SECOND EDITION

THE ART OF LOOM TUNING

by

J. W. Hutchinson

OVER 600 PAGES
520 ILLUSTRATIONS

Author of

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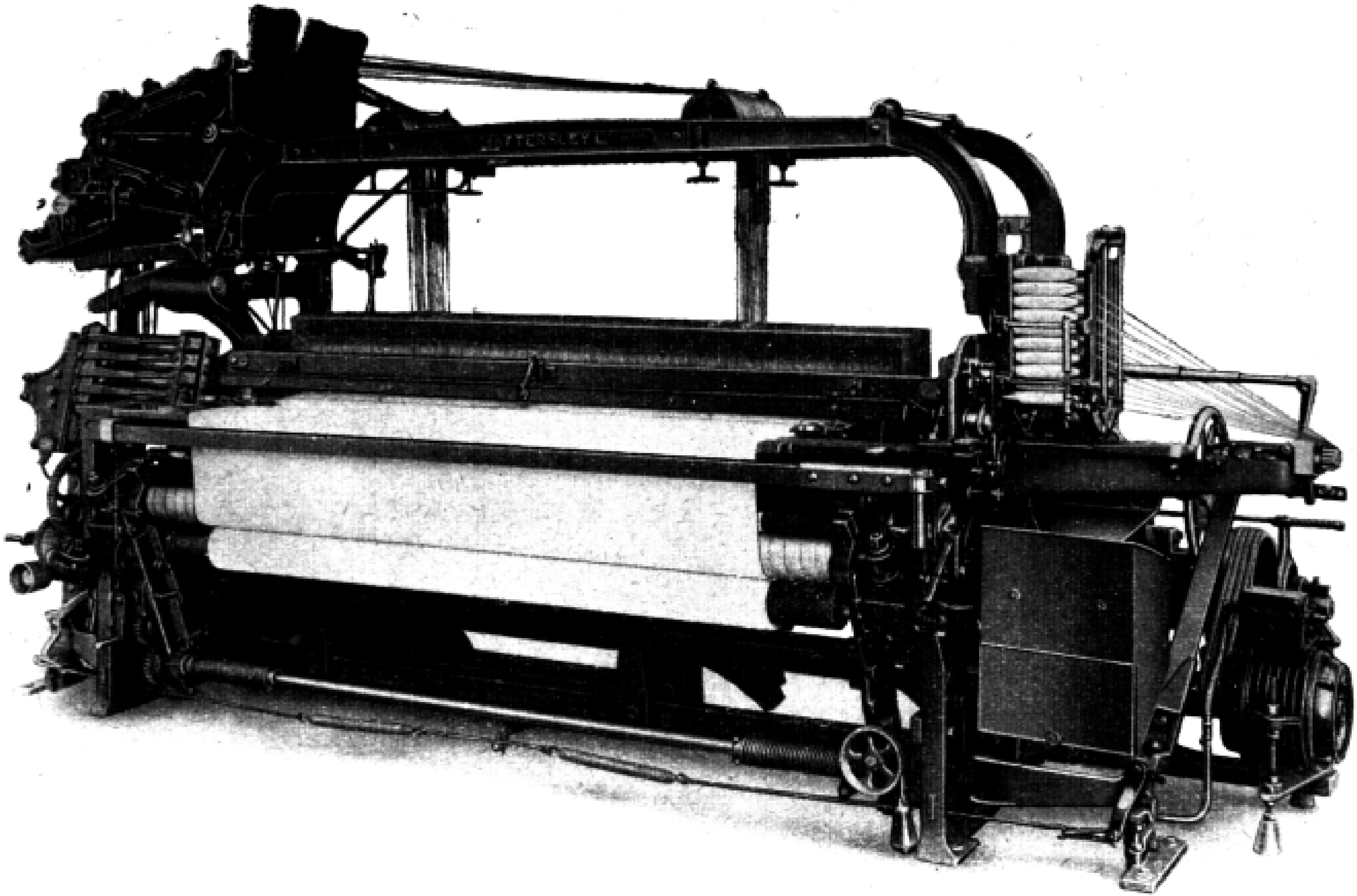

Fig. 1.
Hattersley Standard Model Automatic Bobbin Changing Loom. (Front View).

PREFACE.

IT was most encouraging to the author that the first edition of " The Art of Loom Tuning " was sold out in four days less than four months. The lengthy delay before the 2nd edition could be published was chiefly due to the paper Controller, for nine valuable months were wasted before permission was received to place the order for essential paper.

From the time the last books of the 1st edition were sent off, fresh orders came to hand almost every post, and letters of appreciation were frequent.

Since the first edition was published, there has been several new developments, notably the Electro-pneumatic Loom, but the author failed to receive the co-operation of the Company. What is quite new and incorporated is " The Mordale Bobbin Stripper " and Dracup's safety device for reversing the card cylinder of jacquards. Discovered mistakes have received attention, for in spite of repeated winnowing, some chaff got through. A new set of fancy yarns made by Messrs. Hutchinson of Greengates, Bradford, have been added.

Chapters and pages in both editions are much the same, this being an advantage for classwork.

The author expresses his indebtedness to many people who have recommended the 1st edition to others interested in the textile trade.

May this book prove to be as popular and as useful as its forerunner.

J. W. HUTCHINSON.

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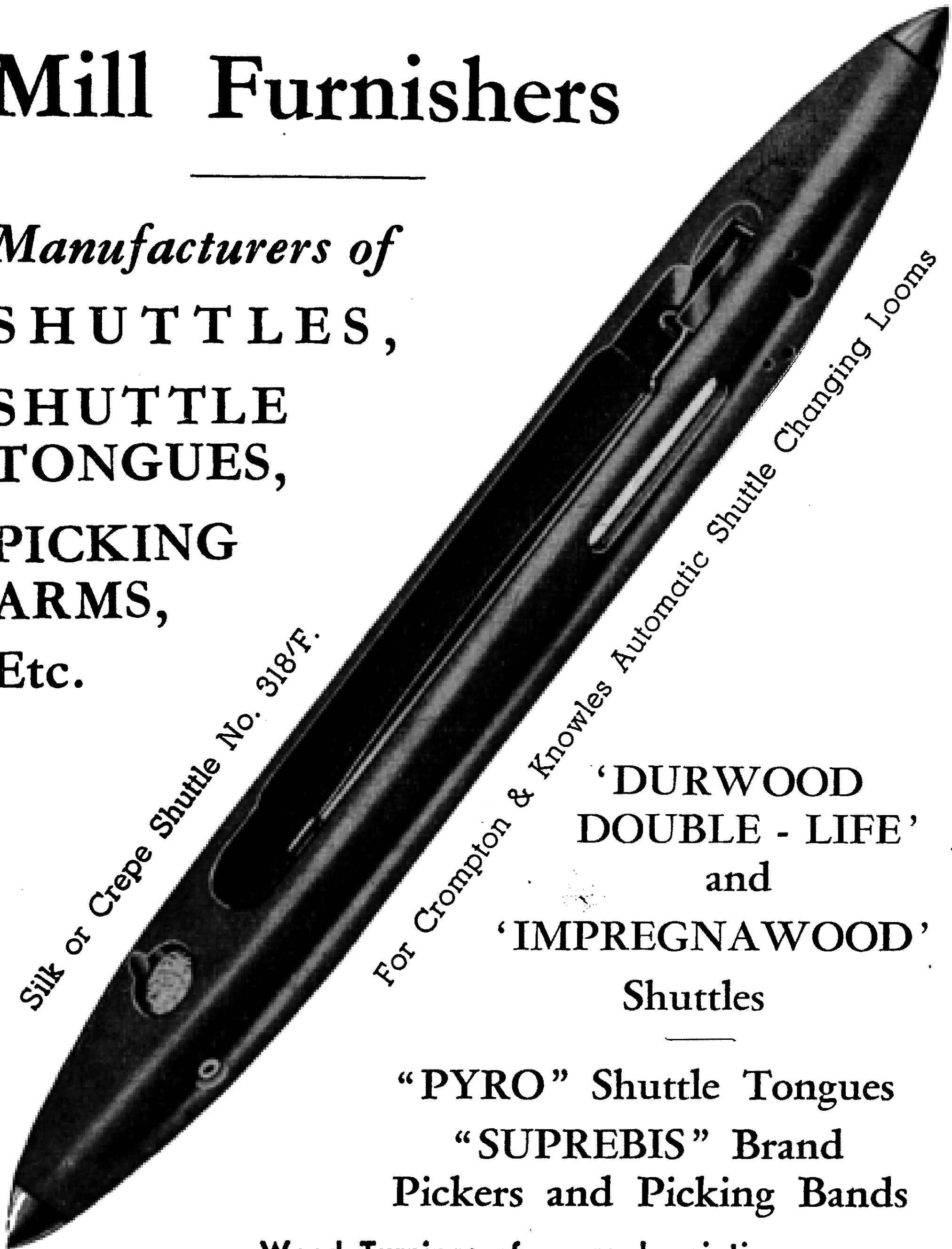

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CONTENTS.

CHAPTERS		PAGE
1	Use of Reeds	1
2	Use of Healds	11
3	Preliminaries of Wéaving	27
4	Tappet Looms	35
5	Leeming Dobby	49
6	Hattersley "V" Dobby	56
7	Hattersley Drop Box Loom for Dress Goods	62
8	Hattersley Standard Model Loom	70
9	Hattersley Automatic Bobbin Changing Loom	106
10	Dobcross Whip Pick Box Loom	115
11	Circular Box Loom	140
12	Rayon Crepe Weaving	149
13	Hattersley Silk and Rayon Circular Box Loom	155
14	Hattersley Drop Box Loom for Silk and Rayon	164
15	Hattersley Automatic Shuttle Changer for Silk and Rayon	178
16	Northrop Looms	184
17	Jacquard Looms	207
18	Dracup's Improved Jacquard Matting Loom	232
19	Use of Belts	237
20	Shuttles	244
21	Pickers	261
22	Leathers	269
23	Shuttle Guards	276
24	Undermotions for Negative Dobbies	281
25	Temples	286
26	Centre Selvedge Motions	298
27	Weft Forks	304
28	Pick Counters	317
29	Electric Driving of Looms	321
30	Problems of the Loom	336
31	Waste Reduction in Weaving	372
32	Weaving Typical Designs	379
33	Faults and Remedies in Woollen and Worsted Fabrics	386
34	Useful Modifications in Weaving	396
35	Adaptability of Designs	409
36	Lancashire Tappet and Dobby Looms	425
37	Hall's Hosepiping Loom	440
38	Hattersley Automatic Shuttle Changer, for Canvas and Duck Cloths	446
39	Wilson and Longbottom's Multiple Fabric Loom	449
40	Platt Bros. Narrow Fabric Looms	456
41	Lancashire Towel Looms	468
42	Causes of Warp and Weft Breakage in Cotton Weaving	480
43	Yorkshire and Lancashire Linen Looms	489
44	New Developments, Mordale Bobbin Stripper	496
	Dracup's Improved Reversing for Jacquards	498
45	Faults and Remedies in Linen Weaving	501
46	The Lure of Cotton and Rayon Mixture Yarns	504
47	Rayon and "Fibro" Developments	509
48	Lancashire Silk and Rayon Looms	514
49	Common Faults in Weaving Rayon	525
50	Developments in New Yarns	535
51	Lancashire Accessories	540
52	Shuttles for Lancashire Looms	553
53	Cotton Designs	563

LIST OF ILLUSTRATIONS.

Fig.		Page
1	Hattersley's Standard Model Bobbin Changing Loom	Frontispiece
2	Ordinary, False and Double Reeds	1
3-4	Ordinary, and Grob's False Reed	4
5	Loose Reed	6
6	All Metal Sley	9
7	Slider Wire Healds	11
8	Cotton and Worsted Healds	13
9	Smith's Patent Healds	17
10	Wool Textile Supplies Slider Heald Frame	19
11	Grob's Steel Healds for Gauze and Leno	21
12	Figured Gauze	23
13	Leno Cloth	23
14-15	"Kartex" Heald Frame and Hook	...25–26
16	Hattersley's Looming and Twisting Frame	27
17-19	Briggs Let-Off Motion	29
20	Hattersley's Looming and Twisting Frame	31
21	Hattersley's Tappet Loom for Woollen and Worsted ...	35
22-3	Plain Tappets	37
24-5	2 and 2 Twill Tappets	38
26	Fancy Matt-Weaves	44
27-8	Single and Extra Back Rails	45
29-30	Early and Late Timing of Shed	46
31	Altering Timing of Shed	47
32	Negative Let-Off Motion	47
33-4	A 6-ply Rope Section	48
35-6-7	Leeming Dobby	49–51–53
38-45	Leeming Dobby Lag Making	...54–55
46	Hattersley's Weft Mixing Loom	56
47	Hattersley's "V" Dobby	57
48	Hattersley's Shedding Rod and Lever	59
49	Eccentric Wheels for Dobby Driving	60
50	Felt Covered Roller on Loom	61
51	Hattersley's Drop Box Dress Goods Loom	62
52	Hattersley's Drop Box Spring and Frog	67
53	Hattersley's Standard Model Loom	69
54	Hattersley's Standard Model Dobby	70
55	Hattersley's Standard Model Picking	74
56	Hattersley's Standard Model Beat-Up	77
57	Hattersley's Standard Model Loom Frog	79
58	Hattersley's Standard Model Let-Off Motion	81
59	Hattersley's Standard Model Let-Off Wheel and Catches ...	83
60	Hattersley's Standard Model Take-Up Motion	84
61-2	Hattersleys' Standard Model Box Lag and Feeler ...	...86–87
63	Hattersley's Standard Model Box Motion	88

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Fig.		Page
64	Hattersley's Standard Model Box Plan	93
65	Hattersley's Standard Model Driving Wheels	95
66	Hattersley's Standard Model Checking Motion	96
67-72	Hattersley's Standard Model Pick Finder Motion ...	98 to 101
73	Hattersley's Standard Model Use of Reversing Handles ...	102
74	Hattersley's Standard Model Picking Forks out of Action ...	103
75	Hattersley's Standard Model Reversing Shaft and Castings ...	103
76	Hattersley's Standard Model Cross Shaft Castings	104
77-8	Hattersley's Standard Model Reversing Collar	105
79	Hattersley's Standard Loom with Automatic Bobbin Changing ...	106
80-1-2	Under Pick Motion	107–108
83	Three-legged Tappet Lever	109
84	Affiliated Levers	110
85	Inner Part of Magazine	111
86	Lever, Slide Rod and Lifting Plate	112
87	Connection to Shuttle Feeler and Weft Cutter	112
88	Battery Latch and Transfer Hammer	113
89	Weft Cutter and Shuttle Feeler	114
90	Dobcross Loom (Electric Drive)	115
91	Dobcross Dobby	116
92	Dobcross Cylinder Bracket	118
93	Dobcross Escape Motion	119
94	Dobcross Shaft Levelling	120
95	Dobcross Reversing Arrangement	121
96	Dobcross Reversing Handle	122
97	Dobcross Picking Shaft and Shoe	123
98	Dobcross Picking Stick and Checking	124
99	Dobcross Let-Off Quadrant	125
100-1	Dobcross Positive Take-up Motion	126–127
102	Dobcross Take-up Cloth Roller	128
103	Dobcross Positive Drop Box, Whip Pick	129
104-106	Dobcross Box Plans	132
107	Dobcross Box Loom Drive (Back View)	133
108	Dobcross Frog	134
109	Dobcross Negative Take-up Motion	135
110	Dobcross Negative Take-up for Coarse Cloth	136
111-112	Dobcross Differential Motion	137
113	Dobcross Automatic Four Box Loom	139
114	Hattersley's Revolving Box Loom	140
115	Six-Cell Circular Box	141
116	Circular Box Loom (Side View)	142
117	Inner Box Hub	147
118-120	Hattersley's All Metal Circular Box	147–148

Fig		Page
121	Settings for Breast Beam and Back Rail for Weaving Rayon Crepes	150
122	Plain Tappet for Crepe Weaving	151
123-4-5	Position of Shafts and Crank	151–152
126	Hattersley's Combined Tappets	153
127	Hattersley's Rayon and Silk Loom	155
128	Hattersley's Tappet Dobby	156
129	Hattersley's Reversing Mechanism	157
130	Hattersley's Silk and Rayon Loom (Back view)	158
131-134	Hattersley's Weft Feeler	160–161
135	Hattersley's Drop Box for Silk and Rayon	164
136	Hattersley's Underpick and Catch Lifter	165
137	Hattersley's Underpick with Arm and Stick	166
138	Hattersley's Checking Tappet and Bowl Lever	166
139	Hattersley's Lever and Spring for Checking	167
140	Hattersley's Drop Box, Silk and Rayon Loom	168
141	Hattersley's Take-up Motion without Change Wheels ...	169
142	Hattersley's Inside Take-up Castings	170
143	Hattersley's Outside Take-up Castings	171
144-147	Hattersley's Tappet Driven Weft Fork	173–4–5
148	Hattersley's Automatic Shuttle Changing Loom	177
149-151	Hattersley's Weft Feeler Motion	178–180
152	Hattersley's Shuttle Changing Tappets	182
153	Northrop's Standard Light Weight "T" Model	184
154	Northrop's Cross Border Negative Dobby	186
155	Northrop's Parallel Underpick	188
156	Northrop's Shuttle Protector, etc.	190
157	Northrop's Roper Automatic Let-Off	191
158	Northrop's Bartlett Let-Off	192
159-160	Northrop's Ratchet Take-up	193
161	Northrop's Midget Feeler Motion	194
162-164	Northrop's Battery Motion	195–6–7
165	Northrop's Shuttle Eyes for Warp and Weft Twist	198
166	Northrop Temples	199
166A	Northrop's Loom Brake and Frog	200
167	Northrop's Shuttle Eye Cutter	201
168	Northrop's Mechanical Box for Warp Stop Motion	203
169	Northrop's "F" Model for Woollen and Worsted	204
170	Northrop's Electric Feeler Motion	206
171	Jacquard Harness Mounting Norwich Tie-up	208
172	Jacquard with London Tie-up	210
173	Jacquard Reversing Mechanism	211
174-5	Jacquard Shedding Disc and Lever	212

Fig.		Page
176	Jacquard Double Lift Single Cylinder	214
177	Dracup's Double Lift Single Cylinder and Reversing Motion	216
178	Dracup's Cylinder Jacquard Motion	217
179	Dracup's Driving Top Motion	219
180	Dracup's Selvedge Motion	220
181	Double Lift Double Cylinder	222
182	Dracup's Vincenzi Jacquard	223
183	Dracup's Section of Vincenzi Jacquard	225
184-187	Jacquard Patterns	228–231
187A	A Unique Jacquard Cloth	231
188	Dracup's Improved Matting Loom Jacquard	232
189	Belt and Loom Pulley Settings	238
190	Fenatex Driving Belts	242
191	Types of Shuttles	244
192	English and Continental Shuttles	251
193	Fixing Box Front in Plain Loom	255
194	Fixing Reed to Shuttle	255
195-6	The "Up and Off" Delivery to Shuttles	257
197	Flight of Shuttle	258
198	Styles of Pickers	261
199-201	British Picker Co. Products	265–6–7
202	Strap Connection in Dobcross Loom	271
203	Hattersley's Under Pick Motion	271
204-5	Bedford Shuttle Guard	...276–7
206-208	Ideal Shuttle Guard	278–280
209	Hattersley's Under Motion for Narrow Looms	281
210	Hattersley's Under Motion for Wide Looms	282
211-212	Kenyon Spring Under Motion	...283–4
213	Ten Ringed Temple	288
214	Dobcross Loom Temple	290
215-6	Walker & Bennett's "Adjustable" Temple	294–296
217-8	Fairburn's Centre Selvedge Motion	299
219-220	Chain Selvedge Motion	...302–3
221	Tumbler Weft Fork	304
222	Horizontal Weft Fork	306
223	Vertical Centre Weft Fork	309
224-5	Hudson's Centre Weft Fork	310–312
226-7	Hudson's First Pick Stop Motion	313–315
228-9	Orme's Pick Counters	317–19
230	Metrovick Motor for Line Shaft Driving	321
231	Metrovick Ten H.P. for Cross Shaft Driving	322
232-237	Metrovick Loom Motors	323–327
238	Metrovick Switch	329

Fig.		Page
239-241	Wigglesworth's Texrope Driving	330–1–2
242	Mather & Platt's Motor Alleyway with Chain Gearing ...	333
243-4	Mather & Platt's Motors in Weaving Shed ...	...334–5
245-249	Timing of Shed	336–338
250	Positive Dobby Shedding	339
251	Dobcross Timing	340
252	Sword and Frog	341
253	Prevention of Sword Rising Up	342
254-5	Loom Breakages	343
256	Loom Brake	344
257	Dobcross Stop Rod Tongue and Frog	345
258	Overpick Motion for Plain Loom	347
259	Overpick for Hattersley Box Loom	349
260	Dobcross Picking	350
261-264	Loom Crank Arms	351–2–3
265	Northrop Shuttle Eye Improved	353
266	V-Rope Construction	354
267	Dobcross Dobby	358
268	Positive Take-up Motion	363
269	Hattersley Drop Box Motion	364
270	Dobcross Box Mechanism	365
271-274	Extra Roller Work	367–8–9
275	Thread Interceptor	370
276	Styles of Weft Bobbins	372
277	Structure of Weft Bobbins	373
278	Prevention of Weft Sloughing	374
279	Angles of Twills	380
280-2	Types of Twills	...380–1
283	Fancy Drafting	382
284	Five Shaft Sateen	382
285-6	Whipcords	383
287	13 Shaft Corkscrew	384
288	Cloth Backed with Weft	384
289	Cloth Backed with Warp	384
290-294	Double Cloths	385
295	Negative Let-Off Motion	386
296	Hattersley Positive Let-Off and Reversing Motion	387
297	Dobcross Let-Off	387
298	Timing Shed for Negative Dobby	389
299	Stop Rod Tongue and Frog	394
300	Hattersley Positive Worm Take-up	396
301	Preventing Shuttle Slipping Back	397

Fig.		Page
302	Structure of False Reed	398
303	Lease Rod Arrangement	399
304	Barker's Picking Mechanism	400
305	Hattersley's Positive V Dobby used as Negative	404
306	15 Shaft Weave with Uneven Lifts	405
307	Weft Divider to Prevent Weft Trails	407
307A	Weaver's Knots ... ... —	408
308-311	Plain Weave Hairlines...	410
312-315	2 and 1 Twill Hairlines	410
316-7	2 and 1 Twill and Three Lined Hairline Check	411
318	Elaborate Check with Plain Weave	411
319	Four end Sateen Check	412
320	Crepe Weave in Check Order	412
321	Crossed Diagonal	412
322	Diamond Pattern with Duplicate Picks	412
323	2 and 2 Twill Check	413
324-5	Figured Diagonals	413
326-332	Colour and Weave Effects	414–416
333	16 Shaft Sateen	416
334-336	Placing Small Spot Figures	416–417
337-8	Twill and Sateen Derivatives	417
339	Shaded Effect	418
340-344	Whipcord Designs	418–419
345	Alternate Pick Design	419
346	Varied Stripe Effect	420
347-349	Bedford Cords	420
350	Figured Mohair Design	421
351	Figured Dobby Pattern	421
352-365	Double Plain Weaves	422
366-7	Backed Cloths	423
368-370	Double Cloths	423–424
371	Robert Hall & Sons High Speed Calico Loom	426
372	Bordered Cotton Blankets	427
373	Plan for Weaving Borders	427
374	Pickles Take-up Motion	428
375	Wilson & Longbottom's Duck Loom	430
376	Underneath Utility Tappets	430
377-8	Tappet Easing Motion for Back Rest	432
379	Spring Top Motion	433
379A	Lupton and Place's Spring Top Motion	434
380	Butterworth & Dickinson Tappet Loom with Circular Box ...	435
381	Hall's Woodcroft Tappet Loom	436
382-3	Woodcroft Tappet Structures	437

Fig. PAGE
385 Ward Bros. (Blackburn) Dobby 438
386-392 Hall's Loom for Weaving Hosepiping 441–5
393 Hattersley's Automatic Shuttle Changer for Weaving Duck and Canvas 446
394-401 Wilson & Longbottom's Multiple Fabric Loom ... 449–455
402-405 Platt Bros. Narrow Fabric Tappet Loom 456
406-411 Platt Bros. Narrow Fabric Loom for Light Fabrics and Ribbons 461–465
412 R. Hall's Drop Box Loom 466
413 R. Hall's Automatic Cross Border Dobby 468
414-5 R. Hall's Turkish Towel Loom 469
416 Butterworth & Dickinson's Terry Towel Loom with four Box Motion 471
417 Side View of Terry Towel Fabric 472
418-420 Wilson & Longbottom's Terry Towel Loom ... 474–478
421 Position of Back Rest for Weft Faced Fabrics 481
422 Position of Back Rest for Warp Faced Fabrics 481
423 Position of Shuttle and Reed 482
424-5 Shuttle Wearing Back and Bottom 483
426 Position of Box Front to Shuttle 485
427-8 Box-Loom Shuttles Protected Against Weft Cutting ...485–6
428A Bradley's Prize Winning Let-off Motion 486
429-431 Wilson & Longbottom's Plain Linen Looms ... 489–492
432 Mordale Bobbin Stripper 496
433 Dracup's New Reversing Motion 498
434-5 Hutchinson's Cotton and Rayon Mixture Yarns ... 505–507
436-7 Woollen and "Fibro" Spun Together. Design 509
438-9 Worsted and Viscose-"Fibro." Design 510
440-1 Viscose and Acetate Ratin. Design 511
442 Viscose and Acetate Warp and Weft 511
443 All Viscose Fibre Fabric 512
444 Viscose Acetate Warp and Weft 513
445 Butterworth and Dickinson's Pick and Pick Silk Loom ... 514
446 Butterworth & Dickinson's Two Box Silk Loom 516
447-8 Outside Under Pick Motion 517–18
449 White & Sons 4×1 Drop Box Silk Loom 520
450-461 Faults in Fabrics Alphabetically arranged ... 525–533
462 Take-up for Nylon Cloth 537
463-465 Lupton Bros. Temples 540–2
466-466A Mather & Platt's Weft Hammer Knock-off Motion ...545–6
467 Mather & Platt's Mechanical Warp Stop Motion 547
468 Mather & Platt's Warp Stop Droppers 548
469 Mather & Platt's Electrical Warp Stop Motion 549
470 Mather & Platt's Electrical Droppers 550
471 Mather & Platt's Humidifier 551
472-3 Pilkington's Silk and Rayon Shuttle 553–5
474-476 Messrs. James Nelson's Hand Threading Shuttle... ...557–9
477-520 Cotton Designs 563–9

THE USE OF REEDS.

REEDS are as necessary for the weaving of cloth, as sound is for a wireless set. Reeds for this purpose are of very ancient date, and many museums contain interesting relics of those by-gone times. In those primitive days they were made of thin bones, but now they are quickly constructed by ingenious machinery of flat wire. An ordinary sley is a complete set of reeds of the same thickness and depth, each reed being placed the same distance apart from each other. They are made in lengths to be suitable for the reed space of the loom, and the inner depth varies from three inches for silk, to 5 inches or over for worsteds and woollens. The reeds may be spaced as low as 8 per inch or as high as 140 per inch in an all metal reed.

Construction of Sley.—Fig 2 is a side view of two kinds of sleys, and of a false reed often required in the weaving of fibrous warps. At A is the flat reed with its front

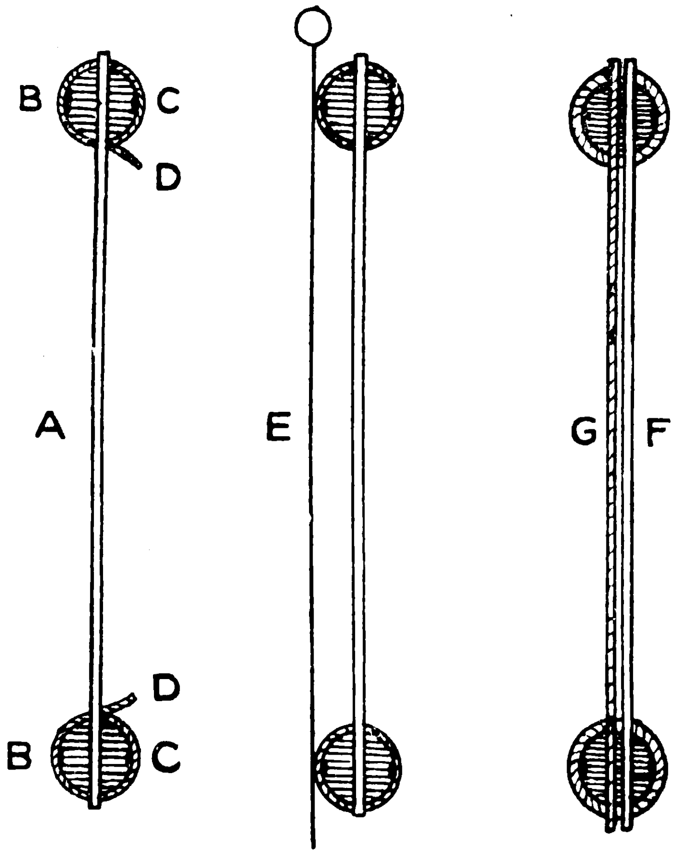


Fig. 2.
Ordinary, False, and Double Sleys.

and back edges rounded off so as to impart a kinder action when the weft is being forced to the fell of the cloth. The reed is embedded in two pairs of wooden strips ,which are termed balks, and are given at B and C. These balks are either white pine or red deal. They are flat on their inner sides, and semi-circular on the outer sides.

Both balks and reeds are held together by the pitch band D, the thickness of the band, and the number of wraps between each reed giving a certain number of reeds per inch for the whole length of the sley. A uniform distance between each reed is of the highest importance for the correct spacing of the warp.

The balks are strengthened on the outer sides by either a strip of flat wire or two small circular ones.

The balks, reeds and wires are made into one consolidated whole by means of boiling pitch, the previously treated band and pitch preventing the reeds turning during the beating up of the weft.

At both ends of the sley a flat piece of metal is placed, and on it is stamped the sett and width which saves the trouble of calculation and measurement.

Functions of the Sley.—The sley has to perform a fourfold duty.

(1) It separates the warp into small groups. Except in special cases like crammed stripes in dress goods, or in the use of knop yarns, the common custom is to have the same number of threads between each reed.

(2) It beats up the weft to the fell of the cloth. The bottom part is held by the sley rack, and the upper part by the handrail, and as these are parts of the going part, they are moved to and fro by the crank.

The going part reaches its highest elevation when the crank reaches its front centre, and is at its lowest when the crank is at its back centre. This movement is known as the reciprocating motion, for a circular rotation oscillates another which moves in the arc of a circle.

(3) It provides one-half of the support needed by the shuttle in its traverse across the loom, the other half being presented by the shuttle race.

(4) It determines the threads per inch of the warp. The reeds per inch multiplied by the threads through each gap, gives the number of threads per inch.

Systems for Warp Setts.

There are many local systems, but the rock bottom of all of them is the number of threads in the English inch. These systems need not be exploited here, but those most extensively used are as follows:—

Bradford.—This is based upon the number of beers in 36 inches, a beer being 40 threads. A 40's sett would give:—

$$\frac{40 \times 40}{36} = 44^4/_9$$ threads per inch. A short method is to add $^1/_9$th more to the sett and this gives the correct answer.

Leeds.—This has a portie of 38 threads and 9 inches as its standard. A 15 portie sett would give

$$\frac{15 \times 38}{9} = 63\tfrac{1}{3} \text{ threads per inch.}$$

Blackburn.—This follows the same line as Bradford except in the standard width. It is the number of beers in 45 inches, a beer being 20 splits, 2 threads in a split. A 60's sett would yield:—

$$\frac{60 \times 40}{45} = 53\tfrac{1}{3} \text{ threads per inch.}$$

Scotch.—The standard width is 37 inches, and 40 threads. A 50's sett would give

$$\frac{50 \times 40}{37} = 54^2/_{37} \text{ threads per inch.}$$

Stockport.—Reeds in 2 inches, Lancashire system.

Huddersfield.—This is the simplest and most sensible system, for it is based upon the number of reeds per inch multiplied by the threads through one gap. A 24's reed 4's would give 96 threads per inch.

Such a method is worthy of general adoption where an inch is the standard of measurement.

Sleys may be used in four positions, for when found worn at the bottom, it may be turned to the top, and the same remarks apply to the opposite side. Such changing prolongs the service of the sley.

Double Sleys.

A common way of making these kinds of sleys is shown at F and G in Fig. 2. Here, the front reed F is made to be midway between the gap in the back reed G. This kind of reed is specially made for the 2 × 2 hopsack weave so as to split the two threads which rise and fall together. In warps containing different colours, there would not be a continuous line of colour if such a reed and method was not adopted.

False Reed.

This additional reed consists of a series of small circular wires with a loop at the top as shown at E in Fig. 2. These wires should be of uniform length, and about 8 inches for worsteds. They are safest when threaded on wire instead of band. Each false reed wire is usually placed between every three groups of threads to part or break the loose fibres, for in doing so, it prevents stitching taking place in the cloth. After being passed through the warp, the long holding wire is suspended from the back of the handrail, Fig. 3, by a series of looped wires at E. The bottom of the wires D are secured by the heald shaft G, that is secured by looped wires H at the back of the going part by means of a series of looped wires. The bottom of all the threaded wires are then secured by a heald shaft of suitable length that is dropped into looped wires secured to the back of lay. All the wires of the false reed should be arranged to work in a vertical position so as to give the least friction to the threads, and prevent reed marks appearing in the cloth. Very small wires may be employed to separate silk threads in a warp, for silk, being of a clinging nature, is apt to vary its appearance in the cloth if not so separated. False reeds are also very useful for such weaves as plains, warp and weft ribs, for when an end is broken and remains in the front shed, it is liable to felter with adjacent threads, and throw the shuttle out of the loom. The wires assist in keeping the broken threads straighter, and so prevents feltering.

In Fig. 3 B is the shuttle race and C the warp reed. At I is the stop rod and J the angle iron that strengthens the going part.

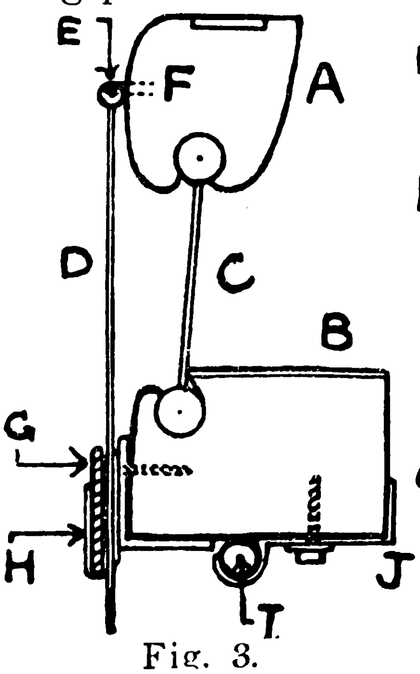


Fig. 3.
Ordinary False Reed.

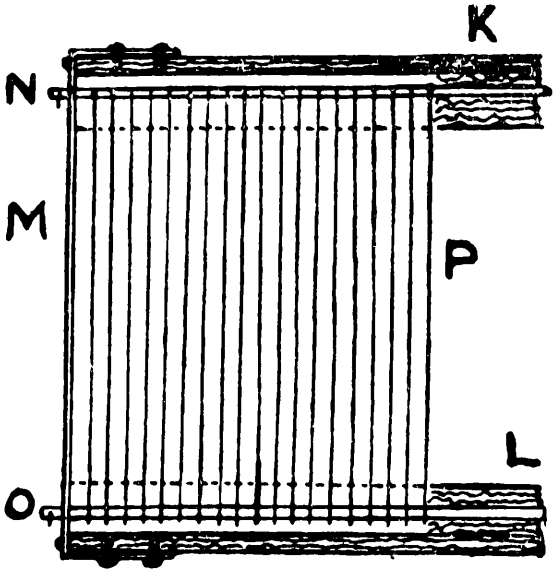


Fig. 4.
Grob's False Reed.

Grob's False Reed.

This is outlined in Fig. 4. The false reed wires are on slider rods N and O that pass through the metal end M. The shafts K and L are the standard depth of 7 inches, the ribs being used for fixing the ends of M by screws. Below the top rib and above the bottom one, there is a depth of $1\frac{3}{4}$ inches that strengthens the structure and aids the healds when bent back by feltered threads or knots. The false reeds O have a standard depth of $5\frac{7}{8}$ inches, and their twisted parts terminate below the upper slider rod, and above the bottom one, but there is no centre eye.

The wires of any set are of the same thickness, but wires are available from 24 to 35 gauge, the lesser the number and the thicker the wire. The wires are cranked near the loops so they form two rows which imparts more freedom to the threads.

For high setted silk and rayon warps, a frame is used that has two pairs of slider rods and healds. When either single or double arrangement is used, the reacher-in moves a false reed wire as arranged by the loomer. On the warp and healds being placed in the loom, the overlooker fixes the false reed behind the handrail.

Adjustment of Sley.

For weaving, sleys are secured in three ways.

(1) In fast reed looms, there is a sley rack at the back of the going part, and this takes the bottom wall of the sley. The top part is held by the groove in the under side of the handrail, the handrail being bolted to the two swords.

(2) In the Dobcross loom, there is a movable rack which contains a series of nuts. These nuts are made use of by grooved screw bolts on the front of the going part. This method of fixing has the advantage of adjusting itself to the thickness of the sley wall, for all sleys are not the same thickness. What has to be aimed at in bracing up, is a uniform pressure on the sley, and this is achieved by first pressing the rack forward by hand, and taking up the slack of the screws with the fingers. It is then finished off by going over the screws twice with the screw driver.

Loose Reed.

(3) In the weaving of dress goods, the holding of the sley is by means of a loose reed mechanism. The chief parts are shown at Fig. 5. At A is the handrail which has to be slided on to the top wall of the sley B, the groove in the

handrail being so constructed, that when the bottom part of the sley is forced backward in the direction of the arrow C, the top of the sley is retained in the groove of the handrail. At D is the shuttle race, and behind it is the right angled rack which is bolted to the curved rack finger E, a series of

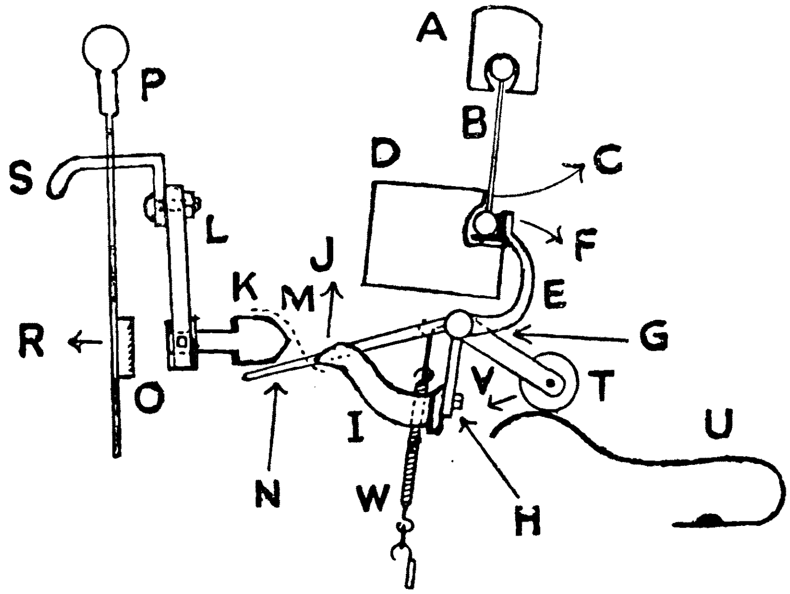


Fig. 5.
Loose Reed.

these being welded to the stop rod G. These fingers are made of wrought iron, and the upper face side of them should be parallel so that the sley rack holds the sley with equal pressure from one end to the other.

When the sley is forced out of position by the shuttle having become trapped in the shed, the finger E moves in a downward curve like the arrow F.

On the stop rod are also a series of slotted straight bars as at H, and to these are bolted the duck bills I. When weaving, the sloping top of the duck bills pass under the frog or beater K, and the pressure so applied keeps the sley firm for the beating up of the weft. When the sley is forced out as explained, the duck bills are raised in the direction of the arrow J, and by being so raised, they slide over the top of the frogs K as shown by the dotted line M, and in this way, a serious shuttle trap is averted.

The sley is easily placed back in its rack by the elevation of the striker N with one hand, and the forward pressure of the sley with the other. If there be additional pieces of sley at the ends of the weaving sley, they must receive attention.

Liberty is here taken to explain the additional parts. The shaft of the frog K passes into a square hole in the frog holder L which, as will be seen, is bolted to the breast beam.

The shaft of the frog is held by a setscrew which passes into a countersunk hole on the shaft of the frog. There should be two countersunk holes as the frogs have sometimes to be moved forward for the weaving of heavy weight goods. In weaving such goods, the fell of the cloth may be from $\frac{1}{4}$ to $\frac{3}{8}$ inch further forward than when weaving light weight fabrics, and this necessitates the frogs being set further forward, and so meeting the duck bills sooner. The fixings should be so adjusted, that each frog contributes its share in the beating up of the weft.

Setscrewed to the end of the stop rod G is the striker N. When the shuttle is trapped in the shed, the forcing out of the sley raises the striker, and brings it in contact with the grid O which is bolted to the setting on handle. This moves the setting on handle P in the direction of the arrow R, and so stops the loom.

Provision is also made to give stability to the sley when the duck bills recede from the frogs, and this is obtained by the bowl T on the lever V coming in contact with the strong curved spring U. This spring slopes appropriately to the downward curve made by the going part. The bowl T runs free on its pin, and by its pressure on the spring, keeps the sley steady for the passage of the shuttle.

The spiral spring W is always exerting a downward pressure on the stop rod, but it is specially valuable when the bowl T leaves the curved spring U, for then it holds down the stop rod until the duck bills pass under the frogs.

As the upper parts of the frog holders L, are slotted, they may be set to give the best possible contact of the frogs with the duck bills, the setting being best carried out when no warp is in the loom. A moderately thick walled sley is advisable for the purpose.

Sley Damages.

Sleys may be ruined by rust if not stored in a dry place, or by rain soaking through the roof, or by the bursting of a steam pipe. If any of these things happen, a dry thrum should be applied as speedily as possible, and then another rubbed across that has been smeared with oil or paraffin.

Dropped bobbins, or the too careless handling of shuttles are sometimes responsible for the bulging of the reeds. Unless badly bent, they may be straightened by applying a lighted match to the upper walls of the sley, for the softening of the pitch assists the reeds to spring back, or they may be straightened and forced upward with a pair of thin sley pliers.

When a shuttle has been trapped between the temple and the sley, and the temple has failed to run back, or only partly so, the reeds are forced back for almost the full distance of the shuttle. The bent reeds may be driven back by placing a flat piece of a heald shaft behind the sley, and hitting the wood with the flat face of a moderately heavy hammer. The front has then to be tested with a straight edge to see where the finishing blows are required, and the sley pliers then do the rest. For very fine reeds, a sley maker is best for the job.

The reeds are sometimes cut into by the head of the temple being placed too far forward. This will either cut into the reeds or break them. If they are cut into, they can first be rubbed with pumice stone to take off the sharp edges, and then each reed has to be finished off with fine emery cloth.

When the reeds are broken, they should be repaired by taking reeds out of the end of the sley. These extracted reeds are sharpened with a fine file, and rubbed with emery cloth. One broken reed is pulled out, and a pointed one pressed into the two holes. This process is repeated until all the broken reeds have been replaced. The application of a lighted taper to the upper wall, and the finishing off by the sley pliers, will make the sley serviceable again.

A far worse injury is done to the sley than the foregoing, when a metal pin works out at the back of the shuttle, for in a very short time, the pin will plough a groove into the sley from one end to the other. Such a disaster can usually be avoided by using a punch that is much smaller than the shuttle pin, for in so doing the woodwork of the shuttle is preserved.

For the weaving of heavy cloth, the piece has to be well templed. If the cap be well worn, or the temple barrel too low, the decreased grip of the temple allows the fabric to contract at the fell of the cloth, and the threads are then forced outward by the reeds with every forward movement of the going part. Such extra pressure forces the reeds inward at the selvedge, and by the extra chafing, many of the threads are broken. The only way by which the reeds can be made to keep upright is by increasing the grip of the temple.

In fast reed looms, the recurring force of beating up the weft, wears the centre part of the rack in the going part deeper. It may be so worn that its upper wall is only barely held by the handrail. When weaving heavy work, the sley will be forced out of the handrail. It may be held in by packing the bottom rack with strong brown paper tapered off in thickness at either end.

All Metal Reed.

A photograph of this latest style of sley for weaving is produced at Fig. 6. The model is 3 inches deep in the reed,

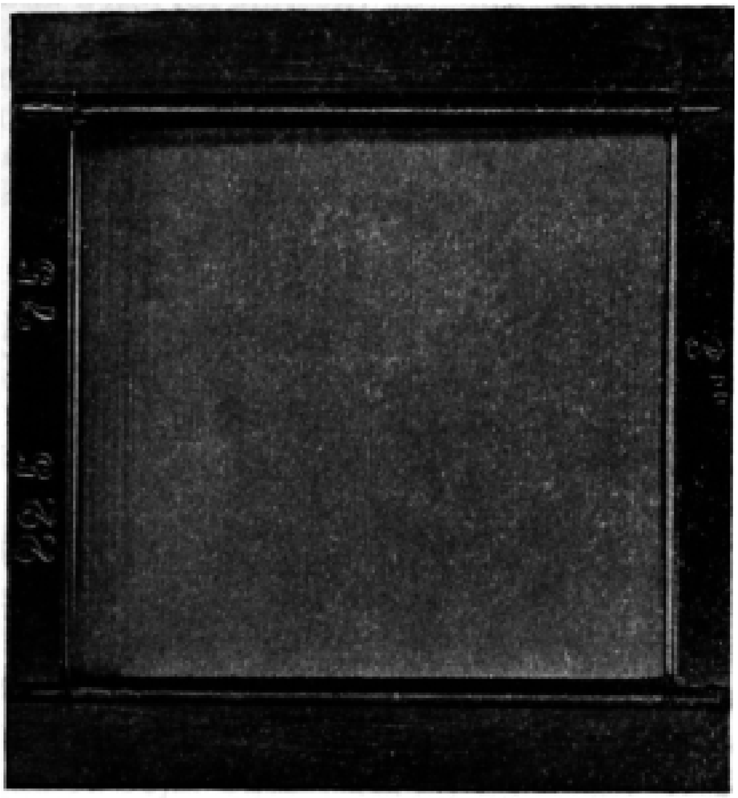


Fig. 6.
All Metal Sley.

and has 75 dents per inch. The depth, number of dents per inch and length can be made as required.

The reeds are placed between two metal balks top and bottom, the balks being small. The tops of the reeds are covered with metal strips $\frac{7}{16}$ths inch deep, and the thickness of the two along with the filling is $^5/_{32}$ inch. The reeds are separated by wire of a given thickness so as to produce a certain number of reeds per inch. The whole is then soldered together, but no solder is allowed to go beyond the balks. Naturally, the reeds are the most pliable at the centre where the warp changes its position in the greatest quantity, and is rigid top and bottom. The accurate spacing of the reeds for so fine pitch as 75 per inch is guaranteed by the uniformity of the wrapping wire.

Both reeds and wrapping wires are standardized, and the finest silk or rayon warps can be woven with them.

For existing looms, a certain amount of modification has to take place for the holding of the sley, for the wall is only $^5/_{32}$ inch thick. Those looms have least trouble in changing that have a movable rack at the bottom. Another make of reed is made by oval shaped wires for the weaving of rayon. By being oval, the least possible friction is imparted to the threads. An ordinary flat reed rubs the threads its full width, and for the full forward and backward movement of the going part. The new style oval reed reduces such friction by half, and is being employed in the making of the latest all metal sleys, as well as those of the more ordinary kind. The oval reed is thinner than ordinary at front and back, and consequently wears quicker by the friction of the shuttle.

This wearing, however, does not adversely affect the weaving of rayon for a considerable time owing to the shape of the reed.

These sleys as well as ordinary ones have all the roughness taken off by a machine specially constructed for the purpose.

" All metal " reeds are made as fine as 140 reeds per inch for the high class silk trade, but it is seldom they exceed 55 reeds per inch for rayon weaving.

There are at least 150 thicknesses of wires for the making of sleys.

Repairs to the " all metal " type have to be done by a reed maker as they require a hot soldering iron to melt the solder.

THE USE OF HEALDS.

Healds are made of various materials, and are of different lengths, diameters, and sizes of loops. Their primary function is to hold the warp threads, and lift or depress them according to a given plan or design. In a tappet or dobby loom, one shaft lifts or depresses a whole series of threads, but in a jacquard loom, one thread may be controlled independent of any other up to one repeat of the engine.

Healds may be divided into six main groups. These are:— (1) Slider wire healds; (2) Knitted wire healds; (3) Cotton healds; (4) Worsted healds; (5) Gauze healds; (6) Jacquard healds. Each of these groups may be briefly considered.

Slider Wire Healds.

Twisted Wire Healds.—The arrangement for slider wire healds is demonstrated in Fig. 7. The wooden framework A is held at the ends by the metal bar C by means of

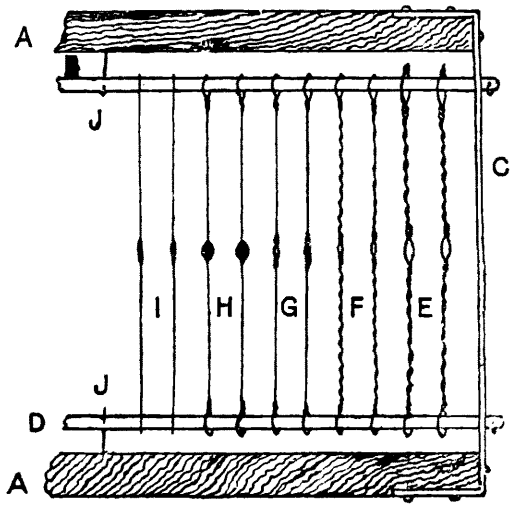


Fig. 7.
Slider Wire Healds.

a couple of screws top and bottom. At two places, the bar C is slotted to allow the slider rod D to pass through. Almost at the end of the rod it is bored through to allow a pin or link to pass through to prevent it losing contact. The shafts A on their inner sides are furnished with the hooks B which hold the slider rod, and take the weight of the healds. These hooks have to be so adjusted that the healds that are adjacent are kept straight, and that they allow the healds to swing back after the weaver has passed her hand through in taking up a broken thread. If the healds are held too tightly, not only are marks liable to appear in the cloth by the healds remaining as pushed by hand, but the centre loop or mail eye is liable to contraction, and this makes it difficult to thread, and for knots to pass through. If the healds are too slack, they bend, and the warp is then subject to much more friction.

At E, the healds are made of strong wire which are suitable for the coarsest kind of woollens. They are cut off at the top beyond the loop, but at the bottom, the wire is only bent to form the loop, and be the starting point of the two lengths of wire to make the heald. By the heald being made this way, the threads can be moved to the full depth between the slider rods without injury.

The length of time these healds will wear partly depends on how they are geared up in the loom, and partly on the kind of work they have to do. The coarser the work and the harder the twist, and the sooner the healds need replacement. On an average they last 15 years. One can form an idea that the healds are nearing the end of their service when a weaver keeps having heald traps, but a reliable test is to bend a heald in the centre. If the heald breaks by or before the third bend, it has become too brittle for service, and if the whole sett has been in use the same time as the tested heald taken from the group of shafts, the sooner they are replaced, and the better it is for the cloth and weaver.

One excellent advantage of wire healds is, that in changing from one sett to another, there are no confusing castings out for the weaver. If the new warp be finer or coarser than the thrum of the former warp, the threads may be tied to those in the healds, and the knots or twistings are then drawn forward. If coarser, the unwanted empty healds are bunched up at the ends of each shaft, but if finer, then additional healds are placed on each pair of slider rods to accommodate the extra threads. The warp, whether coarser or finer setted, is then sleyed over.

At F, the twisted wire healds are made of finer wire, which admits of many more threads per inch, and less friction per heald on the warp. In the example presented, the end of the two wires which form the heald are twisted above the bottom slider, and below the top one. This limits the traverse of the threads, for if the back shafts of a numerous group are compelled to move to the limits of the slider rods, the threads then come in contact with the sharp ends of the heald wires, and are either damaged or severed. The only safe way of working with these healds is to have them deep enough.

Soldered Wire Healds.—One variety is given at G. The two wires are twisted at the centre to form the eye for the thread, but above and below it, the wires are parallel until finally looped and twisted at either end. The heald is then dipped in molten solder, and the two wires become as one. This soldering increases strength and smoothness, and the healds are very suitable for fine counts of worsted and the medium or lower counts of silk and rayon.

Another type of soldered heald is presented at H. This is built in much the same way as G, but at the centre, the wires are flattened out after being twisted, and when soldered, no twist is visible, and the heald is almost as smooth as glass. This is specially suitable for rayon as both the formation of the eye inside and out presents the least possible friction.

Flat Wire Healds.—At I are a pair of flat wire healds extensively used in the manufacture of high grade silk cloth. The two loops for the slider rod are punched out of the metal, and the same thing is done to form the eye. The eye is slightly twisted for threading purposes. The flat side of the wire is parallel with the warp, and as this presents the least possible bulk warp way, a greater number of healds can be crowded into less weaving space than any other kind of heald. They are made in different depths to be appropriate to the plainer or fancier class of general work undertaken. The larger the number of shafts used for any warp, and the deeper the healds must be to coincide with the demand of shedding. These healds usually last 25 years.

Cotton and Worsted Healds.

One style of cotton heald is entirely made of twine, and is varnished to withstand wear, and the humidity of the

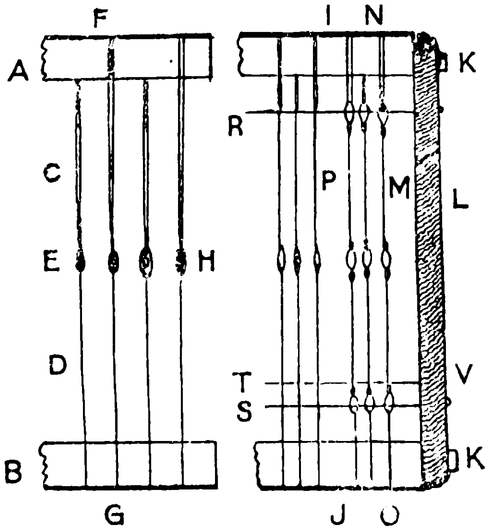


Fig. 8.
Cotton and Worsted Healds.

atmosphere in the weaving shed. They are constructed to be placed on the shafts A and B in Fig. 8 like the healds shown in the drawing. A hardier kind is made with brass metal eyes as brass does not rust. The cotton twine is varnished as in the previous case.

For the worsted trade, the healds have steel eyes, and the twine used may be cotton or worsted. When made of cotton it is usually unvarnished, and this kind of twine is selected to impart a gentler action on the warp which will either be single twist, or two-fold soft twisted. Such healds are somewhat rare, and only last a few months. Worsted healds are much more durable, and are in common use throughout the worsted industry. They are very much lighter in weight than wire healds, and the shafts are less in thickness. In the worsted coating trade, as many as 40 shafts are employed for elaborate designs.

On preparing a set of such healds for looming that have come from the heald maker, one shaft is passed through the top loop in the bundled healds, and another through the bottom loop. When spread out on the shafts, it is then seen that one heald is suspended from a double band on one side of the shaft, and the next heald is suspended from the opposite side of the shaft as shown at C. At the bottom it is different, for each heald passes at the front and back of the shaft as at D. When preparing for drawing the warp through the mails, a shaft is passed through the twine at the bottom in the same way as the shaft B. When the whole series of shafts have been so treated, all the looming shafts are raised to a position just below the metal eye, and are braced there until the whole of the warp is drawn through, and the looming shafts are then pulled out.

For medium and fine counts, small steel eyes are used, the centre bore of the three being the largest for the use of the warp thread. This is given at E. For coarser counts, larger mails have to be used, or knots could not be woven in. These are shown at H. The twine is wrapped round the ridge bands F and G, and if the healds are to wear well, these bands must be made fit to the centre thickness of each shaft to avoid being frayed by an adjacent shaft. When taken care of, they should last between 18 months and two years. When stored, they should be suspended from both ends of the top series of shafts, and the weight of the sley taken off by being placed through a group of healds at either end.

When a heald breaks, it is made good by the weaver passing a piece of worsted heald beeting through the vacated hole in the mail, and tying the beeting to the ridge band. In case both bands of the same heald are damaged, care has to be taken to see that the metal eye is at the same altitude as the others.

The depth of cotton and worsted healds depends on the number of shafts to be used. From 4 to 16 shafts, the total depth is 17 inches, though up to 8 it may be 16 inches. From 16 to 24 shafts it is 18 inches; from 24 to 32 shafts it is 19 inches, and from 32 to 40 shafts, 20 inches. To assist in getting the longest service out of these kind of healds there are three additional points.

(1) Each shaft should never exceed the maximum of 12 healds per inch. If more are needed, then the shafts should be doubled in number. (2) Each shaft should be rounded off top and bottom to prevent any cutting action in its movement. This inspection has to be carried out prior to the heald preparation for looming, and all crooked shafts removed. (3) In gearing up the shafts in the loom, the least possible tension of the bands should be applied, consistent with the healds not buckling when on the bottom shed.

Knitted Wire Healds.

If anything, a set of healds of this kind are heavier in weight than the same number of shafts with ordinary slider wire healds. This is due to the thicker cross shafts I and J, the wooden ends L, and the amount of cotton twine given at N and O. No inside hooks are necessary on the inner sides of the shaft, for each heald, top and bottom, is held by its own length of twine. The twine at the top is on alternate sides of the shaft, but at the bottom the twine for each heald is on both sides of the shaft.

The ends of the ridge bands find lodgement on the protruding ends of the shafts at K. Only one cross wire is shown at R, but there are two, one taking all the odd healds and the other the even ones, in passing through the loops. These wires hold the healds in case the cotton twine is cut or worn through. The same remarks apply to the bottom wire S, though this goes through every loop. The wire T is the looming wire, for this bends round all the healds in plain order. A slot is left in the wooden end L at V, so the looming wire can be raised to fit just underneath the mail eyes, or if such a slot is not made, then a special wire is fixed to the inside of the shaft for the same purpose.

The healds M are twisted and are for heavy work. The healds P are much finer, and are soldered to give the glossiest action to the warp. They are not as handy for the weaver as worsted healds, for the eyes are smaller, and not as distinct for threading, and there is a greater resistance to the hand when threading. In gearing up in the loom, it is advisable to leave the first dobby jack and corresponding bowls to prevent the top back parts of the handrail bumping into the first shaft when on the bottom shed. To provide further working room, the 5th dobby jack and bowls should be omitted, and the shaft lags pegged to these omissions. The bottom jacks are passed over like the dobby jacks, and in this way the cotton twine is better protected. It is also a gain when the shaft ends are thicker than the shafts. The healds per shaft cannot be increased like the slider wire healds, for the number is permanent, but the sett can be decreased by casting out. Though not as handy for the weaver as explained, they are a good investment for the manufacturer, and especially when there are prospects for a good run of the same or similar cloth, for these healds last 15 years for light coatings, about 20 years for the dress goods trade, and 25 years for the silk industry.

Smith's Patent Healds.

In the knitted wire healds mentioned, only a low figure limit could be knitted per inch on each shaft. In high setts, either the warp was too crowded to work comfortably, or double the number of shafts had to be employed to give more space for the warp and shedding.

In ordinary worsted healds with steel metal eyes, the limit is 15 mails per inch per shaft. In knitted and soldered wire healds the eyes are smaller, and allow of 20 healds per inch per shaft, for in both cases the healds may be said to be in a straight line. What has now been successfully done by Messrs. Samuel Smith & Sons, of Eccleshill, Bradford, is the knitting of the healds in four distinct rows, which, along with suitable healds, admit of up to 96 healds per inch per shaft. What formerly required 8 shafts can now be done with equal success on four, and other reductions are made when the weave admits. This is demonstrated in Fig 9. A and B are the two shafts which take the twine, the ridge bands being on the outside of each. Every wrap of twine holds two healds which are at E and G. At E, the twine comes down from the ridge band, passes through the loop in the first heald on the safety wire J, and then goes through the second heald on the second safety wire which is seen in the side view. The twine then ascends to the ridge band by passing behind the shaft A. The healds F are made of two strands of very small wire that are soldered together,

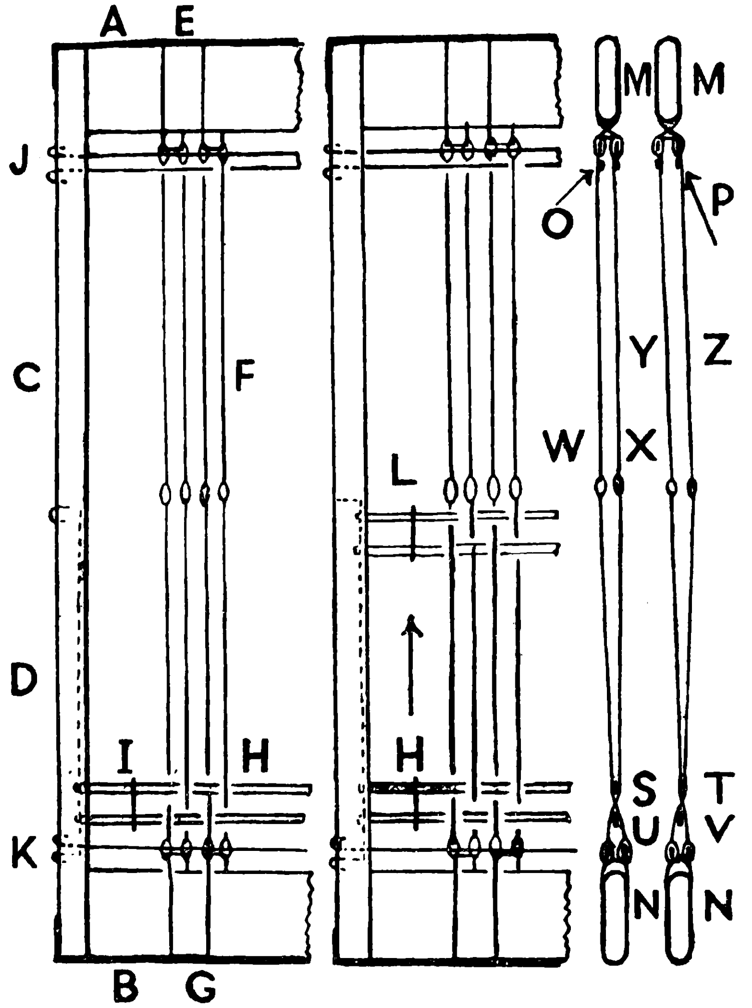


Fig. 9.
Smith's Patent Healds.

the wire being cut off below the top loop, and above the bottom one.

The threading of the loops at the bottom of the healds is much simpler, for the twine passes up the front of the shaft, through the two healds, and then down behind the shaft. Here, however, the healds are leased one and one by the two flat wires H, and I is the looped wire to keep them in position. Each heald is cranked a little just above the loop, the alternate ones being turned in the opposite direction. The cranking keeps the lease wires away from the warp when weaving.

The upper lease wire is copper-coloured, which makes the sighting of the healds all the better for the twister. To draw the warp through the healds, the lease wires are raised to the position L, which places the healds in their proper order. The raising of the lease wires is made possible by a vertical wire which is placed in a long cavity in the shaft end C, and outlined at D. On this wire, the two lease wires are looped. After the warp has been drawn through the healds, the lease wires are lowered to the position H.

The spreading of the healds is brought about by placing the healds at either side of the dividing wires which are just below the safety wires that pass through the loops in the healds. The safety and dividing wires are in a vertical line with each other. At M and N, the top and bottom shafts are shown, and the way the healds are threaded.

The twine comes down on the right side of the shaft M, and is made to pass through the loop on the heald Y on the left. It then crosses to the loop on the heald Z, and then passes back to the left of the shaft M. The crossing of the top twine in the other section shown is the same, but they pass at the opposite side of the dividing wires. At P, the dividing wires are on the left, but at O they are on the right. On the actual shafts, healds W and X are the first two healds, and Y and Z are the second pair behind them, but are placed separate in the drawing to avoid confusion. In this manner the four rows of healds on one shaft are created. Between the outer and inner heald, there is a distance of $\frac{3}{8}$ inch. In the bottom section, the threading of the twine and the crossing of the healds are both alike. The heald W passes to the left of the lease wire S, and to the right of the lease wire U, and is then held by the safety wire on the right. The heald X passes to the right of the lease wire S, and then to the left of the lease wire U, the heald then being held by the safety wire on the left. The twine comes up from the left of the shaft N, passes through both loops in the healds on their respective safety wires, and then goes down on the right side of the shaft. T and V, are the same as S and U. This type is 5 per cent. more in cost than the ordinary knitted wire heald. It has met a long felt need.

New Type of Heald Frame.

Whilst the type of this edition was being set up, the writer's attention was called to a new kind of heald frame, which had been invented by Mr. L. Wilkinson of the Wool Textile Supplies Ltd., Lidget Green, Bradford.

This frame is for the use of slider wire healds, and such are its merits, that it has been readily adopted by the textile trade, and especially by manufacturers engaged in the fine worsted, high grade cotton, and the silk and rayon trade.

The explanation of its structure may be followed by means of the illustration, Fig. 10. At A and B are the wooden cross shafts that are held at the ends by the vertical wooden part C.

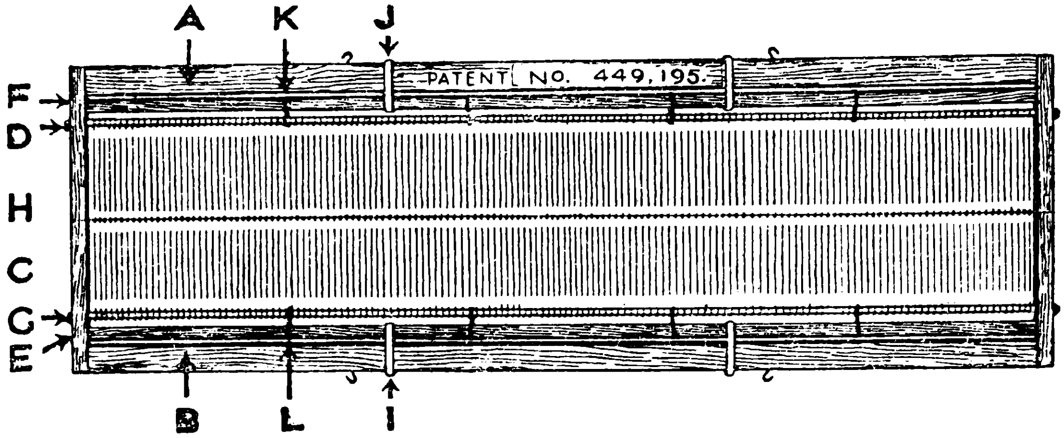


Fig. 10.
Wool Textile Supplies Ltd. New Slider Heald Frame.

In addition to the cross shafts A and B, are two others which are much smaller and are at E and F respectively. The ends of these find lodgment in the vertical shaft end.

These smaller inner shafts are kept in position by the metal clasps I and J which rest in grooves in the shafts A and B. Though these clasps are confined to the grooves, they have at least a quarter inch play, so that whatever be the tension placed on the main cross shafts A and B, they leave the inner shafts E and F, at the same pitch from one another, and the healds are free from end to end.

The ordinary slider rods are at D and G, and on these the healds are placed. The slider rods pass through the shaft ends and are secured by a wire link.

As will be noted, the slider rods are supported at about equal distances by suspension hooks K and L, which loosely clasp the slider rod, and are free on the wooden shafts E and F. By this arrangement all the healds hang plumb straight. They readily respond to the pressure of the weaver's hand when taking up broken threads, and as readily return to their correct weaving position as soon as the hand is withdrawn.

Because of this freedom, many objectionable marks which appear in high grade work, and especially in rayon cloth, when woven with ordinary slider heald shafts, are eliminated, and thus gives a higher per cent. of top price fabrics. Moreover, as there is no chafing of the warp due to healds not being straight, less ends are broken, production is higher, and there are less mending expenses.

As is well known, slider wire healds are very adaptable to changing setts, and are free from empty mails, which are often a snare to the weaver. This adaptability aptly applies to this new heald frame.

Suppose a fresh warp has more threads per inch than the one " felled out," and both are straight gait, the fresh warp is twisted to the threads in the healds. When the twistings are drawn through healds and reed, more healds are then placed on the slider rods to accommodate the surplus warp. When the warp is placed through its proper reed, the healds are then more dense, and it is even possible that the outer set of hooks may be brought in close contact with the metal clasps I and J. This is easily rectified, for the hooks are unhooked, and placed in much the same position as before, and rehooked to the slider rod so as to take an equal share of the weight of the healds and warp.

Though the main shafts A and B in the illustration are straight, there are at least two modifications.

(1) When many shafts are used, the healds have to be deeper, and the frame also. There is then less space for the overpick picking stick. More room is found by sloping the heald shafts downwards towards the end.

(2) The other is for the small depth healds and frame. In this case the top set of shafts are longer than the bottom ones so they can be safely and readily hung in racks.

Gauze Healds.

The latest and most efficient healds for the weaving of gauze and leno are depicted at Fig. 11. They are manufactured by Messrs. Grob & Co., Horgen, Switzerland. They are made of flat steel, which, like the Toledo sword, can be formed into a circle, but springs straight as soon as released. They are highly polished, and by their construction, the weaving of leno and gauze have been simplified. The structure and working may be followed by the diagram.

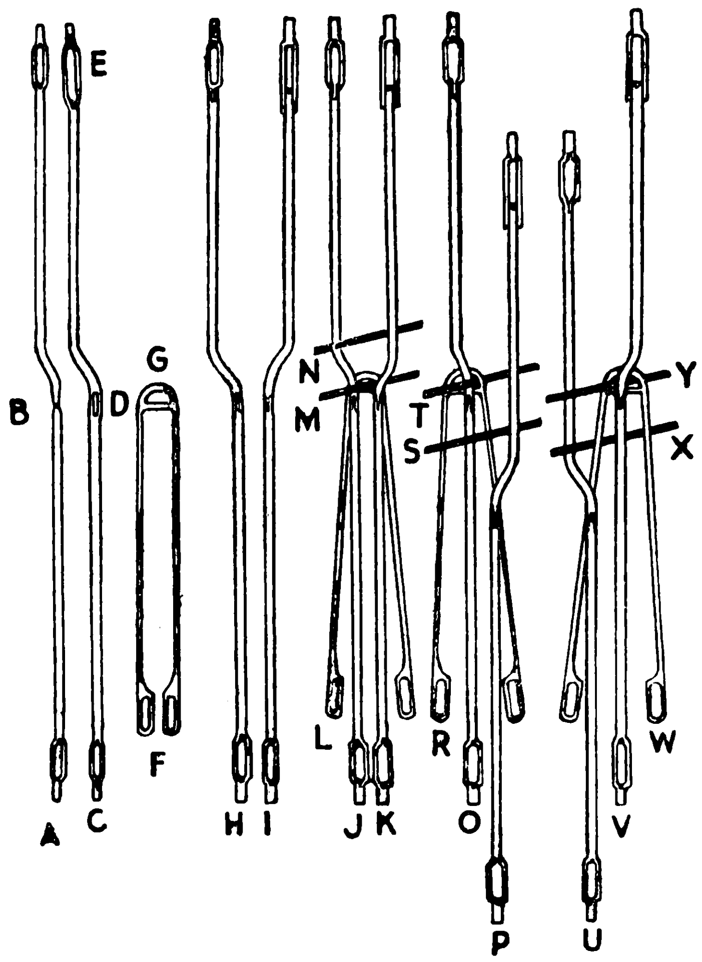


Fig. 11.
Grob's Steel Healds for Gauze and Leno Weaving.

Instead of a doup, doup shaft and slip, there are two doups and a slip. Each doup is made in two parts, and may be termed a double heald. The two parts are at A and C. The part A is cranked, and has a small step at B, and C is also cranked at D and is made with a punched hole for the bottom part of the heald to pass through. At the upper part E the slot is longer, and also has a step upon which the upper end of A may rest when threaded through. At the top half, then, the two healds are as one by interlocking, but at the bottom they are separate. The healds are slotted at both ends for the use of slider rods.

The only difference between the healds H and I is that they are reversed in position. They are placed that way so their cranked centres may be brought near together. The total length of the healds are $13\frac{1}{4}$ inches, and the width of the flat side $\frac{3}{32}$ inch. The slip F is $6\frac{1}{8}$ inches long, and the width over all across both legs is $\frac{9}{32}$ inch.

Though each of the slender legs are only about one third the width of the heald, they are exceptionally strong and pliable. Each leg is slotted at the bottom for the use of a pair of slider rods, and at its upper end G, it is shaped like a half moon, and it is through this the crossing thread is made to pass. The slip is placed in position by opening out the upper parts of each double heald and inserting a leg of the slip through each. The slip cannot be pulled down any further than where the double healds interlock at their centres. This is clearly demonstrated with the healds J and K. What has now to be explained is how the threads are drawn through, and how they are lifted. At M, the crossing thread is drawn through the slip G, and the stationary thread N, is passed through the heald on the stationary shaft behind both doups, and then passed between the two doups.

The next section of the diagram reveals what takes place when the first doup on the left is lifted. When the doup O is raised, it takes with it the slip R, and this causes the crossing thread T to be elevated on the left side of the stationary thread S, and a pick of weft is then inserted with the heald P in its bottom position.

On the next pick, the healds and slip are reversed in position. The heald U is left down, and the heald V is raised, and takes the slip W with it. This move has now placed the crossing thread on the right side of the stationary thread X, and the thread Y has now been in two picks at either side of the stationary one. This completes the weaving of the simplest kind of gauze.

The shafts carrying the two sets of doup healds are kept together with vertical freedom for each, by a plate being riveted to the metal shaft end about its centre, and the first shaft passes through a slot in the plate.

The slots in the slips are higher up than the slots in the doup healds, and as the slips must be elevated every time a doup is elevated, the bulky parts of the healds never cross each other. The slider rods that pass through the slip slots are fixed together, but with sufficient space between for the free working of the two sets of doups. Both doups and slips are brought to the bottom shed by a pair of closed spiral springs for each shaft, and for the slips.

These healds lend themselves to any amount of combinations, for the number of doups with their attendant slips may be duplicated. Then too, instead of one thread crossing one, it may cross as many as desired, for the number of stationary shafts may be also increased. Whatever could be done by the old system can be all the better done by the new.

Fig. 12 is a small figured gauze. In the actual pattern, one twist thread crosses two single twist threads from left

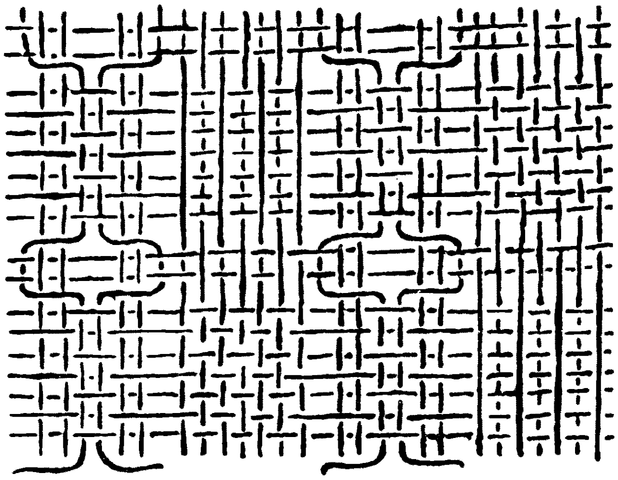


Fig. 12.
Figured Gauze.

to right, and another two-fold twist thread crosses two single twist threads from right to left. The weft is divided into two groups of 7 and 2 respectively. One repeat of the warp is divided into four groups. The first is six threads which gives the gauze effect. The second is seven threads which weaves plain for seven picks commencing from the bottom, but in the following seven picks, the first and

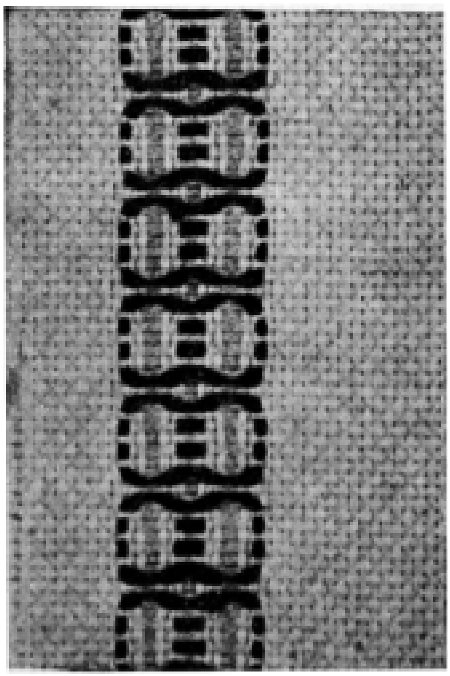


Fig. 13.
Leno Cloth.

alternate threads float at the top over seven picks, whilst the second and alternate threads float underneath. The last two picks in the series weave plain. The third group are like the first group, and the final group weaves the opposite way to the second.

Fig. 13 is a leno cloth. The black crossing threads are ten-fold, and each crosses three four-fold white threads, and produces an effective stripe on a plain ground. The weft is also four-fold. The black threads are wound on a separate beam, and are let off in proportion to the ground threads so as to produce the smartest appearance in the woven structure.

Stainless steel healds are very popular for the weaving of rayon. They prevent the formation of rust, and little or no dust accumulates on them, and dirty marks on the cloth are decreased.

The " Kartex Plus " Frame.

One of the difficulties in weaving fine worsted fabrics, and especially rayon, is the tendency of slider wire healds on ordinary frames to remain as pressed sideways by the weaver when taking up broken threads. This is due to the healds being too tight on one or more of the shafts. If not straightened by the weaver before weaving is resumed, ugly marks develop in the cloth in much the same way as when reeds are bent in the sley. Moreover, the fine filaments of rayon are considerably chafed or broken by the position into which the healds have been forced. Unless " buttons " develop on the threads, or the cloth is badly marked in the loom, much cloth may be woven before the fault is rectified, and such cloth is likely to pass forward as damaged goods.

Marks made by displaced healds are also prone to be made where rod hooks are fixed to the shafts, for at such places, all the healds have to be pressed in one direction. Healds may be quite free in movement when being loomed in the twisting frame, but when geared up in the loom, the pull on the shafts frequently causes the slider rods to reach the utmost limit of the healds, and so makes them bind on the rods. This fault is worst in negative dobby looms owing to the pull of the springs on the under motion. The only way in which the healds may be made more free is by unscrewing the hooks that hold the rod, and this is an awkward task in the loom, and may even then be only a little better, owing to the short bedded length of the hooks.

These serious faults in the weaving of rayon have been entirely overcome by the " Kartex Plus " slider wire heald frame which has been invented by Messrs. F. W. Carr and Son, Peel Mills, Keighley, Yorkshire.

This new type of frame is demonstrated in Figs. 14 and 15. The first shows the front view. Here, A is the top

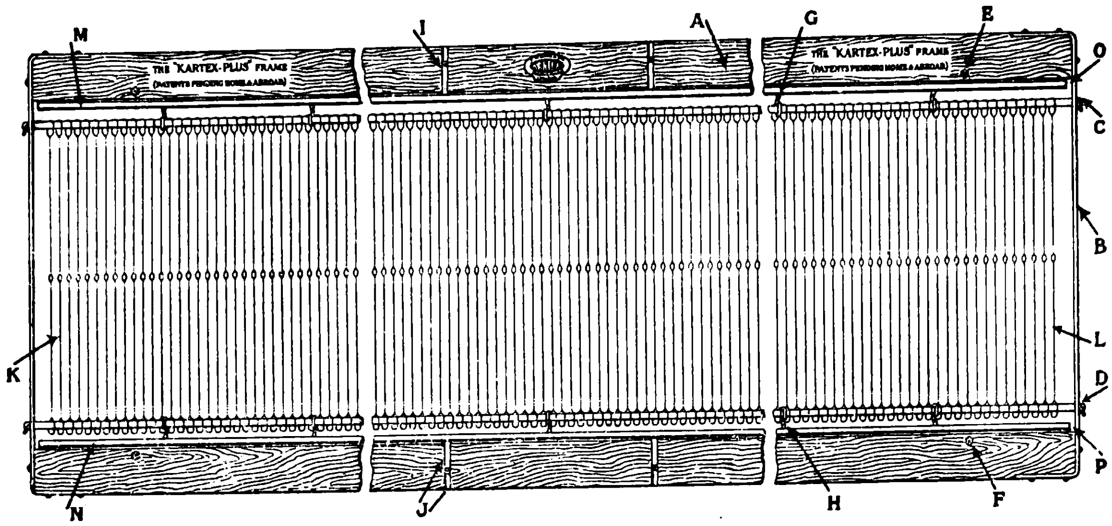


Fig. 14.
The "Kartex" Slider Heald Frame. (Front View).

shaft which is connected to the bottom one by the steel end-stay B. The stay is screwed to the shafts top and bottom, and is slotted for the slider rods C and D to pass through. At E and F are rivets which pass through holes in the special section rails M and N. These rails fit into grooves on the inner side of each shaft, the groove being $\frac{1}{2}$ inch deep, and just wide enough for the thickness of the rail to slide in. These rivets fasten the rails to the shafts, but only towards the end part of the frame, the centres being free. All the pull and strain in the loom is all on the shafts, and is not transferred to the rails, so that all the healds have free play under all conditions, the play being approximately $\frac{1}{8}$ inch.

Near the centre of the frame, the heald shafts are grooved at I and J, and here are placed elongated **U** shaped mild steel clips which pass through a slot in the rail, the clips being riveted to the shafts. The clips have no influence over the rail unless the shafts are abnormally stretched, and draw the rail to the extreme limit of its slot.

The rails M and N are of round section at the under side next to the shaft, which imparts greater rigidity. The centre bottom of the round section is grooved for the reception of the sliding hooks G and H. These hooks have bead heads which pass into the hollow part of the rail, and are flat where they pass through the groove in the rail. By this means, the hooks can be slipped along the rail to any desired position, and in service, are self adjustable to any lateral movement of the healds. Any number of hooks can be put on the rails at the open ends O and P, or may be taken off to suit the lighter weight fabrics if found necessary. The hooks G and H are made standard size so there is an identical suspension for all the healds on every shaft. They are cranked so the slider rods are dead in the centre of the shaft. When disturbed by the weaver, they swing back to their proper weaving position along with the healds, as soon as the hand of the weaver is withdrawn. The healds K and L, may be of any gauge of slider wire heald—either thick and strong, or light and slender, the rails and hooks acting the same way for both.

Fig. 15 gives the side view, and makes clearer the arrangement and its advantages. A is again the shaft, and C-D the slider rod which is held by the cranked hook G-H. The head of the hook is placed inside the open circular section of the rail M-N, the rail being grooved at the bottom for receiving the flat sides of the hook. The flat part of the rail is shown inside the shaft A, and whatever be the pressure applied to the heald shafts, the rail cannot be drawn out of the groove in the shaft. Both top and bottom rails remain at the same level throughout weaving, and the freedom of both hooks and healds on every shaft is assured.

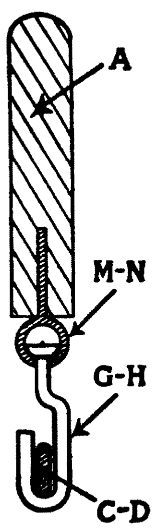


Fig. 15. "Kartex" Frame. (Side View).

By this ingenious and effective arrangement, ugly marks from displaced healds, and rigidly held slider rod hooks are entirely eliminated. The healds last longer; there is a decided reduction in broken threads, and consequently pieces are better woven and mending expenses are reduced. Allowances for spoilt places are considerably decreased, and for these reasons alone, the "Kartex Plus" wire heald frame is a boon to all manufacturers engaged in the high class worsted trade, but especially to those manufacturing any kind of rayon fabrics.

PRELIMINARIES OF WEAVING.

A fair amount of accurate work has to be carried out before a fresh warp is ready for weaving. Suppose an 8 shaft warp is loomed, and has to be woven in a negative dobby, it may be of interest to run over the chief points that have to receive attention before the warp can be ready for weaving.

Gearing Up.—After placing the warp beam in its brackets, the shafts are temporarily attached to a couple of hanger bands. The sley is then placed in its rack, and the shafts are then attached to their respective top bands. This is followed by the bands on the spring levers being placed on the bottom hooks on the shafts. If any spring is seen to

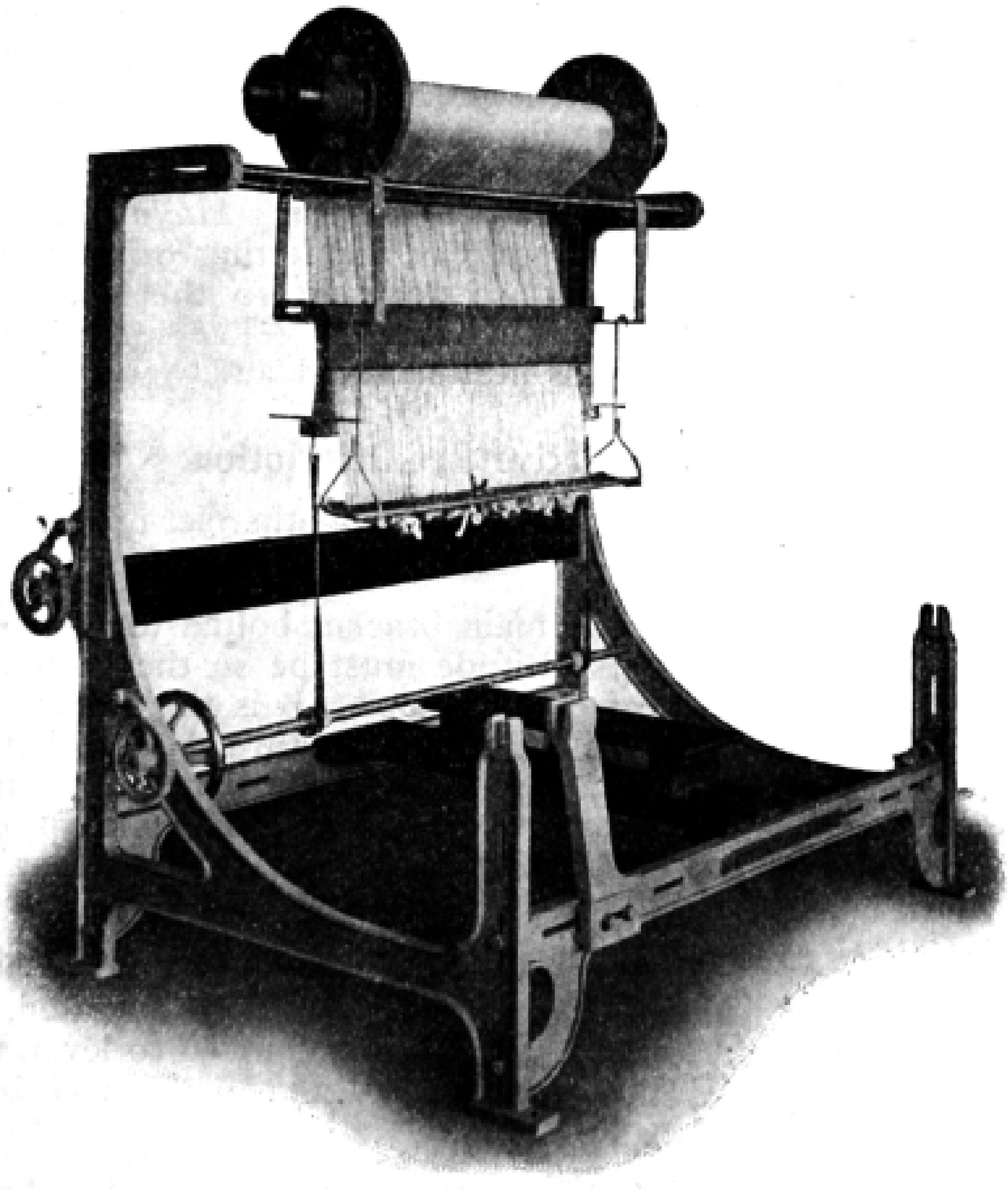


Fig. 16.
Hattersley's Looming and Twisting Frame.

sag, the links associated with it must receive attention and be shortened.

One spring per shaft is sufficient for light weight cloth. but if it be heavy cloth, then a top and a bottom spring lever must be hooked to the same shaft. Every shaft at the bottom should have a double set of hooks for this purpose, so that the spring pull is centred at four points instead of two, and so distributes the weight. The Brigg's motion is now put into position on the warp beam, the bits and cap having previously been filed. The slack of the warp is pulled back on the beam, and the sley adjusted to be in line with the threads in the healds.

The canvas is then wound into position, and should be long enough to be fixed to the cloth beam, and also be wide enough to take the widest warp without the edges being drawn inward when tied up. The warp is now combed or brushed in small sections to get all the threads as straight as possible, and in making the sections small, the threads are more uniform in tension, and the knots are small so as not to hold in their passage to the cloth beam. Having tied the whole warp to the starting canvas, the letting off motion is released, and the warp drawn forward so the knots will pass beyond the range of the temples. The warp is now tightened, and the Brigg's motion fixed and weighted.

Briggs' Negative Let-Off Motion.

This is on a different plan to any other let-off arrangement.

At A, Fig. 17, is the main bracket bolted to the inside of the loom frame. Its altitude must be so the bottom of weight lever J is free from the floor. B is the hooked end upon which the lever F is placed. At C are the two bottom brake caps that fit into recesses on the surface of the main casting A. On these caps rests the collar of the warp beam D. A different cap is placed on the top at E. Its upper part fits into a recess on the under side on brake lever F.

The casting A has a projecting pin at H, and on this is placed the vertical lever G. At the base it is bifurcated, and in it is the weight lever J. Lever G is coupled to lever F by connecting rod I, the working length of the rod being adjusted by locknuts K.

To give a firmer grip to the warp beam collar, before commencing the weaving of the last piece, the caps are filed at their smooth places.

Fig. 18 is a front view, and lettered like Fig. 17. The weight level J swings free on a pivot through the upright lever G, the latter being bored through the bottom for the connecting rod N that couples it to the release lever P.

Arm J is slotted to carry weight bar L held by setscrew K. The weight bar can be shortened by being slided through the slot when weaving light weight fabrics. The weights M meet most demands. At O is the fulcrum for release lever P shown in its weaving position, and held by looped wire R.

After lagging back or combing out, the release handle is liberated and the warp beam can be turned back single handed.

Fig. 19 is lettered the same as Figs. 17 and 18. Here, there is only one cap at the bottom which is covered with felt. Before the beam is placed upon it, the felt is sprinkled with powdered blacklead, and it will then weave a 10-cut warp without further attention. Cap E and lever F. are bored to let blacklead reach the warp beam collar.

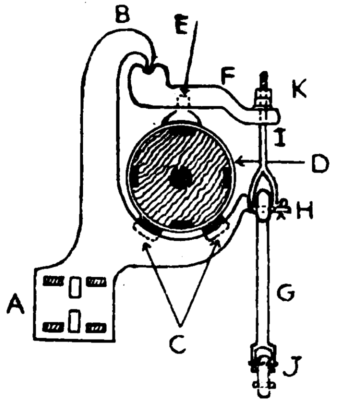


Fig. 17.

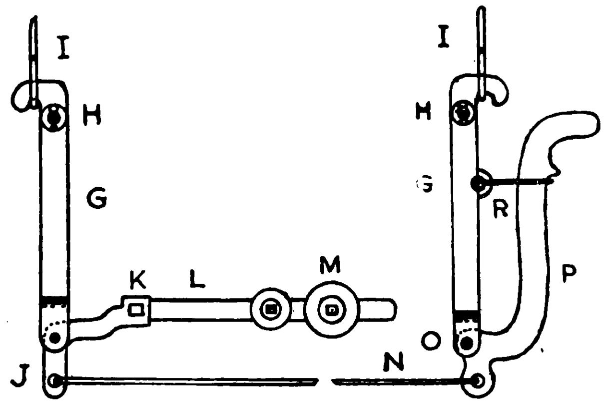


Fig. 18.

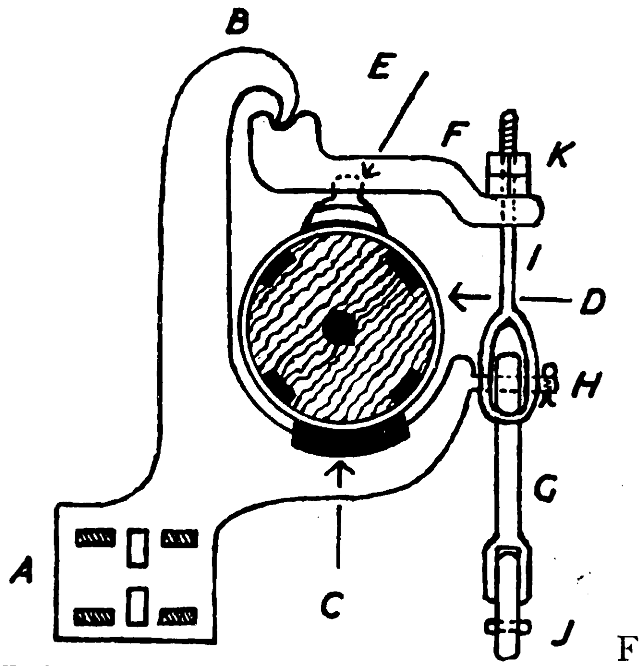


Fig. 19

Fig. 17. Briggs's Let-off Motion (End View). Fig. 18. Front View. Fig. 19. End View with only One Bottom Cap.

Attention to Sley.—A sley is best set when the going part is well forward, for the straightness or otherwise of the warp can then be judged.

Healds that have castings out are liable to put the warp out of line with the sley, and the best possible position has then to be arranged. Comparatively few sleys extend the full width of the sley rack, and this necessitates the filling up of the gaps by other pieces of sleys of the same depth and thickness if they can be obtained. Pieces less in depth have to be packed firm, but those deeper ought never to be used as the weaving sley is then held slack.

A special point is, that the angle formed by the shuttle race and sley should be the same as that made by the shuttle back and bottom. If the shuttle can be tilted backward at the top when resting on the shuttle race and against the sley, it cannot possibly run at its best through the shed. To make the sley angle coincide with that of the shuttle back, the back of the handrail where it meets the swords can be packed with leather to bring the sley forward at the top. This is a simple and effective solution.

Following the bolting up of the handrail, all the shafts are lowered by tilting all the feelers, and turning the balance wheel one revolution. It is a dangerous practice to lower the catches and shafts by taking each catch off the forward bar with a pair of pliers.

The sley is then tested from end to end with a straight edge, for all protrusions must be knocked back, and all hollows knocked forward with the hammer. A new sley has to be no exception to a thorough testing, and more often than not, the thick metal pieces at the ends have to be hammered back. The safe running of the shuttle chiefly depends on a good delivery of the shuttle and the straightness of the sley.

Temple Setting.—Then comes the setting of the temples. On their underside they must clear the shuttle race, and at the front when the sley is at its front traverse, it must be free from the reeds.

For the weaving of light weight cloth, the inner head of the temple is set about level with the last threads in the selvedge, but for heavy work, it is a little further in owing to the extra drag and contraction of the piece.

All the rings should be tested for freedom, and if any work stiff, the barrel must be taken off and any clogging waste taken out. The inner end of the temple barrel is all the better if it dips slightly, for this eases the pressure on the cloth.

Altering Change Wheel.—The particulars for the picks and weave are on the weaver's card, and this has now to be examined. The gauge point for most negative dobbies is 3,600, and the number of picks per inch are now divided into these figures. Suppose it was 60 picks, then the change wheel required would be 60. What is done, however, is to put a wheel on with a cog more than the calculation, as this takes up the cloth a little quicker, prevents the piece bumping, and weaves the cloth all the smarter. The intermediate which gears into change wheel should be tested to see that it works easily.

Lag Changing.—The design is usually indicated by a number, and this is hunted up if not known. A design should be pegged as it has to be placed on the loom. There is then no confusion as to whether it is a right or left hand loom, which is the first pick, and which way the twill should

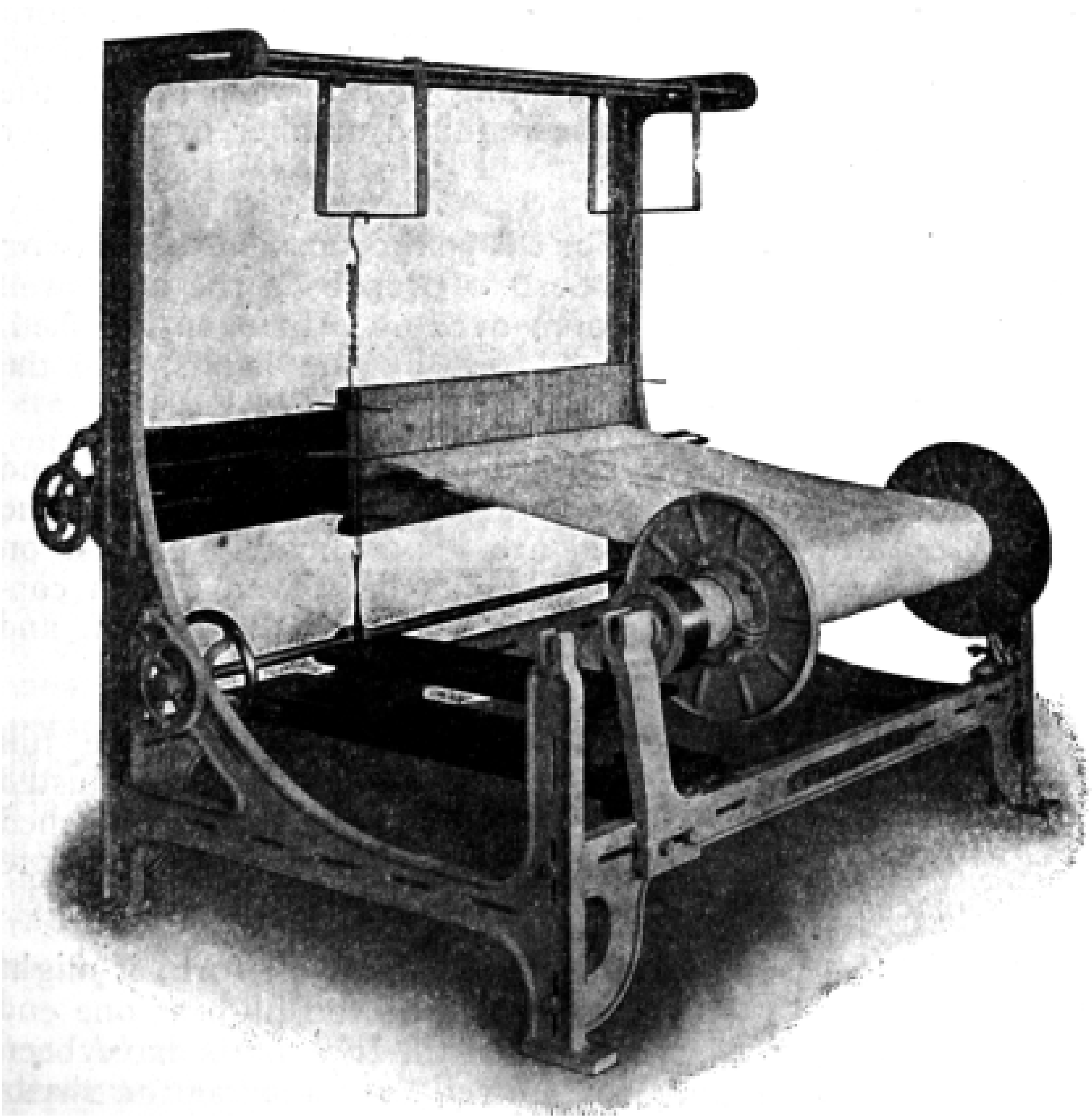


Fig. 20.
Hattersley's Looming and Twisting Frame.

lean. Unless explained otherwise, the bottom pick of a design is the first pick to be pegged. When the pegging is concluded, every peg should be tested with the thumb and finger to see if it is firm, for if not, it must be exchanged for one that gives better results. These remarks apply to wooden pegs.

Quite a number of different makes of negative dobbies will not weave 8 lags with safety, and it is found best to double the number, and pass them over a roller. A couple of strands of loom band is quite sufficient to hold the ends of the lags together by tying, and is a handy method to cut the bands when taking the lags off. It also indicates the starting lag for both simple and complicated patterns.

Weighting Warp Beam.—In the Brigg's letting off motion there is only one weight lever, and the amount of weight required is often surmised if the ounces of cloth are indicated on the weaver's card. When the change wheel is correct, it is then the tensioning of the warp that is the main factor for getting in the required number of picks per inch.

Beginning Weaving.—For the commencement of weaving for any kind of warp, it is best to prop back the box swell finger, and then turn the loom over once to open the shed. The threads are then opened out by the hands, and the shuttle thrown through.

This is repeated for several picks until the full round of the small weave has been treated. If it is found that the threads on the bottom shed are approximately correct on the shuttle race, about an inch may be woven with a contrasting colour of weft so as to show up the design, and reveal any defective places.

Adjusting the Shed.—Having now obtained the full pressure of weight on the warp, the shafts can be adjusted so that each of them places their threads on the bottom shed so they barely touch the shuttle race. The most appropriate testing places are well towards the inner end of the temples.

If the shed was tested by the centre weft fork, it might be found correct there, but it could be too high at one end and two low at the other. When all the shafts have been adjusted to satisfaction, it is as well to glance at the shafts when on the top shed. In negative dobbies one defect develops which does not take place in any other kind of dobby.

When the pins or rod ends become worn on the outer series of jacks, the streamer rod moves the worn distance before it begins to move the shaft. This late start causes the shaft to be lower than the others when on the top shed. This has to receive attention, or there may be an excess of broken threads as well as stitching. If the hooked end of the streamer is not too far worn, it may be bent upward with the two hands when the shaft is on the bottom shed. This must be immediately followed by a lowering of the shaft to its proper level with the shuttle race, and the altitude when on the top shed will have then been improved.

Counting the Picks.—When the contrasting colour of weft has been woven for about four inches, the proper weft may then be used, and after weaving a couple of inches, the picks should be counted. If they are found to exceed the inch, then more weight must be placed on the warp beam lever, but if there be too many, then less weight must be applied.

Examination of Threads.—With a warp woven in the grey or all one colour, it is possible to find every defect in the contrasting weft section. In every case of fancy warp, every shaft has to be raised one at a time, and a thorough scrutiny made to find any fault. Every fault is indicated by a chalk mark or by looping in a bit of beeting. When every shaft has been examined, the wrong places are made correct.

Examination of Patterns.—As an efficient check against making mistakes, a piece is cut out of the woven structure which includes the contrasting weft and the proper one. If it be a fancy design or has fancy colours, a whole pattern must be cut out and taken to the designer or responsible person for inspection. If found in order, then weaving may proceed until a good wrapping is wound on the cloth beam. Having reached this stage, a full length section is cut off for a final examination, and if there be any mistakes discovered, these are put in order, and weaving is then resumed. Most firms have a private starting and felling mark, and these are seen to by the weaver.

As to whether lease rods are placed on the back shed depends on the kind and quality of warp. In every case of fancy colours or fancy drafts, the lease rods are left in or put in as for looming or twisting, as this is an excellent guide for the weaver in taking up broken threads.

Close Setted Warps.—When warps are to be started that are close setted, and are on two beams, it is much better to divide the shafts, all those associated with the bottom beam being left up, and those connected with the top beam put down. A complete separation is then made of the warp, each lot being well combed. The bottom shafts are then raised, and the whole warp re-combed and tied up as is done for one beam. A much better start is then made for weaving.

Overhauling.—It may be hinted, that when time permits, it is a good plan to overhaul loom parts whilst the loom is awaiting a fresh warp. Dobby parts may need attention, picking noses filing, crank arms cottering up, letting off catches sharpening, and stop rod tongues and frogs doing up. As a final, the loom parts needing lubrication should have it applied.

THE TAPPET LOOM.

The tappet loom is the handiest, cheapest, and most reliable loom for the weaving of warps with a small number of shafts, and a limited number of picks in one repeat of the design. An ordinary Bradford tappet loom is well constructed, has few parts, and is run at little cost for repairs.

Range of Makes.—Its simplicity and reliability have made it a mecca of the inventors' skill, for it may now be obtained with a wide choice of additions.

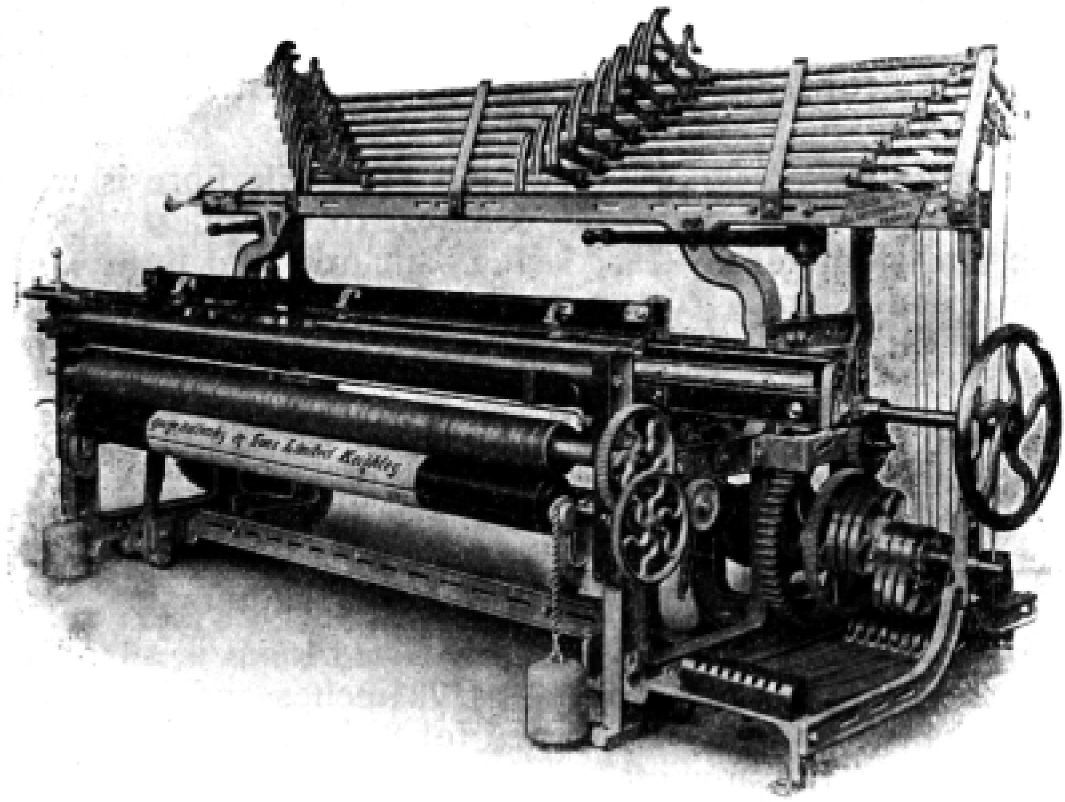


Fig. 21.
Hattersley Tappet Loom.

One has a mixing box at one end of the loom so that woollen weft, or any other kind that requires two shuttles with two picks from each, may be produced.

Another has a four or a six rising box at one end for the weaving of even picked fancy goods.

To include all but the most fancy styles with elaborate designs and odd picks, another construction has a 6 holed circular box at one end, and the same kind of loom is made with a similar circular box at both ends of the loom, each being independent of the other.

As a final in elaboration, an automatic self shuttling device is appended to cope with the plainer fabrics of the worsted trade. Moreover, there are four systems of working the tappets.

(1) The barrel tappet which revolves inside the loom.

(2) Tappets and treadles inside the loom for heavy goods.

(3) Tappets outside the loom known as the Bradford tappet loom.

(4) Positive tappets for the making of moleskins and fustians.

The speed of these looms varies from 90 picks for a heavy woollen loom with a reed space of 110 inches to 210 picks per minute for a dress goods model loom with a reed space of 40½ inches.

Range of fabrics.—Every kind of textile fibre is woven in the tappet loom, from the coarsest to the finest. Coarse jute, and shimmering silk; heavy sailcloth, and light weight dress goods; flimsy cotton, and substantial worsteds; fuzzy woollen threads, and glossy rayon; ancient flax, and artificial wool.

Its constructions and conquests would fill a bulky volume. The present purpose is to explain the main parts of the Bradford tappet loom. As the loom is served with the overpick motion, a negative let off, and a ratchet taking up, these parts are explained in subsequent chapters.

The Hattersley woollen and worsted loom is introduced, Fig. 21. It has a reed space of 72 inches and its speed is 145 picks per minute. It is fitted for 8 shafts, and the outside treading has the advantage of accessibility.

Shedding Mechanism.

The arrangement for dividing the warp is on a different system to any other kind of shedding mechanism, but it achieves the same purpose as the lever and wheel dobby, and in some respects the Jacquard.

Tappet Construction.—The simplest kind of tappet is that constructed for plain weave and is presented at Fig. 22. Weaving overlookers have nothing to do with the making of tappets, but when ordering them, have to state the weave and any special dwell required.

To draw a tappet, two circles are made, the circle A representing a shaft up, and the circle B a shaft down. As plain weave is complete in two picks, the two circles are divided into equal parts by a vertical line. The next point is, what proportion of space must be allotted to the rising and falling of the shaft? The simplest method is for

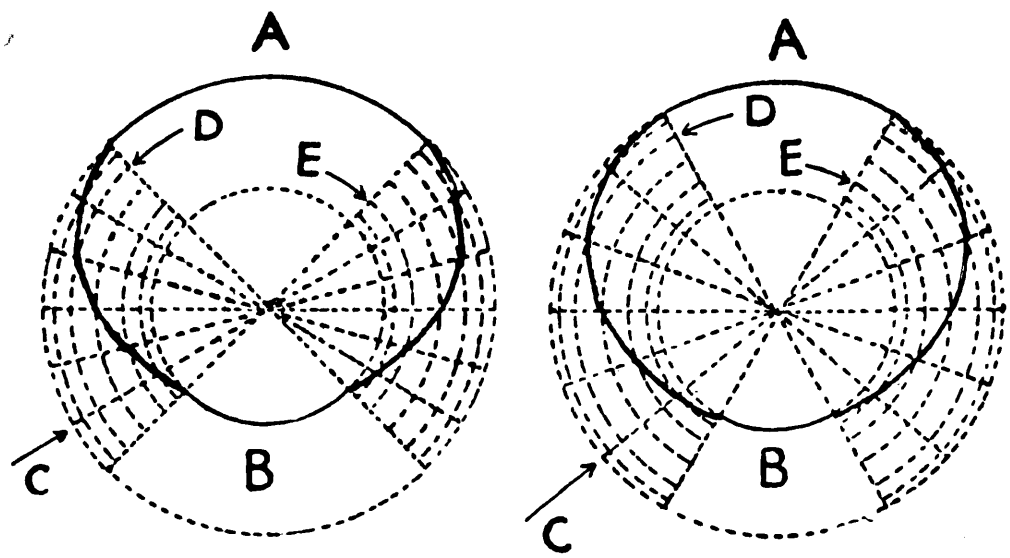


Fig. 22. Tappet for Plain Weave with Half Dwell. (Left).
Fig. 23. Tappet for Plain Weave with one Third Dwell. (Right).

the shed to be open for half a revolution of the crank, and to completely change during the other half. But which part? The shuttle must travel from box to box as the crank moves from its bottom centre to its top centre, and during that period the shed must be open.

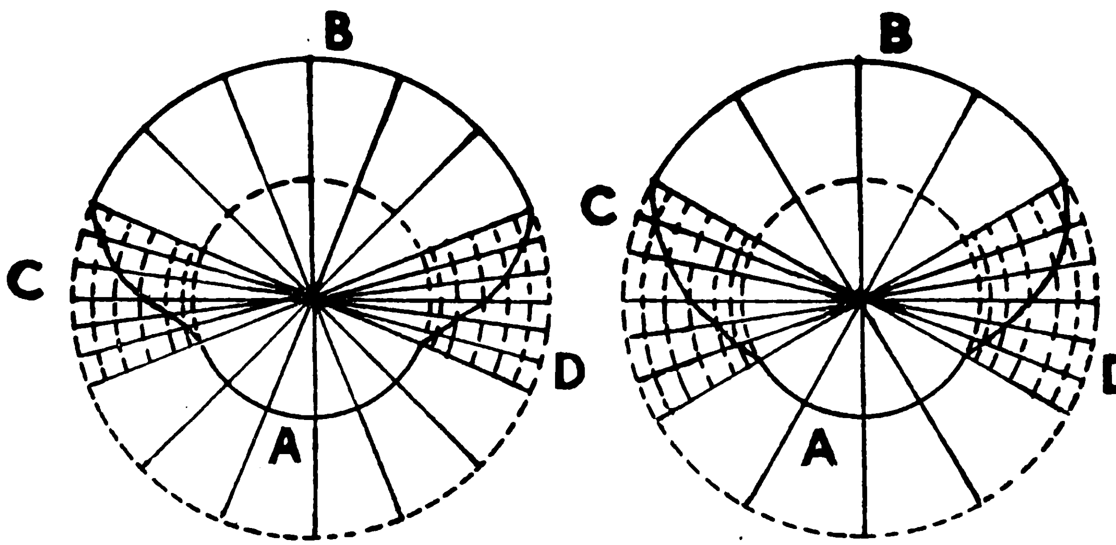
The shed makes the change as the crank moves from the top centre to the bottom one. If the two circles be now divided into eight equal parts, four representing one pick and four the other, it will indicate the eight centres through which the crank passes in two revolutions.

As the shaft must rise and fall in half a revolution of the crank from the top centre to the bottom, on the left and right of the circles is where the two changes must be made. These two parts are now divided into 6 equal portions as shown by the radiating lines C.

What has now to be settled is, how shall the rising and the falling take place? Must it be in equal gradations, or is there a better plan? The most excellent way in which a change of shed can be made is to ease the strain gradually, and move the quickest when the tension is at its minimum. Expressed in words, the speed desired is slow, medium, fast, medium, slow. To attain this on the tappet under construction, the cutting semi-circular lines gradually increase until past the centre of the space, and then gradually decrease in distance from each other. Six semi-circles are made in each of the allotted spaces, and what has now to be done is to draw an ascending line on the left where the lines intersect each other, and then draw a descending line in the other section, and this completes the tappet. At C it is rising; at A the shaft is up; at E it is descending; at B it is down.

Fig. 23 is constructed on a similar plan to Fig. 22, but to give a ⅓rd dwell. This kind of dwell is extensively used in the Lancashire cotton looms with narrow width. With a less dwell, there is more time for the shafts to change position, but less time for the shuttle traverse. At A is where the shaft is on the top shed; B for bottom shed; C for rise of shaft; and E for fall.

Fig. 24 gives the making of the 2 × 2 twill. Here, the shaft must remain up for two picks, and be down for two picks, so that on the two circles, four revolutions of the crank are represented. A similar traverse in crank movement is allotted for the rising and falling of the shaft as in the tappet for plain weave, but the tappet movement is only at half speed. The semi-circular lines are made a little different to the former one so that between the first and last stages there is a more rapid movement of the shaft.



Figs. 24 and 25, 2 × 2 twill.
Left. Half Dwell. Right. ⅓ Dwell.

Necessary Modifications.—It does not follow that because a tappet has been constructed so the change occupies half a revolution of the crank, that the change must rigidly take place between the crank moving from its top to its bottom centre. This is the best position when weaving tender work, because less drag is placed on the threads as the pick is being pushed to the fell of the cloth. But for fibrous work, the timing has to be earlier so as to give more time for the loose fibres to become separated. In fact, when the tappet construction will allow, the change of position must begin when the crank leaves its back centre. The ordinary setting for most warps is for the change to begin when the crank is between the back and top centres. The required picks per inch are then obtained with less weight on the warp beam lever, because the changing threads trap the weft earlier, and it cannot spring back after being beaten up. A further modification is made in the construction of tappets for such weaves as hard wefting corkscrews, and satin cloth. What is required for both, is a longer dwell and a quicker change of shafts so as to give a good open shed to prevent weft curls.

Fig. 25 has a $\frac{1}{3}$rd of a dwell, and with this exception, is similarly constructed to Fig. 24.

Speed of Tappet.—The speed of a tappet depends on the kind of pattern being woven. Plain weave cannot be woven with the speed of a 2 × 1 twill. Every alteration in the repeat of a design must have a fresh setting for the speed.

In the weaving of a plain cloth, no train of wheels is necessary, for both tappets are cast together, and are set-screwed to the low shaft.

In the weaving of the 2 × 1 twill, the crank must make three revolutions to the tappet once. This is accomplished by a train of wheels, the largest being the tappet wheel with 120 cogs. The wheel on the crank shaft by which the timing of the shafts is adjusted must have 40 cogs. As the timing wheel and the tappet wheel are too far apart, recourse is made to an intermediate. Though the number of cogs in the intermediate in this case is of little moment so long as it can be made to mesh successfully with both wheels, a double wheel is more economical which can be used for a 6 shaft pattern. The larger wheel of the two has 48 cogs, 40 of which are turned each revolution of the crank, and the same number of teeth are turned in the tappet wheel.

For a 2 × 2 twill, the timing wheel would have 30 cogs, and the same intermediate as before would be used by adjustment. For a 3 × 3 twill, a timing wheel with only 20 cogs would be wanted, and as the solid part of it is very small, the wheel is made with a rim at either side which adds strength, but increases the difficulty of setting, as the pitch cannot be seen.

Calculations for Intermediate Wheels.—To find the number of teeth required for two intermediate wheels, the number of cogs on the timing wheel are multiplied by the number of picks in the design, which then becomes the numerator. The denominator is the 120 cogs on the tappet wheel. The least common multiple of those figures is the ratio of the cogs for the two intermediates. For a 6 shaft pattern the calculation would be:—

$$\frac{30 \times 6}{120} = \frac{3}{2} \text{ therefore } \begin{matrix} 3 \times 16 = 48 \text{ cogs for one intermediate and} \\ 2 \times 16 = 32 \text{ cogs for the other.} \end{matrix}$$

To find the intermediates for a 7 shaft pattern, let the timing wheel be 30 cogs as before. Then:—

$$\frac{30 \times 7}{120} = \frac{7}{4} \text{ therefore } 7 \times 6 = 42 \text{ and } 4 \times 6 = 24.$$

To prove this correct, multiply the drivers together and the driven together, and divide one by the other.

$$\frac{120 \times 42}{30 \times 24} = 7 \text{ picks.}$$

Selvedge Tappets.—It is the usual practice that when a cloth like the 2 × 1 twill is being woven, which, as a rule, is a warp face cloth, that two sets of tappets are required. One set is needed to weave the warp, and a pair of plain tappets are used to weave the selvedges. The selvedges have to be woven different to the warp, or the edges of the cloth would roll badly when unwound from the cloth beam, and this would cause considerable trouble in the subsequent processes.

To prevent the rolling occurring, the selvedges are woven plain weave, by a pair of plain tappets being set-screwed to the low shaft outside the range of those weaving the warp. One can be timed a little different to the other if found necessary.

Treadles.—These are placed on a stout bar that fits through a cap casting bolted to a horizontally slotted bracket fixed to the framework of the loom. The fixing of the cap casting is very important, for it must be parallel with the width of the loom to give working freedom to the treadles, and also to present the treadle bowls to their respective tappets, without hanging over at either one side or the other. Having secured these two points, there is then the fixing of the treadle grate at the opposite end. This must be set vertically straight so as not to bind the treadles, and its altitude must give range to the treadle so that in its motion, it neither touches the top nor the bottom of the grate.

Each treadle is provided with four holes near the grate, one of which is made use of by the connecting rod to couple it to the cross rail lever which is commonly known as the rat tail lever. The hole nearest the treadle bowl gives the least leverage, and the one nearest the grate the most.

The fixing of the rods might work out that the first two shafts are worked from holes one nearest the bowls, and every pair of rods then advances a hole, but the real test is the efficient service of every shaft.

The treadles are slotted to receive the treadle bowls, the centres of which should be vertical with the centre of the shaft upon which the tappets revolve. The leverage and working is then at its best.

Size of Friction Bowl.—Experience proves that the smaller bowl is best for those weaves that have rapid changes, but for weaves like the 2 × 2, and the 3 and 3 twill a larger bowl is better.

The smaller bowl gives a better dwell, but the treadle has to be examined to see that the tappet does not touch it. If so, then a larger bowl must take its place, or the treadle will have to be ground down until there is a clearance.

For most work, a medium sized bowl gives efficiency.

Connecting Rods.—These are made in different lengths to meet the varying distances to the rat tail levers. They are hooked at the bottom to pass through the treadle, and threaded at the top, and provided with a wing screw. It is the position of the wing screw that influences the position of the pair of half moon levers on the square shaft, for the half moon levers may be either too high or too low. To give the most efficient movement to the healds, the half moon levers should be straight out when the treadle is in the centre of its stroke.

Rat Tail Lever.—The rat tail lever on the bottom square bar governs the first shaft, and the one on the top bar the back one. This lever is open for about 6 inches so the rod and wing screw can pass through. On the upper sides of the divided part there are semi-circular grooves into which the wing screw can be placed. When the wing screw is dropped into the outer groove, the least leverage is obtained, but the greatest is gained at the opposite end. The first shaft requires the least leverage, and the back shaft the most in any group.

The wing screw advance may work out that the first two shafts may be in the same numerical notch, and that each pair after advance one notch, but the size of the shed made by each shaft is the only true guide for the best placing. Every rat tail lever is setscrewed to its cross bar, and should be in line with its own treadle, and each work free of its companion.

Half Moon Levers.—There is a pair on each cross bar, each having a broad groove on its face for a strong strap. This strap is held by a hook that passes through the upper and back part of the lever, the hook being served with a wing screw. To each strap at the bottom is a strong pulley cord, so that any alteration in the depth of the shafts can be readily met. The bottom pair of levers are those which are attached to the front shaft, and the others gradually widen out, to the top ones. They are set as near to each other as can be arrived at without touching, and the hooks in the top of the heald shafts are appropriate to this pitch.

The cross bars are set in a framework that slopes backward, which makes it that though all the half moon levers are the same length, they provide room for the easy motion of the heald shafts without touching each other.

Size of Shed.—From a weaving overlooker's point of view, the size of shed has nothing whatever to do with calculations. He has the machinery to adjust so that when the crank is at its back centre, and the shed is properly set and timed, the top shed nicely clears the top front of the shuttle.

If any shaft be either too small or too large, the rat tail leverage is the first place of attention, but if that is not satisfactory, then the connecting rod is altered in the treadle. To give the calculations from actual measurements, a new shuttle is 2 inches wide and $1\frac{1}{2}$ inches deep. The crank moves the going part 7 inches from the fell of the cloth, so that the depth of the shed 5 inches from the fell of the cloth must be slightly deeper than that of the shuttle. In this case it was $1\frac{5}{8}$th inches. As the healds on the front shaft were 10 inches from the fell of the cloth, the minimum depth at the healds were:—

$$\frac{1{\cdot}625 \times 10}{5} = 3\tfrac{1}{4} \text{ inches.}$$

The $3\frac{1}{4}$ inches represents the minimum rise or fall of the half moon lever, and as this lever and the rat tail lever at its point of contact with the wing screw are each 10 inches, it follows that the treadle moves the same distance at rod contact.

The other calculation is the movement of the treadle at the centre of the friction bowl by the depression of the tappet. The distance from the fulcrum of the treadle to its nearest hole for rod contact is 36 inches, and from the fulcrum to the friction bowl 26 inches. The movement at the friction bowl is

$$\frac{3{\cdot}25 \times 26}{36} = 2{\cdot}34 \text{ inches.}$$

The diameter of the friction bowl was 3½ inches, and the treadle slots in which it revolved were an inch deep.

Direction of Tappet Movement.—This is a point that has to be observed by the overlooker in setting the tappets, or they may cause the twill to be made in the wrong direction. The first tappet to be placed on the boss of the tappet wheel is the one that affects the first shaft. As the tappet wheel meshes with the intermediate, it must turn in the direction of the crank. As the twill must go to the right in the cloth, the second tappet must be fixed to the right for a left-hand loom and all the others to follow to the right one pick later. Each tappet is provided with a couple of setscrews, but each has also a lug in some makes which fits into the recess of the preceding tappet, so that when all are fixed, the whole group is as if it were one solid whole. The tappets are then slided into their working position, the supporting castings bolted up, and the balance wheel keyed on, and the finishing touch is the correct timing of the tappets.

Matt Weaves.—These weaves have several picks in the same shed which is usually two. It therefore follows there must be a catch end at one selvedge to hold the weft. To do this, an extra tappet is placed outside the others which is set to make the extra shaft move up and down when the other shafts are stationary.

It can also be done by means of a half moon lever instead of a shaft. To the half moon a long strap is fixed, a punched hole in it taking the thread. The bottom of the strap is fixed to the floor by means of a weak spring in a vertical position. The other half moon on the 5th cross rail is secured by a band to the spring lever on the under motion, the band passing through the warp at the back of the healds. The half moon is then raised and lowered by the extra tappet in the same way as for a shaft. The wing screw on the rat tail is tied to prevent getting out of its notch.

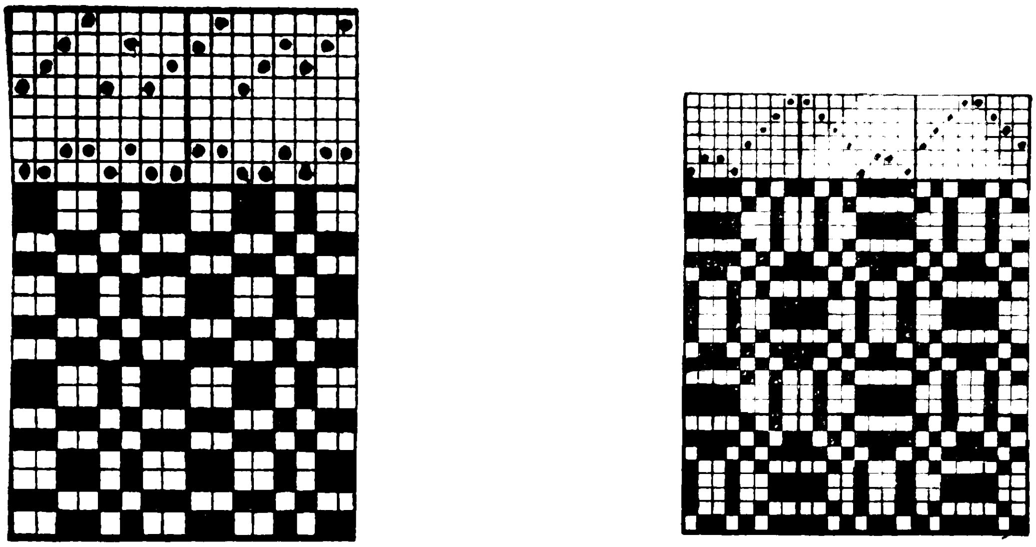


Fig. 26. Matt Weaves.

Two matt weaves are here presented. The one on the left can be drawn on two shafts as shown in the lower draft at the top of the design, but it is more practical to weave it on four shafts as at the upper design.

The other on the right has a little plain ground, and the fancy hopsacks are larger.

It is drafted on 8 shafts.

Weaving Poplins.—Though only plain weave woven on four shafts, it is not easily managed. The shafts are worked by two pairs of plain tappets which are differently timed. They are set so the two back shafts are level when the crank is at its top centre, the two middle shafts level when the crank is midway between the top and front centre, and the two front shafts level when the crank places the reed within an inch of the fell of the cloth. To assist in arriving at an equal tension on the warp, a thick lease rod is inserted when the two front shafts are up and the other two down, and then a thin one is placed in front of the other when the two back shafts are up and the other two down.

If the weft be of a very fibrous nature, then the loose fibres are thrown more to the surface, and a good cover to the cloth is secured.

Back Rails in Plain Looms.

Single Back Rail.—When a single and stationary back rail is employed, it is for light and medium weight fabrics from 6 to 14 oz. per square yard. This may have to be modified owing to the kind of weave, for the more intersections in one repeat of the design, and the more difficult it is to get the required picks per inch.

Fig. 27 presents the parts in their simplest form. A is the warp beam, B the warp, C the flange. At D is the unfolding warp, E the back rest and F the back shed. G is the bottom shed and H the top one, with I the front shed, J the cloth, and K the breast beam.

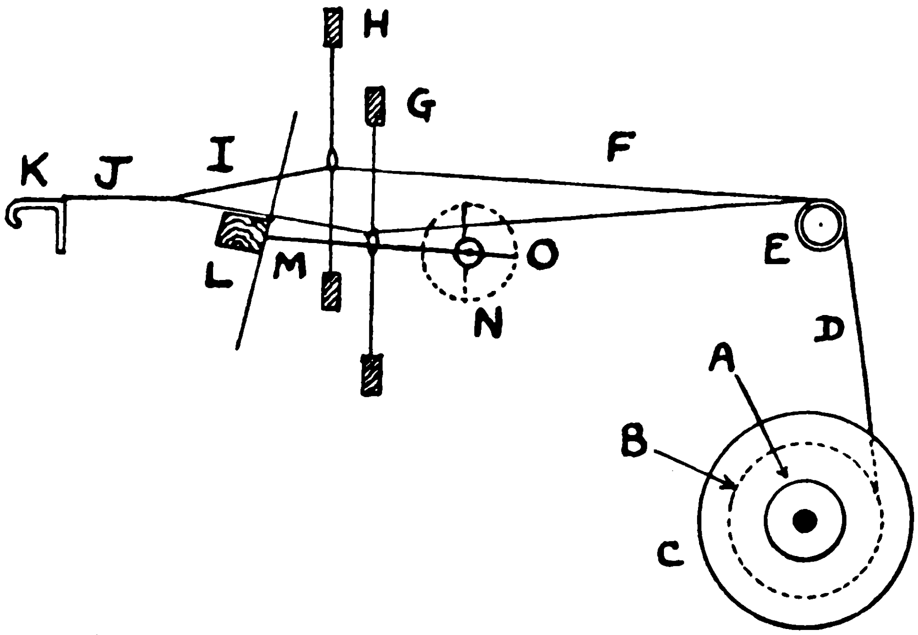


Fig. 27. Outline of Warp from Warp Beam to Breast Beam.

The going part is at L and the sword represented at M. The circular sweep of the crank is at N, and O the crank at its back centre. If there be two racks for the warp beam, most warps weave better in the lower rack, for the tension on the warp is spread over a longer length. The longer the length of warp, and the more friction or weight, or both are needed to brake it. The weights on the warp beam levers have to be daily regulated by the weaver.

Extra Back Rails.—For heavier work, two or even three are used to increase friction and decrease weight. In Fig. 28, A is the warp, with B and C the two back rails and the

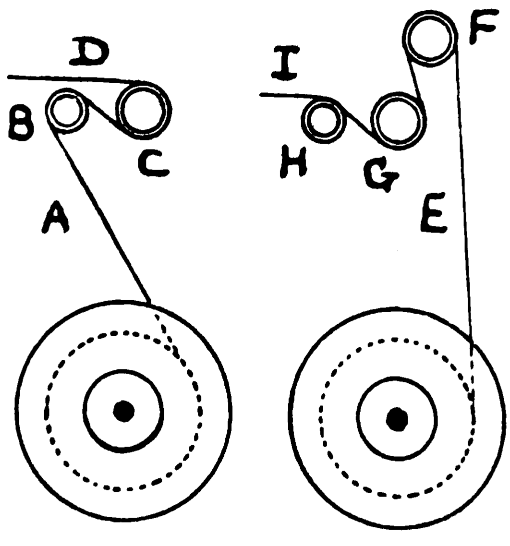


Fig. 28. Extra Back Rails for Warp Tension.

method of placing the warp, and D the passage of the warp to the healds. The way the three back rails are used is shown by the warp E passing over F, under G, over H, and I the warp passing forward to the healds.

Easing Tension by Shed Timing.—Shed timing has a marked influence on the picks per inch. When the weft is trapped early, the picks are got in easier, and with less weight or friction, because the weft cannot spring back after it is beaten up.

In Fig. 29 the earliest timing is shown. The healds A and B are level, and so is all the warp C. At D is the cloth, and the going part at E. The crank arm is at F, and

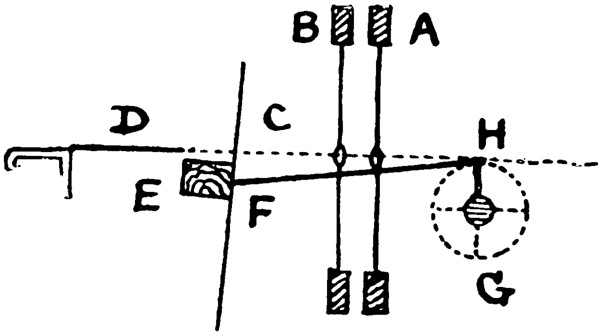


Fig. 29. Shafts with Crank at Top Centre.

the circle of the crank at G, with the crank at its top centre at H. It is much used for hard weaves like corkscrews.

Fig. 30 is the latest timing. At I and J the healds are level, as also the warp K. At L is the cloth, and M the going part at its front centre, and N the crank arm. Then O is the circle of the crank, and P shows the arm slightly short of its dead front centre. Such late timing is neces-

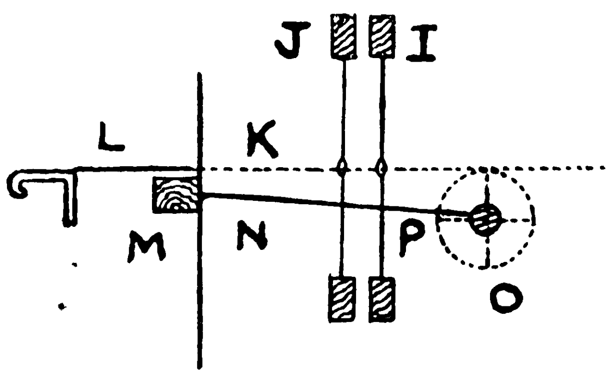


Fig. 30. Late Timing with Crank at Front Centre.

sary for poor warps, for there is much less drag on the threads by the weft. It is also useful in weaving plain cloth in drop box looms using several shuttles, and especially so if the power of the pick is sluggish.

Altering the Timing.—In a negative dobby the timing is altered by the shedding lever on the low shaft, the shedding rod being fixed to the lever. In tappet looms and positive dobbies, the timing wheel is on the crank shaft. The principle of alteration is the same, and is illustrated in Fig. 31. At A is the timing wheel with B and C its setscrews.

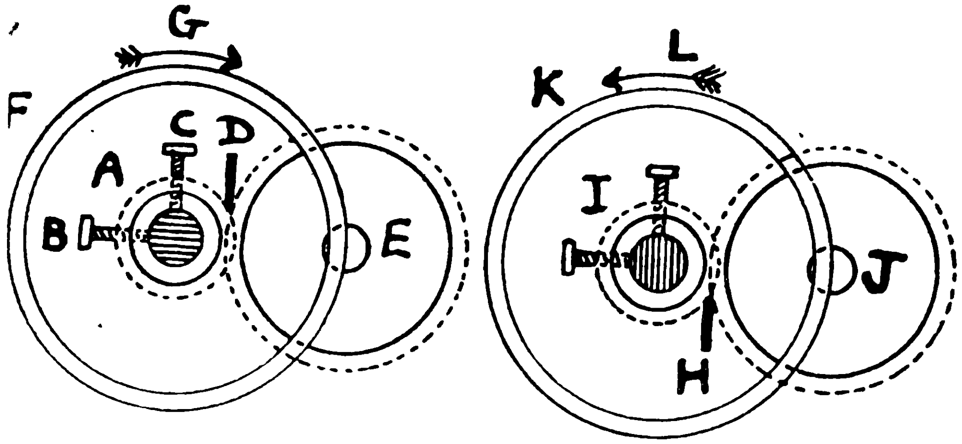


Fig. 31. Alteration of Shed Timing.

If the timing is required sooner, the wheels are blocked at D, the setscrews B and C unloosed and the balance wheel F turned in the direction of the arrow G. If timed later, the wheels are blocked as at H, and the balance wheel K turned as arrow L.

Rope Negative Let-Off Motion.

Most tappet looms have a negative let-off motion which is not only applicable for woollens and worsteds, but also for cotton, silk and rayon. Fig. 32 gives an outline of this arrangement.

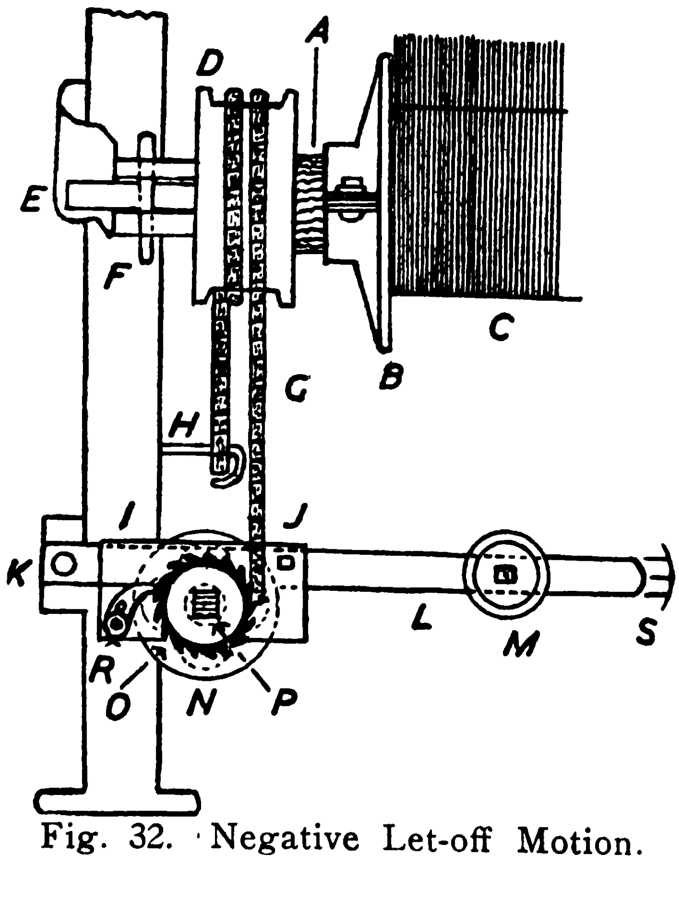


Fig. 32. Negative Let-off Motion.

A is the warp beam, B the flange, and C the warp. At D is the beam pulley which may, or may not be a fixture. At E is the gudgeon, and the hemp rope G is doubly wrapped round the pulley and looped on to the bar H at one end and to the rope wheel N at the other that form part of the ratchet arrangement. F is the holding cotter for beam.

The ratchet bracket I slides on the weight lever L, and fixed by set screw J so the rope is straight. The rope wheel has four openings, and the rope is made to lock itself. At O is the ratchet wheel held by the catch R. At the front centre is a square at P which is made use of by a spanner to wind the rope and lift the weight lever. The last named is at L, its fulcrum at K, and weight at M. The frictional side of the rope is rubbed with block blacklead for woollens and worsted, but for silk and rayon, french chalk is used for cleanliness. S is rise and fall of weight lever L.

It is very essential that before commencing the weaving of the last piece, that the ropes be cleaned, and a fresh dressing applied, so as to give a steady let-off.

Wearing of Ropes.—Ropes are subject to being influenced by climatic conditions. In dry weather they contract; in damp weather they expand and grip the pulley too much. A rope can only be worn on what may be termed two sides, but often only on one. The contour of a 6-ply rope is much like the diagram in Fig. 33. This being a cross section, the outer parts being rounded and the inner parts crushed by pressure.

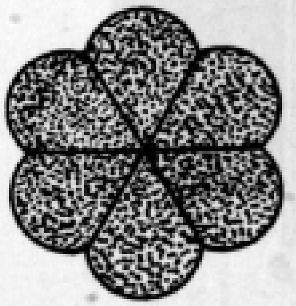


Fig. 33.
New Rope.

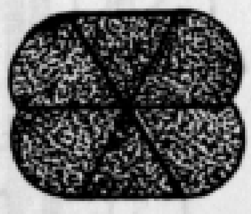


Fig. 34.
Worn Rope.

By wearing, the tension draws the rope out, and decreases the diameter. If worn on two sides, it becomes flat like Fig. 34, and by being flat, its friction surface for one side is from 6 to 8 times larger. Though this increases rope friction, and will reduce weight on the warp beam lever, the weight is preferred owing to the resilience of the weight lever. Better results are obtained with a new rope, and especially so for weaving rayon.

THE LEEMING DOBBY.

The Leeming Dobby is constructed on a different plan to any other kind of dobby. It is a positive dobby, and its capacity is made to requirements. It is constructed to take as low as 12 shafts for heavy woollens, or up to 32 shafts for the fancy worsted trade.

The pitch for the dobby wheels may be as fine as $\frac{7}{16}$ths, or medium with $\frac{5}{8}$ths, or strong with $\frac{7}{8}$ths inch. They are employed in the making of moquettes on either single or double shuttle looms, and are one of the dobby motions used on the Northrop loom.

The structure of the dobby may be traced on Fig. 35.

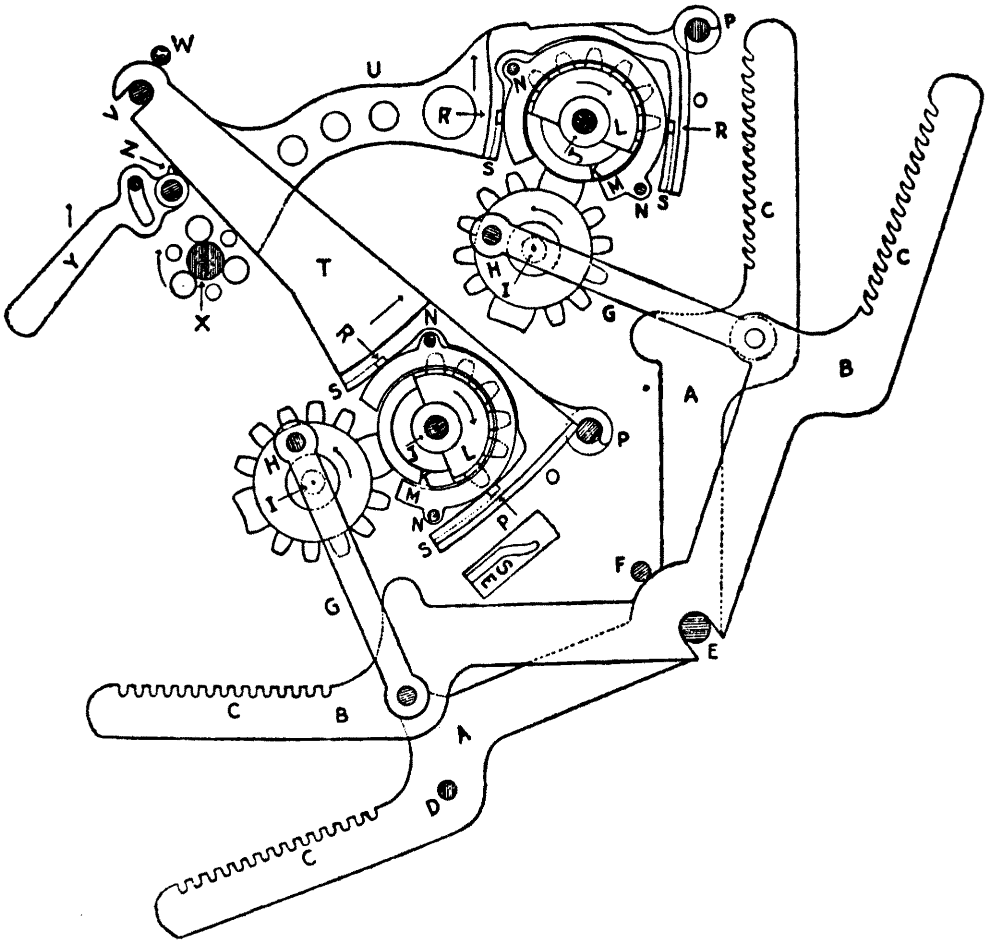


Fig. 35.
Leeming Dobby. (Side View).

Engine Jacks.—These are fulcrumed on a strong bar that passes through the back and bottom of the engine at E, and are prevented from getting off by the small preventive bar F. Both arms C are made with 16 notches so as to give a wide latitude in the size of the shed, and to facilitate alteration.

The jacks are connected to the heald shafts by streamers, wires, and leathers, the latter passing over pulleys both over the shafts, and at the side of the loom. Each jack has a circular projection D on either arm, so that if used for any odd numbered shaft, the bottom one is used by the connecting arm to attach it to the bottom jack wheel. The top button is for an even numbered shaft which is coupled to the top jack wheel. Each arm of the jack passes through a grate which assists in keeping it straight.

Connecting Arms.—These are bored out of the solid, and are placed on their respective buttons on the jacks A or B, and on the jack wheels H. The width of the connecting arms and the closeness of the jacks prevent them from working off. Both sets of arms are straight bars, and when in their resting positions, are in a straight line with the fulcrum of the indicating levers, U and T. With the jacks being coupled to the jack wheels in this way, very little movement takes place at the beginning of the stroke when the wheel has to be turned from top to bottom, but when moving from bottom to top, the jack moves immediately. This arrangement has an advantage, for though the jacks and their respective wheels begin and end their movement at the same time, the odd jacks cross each other a little above their central positions, and the even ones a little below. In any kind of weave, but especially in rapid changing ones like plain weave, repps, cords, and hopsacks, this is a special gain, for one half of the warp is not crossing the other half at the same time where the healds are bulkiest at the eyes. This prevents many ends being broken, and is on a similar plan to the weaving of poplins in a tappet loom.

Jack Wheels.—These wheels at H, fit on the stationary boss I, and are fixtures with rotary movement. There are cogs all round the rim, which are divided into two groups of five each and a double one, the latter bringing the movement to an end.

Each wheel has a button for its own connecting arm.

In the drawing, the jack A is up for the top shed, and the jack B is on the bottom one.

Cylinder and Segment Wheels.—The cylinders K each occupy a semi-circle, but to complete the circle, there is the movable segment wheel L. This has six cogs to turn the jack wheel when the segment wheel is brought into play. The outer ends of the segment wheel rest on the two ends of the solid part of the cylinder. Whenever a jack wheel has to be turned, the bowl lever T or U has to be raised, for this slides the segment wheel into contact with the jack wheel. If the shaft has then to be stationary, a bush, succeeds the bowl. On one side of the wheel is a rim upon which the jack wheel slides when the heald shaft is stationary.

Segment Wheel Cap.—The segment wheel is encased in the cap M which moves on two small rods that pass through the series. These rods are shown at N. The cap covers what may be termed three quarters of the segment wheel, and only leaves space enough for the jack wheels to be engaged at the bottom.

The cap is constructed with a pin at either side, and these are at R. These pins fit into grooves in the bowl levers T and U, the grooves being indicated at S.

The grooves are not straight, but are shaped like the slot S E, in the small sectional drawing shown above the jack levers.

When a bowl lifts a bowl lever, the segment wheel changes its position inside the cap.

The Bowl Levers.—The cap is at the inner end of the bowl levers T and U, which are fulcrumed on the bar V

Fig. 36.
Leeming Dobby. (Front View).

and are prevented from getting out of contact by the check bar W. The lags are made up of rods, bowls, and bushes similar to those used for Dobcross looms, and are at X.

A bowl raises a bowl lever, and the end which resembles three sides of a square, rises in the direction of the arrow. By so doing the cap slides with the segment wheel on the two rods N, and the teeth of the latter are brought in contact with those on the jack wheel. If the shaft was up before this change of the lever took place, then the shaft would be brought to the bottom shed, but if it was down it would be lifted to the top shed.

A bowl then, indicates a change of shaft position, but a bush is for a stationary position.

All the bowl levers are placed on the same bar V, but are separated from each other by collars of metal being left on the turned shaft. They are also kept in position by the front of each lever having a curved end at P which drops into a groove on the bar. Each lever then, rises by means of a bowl, and when a bush succeeds a bowl, the lever drops of its own weight. There is nothing whatever to hinder the fall because the weight of the heald shaft and warp as well as the engine jack is taken by the jack wheel.

Cylinder and Lags.—The cylinder is fitted with six blades, and is turned intermittently by a small wheel behind the engine. The large cylinder wheel has six sections, each of which has five cogs and half a cog. The small wheel that turns it has five cogs and one half, and is without cogs on the other half, the blank section coming in contact with the half cog on the cylinder wheel which keeps the large wheel firm.

Now the method of lag making is not like that for the Dobcross, for in that loom a bowl indicates a shaft raised. In the Leeming dobby a bowl may mean a shaft raised or a shaft down. There has to be two designs: the one how the warp has to be woven, and the other the lag making plan. The principle is, peg for change. Here are a few examples.

To weave plain on four shafts, there would need to be four bowls on every lag. To weave 2 × 1 twill the lags are made according to the design. For a 2 × 2 twill, there need be only 6 lags, and these have to be made like plain weave. In some weaves, this method of lag making has so great an advantage, that only half the number of lags are required.

Cylinder Levers.—The cylinder X rotates at the top of a pair of levers which fit at either side of the engine. The fulcrum is about one third the way down. At the bottom of each lever a rod is attached that carries a strong spiral spring. This acts as an escape motion in case the lags ever buckle or become undone.

The opposite end of the front rod is fixed to a pin on a semi-circular disc, the centre of the sweep being notched.

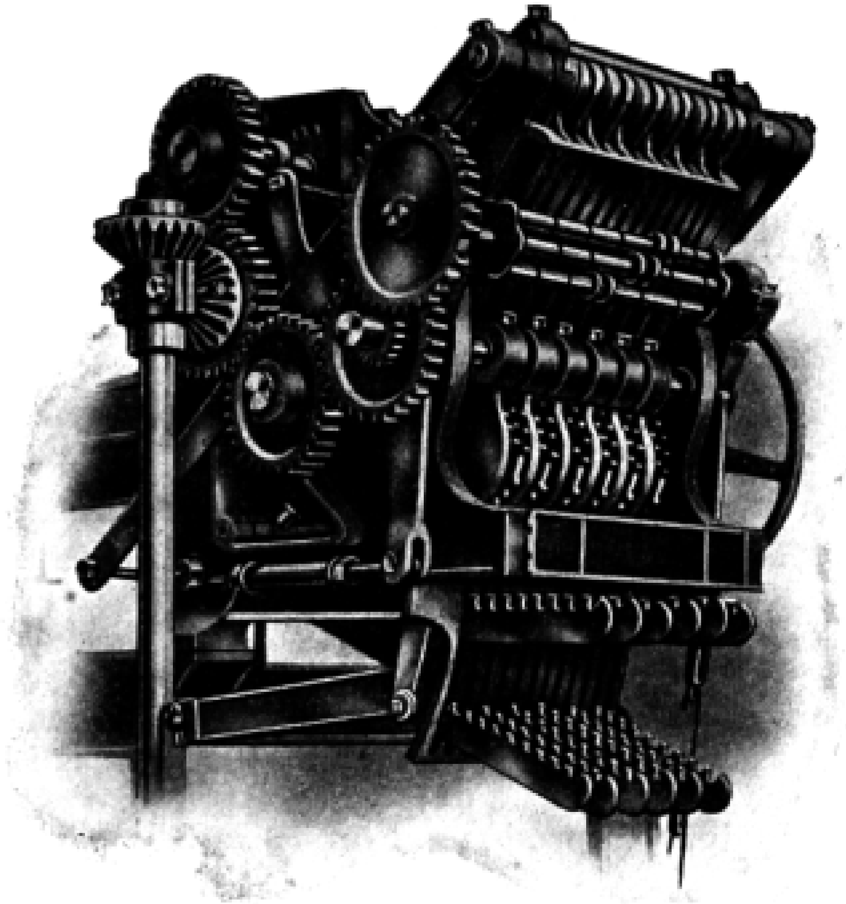


Fig. 37.
Back and End View of Leeming Dobby.

In the notch is a catch, and when so placed, the cylinder is in its weaving position. When the catch is removed, the cylinder can be moved from contact with the bowl levers, and has then no influence on the engine. This is another advantage, for then any shaft may be placed in any position desired either for shaft levelling or for the insertion of lease rods.

Finger Levers.—Behind each bowl lever is the finger lever Y, and when elevated in the direction of the arrow, they act in the same way as a bowl. These come in handy when raising one shaft at a time to look the threads over. Before this can take place, however, the engine is disconnected with the crank by pulling a lever which raises the top part of a clutch box, and the cylinder wheel is then free to be turned in which direction it is needed.

Finding the Pick.—When the weft has broken or run off, the pick is found with the loom standing. The engine is first disconnected with the crank, and the cylinder hand wheel turned in the opposite direction to the one when weaving. When the starting pick is found after pulling back, all that is needed is to put the clutch box in order, and the loom is ready for weaving.

Standardized Parts.—All the wheels are machine cut, and as the jack and segment wheels are placed in alternate positions, they are double the strength owing to the extra amount of space allotted to them. All the parts are fitted with exactitude in the machine shop, and seldom require any attention except oiling. All similar parts are interchangeable, and every part is standardized.

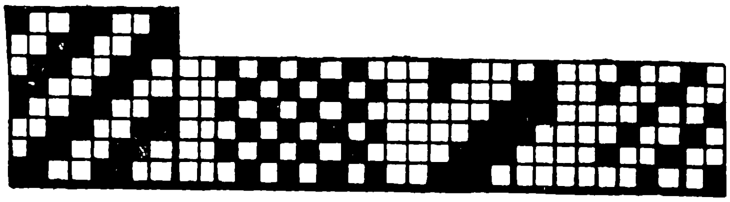


Fig. 38. Fig. 39. Fig. 40. Fig. 41.
Designs for Leeming Dobby.

Lag Making.—The method of lag making is shown from Figs. 38 to 45. Fig. 38 is a 2 and 2 twill, but to weave it on a Leeming dobby, the design has to be altered to peg for change as at Fig. 39. To do this, the last pick is compared with the first one, and dots put down for every change. When this is done it produces Fig. 39 and is plain weave.

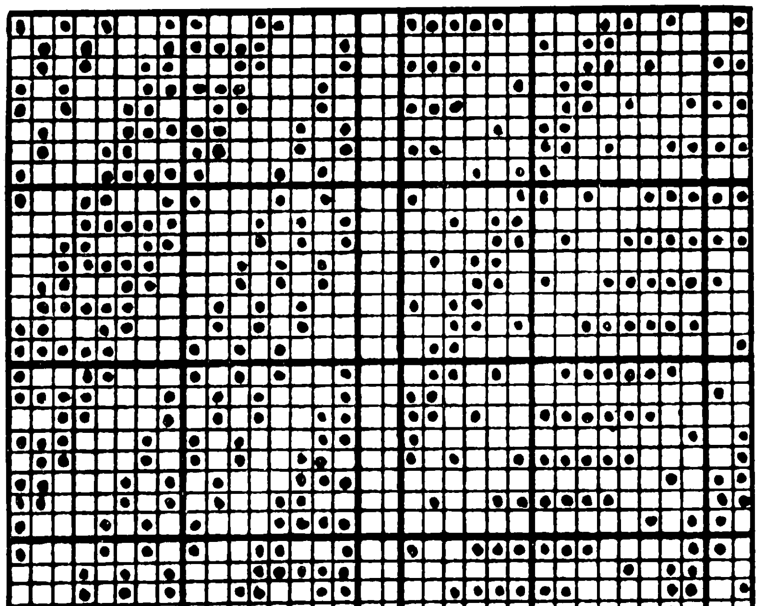


Fig. 42. Original Whipcord Design. Fig. 43. Alteration for Leeming Dobby.

Fig. 40 is a 3 and 3 twill, but becomes a 2 and 1 twill when altered as at Fig. 41. More elaborate plans are given. At Fig. 42 is a 16-shaft whipcord on 32 picks, and the correct

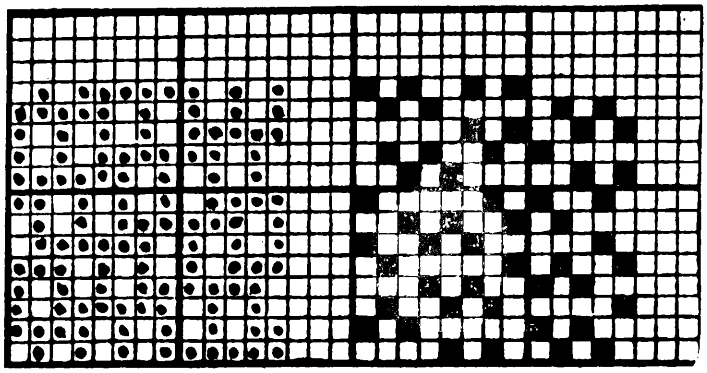


Fig. 44. Corkscrew Design. Fig. 45. Altered for Leeming Dobby.

pegging plan is at Fig. 43. Fig. 44 is a 13-shaft corkscrew weave. One may be led to suppose it would require 26 lags, but only 13 are needed as given in Fig. 45.

HATTERSLEY "V" DOBBY.

This dobby is so named owing to its construction. It is employed on at least ten different looms made by the Hattersley firm, and has won the reputation of seldom making wrong lifts.

The weft mixing dobby coating loom is given at Fig. 46. It is fitted up to 40 shafts, has a reed space of 76 inches and a speed of 125 picks per minute.

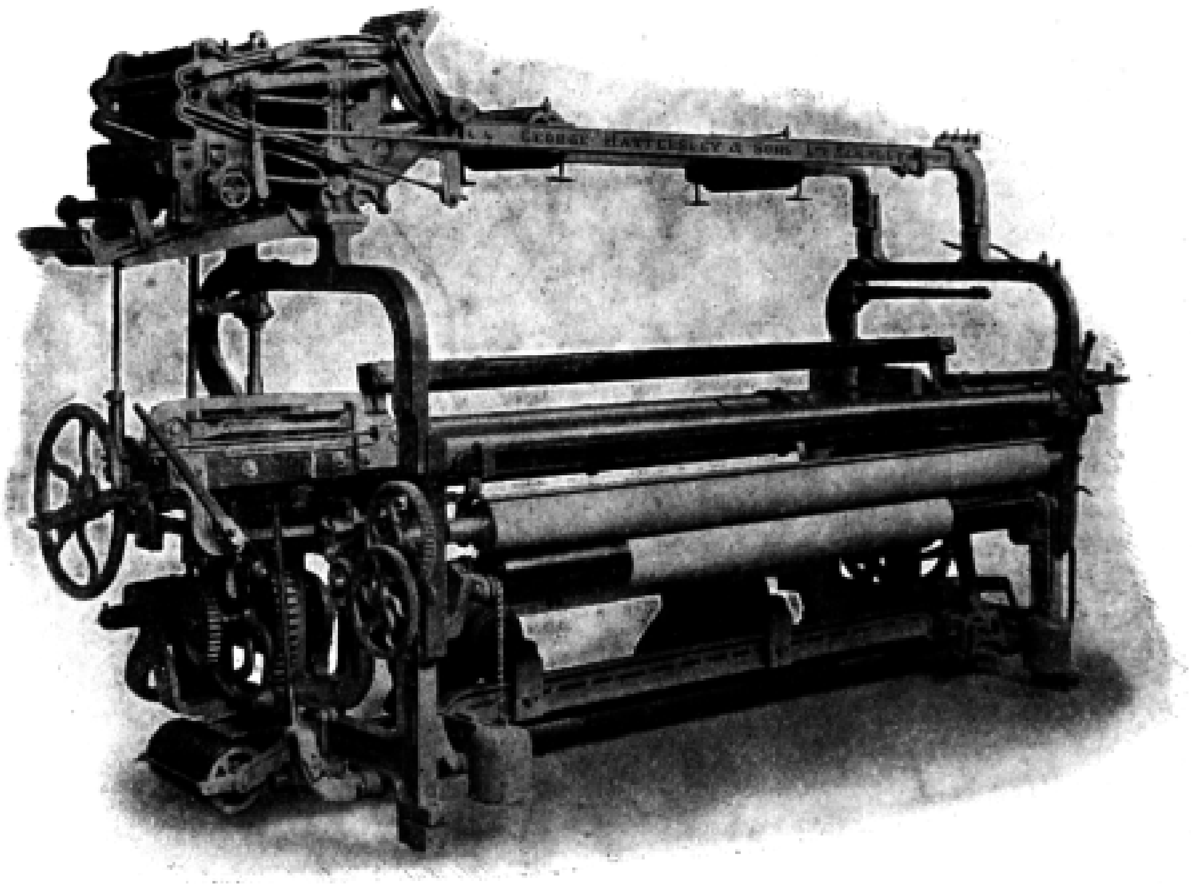


Fig. 46.
Hattersley Weft Mixing Coating Loom.

Dobby.—An outline of the dobby is given at Fig. 47.

The dobby levers A are somewhat bow-shaped, and are hooked on to the strong bar B. The upper and lower arms are notched for shed adjustment, and the centre arm C has the button upon which the balk oscillates. At D is the balk, and on its pins at the front of both ends are the catches E. Slots are made for the easy working of the catches, the largest being at the bottom. The long slot is essential when the upper catch is drawn forward.

Neither catches nor balk can be inserted or extracted without unloosing the setscrews in front of the dobby which keep the jack plates and dobby levers in position. In refixing, care has to be exercised to see that the catches are working in parallel lines through their respective grates.

Any catch that comes off the pin on the balk when working is better discarded, as it is a menace to the safety of the dobby.

Each type of dobby develops faults peculiar to its construction. In this one it is the top catches, which, by the hooks or balk pins wearing, lean too far forward, and cannot rise to be held by the top holding bar. It can be filed shorter in the loom, and remain longer in service. It is easily found by placing all the shafts on the top shed, and putting the shedding rod at its top dead centre.

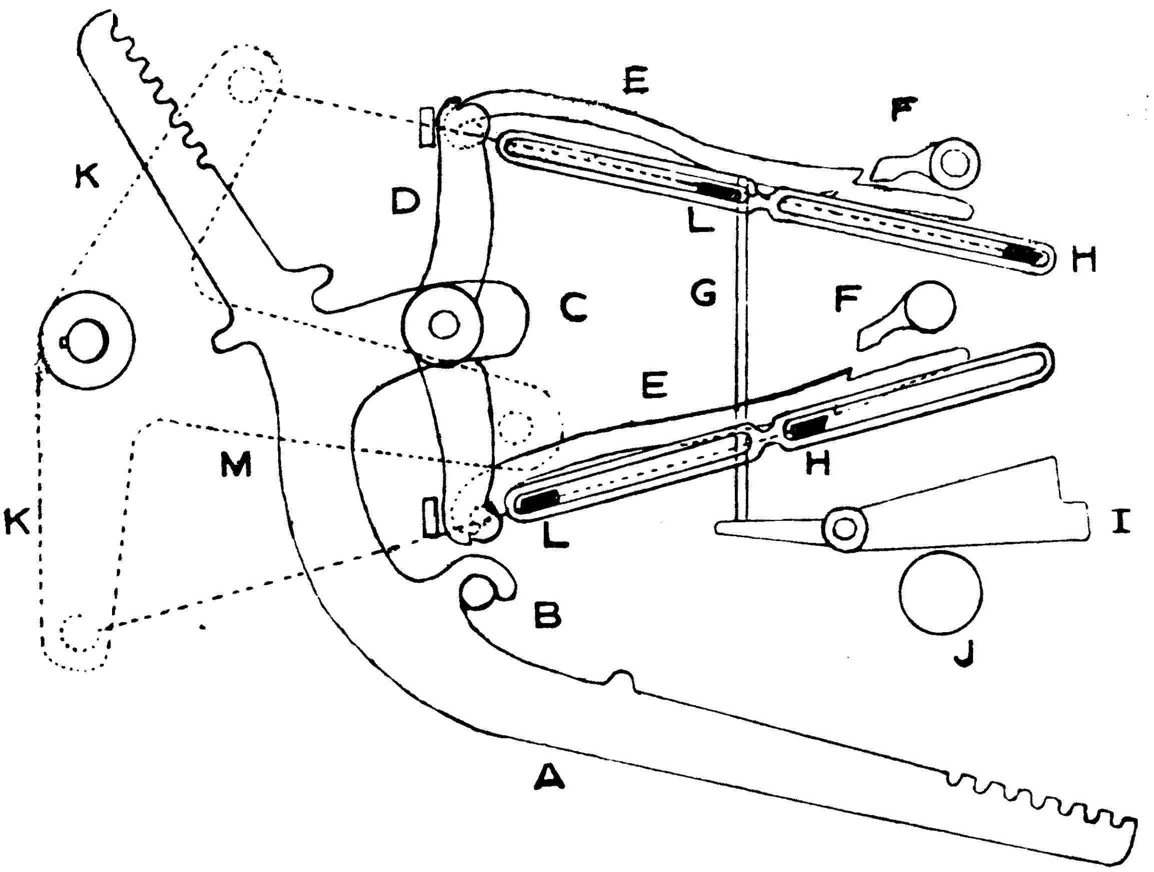


Fig. 47.
Hattersley "V" Dobby. (Front View).

The holding bars F are set so that when the shedding rod is at its dead top and bottom centres, the points of catches should have a clearance of $\frac{3}{16}$th inch. This gives ample room for the catches to change positions.

The needles G operate both the bottom and top catches. It is cranked to give liberty to the bottom catch and provides a shelf for it to rest upon, and the top of it fits underneath the top catch. The needle has to be long enough to elevate both catches so the holding bars F can hold them, and so keep the shaft down, and yet short enough to drop the catches fully on the draw bars when the shaft is needed on the top shed. The important measurements are from the bottom to the top of the shelf, and from the bottom to the top of the needle.

A fresh needle cannot be inserted unless balk and catches are taken out of the dobby. It is then pushed through the upper grate and let fall through the bottom one.

The bottom grate fulfils a threefold purpose: (1) The bottom catches pass through it. (2) The bottom of the needles do the same. (3) The inner ends of the feelers are separated by it.

Draw Bars.—There are two pairs of slots in the engine both front and back, and two pairs of draw bars. The catch bars are at H and the balk bars at L. Each pair are bolted together by a connecting arm, and are the same distance apart, the pitch of the bars is obtained by the balk bars only, and these must just clear the front of the balks when the shedding rod is at its dead top and bottom centres. Having obtained this, the holding bars are then fixed to give the clearance of $\frac{3}{16}$th inch to the catches.

The ends of the balk bars are attached to the main levers of the engine K by adjustable rods, and by these, the pitch of the bars are regulated.

Feelers.—The feeler is at I. It is fulcrumed well forward in its length, which assists in giving it a good drop with little oscillation. The lag pegs come in contact with the outer underside, a peg indicating a shaft lifted, and a blank a shaft down. Wooden pegs are to be preferred to metal ones, for though there is some risk of them falling out in hot weather, they prevent grooves being worn in the feelers.

Cylinder.—This is at J, and has six grooves. It is of the fixed, intermittent, rotary type. Its setting must incorporate three ideas: (1) It must have the same elevation front and back. (2) It must be high enough so the pegs fully deposit the catches on the draw bars. (3) The centre of the pegs must fit into the centre of the feelers.

When the wooden ends become worn, there is too much latitude for the lags. To prevent wrong lifting, the end pegs of groups, and the two sides of single ones may be knife pared to give more room until new ends are fitted.

The cylinder turning wheel is at the back of the engine, and has six grooves as well as the same number of openings for the dolly pin. It is turned by a dolly, and if the pin it possesses is at its back centre when the crank is at its back centre, the cylinder will be correctly timed. The cylinder may be disconnected with the dolly shaft by pulling out a fixing pin. The cylinder is fitted with a check star wheel and finger to keep it steady after being turned.

T *Lever.*—This is at the back of the engine, and is shown at M. It has no long slot as in many makes, reliance being placed on the length of the arm for making a good shed, as well as the notches on the dobby levers. This lever carries the stirrup and shedding rod. At the

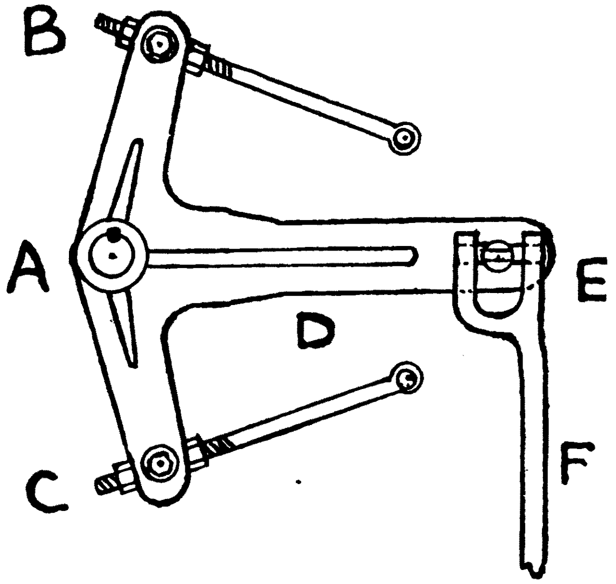


Fig. 48. Shedding Rod and **T** Lever.

bottom it is setscrewed to a slotted connecting arm. It is fixed so that when the connecting arm is in the centre of its stroke, the **T** lever is in the centre of its movement, and gives equal sheds. This is illustrated at Fig. 48. At A is the main shaft of the dobby, with B and C the locknutted connecting rods. D is the long central arm, with E the stirrup, and F the shedding rod. The inner ends of the connecting rods have to be level with each other when the centre arm D is horizontal. Another special point is, that when the shedding rod is at its dead bottom centre the top connecting rod B has to place its draw-bar just free of the front of the balks. The same idea applies when the shedding rod is at its dead top centre.

Eccentric Wheels.—The slotted connecting arm is fixed to a large eccentric wheel at its narrowest part. The long slot in it acts as an escape motion in case anything becomes locked in the engine. This wheel has 50 cogs, and being oval in shape, gives a fairly long dwell to the shed when passing

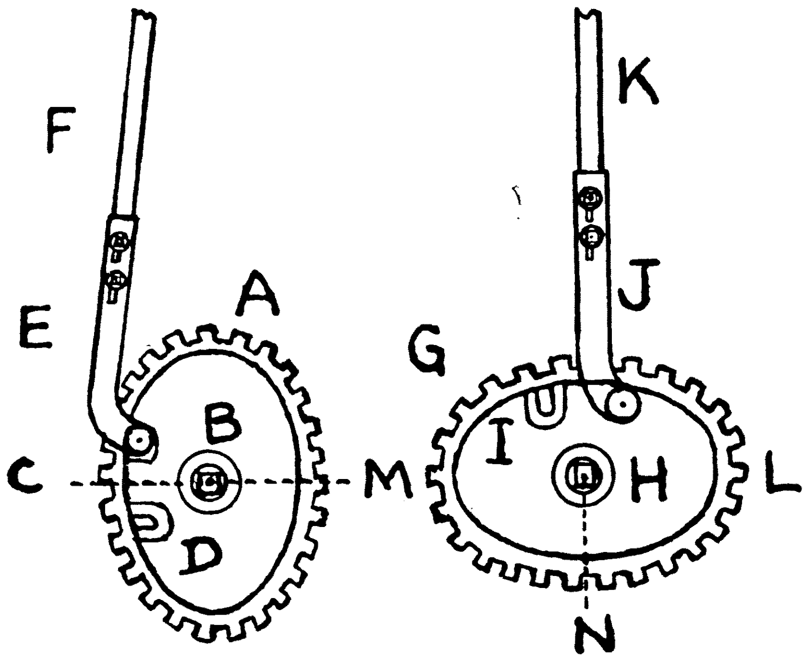


Fig. 49. Eccentric Shedding Wheels.

round the ends of the oval. It meshes with a small eccentric wheel having 25 teeth, and is setscrewed to the outer end of the bottom shaft. By this wheel, the timing of the shed is altered. For most warps, the shedding rod is just past its top centre when the crank is at its back centre.

Fig. 49 gives two views of the eccentric wheels to which the shedding rod F is attached. A is the wheel and B its pivot. C is the line which the bottom of the rod must occupy when the centre arm D in Fig. 48 is horizontal.

There are two slots in the wheel, the one at D being vacant. By these slots, the dwell of the shed may be sooner as fixed, or later by being bolted to the lower slot. E is the slotted arm by which the horizontal position of D, Fig. 48, is secured. At J and K the shedding rod is at its top centre, and the back of corresponding draw-bars has to be just clear of the balks. The same idea applies when the shedding rod is at its bottom centre. L and M are the dwells, and I the extra slot.

The loom is fitted with a worm take-up motion, the gauge point being a tooth per pick.

The letting off is done by friction chains or ropes, and the cloth beam may be removed without stopping the loom.

Timing of Shed.—The shed is timed to suit the kind of fabric being woven. The limit of timing is almost equal to a quarter revolution of the crank. The earliest timing is for the shafts to commence changing just after the crank leaves its back centre. The latest timing is to have the heald shafts level when the reed is against the fell of the cloth. When the timing of the shed is altered, the dolly which turns the lag cylinder must be altered so its pin is at its dead back centre when the crank is at its back centre.

Felt Covered Roller.—This is a necessary addition in those looms where the cloth beam is turned by friction when the yarns are mixed with staple fibre, as the fabric is

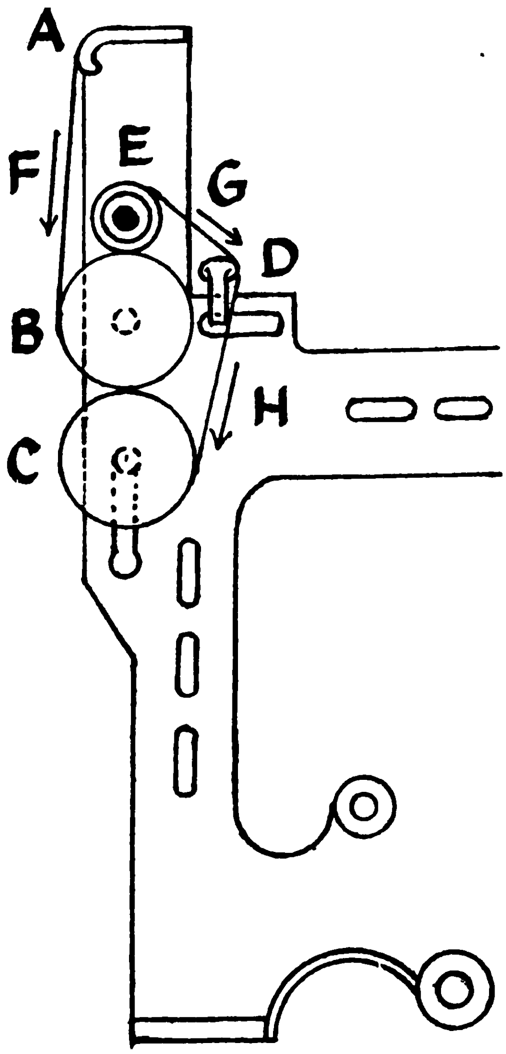


Fig. 50. Felt Covered Roller. Path of Fabric

much more slippery. In Fig. 50, A is the breast beam, and B the take-up roller. C is the cloth beam, and D the ordinary smoother. On top of the take-up roller B, is the felt-covered roller E, which increases the grip on the cloth. The arrows F, G and H, indicate the method of cloth winding.

HATTERSLEY'S DROP BOX LOOM FOR DRESS GOODS.

Messrs. George Hattersley & Sons, of Keighley, have invented a 4 × 4 drop box loom for the weaving of fancy dress goods. It is of the fast reed type with a reed space of 57½ inches, and a speed of 145 picks per minute. It has a negative V dobby capable of working 20 shafts. (Fig. 51).

Engine Jacks.—These are constructed to pass on to a stout bar at the base of the engine by means of a vertical slot. The upper arm has seven notches so the size of the

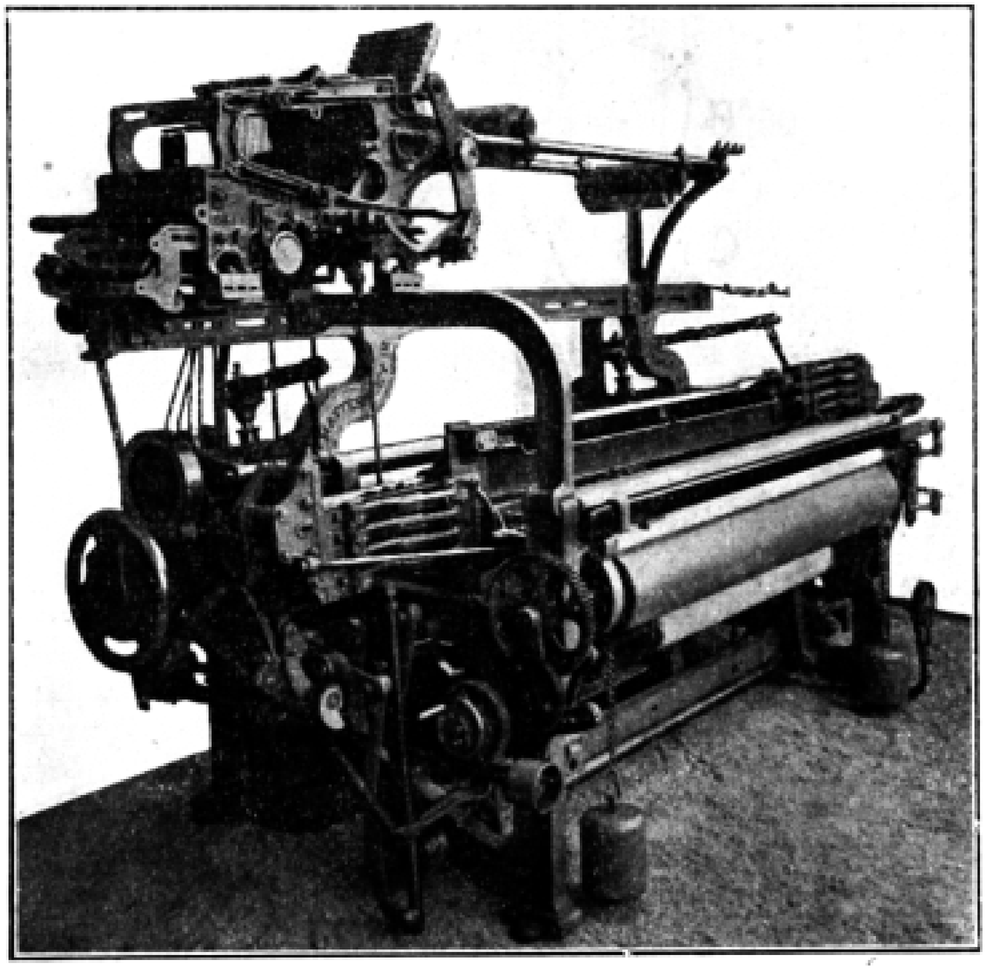


Fig. 51.
Hattersley Drop Box Dress Goods Loom.

shed can be quickly altered to suit the kind of work to be woven. The centre arm is bifurcated to receive the balk which hooks into it. The whole series of jacks are set by jack plates back and front, each plate being regulated by four locknutted setscrews. These screws are adjusted so the catches pass through their respective grates in parallel lines. Both grates are open at the top which facilitates the extraction of any of the balks and catches.

Pulleys for Top Shafts.—The connection from engine jack to the top of the heald shaft is in the ordinary way of streamer, wires, and banded leathers. The special thing is the holding of the pulleys over which the shaft leathers pass. The bar upon which the pulleys are placed fits through castings that are on bright steel bars which take the place of the ordinary top rails of the loom. By this means the pulleys may be altered in their relation to the shaft hooks, but the particular gain is the neat and smart appearance of the loom.

Balks.—The hook at the back centre of its length fits into the divided end of the jack, and owing to this kind of construction, the balk and its attendant pair of catches may be removed without disturbing the jack plates. Each end of the balk is hollowed out to receive the hooked end of the catch, and the pins on it retain the catch. The longest slot in the balk is at the bottom to provide room for the bottom catch when the top one is drawn forward. If ever a catch comes loose during working, it is on the top row, and is due either to the worn condition of the balk pin, or to that of the hook on the catch. It is never safe to attach it again to the balk, as it may come loose again, and do damage to the engine.

Catches.—These are 11 inches long, and with it being a negative dobby, they have only one cut on the underside for the use of the draw bar. The hooked end of it can only be placed on the balk when the balk is liberated from the jack.

The drawbars of the engine are set to suit the cut on the catches, and this is carried out when the shedding rod is placed at its dead top and bottom centres. The connecting rods on the main engine levers are then adjusted so the upper front edge of the draw bar is $\frac{3}{16}$th inch in advance of the edge of the catch cut when raised. This setting is carried out at the end of each draw bar. To give the best possible setting, all the catches should be forward at the bottom when the top draw bar is set, and all the top catches be forward when the bottom draw bar is set.

Feelers.—These are a new pattern. They are $12\frac{1}{2}$ inches long, and pass through grates at either end of their length. The fulcrum is 9 inches from the outer end, and, along with its length and shape, prevents bouncing when it comes to rest. It is curved on its under side to give a steady rise and fall to the catches when actuated by a peg. At its inner end it has two fingers. The upper finger controls the bottom catch, and the lower one has a straight needle upon its upper surface which controls the upper catch.

The needles pass through the back of the top and bottom grates through which the catches pass.

Lags and Cylinder.—The lags are of a new type. They are substantially made, and have a central groove on the face which runs the entire length. On either side of the groove are small countersunk holes in pairs for the reception of the two legs of a metal peg. These holes do not pass through the lag, but are deep enough for the intended purpose. The legs of the pegs are of double thickness at the bottom by the metal being turned up on the inner side. The pegs have a curved top to produce a steady action in the motion of the feelers. After the pegging of each lag, a metal slide is inserted through the centre of the lag and pegs, which effectively prevents any pegs dropping out. This is a special gain over any kind of wooden peg, for in hot weather particularly, the wood contracts, and yards of cloth are too often spoilt on this account, and especially so in double and treble cloths, and fancy designs.

The looped wires which pass through the lags are of reasonable thickness to insure long wearing. In common with all other kinds of lags, the fewer bends there are in long lengths, and the less swinging about, and the better.

Lag Cylinder.—This is fit in three ways: (1) It must be at the same altitude back and front to give an identical lift to all the feelers. (2) The operating lag must be at its dead top centre when it comes to rest, to give and stay so when the maximum lift is given to the feeler. (3) The centre of the peg must be in the centre of the feeler to give the best working and wearing results. The cylinder is checked after turning by the usual method of star wheel, finger, and spring.

Picking.—This is of the overpick order. The shaft of it leans back at an angle of 75 degrees, which fairly coincides with that of the sword and boxes when the crank is at its back centre. This arrangement produces easy picking, and places the least strain on the picker. The cup casting in which the picking shaft rotates rests in a recess on the loom frame and is secured to the framework.

Cone Casting.—This is loose on the picking shaft, and is thrown back every pick by the picking nose, and brought back by a leather and spring. The stud for the picking cone is provided with a good head, but has no thread. The stud shaft is grooved, and passes into the bore through the picking shaft. Another bore in the picking shaft is at right angles to the other, and in this a bolt is placed which fills up the groove in the conestud and holds it secure.

Clutch.—Above the cone casting the picking shaft is square, and on this the clutch is placed. It is provided with a stout leg to fit behind the lug on the cone casting when a pick is required, but is lifted clear of it by the clutch fork when no pick is needed. The correct relation between these two parts is brought about by a regulation screw which passes through a casting on the picking shaft. The head of the screw comes in contact with the loom frame when the shaft is in its stationary position. The working length of the screw is set so that when the head is in contact with the loom frame, and the cone is at the base of the picking nose, the distance between the face side of the clutch leg and the lug on the cone casting is only a good ⅛th of an inch. The less the distance above reasonable passage room, and the better, and steadier is the pick.

A collar and leather with spring attachment draws back the picking stick and shaft after picking.

Bottle Neck Casting.—This is substantially made, with a wing at either side so that it may be held by two good bolts. Such a substantial fixing is required as there is no stay casting at the top of the picking shaft to check the vibrations. As both framework of loom and face of casting are planed, the best possible fitting is obtained along with the rotary freedom of the picking shaft.

Picking Stick Brackets.—These are of the ordinary kind, but the salient points may be mentioned. The bottom one fits on to a square on the shaft which must hold the casting firm, and the square must not pass beyond the upper surface of the casting, or the upper one will be prevented from fitting properly. The bracket must be level at the top so the picking stick neither tilts upwards nor dips downward. Its radiating teeth meshes with those on the upper casting, and by them, the stationary position of the picking stick is determined. This position is, that the stick shall point over the outer end of the box, though this may have to be slightly modified to secure the best working results. The picking stick is only 22 inches long from the centre of the bore to the centre of the strap slot.

Brackets and stick are securely held by a good metal cap and a couple of lock nuts.

Picker.—This is of the horizontal kind, and fits behind the box. It is of buffalo, substantially made, and reversible, and a slot in it provides for leather connection.

It is regulated by a slide at the back of the box, and by the picker spindle. These are set so the back of the shuttle is pushed away $\frac{3}{16}$ths from the back of the box when the shuttle is in contact with the picker at the delivery end, and is lifted up the same distance from the box bottom. At the outer end, the picker is held down by a flat spring, and the spindle is secured by a curved spring at the end of the box.

The picker is brought back after picking by means of a dolly stick and spring. A double spring for this purpose is better than a single one, for then, if one breaks, there is sufficient power to pull the picker out of the danger zone when the boxes move.

Boxes.—These are made of mild steel, and each shelf is well riveted to the vertical plates at either end of the box.

The outer and inner ends of the box fit into slides, the outer slide being at the front, and the inner one bolted to the sword. Whilst the slides must only give the least lateral freedom to the box, the box must rise and fall with ease. The swells are at the front, and are each fitted with a curved spring so as to check the speed of the shuttle on entering the box, and then retain it in its picking position. The swells are easily extracted by the removal of a pin that holds the series, and as they are of a malleable nature, they may be bent to suit the size of new or old shuttles. The least bending is done when a good drop is given to the stop rod tongue when the shuttles are new. The outer slide is fitted with a pair of bowls to keep the tips of the shuttles free from the face of the picker when the boxes change position. These bowls are grooved in the centre so as not to damage the tip end of the shuttle.

It will be observed in the illustration, that the outer slide is made with a rounded projection. This is bored through, and a strong bar is fitted, and is secured at the opposite end to the bearer bracket for the stop rod. This bar strengthens the box end, for there is no box crank, and it nullifies the vibrations set up when the loom bangs off.

The box bottom has a long plate riveted to it, and at the centre of its length, it is formed with a downward circular projector that is threaded inside. Into this part is screwed the long box rod which is secured by a lock nut.

Box Rod.—This rod carries a long and open spiral spring which acts as an escape motion if ever the shuttle is trapped between the shuttle race and the box, for it prevents the box from descending, and the shuttle thus escapes serious damage. The rod passes through a long sleeve at the bottom, from which it emerges. Below the sleeve is a swivel, and on passing through this, the box rod is held by a couple of locknuts. It is by means of the locknuts that the whole series of boxes may be regulated.

The swivel is the means of connecting the box rod to the long connecting arm which couples it to the lifting lever.

The sleeve is held with sliding freedom by an arm fixed to the sword. If it be found that the semi-rigidity of the box is not firm enough, it may be attained by screwing down the locknuts at the top of the open spiral spring on the box rod.

The boxes are raised and depressed by vibrator wheels and semi-toothed cylinders which are fully explained in the Standard Model Loom, and this also applies to the pick finder motion.

Frogs.—These are formed on a different plan to any other make. They are shaped like the letter **S**, and the fulcrum is at the centre of the length. The cut on the frog is at the upper front end, and its stationary position is regulated by a powerful spring which fits between the front bottom of the frog and a casting that holds the spring bolt. Both frogs are set at about the same pitch, though the one at the driving end of the loom may be slightly more forward.

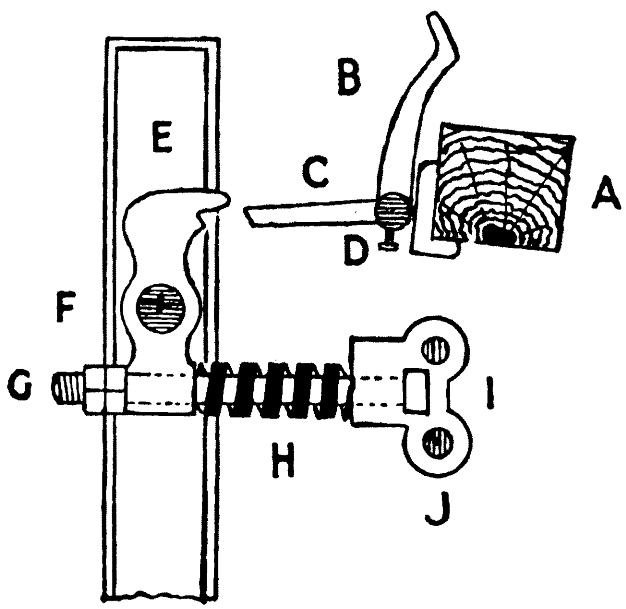


Fig. 52. Spring Frog.

Explanation of Fig. 52.—A is the going part, and B the box swell finger, and C the stop rod tongue, with setscrew at D. E is the upper part of frog with the cut on the under side. The front end of the tongue should be the same shape at cut on frog. The frog pivots on the strong stud at F, bolted to loom frame. Towards the bottom, the frog is bored through to receive the strong bolt G, its head being at I, in casting J, which is doubly bolted to loom frame.

On the long bolt is the powerful spring H.

The setting is done by the locknuts on bolt G until the frog is almost upright. The box swell finger B is unloosed and the going part brought forward until the stop rod tongue is in contact with the cut on frog E. The box swell finger is then set when in contact with the swell head. This gives the best drop to the tongue. Both sides are set alike, but if the one on the driving side is set a little keener, the driving force is got off quicker.

Let Off and Take Up.—The warp is let off by worm and wheel and a pair of catches, the latter being operated by the movement of the sword. As is the law for all double letting-off catches, they must be made and maintained so that one is half a cog in advance of the other.

The taking up of the cloth is also on the worm and wheel principle, the gauge point for the change wheel being a tooth per pick. The circumference of the taking up roller is 21 inches. This size, along with the high fixing of the smoother at the back, prevents the slipping of the cloth. The loom is served with two weft forks.

Driving.—The loom may be driven any way desired. If supplied with an electric motor, the H.P. is 0·75, and the revolutions per minute 960. It is chain driven. The friction driving flange is fitted with 62 circular discs made of cork which give excellent gripping power and a quick release. The rim of the brake wheel is 1½ inches wide and is almost encircled by a leather lined metal strap.

Box Lag Pegging.—It is arranged for a right hand loom to be first hole on right for picking; second for second box on right; third for third box on right; fourth for third box on left; and fifth for second box on left. Two pegs for either end lift the fourth box at their respective end.

Fig. 53. Hattersley's Standard Model Loom. (Front View Parallel Drive).

THE HATTERSLEY STANDARD MODEL LOOM.

This is the first power loom to be standardized in every part, and is different in many respects to any other kind of loom. For the weaving of fancy woollens and worsteds of medium and heavy weight, it is unsurpassed. Each part is constructed of that kind of wood or metal which is best fitted for the service it has to perform. As the loom is constructed in different widths, the speed varies according to the reed space as follows:—

Reed space.	Picks. per minute.
84 inches ...	... 110
90 ,, ...	... 105
100 ,, ...	... 90

The Dobby.— It is a V dobby which is noted for seldom making wrong lifts. It controls 28 shafts which provides

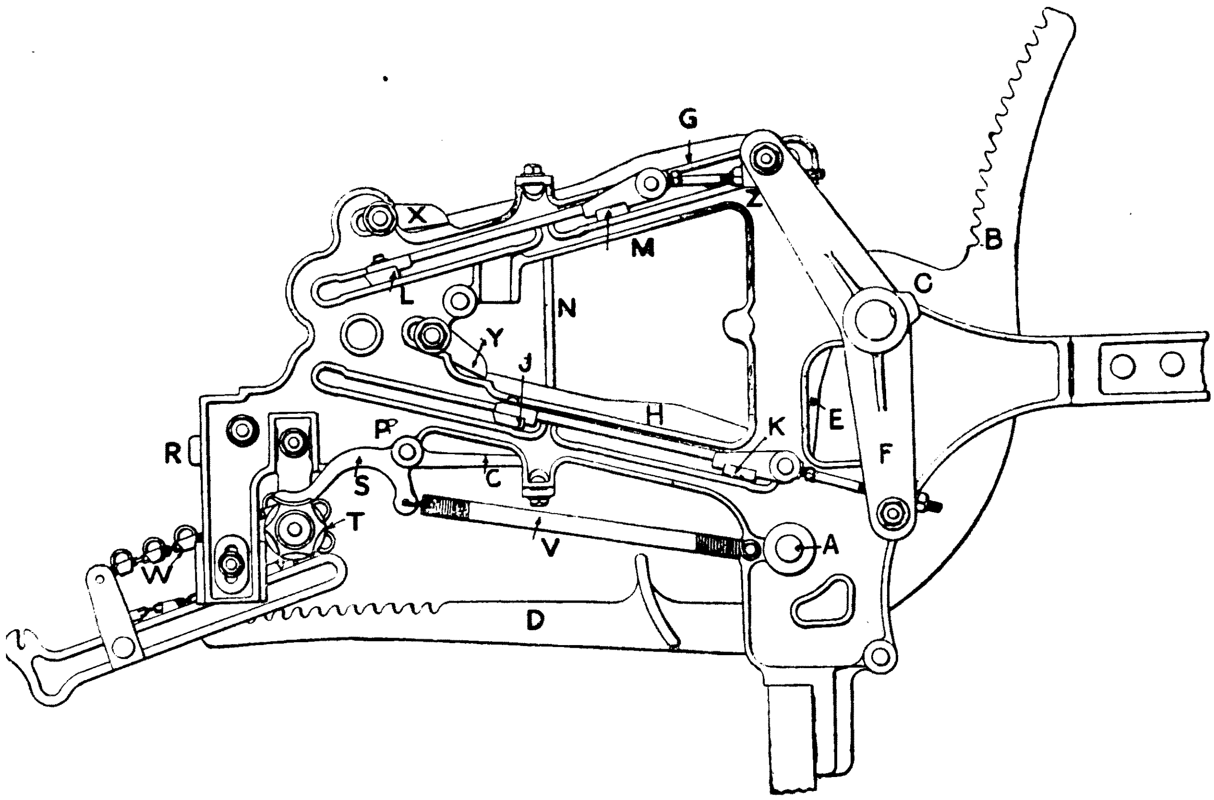


Fig. 54.
Dobby for Hattersley's Standard Model Loom.

a good range for the fancy trade. The dobby is shown at Fig. 54. At A is the strong bar which passes through the lower part of the engine, and on this bar, the hooked ends of the engine jacks are placed. The bar is prevented from turning or working out by a fixing setscrew at either end.

Engine Jacks.—The upper and lower arms of the jack are at B and D. They are notched so the size of the shed may be readily altered. Fibrous warps weave better with a larger shed, for it parts the loose fibres better. Tender warps need the least possible shed to ease the pressure.

The streamers in the notches are usually arranged in tiers of four each, and commence at the third notch nearest the fulcrum. They are placed in the same numerical notch on both arms to give an almost identical movement to the heald shaft, which works on the open shed principle, and gives a minimum traverse to warp and healds.

The centre arm of the jack is at C, and on it is the circular button upon which the balk E oscillates.

All the jacks are kept in their working positions by four lock-nutted setscrews at the front and back of the engine, which apply pressure to a jack plate. The fixings of the setscrews must allow the catches to work in parallel lines through their respective grates.

Balks.—Only a small part of the balk is seen at E. They are made of cast iron with a hole in the centre of their length to pass on to the button on the jack.

They are slotted top and bottom with a pin across the opening, and on each pin is placed the hooked end of a catch. The balk's longest slot is at the bottom to give freedom to the catch when the upper part of the balk is drawn forward. The back of the balk is made with a pair of tapering spurs, so that after being drawn forward, they cannot catch on adjacent balks.

Catches.—There are a pair of catches to each balk, each being 19½ inches long. The upper part of the bottom catch is at H, and the arrow G is on the top catch. Each catch has an upper cut which is seized by the holding bar X or Y, when the corresponding shaft has to be on the bottom shed. There is also a cut on the under side which is made use of by the draw bar J or L when the shed is needed for the top shed.

The catches have three points of interest. (1) Unless the hook on the catch is badly worn, it cannot be put on or taken off the balk pin unless the balk is liberated from its jack. This is done by slackening out one set of regulation setscrews. (2) The natural position of the catches when out of action is for the bottom row to drop back, and the top row to lean forward. When the hooked end of the catch and the balk pin becomes worn on the upper series, the catch then fails to clear the holding bar X, and a wrong lift is made. The shaft making the wrong lift is easily found by an examination of the wrong lift pick, and is confirmed by the elevation of all the shafts by the bottom draw bar, and leaving the shedding rod at its dead top centre. The offending catch may be made fit by filing until it gives a clearance of $\frac{1}{8}$th inch of the holding bar without being taken out of the engine. (3) If the catch is ever separated from the balk when working, it is better discarded, for it is a menace to the safety of the engine.

Needles.—The needle N is kept in position by passing through two grates. It is cranked to provide a shelf for the bottom catch, and then is straight, and fits underneath the top catch. One needle controls a pair of catches. The two important measurements are from the bottom to the top of the shelf, and from the bottom to the top of the needle, and, being standardized, they are reliable. Balks and catches may be taken out of the engine without disturbing the needles.

Feelers.—The bottom of the needle N rests on the upper and inner end of the feeler O which is 16 inches long. It is fulcrumed at P which is $9\frac{1}{2}$ inches from its outer end at R. The part R is what projects through the grate that has vertical slots which keep the feelers in position though allowing them to rise and fall with vertical freedom. The part R is thinner and less in depth than the feeler on its inner side of the grate, for the outer depth is only $1\frac{1}{4}$ inches, whereas the inner one is $3\frac{1}{4}$ inches. As the feeler drops of its own weight, its structure is admirable for the purpose, and prevents the bouncing of feeler and needle. As the feelers are actuated by wooden pegs, the feelers last as long as the loom.

Shaft Lags.—The lags are grooved across the face width with a hole through the centre. The latest kind of pegs are made from beech wood which are very durable, and have an oily nature. They have a rounded top to give a gentle rise and fall to the feelers, and also have flat sides. Their structure answers a double purpose. Their flat sides enable the peg to penetrate the groove in the lag and prevent them turning, and also, that even when the cylinder ends become worn, the peg is prevented from actuating two feelers. The lags are at W.

Star Wheel and Finger.—The star wheel T has 6 curves which correspond to those on the lag cylinder. This wheel is the means of setting the cylinder so the operating lag is at the top centre of the cylinder when it comes to rest. By the curved finger S and the pull of the spring V, the cylinder is firmly held until another lag is required.

Setting of Cylinder.—It is set to attain a threefold object. (1) It must be at the same elevation back and front to impart a similar lift to every feeler. (2) After being turned, the lag must come to rest at the dead top centre of the cylinder to impart a maximum lift to the feelers. (3) The pegs must have their centres opposite the centres of their feelers. The shaft cylinder is made of wood, but the box cylinder is of metal, and can be set independent of each other.

Draw Bars.—These work in pairs, and move in long slots, and are at J and L. The back bars K and M push back the balks to their resting positions, and assist in forming the bottom shed. The upper pair as well as the bottom ones are held together by a connecting casting, and the same applies to those at the back of the engine. There is one common setting for these bars though they have to be adjusted at four places. This is, that the connecting rod indicated at G shall be so set, that the back of the pushing back bars K and M are just clear of the front of the balks when the balks are in contact with their stay bars at the back of the engine. The connecting rod G passes through a double bored casting Z, which is bolted to the main engine lever F. To fix with safety, the locknuts on the connecting rods are slackened, and the shedding rod set at its dead top centre, and the adjustments mentioned are then carried out. The shedding rod is then placed at its dead bottom centre, and the bars adjusted like the top ones.

Holding Bars.—The bars X and Y hold back all the catches that are raised by the feelers. Each bar is on a long stud that spans the engine, and reposes in a long slot. Each bar is fixed when the attendant catches are at their full back traverse, and the upper points of the catches are ¼ inch away.

A peg on the shaft lag tilts a feeler, and deposits the responsive catch on the draw bar which draws it forward, and elevates the corresponding shaft. A blank allows the feeler to come to rest, and in so doing elevates the needle and catch. The catch is then held by the holding bar, and the corresponding shaft is placed on the bottom shed.

Eccentric Shedding Wheels.—The movement of these assist both shed and shuttle. The movement of the shafts are slow at the beginning and the end, and quickest in the centre. The crank movement is $4\frac{7}{8}$ from front centre to bottom, $2\frac{5}{8}$ from bottom to back centre, $2\frac{5}{8}$ from back to top centre, and $4\frac{7}{8}$ inches from top to front centre.

The Overpick Motion.

The picking is on the overpicking system, but in many respects, differs from well known types. Fig. 55 gives the main parts. At A is the low shaft to which the picking boss is secured by a key in a sunk keyway which prevents any

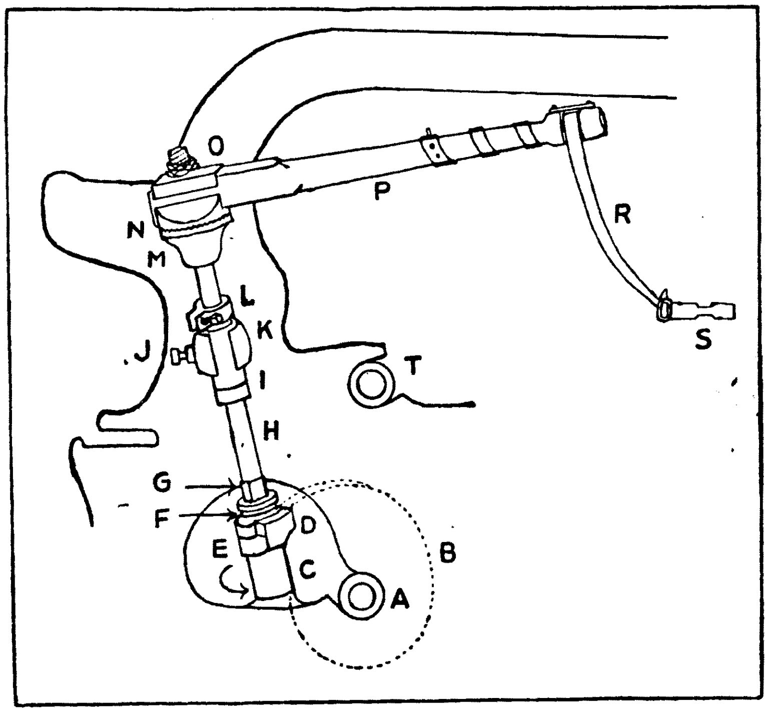


Fig. 55.
Picking for Hattersley Standard Loom.

slipping of the boss. On its face side it has radiating teeth which mesh with those on the shell nose. The boss is best set when the outer side of the picking nose end is level with the outer end of the picking cone when nose and cone are at the limit of their forward traverse. The wearing of both is then at their best.

Shell Nose.—The shell and nose B are in one casting, and a long slot allows of it passing on to the low shaft. The outer rims of boss and shell have to be level with each other. This gives the right sweep to the nose, and its setting must conform to moving the shuttle out of the box when the crank is at its bottom centre. Only two bolts are required to hold the shell nose to the boss, for the teeth on both give additional holding power, and make possible, a very precise timing. When the nose becomes worn, its picking power is weakened, but its curve at the front may be deepened which increases its force, and, if found expedient, it can be set a little further forward. In this way it remains in service until practically worn through.

Picking Shaft.—This is indicated at G (Fig. 55), and is only 31 inches long. Contrary to most overpick motions for woollen and worsted weaving, it is placed outside the framework of the loom. The bottom of the shaft enters a cup bolted to the inner side of the loom, and at J it passes into a barrel-shaped clutch which is part of the loom framework. It is this clutch that determines the position of the cup, for the clutch is a fixture, whereas the cup is movable and must be set to make the shaft rotate with ease.

The picking shaft is secured to the clutch by the metal sleeve H being pushed up from below, the countersunk hole in the sleeve being made use of by the locknutted setscrew K. As the barrel clutch stands further out and further back than the cup at the bottom, the shaft is made to lean in two directions. It leans outward and backward, each of which gives advantages to the picking.

When the picking shaft requires to be taken out, the picking strap S is unloosed, the setscrew K slackened which lowers the sleeve, the two springs uncoupled, and it is ready.

Cone Casting.—The cone casting C is loose on the picking shaft, and on the opposite side to the one shown, it stands forward and is made square. It is hollow at the back, and has a hole through the centre for the passage of the cone stud. The hollow at the back is for the reception of a strong square nut which takes the threaded end of the cone stud. The stud has a large square which is used by a spanner, and when braced up, the face side of the square is level with the square on the cone casting. The outer shaft of the stud is for the cone which is held by a stout washer and a pair of locknuts, the cone being given rotary freedom. Towards the bottom and inner side of the cone casting are two threaded holes, either of which may be used by a setscrew with leather and spring attached. As the cone and casting are thrown backward by the shell nose every revolution of the crank, it is brought back by the pull of the spring. The top part of the casting is flat, and has a stout rim, which, in one place, terminates in a strong, flat faced lug. This lug is made use of by the leg of the picking clutch.

Picking Clutch.—This is at E, the circular groove at its upper end being used by the two ends of the picking fork to elevate or depress it. It is square through its centre to fit on to the square on the picking shaft F. The stout leg on it is at D. When no pick is required, the picking clutch is elevated so the leg is quite clear of the cone casting. When picking has to take place, the picking clutch is made to descend until body up to the cone casting, and the leg and shaft are then turned by the rotation of the shell nose.

Regulation Collar.—The stationary position of the leg D is set by the regulation collar L. This collar is keyed to the shaft G, and the lock-nutted setscrew upon it controls the position of the shaft and the picking clutch, because the inner end of it comes in contact with a part of the loom framework. The best working position is for the leg to slide down with only a clearance of ⅛th inch. There is then no jerking at the commencement of the pick, and the full force of it is spent in sending the shuttle across the loom.

The collar underneath the sleeve H has a leather and spring attached to pull back the shaft and stick after picking.

Picking Stick Castings.—These are built, fit, and set like the ordinary overpick and have already been detailed. It is to be preferred that the picking shaft be a little longer than shown in the drawing so that a small bracket may be used to keep the shaft steady during picking. This bracket is bolted to the framework.

Picking Stick.—The hickory picking stick R is a short one to meet the requirements of the picker T which fits behind the box. As the picking shaft leans backward, the stick is tilted upward at an angle of 75 degrees, which practically coincides with the slope of the sword and boxes when the crank is at its back centre. This leaning backward causes the stick to rise 5½ inches from its base. By leaning outward, the stick makes an upward sweep when picking of 1½ inches from its stationary position.

This results in an acceleration of the power of the pick, and the movement of the shuttle. It also prolongs the service of the shell nose.

Picking Strap.—The strap S may make the power of the pick futile by being too long, but its pitch is obtained by making it begin to move the shuttle out of the box when the crank is at its bottom centre. When the stick and strap are set properly, then the strap ought to pull the picker within a couple of inches of the buffer. There is then correct timing and no binding.

Picker.—This is presented at T, and is of the horizontal kind. Being of buffalo, it ought to be well seasoned for long wearing. It can be used for either hand of loom, and may be reversed at the same end. It fits behind the box, and the spindle can be regulated at its inner end to give the correct throw to the shuttle. The spindle is supplemented by a slide which is so set, that it is a little higher at the inner end than the outer one for shuttle control.

Sword and Shuttle Race.—These are depicted at Fig. 56. The sword at A is solid, and more substantial than the ordinary slotted sword. In consequence, it offers more resistance to the shock of knocking-off and gives more power to the beating up of the weft. It is perpendicular when the crank is at its front centre, and, being at right angles to the fell of the cloth, is at its maximum power when the full beat up takes place. At B is the shuttle race, which

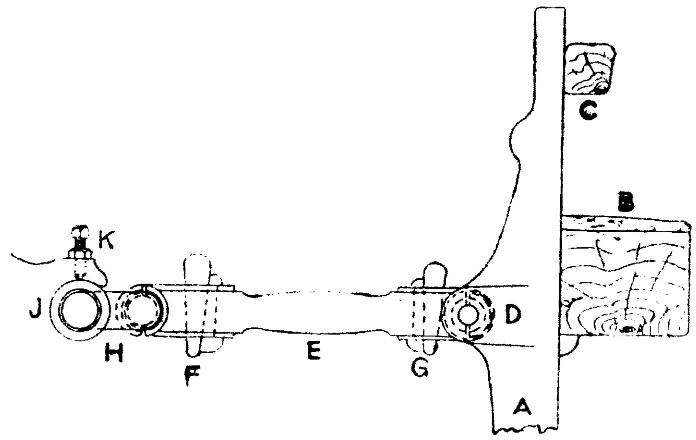


Fig. 56.
Beating Up. (Hattersley Standard Model Loom)

slopes downward a little from the front when the crank is at its front centre. The angle formed by the shuttle race and sley is almost a right angle when the reed is against the fell of the cloth, but becomes a pronounced **V**-shape when the crank is at its back centre. This is an excellent aid to keep the shuttle in its proper course through the shed, for the **V**-shape is the most pronounced when the speed of the shuttle is greatest.

Now the angle formed by the shuttle back and bottom ought to coincide with the angle formed by the sley and shuttle race, for without this, there can be no reliable run of the shuttle, nor long wearing of them. As the bevel is standard for the loom, it must also be standard for the shuttle maker. Any order given for shuttles for these looms should include the "Hattersley bevel."

The upper ends of the swords are slotted so the hand-rail C may respond to the different depths of sleys.

Crank Arms.—Instead of this being hollow as ordinary, it is solid except at the ends where it is slotted to receive the cotters and holders at G and F, Fig. 56. The extreme ends are curved to fit to their respective bushes and there are also recesses into which the lugs on the bushes can find lodgment to prevent them turning. It is practically impossible for these arms to be broken owing to their construction, and to the greatly improved structure of the frogs. In place of the ordinary long and short strap of metal on most looms, there are two short ones on this, with a pair of holders and cotters at each end. The holders face each other, for the metal straps are drawn in opposite directions and independent of each other. The main force of beating up the weft is placed on the front bush on the crank arm, and the back bush on the sword pin, so the metal straps have the comparatively easy task of bringing the going part back from the fell of the cloth. When the slots in the metal straps cannot be cottered further, the bushes D and J may be packed with hard leather tapered off at the ends, which extends the metal straps and are thus kept longer in service.

As the greatest crank arm movement is at H, the bushes here are made of gunmetal bronze, but at the sword pin D, they are cast iron.

Gunmetal Bushes.—There are no pedestal brackets on this loom to hold the crank and bottom shafts, for a better and handier system has been introduced. The framework of the loom has been made with sloping slots, and into these, the crank shaft and low shaft are placed. A gunmetal bronze bush at J is then slided on to the outer end, and fits into the groove in the framework. The inner bore of this bush is grooved in spiral formation and in two directions, which make the grooves cross each other. These grooves retain surplus oil, and continue to lubricate the shaft for a considerable time. On its outer side it is countersunk, and this accommodates the lock-nutted setscrew K, which prevents any movement of the bush.

Movement of Going Part.—The reed moves 7¼ inches, and so provides adequate room for a large shuttle to weave bulky bobbins of woollen weft. The same shuttle is available for other yarns by the substitution of another kind of spindle. The sweep of the crank imparts an excellent momentum to the going part for the beating up of the weft, and though light-weight fabrics are adequately woven, heavy cloth is well within the range of its capabilities.

Stop Rod Tongue.—Fig. 57 gives a good idea of the entirely new type of knocking-off arrangement. At A is the shuttle race and B the box swell finger, the swells being at the front of the box. The finger is in two sections. The bottom part is setscrewed to the stop rod, but the upper one is pivoted to the lower one and is pressed forward by a highly tempered spring which is doubly setscrewed to it, its bottom end being in contact with the lower section. The spring makes the upper section rigid enough to respond to the motion of the box swell, and imparts responsive movement to the stop rod tongue C.

As shown in the drawing, the blunt point of the tongue is at the top, whereas in most cases it is at the bottom. The length of the tongue is sufficient for the prevention of any ends being broken out if ever the shuttle is trapped in the shed when the loom bangs off.

Style of Frogs.—The frog is at D, and is pivoted on the powerful stud E, which is bolted to the loom frame. The top of the frog resembles the sole of a boot, the toe being where the stop rod comes in contact with it. The hollow heel is made use of by the helical spring F, and the stud G which passes through it. The frog is set by the lock-nuts at the top of the heel, its proper pitch being that when no shuttle is in the box that frog and tongue end meet full face together.

Bottle Bracket.—This is indicated at H, and is doubly bolted to the loom frame. Its upper end is bored through for the passage of the long bolt G, and the neck of it receives the bottom part of the spring F. This bracket is a fixture, and has to withstand the downward pressure of the frog when the loom bangs off. What is of even more vital importance is the best possible fitting of the stud E, and its firmness of holding as it has to withstand the greater shock.

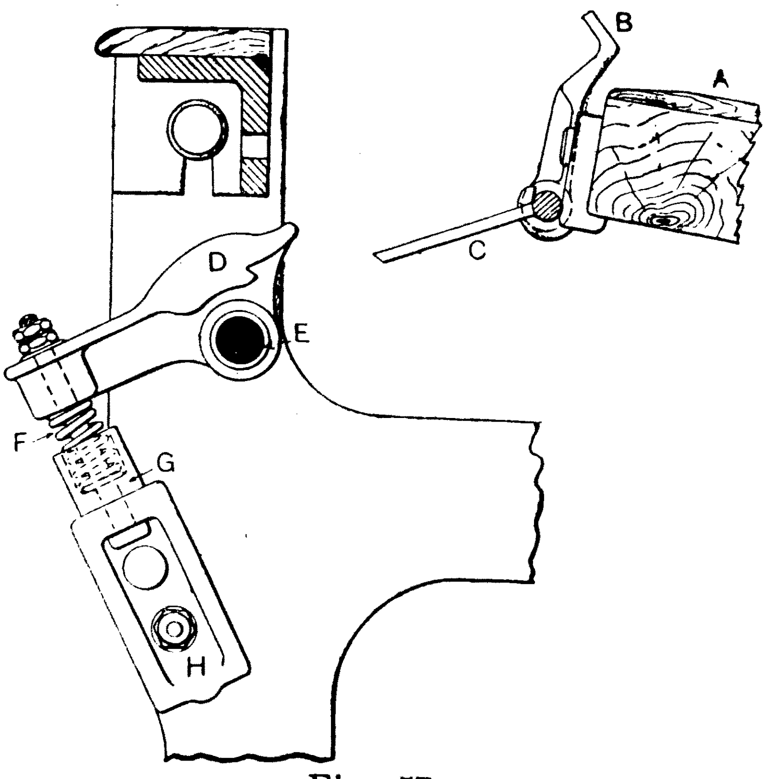


Fig. 57.
Frog. (Hattersley Standard Model Loom).

Movement of Parts.—This system has several important advantages:—

(1) The frog, stop rod tongue, sword pin, and crank arm are in a direct line with each other. In almost all other makes of looms, the frogs are on the outer sides of the swords, so that when the loom comes to a sudden stop, the blow imparts a sudden twist to the swords and sometimes snaps them.

This twisting action cannot occur in the Standard Model Loom, and as the sword is solid, there is much more strength to withstand the shock.

(2) When the sword is at its full forward traverse, it is perpendicular. This being so, the end of the stop rod tongue is well in advance of the sword and passing through the downward arc of a circle. It is in accord with the movement of the frog when struck by the tongue, for though the downward movement be small at the toe, it is much more so at the heel, and the greater the pressure at the heel and the greater is the resistance of the powerful spring. As soon as the blow has spent itself, the spring presses back the frog to its normal position.

(3) The resiliency of the spring greatly reduces the force of the impact, and a minimum of pressure is applied to the loom frame. It may be rightly termed a soft blow rather than a jarring shock.

(4) In some looms that have fast and loose frogs, the force of knocking-off elevates one or both swords, and if an early discovery is not made, a serious shuttle trap is likely to be made the first time the shuttle stops in the shed when the loom comes to a sudden stop. The rising up of the swords in this loom is almost impossible.

Letting Off Motion.

The chief parts of this motion are outlined in Fig. 58. It incorporates several new ideas in a catch let off arrangement.

The Pusher.—This is at A, and is doubly setscrewed to the side of the sword. Its flat and vertical face is 5 inches long, which gives sufficient surface for the curving sweep of the sword, and for any changed position of the bowl B.

Bowl Lever.—This is the right angled lever C which is fulcrumed at D. The bottom part is slotted for 2½ inches so the bowl may be set for the kind of warp to be woven.

Fabrics, as far as picks are concerned, may be divided into coarse, medium, and fine and the range may vary from 30 to 120 per inch.

If the cloth to be woven has only a small number of picks per inch, then the letting off of the warp must be rapid, and the bowl is set at the top of the slot. When the picks are numerous, the movement of the letting off catches has to be slight, and the bowl is fixed in the bottom of the slot. For

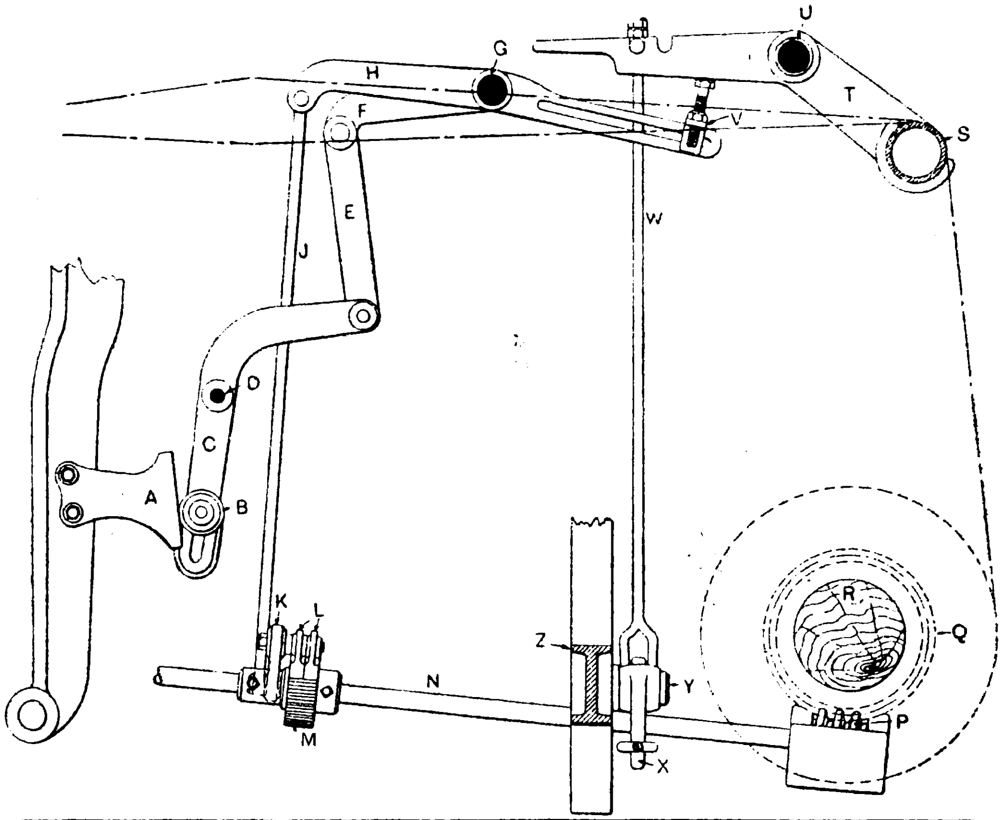


Fig. 58.
Hattersley Letting-off Motion.

a medium number of picks it is set at the centre. As the bowl is free to turn on its stud, it gives the best wearing to the contact surfaces.

Lifting Lever.—The bowl lever C is attached to the lifting lever E at its base. Like C, the lever E is one of right angles, and is fulcrumed at G. At its elbow is the lifting stud F which passes underneath the rod lever H.

When the pusher A forces back the bowl lever C at the bottom, the upper part of it is elevated, and this raises the lifting lever E along with the stud F. This in turn pushes up the lever H which carries the long rod J. The bottom of J is secured to the catch lever that oscillates on the letting off shaft N, and in this way, the letting off wheel is turned.

Rod Lever.—The rod lever H performs a double function, for it lets off the warp, but is constructed with a long slotted arm at the back. This is made use of by the small bracket V which carries a lock-nutted setscrew, which, by means of the slot, can be moved several inches. The bracket V regulates the standing position of the rod lever H, and determines the amount of movement imparted to the catches. If the screw be let out, then the opposite side of the lever is elevated, and the stud F is all the longer in coming in contact with the lever H, and in consequence the movement of the catches is curtailed. The opposite effect to this is obtained when the screw is turned down.

The fixing position of the bracket is significant. If it be placed at the end of the lever as shown, then the least movement is given to the lever H and to the back rail lever T. This position is suitable for fine worsted warps, for they are all the smarter woven when under good tension. The opposite to this takes place when the bracket is moved to the opposite end, for the tension is then much more flexible and in keeping with the successful weaving of tender warps.

Letting Off Wheel and Catches.—The letting off wheel M is keyed to the letting off shaft N, but the catch lever K has rotary freedom. The letting off catches L are on the same stud, and are each weighted at the bottom to keep the point end in constant contact with the wheel. The invariable method for the best letting off of the warp is to have one catch half a cog ahead of the other. When almost at the same pitch, the wheel remains stationary too long, and then, when it begins to move, it does so with too much vigour. The standing of the wheel creates a heavy bar in the cloth, and the too vigorous action makes a light one.

The letting off wheel and catches are perhaps better seen in Fig. 59. Here, the letting off shaft is at A, with B and C the collars to keep the parts in position. At D is the catch lever which is rotated by the connecting rod E. The let-off lever carries the catch stud H, the catches being at F and G. It will be noted that the catch on the right is a little longer than the other, the actual distance being half a cog, and for the reason already mentioned. The letting off wheel I, is keyed to the shaft A, the wheel being of fine pitch, having 40 cogs to give a sensitive response to catch movement. The catches are weighted on the back arm to keep them in constant contact with the wheel. In this make there is no shield.

Worm and Beam.—When the letting off wheel is made to turn, it actuates the worm P, and this rotates the cogged wheel Q which is setscrewed to the warp beam R, which is also held by the head of a setscrew in the beam collar, and passes into a groove on the inside of the wheel. The warp beam wheel is set clear of the loom frame, and the centre of its cogs opposite the centre of the worm. Fig. 58.

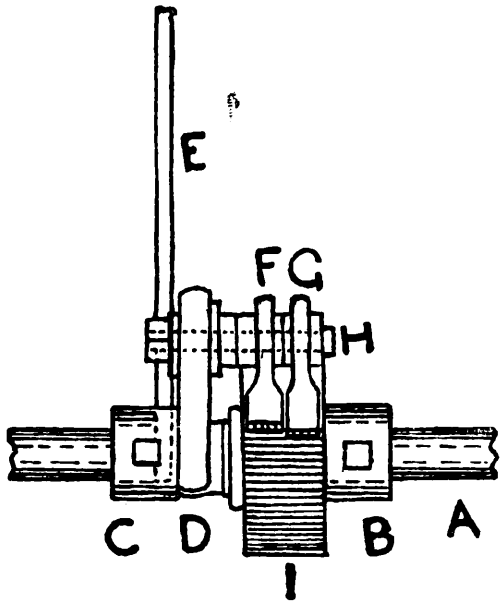


Fig. 59. Hattersley Shaft Motion.

At the front of the loom, the letting off shaft N carries the brake wheel with its rope and weight, the latter effectively checking any excess of movement. When the weaver has been combing out, the warp may have to be rewound a little on the warp beam, but following that, the rope and weight must be replaced or otherwise the cloth will be woven with less picks per inch.

Swing Rail Lever.—The lever is at T, and has its fulcrum at U, with the swing rail at S. At the upper and inner end are two notches, either of which may be used by the wing casting on the vertical rod W. The one occupied in the illustration gives the most movement to the back rail when the weft is beaten up, and the position is appropriate for coarse cloth or tender warp yarns. The other notch is better for fine work and greater tension.

The wing casting must be placed in a similar notch at either end of the loom, though the most important end is where the warp is let off. Fig. 58.

The connecting rod W is looped at the bottom, and is hooked on the notched right angled lever Y. The bottom arm of this lever carries the horizontal connecting rod X, which couples the lever to a similar one at the other end of the loom.

The lever Y is the weight lever, though the arm that carries the weight is not shown in the drawing. The more weight there is on the lever, and the less is the movement of the swing rail lever, with a consequent decrease in the letting off of the warp. For the weaving of tender warps, the less weight there is, and the better, consistent with getting in the required picks per inch.

The setting of these parts are important. The stud U upon which the swing rail T is made to move, must be set so the swing rail S is one inch below the height of the breast beam. This results in the warp being a little tighter on the top shed than the bottom one. It prevents the threads from hanging down when on the top shed, and eases the pressure of the warp on the shuttle race. As the loom is fitted to take two warp beams, the other swing rail lever is set so the top of the swing rail is one inch above the other. The upper swing rail is then keeping its warp free from pressing on its companion.

When two beams are employed to weave a cloth, the beam placed in the top rack is usually the backing beam, and the one in the bottom rack the face beam.

The other setting is that of the wing casting on the swing rail lever. It is regulated by lock nuts which are fixed so the upper part of the swing rail lever has a slightly downward dip when the pressure of the warp is applied to the swing rail. Its oscillation is then above and below the dead level. Both pairs of vertical rods are set to produce this effect.

There is a final point. In the weaving of tender warps, it is a decided gain when there is only one beam, to place the beam in the bottom rest, for this gives a longer stretch of warp. The tension is then distributed over a longer length of yarn, and broken threads are appreciably decreased.

The Taking-Up Motion and Reversing.

Fig. 60 gives the positive taking-up motion, along with the method of reversing. The long shaft which runs along

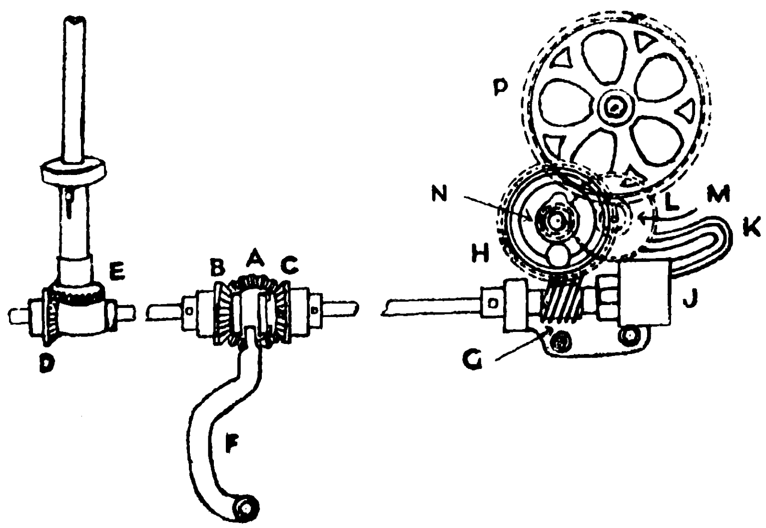


Fig. 60.
Taking-up Motion. (Hattersley Standard Model Loom).

the outer width of the loom is turned by a double wheel at A. This wheel is doubly setscrewed to the end of the low shaft, and by it the timing of the shed can be altered. If the timing be altered either sooner or later, the position of the two bevel wheels B and C have also to be adjusted to suit the new condition, for these wheels control the weaving and reversing of the two lag cylinders. The alteration is carried out as follows: The loom is first placed with its shedding rod at its bottom centre, and the two collars which hold their respective wheels to their common driver are released. The wheels are then slided out of contact with the driving wheel and collar. On each wheel at the face side is a lug, and this is the part made use of by a cut on the reversing collar.

The reversing rod is then set for reversing, and the dolly pin must then be just clear of the turning wheel. The front lugged wheel C is then placed with its lug against the cut on the collar, and outer collar then brought up and secured. The dolly is now moved so the pin is just clear of the turning wheel at the opposite side, which is done by hand. The lug on the wheel B is then brought in contact with the cut on the centre collar, and the outer collar then fixed. Whatever be the timing of the shed, the timing of the cylinder has to be the same as explained.

When the taking-up shaft is turned for weaving, it rotates the taking-up worm G. Into this gears the fine pitched taking-up wheel H having 52 cogs. In front of this is the disc which is provided with a handle and a release pin. When the release pin is in one of the holes, the taking-up wheel is a fixture, but when pulled out, the wheel remains stationary, but by means of the handle, the cloth may be tightened up or slackened out as required. This is a very handy method for the weaver, and also for the overlooker to pull forward the twistings. Behind the taking-up wheel is the standard wheel having 22 cogs which fits at the end of the boss to which the disc is connected. The standard wheel is securely held by two small pins projecting from the end of the boss, which enter recesses in the wheel, the wheel being then secured by a nut. The outline of this wheel is given at N.

Into the standard wheel meshes the change wheel L, the gauge point being a tooth per pick. It is the common practice to put on a change wheel with one cog less than the picks per inch so the cloth may be taken up a little quicker, and the piece prevented from bumping. The change wheel L fits in front of a lever which swings from the shaft of the perforated roller wheel P, and is pinned and bolted to the stud which passes through the bottom end of the arm. On the same stud, and behind the change wheel is the pinion wheel M with 12 teeth. The bottom of the arm is constructed so it can be bolted to the curved slot K, this slot making it possible to adjust the change wheel in proper relation with the standard wheel.

For cloth which has few picks per inch, the standard wheel with 22 cogs is changed for another standard wheel having 44 cogs. This takes up the cloth twice as fast, and whatever change wheel is used, it only allows half the picks to the number of cogs in the change wheel. If the change wheel has 60 cogs, then there will only be 30 picks per inch.

The large wheel P, which has 80 cogs is setscrewed at the end of the perforated roller shaft, this wheel being turned by the small pinion wheel M. To prevent the slipping of the setscrews, flats are made on the shaft.

Dolly Shaft Gearing.—At the back end of the taking-up shaft is the bevel wheel D which meshes with the bevel wheel E at the bottom of the dolly shaft S. The wheel E is made circular above the teeth and is hollow for the reception of a strong, open spiral spring. On its rim at T is a **V**-shaped inlet which is made use of by an outstanding **V** on the sleeve V which is also hollowed out to receive the spring. At its upper end it is slotted at W, and into this is placed a slide attached to a collar which is made to press upon the spring.

If the lags ever become locked, the sleeve V comes out of contact with the wheel section T, the slot W allowing of this taking place. By this escape motion, further damage is prevented. When the cause of the trouble has been removed, the sleeve may be twisted by hand until the **V** sections come together.

Box Lags and Feelers.

A line drawing of a box lag is given at Fig. 61. It is constructed with grooves across the breadth of the lag, and with a hole through for the leg of the peg. For a right hand loom A is the place that regulates the picking. When a

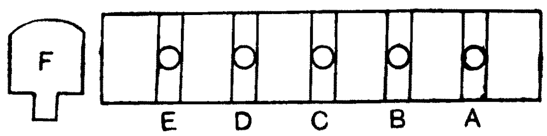


Fig. 61.
Hattersley Standard Loom Box Lag.

peg is inserted, it makes the loom pick from the left hand side, and a blank throws the shuttle from the right. The other four holes are for working the boxes, for B and C control the boxes on the left, and D and E those on the right. When B is pegged, the third box is lifted on the left, but when C is pegged and B is a blank, then the second box is raised on the left. If both B and C are pegged, then the fourth box on the left is elevated.

A peg in D lifts the second box on the right, but when D is blank and E is pegged, then the third box rises on the right. When both D and E are pegged, then the fourth box on the right is brought into service. The inner holes of the four are for second boxes, and the outer ones for third boxes at their respective ends.

The peg F has a circular leg to pass into a hole in the lag, but has flat sides to fit to the bottom of the groove which prevents the peg turning. As these pegs are a little longer than the ordinary circular peg, a better action is given to the box vibrators, and as the base of it is longer there is little danger of the leg being broken.

The cylinder and box feeler are outlined at Fig. 62. There are five feelers to correspond with the five holes in the box lags.

At A is the six grooved cylinder which is on the same shaft as the shaft lag cylinder. Though one is independent of the other, both are usually set alike. The operating lag is made to come to rest when dead level at the top of the cylinder. This imparts the highest elevation to the curved part of the feeler at B, and gives the lowest depression to the opposite arm F, the fulcrum of the feeler being at C.

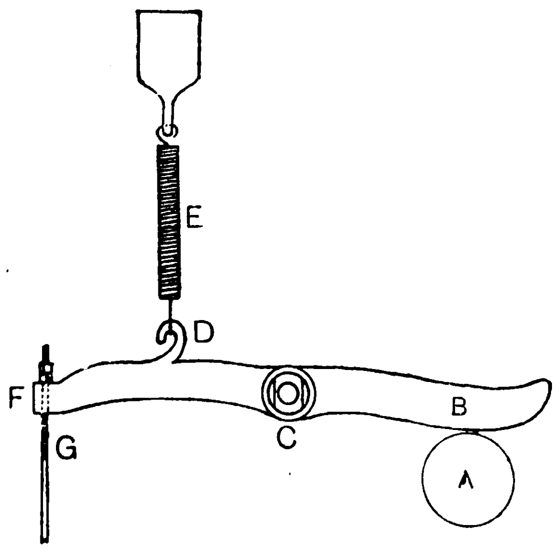


Fig. 62.
Cylinder and Box Feeler.

The end of the arm F is bored through, and finds place for the connecting rod G, which, at the bottom, is attached to the vibrator lever. As the feeler is negative in action, the spiral spring E is connected to the hook D to bring it to its resting position when a peg is succeeded by a blank. The pull of the spring has not to be too strong or unnecessary wearing will take place to the box pegs, neither must it be too weak or the rising and falling of the vibrator will be adversely affected. The rod G is set to keep the underside of the feeler just clear of the cylinder.

Vibrator and Wheels.

The mechanism controlling the boxes is presented at Fig. 63. At the bottom of rod J, which is the same as G in Fig. 62, is the looped casting which fits to a button on the vibrator lever H. By means of the rod, the vibrator lever is raised and lowered in response to the turning of the box lags.

Vibrator Lever.—This lever has three bosses, and its fulcrum is at the centre of the wheel F. The centre boss is used by the vibrator wheel E, and the front one is for the looped casting shown. The outer end of the lever is **V**-shaped, and passes through a grate I shown in the

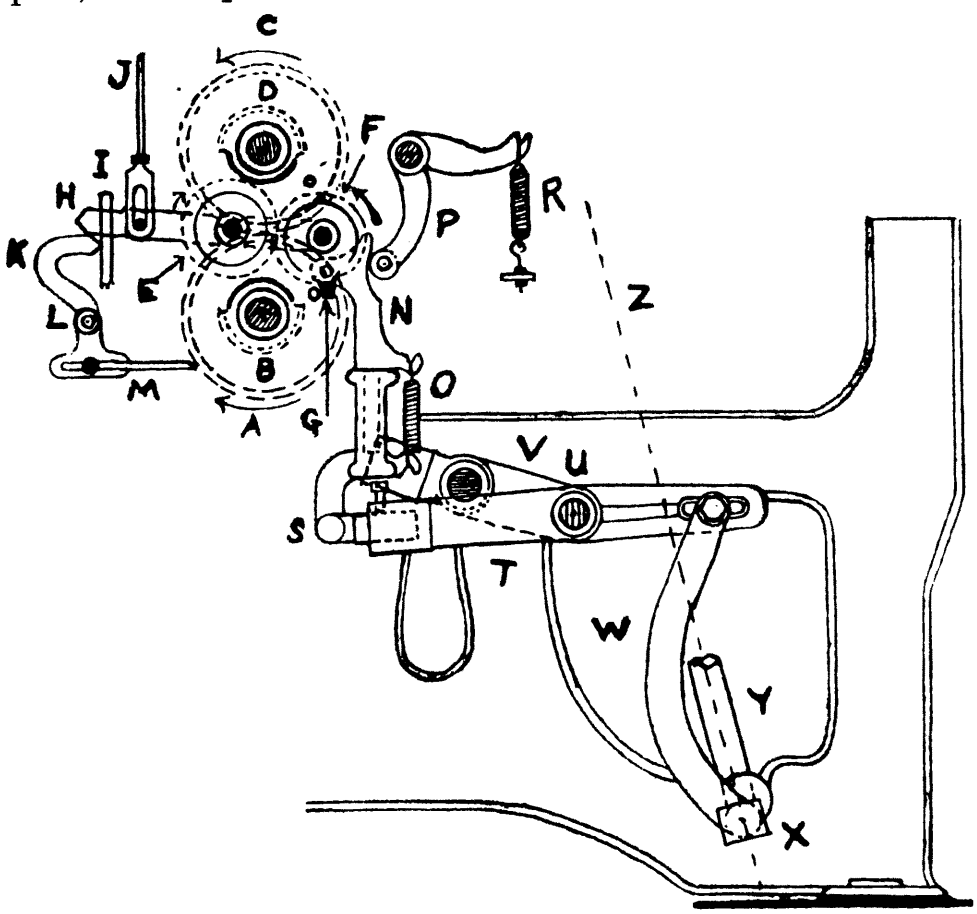


Fig. 63.
Box Motion for Hattersley Standard Model Loom.

diagram, a lock knife K operates in front of the grate I, passing underneath the levers that are elevated, and over those that have been dropped. Its fulcrum is at L.

Wheels and Cylinders.—The vibrator wheel E has a series of 10 cogs in one group and the same number in another, but the spaces between them are unequal. In one part there is a gap equal to one cog only, but the other gap is equal to four cogs. These spaces serve a particular purpose. As this wheel is on the boss of the vibrator lever, it is moved up or down by the rod J. When a peg drops the rod, the lever and wheel descend, and the wheel is then brought into contact with the revolving semi-toothed cylinder B, which has 11 cogs. The first cog on the cylinder B enters the gap in the vibrator wheel, and begins to push the last cog in the other section. The wheel rotates until the last cog on the cylinder follows the last cog on the wheel. The turning of the wheel now comes to an end, and so long as pegs follow each other in the box lags, the wheel will remain stationary owing to the gap of four cogs in the wheel, which enables the cylinder to pass without affecting it.

When a blank follows a peg, however, the vibrator lever ascends, and the wheel is then turned by the top cylinder D, having the same number of cogs as the bottom one, but rotating in the opposite direction.

The bottom segment wheel B raises the box, and the top segment wheel C depresses it.

It takes 5/9ths of a revolution of the crankshaft to make a change in the boxes.

The cogs on the vibrator wheel mesh with those on the connector wheel F. This wheel has 18 cogs in an unbroken series, but there are two extra things that have to be noted. (1) The wheel is furnished with a long tooth G which comes in contact with a stay bar top or bottom which terminates the movement. (2) It carries a button, and on this the connector N finds lodgment. By the turning of these substantially made wheels, the boxes are elevated or depressed.

Lock Knife.—The lock knife K is **V**-shaped at the front; is fulcrumed at its centre; is slotted at the bottom, and is moved by a cam that is cast to the inner end of the bottom cylinder. No alteration of the cam can take place, but if the cylinder be set right, the cam will be correct. The pitch of the knife, however, can be regulated in two ways.

(1) It must rest evenly between the raised and depressed vibrator ends when against the grate.

(2) It must give a clearance of at least $\frac{1}{8}$th inch to the points of the vibrators when thrown back by the cam. The distance is regulated by the slot at the bottom, for it is here that rod M connects the lock knife to a bowl lever which is kept in constant contact with the cam by the pull of a powerful spring. The timing of the lock knife is entirely dependent on the cam, and is as follows:—The lock knife begins to move outward when the sley is within half-an-inch of its back traverse, and when the crank is at its back centre, the knife is at the limit of its outward movement. As there is practically no dwell at this point, it moves inward as soon as the crank leaves its back centre, and by the time the crank has advanced $1\frac{1}{2}$ inches, it is resting against the grate. The inward dwell is a long one, for the knife must remain against the grate during the whole period the vibrator wheels are being turned which is slightly more than half a revolution of the crank.

Wheel Connector and Slide.—The connector is in three parts. The upper one at N fits on to the button of the connector wheel. The back of it is curved, and against a bowl lever P with spring attached applies pressure to press it home. The back is so curved that the bowl lever only moves $\frac{5}{8}$th inch, which gives the least possible wearing along with efficient service. Below the curve is a hook, and on this a spring O is placed which connects it to the bottom casting as shown. The upper part N is made with a leg $4\frac{3}{4}$ inches long, and at its base is a square lug. This leg fits into a long slot in the bottom casting, the two parts being kept together by a slotted plate which is held by four screws to the bottom section. The slots and the leg form an escape motion, for if anything becomes locked with the boxes, the vibrator wheels are turned, and the leg of the connector moves in the slots without doing injury to other parts. When the obstruction has been removed, the connector will slide back to normal. The bottom of the connector is pinned to the slide S, the shaft of which enters a recess in the lifting lever T. This slide is a very handy means of altering the leverage of the boxes without disturbing the first box. If the slide be tapped out, the leverage is decreased, but if knocked in, it is increased. Both slide and slide pin are held by setscrews which are no worse for being examined occasionally.

Lifting Levers and Boxes.

There are two levers for each box which are shown at T and V. At U is the chief fulcrum, this being a powerful stud bolted to the loom framework. The short lever V elevates the third box, whilst the long lever T which is fulcrumed at U controls the second box. When both work in unison, the fourth box is elevated. The cranked connecting arm W couples the long lever T to the swivel at the bottom of the box rod which passes through the sleeve Y.

If reference be now made to Fig. 53 it will be noted that the boxes are constructed with swells and curved springs at the front. As the swells are malleable, they may be hammered to suit the dimensions of old or new shuttles so the stop rod tongue may give a good clearance to the frog. Each box is $1\frac{13}{16}$ inch deep, and the swells are so shaped that the shuttle moves $13\frac{1}{2}$ inches into the box before coming in contact with the swell. Whilst this has the small disadvantage of being longer before commencing to depress the stop rod tongue, it has the gain of decreasing the risk of the shuttle being trapped between the shuttle race and the box.

The largest shuttle used is $16\frac{1}{4}$ inches long, so that it only has to advance $2\frac{3}{4}$ inches after first touching the swell to be quite clear of the shuttle race.

There is the further advantage, that the shuttle is quite free from the swell for three inches before the picker reaches its full forward traverse. When the boxes are not undergoing a change, they may be tested in their relation to the shuttle race at any part of the movement of the crank, but the best place is to apply the test when the crank is well towards its back centre.

If Fig. 53 be examined it will be found that the leverage of the box may be altered at three places.

(1) At the bottom of the box rod which passes through the sleeve Y. It is here that the long box rod is held by a couple of locknuts. By these nuts, the whole of the boxes may be brought lower or raised higher. It is here that the first box is made level with the shuttle race before making an examination of the other boxes.

(2) At the top of the connecting arm W. When the stud at this place is moved nearer the front of the loom all the boxes are elevated, but when moved backward they are depressed. Any alteration to this stud has to be followed by an alteration to the locknuts at the bottom of the box rod.

(3) The leverage of the individual boxes is regulated by their respective slides. In this connection there is one special point. It sometimes occurs that the second and third boxes are accurately set, but when the fourth is brought

into play, it may be either too high or too low. Suppose it was too high, then the leverage to the third box would have to be decreased a little, and the one to the second box increased. This is known as " halving " the leverage. The reverse of this is carried out if the fourth box is too low.

The quickest method of testing the boxes is to have a set of lags made which raises each box in turn, and drops them the same way. The picking motion is put out of gear and the test may be carried out with or without shaft lags.

Planning Box Work.

Though these are positive boxes, and have little or no vibration, it does not follow that any method of working the boxes will do so long as the pattern is correct. Careful planning brings its own reward. Several ideas are worth bearing in mind.

(1) It is better when possible, for the box to rise and the loom to pick than it is for the box to fall and the pick to follow. This specially applies to negative boxes, but is no worse for being carried out with positive boxes. The reason is that when pickers become worn, the hole made is the shape of the shuttle tip and has a tendency to hold the shuttle. Sometimes two and even three boxes have to change the same time as one, and it is therefore safer to plan for a pull up than a push down. When the head of the picker is fairly well worn, it may be made easier for box changing by being gouged out, or reversed.

(2) There is the balance of the boxes to consider. Suppose all four boxes are required at either side, it is much easier for the loom to make one box rise when the other falls, for this balances the weight. This is not always possible, but when it can be applied, it is an all-round working advantage.

(3) It is best in any kind of box loom to skip as few boxes as possible. Though the standard loom is very reliable in either lifting or falling, it is obvious there is less risk in moving one box at a time than three. It is even a gain at times to introduce an extra shuttle to prevent too great a change. The elimination of all unnecessary risk is what all prudent overlookers desire to achieve.

This loom is also made with 6 rising boxes at either end of the loom.

Box Plan.—The worked out plan at Fig. 64 incorporates the points already mentioned. The wefting plan is 36 black, 6 red brown, 6 white, 6 dark green, 6 white, 6 olive, 6 light grey = 72 picks. To prevent a 3 rise or fall, the second box from the top at both ends are left vacant. All the

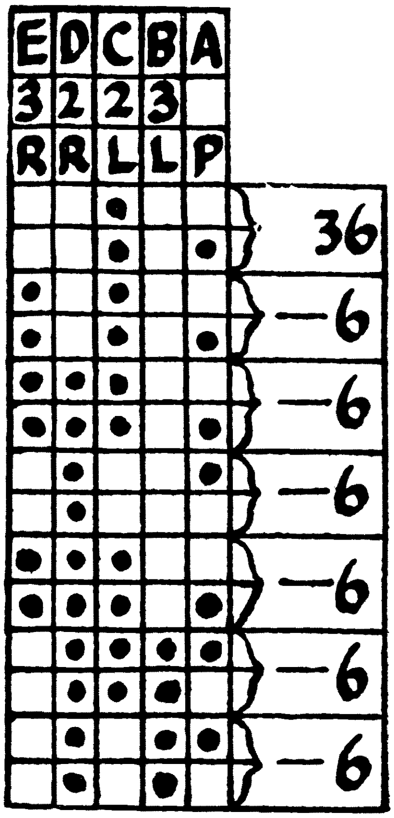


Fig. 64. Box Plan for Four Shuttles.

shuttles on the right can then be run into the second box on the left, and all the shuttles on the left can be run into the 2nd box on the right. The shuttles are placed:—

Right box Black 1, Red 3, White 4.
Left box Green 1, Grey 3, Olive 4.

The picking plan is for a right hand loom, and the top line of picks is the first pick. The line A from top to bottom is for picking, the boxes being numbered and the left and right hands are indicated. When the fourth box is needed at either hand, the 2nd and 3rd holes are pegged. This is a very interesting study, and there are no rises or falls of three boxes.

Driving of Loom.

The driving of the loom is by friction plate, and takes one of two forms according to the arrangement of the mill shafting. If the mill shafting is parallel to the sides of the looms then the driving is at right angles with bevel wheels. Fig. 65. The other form is that of parallel driving by a spur wheel when the mill shafting is parallel with the width of the loom. Fig. 53.

The right angled drive has friction plates with a diameter of 16 inches, the driver having circular holes equi-distant from each other to accommodate the circular cork discs. These discs are little affected by oil, damp and friction, and have a good gripping surface.

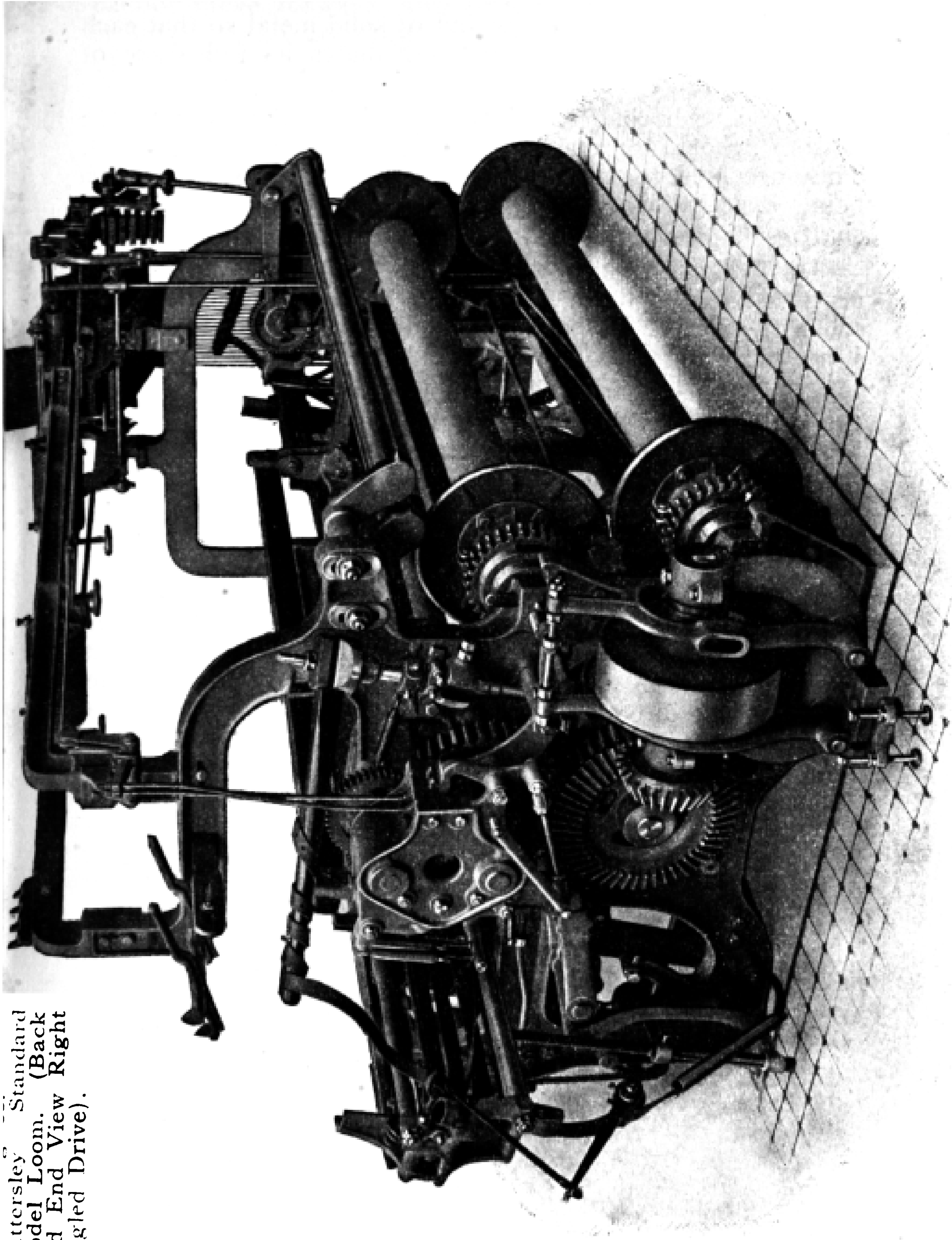
The diameter of the belt pulley is 13 inches and is 3 inches wide for the straight running belt. At the back of the driving flange is the groove for the clutch fork which is operated by the setting on handle. A cap fits inside the groove, the cap being made with a projection at either side which pass into the openings in the clutch fork. The fork has its fulcrum close to the floor, and its pitch is regulated by two pairs of nuts at its upper extremity. The pitch has to be set so the weaver has no difficulty in setting the loom in motion, but must be set keen enough to prevent the slipping of the driving flange. If the belt be moderately tight and in good running condition, it is a good indication that the driving flange should be set a little keener if the loom is running at a reduced speed.

Brake.—The brake is attached to the same mechanism as that which sets the loom in motion, but moves in the opposite direction. When the discs on the driving plate are just touching its companion, then the brake should be just clear of the flange. This setting gives full liberty to run as soon as touched by the discs, and at the same time applies the brake in the least possible time when the loom bangs off, or is stopped in the ordinary way. Such a setting reduces the severity of the blow on the frogs, and unnecessary force to the swords. The power of the brake is tested by trying to turn the balance wheel when the loom is standing, and the crank at its back centre.

The shaft that carries the driving flanges is two feet long, and at the front is the driving bevel wheel which is secured to the flat faced boss of the driven flange by three stout setscrews. The bevel wheel has 26 cogs, but it is not a change wheel. Its teeth must be parallel, and be almost body up to the bevel wheel on the low shaft to give the maximum strength and wearing.

The number of teeth in these wheels are an excellent arrangement. The wheel on the low shaft has 50 cogs and the other 26. There are therefore 13 revolutions of the 50 wheel and 25 revolutions of the 26 wheel before the same cogs are in contact with each other.

Main Driving Wheels.—These have four special advantages.



Hattersley's Standard Model Loom. (Back and End View Right Angled Drive).

(1) All the teeth are cut out of solid metal so that each tooth is at its strongest, and contributes its full share of service.

(2) The back of the bevel wheel and the front of the bottom wheel are machine-turned to make a perfect fit. They are held together by four bolts, the borings of each being exactly alike. Only the inner wheel is keyed to the shaft.

(3) The driving wheels are eccentric, and are so arranged in the fixing, that the quickest speed is reached when the weft is pushed to the fell of the cloth, and makes it a good wefting loom.

(4) The eccentric wheels impart an accelerated force to the picking, and for this reason the picking straps may be left slacker, the picking is steadier, and the parts wear longer.

Checking Motion.

This is presented at Fig. 66. The bearer bracket A is bolted to the inner side of the breast beam, and provides the fulcrum for the checkstrap lever at H, and the resting place for the holding catch E. At B is the rod moved by the setting on handle, and is underneath the breast beam. When moved in the direction of the upper arrow, the collar C takes the checking lever D with it, and places the catch E in contact with the back part of the strap lever F at G, the fulcrum of the lever being at H. By being so held, the lever

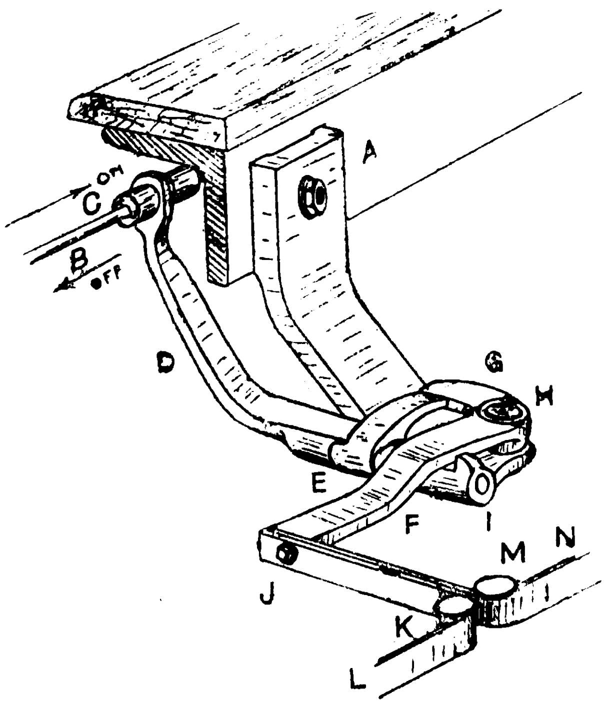


Fig. 66.
Checking Motion.

cannot move forward, and as the going part recedes, the straps L and N are drawn up, and in this way the checking of the shuttle takes place. The length of the straps are determined by the fixing point on the checking buffalo. The strap rollers K and M are part of a casting corkscrewed to the under side of the going part, and move with it. The terminal of the straps is at J at the end of the strap lever F. When the loom is put out of action, the catch E is drawn away from contact with the arm G, and the lever F can then move to the check limit at I, and both the checking straps are then slack. The checking only comes into action when the loom is set in motion, so that the shuttles may be pushed to their outer limit in the boxes, and the full force of the pick is applied to every shuttle.

Pick Finder Motion.

The Standard loom is fitted with an ingenious pick finder motion. If the weft breaks or runs off, the pick finder comes into play, automatically finds the pick, and stops the loom. The whole is completed in four revolutions of the crank, as follows:—

(1) When the weft breaks or runs off in any one of the shuttles employed, the picking at both ends of the loom is put out of action, but the lag cylinder moves forward for that part of the revolution of the crank.

(2) The pick finder now pushes the reversing collar from the weaving to the reversing side, and there it remains for two revolutions of the crank which turns back two shaft lags.

(3) The reversing collar is now pushed back to the weaving side for one revolution of the crank, which brings the shafts lags one forward.

(4) The loom is automatically stopped, the pick is found to be open, and the mechanism assumes the position from which it started as soon as the loom is set on for weaving.

The mechanism which performs this wonderful operation may now be explained in detail by the aid of the drawings.

There are three groups of castings called into play: (1) Those attached to the breast beam; (2) Those influenced by the wheel on the low shaft; (3) Those on the reversing shaft underneath the engine.

Weft Forks.—The three groups of castings are introduced to their quota of service by the weft forks. There are two forks, the distance between them being 38 inches, or in other words, they are each 19 inches from the centre length of the shuttle race. As they are 19 inches nearer the boxes than a centre weft fork, the prongs are perpendicular when the crank is at its back centre, so as to escape being molested by the passage of the shuttle. They act in much the same way as an ordinary weft fork.

Breast Beam Castings.—Fig. 67 gives the group attached to the breast beam. A and B are the two feelers

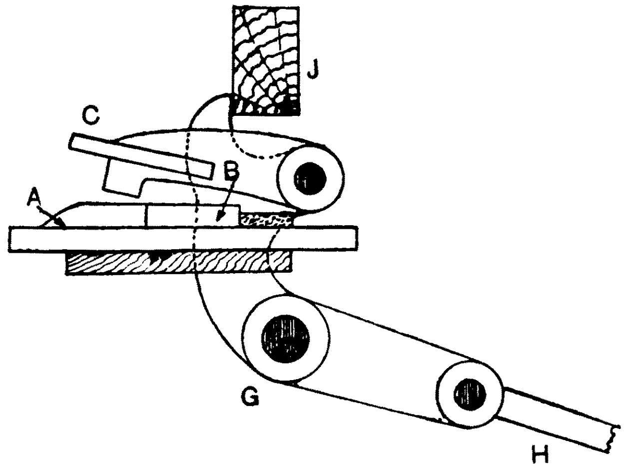


Fig. 67.
Picker Finder Breast Beam Castings. Out of Action.

placed side by side, their respective parts being shown by the vertical dividing line. When the loom is standing, both feelers are level at the front, and the lid C with its lug on the underside is raised as shown in the sketch. This lid is influenced by a swallow-tailed casting, the fulcrum of it being at the neck. A rod passes through the tail, whilst a wing is used to raise or drop the lid when the setting on handle is used. At G is the fulcrum upon which the connector casting oscillates, and J is the wooden block which limits the backward movement of the connector casting after it has been in action. At H is the connecting rod which links the breast beam casting with those associated with the low shaft.

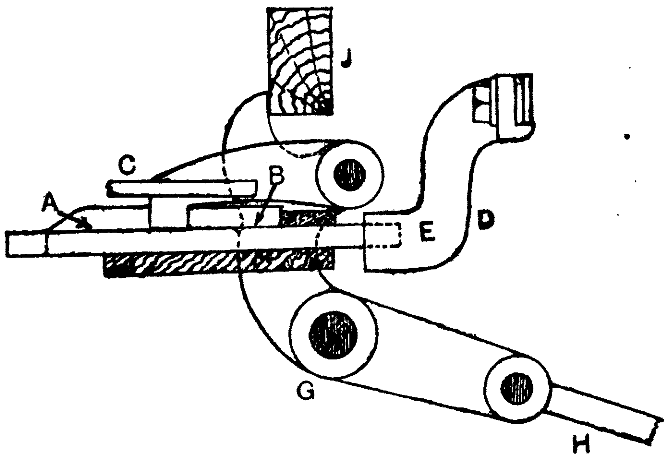


Fig. 68.
Pick Finder with Striker in Action.

Fig. 68 shows the same castings as the previous drawing, but with the addition of the striker D on the weft fork. When the loom is set in motion, the striker D pushes back the outer of the two feelers, and leaves a gap between the two. As the lid C has been released by the swallow-tailed casting, the lug drops between the two feelers as shown, but the inner feeler B remains forward at E. The striker D continues to come opposite the pushed back feeler A but only slightly touches it.

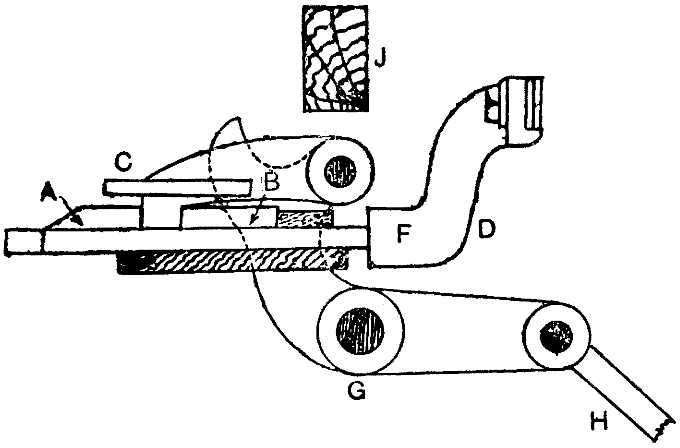


Fig. 69.
Pick Finder with both Feelers Pressed Back.

When the weft breaks or runs off, the catch holds the cut on the weft fork, and the traverse of the striker is curtailed. This brings it opposite the inner feeler B, so that both feelers along with the lid C are forced back as given in Fig. 69 by the cranked end F of the striker D. This push also moves the upper part of the connecting casting G, elevates its lower arm, and raises the rod H.

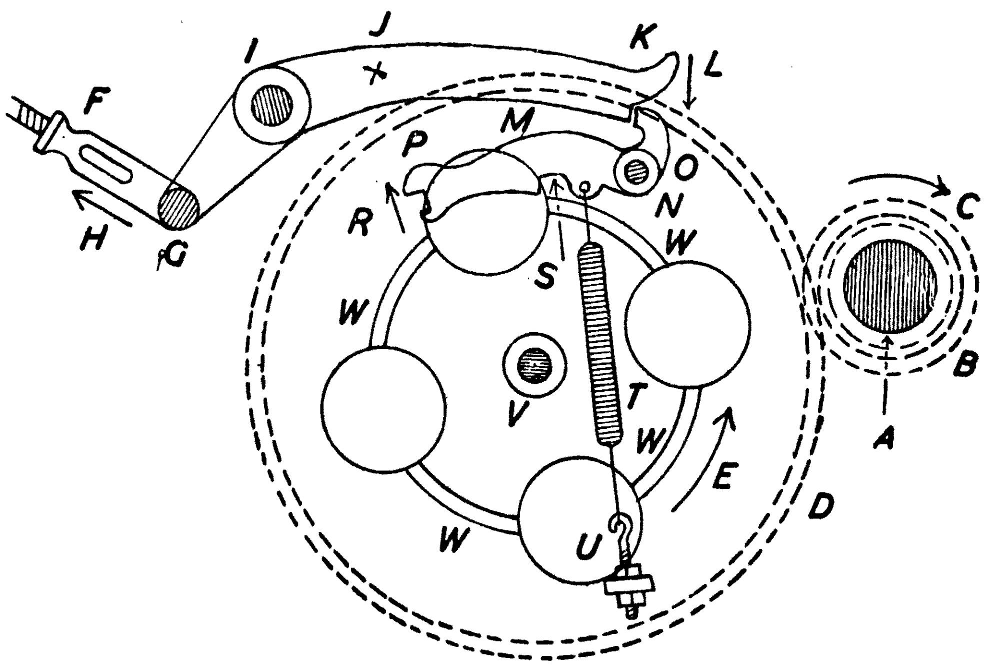


Fig. 70.
Pick Finder Catch Plate Out of Action.

Pick Finder in Weaving Position.—This is outlined in Fig. 70, and in second group of castings. A is low shaft; B clamp wheel; C its movement. D is spur wheel that runs when loom working, and makes one revolution to the clamp wheel four. It rotates as arrow E, but pick finder not affected until weft fails. When weaving, rod F moves as arrow H, and lowers holding lever K like arrow L, and cut on K holds tail O on key-shaped lever M, and its head is elevated as arrow R. In this position, the pick finder is out of action. N is pivot for key catch. Spur wheel and catch plate rotate on shaft V.

In some makes, rod F is fixed to a pin at J, and catch K is pulled up to bring pick finder into action.

Pick Finder in Action.—When weft fails, weft prongs drop into their grooves, and weft fork slide is held by tippler. This curtails traverse of striker, which comes in contact with inner feeler, presses it back, and brings pick finder into action. In this case, rod F is pushed down, and lever K is elevated as at L. The tail O on key-shaped lever M is then free, and spring T on hook U pulls it down. On its under side, key lever has cut at S on under side, and allows rib W on right to enter and hold it. All ribs W are part of spur wheel D. The bottom jaw of key head is shorter than top one, and enables it to clear rib W in front. The key head only holds this rib if the going part is made to go back from any cause of stoppage during pick finding.

When the pick finder has run its course, the usual thing is to find the open pick on terminating its fourth revolution. It is near this termination that rod F is pulled up, and lever K drops, seizes the tail O, and elevates the key head as at R, Fig. 70.

The special thing is the timing. It is set by set-screws on clamp wheel B. When inner feeler on breast beam is pressed back owing to weft failure, the crank is then at its front centre. The key-shaped lever then drops and the rib W on spur wheel D should then be just behind the forward cut S on M. This brings the motion immediately into action.

Function of Control Plate.—The catch plate is Fig. 70 and 71, is fixed by cross bolts to the control plate at Fig. 72, a small space being left between the two. Both plates move at the same time. As seen, the control plate is a heart-shaped tappet that moves as arrow E. On top is bowl lever G, pivoted on H, carrying bowl L, and has rod J attached at I.

When the key lever is held by a rib on spur wheel D, the movement of the heart-shaped tappet forces bowl L out

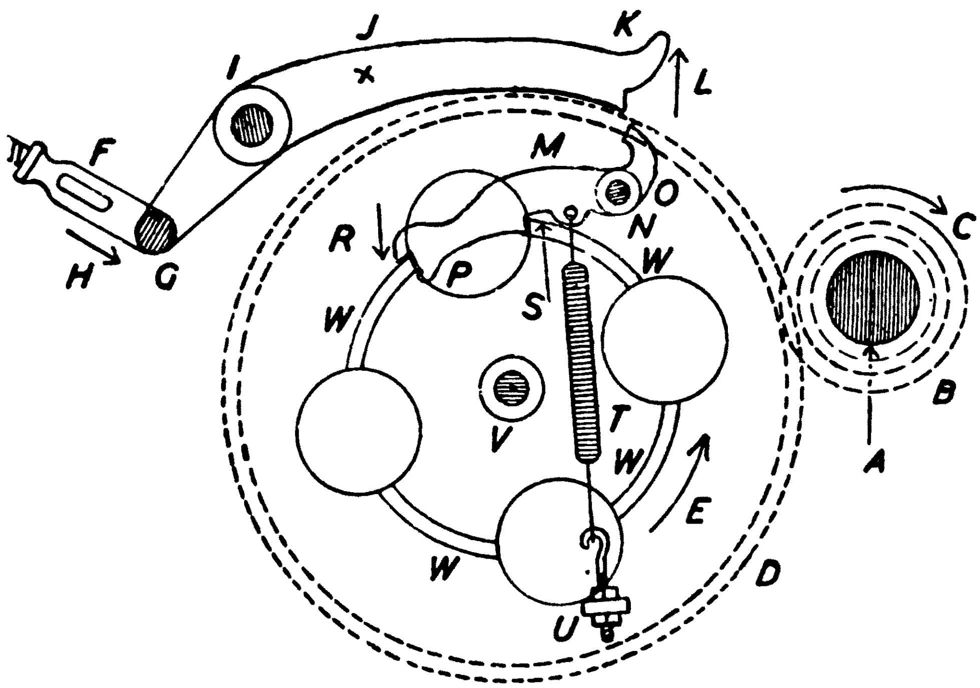


Fig. 71. Catch Plate in Action.

of its cavity at M, and gives the first lift to connecting rod J. This rod is connected to the cross rod at the back base of the dobby.

The first lift of bowl is from M to N, and puts picking out of action, but the lags are moved forward one lag for that turn of the crank.

The second lift follows immediately from N to O, and causes collar on take-up shaft to move from weaving to reversing, and there it remains for two revolutions of the crank and two lags are turned back.

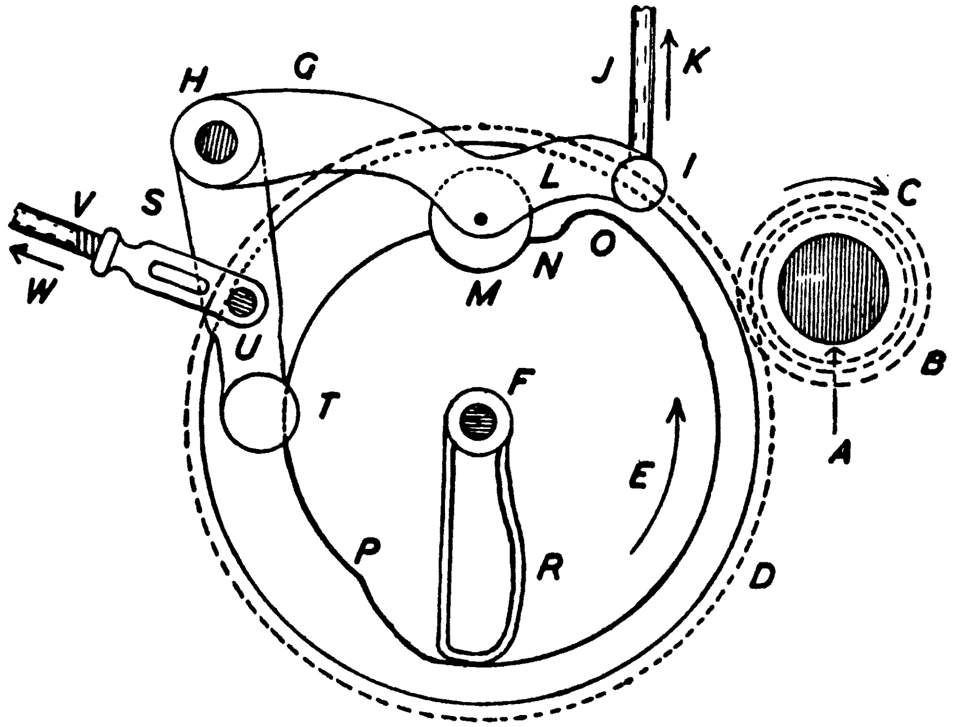


Fig. 72. Control Plate out of Action.

Bowl lever G then makes its first drop to P, and switches collar from reversing to weaving position, and turns one lag forward. Whilst traversing this section, finger R cast to the plate contacts with circular end of **T** on lever S, swinging on pin H, and is forced back. On the lever is pivoted U, carrying rod V and moved as arrow W, and as V is connected to set-on handle, the loom stops. Prior to loom stopping, bowl L slips into cavity M, and pick finder is out of action. The control plate revolves on fulcrum F.

Use of Reversing Handles.

If the pick finder gets out of order, and the overlooker is busy, the weaver finds the pick by using the reversing handles at Fig. 73. A is pivot for both handles, and to reverse, both handles may be pushed over at same time, the short handle B moving to C, and its pin from 1 to 2. This places picking out of action. Long handle D is moved from

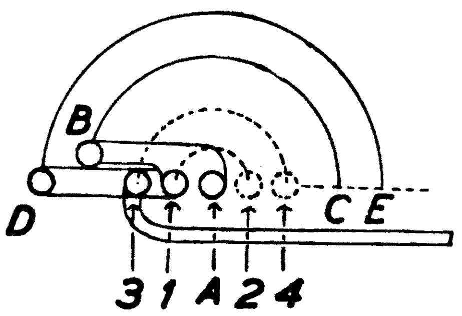


Fig. 73. Reversing Handles.

3 to 4, and shaft and box lags are reversed in action. When open pick found, the long handle is overcentred from E to D, and pin from 4 to 3. This makes the lags move forward when crank turns, and the weaver finds the open pick again, and the short handle is moved from C to B, and its pin from 2 to 1. This places the picking into action.

Effect on Picking Forks.—In Fig. 74 is shown how the picking is put out of action. F is the fork nearest lag end of loom, with G its pivot. Its vertical arm is slotted at H, and carries stud I upon which lever J moves. Rod L moves upward where short reversing handle is used, and passes from B to C, and this conveys K from 1 to 2, and lengthens the distance between picking forks F and P, and both are then out of action.

When the long handle is turned from D to E, the lever J descends from 2 to 3, and the picking remains out of action, but the reversing collar is pushed from weaving position to reversing. At N is the swivel through which the connecting rod passes, and locknuts regulate its working length. Vertical arm P is slotted at O, and the pivot fork is at R.

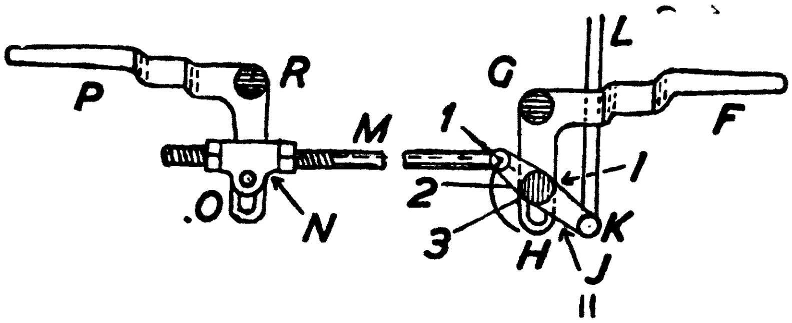


Fig. 74. Reversing Action on Picking Levers.

Reversing Shaft Castings.—These are presented at Fig. 75, and here, rod D is the same as rod J in Fig. 72. When the inner feeler is pushed back by the striker in Fig. 69, rod D in Fig. 75 is forced upward by the bowl lever on the heart-

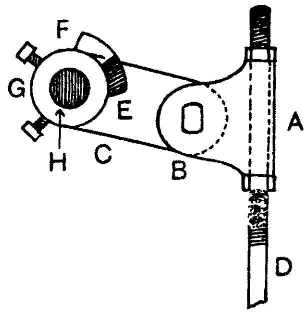


Fig. 75. Reversing Mechanism.

shaped casting in Fig. 72. Rod D passes through swivel A and is locknutted. B is where the swivel is setscrewed to lever C, but is free to move, and C is also free on shaft H.

On lever C is lug E, which is set body up to lug F on collar G. By this means, shaft H is turned by the pick finder motion.

Cross Shaft Castings.—These are depicted at Fig. 76. A is the reversing rod used by the weaver, and is attached to lever B, with position 1 for weaving, 2 for picking out of action, with lags for moving forward, and 3 for reversing lags without picking.

Cross shaft C has five sets of castings, and lever B is the first.

The second set is the one already explained at Fig. 75, and the three positions are the same as for Fig. 76.

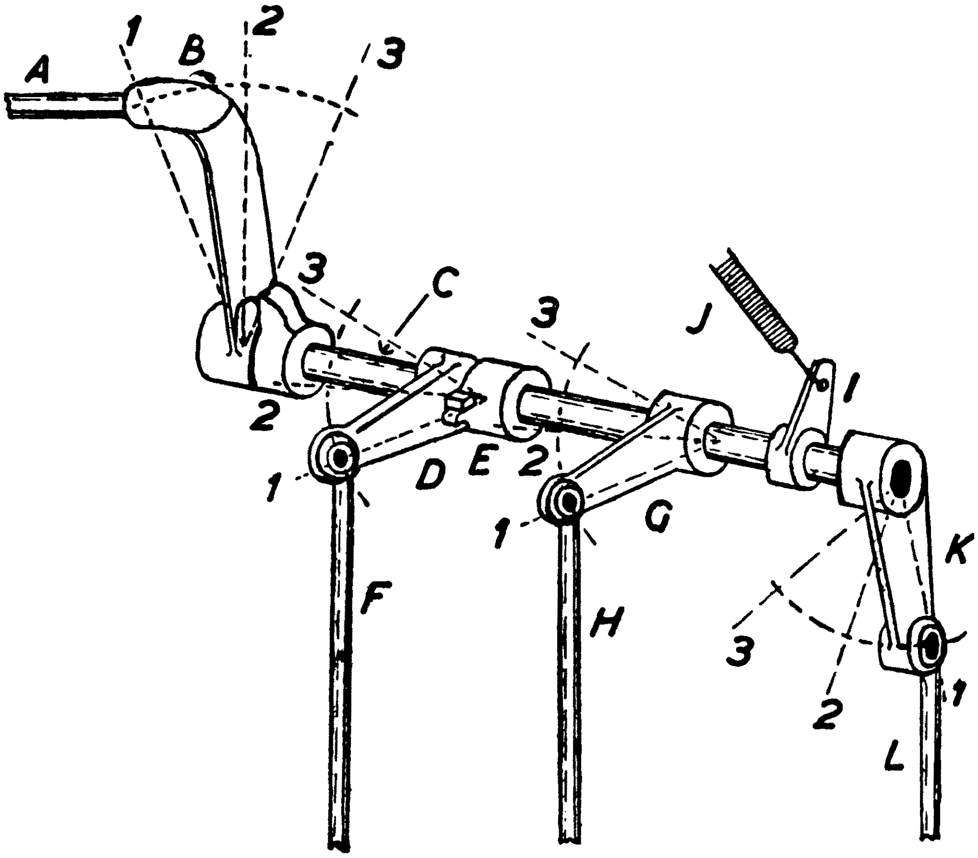


Fig. 76. Cross Shaft Castings.

The third casting is G with rod H that regulates the picking, and gives the same sequence of movements as detailed.

The pick finder is only positive when rods F and H are lifted. The function of lever I and spring J brings shaft and rods back to their weaving positions when the pick finder finishes.

The fifth casting is at K, and its rod L moves the reversing collar on the take-up shaft. The numerical positions act as mentioned.

Effects on Reversing Collar.—When the loom is weaving, collar K in Fig. 77, contacts with bevel wheel H that has lug I fitting body up to lug J on the collar. Rod E, pinned at D, is on arm A, and arm B fits between the flanges on collar K, the lever moving on stud C. The collar slides on saddle key L on take-up shaft F. The bevel wheel is positioned by collar G.

Take-up shaft F turns dolly shaft P as arrow, the dolly being at O, and its pin R rotates cylinder wheel S at its bottom end. The timing of the cylinder is *not* according to the position of the crank, but by the shedding rod when at its dead bottom centre. When at this spot, the pin has to be just clear of the cylinder wheel as shown. The shaft of the cylinder is at T, cylinder at V and direction at W.

Alterations when Reversing.—When rod E is lifted, collar K is moved to its reversing position in Fig. 78. The collar lug J is now in contact with lug I on bevel wheel M, the bevel being positioned by collar N. When shedding rod at bottom centre, dolly pin is just clear on cylinder wheel

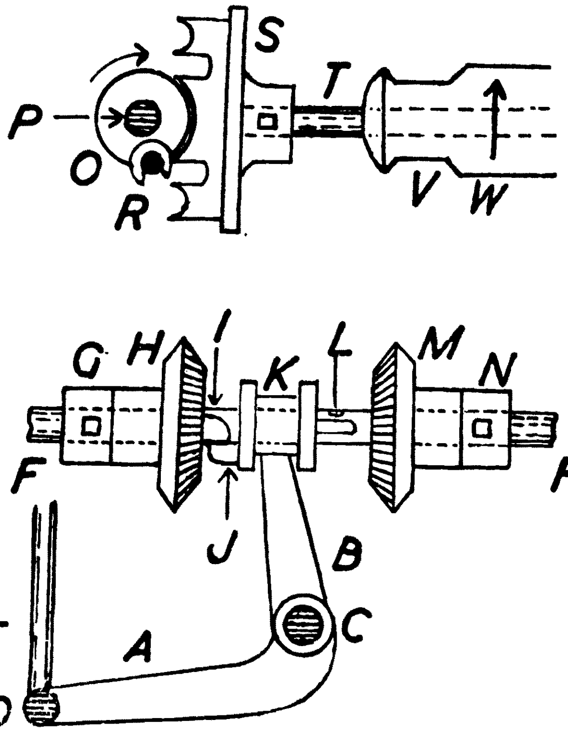


Fig. 77. Reversing Collar in Weaving Position.

S, and cylinder V now turns as arrow W. In case the timing is upset, the quickest way is to set reversing handles for reversing, and turn loom over on pick, and place shedding

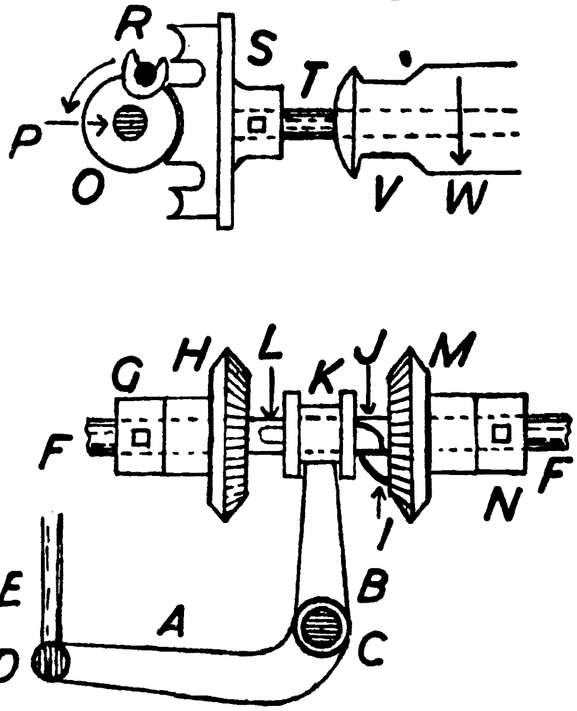


Fig. 78. Reversing Collar in Reversing Position.

rod at bottom centre. Collar N can then be removed and wheel M set in contact with driving lug on bevel M with dolly pin as at R. The reversing handles are then set for weaving, and the dolly can then be turned *by hand*, and if correct, it should be as at R, Fig. 77, but if not, the collar G is undone, and H moved so its lug I contacts with lug J on reversing collar K.

HATTERSLEY'S AUTOMATIC BOBBIN CHANGING LOOM.

This new development has been attached to their Standard Model Loom.

Fig. 79 reveals the front and right hand view. Fig. 80 presents the underpick motion for the right side of a right-hand loom. A is the low shaft, and B, a section of the shellnose for picking. On its inner side it has radiating

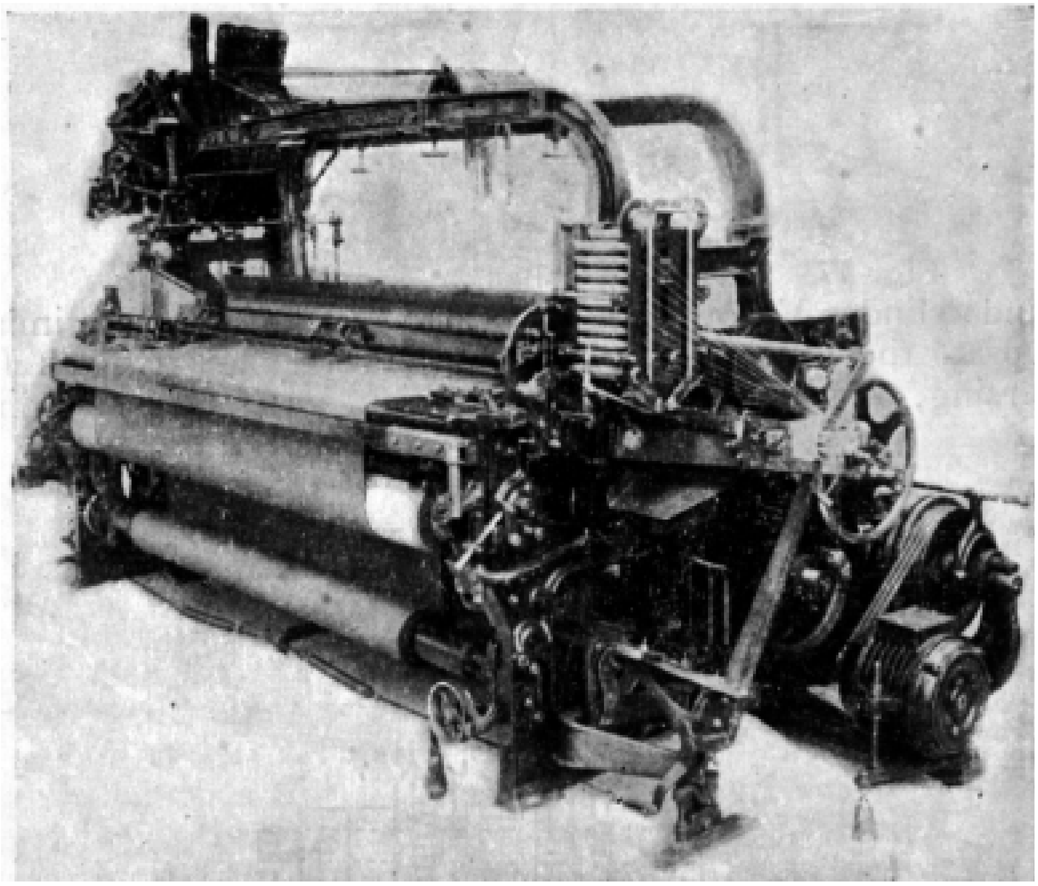


Fig. 79.
Hattersley's Automatic Bobbin Changing Loom.

teeth to mesh with similar teeth on the boss. Nose C forces the bowl D and lever E to move every revolution of the crank.

Picking arm E is inside loom, is fulcrumed and keyed to stout shaft G, the inner end of the shaft turning in bracket F.

The diameter of bowl D is $2\frac{1}{2}$ inches, and its bore $1\frac{1}{8}$ inches, and is case hardened. The bowl stud is part of a pear-shaped casting, setscrewed to head of the picking arm. The arm is on a square shaft, and below its hollow square it is split, bolted, and locknutted, and is firmly held. It is made of malleable iron.

The neb casting H is on the same shaft as the picking arm, and both are brought back after picking by spring J attached at I.

Picking Catch.—This too is malleable iron, and is on the casting secured to the picking shaft N. The catch is moved by a finger pivoted at L, the catch top being at M. The finger is moved from the other end of the loom, is taken out of contact with the picking neb on one pick, and drops of its own weight for picking the next.

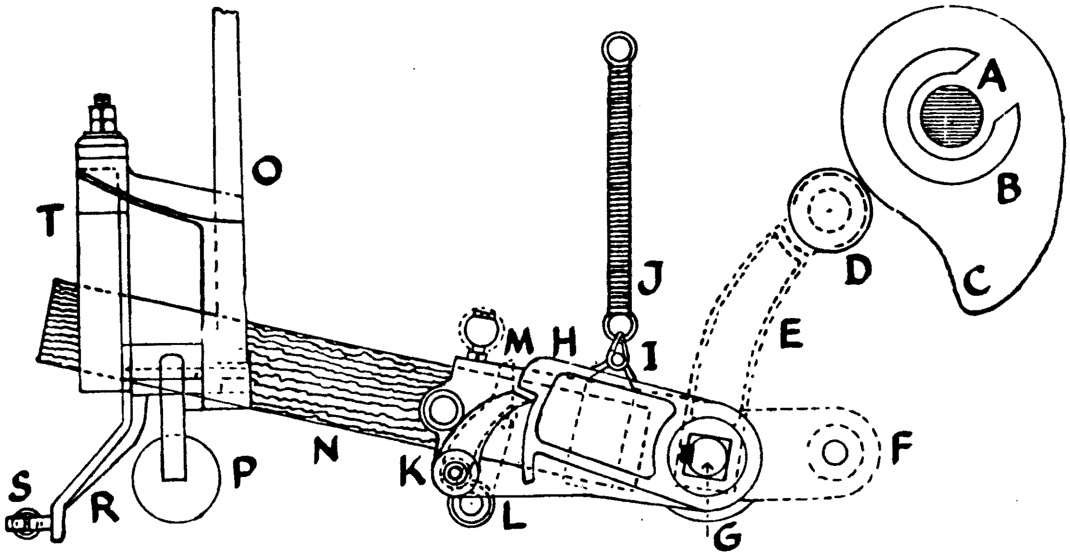


Fig. 80. Left Hand Underpick Motion.

Two special points are:—(1) When catch dropped for picking, there must be a clearance of the neb of a quarter inch. (2) The angle of the cut on neb and picking face of catch has to fit each other for good wearing.

Wooden Picking Shaft.—This is at N, and at the back, is bolted to a malleable sheath. At front, it passes through the guide T. To prevent excess movement, it is pulled up after picking by spring pressure, and the head of a locknutted setscrew is set to prevent it. O is back part of the picking stick, and P the rocking base, and R, the arm attached to the sheath, and S, the strap for spring for stick return.

Picking on Left Hand.—This is lettered like Fig. 80. Here, I influences the catch regulators for the picking. At U is the pivot for lever V that is coupled to the vibrator wheel that operates the boxes. W is the fulcrum for lever T, and X the connecting rod that moves lever on stud L. This lever operates finger M and catch K. Behind fulcrum W is the pin for rod Y, and regulates finger and picking catch at opposite end of loom. When lever T is as in Fig. 80, loom picks from right, but when arm V is raised, it picks from left. If anything goes wrong with the picking, the escape lever comes into play, and places both ends out of action. This is for Fig. 81.

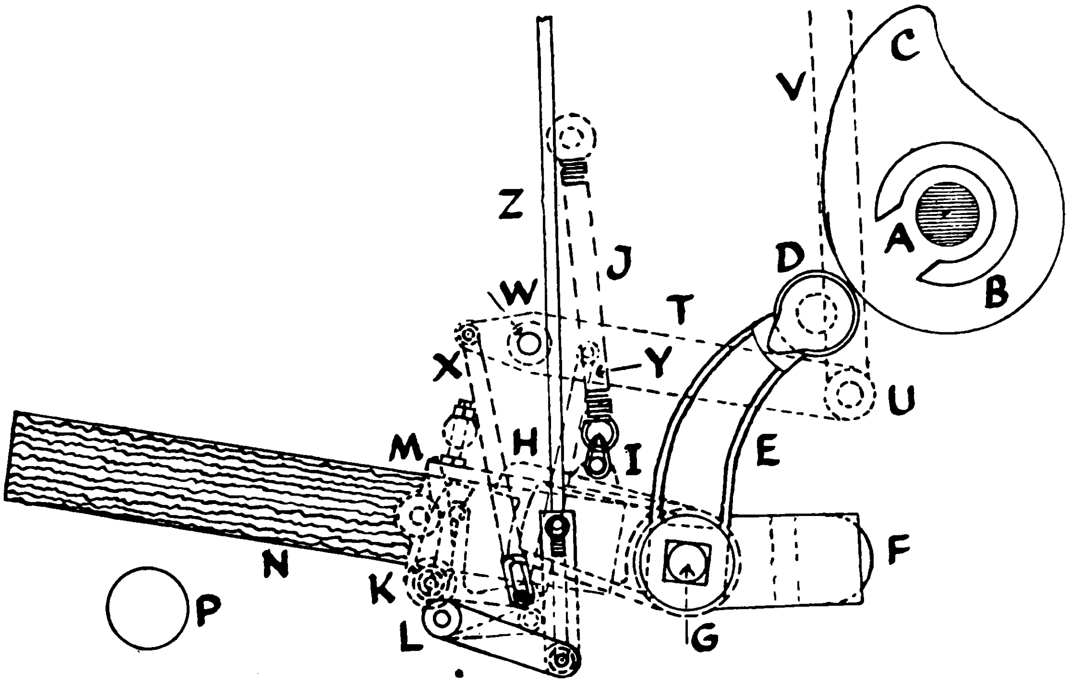


Fig. 81. Right Hand Underpick Motion.

Front View of Picking Parts.—In Fig. 82 A is the bolt connecting B to sword and the fender C. The pivot D is for picking stick. Its malleable sheath is at E, and is continued at F, and bolt G holds picking strap H. Inside the strap is the end of picking shaft I. Arm J finds place for doubled

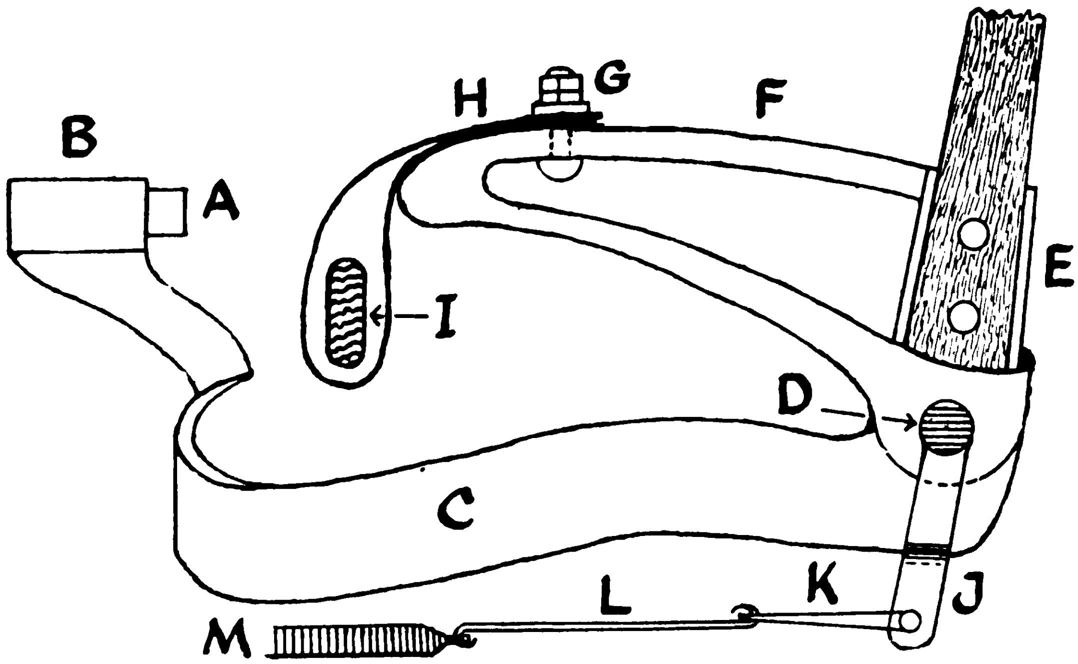


Fig. 82. Front View of Picking Parts.

leather K and spring M to return the stick. The box lags do not control the picking, for it is now done by a small positive tappet, and a link chain on sprocket wheels at the dobby end. Picking stick begins to move shuttle out of box when crank is at its bottom centre. The going part has a forward run of $7\frac{1}{4}$ inches.

Prime Mover for Bobbin Changing.—This is an electric current brought into play by a pimple on a brass flap in the shuttle. As soon as the pimple contacts with a metal bush on the weft bobbin, it raises a vertical rod at the driving end of the loom, and by this simple means, the mechanism for bobbin transfer is brought into action.

The magazine holds four rows of bobbins, each row having eleven. Each of the four boxes at the dobby end has its own row. All the bobbins may be of the same colour, but each row may have its own colour.

The actual transfer takes places in the fraction of a second when the crank is at its front centre.

Three Legged Tappet Lever.—In Fig. 83, A is pivot, and B the bowl that runs in the groove of the positive tappet above crank shaft. The bottom leg C is shaped like a Wellington boot, and D is the heel that assists in bringing

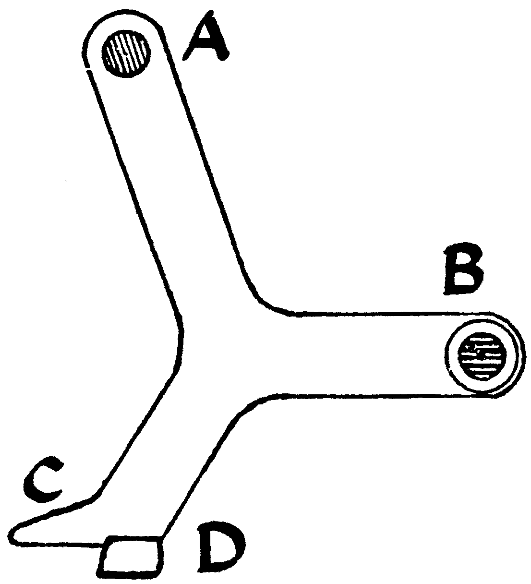


Fig. 83. Three Legged Tappet Lever.

the transfer mechanism into play. The bottom leg is pushed forward when loom is going to pick from driving end, and is brought back when loom is going to pick from opposite end. This double movement is due to the shape of the tappet which is on the inner side of the large wheel having 64 teeth. This meshes with another below on the crankshaft having 32 cogs. The tappet wheel turns clockwise.

The forward movement begins when the crank leaves its back centre. No other part of the changing mechanism moves until the electric current operates.

Affiliated Levers.—These are demonstrated at Fig. 84, A is the vertical rod lifted by the electric current, and by being raised, the aluminium shelf B is also elevated. In the diagram, the shelf is out of action, for boot lever C is in its forward position, and has cleared the shelf. When the shelf is elevated by rod A the heel contacts with the shelf end, and is forced forward. The sloping lever D is pivoted near its centre, and carries a couple of rods at its upper end. E is the rod bearing a spring, and this pushes the lever back. F is the connecting rod between levers D and G, the latter being fulcrumed at H. Lever G has two rods. The spring

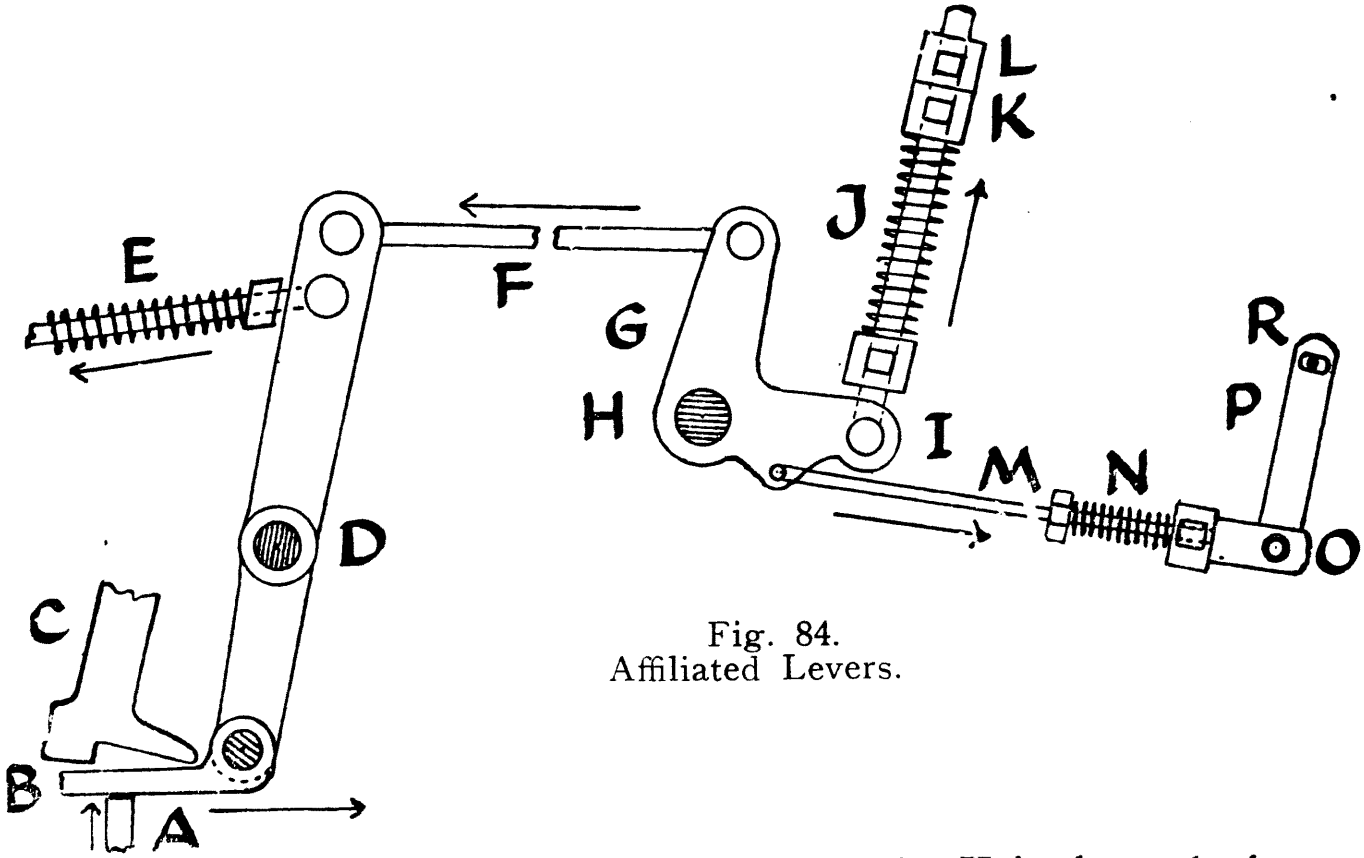


Fig. 84.
Affiliated Levers.

rod is pivoted at I, with J the spring rod. K is the end of the selection bar that lifts the brass slides, and L the small setscrewed collar that prevents any slipping of the under collar. Connecting rod M links levers G and P, and the latter, when pushing to the right as suggested by arrow, releases the curved bar that holds bobbin ready for transfer. The springs impart resilience to the movement. O and R are pivots.

Inner Part of Magazine and Slides.—Here, A, Fig. 85, is the framework of magazine that is a foot wide, and holds four rows of bobbins. Total length of bobbin is 8¾ inches, and the weft occupies 7 inches. The metal bush is 1½ inches long, and the head bears three rings.

At B and C are the bars for support, and D and E are slots for the slide rod that carries the lifting plate that operates the slides. Part F is the innermost slide, for the drawing is a front inner view of the magazine and G is slotted bottom of brass slide and carries the pin at the end of the curved bar that holds a row of bobbins. On this, and all the slides are two lips like H and I, and it is these that are actuated by the lifting plate. The upper lip is for lifting, and the lower one for depression.

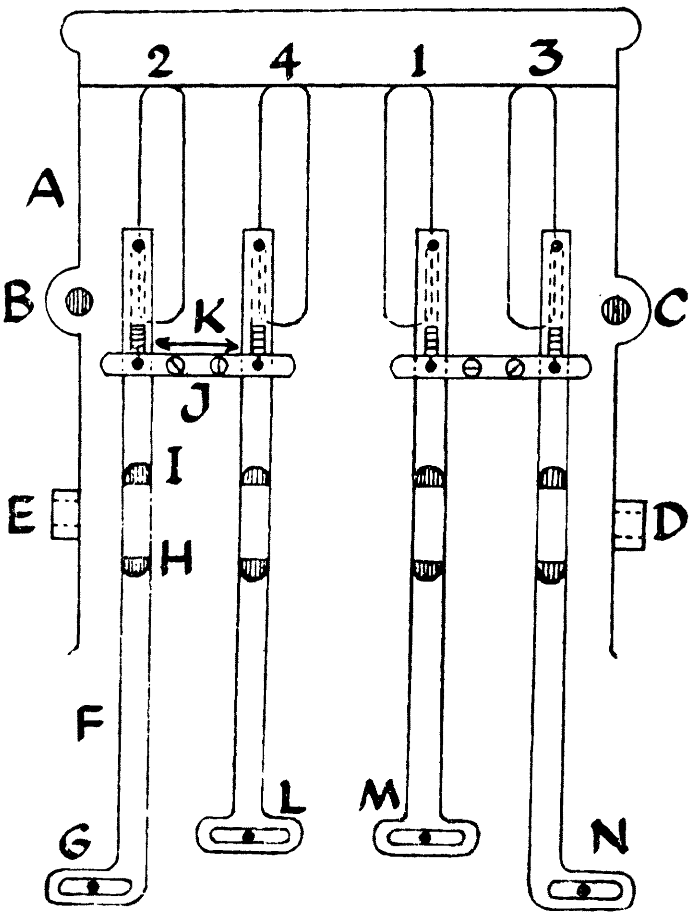


Fig. 85. Slides in Magazine.

The setscrewed plate J holds two slides, and has a couple of knobs to hold the small springs K, and near the top, each slide has a spring that pulls the slide down after elevation. The two inner slides M and L are alike, but slides G and N are longer, and their slotted ends are in opposite direction. All lips on the slides are level when at rest.

When a slide is elevated, the bar holding the bobbins is tilted, and allows the bottom bobbin to descend to the central position in the magazine ready for transfer.

Lever, Slide Rod, and Lifting Plate.—These parts are outlined in Fig. 86. Rod A is governed by position of the drop boxes, and are adjustable to give the exact push to collar D, and lifter plate H. The rod is pivoted on lever B, fulcrumed at C, its upper part resting on the grooved collar D, on the square part of collar D, this being on the square part of rod E. The square part is 6 inches long. F is the same collar as K in Fig. 84. The lifting plate H has four lift-

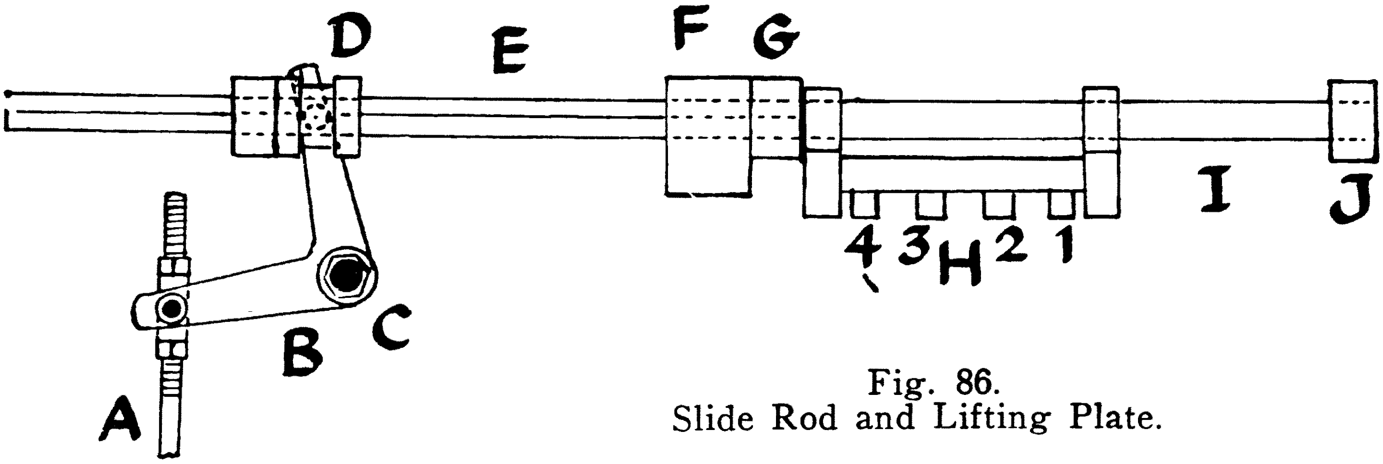


Fig. 86.
Slide Rod and Lifting Plate.

ing fingers. The actual distance from centre to centre are: Fourth to third 1¼ inches; third to second 2¼ inches; second to first 1¼ inches. When operating the slides, the lifting plate moves in an arc, and the push given to it corresponds to the lift of the boxes.

The round part of rod is 7½ inches long, and J is the outer collar through which it slides. The slide rod and plate move so that only one brass slide can be lifted at a time.

Connection to Shuttle Feeler and Weft Cutter.—This is outlined in Fig. 87, and is behind the slide rod in Fig. 86.

It is a peculiar shaped casting as seen at A, pivoted at B, and carrying three rods. The spring rod C brings the casting back after action. At D, rod E is secured, and moves

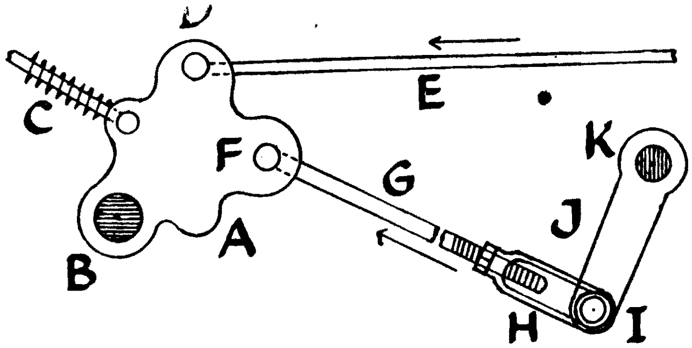


Fig. 87. Shuttle Feeler and Weft Cutter Control.

arrowward. The same rod is at A in Fig 88, and there it is secured to the brass casting B. At F, Fig. 87 is the pin for rod G which carries swivel H, pinned at I, and controls the one-armed lever J fixed to rod K. By turning rod K, lever J moves the shuttle feeler forward to "feel" if the shuttle is fully in the box for bobbin transfer. If not, the feeler is held back, and the loom ceases to run.

Battery Latch and Transfer Hammer.—This important mechanism is at Fig. 88. Here rod A is the same as E in Fig. 87. When rod A is drawn to the right, the brass casting B goes with it, and also the vertical arm of right angled lever E pivoted at F. On its horizontal arm is connecting rod G with its swivel at H, and held by slotted lever I, this being the upper part of the battery latch L. By lifting lever E, the battery latch is elevated at its V-shaped front at K, so as to come in front of the bunter in front of the going part. The forward stance of the battery latch is set by locknutted setscrew M. It has to be set accurately so sufficient pressure is applied to transfer hammer O to push out the spent bobbin in the shuttle and insert a full one.

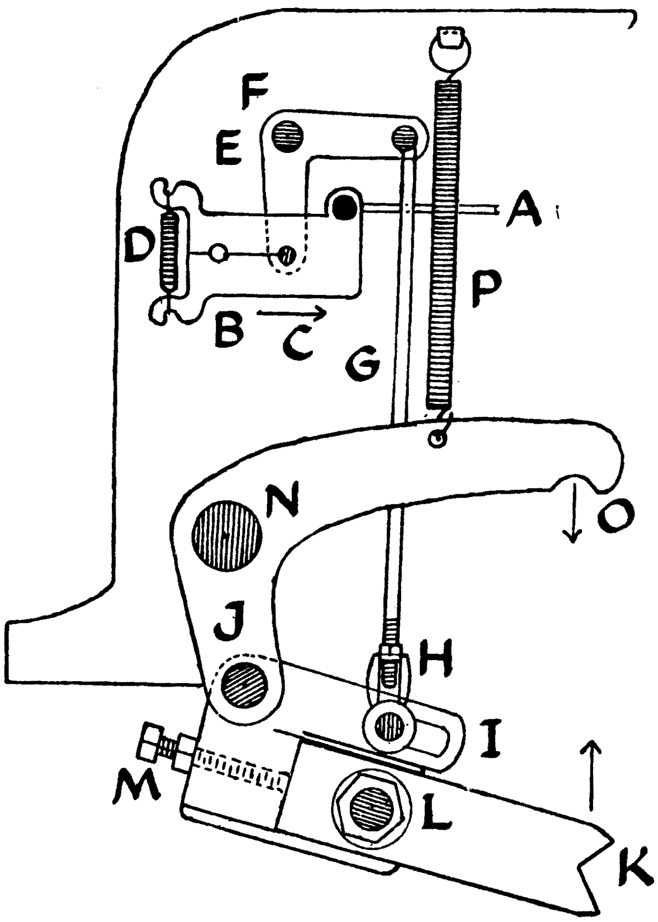


Fig. 88. Battery Latch and Transfer Hammer.

The battery latch swings on stud J, and transfer hammer is strongly bolted at N. The curved part O is very smooth so as to do no injury to the weft. It must be mentioned that the brass casting B is split at the back, and the two parts are held together by spring D.

Shuttle Feeler and Weft Cutter.—Fig. 89 gives an outline of the parts. The casting resembles a ladle. A is a part of the breast beam to which the notched casting B is bolted. The rod C is the same as K in Fig. 87. By twisting the rod, the shuttle feeler is brought forward, and this pulls the point of F out of notch B, pulls down weft cutter G, and throws forward the finger E. These three parts are fulcrumed at H. As the shuttle feeler goes forward, the finger E comes in contact with the head of the locknutted setscrew J on front of going part I, and pushes the finger back. This closes the cutter G that cuts the weft on the right, and holds it on the left.

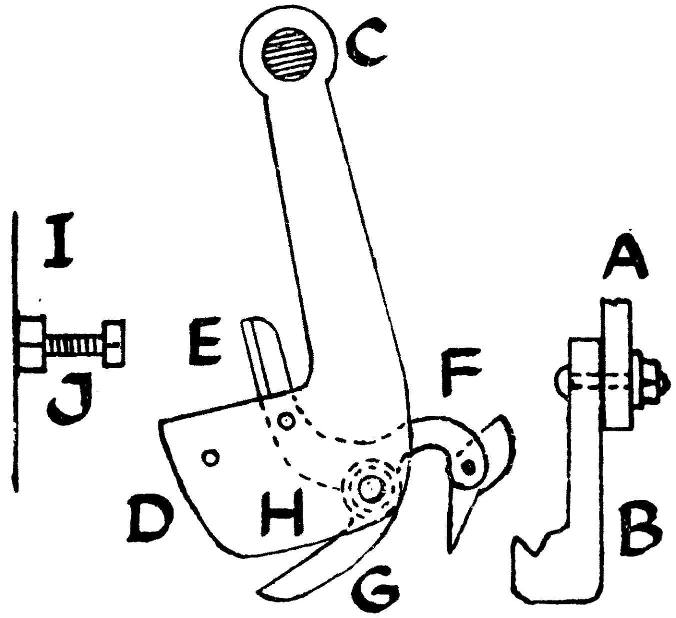


Fig. 89. Shuttle Feeler and Weft Cutter.

Check of Shuttle and Wear of Picker.—The checking of shuttle in plain box has to be so there is no run back, that all three rings on the bobbin head are seized by the jaws of shuttle when transfer takes place. This is secured by a large screw with a gas thread on it that passes through a casting. At its front is a knobbed head that comes in contact with the back of the picker head. The shaft associated with the knobbed head has an open spiral spring upon it, and takes the shock of the incoming shuttle.

As the head of the picker wears, the tip of the shuttle advances further into the box, and if not attended to, would get out of transfer range. The knobbed head can be screwed forward to meet the worn condition.

A groove in front of the threaded casting allows a setscrew to penetrate, and prevents the casting from turning by the vibration of the loom. This idea is far ahead of leather packing on the picker spindle. This loom, with reasonably good work, can weave up to 50,000 picks a day.

THE DOBCROSS WHIP PICK. BOX LOOM.

The Dobcross Hollingworth and Knowles loom is one of the most widely known power looms used in the medium and heavy woollen and worsted industries, and its universality and efficiency are generally recognised. It is used with minor adaptations for goods so diverse as tropical suitings and heavy blankets. It produces costume cloths, suitings, and overcoatings, as well as army and police uniform cloths.

The majority of these looms are belt driven from a main shaft, but owing to the increasing demand for electric driving, it is fitted up for this kind of driving as effectively shown at Fig. 90.

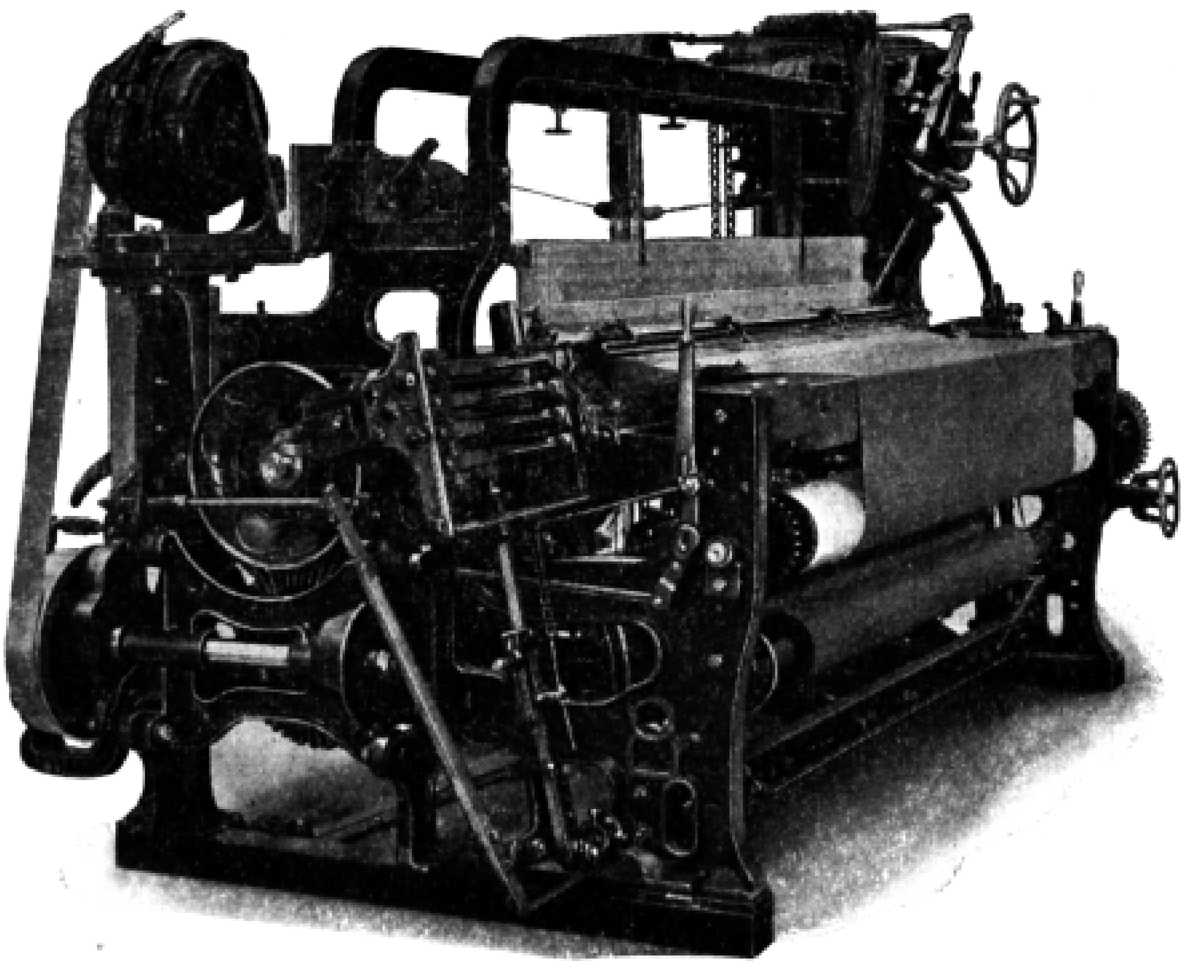


Fig. 90.
Dobcross Drop Box Loom. (Electric Drive).

System of Shedding.

The dobby is made to take 16 shafts for the coarser and heavier work with stronger made parts, or with 24 or 36 shafts for the more elaborate designs, and usually lighter weight fabrics. The usual reed space is 90 inches.

The method of forming the shed was unique when first introduced, and has never been surpassed. This is effectively demonstrated in a very simple manner. If a straight line be drawn, and a semi-circle placed on the baseline, the latter may be divided into six equal parts. A series of straight lines may then be drawn from base to summit. It will now be realised that whilst the base lines are at equal distances, the spaces on the semi-circle are unequal, and interpreted in terms of speed are slow, medium, fast, medium, slow. This is how the shed in the Dobcross loom is formed, for whether the heald shafts be up or down, they ascend and descend as described. The warp threads reach their greatest tension at the slowest speed, and pass at their quickest speed when the tension is most relieved. The details of the dobby may now be given.

Dobby Jack.—At Fig. 91 A is the right-angled jack which is pivoted on the bar C at the base of the dobby. Its

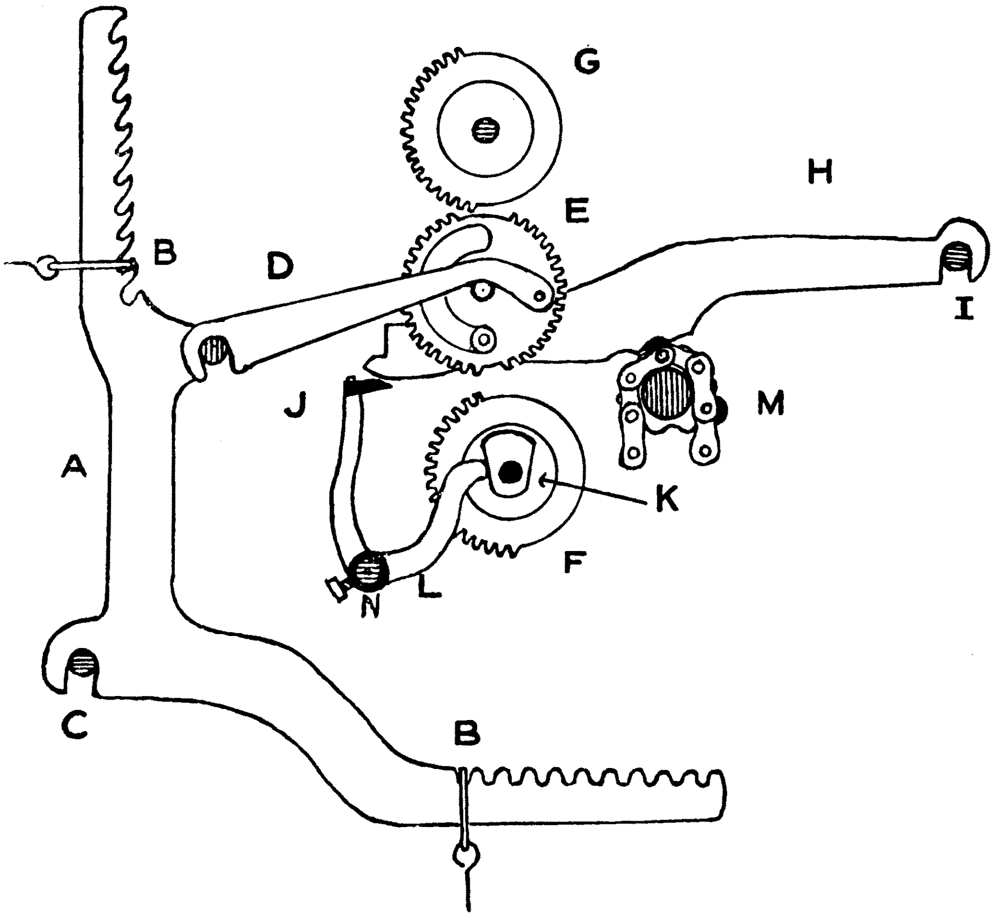


Fig. 91.
Dobcross Dobby.

upper and lower arms are notched for the rapid altering of the size of the shed. On purpose to give the longest service to the healds, the streamer B on the upper arm is placed one notch higher than the bottom arm, so the healds are a little slacker on the bottom shed. For light weight work, only one set of pulleys need be fitted to connect the bottom jack arm with the under-motion jack, but for heavy work, two sets of pulleys are better, as broader leather straps can be used. These pulleys are set half width distance with each other, and open spiral springs on the shafts at the front of the series of pulleys imparts less friction and more flexible movement to the pulleys. The centre arm of the jack has a button at either side for the bifurcated end of the connector D to link it to the vibrator wheel, E.

Connector.—The latest style is made of thin steel plates held together by five rivets, and opened out at either end and slotted. The outer end passes on to a button at either side of the wheel E, and gives a straight pull and push.

Vibrator Wheel.—The centre of the wheel passes on to a case hardened button on the vibrator lever H, the button being a little thicker than the wheel, so that when riveted with a washer, the wheel has rotary freedom. When carrying out repairs at this place, light blows are better than heavy ones. The wheel is furnished with a semi-circular slot, the ends of it coming in contact with a button on the lever which terminates the rotation of the wheel in both directions. The outer rim has two series of teeth, with gaps between the series. The top gap is equal to four teeth, and, when brought opposite the cylinder top or bottom, the cylinder passes without molesting it, and the corresponding heald shaft remains stationary. The bottom gap is only equal to one tooth, but enables the leading on tooth of the cylinder to pass in, and begin pushing the last tooth in the opposite set to those about to be turned by the teeth of the engaging cylinder. Both groups of teeth on the wheel have 17 cogs, but the cylinders which turn them have each 19, so that the last cog on the cylinder follows the last cog on the wheel. The cylinders are made of chilled metal. A connector weight rests upon the upper surface of all the connectors, and assists in pressing them home, and prevents rebound.

Vibrator Lever.—This is at H. It is open slotted at the outer end, and passes on to the bar I, where all the series are kept in position by a cap passing over the top. By means of a long lever which is cast with the cap, and fits snugly at the back inner end of the dobby, the cap can be turned so that any vibrator can be liberated from the engine. In the latest build of lever, the contact with the bowls on the lags M is secured to the lever by a trio of rivets. The three curves on its under side are to first raise the lever steadily, then keep it at its highest altitude, and then lower the lever gently until the lever rests at the bottom of the inner grate through which it passes.

Another special part is the small end that protrudes through the grate. When the lever is lifted by a bowl, the lock-knife J passes underneath, but when lowered, it passes over the top and holds it down until the wheel E has been fully turned by the operating cylinder.

When the small end is worn, it is better dispensed with, for when there is too much play between the top of it and the under side of the lock-knife, the wheel becomes too shallow in mesh with the bottom cylinder, and may injure its teeth.

Lock-knife and Cam.—The lock-knife J is a flat piece of steel, which tapers downward at the front. It is setscrewed to a movable framework at the back base of the dobby, and is fulcrumed at the bottom. On the same shaft is the cranked finger L, which receives its motion from the cam K on the shaft and in front of the bottom cylinder. The cam, by means of the finger, moves the lock-knife in and out. It is moved outward to allow the vibrators to change positions, and moved inward to prevent those at the bottom from rising up when the wheel is being turned. The cam and lag cylinder have to be timed to give the best working results to both. The lag cylinder must not begin to push up the vibrators until the lock-knife is clear of the ends of the levers, and the lock-knife has not to begin to cover the ends of the levers until they have changed positions. If the bowls begin to lift the levers too soon, then the ends of the levers and lock-knife soon become badly worn.

Lag Cylinder and Bracket.—

(1) The cylinder must be at the same elevation back and front to give an identical lift to all the operating vibrators.

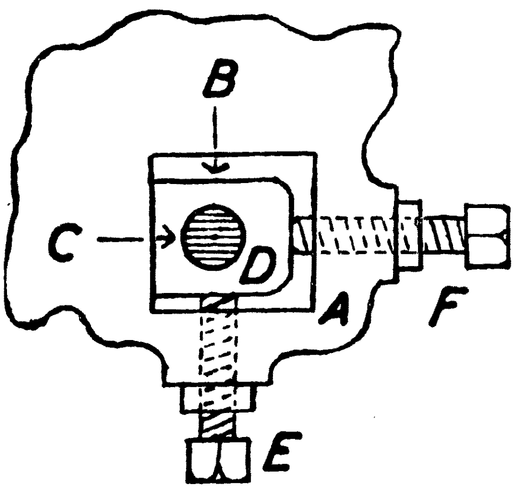


Fig. 92.
Cylinder Bracket.

(2) The altitude has to make the teeth of the vibrator wheels mesh well with the cogs on the top cylinder, but not to bind.

(3) The centre of each bowl has to be opposite the centre of its respective vibrator. When the sides of the bowls and the ends of the bushes become worn, the cylinder can be adjusted so that all wire or band packing can be placed between bushes at the back end of the lags.

For Fig. 92, A is part of dobby frame. B the square for cylinder bracket D. C is shaft of cylinder. E is set-screw for altitude for cylinder, and F for its security.

Escape Motion.—The driver of the lag cylinder is a 16-toothed wheel at the front of the top cylinder. It meshes with an intermediate wheel which may be called the timing wheel for the cylinder, for it gears into the cylinder wheel having 96 cogs. There are therefore 6 revolutions of the driving wheel to one of the cylinder wheel, the cylinder having 6 sections. The escape motion is at Fig. 93. At A

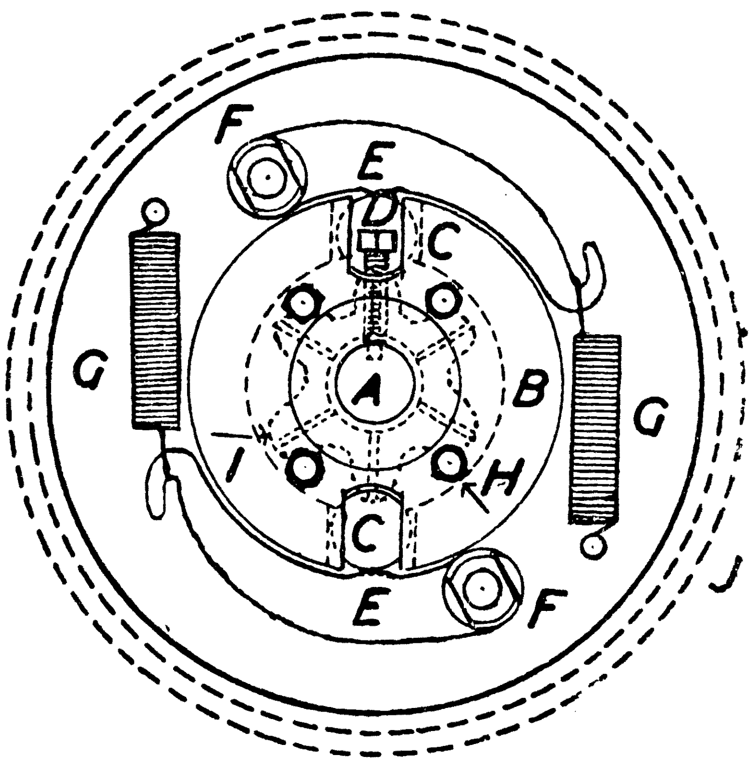


Fig. 93.
Dobcross Loom. Lag Cylinder Escape Motion.

is the shaft of the cylinder, the 6 ends of it being divided to receive the cylinder blades which fit into narrow grooves in the body of the cylinder shaft. Between every two blades, the bowls on the lags fall as the cylinder revolves. At B is the front plate and boss which is secured to the shaft of the cylinder by the setscrew D, and to the face plate behind by four small setscrews shown. Between the two plates are the circular discs C which rest in cavities in the back face plate, and by the levers E fulcrumed at F and the springs G connect the wheel J to the cylinder A. If the cylinder from any cause becomes locked, the discs are forced out of their cavities, and the cylinder remains motionless. When the obstruction has been removed, the discs are easily lodged in their holding places.

Shaft Levelling.—The Dobcross dobby is an open shed mechanism, but at times, all the shafts are required on the top shed. This is done by the aid of the cranked handle A, Fig. 94. This is fulcrumed at C, and fixed to the lifter B, which is triangular. When the handle is pressed down as

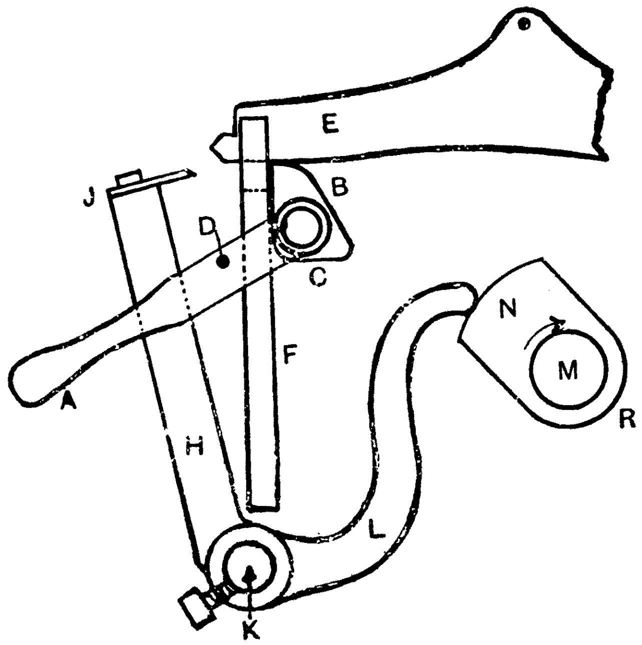


Fig. 94.
Shaft Levelling.

demonstrated, the long side of the triangle B is placed uppermost, and lifts all the vibrators E, so that the top cylinder can engage with all vibrator wheels that need to be turned. One turn of the large hand wheel in front of the bottom cylinder is sufficient to raise all the shafts to the top shed. The hole D in the handle is for one end of the spring which keeps the handle in or out of action. In this diagram is shown the lock-knife J on the framework H, with the cranked finger L setscrewed to the shaft K. The cam that moves finger and lock-knife is setscrewed to the shaft M. Its outer dwell imparted to the lock-knife when the vibrators are changing positions is at N, and the inner dwell when the lock-knife is holding down the ends of the vibrators is at R.

Reversing.—When picks have to be pulled out, they may be combed out, or extracted a pick at a time by using the reversing mechanism. This is demonstrated at Fig. 95. The first thing to be done is to pull down the clutch fork F, for by so doing, the clutch box is disconnected with the dobby. The clutch box is in three sections. The bottom part of C is a bevel wheel which gears into the bevel of the double wheel B, all of them being actuated by the spur wheel A on the crank shaft. At D is the centre section of the clutch box which is both keyed and setscrewed to the upright shaft Y. At E is the cap with its circular groove at

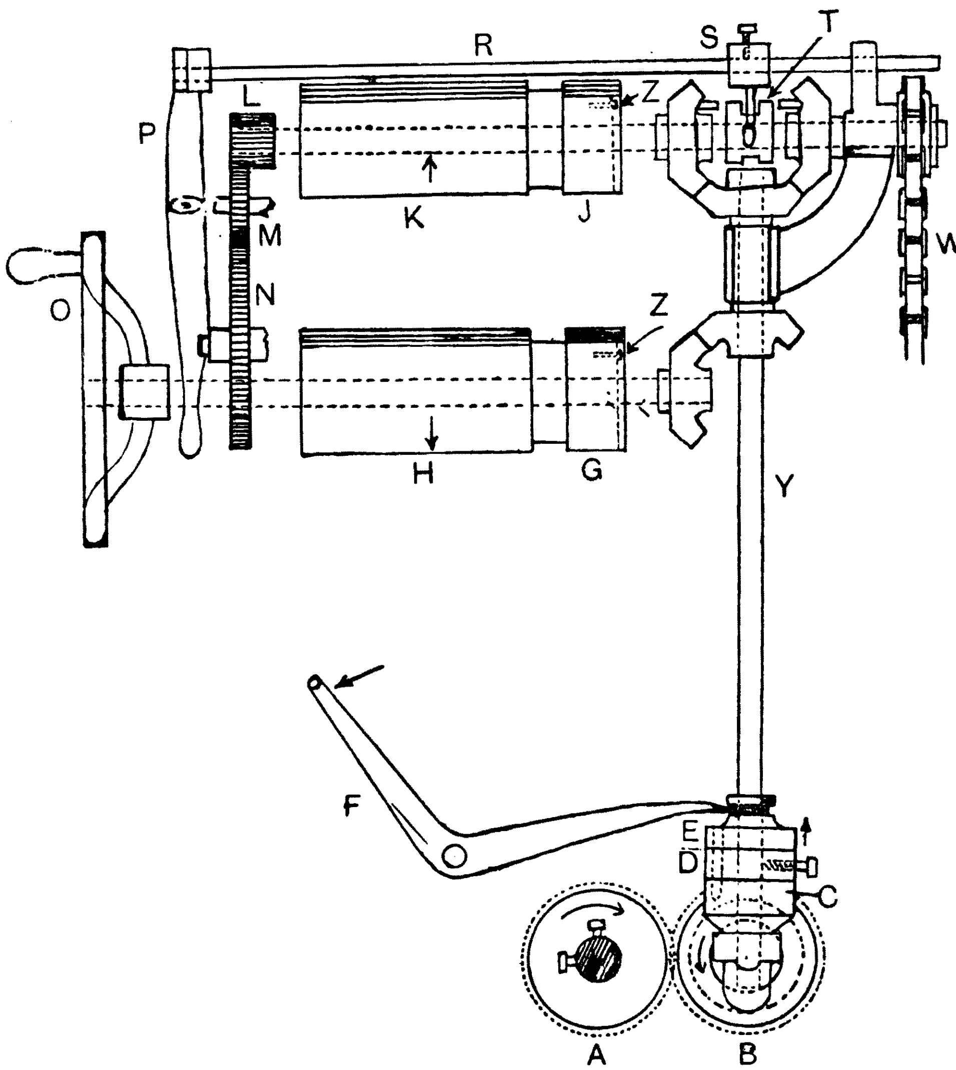


Fig. 95.
Reversing Arrangement.

the top to receive the ends of the clutch fork F. The cap carries a pin which is shown in outline on the left, which, when the cap is down, goes through the centre section, and penetrates the bottom one. When the cap is lifted, the pin is lifted clear of the bottom section C, and the dobby is then uncoupled from the crank.

The next thing is for the weaver to pull the long handle P towards her, for, as this is fulcrumed just above its centre, it moves the rod R to the right, and as the clutch casting

S goes with it, the clutch T is moved from contact with the bevel wheel on the left to the one on the right. The hand wheel O is then turned in the same direction as when weaving, and the shaft lags are reversed in motion.

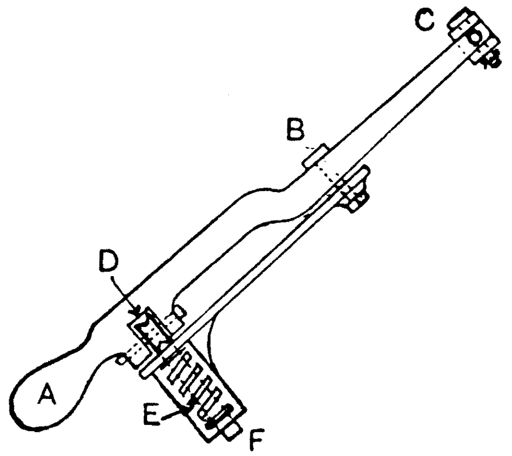


Fig. 96.
Reversing Handle.

The reversing handle is better seen at Fig. 96. Here, A is the lower end of it with the fulcrum at B, and the top rod connection at C. The handle bowl is in the recess at D, which depresses the spring pin F when pulled in either direction by the weaver. At E is the coiled spring that exerts pressure against the head of the pin, the top of which is inverted **V** shape to rest in the centre of the bowl.

Whip Pick.

The picking of this loom is the underpick motion.

Picking Boss.—This part is keyed to the low shaft by a key in a sunk keyway. The key must not go beyond the face side of the boss, or the constant push of the picking tappet may drive it out. The fixing of the boss has to be, that the picking bowl fully fits on the rim of the picking shoe. The boss has only one open slot to accommodate the single leg of the picking tappet, this leg being a strong and solid one 2 inches wide and 1⅜th inches deep. The picking side of the leg should fit full face to the picking side of the boss, so the whole side of the leg takes the full weight of the pick, as at J. Arrow I is direction of picking tappet.

Picking Tappet.—In Fig. 97 the head of the picking tappet D is slotted to receive the stud of the picking bowl F. Both bowl and stud are case hardened to withstand wearing. At G is the locknutted setscrew which sets the position of the bowl stud which is braced up by a couple of locknuts. At E is the bottom shaft on which the picking tappet slides, and H is the substantial leg referred to.

Picking Shaft and Shoe.—The picking shaft is at A, and in one make, is $1\frac{1}{4}$ inches square, except at both ends where it is round to penetrate the bearer brackets back and front, the back one being at C. By wearing, this part of the shaft lets the shoe sink lower, and as the depression of the shoe is decreased, the power of the pick is weakened. To make up the loss, the shaft is taken out, the picking shoe and arm taken off, and the shaft placed so the worn part is at the top. The arm and shoe are then placed and fixed in their respective positions.

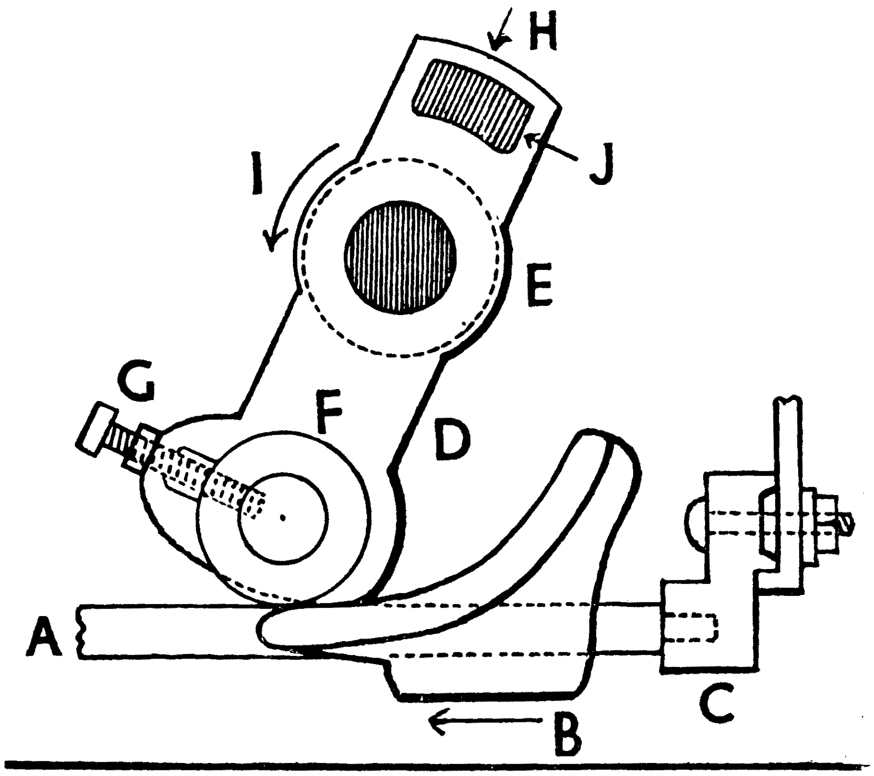


Fig. 97.
Dobcross Picking Tappet and Shoe

When the shoe becomes worn, the vigour of the pick is weakened but it may be partly or wholly restored by fixing it a quarter inch forward in the direction of the arrow B. As the shoe continues to wear, the process may be repeated until it has been moved forward an inch. It is then in its final stage of service. The further forward the shoe is placed, and the more violent is the pick. As to whether it is safe to continue may be judged by placing the hand on the guard of the speed change wheel. If the bump be too violent, it is better to replace the shoe rather than break cogs out of the driving wheels.

Picking Arm.—The arm is in two parts. The back one is doubly setscrewed to the picking shaft, and is toothed at the front so as to mesh with similar teeth on its companion casting. Both brackets are slotted for adjustment—the back one horizontally, and the other vertically, and both are bolted together. The upper front of the front bracket is open slotted for the reception of the picking stick bottom which is doubly bolted to it. The top of the stick at the back comes in contact with a leather pad on the framework at J, Fig. 98. The connection between stick and picker is by picking strap W, the picker being at K. The strap is first secured to the picker and then wrapped round the stick at H, its place being maintained by a couple of wire pegs. The working length of the strap has to begin to pull the shuttle

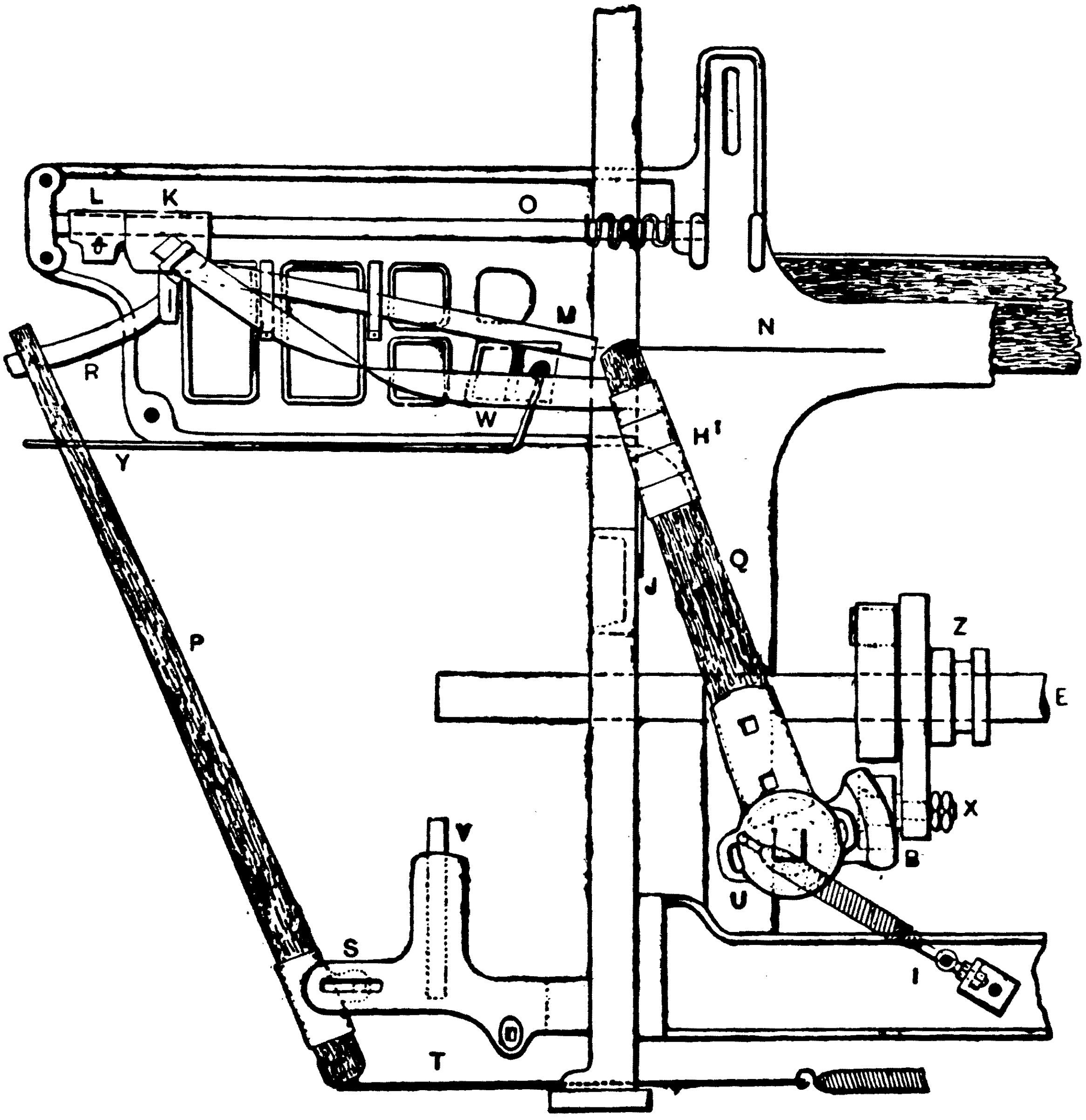


Fig. 98.
Dobcross Picking Stick and Checking. (Back View).

out of the box, when the crank has just passed its top centre. The minimum standard for strap W is 50 inches long and 1¼ inches wide. The picking stick after picking, is brought back by the pull of the spring I, and the picker is brought back by being connected to the pulling back stick P which is fulcrumed at S, and kept in position by the wire guide Y, and attached to the leather and spring at T.

The forward movement of the picking stick is limited by the picker on the spindle O coming in contact with the buffer on the spindle. The forward movement of the pulling back stick is terminated by coming in contact with a rubber behind the box.

On the spindle and behind the picker is the buffalo checker L, which is connected to the strap M and the checking wire N. These parts are controlled by the checking motion in the centre of the loom front.

Beating up.—The crank arms are capable of fine adjustment at both ends. The metal straps are served by **T**-shaped castings. The top of the **T** is placed vertically in a hollow part of the arm, and the fixing bolt passes through. The shaft of the **T** is horizontal and threaded, and into it passes a gas threaded screw bolt through a bore in the crank arm. This screw bolt is screwed moderately tight to draw the metal strap and holding bolt forward, and the latter is then braced up. The sley is held at the top by a hand rail, but at the bottom is a movable rack which is drawn forward by screw bolts in front of the going part. These bolts are best braced up a bit at a time to give uniformity of pressure.

The beating up of the weft is aided by the warp passing over a swing rail at the back of the loom, which is drawn inward at the beat up of the weft, and swings back again as soon as the reed recedes from the fell of the cloth. This system adds flexible weight and drag to the beat up, and makes it an excellent wefting loom for heavy weight fabrics.

Letting-off.—The unwinding of the warp is effected by a rod connected to the back of the sword, the opposite end of the rod being coupled to the double quadrant A, Fig. 99.

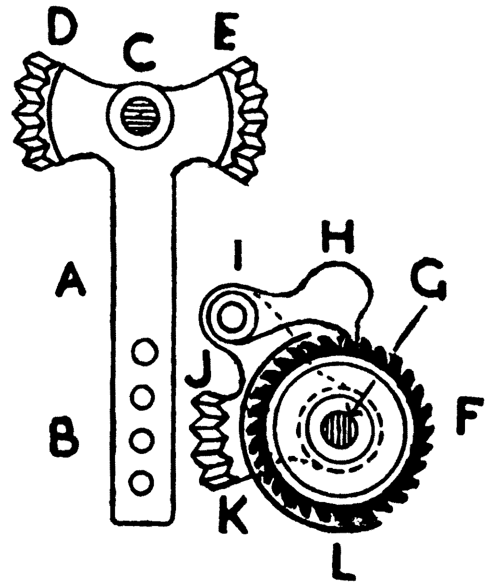


Fig. 99.
Letting-off Quadrant.

It is fulcrumed at the top centre C and has 5 teeth D and E at the end of either arm which engage with those on the quadrant which carries the letting-off catch H. There are a pair of these quadrants and catches. Though the double quadrant and its catches are made to move the same distance every revolution of the crank, the amount of warp let off varies, because the shield L restricts the operation of the letting-off catches. The shield is connected by a rod to a lever which is influenced by the swing of the back rail. When the rail moves in by the beat up of the weft, the shield sinks a little, and exposes more teeth to the catches, and when the rail moves outward again the shield advances. The standing position of the shield is controlled by lock-nuts on the threaded connection rod. F is let-off wheel and G shaft.

Taking-up Motion.—This is a positive motion, and run by a driving chain on a sprocket wheel at the back of the top

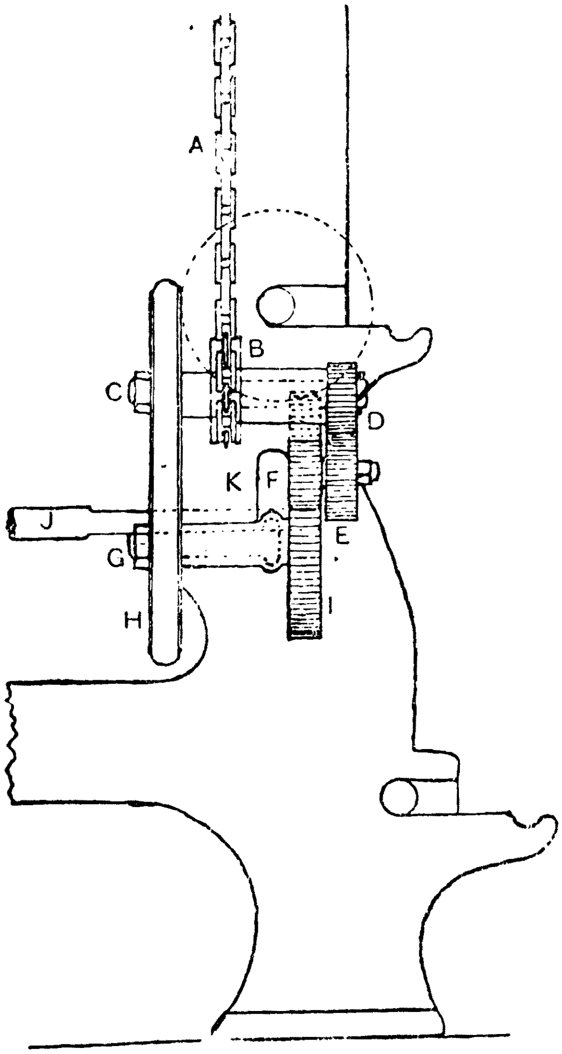


Fig. 100.
Dobcross Positive Taking-up Motion. (Back Part).

cylinder. The chain A, Fig. 100, passes round the sprocket wheel B on the stud C. This wheel is fixed to a sleeve at one end, and the pinion wheel D at the other. When the chain wears, it can be lowered by the stud C. The chain wears best when only moderately tight, and should be kept well oiled. The change wheel is at E, the gauge point being a tooth per pick. Behind it is the pinion wheel F that meshes with the wheel I on the stud G. The spur wheel K is keyed to the taking-up shaft J which extends the full width of the loom. The casting H has a curved slot so studs C and G may be set with exactitude. The taking-up section at the front of the loom is at Fig. 101. Here, J is the same taking-up

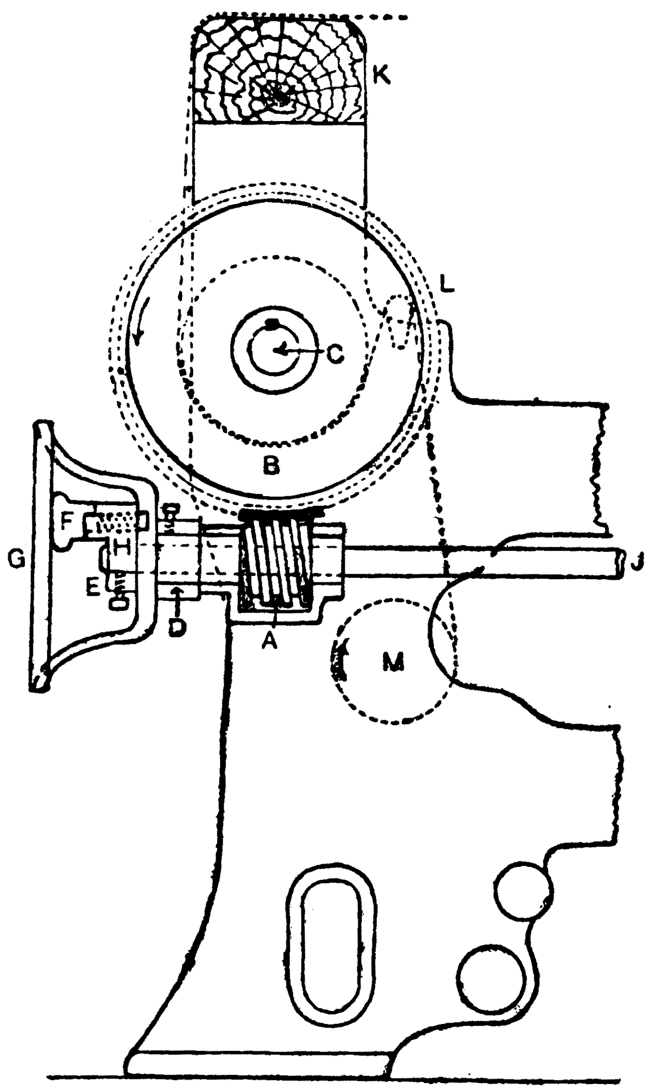


Fig. 101.

Dobcross Taking-up Positive Worm Motion. (Front Part).

shaft as in the previous illustration. On the shaft is the worm A into which gears the teeth of the large taking-up wheel B on the taking-up roller shaft C. The taking-up roller is given in outline.

Setscrewed to the sleeve of the worm is the handwheel G. To fix the handwheel to the taking-up shaft J, a small bracket E is setscrewed to the shaft, and carries the knob F.

The knob has a short spring on its shaft at H, and when weaving, the shaft of the knob penetrates one of a series of holes in the face plate of the handwheel as presented in the drawing. When the piece requires to be slackened, or the warp drawn forward, the knob shaft is pulled out of contact with the hand wheel, and the taking-up shaft remains stationary, but the perforated roller may be turned in either direction. The path of the cloth is shown in dotted lines. It passes over the breast beam K, round the bottom of the perforated roller, over the smoother L, and finally on to the cloth beam M. Fig. 102 gives the details for the winding on of

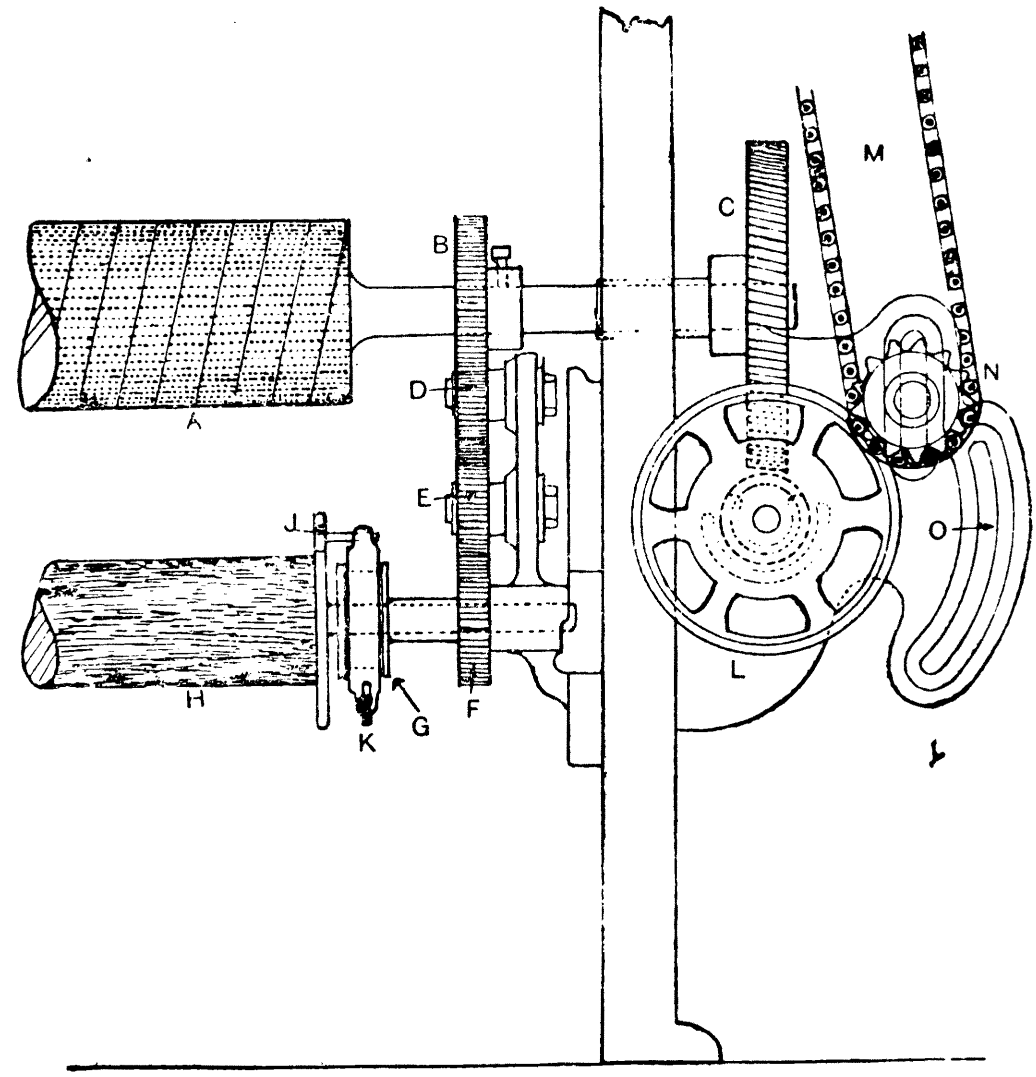


Fig. 102.
Dobcross Take-up with Cloth Roller. (Front View).

the cloth. At A is the perforated roller with the driving wheel B on its shaft, and C on the outside of the framework the taking-up wheel. At D and E are two intermediate wheels with 15 teeth each, but the bottom wheel F of the series has only 14 cogs. This wheel is sleeved, and carries the friction pulley G which is bored to receive the pin at the end of the handwheel J on the cloth beam H. On the pulley is the friction clip with its spring and wing screw K. By regulating the screw, the cloth may be wound on tighter or slacker, but is made keener as the cloth increases in weight and diameter. At L is the hand wheel, M the taking-up chain, N the sprocket wheel, and O the slotted casting.

Box Motion.—The drop boxes are made of mild steel, and are presented at Fig. 103. Each shelf is riveted at C to the framework of the box A and B as well as at the back. The malleable swells are at D, the series being held at the outer end by the long pin E. Each swell is provided with a curved spring G, by which the speed of the shuttle is

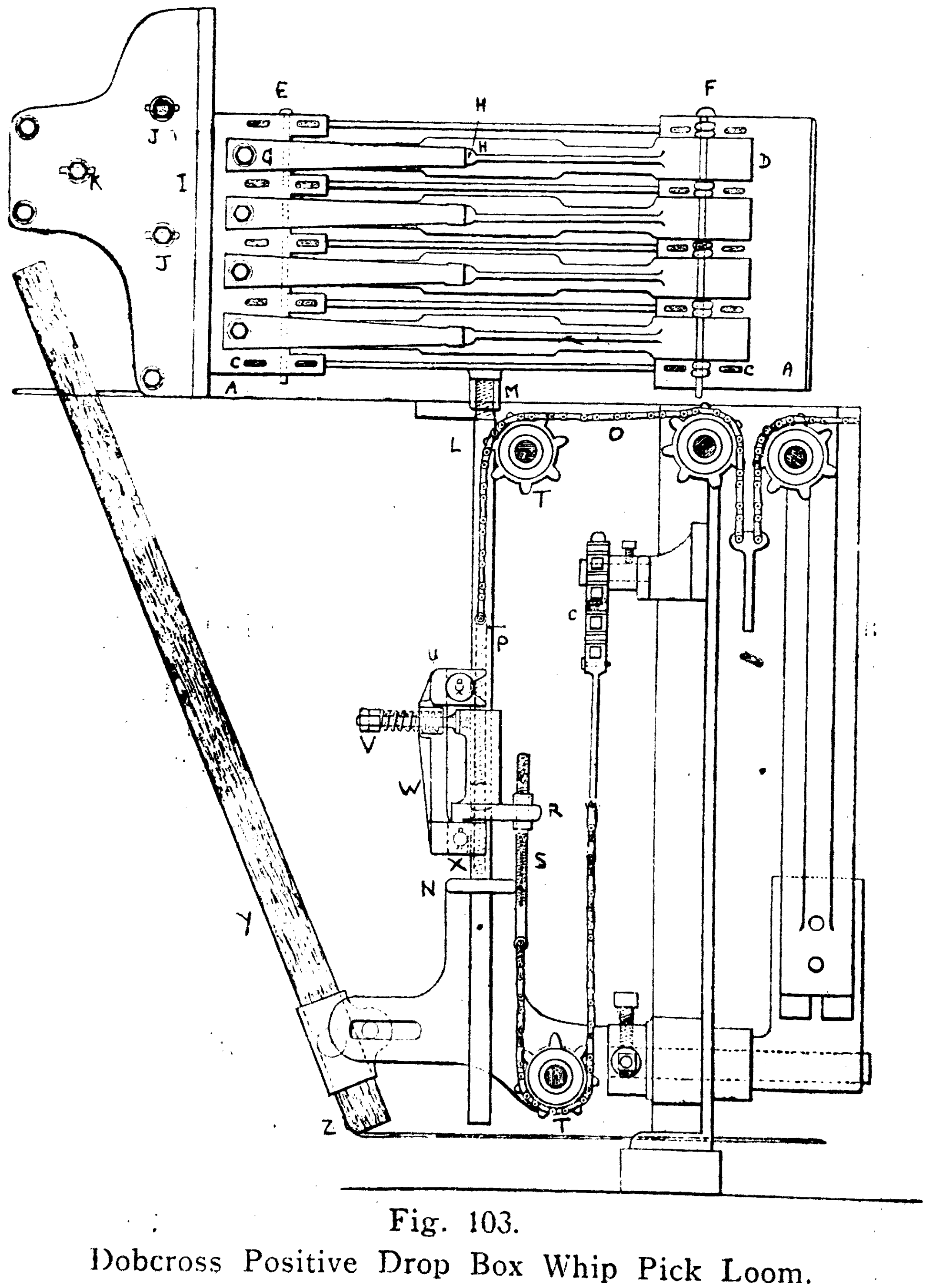


Fig. 103.
Dobcross Positive Drop Box Whip Pick Loom.

checked in the box, and flexibly held in its picking position. Spring and swell meet at H, and the swells are also served by the stay pin F.

The box moves vertically in slides, the inner one being setscrewed to the front of the sword, and the outer one being at I, and setscrewed to the frame work of the box.

The box should only have the least lateral freedom, but easily slide vertically. To the two bolts J, the bowls are fixed that keep the tips of the shuttles away from the face of the picker, and at K is the bolt that holds the casting containing the rubber that fits behind the picker. At L is the box rod, which, at the top, enters the threaded nipple M underneath the box. Below this point the box rod is square, and passes through the guide N on the upper part of the pulling back stick bracket.

As shown in Fig. 103, the chain O is fixed for the bobbin changing mechanism. For ordinary box work, the chain passes straight forward.

Escape Motion.—On the rod is the escape motion W to which is locknutted the lifting chain O, with the threaded rod P at the end, and the pulling down chain S, which passes through the holder bracket R. Whenever the lifting chain requires adjustment, the pulling down rod must be altered at the same time. The open link chains pass over sprocket wheels T, and in this way the chains are little worn.

The escape motion is fulcrumed at X, and the spring casting W carries the small bowl U at the top which fits into a groove on the shaft of the box. A pin passes through the opening in the spring casting W, and on it is the spring V which keeps the bowl in contact with the box rod. When the box is locked by a trapped shuttle, the bowl is forced out of its groove, and the box remains stationary. At Y is the pulling back stick, and Z the lower part of the stick with strap attachment.

Box Control.—The four boxes at either side of the loom are controlled by four levers behind the dobby. These are brought into service by bowls on the box lags which actuate vibrators and wheels in the same way as for shaft lifting. The cylinders G and J, Fig. 95, that turn the vibrator wheels are adjustable by setscrews Z. Their teeth may be set level with the cylinders controlling the heald shafts, but they may be set 4 or 7 cogs behind. The shed has to be set to suit the kind of work to be woven, but when so altered, the box cylinders must be adjusted to give the same timing as before the alteration took place. Whatever be the timing of the shed, the boxes must begin to change when the crank is at its bottom centre, and come to rest by the time the crank has reached its top centre. From that there can be very little variation.

The plan for box lag making is that the picking is on the first inside position, followed by the second and third boxes on the right side of a left hand loom, and the fourth and fifth positions are for the third and second boxes on the left side of the loom. Two bowls in the second and third position lift the fourth box on the right, and two bowls in the fourth and fifth position lift the fourth box on the left side. A bowl makes the loom pick from the left hand box, and a blank makes it pick from the right hand. The box connectors are made with a slot and pin for the divided end of a small arm to pass in. The upper part of the arm has spring pressure applied to it to force the connector home and prevent rebound. Each connector is fitted with a slotted slide so that the leverage to the boxes may be suitable adjusted.

Pick Jack and Slides.—Being a pick and pick loom, the picking slides or tappets are influenced by a pick jack and its spring rod. The upper part of the pick jack takes the end of the dobby connector, and its lower arm has on it the spring rod that passes through the end of the lever attached to the picking tappet. Strong and open spiral springs are placed on the rod above and below the arm on the picking tappet, the springs being confined by setscrewed collars. When in action, the picking slide has to fit body up to the boss, but when out of action the picking bowl must be quite clear of the shoe.

Making Box Lags.—Though the arrangement for using the boxes is a positive motion, it is better for safety, and for easy working, to lift or depress one box at a time rather than two, or two instead of three.

Three examples are presented.

Fig. 104 illustrates the best way of mixing weft, using three shuttles in two boxes at either end of the loom, and taking a pick from each shuttle in rotation. All three examples are for a right hand loom, and each one commences at the top, and the picking is on the right.

A bowl is for picking from the left, and a blank from the right.

Fig. 105 is an arrangement for an overcheck with 4 colours as follows:—

Brown	2	2	2	2	
Black	2	2	2	2	= 20 picks.
White	1	1	—	—	
Rust	—	—	1	1	

The white is placed in the first box, black 2, brown 3, rust 4 in left hand boxes.

The black and brown run into the first box on the right where the weaver stands, and the white and rust run into the second box on the right.

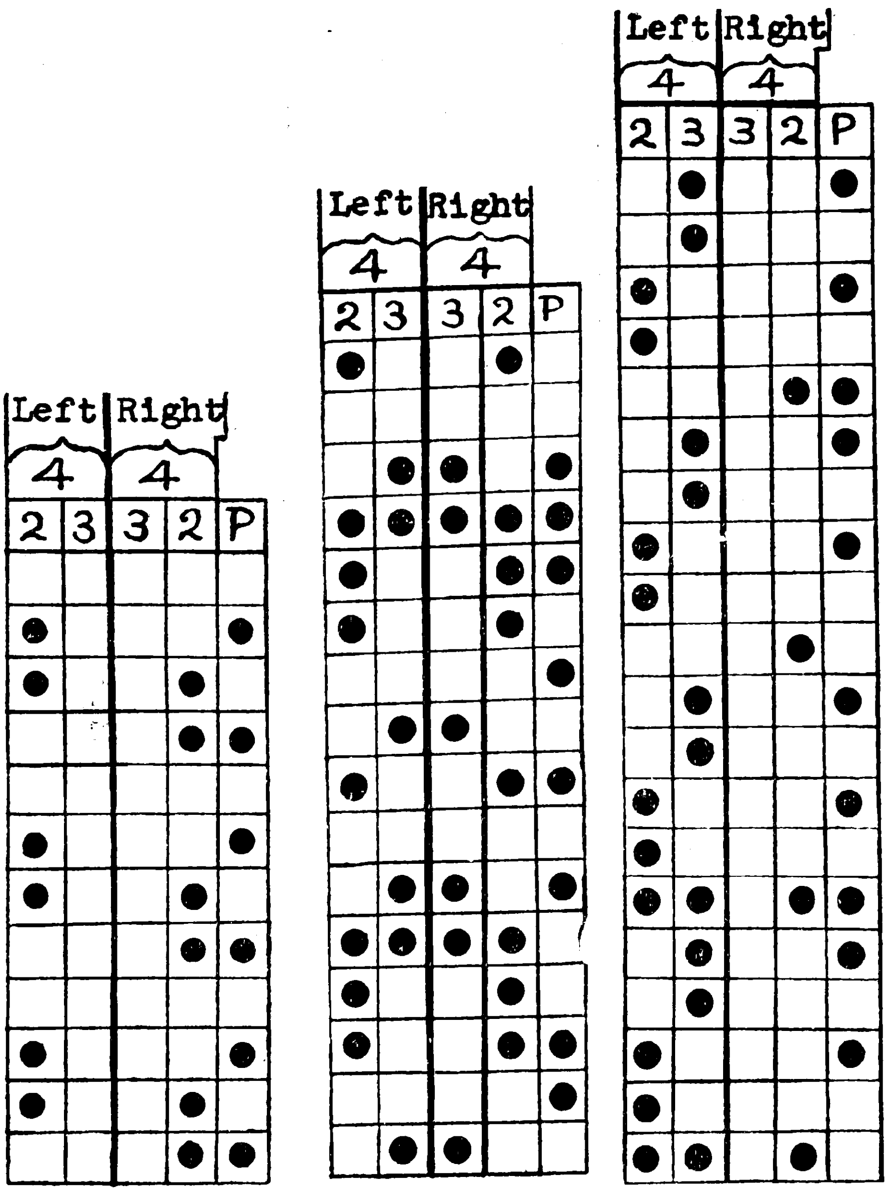


Fig. 104. Fig. 106. Fig. 105. Box Plans.

Fig. 106 is one of quick changes.

White	1	2	
Brown	1	1	= 8 picks.
Blue	1	1	
Red	1	—	

As the white and red have odd picks, the box chain has 16 lags. The white is placed in box 2, brown 1, blue 3, red 4. Double rises and drops are inevitable, but each colour of weft is kept to the same numerical box.

Driving the Loom.—Fig. 107 shows the loom being driven by an individual electric motor though many are belt driven from line shaft. The setting on handle at either end of the loom is moved towards the weaver, and pushes forward the hollow pulley with its driving belt on to a tapering leather covered pulley. This system gives a quick start and a quick stop.

The brake is on the outside and bottom of the friction pulley, and is moved away from it when the loom is set in motion. At Fig. 91 the back view and belt drive is given.

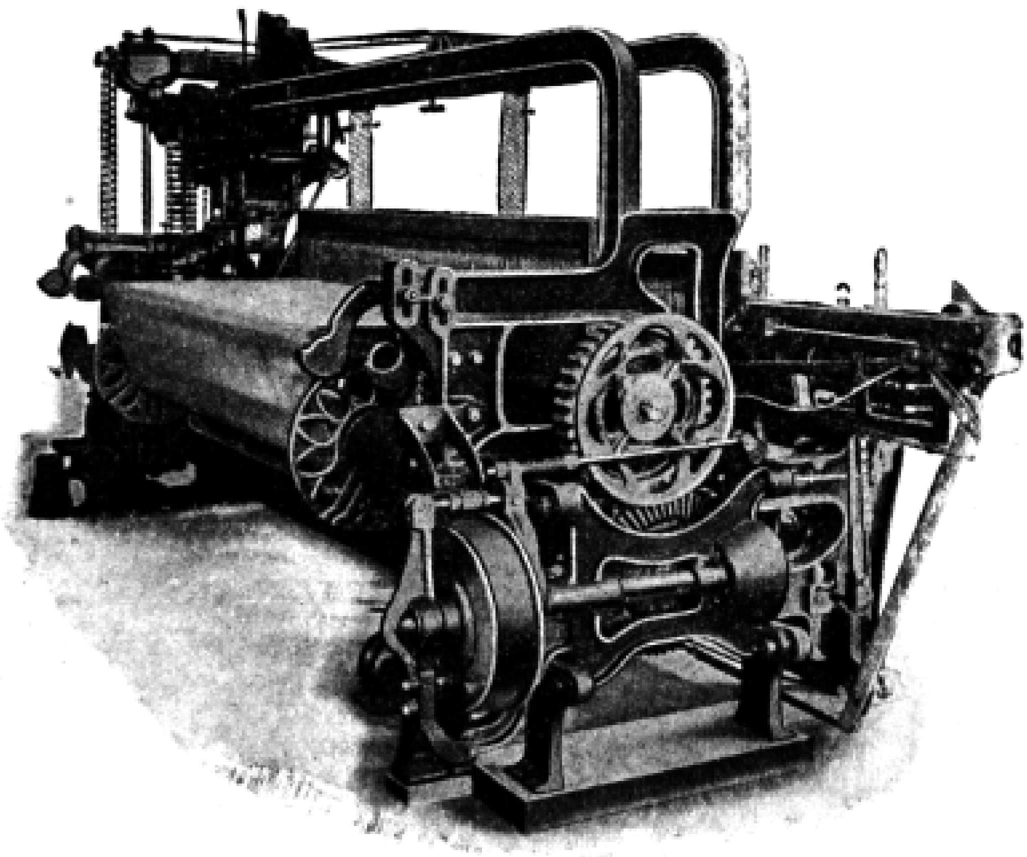


Fig. 107.
Dobcross Drop Box Loom Drive. (Back View).

The loom is driven by two pairs of wheels, at one end of the loom, the teeth being cut out of solid metal. The first pair are on the crank and bottom shafts respectively, and have the same number of teeth. The bottom one is placed on the boss of the outer bevel wheel, the two being braced together by two powerful setscrews. The bevel wheel is keyed to the bottom shaft by a long key in a sunk keyway.

It is a counter shaft that carries the driving pulley and its companion, and on the front end is the change bevel wheel. This latter wheel fits on to a key in a sunk keyway, and is further secured by a pair of strong locknuts.

Change wheels are made with 18, 19 and 20 teeth, so the speed of the loom can be rapidly altered, a cog making a difference of five picks per minute. In setting the change wheel, it has to be just as deep in mesh at the back as at the front.

Knocking-Off.—When the shuttle fails to reach the box in time, the stop rod tongue remains elevated, and as the going part moves forward, the tongue comes in contact with the frog A (Fig. 108) which fits into the large casting B

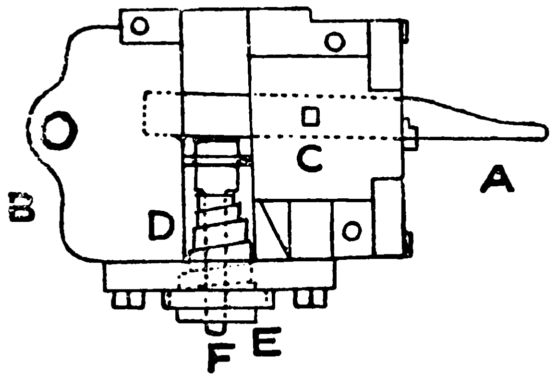


Fig. 108.
Dobcross Frog.

bolted to the framework of the loom underneath the breast beam. It is fulcrumed at C, and the tapering end A must be in contact with the setting on handle when set for weaving. At D is the coiled spring that applies pressure to the frog by means of the pin F. This pin has a large head in contact with the back of the frog, and the shaft of it passes through the cap E. The cap is held to the framework of the frog by two strong setscrews.

When the stop rod tongue strikes the frog, the coiled spring contracts, but offers good resistance to the forward movement of the going part. The part of the frog which meets the impact is **V**-shaped to fit with end of the tongue. The end of the tongue should be kept tapered downward at the top end to prevent jamming at the top of the frog. Both frogs should be hit almost at the same time, but the one on the driving side ought to have a slight lead over the other to give a start for forcing off the setting-on handle.

Negative Take-up.—The positive take-up motion is best adapted for worsted weaving, but for woollen with its uneven diameter of weft, a negative motion is best. This is shown at Fig. 109. At A is the intermediate wheel outside

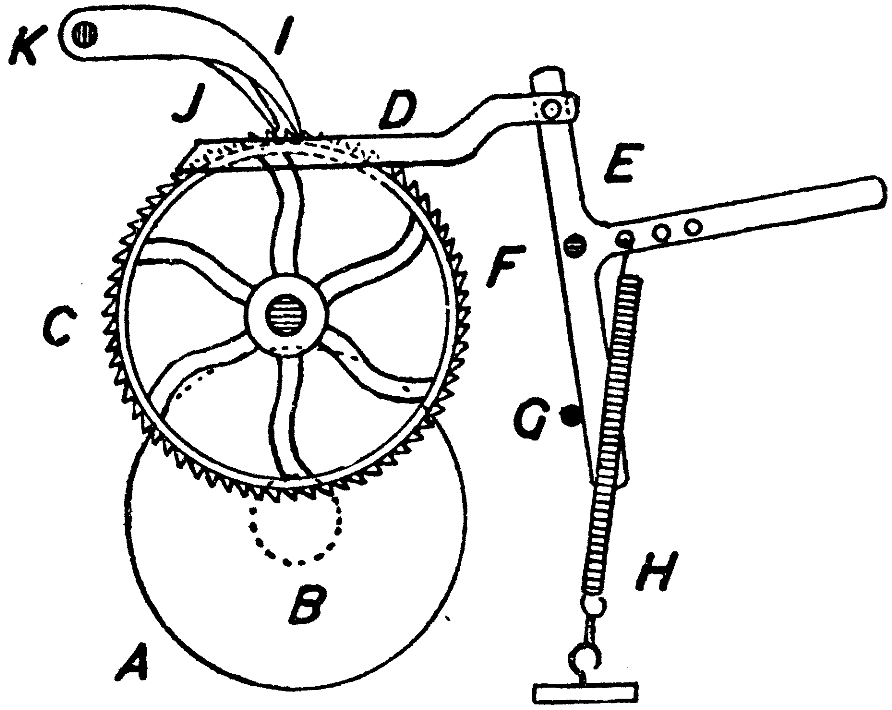


Fig. 109.

Dobcross Negative Taking-up Motion.

the loom frame that is on the same shaft as the pinion wheel with 16 cogs that meshes with the cloth beam wheel having 72 teeth. The intermediate wheel A gears into the taking-up wheel pinion having 16 cogs and A is behind the taking-up wheel B.

Now there are two makes of taking-up wheels. The finer makes of the two has 106 teeth and is very suitable for pieces woven with over 50 picks per inch. The coarser one has 72 cogs and is applicable for cloths with less than 50 picks per inch. The finer toothed wheel will do the work of the other but is worn much quicker. At C is the pulling or taking-up catch which is loosely pinned to the **T**-lever D, this lever being fulcrumed about the centre of its length. The lever at the bottom is brought forward by the pull of the spring F which draws the taking-up catch C to the right and takes up the cloth. The catch is thrown forward by the pin E which is setscrewed to the side of the sword. The stronger is the spring, and the quicker the cloth is wrapped on the cloth beam. When the teeth on the taking-up wheel are worn, or the pulling catch end is too blunt, then barry places are made in the cloth. The catch may be chipped and filed, and the cogs on the wheel deepened by the use of a fish-back file.

The spring F is made vigorous in action by tightening up the band at the base, or by placing it in one of the holes further away from the fulcrum.

The two holding catches are at G and H, one having to be half a cog ahead of the other for the best control of the wheel. When desired, the loom can have the Hattersley pick finder motion fixed to the loom. In the case of special picks a differential motion can be fitted to the loom.

Low Picked Cloth.—For these kind of goods the take-up spring F is aided by the weight K on the lever D, as in Fig. 110. If this is not sufficient, the spring may

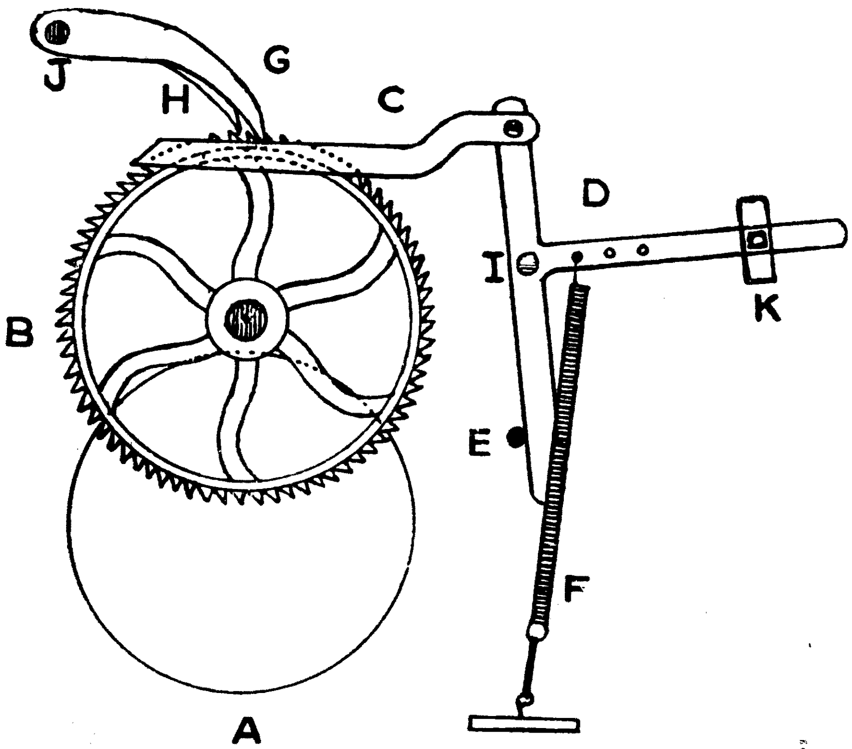


Fig. 110. Negative Take-up for Low Woollens.

be moved to the right on lever D, and if this be still not all that is required, another small weight may be added.

Differential Motion.

In the weaving of fancy checked woollen and worsted fabrics, one or more picks of cotton, silk, or rayon is inserted in each repeat of the pattern. When woven with a positive take-up motion the take-up is the same amount every pick. On the thinner picks, an open space is left in the fabric.

To overcome this, Dobcross loom makers have invented a differential motion outlined in Fig. 111. A is the link chain that receives its motion from the sprocket wheel behind the top cylinder of the dobby. The chain runs sprocket B, the stud for the wheel being at C and bolted to framework D.

E is the bevel wheel keyed to the same sleeve as the sprocket wheel, and moves as shown by the arrow. It has 29 teeth, and meshes with centre bevel wheel F at the back,

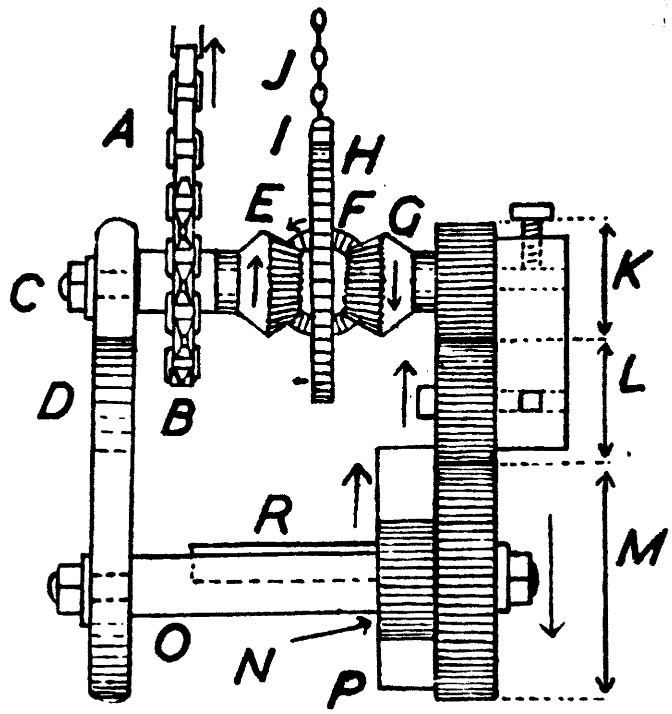


Fig. 111. Differential Motion.

that has only 19 cogs, and rotates from right to left. The third bevel wheel G moves in the opposite direction to E, and actuates the train of wheels on the right.

The first is at K, the second at L, and the third is the change wheel at M. At the back of M is pinion wheel N, the change wheel and pinion being on shaft O bolted to the curved and slotted frame D, by which the change wheel can be set to wheel L.

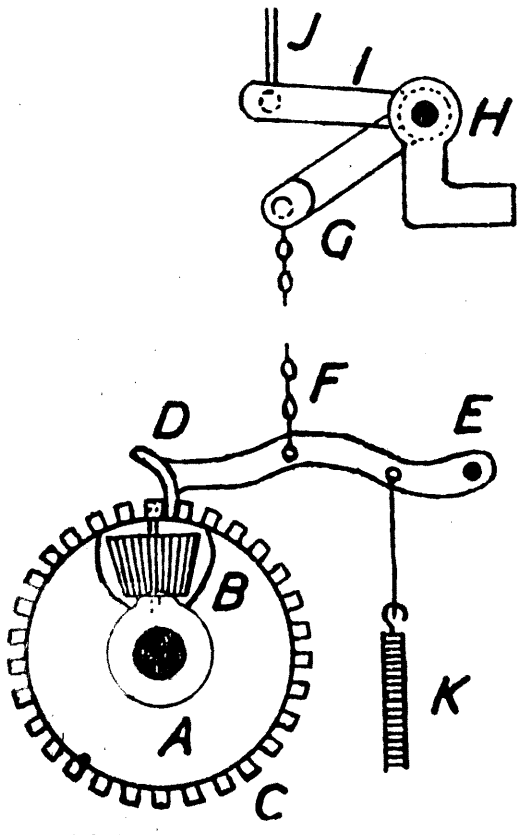


Fig. 112. Differential Motion (Lock Wheel).

Wheel P has been left blank for clearness, and is the take-up wheel keyed to take-up shaft R that carries the take-up worm. The direction of lock wheel is shown by an arrow.

Between bevel wheels E and G is lock wheel H, through which passes bevel wheel F, and transmits the motion of wheel E to G, and the following train of wheels. The lock-wheel H is free upon the stud, but can be held by the lock knife D in Fig. **112**.

Function of Lock Wheel.—Lock wheel and knife are outlined in Fig. **112**. A is the stud upon which the lock wheel revolves. Through the opening in wheel C is the bevel wheel B, and connects bevels E and G in Fig. **111**, Lock wheel C has **30** broad cogs, one being bored through for the holding rivet for bevel wheel B.

The lock knife as shown, is holding the lock wheel, and when stationary, the bevel wheel E transmits its movement to the set of wheels on the right, and the positive take-up of the cloth continues. Fig. **111**.

When the lock knife is raised by chain F and levers G and I pivoted on bar H, and pulled up by connector J in Fig. **112**, the wheels on the right in Fig. **111** cease to run, and no cloth is taken up. As wheel C rotates, the bevel wheel B circles round bevel wheel G in Fig. **111** until the lock knife drops, and lock wheel C ceases to move, and normal weaving is resumed.

The lock knife is lifted by a peg in the lags operating the last jack in the dobby. When the jack is lowered, the lock knife is drawn down, by spring K, Fig. **112**.

In this way, " cracks " in the woven structure are avoided.

Automatic Weft Changing.

Fig. 113 shows the loom constructed with a four colour automatic cop changing device. At the magazine end there is only one box, but at the other there are four drop boxes, though looms are made with only two boxes. The cop changing device is for a right hand loom, and is even picked. The speed of the loom is the same as for an ordinary box loom.

The prime mover of the motion is a positive tappet bolted to a wheel run by the spur wheel on the crankshaft. Any alteration to the timing has to be done by taking out the stud of the tappet wheel and altering it in relation to the spur wheel. The bowl that runs in the tappet is bolted to a lever which is fulcrumed about the centre of its length, and operates underneath the magazine, and assists in the liberation of the fresh cop or bobbin.

There is a feeler motion that penetrates the holes in the box and shuttle and comes in contact with the weft. The

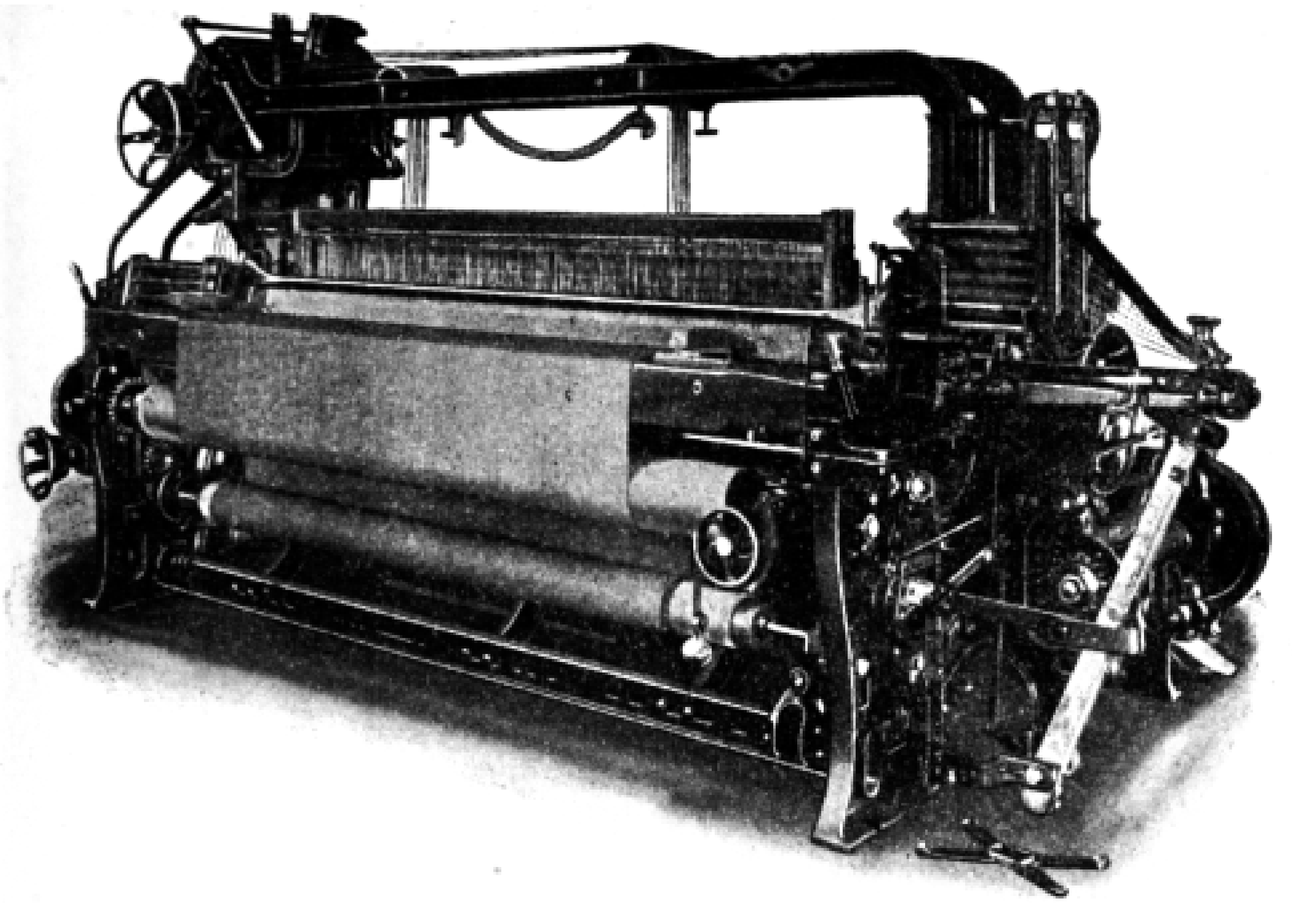


Fig. 113.
Dobcross Automatic Four Box Loom.

weft coils keep it straight, but when they are failing, the feeler slips on the bobbin and brings the cop changing device into action. The spent cop is forced through the bottom of the shuttle at the same time as the fresh one enters it when the loom is at its dead front centre. The change takes place without stopping the loom, or reducing its speed.

There is a weft cutting mechanism which is moved into position at the same time that the transfer takes place, and severs the weft just prior to the ejection of the spent cop. The magazine has four rows of cops which may be all alike for weft mixing, or have up to four colours for the weaving of fancy checks. Each row will hold nine cops, so the magazine holds 36 of them when full. A weaver is able to attend to two of these kind of looms and two ordinary drop box looms, the whole four being fitted with droppers.

CIRCULAR BOX LOOM.

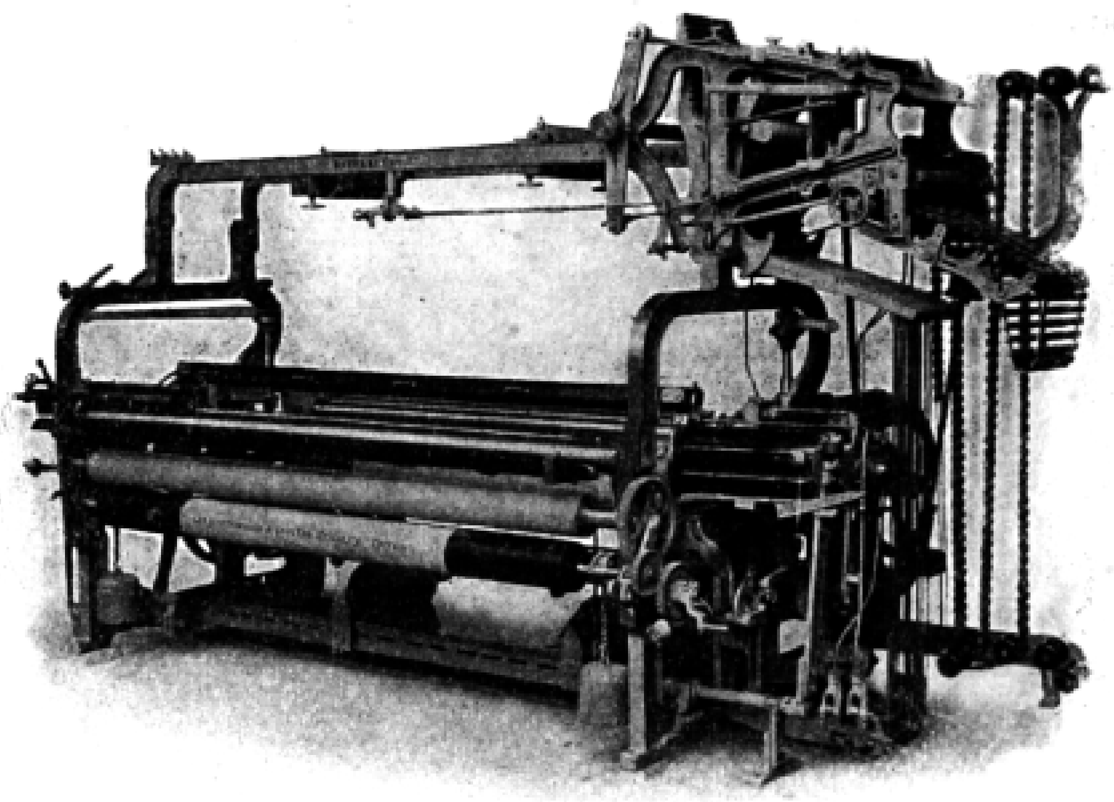


Fig. 114.

Hattersley's Revolving Box for Light and Medium Coatings.

The circular box loom was invented by Messrs. George Hattersley & Sons; Keighley in 1858. Its popularity for the dress goods trade is shown by the numerous loom makers who have adopted it. It is specially suitable for light weight dress goods, because most of these looms are of narrow width, high speed, and can cope with as many as six colours of weft.

The speed of the loom varies according to the width of the reed space, for one with 40 inches may be run at 200 p.p.m. but one with a reed space of 64 inches has only 120 picks per minute.

The Hattersley revolving box loom for light and medium coatings is shown at Fig. 114. It will take 24 shafts, has a reed space of 76 inches, and a speed of 130 p.p.m. The revolving box is controlled from the dobby.

Construction of Box.—The inner end of the circular box is outlined at Fig. **115**. At A is one of the 6 boxes, each of which may be used in turn, but only one can be turned at a time. What is termed the top box is the one in operation. As there is only a circular box at one end of the loom, it is only altered at soonest every other pick after the shuttle has entered it.

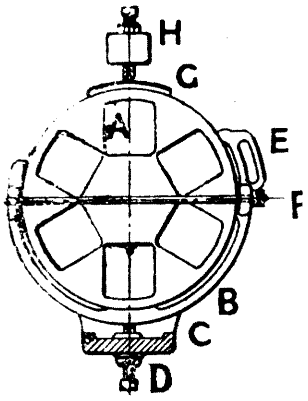


Fig. 115.
Six Cell
Circular Box.

The front inner side of each box is grooved to be opposite the groove in the shuttle front, and the back of each box carries a curved spring to check and hold the shuttle in its picking position.

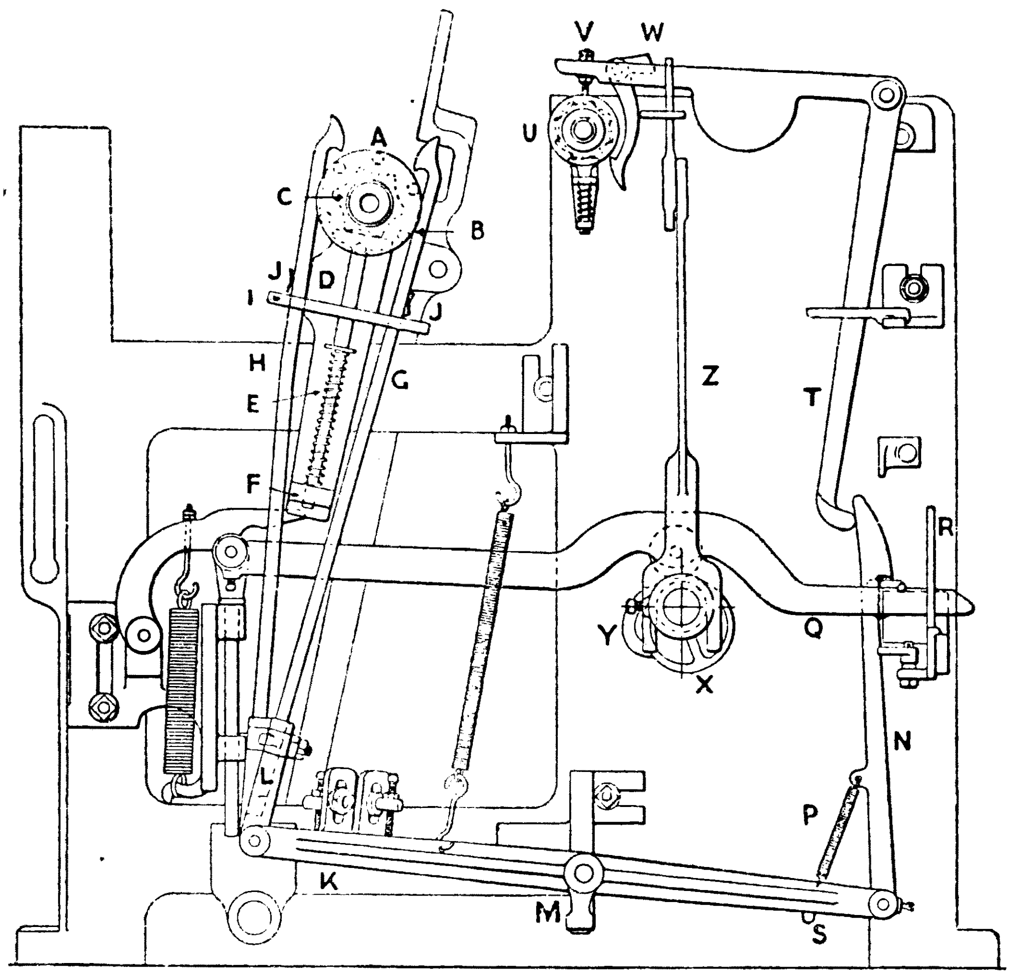
At B is the semi-circular box rest, which has the slotted check strap guide E at the front, and the bracing rod F passing through both ends. As the rest B is malleable, it may be tightened by the rod to prevent too much oscillation of the box. At C is part of the under framework of the box, and through it passes the lock-nutted regulation screw D. This screw brings the bottom of the operating box level with the shuttle race.

At G is a small cap kept in position by the screw H to prevent the box from rising up, or swaying too much in either direction. The outer end of the box is set dead level with the shuttle race.

Fig. **116** gives the side view of the principal motions by which the box is made to revolve.

Pin Cylinder.—At A is the pin cylinder which is attached to the shaft of the box by a headed key and a couple of set-screws. There are 6 pins, one being for each box, though the upper central one is not used until the box is turned by one of the forks using a side pin. The flat on the box shaft should be so made that when the key is driven into the pin cylinder, that the pins nearest the forks should be at equal distances from them, for then the timing of turning the box is identical whether the turning be forward or backward.

Star Wheel.—On the inner side of the pin cylinder is the star wheel C. Its 6 points should be at equal distances apart, and is so fixed that when any box is turned, the back of the top box is in a straight line with that of the reed. The star wheel has two other duties. It assists in making the box turn very quickly, and keeps the box firm after being turned. It is doubly setscrewed to the box shaft. In course of time, the points become blunt, and the box is then



SIDE VIEW OF CIRCULAR BOX LOOM.

Fig. 116.

slower in completing its movement. If filed to make the points less rounded, the distance between one point and another should be the same all round.

Hammer.—The two bottom points of the star wheel rest in the hollowed out head of the hammer D. Below the head, the shaft of the hammer is square, and as this part passes through the guide fork I, it is kept straight. Below the square section of the shaft it is circular, and on this is placed the open spiral spring E which contracts when the box is being turned, and keeps the box firm after coming to rest. The bottom of the hammer shaft passes through the pressure casting F, which can be elevated by a lock-nutted setscrew below it to increase the pressure of the spring.

Box Forks.—The back fork is given at G and the front one at H, the front fork pulling the box forward and the other backward. Both are held to their respective sides of the box by the pressure of the flat springs J.

The working length of each fork is regulated by the fork holder which is pinned to the front end of the lever K and is indicated at L. The fork holder has an open slot at the front into which the bottom of the fork passes. The fork is held to the holder by an eyebolt through which the fork passes and by which it is secured. The eyebolt acts as an escape motion. The working length of the forks is an important matter, for the higher the catch on the fork is above the pins on the cylinder, and the longer they will be before commencing to turn the box. On the other hand, they may be set so low that when one fork is turning the box, the other may be catching on the pin that has to travel past it. The downward fixing of the fork is limited by the clearance of the other fork catch with that of the cylinder pin that has to pass it.

Lifting Catch.—This is situated at the back end of the lever K, the lever being fulcrumed at M. At the bottom, the lifting lever is pinned to the lever K, and at the top it passes through a slot in the tappet lever O. There are a pair of levers like K, and a pair of lifting catches like N, for one controls the front fork and the other the back one. The lifting catch is held back by the small spring P, and the long lever K is pulled up after turning the box by the long spring shown. The limit of the upward pull is reached by the back and under part of the lever K coming in contact with the stay bar S. The stay bar casting is slotted, and is bolted so the cut on the catch nicely clears the upper part of the tappet lever when the latter is at the bottom of its movement. The stay bar is set first to suit the lifting catch, and the box fork setting follows.

Indicating Lever.—The lifting catch N is controlled by the indicating lever T which fits behind it. It is a right angled lever, and midway on the vertical arm it passes through a slotted guide. It is fulcrumed at the elbow, where, in some makes, the horizontal arm is slotted so the vertical arm may be altered in its relation to the lifting catch by a bolt.

The horizontal arm has three things to note. (1) On its under side it is made semi-circular to give extra weight of metal as it has to drop of its own weight. (2) It carries the catch W which turns the box lag cylinder one cog forward every other revolution of the crank. (3) At its under front end is the pin V which in some cases is a fixture, but in others it is held by a nut, and is regulated in a short slot. Whether one style or the other, the pin has to pass through the holes in the lags and cylinder as centrally as possible. If the pins be fixtures, the levers are moved bodily by the stud at the fulcrum to secure correct dropping, but the other make is moved by the pins.

Box Lags and Cylinder.—The cylinder is indicated at U. It is hexagonal in shape, and each flat has two holes with a tapering pin on each flank. The upstanding pins penetrate the holes at the sides of the lags, and keep them in position. Every lag has these holes at either side, but there are 3 kinds of lags. (1) With solid centres. This prevents any movement of the box, for the lifting lever is not affected. (2) With a hole nearest the loom framework. Such a lag controls the front box fork, and turns the box forward. (3) With a hole on the outer side. This lag controls the back fork, and turns the box backward.

It is obvious that there are no lags with two holes, as only one lifting catch can be moved at a time.

The box is made to move in this way. When there is a hole in the lag, and the upper part of the indicating lever descends, the pin passes through the holes in the lag and cylinder, and in doing so, the vertical leg moves the lifting catch forward. The cut upon it is seized by the tappet lever O, and on being lifted, the corresponding box fork is drawn down, and the box is turned. When the tappet lever descends, the lifting catch is drawn back by the pull of the spring P. The cut on the catch must clear the tappet lever when down at least $\frac{1}{16}$th inch.

The cylinder U is provided with 6 pins, each of which in turn are seized by the weighted catch W, so the cylinder is turned one lag every other pick. The two bottom points of the cylinder rest on a small hammer head which works on the same principle as that for the box. The spring on the shaft of it gives way when the cylinder is being turned, but holds it firm when the operating lag is dead level at the top.

Tappet Lever.—This lever passes through the grate R at the back part of the loom, and is fulcrumed at the opposite end. It is at the front of the loom where the top of the lever is pressed upon by a curved lever which is held down by the powerful spring shown underneath it. This acts as an escape motion in this way. Suppose the box lags became undone and fell off, then both indicating levers would pass into the exposed holes in the cylinder. This would lead to both lifting catches being seized by the tappet lever. As both box forks would come into play about the same time, they would lock the box. As the tappet lever would be bound to rise, it does so at the front of the loom, by means of the long rod which passes through the two guides shown. This prevents a serious accident, and when the loom is turned over by hand, the indicating levers rise, and the tappet lever descends to its normal position.

Above the tappets X and Y, the under side of the tappet lever is fitted with a bowl, and as this is constantly on the turn when the loom is running, it should be well lubricated.

Tappets and Fork Lever.—The tappets X and Y are cast together and are setscrewed to the low shaft. Behind the inner tappet is the rim which keeps the forked end of the lever Z in its working position. Above the forked part is a shelf that stands forward, and it is this shelf that rests upon the upper surface of the inner tappet. As the tappet revolves, the forked lever rises and falls. This is the means employed in raising the indicating levers, for each pass through the slots in the upper part of the fork lever Z.

The fork lever is in two sections, for though the lower part must rise and fall the same, the upper section may be set higher or lower so as to impart the best movement to the vertical legs of the indicating levers. The fork lever is kept upright by passing through a slotted casting at its upper end.

The outer tappet is more oval in shape than the inner one, for as it controls the tappet lever, there must be a quick rise and fall of the lever to turn the box, and a quick return to be ready for the next pull.

The timing of the tappets is very important. It must be so set that the box begins to turn when the crank is at its top centre. This gives time for the shuttle to enter the box from the opposite end of the loom, and gives ample time for the box to turn and come to rest before the shuttle begins to move out of the box for the following pick. If the outer tappet gives this correctly, then the function of the inner one is also correct.

Box Problems.—There are several things connected with the circular box that have to receive special attention. When the shuttles are in the circular box and the box is turning, if the hole made in the picker by the shuttle tip is fairly deep, the box fork will have some difficulty in dragging it out. To relieve this pressure, the picker may be taken off and rasped across the hole to make it shallower.

Another thing that has to be guarded against is the picker standing too far forward when the box is turning. It is prevented from doing so by a knuckle or curved spring which is setscrewed at the end of the box. After picking, the picker stands forward in the box, but when the shuttle returns, it pushes the picker beyond the spring, and keeps the foot of it free from the turning box. As the spring is slotted, it may be secured to give the best results obtainable.

The bottom of the picker foot has to just clear the bottom of the groove in the box bottom for easy working, for at the buffer end of the spindle it is elevated a little by the spindle to give the " up " movement to the shuttle. If the foot was too shallow at the outer end of the box, it would be liable to be forced out of the groove at the buffer end by the force of the pick.

When the circular box is working, only a short run is given to the check strap so the picker can be kept as free as possible from the turning box.

The upper part of the bowl casting has to be level with the bottom of the box, and its groove level with that in the box. The bowls have not to be set too prominently forward when the picker is new, for if so, the box is liable to hold too much when the picker is worn.

The hooks on the box forks have to be deepened at times to prevent them slipping off the pins on the cylinder. Bulb-nosed shuttle tips are to be preferred to long tips, for the latter hold too much in the picker when worn.

The circular box is associated with both the loose and fast reed styles of fixing the sley. The loose reed is particularly built for dress goods, for, being of narrow width and lighter weight, the loom can travel with safety at a higher rate of speed than the coating loom. The various parts of its structure are outlined at Fig. 5 and chapter on " Use of Reeds."

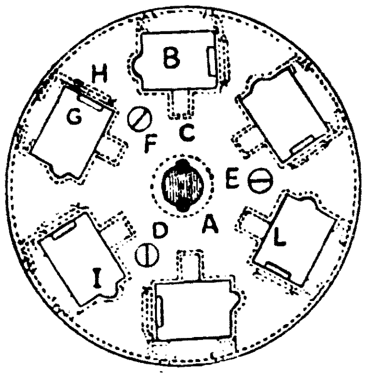
Hattersley's All Metal Circular Box.

The latest development by the Hattersley firm under the heading here dealt with is an All Metal circular box.

The chief fault with the wooden circular box is, that when the shuttle has made a good hole in the picker, much more stress is placed upon the base of the box when it is made to turn. Were this to continue indefinitely, that section of the box would probably be torn from its base and rendered useless.

A disaster like that cannot happen to the all-metal box because of its strength and construction. The actual shape of the box follows much the same contour as the wooden one, but what forms the front and back of each box is made from the same piece of metal.

Fig. 117 gives the outline of the inner box hub, the outer one being the same size and shape. At A is the bore which



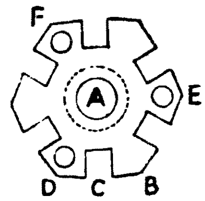


Fig. 118. Fig. 117.
Hattersley's All Metal Circular Box.

fits on to the inner end of the shaft, the latter being $\frac{11}{16}$th inch thick. The slots C make room for the leg of the picker, and the threaded holes. D, E, and F are for the use of three powerful screws with flat heads that secure the outer box plate to it. The hub is keyed to the shaft.

Fig. 118 is the front or entrance view of the box. At A is the end of the box shaft that has the hub behind it. Both hub, shaft and plate are bored top and bottom and then threaded. Into these holes a setscrew is placed, and after being screwed tight, the outer parts are cut off level with the face plate, which makes the end of the box like a solid whole. The black dots represent the setscrews, and D, E, and F are the screws that hold the face plate to the hub.

Then B is the operating box with C as the groove for the leg of the picker. At G is the curved spring inside the box that slows down the incoming shuttle, and holds it in its picking position, and H is the back of the box which provides room for the pin which holds the curved spring. At I is the box groove which coincides with the grove in the shuttle front, and J, K are the places where the lips of the two sides of the box are riveted to the rim of the face plate. Every box is fixed the same way. On the inside, the rivet heads protrude as they cannot come in contact with the shuttle, but on the outer side, the rivets are flush with the plate. At L is the grove for the leg of the picker, the bottom of it at both ends of the box being riveted to a lip on the hub. In addition to this fixing at the outer end of the box, the back of each box has a flange that is turned at right angles towards the back of the loom. The front part of the box has a flange turned towards the front of the loom and is in front of the other, and both are riveted together which adds to the stability of the box.

The front view of the box back is given at Fig. 119. At A is the entrance to the box which is about ¼ inch higher than

Fig. 119.

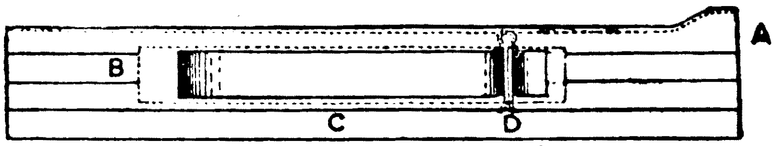
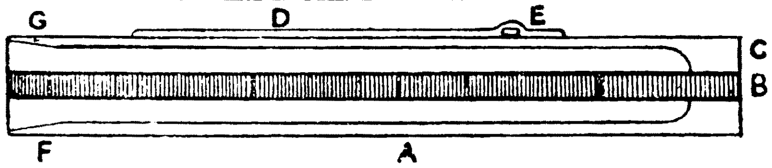


Fig. 120.



Hattersley's All Metal Circular Box.

the opposite end. At B is the recess for the curved spring which is both longer and broader than the spring, the length being 8¼ inches and the depth ⅞ inch. At D the metal is pressed still further back, and is bored for the use of a split pin that holds the spring.

The top view of the same box is given at Fig. 120. The front lip that keeps the shuttle in the box is at A, a similar one being at the opposite side. Then B is the groove for the picker leg, and C is the upper front entrance end of the box. At D is the pressed back recess for the spring with E as the place for the split pin that holds it, while F and G are the tapering lips of the box top.

Compared with the wooden box, the weight of the metal one is about 2½ lb. heavier, but it has a special advantage. The top weight is lighter, but the central weight is heavier, both of which assist in a better and quicker turning of the box.

The box shaft extends beyond the box proper for 8 inches, and on this are three flats. The inner one is for the star wheel, and the other two for the pin cylinder.

The total length of the box is 14⅝ inches, and the inner width of each box 1$\frac{11}{16}$th inches. The depth from box top to where the shuttle runs is 1½ inches, and from the top to the bottom of the groove 2 inches. The groove for the weft extends from the outer end to within ¾ inch of the opposite end.

This box is another triumph for the Hattersley firm.

It would only appear possible to weave a wefting plan with even picks on a loom with only one circular box. That idea is misleading. Odd picked weft can be woven for the checking if not too numerous, by dropping all the shafts on that pick when the checking shuttle is sent back to its box. The float of weft is cut off by the weaver. This, of course, is done in a dobby loom.

RAYON AND CREPE WEAVING.

The making and manufacturing of rayon has made great progress in recent years, and is now one of the staple industries of the world.

The commercial aspect of it began when Count Hilaire de Chardonnet patented his nitro-cellulose process in 1884, and became the " father " of the rayon industry.

Eventually, the Count came to England, and founded the firm of Kirklees Ltd. at Kirklees, Tottington, near Bury.

The firm flourished, and Kirksyl viscose crepe yarns attained world-wide reputation.

This was followed by the cuprammonium process in 1892, Messrs. Cross & Bevan in England instituted the viscose process. In 1894 came the advent of acetate. Viscose and acetate have become the popular kinds of rayon.

Viscose is mainly made from wood pulp, and acetate from purified cotton linters or cotton waste.

Viscose, nitrate, and curprammonium take the same dyes, but acetate has its own preparations. If acetate is woven with any other kind of rayon, the same dye bath produces a two colour effect on the cloth.

Staple fibre is derived by cutting filament rayon into lengths to correspond to the average fibre length of the cotton or wool with which it is to be blended.

Fibro is cut from 1½ to 3, or 4½ denier and in lengths from 1 to 8 inches. One of the simplest tests to find what kind of threads are made of, is by burning. Viscose, nitrate, and cuprammonium burn quickly like cotton, and have little odour and ash. Acetate burns slower like wool, creates a bulb, and smells like silk.

Most rayon yarns require to be woven dry, as wet decreases their strength.

The term " artificial silk " was abandoned in 1924 and the word " Rayon " substituted and generally adopted.

To prevent the rupture of filament rayon, all undue friction has to be avoided.

Weaving Rayon Crepes.

The settings of various loom parts for these goods do not follow ordinary fixings, for if so, they would not produce the desired effects in the finished fabrics. In some Continental looms, parts are made and act for crepes, but for many English looms, the adjustments have to be made by the overlooker.

Breast Beam and Back Rail.—The breast beam top has to be made slope at the same angle as the shuttle race when the crank is at its top or bottom centre. This is set forth in Fig. 121. A is the sword; B the going part; C the tilted

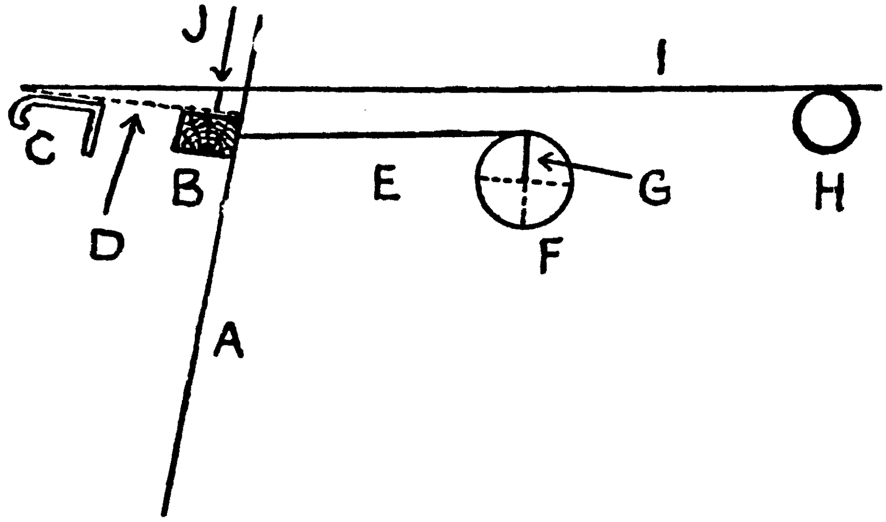


Fig. 121. Setting Pitch of Back Rail.

breast beam; D the dotted line from beam to shuttle race. This allows the threads on the bottom shed to bed on the corduroy on the shuttle race and decreases shuttle friction on the top shed.

The flat topped breast beam has a bow-shaped front and that assists in spreading the cloth, and diminishes creases. E is the crank arm; F the crank circle; G the crank at top centre.

The second alteration is to the back rail H.

For many cloths woven with plain weave, the top of the rail is level with the breast beam to give as near equality of tension on the threads as possible.

To set for crepe weaving, a band is passed over the rail H from the breast beam C, with a weight at the end. The back rail is then elevated until the band is from $1\frac{1}{8}$th and $1\frac{1}{4}$ inches *above* the shuttle race when the crank is at its top centre. The measurement is made at J. This tightens the bottom shed and slackens the top one, and imparts a better cover to the cloth.

Construction of Tappet.—The ordinary make of tappet is not suitable for rayon crepe weaving. A better construction is detailed at Fig. 122. It has longer dwells and shorter changes (See chapter on Tappet looms). The longer dwells gives more time for the shuttle to get through the shed, and prevents friction marks being made by the top of the shuttle. Such marks may not show much in the loom, but are

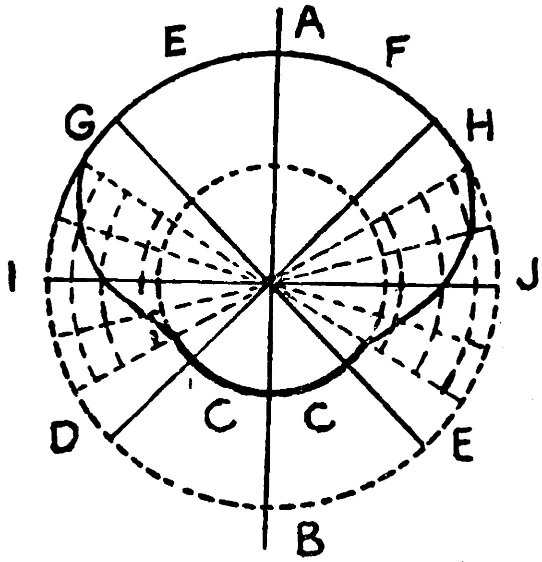


Fig. 122. Tappet for Crepe Weaving.

plainly evident in the finished cloth. The tappets are cast in pairs.

Looming and Tappet Rod Connections.—The warp may be loomed straight gait, or drawn 1, 3, 2 4, each having its favourable points. The diagrams illustrate the latter method. When weaving, the first two shafts rise and fall together, and the second pair vice versa. The second shaft, however, has to be actuated by the third tappet, and as this controls the third bowl lever, the connection rod, has to be coupled to the second rat tail on the cross rod which is moved into position. The third shaft is moved by the 2nd tappet and the connecting rod has therefore to be adjusted. This is Fig. 123.

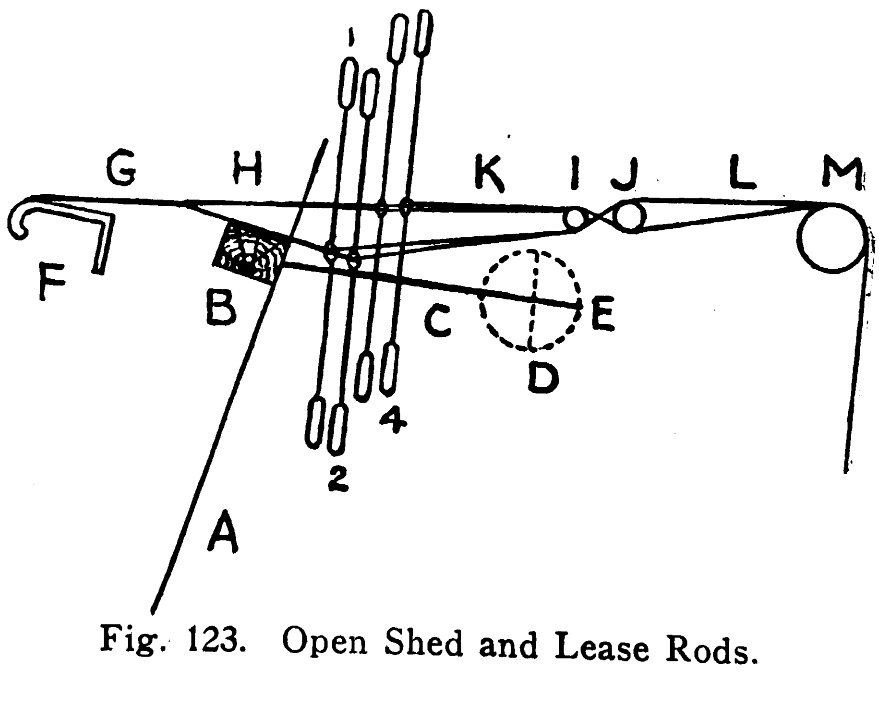


Fig. 123. Open Shed and Lease Rods.

Open Shed and Lease Rods.—These are outlined in Fig. 123. A is sword; B going part; C crank arm at back centre E; D is circular sweep of crank; tilted breast beam at F and cloth at G. The front shed is fully open at H, and heald shafts consecutively numbered. The warp is leased 2 and 2, but can be leased 1 and 1 to prevent the threads rolling and neps forming. As given, the thick back rod is inserted when the two back shafts are down, and the two front ones up. The thin front rod is put through when the two back shafts are up and the two front ones are down. This places more tension on the two front shafts as these make a lesser shed. The tappets used are negative, so an under-motion is required. Instead of a Kenyond motion, stands are bolted to cross rails in line with shaft hooks. Each rod has a casting at the top with two semicircles, one being larger than the other. To these, straps are attached, and the free ends are placed on the shaft hooks.

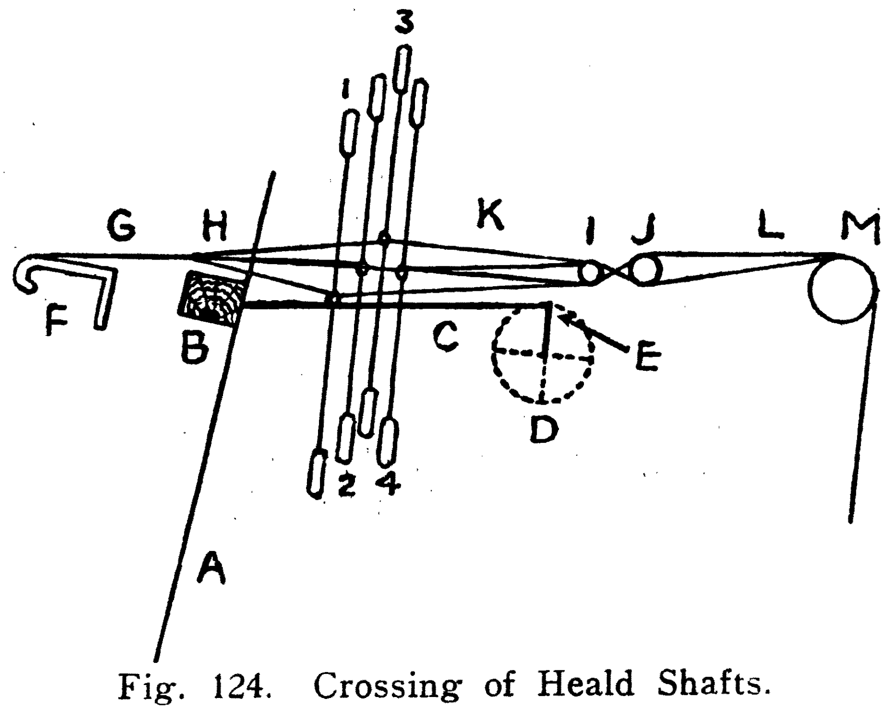


Fig. 124. Crossing of Heald Shafts.

Crossing of Heald Shafts.—This is very important in weaving high grade poplins and rayon crepes. The warp threads have *not* to cross each other at the same time, and this is achieved by timing the tappets.

In Fig. 124, crank E is at top centre, and the tappets are set so the 2nd and 4th shafts are level when the crank is as stated. The 1st and 3rd shafts are level when the crank is within a half inch of the cloth fell, Fig. 125. This prevents the breakage of many theads, and provides more room for the bulkier healds eyes. The necessity of such timing is obvious, for in a 44 inch reed space, there may be from 8,000 to

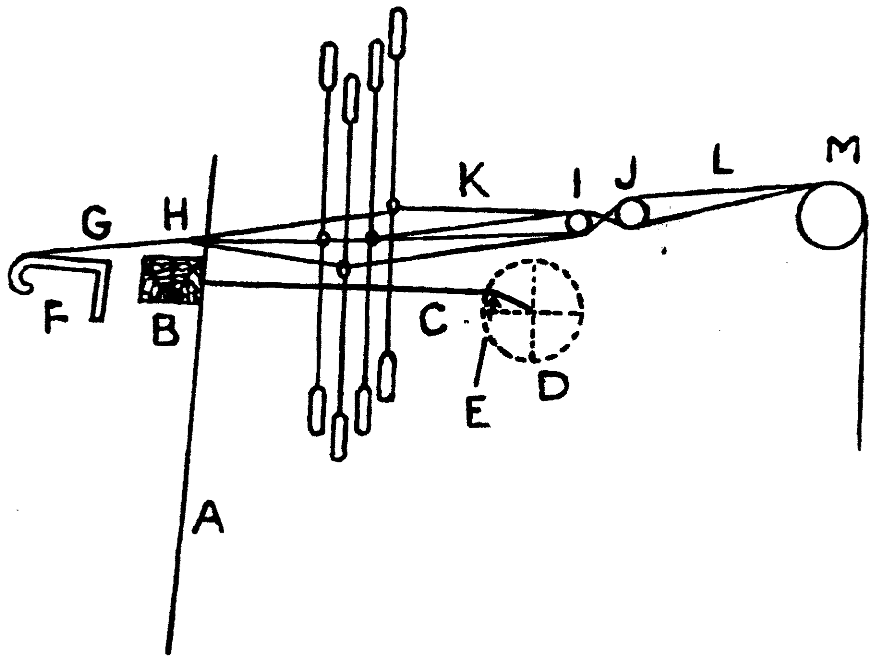


Fig. 125. Position of Healds with Crank at Front.

14,000 threads. Broken threads are taboo in these goods for when sewn in, they are liable to show when finished.

Hattersley's Combined Tappets.

These are outlined in Fig. 126, and were evolved after many experiments. All the tappets are cast together, so that one correct setting suffices for the lot.

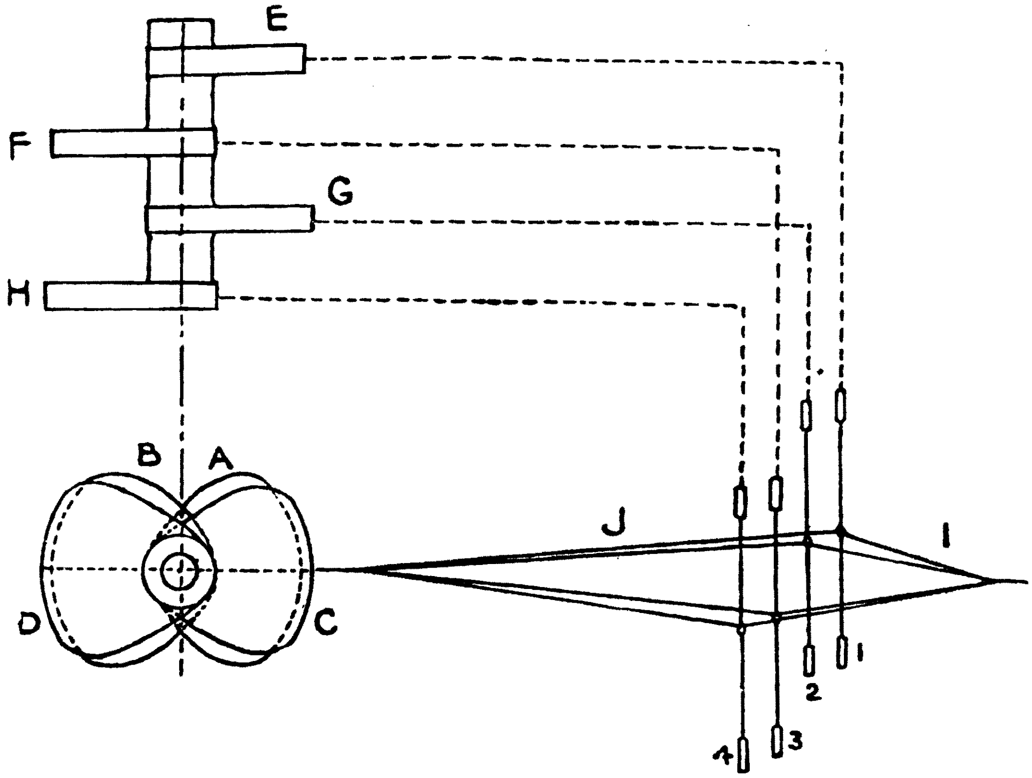


Fig. 126. Hattersley's Combined Tappets.

In the diagram, tappets A and B are vertically deeper, and horizontally narrower than tappets C and D. This leads to the abolition of 50 per cent. congestion of warp when the threads are crossing. Less threads are broken, weight tension decreased, and much less repairing of pieces. The top view of tappets at full tread is outlined above the side view, the sequence being, E, F, G. H. The threads are drawn skip-shaft. As shown by dotted lines, the first shaft is governed by tappet E, the 2nd by G; third by tappet F; 4th by tappet H. I is the front shed and J the back one.

Box Work.—Though plain weave is used to produce the bulk of worsted and rayon crepes, there are two other sources.

The first is the use of both right and left twist in making chiffons and georgettes in plain weaving. The range is limited to even numbers, and from 2 and 2 to 8 and 8.

In a drop box loom, the reverse twist is placed in the first box, and in a circular box it is put in the forward box. The weft is prevented from entanglement by strips of swansdown placed at the box entrance. The fur inside the shuttles has the hair vertically downward at both sides. At one side, the hair is lifted, and at the other it is brushed down by the weft. There is then the same drag on each kind of weft. The mop near the shuttle eye is made from 70's botany. The other need of boxes is when weft mixing is desirable.

There are a large amount of mixture effects.

THE HATTERSLEY SILK AND RAYON CIRCULAR BOX LOOM.

Messrs. Hattersley's, of Keighley, have brought out four silk and rayon looms, the one with the circular box herewith explained. It contains many new ideas, most of them being seen in the illustrations.

Parts which need not be enlarged upon because they have been fully explained in other chapters are the overpick motion, the negative let-off, and the 6-cell circular box. The loom has a speed of 180 picks per minute, and the reed space is 48 inches.

The Dobby.

The loom has a negative dobby which can operate 16 shafts. As will be observed, the dobby jacks are notched,

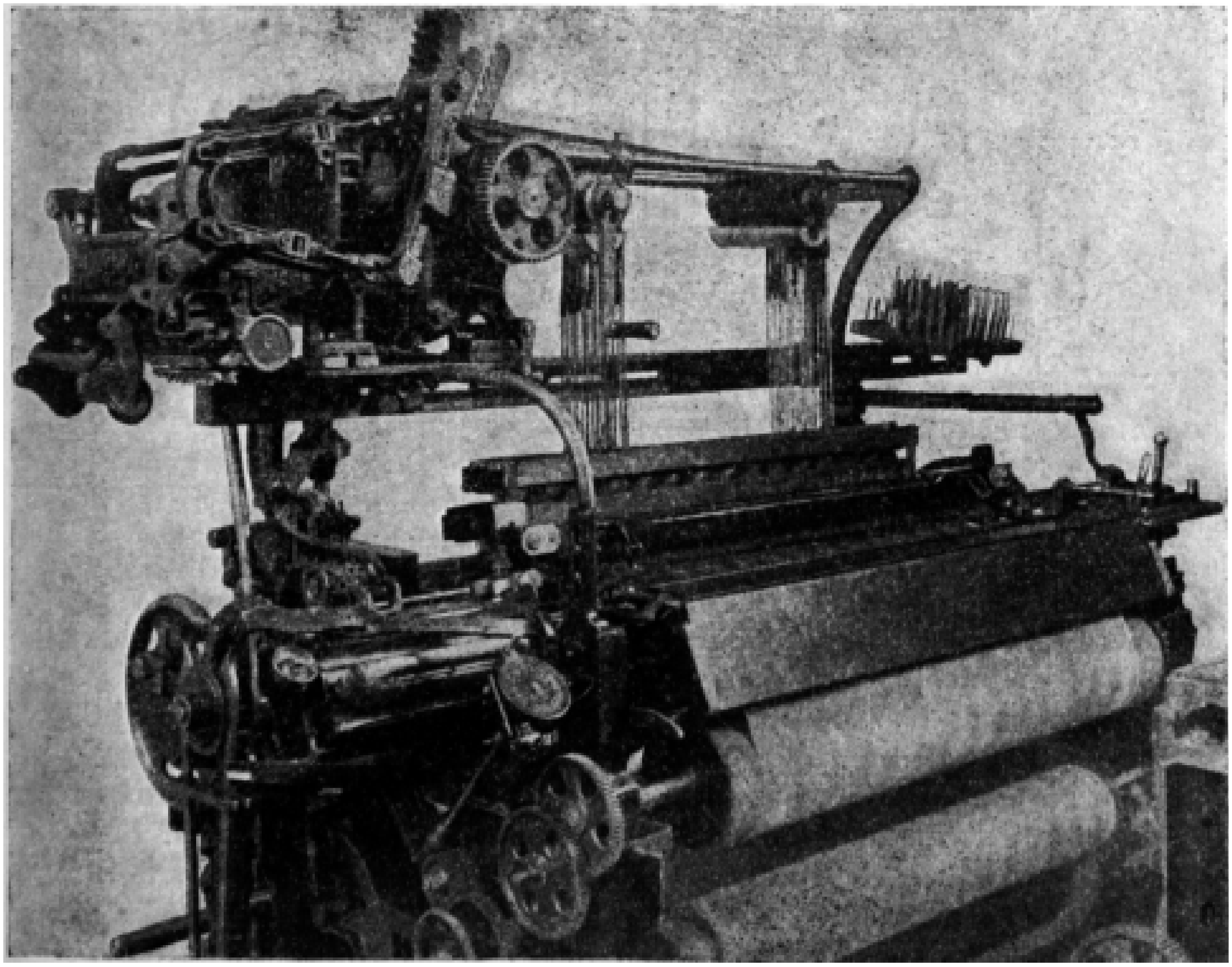


Fig. 127.
Hattersley's Rayon and Silk Loom. (Front View).

and the strap connections to the shafts pass over pulleys, the bearer castings being adjustable on bright steel bars. The centre arm of the dobby jacks is bifurcated to receive the hooks at the back of the balks. This makes possible the extraction of the balks with their attendant catches without disturbing the jack plates.

Each balk has a pair of catches, the bottom one being actuated by a fingered feeler, and the top one by a tempered needle. The feelers are tilted by wooden pegs having flat sides and rounded tops, and each shaft lag represents two picks.

Shedding Levers and Tappets.—It will be seen in Fig. 128 that the shedding levers are independent of each other. A is the fulcrum of bottom draw bar C, fixed at B, and moving in slot E, the draw bar being held by casting D.

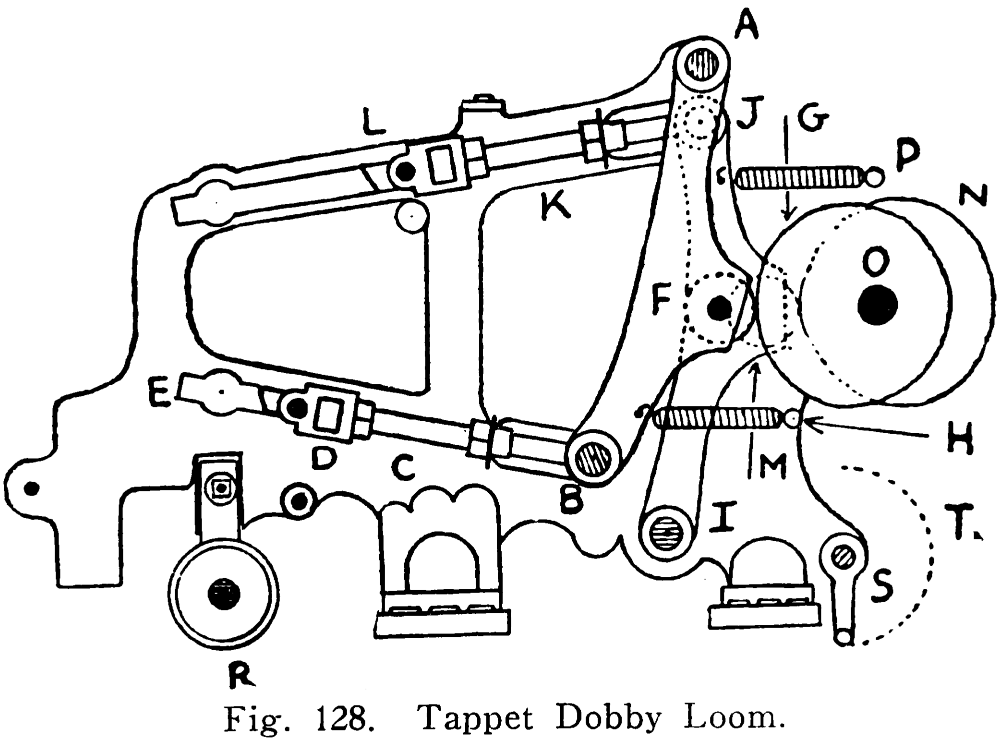


Fig. 128. Tappet Dobby Loom.

The back centre of each lever is open to receive the anti-friction bowl F, having a diameter of $2\frac{1}{2}$ inches. I is pivot for lever J, and carries connecting rod K that holds top drawbar L. As shedding levers are negative, lever B is drawn back by spring H, and lever J by spring P. The levers at back of dobby are fitted the same way. Tappets G and N are cast together and made to slide on a key in a sunk keyway and then doubly setscrewed to shaft O. The tappets have each a surface width of $\frac{7}{8}$ inch. Tappet G is in contact with bowl F, and tappet N with bowl M.

Shaft O runs in ball bearings. Two kinds of tappets are used; those having a half dwell, and those with a third dwell. These have been fully explained in chapter on

Tappet Looms. At R, Fig. 128, is the lag cylinder. The lags are grooved across to receive the flat sided pegs that have rounded tops. Each lag represents two picks.

Reversing Mechanism.—When picks require to be taken from the cloth, it is done with the loom standing. In Fig. 128, the reversing handle is at S, and is turned in the direction of the line T. This move transfers a clutch behind the dobby from its weaving to its reversing position. Fig. 129 outlines the reversing mechanism. The large wheel A is keyed to the shaft B, this being the same to which the shedding tappets are fixed.

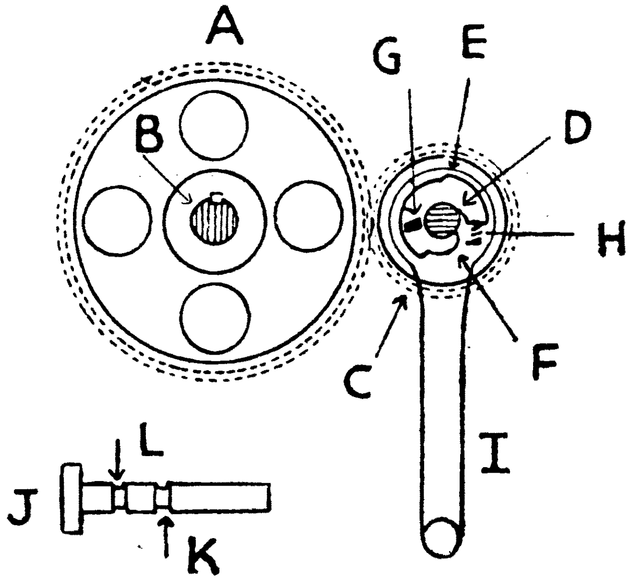


Fig. 129. Reversing Mechanism.

The small wheel C that meshes with A is placed out of action when the loom is weaving, by being pushed backwards. This is made possible by the length of the wheel stud at J that has two grooves. The groove K is occupied by the thumb catch when the wheel is out of action, but when reversing has to take place, the thumb catch is raised, the wheel C drawn forward, and the thumb catch then occupies groove L.

The projection on the thumb catch is at G, and at the opposite side is the small spring H that keeps the catch in either groove. The catch end is at F, and is part of the thumb plate E. The stud D is the same as J below, and the reversing handle is at I, the length of it making it easier for the weaver to move the shafts. When the necessary picks have been taken out, and the starting pick found, the thumb catch is again raised, the small wheel pulled out of mesh, and the handle I placed on a stop pin. The small reversing handle S in Fig. 128 is then turned to its bottom centre, and the loom is ready for weaving.

Letting Cloth Back.

If picks have had to be combed out, or a few extracted by the reversing mechanism, then the woven structure will have to be let off a little, and the warp beam turned back to take up the slack warp. This is performed in an ingenious way without soiling the hands of the weaver. Just above the shaft of the taking-up roller (Fig. 127), is a smooth handle and when this is depressed, it raises both the pushing and holding catches on the ratchet wheel. The handle should be used when the crank is at its back centre. At the same time, and by the same movement of the smooth handle, a connecting rod is moved forward that actuates a cam that depresses a slide. The base of the slide holds the bottom of the inclined rod shown outside the loom frame. At the bottom of the inclined shaft is a worm that engages with the inner wheel of two at this place, the outer one being the change-wheel. The gauge point for the change wheel is a tooth per pick. Having now been coupled up, the handle on the smooth wheel at the summit of the inclined shaft is then turned from left to right, each turn representing a

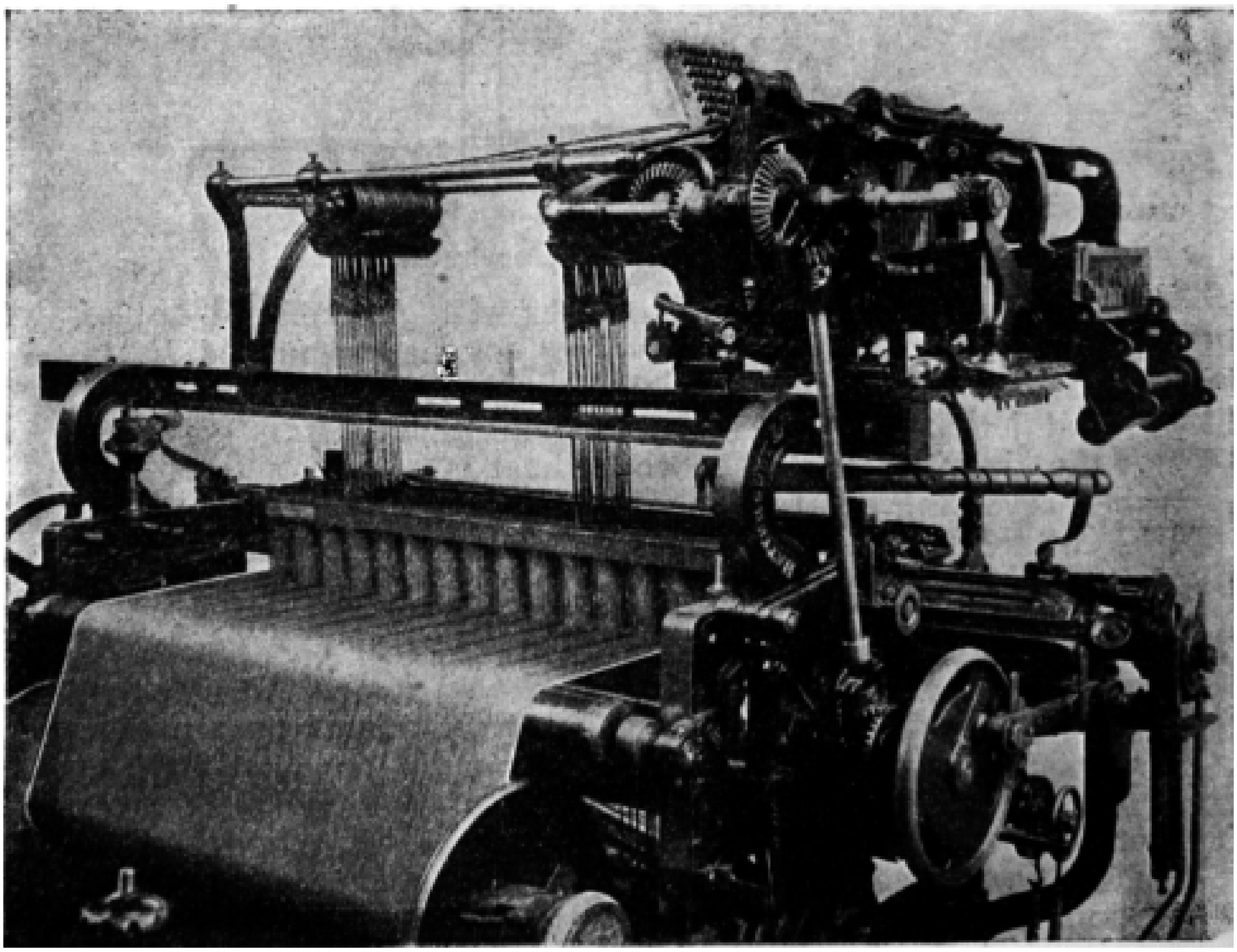


Fig. 130.
Hattersley's Rayon and Silk Loom. (Back View).

pick, and the number of turns being in accord with the number of picks extracted. This brings the fell of the cloth to its proper pitch.

The handle on the wheel is left nearest the circular box for on its under side is a rim, and in the rim is a gap. Into the gap falls a broad catch that holds it in position, the catch being held by the pull of the spiral spring shown at an oblique angle below the smooth wheel.

As soon as the smooth handle is let go, the two catches on the ratchet wheel fall into position, and the slide at the base of the inclined shaft rises at the same time and disengages the worm.

Temples.—Cloths are best controlled at the edges by temples specially constructed for the kind of cloth to be woven. Overlookers, however, have to make the best of available material. The temples used on this loom weaving rayon, had two rollers, the casting containing them being setscrewed to a flat bar that passed underneath the cloth. The outer end of the bar passes into the bottom of a right-angled casting, the upper end being held by a threaded rod by which the forward position of the temple is set. At the back, the rod passes through two projections on a bracket bolted to the front of the breast beam. On the rod, and between the projections is an open spiral spring with a set-screwed collar at the front to regulate the power of the spring. The collar is set so the spring is strong enough to hold the temple forward, and yet sensitive enough to readily contract if the shuttle is ever caught between the temple and sley. The bracket bolted to the breast beam sets the altitude of the temple.

Passage of Piece.—After leaving the temple, the piece passes over a steel breast beam which is stationary. It is slightly grooved in opposite directions from the centre to keep the cloth at about the same width as at the fell. The grooves are at an angle of about 75 degrees. The cloth then passes down to the taking-up roller which is covered with emery cloth, and has a circumference of 24 inches.

Mounted well forward on its upper surface is a felt covered roller with a similar one behind it, and round these two the cloth passes on its way to the cloth beam. On the extreme right of the taking-up roller in Fig. 127 is a sprocket wheel and chain, the latter connecting it to another sprocket wheel behind the cloth beam. This latter is a double wheel, the plain one meshing with a similar one on the shaft of the cloth beam.

Track of Warp.—In Fig. 130, it will be observed that the warp passes over a wooden roller, the ends of which are encased in metal. The gudgeons of the beam revolve in ball bearing brackets which makes the roller respond to the lightest touch, and places practically no friction on the warp. The bearer brackets are bolted to the loom frame and can be altered to the requirements of the warp and weave.

Weft Feeler Motion.

This mechanism is applicable to the weaving of rayon weft as well as to woollens and worsteds. It comes into operation before the tumbler weft fork, for it stops the loom before the weft is exhausted. By being brought into action before that of the weft fork, many light places are avoided which show when finished in delicate structures, and weavers who have to attend more looms than formerly, find this mechanism a valuable asset.

The Feeler.—Fig. 131 gives the outer view of the new motion. At A is the main casting which is fulcrumed at B. It is made of brass, and there are flanged guides at C and D

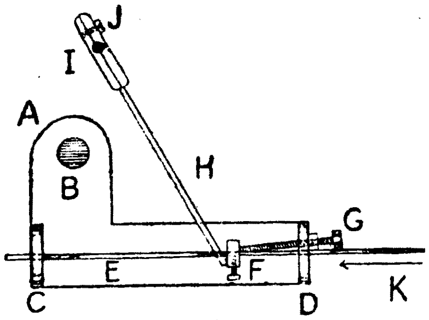


Fig. 131.

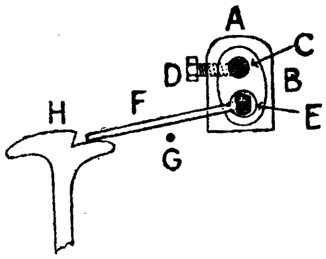


Fig. 132.

Hattersley's Patent Weft Feeler (End View).

through which the circular steel feeler E is made to pass. The feeler tapers a little at the front, the end of it being small and highly polished so as not to injure the most delicate weft. The feeler is long enough to be retained in the guides whatever be the movement imparted to it.

On it is the small setscrewed collar F, and against the front of it is the locknutted setscrew G which regulates the stationary position of the feeler. The setting of the feeler has to be, that when there is a sufficient covering of weft on the bobbin the loom will continue to weave, but as soon as the feeler can penetrate the slot in the bobbin, the loom is brought to a stop.

When the going part is brought forward by the crank, the feeler passes through a slot in the box front and shuttle front, and thus comes in contact with the weft, and is pushed back by it in the direction of the arrow K.

Needle.—Behind the collar is the needle H which is in two parts at the top and embraces the small spring rod I. The two parts are held together by the screw J which thus forms a clamp. By being so constructed, the spring rod can be set to give the best working results.

Knock-off Finger.—Fig. 132 gives in outline the mechanism at the inner end. At A is the casting at the end of the knocker-off bar which passes in front of the setting on handle. At B is a very short lever which is fulcrumed at C, the pin of which is held by the setscrew D. At E is the screw nut, and upon its boss the small finger F oscillates. The inner end of the rod rests upon the back part of the hammer head belonging to the tumbler weft fork.

At G is the inner end of the spring rod that passes underneath the finger F.

When the weft feeler is moved backward by weft pressure every other pick, then the spring rod G elevates

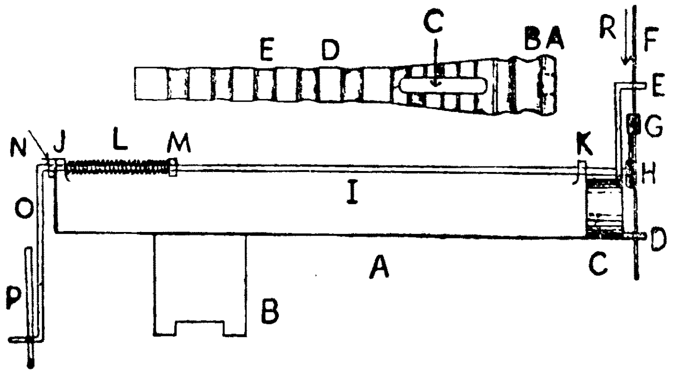


Fig. 133.

Top View of Feeler Motion.

Fig. 134.

View of Bobbin.

the finger F above the hammer head H, and the loom continues to weave.

When, however, the feeler penetrates the slot in the bobbin, the feeler and attendant parts remain stationary. When the hammer head now moves, it forces back the finger F and the knocker-off bar B and so stops the loom.

Fig. 133 gives the top view of the parts involved. At A is the framework of the motion, the part B being bolted to the front of the breast beam. At C, is the top of the brass casting with its guides for the feeler at D and E. At G is indicated the collar on the feeler, but the regulating setscrew is omitted. At F is the feeler with the arrow R showing its backward movement. The clamp that embraces this end of the spring rod is at H. The rod passes through guides J and K and on it is the spiral spring L which is held by the guide J at one end, and at the other by the setscrewed collar M.

It will now be realized that it is the spring L that keeps the feeler forward, for the clamp needle H exerts pressure behind the collar G on the weft feeler. The collar N prevents lateral movement of the spring rod. When the feeler F is forced in the direction of the arrow R, the collar G forces back the clamp needle H, and twists the spring rod I so that the end O raises the finger P above the hammer head, and the loom continues to weave.

When the weft feeler remains stationary, all the other parts do the same, and the hammer head then forces back the finger P and the knocker-off lever and so stops the loom.

Bobbin.—This is shown above the feeler motion, at Fig. 134, its actual size being 6 inches long. The head end A is capped with tin, and grooved top and bottom so as to be held by the solid projections on the spindle block in the shuttle. The bobbin cannot then turn and the groove C is retained at the front. The groove in the bobbin head at B is where the claws of the shuttle hold it. The slot C is 1⅜ inches long and ¼ inch wide, which gives ample scope for any variation in picking and checking of the shuttle.

There is only one slot in the bobbin, and the weaver has to see it is placed at the front in the shuttle. It is easy to tell as the weft is flatter.

Advantages.—The mechanism is remarkable for the lightness of its construction, and its sensitiveness in action.

It is simply made and reliable. As mentioned, the feeler stops the loom when there are only a few picks of weft on the bobbin, this being about equal to the management of a good weaver on an ordinary loom. Only a minimum amount of waste is made, and light places which are often a blemish in delicate pieces are entirely missing.

The new weft feeler motion has a knocker-off bar of its own which fits above the ordinary one attached to the tumbler weft fork.

HATTERSLEY'S DROP BOX LOOM FOR SILK AND RAYON.

This loom is the third which the Hattersley firm have constructed for the weaving of silk and rayon.

It is fitted with four boxes at either end, has a reed space of 57 inches, and has a speed of from 140 to 160 picks per minute and presented at Fig. 135.

Dobby.—The loom has a tappet dobby which has already found much favour. It is the same kind of dobby as the one for their circular box loom for rayon weaving. As this has already been explained, the reader may refer to it. There are, however, two differences (1) The boxes and picking are controlled by the shaft lags. (2) Instead of the shaft lags revolving inward for weaving, they turn outward.

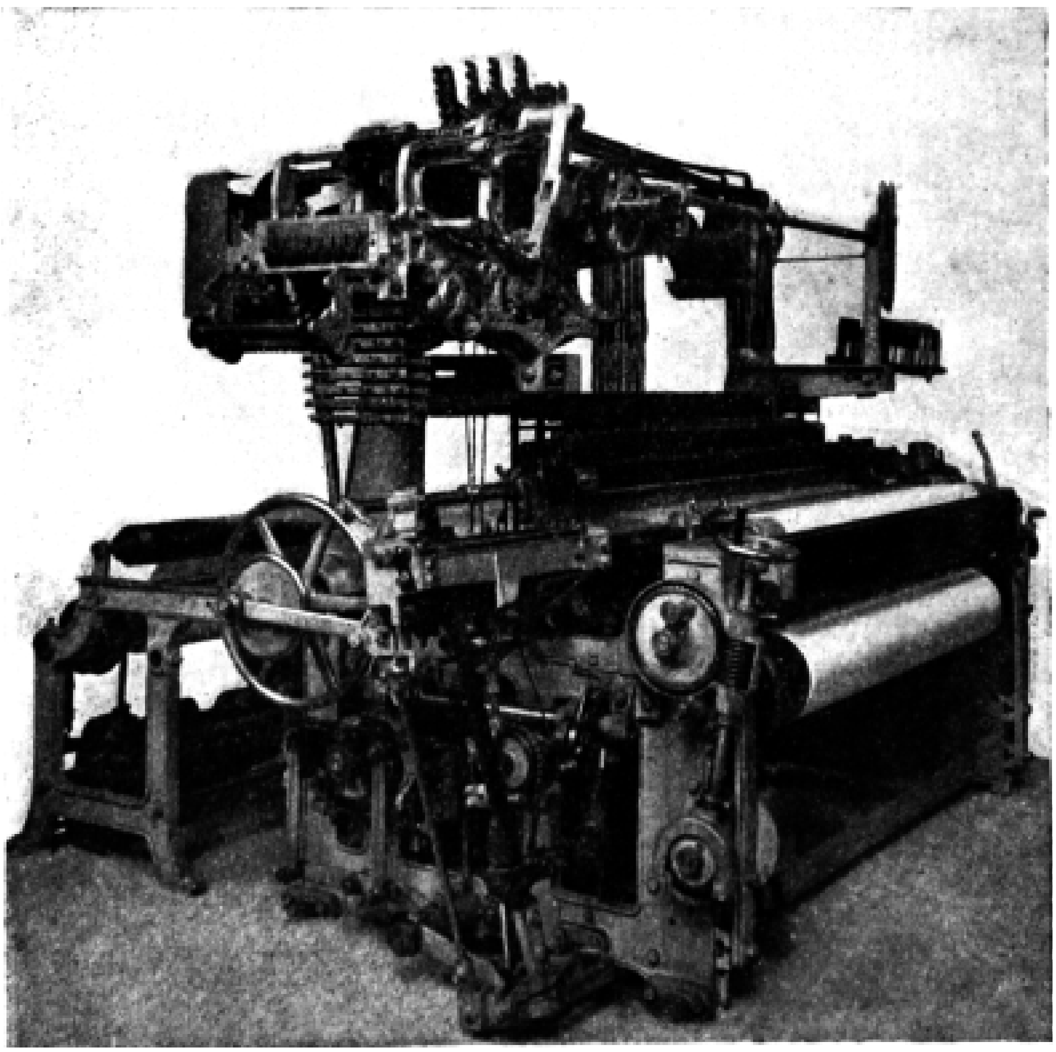


Fig. 135.

Hattersley Drop Box Silk and Rayon Loom. (Front View).

Picking.—An outline is at Fig. 136. A and B are the strong bearer brackets bolted outside the loom frame. C is the horizontal picking shaft, and is flat and bored at D for cone stud E. The cone stud diameter is $1\frac{3}{4}$ inches to generate a strong pick, for the low shaft is only half the speed of the crank shaft.

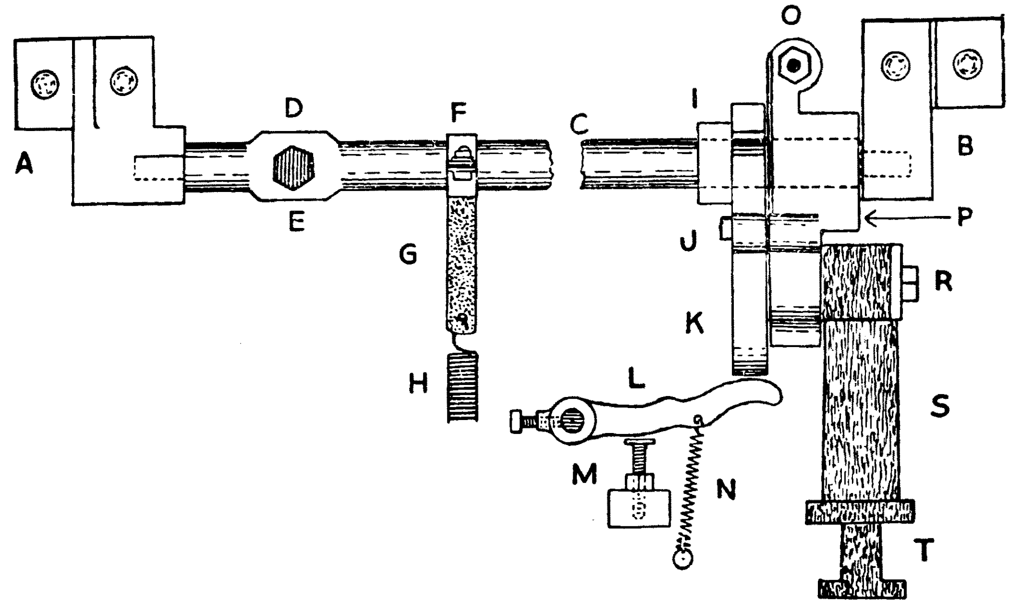


Fig. 136. Outside Horizontal Picking.

There are a pair of tappet noses at each end of the loom, and the picking boss is fixed so the end of the nose is level with the end of the cone. The cone is thrown upward when picking takes place.

F is the clamp on the picking shaft, and to this is attached strap G with spring H to pull the shaft round after picking. I is the boss of the picking cam keyed to the shaft. The larger diameter of the cam has a sloping cut that holds the sloping end of the picking catch when dropped for picking. The catch is fulcrumed at J and its lower curved part at K.

The lifting finger L is controlled from the box swell at the opposite end of the loom. If there be a shuttle in the boxes that are level with the shuttle race, the loom does not pick from either end, and the loom stops. The stationary position of lever L is regulated by the locknutted setscrew M, and is pulled back after action by spring N. When the picking catch is raised, the swing casting P and the wooden picking arm S are stationary, but on the catch dropping, both are brought into play and the shuttle is sent across the loom. The standing position of P is set by setscrew O the head of it contacting with loom frame. On casting P is the strong part R that holds the wooden arm S.

The arm is 9 inches long and $1\frac{3}{4}$ inches broad, and at T. is grooved to retain the looped picking strap.

Picking Stick and Arm.—At A, Fig. 137, is the pivot of the vertical picking stick. It is held in the cavity of the rocker casting, and has a covering bracket B, fulcrumed at C and held down by spring D. At E is the sheath for the upright picking stick F which is doubly bolted. G and H are bolted together and hold the regulation strap I that has charge of the thick strap J. The latter is bolted at K

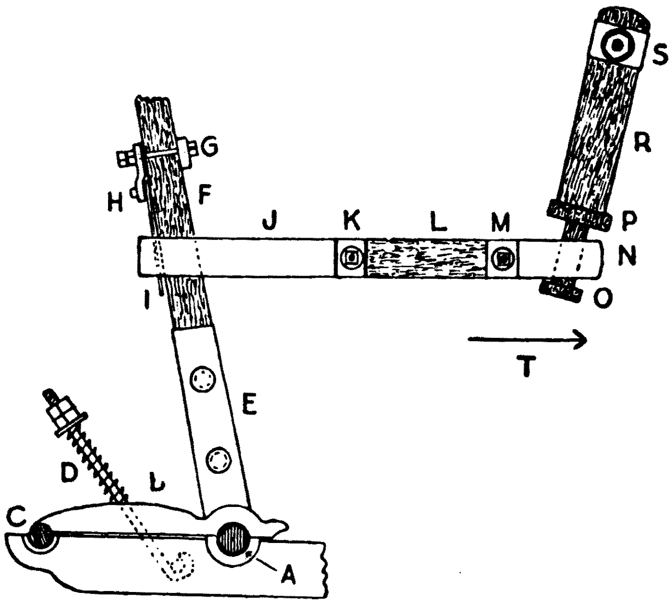


Fig. 137. Picking Arrangement.

to the short wooden arm L, and looped strap M passes at N round picking arm R, and kept in position by the circular projections O and P, the arm being centred at S. This arrangement generates a smooth and steady force very suitable for weaving silk and rayon yarns.

Tappet Checking.—Fig. 138 shows that A is the connecting rod that couples the straight lever C, D on the cross shaft F to a right angled lever near the shuttle boxes. B is the swivel casting.

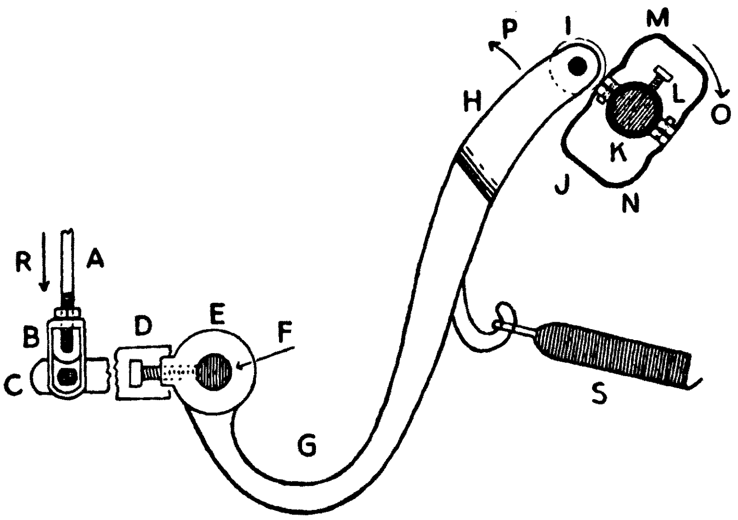


Fig. 138. Tappet Checking of Shuttle.

The curved lever G is the bowl casting with its boss at E on shaft F. It is bifurcated at H to receive bowl I. At J is the tappet clamped to the low shaft K, and timed by set-screw L. It is timed as shown, for when the crank is at its back centre, the bowl I is at or near the centre of the tappet. When the bowl is in this position, the picker and stick are forward for checking. When the tappet forces the bowl lever as arrow P, picker and stick slide back to the box end.

The tappet turns like arrow O, and rotates cross rod F from right to left, and lever C and rod A move downward as at R.

The bowl lever is kept in contact with the tappet by spring S. The corners M and N are more rounded than the opposites, so the bowl lever falls steadier than the ascent.

Spring Rod and Checking Lever.—These parts are at Fig. 139. A is the same rod as in Fig. 138. B is a right angled lever, and holds the spring rod D, the spring being confined by collars C and E. The spring rod passes through the curved casting G, emerges at F, and is held by a third

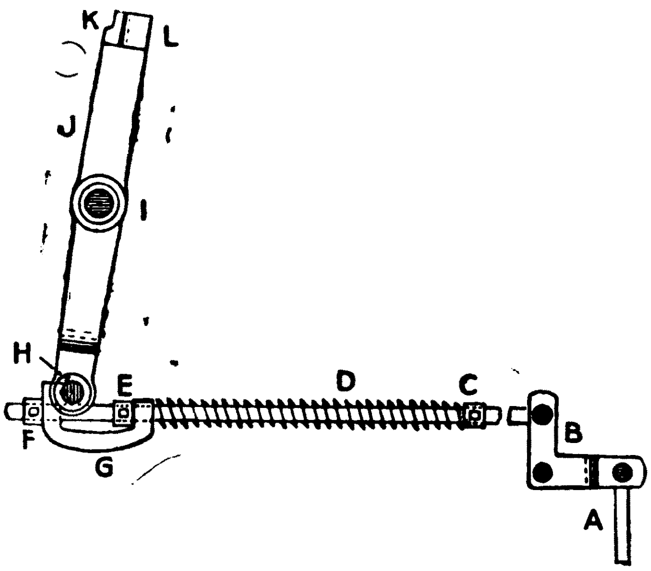


Fig. 139. Spring Rod and Checking Lever.

collar. Casting G rotates on pivot H. The checking lever J swings on stud I, and at its summit is the part K against which the back of the picker rests, and the head of its contacts at L.

When the crank is at its back centre, the picker is drawn forward from $\frac{3}{4}$ to $\frac{7}{8}$ inch to check the incoming shuttle.

The vertical picking stick passes through a slot in the buffalo picker that is blocked with leather at the inner front to protect the stick.

Fast and Yielding Reed.—The handrail visible in both photographs has nothing to do with holding the sley, but is a convenience for the weaver. Below it is the upper part of the reed case which is best seen in Fig. 140. It is converted int6 a fast reed by fixing a strong setscrew into either end of the reed case.

The fast reed is best for the heavier kind of work. By the extraction of the two setscrews, it does not make it an ordinary loose reed, for instead of the reed swinging free from the bottom of the reed case, and being retained at the top, the whole sley moves backward, and is therefore a " yielding " reed.

It is forced back when the shuttle is trapped in the shed. As soon as the going part is moved back by turning the balance wheel, the two powerful springs that are attached to the reed case push the sley back to its normal position. Below the reed case, but attached to it, is a finger towards either end of it. These pass under bowls on adjustable brackets which are bolted to the breast beam.

When the reed is forced backward, the two fingers rise, and ride over the tops of the bowls, this movement con-

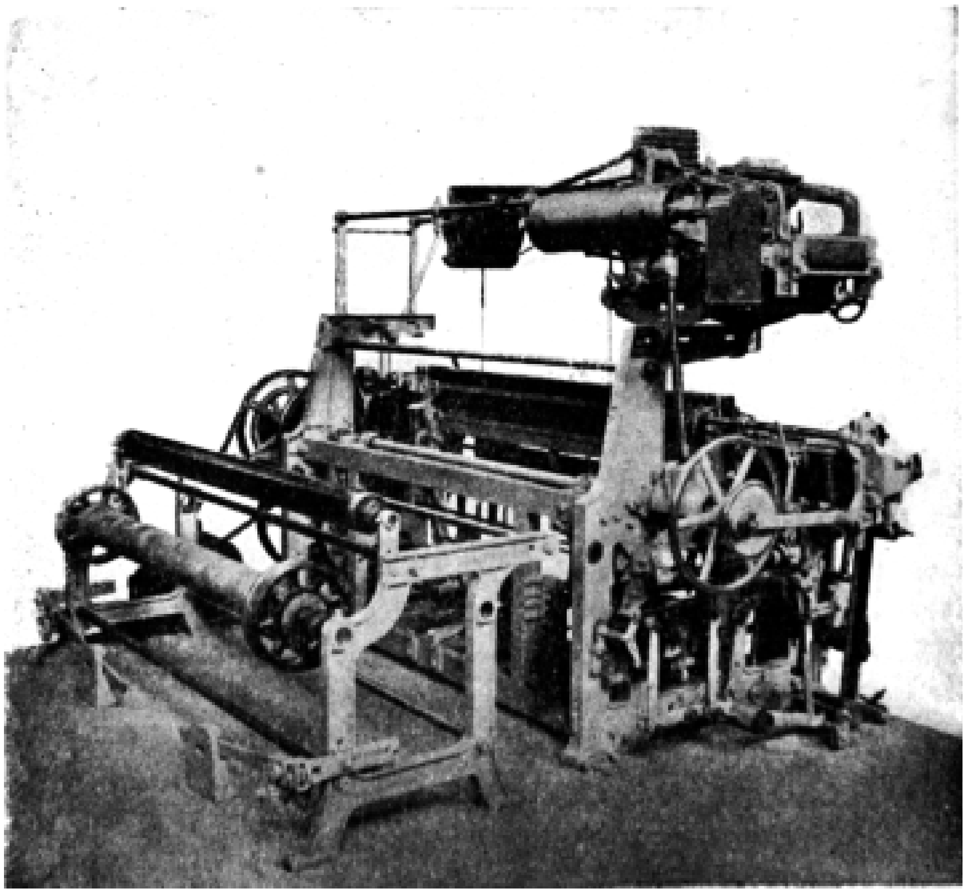


Fig. 140.
Hattersley Drop Box Silk and Rayon Loom. (Back View).

siderably easing the pressure of the shuttle on the warp, and prevents serious damage.

Negative Let-off.—As will be observed in Fig. **140** there is a separate frame for the warp beam and the back roller. This gives a good length of warp behind the healds, and spreads warp tension over a long length. The warp beam is provided with large flanged pulleys which are turned dead true, and are screwed fast to the beam.

The method of braking the beam is by rope and weight lever, the friction side of the rope having French chalk applied.

The gudgeons of the beam as well as those on the back roller over which the warp passes, revolve in ball bearing brackets. The brackets for the roller are adjustable, so as to meet the altering needs of the warps and weaves.

New Method of Take-up.—The back levers which govern the taking-up motion are seen just inside the back of the loom frame in Fig. **141**.

The construction of them is detailed in Fig. **140**. At A is the low shaft on which the tappet B is clamped, setscrewed, and timed. The bowl lever C is fulcrumed at D, and is kept in contact with the tappet by the pull of spring E. At F is the fulcrum of the regulation lever with its curved part at G, and its central open section at H. In this open section is the long rod which is finely threaded, and turned by the small handwheel I at the top.

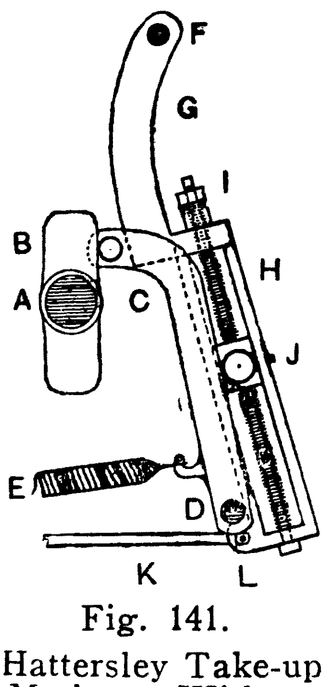


Fig. 141.

Hattersley Take-up Motion Without Change Wheels.

On the rod is the bowl casting J, the bowl coming in contact with the bowl lever C in front of it. The bowl casting J has a small pointer at the front, for on the face side of the lever, it is marked in inches down to quarters to record the position of the bowl casting, and indicate the number of picks which will be put in the cloth.

When the bowl casting J is at the top of the rod, it registers as few as 17 picks to the inch, but when near the bottom, it puts in **200**. That is a very wide range. At the base of lever H is the flat rod K, which is pinned to lever L, and connects the lever to the taking-up drum seen just inside the front of the loom frame in Fig. **135**. Inside the drum are two wheels that are cast together. The inner wheel has its teeth pointing towards the front of the loom, the teeth of the other are the same way but are not as broad.

The inner wheel is served by 31 taking-up catches, that are pinned inside the drum, and are swung backwards and forwards by the action of the flat connecting rod K in Fig. 141.

The outer section of the drum is stationary, and carries 31 catches. These prevent the wheels from running back. If, now, the two groups of wheels be multiplied together, it will be realized that the taking-up motion works almost to a 1,000 part of an inch.

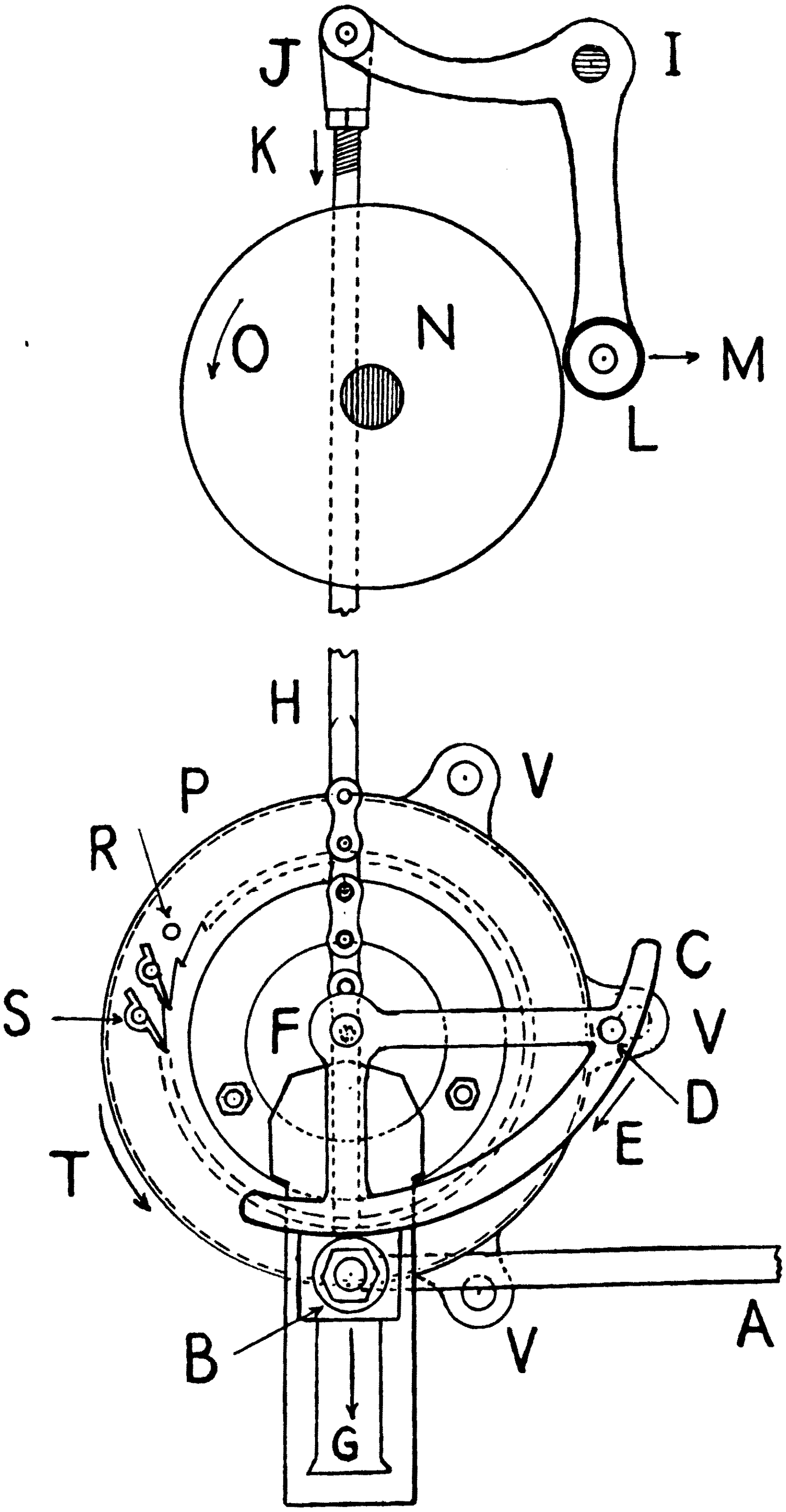


Fig. 142. Take-up Drum Inside Loom.

Take-up Drum.—At Fig. 142, rod A is the same as K in Fig. 140, and is fixed behind bowl B. Drum P has a diameter of 7½ inches, its movable part being innermost, and the back stationary part is bolted to the loom frame at the three projections V. At R are the pivots for the pushing catches S, the catches being held to the drum by special springs. In front of the drum is a compensating lever. The bowl B is on a slide that moves downward as the diameter of the cloth increases, and can move down over 2½ inches as suggested at G.

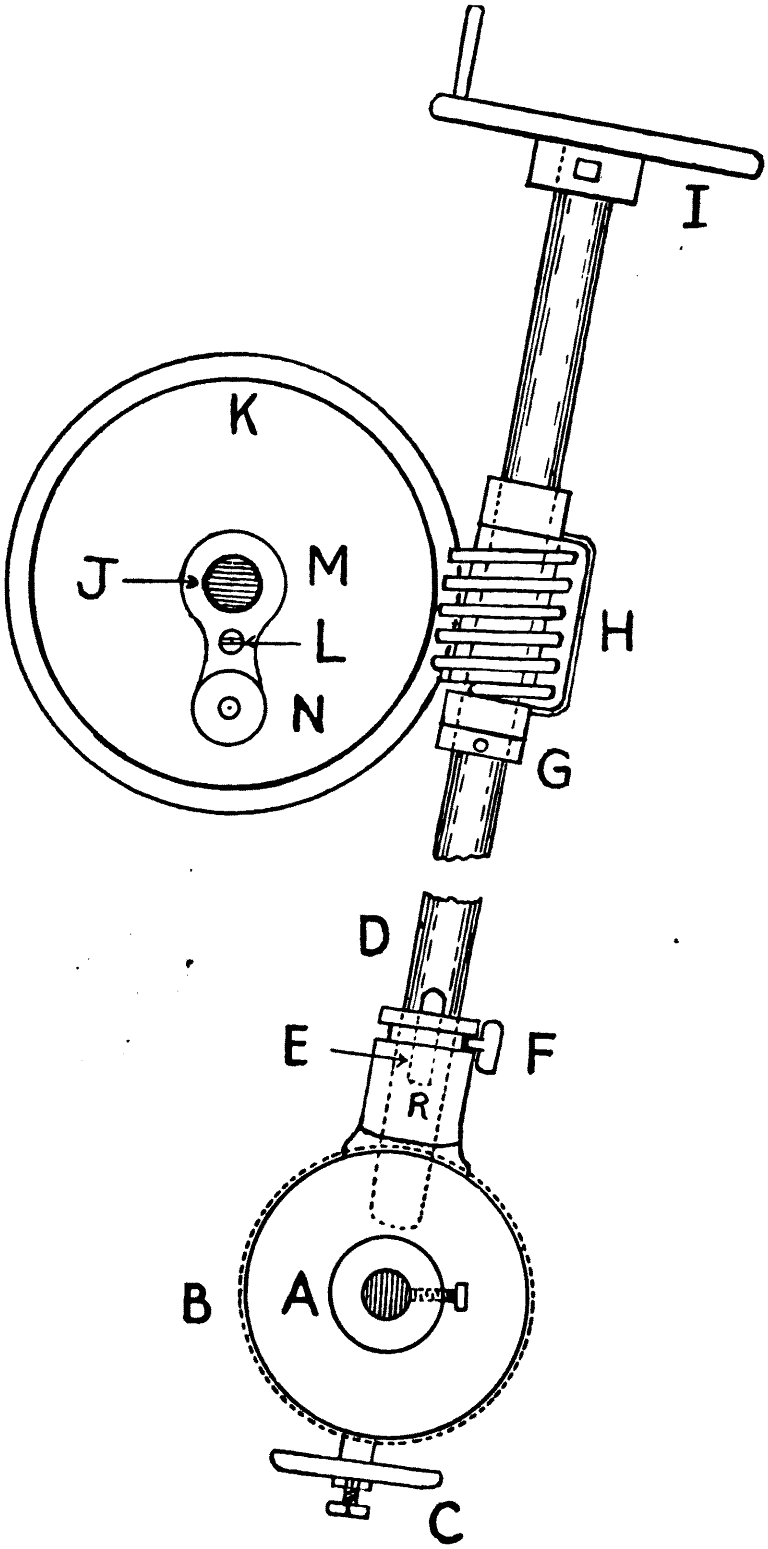


Fig. 143. Take-up Mechanism Outside Loom.

The large cloth roller is at N, turning as arrow O. Behind it is the felt-covered roller L that moves out as arrow M as the cloth wraps increase. The lever holding the felt-covered roller is on stud I, and its horizontal arm holds the swivel J that holds and regulates rod H that descends as the cloth increases in diameter. This influences the curved lever C that rests on the bowl top, and moves like E by means of coiled spring pressure, and keeps it in correct working position. The curved lever is fitted with a small handle at D, fulcrumed at F, and moved by hand when required.

Outer Take-up Shaft.—This diagram is at Fig. **143**. A is the outer end of the drum shaft, to which bevel wheel B is setscrewed. Any surplus oil is caught by the metal holder C. The strong take-up shaft D carries the bevel wheel E at its base. This can be lifted out of contact with bevel wheel B, by clutch fork F that is connected to handles at either end of the loom. Bevel wheel E slides on a saddle key on shaft D. By means of handwheel I, the cloth can be let off or taken up. Shaft D is held in its rotating position by collar G. Worm H is rotated by the take-up drum, and turns the large wheel K that meshes with it. K is loose on shaft J, but arm M is fixed to the wheel by screw L. At the base of arm M is the plunger N, which, when withdrawn, liberated the cloth beam. On short shaft J, but inside loom is a small wheel that meshes with a large cogged wheel that turns the cloth beam. The large wheel has a series of holes used by the plunger N, but is hollow inside. Into it is placed a star wheel having ten parts, and into any two of its gaps which are opposite each other, two projections on the hollow side of the wheel make entrance. As the star wheel is fixed on the shaft of the cloth beam, it rotates by the action of the take-up drum.

At the opposite end of the loom, the shaft of the cloth beam is held by a sleeve, which, when withdrawn, the cloth beam and cloth can be removed and an empty one substituted.

Box Motion.—The segment wheels with their attendant levers are best seen in Fig. **140**. All three segment wheels have two sets of teeth. The centre wheel that turns the others is setscrewed to the low shaft, and by it the movement of the boxes are timed. The boxes begin to move when the crank is at its top centre, and they have changed and come to rest when the crank has reached its bottom centre.

All three wheels are turned every pick, but the boxes are only moved when the legs of a clutch penetrate the plate in front of the small wheels which carry the connecting arm to the lifting lever of the boxes. The clutch forks are influenced by pegs in the shaft lags. The back segment wheel controls the second box, and the front one the third box. When both work in unison for lifting, then the fourth box is brought level with the shuttle race.

But there is a further invention. It will be noted in Fig. 135 there is a drum with a chain attachment about the centre length of the box rod. The lower end of the chain is fixed to a casting on the box rod. Inside the drum is a coiled spring that exerts pressure anti-clockwise to the drum. This makes the lifting of the boxes a very easy matter, for when the escape motion is released from its groove on the box rod, the box immediately rises to at least half its depth.

As may be observed in Fig. 135, there are two weft forks, each being set at an equal distance from the centre of the shuttle race. Each fork has three prongs. The shape and movement of the forks are better understood by an examination of the drawings.

Tappet Driven Weft Fork.—This is at Fig. **144**. Tappet A is in two sections, and clamped to the low shaft B. It is timed by setscrew D. The prongs reach their highest when the crank is at its back centre, and the elevation must allow

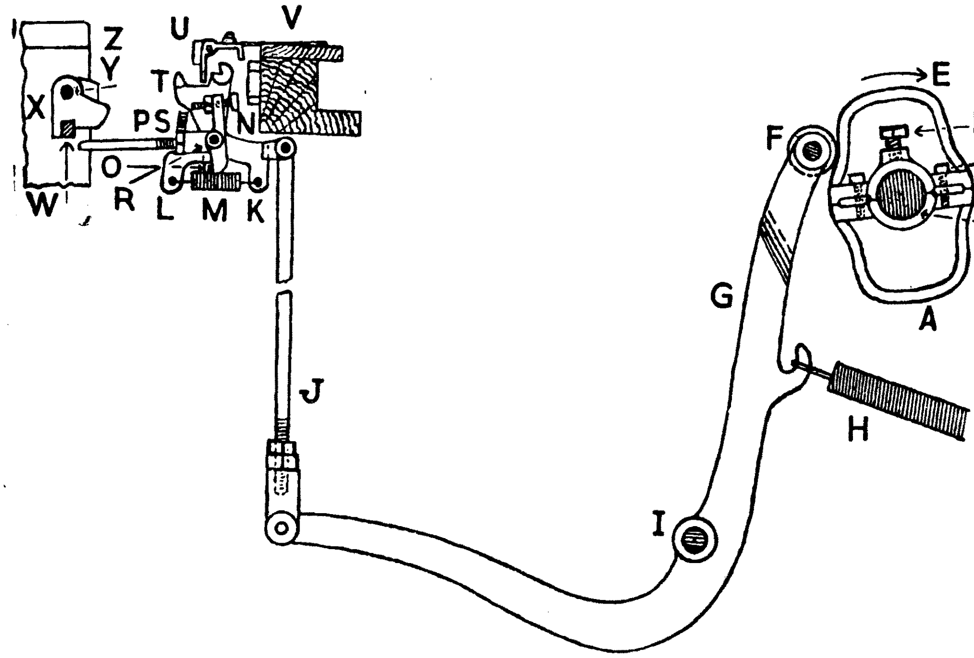


Fig. 144. Tappet Driven Weft Fork.

the shuttle to pass underneath with a quarter inch to spare. The tappet moves as arrow E.

Bowl Lever and Connecting Rod.—The anti-friction bowl is at F, and the long lever at G moves on I. After action, it is brought back by spring H. Connecting rod J is fixed by a swivel to the inner end of bowl lever. The top of the rod is pinned to the short lever K.

Fast and Loose Levers.—Cross rod R, Fig. 145, takes the place of a stop rod. On it are placed both fast and loose castings. Lever K to which connecting rod J is pinned, is a loose casting but its front end comes in contact with the back of the short lever L that is screwed to cross shaft R. They are kept in contact by spring M that is fixed to both levers, so that when the tappet elevates rod J, lever L is moved downward and other fixed castings move with it, and vice versa.

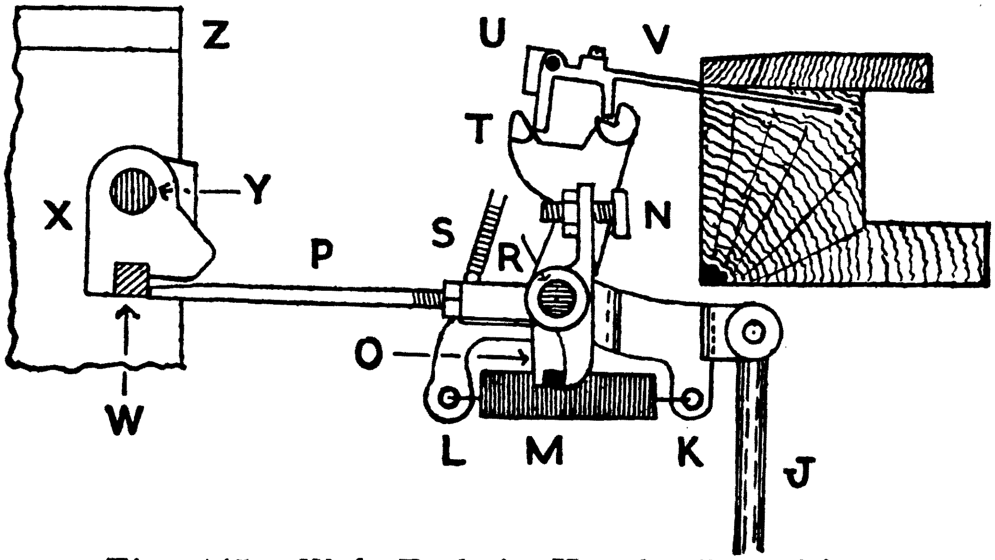


Fig. 145. Weft Fork in Knock-off Position.

Another loose part on the shaft is the casting into which the stop rod tongue P is screwed and locknutted. By being threaded, the working length of the tongue is altered, for on becoming worn, it may be lengthend. Along with stop rod casting P, is the double-armed lever N that works in unison with the stop rod casting. It has a locknutted set-screw, the head of it coming in contact with the lay, and limits the upward movement of the tongue.

Both stop rod P and lever N are moved by the short arm O for it contacts with N.

It is the locknut on N that imparts the correct position to the point on the stop rod tongue in relation to frog W.

Weft Fork Regulator.—This part is at T in Fig. 144 and is screwed to cross shaft R. It has a horn on the left, and a head on the right. The diagram illustrates that the weft is holding up the prongs, and has allowed the head of the regulator to pass clear of the right leg on the tippler, so the loom can continue weaving.

When the connecting rod J descends, the regulator moves to the right, and the horn comes in contact with the leg on the left, and raises the prongs. When the stop rod tongue P contacts with frog W, the stop bracket X swings on its pivot at Y, and releases the setting on handle and stops the loom. The breast beam is at Z.

Knock-Off Positions.—Fig. 145 represents the parts when the weft fails. The lettering is the same as Fig. 144. As there is no weft to hold up the prongs V, they sink into the groove in the shuttle race. The cut in the head of regulator T seizes the short leg on the weft fork and stops the movement of the fixed castings on cross shaft R. As the stop rod tongue does not sink, it strikes frog W on casting X, and the loom ceases to run before the reed contact with the cloth. This prevents light places being made in the fabric. The tappet raises the rod J to the same height, and because the fixed castings do not move, the spring M is extended.

Positions When Crank at Back Centre.—These are illustrated in Fig. 146, rod J is down to its limit, and has moved the weft fork regulator T to the right, and the horn

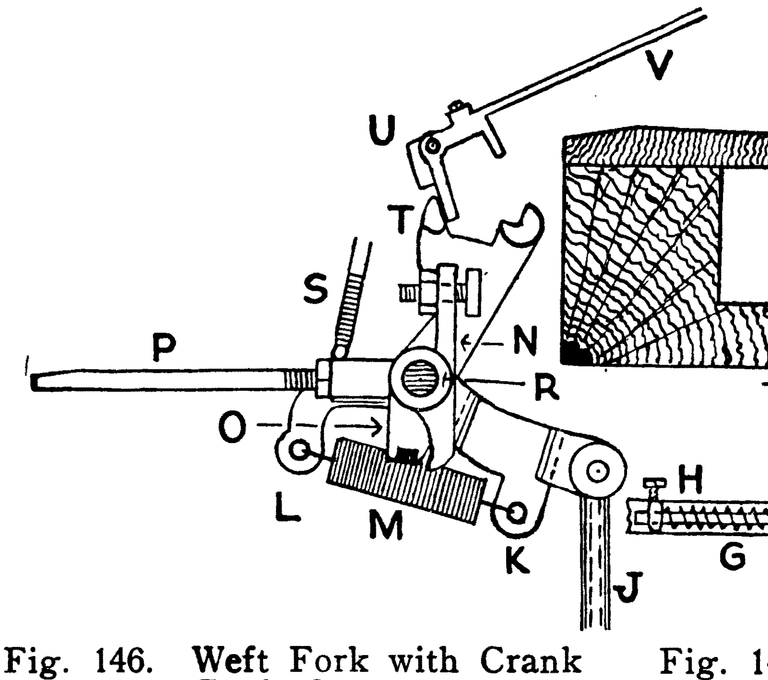


Fig. 146. Weft Fork with Crank at Back Centre.

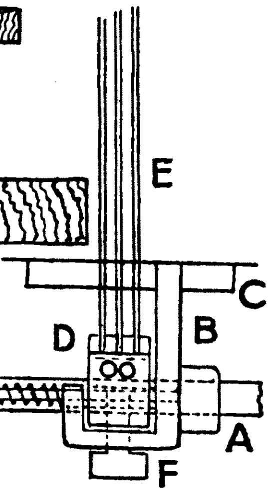


Fig. 147. Front View of Weft Fork.

has come in contact with the long leg on the weft fork. As the contact parts are case hardened, they last much longer.

Front View of Weft Fork.—Fig. 147 shows A as the cross rod, and is the same as R in the other drawings. B is the casting attached to the lag C, the casting holding the short rod upon which spring G is placed. The spring is straight at either end, and enters a small recess in B and H. By collar H the spring can be made weaker or stronger, and compels the weft fork prongs to begin their descent as soon as the crank leaves its back centre.

At D, the weft fork casting has three grooves and carries three prongs, three being much better than two to hold the slippery weft. The free ends of the prongs are placed at an obtuse angle so as to gradually slide off the weft. A couple of screws hold the plate that retain the prongs in the casting. At F is the upper part of the head of the regulator.

On the same loom is a pick control. The picking is not governed by pegs in the box lags, but by the swells of the boxes. If there be a shuttle in each box that is level with the shuttle race, the loom will not pick from either end. It is a very clever invention.

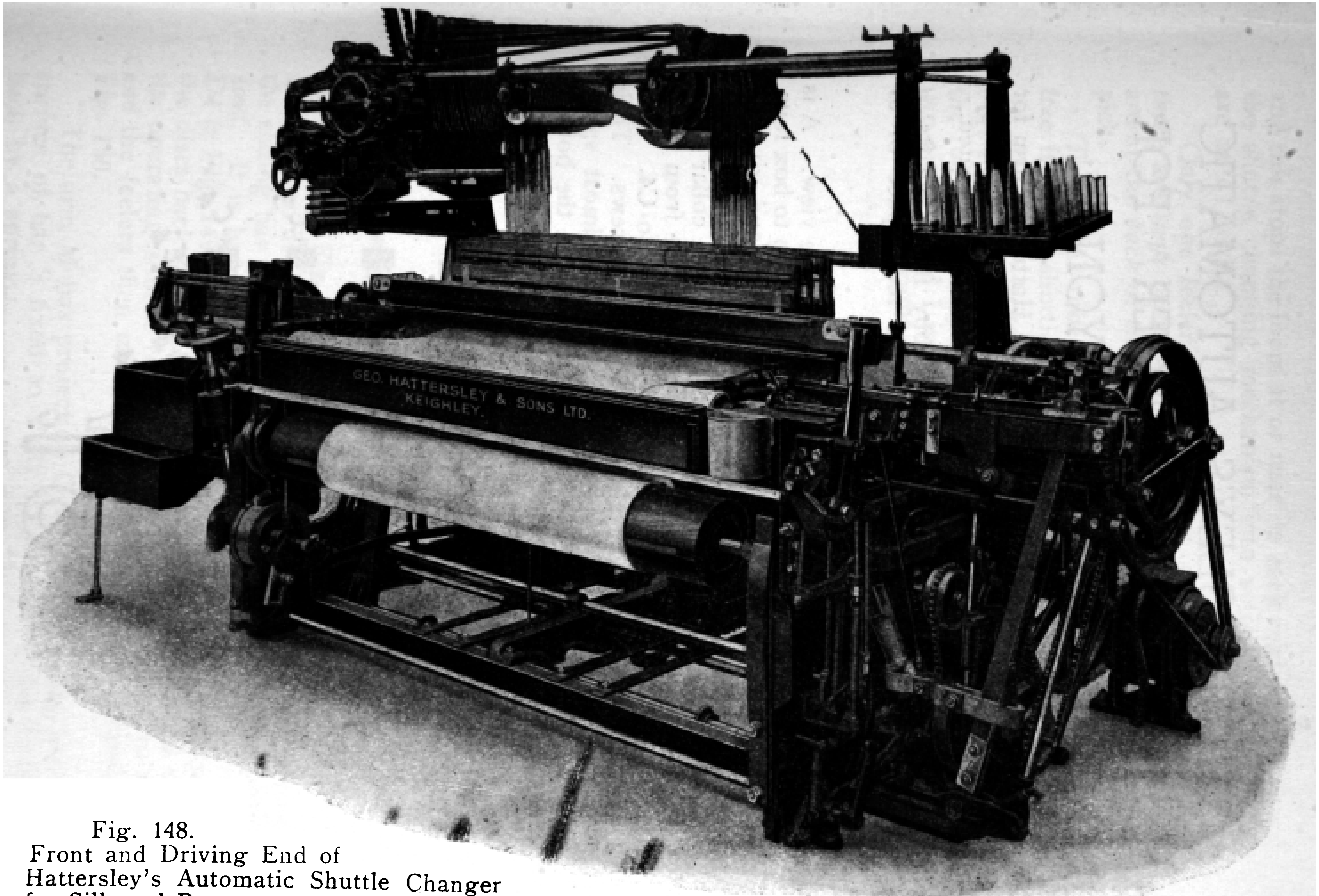


Fig. 148.
Front and Driving End of
Hattersley's Automatic Shuttle Changer
for Silk and Rayon.

HATTERSLEY'S AUTOMATIC SHUTTLE CHANGER FOR SILK AND RAYON.

This is the fourth loom made by the Hattersley firm for the weaving of silk and rayon. Parts of this loom are the same as the 2nd and 3rd looms and need not be repeated.

The loom has a tappet driven dobby for 24 shafts, a speed of 148 picks per minute, and a reed space of 57 inches. Fig. 148.

Weft Feeler Motion.—Fig. 149 gives a side view. A is the shuttle in the first box at B, and others fill up to box four. The box shelves are turned up at the front, and give the weaver good visibility of the weft. At C1 to C4 are the round steel feelers each having two discs and a collar along with an open spiral spring. The front discs are from D1 to D4, and the back discs and collars are at C1 to C4. Each disc is adjustable by a couple of threaded screws. Their positions are set so that when the weft is almost spent, the front of the feeler can penetrate the slot in the bobbin,

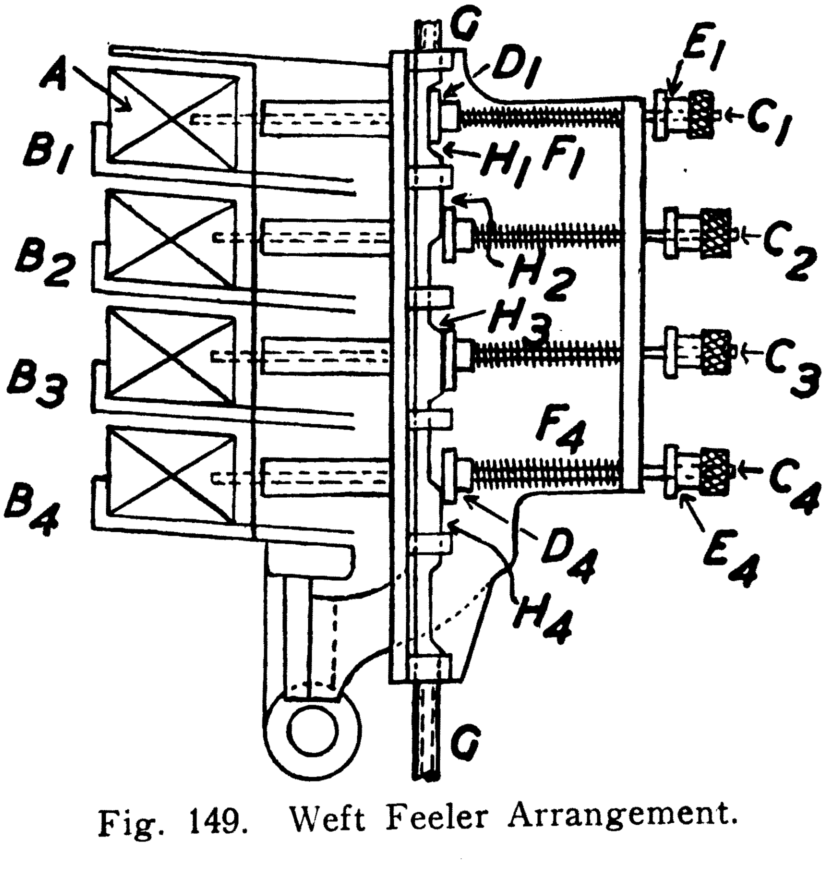


Fig. 149. Weft Feeler Arrangement.

and this stops the loom at or near its back centre, and brings the shuttle changing mechanism into action. The springs are at F1 to F4.

Only one feeler can operate at a time, for the other three are kept back by the turning of rod G. The feelers are at the *back* of the drop box, and only move every other pick.

The metal tubes through which the feelers pass, are free from the shuttles.

Cam and Lever Movements.—These are outlined in Fig. 150, and its lettering continues from Fig. 149. At I is the rod actuated by a cam that makes one revolution every two picks. Rod I is pivoted at J, and at K and M are the two arms of a right angled lever with L the fulcrum. Arm

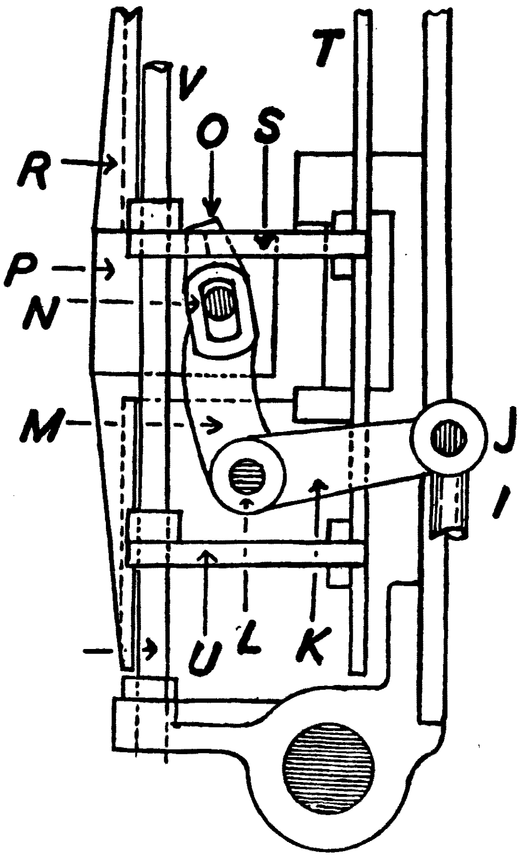


Fig. 150. Cam and Lever Control.

M is slotted at the top to receive pin N. This pin is part of the sliding bar P and has bar R fixed to it in a vertical position. It is bar R that comes in contact with discs D1 to D4 in Fig. 149. When slide P moves horizontally, R moves the discs backward from the shuttles, and are retained until the operating shuttle returns to the box and comes to rest, and the feelers then move forward by rod I being raised in Fig. 150.

The arm M has projection O which affects the inclined surface of bar S fixed to shaft V, the bar being brought back by a spring.

It is when rod I is raised that the fully operating feeler makes contact with the weft on the bobbin, and the whole series are taken away before picking takes place by the downward movement of rod I.

As bars S, T and U are associated, they move at the same time. If now, there be sufficient weft on the bobbin to keep the operating feeler back, the bar T passes in front of the back disc E1 in Fig. 149 and the loom continues to weave.

If, however, the feeler penetrates the bobbin, it moves further forward, and in this way the back disc E1 arrests the movement of bar T, and this leads to the loom stoppage.

Loom Stoppage by Feeler Action.—Fig. 151 is lettered like the two previous diagrams. Here, C1 is again the feeler, with D1 the front disc and B1 the back one. F1 is the spring and G the top part of the rod that controls the front discs. At I is the top of the rod that rises on one pick and falls the next.

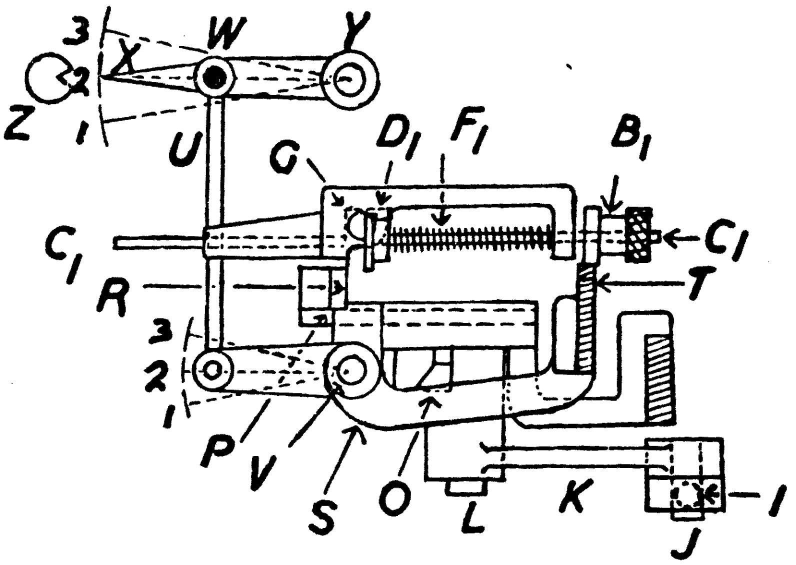


Fig. 151. Feeler Motion in Knock-off Position.

It is this that moves the right angled lever, one arm of which is at K with its fulcrum at L. O is the projection that moves the parts P and R and the lever S, and the attached stop bar T. Levers S and U are fixed to the top of rod V, and thus move together when the rod is turned. The rod U is connected at the top to the stop pointer W and rod V. The front of the pointer is at X, and pivoted at Y.

When weaving, lever U moves from position 1 to 3 in the arc of a circle, and so does pointer W, going forward on one pick, and brought back the next. When feeler C1 penetrates the bobbin, it prevents bar T from completing its movement. Lever U and pointer W are also arrested at half traverse, and pointer X is brought opposite the cut in stop pin Z, and as the going part moves forward, Z is forced back and stops the loom with the crank at or near its back centre.

Shuttle Changing Tappets.

When the stop pin is forced back, it drops a small bar behind the hammer head bolted to a bayonet lifted every other pick by a tappet on the low shaft. The forcing back of the small bar stops the loom and brings the shuttle changing mechanism into play at the opposite end of the loom.

Functions of Tappets.—These are set forth in Fig. 152. There are four tappets, each of which are doubly setscrewed to the tappet shaft A.

Tappet 1.—This is at B, and is shaped like a half moon. On its upper surface it carries the rounded end of a right-angled lever C. Its other leg is at D and at its end there is the locknutted setscrew E. When tappet B raises lever C, setscrew E is brought in contact with lever F fulcrumed at G, and is on the same bar to which the bottom of the picking stick K is secured. The lifting of lever C pushes the picking stick to its outer limit, and makes possible the discharge of one shuttle and the entrance of another.

At H is the checking lever at the back of the picking stick, and makes it stand forward for the picker to receive the incoming shuttle. The amount of resistance is regulated by the strong spring shown. At I is the metal casing that holds the stick. The thick connecting leather J is bolted to a short wooden part L, and the looped leather M connects it to the wooden picking arm. The length of the leathers have to make the shuttle begin to leave the box when the crank is at its bottom centre.

Tappet 2.—The largest tappet of the series is at N, and controls the carrier for the shuttles. The carrier is pivoted at its base but on its shorter arm at O, it carries a bowl that rests on the tappet. There is only one carrier, whether the loom is fitted for two shuttles or four. The carrier has a threefold movement. It is moved outward to be under the shuttle to be dropped; it moves forward to deposit the shuttle in the box; it moves back to its stationary position.

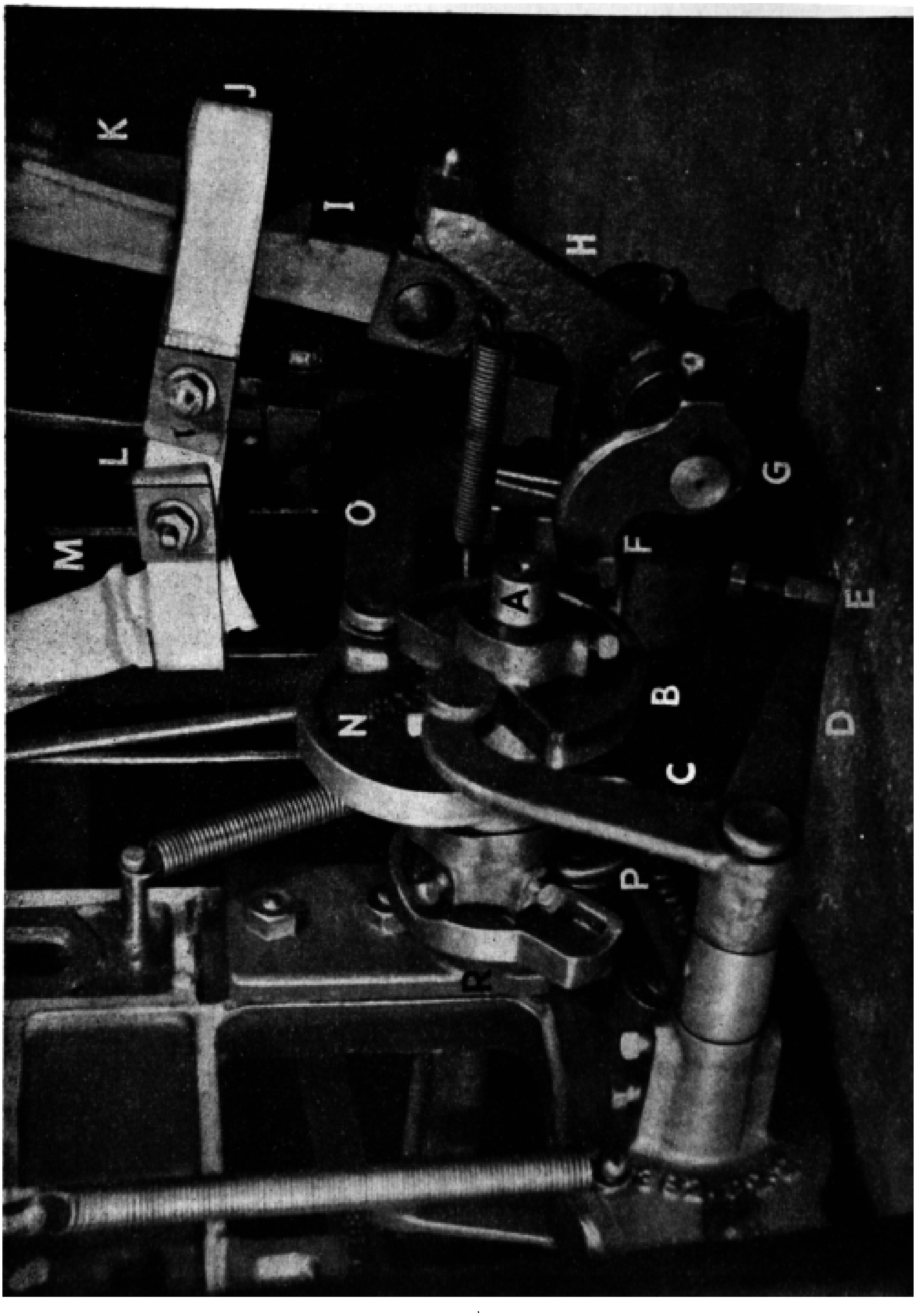


Fig. 152. Shuttle Changing Tappets.

Tappet 3.—This is the smallest of the four, and only a little of it is seen at P. It operates the horizontal lever pinned to the same shaft as the picking shaft lever.

To the front of the bowl lever, a rod is attached to the lever pin, and by lever and rod being depressed, the front of the shuttle box is raised for the ejection of one shuttle and the insertion of another. By the upward movement of the front, there is a forward movement at the back part of the same casting, for there are two vertical rods that move forward, and push out the spent shuttle, that falls into a padded box. As soon as the carrier plate has deposited a fresh shuttle in the box, and makes a clearance, the box front descends, and the two rods return to their grooves in the box back.

Tappet 4.—The inmost tappet is at R, and is the " prevention " tappet, for it arrests all movement if anything goes wrong. The front of the tappet engages a bowl which is pivoted in front of the tappet. The bowl lever has charge of two catches. When the bowl lever is depressed, both catches are thrown forward and are then held and lifted by the lever at its tapered top. Both catches are " safety " catches, and, by means of a rod, are indirectly in contact with the box swell. If the fresh shuttle is not properly in the box, the swell of the box is still in its inner position, and the going part cannot move further forward than the frog allows. The tappet shaft is turned by a link chain that runs three sprocket wheels. One wheel is at the outer end of the tappet shaft at the driving end of the loom; the second is secured to the crank shaft; the third is on the shaft that carries the clutch for driving the tappet shaft.

Setting Loom in Motion.—When the changing of the shuttle has been safely accomplished, the loom is automatically restarted by means of another tappet on the tappet shaft, but at the opposite end of the loom. This is a *positive* tappet that depresses a bowl lever fulcrumed about the centre of its length. At the front, it has a tapered catch on its forward side. This part of the lever is raised, and the catch then comes in contact with a cut on the vertical arm that is secured to a rod, that is on one arm of the set-on handle. The tappet gives sufficient depression to the bowl lever to raise it at the opposite end, and by this lift, the loom resumes weaving. The loom only stops four seconds to change the shuttle, and is a great credit to the inventor.

THE NORTHROP LOOM.

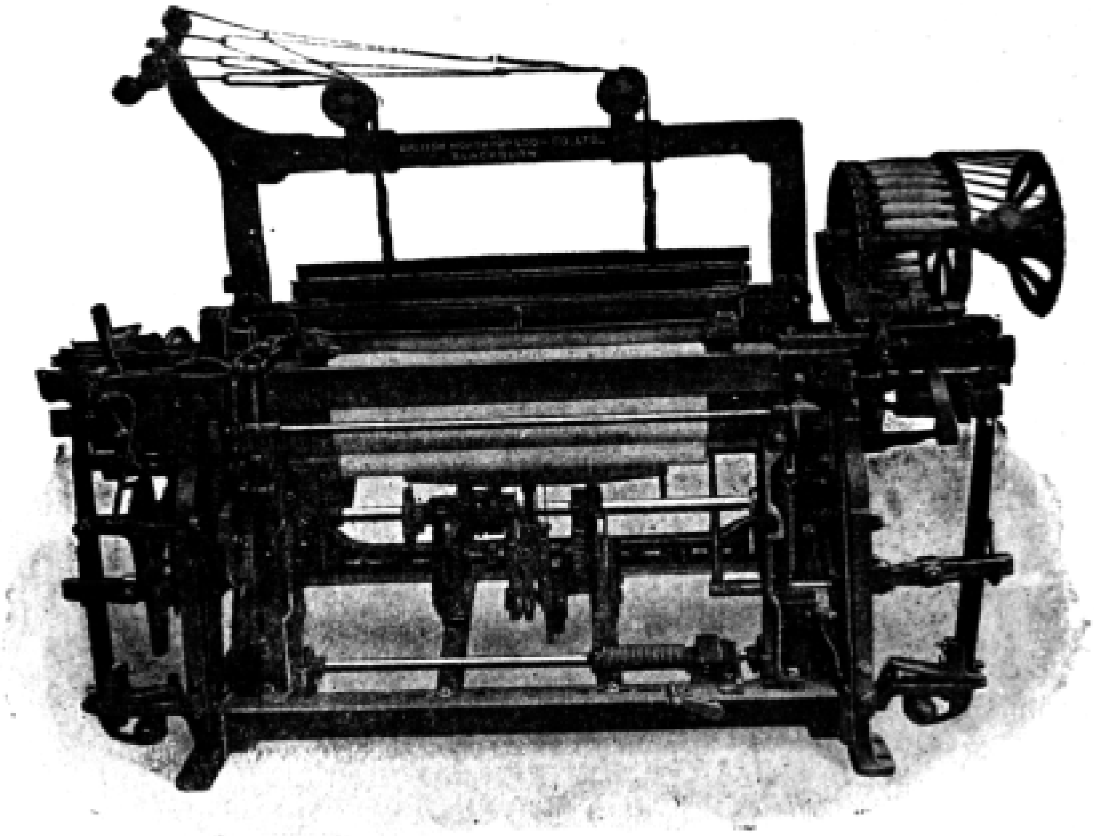


Fig. 153.
Standard Light Weight " T " Model.

The Northrop loom (Fig. 153) is the most successful automatic loom that has yet been invented. Though much slower in being adopted in the British Isles than in most parts of the world, it is gaining ground in the native country of its inventor. The credit of it is due to Mr. J. H. Northrop who was a native of Yorkshire, but emigrated to America. He brought out his patent in 1894 which changed the bobbin in the shuttle without stopping the loom. From this beginning, it has been improved and applied until to-day there are 600,000 of these looms at work in the factories of the world.

There are many makes of this loom engaged in the manufacture of all kinds of goods, both plain and fancy. The Northrop bobbin changing motion is applied to tappet looms, dobby looms, and jacquards, and may be run with one shuttle or up to four.

Dobbies.—There are three chief kinds of dobbies, these being the Lancashire type with ball and socket construction:

the Leeming dobby of positive construction which has previously been explained, and also a special dobby for the weaving of Terry towelling.

One kind of Lancashire negative dobby is the " K " model. This dobby is for 16 shafts. The jack plates front and back are set by three locknutted setscrews which are seldom disturbed, because balks and catches can be taken from the dobby without unloosing the screws. The balk is ball-hooked at its back centre to fit to the dobby jack, and the catches are also ball-hooked to oscillate in the recesses on the balk. The front part of the jack and balk are divided to keep balk and catch in position.

The catches have only one cut on the under side. The top series are actuated by needles which rest on the upper and inner ends of the feelers, but the bottom catches are moved by fingered feelers.

The lag cylinder has 8 grooves, and each lag represents two picks. The cylinder is turned by a pawl, the shaft of it being bolted to the lower arm of the front shedding lever. On the shaft of the pawl is an open spiral spring which is strong enough to pull the cylinder round without contracting, but gives way if ever the cylinder becomes locked. On the cylinder shaft is a wheel with 8 coarse pitched teeth by which the cylinder is turned. In front of it is a small brass handwheel for the use of the weaver.

At the back of the dobby, the cylinder shaft is fitted with a star wheel and a curved check finger by which excess movement is checked, and the cylinder held steady after being turned. No excess movement need be made if the pawl be well set. The cylinder is fixed so the pegs fully meet their respective feelers, and drop their respective catches fully on the drawbars. The pegs have rounded tops to impart a steady rise and fall to the feelers.

Underneath the outer and bottom end of the feelers is a levelling bar, which, when pulled towards the weaver, elevates the whole series, and then by one turn over of the loom, all the shafts are brought to the top shed.

As shown, the draw bars are connected to the shedding levers by adjustable rods that are set in two ways. (1) They are placed in the centres of their slots, so that if anything becomes locked, they can be forced in either direction. (2) When at their dead back centres, the top front of them gives a clearance of $\frac{3}{16}$th inch to the cuts on the catches. The **T** lever behind the engine is in two parts, for the centre arm is hollowed out to pass on to the main shaft of the dobby, and its two wings are setscrewed to the face of the shedding lever. The stirrup at the top of the shedding rod is also in two parts, the shedding rod being bolted to the major one. The bottom of the rod is fixed to a slide bracket and is adjusted so that when at the outward centre of its sweep, the **T** lever is at the centre of its stroke. This produces equality of sheds.

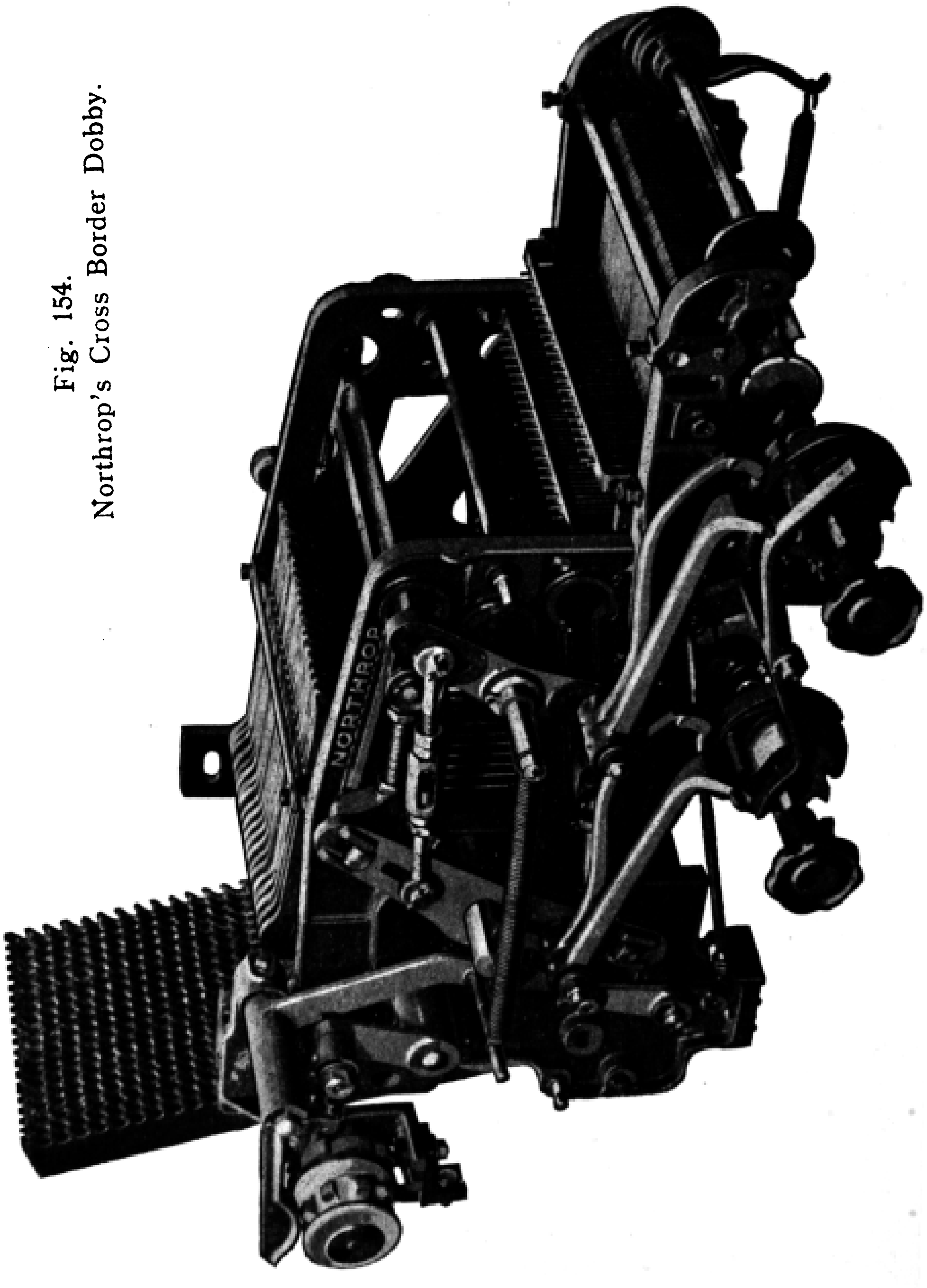


Fig. 154.
Northrop's Cross Border Dobby.

Much of the foregoing equally applies to the Northrop negative two barrelled cross border dobby seen in Fig. 154 that weaves terry towels, etc. This dobby takes 20 shafts. It is fitted with two cylinders that operate the dobby, and a small master cylinder that puts one cylinder out of action, and bring another into play.

The lags on the master cylinder are turned by a catch wheel and pawl behind the small cylinder.

When a peg on the small cylinder operates, it lifts a lever, the under side of which is convex, and above the master cylinder, and turns it inward. In so doing, one of the large cylinders is put out of action, and the other brought into play.

Each of the larger cylinders have two catches, one catch operating the lag cylinder every other pick, and the other turning it half way when not wanted. On not being required, the other cylinder is first given a half turn that brings it into action and then proceeds in the usual way until arrested. All the catches have to be set to give the correct leverage. The lever above the master cylinder is brought back by the long spring seen in the illustration.

Picking.—In a weft mixing loom, there is a plain box at one end, and a mixing box at the other. As this structure employs two kinds of picking it is given preference. It is an underpick loom. The picking boss is held to the shaft by a key in a sunk keyway, and by a couple of setscrews. The shell is fixed to the boss by a couple of bolts, the former having a width of $\frac{3}{4}$ inch. The two wings of the boss have radiating teeth which mesh with similar teeth on the shell and assist in holding it firmly. If bolted in the centre of the slots, and the driving wheels properly timed, then the shell can be adjusted in either direction to produce the best effect.

As this loom is of the heavier make, the picking shaft is below the tappet shaft. It is the usual practice with this model to have the crank at 25 past when the picking stick is just beginning to move the shuttle out of the box. Modifications are essential when the picking nose is worn.

Whether the picking shaft be above the tappet shaft as in light model looms, or below for heavy makes, the picking shaft in both is held in position outside the loom frame. In the former, Fig. 155 the picking shaft has a flat slab, and to this is bolted the strap casting. The looped strap at this end as well as that which passes round the picking stick, is bolted to a short wooden arm, the total length of the three

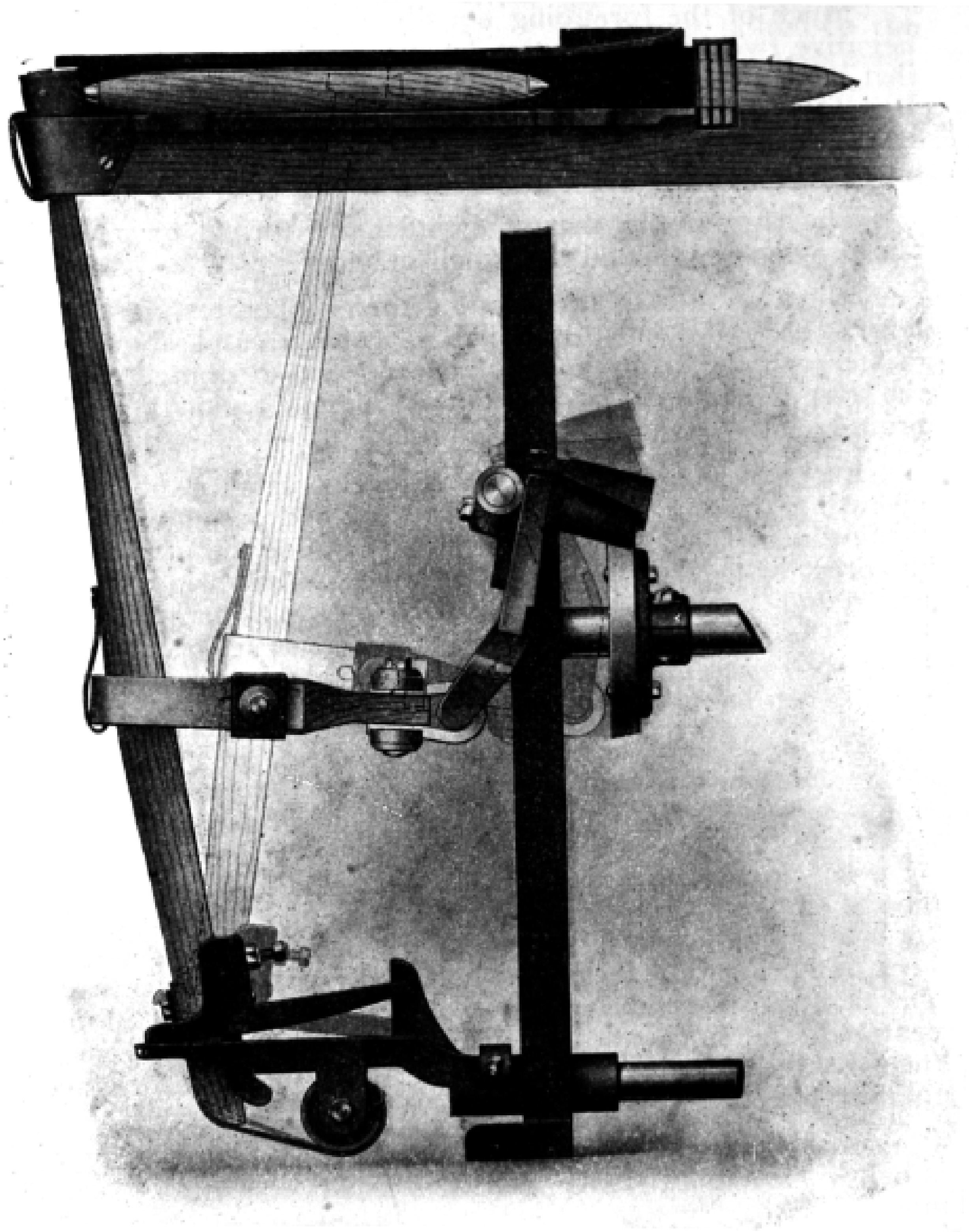


Fig. 155.
Parallel Underpick Motion.

parts being adjusted to make the shuttle begin to move out of the box at the right time. So that no binding can take place between strap connection and stick, there should be at least a finger's breadth allowance between the back of the stick and the strap when the crank is at its top centre, and the stick at the end of its outward traverse. The length of the lug straps have to be set so that a stroke of 7 inches is given to the picking stick for narrow looms, 9 inches on medium width looms, and 11 inches on wide looms.

The stirrup strap that holds up the lug strap is behind the stick, and should place the bottom of the lug strap 9 inches above the parallel, which brings it about level with the fixing at the opposite end. Level working gives the best results. Towards the bottom, the picking stick is bolted to the rocking shoe, and at the top front of the shoe is the regulating screw by which the picking stick may be made higher or lower to give a correct delivery to the shuttle.

When the picking stick is at its full forward traverse, and the shuttle tip in the hole of the picker, the bottom of the shuttle nearest the picker should be lifted $\frac{1}{16}$ inch above the shuttle race. The two toes of the rocking shoe which are elevated in the illustration, fit at either side of an upright projection at the front part of the parallel, and the heel of the shoe at the opposite end rests on the parallel when the stick is at the limit of its outward traverse. The base of the shoe is curved, and when the stick is about the centre of its movement, the shoe is at the centre of its length. The parallel is fixed to the rocking shaft at the foot of the loom by a couple of setscrews. By these screws, the stick should be set in the centre of its movement which the parallel can make when the fixing screws are slack.

After picking, the stick is brought back by the coiled spring underneath the parallel. The projecting iron wedge seen at the front base of the stick has to be well lubricated to prevent unnecessary wearing, as this part affects the throw of the shuttle.

The picker may be made of leather or canvas, and if the latter, they will wear better when stored in a damp place. Canvas is cheaper, but leather lasts longer, and has a better effect on the shuttles.

On placing a fresh picker on the stick, it is first tested for altitude, for whether the stick be at either limit of its traverse, the picker must be a little above the box bottom. The picker is then marked by the shuttle tip at both ends of the stick movement. It is then taken off, and a shallow hole is gouged, the centre of which must lift the shuttle $\frac{1}{16}$th inch above the shuttle race as mentioned. If at any time a further adjustment is essential, it can be done by slackening the binding bolt in the shoe, and adjusting the setscrew at the top of the shoe.

Having attained these points, the picker is screwed to the stick, a gimlet being first used to prevent the stick splitting. The hole in the picker is countersunk to take the head of the screw so as not to catch the weft.

The other style of picking is different. The front end of the picking shaft is turned up at right angles to the shaft, and on it is a setscrewed collar with a sloping top. The inner of the two thick lug straps rests on the top of the collar, and the higher the collar is placed, and the greater is the movement imparted to the stick. In both types of picking, the top of the stick when in the centre of its stroke, must be below the overhanging top of the box back.

At the mixing box end, the picking stick passes through a long slot in a buffalo picker. The part of the picker nearest the weaver has a rib which fits into a slide setscrewed to the front of the box. The slide keeps the picker in a horizontal position, and assists in a correct delivery being given to the shuttle. A spindle passes through the picker in front of the box, the outer end of the spindle being adjustable by the casting through which it passes.

Checking of Picking Sticks.—At the plain box end, a canvas strap passes at either side of the picking stick, both ends being bolted to the bracket below the box. The front part of the strap is upheld by the check strap bracket, and an adjustable regulating finger in front of a gap in the casting, regulates the amount of friction applied.

The forward movement of the stick forces the check strap forward, and the backward movement of the stick draws it back. These straps are made to regulation length. At the drop box end, a coiled leather pad fits behind the stick. This is moved by a tappet on the tappet shaft coming in contact with a lever coupled to the leather pad. The

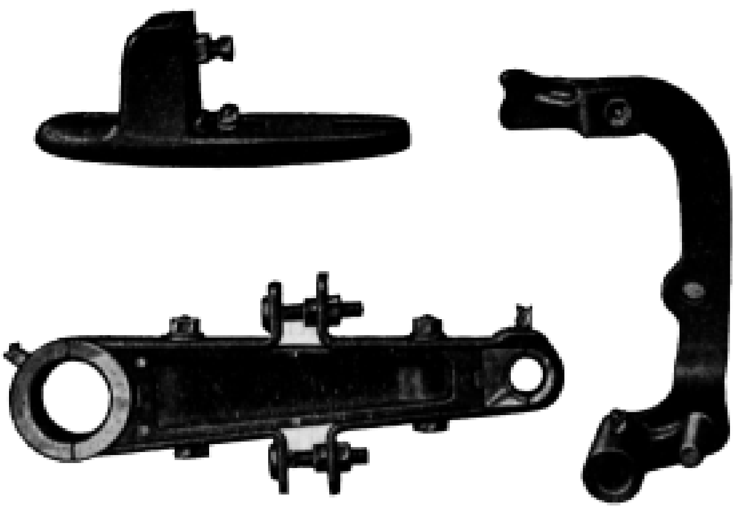


Fig. 156.
Shuttle Protector Picking Shoe and Crank Arm.

movement to the pad is regulated according to the requirements of shuttle checking, the usual distance being 1½ inches.

Beating Up.—(Fig. 156). Crank and sword pin are bushed with brass, and these along with the crank arm are held as one solid whole by a pair of metal straps. Where the straps face each other, they are turned at right angles to their length, and both ends are held by the same bolt, the bottom being likewise. The sword ears are fitted with eccentric pins, the ends being countersunk and held by set-screws. The pins are turned so as to give exact measurements from the front of the breast beam to that of the sley or sword fronts.

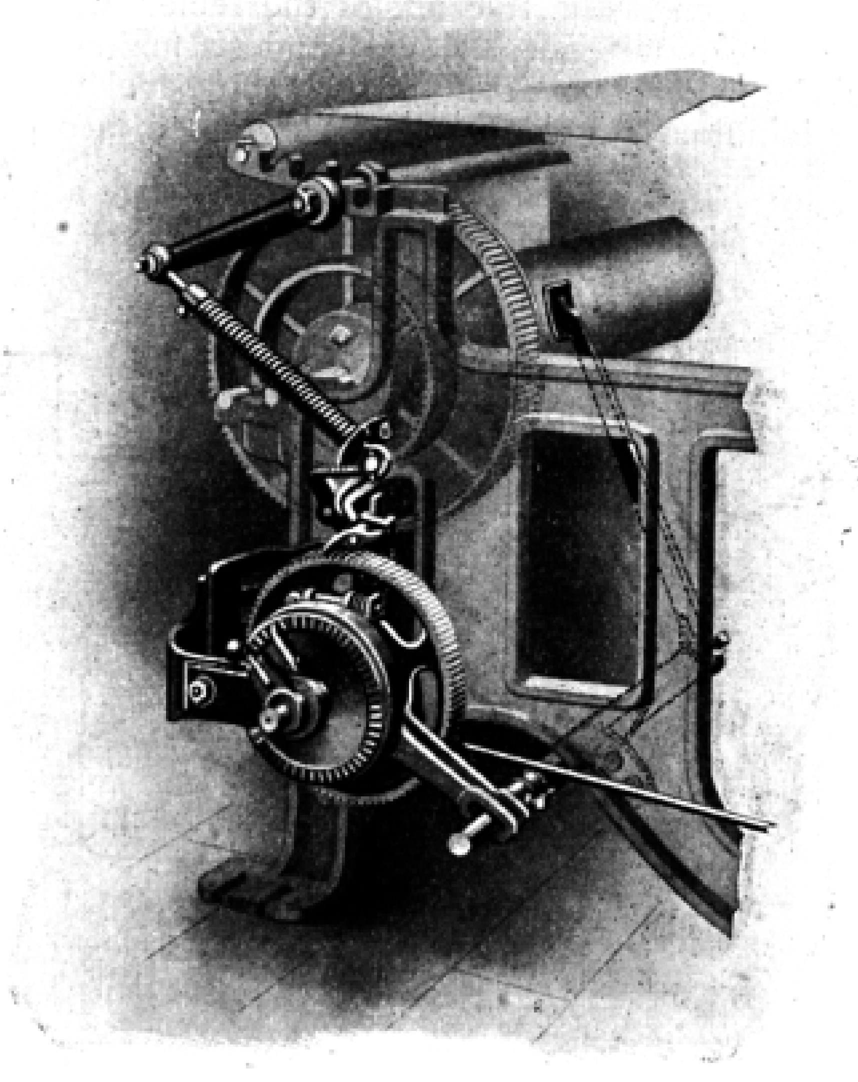


Fig. 157.
Roper Automatic Warp Let-off Motion.

Letting Off.—To dispense with the regulation of weights on the warp beam levers automatic motions are installed. For light and medium weight cloths there is the " Roper " motion, but for wide and heavy cloth the " Bartlett " let off is preferred. As an alternative to the latter, there is a worm let-off motion which is built on a similar plan to the Dobcross letting off motion already described.

The " Roper " mechanism is presented at Fig. 157. It is made in two strengths, one being suitable for a low number of picks, and the other for a large number per inch. The driving force is imparted by the horizontal rod at the loom base which is attached to the loom sword at one end and the pawl lever at the other. The control of the force is vested in the strong spring attached to the back rail lever, for the stronger it is made, and the less movement is made by the rail and the pawl. The other is the warp beam feeler seen pressing against the warp on the beam. As the warp decreases in bulk, the feeler moves nearer the empty beam, and the rod which is the fulcrum of the feeler increases the leverage of the pawl control lever, and so makes the warp beam move quicker. In front is seen the bevel wheel with its folding handle. When the handle is pulled into position,

"BARTLETT" LET-OFF MOTION

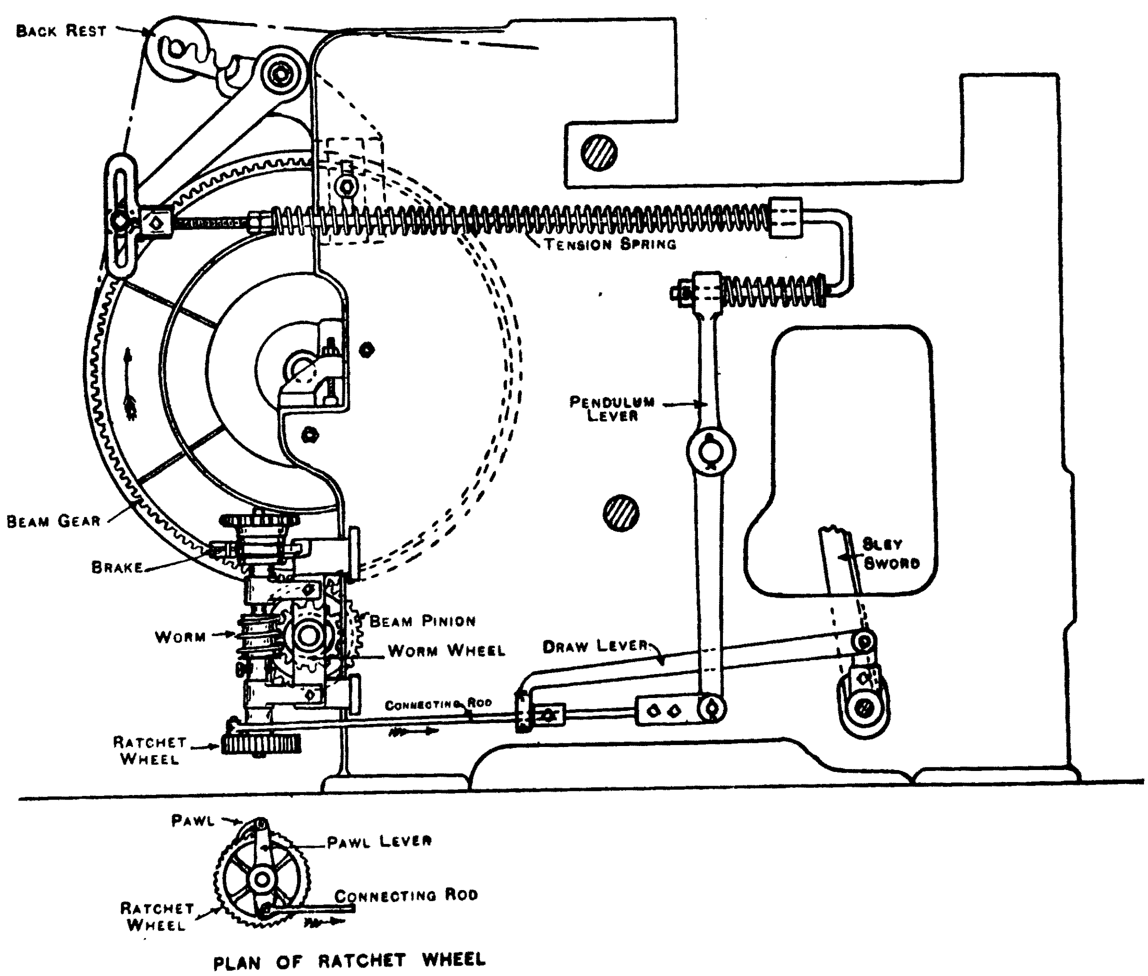


Fig. 158.
Bartlett Let-off Motion.

it releases the holding catch, and the wheel may then be turned either way to let off or wind on the warp. The beam feeler is set so that when resting against an empty beam, the stud in the control pawl lever is $\frac{1}{4}$ inch from the bottom of the lever. When the warp beam has a warp on measuring 22 inches in diameter, then the pin mentioned is almost at the top of the pawl lever. Tables are provided showing the necessary wheel changes for the number of picks per inch required in the cloth.

Fig. 158 is the "Bartlett" let off. In this mechanism, the beam pinion is moved by a worm in the centre of the vertical shaft shown, and the ratchet wheel at the bottom. The hand wheel at the top is for the use of the weaver. The long vertical arm beyond the worm is the pendulum, and this is set vertically when the crank is at its back centre. When the crank is at its front centre, the draw lever attached to the sword, and on the extreme left bottom of the illustration, has drawn the connecting rod so that the pawl lever is in line with the back rail of the loom. When in this position the collar on the connecting rod should now be against the face of the draw lever connected to the swing rail. The tension on the warp is regulated by the long spring on the rod at the base of the swing rail lever.

Taking-Up Motion.—As will be seen from Fig. 159, the ratchet wheel is the bottom of the series and is moved one cog at a time. Behind it is the ratchet pinion having 28

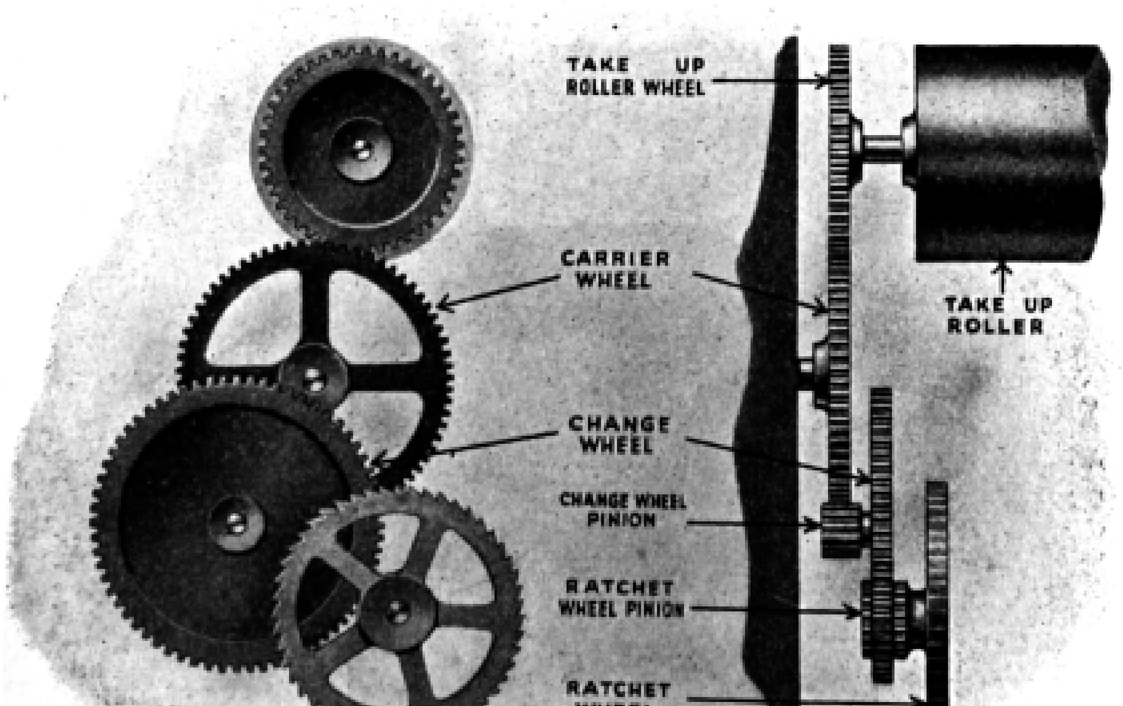


Fig. 159 (Side View). Fig. 160 (Front View).
Ratchet Take-up Motion.

cogs when the picks per inch do not exceed 90, but above that, another wheel is substituted having only 14 cogs which turns the series of wheels at half the speed. The gauge point for the change wheel that meshes with the ratchet pinion is a tooth per pick. The change wheel pinion runs the intermediate wheel, and the intermediate is companion to the wheel on the shaft of the taking-up roller. Fig. 160 gives the front view. The taking-up catch has a long finger by which it is raised by hand, and the holding catch is lifted with it. By both being raised, the cloth can be let back. Below the taking-up catch is a lever by which the cloth may be quickly regulated, or the warp drawn forward.

Bobbin Changing Mechanism.

There are two chief methods by which the bobbin changing mechanism is brought into action, one being mechanical, and the other electrical.

In the first, the "Midget" feeler shown at Fig. 161, is the latest development. In this, a wire with a looped end and a gimped front projects from the box. When this wire

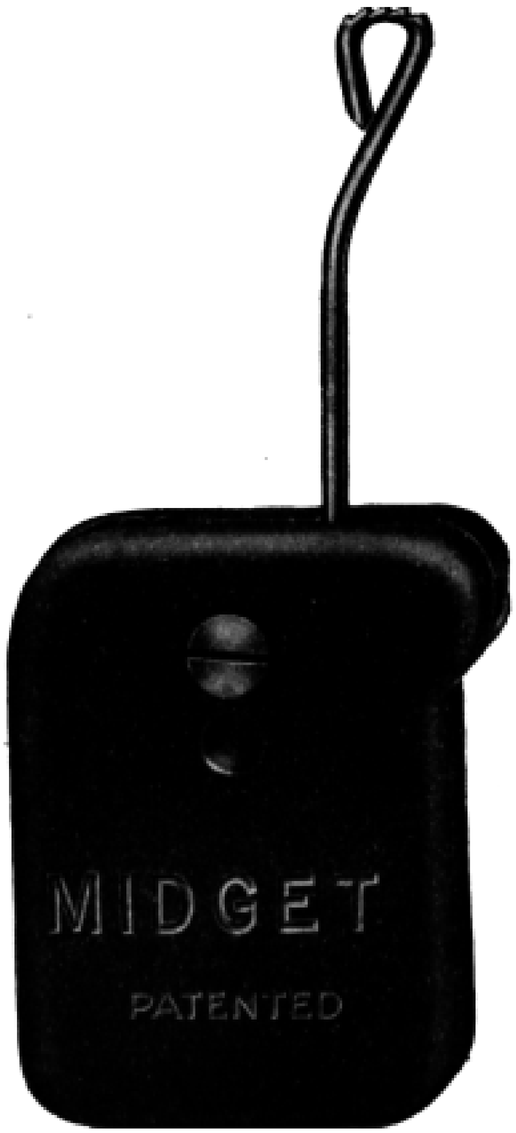


Fig. 161. Midget Weft Feeler Motion.

passes through the box and shuttle front, it comes in contact with the weft. So long as the coils of weft hold the wire straight, the loom continues to weave, but when the coils become scarce, the wire slips on the bobbin, and causes an attached rod not shown to let fall the trip lever. When the trip lever descends, it finds lodgment in the trip heel which is on the outside of the weft fork hammer. When the hammer moves towards the weaver when the trip lever is down, the latter is forced back, and as it is fulcrumed to a strong bar associated at the opposite end of the loom to the bobbin changing mechanism, it is brought into operation.

For the "Midget," it is necessary to have a small bunch of weft wound at the base of the bobbin to prevent undue waste being made.

The parts involved by the trip lever being forced back are as follows:—

Battery in Weaving Position.—Fig. 162 gives details of the parts in their weaving position. When the battery is set correctly, the bottom bobbin in it is horizontally straight with the shuttle box. On the crank reaching its front centre, the battery bobbin is parallel with the bobbin in the shuttle.

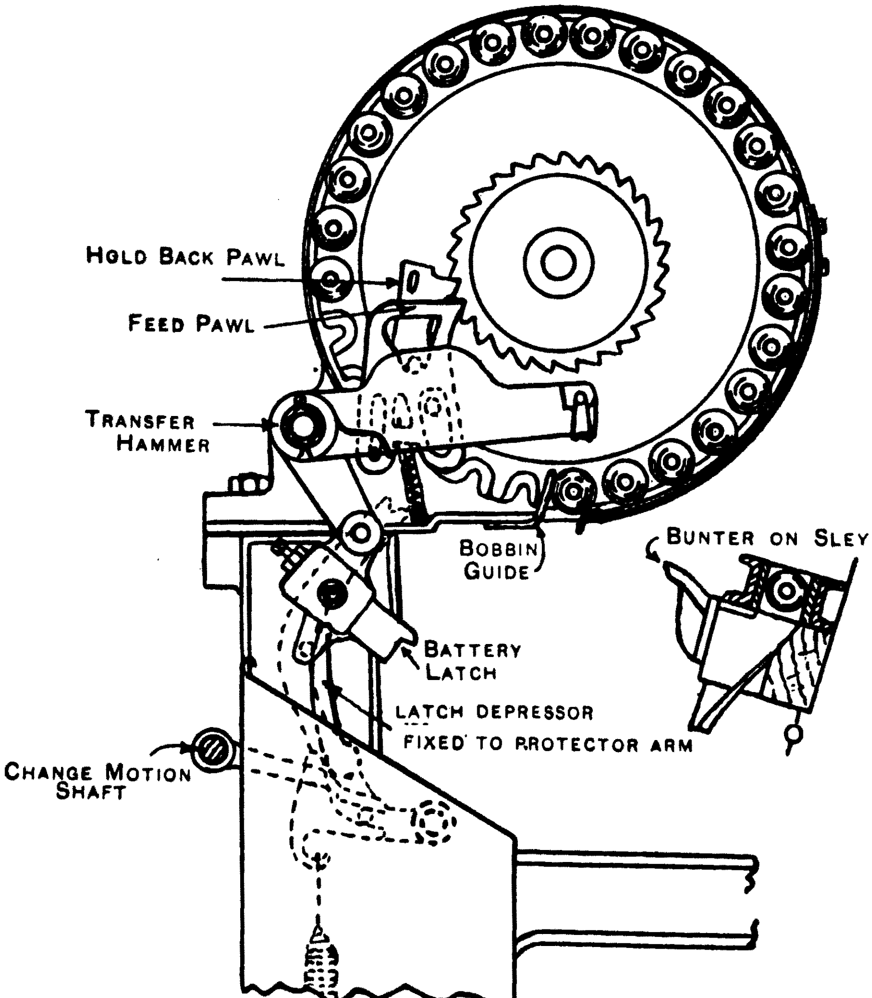


Fig. 162. Northrop Battery in Weaving Position.

During weaving, the transfer hammer is up, and the battery latch is down, and free from the bunter in front of the box. Another thing that the overlooker has to be particular about is the checking of the shuttle in the box so that it comes to rest when fully in the box. As the picker wears, the shuttle advances further into the box, and the grooves in the jaws of the shuttle get a little out of line with the three rings on the bobbin in the battery. As there are only 4 pairs of grooves in the shuttle, and three rings on the bobbin, there is only $\frac{3}{16}$ inch to work on for all three rings to be held. As the shuttle wears the picker, a strip of leather is fixed at the outer end of the picking stick slot to make the stick stand further forward.

In Changing Position.—In Fig. 163, the parts are outlined ready for bobbin transfer. When the weft is almost bare on the bobbin in the shuttle, the " Midget " feeler slips inward and sets in motion the mechanism that turns the change motion shaft in Fig. 162. This causes the shuttle

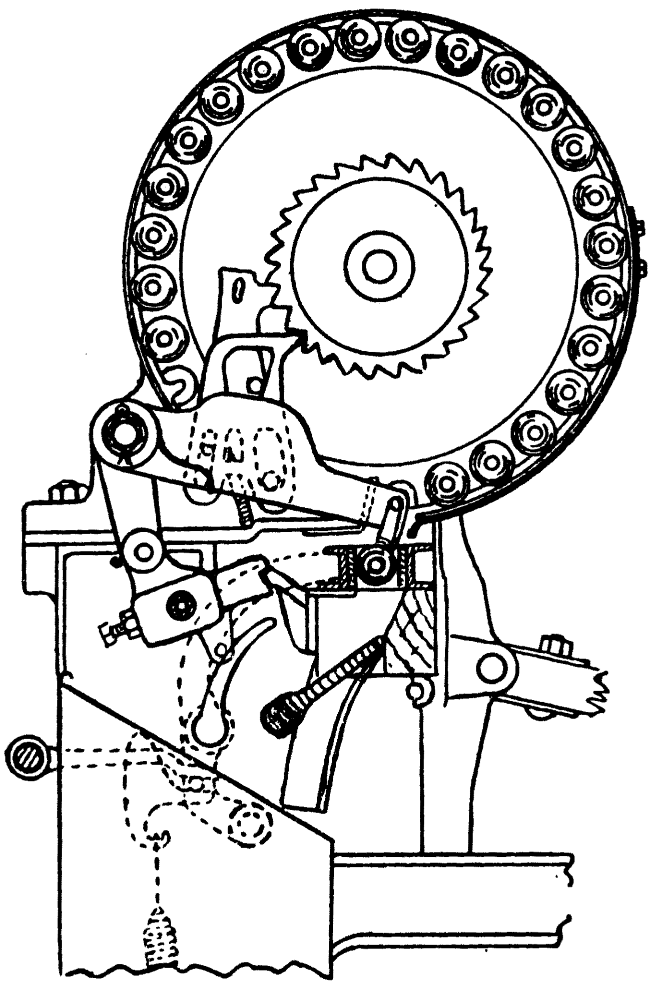


Fig. 163. Northrop Battery in Bobbin Changing Position.

protector arm to go forward to feel if the shuttle is fully in the box. By the same movement, the battery latch is lifted as in Fig. 163, and as the going part is brought forward by the crank, the bunter in front comes in contact with the battery latch, and forces it back.

As the battery latch is connected to the transfer hammer, it is forced down, and carries the bottom bobbin in the battery with it. The depression of the transfer hammer has to be such, that the bobbin in the shuttle is forced through the shuttle bottom, and the bobbin from the battery is weavably placed in the shuttle, and if so, the loom continues to weave.

When the transfer hammer is drawn up by a powerful spring, the feed pawl on the hammer pushes the battery one cog forward, and brings another full bobbin under the transfer hammer.

At the same time that the protector moves forward, the battery latch at the base of Fig. 163 is raised, and as the going part continues to move forward, the **V**-shaped front of the latch comes in contact with the strong

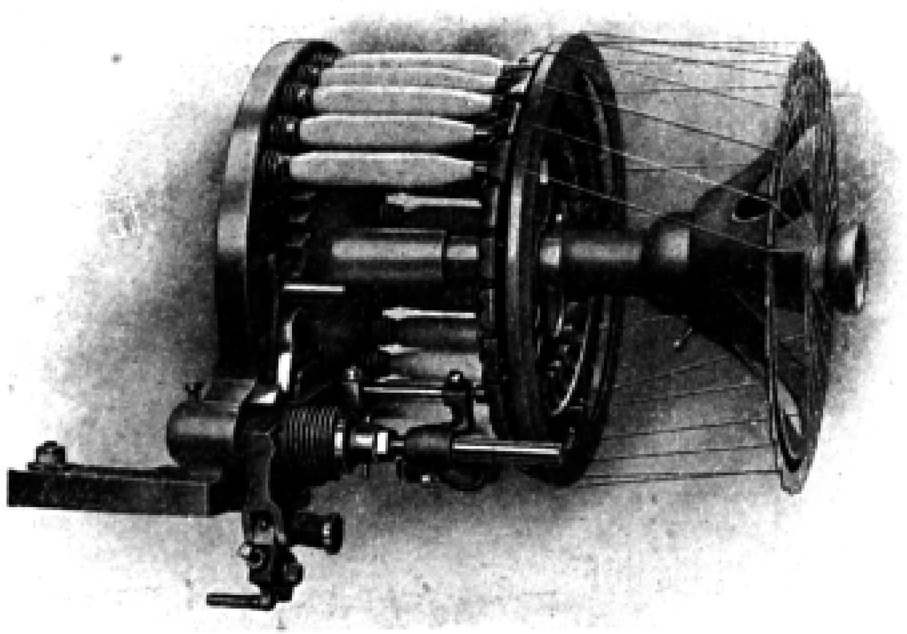


Fig. 164.
Northrop Battery for Ring Weft Bobbins.

bunter in front of the going part. This contact forces back the latch, and as the latch is fixed to the bottom of the transfer hammer, the latter descends. As the hammer rod with its castings fit over the bobbin in the magazine, the bobbin is forced downward, and on coming in contact with the spent bobbin in the shuttle, the spent one is forced out and the full one placed in. There is a sound like " crick," and the transfer has been effected in the fraction of a second when the crank was at its full forward centre.

(4) When the transfer hammer descends, it takes with it the feed pawl on the inner side of the hammer shaft. When the hammer ascends by means of the powerful coiled spring at the left base of the magazine, the feed pawl turns the magazine one cog forward, and brings another full bobbin into its transfer position.

Magazine.—The ring bobbin magazine is given at Fig. 164. It will hold 24 bobbins or cops. The nose of the bobbin is placed on the outer end, its holding clip being held by an open spiral spring. The head of the bobbin has three rings, and these find lodgment in the jaws of the shuttle when the transfer has taken place. As is readily seen, the threads from the bobbin pass over the plate called an arbour, and are then wrapped round the button in front. It is held so following the first pick after the transfer, for the shuttle is not threaded until the second pick is taking place. It is then threaded by the traverse of the shuttle, and the drag on the weft.

Weft Winding.—The twisting and winding of weft on a bobbin is done in two ways. The ordinary way is weft way, which in unwinding goes from top to bottom as seen in the bottom section of Fig. 165.

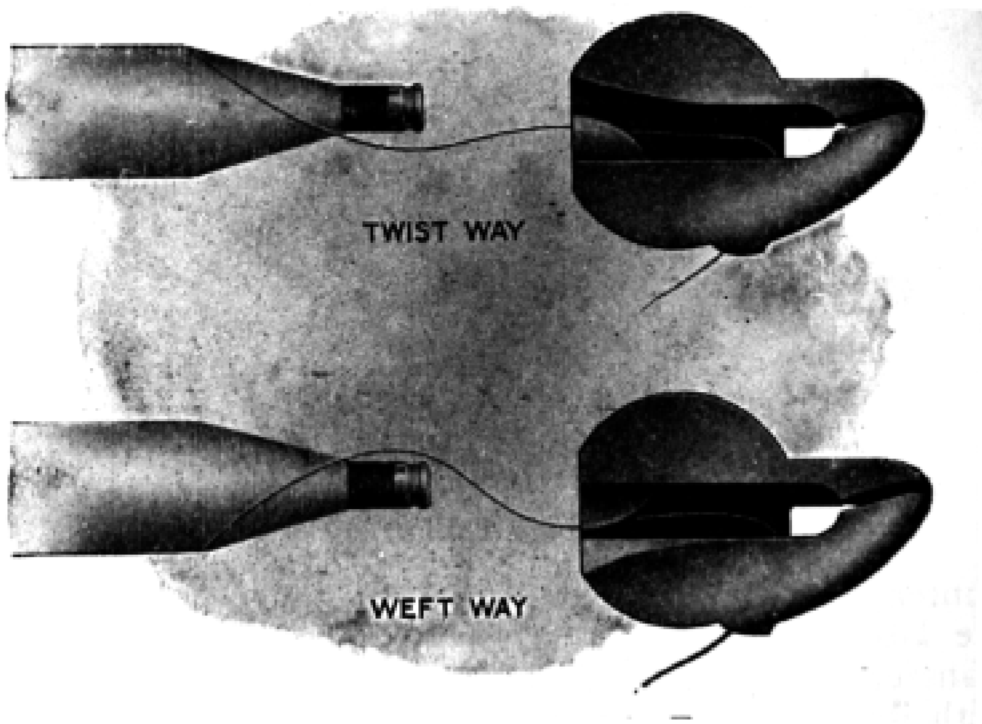


Fig. 165. Structure of Shuttle Eyes.

The other is warp twist way as shown in the upper illustration, and in unwinding goes from bottom to top. The eyes of the shuttle are made so as to meet the unwinding weft so as to be self threaded.

Cutting Weft at Temple.—Though the weft is cut near the eye of the shuttle for the ejected bobbin, there are still two strands to cut, one being that of the ejected bobbin stretching from selvedge to weft cutter, and the other the newly acquired weft stretching from selvedge to arbour. These are severed by a cutter in the head of the right hand temple.

Four styles of Northrop temples are presented at Fig. 166. The one on the left has 9 rings to hold heavy cloth;

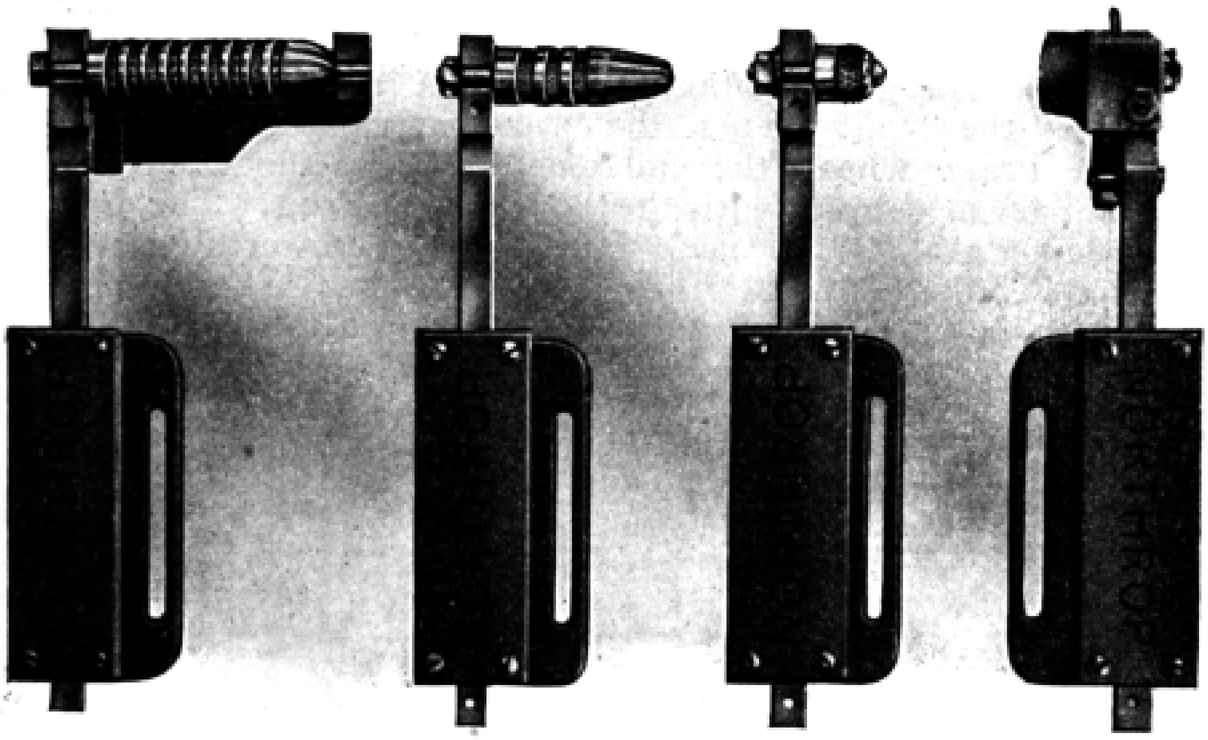


Fig. 166.
Northrop Temples.

the next three rings for lighter fabrics, but the third is just to hold the selvedge. The fourth is the one ringed temple with a weft cutter. The cutter consists of three blades, one being at either side of the cutter in the centre. The cutter is stationary, but the other two are moved by the going part coming in contact with an attached finger on the under side of the temple. When the finger is pressed back, the operating blades make a downward movement to seize the weft, and then a backward movement to sever it. An intermittent cutter is also available.

Shuttles.—The spring jaws in the shuttle have four grooves, three of which seize and hold the rings on the bobbin or cop. The extra groove allows for the wearing of the picker, or any slight variation in the checking of the shuttle. It has two slots at the front, the one near the eye of the shuttle being used by the weft cutter, and the other by the feeler. The shuttles are strongly made to withstand the pressure of bobbin changing.

Brake and Frog.—The loom brake is fulcrumed at the bottom, the stud of it being in a slot for adjustment. The whole leather face has to be in contact with the brake wheel when brought into action. It is best set when free from the brake rod, for one hand can then exert pressure at its centre, while the other tightens the nut. The brake rod passes through the brake centre, and at its outer end is provided with a powerful open spiral spring which gives a certain amount of flexibility when the brake is brought into action. The front part of the brake rod is slotted, and rests on the boss of the frog. When the brake is about $\frac{1}{8}$ inch clear of the brake wheel, the end of the slot in the brake rod should be in contact with the boss on the frog. The frog is pressed to its full back limit by two powerful curved springs bolted to the foot of the loom. These apply pressure to a short rod that passes through the framework and is in contact with the front of the frog. Fig. 166A.

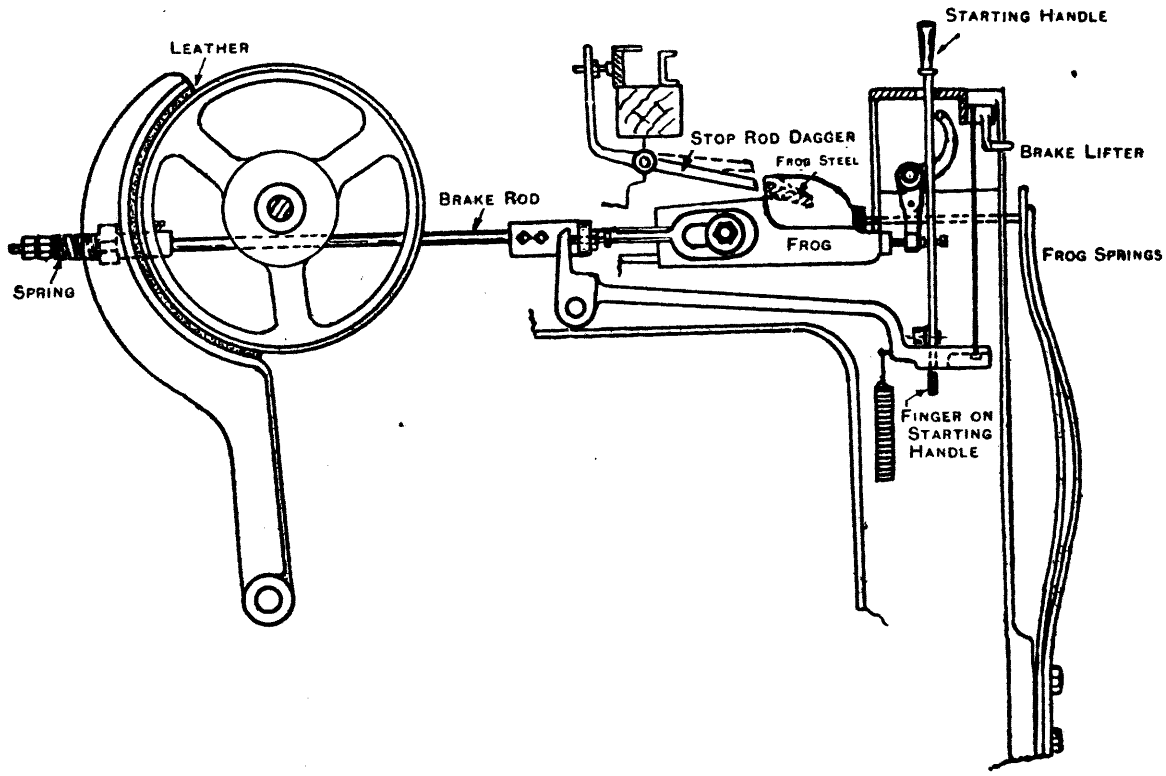


Fig. 166A. Northrop Brake and Frog.

When the setting-on handle is in its weaving notch, the setscrew in the knocking-off lever should be just clear of the nose of the frog, and is then ready for instant action.

The frog at the starting handle end has to have a lead over the other frog of $\frac{1}{8}$ inch to get the power of the drive off as soon as possible. The loom frog steels are reversible. By means of a brake lifter at the end of the breast beam, the brake can be moved clear of the brake wheel so the loom can be moved to the position desired.

Box Swells.—The swells in the shuttle boxes are fitted with adjustable eccentric bushes. When parts are new, the swells are placed as far back as possible, but when the shuttles become worn, they are set further forward. When the shuttle is fully in the box the dagger should clear the top of the frog by $\frac{1}{8}$ inch, and this can be maintained for a lengthy period by means of the eccentric bushes for the swells.

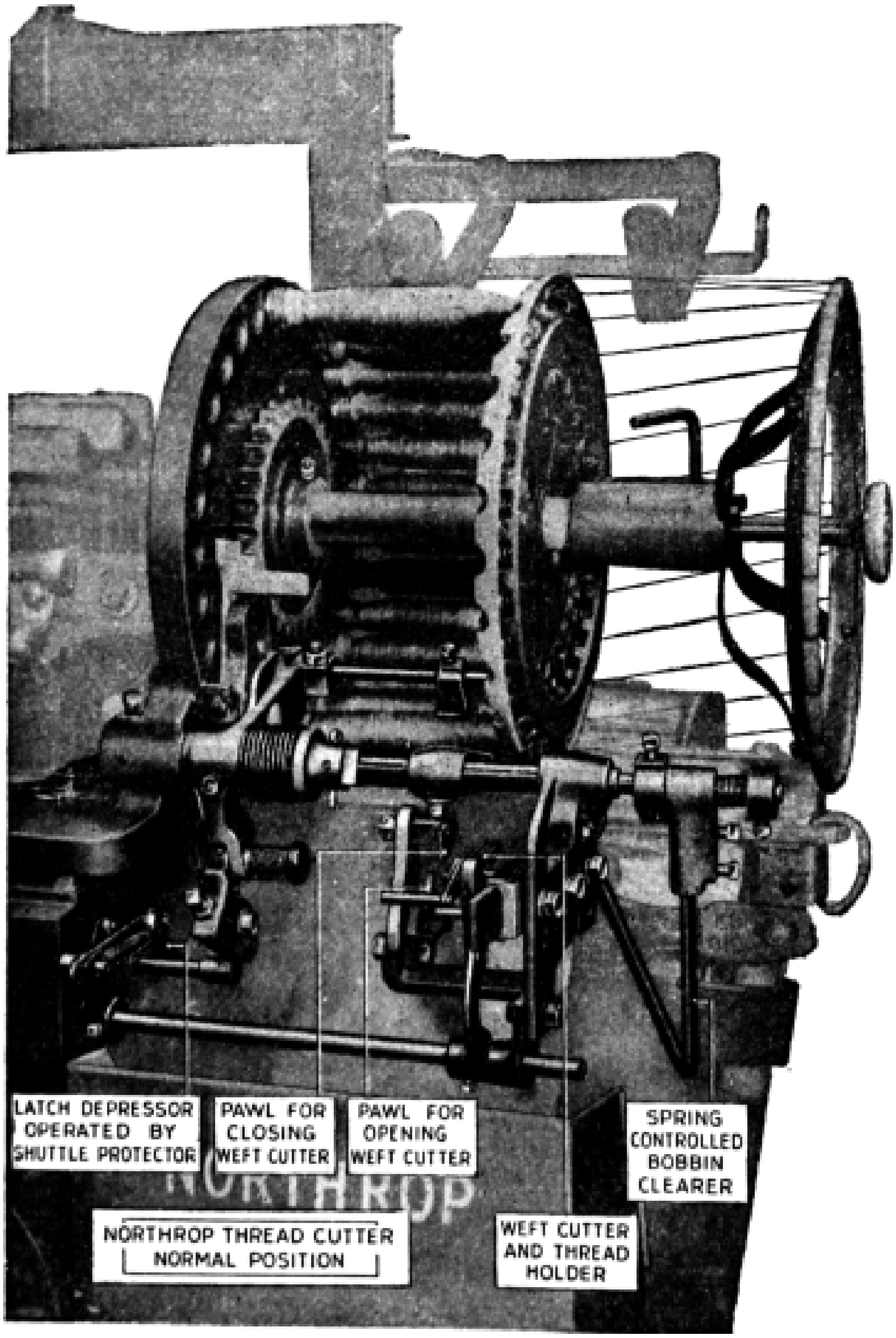


Fig. 167. Northrop Shuttle Eye Weft Cutter.

Shuttle Eye Weft Cutter.—This idea has been a great improvement on the Northrop loom, and has greatly reduced double strands of weft being left in the cloth. A further effective alteration was the obtuse run forward of the weft cutter instead of a straight run, for on receding, the pressure on the held weft was eased. The parts are exceptionally well illustrated in Fig. 167.

When the weft cutter moves forward from its standing position, it comes in contact with a small wedge that pushes up a pin on the weft cutter, and opens the cutter at the front to receive the weft. The box front is cut out to receive the cutter, and so is the shuttle front near to the eye of the shuttle. As soon as the going part begins to recede, the jaw of the cutter is closed by a pin on the back part of the cutter coming in contact with a cranked square bar on the pressure shaft that changes the bobbin. The closing of the jaw cuts the weft near the shuttle eye, but traps and holds the weft at the opposite side of the jaw. The box front is made with a sloping cut, so that as the cutter recedes, the strand of weft is pulled over the box top, and is held until the next forward run when it is dropped as soon as the jaw is opened, Fig. 167.

In Fig. 167 as seen on the right, is a spring controlled spent bobbin clearer. The weft cutter comes next, and one pawl is shown that opens the jaw on its forward run, and another pawl to close it as soon as the return journey commences.

The latch depressor is also shown that is controlled by the shuttle protector. These indicate the latest developments.

Mechanical Box For Warp Stop Motion.—This is one of the indispensable things for the Northrop looms owing to the number of looms that can be attended by one weaver.

It is fixed to the loom by a couple of bolts, and may be operated direct from the crank, or by means of a short belt, or by link chain and sprocket wheel.

The position of the mechanism, as well as the height, can be altered to be the most suitable for the warp to be woven.

If there be need for lease rods, they can be placed in front or behind the warp stop motion.

In Fig 168, the mechanical box is outlined. On the left is the driving pulley, with the cam on the same shaft. The cam moves the plunger to and fro; and as the plunger is fulcrumed at its centre, the top moves in the opposite direction to the bottom. Near the top, the plunger has charge of the arm that moves the serrated bar " to and fro " in front of the stationary serrated bar, the latter being slotted for the pin on the moving bar to have freedom of action.

The position of the two serrated bars have to be fixed so that when the plunger is in its full back position, the centre of the cut on the moving bar is in the centre of the cut on the stationary bar. The forward push given to the moving bar carries it so its centre is opposite the centre of the stationary bar.

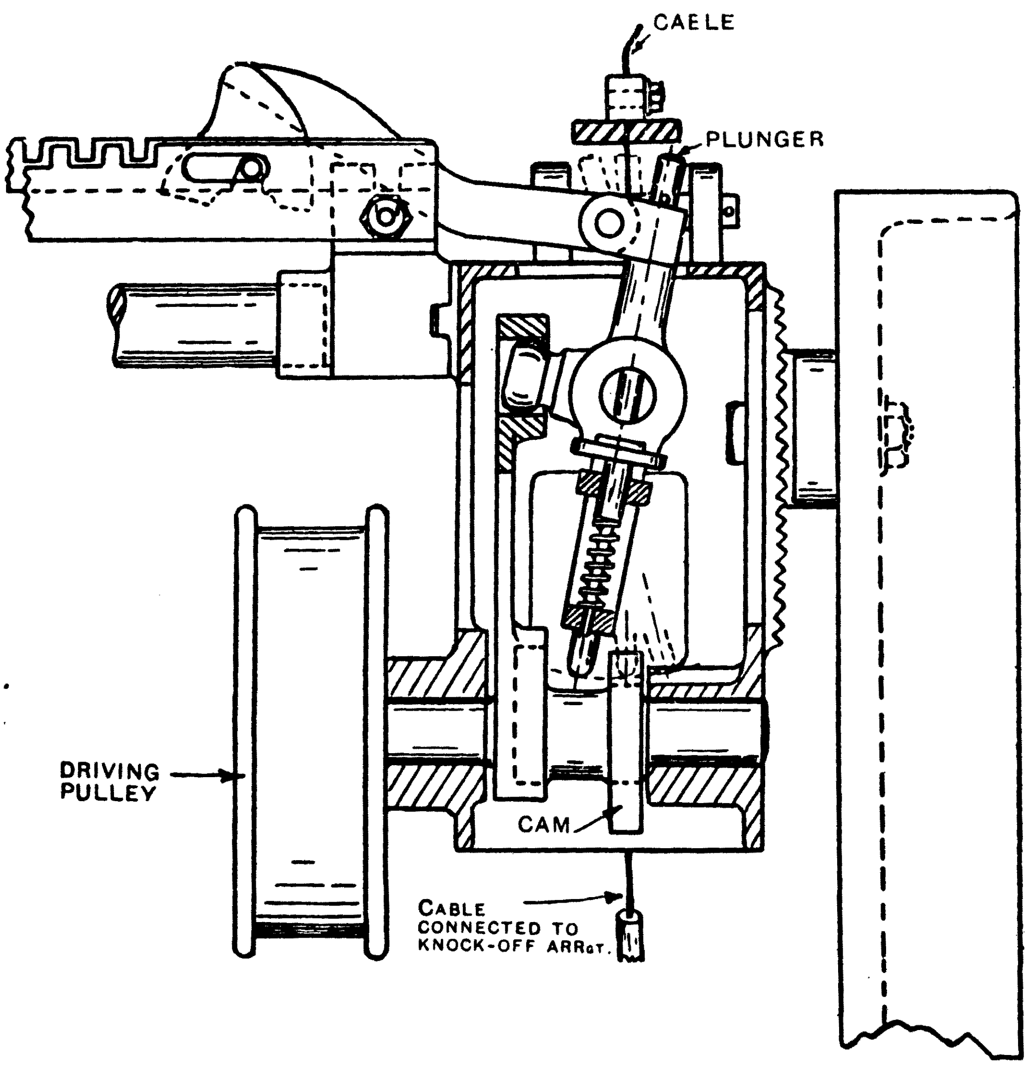


Fig. 168. Mechanical Box for Warp Stop Motion.

Droppers.—These are made of strip steel and are made in many shapes and weights. The standard droppers that are extensively used for most warps, with the exception of very heavy or very light yarns, and are eight thousandths part of an inch thick. This is in demand for warps up to 40 threads per inch on one set of bars, but if there be two sets of bars, then it is 80 threads per inch. The motion can be fitted with 8 bars and so gives a wide range of threads per inch.

The two chief kinds of droppers are the closed ones that have to be threaded at the same time as looming, and the other is open at the bottom, and can be put on the warp in the loom.

There is another division for there are mechanical droppers and those used along with electricity.

Stopping the Loom.—The loom continues to weave until a thread breaks, and the attached dropper falls. As the dropper becomes wedged between the stationary and moving bars, it holds the moving bar, and tightens the cable this brings the trigger attached to the cable opposite the bunter on the front of the going part

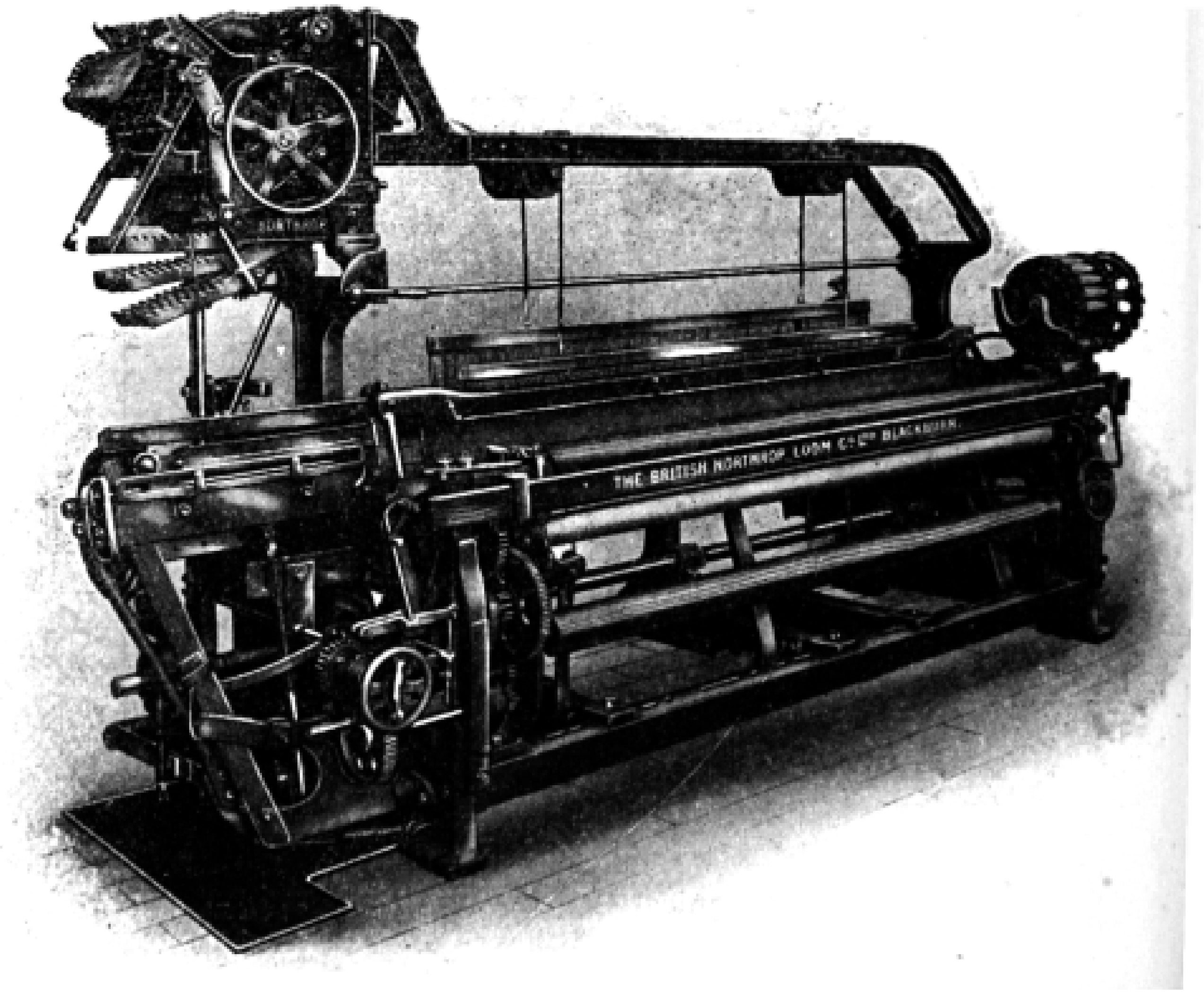


Fig. 169.
Northrop " F " Model Woollen and Worsted Loom with Leeming Dobby.

and as the going part moves forward, the knock off lever is brought into play, forces the set on handle out of its notch, and stops the loom.

Individual Drive.—The best drive for the Northrop loom of any kind is the individual electric drive. Of these there are two main structures, these being the cone clutch drive and the disc drive. For the first, the clutch insertion has not to move more than $\frac{3}{16}$th inch to attain full power for the driving of the loom, and only the same limited movement to stop it. The disc clutch drive is fitted with circular cork insertions, and the power to drive is quickly applied, and as quickly withdrawn. The Northrop system is to have the motor mounted on the loom. The horse power required varies according to the build and width of the reed space. A ½ h.p. will drive a narrow loom; 1 h.p. is sufficient for a loom of medium weight and width; 1½ h.p. will efficiently cope with a wide woollen or worsted loom, but a 2 h.p. is needed for wide looms weaving canvas, duck, and blankets.

There are four methods by which the driving power is transmitted. (1) Belt; (2) Gear; (3) Chain; (4) Rope. Of the four, the **V** Rope is the most silent, clean, reliable, and requires least attention. Further particulars will be found in the chapter on "The electric driving of looms."

Speed of Loom.—The speed varies considerably and is based upon the reed space.

A loom with 24 inch reed space makes approximately 180 picks per minute. A 48 inch reed space inserts 165 picks per minute, and a 95 inch reed space goes at 105 picks per minute. The average rate is the dropping of 5 picks per minute for every increase of 5 inches in reed space.

Looms per Weaver.—No rigid rules can be enforced, for much depends on the quality and kind of work, as well as the width of the loom.

The general run is for an overlooker to attend to from 80 to 100 narrow looms, or from 60 to 70 of medium width, or from 32 to 48 wide and heavy looms. Briefly stated, when a weaver attends to 16 looms, the overlooker has 48 and 3 weavers. When a weaver has 24, the overlooker has to manage 72, and again has 3 weavers. If a weaver follows 48 looms, then an overlooker's share is 96 looms and 2 weavers.

The dropper system for the warp and good rewound weft to take out the weak places are valuable aids for production by the Northrop loom.

Droppers are dealt with in the Lancashire loom section.

Electric Feeler Motion.—This is presented at Fig. 170. It is shown operating horizontally, but can be placed vertically when the loom requires that position. It is of the two prong construction, and in the illustration, has the lid off. When the prongs come in contact with the metal sleeve on

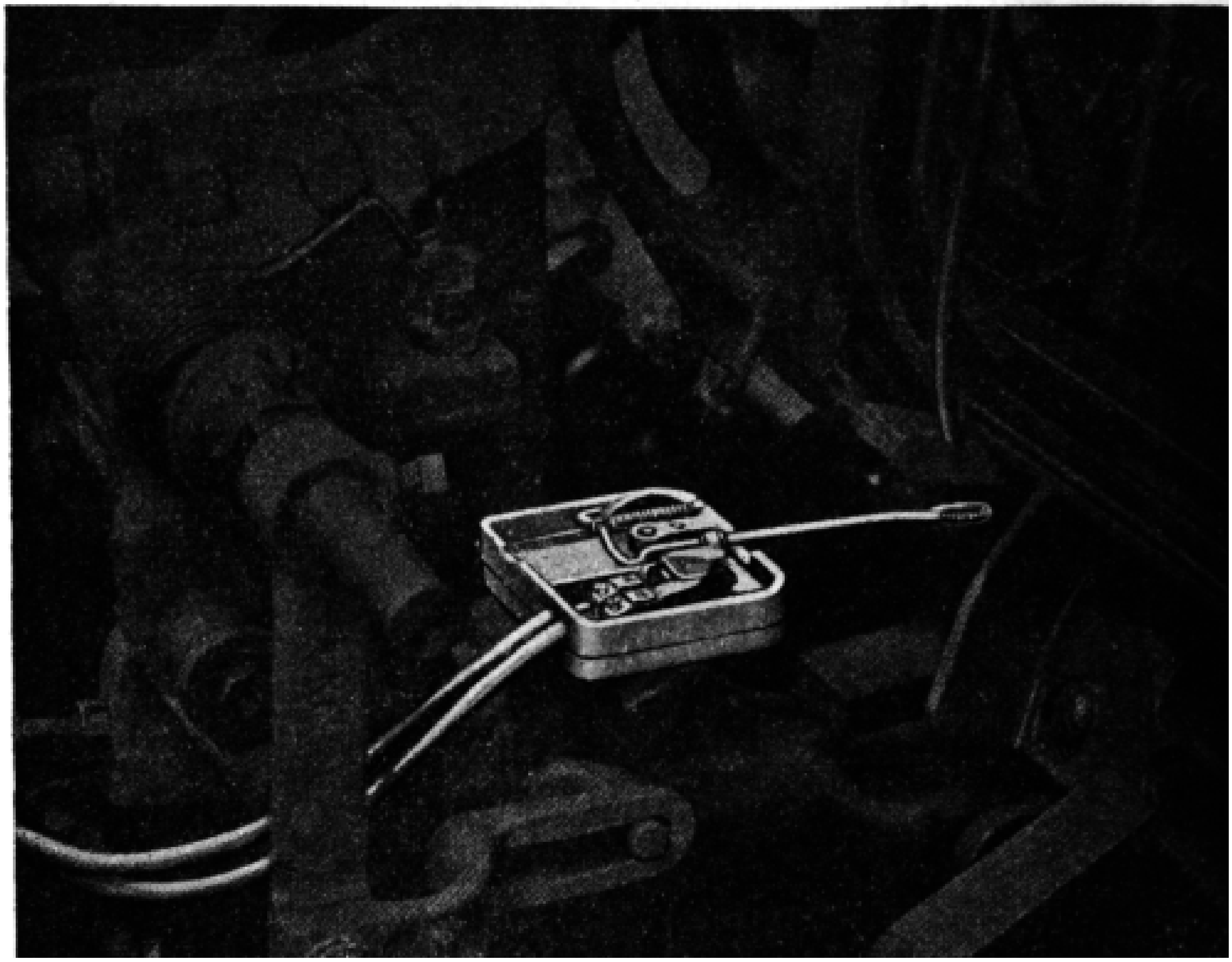


Fig. 170. Electric Feeler Motion.

the bobbin, it is quicker in action than the "Midget" mechanical feeler previously explained. The current generally used is 22 volts D.C., and an output of 16 amps supplies the need of 60 looms.

THE JACQUARD LOOM.

Joseph Marie Jacquard whose name is associated with all jacquard machines was not the inventor, but the skilful improver of Vaucanson's clever conception.

Jacquard was born at Lyons, France on July 7th, 1752 and died August 7th, 1834 at the advanced age of 82 years. Jacquard improved Vaucanson's machine in 1804 when he was 52 years of age, and for it, he was granted a royalty and pension. The jacquard was introduced into England in 1818 and came into popular use in 1824.

Messrs. Samuel Dracup & Sons, of Bradford were the pioneers of the British machine, and have now made them for over a century, commencing in the year 1825.

General Remarks.—The jacquard is the finest machine for making figured cloth that has ever been invented. It does with a single heald what a dobby does with a shaft. Its figuring capacity goes to the limit of the number of hooks the engine contains.

The 400 machine is made in rows of 8: the 500 in rows of 10, and the 600 and 900 in rows of 12.

There are 7 different pitches in the making of the engine, and the cutting of the cards for the various makes, the English pitch being the coarsest and the Verdol the finest.

Full Harness Mounting.—Norwich Tie-up. The principal parts are presented at Fig. 171. At A are the upright hooks, the bent tops being towards the cylinder G. At B are the blades of the griffe which lift the hooks. They lean at an obtuse angle, and just clear the hooks when in the position shown. The griffe is adjustable so the size of the shed can be altered. The usual lift is for the top shed to clear the front top of the shuttle when the crank is at its back centre. The timing of the griffe is set to the motion of the cylinder, for it must be below the points of the hooks when the cylinder begins to push back the needles, and have seized all those that have not been pressed back by the card on the cylinder before the cylinder begins its outward movement. The clearance between top of the griffe when down and edge of hook is $\frac{3}{16}$ or a quarter inch.

Then C is the spring box. At the inner end, it receives the looped ends of the needles, a pin passing through the series of loops to prevent them turning, and to retain them opposite the centre of the springs. The measurement inside

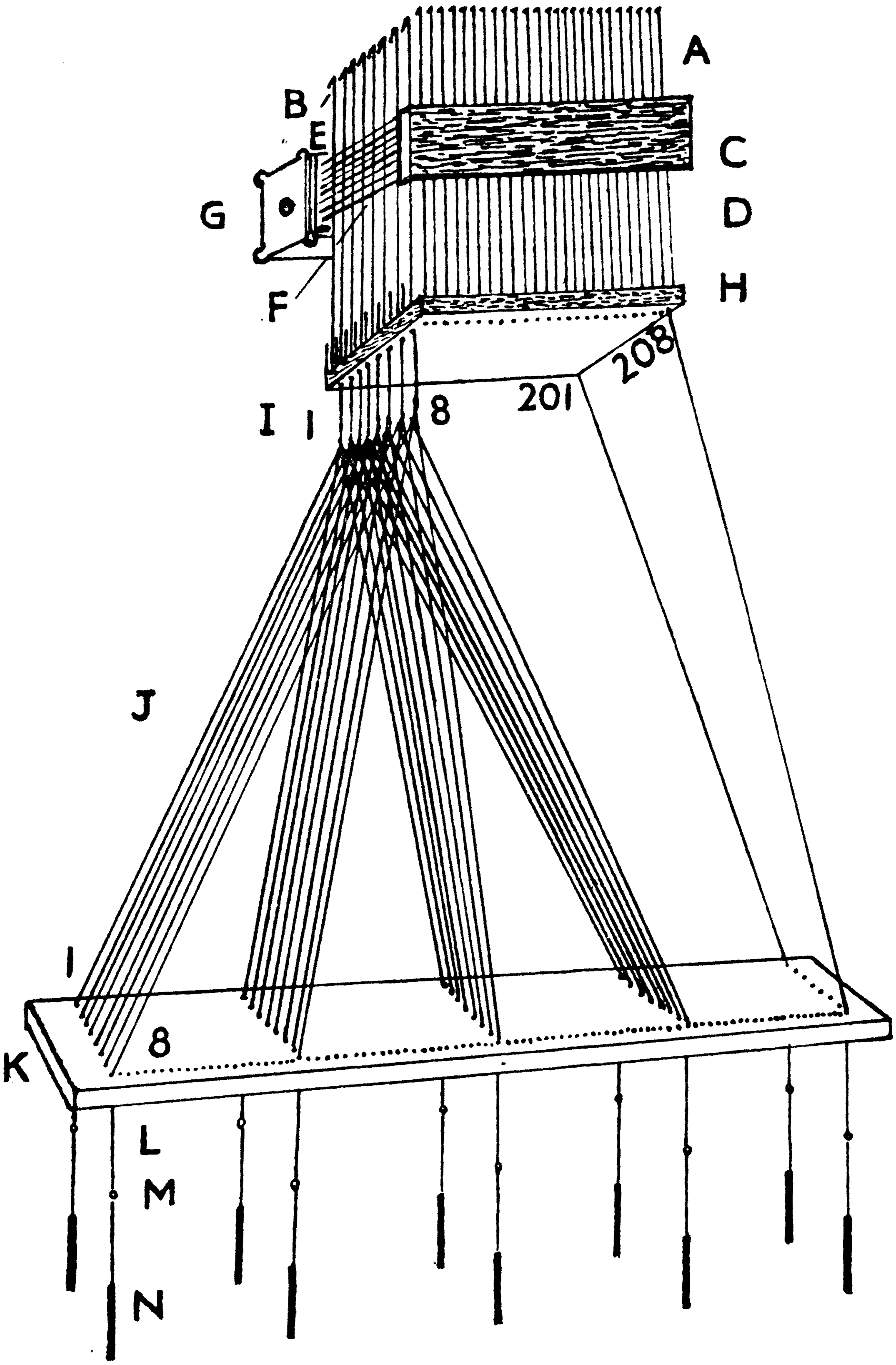


Fig. 171.

Jacquard Loom. Full Harness Mounting. Norwich Tie.

the loop is $\frac{7}{16}$th inch which provides latitude for the blades of the griffe to miss the hook when pressed back by a blank place on the cylinder card. The springs are at the back of the spring box at C; each spring having a place of its own. At the outer end, a vertical series are held by a pin passing down their end centres. If one breaks or has lost its power, the holding pin is extracted to replace it. The needles are at F, and pass through the needle box E, which keeps them straight, and presents them to the cards on the cylinder, the latter being at G. The needles have half loops for the hooks to rest in, and be moved by them.

The cylinder shaft is set in castings that allow of it being set vertically and laterally so that its borings and the holes in the cards may let the needle points pass through their centres. One of the best ways of testing the setting is to have a card punched for plain weave. This is placed on the operating side on the cylinder. The ends of the needles are slightly smeared with oil, and the cylinder with its card brought against the needles. The marks left by the points of the needles indicate which way the cylinder should be adjusted if it needs moving. In the old style, the cylinder was suspended in a batten motion, fulcrumed at the top of the engine, and moved the cylinder in and out in the arc of a circle. The more modern and better idea is to move the cylinder by a dead level slide and turn it by a star wheel.

The hooks A are looped at the bottom, and pass through the grid H which is slotted for each hook, and prevents them turning, and provides a semi-circular rib for the looped end of the hook to rest upon. The altitude of the grid fixes the standing position of the tops of the hooks.

To the bottom loops of the hooks, the neck bands I are attached. Each neckband contains the same number of cords as there are repeats required. These cords are either woven together in plain weave order, or are woven by hand, with one cord passing from the right, and another passing from the left in the same shed, and pressed home by a steel beater.

To these neckbands, the harness cords J are tied, and are then made to pass through the comberboard K. No comberboard is made without being seasoned for seven years. At L they are tied to the upper loops of the wire healds, the eyes of which are at M.

When all the hooks are at rest as shown in the diagram, then the warp through the mail eyes M should be just clear or slightly touching the shuttle race.

The lingoes are at N, and vary in weight to be suitable for the light or heavy weight cloth to be woven.

The upper part of the lingoe is attached to the bottom loops of the wire heald by a small wire loop.

The harness cords pass through the comber board like 1 to 8 and the last row is 201 to 208, and is a 200 jacquard.

It will be observed that the harness cords go straight to the comberboard. This is known as a Norwich tie-up, and is the simplest, and has the least friction on the cords. It is, however, liable to swing more when in action. The harness cords are specially made of 8 ply yarn that are spliced so

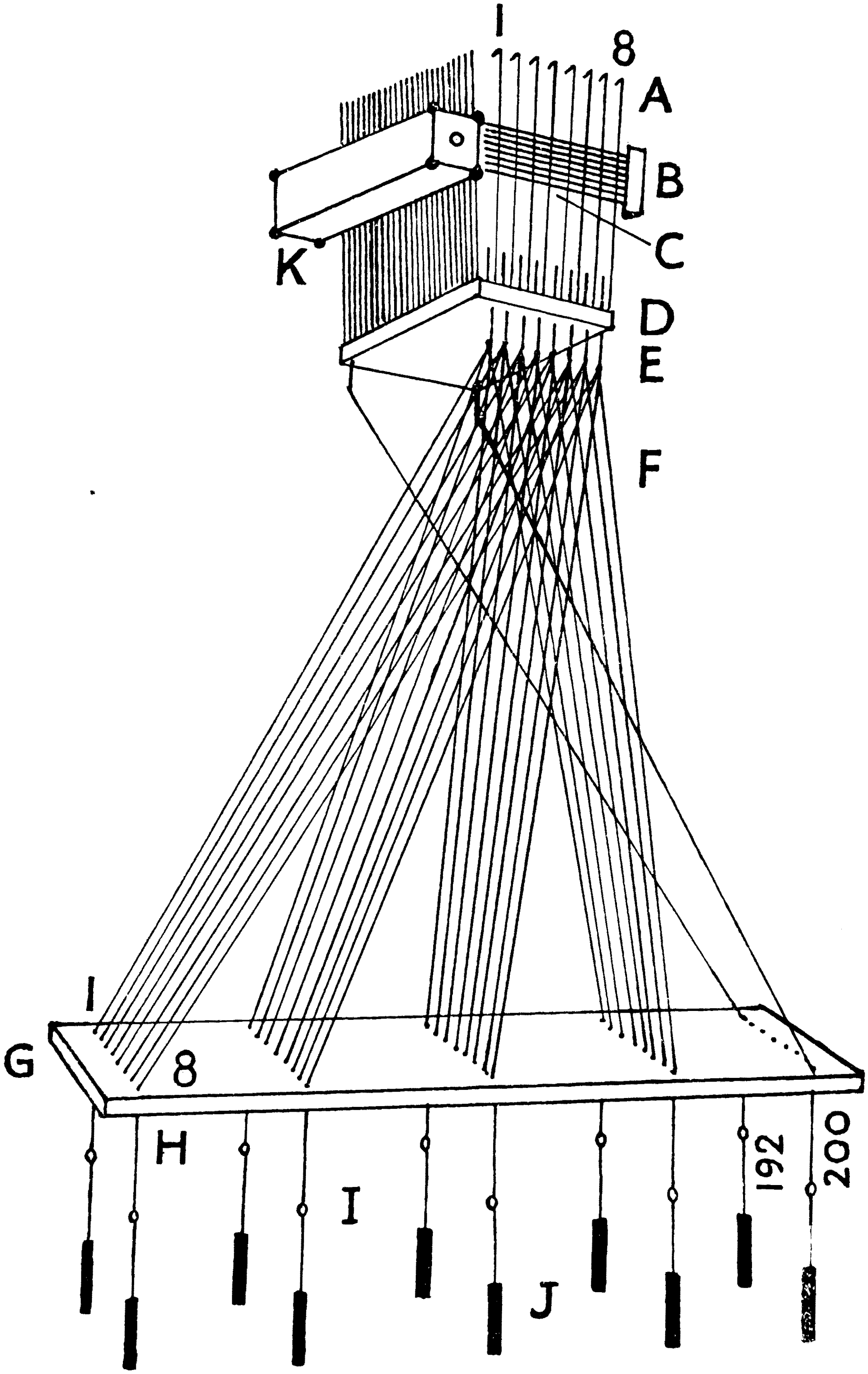


Fig. 172.
London Tie-Up of Harness.

that no twisting of the mail healds takes place. The cords are also well varnished to withstand moisture and give long service.

London Tie-Up.

In Fig. 172 the London method of placing the engine in relation to the comberboard is given. In the Norwich arrangement, the engine is parallel with the comberboard, but in the London tie-up it is at right angles to it. This makes it that the harness cords have a quarter twist. It generates more friction on the cords, but gives a steadier motion when in action. At A are the hooks, and B the spring box, the springs applying pressure to the needles C. At D is the rest board for the turned up ends of the hooks. The neck bands E are attached to the bottom of the hooks, and pass through the rest board, and the harness cords F are tied to them. The harness cords are threaded through the comberboard G, the one at H being typical of all the others. At I is the heald eye and J the lingoe. The weight of the lingoe has to be suitable for the kind of work being woven. The four sided cylinder is at K. The small end of the rest board is parallel with the comberboard, and this gives a quarter twist to the harness cords and curtails swinging

Reversing Mechanism.

In the older build of jacquard, the reversing of the cards have to be done by hand, and this mechanism is outlined at Fig. 173. The shaft A is just above the top rail of the loom, and behind the harness cords.

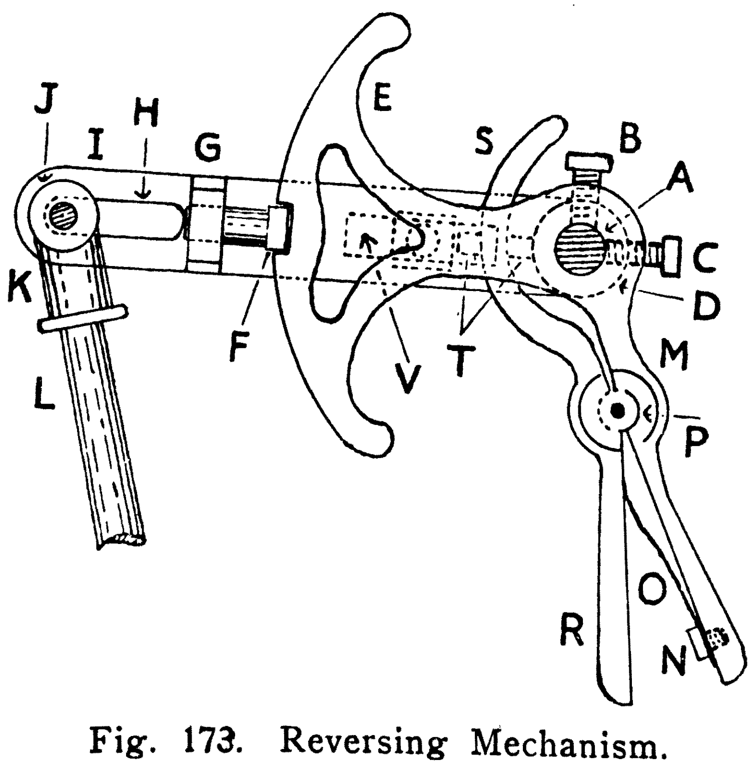


Fig. 173. Reversing Mechanism.

The setscrews B and C hold the crescent-shaped lever E to the shaft A.

At the centre front of lever E, it is cut out to receive the head of the stopper F. The shaft of the stopper passes through the projection G, which is cast to the lever I and fulcrumed at D.

The slot H receives the shaft of the holding pin F when it is pushed forward. At J is the stud for the swivel K, and L the connecting rod from the eccentric motion on the crank shaft that moves the lag cylinder in and out.

Lever E has arm M, and on its lower extremity is set-screw holding curved spring O that presses on inner part of lever R. This lever is fulcrumed at P on arm M. The upper part of lever R is shaped like a sickle at S, and passes between two lugs at T. The movable lug is at the front.

When the weaver has to comb out the picks, she counts the number, and then to find the right card, grasps the two handles M and R. A string connected to two hooks that turn the card cylinder is pulled down. This elevates the top catch and places it out of action, and brings the bottom one into play. When the handles M and R are given a " to and fro " movement, the cards are turned back for several picks beyond the number extracted, so the loom can then be set in motion a pick at a time to find the open pick.

On completing the turning of the cylinder the quadrant E is brought to its central position, and the head of the

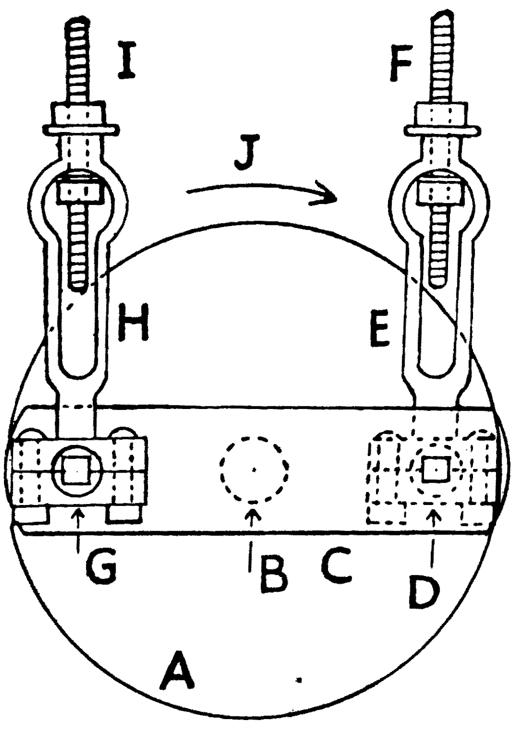


Fig. 174.
Jacquard Shedding Lever and Disc.

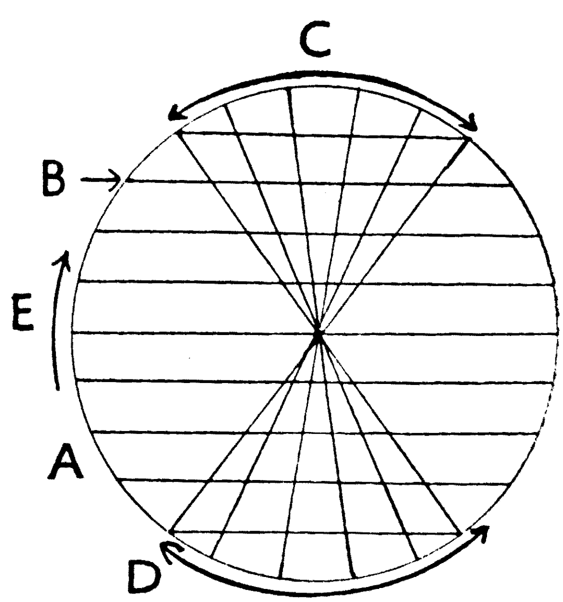


Fig. 175.
Bottom and Top Dwells of Shedding Levers.

spindle enters the cut on it. The hooks are adjusted for weaving by the band. The cloth and warp beam have to be adjusted before weaving can take place.

Shedding Disc and Lever.

These are outlined in Fig. 174. A is the disc, and B the end of the low shaft to which the disc is doubly set-screwed. C is the shedding lever, and behind it on the right is the clamped casting D, doubly bolted to the stud on the disc. E is the slotted part that holds the shedding rod F, the rod at the top being connected to the back head lever connected to the griffe. The rod is locknutted at its base, and is fixed so that when lever C is in the centre of its traverse as shown, the head of the levers and griffes are level.

G is the clamp fixed to lever C only, and at the front of it, H corresponds with E, and I with F. The shedding rod I is pinned to the front head lever, and usually to the outer hole, whereas the other is in the second hole from the end to give a little more lift to the griffe. The traverse of disc and lever follow arrow J. A slot in the disc is 4 inches, and the one in the lever is 5 inches.

Suppose the size of the shed was required to be less, disc and lever would be placed in position shown and the driving wheels blocked. The stud on D is unloosed and tapped inward, and stud on G moved inward too. There should be the same measurement from G to the centre of the low shaft B, as there is from the centre of D to B. Any further alteration is then made to the working length of the shedding rods.

Dwell of Disc and Lever.

This is illustrated in Fig. 175. The circle A is divided into ten equal parts horizontally, and the top and bottom sections are then divided into five equal parts on the top and bottom lines. Radial lines are then drawn from circumference to centre. This reveals the dwell of the shedding rods when passing their top and bottom centres at C and D, and moving as indicated at E. Though not actually a dead stop, the spacing is gradual at both ends, and the downward and upward movement are each only equal to one tenth of the spacing as at B. Jacquards may be divided into four groups, most if not all of them being made by every firm of jacquard makers. Each maker has made improvements which are distinguishing features. The four groups are: (1) Single lift single cylinder; (2) Double lift single cylinder; (3) Double lift double cylinder; (4) Twilling jacquard.

Except for special requirements, the single lift single cylinder is seldom made, being too slow, and involving too much motion in comparison with others. The twilling jacquard is also on the single lift principle with a single cylinder, and may be said to be more of a special jacquard.

The two kinds that are most extensively used are the double lift single cylinder and the double lift double cylinder, and these are given in detail.

Fig. 176 gives an outline of the double lift single cylinder. The hooks are at A, and both griffes are down at

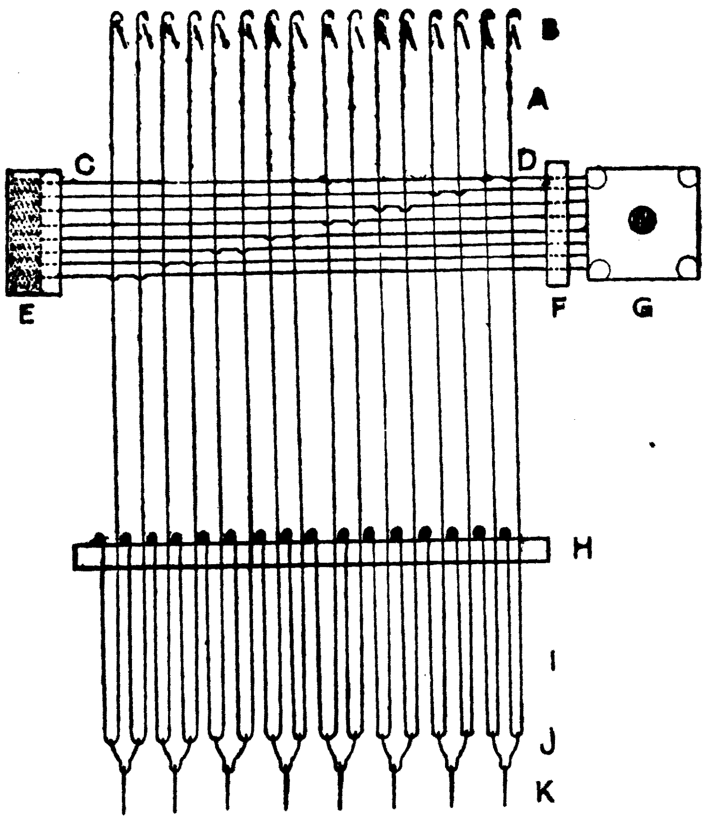


Fig. 176.
Double Lift Single Cylinder Jacquard.

B. The needles are at C, and it will be observed that each needle is made with two bends so that two hooks are affected by the same movement as at D. The spring box previously detailed is at E, and the needle box at F. The cylinder G is built on the square, but some have 5 to 8 sides to give steadier working. Then H is the slotted grid, and I the doubled end of the hooks. At J is the double link that connects each working pair of hooks, and K is the neck band to which the harness cords are tied.

Double Lift Single Cylinder.

Fig. 177 presents Messrs. Samuel Dracup & Sons, of Bradford, patent cylinder motion for their double lift single cylinder jacquard. It is a 400 machine, and has several special features.

The griffes are worked from the crank shaft by means of a coarse cogged wheel having 12 teeth. This wheel is secured by a couple of setscrews, and is the timing wheel for the griffes. It is connected to another coarse pitched tooth wheel above it having 24 cogs to give a lift to each griffe in turn, and complete both in two revolutions of the crank. As the chain becomes slacker by wearing, it is tightened by the pressure of a bowl, the stud of which is in a slotted bracket. At the inner end of the shaft which carries the large chain wheel is the sweep wheel, to which the connecting rod is coupled that governs the griffes. The sweep wheel is slotted so the movement of the griffes may conform to requirements. The ordinary lift of the griffe is to make it lift the healds so the warp on the top shed just clears the top front of the shuttle when the crank is at its back centre. For strong and fibrous warps it may be made to make a larger shed so as to part the loose fibres better.

When the jacquard is a fast reed loom, it should be false reeded to see if it will prevent stitching, for if so, then the griffes need not be molested.

The upper end of the connecting rod mentioned is adjustable by locknuts, and when the sweep is in the lateral centre with the connecting rod, the tops of the griffes should be level to give equal size of sheds. The griffes are at their lowest and highest when the crank is at its back centre, but may be altered a little to give an earlier timing for the shed.

Fig. 177 illustrates the reversing motion. This also is connected to the crank shaft by two open linked chains and sprocket wheels. At the outer end of the connecting shaft is the reversing wheel. It is disconnected with the crank by pulling out a spring rod, and the cylinder can then be turned in either direction. There is no need to have the crank at its back centre when reversing the cards by hand, for the slide which operates the " to and fro " movement of the cylinder comes into action as when weaving. There is no risk of needles being bent, or cards becoming fast or torn.

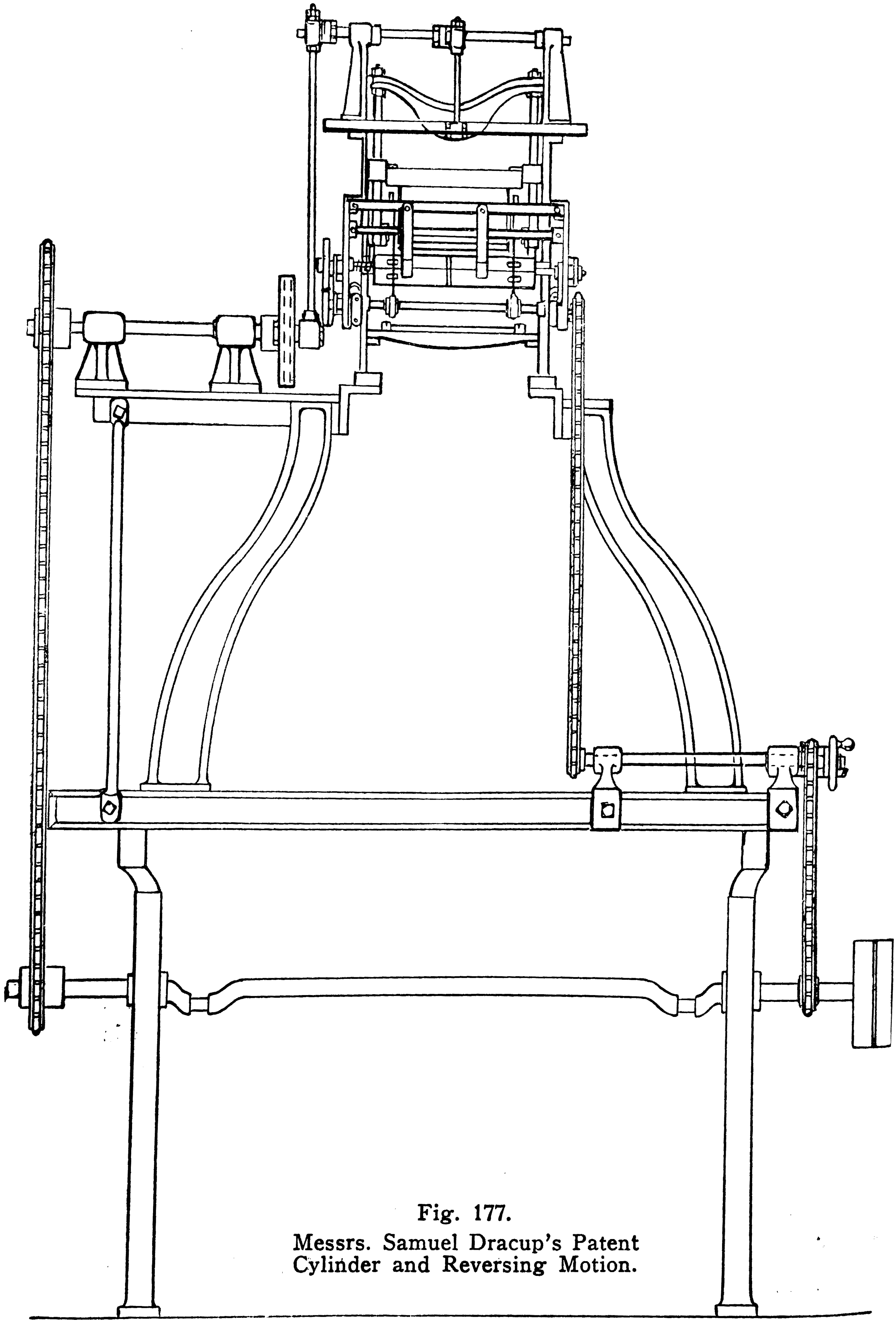


Fig. 177.
Messrs. Samuel Dracup's Patent
Cylinder and Reversing Motion.

When the proper card has been placed in position, the spring rod is put back, and the loom is ready for weaving. Fig. 178 gives a good view of the engine. It will now be noticed that the cylinder has 5 sides, which gives a slower

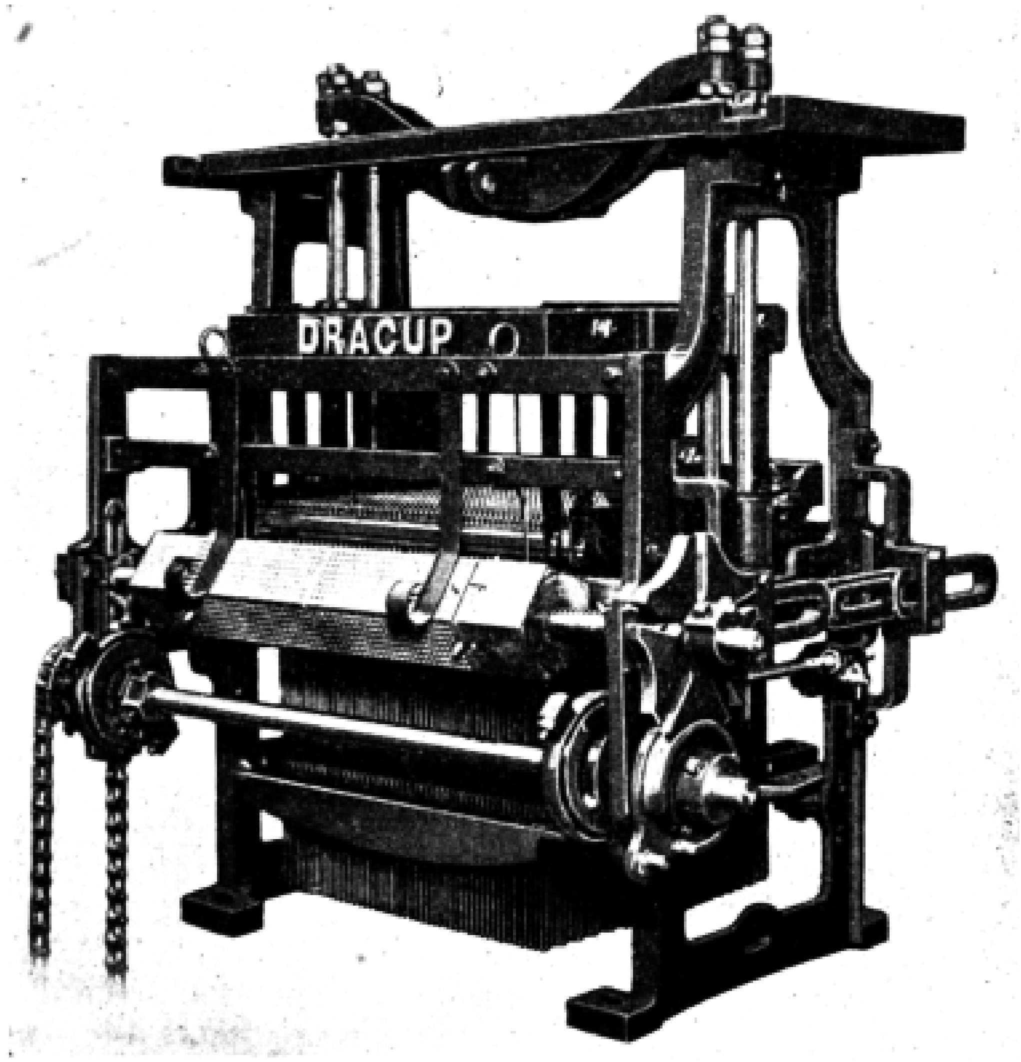


Fig. 178.
Messrs. Samuel Dracup's Patent Cylinder Jacquard Motion.

and steadier motion than one with four. At the outer end of the cylinder shaft is the 5 sectioned star wheel which is turned $^1/_5$ of a revolution for every revolution of the crank shaft. It is turned by the pin wheel below it. The star wheel is not fixed to the shaft, for its inner side has several **V**-shaped projections that fit into the hollows of a casting setscrewed to the shaft. The star wheel is kept in contact with its companion by the pressure of an open spiral spring which acts as an escape motion if the cards ever get out of order.

The pin on the wheel that operates the cylinder star wheel is at its bottom centre when the crank is at its back centre.

On the same shaft as the turning wheel are the two eccentrics which move the cylinder in and out. They are setscrewed to the shaft, both being timed alike. The eccentrics are flanged at either side, and receive the split caps attached to the slides of the cylinder. When the eccentrics have moved the cylinder to its outward limit, the edge of the cylinder when turning, is one inch away from the points of the needles.

Card Strippers.

Though not shown in the illustration, the cylinder is grooved just inside where the tapering pins project from the cylinder that keep the cards in position. In these grooves a chain is placed that passes round a loose flanged bowl on the shaft carrying the eccentrics. These chains effectively prevent the cards ever sticking and getting fast, for as soon as they begin to cling, they are forced off by the chains. Because of the efficiency of this device, the loom may be run from 15 to 20 per cent. faster without fear of the cards wrapping round the cylinder.

Movable Needle Plate.

Another special feature which cannot be seen in the picture is an extra metal needle plate. This is so evenly bored and fixed that the needles do not touch it unless forced out of the straight. It fits in front of the ordinary needle board, and goes almost to the points of the needles. As the cylinder moves in, the needle plate is forced in by the cylinder, and exposes the needle ends to the cards. As soon as the cylinder moves outward, the springs behind the needle plate push it to the limit, and so protects the needle ends. The needle plate does not require much force to move it, so that little extra work is placed on the cylinder mechanism.

As soon as the crank leaves its back centre the cylinder begins its outward traverse, and starts to turn when the crank is within $\frac{1}{8}$th of a revolution from the front centre. The cylinder has fully turned when the crank has made $\frac{1}{8}$th of a revolution after passing its front centre.

Dracup's Driving Motion.

The new style of lifting motion for the griffes is presented at Fig. 179. The long connecting rod on the right is coupled at the bottom to a straight lever with its fulcrum at the centre. At the opposite end of the lever is another rod connection, the bottom end of which is secured to a wheel that meshes with another wheel on the crank shaft, which is the driver of the motion, and times it. The timing wheel

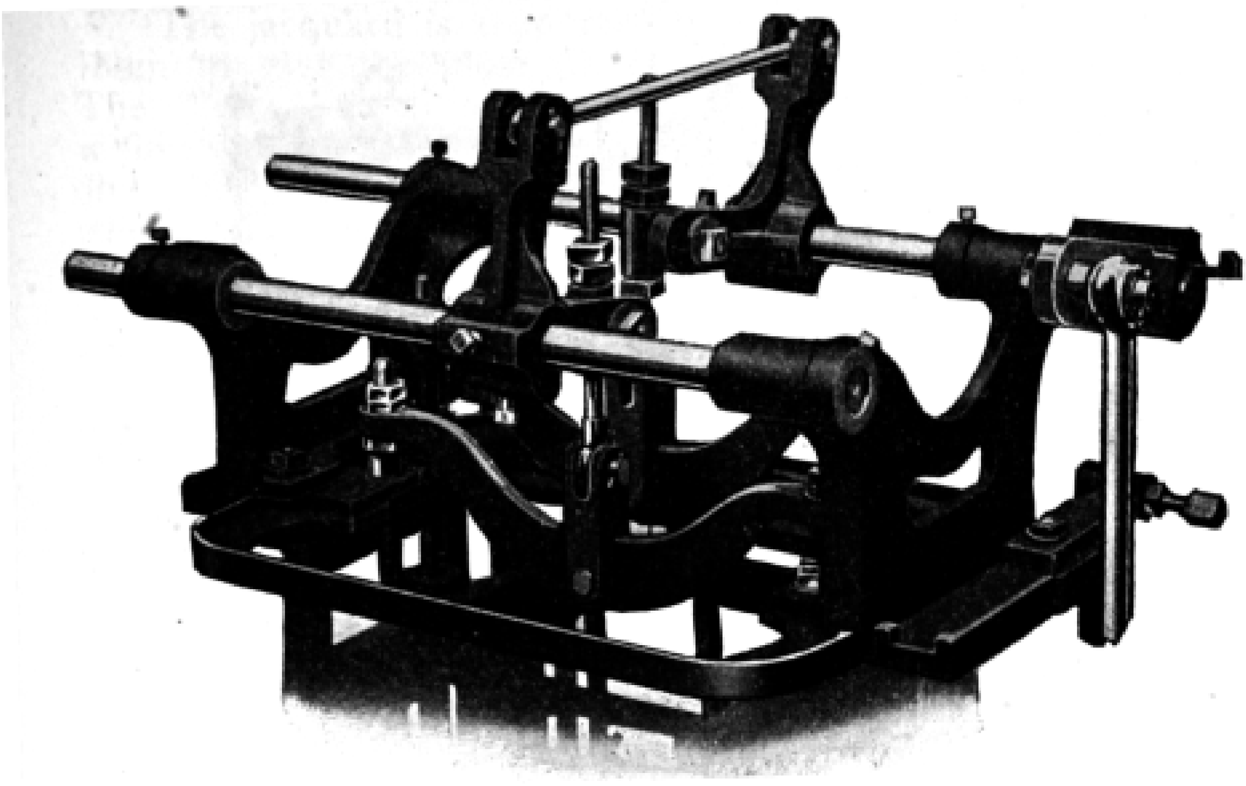


Fig. 179.
Messrs. Samuel Dracup's Patent Driving Top Motion for Jacquard.

has only half the number of cogs of the other. The straight rod lever is slotted at both ends for rod adjustment.

The rod seen in the illustration is secured to a small but strong lever at the outer end of one of the cross shafts, the lever being keyed to the shaft in a sunk keyway.

On the cross shaft is a right angled lever setscrewed to it. Its lower arm carries the swivel that is coupled to the balks that hold the slide rods of the griffes. The upper arm of the right angled lever has the connecting rod that transmits the lever movement to a similar lever in command of the other griffe, the levers facing each other. When the lower arms of the levers are opposite each other, and in the dead centre of their movement the griffes are level. By this means the griffes are given a perfectly straight and central lift, and the upper gantry and pillars are dispensed with.

Dracup's Selvedge Machine.

Many manufacturers these days desire their firm to have their names or badge woven in the selvedges. This guarantees the cloth to the customer, and, to a certain extent, prevents imposition and piracy by others.

The machine is shown at Fig. 180. It is a 96 hook jacquard, and works in the same way as a double lift single

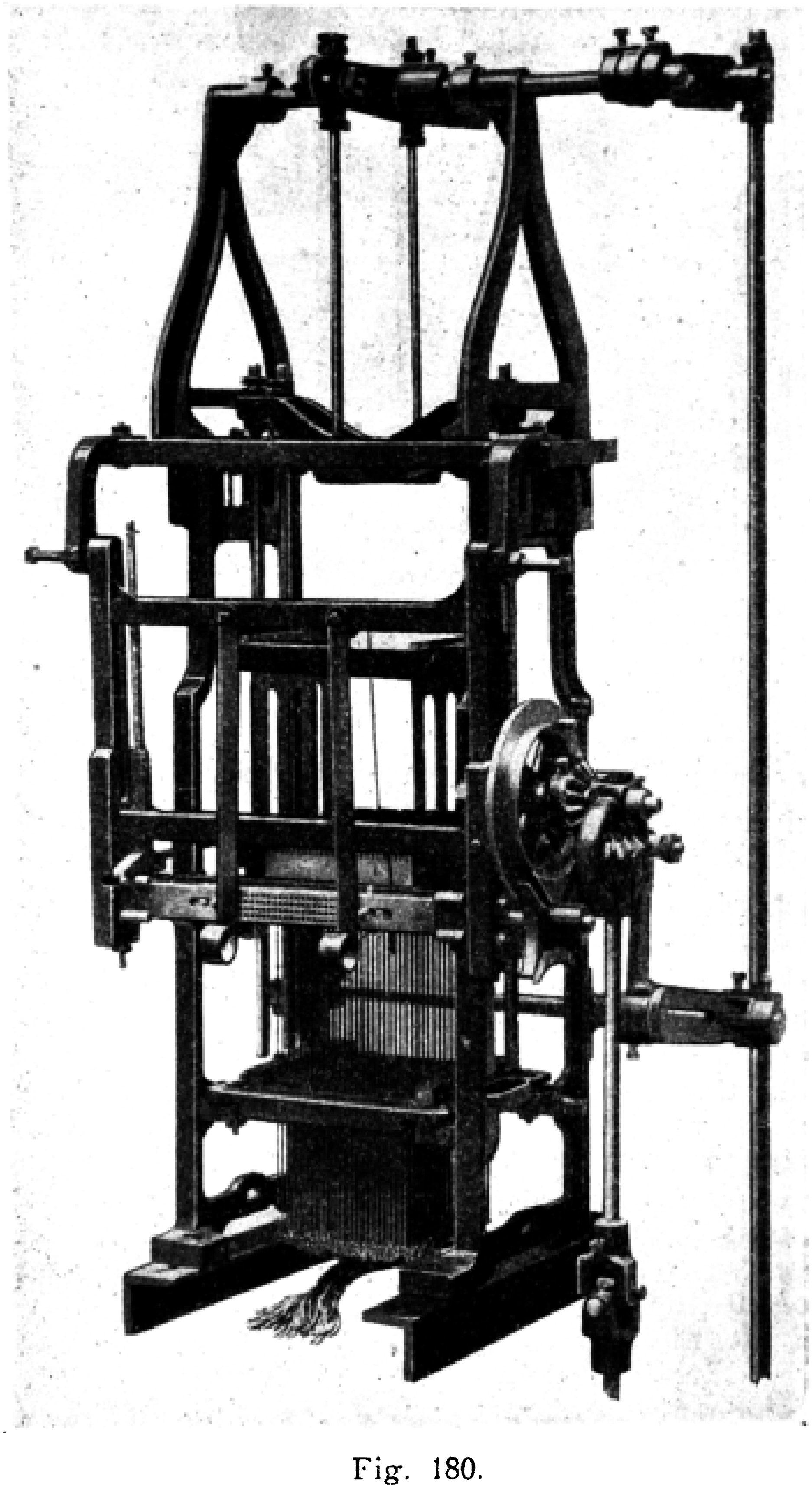


Fig. 180.

Messrs. Samuel Dracup's Jacquard Selvedge Motion.

cylinder machine. The cylinder with its four rows of holes is made from solid drawn brass tubing, and the harness cords are made from the best Irish linen thread.

The jacquard is supported over the centre front of the loom to give the most direct way to the harness cords. The "non-wear" metallic comber boards are adjustable within certain limits. The jacquard may be fitted with a direct drive from the dobby, or may be run by sprocket wheels and open chain from the crank shaft. The former is much the cleaner. The timing of lifting the griffes has to be in accord with that of the dobby, so the making and changing of the shed is practically identical. The cylinder is moved in and out on the slide principle, and is turned by a four pointed star wheel rotated by a pin wheel above it.

It must be understood, before going further that most jacquard makers construct every kind, or almost every kind of jacquard.

Double Lift Double Cylinder.

An outline of this is given at Fig. 181. This make of jacquard is the best kind of jacquard, for, with having two cylinders, it may go at half speed of that of a single cylinder machine, or may work at a higher speed in the number of picks per minute, and yet go at a much reduced speed as regards the motion of the cylinders as compared with a single cylinder engine.

The hooks A are now turned in both directions, for the bent ends now face their own cylinders, the hook A being the first in the upper section, and the hook B the first in the lower section. There is now only one needle to one hook. At C are the blades of the griff in attendance on all the odd numbered hooks commencing from the left, and at D are the blades of the other griffe that answers the requirements of all the odd numbered hooks commencing on the right. The upper needle box is at E with the looped ends of the needles at F, whilst at the opposite end, G are the protruding ends of the needles, H the needle box, and I the representative eye of the needles. Most of the cylinders for this make of machine are four-sided as given at J and R.

They may be suspended from a batten, or be worked by a slide, made to revolve by shears, or turned by a star wheel. Taking everything into consideration, the slide and star wheel are to be preferred to batten and shears, for lanterns, hammers, springs and shears are not required as the parts are simplified, and the slide and star wheel are steadier and more reliable. At K and S are the respective cylinder shafts. The lower spring box is at L, and the looped ends of the

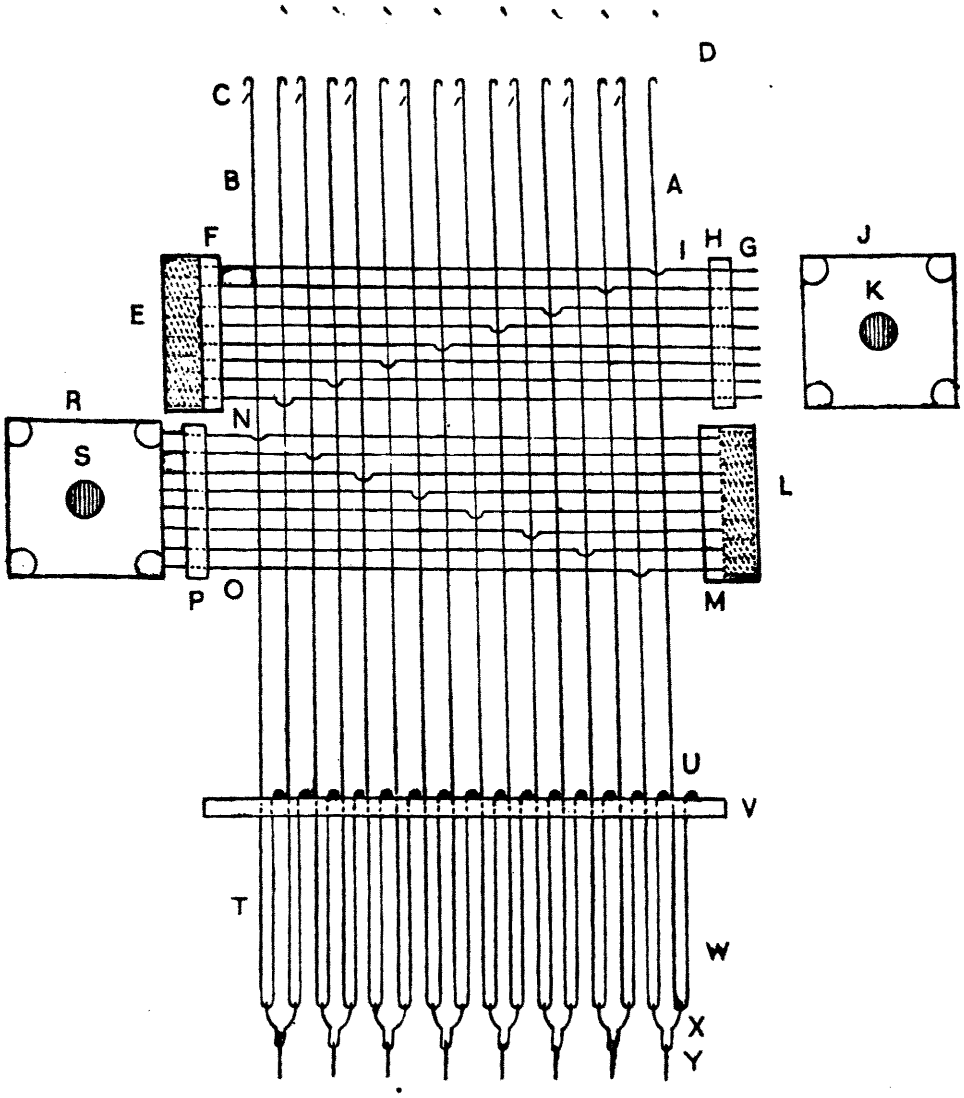


Fig. 181.
Double Lift Double Cylinder Jacquard.

needles at M, whilst N is typical of the bottom series of needle eyes, with O as the bottom needle of the whole series, and P the bottom needle box. The looped ends of the hooks and the ribs on the grid are at U, and V the grid. At W is the doubled section of the hooks, with X as the link connecting two hooks together, with Y as the neck band.

In both the double lift single cylinder, and the double lift double cylinder jacquards, there are all the advantages of the principal of the open shed.

Vincenzi Pitch Jacquard.

This French fine pitch jacquard is given at Fig. 182, this one being a 1,760 hook machine. There are various sizes of this jacquard, for one has 880 hooks and the others 1,320, 1,760, 2,640, and larger if required.

Much of the description of this jacquard may be traced in the illustration.

Griffe Rod and Disc.—On the upper and left hand is the cross bar, and on it is the casting that holds the rod controlling the griffes. Towards its outer end, the griffe rod carries the swivel with a collar at either side to keep it

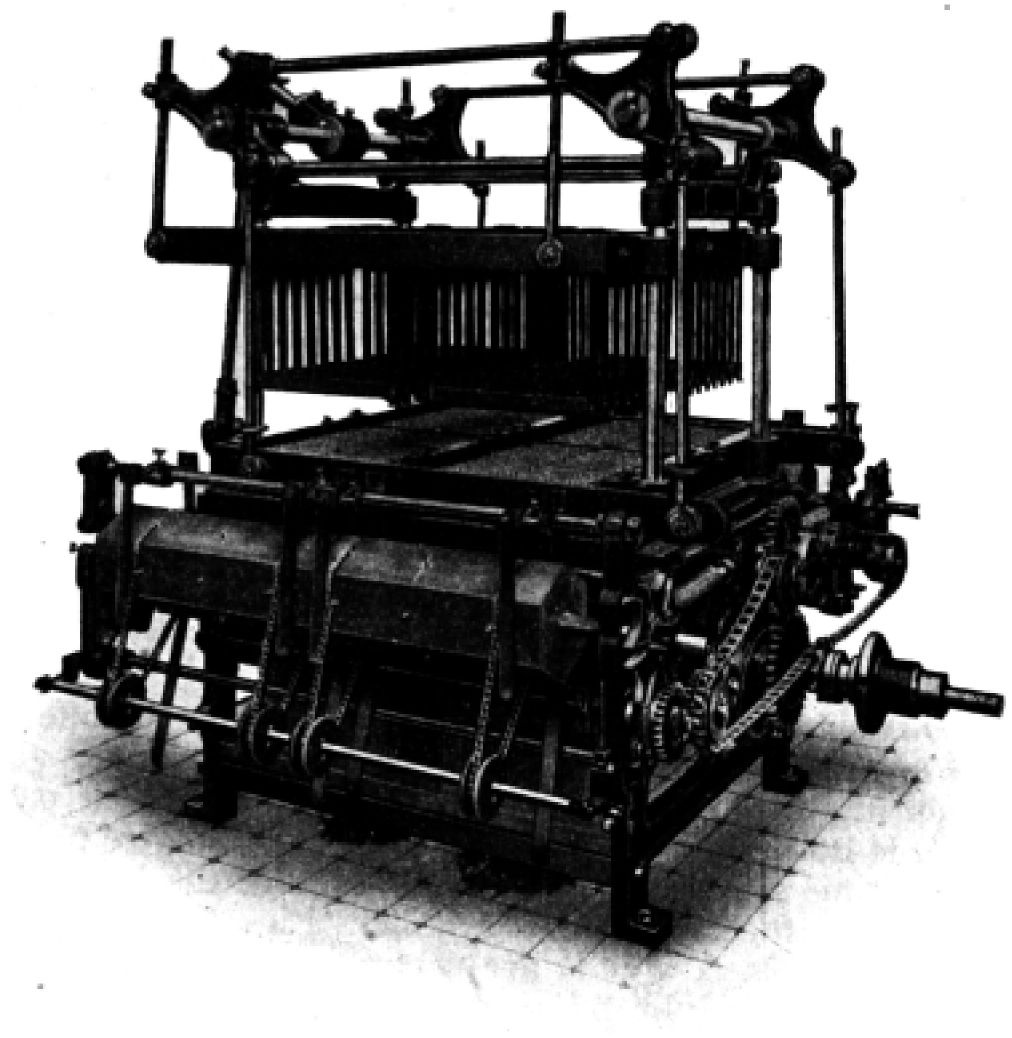


Fig. 182.

Dracup's Vincenzi Jacquard Double Lift Double Cylinder.

in position. The swivel influences the size of the shed, for when pushed nearer the griffes, the shed is made larger, but when set further away, it is decreased. When either alteration is effected, then the adjustment to the griffes must follow, to get the correct pitch.

Through the bottom of the swivel is the pin that holds the shedding stirrup.

An adjustable rod connects the top swivel to the bottom one, the latter being bolted to a disc, the disc being slotted in two places, so it can be set to run clockwise, or anti-clockwise. The slots give scope to secure the best timing of the shed to suit the warp.

The disc is keyed to its shaft in a sunk keyway, and so is the tappet behind it that operates the cylinders.

The disc is for the movement of the griffes, and when the connecting rod is in the centre of its movement, the griffes are set to be level at the top.

Griffes.—It will be noted that the triangular levers at each corner of the jacquard, are connected by adjustable rods to the framework of the griffes, the arms on the left having the shorter rods, and on the right, the longer ones. When these arms are dead level, the tops of the griffes should be the same. The back central arms of the triangular levers are connected by a rod, and the same applies to the front ones.

The blades of the griffes are slanted so as to give room for the ends of the hooks, and are pinned by wire.

The griffe blades are made to fall from $\frac{3}{8}$ths to half an inch below the ends of the hooks, when the bottom of the hooks are resting on the bottom board.

This distance gives time and space for the hooks to change position for the next lift.

Hooks and Needles.—These are constructed differently to the ordinary double lift double cylinder machines. There is no spring box, for the formation of the bottom part of the double hook made from the same length of wire produces all the spring necessary at E. The ends of the hooks made by one wire, face their own cylinder, Fig. 183. Each row of double hooks A and B are separated by rods C and D, and are kept straight by passing through a slotted grate on their way to the bottom board below.

In the loop at the bottom of the double hook is an endless cord G the doubled length of it being $7\frac{1}{2}$ inches long. This cord is made to pass through a hole in the bottom board F. The bottom of the cord has a steel hook attached, the end of the bottom loop L resting in a scooped out place on the down going part of the wire. To this hook is attached the harness cords. The needles H are doubly bent to influence each hook nearest to it, a blank on the card indicating a thread down, and a hole, a thread lifted.

The bends J and K on the needles lean towards each other, so there is no slipping of the hook, and in addition, they lean downward a little in the machine so as to take up less space.

Each needle has also another bend I of a less, but more open shape in the needle box. This bend rests on a flat bar, and prevents the needle from turning. Each horizontal row of needles are separated by flat bars, and each vertical row of needles are separated by vertical and circular pins. If a needle has to be extracted for any cause, then the corresponding pin has to be pulled out. A very small tube

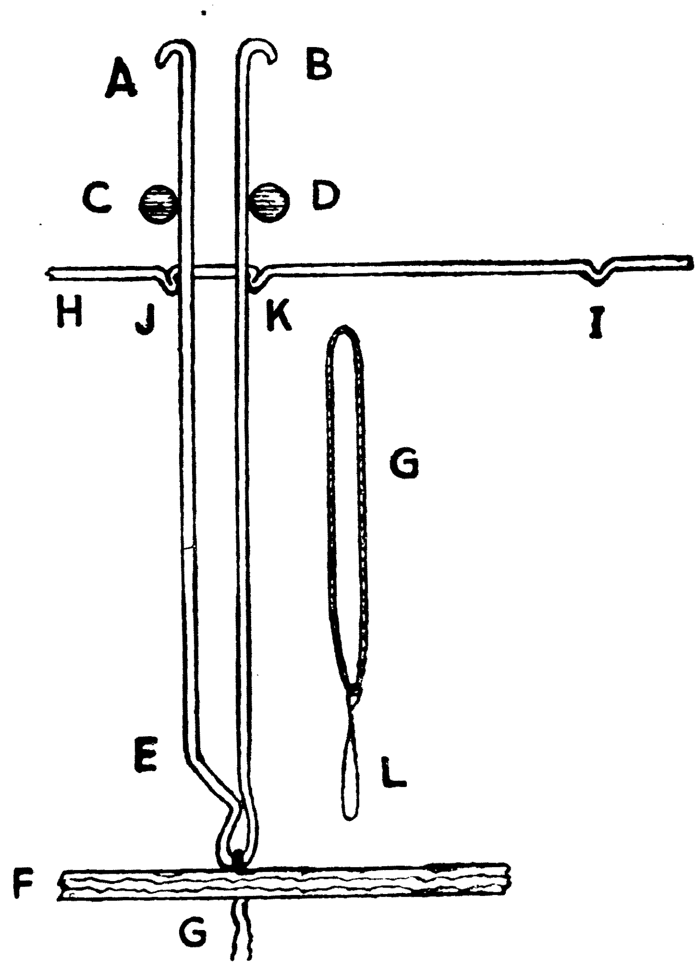


Fig. 183.
Section of Vincenzi Jacquard.

then takes one end of the needle, and is pushed through the machine until it emerges at the opposite side. The fresh needle is then pushed into the tube, and follows it through the machine, and so finds its length and place immediately.

If a hook has to be extracted, the harness cords are uncoupled, and a band is attached to the looped wire.

The double hook is then drawn upward, along with the attached band. The band is then taken off the extracted hooks and placed on the fresh hooks, which are then drawn into position, and the band taken off, and the harness cords coupled up.

The ends of the needles pass through a brass needle plate which has already been explained.

Cylinders and Card Strippers.—In the machine exhibited, the cylinders are hexagonal in shape, and have at least two advantages over square cylinders. (1) They turn slower and steadier, and there is much less danger of them getting out of place. (2) They wear much longer, as there is much less wear and tear. The brass pegs which pass through the perforations in the cards are not held up by springs, but are fixtures.

Each cylinder is set in two ways.

(1) On the right side of the cylinder shaft is an open spiral spring that presses the cylinder forward. The lateral pitch of the cylinder is set by a locknutted setscrew on the outside of the casting that receives the shaft of the cylinder on the left.

(2) The vertical position of the cylinder is obtained by brass castings inside the framework that holds the cylinder. Locknutted setscrews pass through the bottom of the framework, and influence the altitude of the cylinder. The pitch laterally and vertically is, that the needles must penetrate through the centre of the holes in the cards and cylinder.

A brass casting fits over the top of the cylinder shaft.

The card strippers are seen in the illustration. These are chains that pass into grooves in the cylinder, and just outside the outer pegs for the cards. At the bottom, they pass round small flanged pulleys that are loose on their shaft, but are prevented from getting out of line by a split pin at either side. If any card is liable to stick on the cylinder, it is forced off by the chains. Curved and flat springs press the cards on to the cylinder front and back.

Cylinder Tappet and Slide.—Both cylinders are mounted on the same slides, and move by the same tappets.

When one cylinder slides inward, the other moves outward, and *vice versa*. As shown, the cylinders are turned by a six sided star wheel, this wheel being turned by a pin on the arm of a bevel wheel. The pin enters an opening at the side of each section of the wheel, and turns it every other pick when the cylinder is moving outward. The pin bevel wheel meshes with another at the base of an inclined shaft, and at the upper end, the bevel at that place gears into the driver bevel for both cylinders.

Behind the driver bevel is the ordinary wheel that is run by a similar wheel below it, and is on the driving shaft. The shaft carries the driving sprocket wheel on its outer end, which is coupled by link chain to the sprocket wheel on the crank shaft. Another important point must not be overlooked. The tappets that operate the cylinder slides give a dwell of a quarter revolution of the crank shaft to the cylinder when in contact with the needles. This gives time for the hooks to change position, and the griffes to be level with each other before all pressure is withdrawn from the needles. The outer dwell of the cylinder is the same as the inner one, for then the other cylinder is in contact with the needles.

Inner Pitch of Cylinder.—The bearer casting of the cylinder has a stout rod screwed into it. This is seen on the right next the star wheel. The rod passes through two bores in the slide, and in between the bores is a strong and open spiral spring. The strength of the spring is regulated by a nut. A couple of locknuts in front of the back bore sets the pitch of the cylinder when against the needles. When the nuts are screwed towards the cylinder the cylinder exerts more pressure against the needles, and force the hooks a farther distance, but if the nuts are turned in the other direction, the effect is opposite. Both sides must be set exactly alike.

Reversing Cup.—On the inner side of the driving sprocket wheel is the reversing cup. This is made with a long slot at either side.

This cup cannot be made use of unless both cylinders are at about equal distances away from the needles. When so situated, the weaver pulls a pedal lever down, the pedal then being held by a catch. Attached to the pedal lever is a finger which moves into one of the slots mentioned in the cup casting.

The cylinders can then be rotated by a handwheel used by the weaver after a release pin has been pulled out, and the cylinders cannot get out of order with each other.

Inside the cup is a flat plate or disc which is held off from the bottom of the cup by locknutted setscrews. The plate is pressed upon by an open spiral spring which acts as an escape motion. The spring applies pressure to a clutch. The fork that moves the clutch is fulcrumed below, and behind the clutch is a casting that has an inlet V. Into this inlet fits an outstanding V on the sprocket wheel. As shown, this sprocket wheel is connected to another on the right of the illustration. The clutch is made to slide on a saddle key, and the clutch sprocket wheel is connected by chain to the reversing sprocket wheel.

Advantages.—This jacquard may be run with safety at 170 picks per minute. As it is smaller for a similar capacity than the English machine, it is much lighter in weight, and more light is available for the weaver. As the whole mechanism of the jacquard is run by a single chain, and as driving and cylinder motions are simplified, adjustments are made very quickly.

The hexagonal cylinders considerably lengthen the service of the cards.

The cards are three-ply, and are constructed to withstand atmospheric conditions.

As there are only one set of needles, and no needle springs, the mechanism is simplified.

The cylinders are positively rotated so that cylinder hammers, turning catches, and lanterns, are unnecessary. Card strippers prevent the cards from wrapping round the cylinder, and much less power is needed to work the machine.

Jacquard Patterns.

Worsted.—Fig. 184 has all the figuring done by the weft, one figure only being worked out on 104 threads and 94 picks. The figure is formed by two picks float and two picks plain weave, and has a plain weave ground. The plain binding weave is made wavy to cut the long floats in the floral effect. The full pattern is four inches square.

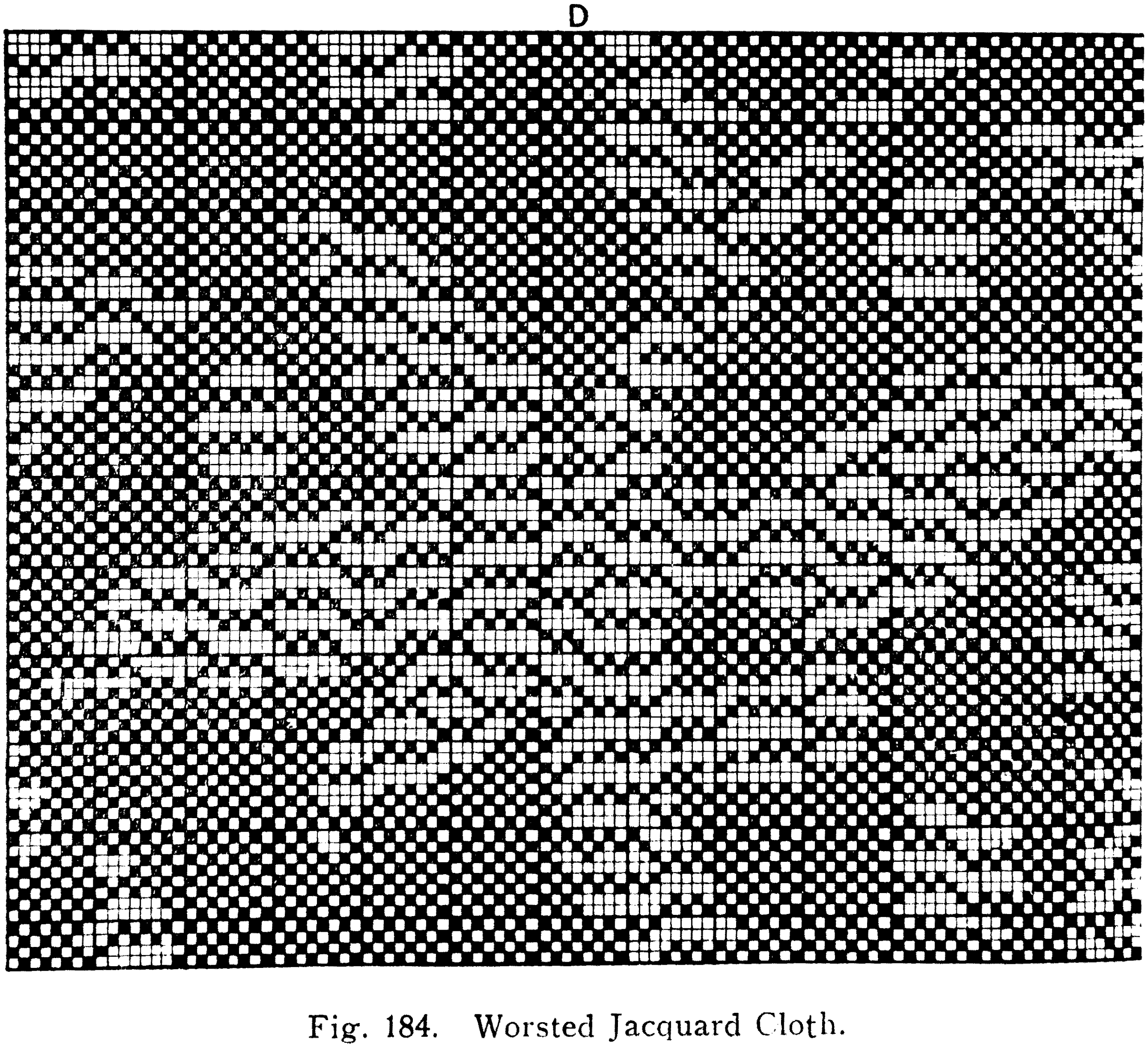


Fig. 184. Worsted Jacquard Cloth.

Warp 34's worsted with 62 threads per inch.

Weft 28's worsted (crepe twisted) with 56's worsted (crepe twisted) the final twist having 14 turns per inch, with 54 picks per inch.

Cotton.—This is a point paper plan of an ivy leaf worked out on a five end sateen ground. The figure may be placed in plain order with the figure leaning in two directions, or in five or eight end sateen order. It is worked out on 55 threads and 80 picks. Such designs are much used in cotton table cloths, Fig. 185.

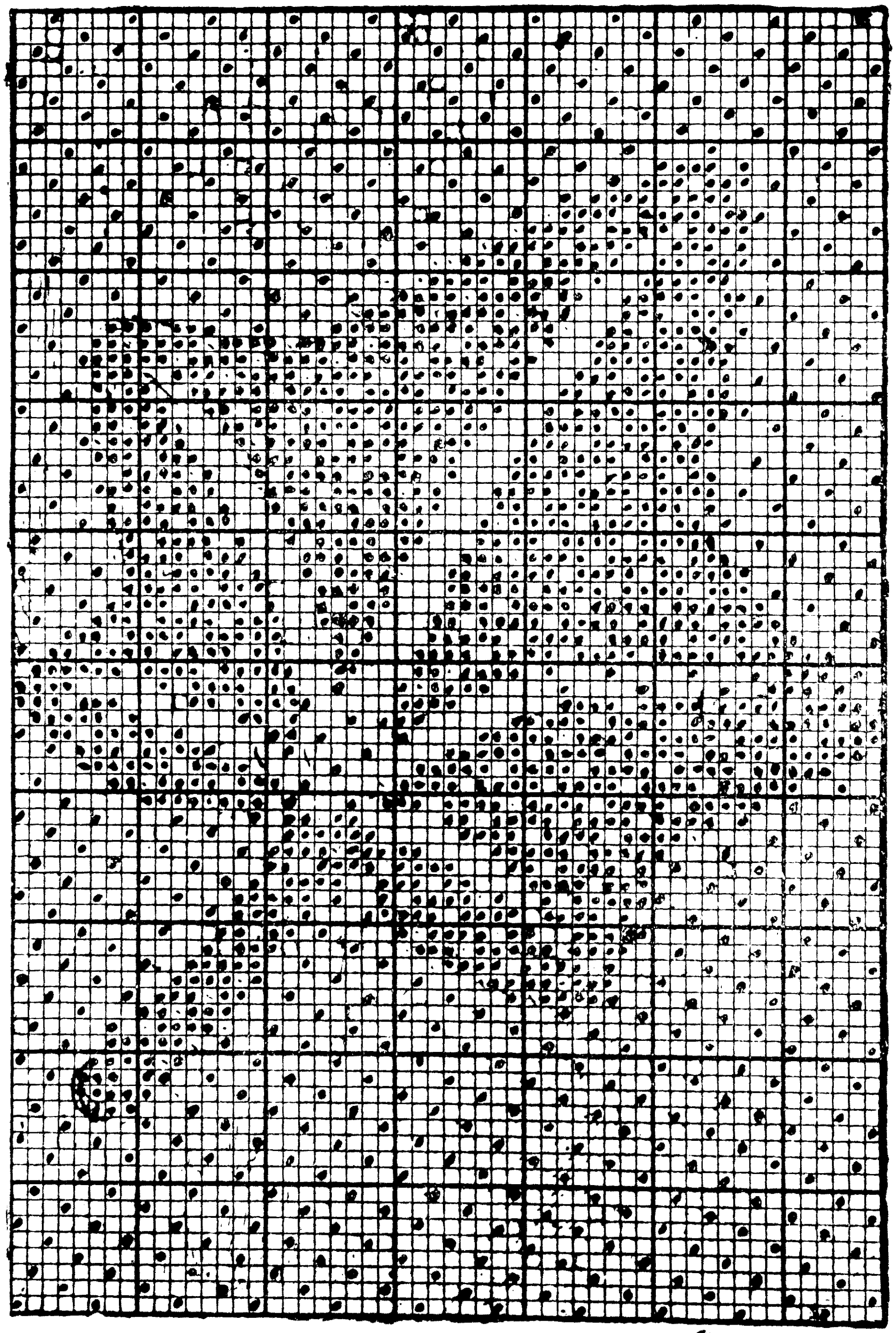


Fig. 185. Cotton Jacquard Pattern.

Rayon.—The pattern at Fig. 186 is a two weft rayon crepe brocade. The warp is 100 denier Lansil acetate rayon with 26 filaments. It has 140 threads per inch, and woven in 140's reed, two threads per dent.

It is woven with 88 picks per inch and is a pick and pick effect. One pick is 2/60 Bemberg with 70 turns per inch in the single yarns, and 12 more turns per inch in the doubling.

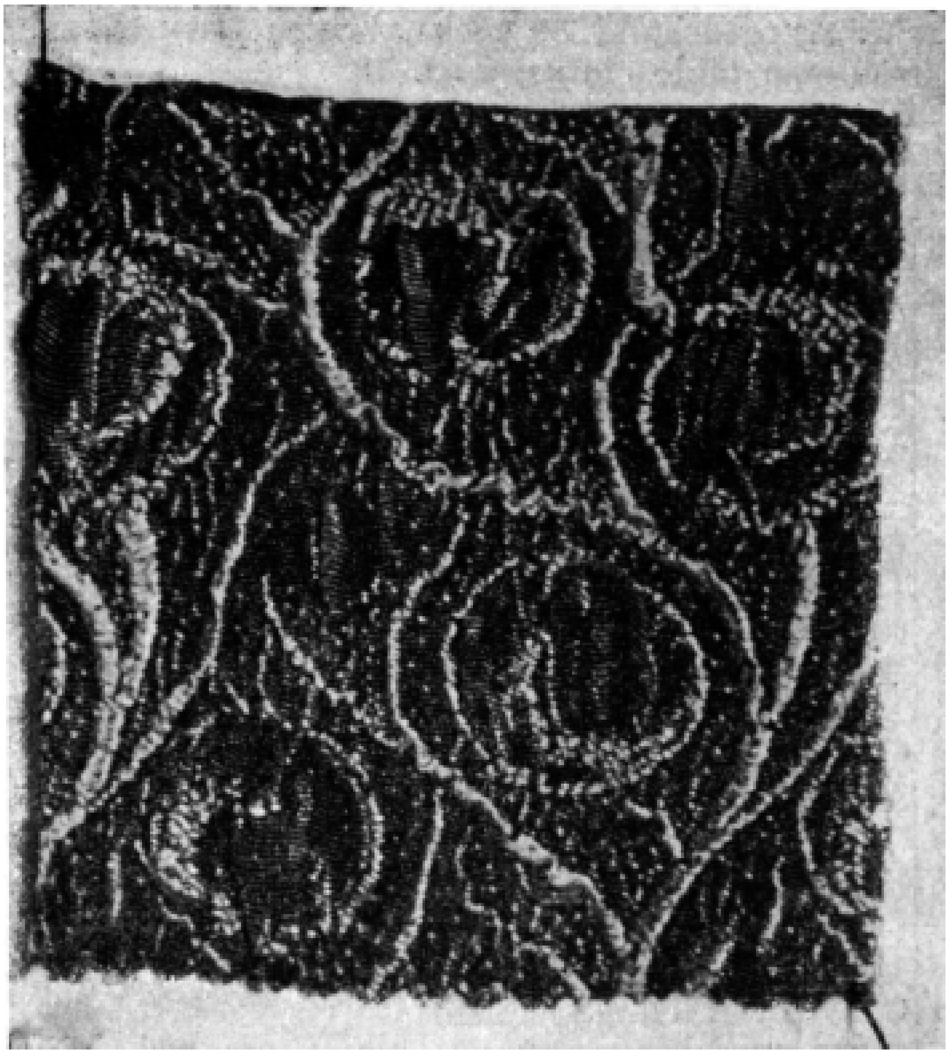


Fig. 186. Prize Winning Rayon Cloth.

The other pick is 30's denier viscose with 26 filaments. It was woven in a 400 Jacquard double lift single cylinder, the full pattern being on 400 threads and 300 picks.

The fabric was cross dyed, the crepe in bronze and the other in gold for figuring.

Silks.—Fig. 187 is a lily pattern, the beauty of it being in the design. It was woven with 180/2 silk with 192 threads per inch. The weft was 80/3 silk with 128 picks per inch. The ground weave is 8 shaft warp sateen. The leaves and

Fig. 187. Choice Silk Brocade.

petals are shaded with various twills and sateens to bring out the effect in light and shade as in nature. The warp is white and the weft one pick pink one pick stained blue.

Fig. 187a.
A Unique Jacquard Silk Texture.

Woven in eight colours. Each colour has 120 threads per inch and brought to surface when needed. Depicts train running, trees waving, flowers blooming, clouds rolling. A little village nestles at foot of hills. Pattern between selvedges 5½ inches, and warp way 2½ inches. Weft in selvedge 200 picks per inch.

DRACUP'S IMPROVED MATTING LOOM JACQUARD.

Dracup's Improved Matting Loom Jacquard.—This Jacquard has a centre shedding motion, is an 800 hook machine, and weaves matting 75 inches width, though the normal width is 72 inches. The speed is 130 picks per minute. It is strongly built for the heavy work it has to do.

It is estimated that when the lifting board is raised every pick, that at the period of hook change, it has to sustain a weight equal to one ton.

A back view is seen at Fig. 188.

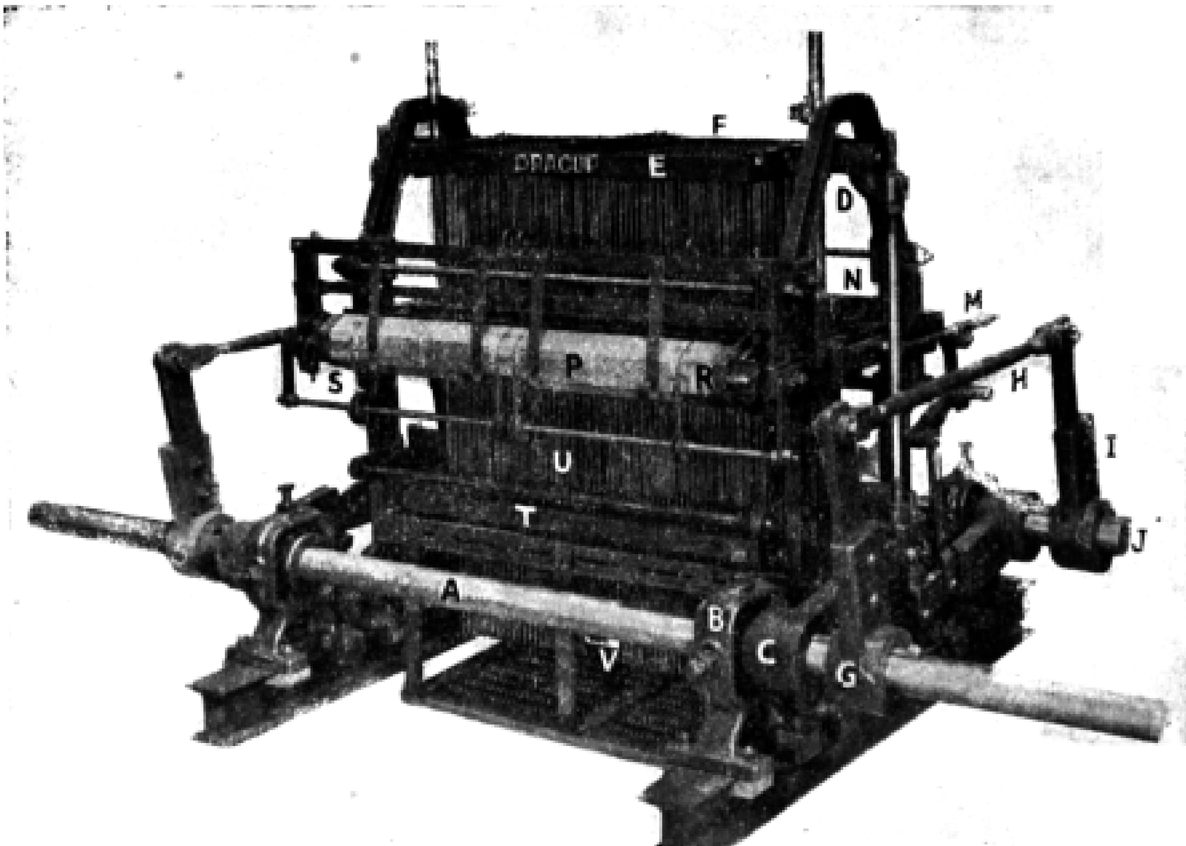


Fig. 188. Dracup's Improved Matting Jacquard Loom.

Oscillating Shaft.—Shaft A has a diameter of three inches, and is at the back of the Jacquard. The shaft passes through two sleeves, each being in a square casting like B, and is fitted with four powerful setscrews to get exact alignment for easy working.

On the shaft is the one-armed lever C, and coupled to it is the rod connection to the griffe casting D. By oscillating shaft A, the griffe rises and falls every pick. On the same shaft is the strong lever G, which, like C, is held by a key in a sunk keyway. At its upper end, lever G carries the stout rod H, and joins it to lever I on shaft J, the latter being a duplicate of shaft A. Shaft J is connected to lever K, and by a short rod is fixed to lifting board T. When shaft A turns toward the back of the loom, lever C raises griffe F, and by lever G being connected to J the lifting board T is lowered by K, and in this manner the shed is formed.

Slide and Cylinder.—Lever K holds the connecting arm L, and the top of it is held by a right angled lever, the upper arm of it carrying the spring rod M. The spring rod is connected to the cylinder slide O that moves the cylinder outward and inward every pick. The cylinder moves outward two inches, but does not begin to turn until it is free from the points of the needles, and is then rotated a sixth part of its circumference.

At each end of the cylinder is casting R with its rounded parts, one of which is made use of by the upper turning catch every pick. The turning of the cylinder is very steady, and there is little danger of the cards being deranged or damaged.

The slabs of wood forming the cylinder are made of seasoned birch, and the grain is arranged so that one is the opposite way to the next, and prevents expansion.

The holes in the cylinder for the needles are made by precision borings, and the setting of the cylinder has to be with exactitude.

To attain it, the ends of the needles are smeared with oil, and when the cylinder is brought forward, with plain weave cards upon it, the oil marks made indicate how it should be altered if not correct.

The cylinder is fitted with brass spring cones that enter the larger punched holes at the outer ends of the cards. The curved and flat vertical springs press the cards to the cylinder.

Safety Chains.—The cylinder is in two sections, each controlling 400 hooks. Each section is grooved in two places to allow an endless chain to fit into it. The chains prevent the cards clinging to the cylinder after they have operated.

One of the hidden things is, that the shaft of the cylinder passes through from one end to the other, and so prevents any sagging in the centre.

Timing of cylinder.—The timing is arranged so the cards begin to press the needles back after the hooks have been liberated from the griffe. Having pushed the needles to the limit set, the cylinder has to dwell until the griffe has a firm hold of the selected hooks. The overlooker can make sure these points have been achieved if he observes the motion while the weaver slowly turns the balance wheel.

The Griffe.—The framework of the griffe E is cast steel to withstand weight and wear. The raised griffe is at F, with hooks on the blades. The griffe has eight steel blades. They have straight backs and sloping fronts. The blades are 1½ inches deep, and 32 inches long, but are supported at their centres by a cross bar. The upright shafts seen in the illustration above the Jacquard, pass through three bores, and keep the griffe steady and reliable.

Griffe and Lifting Board.—The hooks that have to form the bottom shed, fall and rise with the lifting board. Its upper surface has a fibre covering, and has a " cushy " action on the bottom of the hooks. When the griffe descends, the board rises and when at its upward limit, the points on the hooks are about ¼ inch clear of the griffe blades.

The Hooks.—These are at U, and are spring hooks, and do not need a spring box. The hooked part is 20 inches long and the spring length is 18 inches. In between each row of hooks, and at the back of the spring section is a cross-bar that acts in much the same way as a spring box. By exerting pressure, it keeps the needles forward until pressed back by the cylinder card.

Neck Bands and Wires.—The top loop of wire V is on the spring bend of the hook, and the bottom loop has an oblong ring attached. On the ring is a three-play cord that passes through the cord board W, and also the comberboard below which is not shown. Below the comberboard is the wire connected to the cord at the top and the heald eye at the bottom. Below the heald eye is another wire that also carries the lingoe. The connecting wires are over 20 inches long. The rows in cord board W are in alternate rows, and are fitted with porcelain eyes.

Hook Guide Board.—This is not visible in the picture. It is formed by a strip of wood at either side of the whole series of hooks, and another strip passes through the central division. Through these three strips of wood, and also through each row of hooks at their base, a rod passes that keeps the hooks straight.

Attached to the outer woods are wires, which at their tops, are fixed to an appropriate griffe blade. In this way, the hook guide grate travels with the griffe.

When the griffe is down, and the lifting board is raised, the distance between the two is six inches. The cross rods are secured by a split pin.

When from any cause a hook has to be extracted, the split pin is pulled out and the cross rod pulled beyond the damaged hook. The oblong ring is then detached and a band is fastened to the wire at the base of the hook. The hook is then taken out, and a fresh hook attached and drawn into position.

Needles.—These are 22¼ inches long, and on their length they are doubly bent to the position they have to occupy for the hooks they have to serve. To prevent any sagging, steadying cross rods pass underneath each row at their centre length.

The front end of the needles are looped for ½ inch. Through each vertical series, a pin passes to prevent them turning. At the opposite end, the needles pass through a needle plate, the boring being in four sections of eight each.

The needles protrude ⅜th inch.

A hole in the cylinder card indicates a hook lifted, but a blank is for the bottom shed.

Press Board.—The board is indicated at N, and is attached by its pin below spring rod M, to the right angled lever that receives its motion from lever K, on the cross bar J. The press board is moved in and out every pick. Its function is to exert pressure on any needle not responsive to the pressure of the spring hook.

The press board is adjusted to give the required push so that all the needles are level in front of the needle plate.

When a needle requires attention, the press board is taken off, the pin extracted from the needle board, and the needle is ready for extraction. Any replacement is a two-handed job, for the one who pushes it through must have a helper to see that the needle occupies its right place in the needle plate. On pressing the needle forward, it is turned a quarter way so its doubled parts do not catch on the hooks.

Comberboard.—For this kind of loom the comberboard is 72 inches. Its actual length is 75½ inches. The board is built in sections, each section having 72 porcelain eyes for the harness cords to pass through. The eyes are arranged in a slanting position, the back of the same row being a half inch to the right of the front row. There are eleven sections, and as there are 72 eyes in each section, there are 792 harness cords, and only *one* cord for each hook.

Heald Eyes and Lingoes.—As the warp is made with thick threads, the heald eyes have a full depth of 1¼ inches, and the bore for the thread is $\frac{7}{16}$ inch. The lingoe weighs two lbs., is 20 inches long, and a ½ inch thick.

The shed made by the Jacquard is usually 10½ inches, but this can be increased if necessary.

ACCESSORIES OF THE LOOM.

The Use of Belts.

Though electricity is making headway in the driving of looms—both by the group method, and the individual drive—it still holds good, even with electric motors, that the great majority of looms are run by belts. The motor method is much shorter, but the longer one from the mill shaft pulley to those on the loom is not likely to be superseded for a considerable time. The quality and use of belts is a subject well worth consideration.

Quality of Belts.—The quality of a belt may be judged in four ways:—

(1) By the grain at the cut end. If it be coarse, it will stretch the most and give the least wearing, and may be so lacking in strength that a belt fastener can only hold it together for any length of time by being riveted. It might manage for some little time on a light loom, but is a first-class nuisance on a 90 inch box loom.

(2) By the use of a knife. A poor belt when well pressed will offer a moderate resistance to a sharp knife, but good belting will resist still more. One of the best tests is to match a piece of good belting against one that has not been tried, both as regards grain and cutting.

(3) By bending. When a belt is bent several times, and shows prominent creases on the outer side, it has not that resistance that a good belt possesses.

(4) By wearing. A belt that has to be tightened up several times a day when new, will lack durability, and every act of tightening up is a " slimming process " for the belt.

Belts are made up of sectional lengths, each part being tapered off at either end, one being on the face side and the other at the back. As the tapering is usually very accurately done, the joinings fit together very well, and are sewn together by whangs or copper wire. Whangs are the most common form of sewing for loom belts, as there is no danger to the hand when running, and none to the knife when repairing.

Methods of Loom Driving.—There is a right and a wrong way of putting a belt on a loom, for the thin end of the inner tapered part must go last round the shafting pulley. If it takes the lead, it will eventually curl up and tear part of the sewing out. There are three ways of driving a loom, these being the straight, the half cross, and the cross drive. The last named gives the best belt grip as the belt wraps better round the pulleys.

Correct Lineage.—In the straight drive, like that applied to the Hattersley friction box loom, the centre of the mill shaft pulley should be opposite the centre of the loom pulley when out of action.

To give satisfactory results for the half cross drive when the mill shaft pulley runs towards the loom as well as away from the loom, Fig. 189 is introduced. The plumb line A is dropped from the running down side of the mill shaft

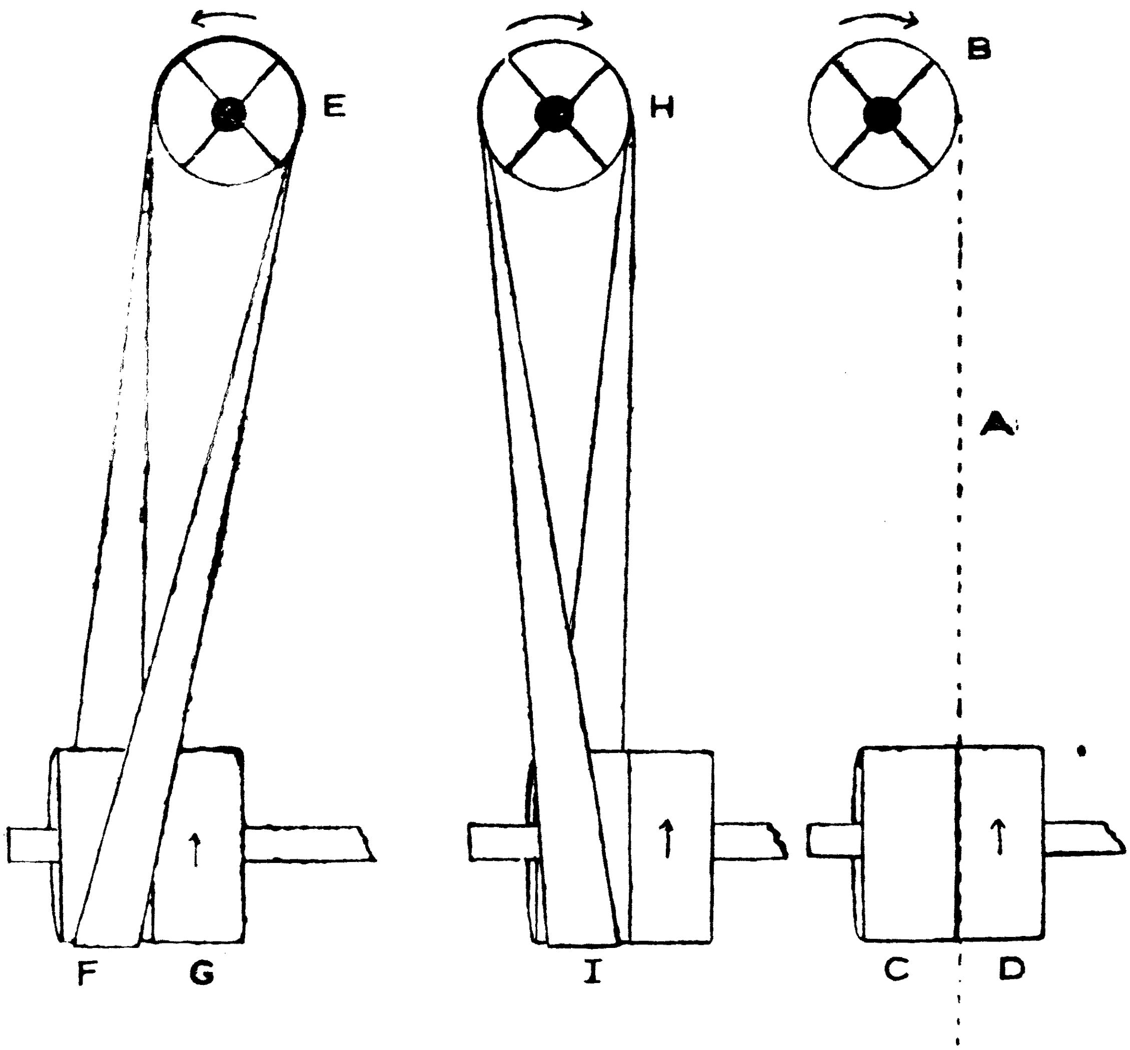


Fig. 189.
Belt and Loom Pulley Setting.

pulley B, behind the loom pulleys C and D. The last named is the fast pulley and the other the loose one. The direction the loom pulleys move as indicated by the arrow. The plumb line should fall about a ¼ inch on the fast pulley. This system of driving is the best possible when the mill shaft pulley runs towards the loom; and is demonstrated in the centre section of the diagram. At H is the mill shaft pulley, and the belt running down to the front of the loom pulleys. On coming behind at I, the belt is drawn *away* from the fast pulley and this greatly assists in the safe running of the loom. When the loom knocks-off from any cause, the belt must be forced off the fast pulley in the least possible time, and it is obtained by this method of driving.

The worst method is shown in the first section. As before, the plumb line is dropped from the running down side of the mill shaft pulley E, and it is an advantage if it rests a little on the loose pulley and behind it. It will now be observed that the belt behind the loom pulleys leans away from the loose pulley F and touches the fast pulley G. This indicates that the belt will remain on the fast pulley the longest possible time when the loom bangs off, and this is a direct menace to the safety of the loom.

Only through sheer necessity should any loom be driven in this manner. The shorter the drive and the more the belt leans over the fast pulley when the loom is stationary.

Cross Drive.—In the Dobcross friction drive, the belt is straight, but in the fast and loose pulley method, the best driving is obtained with a cross belt. In this loom the bottom half of the crank turns first. The mill shaft drum is set so that its centre is opposite the centre of the loose loom pulley. The most effective way of crossing and working the belt is to throw it over the leading on side of the mill shaft, bring the end down *behind* the long length, pass it through the belt guide, and then fasten the ends together. When the loom is set in motion, the back length of the belt pulls the other with it, and transmits the full power in a fraction of a second, and gives the loom a good start. When the belt is pushed off, the back length is pushed off first, and drags the other after it. This reduces the belt power in the quickest possible time, and, in case of the loom knocking-off, the blow on the frogs and loom frame is minimised.

Whether a loom be running or standing, no belt ought to hang over the mill shaft pulley for any kind of drive.

There are different widths of belting. Narrow looms will work comfortably with belts 2¼ inches wide; wide looms need 2½ inches, but Dobcross looms, must have belts from 3 to 3¼ inches.

Long Driving Belts.—Long belts are to be preferred to short ones, and especially in the half cross drive. A good working length is 18 feet, for the pull is distributed over a good area.

When it can be arranged, a fairly large pulley on the mill shaft gives much better results than a small one as it has much better grip, and there is less variation in loom speed. This is chiefly a question of the speed of the mill shaft. It is better management to run the shaft at a reduced speed and have larger pulleys than to have it at a higher speed and have lesser pulleys.

Belt Tension.—When the belt is running on the loose pulley, it should be quite clear of the fast pulley both front and back or otherwise, nasty accidents can easily occur by the simple pressure of the long setting-on handle in the Hattersley loom.

The amount of pull given to the belt by the setting-on handle and belt fork is only sufficient to draw the belt half-way, or a little more than half way on the fast pulley, and this is enough to drive the loom effectively at a proper speed if the belt is in good condition and not too slack.

For belt tension, it is better to err on the side of slackness than tightness, for tightness considerably shortens the service of the belt, puts undue strain on the crank shaft in plain tappet and dobby looms, makes it more difficult to get the belt off the fast pulley when the loom bangs off, and causes the loom to run at an excessive speed, except in the weaving of very heavy cloth.

A slipping belt wears shiny on the inside, and the loom pulleys are bright, but a belt that is doing its work properly is dull in appearance and so are the pulleys.

Twisting Belts.—Belts sometimes twist over when driving the loom on the half cross method. This may be due to having been put on wrong way first after repairing, or through having repaired one section with an unsuitable length from another belt. It may arise from the point of contact with the belt fork being too far away from the loom pulley for this will impart too much leverage to the belt.

There is also another cause. The fast pulley is usually a little larger than the loose one, and sometimes the edge of the fast pulley is too prominent. The edge of it can be rounded off with a good file when the loom is running.

Conditioning Belts.—The heat of the factory, coupled with the friction generated by running the loom, dries the nature out of the belt and makes it liable to crack. Its pliability is restored, and its working hours materially prolonged by the judicious application of castor oil the last thing in the evening, or better still, the last thing before stopping at the week end. When the oil is applied to the inside of the belt when running on the loose pulley the oil can be evenly distributed, and gets well soaked into the leather before starting time. When extra gripping power is needed for the weaving of heavy fabrics, the belt may have to be tightened a little, but its grip will be materially aided by mixing a teaspoon full of powdered resin with three times the quantity of castor oil. It is put on at the times previously mentioned.

Belt Repairing.—In repairing belts of any kind, and especially those run with the half cross drive, the mark of an arrow may be placed with advantage on those pieces that are without sewing. In wearing, the belt is drawn out most on the left-hand side of a right hand loom by reason of its working position, this being the side to run the loom. If a section be held straight out as working, it will be seen to have a distinct curve to the right. In left hand looms the curve is to the left, and as this is opposite to the other, it follows that to get the best wearing results, each hand of belt are better kept for their own repairing. What has been the leading on side of one hand of loom, should be the same on the same hand. This cannot always be adhered to, but results are better when followed.

The slightly concave malleable iron fastener, with its double row of teeth at either side, is a very serviceable means of joining the belt ends together. By hammering, however, the fastener is liable to be made flat if hit too hard. The original shape should be preserved if at all possible, for it conforms to the circumference of the pulleys better, and there is less chance of it parting company with the belt. The smaller the pulley, and the more likely this is to happen. For poor belts, when difficulty is experienced in keeping the belt intact, the outer sides of the ends of the belt which are the most rigid may be pared down. This will make it a little more pliable, and will cause the teeth of the fastener to protrude through the leather. The teeth can then be bruised, and though the fastener is then spoilt, it will keep the belt running.

Rubberised Solid Woven Belting.—This type of belting, manufactured only by the firm of Messrs. J. H. Fenner and Co. Ltd., of Hull, is the result of research extending over a period of years.

The manufacture of this completely new class of transmission belting first began in 1930, and its progressive stages have been marked by seven British patents being taken out, and eighteen foreign ones.

Ordinary Woven Belting.—This is subject to the formation of ridges on the working face as the belt passes over the pulleys. Owing to the recurring pressure on these ridges, they are flattened out, and the threads are cracked. The outer part of an ordinary woven belt is subject to expansion when passing over the pulleys, and by being so stretched, they are subject to cracking.

When ordinary ply type, or solid woven belts are joined by malleable belt fasteners of the Harris type, the fasteners are frequently pulled through the ends of the belt. The edges too, are considerably frayed by the friction of the belt fork.

Ply belting suffers from the rubber or balata breaking away inside, and becomes almost like two belts, one working above the other.

These disadvantages have been overcome by the "Fenatex" type of rubberised belting. Fig. 190.

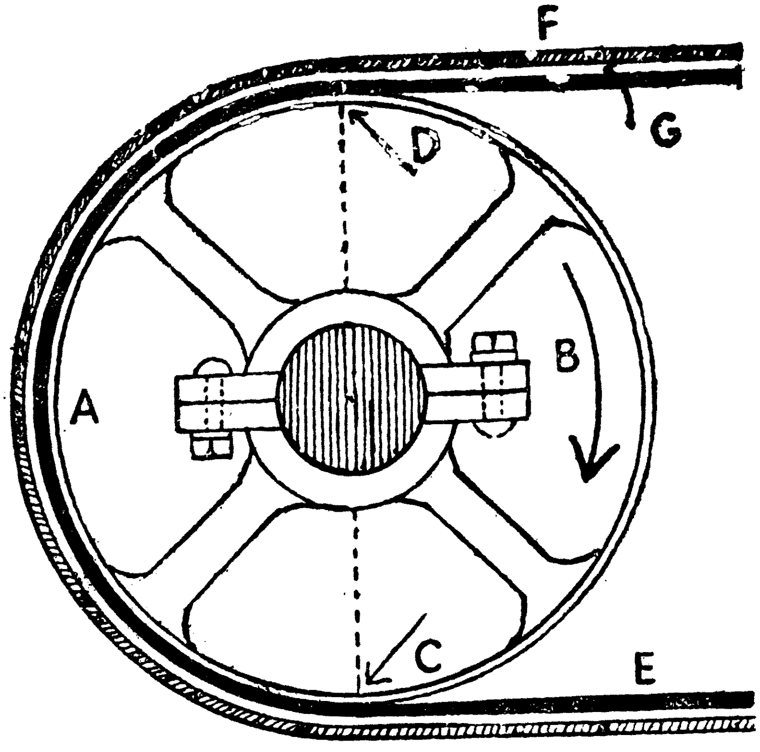


Fig. 190.
"Fenatex" Driving Belt.

Five Special Points.—The advantages of this kind of belting may be set forth as follows:—

(1) The driving face of the belt is woven so it will contract without forming prominent ridges when passing over the pulleys. Small spaces are left which form pockets, and the number of them working out at 25 to the square inch.

These pockets act as vacuum cups when passing over the pulleys, and increase the gripping power of the belt.

(2) The inner pitch line fabric is closely woven, and is the strongest section of the structure. This place in the belt is the "neutral axis," and it is here where the belt expands and contracts the least. The dense fibre structure at this place holds the fastener firmly.

(3) The outer layer of the belt is the most flexible of the three, and of the fourth in a standard $6\frac{1}{2}$ m/m. construction. It is here that the most expansion of the belt takes place.

It has been estimated that when the belt is $6\frac{1}{2}$ m/m. thick, and passes over a 4-inch diameter pulley, that the working face contracts seven per cent., and the outer surface expands five per cent. "Fenatex" belting is correctly designed to withstand the stresses set up by this expansion and contraction.

(4) Both edges of the belt are woven with a double selvedge to withstand the continuous friction of the belt fork.

(5) The belting is solidly woven by special and heavy machinery, and is converted into a homogeneous but flexible whole by the application of patented "Z" rubber impregnation, which imparts strength and durability.

The rubberising makes the belting impervious to atmospheric conditions, but it must be kept reasonably free from mineral oil, as this is injurious to rubber.

During hot weather, or in hot climates, a small quantity of castor oil will keep the belt face in good condition. When employed in a dusty or fluffy atmosphere, the accumulation of dirt on the belt, may be got rid of by the simple agency of soap and water. "Fenatex" beltings have no joinings, are virtually stretchless, and may be obtained in various thicknesses, and up to 1,000 feet in length.

Demonstration.—Fig. 190 gives a good idea of how the belt meets the three-fold requirements explained. The pulley A turns in the direction of the arrow B. At C, the belt comes in contact with the pulley, and is forced into a concave position until nearing its departure from the pulley at D.

The black line of the belt at E indicates the working face which contracts 7 per cent. when passing over the pulley. The central white line G is the "neutral axis" where the belt varies the least. The outer shaded part F is the one that expands 5 per cent.

SHUTTLES.

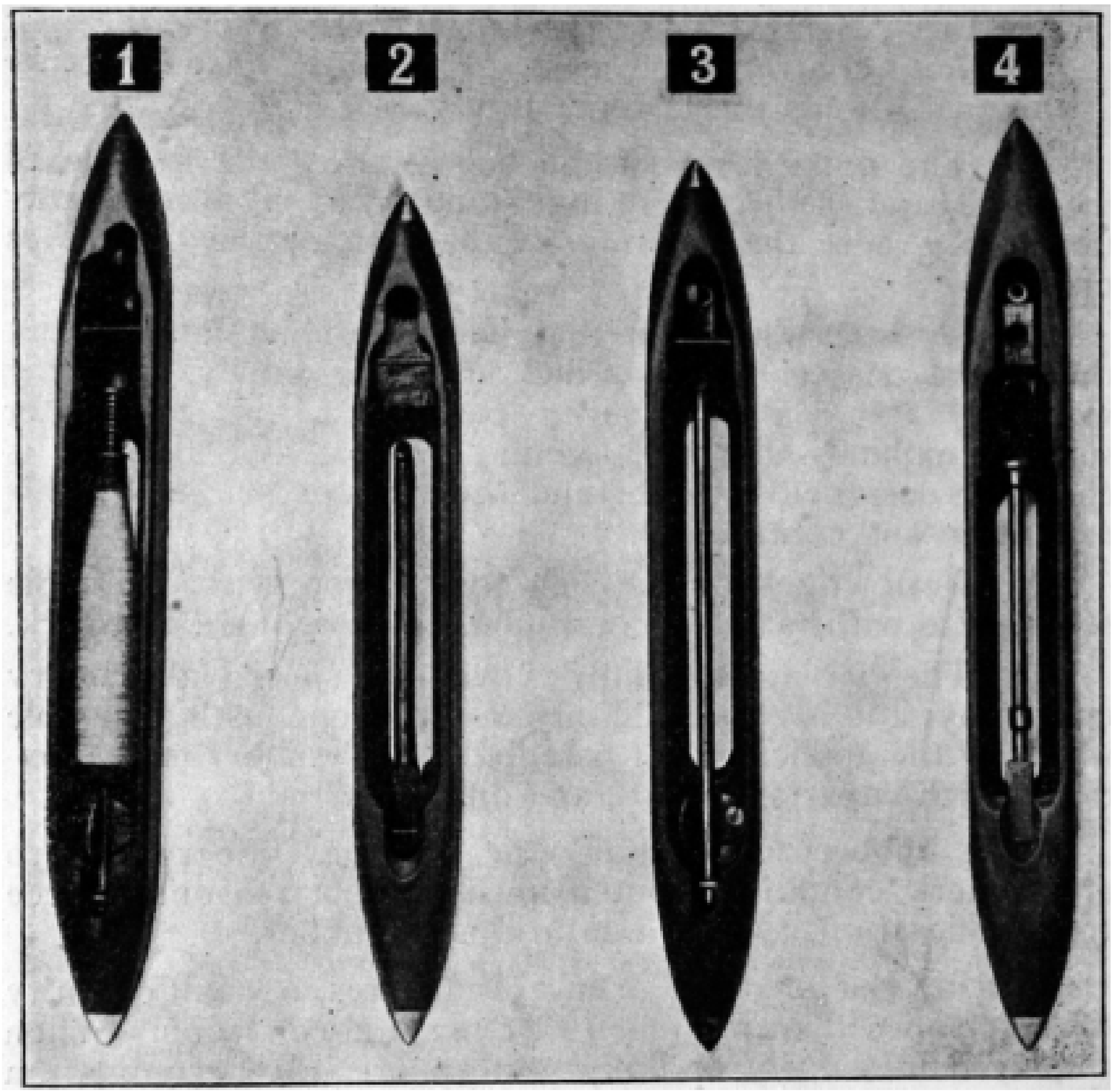


Fig. 191.

Types of Shuttles.

1. Clip Spring Woollen Shuttle.
2. Worsted Shuttle with Fast Spindle.
3. Box Loom Woollen Shuttle with Clip Spring.
4. Box or Plain Loom Woollen Shuttle with Block and Loose Spindle for Worsted Weft.

Since John Kay placed his " fly shuttle " on the market in the year 1753, great strides have been made in shuttle making. Now, there are shuttles constructed to suit every section of the textile trade—from the coarsest sacking to the finest silk. The outward shape is much the same for all, but the size varies considerably, and the internal fittings are a revelation of manifold ingenuity.

Progressive Stages.—Before the advent of the "fly shuttle," the average weaving per minute was 20 picks, and for wide widths, two persons were required to weave the cloth.

By Kay's invention, 40 picks were attained, and only one person required for a cloth of wide width as for a narrow one. Even during the past 60 years enormous strides have been made in cloth manufacturing. Sixty years ago, hand loom weaving was pretty general, but this gradually died out, and was succeeded by the factory system and power looms. In the old type of top swing loom like Pearson and Spurr's, the shuttles ran on wheels at not more than 60 picks per minute. The latest development for a narrow width cotton loom with a reed space of 40 inches, the shuttle makes 230 picks per minute, and the shuttle is changed automatically without stopping the loom. This is the Platt-Toyodo loom.

Importance of Shuttles.—Though numerous ideas have been tried to dispense with the service of the shuttle, none so far have displaced it to any extent. The Gledhill shuttleless loom is perhaps the most successful at the time of writing, at Bridge Mills, Holmfirth, Huddersfield.

The importance of the shuttle can be estimated from the following remarks. All the motions of the loom are built to serve it. The shed is made to make a passage for its flight, and the picking provides the power to propel it. The beating-up immediately follows after every run it makes, and the letting-off more scope for its services. The taking-up records the work accomplished, and the boxing motion adds a range of colours with which to beautify the fabric. On its flight depends the wages of the weaver, the profits of the master and the adornment of the wearer.

In a fabric made with as many picks as threads per inch, it is responsible for the building of half the woven cloth. No wonder then, that inventors have spent years of hard study to improve its structure, and that new ideas have had to be adopted for new types of weft yarns, and modifications made for new types of looms.

Wood for Shuttles.—As shuttles are subject to hard usage and considerable buffeting, it is a vital necessity that they be composed of strong and reliable material. Shuttles are made from woods that are fine in grain, hard in structure, and capable of taking a very smooth polish. Whatever kind of wood is used has to be well seasoned.

Boxwood is the ideal kind for shuttle making, but owing to its scarcity and high cost, it is almost unknown in the factories. Its dry weight ranges from 52 to 72 lbs per cubic foot, and the grain is extremely close and dense.

An excellent substitute is found in cornel wood which is fine in grain, and capable of withstanding the rigours of the weaving process. What knots it possesses are very small, and, as a rule, the grain is fairly straight. The straightness of grain is what an overlooker values in a shuttle as there is little danger of splitting. Its dry weight per cubic foot is 47 to 50½ lbs., and varies less than boxwood.

Another kind which is cheaper still is persimmon wood. This is dark in colour, coarser in grain, and lighter in weight than cornel, and much more liable to split owing to the grain being more across. Only in rare cases do persimmon shuttles wear as long or as well as cornel shuttles. The dry weight of persimmon wood is from 45 to 53 lbs. per cubic foot. Another species of wood which is an improvement on persimmon, is stone wood, its chief advantage being its greater density. It is very fine in grain, and the dry weight per cubic foot is from 47½ to 58 lbs. It is lighter in average weight than boxwood, but more variable than cornel. If more was grown, it would be a greater rival to persimmon than it is at present.

Proportions.—The size of a shuttle is determined by the kind of material to be woven, the length of the pirn or bobbin to be used, and the make of loom. The longer the bobbin upon which the weft is wound, and the longer must be the shuttle; the wider the loom and the heavier and bulkier the shuttle. The greatest contrast both in the material woven and the size of the shuttle is that between silk and sacking.

Shuttles are made hollow in the centre to allow the cop or bobbin to be placed inside. This implies that a large part of the solid block of wood out of which the shuttle is made is cut away by an ingenious series of machines, and recourse is then made to insert a couple of rivets through the weakest parts to strengthen them.

Fig. 191. *Shuttle* 1.—This is a woollen shuttle with a clip spring for the weft bobbin. The clip spring is a capital idea for the holding of the loose spindle, and very few shuttle traps are made by this arrangement. Even if the open spiral spring breaks, which applies pressure to the movable flap, the spindle almost invariably remains level in the shuttle. If the spring be broken, the weaver instantly knows when taking out or putting in the spindle.

The lower part of the spindle block is held by two pins—one towards either end, and the lip on the opposite side to the movable flap is held by a screw. In shuttle repairing, it is a good plan to unscrew the screw and test the block for firmness. When the holding pins are worn, too much pressure is placed upon the screw. A further point is this. After considerable wearing, the depth of the shuttle is reduced, and as the bottom wears most, the spring block may become too prominent and require taking out and filing. In most shuttles, the block is still wearable when the shuttle is done.

The movable flap of the block is pivoted on a riveted pin towards the base of the block, and on the upper part of its under side is a circular projection, and on this, the upper part of an open spiral spring finds lodgment, and exerts pressure on the flap.

The spindle has two grooves, one being at the top, and the other underneath. These rest on pins which pass through the shuttle. When the spindle is being inserted, the upper groove is placed on the back pin, and the spindle forced downward. This presses the movable flap outward, and as the spindle comes to rest, the spring pushes the flap forward, and holds the spindle in its weaving position. The inner part of the flap and stationary block conform to the shape of the spindle, Waddingon's Patent, Little Horton, Bradford.

In the example given, a 7-inch spindle is being used for a 6-inch bobbin. The difference between the two lengths is spanned by an open spiral spring with a washer at the bottom to prevent damage to the bobbin. This is a very simple but effective remedy for weft sloughing, for the spring responds to the bump of the shuttle against the picker, and so eases the coils of weft.

Shuttle 2.—This is for the weaving of worsted fabrics. The spindle is held in position by a pin passing through it well towards the end of the block. The bobbin is held on by a small brazened on head, and a highly tempered flat spring underneath which is about the length of the bobbin. The spring is curved, and given a small amount of liberty to respond to the contraction of its curve by the pressure of the bobbin. The flat curved spring is a great improvement to the curved tongue, as it prevents bobbin splitting. The under side of the spindle is **V**-shaped, and when lowered to its weaving position, rests on a **V**-shaped block held by one of the shuttle pins. It is of value to have **V**-blocks made for repairing purposes that are a little higher in the **V** from the bottom, so that no packing of the **V** is necessary when the under side of the spindle is worn.

A good worsted yarn brush is passed through the bottom of the shuttle for the braking and control of the weft. Whilst this has to be reduced for single twist weft, it has to be at its maximum for fine twofold worsted. This brush is near the pot eye of the shuttle, and a small pin passes through the top part of the shuttle midway between the eye and the head of the spindle to confine the weft to the shuttle. The spindle is held down by the pressure of a curved spring at the back and under side of the spindle block. A groove passes along the centre front of the shuttle as a safe resting place for the weft when the shuttle enters the box. It is seldom this weft groove needs attention, but it may need deepening in shuttles that wear a long time.

The shuttle tips are made of very hard metal, and the shaft of it is grooved in three places to assist in holding it firmly in the shuttle. After a block of wood has been cut to the shape required for the making of a shuttle, it is then bored at either end just a little deeper than the length of the shaft of the tip, and a little less than the thickness of the shaft. A circular cut is then made round the hole for the reception of a spring, and the tip is then pressed home.

Shuttle 3.—This also is a clip spring shuttle for the weaving of woollens, but differs from Shuttle 1 as it is a box loom shuttle. The interior is practically the same, but the top front of it has small extra pot eyes for the braking of fine twisted weft which is often used for checking purposes. The chief thing is the bottom shape of the shuttle front, for instead of this being flat with the exception of the weft groove, it is cut away to conform to the turned up front of the box shelves in one make of Hattersley box looms.

Shuttle 4.—This is a woollen shuttle extensively used for the Dobcross looms. In this case the spindle is removable, and is inserted in a spindle block. Like the worsted shuttle shown, it is held in its weaving position by the pressure of a highly tempered curved spring at the back and bottom of the block. The spindle block is made to swing on a shuttle pin, and on its under side is cut out so as to repose on another pin.

The spindle is constructed with a flat end to pass underneath the pin that holds the block, and also has a groove on its under side to fit on to the front pin.

An advantage of this shuttle is, that the spindle can be changed to one that is suitable for the weaving of worsted weft. This spindle is shown in the illustration. It is made with two collars to fit the larger interior diameter of worsted bobbins. There are three pot eyes, for there is the ordinary one at the side, but another passes through the bottom of the shuttle as shown, whilst a third is made to slant at an angle of 45 degrees to take the weft when passed through the bottom eye. This arrangement is specially useful for hard twisted weft.

Shuttles for Rayon and Crepe Yarns.

For rayon and crepe yarns, the interior of the shuttles are different to those used for woollen, worsted and cotton. Excessive ballooning and overrunning due to the smoothness of rayon has to be checked, and the tendency to snarl in crepe yarns has to be overcome.

Fig. 192 gives a group of five shuttles, each being fitted up in different ways.

Fig. 1 is fur lined to brake and curtail the ballooning of the weft. It is fur lined mostly at the back, for at the shuttle front is an oblong opening $1\frac{3}{8}$ inches long and $\frac{3}{8}$ inch deep for the use of a weft feeler motion. The paper pirn is well grooved for the holding of the weft, and is also slotted at the front for the weft feeler to penetrate. It has a small slot at the base to pass on to a projecting pin on the spindle, and also a small hole for another pin on a movable part of the spindle to pass through and hold it securely. The movable part of the spindle works in a long slot in the spindle, and when lowered, its under side comes in contact with the head of a one legged elevator, the leg passing through the bottom of the shuttle. When the spindle becomes too low, the elevator is punched out, and a tin washer placed on the leg to elevate the head. Towards the eye of the shuttle, it is tunnelled, and has a narrow slit at the top for weft threading.

A small hole is bored through the back of the shuttle, and a suitable yarn brush is inserted, and is made to pass through the eye of the shuttle to check the weft. The porcelain eye of the shuttle is placed at an obtuse angle to ease the drag on the length of the shuttle, and increase the short one, so as to equalise the pull on the weft.

Fig. 2. In this shuttle, the movable part of the spindle has five spikes on its upper surface. When pressed by the elevator, these spikes rise up and hold the pirn from the inside. Like No. 1, it may be fur lined, but it is shown fitted specially for the weaving of crepe twisted yarns. To prevent snarls, and curtail ballooning, a piece of pliable washleather $4\frac{1}{2}$ inches long, and $3\frac{1}{2}$ inches wide is glued to the inner sides of the shuttle, the sides of the shuttle being shaped to suit it. The washleather passes over two strands

of thick elastic which are held at the eye end of the shuttle by a porcelain eye in the shuttle tunnel. At the opposite end, the shuttle top is grooved to let the elastic sink in, and the strands are then pegged down beyond the spindle block.

The large circular hole is for the use of a yarn brush made from combed top. The eye of the shuttle which allows the weft to pass out is at right angles to the length of the shuttle.

Fig. 3 is a Continental type of shuttle. It is 1½ inches longer than the two previous examples, is slightly less in depth, and about the same width. For weaving, it is lined with fur, but the spindle is shown better without it. As will be seen, the spindle is divided from block to summit, and this exerts spring pressure to the inside of the pirn. The base of the spindle is spirally grooved, one edge of it being left prominent for holding. The weft exit of the shuttle is hollow, the openings at either side being 1¾ inches long, and is approached by a small porcelain eye centrally placed. No brush is needed in this part, for the weft is controlled by the internal arrangement.

On the left, and nearest the head of the spindle is a screw which is finely threaded, and bored through for the threading of a piece of elastic. The elastic is passed through the back loop of the weft brake which is held by a second and larger screw. The weft brake has four loops, one, or more, or all can be used, the more giving the greater drag on the weft.

The weft is threaded through the number of loops required by being pressed to the front of the shuttle by the finger, and then when let go, the elastic draws it back. It will be observed in the illustration there are five pin holes which form a high angle. These pins fit to the right of the loops in the weft brake, and thus make the weft zig-zag to the outlet. Two additional pins guide the weft to its exit. In this way, the weft is sensitively tensioned.

The shuttle is constructed for the weft to traverse the outer length of the shuttle, but also to pass over the top of the shuttle if desired, and so prevent the weft being soiled by the box side. When the spindle is in its weaving position, it is held down by the pressure of an open spiral spring at the back end of the spindle block.

Fig. 4 has the same hollow tube with spikes as Fig. 2. The spindle in this case is prevented from moving from side to side when weaving, by passing between a three sided plate, which is pinned near the bottom of the shuttle.

The back end of the spiked part is made with a flat plate, and on its under side, upward pressure is applied by a small open spiral spring which is lodged in a hole in the spindle block. This spring exerts a responsive pressure to the holding requirements of the pirn. The spindle is held down by the pressure of an open spiral spring encased in a tube,

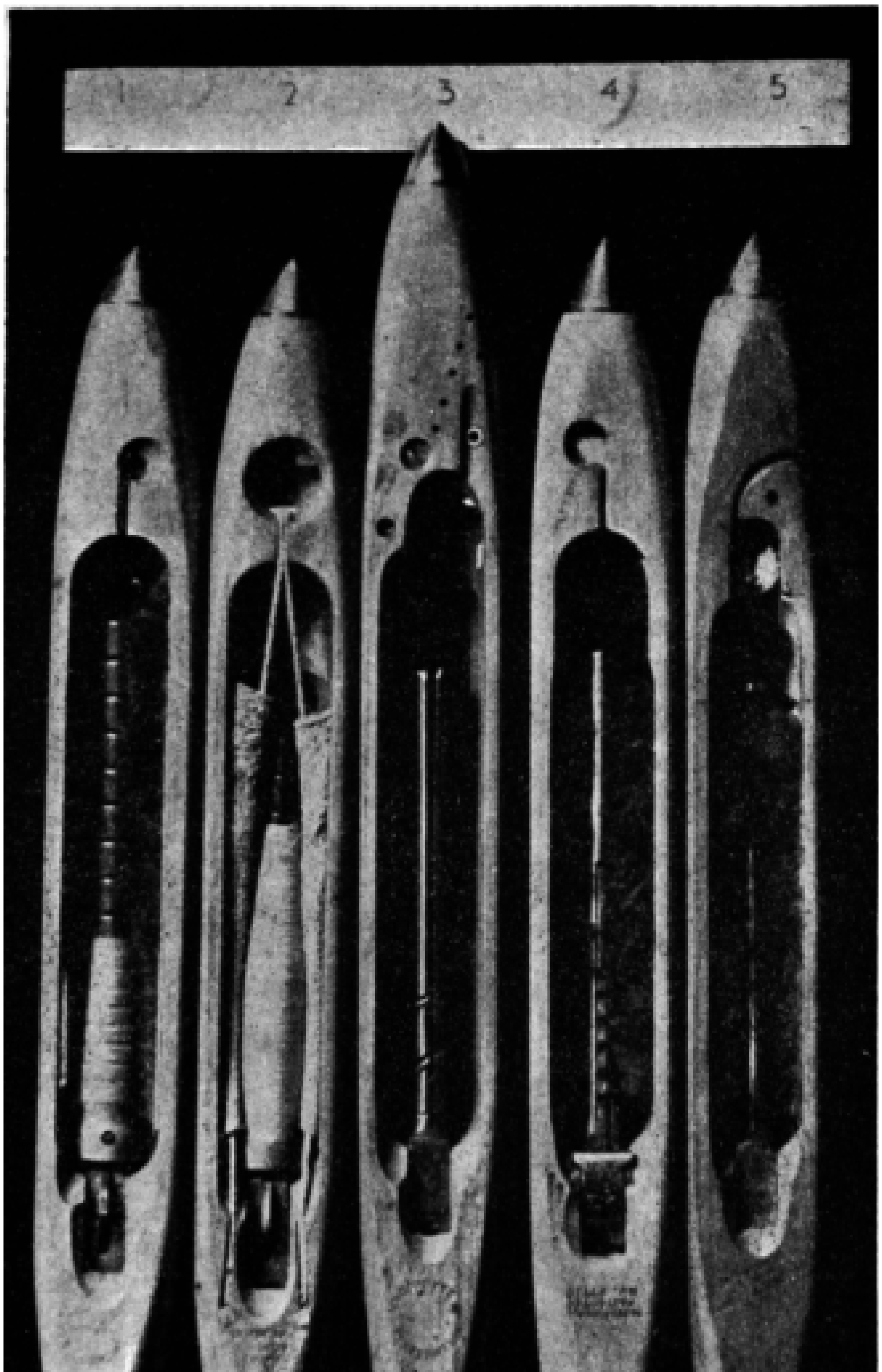


Fig. 192.

English and Continental Shuttles.

the tube being in contact with the back end of the spindle block. The interior of the shuttle is lined with fur, and the eye is at an obtuse angle to equalise weft brakage.

Fig. 5 is specially constructed to weave silk or rayon, and to abolish the health destroying habit of "shuttle kissing." The spindle has a curved, flat spring at the top, which is brazed to the head of the spindle. A spiral twist of metal near the block contributes holding pressure to the pirn.

The spindle is held for weaving by a curved spring exerting pressure on the under side of the block.

As usual, the shuttle is fur lined, and a small yarn brush is threaded through either side of the shuttle to direct the weft centrally to the tunnel. As will be seen, the shuttle is cut in a curve for threading, and a pin passing downward, acts as a guide to the weft.

The special part is a brass plate, which has a circular nipple on the inside. The nipple is hollow, and threaded inside. It is made use of by a screw which enters it from the opposite side of the shuttle.

On the shaft of the screw, a spring washer is placed, which exerts pressure against the head of the screw, and keeps screw and plate secure.

The plate conforms to the contour of the shuttle, and a space is left between the inner side of the plate, and the wood of the shuttle.

A forward and backward move of the hand is all that is required for threading the shuttle.

A leg on the plate on one side, and a pin on the other, directs the weft according to shuttle traverse.

In every one of the shuttles here presented, smoothness, equality of drag, and cleanliness of weft are a trio of requirements that must be attained and maintained for the production of smart and saleable cloth.

Selection of Shuttles.

When new shuttles are needed for a loom, several points have to be considered to secure the best all round results. Though shuttles are of the same make, they are not all the same weight. This difference is largely due to the varying density of the wood even in the same tree.

Weight of Shuttles.—The influence of weight is such that a heavier shuttle travels at a greater velocity than a lighter one, and the amount of checking that would do for one, will not do for both. This is more pronounced in box looms than in plain looms. It therefore follows that a careless selection means increased work for the overlooker and less production by the weaver.

To have well matched pairs or groups, every one should be weighed on a spring balance, and the weight in ounces recorded on the shuttle. Those nearest in weight may then be grouped together. Judging shuttles by lifting them with the hand will give approximate results, but a spring balance ensures accuracy. The weights of shuttles used for the woollen and worsted industry are here appended.

WOOLLENS.

Hattersley plain looms	...	17 to 19	oz. each.
Dobcross plain looms	...	17 to 19	,, ,,
Dobcross box looms	...	19 to 21	,, ,,
Hattersley box looms	...	19 to 21	,, ,,

WORSTED.

Hattersley plain looms	...	17 to 19	,, ,,
Dobcross box looms	...	19 to 21	,, ,,

It will be seen from these particulars that there is an average difference of 2 ounces in the same make of shuttles, but those two ounces make all the difference between good and bad working.

Grain.—Whilst grain affects the weight, it also influences the wearing. A fine grained shuttle will wear much longer than one of coarse grain, and in time this would make a difference in the movement of the stop rod tongue. The fine grained one may cause no trouble, but the other with being less, would cause the loom to keep banging off. This can only be remedied in using the same shuttles, by filing the bigger one down to the size of the smaller one, and then adjusting the boxes.

Size.—The same make of shuttles are not all the same size, but the difference is easily detected by the use of a pair of inside calipers. The more exact the shuttles are in this respect, and the more efficiently they run into the boxes, and give a uniform lift to the stop rod tongue.

To sum up the process of selection, first weigh a dozen or more separately on the spring balance, and record the weight on each. Examine the backs of the shuttles of the same weight for grain, taking those out approaching similarity. Cross grained shuttles when possible, should be reserved for the weaving of the plainest work. Measure for size, and pair them as accurately as possible. Time spent in selection is amply repaid.

Steeping in Oil.—Some shuttle makers send new shuttles to the factory in a perfectly dry state, and when they are put into store, they should be kept dry and cool. When new shuttles have been selected, they may be improved by being rubbed over with oil a few times and left to dry, for this prevents cracking.

The best results are obtained by rubbing them instead of steeping them in oil, for steeping them has a tendency to swell the wood and slacken the shuttle tips.

The process of rubbing them has to be repeated for several days for the oil to penetrate, and the surplus oil can be run off into the oil can when the shuttles are suspended for drying.

Brake Brush.—When smooth yarns are woven such as worsted, a brake brush is placed in the shuttle as shown in shuttles 2 and 4. The brushes must exercise the same amount of restraint on the weft, for if one be slacker than the other, it will show in the selvedge by one part being drawn in more than the other. The amount of brake is tested by pulling the weft quickly through the eye of the shuttle, alternate pulls giving the impression if one be stronger than the other. The finer the weft in twofold yarns, and the keener the brush must be.

Loom Adjustments.

Plain Looms.—In a plain loom, the preparation for putting a pair of new shuttles on the loom is carried out as follows. The power of the box swell finger is first removed, and the going part brought forward until the stop rod tongue is almost in contact with the cut on the frog. The wooden shuttle guide E at the top front of the box is raised, and the box end unloosed. The box front D, Fig. 193 may now be liberated, and then set by its setscrews so that it is a little wider at the inner end than the outer one. The height of the stop rod tongue above the frog should not be less than $\frac{3}{16}$th inch. The special point to be aimed at is to make the slope of the inner box side be at the same angle as the shuttle front when fully in the box. It may lean back at the top as at A, or lean forward at the top as at B, but if weft cutting is to be avoided, and the shuttles made to wear well, the angle C will have to be obtained. If the box front leans back as at D, the feet of the box may be packed with tapering cardboard of sufficient thickness at the front. The exact fitting can be seen by looking through the opening between the shuttle and the box side, the shuttle being at F.

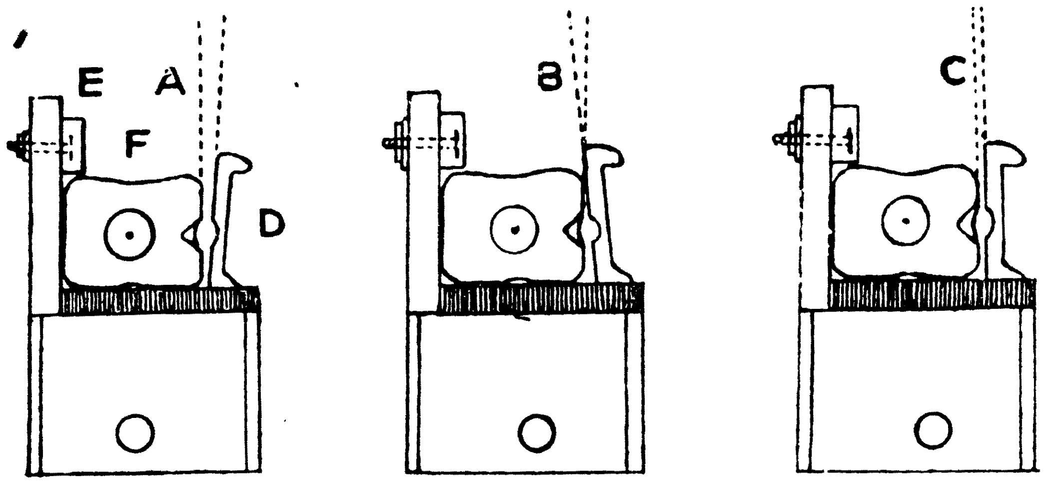


Fig. 193.
Fixing Box Front in Plain Loom.

If the box leans forward as at B, then the packing will be put in at the back. One might get the impression that to file the feet of the box would be to make a permanent job of the business. Unfortunately the bevels of one group of shuttles may be different to the next, and the time spent in fitting is wasted.

If a shuttle is to keep its proper course from box to box, the back of it must be kept in contact with the reed, for the reed provides half its support.

Shuttles are supposed to be made at a particular bevel to suit a certain make of loom, but are not always correct. When not suitable, it is not the shuttle that is altered, but the loom. This is outlined in Fig. 194.

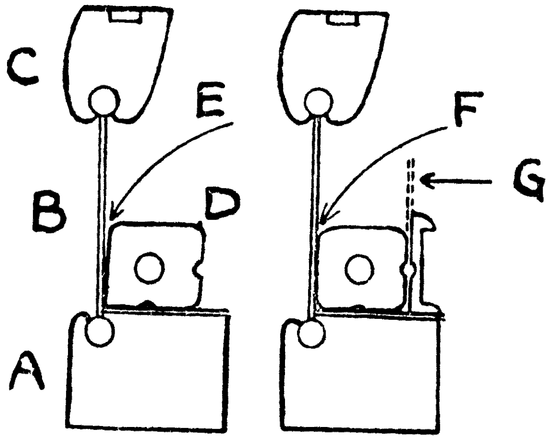


Fig. 194. Fitting Sley to Shuttles.

A is the going part; B the reed; C handrail; D shuttle.

As indicated by arrow E, there is a gap between the top of the shuttle back and reed. The shuttle only contacts with reed at its back bottom. When like this and the finger is applied to the front top of shuttle, it will tilt back, and therefore cannot possibly run steady through the shed. As the shuttle race moves downward with the crank going to its back centre, the shuttle tilts over against the reed, and is then only running on the back part of the bottom. When the going part comes forward, it tilts back, and assumes the position as in the drawing. To make the reed correct, the handrail C is packed with leather, between handrail and sword top to the required thickness.

The other way in which the shuttle fits badly against the reed is when it is off the reed at its back bottom, and to make this correct, the handrail has to be cut to make it lean further back, or the lay itself can be packed where it is bolted to the sword. For good running the shuttle should be as at F, and its front parallel with the inner box front as at G.

Box Loom.—When new shuttles are placed on box looms, the proceedings are different to that for a plain loom. In the Dobcross and the Hodgson looms as well as the Hattersley Standard loom, the box swells which are at the front have to be taken out and the bend in them reduced by hammering. In the Hodgson loom with the box swells at the back, the same thing has to be done.

In the Hattersley box looms with the shelves turned up at the front, the three rods holding the shelves have to be slackened out, and the top shelf then set a little wider at the inner end than the outer one, and without any binding action on the shuttle. Having got one box correct, the others may be set to the same dimensions by means of a pair of inside calipers. The whole is then braced up by the three nuts, and the opposite box then set the same way. The shuttles used for these kind of boxes are those at No. 3, Fig. 191.

Delivery of Shuttle.—The delivery of a shuttle is the same in all kinds of looms, whether " box " or " plain," or a " circular." The picker spindle is so adjusted as to lift the shuttle $\frac{3}{16}$th inch from the shuttle race, and the same distance away from the box back. The elevation of the shuttle is shown at Fig. 195. It will be observed that the picker is at the inner end of its traverse. This is called the

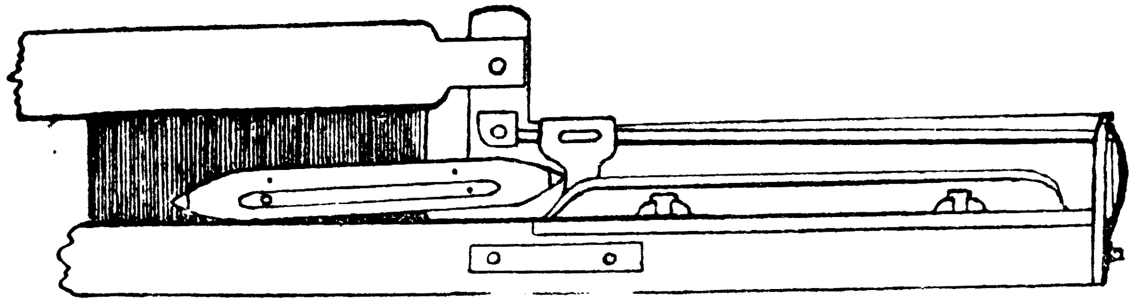


Fig. 195.
The " Up " Delivery of Shuttle.

" up " movement. In Fig. 196 is given the " off " movement. The first presses the shuttle downward on the shuttle race

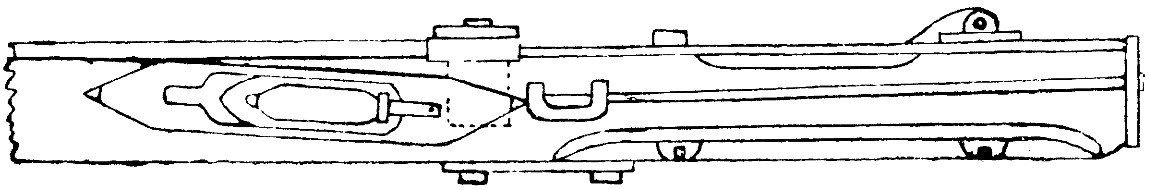


Fig. 196.
The " Off " Delivery of Shuttle.

by being elevated at the back, and the second presses the leading end against the sley by being pulled off the shuttle back.

If the spindle bracket in a plain loom does not give it, then it should be made to do before the loom is allowed to weave. In a box loom like the Hattersley type, there is a picker slide at the front which is used to elevate the picker.

In the Hattersley Standard Loom, the slide is at the back, but whatever be the type of loom, the same double move is demanded. For the weaving of rayon, the distance of the double pull is decreased to $\frac{1}{16}$ inch.

Flight of Shuttle.—In Hattersley looms, the shuttle begins to leave the box when the crank is at its bottom centre as at B, Fig. 197, and must reach the opposite box by the time the top centre of crank traverse has been reached as at E.

For more than half the traverse of the shuttle, the sley is travelling backward from B to C, and for the remainder of the journey, it is moving from D to E, the movement of the going part being indicated by arrows at either side, and commencing from the fell of the cloth on the right of the drawing.

The following pick is demonstrated in the lower section, with the picking taking place from the left hand. The going part commences from the fell of the cloth again at G, and the picking begins at H. The flight of the shuttle as the sley moves backward is shown at I, and as it moves forward at J.

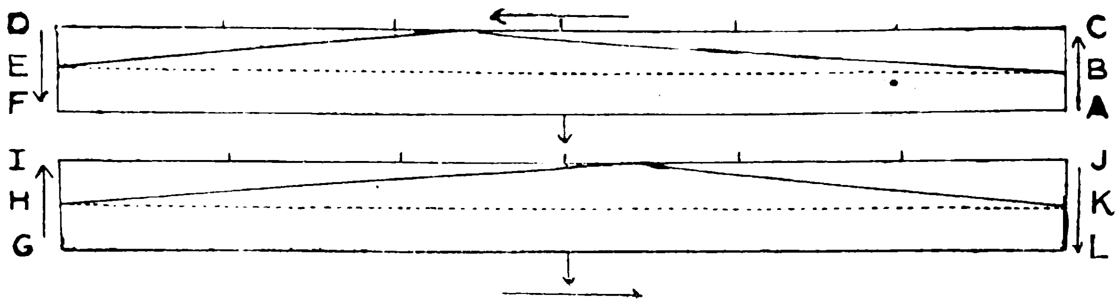


Fig. 197.
Flight of Shuttle.

At K it has fully entered the opposite box, and at L, the reed is again at the fell of the cloth. The two picks are thus completed.

The shuttle is kept in its course by the way the shuttle is thrown; by the top part of the shed at the entrance and exit; by the running board at the bottom, and the sley at the back.

The Angles.—Another factor is the angle formed by the shuttle race and sley. This is not a right angle. When the loom is at its front centre, the running board has a gentle slope downward of $\frac{1}{16}$th of an inch, and the swords which hold the lay or going part are perpendicular. To reach the back centre, the swords and running board describe the arc of a circle, and on reaching the termination of the downward curve, the angle has increased to $\frac{13}{16}$th inch. The angle gradually increases as the going part recedes, and decreases as the lay moves forward, which fairly coincides with the varying speed of the shuttle.

Speed of Shuttle.—The greatest velocity is attained in the first half of the flight, for if the running board be divided into six equal parts as shown at the top of the two sectional drawings in Fig. 197 the shuttle will at least have traversed $3\frac{1}{2}$ of them by the time the back centre has been reached.

The top diagram illustrates the flight from right to left, and the bottom one from left to right.

The speed of the shuttle is governed by the width of the loom, and the revolutions of the crank per minute. To take two typical examples: A Hattersley plain loom with a reed space of 85 inches gives a traverse to the shuttle of 98 inches. As the loom gives 125 picks per minute, the actual distance is:—

$$98 \times 125 = 12{,}250 \text{ inches or } 340 \text{ yards per minute.}$$

In the Dobcross plain loom with a 91-inch reed space, the shuttle travels 104 inches, and as the loom speed is 100 picks per minute, then, $104 \times 100 = 10{,}400$ inches, or 289 yards per minute. In actual time, however, it is traversed in half the time stated, for the shuttle completes its flight in half, or a fraction over half a revolution of the crank.

In box looms, the arrival of the shuttle in the opposite box has to be a little sooner than in a plain loom, for in the latter, the check strap is stationary, but in the drop box it is a running check. To secure a good check in the box loom, the shuttle ought to be well in the box by the time the crank is between its back and top centre.

Wearing of Shuttles.—By the shuttle being given the "up and off" movement, it is worn in time by the sley and shuttle board until the back and bottom, which were slightly hollow at the commencement, have both a pronounced curve downward when a straight edge is applied.

The back and front are also still further reduced by the shuttle having to force back the box swell, and lift up the stop rod tongue. When the downward curving at the back and bottom becomes prominent, the shuttle runs a very erratic course through the shed, and either breaks the warp threads, or makes a cracking noise when it enters the box, or flies out of the loom. This is remedied by filing the back and bottom until the respective sides are slightly hollow, the proper pitch being obtained by the frequent application of a straight edge. If a fair amount has been filed off, then the boxes must be reset to suit the decreased bulk. Only in very rare cases has the shuttle front to be filed, though its groove has occasionally to be deepened. The wearing marks on a shuttle to an overlooker of experience are mute eloquence of the way it is running.

If ridges appear on its back, it is a good indication that the crank arms are slack, and if chafing marks appear in front of the shuttle eye of a right hand shuttle, it is failing to pick straight from the right hand side. If worn underneath at one end, the end worn clearly points to the box bottom not being level, but is above the shuttle race at that side where the worn end first enters the box. If the top part of the shuttle is being rubbed off, either the spindle bracket or the buffer is too low in a plain loom, and rubs is as it is being delivered by the picker. When marks are worn inside the shuttle opposite the spindle head, the block or clip is giving too much freedom to the spindle.

Fixing Loose Tips.—The most difficult thing to repair in a shuttle is a loose tip. The best idea is to find a tip of the same make with a slightly larger shaft, as this will exert a uniform pressure inside the bore of the shuttle when inserted. It could be damped with salts of lemon before being put in, as this will help to rust it fast. But if a tip with a larger shaft cannot be found, the same tip may be made servicable by first inserting two small pieces of tapered cane, tapering both in thickness and width, the thickest and widest part being placed in the bottom of the recess, the two pieces being placed opposite each other.

The recess should be smeared with liquid glue before inserting the cane. The tip is then gently tapped in with a hammer, any holding indicating that the packing is too thick.

The glue should have time to set before the shuttle is used, and the tip end and edge examined before being given to the weaver.

Life of Shuttles.—With ordinary wear, a pair of shuttles on a Hattersley loom, 85 inch reed space, and 125 picks per minute, should last on an average 15 months, though some have run 18 months and over.

In the Dobcross plain loom, the average wear is 18 months, the reed space being 90 inches and the speed 100 picks per minute.

In box looms, a group of shuttles may be safely reckoned at two years with good matching.

The coarser the materials woven, and the quicker the shuttles wear owing to increased friction. In oiling the blocks and spindles of shuttles, a few drops at a time is quite sufficient, for too much soaks into the wood, and loosens the shuttle tip.

PICKERS.

Pickers that are made from buffalo hide are of many shapes and sizes. They may be sent to the factory steeped and dried, and only require boring and trimming to be quite ready for the loom. As is to be expected, they cost more when so sent, so to reduce the cost, and possibly increase their service, they may be ordered in their first drying stage. Some pickers pass through 16 processes in the making.

Ordering.—To prevent any mistake in size and shape it is not without merit to send a sample picker with the order. Both in the making and reading of figures it is so easy to make a wrong impression, whereas a sample is unmistakable, and the checking is quickly accomplished. Some firms have as many as 200 dies for different styles of pickers.

The time for ordering should not be less than twelve months ahead of actual loom needs. The need is based upon the number of looms in use along with the average weekly wastage. What this amounts to per annum ought to be the approximate number of pickers in stock at the time a fresh order is given. This leads to no more stock for a mixed lot of looms than for one with all the same make of loom.

For vertical plain loom pickers, the chief measurements are the length of the leg; the length of leg and body to centre of spindle hole; the width of body; width of slot for strap.

If the leg be too short, the picker will be pulled out of the slot at the bottom of the box. If the spindle bracket be lowered to aid it, such a move might be detrimental to the delivery of the shuttle. On the other hand, if the body be too long, part of the bottom has to be cut away, and the picker is consequently weakened.

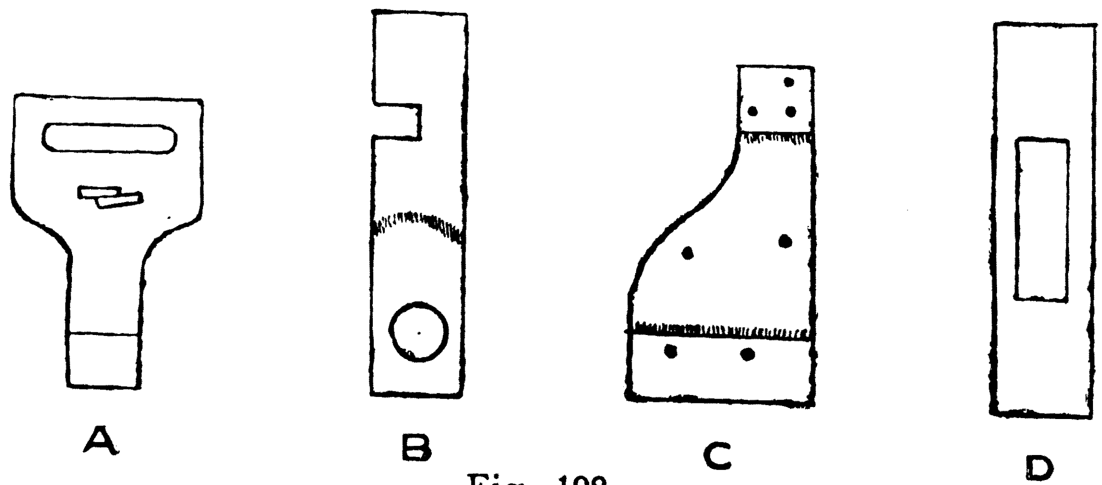


Fig. 198.
Styles of Pickers.

The standard size for a Hattersley plain loom, 81 inch reed space, is as follows:—Length from bottom of proper spindle hole to bottom of body $2\frac{1}{4}$ inches: length from same hole to bottom of leg 3 inches: total length $4\frac{1}{4}$ inches: width across front where picker strikes, 1 inch. The same care as is here detailed is required for every kind of buffalo picker, for in the process of seasoning they dry in a little. The shape of the Hattersley plain loom picker is given at A (Fig. 198).

Preparation.—When pickers are sent to the factory in the first drying stage, they are hung up in a cool and dry place to get rid of the moisture they contain, which is about 10 per cent. This moisture resists the inroad of the steeping oil. The pickers dry all the sooner and better when not overcrowded, and this process ought not to be less than a couple of months.

Steeping and Oil.—The steeping is the most effectively carried out when the strings of pickers are laid in the bottom of a moderately large tank, without overlapping. The oil then has the chance of getting to every part about equally, which is hardly the case when the strings are suspended. Three kinds of oil are used for steeping, these being sperm, Gallipoli, and neatsfoot, their respective merits being in the order given. Sperm is best, for being thinner in density. it penetrates quicker. A mere smearing on the outside is of no use whatever. The steeping should occupy not less than 12 months so as to give time for the oil to penetrate to the core. The usual heat in the factory prevents the fatty matter in most oils from coagulating in winter.

Pickers that have not been well steeped have the faults of wearing very rapidly, cracking, and making elongated spindle holes.

Second Drying.—After being well steeped, they are suspended over the tank to drain off the surplus oil. They may then be moved to a cool, dry place, and at the end of three months are in an excellent state to be made ready for the loom. Such steeping and drying gives resiliency to the picker which would otherwise be soon cut in pieces by the impact of the shuttle and its propulsion.

Preparation for Loom.—The spindle holes are only small when sent to the factory, and these have to be bored out to be suitable for the picker spindle. A spiral drill $^1/_{32}$ inch thicker than the spindle is excellent for the purpose as the bore is then straight, and gives the longest possible wearing along with freedom of action. Rivets or wires have to be made firm, and the whole of the picker then trimmed with a sharp knife so the weft cannot be caught upon it, nor the check strap or buckle injured.

,Every kind of picker can be prepared up to this point so as to be ready at a moment's notice for the loom. As the prepared stock diminishes, others are prepared to keep well up to demand.

Some manufacturers and overlookers prefer the black or brown raw hide pickers as they have not been subject to the liming process. It is safer, however, to have them limed to prevent any possibility of anthrax. The Lanacashire trade generally prefer round foot pickers for the plain loom make, but in Yorkshire the square foot is best.

Working Conditions.

When a new picker takes the place of an old one, there are several things which need adjustment in a plain loom. It is the usual thing to place the new picker on the spindle, and then push it to the outer end of the box. The shuttle is then held down in the box with one hand, while with the other the picker is bumped against the tip of the shuttle. Where the mark is made a shallow piece is gouged out for the shuttle tip to find its delivery place. On replacing the picker on the spindle, an examination is made of three things.

(1) *Screed or Shuttle Guide.*—At the top front of the box back is a screed or wooden shuttle guide. This has to be adjusted so the shuttle is prevented from rising up in the box, and is guided to the same place on the face of the picker. To achieve this purpose, it is fixed just clear of the back part of the shuttle top at the outer end, and the inner one is set a little higher owing to the upward slope of the picker spindle.

If the picker is to wear well, the shuttle tip must be made to come in contact with the centre of the picker face, and anything which hinders it from doing so should be modified to achieve it.

(2) *Tongue Lift.*—The going part is then drawn forward to see if sufficient lift is imparted to the stop rod tongue when the shuttle is fully in the box. The tongue ought to be lifted clear of the frog a good $\frac{1}{8}$ inch, for any excess above this is a waste of power and material. If the lift is found insufficient, the shuttle can be taken out of the box, and the crank turned forward until the tongue is in

contact with the frog. The box swell finger is then examined to see that it is in close contact with the head of the box swell. If not, it is unloosed, tapped forward, and then secured. If found correct, however, the shuttle box front is tapped in a little, for this increases the lift of the tongue, but on no account has the shuttle to bind in the box. It is much to be preferred to alter the box front when the picker is new than any time afterwards, for then, alteration forces the shuttle away from the naturally made hole in the picker, which may lead to the cutting of the weft. Should this occur, the picker may be gouged out a little on that side which is towards the back of the box.

(3) *Delivery of Shuttle.*—If the shuttle is to run well through the shed, it must have a particular delivery. This is, that when the picker is at the inner end of the box, and the shuttle tip is placed in the hole of it, the shuttle should be raised from the shuttle race $\frac{3}{16}$th inch, and be drawn away from the box back for the same distance. The spindle bracket is bored to give the " off " movement, and it is fixed to give the " up " movement. By securing such a delivery, the end of the shuttle which first enters the shed is pushed downward and inward, which coincides with the receding of the going part, and so promotes safe running. Figs. 195-196.

Stand of Stick.—When the picking stick is in its stationary position, it points over the end of the box when the crank is at its back centre. As the picking cone wears, it stands further out, and to make it begin to pick when the crank is at its bottom centre, the picking strap has to be tightened up. This is against a lengthy wearing of the picker, and it is therefore a better way to set the picking stick forward as before, or even a little ahead, by means of the brackets that hold the picking stick. The standing further out than the box end is justified when the picking nose is new, and the force generated by it is too strong.

If the strap is tight when the crank is at its front centre, or in the centre of its swing, or when the picker is against the buffer, all these are against the service of the picker, for any one of them may tear off the top part of it.

There is a further point. When plain loom pickers are constructed so they can be used either way for delivery of the shuttle, it is an advantage to place the hollow side of the picker at the front. The picking stick moves in the arc of a circle, and by placing the picker as stated, the greatest top strength of the picker is then opposed to the motion of the picking stick. So much is this an advantage, that whereas a share of looms required 13 new pickers per week on an average, it was brought down to three per week.

Buffer.—The buffer at the end of the picker spindle which is struck by the picker as it terminates its stroke ought to be made of the most springy leather that can be selected. The harder it is, and the more injury is done to the picker. If a loom goes at 140 picks per minute, then each picker is knocked against its buffer 70 times per minute when the loom is in motion.

Hattersley Box Loom Picker.

This is outlined at B (Fig. 198) and is constructed on an entirely different plan to the one previously explained. The picker runs horizontally instead of vertically, and the chief measurements are from the inner end of the spindle hole to the cut or groove shown on the under side of it,

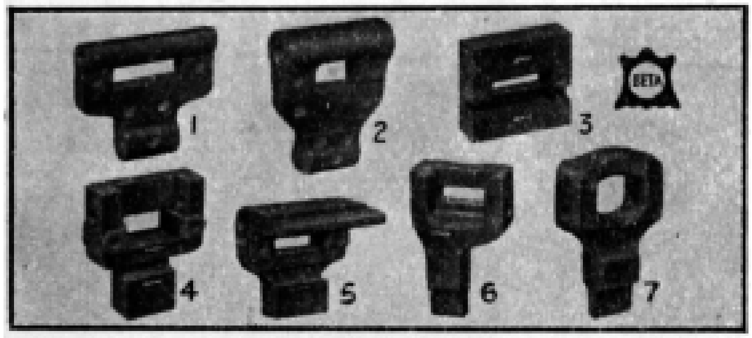


Fig. 199.
British Picker Co. Ltd.
Buffalo Pickers.
(1) Ruti Type Underpick; (2) Crompton and Knowles Underpick; (3) Small Silk Square Box; (4) Continental Loom; (5) Omita Loom; (6) Special "P" Shape; (7) Hattersley & White's Circular Box.

which is $1\frac{1}{8}$th inches. The groove in the picker is for it to work clear of the upturned box shelf. The other measurement is from the same part of the spindle hole to the end of the head which is $3\frac{1}{8}$th inches. The end of the head has to work clear of the box swell, or the picker may hold, and be too late in getting back for the changing of the boxes.

If the under side of it is not level, it will have to be rasped to make it so, for the under side runs on a slide, and if the picker is not level, the recurring friction wears it away and the delivery of the shuttle is adversely affected.

The under part of the picker head has to work clear of the outer end of the box shelf, and at the other end, must lift the shuttle clear of the box bottom by $\frac{3}{16}$th inch. This is obtained by the fixture of the slide. The pull away from the box back for the same distance is got by the outer spindle bracket being further in than the spindle bracket at the buffer end of the spindle. The head of the picker has also to have working clearance of the upper and lower bowls which are bolted to the outer box back, and against which the shuttle tips come in contact when the boxes change position.

Two leathers are attached to the picker. One is secured at the other end to the dolly stick, by which the picker is drawn back after picking by the pull of a strong closed spiral spring. It is better to have two springs, both of which are about equal to the pull of the stronger one. By this arrangement, if one spring breaks, the other can drag the picker back out of the way of the changing boxes, whereas if the only one breaks, it can cause a fair amount of damage.

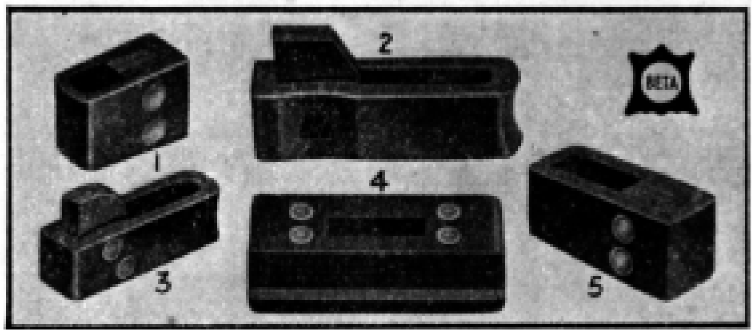


Fig. 200.
Charles Walker & Co. Ltd., Leather Pickers. (1) Northrop; (2) Large Underpick; (3) Small Diederich Underpick; (4) Ruti Underpick; (5) Large Northrop Underpick.

The other leather is the picking strap. This is adjusted so the shuttle begins to move out of the box when the crank is at its bottom centre. The standing place of the picking stick is usually a little in advance of the outer end of the box, but it is set to give the best working results.

Dobcross Pickers.

For the Dobcross box loom, the picker C (Fig. 198) is used for the older make of loom. It is put into position at the back of the box and runs in a long slot in the box framework. The " up " movement in the delivery of the shuttle is obtained by the box fork, which tilts the box a little higher at the outer end than the inner one. The "off" delivery is secured by the picker spindle at the inner end being a little nearer to the box than the outer end.

The picker is riveted in seven places, and the back one nearest to the picking stick is best placed $\frac{3}{4}$ inch from the outer edge so as to eventually save damage being done to

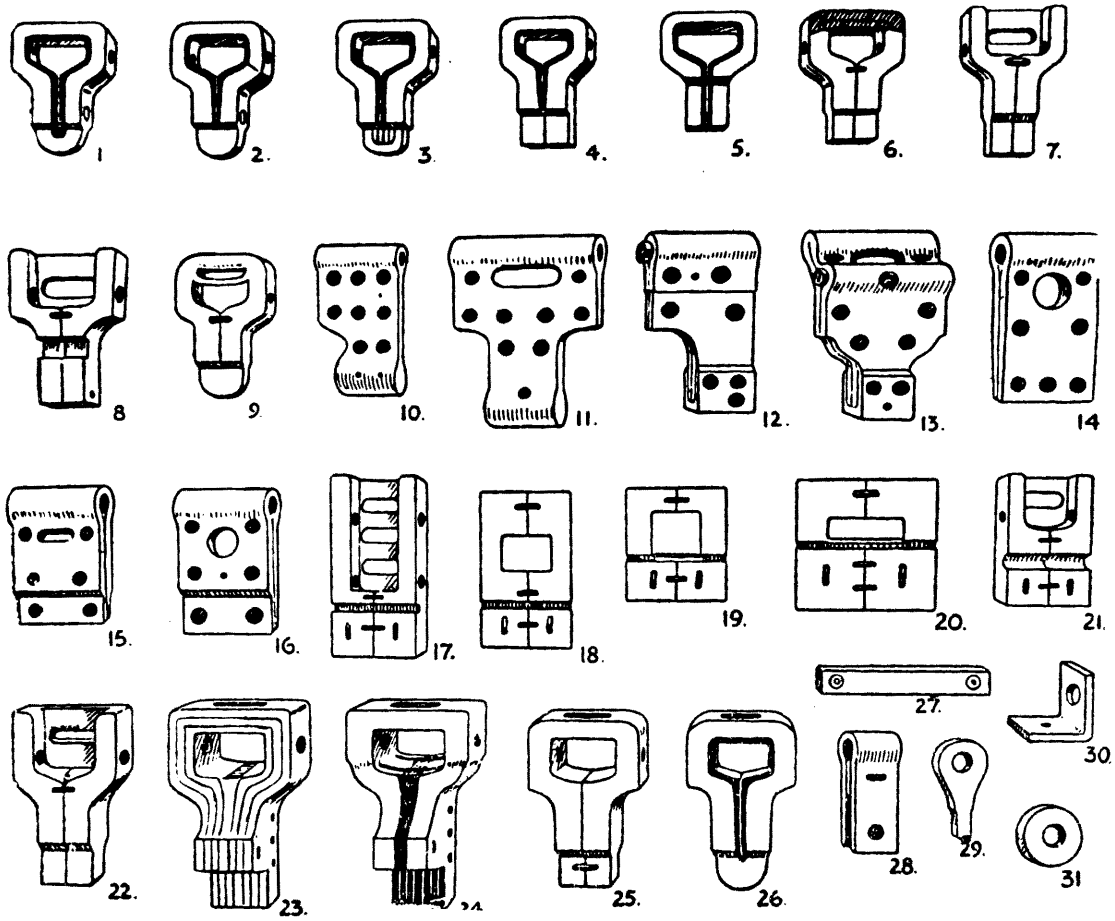


Fig. 201.

British Picker Co., Ltd. Buffalo Pickers and Buffers.

(1) Roundfoot; (2) Dixon Fold; (3) Open Foot; (4) Press Foot; (5) Small Folded Dropbox; (6) Helliwell Squarefoot, for Cotton Looms; (7) Hattersley or Sowden Scoop; (8) Hattersley or Sowden Dropbox; (9) Double Cap Roundfoot; (10) Coiled Yankee; (11) Reversible; (12) Dobcross; Hodgson; (13) Whip Pick; (14) Tapered Jute; (15) Centre Foot Jute; (16) Side Feather; (17) Three Slot Dropbox; (18) Solid Dropbox; (19) Small Square Silk Box; (20) Square Box; (21) One Spindle Dropbox; (22) Hattersley Scoop; (23) Open Side Top Swing; (24) Folded Top Swing; (25) Blanket Loom Squarefoot; (26) Blanket Loom Roundfoot; (27) Stick Bit; (28) Picker Protector; (29) Dobcross Picker Protector; (30) Buffalo Angle Piece; (31) Buffalo Washer.

the strip of buffalo on the picking stick. Before the picker is placed on the loom, all the rivets need to be bruised with the hammer to make the picker firm.

The picker for the whip-pick is a much larger and more costly buffalo picker. It is fitted with a slotted flap, the picking strap taking one slot, and the dolly strap the other.

For the Dobcross plain loom the picker D (Fig. 198) may be made of either leather or canvas. Leather pickers on an average wear three times longer than canvas, for when the loom is run at 100 picks per minute, the average wear is six weeks, but the canvas one is done in a fortnight. Canvas pickers give the best wearing results when stored in a damp place. Both kinds of pickers are made with a slot in the centre $1\frac{3}{4}$ inches long through which the picking stick passes. Before being placed on the stick, the inner corners of the slots are rounded off with a knife to prevent the picking stick wearing.

To place the picker in position on the stick, the screed or wooden shuttle guide is slackened at the inner end and made free at the other. The screed is then dropped, and the picker and stick moved to their forward limit. The stick is held forward with one hand while the shuttle is bumped against the picker with the other. The picker is now taken off the stick, and with a knife, a shallow hole is made the centre of which has to be a little above and a little towards the box front, to give the correct throw to the shuttle. The screed is then secured so the outer end is just clear of the shuttle top, but the opposite end is placed a little higher.

Extra care has to be taken when the picking stick is worn, for then the picker has much more liberty to move about in the box. A large, but shallow hole is made with the knife so the shuttle may be guided to its proper picking centre.

In case the picker binds at all between the picking stick and the box swell, the swell may be packed back a little with a thin strip of leather being tacked to the place where the inner part of the swell head comes in contact with the box back, but this must be followed by a readjustment of the stop rod casting. If such packing cannot be inserted, then the back of the picker may be pared down.

The chief standard makes of both leather and buffalo pickers are presented at Figs. 199, 200 and 201.

LEATHERS.

Quite a number of things associated with a loom are made of leather, and on their quality and suitability partly depends the working cost of the establishment, reasonable or otherwise.

Picking Straps.—For looms that have the overpick motion, picking straps are the prime leather cost, as they have the greatest amount of service to perform.

They are of two lengths, which are known as butt and hide. The former are the shorter of the two, and are particularly adapted for narrow looms with their shorter picking sticks. But whether short or long, they should be of good quality. This implies a fair resistance to a sharp knife, only a moderate stretch when pulled, and a reasonable thickness at the end which is used by the picker. It must also be pliable, for if too stiff, it would spring off the pin on the picking stick unless tied fast. Bark tanned leather is the best.

Picking straps are usually $1\frac{3}{4}$ inches wide, and thicker at one end than the other. The thick end is for the picker, and the thin one to wrap round the stick. When of about uniform thickness, they are not quite as serviceable as the tapering kind. In preparing these leathers for the loom, the slit at the thick end should be no longer than will allow the strap to pass through. Some 18 holes are punched at the opposite end so the strap may be set to its best working length on the loom. The strap is well stretched by hand so as to give the least stretch on the loom to avoid knocking off.

Method of Attachment.—Several methods are adopted in fixing the strap to the picker, the most common being to pass the thick end through the slot in the picker, pass the thin end through the cut in the strap, and then wrap the free end round the stick and fix on the pin. If the leather be thin, a much better way is to first loop the leather, and then pass the thin end through the picker, and follow through the loop. It has to be well braced up before being wrapped round the stick. While this takes up more leather, the full width of it does the work instead of half in the previous example.

The third way is to make two slits at the working end one being above the other. After passing through the picker, the thick end is threaded through the second cut, and the thin end put through the first cut, and then wrapped round the stick. This system is better to unloose than the second one but uses more length, and gives quite as good service. It is very handy when the length of strap is too long for the back pin on the stick.

Pitch of strap.—Before the loom commences to weave, either weaver or overlooker ought to test the strap for length. There are two tests. The first is, that the length of it should begin to pull the shuttle out of the box when the crank is at its bottom centre. The second is, that when drawn to its full forward traverse, the picker should then be two inches away from the buffer. The first begins the shuttle movement at the right time, and the second prevents the picker from binding and having the top torn off. When the strap end is seen to be well worn, it is safer to cut it off and make a new slit. Straps that have stretched in working are noted by the increased length between picker and stick, and also by the slower movement of the shuttle when entering the box.

In the Hattersley clutch box loom, the strap is the most accurately set by removing the pressure of the brake, turning the loom over by hand, and making the length so the shuttle begins to move out of the box when the loom has the crank at its bottom centre. Another and handier way but not so accurate, is to place the loom with the crank at its front centre, and then leave the strap just slack. If the shuttle bounces back in the opposite box, it is slackened out a hole to weaken the force.

Under Pick Motion.

The same kind of picking leather is used for the under-pick motion, but in a different way. It is made the regulator strap for the thick picking leather D that passes round the stick. It is looped round the leather, and secured to the back of the stick E. (Fig. 202). The shorter this strap and the lighter the pick: the longer the strap, and the greater the force. As the strap is looped, it would work upward in picking, but another short strap is looped round the thick leather in the opposite direction, and is secured to the stick below the thick leather. The pitch for the screw that secures it is obtained by pulling the stick forward, and then marking the place on the stick. This is the usual method for the Dobcross loom. For the Hattersley under pick (Fig. 203), some overlookers make one strap suffice by securing it above

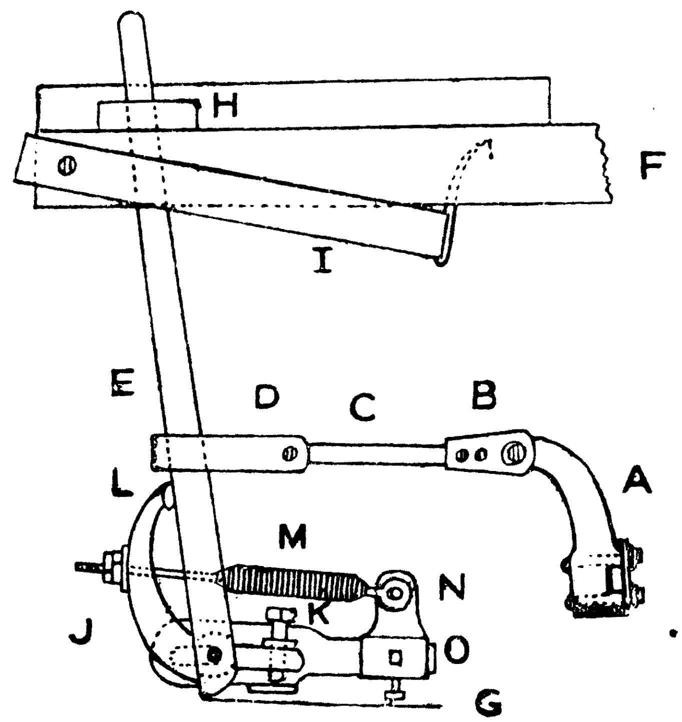


Fig. 202.
Strap Connections on Dobcross Loom.

and below the thick strap on the face of the stick, but the other fixing at J gives much better results.

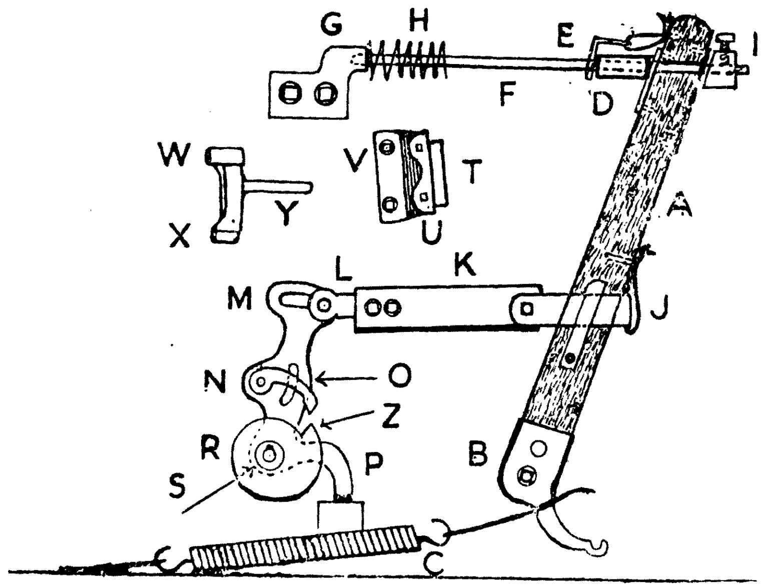


Fig. 203.
Hattersley's Under Pick Motion Strap Connections.

Controlling Picking Stick.—Another useful way in which picking strap lengths are applied, is in being a medium to pull back the picking sticks in the Dobcross loom after picking. Both sticks are attached to the same spring contrivance which consists of a circular iron rod looped at either end to which is attached a pair of closed spiral springs.

The strap G connects the stick bottom to the spring, and should be of thick leather at the stick end. It is a good plan to round-off the stick bottom so as not to cut into the leather, Fig. 202.

Shaft Leathers.—The best end of a picking strap may be made into leathers for the top of heald shafts when pulleys are used. Its width allows of three straps being made for each length cut. Its pliable nature combined with tanning moisture, make it very serviceable for this purpose.

When those are used that are manufactured, and have tinned holes, the smooth side is best placed downward on the pulley, for then the movement is all the smoother, and the leathers last longer.

Check Straps.—In many kinds of tappet, dobby, and harness looms where only one shuttle is in operation, the check strap passes through metal guides in front of the going part, and extends for more than the whole length of it. It is made about 4 inches longer, and the ends are placed at the outer ends of the spindles, and held on by a highly tempered curved spring. An even better way is to terminate the strap a couple of feet from either end, and lengthen it by a good piece of picking strap at either end. The picking strap is much more pliable and durable, and when worn, can be replaced with new. On this extra piece of check strap the checking buckle is placed, which is the means of checking the shuttle.

Buckle.—A cheap and handy buckle can be made from short pieces of old belting 2½ inches wide and cut about 5 inches long. A slot is made at the bottom end for the check strap to pass through. At the other end, a doubled piece of picking strap is nailed on, and a round hole punched through within half an inch of the end. A check pin is then inserted into the belting part, and made to cross the centre of the slot, and project ⅜th inch beyond the bottom of the leather. The end of the check strap is passed through the slot in the buckle, and the buckle pin inserted in one of the holes punched in the strap made for the purpose, and the end of the strap secured as suggested. The buckle in a wide loom is given a run of about 2½ inches. The buckle has not to touch the box end when forced back by the shuttle, or there would be a possibility of the box end eventually being broken.

Increased Check.—When very fine weft is used, a longer check than usual is an improvement, for it then gives a more gradual glide to the shuttle, and assists in keeping up the prongs of the centre weft fork without excessive brush in the shuttle. Too short a check is liable to make the shuttle bounce back in the box, make the weft curl by the selvedge, and also at the weft fork, and cause the loom to slip off.

Dobcross Check Strap.—In the Dobcross plain loom, Fig. 202 the check strap I is entirely different to that described. This strap is 2½ inches broad, and from ¼ to ⅜ inch thick, and 5 feet 5 inches long. This length has the advantage of the strap being used twice without being to sew with whang. The Dobcross loom has the under picking motion, and the picking stick moves in a long slot at the end of the loom. At the inner end of the slot is a narrow looped strap, the loop only allowing the check strap to pass comfortably underneath the box. The check strap is secured by a long bolt passing through the outer end of the going part.

It is most essential to have the proper working length of the checkstrap, for if it be too long, then the stick comes in contact with the end of the box, and is split by the impact. The most effective method is to secure the back length of the check strap by the bolt, pass the strap through the loop, mark the place on the strap opposite the bolt hole, and then cut a hole in the strap 2 fingers breadth in front. This distance is quite safe when the leather stretches little, but with leather that sighs out more, the distance must be increased. These straps should be hand stretched before being placed on the loom. When worn through, the best parts of the strap are kept for "middles," and pieces are sewn on at either end with whangs. The actual checking of the shuttle is done by a semi-circular casting J working on the stout stud that holds the picking stick E the casting being held by a powerful spring M and regulated by a lock-nutted setscrew.

Hattersley Box Loom Check.—The check strap arrangement for this loom is different in every respect from the two already dealt with. In the plain loom, the check strap extends the whole length of the going part, but in the box loom, each end is separate. The inmost length of leather is screwed to the front of the going part, and at the outer end a slit is cut. This stretch of leather passes through a looped leather bolted to the inner side of the breast beam. The looped leather plays an important part in the checking of the shuttle for on its length depends the amount of check imparted to the shuttle.

The second length of leather is secured to the spindle behind the picker while the opposite end is passed through the slot in the first length and secured to it by a bent pin. A further short leather is placed in front of the one on the spindle, and held at the other end by the outer end of the spindle. This short length is to prevent the checking leather from moving too far forward when the loom has picked.

Improved Arrangement.—A much better idea for this make of loom is to have the section made in two parts. The one fitting on the spindle is made from an ordinary picking strap cut down to half its width, except where it is bolted to the continuing leather. It is doubled for the whole of its length, and after being looped round the spindle behind the picker, it is held together by a thin piece of wire passing through it to prevent it from opening out. The following leather is then placed between the two ends of the outer ones, and all three are then bolted together and locknutted. This plan gives excellent working results. The total length of the 3 pieces is made just long enough to extend to the end of the spindle when the loom is at its front centre. The loop through which the check strap passes must be short enough to pull the checkstrap forward from 2½ to 3 inches when the crank is at its back centre, and be long enough to only give a slight action to the checkstrap when the loom is about to pick.

Dobcross Box Loom Checking.—Here again is another variety of checking. The check leather is passed round the back of the picking stick and screwed fast as near as possible to the under framework of the box. The inner end is held by a bent wire fixed to a lever attached to the going part at its back centre, one wire being at the top and the other at the bottom of the lever which is fulcrumed at its centre. The lever is worked by a rod which is affected by another in a tube. Near the outer end of the tube a plug pin is placed which bars the operating rod as the crank passes its top centre, and by so doing, imparts movement to the centre lever and draws up both picking sticks to check the shuttle. The amount of check is regulated by the straps screwed to the picking sticks. When the weaver has to find the pick, the plug pin is pulled out of position by the lever which disconnects the crank shaft and the engine, and so liberates the picking sticks.

Another style of checking is the same as the one described in connection with the Hattersley Standard Loom, but for economy of action, the other one is to be preferred.

Hattersley Friction Drive Check.—This check (Fig. 203) is on a somewhat similar principle to the Hattersley clutch box loom already outlined, but as the friction drive has the under-pick motion, the weight of the stick A and the powerful pull of a strong spring C that pulls the stick back have to be taken into account. A right angled strip of buffalo is bolted to the outer end of the check strap and takes its place on the spindle behind the picking stick.

It will now be realised that the checkstrap works in different ways in different looms. In the Hattersley plain loom it pulls up the buckle and picker; in the Dobcross plain loom it prevents the picking stick hitting the inner end of the slot in which it moves; in the Hattersley clutch box loom it has the light service of pulling up the picker only, while in the Dobcross loom and the Hattersley friction drive, it has the heavy task of moving both picking stick and picker.

SHUTTLE GUARDS.

Shuttle guards are attached to the front of the hand rail with the primary object of preventing the shuttle from flying out of the loom. There are four essentials required.

1. The guard must come into play on the first bump of the sley against the fell of the cloth.

2. It must remain rigid during the time the loom is weaving.

3. Readily fold back for the weaver to take ends up or change the shuttle.

4. As far as possible, prevent the shuttle from flying out of the loom.

There are many types of guards, but those herewith explained are the most reliable with which the writer has had to deal.

Bedford Guard (Centre Spring).

Fig. 204 gives the centre mechanism of this guard. At 1 is the casting which is screwed to the handrail, and stands

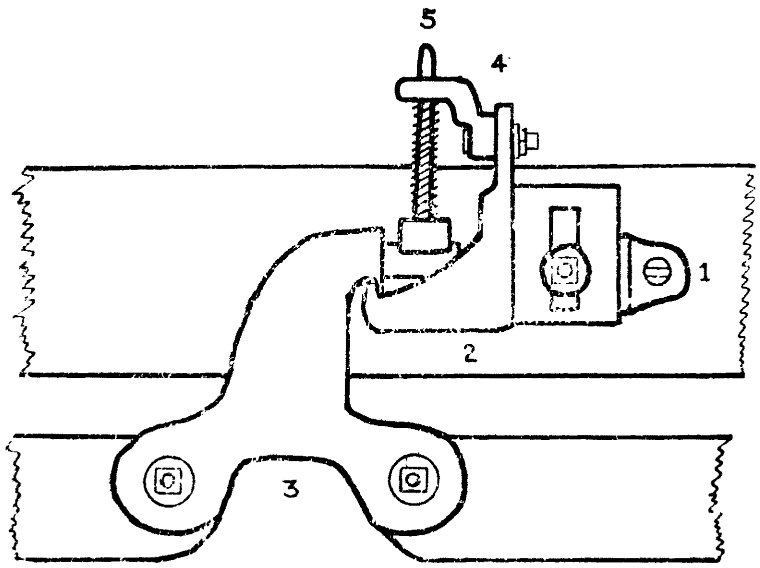


Fig. 204.
Bedford Shuttle Guard. (Centre Section).

forward so a small bolt may pass through it to hold casting 2. As shown, this casting is slotted so it can be placed to the best advantage for weaving. The bottom of it is **V**-shaped to accommodate the rocker casting 3. Part 2 has a lip on the left hand side so the rocker casting cannot get away, and at its upper end is a curved slot which is made use of by the regulator 4. Through the bore of the regulator, the shaft of the spring casting 5 passes.

The position of the regulator has to be, that when the guard is down as demonstrated, that it is firmly held, but it must also hold the guard up when pressed back by the weaver. Its position need not be quite central, for it must be strongest when down for weaving, and the most sensitive when folded back, for it is expected to fall on the first bump of the sley against the fell of the cloth. It is the latter that is the test of efficient fixing. The spring casting 5 is V-shaped at the bottom so as to be astride of the upper part of the rocker casting. When the guard is down, the pressure of the spring is at the front of the rocker casting, but when pressed back, it is at the back. The base of the rocker casting is curved so the prongs of the centre weft fork can work free when the guard is down.

The two pairs of side castings (not shown) along with the spring, all work in unison when the guard is down, and the side castings limit the forward position of the lath, and the top backward movement of casting 3. This is a very serviceable guard.

Fig. 205 is another type of the Bedford Guard. The casting 1 is the same as in the previous example. No. 2 is

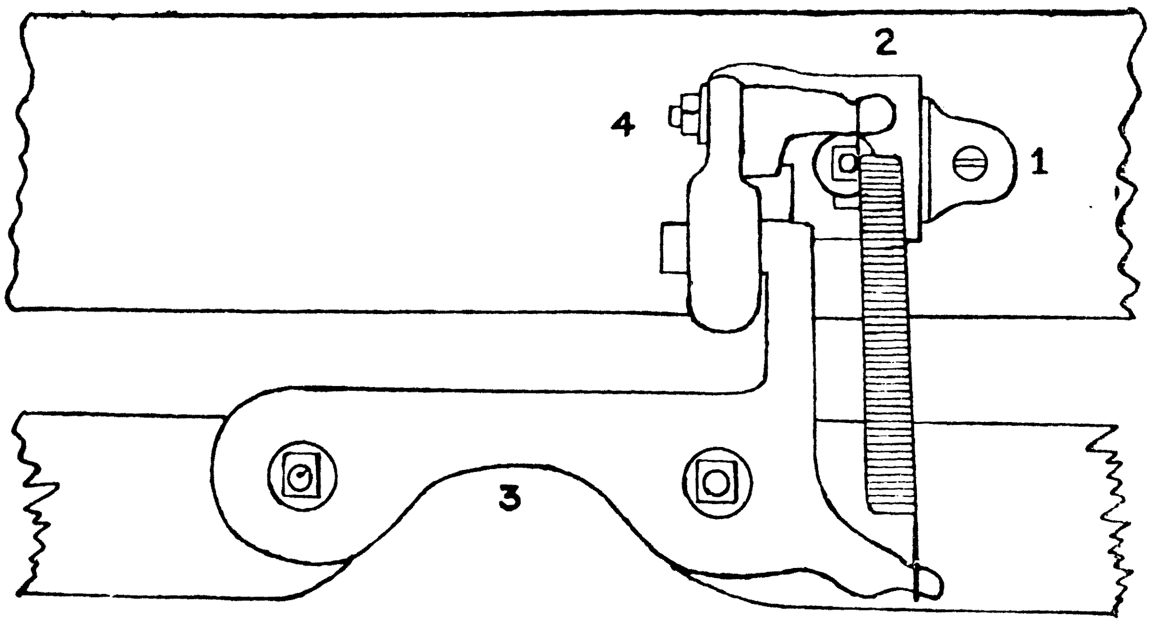


Fig. 205.

Bedford Shuttle Guard. (Side Spring).

of a different shape, and towards the bottom is hollowed out to receive the upper end of No. 3. This part is grooved at the top, and comes in contact with a blunt projection at the top of the opening in No. 2, and is the fulcrum of the movement. At 4 is the small casting held by the bolt shown, and can be moved in the slot of No. 2. No. 4 acts in much the same way as No. 5 in the former example. From a projection on No. 3 a closed spiral spring bridges the distance to No. 4. This acts the opposite way to Fig. 204, for in that the pressure is downward, but in this case it is upward.

The base of No. 3 is curved to miss the prongs of a centre weft fork. This is a rather safer guard than the other, but not quite as good in the wearing owing to the small wearing fulcrum surface of No. 2 casting.

Fig. 206 is another style of guard and gives an added measure of safety. It has been named the "Ideal"

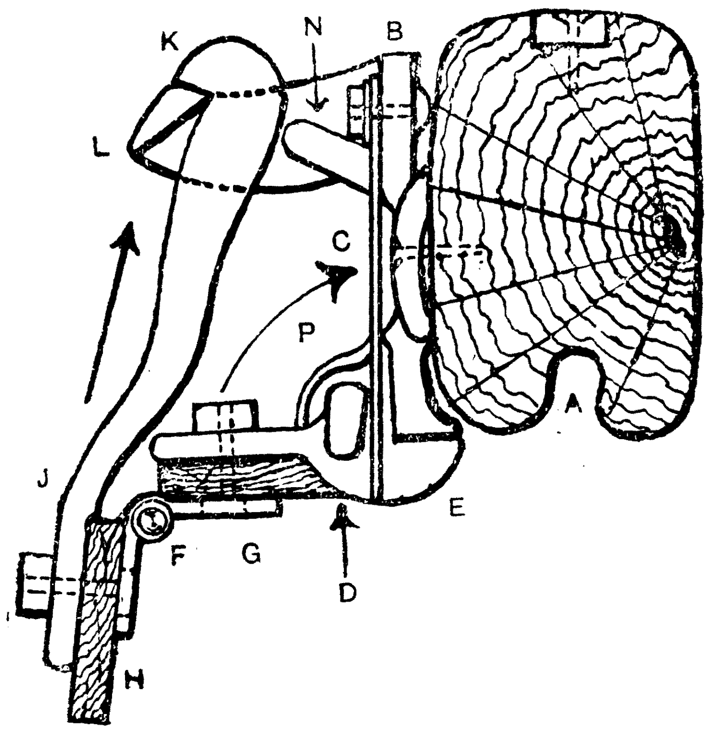


Fig. 206.
Ideal Shuttle Guard. (Centre Side View).

shuttle guard and has strong claim to the title. It is the patent of Gabitass & Coope, Greengates, Bradford, and made for the patentees by Messrs. Lightowler & Keighley, Soho Works, Thornton Road, Bradford.

The centre part is explained as follows. At A is the top rack for the sley, and B is the main casting which is screwed to the front of the hand rail. To B is bolted the highly tempered flat spring C, which exerts pressure at the back of the almost oval lug D, and assists in keeping the guard rigid when weaving. At E is the lip that fits underneath the main casting, each group of three castings having a similar lip which all come to rest at the same time, and creates a solid base for the guard.

In the two former examples there is only one lath, but in this there are two which are held together by the hinge F, the laths being at G and H respectively. The bolts holding the laths have flat heads that sink into the countersunk parts of the hinge, and can thus do no harm to the shuttle in case it tries to get out of the shed. The bottom part of the hinge assists in holding the bottom of the curved catch J. The head of the catch K rests on the triangular shaped part L, and comes to rest when down as shown at the same time as the lip E. The metal prop N which is part of the main casting prevents any vibration of either of the laths when the loom is weaving. The curve of the catch is so it can pass easily between the support L, and the prop N, when the guard is being folded.

When the weaver wishes to fold the guard for any purpose, she can do so by placing her fingers underneath the bottom lath at any part of its length, or if at either end, can use one of the lips best seen in Fig. 208 in an upright position. The catch then follows the arrow in front of it, and the laths fold up in the direction of the arrow P. When this is carried out, the pressure of the flat spring C is transferred from the back of the lug D to the top, and this pressure is sufficient to keep the guard folded until the loom begins weaving. On the first bump of the sley against the fell of

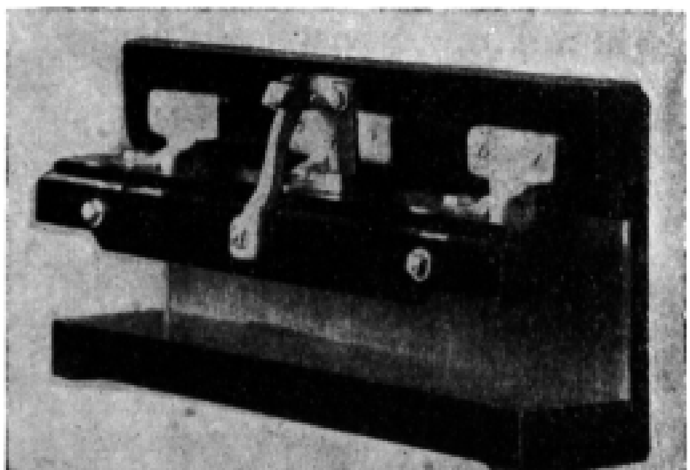


Fig. 207.
Ideal Shuttle Guard. (Weaving Position).

the cloth, the guard automatically falls. In fixing the guard to the handrail, a shuttle is placed at either end of the guard, and the bottom of the lath when down is then set to just clear the top of the shuttles.

It will be noted in Fig. 207 there are three groups of castings, but for narrow width looms there are only two. This photo of the model shows the guard ready for weaving, but Fig. 208 gives it out of action.

By having two laths, the shuttle is prevented from rising up if it attempts to get out of the shed, and the vertical lath prevents it from getting out at the front.

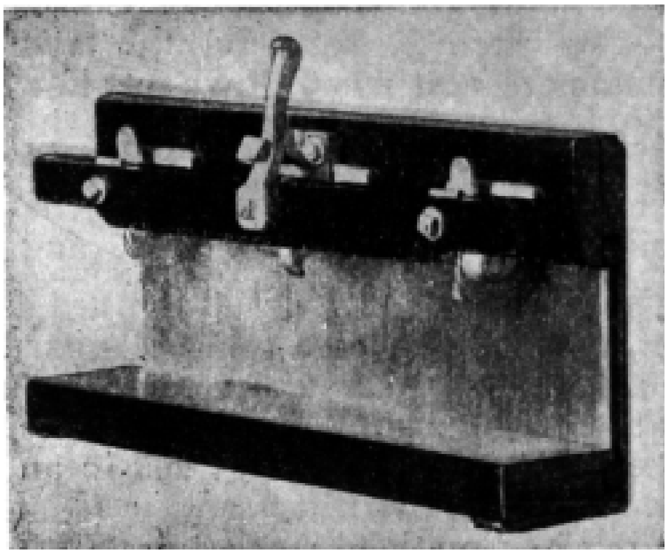


Fig. 208.
Ideal Shuttle Guard. (Closed).

The fulcrums are substantially made, the parts are simple and the castings are rounded off to avoid catching. The cost is light and the service is efficient.

UNDER MOTIONS FOR NEGATIVE DOBBIES.

The Kenyon or under motion for tappet looms and negative dobbies superseded the old stocks and bowls. The latter have been completely outclassed both in the simplicity of parts, the speed of fixing to the shafts, and the number of shafts that can be controlled. Each shaft is on its own, whereas the old stocks and bowls had all the shafts linked together, so that an accident to one usually upset the lot. Fig. 209 is not a Kenyon motion, but the Hattersley spring under motion for narrow looms. The spring levers are fulcrumed on the two cotter pinned rods seen at the top

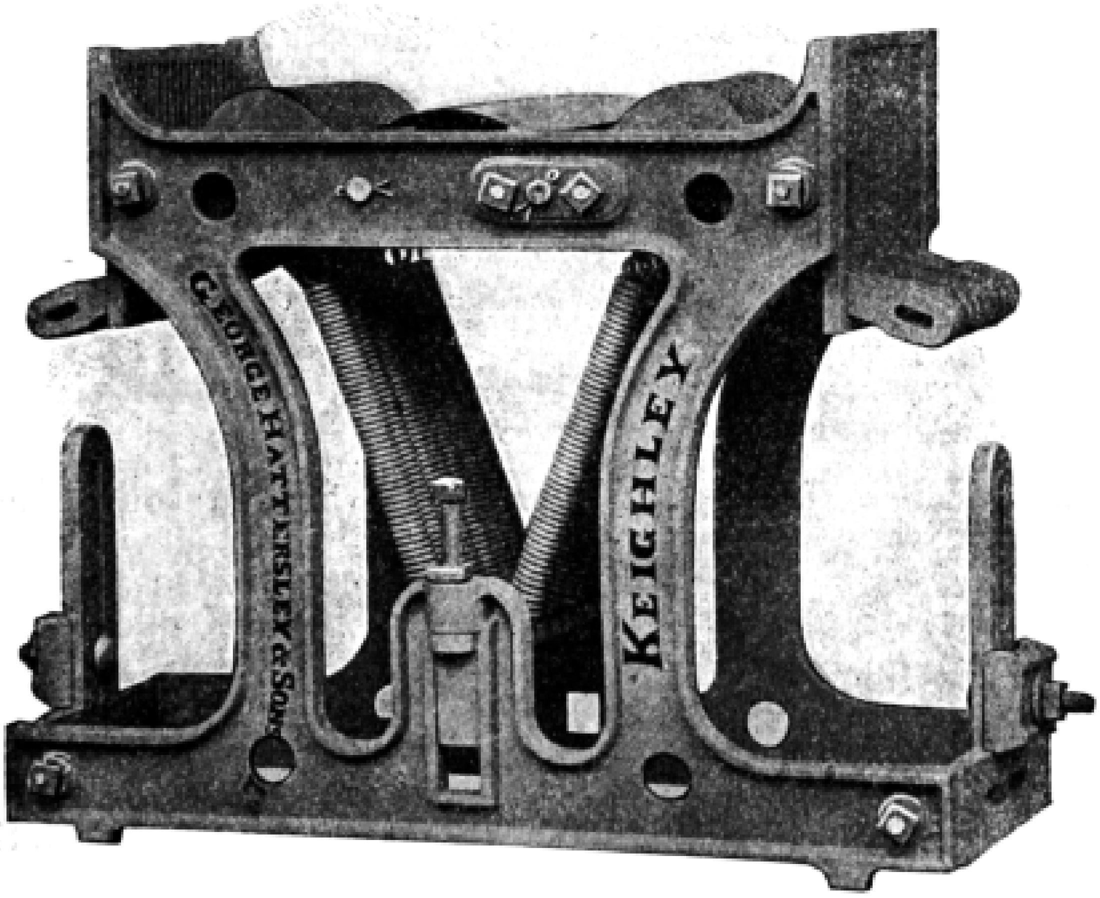


Fig. 209.
Hattersley's Under Motion for Narrow Looms.

of the framework. The levers pass through long slotted grates at either side, and are themselves slotted to receive either wire or strap to connect them to the bottom of the shafts. On the under side, the levers have a hook upon which a closed spiral spring is placed. The bottom of the spring passes on to another hook on a bar which fits into a slotted part of the framework. This bar can be elevated or lowered by the locknutted setscrew at the top of the slot, a similar one being at the opposite end of the bar. This is a very convenient way of meeting the different weights of cloths, for the shafts engaged in weaving a light weight fabric need have little pressure placed upon them, but for heavier goods, more pressure has to be brought to bear to prevent the healds from buckling when on the bottom shed.

The frame is bolted to the cross rails of the loom, the bottom of it resting on the floor.

The one thing to be avoided is to prevent the levers from touching the bottom of the grate when the shafts are down.

Fig. 210 gives the Hattersley motion for wide looms. In this there are two tiers of levers, the upper ones being

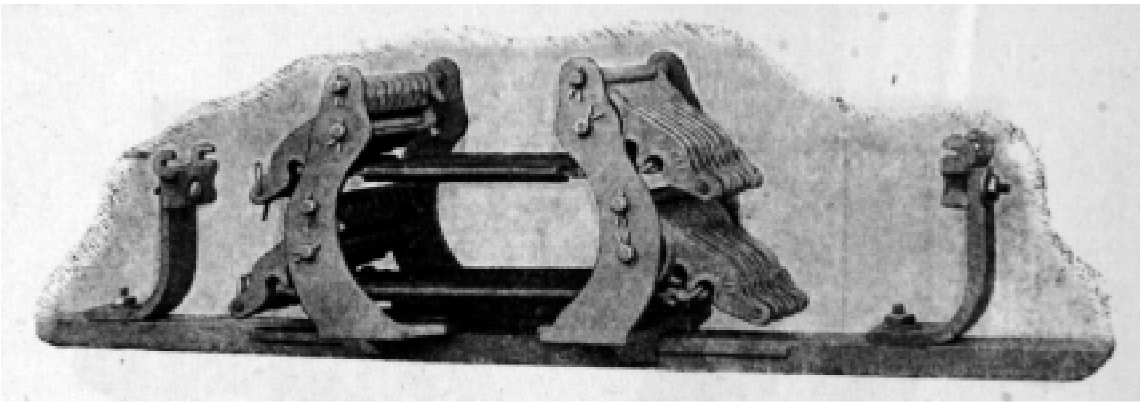


Fig. 210.
Hattersley's Two Tier Under Motion.

two inches further in than the bottom ones, and are so arranged that when an upper one is down and a bottom one is raised, they miss each other. On all shafts destined for use by an under motion, there should be two rows of hooks opposite the ends of the levers so that when the bands are attached, all the shafts work vertically straight, for when so working, much less friction is placed upon the warp.

There are upstanding brackets at either end to attach the spring motion to the cross rails of the loom.

To give working details, reference is made to the sectional drawing given at Fig. 211.

Spring Levers.—The spring lever A is made of malleable iron, so that if a band breaks and the lever suddenly drops, it remains whole. It is fulcrumed on a bar that passes through the framework C. Towards the back of the lever is an opening and into this is placed the switchback casting

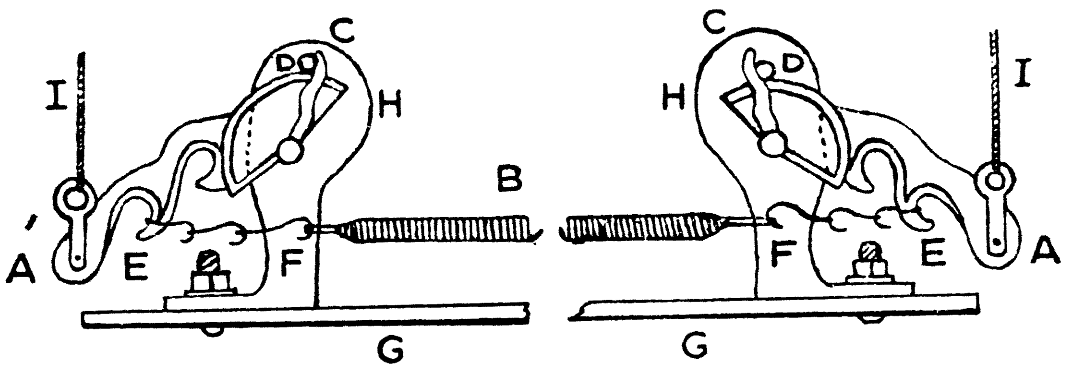


Fig. 211.
Kenyon Spring Under Motion.

C, the upper part of which comes in contact with the stay bar D and limits the downward movement of the lever. This switchback is used in place of the curved lug that is cast to the lever. The spring lever has two hooks underneath, either of which may be used by the hook links. The inner hook gives the least spring pull, and the outer one the greater, both being at E.

In the course of service, the bar upon which the spring levers oscillate becomes worn, and the wearing allows the levers to lean towards the front of the loom. This leads to the hook links catching each other as they pass, and throws additional weight upon bands and healds. If the bar has not previously been turned, it may be twisted half way round by a pair of footprints, and the levers then work straight.

Hook Links.—The spring B is from 6 to 8 inches shorter than the distance between the levers, and this is made up on either side by the hook links F. Some of these are made of malleable iron, but the later ones have an iron strip hook and a square or oblong wire holder. These links are made in four different lengths so as to give the best results in spring tension. The springs are fixed when the levers are down, and the distance to be stretched should not be more than one inch. This allows for the wearing of the parts, does not allow the spring to sag when out of action, and places no unnecessary force upon the levers. If any spring is seen to be slack when changing the healds, a shorter hook link will rectify matters.

If the links next the spring are placed with the hook upward, they are then in a position to have an extra spring attached in case heavier work than ordinary has to be undertaken.

The racks H are bolted to the cradle G, and for wide looms, the inner hooks of the shafts are 19 inches from the centre, and the outer ones 21 inches.

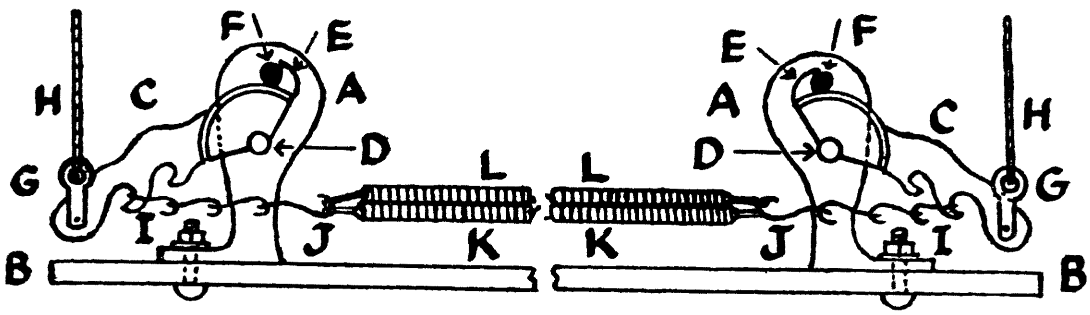


Fig. 212.
Double Springs for Heavier Work.

Spring Tension.—In testing the power of the spring with a spring balance when the hooks were placed on the inner projections of the spring levers, it registered 8 lbs. at the bottom and 5 lbs. at the top. On altering the hook links to the outer projections on the spring levers, and giving the spring a stretch of one inch as before, the pull registered 14 lbs. at the bottom and 6 lbs. at the top. This clearly demonstrated that the inner hooks are adapted for light weight fabrics, and the outer ones for heavier work.

The springs on the outer stretch are sufficiently strong to weave an 18 oz. cloth with one spring to one shaft if the warp is woven on 8 shafts and the weave 2 × 2 twill. If, however, the cloth be 20 oz., then two springs will have to be attached to each shaft to overcome the increased tension on the warp and healds.

The spring power may be altered in the opposite direction. Take the case of a 2 × 2 twill face cloth woven on 4 shafts, and a light backing cloth at the back on 8 shafts. The light backing may be woven with much weaker springs than the face. This reduces the pull on the healds and the work of the engine.

By the pull of the springs, the warp sinks lower much quicker than with a positive dobby, and in consequence has to receive more attention. It also follows that as the weight and work on the engine is greater, that it must be well oiled to prevent rapid wearing.

Difference in Spring Pull.—The reason why the spring pulls the strongest at the bottom and the least at the top is, that when the levers are down, the levers are directly pulling against each other. The levers move in the arc of a circle from bottom to top, and in doing so, they lift the spring 2¼ inches. On passing the centre, the main weight is thrown on to the fulcrum instead of the shaft, though the spring has been stretched two inches.

Leasing the Warp.—Unless the power of the springs is weak it is foolish to drop the engine catches off the draw bar with a pair of pliers. It is much safer, to lift the catches with the fingers if there is only a small number, or thread them on to a foot rule, and then turn the loom over by hand with the balance wheel.

Additional Strength to Spring Motion.—For the heavier kind of work, the ordinary spring motion is not powerful enough, but could be made so by stronger springs. When not strong enough the shed contracts and the shuttle cannot get through, and the loom is constantly banging off.

To save the purchase of stronger springs, and the labour associated, the same kind of spring is made an addition as depicted in Fig. 212. It is done by turning the two inner links with their hooks upward at K and the additional spring then finds accommodation as at L.

TEMPLES.

It is possible that many weaving overlookers these days have never seen a wooden temple as was generally used on the old hand looms. It is only on rare occasions that they are ever required, and only then as an aid to a modern temple weaving very heavy woollens.

By experiments and experience, different kinds of metal temples have been evolved that are suitable for the production of different kinds of cloths, and made of widely different materials. They are scientific, easily adjustable, can be taken to pieces for cleaning, and have the upper hand of the work they have to perform.

Necessity of Temples—Although loom makers have left this field of invention to others, temples are just as necessary for the production of the great majority of cloths as a weft fork, a brake, or a pair of frogs. They are required for at least three reasons:—

(1) To overcome the drag on the selvedge when the shuttle passes from one box to the other.

(2) To counteract the shrinkage of the fabric due to the interlacing of warp and weft.

(3) To keep the fell of the cloth at the same width as the warp in the sley.

Contraction of Pieces.—The following particulars from measurements give the contraction in pieces when various types of yarns are employed.

All Woollen.—Warp 30 skein, 28 threads per inch, 72½ inches wide. Plain weave. Weft 26 skein, 32 picks per inch. Width on cloth beam 66½ inches. Contraction 6 inches.

Worsted Warp: Woollen Weft.—Warp 2/24's worsted (long wool) 40 threads per inch, 76 inches wide. Weave 2 × 2 twill. Weft 12½ skein woollen, 46 picks per inch. Width on cloth beam 72 inches. Contraction 4 inches.

All worsted.—Warp 2/48's Botany, 62 threads per inch, 65½ inches wide. Weave 2 × 2 twill. Weft 1/26's Botany 64 picks per inch. Width on cloth beam 60½ inches. Contraction 5 inches.

Without some contrivance to overcome this shrinkage at the fell of the cloth, it would be impossible to produce a well woven fabric.

Types of Temples.

For the medium and heavy kinds of cloths, three distinct types of temples are employed.

(1) Tapered rings and tapered cap with all the rings inclined.

(2) Inclined rings, all the same size, with semi-circular oblong cap.

(3) Inclined and straight rings on the same shaft, with semi-circular oblong cap.

(4) Roller temples, the rollers being covered with short spikes. The two rollers are covered with a convenient cap.

For the major part of medium and heavy goods, No. 1 is very suitable. This gives a maximum pull at the selvedge and a minimum pull at its inner end. In Dobcross looms that are not fitted with a perforated roller to take the cloth, the stronger make as given at No. 2 is to be preferred.

For medium weight cloths up to 18 oz., No. 3 gives good results.

No. 4 is specially built for the weaving of cotton cloth. In narrow looms for the weaving of dress fabrics, two distinct kinds are used.

(1) A temple built on similar lines which may be on the plan of No. 1 or 2. There are, however, only two, or at most three rings, but these are broader and possess 3 or 4 rows of pins. The cap is short to suit.

(2) The star temple which has no cap. The flat, revolving disc is supplied with rows of pins to seize the piece, the disc being completely hidden by the cloth. In some cases there are two discs, one being below the other. These star temples are far from convenient, and are seldom employed.

Construction of Temple.

With the exception of the star and roller temples, the general structure of the others consists of a series of washers and rings that are placed on the shaft A, Fig. 213, the shaft washers and rings constituting what is known as the barrel. The washers are flat on one side, and are made with a boss on the other upon which the ring revolves. The width of the boss is slightly larger than the width of the ring, and this gives the ring working freedom. The washers are bored while in a slanting position, and make the boss appear eccentric. The outer shape of the washer and the position of the boss is so arranged, that when the ring is placed on the boss, the ring with its pins is exposed at the top and sides,

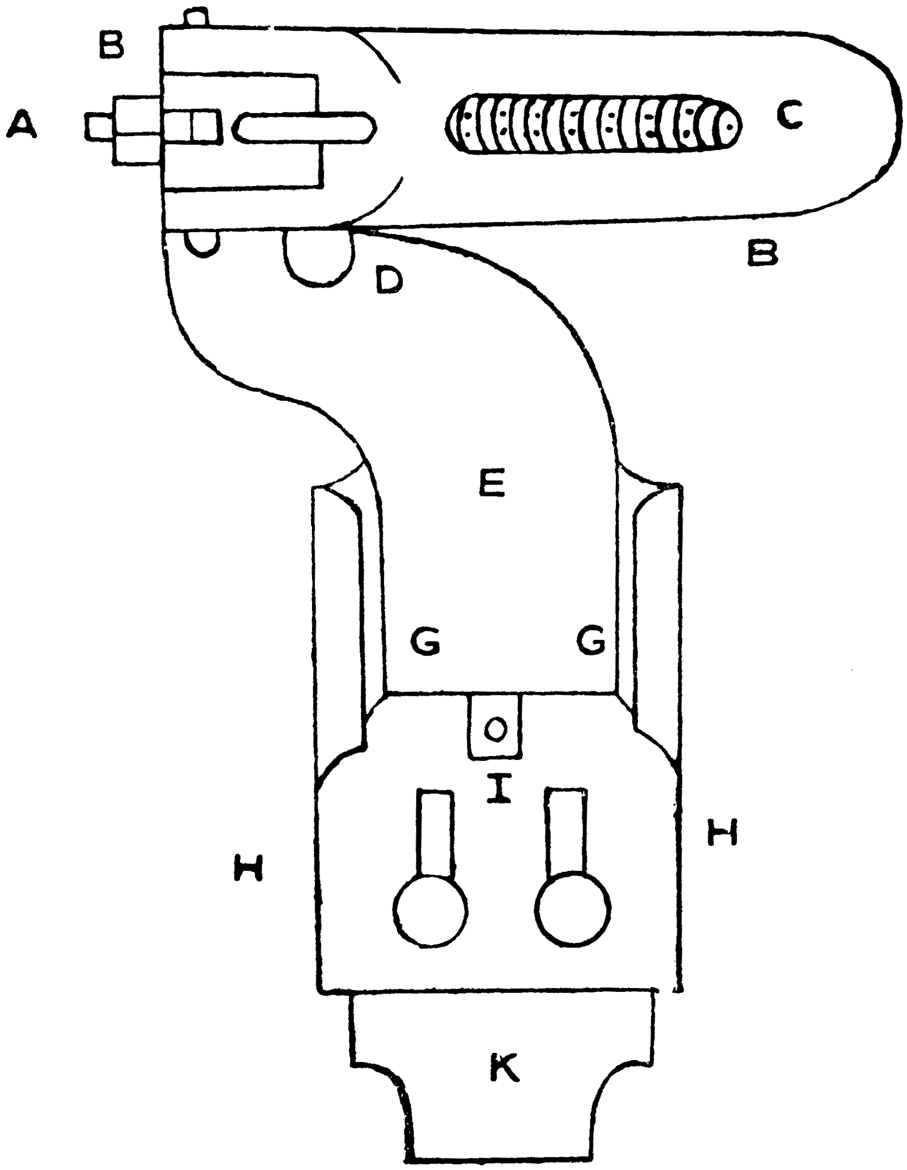


Fig. 213.
Ten Ringed Temple.

but is well covered at the bottom. This covering is very essential, for if the temple dropped on to the shuttle race when the loom was running, many of the pins on the rings would be damaged if improtected.

Advantage of Sloping Rings.—The rings C are made of brass to minimise friction, and are equipped with 24 radiating steel pins. These pins taper to a fine point so as to readily pierce the cloth, but not to damage it. When placed on the boss of the washer, they slope back at an angle of 72 degrees. This backward slope gives three advantages. It prevents the fabric from slipping over the top of the pins: it gradually stretches the piece $\frac{3}{16}$th inch: it gradually allows the piece to contract as when it was first seized.

Function of Cap.—The cap B being semi-circular in shape, covers the top part of the temple barrel, and though riveted to the head of the temple, can be swung back when necessary. It is held down by a wing screw attached to the temple head. The main function of the cap is to force the fabric on to the ring pins, and, when new, the piece is gripped by the pins for $^2/_5$th of the outer surface of the rings.

Regulating Barrel.—The barrel A is bolted to the side of the temple head, and can be adjusted as the head is slotted. The slot allows of a gentle or harder grip being given to the cloth according to whether the barrel is lower or higher in relation to the cap. When the cap is worn at the front, it becomes necessary to elevate the barrel, but the points on the pins must be clear of the under side of the cap or they will either be broken off, or turned into small hooks. Great care is required in fixing the barrel to the head of the temple, for it must fit in the centre of the cap. The cap is so shaped as to give a clearance of $^3/_{32}$nd inch at either side to the points of the pins. Behind the cap is a projection at D, which assists in keeping the cap firm during weaving.

Escape Motion.—Most temples are fitted with an escape motion, so that when the shuttle is caught between the temple and the sley, the temple casting will slide back, and prevent the breaking of the shuttle and the bulging of the sley. This is brought about by a very simple arrangement. The temple casting E is made with a slide at either side, and these fit into a sheet iron plate which is turned over at either side as shown at H. On this plate is riveted the spring I with its knuckle head, the head resting in one of the grooves on the under side of the temple casting. The strength of the spring is sufficient to keep the temple casting in its ordinary working position, but should there be any obstruction at the front, such as a piece of broken bobbin or the shuttle, the spring is forced out of its groove, and the temple casting slides back. The resetting is done very quickly. When the holding spring is weak, sometimes a piece of wood is wedged into the base of the temple casting, but this is very risky, for the temple is hindered in its retreat.

All escape motions for a temple should be made so as to allow the run back to be a little more than the width of the shuttle to secure safety. It must be either that, or for the temple casting to be forced out of position. The part K is the casting to which the sheet iron plate is bolted. The slots shown in the plate give a good range for the setting of the temple, which must just clear the sley when the going part is at its dead front centre, and also be in a parallel line with the fell of the cloth.

On the under side, it is bored to receive the curved end of the threaded regulation hook by which it is elevated or depressed. The under side of the temple barrel must just clear the upper surface of the shuttle race.

The casting K is placed in the centre of a stirrup-shaped casting, both being bored for a pin to pass through to hold them together. The stirrup is setscrewed to a rod held by brackets bolted to the inner side of the breast beam, for by the rod, the temple may be moved over a foot in length.

Fig. 214 is another type of temple which is much favoured for the Dobcross dobby loom. One of the differences

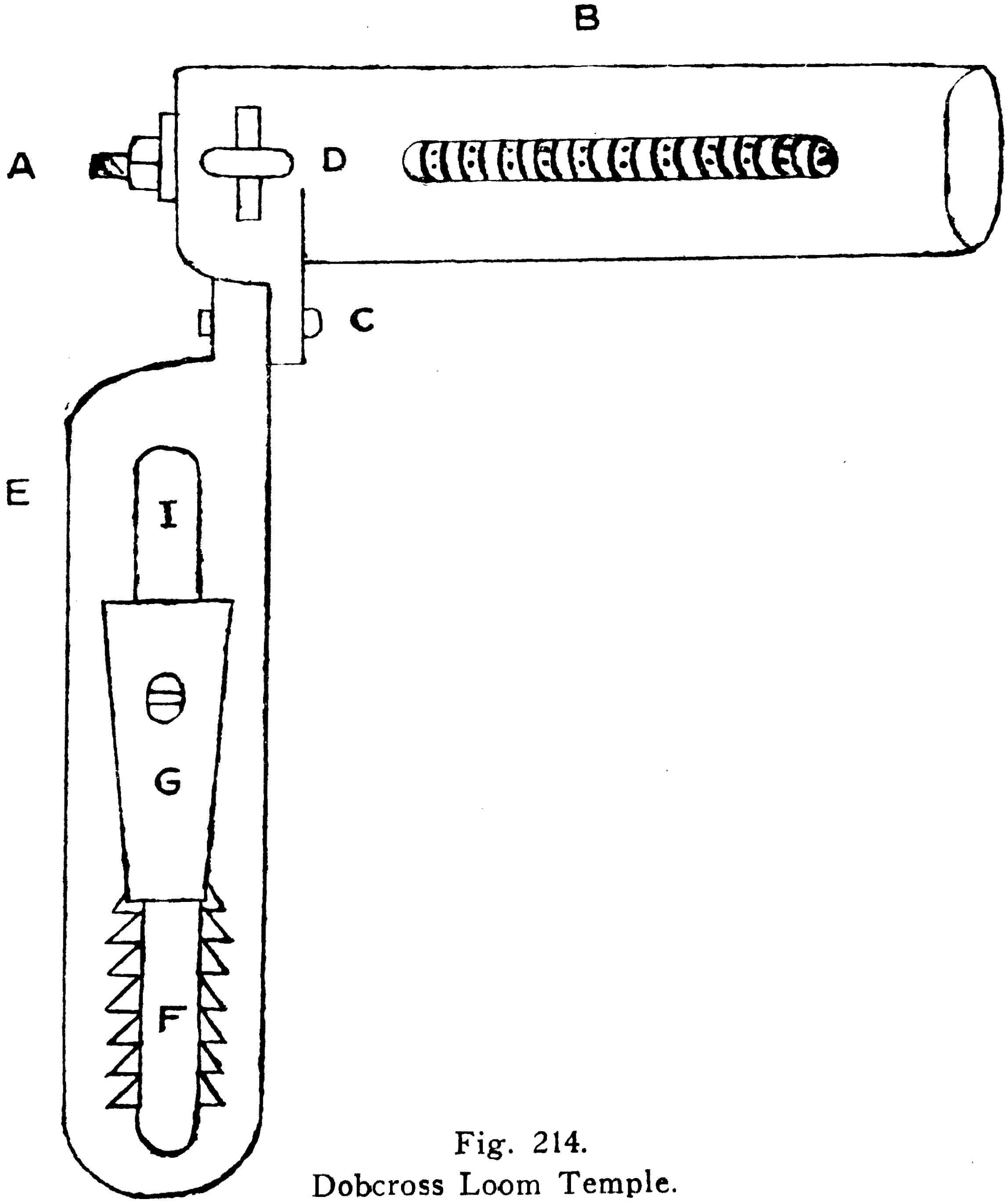


Fig. 214.
Dobcross Loom Temple.

is, that the temple cap and barrel are longer for a special purpose which will be explained later. At A is the end of the temple barrel, and B is the long oblong cap which is held to the head of the temple by the rivet C which gives it swinging freedom. At D is the wing screw that holds the cap over the barrel. The long temple casting is at E which is provided with the long slot I, so that in case of accident it can run back for more than the full width of the shuttle. On the lower part of E are a series of grooves at F, any two of which may be made use of by the end of the tapering spring G. This spring keeps the temple firm during weaving. The screw on the spring G enters the rod casting by which the temple is set to suit the width of the warp and the height of the shuttle race. If anything bulky stays between the sley and the temple, the spring G is forced out of the grooves, and the temple runs back as far as it can be pushed by the sley.

Now the ordinary temple of this make has 10 rings which are quite adequate for most warps, but for tender weft, and with quick interchangings like plain weave, the fabric is very liable to split at the inner end of the temple.

A cloth contracts most at the selvedges, and it follows that the nearer the centre of the cloth is approached, and the less contraction takes place. It is for this reason that the longer temple and cap is used to prevent tearing taking place, and this longer temple has 15 rings. What cannot be woven with 10 rings can be safely undertaken with the longer length and the larger number.

Inclined and Straight Rings.—The temple barrel containing inclined and straight rings works on a similar principle to the tapered variety, for it gives a maximum grip at the selvedge and a minimum one at the inner end. It has a stronger grip on the fabric than the tapered variety, because all its rings are the same size, though leaning at a different angle. The difference in angle is due to the structure of the washers, those at the selvedge having the greater incline while those at the opposite end are perpendicular. By this arrangement, there is little risk of any temple marks showing in the woven structure. This is a very serviceable temple where the general run of cloth is about 20 oz. or upwards, and where the loom is fitted with a perforated roller, as in some makes of the Hattersley and Dobcross looms.

Rings of same Size and Angle.—This structure gives a maximum grip the whole length of the barrel. It is made to take 8, 10, 15 or 18 rings, but the number usually employed is 10. The 10 ringed temple is specially adapted for those looms that have no perforated roller to take the piece before it is wound on to the cloth beam. In this structure of a Dobcross loom, the distance from the back of the temple to the back centre of the cloth beam is 28½ inches, and for the whole of that stretch there is nothing to assist the temple in checking the rapid contraction of the fabric. A temple with a particularly strong grip is therefore a necessity.

Setting of Temple.—Though hints for this have already been given, it will make matters all the more clear to concentrate the points. In the setting, four points have to be observed before weaving operations can be properly undertaken.

(1) The temple barrel A must be set parallel with the shuttle race if there is nothing in the loom, or if there be, it is made parallel with the fell of the cloth. If the inner end of the temple points forward or backward, the ring pins will be working somewhat across in the piece and have a tendency to tear it.

For the temple with the sheet iron plate, the exact pitch is obtained by slackening the two bolts that hold the plate, and then twisting the temple head to the correct position. Before bolting up, a straight edge is placed along the centre of the temple cap, as this magnifies any leaning of the temple.

In the Dobcross temple with the long slot, the adjustment if any is required is by the cranking of the rod of the temple, or by the insertion of leather packing behind one or the other of the bearer brackets.

(2) The temple bearings have to be adjusted so that the under part of the temple clears the shuttle race by at least ⅛ inch. Any dropping after a good fixing is usually due to the weaver pressing down the temple cap when refixing after combing out. The temple has to be clasped with the hand instead of being pushed downward.

(3) The outer and inner position of the barrel must present a fairly even surface to the cloth, and if there be any divergence at all, it must be a slightly downward tendency at the point of the barrel. If this end points upward, it would raise the warp and cloth at that place, and might cause the shuttle to be thrown out of the loom. Were it to point downward too much, the threads at that place would be subject to unnecessary friction on the shuttle race, and be liable to constant breakage.

(4) The temple must also be set so that when the going part is at its dead front centre, there is a working clearance of $\frac{1}{16}$th inch between the sley and the front of the temple

cap. If set too far forward, the temple bulges the sley, or breaks the reeds, and if set too far back, the selvedge threads are subject to too much chafing.

For every new warp, the clearance of the shuttle race and sley by the temple has to be examined, for in light weight fabrics, the going part has less pressure to withstand, and goes a little further forward, but in heavy work, it is held back to its utmost limit.

Function of Side Spring.—The temple at Fig. 213 with the sheet iron plate has a bent spring screwed to the front of the temple bearer rod. The function of the spring is to prevent the temple head from moving forward when the loom is weaving.

In the making of heavy fabrics, or when the spring end has become worn, the spring pressure is too weak to keep the temple in its proper place. This weakness allows the temple head to move forward every time the going part recedes, and is then forced backward as the going part drives the last pick home. This unnecessary action wears away the sley at least an inch, makes the selvedge difficult to weave, and ultimately breaks the reeds if the fault is not discovered. The spring may be taken off and bent to increase the pressure, or a new one take its place, or an extra one be fixed.

Temple Marks.—This is one of the common faults made by the temple. They are caused by the ring pins forcing the warp threads out of their proper position in the piece.

Heavy cloths are usually free from this defect, but if made, they completely disappear in the subsequent scouring. Light weight fabrics are much more liable to the making of these marks. Providing the temple is properly set, the offending ring may be removed, but if the next one begins to mark the cloth, all the rings but two to hold the selvedge will need to be taken off the barrel before the marks disappear. For the weaving of a light weight fabric, two rings are sufficient to hold it.

Piece Tearing.—Sometimes a ring becomes choked with weft, which is usually due to the weaver not breaking the weft off close to the selvedge after changing the shuttle. The ring will then fail to revolve, or will only do so intermittently, and in this way the piece is torn. The temple barrel has to be taken off and the rings and washers cleaned and oiled, care being taken to keep washers and rings in the same position as before.

Defective Pins.—If one of the ring pins becomes bent by being hit, or by being placed too near the temple cap, it will loop or cut a thread or pick every revolution of the ring. This is usually shown at the back of the cloth. The bent part is either straightened or broken off by a pair of sley pliers, and if necessary smoothed off with fine emery cloth.

Effect of Worn Cap.—When the cap is well worn at the front, it fails to force the fabric sufficiently on to the ring pins, and allows the piece to contract at the fell of the cloth. This is all the more pronounced when weaving heavy cloth, and threads in or near the selvedges are constantly broken. If it can be allowed, the barrel may be elevated, but the best remedy is a well fit new cap.

Slack Sley and Temple.—When temples have been properly set at the commencement of a warp so that the last outer ring grips the woven fabric without making it curl over, it has sometimes to be altered owing to the selvedge curling. This is seldom due to the slipping of the temple, but to the movement of the sley. When warps have been beamed from a warping reel, the threads vary in the winding on the beam. If the sley be slack, the difference in the position of the threads on the warp beam moves the sley, which has to be made firmer to prevent it.

Walker and Bennett's Temple.—This has been given the name of the "Adaptable" temple, as it can be quickly altered in various ways to meet the needs of most textile textures. As presented in Fig. 215, it is very suitable for weaving the heavier type of woollen and worsted fabrics, but is adaptable for cotton, linen, silk and rayon.

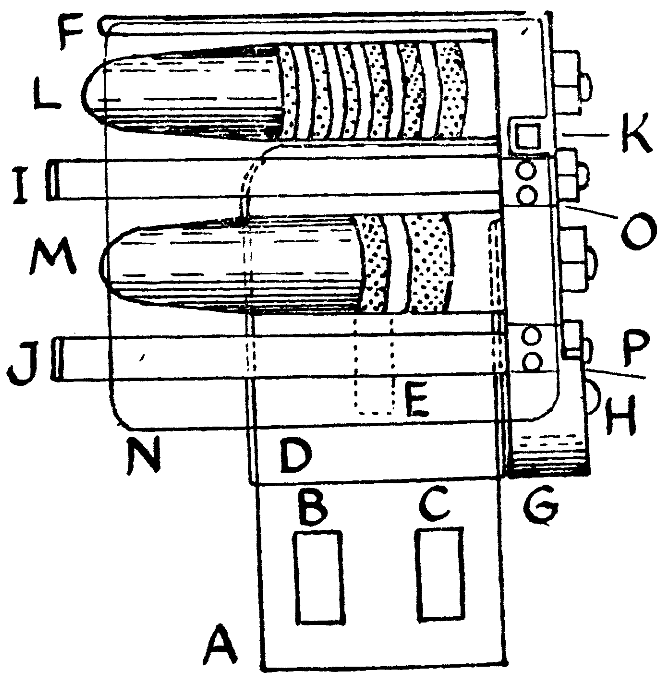


Fig. 215.
Walker and Bennett's "Adaptable" Temple.

Construction, Pressure Lever and Plate.—Fig. 215 shows the top view. At A is the sheet iron plate with its slots B and C, by which it is bolted to the bearer casting, and set to be parallel with the fell of the cloth. D is part of the strong malleable body of the temple, and E the spring that holds the temple forward in its weaving position. F is the steel plate that takes the place of the ordinary temple cap. Its inner side is free from the spikes on the rings on the front barrel. When fixed for weaving, its bottom edge is within ⅛ inch of the bottom of the washers on the temple barrel. It is rounded off at the bottom so as to do no injury to any kind of cloth. It is an inch deep at its outer end, but only ½ inch at its inner end. Up to the second spiked ring it is straight at the bottom, and gradually tapers upward, and so eases the pressure on the cloth.

The pressure lever and plate are in one piece the lever G extending to the top. It is pivoted on rivet H, and when liberated from the holding setscrew K, can be swung up in the arc of a circle. The pressure lever carries two studs that are screwed into the downward parts of the lever. On the studs are steel bushes at I and J which revolve by cloth pressure, but do not glaze the cloth. Each bush is 3.7 inches long and ⅜ inch diameter. The screw studs pass through the frame and then held by a nut. As seen, the bush I is between the first and second barrel, and bush J behind the second barrel. They apply pressure to the cloth, and cause the spikes on the rings to have a firmer grip. The distance between the two bushes from centre to centre is 1½ inches. The overall length of the pressure lever is four inches.

Construction of Barrels.—Both barrels L and M are bolted to the main and malleable structure of the temple. The first barrel L in Fig. 215 is 3.6 inches long, and the bossed washers take up 1.6 inches. The two outer brass rings have each 25 rows of diagonally placed spikes, each row having 5 spikes. The third ring has 25 rows and 3 spikes in a row. The other three rings have each 14 rows with two pins in each row. The first rings lean backward at an angle of 75°, the second at 72°, and the other four at 67°.

The second barrel M is about the same length as L, but contains only two rings. The outer ring has 30 rows and 6 spikes in each diagonal row. The second ring has 30 rows with 4 spikes in each row. The outer ring in M, leans backward at an angle of 72°, and the inner one at 67°. The first washer on barrel L has a top width of 0.3 inches, but the first washer on M has a top width of 0.5 inches, and conforms to the contraction of the cloth. The distance between the two barrels is 1.6 inches. The inner tapered end of the first barrel is 1.7 inches long, but on the second barrel it is 2.3 inches long, and has a sharper taper which relieves the pressure on the fabric. The advantages of the sloping rings has previously been detailed.

The barrels and bushes are covered with a transparent synthetic guard at N. Fixed to the guard are two small clamps at O and P. The guard is easily removed and replaced. A small piece is cut out to allow the setscrew K to hold the pressure lever and plate in their weaving position.

Fig. 216 is a side view of the temple and is lettered like Fig. 215. At A is the sheet iron plate with its spring at E, and its turned up sides for the main casting D to slide into.

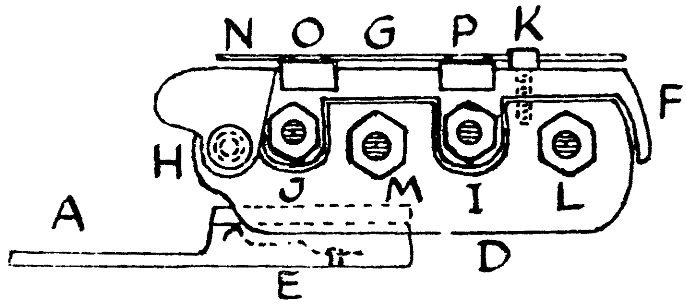


Fig. 216. Side View of "Adaptable" Temple.

If ever the shuttle is caught between reed and temple, the temple slides back and prevents serious damage. At F is the pressure plate and G the pressure lever is underneath the synthetic guard N with its clamps at O and P. H is the rivet for the pressure plate G, and K the setscrew that secures it, M and L are the bolts that hold the barrels, and I and J the nuts that secure the bushes, these latter being part of the pressure plate.

Settings.—There are four.

1. The pressure plate F should be from $\frac{1}{16}$ to $\frac{1}{8}$th inch clear of the reed where the reed is at its front centre.
2. The centre of the first barrel has to be in a parallel line with the cloth fell.
3. The under side of the temple has to be clear of the shuttle race.
4. The outer end of the outer ring on the first barrel must grip the selvedge, and the cloth not to be more than a $\frac{1}{4}$ inch beyond. There is then no curling over of the cloth, and no rings are idle.

Alterations.—As explained, the temple as presented is for heavy woollens, worsteds, cotton duck, sail cloth, linen and jute fabrics.

For lighter weight fabrics, the back temple and bush are taken off, and for lighter goods still, the back temple takes the place of the front one, with only one pressure bush. For the weaving of rayon another barrel is substituted that has only one spiked ring, though here again the second barrel can take the place of the first one, and the inner ring taken off. If desired, other barrels are fitted to suit special work without removing the temple from the loom.

CENTRE SELVEDGE MOTIONS.

The original inventor of this motion is Mr. J. Fairburn, Textile Engineer, Trafalgar Street, Burnley, Lancashire.

The centre selvedge motion is a very necessary adjunct to the fancy worsted trade, and to other textile manufactures when two narrow cloths are woven at the same time in a wide loom.

As far as worsted fabrics are concerned, pieces for this trade are woven in wide looms with a reed space from 76 to 90 inches. In the numerous ranges of patterns issued every season, there is often the same design and the same wefting plan, but the colours of the warp and the warping plan, and even the drafting may be different. In ordering, merchants may request narrow or wide width pieces, and if orders are such that two narrow pieces can be woven at the same time, then a centre selvedge motion will be most useful. Such pieces are known as " split ups." When eventually two narrow pieces are divided, if there were nothing to hold the outer selvedge threads in each fabric where split, the threads could easily be pulled out or disarranged, neither of which is to be desired.

The centre selvedge motion prevents either of these things taking place, because the edge threads on what may be termed the double selvedge are made to weave like a simple gauge crossing. This moving of one series of threads, first to the left and then to the right of adjacent stationary threads, binds the warp and weft together, and makes a secure edge. The mechanism to secure this is shown in the two illustrations.

Fig. 217 gives the side view. The mechanism is made in four depths of needles and traverse which are constructed to meet the position the selvedge motion will occupy, and the depth of shed the threads will be expected to make. The range varies from 3 to 6 inches, but the mechanism in each construction is on the same principle.

Whenever possible, the selvedge motion should be placed at the front, for the threads they weave then make the best shed for the shuttle to pass between. This is not always possible, and it then follows that if placed at the back of the healds, that the more shafts there be, and the bigger must be the vertical traverse of the needles that hold the threads. If the threads make too small a shed, the shuttle may damage them, and the effect in the fabric is spoilt.

What is done is to adjust the motion so the bottom threads are above the shuttle race, but not so the shuttle can pass under them.

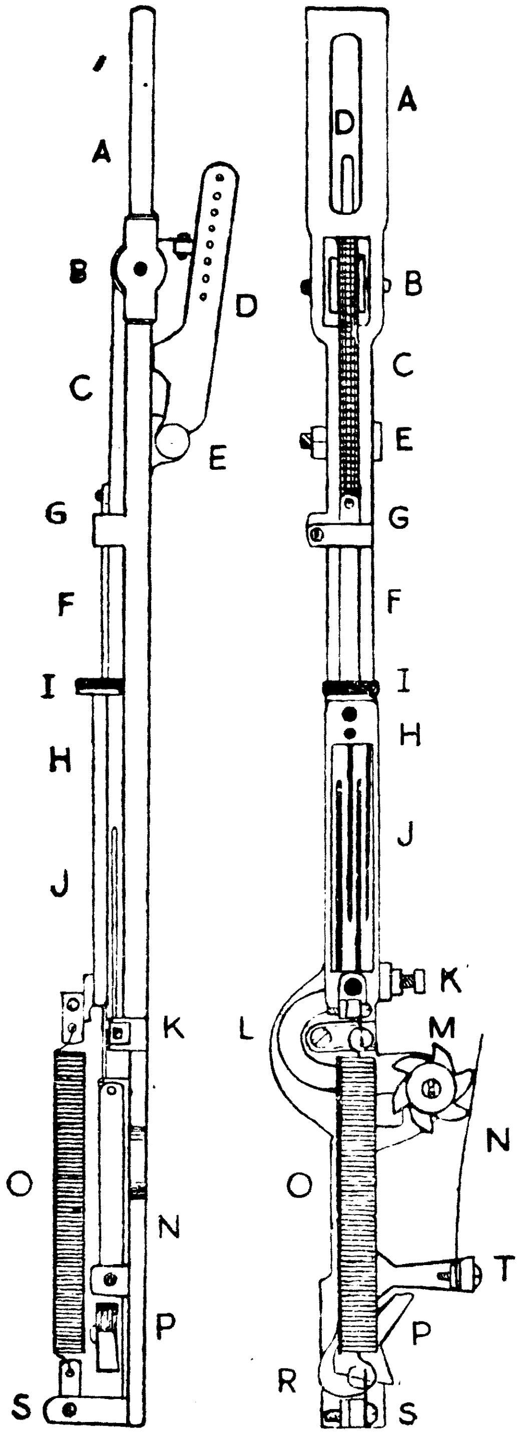


Fig. 217. (Side View). Fig. 218. (Front View).
Centre Selvedge Motion.

In both diagrams the lettering of the parts are alike, but in the side view, some parts are not visible that can be seen in the other, which explains the omitted letters in the first one.

At A (Fig. 218) is shown the long slot at D which has a depth of 4 inches, and as this is where the motion is secured, the slot gives a good length for adjustment.

Method of Setting.—In setting, the threads are passed through the needles and sley and tied tight at the front. The motion is then moved on the angle iron to which it is bolted, until the threads forming the bottom shed are an $\frac{1}{8}$ inch above the shuttle race. At B is the bowl over which the tape C runs that is connected to the pulling lever D, and is fulcrumed at E. The lever D is made with 8 holes, any one of which may be used to couple the lever to the handrail, the outer holes giving the larger movement. The lift imparted to the needles has to be such that the back set of needles change their lateral position, and this is only accomplished when the rubber I, touches, or just clears the guide G when the crank is at its front centre. The quickest setting is to place the crank at its dead front centre, and then adjust the connecting band so the lateral movement of the needles take place.

When the crank is at its back centre, the connecting band or leather is slack, and the lever D rests against the main casting as shown in Fig. 217.

Function of Needles.—At F is the first flat connecting rod which is the means of connecting the tape C to the brass needle case H to which it is riveted. As this case must move up and down at least 4 inches every pick, and being very smooth, it exerts the least friction on the warp at either side of it. The needle case H would appear to have 4 needles, but it has only two, and these have their heads downward. The other two are connected to the rocking shaft L which is indicated by the semi-circular curve, and is fulcrumed at R. The needles are highly tempered and exceedingly smooth, and have pointed ends that are rounded off. Moreover, they are grooved on either side of the eye lengthwise, so as to have a gentle action on the threads.

On every pick, the needle case H is lifted and dropped in precisely the same way, but the upright needles move laterally, though the movement is only $\frac{1}{4}$ inch. This alteration occurs every pick.

In Fig. 218, and commencing from the right, the top needle is 1, the bottom 2, the top 3, and the bottom 4. On the next lift, however, the reading would be bottom 1, top 2, bottom 3, top 4, which is the reverse of the other.

Star Wheel.—The alteration is brought about by the catch P turning the star wheel M when the lever D is pulled forward by the handrail. It will be observed that the turning of the star wheel cannot take place until the needle case is at the upper end of its movement, when the two sets of threads are clear of each other. Behind, and cast to the star wheel, is a small tappet that has 3 rises and falls which coincide with the 6 cogs on the star wheel. The star wheel revolves on a screw stud secured to the framework of the selvedge motion, and the rocking shaft is kept in contact with the tappet by means of the arm T which forms part of the rocking shaft, and the pressure of the curved spring N. This spring performs the double function of checking the motion of the star wheel as soon as turned, and keeping the rocking shaft in contact with the tappet at the back.

When the catch P has turned the star wheel, it is tilted upward by the next cog as it descends, but drops back to its stationary position by its own weight, the heaviest part of it being at the bottom. As the selvedge motion is negative in action, there is need of the spring O to bring it down after being lifted. This spring has not to be a strong one, but one that will stretch well, and has a good recovery. The bottom end is secured to the short arm S, and its upper end is attached to the needle case. There need only be a small margin of pull when the needle case is at its bottom limit.

Setting of Rocker Shaft.—A very special part of the setting has to do with the adjustment of the rocker shaft needles, for these must fit as near the centre of the gaps in the needle case as can be arranged. This setting is obtained by the locknutted setscrew K, for the point of the screw comes in contact with the forward part of the head of the rocker shaft. All four needles must be perfectly straight, and kept so. It is only on rare occasions that the ends of the needles require polishing with fine emery cloth, for when threads break out, it is either for lack of proper needle adjustment, inadequate tension on the selvedge bobbin, or a poor adjustment of the motion. The ends of the spring O, occasionally snap, but that is easily remedied so long as the spring is not entangled in the warp.

It is better when the weaver makes an early discovery when anything is amiss, but usually, there is no pulling back required when the threads have failed to act.

Selvedge Threads.—The threads used for this purpose ought to be of good strength and quality, and are wound on a flanged bobbin so it can be weighted. Two threads are placed through each needle eye, so that 8 threads are essential. They are threaded through the dent next to the warp, and form a very neat edge. Whatever kind of healds are used for warp, space has to be left between the two centre selvedges that is about equal to the full width of the needle case. There is then only a minimum friction on the ordinary selvedge threads.

The selvedge motion from which the diagrams were drawn was one with a needle case lift of 4½ inches, and the length over all was 33 inches.

Chain Selvedge Motion.

Another motion is depicted at Figs. 219 and 220, which is worked by a chain on the doup principle.

Both diagrams are lettered alike, but there are different positions of shafts and threads. The ordinary warp is given in outline and the extra threads are solid.

In Fig. 219 A is the back rail, and B the warp, with C the thick lease rod and D the small one. E and F are the ordinary heald shafts. Then G may be named the doup shaft, and is only a skeleton shaft to weave the outer selvedges. On this, two healds are tied up in the centre for the weaving of the safety edges. Ordinary heald eyes are employed, and are placed at the same pitch as the others. An ordinary doup is really only half a heald, but in this arrangement, it takes the form of a very small and flexible

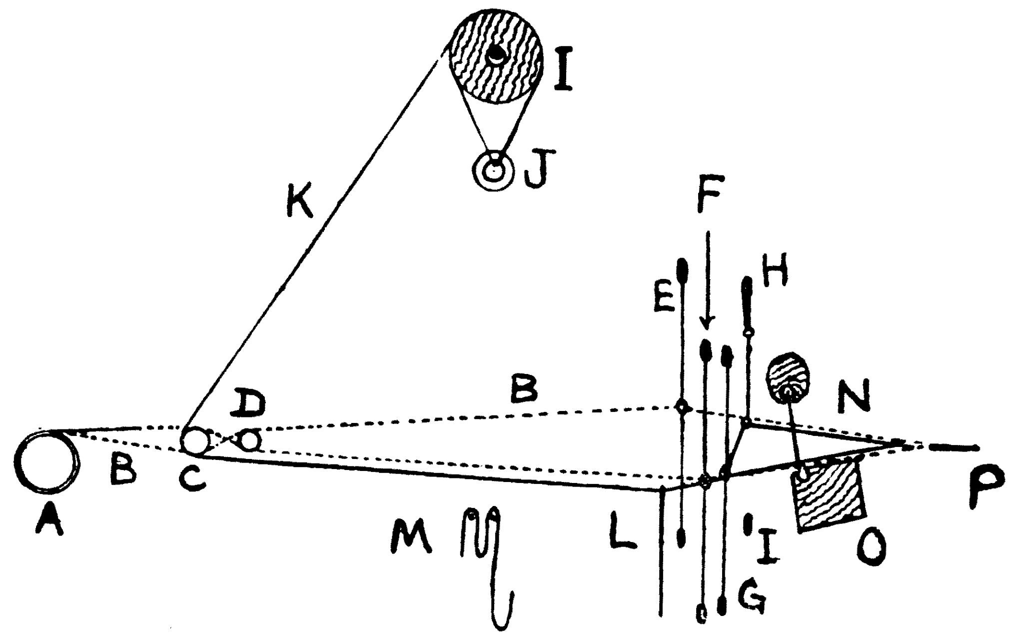


Fig. 219.
Centre Selvedge Chain Motion. (Doup Shaft Up).

chain with a very small ring at either end. It is four inches long, and is suspended from the heald shaft H by a heald band. When the doup shaft G is level with the doup H on the top shed, the bottom ring on the chain is set just below the heald eye on the doup shaft. It is not connected with the heald shaft I, for this is only used for the weaving of the outer edges for the selvedge.

Bobbin and Weight.—The threads which are to be lifted first on one side and then on the other of the stationary threads are wound on a flanged cheese I, the flanges being grooved to hold the weighted brake band J. The weight is only small and has to be experimented with to obtain good results. The distance between cheese and weight has to be short to prevent the weight swinging.

Wire Grid.—Before the threads from the cheese are placed in position, a wire grid is made and fixed to the central support of the crank shaft. As shown, this grid at M is shaped like the letter **M,** the long leg of it being looped for adjustment. The two upper loops receive two threads each from the warp and two each from the cheese. The grid is fixed so that its upper surface is just clear of the underside of the bottom shed, for the angle then formed by the threads is at its easiest for working and is shown at L.

Path of Selvedge Threads.—There are four groups, but only two need be explained, as the other two groups are duplicates and form the other edge of the selvedge.

Two warp threads are passed underneath the back lease C, through the grid L, and then through the reed. They do not pass through any heald as they are stationary threads. The cheese threads K should come from the top of the cheese as shown, for they cannot then come in contact with the weight. They pass behind and below the back lease rod C instead of over the back rail because the lease rod imparts more oscillation to the threads. They are put through the same slot in the grid L, and then enter the heald eye on the doup shaft. As the warp threads pass on the inner side of the doup shaft heald, the cheese threads pass underneath them, and then through the bottom ring in the chain. They then enter the same dent in the sley as the warp threads and are secured for weaving.

Weaving Positions.—In Fig. 219 the chain doup H is lifted and the doup shaft G is on the bottom shed. The necessity for slackness of the cheese threads is apparent, for the doup shaft is holding the cheese threads down, whilst the chain doup elevates them on the right side of the stationary warp threads. The shed is smaller than the ordinary warp, but large enough for the passage of the shuttle. The stationary threads are lifted a little above the shuttle race, and the crossing threads are a little below the top shed.

In Fig. 220 the positions of all the shafts are reversed. The doup shaft is now raised and the doup H is depressed.

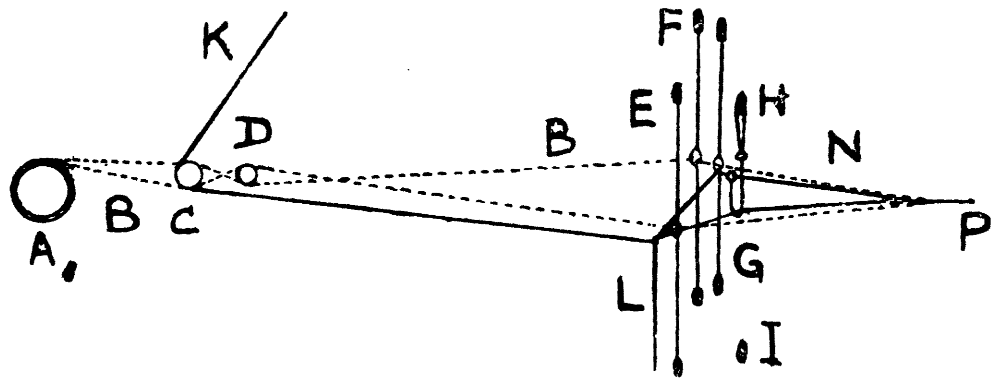


Fig. 220.
Centre Selvedge Chain Motion. (Doup Shaft Down).

The doup shaft has elevated the cheese threads on the left of the stationary threads, and by the doup descending, the chain is looped underneath the stationary threads. The angle now formed by the cheese threads is from the grid to the doup shaft, whereas in Fig. 219 it is from the doup shaft to doup. At O is the going part, N the front shed and P the cloth.

When carefully adjusted, the centre selvedge threads weave just as well as the ordinary warp and a safe edge is made at very little cost. As little weight is required for doup and doup shaft, the ordinary springs on the under motion are substituted by much weaker ones.

WEFT FORKS.

A weft fork that is kept in good order is an excellent aid to any weaver, for it curtails the making of waste, reduces bad setting up places, and promotes production. Though there are a number of very reliable mechanisms which differ in their mode of action, the principle in each case is much the same. These are:—

(1) Two, three or four prongs to come in contact with the weft.

(2) A catch arrangement to come into play when the weft fails.

(3) A mechanism that will stop the loom.

There are four chief styles each of which will be considered.

(1) Tumbler Weft Fork.

Though this is the oldest of the four, its merits are such that it is extensively used to-day. It is most in evidence on tappet looms. An outline of its parts are given at Fig. 221.

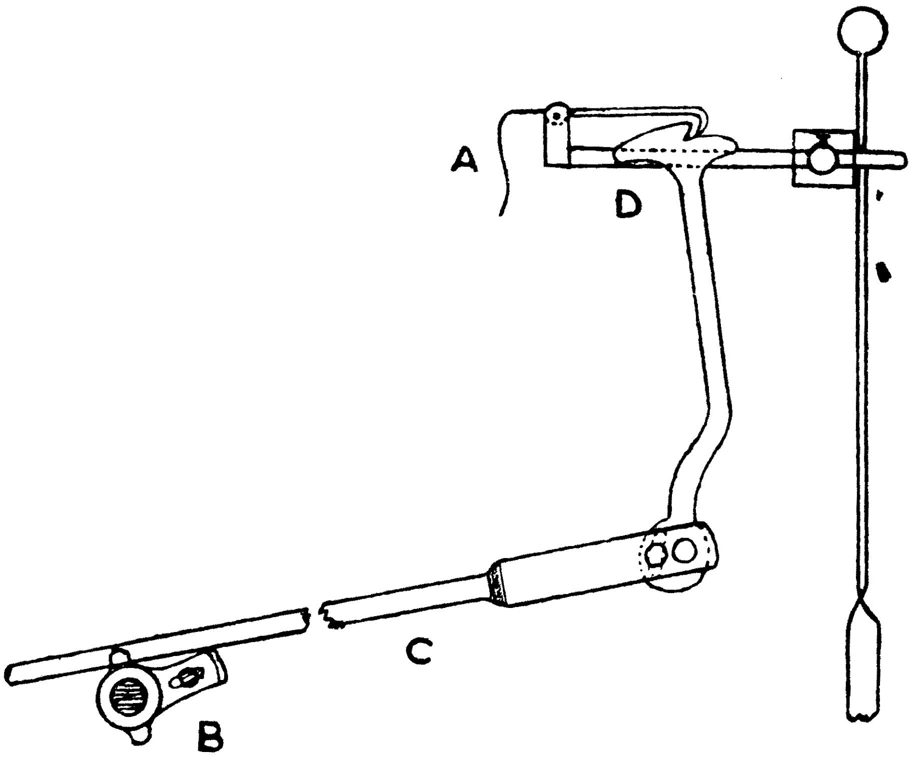


Fig. 221.
Tumbler Weft Fork.

At A are the three prongs which pass through a grate screwed to the end of the sley rack, and at the belt pulley end of the loom. It is usually sufficient if the prongs pass through the grate an ⅛th inch, though this distance has sometimes to be reduced for tender single twist weft. This distance beyond the grate is when the crank is at its dead front centre. The fork is fulcrumed as shown in the drawing by a screw passing through it, the screw having a fine gas thread, and bridges the distance between the two uprights of the holder. The weft fork must swing freely, but have very little lateral movement, for if so, the prongs might come in contact with the grate, and make the fork of non-effect.

The fork has three settings: (1) The forward setting is that beyond the grate mentioned; (2) Each prong must be in a parallel line with the grate, and fit in the centre of the opening; (3) Its altitude must leave the top of the fork free from the top of the grate, and the bottom of the prongs free from the groove in the shuttle race, both when stationary and tilted. All three settings are obtained by the knob casting which is shown in front of the setting-on handle.

At the opposite end to the prongs is the catch, which is made to slope inward, and rests upon the hammer head D when out of action. It is lifted clear of it when the weft passes between the prongs and the grate, for then, as the going part moves forward, the weft presses the prongs backward and the catch is tilted upward. The further the prongs pass beyond the grate when the going part is fully forward, and the more violent is the action of the fork. All that is necessary is for the catch end to be lifted clear of the hammer head, with a due allowance for a little slacker weft.

The hammer D has also three settings: (1) Its altitude has to be such that the shaft of the fork is about level as shown in the diagram. The prongs are then about vertically parallel with the grate. This position is obtained by the casting into which the rod passes that forms the fulcrum for the hammer shaft, as well as the bayonet C. This casting is bolted to the framework of the loom; (2) The lateral position is obtained by the fulcrum rod which is set so the catch of the fork is in the centre of the hammer head. This cannot always be brought about by keeping the shaft of the fork straight, but as it is of a wiry nature, it can be cranked with the pliers to obtain the central position. (3) The forward position is obtained by means of a curved slot at the base of the hammer shaft, for at the base, the hammer shaft and bayonet are bolted together. The distance between the raised point of the catch on the fork and the edge of the cut on the hammer need not be more than ⅛th inch. The bayonet C has to be of such a length that when the tumbler B is in the opposite direction to that given in the drawing, the end of it should be a couple of inches beyond. There is then no catching by the tumbler whenever the loom runs back.

The tumbler B which is clamped and setscrewed to the low shaft is in three parts. There is the bottom curved section which is setscrewed at either end to the upper one, and carries the timing setscrew. The second section has a slotted arm, and it is to this that the tumbler is bolted. The tumbler has a rounded upper surface, for it is this that lifts the bayonet every revolution of the low shaft. The height of the tumbler regulates the movement of the bayonet and hammer head. The movement of the hammer head has to be sufficient to pull back the weft fork so the flat lever which holds the knob casting pushes the setting-on handle out of its niche, and so stops the loom. The tumbler must begin to lift the bayonet when the crank is at its front centre.

This kind of weft fork only acts every other pick, and as it is at that end of the loom where the weaver changes the shuttle, care has to be taken to avoid hitting the prongs, for if bent, they may sever the weft, or fail to stop the loom. There is a further point worth including. In very wide warps the utmost room is taken, and so much so at times, that the prong nearest the warp has to be broken off. The weft fork will act with two prongs, but the brake brush in the shuttles may have to be made stronger to make the weft tighter and prevent the loom "slipping off."

Centre Horizontal Weft Fork.

The main parts are presented at Fig. 222 and is the patent of Brook and Pattison. This weft fork acts every

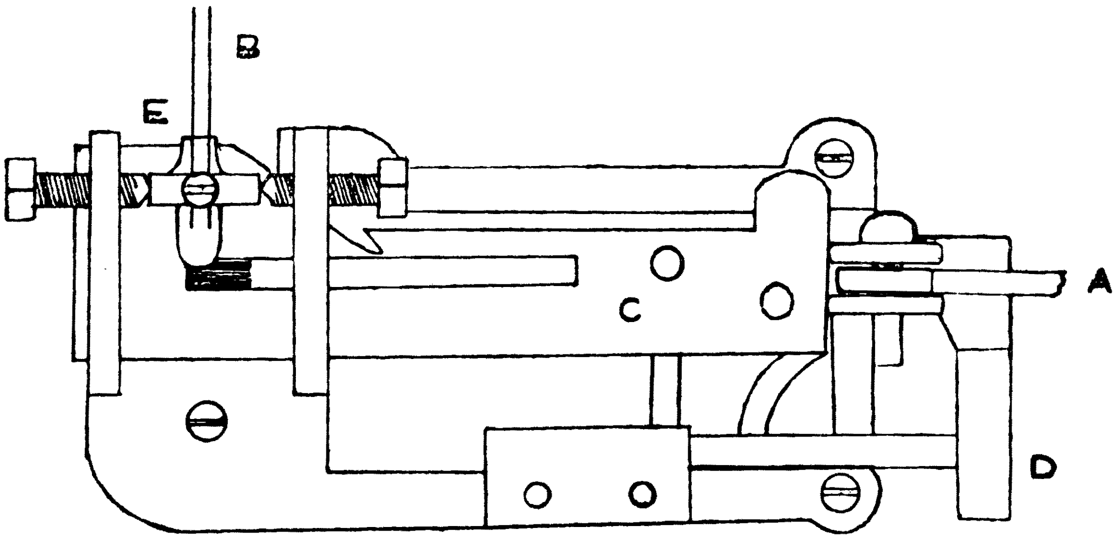


Fig. 222.
Horizontal Centre Weft Fork.

pick, and most of the parts are made of brass to bring friction to a minimum.

At A is the connecting rod which is looped at this end, and is held to the slide C by the pin shown. At the opposite end it passes through a swivel, the leg of which oscillates in a casting corkscrewed to the underside of the breast beam. The rod has a swaged collar about three inches in front of the swivel, and this space is spanned by an open spiral spring which keeps the rod forward when weaving, and the slide takes its full run. The rod gives its best service when 18 inches long, for then the movement of the slide is both steady and efficient. The position of the slide C is set by the casting holding the swivel, which is fixed when the going part is at its back centre. When in this position, a shuttle is placed behind the raised prongs B, the back of the shuttle being against the sley. The prongs have then to clear the top of the shuttle front $\frac{3}{16}$th inch.

To the open brass framework of the slide, the mild steel plate C is riveted. As will be observed, it passes through the two projections which hold a pair of setscrews. The inner centre part of these projections are cut out to let the small bar on the steel plate slide through. The function of this bar is to prevent the tippler E from toppling over, but so that it can rise up on the inclined part of the slide, it is made to taper at the shaded end.

The inclined piece of the steel part of the slide ends in a cut. It is this which seizes the upper part of the tippler when the weft fails, and in doing so, both slide and rod are prevented from going forward. As the going part moves up to the fell of the cloth, the spring on the rod contracts, and brings the part D opposite the knocker-off, and when this is forced backward, the loom is brought to a stop.

The tippler E has two shallow cuts on its face, and in these are placed the two prongs B. These prongs are elevated when the slide is out as shown, and, when set as mentioned, are high enough to miss the shuttle as it passes underneath. As the going part moves forward to the fell of the cloth, they gradually sink into the cut made for them in the shuttle race. When the weft is laid in the shed by the shuttle, the drag upon it holds up the prongs until the cut in the slide has passed the catch on the tippler, and the loom then continues to weave, and the weft slides off the ends of the prongs.

There are several important points in the fixing of the tippler which must be mentioned. The two setscrews upon which it swings are centrally pointed, and while they let it swing free, it has to have the least lateral freedom. The setscrews have also to be set so the prongs fit centrally in the groove in the shuttle race, for if the prongs touch either side, the weft fork is out of order. The prongs have to be free from the back of the groove, and not come in contact with the bottom of it when the tippler is caught by the catch in the slide. This is most likely to occur when the slide is worn, but can be prevented by the prongs being pulled upward a little by the pliers.

When curls appear in the fabric opposite the weft fork, either small brushes are needed in the shuttles even for weaving woollens, or if the curls then continue, the slide should be tested by taking out the connecting pin. A strand of weft is then held across the back part of the groove, and the slide then moved forward with the other hand. If it is then seen that the catch strikes the tippler, the prongs may be bent downward so as to be held by the weft sooner and longer, and it holds the tippler higher.

There are two things that have to be avoided. The first is the slipping back of the casting underneath the breast beam that holds the swivel. The second is the wearing of the holes in the slide through which the connecting pin passes. This can be indefinitely postponed by systematic lubrication. The danger from these two sources is that the slide might come out of the slot on the left in the drawing, and if so, there is a possibility of that part being broken off by the forward thrust of the slide.

Vertical Centre Weft Fork.

This style is presented at Fig. 223. The framework A is screwed to the front of the going part, and is set so the top of it is slightly below the level of the shuttle race. The vertical slide is at B which is kept in position by the two plates C, these being secured to the main framework A. The slide cannot be removed unless these plates are liberated. The bottom of the slide is bifurcated and bored so the top part of the rod D may be held to it by a rivet. At H is the lug which comes in contact with the knocking off mechanism when the weft fails. Above the lug the slide is slotted, but is bridged by metal at the top. It is this bridge that is the means of raising and lowering the tippler that holds the prongs G. This tippler is shaped much like a straight thumb and a bent forefinger, the end of the finger forming a catch. It is this catch that holds the bridge on the slide when the weft fails, and brings the lug H opposite the knocking off mechanism, and so stops the loom.

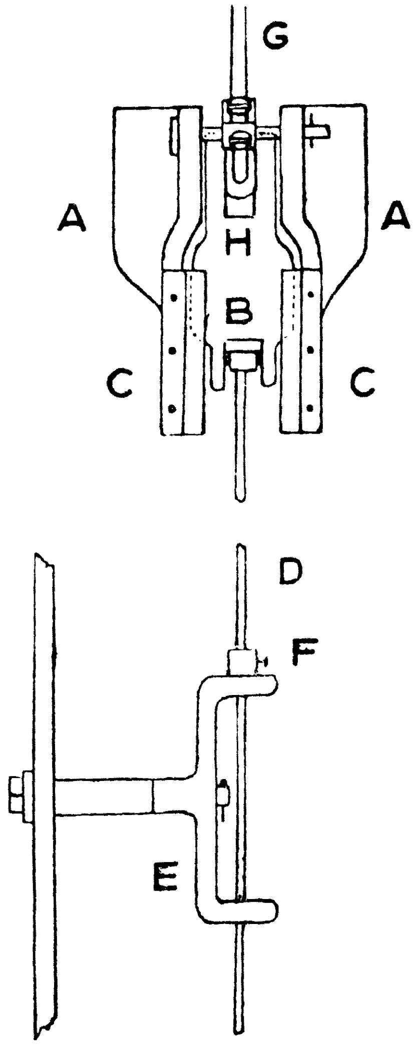


Fig. 223.
Vertical Centre Weft Fork.

The rod D passes through the guide E at top and bottom, the guide swinging free on the stud depicted. On the rod is the collar F, and by it the altitude of the tippler and slide are determined. It is fixed in much the same way as the horizontal centre weft fork, for the crank is placed at its back centre, and the shuttle put against the sley. The rod is then moved so the prongs are $\frac{3}{16}$th inch clear of the top of the shuttle front, and the collar is then secured to the rod on the upper end of the guide.

The tippler is secured to the pin that passes through it, and must be fixed so the prongs are central to the groove in the shuttle race. The points about the prongs set forth in the horizontal weft fork equally apply to this mechanism.

The tippler will fail to stop the loom when the catch end has become worn, or the top of the lug and the knocker off have become rounded off. These can be tested by hand, but if the warp and cloth be in the loom, the warp will have to be slackened for observation to be made.

When weaving, the weft holds the prongs long enough to allow the slide to move out of range of the tippler, and in this way the loom continues to weave.

Hudson's Centre Weft Fork.

Another weft fork that has won extensive adoption is one patented by Hudson's, Great Horton, Bradford. In some respects it is like Brook and Pattison's, but as will be seen by the illustrations, some of the parts are different.

In block 224, Fig. 1 gives the front view. Prior to fixing, the centre of the shuttle race is first found, and an

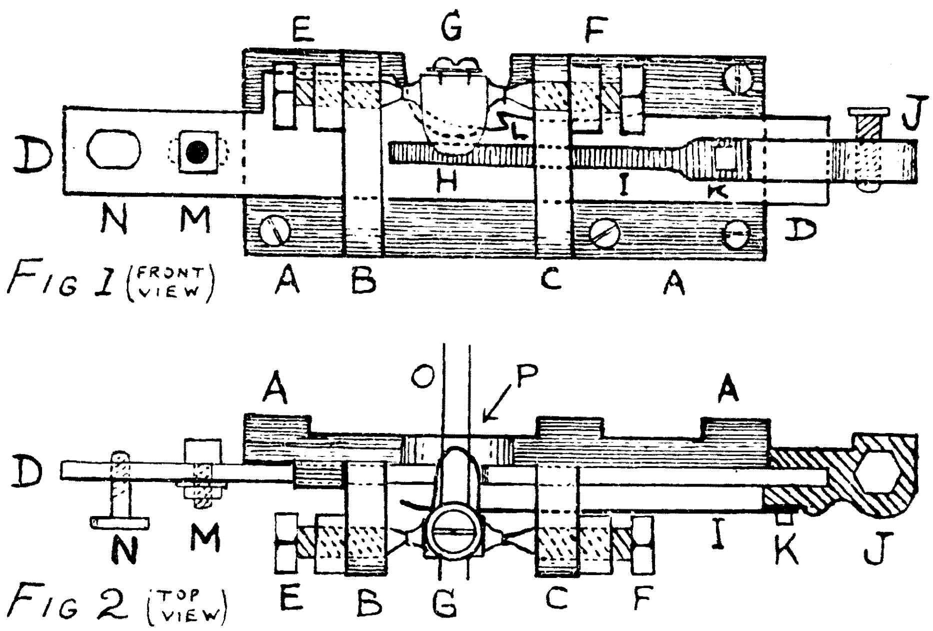


Fig. 224.
Hudson's Centre Fork.

inch is then allowed nearer the box into which the eye of the shuttle penetrates most. At this place, a groove is cut which is ⅝th inch wide and ¾ inch deep. The depth must allow the weft prongs to be free when the notch on the slide is holding the tippler.

The Framework.—This is given at A, and is fixed to the front of the going part by half a dozen screws. Its upper surface is parallel with, and slightly below the shuttle race, and its hollow part at G is directly opposite the groove. There are two slots for the slide D to pass through at B and C, and as these stand forward, their upper ends are bored and threaded, and receive the lock-nutted setscrews E and F which hold the tippler G.

Tippler.—As will be observed, this has a short wing at either side, both being countersunk to receive the blunt pointed ends of the locknuts E and F. The tippler is left with little side play, but must have rotary freedom. On its upper surface are two grooves, and in these are placed the weft prongs O, which are secured by washer and screw. The usual setting is to have the prongs so they just miss the back of the groove, and this gives the longest length which is specially required in the weaving of fibrous warps. The tippler has two fingers, the front one at H, Fig. 1, being pressed against by the small flat spring I so as to keep the back finger P, Fig. 2, in contact with the slide D.

Slide.—This part is coupled to the connecting rod by the setscrew J which cannot come loose to adversely affect the warp. At K, Fig. 1 and 2 the flat spring is held by a small setscrew. The power of the spring may be altered by bending, but whether much or little, the pressure on the tippler must be removed just prior to the prongs coming in contact with the weft. Any spring pressure at this point would make weft curls down the piece. At L, Fig. 1, is the slide notch which seizes the back finger of the tippler when the weft fails. When the notch is worn, it may cease, or only occasionally hold the tippler, and the loom will then continue to run without weft. If so found, the slide has to be taken out and filed.

At M is the stop bolt which is in a short slot, and regulates the height of the weft prongs. This height above the shuttle front is about $\frac{3}{8}$th inch when the crank is at its back centre, and the square head of the bolt against the framework. On rare occasions the slide has to be taken out, and this is accomplished by liberating the rods attached, slackening out the framework, and unfixing the stop bolt. At N is the setscrew that secures the knock off peg rod to the slide.

Brake Rod.—(Fig. 225). Figs. 3 and 4 give the front and top view of this rod with its fittings. At A is the right angled casting which is bolted to the breast beam, and to this is attached the slotted brake rod bracket B which regulates the working length of the rod.

As this weft fork is suitable for narrow looms as well as wide ones, the working length of the rod is shorter for a crank sweep of five inches, and longer for one with a sweep of eight inches. Moreover, if a slower movement of the prongs is desired, bracket B is set nearer the going part, but if a quicker one is needed, then it is set nearer the breast beam.

The usual setting is to have the brake bracket parallel with the breast beam, and when the crank is at its back centre, to have the back end of the brake bush D within $\frac{1}{4}$ inch of the outer end of the brake leather E, which is

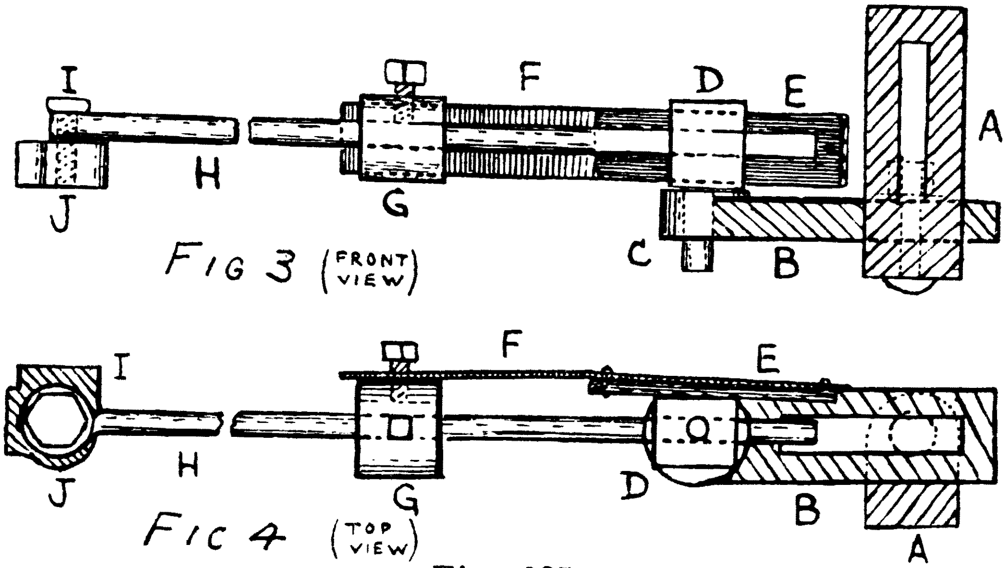


Fig. 225.
Hudson's Centre Weft Fork Brake Rod.

riveted to the flat spring F. At this pitch, the leg C, Fig. 3, on the brake bush D, should easily pass through the bore in the brake rod bracket B. When so set, there is little sliding movement with the brake leather during normal weaving, but as soon as the weft fails, then the notch seizes the back finger on the tippler, and as the going part continues to move forward, the brake rod is forced through the brake bush D for about an inch, and as this action also curtails the rod at the opposite end of the slide, the loom ceases to run. As soon as the weft supply is ready, the motion of the going part draws out the brake rod to its normal working length.

Brake Leather and Spring.—The highly tempered brake spring F is setscrewed to the rod collar G, the collar being setscrewed to the rod so the brake leather E at its outer end is only about $\frac{1}{4}$ inch beyond the brake bush D. The collar is also set so the depth of the spring is parallel with the side of the brake bush to give full power. The leather must be kept free from oil, for if soaked with lubricant, it will fail to grip the bush and be constantly slipping. The side pressure of the leather may be increased by bending the spring, but it is more reliable when straight. The pressure is weakened when the rod and bush bore become worn.

Extension Rod and Angle Finger.—The rod screw N (Fig. 224) couples the extension rod to the slide. This rod passes through the metal guides for the check strap, and at its outer end, has the knock-off peg bolted to it. This peg works in conjunction with an angle iron which is secured to the knock-off bar that passes in front of the setting-on handle. The angle finger may be vertically straight or cranked, but is set so it is missed by the knock-off peg when the loom is weaving, but is hit by it when the weft fails. The face of the peg has to be level, for if too much rounded off or slanting, it may touch, but slide off the angle finger and so fail in its function. The space between non-contact of the two parts is only small so that to preserve the distance, the setscrew J should be reasonably lubricated. An open spiral spring on the horizontal shaft of the angle finger is held and regulated by a suitable collar, and the stationary position of the finger is attained by a small one-armed lever on the shaft of the finger.

Hudson's First Pick Stop Brake Motion.—To weave rayon successfully, the special need is, that as soon as the weft fails, the loom has to be stopped before the cloth moves forward, and before the reed contacts with the cloth. Both ideas are efficiently carried out by the first pick brake stop motion invented by Mr. Irvin Hudson, Mansion Works, Great Horton, Bradford.

Pendulum and Slide.—These parts are at Fig. 226. At A is the adjustable connecting rod from the weft fork that screws into the slide B, the latter being kept in position by the metal bar C. The slide has a long slot, the part D being deeper than E. At D is the pin screwed to the pendulum

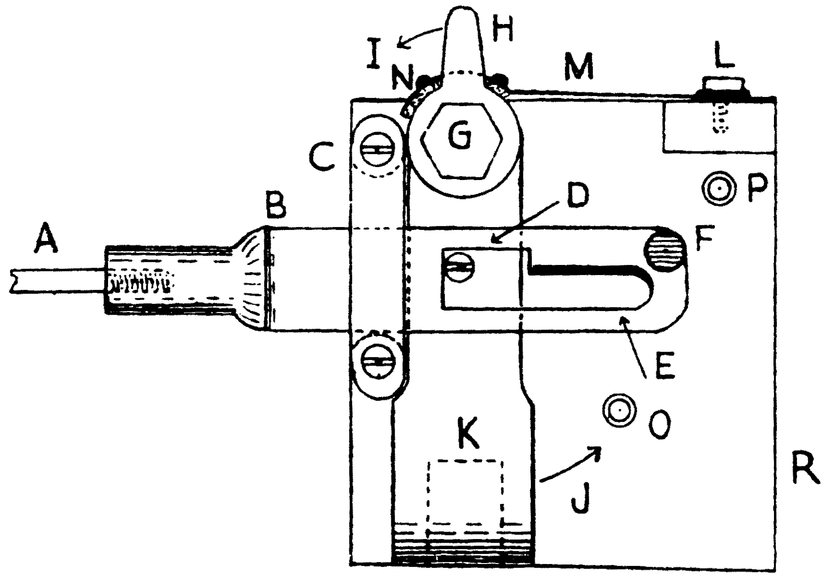


Fig. 226. Pendulum and Slide.

and fulcrumed at G. As shown, the pendulum is ready for pushing to the right by the slide, its lower part moving in the direction of arrow J, and the pointer at the top moving as arrow I. When pushed to its limit, the pendulum exposes the cut K in the going part, and into this a stop lever enters, and the loom continues to weave.

When the pendulum has to be drawn back, the pin D contacts with the right hand end of the upper cut, and at that end it remains when the slide has come to rest. For the slide to come to the position in the drawing, it moves the distance of the deep slot before it affects the pendulum, and this is equal to the distance the weft fork has to traverse from its highest position when the crank is at its back centre, to where the tippler is caught by the cut on the weft fork slide.

When the weft fails, the pendulum hardly moves, and the front bottom of it contacts with the stop lever, and the loom instantly stops.

To prevent excess movement of the pendulum, the spring M that is fixed at L, with its curved opposite end at N, and has a cork brake, applies sufficient pressure. The small knob at F, is used by the weaver to lift the slide above the pin, and make it enter the narrower part of the slot, and puts it out of action for one pick to prevent light places in the cloth.

The bores O and P are for fixing screws.

Brake Motion.—This is set forth at Fig. 227. A is the upper part of pendulum, and B the slide pin that gives it motion. C is the stop lever pivoted at D, and E is the upper part that meets the bottom of the pendulum when the weft fails.

F is the bar that is doubly setscrewed to the stop lever, and at its outer end, carries the locknutted setscrew, the head of which pushes off the set-on handle and stops the loom.

Below bar F is the head of a setscrew, and on it is placed one end of a closed spiral spring H. This draws the stop lever forward as soon as it is liberated. At the base of the stop lever C is the strong pin G that controls the slotted casting I, and the spring rod J.

Spring Rod.—The rod extends almost the whole width of the loom side. At the front, it is setscrewed to the the slotted casting I, and after passing through a bearer casting at the opposite end, its working length is fixed by the setscrewed collar P. It is this collar that controls the forward position of the stop lever C at its upper end E.

In the diagram, the crank is at its top centre. It is at this point in the crank's revolution that the tippler of the weft fork has stopped the progress of the slide, and has only stirred the pendulum A. It is now that the bottom of the pendulum meets the stop lever at E, and forces it back.

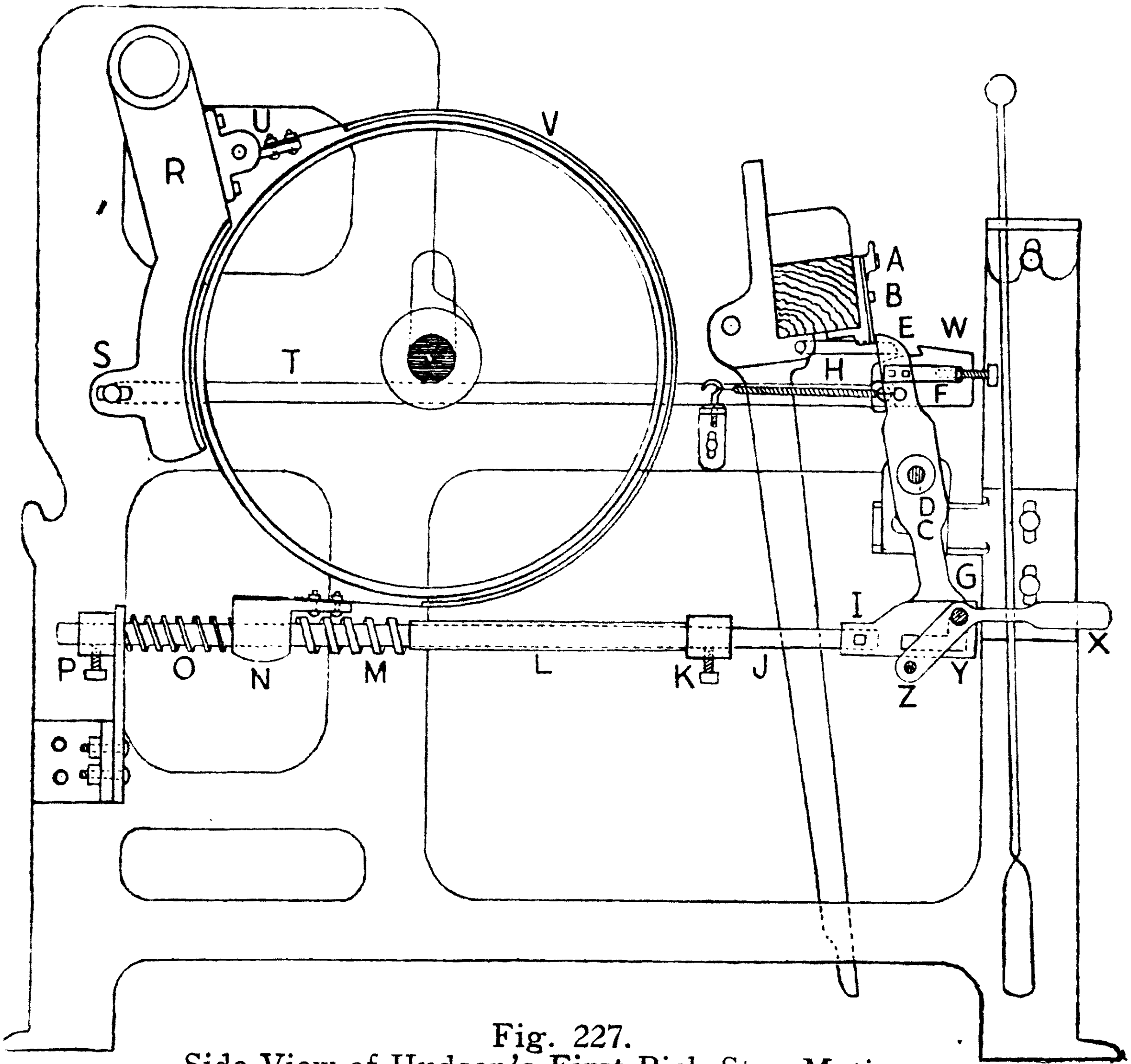


Fig. 227.
Side View of Hudson's First Pick Stop Motion.

In doing so, pin G applies pressure to the upper part of the slot in casting I, and forces the spring rod to the left. This applies the two brakes to the brake wheel.

On spring rod J is a second collar K that determines the amount of space between the inner lining of the brake band V, and the surface of the brake wheel. The nearer the brake band is set to the brake wheel, the quicker the brake is applied, and the sooner the loom is stopped.

A space from $\frac{3}{16}$ to $\frac{1}{4}$ inch is ample. Next the collar K is the bush L that meets spring M, and forces the brake band holder N forward and applies both brakes. Behind holder N is spring O which is much weaker than M, and acts as a cushion spring. Its other function is to put the brake band free of the brake wheel before weaving is resumed.

Ordinary Brake and Brake Band.—The ordinary brake is at R, and at S, the brake rod T is coupled to it. At its opposite end, it is attached to the frog W, and works in the ordinary way. To the upper front face of the ordinary brake R is setscrewed casting U, and on its stud the brake band is secured. The brake band is lined with leather, and supplies quite enough grip to the brake wheel. The two brakes cover two thirds of the surface of the brake wheel.

Measurements taken on a narrow Lancashire cotton loom reset for weaving rayon, showed that when the crank was at its top centre the reed was $7\frac{5}{8}$ inches from the front of the breast beam. When the loom stopped for weft failure the reed was $6\frac{1}{8}$ inches away from the front of the breast beam. The reed had only moved $1\frac{1}{2}$ inches. The stoppage is not a dead stop, and that is all the better for the cogs on the driving wheels. The distance between reed and cloth when the weft fails and the loom is automatically stopped may be increased or decreased by collar P.

Release Lever.—When the two brakes grip the brake wheel, the going part cannot be moved until brake pressure is removed. This is obtained by pushing down the release lever X. This elevates casting I by means of pin Z, and causes stud G to slide into the horizontal part of the slot at Y, and both brakes are removed.

If a part pick is in the open shed, it is pulled out, and the replenished shuttle is placed in the box last used for picking and sent across the loom by the picking strap. When the loom is set in motion, there is no light place in the fabric as the take-up motion has not acted. If from any cause the reed has reached the cloth fell when the loom stops, a delayed action by the weft fork is obtained by pushing the finger H to the left in Fig. 226. This ingenious mechanism has been widely adopted by rayon manufacturers.

ORME'S PICK COUNTERS.

A pick counter is a mechanical aid for registering the number of picks woven in an hour, a day, or week.

There are several ways of working it, but the worm motion is perhaps the most popular. For the dial there are three kinds, the simplest having one row of figures, another, two rows, and the other having three.

Fig. 228.
Messrs. George Orme's Single Pick Counter.

The first is adopted where a weaver has to attend to a group of looms usually of the automatic kind. The second is very useful for the two shift system, and the other for continuous running on weekdays. (Fig. 228).

General Construction.—The worm is placed on the tappet shaft on the outside of the loom, and is encased in a casting into which passes the shaft with a worm wheel at the bottom. The shaft is joined to the clock rod by a universal joint, which gives latitude for the fixing of the clock shaft to a part of the loom which is the freest from vibrations, the shaft being adjustable by locknuts. The first figure on the right is for units, whilst at the opposite end they indicate the 100 thousands. The six figured dial meets the need of practically every kind of loom down to the narrowest width and quickest speed.

Suppose the loom speed was 200 picks per minute, and the usual working week was for 48 hours, then if there were no stoppages at all, the loom could not make more than $200 \times 60 \times 48 = 576{,}000$ picks for the full week.

No loom ever gives the 100 per cent., and as the clock will register 900,000, there is an amplitude of margin.

Equity of Payment.—Payment for cotton weaving is based on the 100,000 picks, but for the broader looms, slower speed, and more costly cloths made from woollens and worsted, it is based on the 1,000 picks.

By this system, the weaver is paid for the work done up to the time of booking. Under the payment per piece, at times there is a considerable surplus for the following week, though some masters are considerate and pay for half pieces.

There can never be much doubt as to how much ought to be paid, and no suspicion on the weaver's part about weaving a longer length for the same money.

In occasional cases, where combing out has to be resorted to for getting rid of faulty places, the clock may register more picks than is actually in the cloth, but a difference in wages is only fractional. The system is equitable to both master and operative.

Reliability.—A pick counter like that made by the firm of Messrs. George Orme, of Oldham, as shown in the illustration is well made, and can be relied upon by the interested parties to make a faithful record. The record of an hour will give a basic calculation for a piece, or a series. A week's record, or a warp record can be preserved for comparison, and is an account for estimating the efficiency of the loom. The clockwork must not be tampered with, and the only person who should be allowed to set it or reset it is the overlooker.

Incentive.—An observant weaver soon knows what the loom is capable of doing as a maximum, and this is the goal of her daily endeavour. Higher figures mean more money. It is a check against gossiping and laziness, and also acts as a spur to the overlooker to keep every loom in a state of efficiency. The way to keep good weavers is to make it possible for them to have a good average wage.

Fig. 229.
Orme's Multiple Pick Counter.

Shift System.—If there be only two shifts, then the pick counter need not have more than two rows of figures. The mechanism for one set is put out of action to bring the other one into service. The latest development stamps a card, and has a special column for recording time for repairs, and standing for a fresh warp. The three lined dial is for the three shift system of 8 hours each. Each shift has then its own line and record. These counters are the most complicated and most expensive. At the end of the pay period, the records are taken off and the counters are set at zero.

Fig. 229 is for the two shift system, one set being put out of action to let the other operate.

ELECTRIC DRIVING of LOOMS.

Electric driving is the modern method of driving looms. As old factories and weaving sheds are modernised or replaced, the choice is increasingly for electric driving. There are three methods: (1) Line shaft drive (2) Group drive (3) Individual drive.

(1) *Main Group Drive*.—This method utilises one large motor, driving the main shafts either by direct coupling, or indirectly by means of belts, ropes, tex ropes, chains or gears. The looms are then driven from line shafting by the ordinary fast and loose pulley system. The line shaft drive gives concentrated power which is easily supervised.

As with steam engine drive, however, if anything goes wrong, the whole of the dependent machinery has to stand until repairs are completed.

Fig. 230 shows a 450 h.p. chain driven motor for a weaving shed containing 1,000 looms.

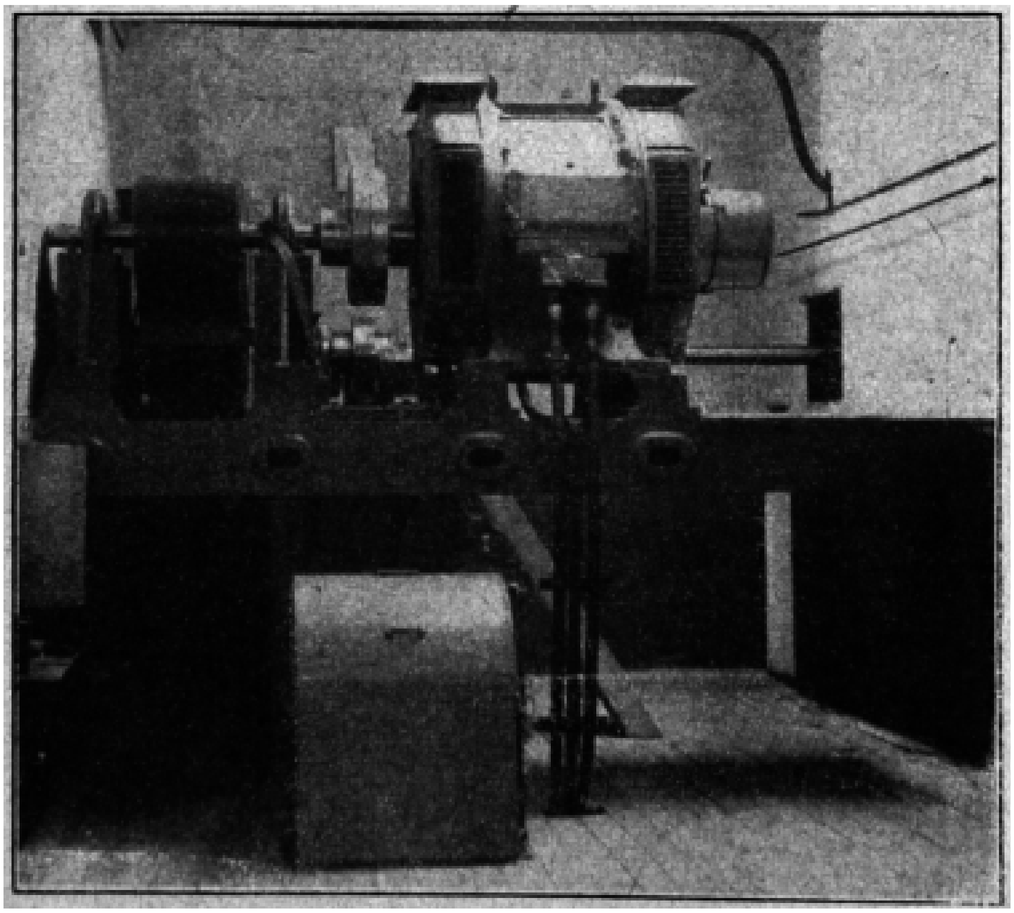


Fig. 230.
Metrovick Motor for Line Shaft Driving.

(2) *Sectional Group Driving.*—This is illustrated at Fig. 231. These motors are usually of the squirrel cage type, and are built to suit the speed required. The one shown is of 10 h.p. and runs 24 looms. It goes at 720 r.p.m., and the connection between motor and shaft is by laminated gears with staggered teeth. When looms are of light construction, this kind of driving is arranged to drive two cross shafts.

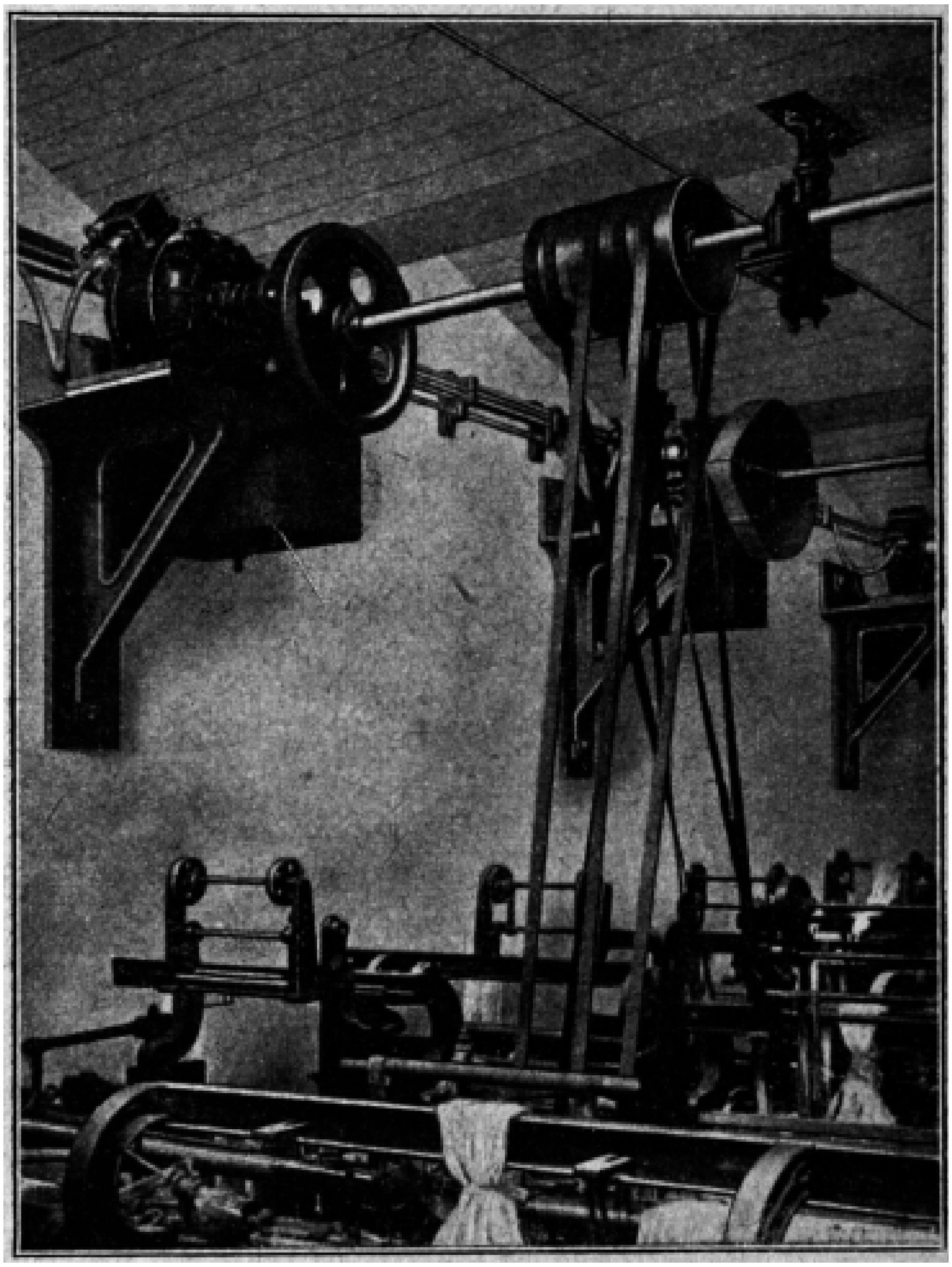


Fig. 231.
Metrovick 10 Horse Power Cross Shaft Motor Group Drive.

The motor is mounted between two shafts and connected to them by chains or vee ropes. This method of driving is often applied to an existing shed, which dispenses with main shaft and bevel gears, though line shafts and belts are required. Such an arrangement improves the lighting, and by considerably reducing vibration, repairs to the roof are decreased.

(3) *Individual Drive.*—The problem for constructing a motor suitable for driving a loom is a very complicated one. Some weaves have heavy and light lifts, then there is the power absorbing effect of picking, the intermittent beating up of the weft, and the different weights of cloth. There is the vital demand for a quick full speed from rest, and the sudden shock of the loom banging off.

In the more complicated looms, there is the additional weight of the rising of one or both boxes, and for the automatic loom, the swift changing of the bobbin. To bring out a motor that could adequately meet these conditions was nothing short of an engineering triumph. The individual drive is largely adopted for new sheds, and also for automatic looms which give better results than when driven from a line shaft. With this drive, all overhead shafting and belts are eliminated, better lighting is obtained, and the construction of a weaving shed is simplified.

Fig. 232 is one of Metrovick's squirrel cage motors of the L type totally enclosed and dust proof. On the left is the protruding shaft to take the driving pulley or pinion. This type of motor is made in five frame sizes, commencing with $\frac{1}{2}$ h.p., and advancing by a $\frac{1}{4}$ h.p up to $1\frac{1}{2}$ h.p. They run at 960 revolutions per minute, but if required they are run at 720 on 50 cycle units. Fig. 233, reveals the details of construction.

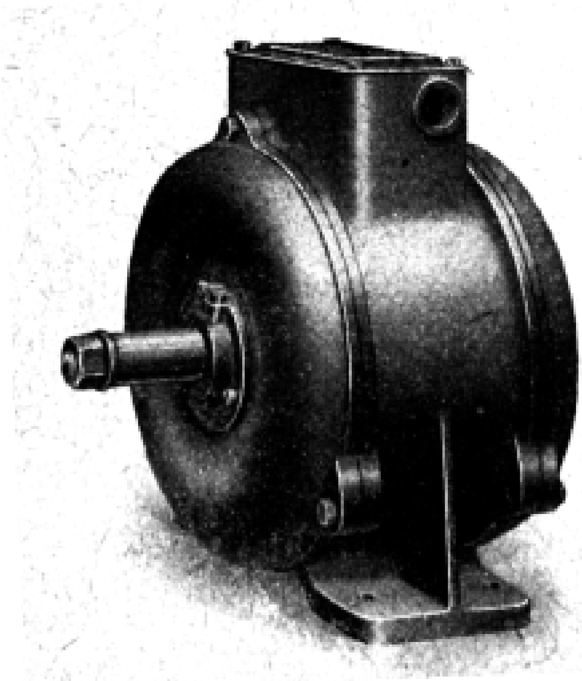


Fig. 232.
Metrovick Loom Motor (L Type)

1. This is the stator frame of cast iron with a machined spigot at each end that assists in ensuring concentricity with an accurate and uniform air gap.

2. The stator core is built up of laminations of specially low-loss steel rigidly held in the frame, and grooved on the inner periphery from the frame spigot.

3. The stator windings are wound with enamelled and cotton covered copper wire, with high insulation value that reduces the risk of breakdown between turns to a minimum. The windings are insulated from the core by a slot lining consisting of high grade insulating materials, and so arranged as to give the most electrical and mechanical strength. The stator windings are impregnated with insulating varnish to make them waterproof.

4. The terminal box is at the top of the frame and gives easy access to the terminals. It is bored for conduit at each end, the unused hole being fitted with a blank plug.

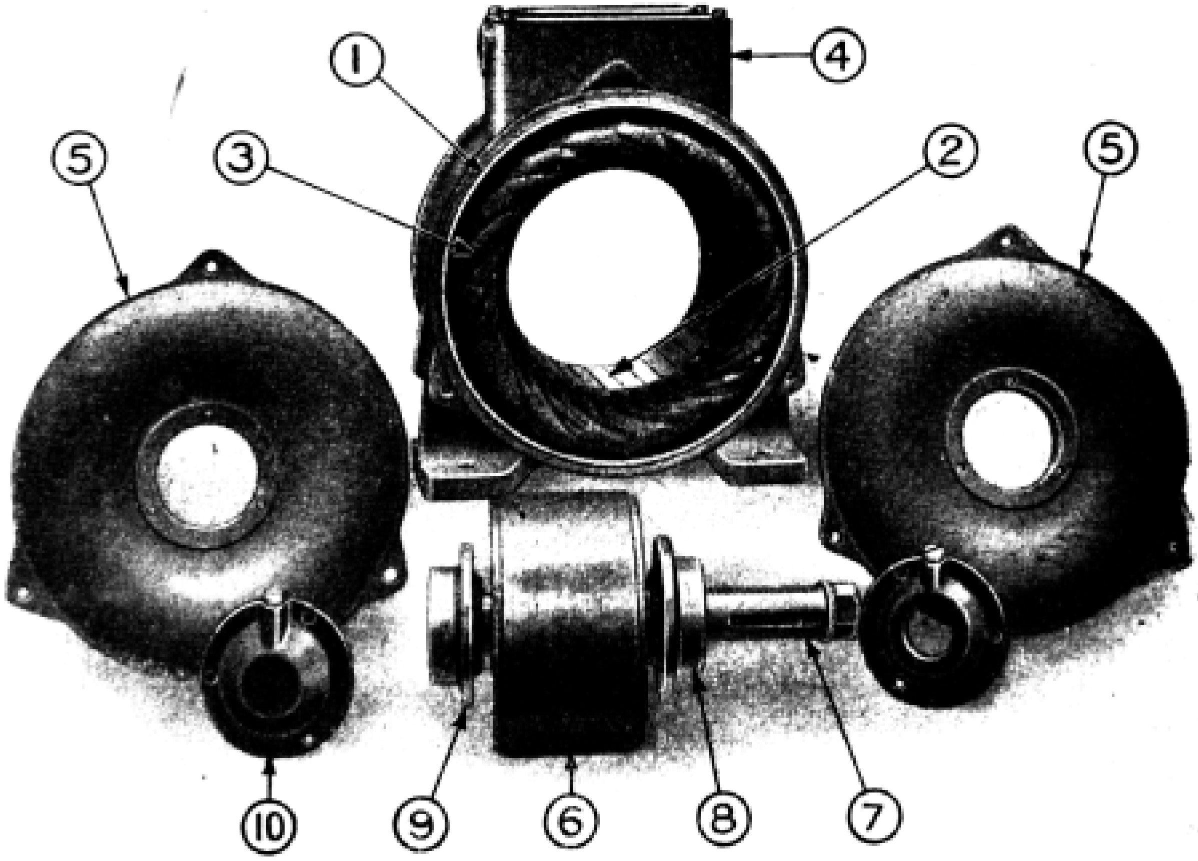


Fig. 233.
Metrovick's Component Parts of Type L Loom Motor.

5. There are shields at both ends. These are substantial castings spigoted into and bolted to the frame, and accurately machined to take the bearings and dust caps.

6. The rotor is of the cast aluminium type, the bars and end rings being cast in one piece by a patent process, thus eliminating joints, and making the motor almost indestructible. This construction supplies a rotor of small inertia and very suitable for running a loom. The rotor core is ground from its shaft after assembly, and ensures true running.

7. The shaft is of high grade steel, and large for the size of the machine. This gives strength where strength is most required.

8. Ball bearings are fitted at both ends. All bearings are lubricated by grease, and will run for long periods without attention.

9 and 10. These are the inner and outer dust caps respectively.

The three kinds of drive are by belt, pinion, and rope, the last named being the most popular.

The brass bushes which surround the motor shaft reduce friction to a minimum, and the steel pinion wheel is cut out of solid metal to give maximum strength to every tooth.

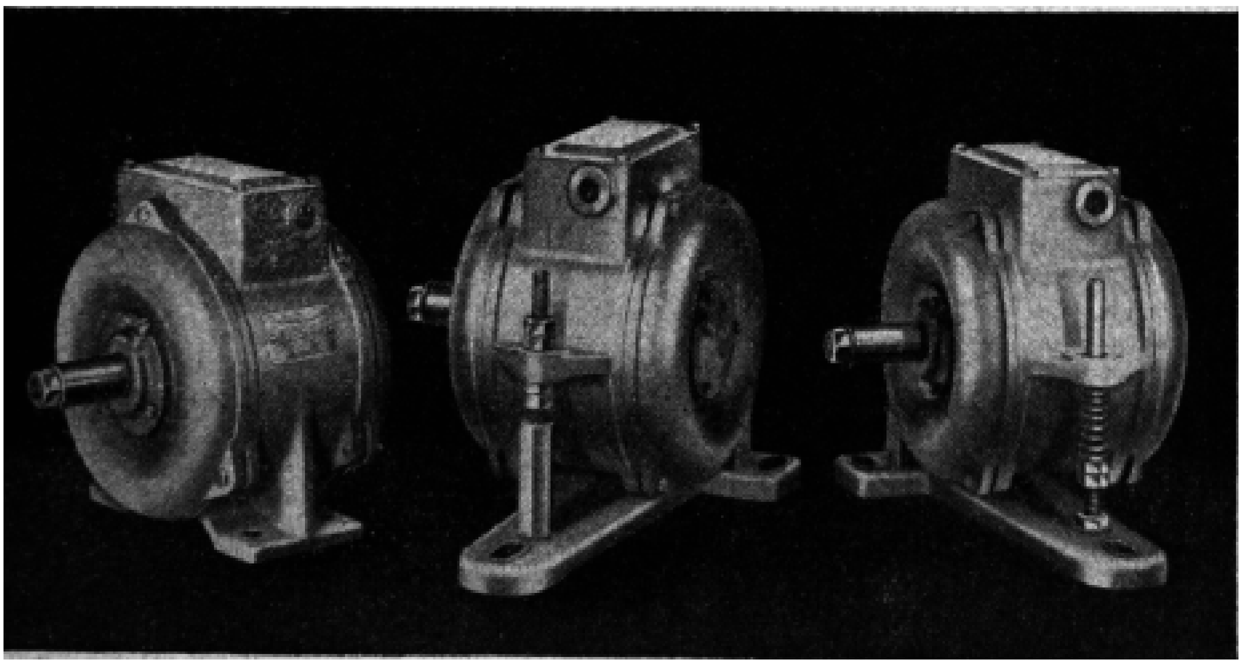


Fig. 234.

Metrovick Loom Motors for Individual Drive.

Back Motor Fittings.—Three of these are presented at Fig. 234. Each of them are of ½ h.p. for driving narrow looms. The driving medium is missing, but they may be fitted with sprocket wheels for chain driving, grooved pulleys for vee ropes, or plain pulleys for belts. The motors are totally enclosed so as to be kept free from dirt and fluff.

The temperature rise of these, and other standard motors do not exceed 35°C. above a surrounding air temperature of 30° C. This is extremely small, and to the decided advantage of the motor. The shafts are fitted with ball bearings which only require lubricating at long intervals.

Another interesting feature is the back fittings of the motors.

The one on the left has two bored feet for rigid fitting, but for alteration in case of a too slack belt. The centre one has a hinged base, and the one on the right a spring base, which are further explained.

Transmitting Power.—The power from a loom motor may be transmitted in four ways: (1) Belt, (2) Chain, (3) Gear, (4) Tex rope.

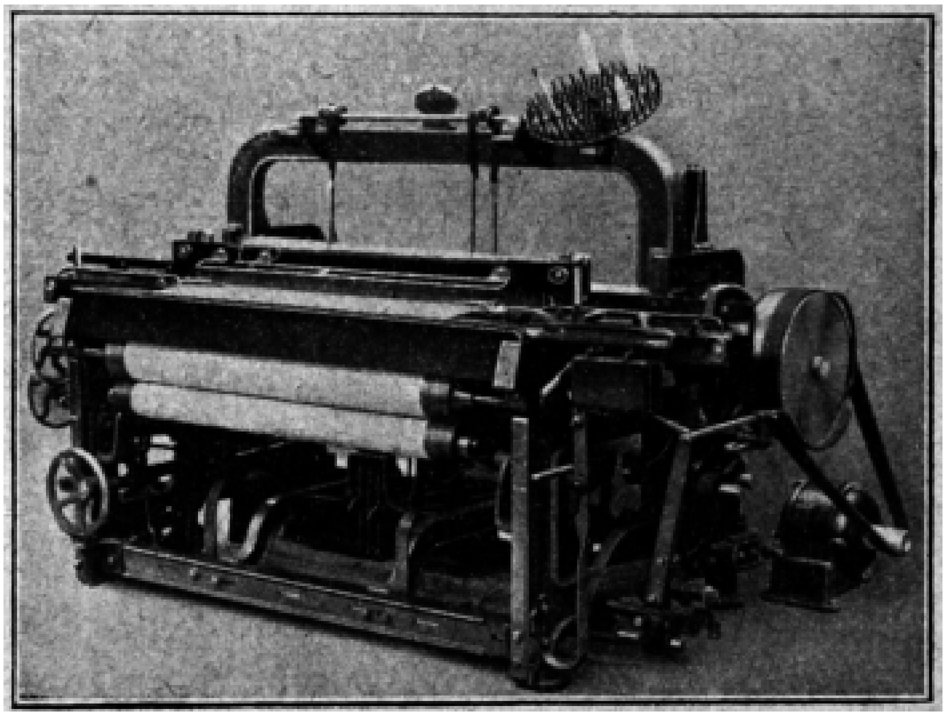


Fig. 235.
Metrovick Belt Drive for Linen Loom.

(1) Belt drive is demonstrated at Fig. 235. This is a linen loom of strong make for plain or twilled goods, but belt driving is equally applicable for other makes of looms weaving other kinds of yarns. When the motor has a spring base like the right hand motor in Fig. 234, it automatically maintains belt tension, but also allows the belt to slip when the loom is brought to a sudden stop. These short belts should be of the best quality, and of the stretchless kind.

(2) Chain driving is shown in Fig. 236. This is done by means of chain connection between a sprocket wheel on the motor shaft, and a large wheel on the crank shaft.

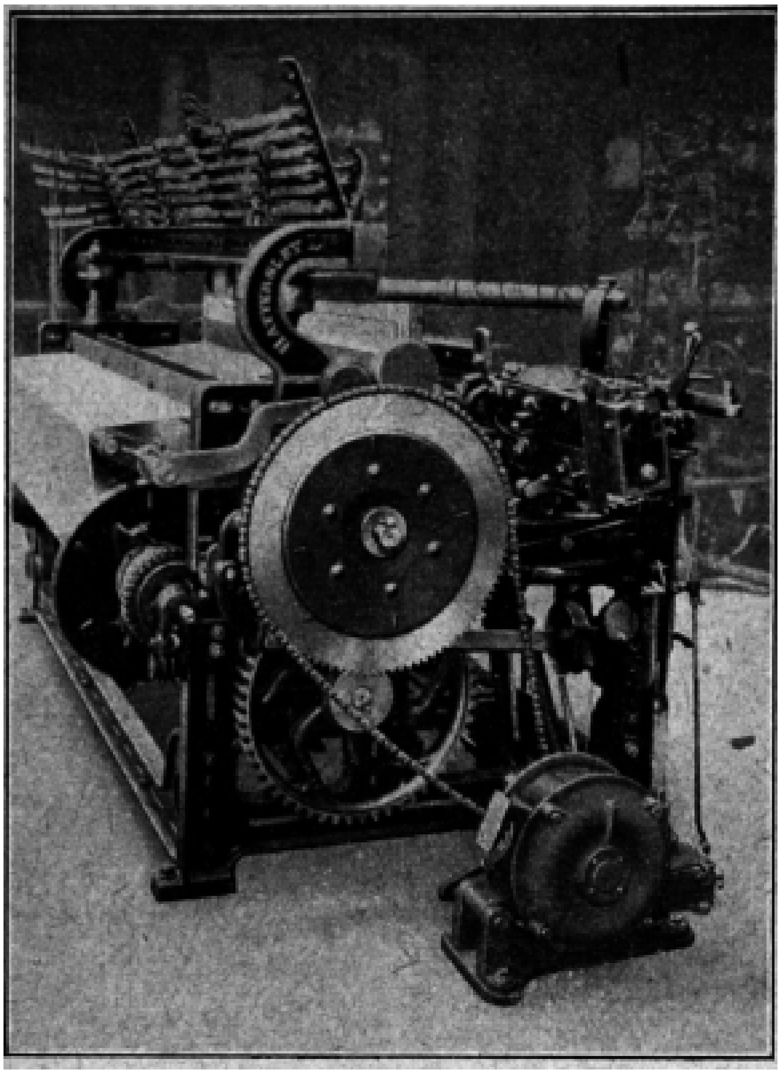


Fig. 236.
Metrovick Chain Drive for Hattersley Tappet Loom.

It is attached to a Hattersley tappet loom, the motor being started and stopped by the setting-on handle.

The motor is mounted on a hinged base, and chain adjustment is provided for by means of locknuts shown on the centre motor in Fig. 234.

The connection between motor and loom is positive, but in order to provide for a certain amount of slip when the loom bangs off, a special type of friction clutch is incorporated in the driven chain wheel.

This kind of drive is preferred in certain classes of silk goods. This is on account of the necessity of obtaining a good first pick when starting. When a loom is set in motion, the motor develops approximately 2½ times full load torque, and accelerates the loom up to speed very quickly. If, however, there is slip in the transmitting medium, part of the motor energy is wasted, the acceleration is slower, and on certain classes of goods, a setting-on mark is left in the finished cloth.

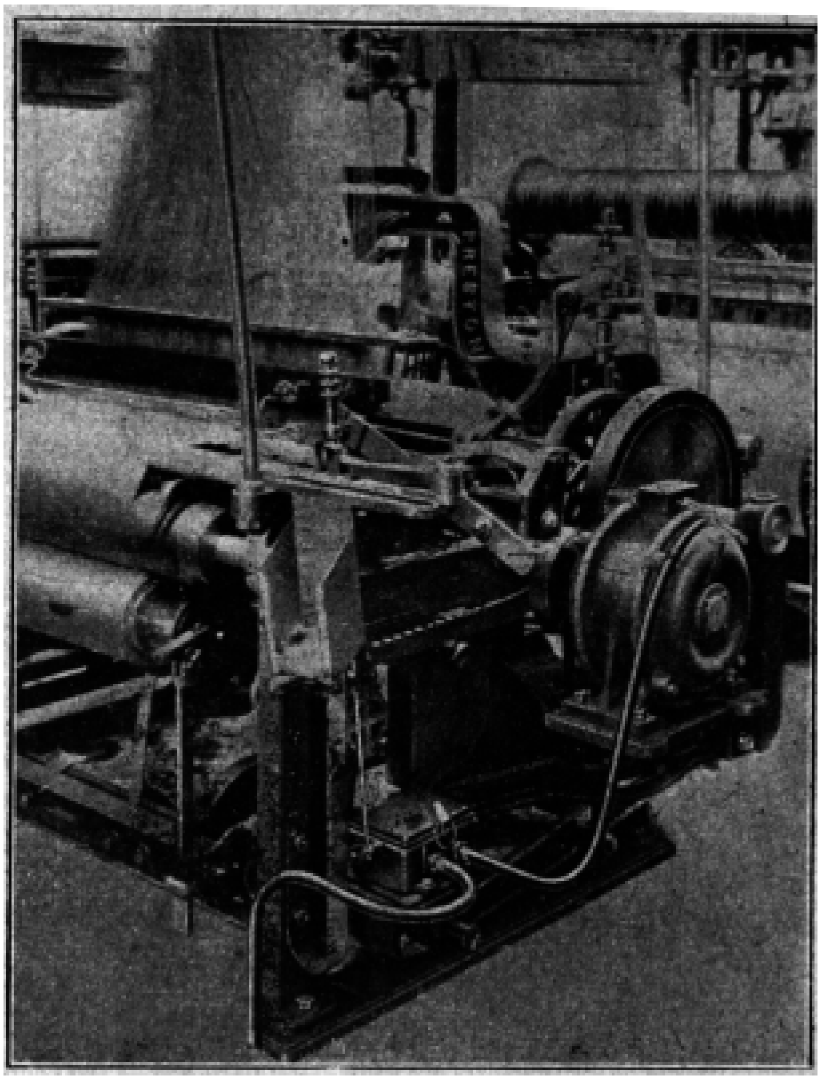


Fig. 237.
Metrovick Combination Clutch Gear Drive for Jacquard Loom.

(3) *Gear.*—The clutch gear drive is seen in Fig. **237**. It is more positive than belt drive, and much cleaner and safer than chain drive. It has a further advantage over the two previous examples, for it is mounted on the loom frame, so that the meshing of the cogs in the two wheels are constant. By the wheels being in direct contact with each other, it is the most positive drive of the three.

In the example given, it is used for a jacquard loom, but generally, it is only used for heavy or slow speed looms.

Loom Switches.—When individual drive is adopted, two methods of control are available.

(*a*) The motor may start and stop with the loom. When so arranged, the starting switch will have to operate several hundred times a day. For such a service, special switches are designed, having provision for lubricating the contacts to avoid mechanical wear. A typical switch is illustrated at Fig. 238.

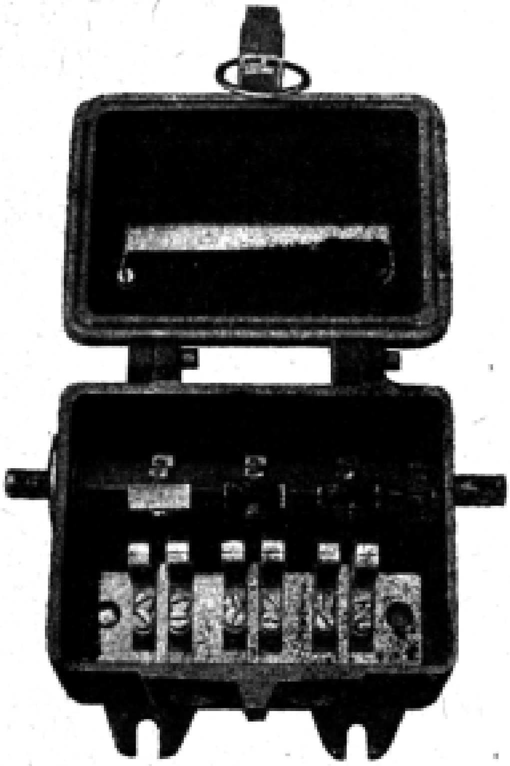


Fig. 238.
Metrovick Switch.

(*b*) The other method is to allow the motor to run continuously, the loom being started and stopped by means of a clutch operated by the starting handle. In this case, the starting gear for the motor is only brought into action occasionally, and so can consist of a single switch, or switch fuse which is operated by hand. Modern practice tends to this method for heavy looms and automatics.

(4) Though each of the three styles mentioned have certain advantages, the texrope drive is ahead of them all. It is an ideal drive for short centres. In Fig. 239 is shown as applied to two tappet looms. It will be noted there are only two ropes from motor to loom pulley, and this connection is sufficient to run the loom successfully. On some looms there are four ropes. If, after long service one of the ropes gives way, the loom can " carry on " until

a convenient time for repairs to be carried out. It is the invention of Messrs. Frank Wigglesworth & Co., Ltd., of Shipley, who are the original makers.

The belt cores are formed in accurately machined moulds and are endless. The outer wrapper prevents dirt from working into the cord section, and water has no detrimental effect upon it. What has to be avoided is oil, and as no lubricant is required, there is little fear of this accumulating. The working face of the rope is somewhat **V**-shaped at the sides, but is flat at top and bottom. The

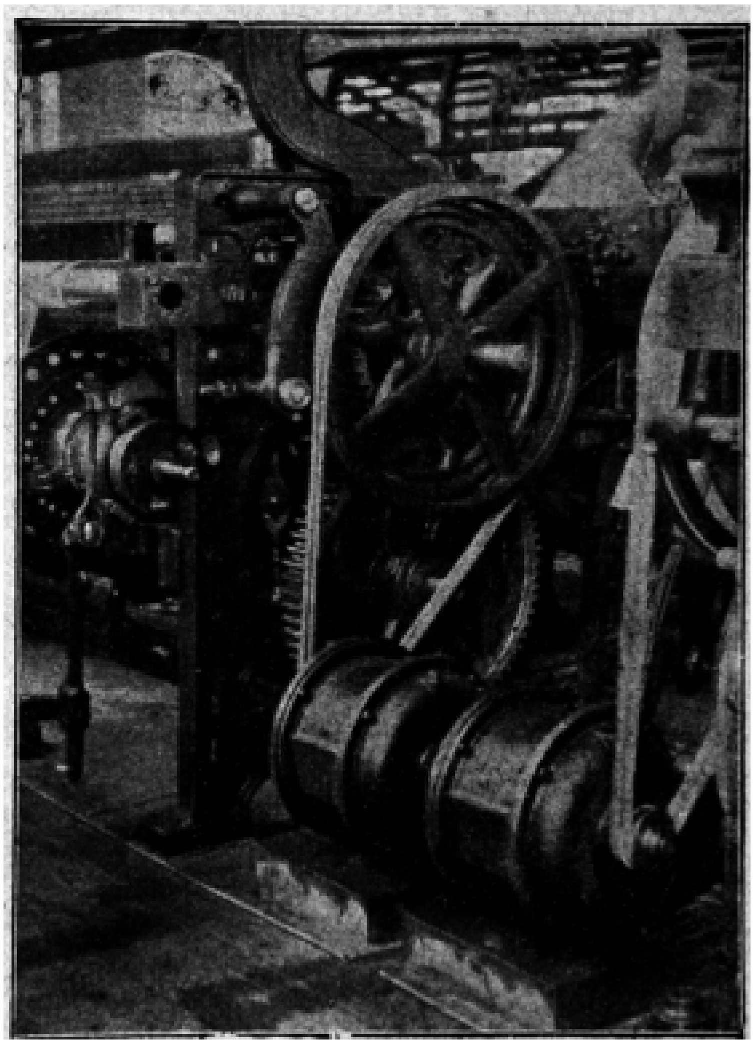


Fig. 239.

Wigglesworth's Texrope Driving for Looms.

rope does not fit body down to the pulleys, for the grooves in the pulleys are less than the rope, so the sides drive instead of the bottom. The drive is silent, and absorbs vibration and shock. It is a safe and simple transmission of power, and is quickly installed. It is applied to machines low as ¼ h.p., and as high as 2,000 h.p.

The grooved pulleys in which the ropes run are perfectly balanced, and are made to achieve a vibrationless movement. It is to this reliable seating for the ropes that assists in giving long service.

Fig. 240' presents another type of motor for tappet looms. At the back, it will be observed that the motor case is fitted with a rod that passes through a bore, is threaded at either end, and a strong spring is placed at either side of the

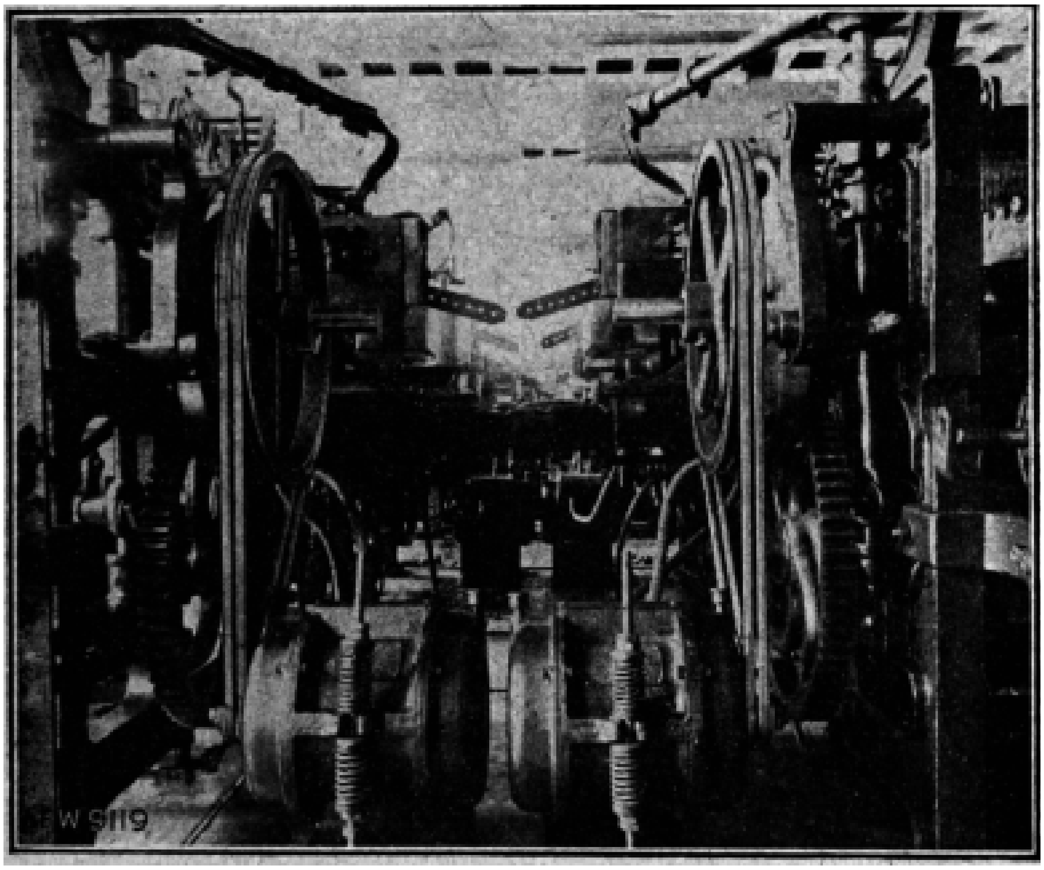


Fig. 240.
Wigglesworth's Texrope Drive for Tappet Looms.

bore. The strength of the two springs is secured by locknuts. This method is superior to a rigid motor, for when the loom knocks off, the shock of the quick stop is mainly absorbed by the springs, whereas with a rigid motor, it has to be taken by the tex ropes which are driven deeper into the grooves of the driving pulleys.

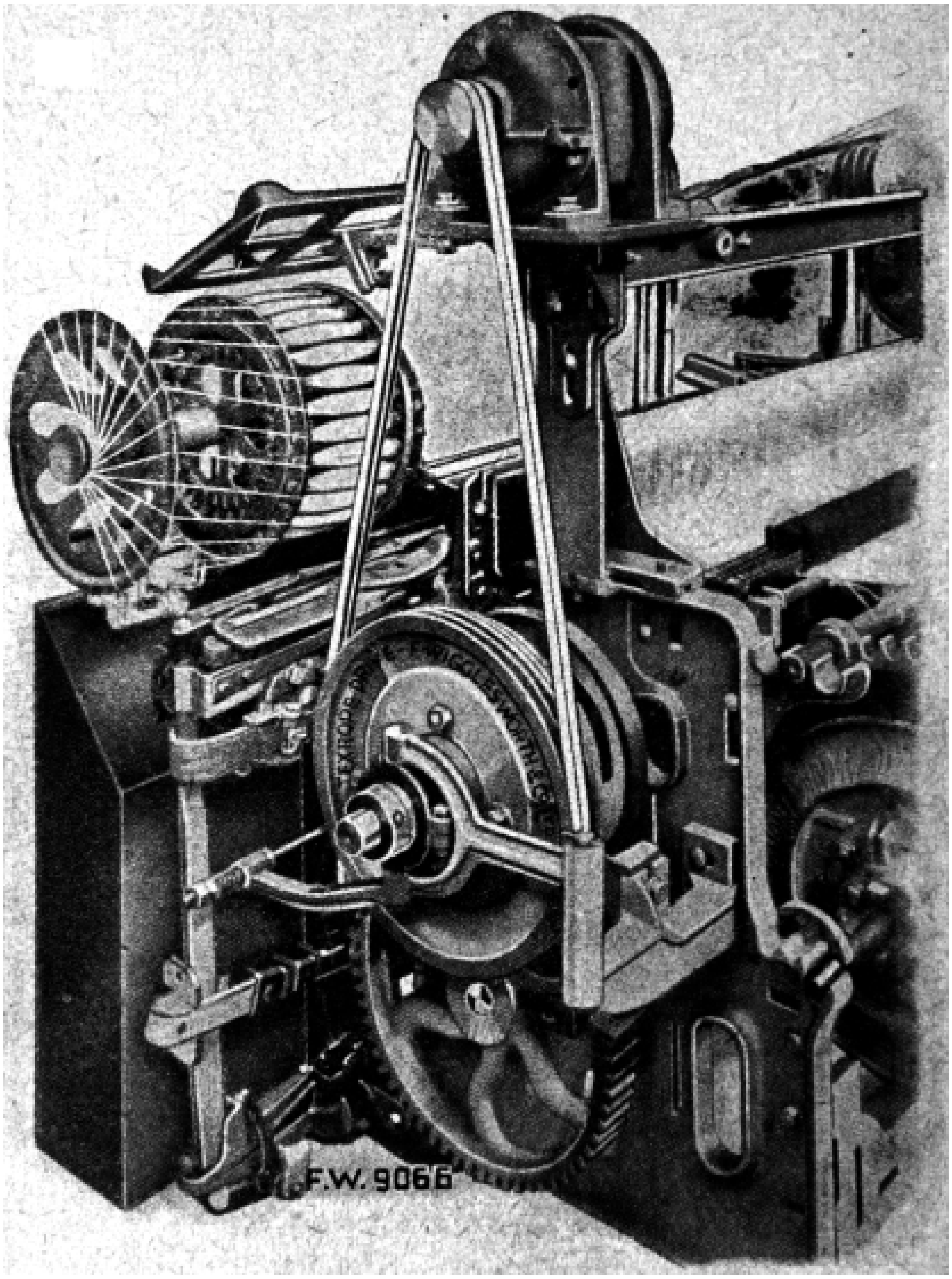


Fig. 241.
Wigglesworth's Texrope Drive for ¾ Horse Power Northrop Automatic Loom.

In Fig. 241, the texrope drive is applied to the Northrop loom, and here again, only two ropes are used. As the Northrop loom is heavier than ordinary, and as the bobbin changing has to be carried out in the fraction of a second, it speaks well for the constancy and power of the texrope drive when it runs such a loom successfully.

It is superseding the chain drive because it is cleaner, cheaper, noiseless, less dangerous and unaffected by dust and fluff.

The firm of Messrs. Mather and Platt's, of Manchester, are another firm who have made a special study of the requirements for spinning and weaving. Their first instalment was erected over 45 years ago, and since then they have supplied plant totalling over a quarter million horse power.

Fig. 242 gives one style of electrical motor driving for a weaving shed. The motors are mounted for group driving outside the weaving shed, and two line shafts are driven

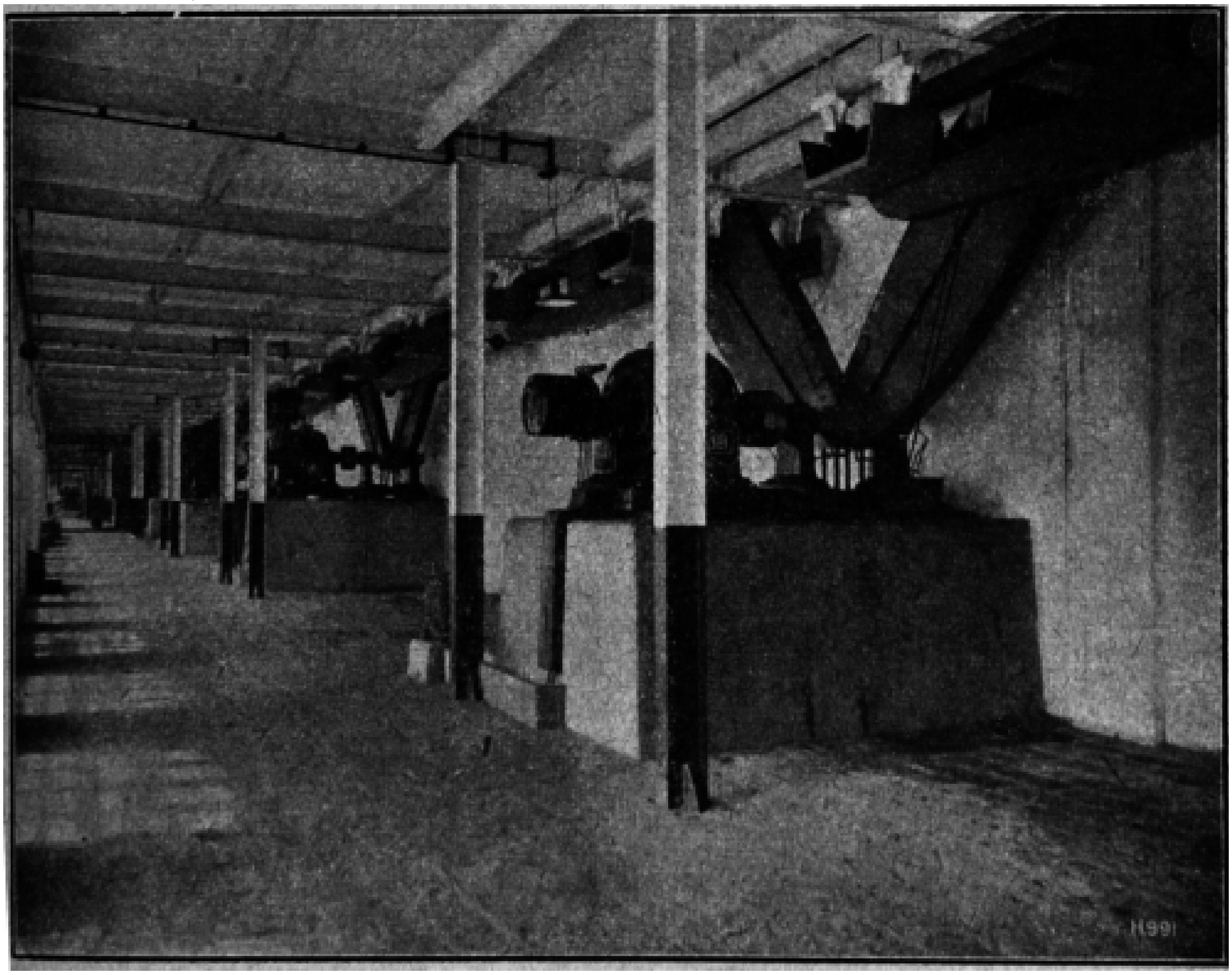


Fig. 242.
Mather and Platt's Motor Alley Way. Chain Gearing for Weaving Shed.

by the same motor. The motor is coupled by link chains to sprocket wheels on the mill shaft, and in this way, the motor speed is transmitted without slipping. As the chains are run in oil, the the wearing of them is brought to a minimum, and the noise considerably deadened.

By being outside the weaving shed, any surplus lubrication has no chance of getting near looms or fabrics.

Further, the motors are built to the horse power and speed suitable for the work they have to do. In case of repairs after a long period of service, only one section of the weaving shed is affected.

Fig. 243 presents another kind of group driving. In this example, each line shaft has its own motor inside the weaving shed. The looms are weaving heavy goods by the aid of Woodcroft tappets.

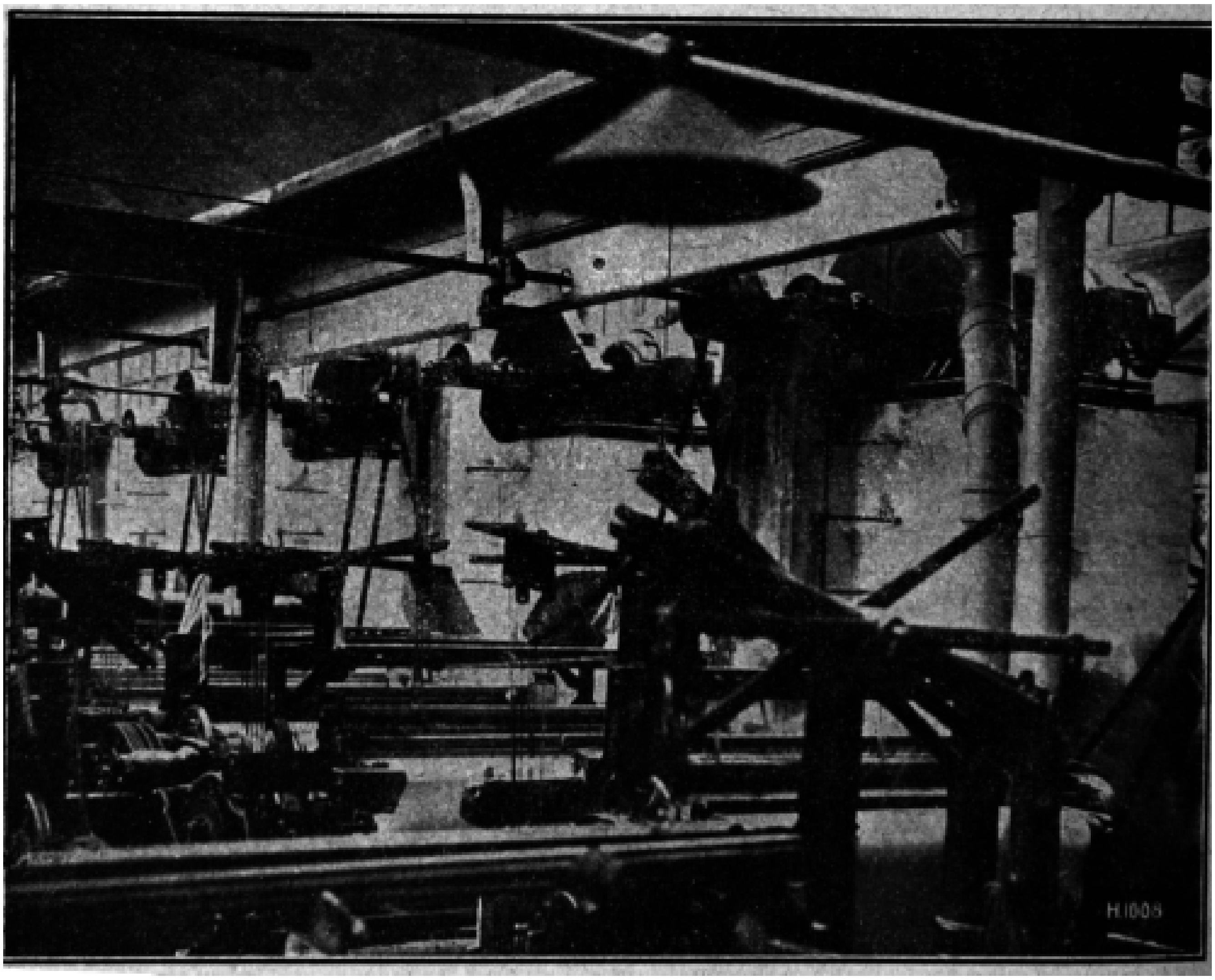


Fig. 243.
Weaving Shed run by Mather and Platt's Electric Motors.

Fig. 244 gives a fine view of the individual drive, each loom being independent.

More floor space is taken up with this arrangement, but the horse power of each motor is in accord with the requirements of the individual loom. Wide looms with heavy work, demand more power than narrow looms weaving light weight goods.

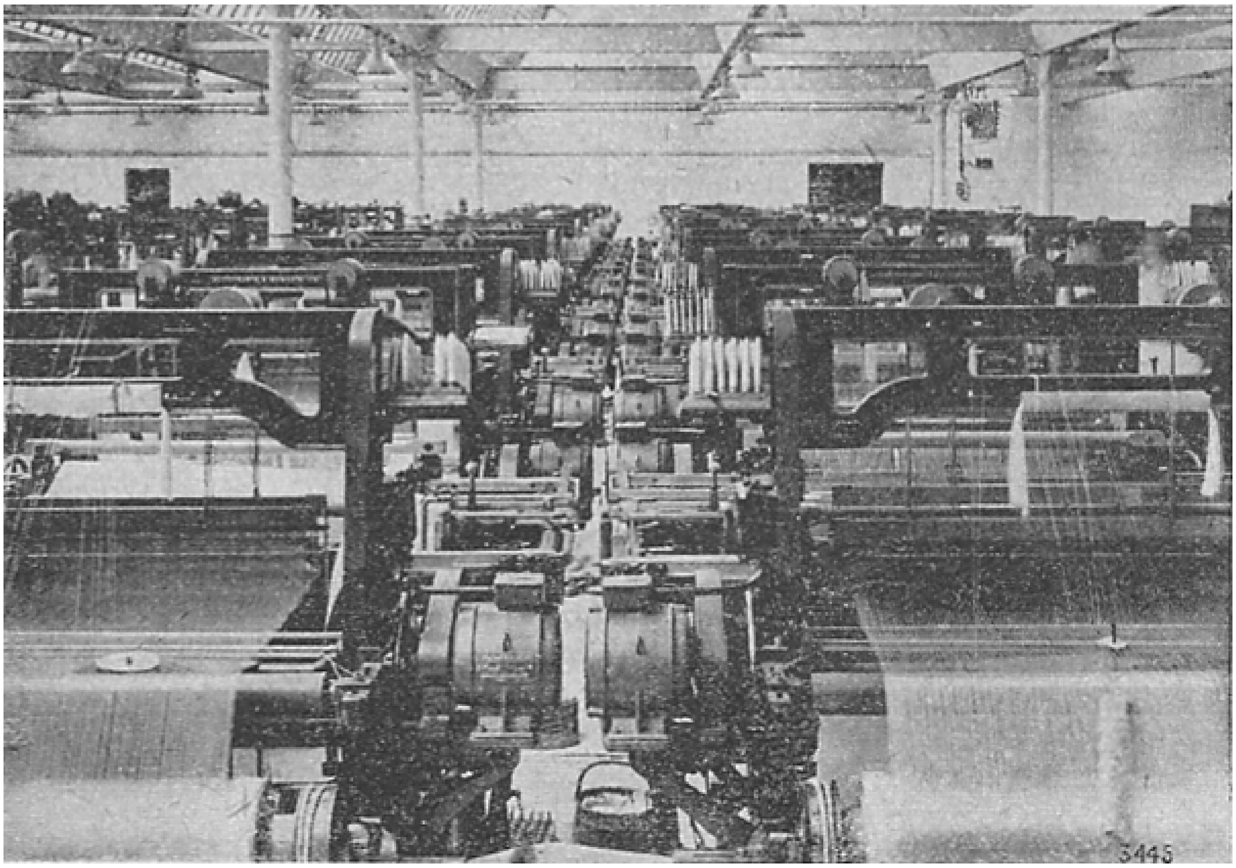


Fig. 244.
Mather and Platt's Individual Drive on Butterworth and Dickinson Looms.

The two rows of looms shown are by Butterworth and Dickinson of Burnley.

In this arrangement, the looms are gear driven, the wheels being guarded by sheet iron.

Here again, no slipping can take place, but it is a wise precaution in case of knocking off, to see that the loom brake is in the best condition. This greatly assists in diminishing the shock to the driving wheels.

PROBLEMS OF THE LOOM.

Whatever kind of loom or looms a weaving overlooker has to manage, fresh problems arise almost every day, and these can only be overcome by patient investigation, keen observation, commendable experiment, and the spirit of determination to master difficulties. Where several overlookers are employed, one may assist another in perplexity, but to obtain self reliance, every problem has to be fought to a finish. The following defects which develop during weaving are amongst the many things a weaving overlooker has to tackle.

Power looms are constructed so that certain parts can be altered to the requirements of different kinds of warp and weft.

Timing the Shed.—Fig. 245 illustrates the cycle of the crank by arrow A, and the theoretical timing of the shafts on the half dwell principle. B is the crank shaft, which is at its back centre C. D is top centre; E front centre; F bottom centre. Each quarter of the cycle is divided into eight equal parts at H, and its full traverse at G. The shed begins to change when the crank is at its top centre at D, and has fully changed at bottom centre F. The change takes place between I and J. The half circle formed by the two quarters K and L are for the shuttle to pass through the shed. This kind of timing is very seldom used in the weaving shed.

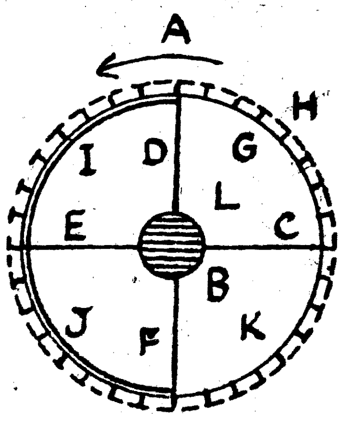


Fig. 245.
Theoretical Timing.

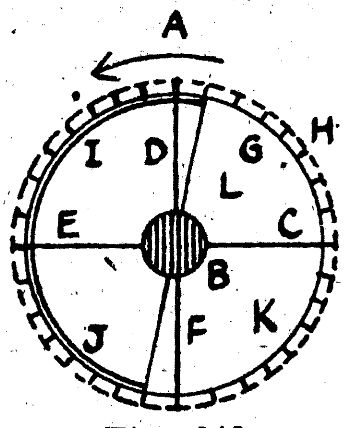


Fig. 246.
Late Timing of Shed.

Late Timing.—This is at Fig. 246. Timing for any kind of warp is limited to rather less than a quarter of the crank's cycle at C and D. In this case, the crank moves seven points in the quarter circle before the shaft begins to change and is therefore late timing. It is very suitable for poor quality warps, because much less friction is placed on the warp when beating up the weft, for the threads are only slightly crossed when the reed is in contact with the cloth. Useful for plain cloth weaving, and for weaves with quick changes such as warp and weft ribs and hopsacks.

Ordinary Timing.—It is named " ordinary " timing because it is applicable for many fabrics, that have gradual shaft changes.

Most worsteds have a clear cut finish, to show weave and colour, and this is obtained by the shed being timed soon, or moderately soon along with good tension. Moderately soon is the central position between late and early timing as in Fig. 247. The lettering in all four diagrams are alike. By the shafts changing earlier, the threads are well crossed before the crank reaches its front centre at E. This prevents the weft springing back after the beat up and is done in the space I and J.

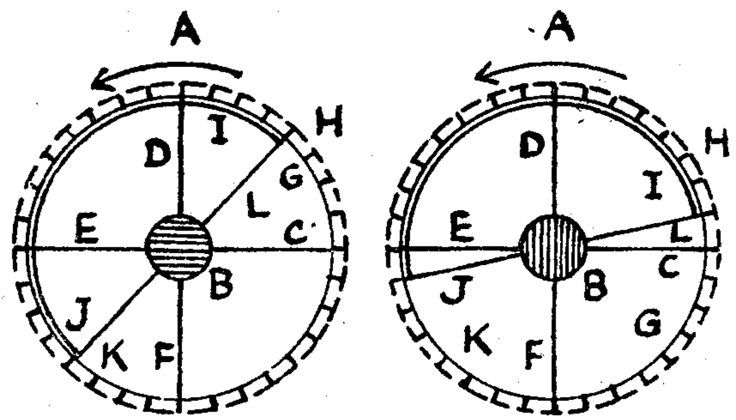


Fig. 247. Ordinary Timing. Fig. 248 Early Timing.

Early Timing.—By making the shafts change soon after the crank leaves its back centre, at C, in Fig. 248, the weft is trapped earlier, and is well held at the beat up by the crossed threads. Without such early timing, cloths like corkscrews could not be woven with satisfaction, for the face of the cloth would have numerous curls.

How Timing is Altered.—This is demonstrated at Fig. 249 and is a six shaft weave in a tappet loom. The crank shaft is at A, and B the timing wheel held by setscrews C and D. F is the balance wheel keyed to the crank shaft, and moves as inside arrow. G and H are intermediate wheels cast together, and connect timing wheel B to tappet wheel N on low shaft J. The intermediates follow arrow I.

If shed has to be timed sooner, timing wheel B and intermediate wheel G are blocked at the top, and setscrews C and D are unloosed. The balance wheel is then turned as at arrow M, the setscrews refixed, and the blocking material removed.

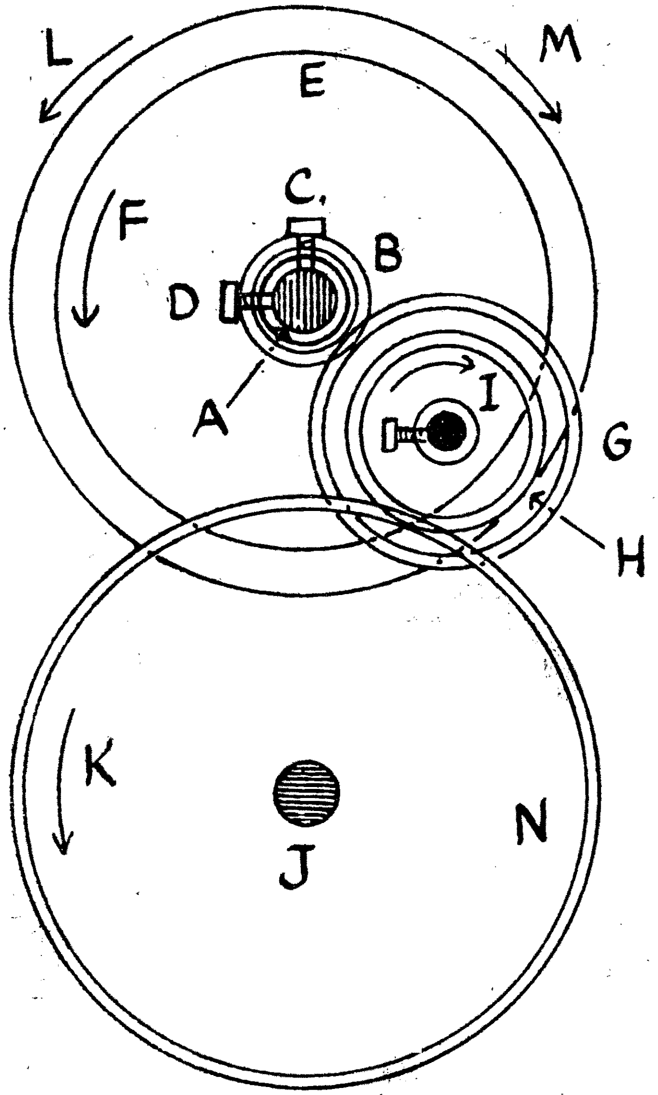


Fig. 249. Altering Shed Timing.

If the shed has to be timed later, the balance wheel is turned as at L. Before commencing to weave, the balance wheel should be turned slowly to judge the timing.

Negative dobby timing is illustrated in chapter " Faults in Fabrics," under sub-head " Curls."

Positive Dobby Shedding.—The diagram at Fig. 250 is a Hattersley positive dobby with eccentric wheels. A is the small timing wheel on low shaft B. It is a double wheel, for bevel wheel C meshes with bevels on the take-up shaft. The small eccentric A works with the large eccentric F on stud E, the movements being as arrows D and G.

On the upper front, bevel F has two slots, each being at an equal distance from the centre line H. To one of these slots, the bottom of the shedding rod is bolted. If fixed at J, the shed is timed sooner, but if at I, it is later. This makes a difference of six cogs, and as the wheel F has 60 teeth, and represents two picks, the difference of six cogs are equal to a quarter of the cogs used for a single pick.

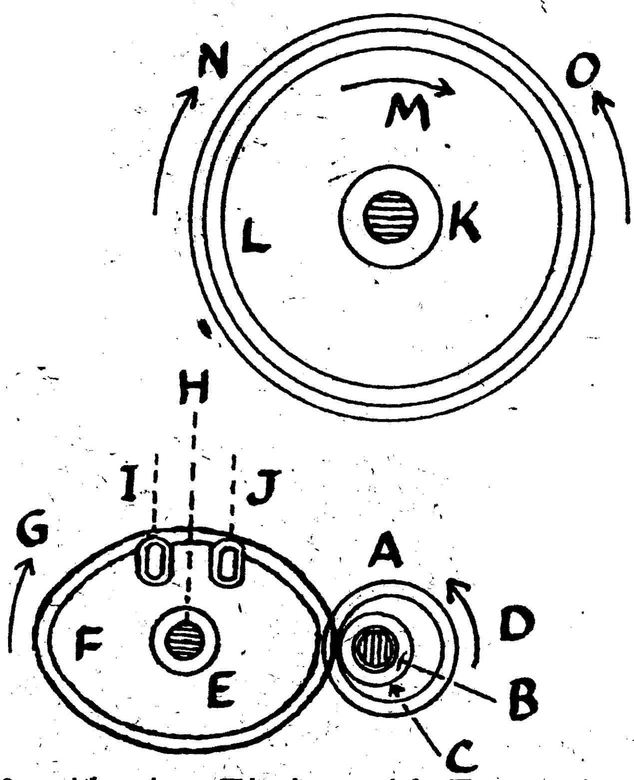


Fig. 250. Altering Timing with Eccentric Wheels.

The two slots indicate early and late timing, without recourse to timing wheel A. If neither of the slots produce what is required, then the timing wheel supplies the means. The balance wheel L is keyed to crank shaft K and turns as arrow M.

To make the alteration safely, the slots should be at the bottom to prevent the wheel slipping, and the eccentrics blocked top and bottom. The setscrews for eccentric A are then unloosed. If the timing has to be earlier, the balance wheel is turned back as at O, but if later, it is turned forward as at N.

Though the eccentric wheels allow more dwell to the shed, the shafts change more rapidly than when circular driving wheels run the loom.

Dobcross Timing.—The Dobcross crank moves bottom half first towards loom front, and therefore anti-clockwise, In Fig. 251 the timing wheel is at D on crank shaft A, and held by setscrews B and C. When timing is moderately soon, it will weave most warps without further alterations.

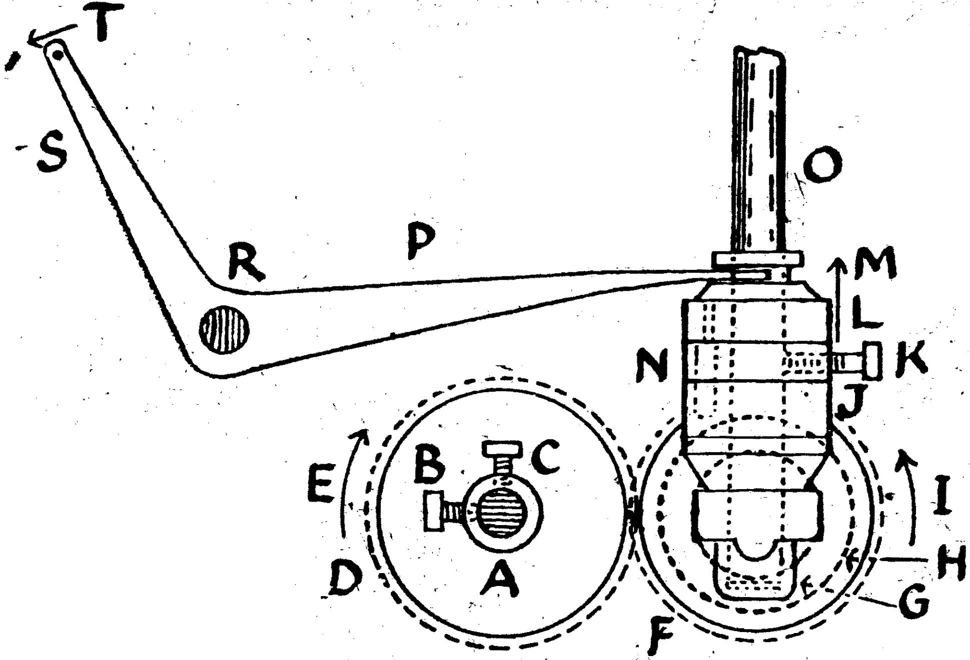


Fig. 251.
Dobcross Timing.

If the shed is required sooner, the driving wheels are blocked, setscrews B and C unloosed, and the balance wheel turned towards the loom front. If later, it is turned away from the loom front.

Jacquard Timing.—See Jacquard loom.

Knocking-Off—Causes.

The sudden stoppage of the loom may be brought about by a large number of causes. What is first looked for is some defect at that end of the loom from which the shuttle made its last traverse. In the overpick, it is the picking strap that is first tried for pitch, for it ought to begin to move the shuttle out of the box when the crank is at its bottom centre. If later, then the strap may need tightening up, but the picking stick may be loose, or the shell have shifted. The weaver regulates the strap, but the overlooker attends to loom parts. The first thing the overlooker does as a rule is to try the strap, but if at the right pitch, he draws the going part forward to examine the stop rod tongue in relation to the frog. The parts are shown at Fig. 252. The crank B is at its top centre, and the stop rod tongue G is almost in contact with the frog M. When the shuttle is fully in the box, the tongue should clear the top of the frog a good ⅛th of an inch. There are two things to attain it. (1) The box side L may be slackened and

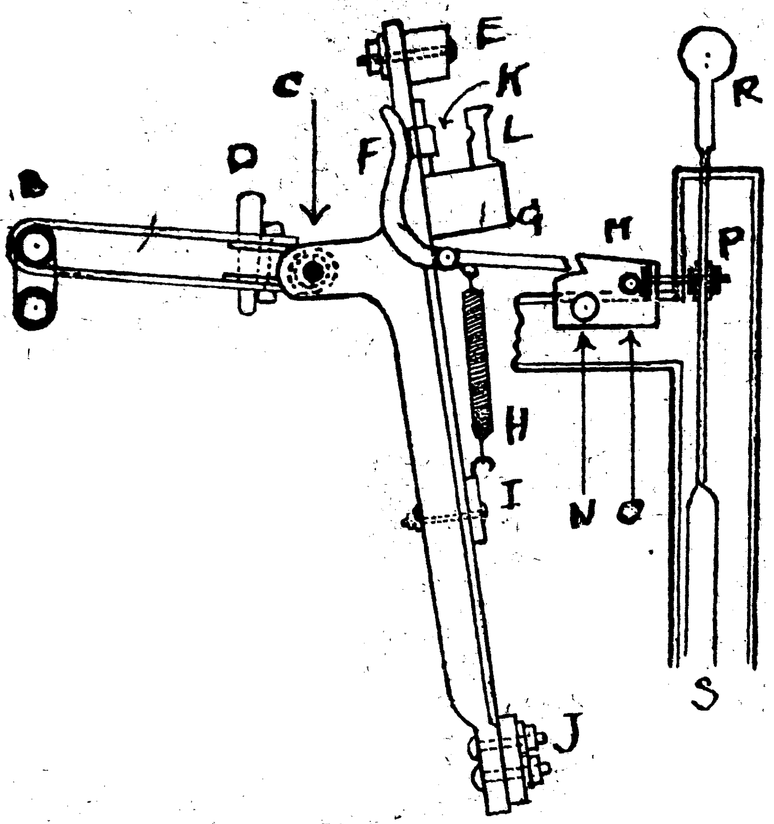


Fig. 252.
Sword and Frog.

pushed in a little, for this will force back the box swell K rather more, and lift the tongue higher. (2) The box swell finger F may be too far away from the head of the box swell, and may require resetting. It should be pressing against the swell when the tongue is at the bottom of the cut on the frog. These two points need supplementing. (3) The closed spiral spring H connects the hook on the stop rod with the casting I bolted to the sword. The spring should have sufficient power to prevent any rebounding after the shuttle has entered the box. To aid it, a regulation strap is fixed behind the box swell finger F so as to give only slight play to the finger when the shuttle is fully in the box.

The sudden knocking-off of the loom may crack the cast iron bushes on the sword pin at C. A very valuable aid for the safety of the loom is to have the cranked knocking-off bolt P in contact with the finger O on the frog when the setting on handle R is in its weaving notch. As soon as the frog M is forced forward by the tongue G coming in contact with it, the setting on handle is forced off. At N is the circular projection for the brake rod. At E is the hand rail, and S is the lower part of the setting on handle. If the picking shell A, Fig. 258 has shifted, it can be immediately discovered by turning the loom over, for if the strap is found to be the right length, and the stick is secure, and the timing late, it is a good indication. To reset, the crank is placed just a little in advance of its bottom centre, and the picker is then lashed to the outer end of the box. The shell is then slackened, and pulled forward to its limit. Each of the four holding bolts are tightened up a little at a time to achieve a uniform pressure

If the pick has become too weak at one end of the loom, the shuttle emerges sluggishly from the shed. The power of the pick may be increased by deepening the curve of the nose, or by a new one, the nose being at B, Fig. 258.

A loose box front, a broken buckle, a cracked picker, or worn out leather or spring that returns the picking shaft after picking are contributory causes that make the loom bang off.

Knocking-Off—Effects.

Some looms are much more sensitive than others, but the less any loom comes to sudden stoppages and the better. The chief effects of the loom banging-off are here detailed.

(1) *Rising of sword.*—As the fulcrum of the stop rod tongue in most looms is above that of the frog, the tendency of sword is to move upward by the sudden impact. If this takes place, and an early discovery fails to be made, a serious shuttle trap is likely to occur the first time the

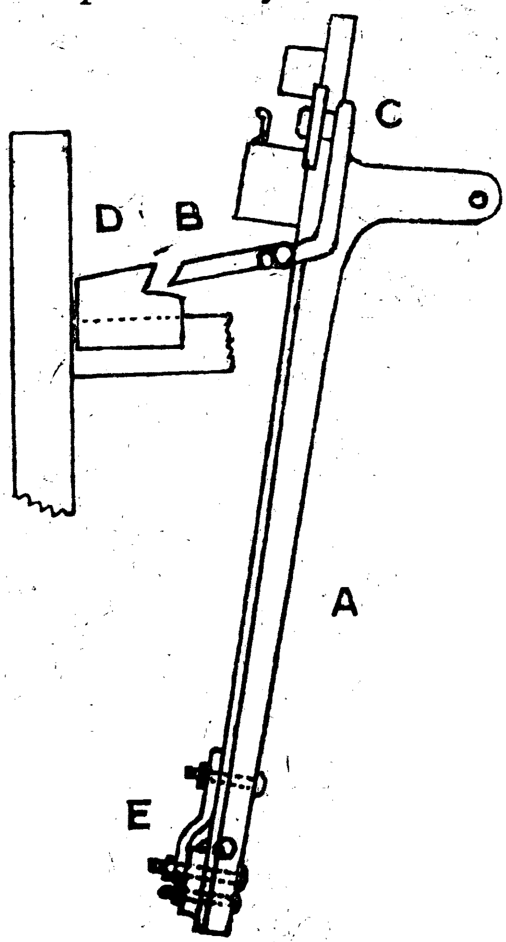


Fig. 253.
Preventing Rising of Loom Sword.

shuttle is trapped in the shed. If the sword is subject to this complaint, steps have to be taken to stop it. A small block of wood may be placed underneath the bottom bolt in the sword foot. A more effective plan is given at Fig. 253. At A is the sword, and B the stop rod tongue, and C the box swell finger. The part D is the fast frog which rests against the front part of the loom frame. The sword foot is at E, and it is here where the alteration is made. A flat wrought iron bar is bent and bored so as to take the top bolt in the sword foot and another bolt that fits through the bottom of the first available slot in the sword. This makes the sword incapable of rising, and, so long as the brake motion is in order, there is no increase of danger.

(2) *Broken Sword.*—In the majority of looms, the stop rod tongue B, Fig. 253, is on the outside of the sword A, so that when the loom comes to a sudden stop, the sword is subject to torsion strain. If the twisting effect is excessive, it may break the sword at the upper end of slot A, Fig. 254 on one side, and the lower end of slot B on the other. The broken sword may be plated with wrought iron back and front, but the more desirable thing is to prevent breakage. The special points are:—(1) To remove the driving belt as speedily as possible from the fast to the loose pulley, (2) To have the brake in the best possible condition. (*See* Fig. 189).

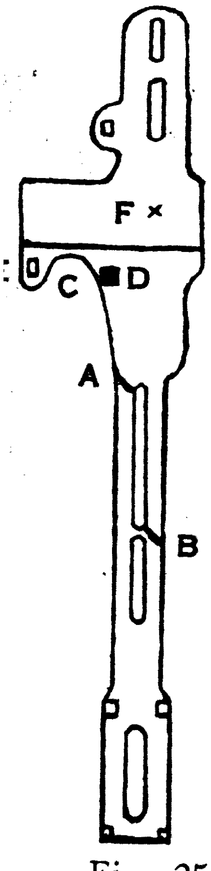


Fig. 254.
Sword Breakage.

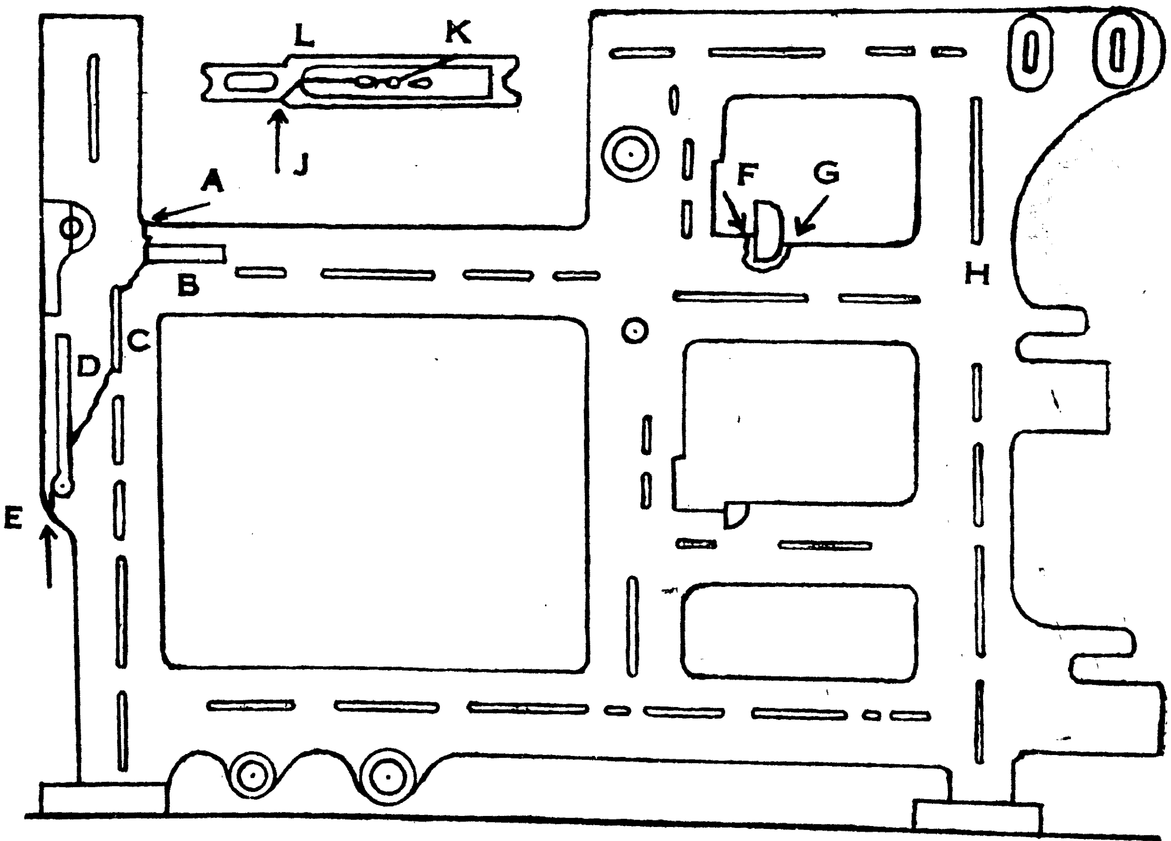


Fig. 255.
Loom Frame Breakage.

(3) *Broken Crank.*—When a crank is broken, the banging-off of the loom is only a contributory cause. The breakage is brought about by the long continued torsion strain in the weaving of heavy cloth. A tighter belt, and the cottering up of the crank arms are valuable aids to the weaving of heavy goods.

(4) *Loose Pedestal Brackets.*—These brackets hold the crank shaft to the loom frame, and for the service they have to perform, ought to be made fit at their best. If not firm, they can be packed with sheet iron which is bent at either end to prevent it getting out. If both brackets have to be packed, the insertion must be at the same side as the other. The test is made, by placing the crank at its front centre, and then measuring from the front of the breast beam to the sley, and as near to the swords as possible. Both measurements should be alike.

(5) *Broken Loom Frame.*—This is the most serious breakage that can occur to a loom, and there are two places where the breakage occurs. The least expensive of the two is the back support of the pedestal bracket G, Fig. 255 which may be due to the loom violently banging-off when this bracket is loose, and either the frog or brake are out of order. The shock has then to be taken by this bracket and its back support. When broken, it cannot well be repaired, but a wrought iron bar may be used as a prop which is bolted to the back part of the loom H. The more exact is the boring of the bar, and the better held is the broken frame.

The brake plays a very important part in preventing such breakage and is given at Fig. 256. At A is the brake wheel which is keyed to the crank shaft. At B, is the brake which is fulcrumed at the top. The position of the stout

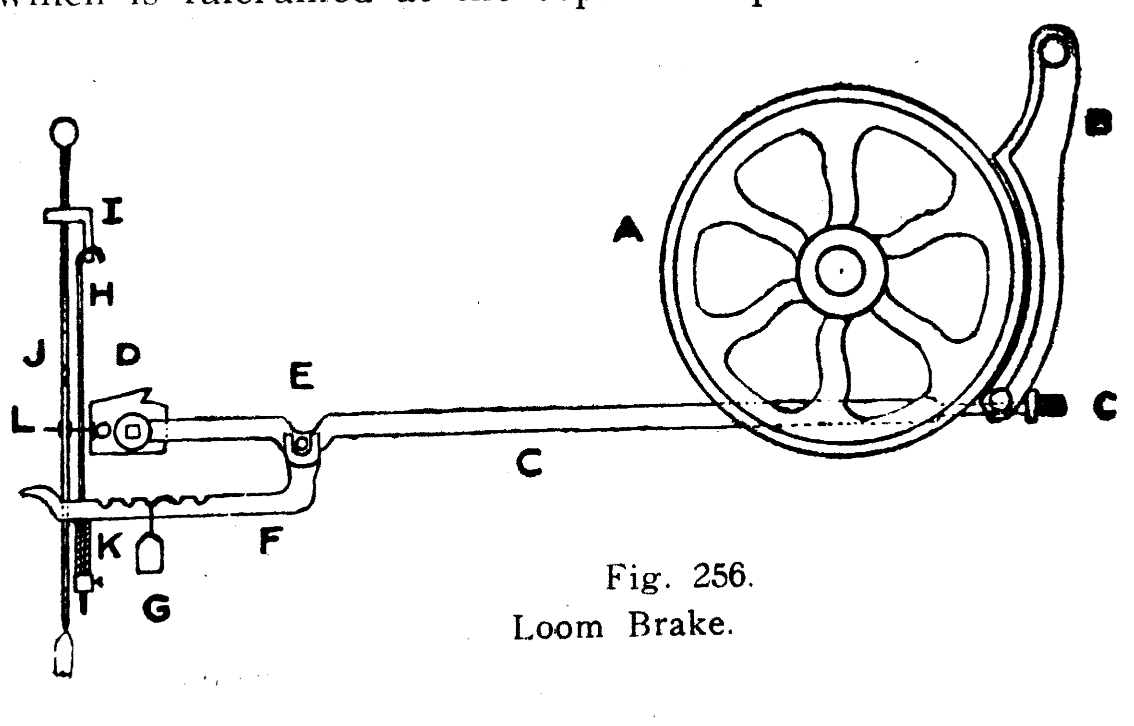


Fig. 256.
Loom Brake.

stud that holds it is very important, for if too far away, the brake only comes in contact with the brake wheel at the bottom end, and so loses part of its power. If the stud is too far forward, then the brake comes in contact with the wheel at the top, and there is grave danger of the brake being broken the first time the loom bangs-off. The length of the brake becomes leverage against its own safety. The brake must be made to fit fully to the wheel. The brake rod at C passes through a casting bolted to the bottom of the brake, the length of the rod being regulated by lock nuts. This length is that when the loose frog is just clear of the loom frame, the brake is then in full power on the wheel. The flat part of the rod is at C and is placed on the side of the frog D. At E is the brake pin for the weight lever F, which carries the weight G. Through this lever passes the rod H connecting tumbler I to the lever and by means of the spring K, the brake and lever move the brake rod and brake away from the brake wheel when the loom is set in motion, but as soon as the loom bangs-off, the setting on handle is forced out of its notch, the tumbler drops, and the weight and lever assist in bringing the brake into action in the least possible time. At J is the setting-on handle, and L the cranked knocking-off finger.

The larger and more serious breakage is to the front of the loom frame. This cannot well take place to an ordinary tappet or dobby loom if the frog and brake are in good order as detailed, but if by some oversight it should be broken, it can be repaired by a boiler plate cut to a brown paper pattern. This serious breakage is illustrated in Fig. 255. The crack begins at A, passes down to the end of slot

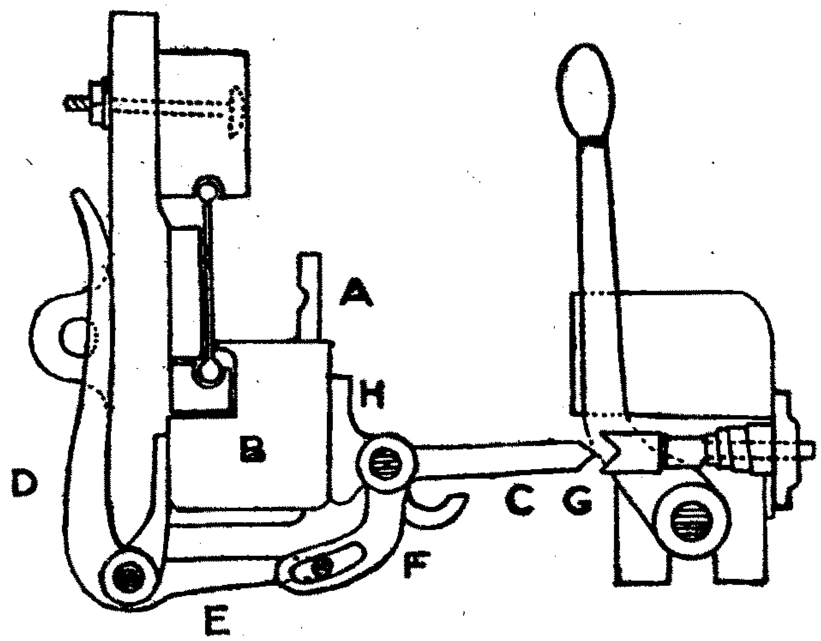


Fig. 257.
Dobcross Stop Rod Tongue and Frog.

B, and through the bottom of slot C, joins with slot E, and passes out at E. When the crank arm L is broken it is usually at J and K.

In the Dobcross plain loom and the older type of box loom, the trigger has to be in contact with the back of the setting-on handle so that as soon as the trigger is forced back by the stop rod tongue, the belt is travelling off the fast pulley. This is illustrated at Fig. 257. At A is the front of the box and B the movable sley rack. At C is the stop rod tongue pointing directly to the V-shaped front of the trigger, the coiled spring behind it keeping it forward. At D is the box swell finger, with E its bottom arm, the pin on it passing through the slot of the casting F setscrewed to the stop rod. When the shuttle enters the box, the box swell is forced back along with the finger D. This movement sinks the stop rod tongue C and it passes underneath the trigger G. When the shuttle fails to box, the mechanism remains as shown and the loom is brought to a stop.

The long, open spiral spring on the setting-on rod ought to be tested after a few years service, for if it is materially reduced in power, it will be all the longer in getting the belt off the fast pulley.

(6) *Stiff Running Loom.*—The frequent banging off of a loom that has a pair of driving wheels at each end of the loom leads to it running stiffly. The cause is that one of the wheels has shifted on its key bed, and the cogs have become locked. When the loom runs easily, both the wheels on the crank shaft are the drivers, for the teeth of the top wheel are pressing against those on the bottom one. When the cogs are across, however, all the driving has to be done by one pair of wheels, for at the opposite end, the cogs of the bottom wheel are binding against the front of the cogs on the top wheel instead of at the back.

The remedy is made by knocking out the key on the bottom wheel, and filing the key way a little wider on that side where the wheel has to be thrown.

Defective Picking.

Some defects in the plain loom overpick have already received attention in the previous sections, and need not be repeated.

Overpick.—(Fig. 258). The upright picking shaft E breaks in two places. (1) By the square. It is this square that holds the bottom of the two toothed brackets J controlling the picking shaft. When broken at this place, either the picking strap has been too tight, or the shuttle has been too tight in the box. It is much better to have flexible spring power to slow down the speed of the shuttle, and retain it in its picking position, than to do so by rigid box pressure. If there be an insufficient lift imparted to the stop rod tongue when the shuttle is reasonably slack in the box, recourse must be made to some other means than tightening up the box front. Either the box swell finger is away from the head of the box swell, or the pin of the swell, or the hole in it is worn.

(2) *By the Cone C.*—When the shaft is cracked by the cone stud hole, the picking nose has most probably been bearing down on the cone instead of giving it an outward push. This can take place when the picking nose is too hooked, or the cone worn too small. Both suggest the improvement. What has been found of value is that instead

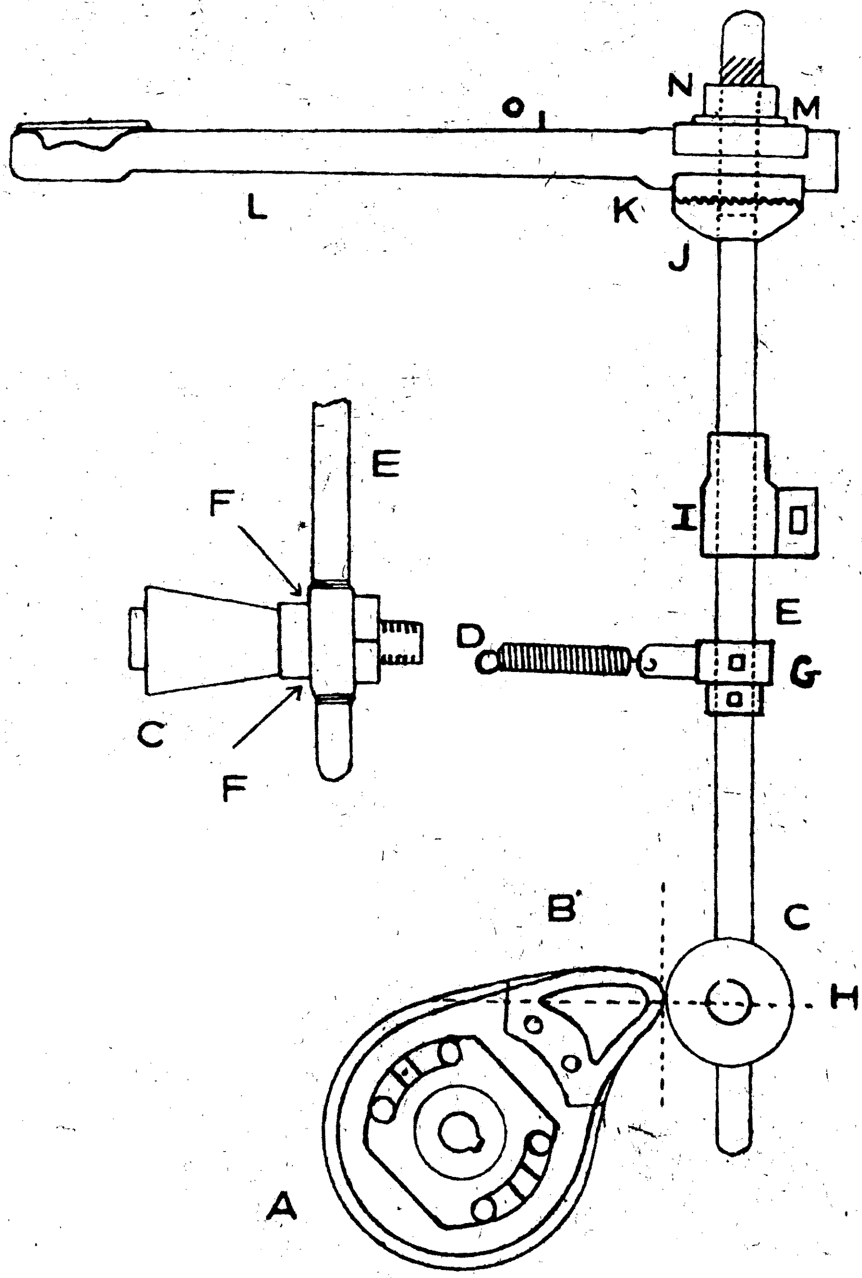


Fig. 258.
Overpick Motion for Plain Loom.

of the shaft being made circular through which the bore is made, it is much better to have it oblong, for then there is no line of least resistance.

Cone Stud.—When the cone stud D is broken, the nature of the break gives a clue to improvement. If it be as if cut through most of the way like as cut with a knife, the collar F behind the cone has not been made to fit properly to the shaft, and the stud has been subject to springy action. If the stud has the appearance of being torn from together, then the stud has probably been loose for some time.

It does sometimes occur that the hole in the picking shaft is too low, for then the nose gets too far over the cone. The position of the hole should be that the centre of the picking stud H be parallel with the end of the nose when the nose end is at the centre of the cone. One is then at right angles to the other as demonstrated by dotted lines.

Bouncing Picking Stick.—When the loom is running, some picking sticks never come to rest. This is chiefly due to lack of balance between the picking cone and picking stick. If the stick be moved forward one cog, the balance is better maintained, and much of the bounce disappears. On rare occasions, it is the shell that is worn into a deep groove into which the end of the cone enters, and is forced out again by the rotation of the shell. The rise from the groove may be made less abrupt by filing, but a new shell is better.

Hattersley Catch Pick.—The picking catch W, Fig. 203, is made with a long pin Y which fits through a curved groove O in the picking arm. If the face of the catch X does not fit with the cut on the cam R when picking takes place, then the catch is thrown upward, and the pin is broken off by coming in contact with the top of the slot. The catch is of no further use until repaired. To prevent the jumping of the catch, the slope of the cut on the cam has to be maintained as when new, and the face of the catch made fit full face to the cam. The force of the forward finish of the picking stick is deadened by the stick coming in contact with a good quality rubber 6 inches long and $1\frac{3}{16}$th inches thick at T. The leather buffer H on the spindle has to coincide with the rubber T.

Hattersley Clutch Pick.—Reference is here made to the one with two legs. (Fig. 259). After a fair amount of wearing, the clutch comes out of contact with the bottom casting E when it should pick, and a dummy pick takes place. This is due to the rounding off of the two picking sides of the clutch legs and those contact sides on the bottom casting. A temporary improvement may be made by applying French chalk, or other gritty substance to the legs, but as soon as ever convenient, the two picking sides of the bottom casting have to be cut straight with a small chisel. This can be done when no warp is in the loom, and there is then no need to take out the picking shaft.

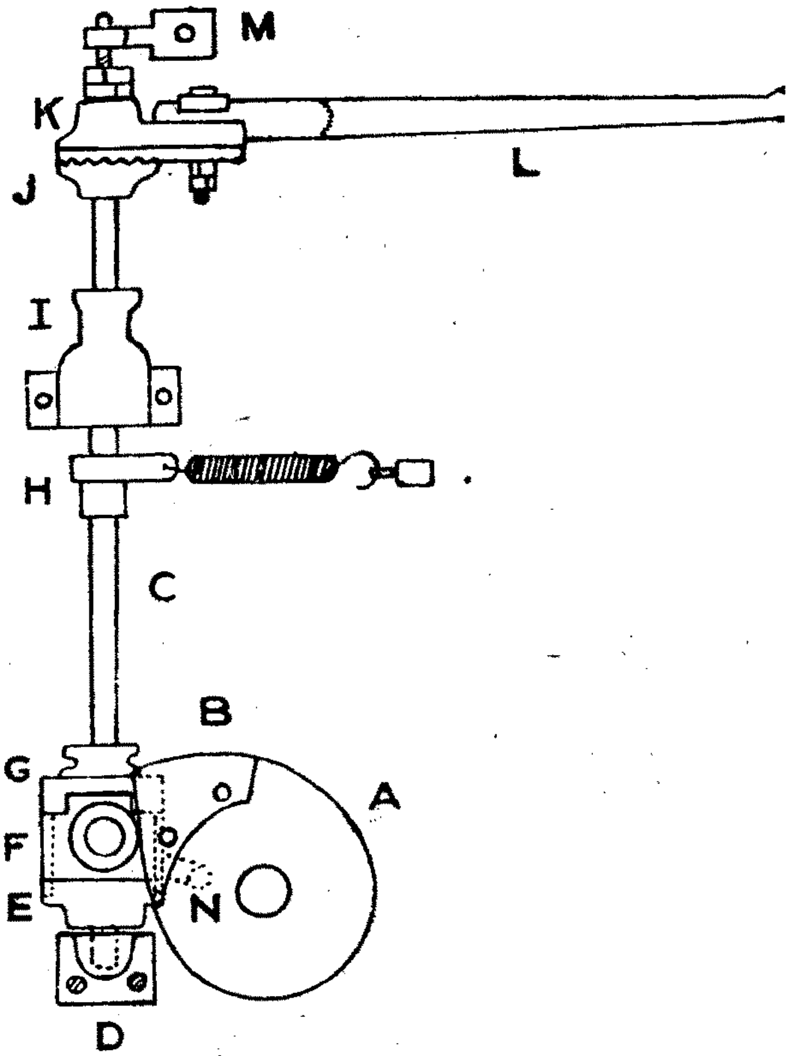


Fig. 259.

Overpick for Hattersley Box Loom.

Dobcross Picking.—This has a strong underpick motion, and is brought about by a bowl which makes a circular sweep depressing a picking shoe E (Fig. 260) fixed to a horizontal shaft with suitable connections to the picking stick. If the loom bangs off, the first thing tried is the timing of the pick. As the crank in this loom goes bottom half first, the picking commences when the crank has just passed its top centre. If later than this, the thick strap that passes round the picking stick will need tightening up. Weak picking is often due to the wearing of the shoe, which has to be advanced $\frac{1}{4}$ inch so as to receive more depression.

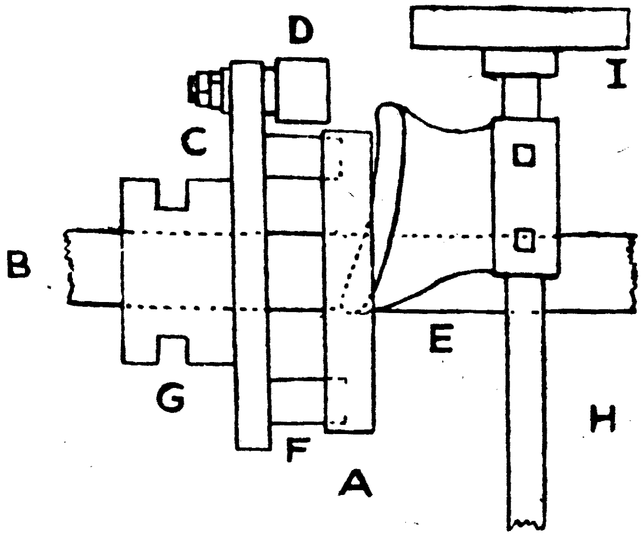


Fig. 260.
Dobcross Picking.

As the shoe E continues to wear, it may be moved forward four times, ¼ inch each, but at the last move, it is at its final stage of wearing. The further forward the shoe is placed, and the more sudden is the picking. This kind of picking is detrimental to the driving and change wheels. If the hand be placed on the guard of the change wheel, and a bumping sensation is felt every time the loom picks from one end, it is better to discard a picking shoe than have cogs broken out of the driving wheels. Sometimes the picking shaft at the back and bottom is worn, and the pick is weaker on that account. Power lost in this way may be restored by taking the shaft H out, and refitting the shoe and picking arm, after turning the shaft half way round. The picking bowl needs to be well lubricated to prevent rapid wearing of bowl D, stud, and shoe.

Shuttle Running.

If a shuttle is to run its proper course from box to box, there are several important points that will have to be attained and maintained. These may be set forth as follows:

(1) That the angle formed by the back and bottom of a new shuttle must coincide with the angle formed by the shuttle race and sley. (Refer Fig. 193). This is not a right angle, but is slightly **V**-shaped. The **V** becomes more pronounced as the going part recedes from the cloth until its maximum is reached when the crank is at its back centre. When a new shuttle is placed on the shuttle race and against the sley, it ought not to be able to be tilted against the sley, or be pushed in at the bottom.

(2) The sley for every fresh warp should be tested from end to end with a straight edge, and also any additional pieces that may be used to fill up the gaps at either end.

Any hollows or protrusions are liable to force the shuttle out of the path of safety.

(3) The delivery of the shuttle whether " box or plain " must be so arranged, that when the shuttle is against the picker at the inner end of the box, that it is drawn away from the box back for $\frac{3}{16}$th inch, and also lifted from the box bottom the same distance. Such a delivery tilts the shuttle a little downward and inward at the end which first enters the shed, and this materially assists in keeping it in its true course across the loom. These points may be termed the three fundamentals.

Though they be secured, there are other factors that must receive attention if the shuttles are to work with satisfaction. If a weaver hears a shuttle make a clattering noise as it enters the box, she will know something is wrong.

Ends that have feltered in the front shed, and especially so in quick changing weaves, may cause the shuttle to be thrown out of the loom.

Slack Crank Arms.—When these are too slack, they impart a shaking motion to the going part and shuttle. If this has been going on for some time, it will be found that the back of the shuttle has developed vertical ribs. If the cottering has reached its limit, the outer bushes at the crank and sword pin may be packed with hard leather, for then the metal straps will continue longer in service. Both ends should combine firmness with freedom. The ordinary crank arm is at Fig. 261. A is the outer bush and B the crank. At C is the lug and recess, and D the crank arm. The long metal strap is at E. At F is the short metal strap, and H and

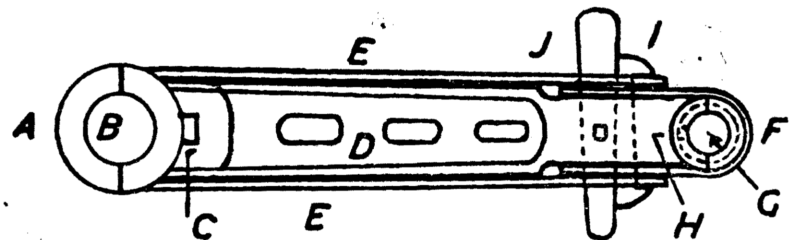


Fig. 261.
Ordinary Crank Arm.

I the two bushes on the sword pin. The holder is at J and the cotter at K which is driven downward to tighten up both straps.

Fig. 262, has been named the " Adamant " by the patentee, Mr. Arnold H. Stow of Wilsden, Bradford, and has met with much favour by manufacturers. The half bush A is brass, and is flanged at either side. Half bush B is brass, but has only one flange at the opposite side to the one shown. C is the lug for it to be held in position.

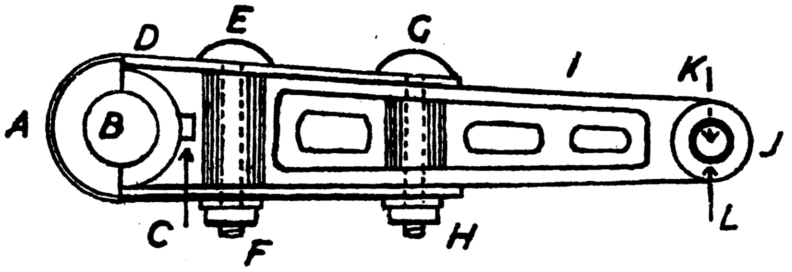


Fig. 262.

There is only one metal strap as at D, and this is slotted in two places top and bottom to receive the fixing bolts E and G. These bolts pass through the more solidly made parts of the crank arm, and are held by self-locking nuts at F and H. All four slots extend to the left to take up the slack made by wearing. At I is the arm, and at the end J, there are no half flanged bushes. They are substituted by a circular brass bush L, that is driven tightly into the bore of the crank arm. The bore K through the brass bush, is for the sword pin to pass through. When the sword pin is worn, it may be turned half way round and held by a setscrew, or replaced.

Fig. 263 is made for the Hattersley Standard Model Loom. A and B are the flanged gun metal bronze bushes on the crank shaft, the inner one having a lub to prevent them turning. C is the cotter and D the gib for holding the short metal strap E, the surplus of the slots being on the left. F is the crank arm that is solid in the centre, but slotted vertically towards both ends for gibs and cotters to pass through.

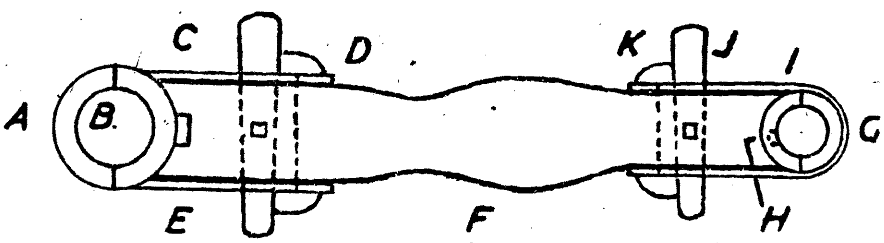


Fig. 263.

The bushes for the sword pin are cast iron and are at G and H. As I is the other metal strap, with its cotter at J and gib at K, the surplus of the slots are on the right.

This style reduces the length of the metal straps, the holding power is doubled, and is more readily adjusted.

Fig. 264 is the Northrop crank arm, with A and B the brass bushes for the crank. At C, top and bottom is the metal strap, which is turned at right angles at the ends. An almost similar strap, but with extra thickness at G, embraces the sword pin and bushes.

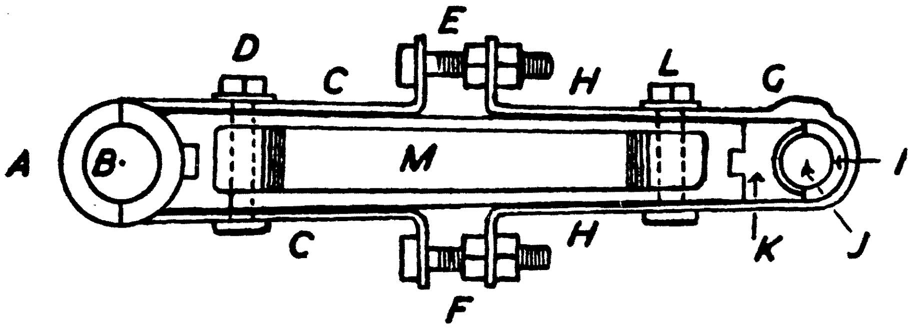


Fig. 264.

The two metal straps are bolted together at E and F, the bolts being locknutted. Only the slightest lateral play is conceded to crank arm M, and then, the holding bolts D and L are braced up by the spanner.

The outer flanged bush on the sword pin is at I, and the opening at J is for the sword pin. The locking casting K is indicated by the arrow. The crank arm is solid, but is thicker where the holding bolts pass through.

Improved Northrop Shuttle Eye.

A side and top view is given at Fig. 265, and at A is the circular leg that passes through the bottom of the shuttle, and B the chief screw bore to hold it in position. C is another bore which is cut into to allow the weft a passage through the casting and to pass outside the shuttle. A third bore is from the back of the shuttle, and is to tighten the spring pressure on the weft, the spring being at D.

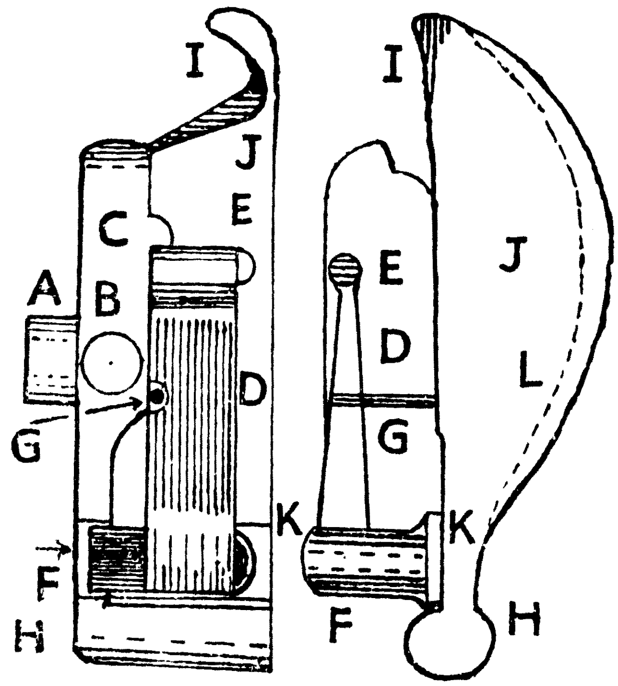


Fig. 265. Improved Northrop Shuttle Eye.

At E is the riveted pin for the spring D, the end of the spring being at F. It is semi-circular with a rounded top that comes in contact with a steel plate K, which is doubly riveted to the brass or main copper casting. G is a riveted pin that passes through both parts of the spring D. At H is the rounded end of the casting, the shuttle being gouged out to let it slide downward. At I is the rounded lip of the main casting that enables the weft to pass downward in the self threading process. J is the main casting to which the small steel plate is riveted. Both figures are lettered alike. The contour of the shuttle eye is made to suit the warp twist in one make, and weft twist in the other. At L is the sloping down side of the main casting. This and others are Mr. P. Tyler's patent, High Street, Kingswood, Wotton-under-edge, Gloucestershire.

V Rope Construction.

The usual size for the running of a loom is $\frac{1}{2}$ wide, and $\frac{11}{32}$ inch thick. The vital parts in the construction of the rope are demonstrated at Fig. 266. At A is the outer rubber which has sufficient flexibility to withstand bendings without injury. It is the outer part of the rope that expands the most. It also keeps the cords in their correct positions. These series of cords are shown at B, and do the actual work of driving the loom. There are 25 cords in each of the eleven rows, each row being laid in parallel lines at, and above the pitch line. This prevents twisting in the grooves when running. At C is the bottom rubber, which is heat resisting. It is tough but pliable, and easily bends over the small motor pulley.

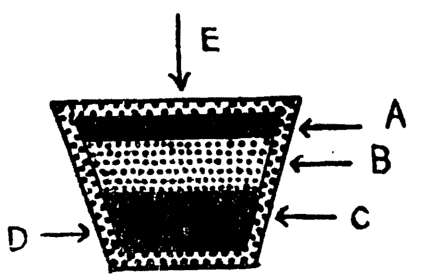


Fig. 266. Construction of "V" Rope.

At D is the inner cover which reinforces the outer cover, and effectively prevents moisture, dust and dirt from reaching the central drive cords at B. At E is the outer cover. This is a rubber impregnated fabric which gives excellent resistance to wear, and maintains the same co-efficient of driving friction for a long term of service.

The ropes are manufactured individually in metal moulds, and are then vulcanised under pressure. The accuracy of the moulds ensures that all the V-ropes from the same mould are identical in width, length, thickness and angle. Each rope is thus compelled to give its full share of service for the driving of the loom.

Worn Shuttles.—By the style of their delivery as well as having to force back the box swell, shuttles become worn at front, back, and bottom. The back and bottom are the most important. If a straight edge be applied, it will be found they have become bow-shaped. Such a shape is against good running. By the judicious application of a moderately coarse file, the back and bottom may be filed straight, or slightly hollow. Both should be the same size when finished off. Such filing away may have to be followed by an adjustment to the boxes. (*See Fig.* 191).

Dropped Boxes.—In box looms, whether controlled by chains or levers, the boxes drop a little below the shuttle race. The delivery of the shuttle is thus adversely affected as well as the entrance into the box. Such dropping causes marks or chippings to be made on the shuttle, and ought to act as a warning to the weaver. Before any further weaving takes place, the boxes have to be reset by the overlooker. When some kinds of chains are used for the movement of the boxes they have at times to be packed to get the correct altitude for all the boxes, or they may be turned over.

Weft Cutting.

This is one of the worst things an overlooker has to contend with. A plain loom is even worse than a box loom, for the shuttle front is well covered by the box front, and the actual process cannot be seen. The speed too, often eludes the sharpest eyes.

What has proved of great value in a plain loom is to make the box front slope at the same angle as the shuttle front. This is the most effective way of preventing the weft from dropping between the box and shuttle front, and being cut as the shuttle is being forced out of the box. This is a simple but very effective remedy. It has to be carried out for both boxes, and then the shuttles wear evenly at both sides of the loom. To get the correct slope of the box front, the feet of it are packed with tapering cardboard which is put in front or back to secure the desired effect. Fig. 193.

Weft Fork Cut.—The side weft fork is liable to be knocked by the weaver when changing the shuttle. The knock bends one of the prongs, and brings it in contact with the grate through which the prongs pass. Such contact severs the weft. The length of weft from the selvedge gives a good indication which prong requires attention, but the spot may also be found by drawing the going part forward. Any sharpness can be smoothed with emery cloth. (*Refer* Fig. 221, Page 304).

Box Loom Shuttles.—In boxes with open fronts, the shuttle is held in the box by the turned up front part of the shelf. As the shuttle must force back the box swell, it is worn away most, well towards both ends. It is at these places that the weft drops between the box and shuttle, and is severed as the shuttle is propelled from the box. The dropping is prevented by pegging a small strip of a frayed and twisted thrum along the front of the shuttle.

In these boxes, it is the removal of a fruitful source of weft cutting when the rod and bushes at the front entrance of the box are substituted by a shaft top leather. (Box, Page 397, Figure 301. Shuttles, 485-6, Figs. 427 and 428).

Weft Breaking.

This is different from weft cutting. It may be distinguished by an examination of the severed end of weft. When cut, all the fibres are practically cut straight, but in breakage, there are differences in fibre length. Breakage occurs in many ways. The shuttle spindle may have dropped, and the drag be too severe when the weft is nearing exhaustion. The spindle might be too slack and vibrate vertically, and the weft be broken as it lifts. It may be too slack horizontally and the weft coils are forced against the inner sides of the shuttle. At times the pot eye is cracked and damages the yarn. Sometimes the shuttles are so worn at the bottom, that more bulky weft than ordinary protrudes through the bottom, and is rubbed on the shuttle race.

Careless spinning results in the weft being too bulky for the shuttles, and to save the expense of rewinding, the inner sides of the shuttles have to be scraped to make room for the weft. Smooth weft like worsted, combined with bulky weft like those on Universal Winder bobbins, makes the weft fly out of the shuttle. This is caught at various places and broken. The " flying " has to be checked, and this is done by a double strand of loom cord being placed on the shuttle pin near the eye, and the cord then pegged down at the opposite end of the shuttle.

A cracked shuttle may hold the weft, but by pressing the cracked side inward, and rubbing it with fine sand paper, the shuttle may last for some time longer. Rough pickers are sometimes responsible.

Weight of Fabrics and Make of Loom.

Some looms are only made to weave light or medium weight cloths, but occasionally the heavier cloth has to be woven, and from start to finish, it is a struggle for overlooker and weaver to get the work done. The warp has to be placed over two back rails, the loom belt tightened up, the shed enlarged, the shuttle front top rounded off, and there may be also need for a pair of new picking noses. The crank arms may need cottering up or packing, and it is quite likely that when all points have been attended to, that the loom will bang off many a time a day because the work is too heavy for the loom.

If the loom has a rigid handrail, it is nothing unusual for the inner top sides of the swords to be broken off.

If the loom is served with a centre weft fork, and a wooden hand rail, a continued weaving of heavy cloth has broken the shuttle race in the centre where it springs the most.

Whenever possible, such weaving should be avoided.

Worn Sleyrack.

The reeds of sleys are square cut at their ends, and when the covering of paper has worn off, the constant force required to beat up the weft gradually scrapes away the bottom of the rack behind the shuttle race. This wearing away occurs most in the centre, and in course of time, it becomes so hollow, that when a heavier cloth than ordinary has to be woven, the sley is forced out of the handrail. To meet the situation, the place nearest either temple where the sley can be moved upward can be marked on the cloth. Strong brown paper of the length between the marks may be folded, and the folds then decreased towards either end. The whole length of paper is then curved, and inserted in the bottom of the rack. The handrail is then secured, and the sley again tested for firmness, and any further alteration then made.

Wrong Lifting.

Quite a number of things are responsible for the shafts not lifting according to the design, and each make of loom has its own particular causes.

Hattersley " V " Dobby.—This is one of the best dobbies ever invented for reliability. The feelers have practically no bounce when a peg moves away, and the lags and pegs are so made that no peg actuates two feelers.

When a wrong lift occurs, it is one of the top catches that makes it. This is brought about by the wearing of the hook on the catch that connects it to the balk, as well as the balk pin (*Refer* Fig. 47). The structure of the dobby makes the bottom catches fall back when the bottom of the balk is against its rest bar, but the top ones lean forward. When catch and balk are worn, the upper cut on the catch extends beyond the holding bar that holds the catch back when the corresponding shaft is needed on the bottom shed, and this makes the wrong lift.

The defect can be immediately discovered by placing all the shafts on the top shed when the bottom draw bar is forward, and the shedding rod at its dead bottom centre. The catch can be filed shorter without disengaging the balk, and thus be made to wear much longer.

Dobcross Dobby.—After considerable wearing, the bushes on the shaft lags become worn at the end, and this gives the bowls too much liberty. One bowl may then engage two vibrator levers H and so make a wrong lift. The bushes may be packed with band to make all the bowls be directly opposite their respective levers. To this end, the cylinder K can be arranged so the packing is done away from the bowls. (Fig. 267).

Another cause is when the vibrator does not work freely in the two grates through which it passes. The shaft then remains on the top shed when it ought to be on the bottom one.

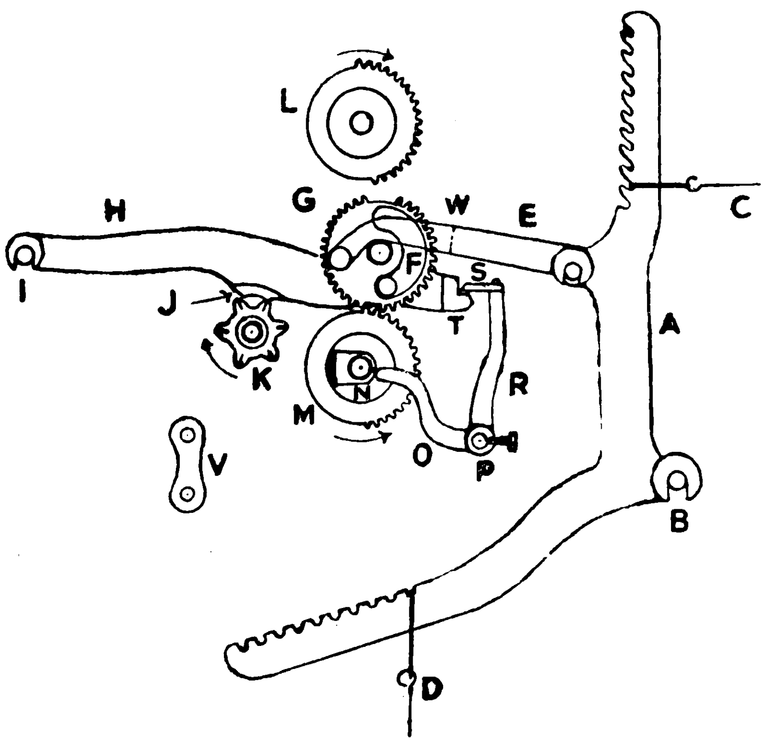


Fig. 267.
Dobcross Dobby.

When the lever does not drop easily, it is either bent or twisted, or the connector E is out of line.

The worst aspect of wrong lifting is when one or both of the semi-toothed cylinders have their teeth damaged, L and M, Fig. 267. If the top cylinder is affected, the vibrator lever and wheel have been lifted too high, or the vibrator wheel has been of harder metal than the cylinder. If the bottom cylinder has sustained injury, then either the harder wheel is the cause, or the end of the vibrator lever which fits through the inner grate is worn so it is not held firm enough by the lock knife S. The shallow meshing of the cogs begins the spoiling process.

In the Dobcross loom nothing requires more careful setting and more frequent observation than the cylinders.

Lag Faults.—A lag or lags that have become too short in length are better broken up, for they allow pegs to touch two feelers instead of one. Cracked lags, unless the holes are packed, cause pegs to drop out. Short pegs may be discovered by holding each lag of a set level with the eyes. All pegs should be tested for firmness before the set is placed on the loom. This saves much fruitless labour as well as expense in waste. Elongated loops and links cause the lags to catch on the top of the cylinder, and either compel the engine to make a wrong lift or the connection is torn asunder.

Timing of Lag Cylinder.

This may be said to be a fixture, but different looms have different timings, and in some cases, and under certain conditions, it is one that is easily overlooked. Unless the cylinder is timed and set correctly, the engine is unable to do its work properly. Occasionally the lags become entangled, and the wrench may dislodge the dolly, or in case of a negative dobby, it may alter the leverage.

Negative Dobby.—The catch that turns the cylinder is bolted to the bottom arm of the front engine lever. It turns the cylinder as it moves forward, and completes the turn at the end of its forward stroke. It has neither to be excessive nor short, but of the two, it is better to be a little short as the star wheel and spring behind the engine will complete the turn. If excessive, then the operating lag is forced past its dead top centre, and causes the feelers and needles to sink, and then rise again when the cylinder moves back. This is very bad setting, and wears the points of the star wheel. The quickest way of setting is to place the shedding rod at its dead bottom centre, and then fix the turning wheel with the bottom of the cog against the turning catch.

Square Dobby.—This make of a Hattersley loom has two dolly pins to operate the turning wheel, and two to reverse it. It is the usual practice to have the dolly with its pins level with the width of the loom. By practice, however, it is found that better results are obtained when the dolly is set a little in advance. The bounce of the feelers is less pronounced, and if a leather covered lag be placed underneath the outer ends of the feelers which is slightly higher than the ordinary resting position of the feelers, there is a marked reduction in wrong lifting.

Dobcross Dobby.—In this loom, the lags are in continuous motion when the loom is running, the cylinder turning in fixed castings at either end. In either the old style or the new, a fresh lag should not begin to push up the vibrator levers until the lock knife has cleared the ends of the levers. To have it timed a little earlier would not make the engine lift the shafts wrong, but would badly wear the ends of the levers T and lock knife S in a short time. Fig. 267.

The lock knife is moved by a cam on the shaft of the low cylinder at the front of the engine, and imparts an outer and inner dwell to the lock knife. The outer dwell of $\frac{1}{4}$ of its revolution gives ample time for the levers to change their positions, and the inner dwell of half a revolution of the cylinders is essential to hold down the vibrators whose corresponding shafts are required on the bottom shed.

In connection with the lags, it may be here stated that old and new side links V, as above, will not work in harmony, and if a length be held up for inspection it will be at once seen how wavy they are in appearance, and how different are the spaces between the lags. Worn side links are the means of breaking the blades of the cylinder by throwing the weight of lifting the vibrator levers on to the blades, instead of the ends of the cylinder.

Hattersley Standard Loom.—(Frontispiece). The dolly on this loom has only one pin, but it has important work to perform. Not only has it to do the ordinary work of turning the shaft and box lag cylinders, but it must move in response to the pick finder motion. It is timed by the shedding rod, and there are two timings. (1) The one for weaving on a right hand loom has to be at its right hand centre when the shedding rod is at its dead bottom centre. (2) The one for reversing has to be at its left hand centre when the shedding rod is in the same position as before. The ordinary weaving and the automatic pick finding then works in harmony. (*Refer* Fig. 65).

Ordinary "V" Dobby.—The timing of the lags for this dobby is to have the dolly pin at its back centre nearest the observer when the crank is at its back centre. This is the correct timing whatever be the timing of the shed. When the timing of the shed is altered, the position of the dolly pin is altered with it. Before restarting weaving, however, the dolly pin must be brought back to its former position by altering the bevel wheels that are influenced by the reversing collar. (*Refer* Fig. 47).

Letting-Off Catches.

For the positive letting-off motions, there are three styles.

(1) This has only one letting-off catch, but the wheel it turns has fine teeth. It is the fineness of tooth pitch that makes it effective in the even letting-off of the warp. Any jumping of the catch leads to light and heavy bars being made the weft way of the cloth. The blunt point of the catch has to be kept in good condition, for the catch wears the wheel, and if the cogs are to be kept a good shape, the catch must be kept in good trim. If the wheel be considered as a circle, then the catch has to operate in the upper right hand quarter of it, and the nearer it oscillates at either side of the centre of that quarter and the better.

If the catch at any time shows signs of jumping, and the catch point be in good condition, then a leather strap with a weight attached may be passed over the back of the catch to keep it down. Though this plan makes the catch and cogs wear a little quicker, it prevents uneven pieces being made.

(2) Let-off and reverse catches are on the same stud, and are **V**-shaped into one another (Fig. 296). Each catch end is in two sections for the blunt part slides on a raised part of a shield which covers part of the letting-off wheel, whilst the other on passing beyond the shield, turns the wheel. In time the letting-off catch becomes blunter and shorter, and it is the shortness more than the bluntness that causes barry places to be made in the cloth. The sharpening up of the blunt point is quite in order, but the catch stud must be placed a little lower if the wheel is to be turned efficiently. The lowering of the catch stud has not to be excessive, or the **V** parts of the two catches will be opened out and quickly worn, and the catches become useless. The letting-off wheel is a double one, for one section is for weaving with the cogs pointing backwards, but those for reversing point forward.

(3) Double catches are used on most positive letting-off motions. In every case, these are arranged so the back catch is half a cog ahead of the front one. When both operate too near together, the wheel remains stationary too long. and then when it does begin to move, it does so with too much vigour. The standing makes a heavy weft bar in the cloth, and the too vigorous action a light one. An occasional examination when commencing a fresh warp may be a very profitable transaction. (*See* Fig. 297).

Quadrant Letting Off Catches.—The fitting of these catches on the Dobcross loom is an important matter, for if not properly adjusted, the woven fabric cannot be as even as should be. (*See* Fig. 99).

It is not enough that the arm of the quadrant be vertically straight when the crank is at its top centre, though this is the proper setting. It is the catches that need attention. The front catch should be half a cog behind the other, when the back one is at the base of a cog. This setting gives the best letting off of the warp.

To have the catches at the same pitch when in the position stated, is to cause the letting off wheel to be too slow, and then too fast in movement. When too slow, a small dark bar is formed in the cloth, and when too rapid, a light bar is made.

The best test is not at the loom, but at the bench. Both catches should be placed on a pin that will just slide through the bore of the catches. The pin is then held parallel to the wheel, and the back catch placed at the base of a cog. The front catch point should then be in the centre of the cog upon which it rests.

Positive Taking-Up Motion.

Most plain looms are fitted with the ratchet positive taking-up motion, the gauge figures being 3,600. The number of picks per inch is divided into those figures, the quotient giving the number of cogs required in the change wheel. It is customary to put on a change wheel with one cog more than the calculation to take up the cloth a little quicker. The ratchet wheel has to be turned with precision or small bars appear in light weight fabrics, but they are not likely to be detected in heavy ones.

There are five points in the working of the ratchet, the neglect of any one being to the detriment of the fabric. (Fig. 268).

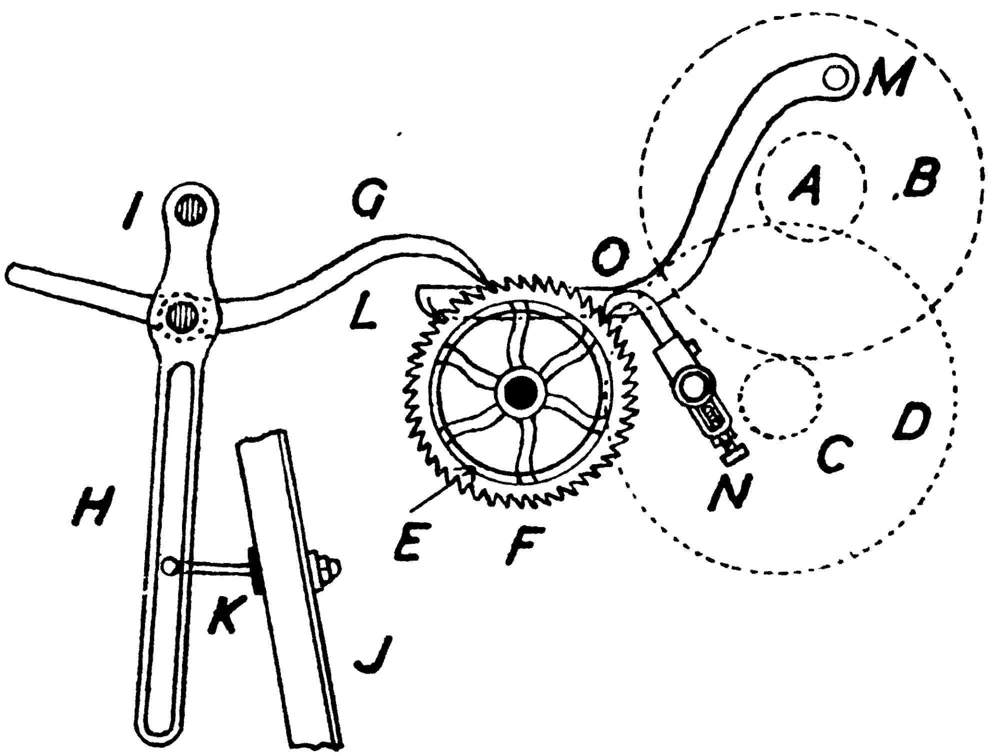


Fig. 268.
Positive Taking-up Motion.

(1) The holding catch L which drops of its own weight, should be so free as to readily seize the first cog on the slight run back after turning. To this end, the finger on the same rod but at the opposite end of the loom has to be clear of the knocking-off bar in front of it, for only by such a clearance can the holding catch work as expected.

(2) The pushing catch G has to be in the centre of the cog upon which it rests when the crank is at its back centre. This insures a good drop when the going part goes back, and an adequate start.

(3) The leverage imparted to the catch G must be such that the holding catch drops over the cog when the sley is within an inch of the cloth.

(4) When two cogs are taken up at a time when few picks per inch are to be woven, the starting place is as before, but the holding catch must now drop over the second cog when the sley is within an inch of the cloth.

(5) When the weft breaks or runs off, the holding and pushing catches are elevated, and it then rests with the running back catch O to hold the ratchet wheel F. This catch is on the front of the wheel, and the shaft of the catch fits into a slide, the working length of the slot being regulated by a locknutted setscrew at its base at N. It can be made to run back one cog for a one tooth take-up leverage, or two cogs for a two teeth take-up.

The taking-up lever is at H and oscillates on the pin I. The lever H is swung to and fro by the cranked rod K. bolted to the sword J. At E is the change wheel on the same stud as the ratchet wheel.

Testing of Boxes.

It is a saving of the weaver's time if the boxes be examined prior to a fresh warp being started. A set of lags can be made and kept for the purpose of raising one box at a time, and dropping them the same way. The lock-nuts at the bottom of any box rod affects the whole of the boxes, but individual levers control one box each. When two work in unison, there is then a double lift or drop. As an example, the Hattersley drop box motion is introduced. (Fig. 269). At A is the rod, the top of which passes through

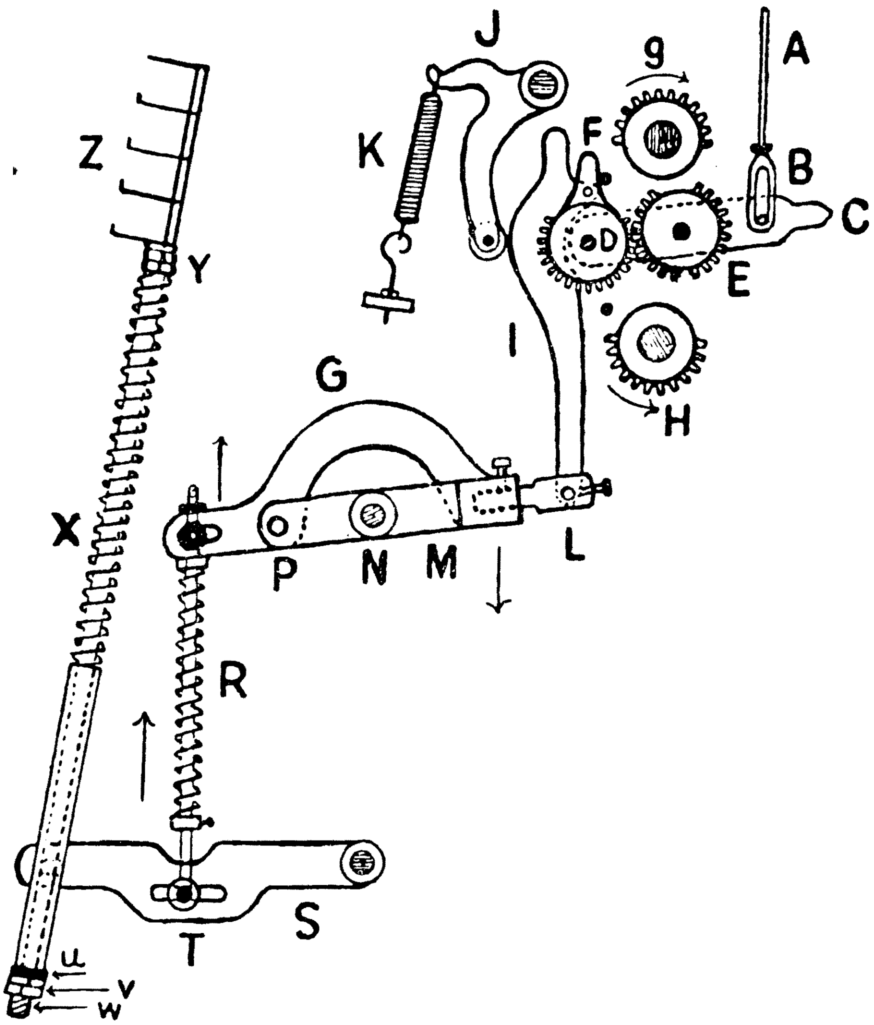


Fig. 269.
Hattersley's Drop Box Motion.

the lag feeler, and is influenced by the pegs in the box lags. At the bottom of the rod is the slotted casting B which fits on a button on the vibrator lever C. The vibrator wheel E which is fulcrumed on the lever C, meshes with the box vibrator wheel D. The wheel E is turned in one direction by the toothed cylinder G to depress the box, but is brought in contact with the bottom toothed cylinder H to raise the box. The connecting arm I is on a button on the wheel D, but at the bottom, is held to the slide L. This slide is one of the means of regulating the leverage imparted to the box, for if tapped out, the leverage is less, but if tapped in, it is increased. There are two slides and two levers to regulate the boxes at each end of the loom. Both slides cannot be shown, but both levers are visible, the one regulating the second box being at G and the one controlling the third box being at M and fulcrumed at N, the other being fulcrumed at P. When both work in unison, then the fourth box is brought level with the shuttle race. There are in all, five places where the leverage to the boxes may be altered.

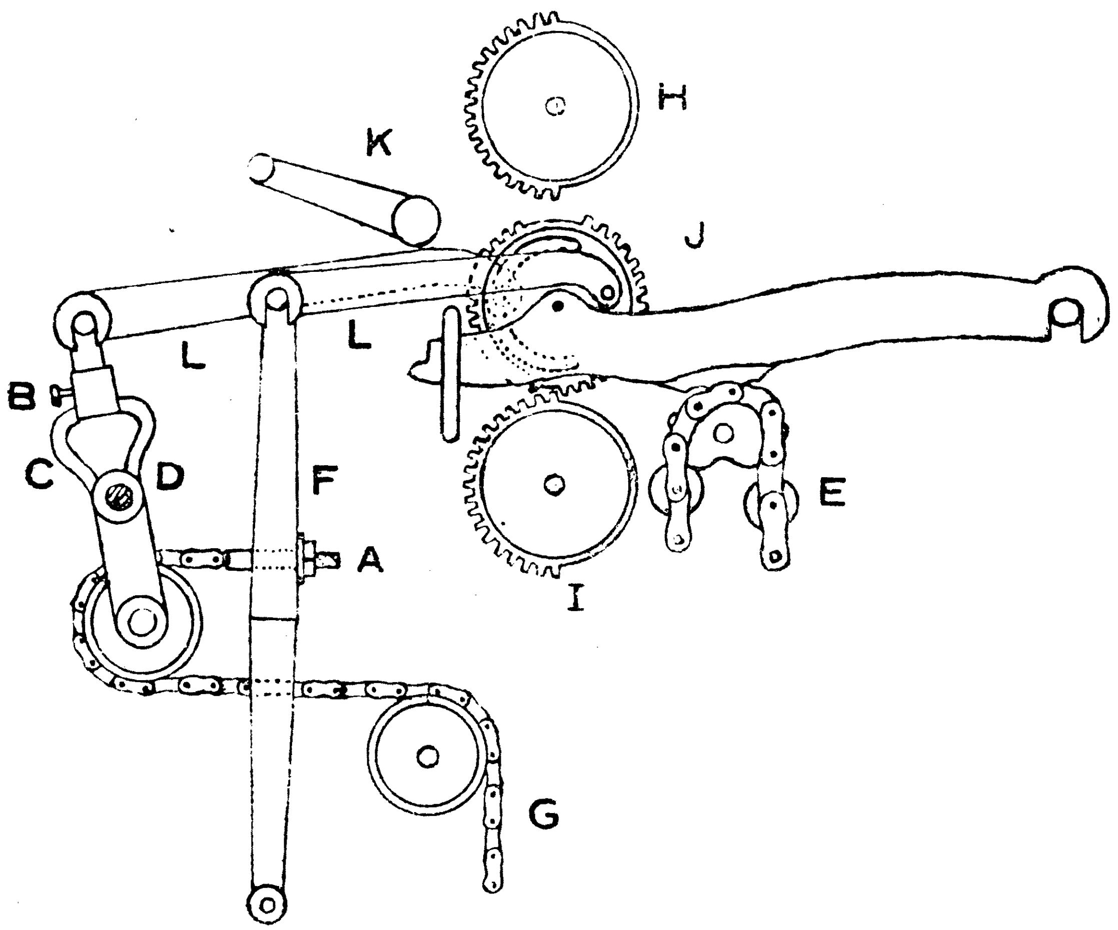


Fig. 270.
Dobcross Box Mechanism.

(1) By the slide mentioned. (2) By the stud at the top of the spring rod R, which is seldom molested. (3) By the stud on the box lever S which is shown at T. When placed nearer the fulcrum, the leverage to all the boxes is increased. (4) By the locknuts V at the bottom of the threaded end of the box rod W. These are used to bring the first box level with the shuttle race. (5) This cannot be seen in the

diagram as it is concealed by the box rod. It is by the stud on the outer end of the lever S, for the stud holds the connecting arm, the bottom of it being at U above the locknuts V.

A special difficulty arises after the loom has been running a few years. Most work for the boxes is confined to three boxes. When the fourth box is needed, it is found to lift too high. No amount of " halving the leverage " will make the box level, because the stud is least worn where the connecting lever rests when the fourth box is up. What can be done is to turn the stud half way round and reset all the boxes, if it has not been previously turned, or insert a new stud. In the older type of Dobcross box loom shown at Fig. 270, the box chains pass over several flanged pulleys like those at G. At A is the end of the chain which passes through the lever F and the higher it is set and the greater is the elevation given to the second box. At B is the slide, which, when tapped in gives greater leverage to the third box. The two acting at the same time control the fourth box. The stud for the third box is at D, but the stud for the second box is the pin that holds the flanged bowl at the bottom of the double lever C. In the Hodgson drop box loom, it is a gain to alter the long star wheel rods so the weight assists the alteration. The levelling for the first box is best and the easiest performed by the locknuts at the back end of the swing lever instead of by the locknuts at the base of the box rod.

Extra Roller Work.

One of the many ways of making woollen and worsted fabrics more attractive, is by introducing coloured twist threads. Cotton and worsted are often twisted together, the most prevalent colours of cotton being blue, yellow, red, or light brown. The choice of colour chiefly depends in what colour the fabric will be piece dyed.

The colour of a twist thread is halved by the twist, and reduced to a quarter by an even weave. As the shrinkage of woollen, worsted, cotton, silk and rayon are each different, it is prudent to have the twist threads wound on a separate roller to be let-off independently. If cotton or rayon be woven too tightly, they are liable to " crack " in finishing.

When threads are thicker or thinner than the ground threads, these too must be woven from a separate roller.

Rope Wrapping for Light Work.—This is outlined in Fig. 271. A is the upper cross rail of the loom, and B the holding hook for brake rope C. D is the weight that has to conform to the correct speed of roller. E is the roller and F the extra threads that pass under rod G on their way to the healds. H is the ordinary back rail, with I the ground warp.

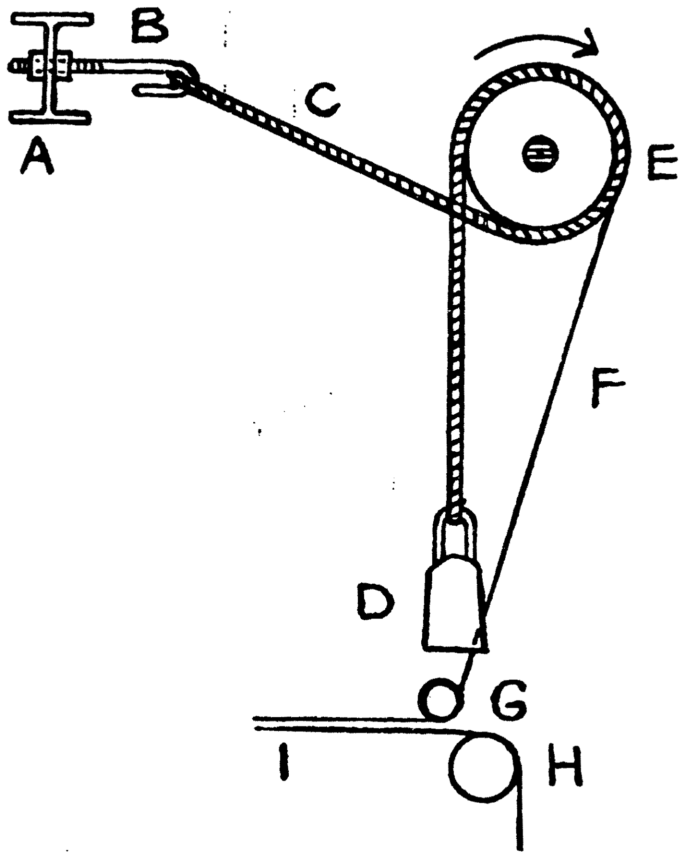


Fig. 271. Weighting Light Roller Work.

What is of importance is how the rope is wrapped, and which way the roller turns. Rope C does not make a complete turn on the collar of the roller, and gives a lighter and easier braking of the threads.

The weight end of the rope must always pass on the inner side of the wrapping, to prevent it working off, or being knocked off the collar.

The roller turns *away* from the weight. This imparts resiliency to the unwinding, for as the roller turns the weight is lifted a little, and then drops back. To obtain the best slippage, the frictional side of the rope is rubbed with block blacklead.

Rope Wrapping for Heavier Work.—In Fig. 272 the rope is wrapped $1\frac{1}{2}$ times round the collar, and the arrow indicates roller movement. The way the roller has to rotate, has to be decided before looming takes place.

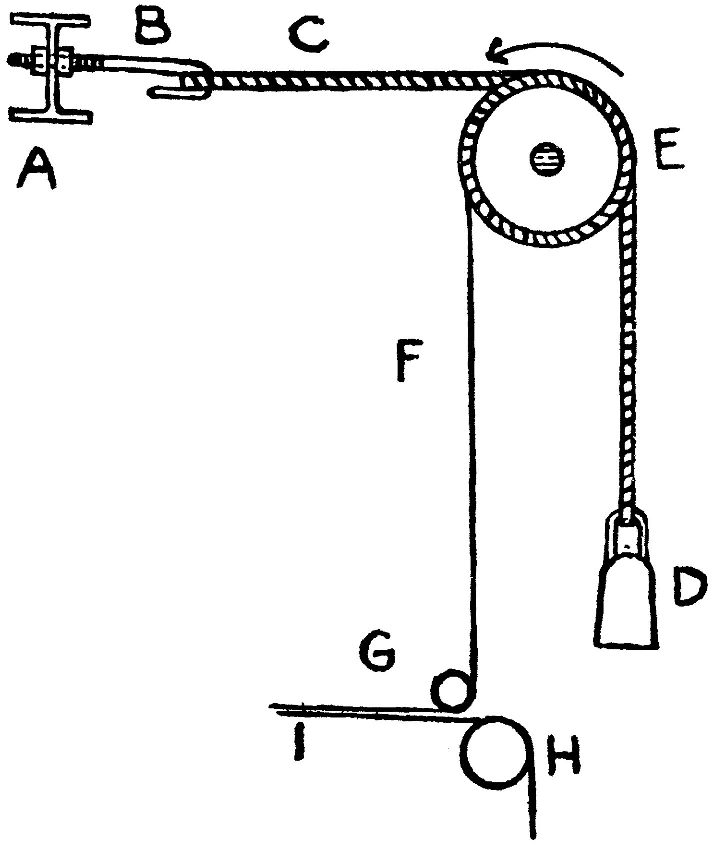


Fig. 272. Braking Heavy Roller Work.

One rope may suffice if the threads are not numerous, but if they are, then a rope is needed at both ends.

In any adjustment, the coils of the rope have to be kept straight, for if locked, the whole of the extra threads may be torn out. The turn of roller and the placing of weight are the opposite way to the previous example.

Front View of Roller.—In Fig. **273**, roller A is turned as arrow B, and C is the gudgeon in the holder bracket D. The metal roller collar E and the rope wrappings show the weight length on the inner side of F. At H is the packing to prevent the roller making lateral movement. The holding brackets are all the better for being wider than the beam, for at times, the winding does not conform to the ground threads. The extra space allows of the best spacing of the roller.

Measurement for Relative Speeds.—A correct amount of brake weight has to be obtained as soon as possible, and a system of checking arranged. A good method is outlined at Fig. **274**. A starting line is made at A, and a finishing line a yard below. A few spare threads from the ground warp at D are wound on bobbin E. As weaving proceeds, the threads at B are wound on spool C, and spare threads from the roller cloth are examined to see that no curls are made by slackness, and tightness is found by pressing the edge of the

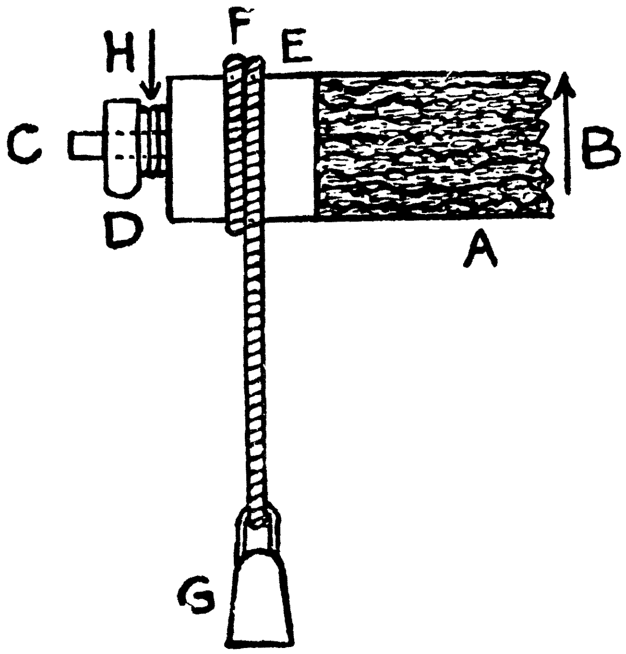


Fig. 273. Correct Rope Wrapping.

hand downward on the cloth, for then ridges are felt, and brake weight reduced. When the heads of the bobbins have reached the lower mark, the distance between them is measured, and any necessary adjustment is then made.

Other Yarns.—When silk is used on the roller in connection with woollen or worsted ground warp, the silk must have a thin false reed wire placed at either side of single threads, or a group so as to show them clearly in the cloth. The loose fibres on the ground warp drag at the silk, make it slack, and it appears and disappears in the fabric and spoils it. The false reed wires prevent this.

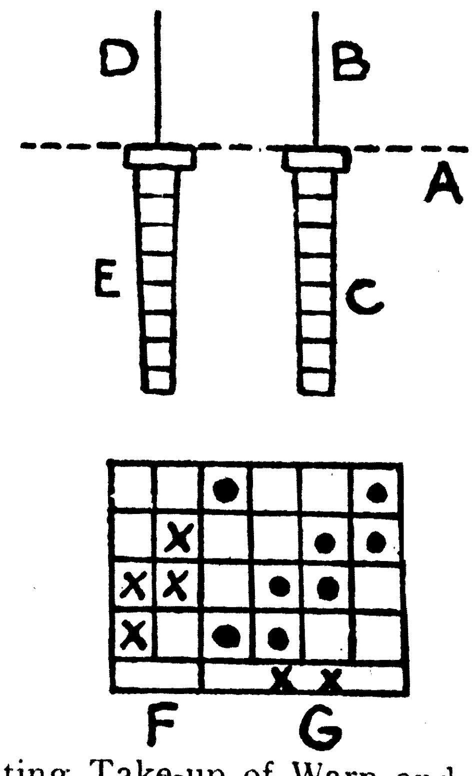


Fig. 274. Testing Take-up of Warp and Roller Threads.

Filament rayon has to be kept as free from friction as possible. If the threads are chafed, the broken filaments are pushed back by the reed and form " buttons." What has to be done is to pass a rod underneath all the rayon threads and draw them forward while the weaver turns the roller. The buttons have to be individually threaded through the reed. A few picks may be woven by means of the balance wheel to fasten them down, and the shafts bearing the rayon have to be elevated to make them clear the shuttle race. Suppose rayon is drawn on the first two shafts as suggested by crosses in Fig. 274, they will be on shafts G, and these must clear the running board at back centre.

Thread Interceptor.—This has proved to be a valuable aid on the Northrop loom in preventing unwanted strands of weft getting into the shed. It was invented at the firm of Messrs. Henry Lister & Sons Ltd., Troydale Mills, Pudsey, Leeds, Fig. 275. A is the lever on the change shaft which moves arrowward as B, when bobbins are changed in the

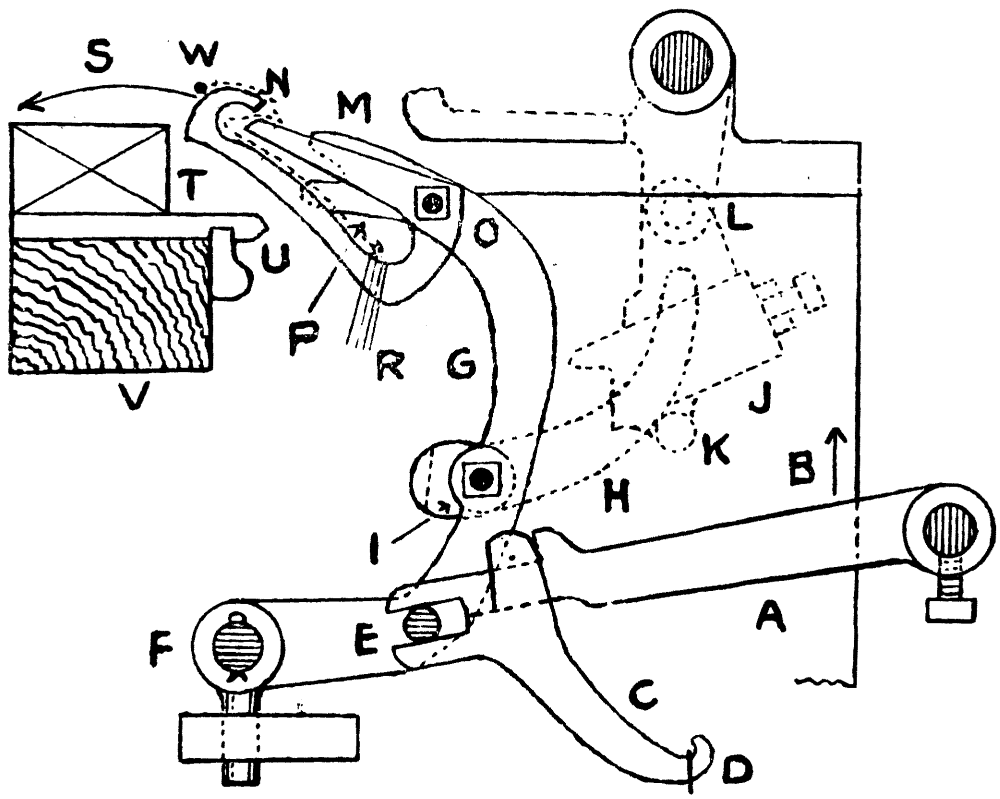


Fig. 275. Weft Interceptor.

shuttle. C is the spring lever, the spring being hooked at D. At F is the fulcrum of the protector G, and E its pin by which the protector is moved by lever A. At I is the fixing point for the latch depressor H that exerts pressure on pin K when the shuttle is not properly in the box at transfer.

The battery latch at J swings on its pivot at L, and M is the bifurcated end of the shuttle protector. N is the hooked end of the thread interceptor that is bolted at O to the shuttle protector.

The interceptor is pear-shaped and made of mild steel, its total length being four inches. It is made with a slot at P, that is $3\frac{1}{4}$ inches long. The hooked end N is $\frac{3}{4}$ inch in front of the protector, and when both are pushed forward, and the reed is at its front centre as at S, the front of the interceptor is only $\frac{3}{4}$ inch in front of the reed.

The interceptor cannot be set backward or forward, but can be moved up or down. It is set so that when the protector is at its full forward traverse, the strand of weft is not below the centre of the hooked end of the interceptor. When so arranged, the forward movement of the reed, conveys the weft over the hooked end, and deposits it on the sloping upper part.

As soon as the protector moves backward, the weft slides into the hooked end, and there it remains until the cutter in the temple head severs the weft.

As the interceptor is tilted upward as shown after being moved backward, the weft slides down the slot to the position at R, and is then quite out of the way of being dragged into the cloth.

The path of the weft traverse is indicated by the dotted line W.

T is the shuttle box, and U the bunter that meets the battery latch when the transfer of bobbins take place. V is the going part. There is no weft cutter at the mouth of the box, and the weft waste in the interceptor is removed by the weaver.

When inspected by the writer, it was doing excellent work in the weaving of army blankets.

WASTE REDUCTION IN WEAVING.

All weaving yarns go through an elaborate process between the raw and finished state, which increases the cost per lb. considerably. As a matter of business principle, all conscientious workers endeavour to convert the maximum amount of yarn into saleable cloth. The less waste is made, and the more is gained in output with the same expense of labour and machinery.

As waste is valued at about $\frac{2}{3}$ less than the cost of yarn, there is a drop of $66\frac{2}{3}$ per cent. between the yarn on the bobbin and the waste in the basket. The question therefore arises as to ways and means of preventing excess waste.

Structure of Bobbin.—When a weft bobbin is properly grooved; it is a good foundation for the weft to rest upon.

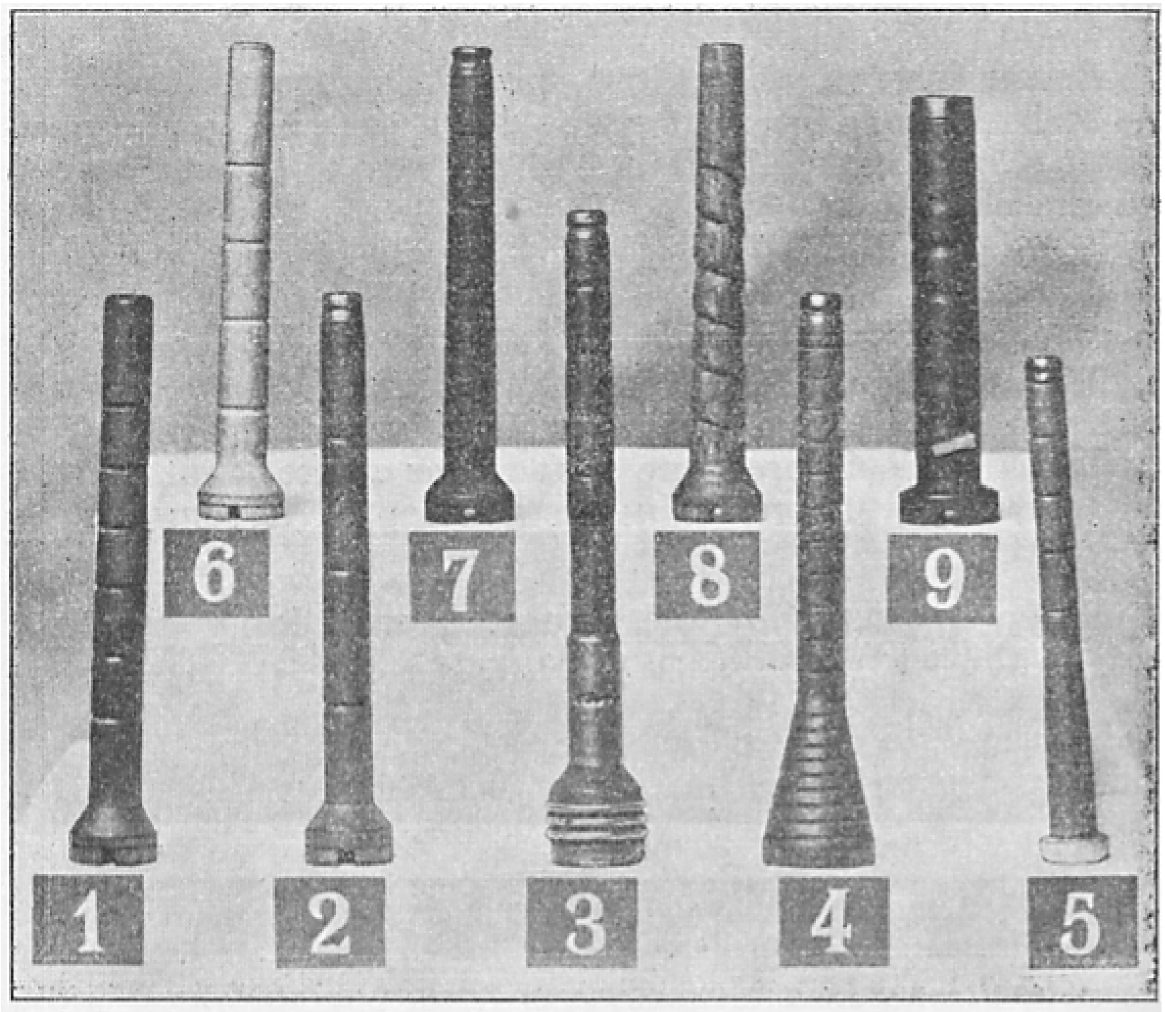


Fig. 276.
Styles of Weft Bobbins.

A 7 inch bobbin that has only three grooves is a prolific waste producer, and a profit destroyer. Such a bobbin is shown at No. 2, Fig. 276. A 6 inch bobbin for woollens should never have less than 5 grooves equally distributed on its shaft, and a good thickness for its shaft is $\frac{11}{16}$ inch from base to summit. This size gives ample wood for 6 grooves, which is an improvement on the five. This style of bobbin is presented at E, Fig. 277. A 7 inch bobbin of the thickness mentioned can have 8 grooves, and is an excellent bobbin.

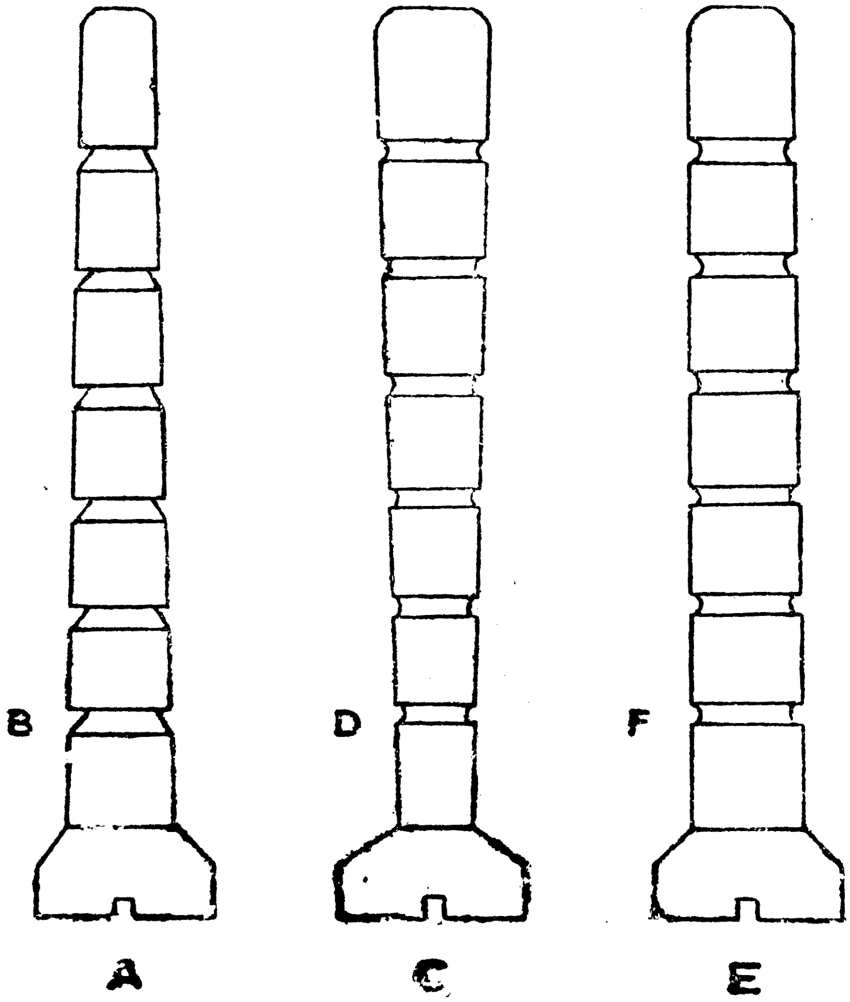


Fig. 277.
Structure of Weft Bobbins.

The best kind of groove is semicircular. The one formed like an inverted **L** at B, on the bobbin marked A, would appear in theory to be a very good groove to hold the weft, but it is not. If the coils move at all, they are wedged fast, and the weft is constantly breaking during weaving.

The bobbin C has a reverse taper on the shaft to the one at A, and is claimed to be a non-slough bobbin, but it has not been generally adopted.

Another style of groove is that with a spiral groove at No. 8, Fig. 276. This has 6 turns on 6 inches. It was found to be too chippy for fine work, but was good for the medium or low skein woollens. Metal tipped bobbins as at Nos. 2 and 7 are not a necessity, and fine grooves as at No. 7 are only useful for the finest weft. No. 3 is the well-known but costly Northrop bobbin, and No. 4 the Universal winder spool, and No. 5 one kind used for cotton. At No. 9 is the substantial worsted spool, tipped with metal.

Winding of Yarn.—However perfect the bobbin, its advantages are nullified for the time being if the weft is too slackly wound. Slack spindle bands also cause slack weft. The nose of the bobbin is an important factor in reducing waste, for long nosed winding gives better results than a short one. A short nosed bobbin D is 1½ inches, but a long one E is from 2 to 2¼ inches. The width at the base of the coils is the same in both, but the inclined angle is less severe in the long nose. When the weft is well wound, there is less waste made with a 7 inch bobbin than with a 6 inch. (Fig. 278).

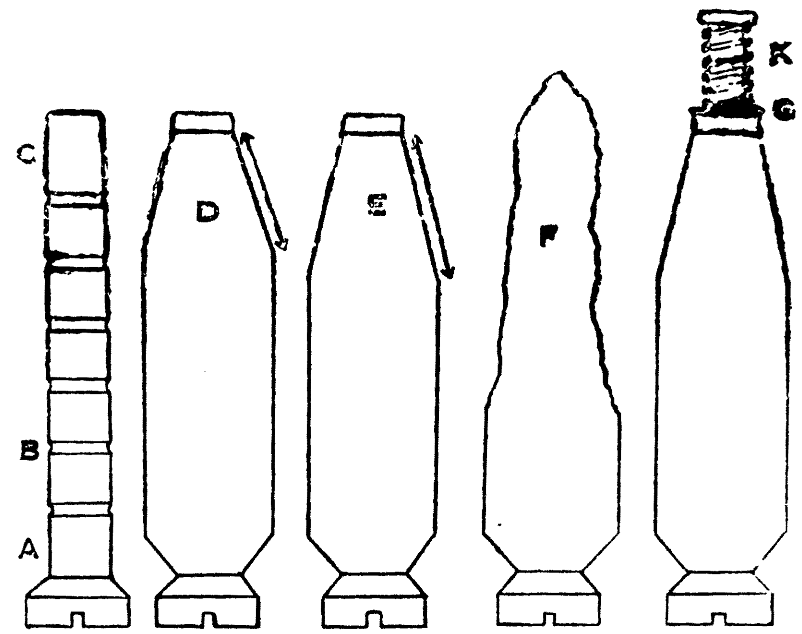


Fig. 278.
Prevention of Weft Sloughing.

Mule spinners are provided with a gauge fork, or a ring to test the diameter of the yarn on the bobbin. When too bulky, the weft binds against the inner sides of the shuttle. To make the weft weave, the inside of the shuttle has to be scraped, which weakens it.

Adjustment of Loom.—When well wound weft sloughs during weaving, it is chiefly due to hard picking from the right side of a left hand loom. When the coils collapse, as at F they do so owing to the bump of the shuttle against the picker in the left hand box. Coils collapse towards the nose of the bobbin, and, to a certain extent, are driven on towards the head when weaving.

In the overpick motion, harsh picking is mainly caused by the picking nose being too pronounced in its curve, and is modified by rounding the end off. Its power may be decreased by giving more length to the picking strap, or, when possible, by setting the stick a cog further back. In the under pick of the Dobcross type, the thick strap round the picking stick is elevated, or the picking shoe is set further back a quarter inch.

The checking of the shuttle is also partly responsible for the sloughing of the weft. The shuttle is travelling at a good rate of speed when it enters the box, but is slowed down by the friction of the box side, the box swell with its spring pressure, and by the picker and its check. When the blow against the picker is nearest the nose of the bobbin, the weft has a tendency to slide forward. The higher the speed of the shuttle when it enters the box, and the more severe is the blow of the shuttle on the picker, and the greater the possible disturbance of the weft. What has to be done is to either increase the amount of check, or decrease the picking power, or modify both. As force is the chief factor, it is usually reduced unless the checking is too slack. It is reduced consistent with preventing the loom banging off.

As showing the importance of keeping the coils of weft in their weavable position, a 7 inch bobbin carrying 34 skein yarn will weave 4 inches of cloth 72 inches wide with 40 picks per inch. This would give 320 yards of weft on a bobbin. In ordinary weaving, not more than 6 yards per bobbin need be turned to waste. If such a bobbin were to slough almost at the beginning of weaving, it would make as much waste as 50 good ones.

Fig. 278 shows a standard woollen bobbin, 6 inches long having 6 semi-circular grooves. The bobbin on the right is fitted with a loose spindle. On it is the washer G to prevent damage to bobbin nose, and above it at K is an open spiral spring which takes checking shock, and prevents the weft from sloughing.

Weft Fork Assistance.—Weft forks play their part in waste reduction. When in order, it should stop the loom within two picks of the weft breaking or running off. In most factories, an allowance is made for three picks to be missing out of a piece, but beyond that there is a possibility of a fine being imposed. Rather than be fined, the weft is pulled out. (*See* chapter on weft forks).

When weft runs off and the fork is out of order, the loom continues to run until stopped by the weaver, but if the weft breaks and catches on again as is often the case with poor or soft twisted weft, the picks have to be pulled out.

Cut weft is different, for poor weft leaves a trail of fibres at the end, but cut weft is shorn as with a pair of scissors. It is usually cut in the box by the weft dropping down between the shuttle and box side. It is prevented from doing that by making the inner box front of plain tappet and dobby looms slope at the same angle as the shuttle front. The feet of the box are packed with tapered cardboard. (Fig. 193, Page 255).

The good condition of the weft fork is all the more demanded when a weaver has to attend to several looms.

The tumbler weft fork cuts the weft when the prongs do not fit through the centre of the grate.

Missing Pegs.—Wooden pegs have the excellent advantage of wearing the under side of the feelers very little in years of service. They have the disadvantage, however, of drying in during hot weather, and then dropping out. Before any set is placed on the loom, every peg should be tested with the finger and thumb to see they are secure. Long lengths have to be prevented from swinging, and should have as few bends as can be arranged. The worst weaves for pegs missing are warp backed cloths and double cloths. If a peg be missing belonging to the back cloth, a couple of yards can easily be woven before a discovery is made, for in all looms, the cloth back cannot be seen until it reaches the cloth beam, unless the piece is slackened, and taken off the temple. Though in the back cloth, it may spoil the face cloth. No litter should be left on the floor underneath the lags, so that any dropped pegs may be better seen. Secure pegs saves much time, labour and waste.

Wrong Lifts.—A wrong lift is made when a shaft is up when it ought to be down, and down when it ought to be up. Worn bushes in the Dobcross loom may be packed with band to prevent two levers being actuated with one bowl. In looms using wooden cylinders, the ends become worn and give too much play to the lags. New ends are best, but as a temporary measure, the end pegs of groups, and both sides of single ones may be pared down to prevent them touching too many feelers. Short needles, short pegs, worn hooks on catches, and wrong timed cylinders are some of the causes of wrong lifting.

The more complicated the weave, and the darker the colour, and the less chance there is of making an early discovery if something is wrong. Such defects in cloth have to be made good by the weft being taken out, but if too much has been woven, it goes forward as a damaged cloth. If time will allow, a periodic overhauling of the dobbies is an all round gain.

Tearing at Temple.—Weak weft is usually responsible for the cloth being torn at the inner end of the temple, and it is mainly woollen weft. Most woollen and worsted cloths are woven with temples having 10 rings. Now pieces contract most at the selvedges. If a cloth tears with such a temple, the picks may be reduced to ease the tension, but the real remedy lies in having a temple that reaches further into the cloth. What cannot be done by a temple having 10 rings, is safely performed with one having 15 rings. (*See* chapter on " Temples.")

Bulb-nosed Weft.—In worsted weaving there is seldom any sloughed weft, owing to the high speed of winding the yarn. Such compactness greatly assists in overcoming the shocks of weaving. What weft does slough is single twist, and what bulk of waste is made is through the wearing of the heart-shaped lifter cam having become flat in one place, which keeps the lifter stationary. The winding then takes place at the same spot. Such winding cannot well be woven. When bobbins are wound too full, or wound too much on the head, more waste than by proper winding will be made.

Clean Yarn.—This is a great aid to a high per cent. of weft being woven. Burrs, slubs, pieces of waste, long ends on knots, single yarn instead of two-fold, crushed bobbins, and soiled weft for delicate colours, are all waste makers.

Cracked Bobbins.—Cracked bobbin ends may be held together with wraps of cotton, but if the weft can be woven off, the bobbin should be broken up after. In worsted shuttles, the welded tongue used to be a prolific source of bobbin breakage. The more flexible curved spring is a great improvement.

Ravages of Moths.—Stored yarn spoilt by moths, and not too badly damaged may be partly woven, but it saves much of the weaver's time if it is rewound. Wormwood is one preventative, flaked napthalene another, but eulan is about the best means of preserving the weft.

Warp Waste.

Whilst warp waste never approaches the dimension of weft waste, it is most made in the fancy woollen and worsted trade. One cut orders means considerable resetting in the warping creel, and extra waste is made by looming or twisting, as well as starting and felling the warp. Lengthy warps are better than short ones in this respect.

Warping and Beaming.—Accurate clock work in automatic warping machines curtails waste. Defective beam bands and too few bands may mean the loss of a yard or more of cloth. The reasonable position of lease bands and lease rods is of some consequence in yearly reckoning. The proper weighting of the warp beam before twisting, and the commencement of weaving as near the twistings as is safe to do, are each items for the prevention of warp waste.

Backed and Double Cloths.—The speeds of two beams contributing to the same cloth needs careful calculation, setting, and daily examination. Even if the warp be the same on the two beams, the one that does the binding has to be the longer. When there is the binding and also a drastic difference in the take up of the two cloths, careful management is imperative if the felling ends are to be together at the end of a 6 cut warp. The designer orders the different lengths of warp, and the overlooker makes the calculation, sets the weights, and measures the initial speed marks when weaving in. Waste reduction implies good workmanship both before and during weaving. (*See* Figs. 291-2-3-4, Page 385).

THE WEAVING OF TYPICAL DESIGNS.

Both warp, weft, and weave, have each to receive due consideration if any kind of cloth is to be woven with credit. Loom adjustments that are admirable for one kind of cloth are unsuitable for another. Experience decides. Weaves are here presented along with suggestions that might prove helpful. The simplest designs are omitted, but their treatment is included.

Floats for Worsted Weaving.—As an approximate guide for the making of designs in relation to the yarns to be used, the following particulars are given:—

Floats.		Minimum Counts.
4	......	2/36
5	......	2/48
6	......	2/60
7	......	2/66
8	......	2/72

Plain Weave.—This is the simplest of weaves, but not so easily managed. For most cloth produced with this weave, four things are required.

(1) *Timing of Shed.*—In an ordinary dobby loom, the shed has to be timed fairly late, for if soon, the bottom shed rises too quickly from the shuttle race, which is likely to cause stitches near the selvedges, broken threads, and tilts the shuttle before reaching the box. If the warp be tender, the shafts should not cross each other until the reed is almost in contact with the fell of the cloth. There is then much less drag on the warp.

Poplins are woven on four shafts in a tappet loom, and with two pairs of plain tappets. They are set in relation to the crank so the two back shafts are level when the crank is at its top centre: the two centre shafts level when the crank is midway between the top and front centre, and the two front shafts level when the reed is within an inch of the cloth. This relieves considerable friction on the warp.

(2) *False Reed.*—This has been fully explained elsewhere, and reference may be made to Fig. 302, Page 398.

(3) *Lease Rods.*—Front shafts make a less shed than the back ones, and to equalise the tension on the warp, lease rods are placed in the back shed as given at Fig. 303, Page 399.

(4) *Good Temples.*—Pieces contract most at the selvedges, and the more intersections there are in one repeat of the weave, and the greater is the shrinkage. The use of temples are fully explained in Chapter on temples.

Hopsacks.—When the warp is all one colour, it may be woven with an ordinary sley, but if there are colours in single threads, they have to be woven with a double sley when the back reeds are in the centre of the gap in the front one. (*See* Fig. 2).

Angles of Twills.—These are at Fig. **279.** There are nine, and each is given its degree. The **45°** is the most common, but all have their uses.

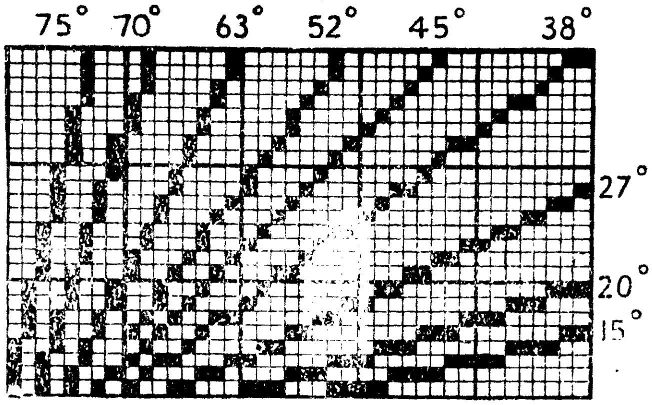


Fig. 279. Angles of Twills.

Ordinary Twills.—Twills like the 2 and 2 and the 3 and 3 are fairly easy to weave unless overcrowded with picks. The following points for their production are advanced.

(1) Except for fibrous warps, the timing of the shed is late to avoid stitching at the edges, and especially if the picking is weak at either or both ends.

(2) In pieces of light weight, and woven with a negative let-off, the weaver should observe the motion of the warp beam. Any holding and sudden jerks should be mentioned at once to the overlooker, for such an unsteady motion spoils the cloth.

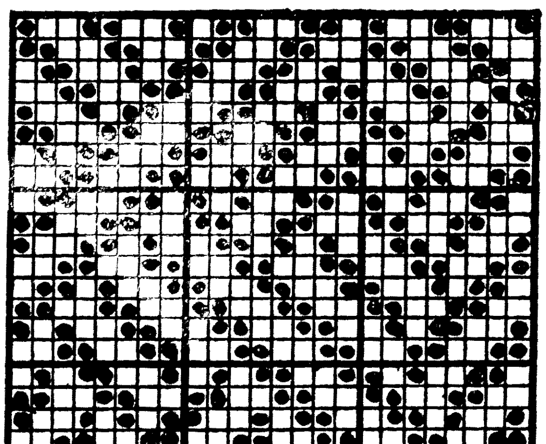


Fig. 280.
Diamond Twill.
(No Duplicate Picks).

(3) In heavy work, good temples must be used to keep the fell of the cloth at the same width as the warp in the sley.

Diamond Twills.—These are excellent variations of the 2 and 2 twill. Fig. 280 is on 24 threads and picks for one repeat, and, contrary to most, has no duplicate picks. There is therefore no excuse for making broken patterns after extracting picks.

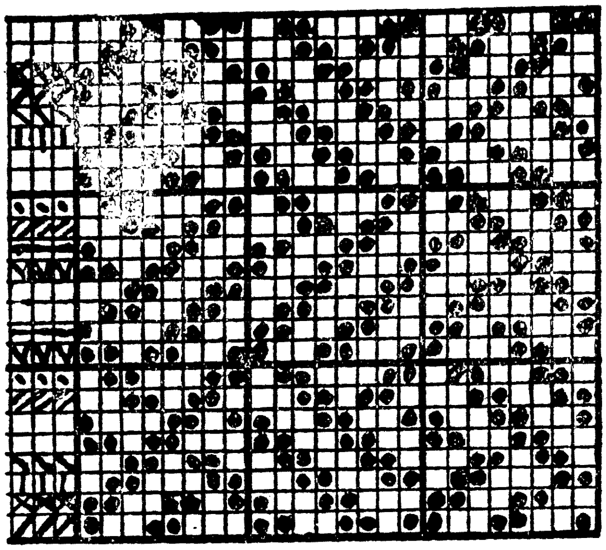


Fig. 281.
Diamond Twill.
(With Duplicate Picks).

Fig. 281 is built a little similar to the previous example, and is on the same number of threads and picks, but in it there are 12 duplicate picks. These are marked on the left of the design, each kind of mark having the same lift. Such weaves ought only to be woven by experienced and careful weavers. To avoid wrong patterns, the following plan is suggested. (1) The 5th lag of the series is marked, because this has no duplicate. (2) When this lag operates, the position of the shafts are marked on the loom front. (3) Before any combing out takes place, the marked lag is brought into play, and the shafts are checked by the numbers on the loom. (4) The combing out must pass beyond the defective place until the pick is open, and this pick is left in the cloth. (5) When the cloth and warp have been adjusted, the loom is ready for weaving.

In some diamond weaves every pick has duplicates, and such weaves demand the best weavers and the best condition of the weft fork.

Twills with Heavy and Light Lifts.—This kind of weave is demonstrated at Fig. 282, the pegging particulars being lift black. In picks one and two, 6 shafts are lifted out of 16, but on the third pick, 12 shafts are raised. The average lift for the three picks is 8 shafts, which gives equal quantities of warp and weft on the face. The shafts, however, have to be set different to a regular twill. The shafts are set for the bottom shed when the heavy lift takes place, for this pulls the bottom shed higher, and when set, should be a little above the shuttle race. If set lower, too much friction is placed on the threads by the shuttle race, and " buttons " are formed on the front shed. They may even form when the shafts are well set. On their first appearance, a " sweeper " is made of coarse listing. The

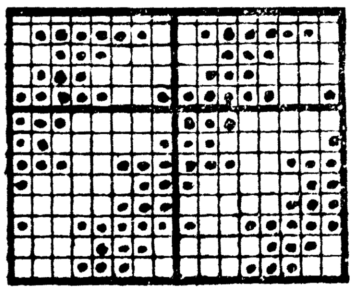


Fig. 282.

length of it has to be longer than between the swords. The "sweeper" is tied level to the swords, and when the crank is at its front centre, it should be slack enough to reach the first lot of healds. This method collects some of the loose fibres, and sweeps others to the floor.

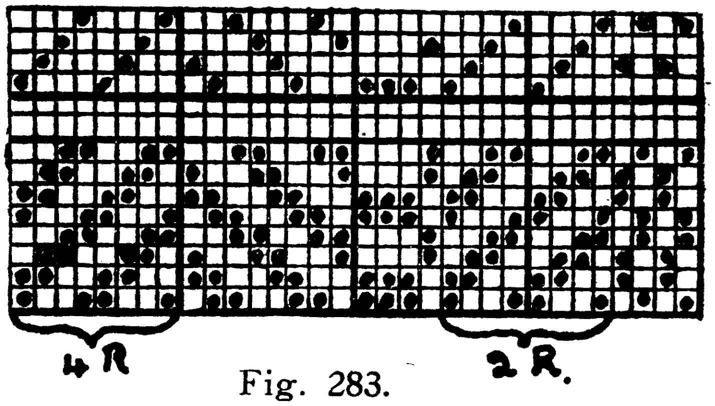


Fig. 283.
Fancy Design and Draft.

Fancy Drafts.—In the fancy woollen and worsted trade, elaborate patterns are woven on few shafts by drafting and pegging.

Fig. 283 is one of the simpler examples. Though on 4 shafts, it takes 64 threads to complete the pattern. The upper section is the draft, and the first four threads on the left of the design is the pegging plan. To keep such cloths free from mistakes there are 5 safeguards. (1) A draft with special threads marked is supplied the weaver. (2) A few inches of contrasting weft is woven at the beginning of the cloth, and a full pattern is sent to the designer to pass. (3) Before proceeding, every shaft is separately lifted and all the threads examined. (4) The lease rods are left in the back shed. (5) A full width strip of cloth from the starting of weaving is sent to the designer.

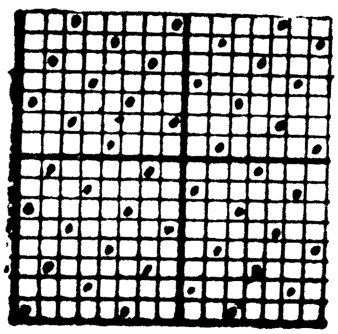


Fig. 284.

Sateens.—For woollens, the 5 and 8 shaft sateens are the most popular, but for worsteds and linings, a larger number of shafts are used. A 5 shaft is woven face up, but the 8 shaft and those above are produced back up as missing threads are quicker seen. Care has to be taken to see the lags are pegged right.

Fig. 284 is the 5 shaft sateen back up and twilled to right, the pegging particulars being lift black. There are two other matters. (1) There must be a fresh setting of the back rail. If only one shaft out of 5 is now lifted, the most tension would be on the raised threads. It is transferred to the bulk of the warp by elevating the back rail. (2) The selvedge threads must be woven different to the warp or the cloth would roll badly when liberated. The selvedges are woven on separate shafts weaving 3 up and 2 down on one shaft and 2 up and 3 down on the other, along with a catch thread. To make the selvedge rather slacker and for 10 lags, it would be pegged 3 and 3, and then 2 and 2.

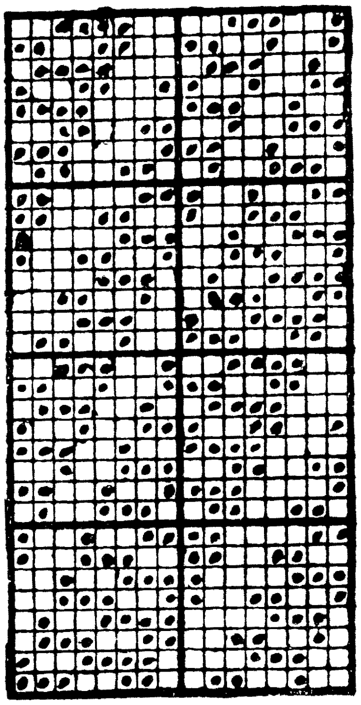


Fig. 285.
Whipcord Design.

Whipcords.—These are constructed from two ordinary twills on the same number of threads and picks. One design is placed on all the odd picks, and the other on all the even ones. The ordinary twills give an angle of 45 degrees, but the new design is at least 65 degrees, and entirely different in appearance. In Fig. 285, the strong twills are made with weft, and the low angled cross twills with warp. Such goods require good tension in weaving, and the cloth is given a clear cut finish to show the weave. The selvedges are woven on separate shafts. Design 286 is a contrast, the pegging particulars being lift black.

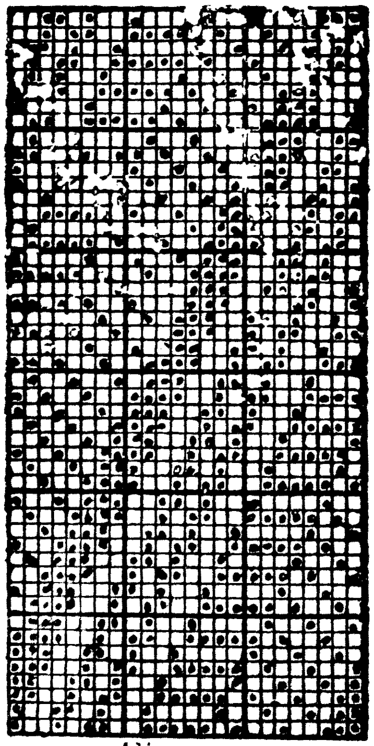


Fig. 286.
Whipcord Design.

Corkscrew.—These are difficult to weave owing to the amount of plain weave the weft way of the design. The 13 shaft corkscrew is at Fig. 287. The warp has to be well tensioned, good brushes in the shuttles, and the shed as early timed as possible. The tension required involves well gripping temples.

Cloths Backed with Weft.—This is the cheapest way of adding weight to the cloth. Fig. 288 is for one face and one backing pick, and requires two boxes at either end of the loom. The pegging particulars are lift white. The face cloth is 2 and 2 twill and the backing cloth 3 and 1 twill. In making the box lags, it is better for the weaver if the backing weft runs into the top box where she stands, and goes into the second box at the other end of the loom. As the backing weft runs off quicker, and may be black or brown, it is much better observed. Face lifts and face picks must go together on the cylinders.

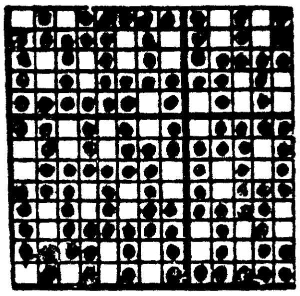


Fig. 287.
13 Shaft Corkscrew.

Cloths Backed with Warp.—These are of better quality than those backed with weft, and may be woven in a plain dobby loom, but it must be fitted to take two beams. Fig. 289 has a 13 shaft corkscrew face and a 13 shaft sateen back. In addition to the points about corkscrew weaving already given, there is the additional one about the respective speeds of the two beams. Having ascertained how much quicker the face takes up in comparison to the backing, a yard is measured from the fell of the cloth, and both warps are then marked at that spot. The difference between the two is then measured just before the marks are woven into the cloth, and the weights adjusted if not correct. This has to be carried out daily.

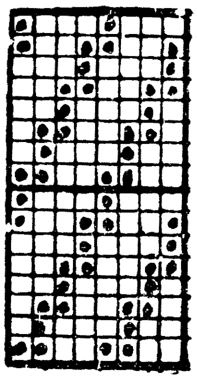


Fig. 288.

Double Cloths.—One of the simplest and lightest makes is given at Fig. 290. The face weave is 2 and 2 twill, and the backing weave plain, and stitched to the face in 8 end sateen order.

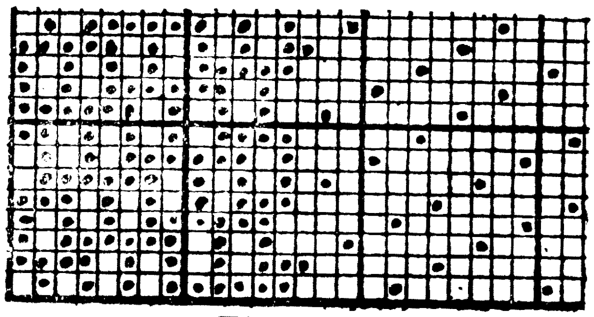


Fig. 289.
Cloth Backed with Warp.

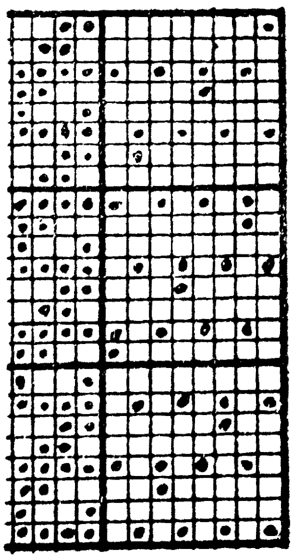
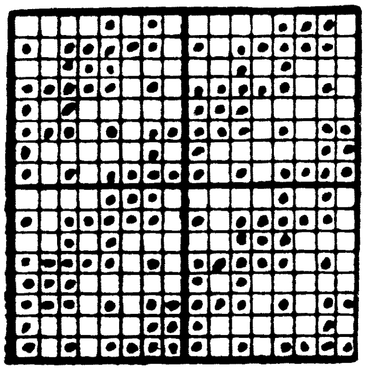


Fig. 290.
Peg Plan.

There are 2 threads face to 1 backing, and the same with the weft. Two beams are required though both have the same counts of warp. The weft is woollen and the pegging particulars are lift black. There are two settings of the shed, one being for the face weave and the other for the backing. The respective speeds of the beams have to receive attention. If woven in a negative dobby, the spring on the under motion may be weaker for the backing shafts. Fig. 291 is a proper double cloth, both cloths being 2 and 2 twill, the back one being stitched to the face in 8 end sateen order. The backing warp has to be longer than the face.

The face lift and the backing have to receive separate attention in adjusting the shafts.



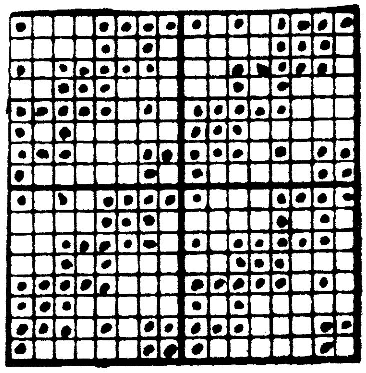
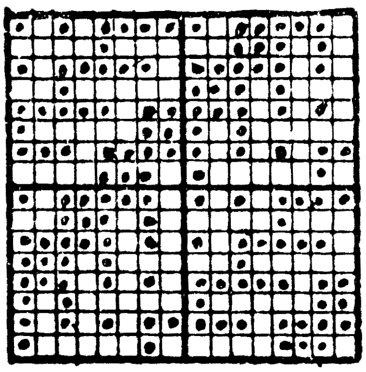


Fig. 291. Double Cloths. Fig. 292.

Fig. 292 is the same double cloth design as the previous one with the exception of stitching. In this, it is stitched backing to face, and face to backing in 8 end sateen order, and as the taking up is the same on each thread, only one warp beam need be used. Fig. 293 is a fancy twilled double cloth, for both face and backing weave are 3 up, 2 down,



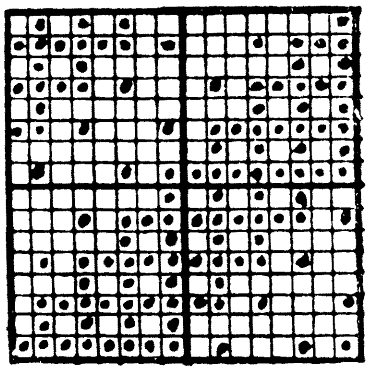


Fig. 293. Double Cloths. Fig. 294.

1 up, 2 down. The back is stitched to the face in twill order. If any fault is suspected in any backing cloth, the piece is slackened out, taken off the temple and examined.

Fig. 294 is the 4 and 4 twill weave for face and back, the face being stitched to the back in twill order, and is the longer warp.

FAULTS IN WOOLLEN AND WORSTED FABRICS.

The chief faults found in fabrics are herewith placed in alphabetical order.

Barry Places.

(1) *Cheese Bars.*—Made during warping by variation of tension in winding cheeses. Rectified during beaming by hand braking.

(2) *Letting-off Bars.*—Fig. 295 gives the negative chain

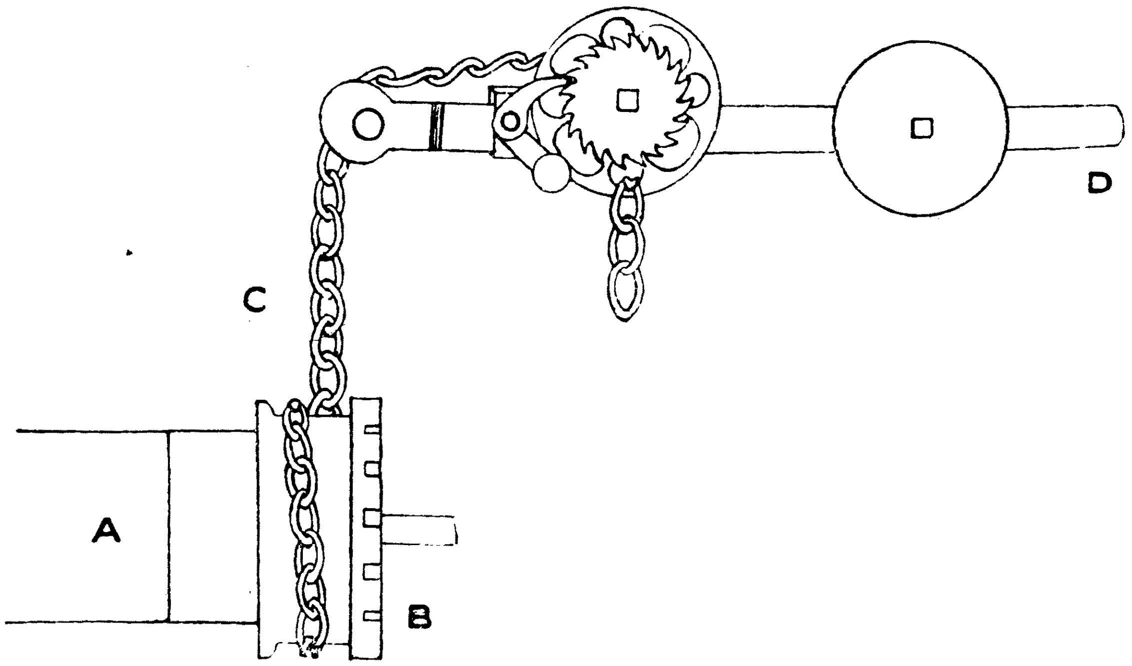


Fig. 295.
Negative Let-off Motion.

arrangement. Bars are made across the cloth by the erratic movement of pulley B. A good system is to clean chain C and pulley before beginning to weave last piece. It is then sprinkled with powdered graphite. Hattersley's positive motion is shown at Fig. 296. By wearing, catch C becomes shorter and blunter and misses cogs on wheel F. The catch is sharpened and the catch stud lowered a little. Back catch for reversing. At Fig. 297 the double catches used on the Dobcross loom are shown. To avoid barriness, one catch E must be half a cog ahead of the other on wheel F.

(3) *Mixed Weft Bars.*—Usually mixed by carelessness in spinning department. Should be discovered by different appearance in cloth, both colour, and angle of twill, and, when thicker counts, by the bumping of piece.

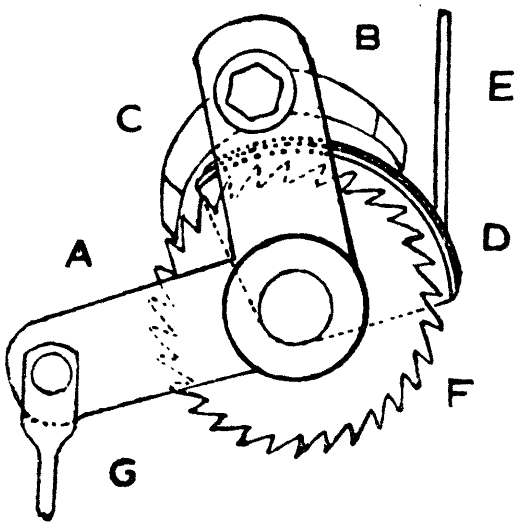


Fig. 296.
Hattersley's Let-off and Reversing Motion.

(4) *Taking-up Bars*.—In the negative motion (Fig. 110), by the slipping of pulling catch C, and also the holding catches not being half a cog distance between as at G and H.

In positive take-up (Fig. 268), when the leverage given to the pushing catch G is inadequate the chief offender is

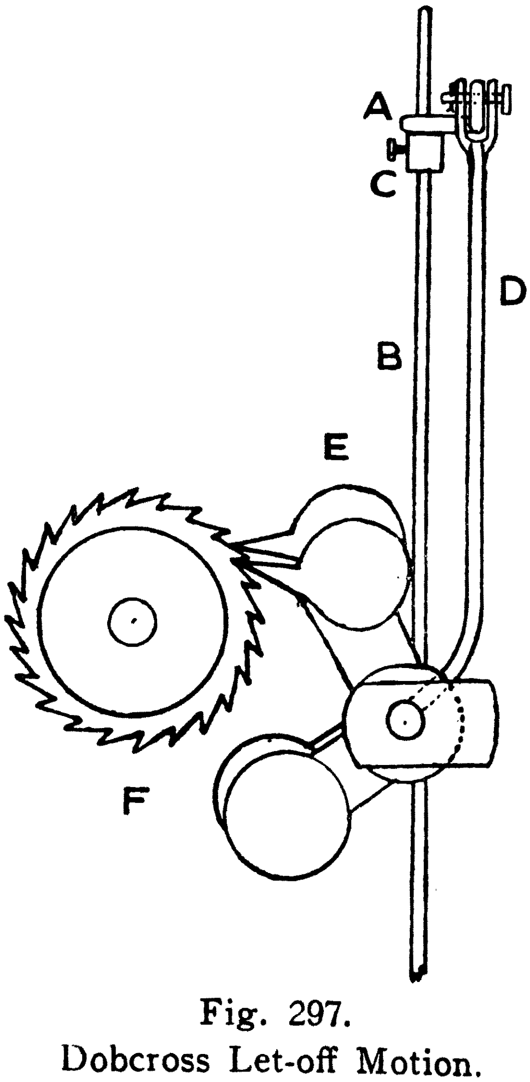


Fig. 297.
Dobcross Let-off Motion.

the holding catch L when it fails to hold the ratchet wheel F. This wheel is sometimes defective owing to snipped cogs. Occasionally the swan-neck casting drops, and has to be packed with metal.

(5) *Setting-up Bars*.—Due to inaccurate adjustment of cloth and warp after combing out by weaver. Light weight goods more subject than heavy cloth.

Bright Picks.—Confined to rayon. Made by stretching the yarn abnormally. A knot on the weft, a sunk shuttle spindle, or catching inside the shuttle, or a rough shuttle eye.

Broken Threads.

(1) *Healds*.—Defective eyes, or ravelled yarn on cotton and worsted healds. Broken mail eyes in wire healds.

(2) *Shed*.—When too large, too much tension placed on warp. When crank at back centre, shuttle top front to just clear top shed. In negative dobby loom, all bottom shafts to have double row of hooks for spring levers, for straight heald movement.

When on bottom shed, warp to barely touch shuttle race. Timing of shed to be in accord with warp and weave.

(3) *Shuttles*.—Rough shuttles to be rubbed with fine sand paper. Shuttle spindles to be held firmly, and loose tips fixed, or shuttle dispensed with. Cracked cross grained shuttles to be removed.

(4) *Sley*.—Rusty sleys treated with paraffin. Broken reeds removed and replaced with others obtained from end of same sley. Choked sley rubbed with paraffin and cleaned with carding. All sleys tested with straight edge for good running of shuttle.

(5) *Temple*.—Worn cap to be replaced as there is insufficient grip at selvedge. Must be set to miss shuttle race and reed.

(6) *Twist*.—Hard twisted yarns wear grooves on shuttle race if not well set by shafts. Such grooves snaps threads by their knots. Race filed when waiting for warp. Soft warps lack twist. Improved for weaving by damp cloth behind healds. Another improvement by mixing 1 lb. of white sugar with 1 gallon of clean water. It acts on warp like sizing, and no ill effects after. Hard twisted yarns working with others with less twist, best separated by broad heald shaft behind healds.

(7) *Warps.*—Over-dried warps sprayed with paraffin. Moderately fibrous warps treated with French chalk. Tender warps improved by Stephenson's wax rollers placed on warp beam. When finer threads in warp break, and are all on one or two shafts, those shafts decreased in lift, and the others increased. In looms having two beam racks, the beam to be placed in bottom rack to give longer length. Overdrafting responsible also for very weak warps.

Cracks.

These made by slack crank arms. On setting loom in motion, less momentum by going part. If cottering at limit, outer bushes can be packed with hard leather.

Curls.

Made by rebounding shuttle. By shed not being properly timed. Fig. 298 shows range of shed timing from

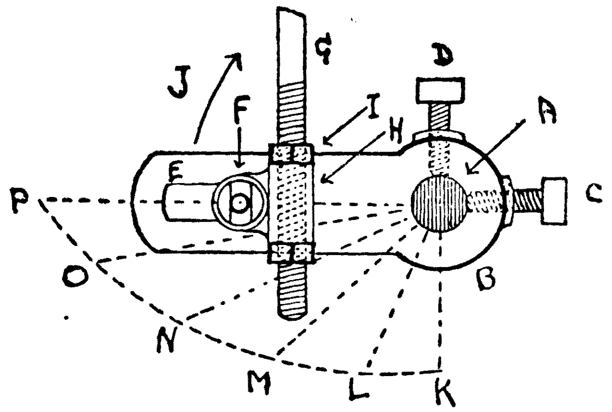


Fig. 298.
Timing Shed for Negative Dobby.

K to P, which is equal to quarter revolution of crank. It is altered by setscrews C and D on lever B fixed to shaft A. Weaves like corkscrews are timed early, and plain weaves timed late.

(1) *Shuttle.*—Smooth yarns like worsted and mohair, when the former is two-fold need a good Botany brush, but silk and rayon must have the shuttles fur lined. There should be the same drag on weft in both shuttles.

(2) *Warp.*—Worst kind for making curls is one close setted and somewhat fibrous. A double sley where back reed is opposite front gap is the most effective remedy. (*See* Fig. 2).

(3) *Weave.*—The one most subject to curls is the corkscrew owing to the amount of plain weave the weft way of the design. It must be timed early, be well tensioned, and shuttles have good brushes.

(4) *Weft Fork.*—Centre weft fork makes curls down cloth when cut on slide catches tippler. The prongs have to be bent down a little to hold prongs up longer.

Cockled Pieces.

Due to pressure between breast and cloth beams. A fruitful source is additional roller above taking-up roller. It accumulates waste, or strips of cloth or canvas, which exert pressure on passing cloth. The weft fork rod bracket is sometimes too low. Pieces are also cockled by unbalanced weaves. Another source is a marked variation in the amount of twist in the yarns.

Dirty Weft.

It may be soiled by long storage. Pieces destined for creams and delicate colours have to be kept exceptionally clean. Warp and cloth during weaving protected with brown paper. Picker spindles oiled with feather, and buffers made from dry leather. When weft soiled in box, usually the most effective cure is to make the inner box front slope at the same angle as the shuttle front. (*See* Fig. 193).

Double Picks.—Many due to carelessness of spinners. Others caused by too tender weft which breaks and catches on again. Some are left in the fabric by the weaver. Another source is the defects in the weft cutting mechanism on the Northrop loom. It has been greatly improved in this respect. (*See* Fig. 275, Page 370).

Fleaks.—Made by a number of threads being held together in front shed. They are easily formed in quick changing weaves such as plains and reps. Broken worsted and cotton healds are also responsible.

Heavy Pieces.—One cause is when yarns are spun to rather lower counts. The warp cannot well be altered, but picks can be reduced. Pieces woven beyond felling mark are checked by measurement.

Knotty Places.—A fresh setting in the warping creel may be spread out and cause little inconvenience. Heald traps cause many knots to be made, but a shuttle trap is about the worst. A weak shuttle spring, stop rod mounting frog, a bobbin left behind box swell and finger, a split shuttle, frogs not set further forward for tender warp, are causes for warp damage. Knotty places on worsted warps weave in much better with the aid of soap and water.

Light Weight Pieces.—By warp, weft, or both spun to higher counts. The use of wrong change wheel, or weight dropping off warp beam lever. Too short in length. Last piece of double cloths lack weight when speeds of warp beams not properly regulated, and length of warp left on one beam.

Loom Stains.—Droppings from top jacks. Surplus oil from shuttle springs. Excess oil from picker spindles. Marks from overlooker's hands in service under loom. Oil from shuttle guard and weft fork.

Misplaced Threads.—Every warp with fancy draft and a number of colours should have lease rods left in back shed. and weaver be supplied with heald plan. Threads on every shaft to be examined at commencement of weaving, and every dinner hour. A commencing strip of first piece to be supplied designer for examination. Reversed threads best discovered by weaving a strip of contrasting coloured weft.

Mixed Weft.—May be detected by vigilant weaver. If thicker, angle of twill higher, and piece will bump more. If smaller, the piece thinner, and angle of twill lower. If woven in grey, usually a difference of appearance in cloth. Mixed weft due to carelessness. All dropped bobbins best handed to weft man. Bobbins of old and new lot can be woven pick and pick if one set are marked.

Pegs Out.—All wooden pegs to be tested for firmness before being placed on loom, especially so in hot weather. Long length of lags, elaborate designs, and double and treble cloths need greatest care. No litter to be left underneath lags.

Picks Missing.

Three picks out of a piece is the usual allowance. Missing picks may be caused by:—

(1) *Weft.*—Soft spun to be woven with small brushes in shuttle, or none at all. Shuttle spindle level, and picking not too violent so weft coils not disturbed.

(2) *Shuttle.*—Cracked ones to be sandpapered or removed. Spindle block to be firmly held, and eye whole. Brush centrally grooved. Long worsted pirns checked by double length of loom cord. Cotton cops to be aided by side brushes, and rayon by fur. Shuttles held by turned up shelves to have frayed thrum pegged on shuttle front.

(3) *Box Side.*—Blow holes filed and polished. Plain box front to be made same angle as shuttle front. No nipping of shuttle in box.

(4) *Weft Fork.*—(*See* chapter on this subject).

Picking Over.—One cause erratic run of shuttle. Delivery wrong, or shuttle hump-backed, or reed not straight. Late picking by strap not right length, or picking nose too weak, or shell having slipped. In horizontal pickers, underside wears and delivery alters. (*Sec* Figs. 195-196).

Reed Marks.—Bent by careless shuttling, loose tips, and bumps by bobbins. Reed marks showing for lack of cover in fabrics like poplins. Cover obtained by increasing height of back rail, so loose fibres on weft thrown more on cloth face.

Selvedge Faults.

(1) *By Beam Flange.*—Beam flange insecure and slips. Fallen threads can be lifted out and held back by looped wire. If not, a flanged bobbin weighted containing number of ends required takes their place.

(2) *Temple.*—A worn cap to be replaced, and temple set far forward without touching sley. Selvedge hook and weight may assist.

(3) *Shuttle.*—Brushes to be equal in drag. (*See* Fig. 191). Spindles to be level. Edges of tips next to wood become prominent and have to be ground down. Loose tips difficult to fasten. Liquid glue and pieces of tapering cane give good results, the thickest part being at bottom.

(4) *Sley.*—A rusty end rubbed with paraffin. A rough one rubbed with pumice stone and smoothed off with fine emery cloth.

Setting Up Places.—Made by weaver after lagging back or combing out. On restarting, the fell of cloth too far off or too near sley. The greater care needed with light weight fabrics.

Stitching.

Stitching and picking over much the same, but the latter is larger.

(1) *Warp Stitch.*—When bottom band too slack or has broken, or bottom jack wire or rod worn through. Surplus healds of worsted or cotton at end of shafts are better bunched.

(2) *Weft Stitch.*—When shuttle passes over warp. One cause is wrong timing of shed. (*See* Fig. 298). In some looms, 2-and-2 twill has to be timed late, and same for 3-and-3 twill. Shedding rod G to be at or near its top or bottom centre when crank at back centre. If this be correct, then power of pick to be increased on opposite side of loom to where stitches made. Stitching caused by fibrous nature of warp which must be timed early and be false

reeded. The way the shed is being formed can be viewed from end of loom. Such warps aided by good tension. New worsted healds with soft warp are aided by French chalk on healds, or oil, but not both.

Temple Marks.—Made by the pins forcing threads a little further apart. In medium and heavy woollen and worsted cloths, such marks disappear during scouring. In light weight fabrics they are apt to show. All rings but two are taken off, wrapped in brown paper and carefully stored. Two rings sufficient to grip cloth. (*Refer* Figs. 213-4). Temple marks made by cutting is done by pins on rings, which, by blows or pressure, become hooked. Bent ends to be nipped off by sley pliers, or other rings fitted.

Torn Places.—Most responsible agent is perforated roller. Tacks holding tin should have round heads, and all torn tin removed. When cloth torn at beginning, caused by ends of knots being left too long, which are gripped by perforated roller, or by knots being too bulky to pass between roller and smoother.

When pieces pulled off cloth beam, any projections on shuttle guard should be covered. Pieces split at temple due to tender weft and cloth contraction. It is overcome by longer temples having more rings.

Traps.—Two kinds. Heald traps and shuttle traps. (*See* Knotty places). The end of the stop rod tongue as well as the cut on the frog may have become rounded off, these being at A and B respectively in Fig. 299. When so worn, the tongue will mount the frog when the shuttle is in the shed, and tear out top shed for length of shuttle. After filing, the loom is set on to observe effect, and further filing takes place if not efficient. Box swell finger at C which has to be kept in close contact with head of swell for maximum lift to stop rod tongue. Cross grained shuttles subject to sudden splitting, and ought to be set apart for plainest work.

A trap caused by peg dropping out of box lags, when shuttle tries to enter box already occupied.

Uneven Colours.

(1) *Hopsacks.*—When these woven in colours, and some of colours in single threads, the line of colour in cloth appears and disappears by threads rolling round each other. This is prevented by using double sley. (*See* Fig. 2). A different pegging will sometimes improve matters.

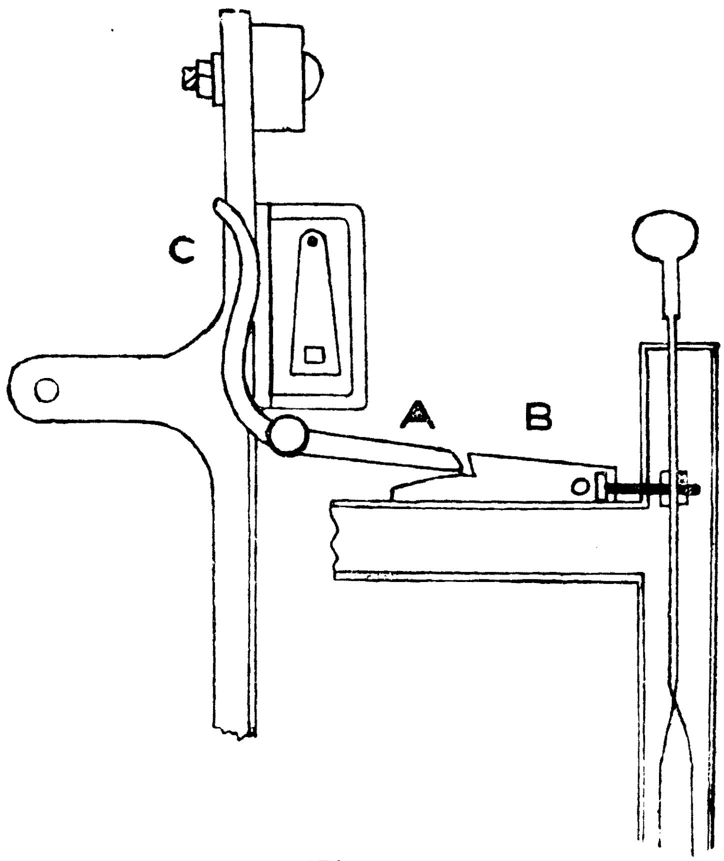


Fig. 299.
Stop Rod Tongue and Frog.

(2) *Silk Stripes.*—Both woollens and worsteds enriched by introduction of silk threads. These appear and disappear in cloth by clinging to adjacent threads. The defect rectified by use of fine false reed wires placed at either side of silk threads.

Variation in Twist.—Mixed lots of same counts and quality cause faulty fabrics by variation of twists per inch. Twist varies in all threads, but average difference of 6 to 8 per cent. in two-fold yarns will show in finished cloth. In single twist it will take a variation of 20 per cent. to make obvious difference in cloth.

Wrong Lifts.

Made when shaft remains up that ought to be down, and when shaft remains down that ought to be up. Usually at irregular intervals. Quickest way to find mischief is to lag back to faulty pick, or comb out to it. Wrong lift examined by overlooker who notes which shaft, and which draw bar forward. A short needle does not lift catch high enough to be held by holding bar. A too long needle prevents catch being properly seized by draw bar and may slip off. Worn cylinder ends gives too much freedom to lags, and one peg actuates two feelers. A wrong set, or wrong timed cylinder detrimental to cloth. Deduction from observed facts is invaluable for a quick and effective remedy.

Wrong Colours.—Misplaced colours as bad as misplaced threads. As correction, a comparison to be made by weaver between one where broken threads taken up, and one with none down, or with plan. Shafts should be lifted separately for checking and correction. Weavers defective in colour sense are better on plain work.

Wrong Patterns.

No wrong starting places should ever be made with 2 and 2 twill, but when checks made by cuts with same weave is another matter. Lags should be marked. Some diamond designs made from the same weave have duplicate picks in one repeat. If any pick is different, it becomes a guide for weaver. This lag is marked, and its lift chalked on loom. When combing out has to be done, the loom is turned over until marked lag is operating. The combing out goes beyond defective place until pick is open. In this way wrong patterns are eliminated. (*Refer* Fig. 280-81).

In 2 and 2 twill weave as example with checking and overchecking, the size of check made on back of weaver's card as guide. It is done the same way with plain weave. A few picks more, or less, is easily made. In all colour and weave effects the relation between shaft and box lags must be maintained all through. One lag difference spoils pattern and piece. The first shaft lag and first box lag are marked as guide if ever lags become undone.

P.S. Many of the foregoing points equally apply to cotton cloths, and to silk and rayon fabrics.

USEFUL MODIFICATIONS IN WEAVING.

No weaving overlooker can ever hope to make the most of the materials to be woven if he adopts stereotyped methods, for adaptability is the fine art of loom management. What is constantly needed is the application of new ideas to new conditions. This subject is presented in alphabetical order.

Bumping Pieces.

When a cloth begins to bump at the commencement of weaving, it suggests a lack of balance between the letting off and taking up motion. If the change wheel G (Fig. **300**) is the correct one, then more weight is added to the warp beam lever. At A is the taking up shaft, with B the smooth

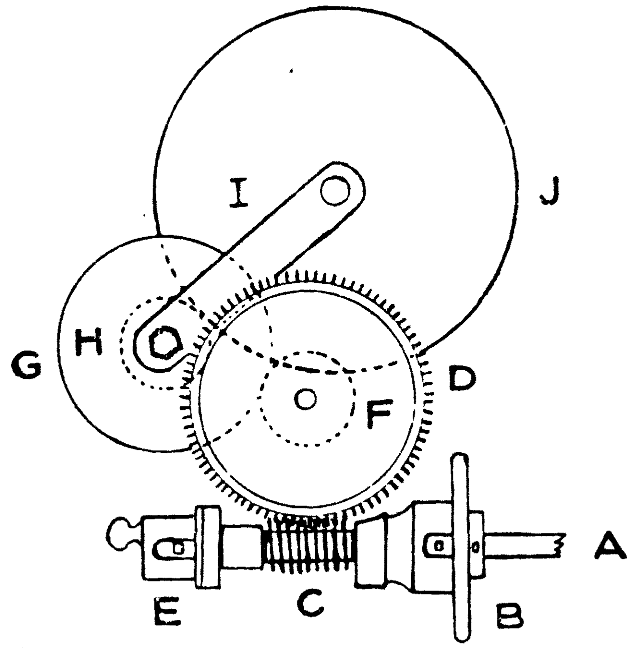


Fig. 300.
Hattersley Positive Worm Take-up Motion.

wheel used by the weaver. At C is the worm, and D the worm wheel, with F the standard worm wheel pinion. Into the latter meshes the change wheel G, the change wheel pinion being at H. The last two are at the end of the straight lever I, the fulcrum being the end of the take-up roller shaft which carries the wheel J, and is turned by wheel H. The change and pinion wheels are adjusted by a curved and slotted casting. A piece may begin to bump when weaving a new supply of weft. The weft may be wrong, or be spun a little thicker. If the latter, another wheel to take the cloth up a little quicker is put on the loom. Calculations have little to do with the qualities of warp and weft, but they sometimes need loom adjustments.

In looms served with a negative taking up motion like Fig. 109, the spring is tightened up when the cloth bumps, but pick counting should follow. If, however, any of the catches are not doing their work properly, they have to receive attention.

In the ratchet take up motion, Fig. 268, the fault chiefly lies with the holding catch.

For heavy cloth, and in plain tappet and dobby looms, the warp is passed over two back rails to relieve weight on the warp beam levers by increasing friction. Figs. 27-28.

Checking of Shuttles.

Shuttles cannot work in harmony with each other unless they be as near as possible, the same size, weight, and grain. This is fully explained in the chapter on " Shuttles."

In some wefting plans, the checking shuttle has to remain in the box for a considerable time. By the beating up of the weft, and the force of picking, the shuttle is apt to slide back from its picking position. On coming into play, the loom bangs off for the lack of the full force of the pick being applied to the shuttle. One way of assisting the shuttle to retain its proper position is outlined at Fig. 301.

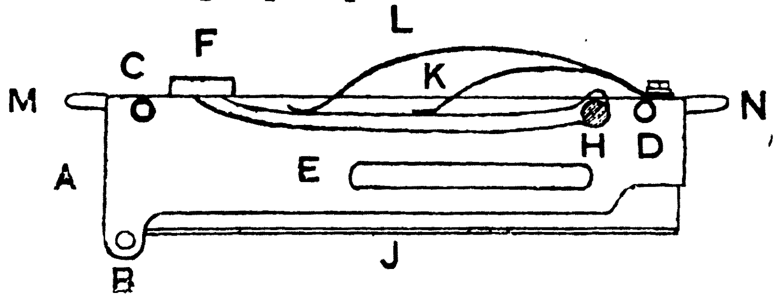


Fig. 301.
Preventing Shuttle Slipping Back.

At A is the entrance to the box, and B the front pin that braces up that end of the box. At C and D are the rods that pass through all the shelves and tighten them up. The front of the swell is at E, and F the head of it which is used by the box swell finger. The pin holding the swell is at H, and the shelf of the box at J. The ordinary spring that applies pressure to the swell is at K, and the ends of the box which fit into slides are at M and N. What is now done is to weaken the spring K, and add the longer spring L, the two applying about the same pressure to the swell as before. The pressure from the swell is now more towards the back end of the shuttle. Should this not prove as effective as desired, the box shelf is knocked in a little at its inner end, and a little out at the outer end to give more pressure at the back end of the shuttle.

False Reed.

Loose fibres on warp, hinder the making of a clear shed and cause stitching. Greater tension and earlier timing give improvements, but a false reed is the most effective remedy. This is given at Fig. 302. It is composed of small circular wires at F which are about 9 inches long with a loop at the top, and are threaded on wire. The false reed wires are each placed between every third group of threads except the selvedges, but between every two groups for very fibrous warps. The long wire is then fixed by wire staples to the back of the hand rail A, and the bottom of all the wires are held by the heald shaft J being placed in looped wires like H behind the going part. The sley is at B, the going part at C, the holding plate at D, and the stop rod at E.

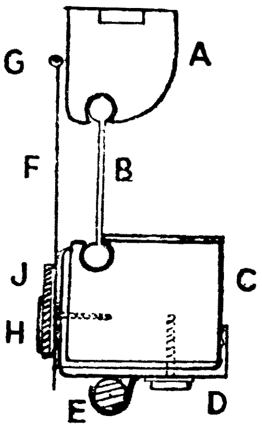


Fig. 302.
False Reed.

Lease Rods.

These considerably assist in the good weaving of some kinds of warp and weave. Fig. 303 shows two methods. In the top section, A is the warp beam and B the warp. At C is the back rail and D the back shed. The two heald shafts are at E, and the going part at F. The cloth is at G and the breast beam at H. The back shed extends from the back of the healds to the back rail. By curtailing it, more tension is placed on the threads, and is done in two ways.

(1) In the second section at I, the first thread is made to pass underneath the first rod nearest the healds, and over the second. The second thread is the opposite way. In ordinary one and one leasing for looming or twisting, the ordinary lease rods are used, and are an excellent guide to the weaver for fancy drafts and intricate warping plans. For poplins, there is another method. The front shafts make a less shed than the back ones, and to equalize the tension, a thick and thin lease rod are employed.

The thick rod is about three times thicker than the other, and is inserted when the second and fourth shafts are down. The thin rod is put through the warp in front of the other when the first and third shafts are down.

(2) The other arrangement is in the third section at J. One rod is placed at the top of the warp, and the other

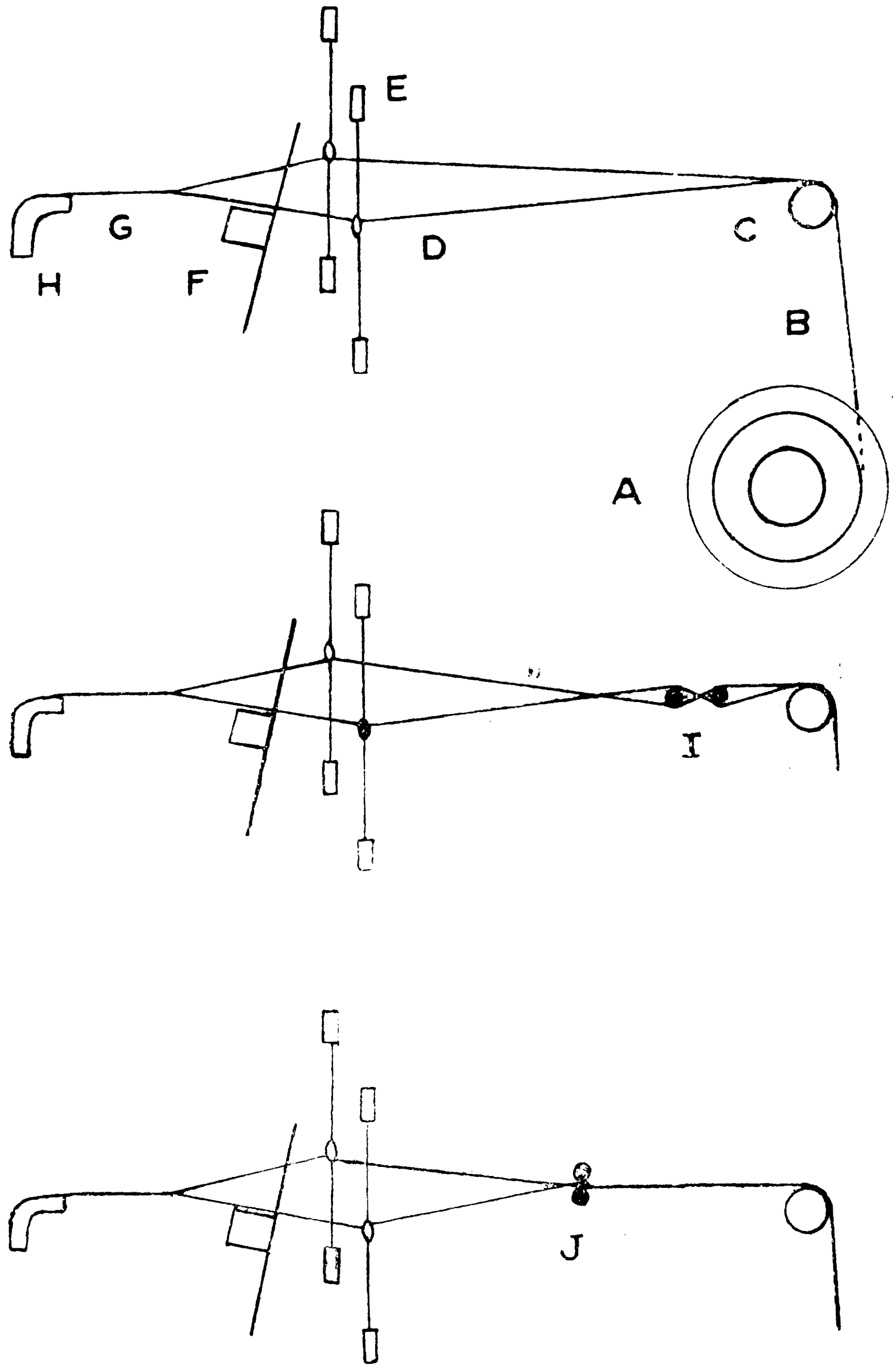


Fig. 303.
Arrangement of Lease Rods.

underneath, and the two are then lashed together. The nearer they are fixed to the back shaft, and the greater is the tension on the threads.

Picking.

The effective length of a picking stick for looms up to about 90 inch reed space may be obtained by dividing the reed space by 2.25. A 45 inch reed space would need 45 ÷ 2.25 = 20 inches long picking stick. This rule does not apply for very wide looms. The usual standing place of a picking stick for the overpick is for the strap end to point over the outer box end. This is modified by the condition of the picking nose. If the nose is new and very strong, the stick is placed a cog further back, but when the cone is worn, it has to be set one or two cogs forward. When the velocity of the shuttle is so rapid that the bump of the shuttle against the picker disturbs the coils of weft, it may be modified by rounding off the nose, but this may be possibly avoided by using an old nose not too far worn. In the underpick of the Dobcross type, the picking shoe may be set a quarter inch back, but in the older type, the stirrup strap is elevated.

Barker's Patent Picking Mechanism.

A new style of picking stick and brackets has been invented by Messrs. David Barker of Crampton Street, Bradford, and are at Fig. 304. The side view is on the left. The picking shaft A and the toothed bracket B are of ordinary make. The upper bracket C is thicker at the front than back, and tilts the stick F upward, and prevents it injuring the tops of the healds and shafts. The upper surface

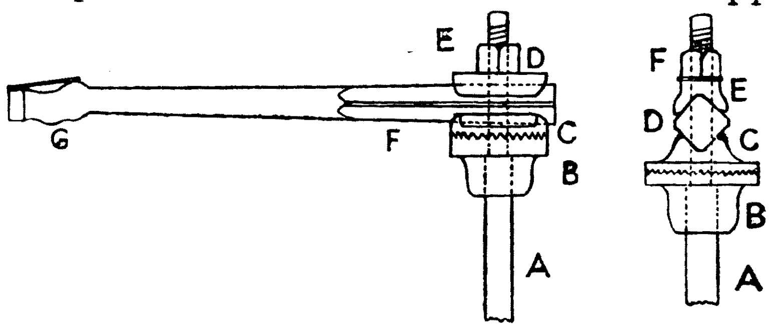


Fig. 304.
Barker's Patent Picking Mechanism.

of C is **V**-shaped, and so is the under side of the cap D, to fit with the new style picking stick G. The brackets and stick are held together by the strong nut E.

The shape of the stick and brackets are better seen by the diagram on the right. The bracket C and the cap E coincide with the shape of the stick D, which has the appearance of being tilted on one corner. The stick, however, is made $\frac{1}{8}$ larger in the diagonal than the brackets, and is held by its sides instead of top and bottom. If ever found necessary, a larger stick may be used with the same brackets. This method leaves more wood, and the stick is stronger. The cap E is malleable, and admits of a powerful grip. It is estimated that the cost of picking sticks is halved, and considerable time is saved as none come loose. The picking sticks are made in different lengths, and existing picking arrangements may be altered to this one at comparatively small cost.

The Hattersley Clutch Pick.—There are two kinds, one being outlined at Fig. 259. The latest type has only one leg, but the other has two, and it is the latter that is here mentioned. After being in use for some time, the bottom of the legs on their picking side become rounded off, and cause the clutch to be forced upward, and the loom misses picking. As a temporary measure, the grip of the legs may be increased by the application of some gritty substance. As soon as opportunity offers, the picking sides *only* of the bottom casting which receives the legs are chipped with a cross-cut chisel. This is best done when the loom is empty.

Dobcross Pick.—When more pick is needed in the older type, the thick strap on the picking stick is lowered, but if this be at its limit, then the picking shoe is brought forward a quarter inch. This shoe movement is the same for the whip pick when the picking strap is the right length, and there is a lack of power. The old style is at Fig. 260, and the new at Fig. 97.

Selvedges.

Warp and weft faced cloths have selvedges woven on separate shafts, and a different weave to the cloth. The 2 and 2 is selected for coarser work, and the 3 and 3 for the finer, and a catch thread is needed for both.

When hopsack weaves are woven in a tappet loom, the working of a catch thread is a little ingenious, and as it is only for one selvedge, it is fit up the farthest away from the tappets. A half moon lever is fixed in position on the 5th cross bar, and a long strap with a punched hole in to take the catch ends is held at the bottom by a closed spiral spring. Another half moon on the same bar is secured by a band to a spring lever on the under motion. This spring pulls down the half moon levers when the tappet allows. The wing screw on the rat tail is secured by band. An extra tappet is fixed to make the half moons move when the others are stationary.

Temples.

When experience decides that temple marks will show in the finished product, all the rings but two are taken off the barrel. On the other hand, when pieces with tender weft are split at the inner end of the temple, a longer temple with more rings is what is required. A piece contracts most at the selvedges, and least at the centre. (*Refer* Figs. 213-14).

Under Motion.

The spring power on the under motion has to be modified in two ways. (1) For selvedge shafts, and also for a light warp backing when being woven to a face cloth.

The springs may be changed for weaker ones, or the links may be placed on the inner hooks of the spring levers. (2) For heavier work, the spring power has to be increased, the most ready way being to attach two spring levers to one shaft. If the number of shafts will not admit it, then either stronger springs are used, or an additional spring is fixed to the inside links. (*See* Figs 210-211).

When a spring motion has been in service some time, the fulcrum pins become worn, and the levers lean towards the front of the loom. This is quite against good working. If the fulcrum pin has not been previously turned, it may be moved half way round by a pair of footprints.

Weft Fork.

When the weft is pulled off at an excessive speed, it becomes so slack, that the prongs of a centre weft fork are not held up long enough. The slide then holds the tippler, and the loom stops. This is known as " slipping off." For woollen weft, shuttle brushes are seldom used, but when slipping off recurs, small ones are inserted. If there is a good distance between the nose of the bobbin and the first brake pin, an extra pin nearer the nose is useful. (*See* chapter on weft forks).

When small cotton cops are substituted for worsted or woollen weft in the same shuttles, and the spindles are changed, small side brushes are inserted on that side of the shuttle to meet the weft as it comes from the bottom of the cop. They are better when tapered upward. Though prongs are highly tempered, they have sometimes to be bent downward a little to keep the prongs up longer.

Condition of Warp.

Warps are placed in the loom in all kinds of condition, and the overlooker has to find the appropriate method of dealing with them. Here are hints, the defects of warp being alphabetically arranged.

Brittle.—When over carbonised, or dried too long, or not had time to get its natural regain, it feels parched and rough, and when weaving, the threads snap and fly to the back rail. The warp may be sprayed with paraffin, and a chalk mark placed to the back limit of spraying. When the mark reaches the healds, the back shed is sprayed again.

Different Diameters.—Warp that is less or larger than the ground warp ought to be wound on a separate roller. When warped on the same beam, ways have to be found of making them weave. If the threads constantly breaking are smaller, and on particular shafts, those shafts may be reduced in size of shed, and the others increased to take the most tension. (*See* Figs. 271 to 274).

Fibrous.—French chalk placed in a dry cleaning cloth and shaken over the opened out heald shafts is an improvement. A handier and cleaner method is to use wax rollers. These are made by Messrs. Stephenson's, of Bradford. The firm have manufactured them for over 70 years, and can be highly recommended. These rollers are placed on top of the warp beam and against the unwinding warp. The friction leaves a double deposit of wax on the threads, for they are rubbed by the warp on the beam, and by the sheet of warp being pulled off. The latest development is abreast of the times. Instead of the ordinary wooden centre for the wax to adhere to, they are made with a hollow brass tube as the centre. This kind is specially made for the weaving of rayon. In ordering, the width of the warp is given, and the inner width of the loom. The rod is then placed in open brackets on the loom sides and above the warp, so the roller may rest upon it, and be turned by it. It is placed near the back rail where the warp is most solid, and is no hindrance to the weaver.

When fibres are longer, the warp is false reeded (Fig. **302**).

Overcrowded Warp.—All warps are not calculated on a scientific basis. Some are much too overcrowded, and if the yarn is somewhat on the fibrous side, innumerable curls appear on the fabric. Additional weight and early timing make little difference. The effective remedy is a double sley where the back reeds are directly opposite the gaps in the front ones. (*See* Fig. 2).

Overcrowded Picks.—The most obvious way is to reduce the picks per inch, but this would alter the weight of the cloth.

Woollen weft is often steamed, or wetted through with a pump, and the surplus water whizzed off. Early timing of the shed traps the weft, and gets the picks in easier.

Rolling Threads.—This takes place when one set of threads has more twist than others. These should be separated in the back shed by a broad heald shaft. If found that particular threads coil round each other, these may be separated if on different shafts, and a rod split in half, smoothed, and placed between the series. The edge of the rod acts as a blunt knife to sever the early making of buttons.

Sized.—Most woollen warps are sized, but some are over sized. They are difficult to open out and weave. A moderately damp cloth placed behind the healds is of assistance, but must be removed a little before ceasing work in the evening.

For ordinary woollen warps **36** lbs. of glue is boiled in **40** gallons of water.

When white sizing takes the place of glue, the quantity of size is 8 lbs. to 40 gallons of water.

For single twist worsteds, there is 56 lbs. of glue to 40 gallons of water.

Soft Spun.—When too little twist is inserted, many threads are drawn in two, and leave a trail of fibres at either end. A damp cloth placed on the warp behind the healds is helpful, and when 1 lb. of white sugar is mixed with a gallon of clean water and applied to the cloth, it acts in the same way as sizing.

Tender.—It may be owing to poor materials for woollen. or overdrafting for worsteds. Shed reduction and speed reduction assist the weaving, and so does a reduction in picks per inch. Wax rollers reduce friction. (*See* Fibrous Warp).

Unions.—In some worsted warps, union threads are introduced for striping effects. The union is one thread worsted and one thread cotton twisted together. These threads, though both white, have to be made distinguishable from the others, or results may be serious. The unions are treated with a fugitive tint which is easily removed when the cloth is scoured. Particular pains has to be taken at the commencement of weaving to see that all the threads are correct.

Uneven Lifts.—There is not much difficulty in weaving warps with uneven lifts in a positive dobby loom, but the light lift should be set when the shuttle is sent to the end of the loom where the weaver stands. The loom is much easier to stop.

In negative dobbies, the pull of the spring under motion has to be reckoned with.

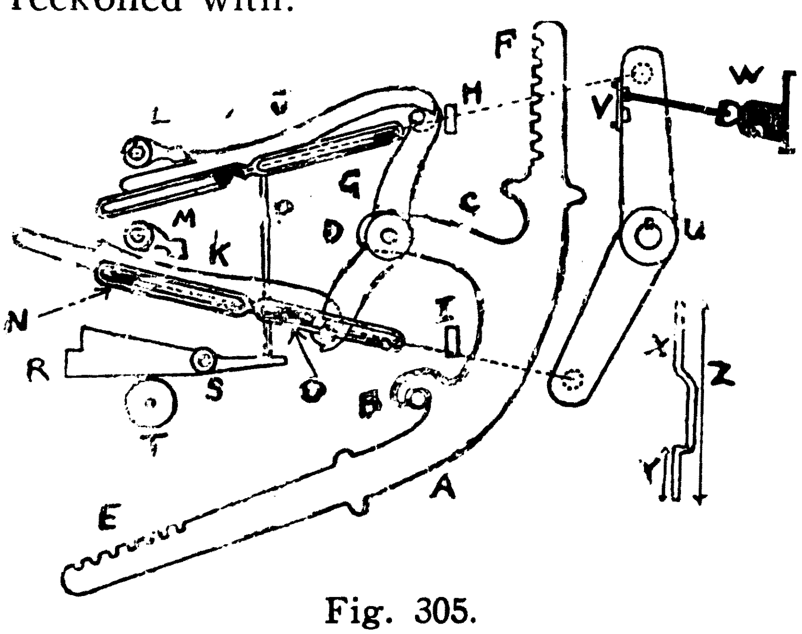


Fig. 305.

Hattersley's Positive " V " Dobby Used as a Negative.

In the diagram, A is the main lever and B its fulcrum. At C is the centre arm with its button for balk G. At H and I are the rests for the balk, and the pair of catches at J and K. Then L and M are the holding bars, and N the draw bar. At O is the pushing back bar, and P the needle. The feeler is at R and S, and T the cylinder.

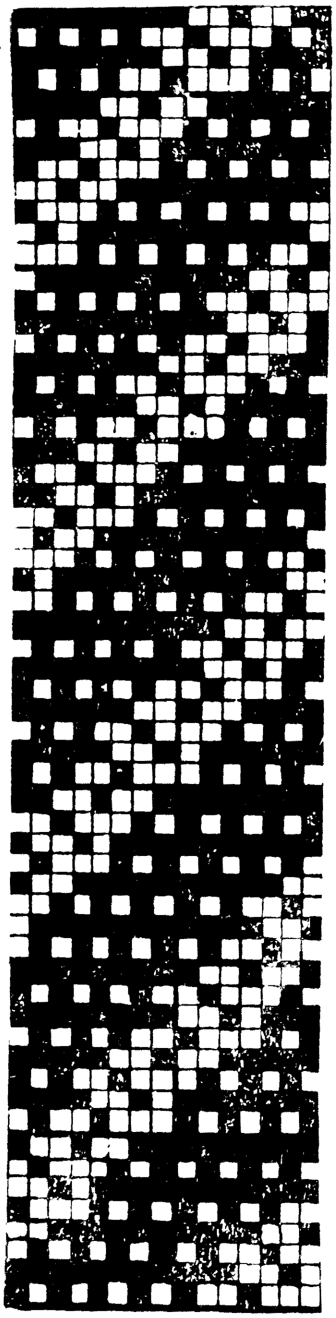


Fig. 306.
Design with
Uneven Lifts.

Uneven Lifts.

In a 15 shaft weave as a concrete case, the design is produced at Fig. 306. It is a fancy twill on 15 threads and 60 picks. It is a misleading design if not carefully followed. It is really a pick and pick effect, where the first pick moves one step forward on the 3rd pick, and takes two steps forward on the 5th pick. This move is maintained all through. The second pick has a heavy lift of 12 shafts; and on the 4th pick, takes two steps forward, and has 11 shafts to lift.

The first three threads are for the selvedge.

On the heavy lift the loom would hardly turn over, but on making the shed, the loom could not be stopped on that pick. What was needed was a balance of the weight. This is seen at Fig. 305. A strong spring W was attached to the upper arm of the main lever V, this part being forward when the light lift took place. The spring was 33 inches long to impart power and have good recovery. When the lever was full back it was given a stretch of one inch. When the heavy lift was about to take place, the spring was well stretched, and thus materially helped the heavy lift. The loom was then able to be stopped as exactly on one lift as the other.

Condition of Weft.

Bulky.—When weft is too bulky for the shuttles, the inside of the shuttles have to be scraped to make more room.

Curly.—When new spun, and a length is let slack, long curls are sometimes made 7 to 9 inches long. This may leave snarls in the cloth. The weft has not had time to condition. It is improved by being exposed to the atmosphere all night, and also by a wet cloth being placed over the bobbin board.

Dropping.—Weft that drops in the shuttle box is liable to be soiled or cut. For boxes in plain looms, the box feet can be packed with cardboard to make the box side slope like the front of the shuttle. (*See* Fig. 193).

Hard Twist.—This has to be well braked in the shuttle by good brushes. When the weft is made to pass through the bottom of the shuttle, and then out at the side, the ordinary brush may be made a double one by being left on the shuttle bottom, but trimmed. (*See* Figs 191-2).

Opposite Twist.—Some fabrics are woven 2 picks right twist and 2 picks left twist with the aid of a mixing box. These wefts have to be prevented from getting entangled with each other. Many of these fabrics are woven in a circular box loom, and in front of the box, a piece of swansdown is glued to the shuttle race to keep the two wefts separate. In a drop box loom there are several ways, one of the most effective being shown at Fig. 307.

Sloughed.—Soft wound weft sloughs off the bobbin by the force of the pick. For right hand shuttles, the power of the pick has to be reduced on the right side of the loom, and the checking to receive attention. Expanding spindles are very effective in prevention, but somewhat costly. A much less costly way is shown at Fig. 278 and shuttle one, in Fig. 191.

Smooth.—When weft is bulky and smooth like worsted weft wound on universal winder bobbins, it "flies" out of the shuttle. To stop it, two strands of loom cord are looped round the shuttle brake pin, and pegged down beyond the block of the shuttle. For drop boxes with open shelves, a frayed thrum is pegged on the shuttle front just below the groove.

Silk and rayon have fur lined shuttles, the fur being of a particular kind suitable for the yarn.

Slubby.—Such weft is made by faulty carding. If there are brushes in the shuttle, they have to be cut down, or the weft would be frequently broken.

Tender.—Single twist worsted only requires very small brushes to aid the weft fork, or none at all. Twitty woollen weft has very thin places, and all unnecessary pull on the weft has to be removed.

Uneven.—The most uneven weft is woollen, and to make the most level pieces, three shuttles are used, and a pick taken from each in rotation. The pegs in the box lags must all be firm, for the three shuttles only engage two boxes on either hand. Uneven weft of any kind may be woven the same way with beneficial results.

Weft Trails.—These are difficult to avoid with newly spun, or hard twisted, or opposite twisted weft. To prevent them, a weft divider may be made as represented at Fig. **307**, this being used on the Dobcross loom, the principle holding good for other looms. The wrought iron casting A is made with the long slot B and the shaft C. On the shaft are placed the spindle whorls D, E, F, and held on by locknuts H, and divided by washers G. This casting is for the front of the

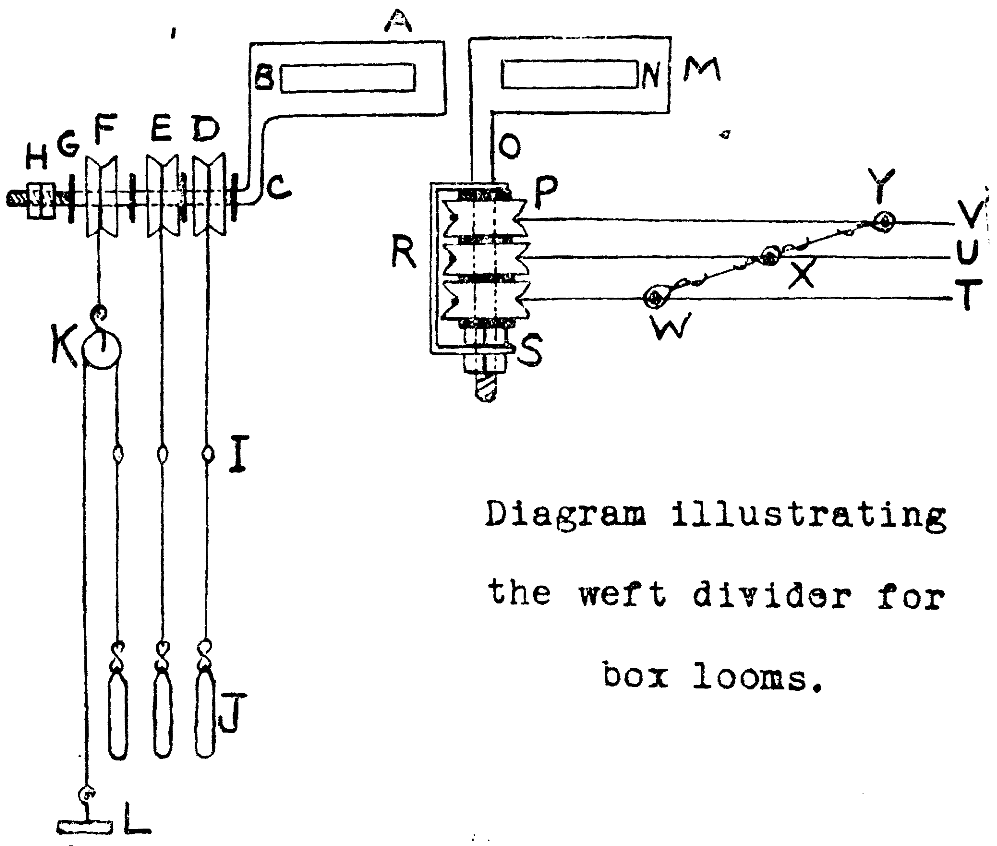


Fig. 307.
Weft Divider Motion. (To Prevent Weft Trails).

loom. The healds are at I and the weights at J. The casting M with its slot N is placed on the back top rail. It has the straight shaft O, which holds the three spindle whorls P, held on by locknuts S. At R is the cord guide which keeps the cords on their respective whorls when slack. These cords are at T, U, and V. The band T is connected to U by the looped band between the knots W and X, and the bands U and V are connected with a similar looped band holding the knots X and Y. These connections are essential, for when the 3rd box is lifted, the band T which is used for the second box must also be raised. When the 4th box is brought into service then the bands for the 2nd and 3rd boxes are retained for the top shed. Common blue cotton used for headings is employed for dividing threads. It is wound on to a flanged roving bobbin and weighted. There are 6 threads, two for each heald. After passing through the mail eyes and sley it is wound on to the perforated roller, or cloth beam. Special provision is made for the 4th box, for the lifting of it is by levers controlling the 2nd and 3rd boxes. When these levers have the same lifting band attached, there is then only half leverage. The full leverage is obtained by the lever band being attached to the whorl K, and the heald band being fastened to the floor. The dividing threads are placed midway between the selvedge and the entrance to the box.

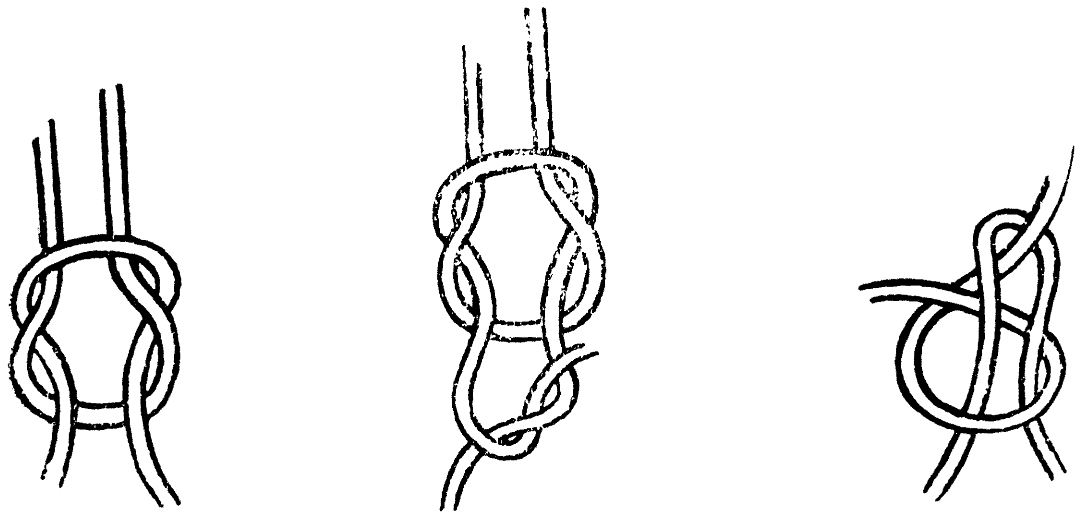


Fig. 307a.
Weavers' Knots.
Left, Woollen Knot; Centre, Worsted Knot; Right, Knot for Fine Worsted, Mercerised Cotton, Silk, Rayon and Nylon.

ADAPTABILITY OF DESIGNS.

In planning a design for cloth, there are essential considerations such as the yarns to be employed, the type, weight, weave, colour, cost, and finish, the claims of fashion, and the season. Except for novelties, there are fairly well defined limits in most classes of fabrics, beyond which lie the perils of poor construction.

The fancy flannel trade relies much more on colour than weave. For low woollens, it is seldom there are more floats than three. In high-class woollens, there are floats of 6 for buckskins, and 7 for sateens, and in rare cases 9 for fancy twills.

Yarns made from low crossbred wool follow much the same course as for low woollens, but Botany yarns which may run from 30's to 80's counts are elegible for the most elaborate designs. In cotton goods, the range of designs are much more limited than for the better class worsteds, but there are weaves like honeycombs, reversible effects in table cloths, embossed figures in quiltings, and others that are peculiar to the trade. Silk goods yield the largest variety of weaves in one fabric, and give the widest scope of any textile yarn for the ingenuity of the designer in colour and decorative art.

The strength and elasticity of the threads makes possible the use of plain weave, twills and sateens, and long floats in the same fabric, and without ill effects afterwards.

Mohair stripes and figures have also a class of their own in the dress goods trade, and though it is impossible to spin to such fine counts as either worsted or silk, the special lustre which the fibres possess is made the most use of in both ordinary weaves, ornamental fabrics, and gauze.

Hairline Stripes and Checks.—As mentioned, the simplest weaves are employed in the woollen trade on account of the fibrous nature of the yarns, the thickness of the threads, and the nap finish given to many of the cloths. The introduction of colour makes a wonderful difference. This is evident in the making of hairlines. A hairline running in the direction of the warp is made by the same colour of weft covering its own colour of warp. A hairline in the direction of the weft is formed by the same colour of warp covering its own colour of weft.

A change from one to the other may be made by altering the weave, or altering the footing of warp or weft.

Fig. 308 is plain weave, but when warped 1 black, 1 white, and wefted 1 white, 1 black, it produces the warp hairlines at Fig. 309. When the same warping and weaving plans are employed, but the wefting is 1 black, 1 white, it creates the weft hairline at Fig. 310. To give both effects as demonstrated at Fig. 311, plain weave is placed on design paper for

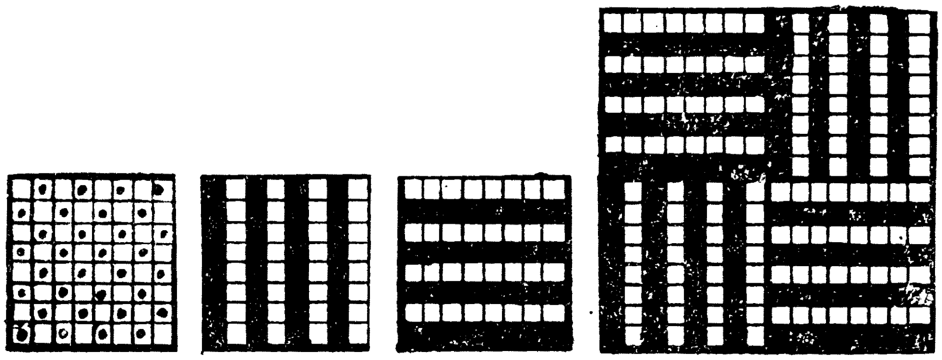


Fig. 308. Fig. 309. Fig. 310. Fig. 311.
Plain Weave Hairlines.

16 threads and picks. It is then warped 1 black, 1 white to 4 repeats, and 1 white, 1 black to 4 repeats. The wefting is 1 white, 1 black to 4 repeats, and 1 black, 1 white to 4 repeats. The pegging particulars are lift black.

For a three coloured hairline, a weave is essential that is complete on 3 threads and picks. This is the 2 and 1 twill as at Fig. 312 and the pegging particulars in this series is lift white. Fig. 312 is a warp twill and Fig. 314 a weft twill.

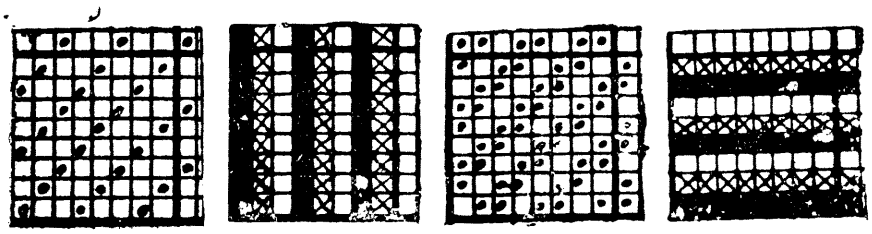
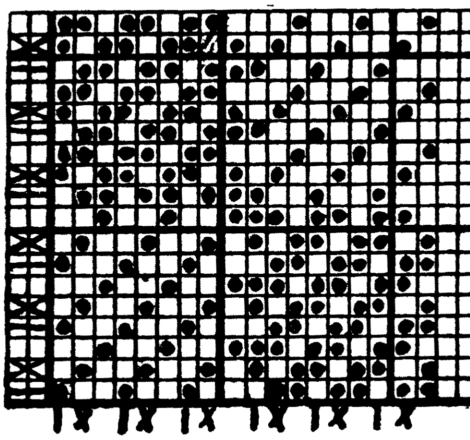


Fig. 312. Fig. 313. Fig. 314. Fig. 315.
2 and 1 Twill Hairlines.

When the first of these is warped, 1 black, 1 grey, 1 white, and wefted the same, it produces Fig. 313. With the same warping and wefting plans, but with the 2 and 1 twill at Fig. 314, the hairline then goes the weft way of the cloth as at Fig. 315. If a check with these two weaves is required, they are combined as at Fig. 316. From a weave point of view, there are objectionable floats of 3 in both warp and weft, but this is the only way a complete hairline on every thread and pick can be built.

If the warp twill be placed as given, and the weft twill reversed, then both sections of vertical hairlines are correct, but only the grey hairline is preserved weft way, the other two lines being mixtures. In the first, the correct weave is sacrificed for the sake of complete hairlines, but in the



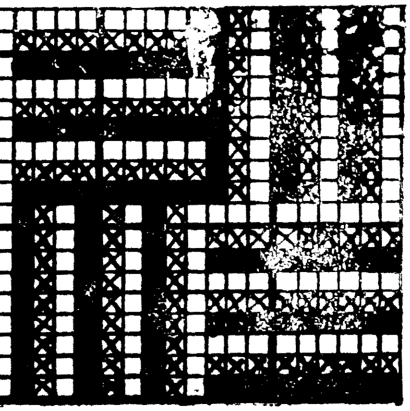


Fig. 316. Fig. 317.
Three Coloured Checked Hairline.

second, it is the hairlines that are broken for the sake of a correct weave. The full three lined check is given at Fig. 317. A four-lined check hairline is woven with the **3 and 1 and the 1** and **3** twill.

Elaborate Hairline.—This is presented at Fig. 318. The weave is plain weave throughout, but it is the warping and wefting plans that make the elaboration so effective. It is warped and wefted:—

White	1	1	—	1	—	1	—	1	—	2		=40 threads.
Black	1	—	2	—	1	—	2	—	2			
	5R		3R		5R		2R					

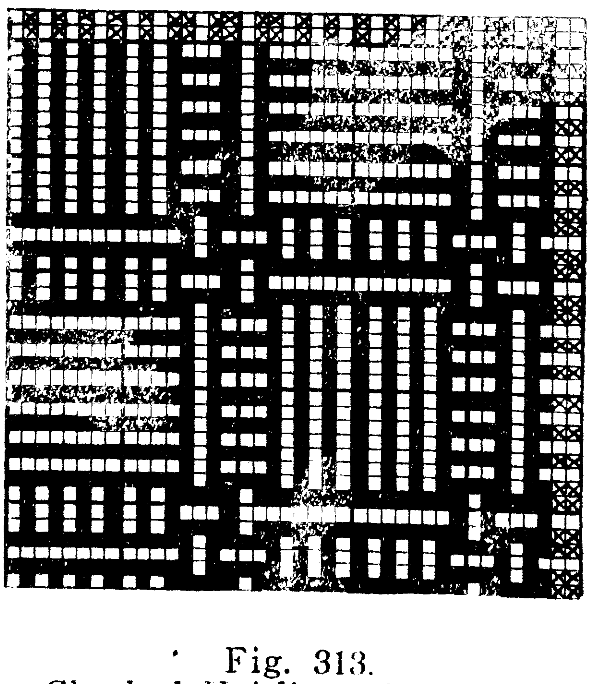


Fig. 318.
Fancy Checked Hairline with Plain Weave.

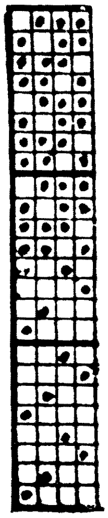


Fig. 319.

Four End Sateen Check.—A pretty effect for ladies' wear is made with design at Fig. **319.** This is the 4 end sateen in warp and weft with 12 picks of either. It may be constructed from 28 skein warp and weft and with 36 threads and picks per inch. It is warped 12 threads light brown, 12 threads white, and woven on 4 shafts with white weft.

Crèpe Weave in Check Order.—One of the neatest crêpe weaves is given at Fig. **320.** It is the 2 and 2 warp and weft ribs placed in check formation on 4 threads and 4 picks. It is an all-over effect, and when woven in the grey, can be dyed any fashionable colour.

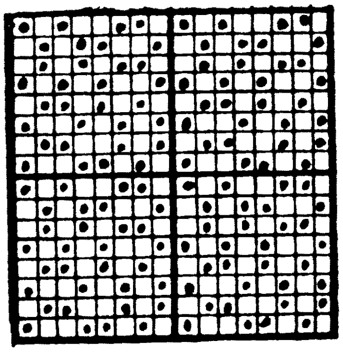


Fig. 320.

Crossed Diagonal.—The 2 and 2 twill is one of the most serviceable weaves, and a very pleasant diversion from an ordinary reversible effect is at Fig. 321. As it cannot be drafted, it is woven on 24 shafts. The floats of three are modified by weaving it with fine yarns.

Diamond Patterns.—Fig. **322** is another fruitful way in which the 2 and 2 twill is employed. Though on 24 threads and picks, it may be woven on 6 shafts. The weaver has

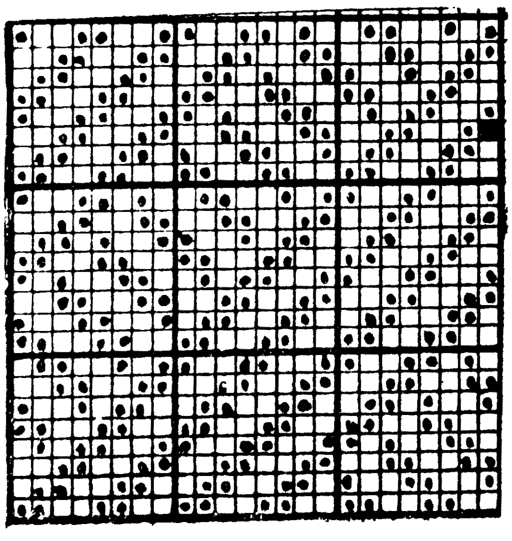


Fig. 321. Crossed Diagonal.

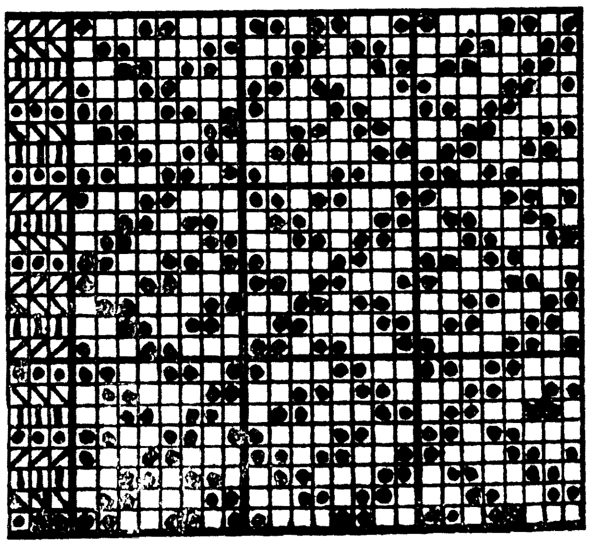


Fig. 322. Diamond Pattern with Duplicate Picks.

to be wary not to make broken patterns, for each pick is duplicated 6 times in one repeat. The marking of a lag in this case is of no use. The duplicated picks are marked the same way on the left of the design.

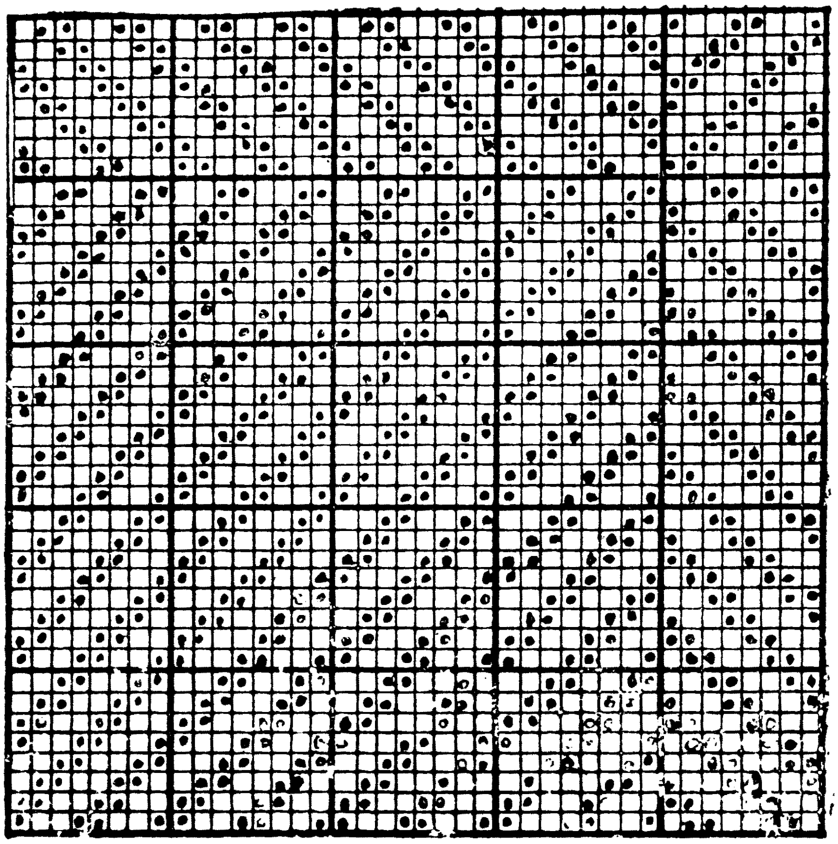
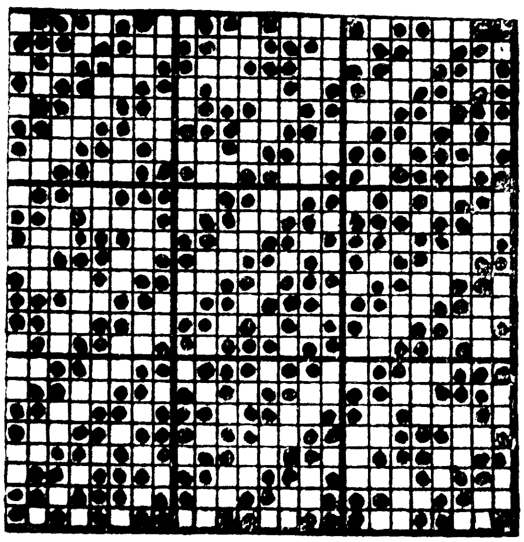


Fig. 323. 2 and 2 Twill Check.

Two and Two Twill Check.—Fig. 323 is the 2 and 2 twill placed in check formation. Though on 40 threads and picks, it can be drafted on 4 shafts, but 8 will weave better. The pegging plan is the first 4 threads and 40 picks. The weaver's special care is to have the large section correct, for it is an all too easy matter to have 4 picks too little or too many. The exact size is marked on the back of the weaver's card for comparison.

Figured Diagonals.—The design submitted at Fig. 324 has four twills, two of the spaces between being figured.



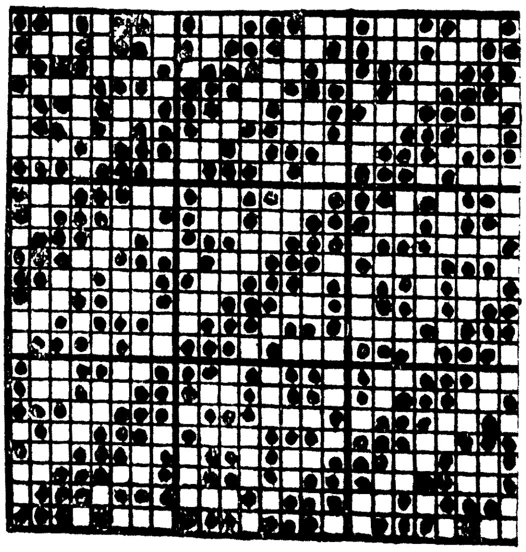


Fig. 324. Figured Twills. Fig. 325.

Both figures occupy the same number of small squares. The design is complete on 24 threads and picks.

Fig. 325 is a further example with bolder twills and different figures.

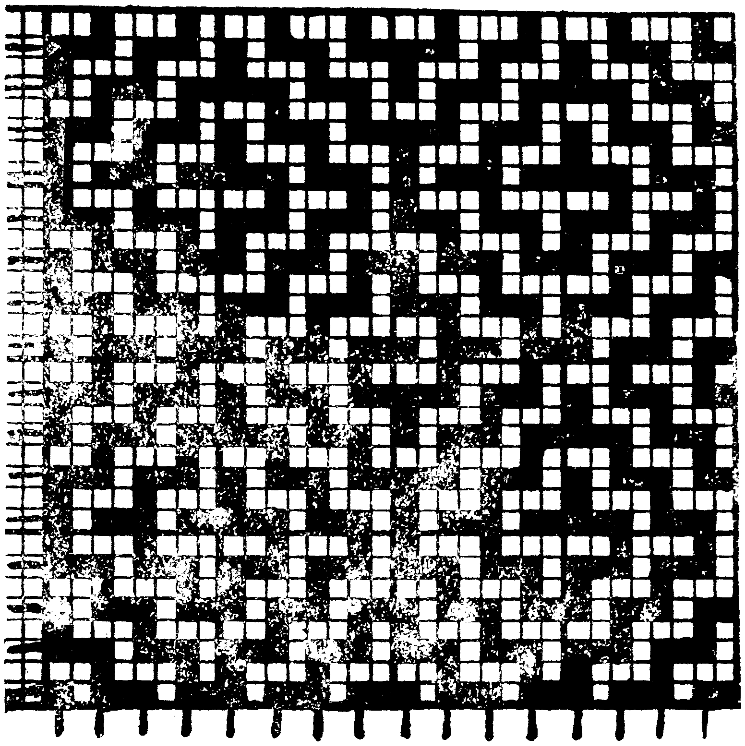


Fig. 326. The Maze Pattern.

Colour and Weave Effects.

Simple weaves are beautified by colours. The " Maze " pattern at Fig. 326 is a striking example. It is composed entirely of the 2 and 2 twill, 8 threads and picks twilling to right, and the same number twilling to left. It is warped and wefted 1 dark 1 light and complete on 16 threads and picks. It can only be made as demonstrated in this way. If dots mean warp, then the first two threads in the left hand corner are dotted, and all the rest can then follow on the lines mentioned. Misplaced threads have to be avoided, for the colour sequence may be right, but the draft may be wrong.

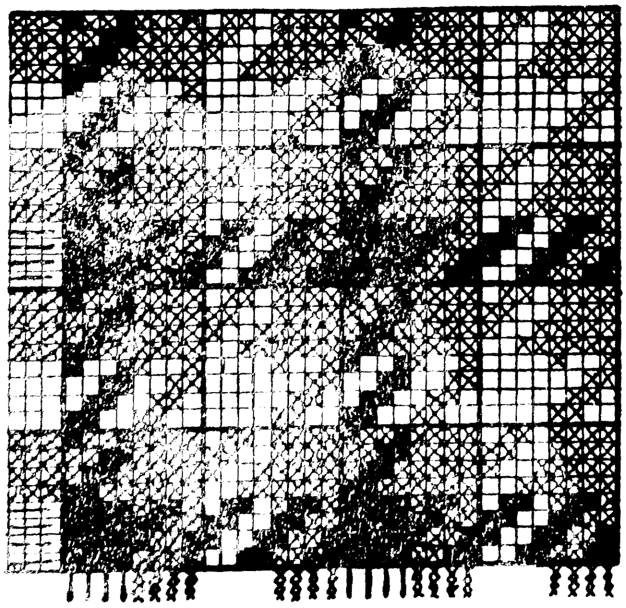


Fig. 327. Shepherd's Plaid.

Shepherd's Plaid.—This is an excellent contrast to the Maze pattern. It is given at Fig. 327, and is woven in black, grey, and white, the grey section forming the ground. All the figures are of equal shape, and the twills, are solid in all three colours. This simple weave is the basis of the fascinating Glenurquhart check and the Gun Club variety.

Eight Shaft Step Pattern.—The weave to give the effect at Fig. 328 is shown on the left of it. The pattern is

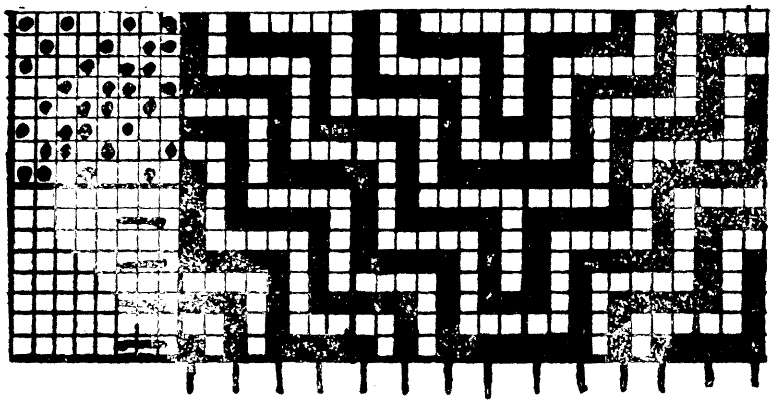
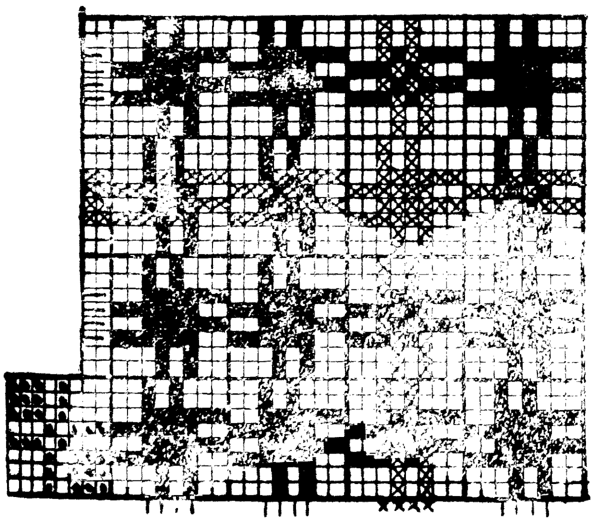


Fig. 328. Fancy Step Pattern.

worked out on 32 threads and 16 picks, but by drafting, 8 shafts will suffice.

All-over Figures.—The Design at Fig. 329 produces an all-over figure effect, and is worked out in three colours which produces five different effects. The design used is an adaptation of the 3 and 3 hopsack weave.



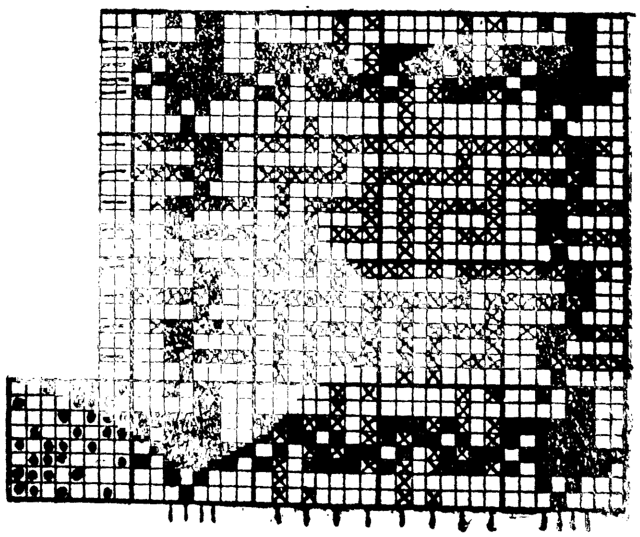
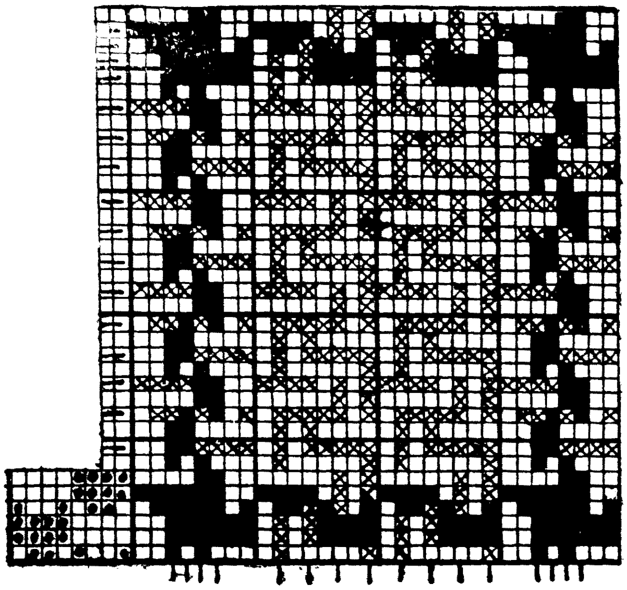


Fig. 329. Colour and Weave Effects. Fig. 330.

Novelty Colour and Weave Effects.

By using a weave of broken character, some remarkable effects in colour and weave are developed. Here are three. In Fig. 330, the interior is somewhat after the Grecian pattern, and when woven in low counts of worsted, develop very well. The design is a small spot figure which leans in alternate directions. Another example is at Fig. 331, and



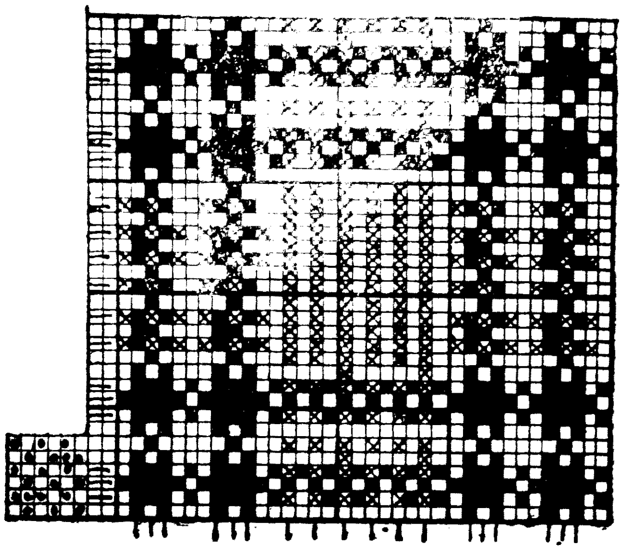


Fig. 331. Colour and Weave Effects. Fig. 332.

is more elaborate. It is formed by a weave which gives alternate warp and weft figures on 8 threads and 6 picks. Fig. 332 is another choice example. The centre develops a warp hairline effect. The weave is on 6 threads and picks. For each design, warping and wefting are indicated.

Warp Face Cloths.

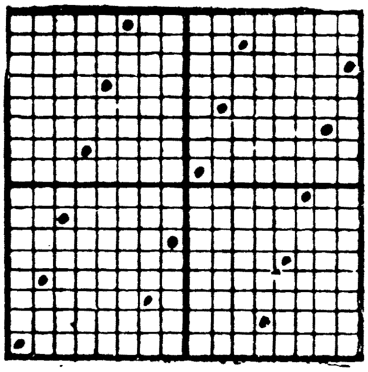


Fig. 333.

These kind of cloths have more warp than weft on the face. The 16 shaft sateen is given at Fig. 333, the pegging particulars being lift white. Pieces of this kind have, as a rule, the same colour of weft as warp.

The rule for making sateens is, that the stepping of the dots must not be a measure of the number of threads in one repeat of the design. Patterns which are made beyond half the number of the threads employed are reverse twill to those already made.

The sateen base is an excellent means of developing other styles

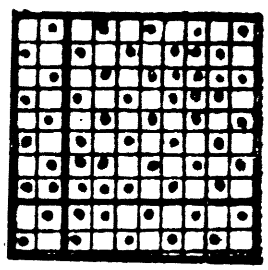


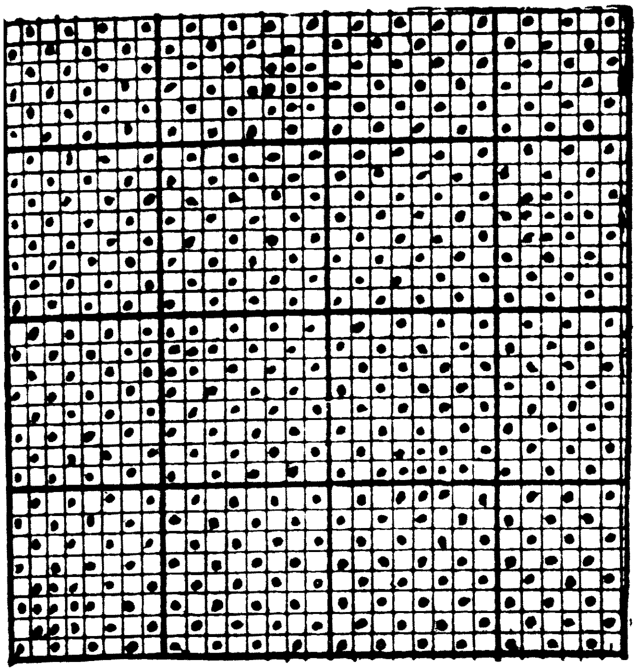
Fig. 334.

These are:—(1) The placing of spot figures; (2) Sateen derivatives; (3) Shaded effects. Examples of each follow.

(1) *Placing of Spot Figures.*—In dress goods, spot figures play a prominent part. At Fig. 334 there are two small figures on a plain ground, the whole being on 10 threads and picks.

This is placed in 5 end sateen order at Fig. 335, only one spot in design 210 being used.

A further example is at Fig. 336 where the small spot



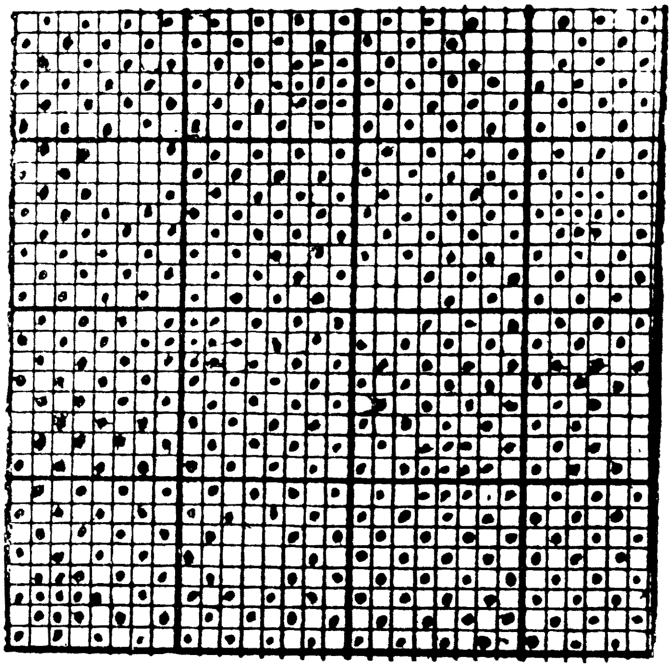


Fig. 335. Placing Spot Figures. Fig. 336.

is developed in both warp and weft. To make any kind of figure have a clear outline with plain weave, it should be on an odd number of threads and picks.

(2) *Sateen Derivatives.*—This is a very fertile way of making new designs. The sateen base is first placed on design paper, and a twill on the same number of threads and picks is then placed on the sateen base. As an example, the sateen base on 16 shafts with a 3 step advance is at Fig. 333. The twill used is at Fig. 337, and the sateen derivative is at Fig. 338.

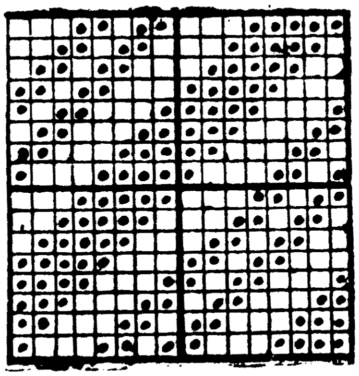


Fig. 337.
Ordinary Twill.

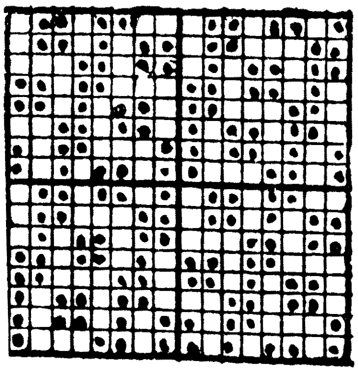


Fig. 338.
Sateen Derivative.

(3) *Shaded Effects.*—Such effects are used for ribbons, and all kinds of silk structures, and especially for floral designs.

A sample of a shaded stripe effect is at Fig. 339. It is developed on the 5 end sateen base, shading from warp to weft and back again. The full repeat occupies 32 threads and 5 picks.

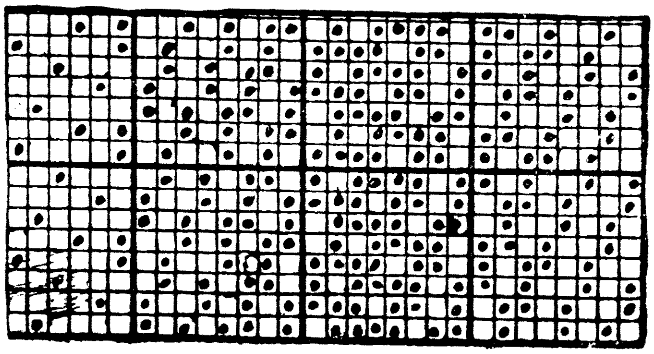


Fig. 339. Shaded Effect.

Pick and Pick Effects.

These designs are known as whipcords. They are derived from two common twills, each twill, as a rule, being on the same number of threads and picks. One twill is placed on all the odd picks of the new design, and the other on all the even ones. The result is quite as transforming as sateen derivatives. Figs. 340 and 341 are on 12 threads and 24 picks. The first two picks in each design are the twill bases.

Fig. 342 is on 14 threads and 28 picks. It develops two strong twills, and a 2 and 1 section twilling to the left.

These, and such designs, are particularly suitable for worsted coatings. Fig. 343 is on 16 threads and 32 picks.

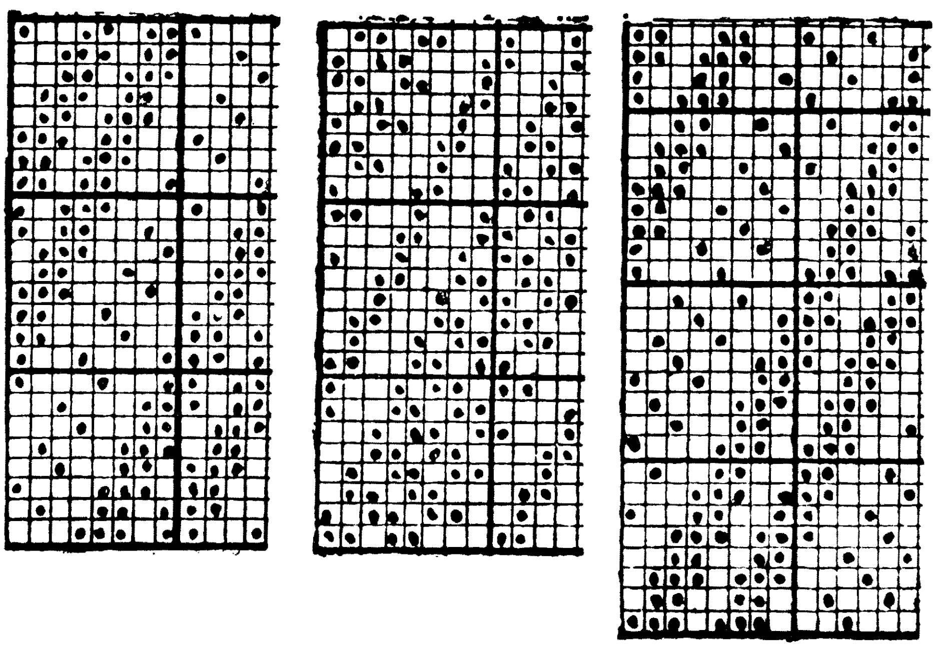
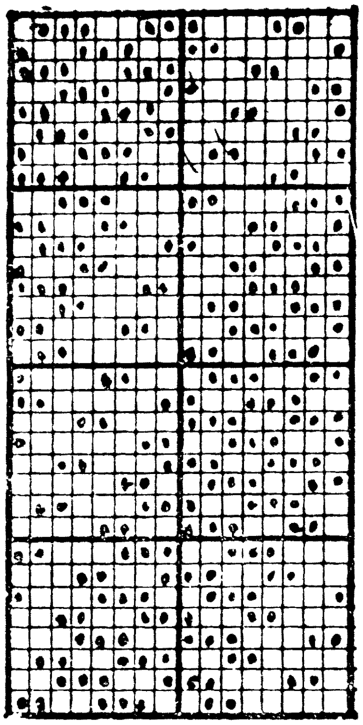


Fig. 340. Fig. 341. Fig. 342.
Whipcord Designs.



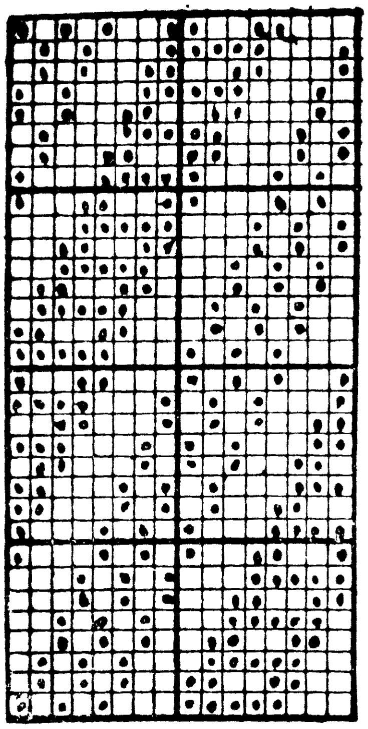


Fig. 343. Fig. 344.
Whipcords on 16 Shafts.

It produces a much flatter effect in the cloth than the previous example. Fig. 344 is in contrast to the two previous examples. There is a running warp and weft cord. If the twills developed are to be the chief feature of the cloth, then the pegging particulars would be lift white, but if the cords are catered for, it would be lift black.

Alternate Pick Design.—Instead of using a pick in turn from two twills, all the odd picks from one twill may be placed on all the odd picks in the making of another design. The odd picks in the other base twill are then placed on all the even picks on the design under construction. These develop peculiar constructions like the one shown at Fig. 345. It is a wavy effect which leans to the left, though it may be made to lean in the opposite direction.

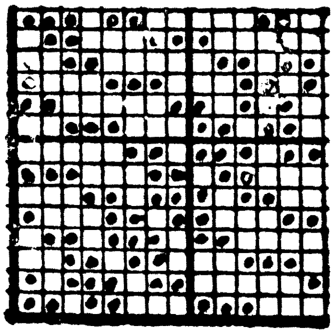


Fig. 345.
Alternate Pick
Design.

Stripe Effect.—A wavy twill is introduced in stripe formation in Fig. 346. It occupies 16 threads, and is separated from the 2 and 2 left twill section by two stripes of warp cord. The design would require 20 shafts.

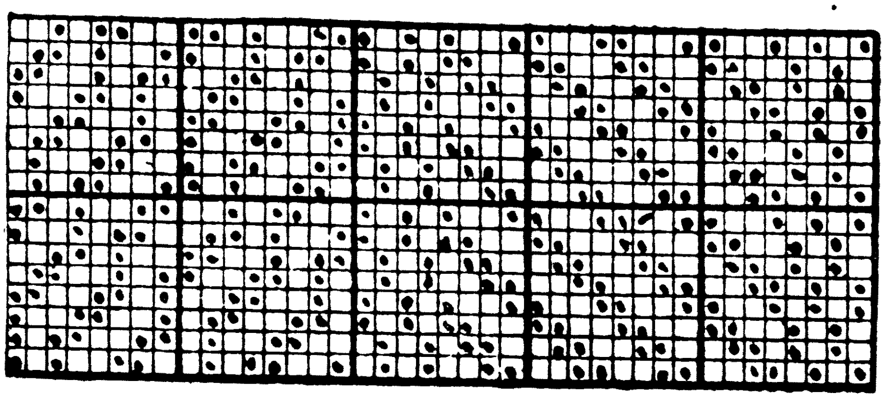


Fig. 346 Fancy Stripe Effect.

Bedford Cords.

These fabrics are made in four styles. (1) Vertical stripes; (2) Diagonals; (3) Squares; (4) Figured. In all four there is a basic similarity, for one pick will weave plain for a certain number of threads and then float. A subsequent pick will float where the other was plain weave, and weave plain where the other floated.

The weft is usually single twist and chiefly woollen owing to its better shrinking properties. On shrinking during scouring, it increases the roundness of the cord effect which is the special feature of this kind of cloth. The structure is not confined to the 1 and 1 build of cloth, but may be 2 and 1, or 2 and 2, or any other way desired.

Fig. 347 is one of the simplest kind. One repeat is on 16 threads and 4 picks. Drafted to a minimum, it could be woven on 6 shafts, though it would work better on eight.

Fig. 348 is a 2 and 2 arrangement, a complete pattern being on 20 threads and 6 picks. It is harder to weave than the previous example, for there are two plain picks together, and the shrinkage is greater.

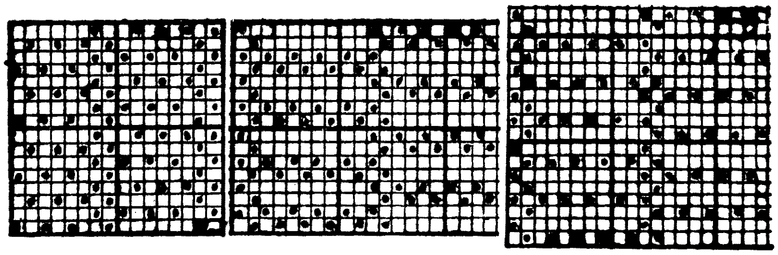


Fig. 347. Fig. 348. Fig. 349.
Bedford Cords.

Fig. 349 is a 2 and 1 style, and has a flatter effect than Fig. 348. It lends itself to a fine face effect.

Figured Mohair Design.—In these cloths, it is customary to give the lustrous mohair the fullest surface display. One

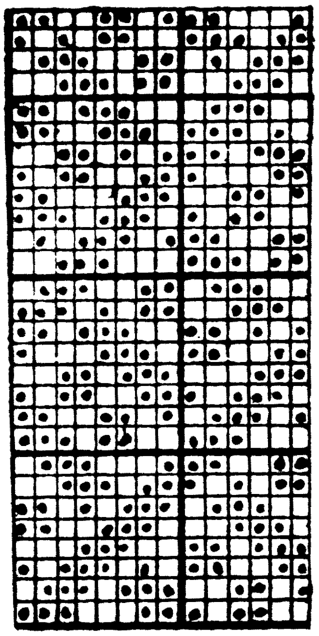


Fig. 350.

example is at Fig. 350, and is on 14 threads and 28 picks. It has heavy 3 float twills in both directions interspersed with hopsack. In cheaper fabrics, the ground is cotton, but in more expensive cloths it is worsted.

Figured Dobby Work.—A good example of this is shown in Fig. 351. This is for a neat and substantial coating cloth. The warp is 22 skein with 38 threads per inch, and the weft 18 skein with 31 picks per inch.

The figures are made with 2 and 1 warp twill, and the ground is 2 and 1 weft twill. Both figures and ground twill to right and left. One complete pattern is on 24 threads and 26 picks.

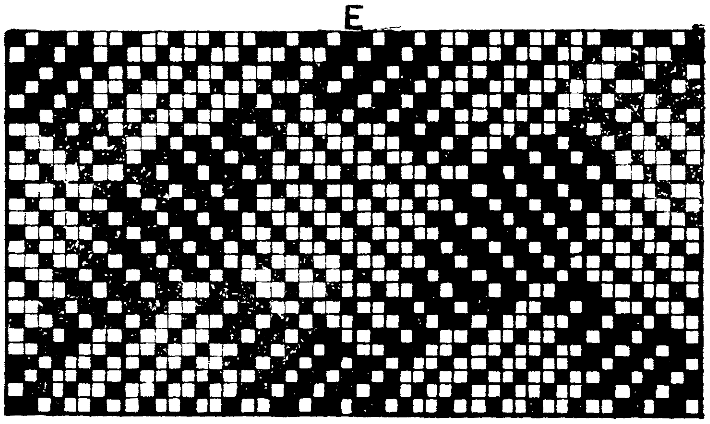


Fig. 351 Figured Dobby Work.

Double Plain Cloths.

These textures are very neat, and, by being double cloths, are much heavier than a single cloth made from the same counts of warp and weft. When they interchange frequently, no stitching of one cloth to the other is necessary, but otherwise, the 8 end sateen is a handy method. On the plan of interchange, reversible cloths, carriage rugs, and fancy effects are easy of production. By the adjustment of the weave, and the application of colours to warp and weft, seven distinct effects are produced. These are demonstrated. All the odd numbers are designs, and the even numbers are cloth. Fig. 352 has the first section warped and wefted 1 black, 1 white, the pegging particulars being lift black. This first thread and pick are for the face, and the second thread and pick for the backing. Fig. 353 is the result. The face cloth is solid black, and the backing cloth all white.

For Fig. 354, the warping and wefting are the same, but the weave is altered to make the first thread and pick for the backing cloth. At Fig. 355, the face cloth is now white,

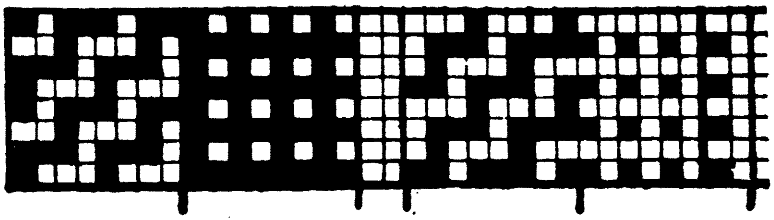


Fig. 352. Fig. 353. Fig. 354. Fig. 355.
Double Plain Designs.

and the back cloth black. Other styles of double plain cloth are given from Figs. 356 to 359. At Fig. 356, the design is arranged 2 threads backing and 2 threads face, and the same with the weft. By having it warped and wefted 1 black, 1 white, it develops a horizontal hairline on the back cloth, and a vertical hairline on the face as given at Fig. 357.

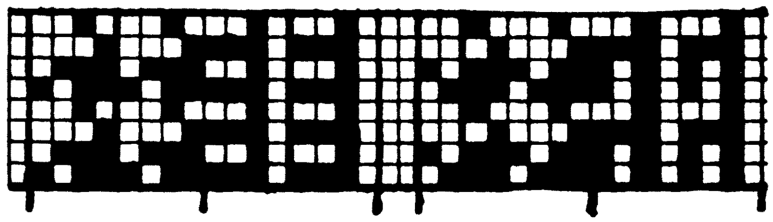


Fig. 356. Fig. 357. Fig. 358. Fig. 359.
Double Plain Designs.

At. Fig. 358 the footing of the weave is altered for the backing, but the face is the same. It now produces vertical hairlines on both cloths as at Fig. 359.

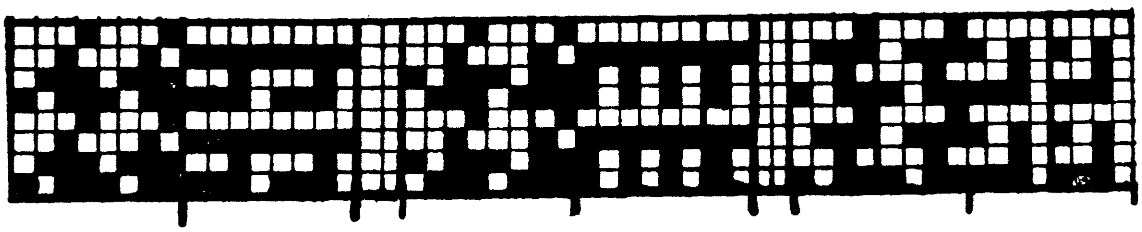


Fig. 360. Fig. 361. Fig. 362. Fig. 363 Fig. 364. Fig. 365.
Double Plain Designs.

In Fig. 360, both sections of the design are altered, and Fig. 361, horizontal hairlines are formed for both cloths.

At Fig. 362 there is the same face weave as at Fig. 360, but the backing weave is altered, and gives a horizontal hairline face, and a vertical hairline back as at Fig. 359.

As a final, Fig. 364 is on a different designing footing to any of the others. It is planned to have 2 backing threads and 2 face threads as before, but the wefting is now 1 back, 1 face. This gives a white bird's eye effect on the face—that is, a small white spot on a black ground, and on the backing cloth, it is a black bird's eye effect as given at Fig. 365.

Backed Cloths.

To add weight, a cloth may be backed with warp or weft. Fig 366 is for a cloth backed with weft, the first pick being face, and the next backing, the pegging being lift black. It is an 8 shaft weave on 16 picks.

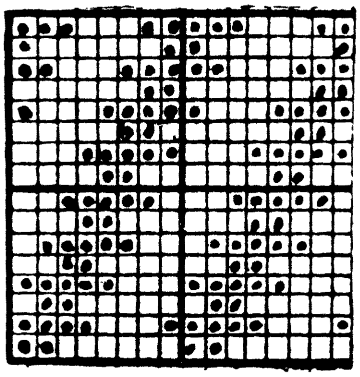


Fig. 366.
Twill Backed with Weft.

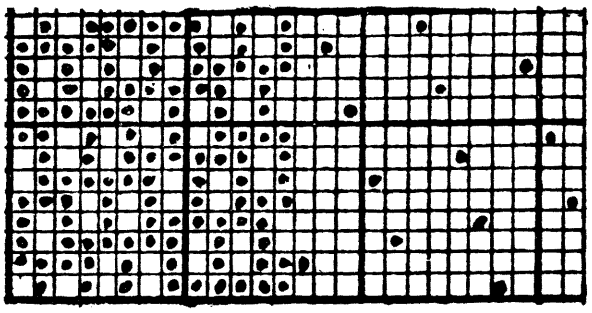


Fig. 367.
Corkscrew Backed with Warp.

As an example for a cloth backed with warp there is Fig. 367. It is a 13 shaft corkscrew face, and a 13 shaft sateen back. It is one of the most difficult cloths to weave.

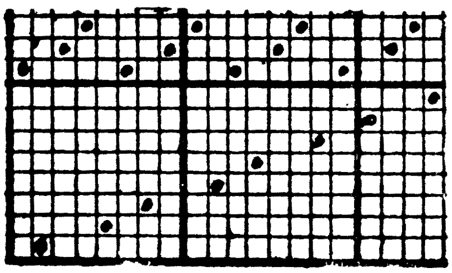


Fig. 368.
Draft for Cloth Back with Warp.

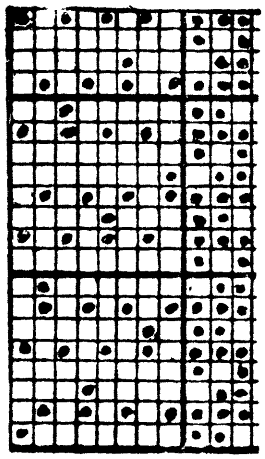


Fig. 369.
Full Design.

Double Cloths.

A proper double cloth is one where two cloths are woven at the same time, the two cloths being held together by stitching. The stitching may be backing to face, or face to backing, or both. One of the less costly kinds of double cloth has the draft at Fig. 368. The 3 face shafts are placed at the back, and the 8 backing shaft at the front. It is loomed 1 face, 1 back, 2 face, 1 back, and there are 20 threads in one repeat. There are 12 face threads and 8 backing threads.

The face shafts weave 2 and 1 warp twill, and the backing shafts weave plain, and are stitched to the face in

8 end sateen order. This can be traced at Fig. **369**. Both warps are single twist worsted, and are sized.

A more substantial double cloth is at Fig. **370**. The weave is the running hopsack for face and back, the healds

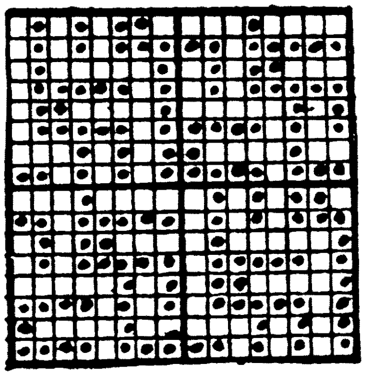


Fig. 370. Running Hopsack Double Cloth.

being drawn straight gait, 1 thread face 1 thread backing. The backing is stitched to the face in 8 end sateen order.

LANCASHIRE TAPPET LOOMS.

A good part of the foregoing chapters aptly apply to the Lancashire cotton industry, as well as the woollen and worsted trade. Such looms as the circular box, the jacquard, and the Northrop have much in common for the staple trades of Yorkshire and Lancashire. Then the negative let off, the overpick, the fast and loose reed, and the Kenyon under motion all work on the same principle. In the use of shuttles, belts, pickers, temples, and electric motors, the principles already propounded hold good, and therefore need not be repeated. Mention has also been made of rayon weaving.

There are differences, however, and these are set forth in the following pages.

The Lancashire Calico Loom.

The ordinary Lancashire inside tappet loom has a reed space of 45 inches, and a speed of 180 picks per minute. The heald shafts are assisted in making the shed by a horizontal shaft seen above the upper framework. On the shedding shaft are two pairs of rollers, the smaller pair being connected to the two front shafts, and the larger pair to the two back ones. The first two shafts rise and fall together, and so do the two back ones. The warp is gaited 1, 3, 2, 4, and weaves plain cloth.

When the heald shafts are level, the setscrews holding the rollers or shedding collars are just above the centre of the rollers. This gives liberty for the winding and unwinding of the straps without binding. The amount of collar turn depends on the leverage imparted by the tappet treadles. It is customary to have the size of the shed, so that when the crank is at its back centre, the top shed is just clear of the top shuttle front. The tappet for the two back shafts may be from $\frac{1}{8}$th to $\frac{1}{4}$ inch larger than the other so as to give a larger movement to the healds. The dwell made by the tappets may be from $\frac{1}{2}$ to $\frac{1}{3}$rd a revolution of the crank, and for light weight goods, it is usually the latter. The picking, as shown in the illustration is the overpick, and though acting in the same way as already expounded, the shaft is outside the loom frame, and is more readily unloosed. The back rail is set a little higher than the breast beam, so the warp is slacker on the top shed than the bottom one, and gives better " cover " to the cloth.

The letting off is the negative one of rope or chain and weight lever as already explained.

Fig. 371 gives Messrs. Robert Hall's high speed calico loom. This has a reed space of 36 inches, and a speed of

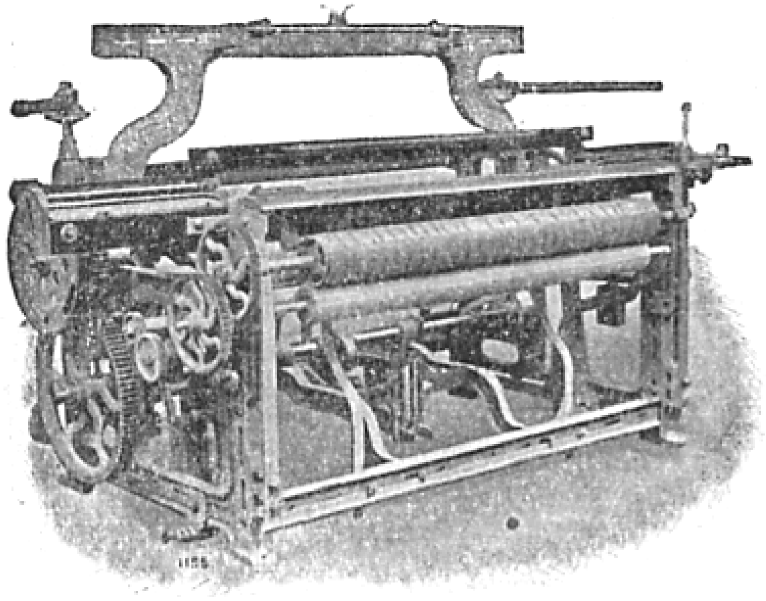


Fig. 371.
Robert Hall & Sons High Speed Calico Loom.

210:220 picks per minute. (*See* Chapter on "Tappet Looms.")

Bordered Cotton Blankets.—Many makes of Lancashire looms are of simple construction, but gadgets are added to weave certain types of fabrics. One of these is for the weaving of bordered cotton blankets and shawls for the South African and South American markets. There are also huckaback towels, scarves of the cheaper kind, and certain makes of tablecloths. These are woven by an arrangement that automatically stops the loom when the borders have to be woven.

Chain Motion.—In Fig. 372, A is the shaft of the take up roller, and to it is setscrewed the chain wheel B, having 32 teeth, the fixing screw being at C. Roller D has a circumference of 16 inches, so that one tooth on the chain wheel B will weave a half inch of cloth.

The link chain path is at E. After contacting with the teeth on the change wheel, it passes over the flanged guide bowl F, and in the loop at the bottom, is the hooked weight G that prevents the chain from sagging. At H is the stop bracket clamped on weft fork lever I, and is fixed by set screws. The weft fork lever is in front of set-on handle L, and moves on the surface of breast beam J. On the surface of stop bracket H, are three pegs set at equal distances. These form two grooves, the most convenient being used by the chain.

All parts controlling chain traverse have to be plumb straight to keep the chain in contact with the chain wheel.

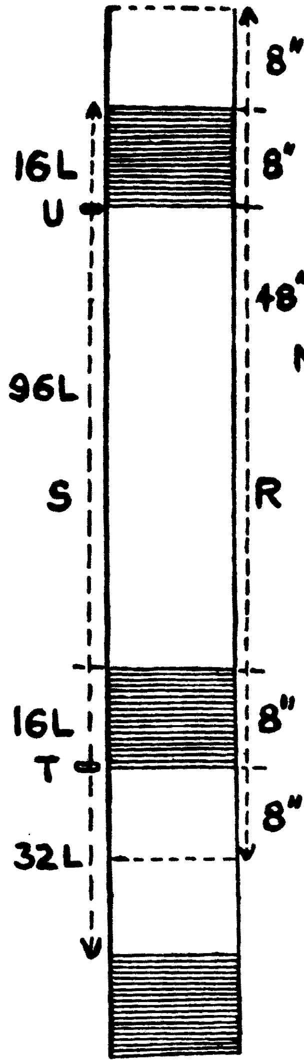


Fig. 373.
Bordered Cotton Blankets.

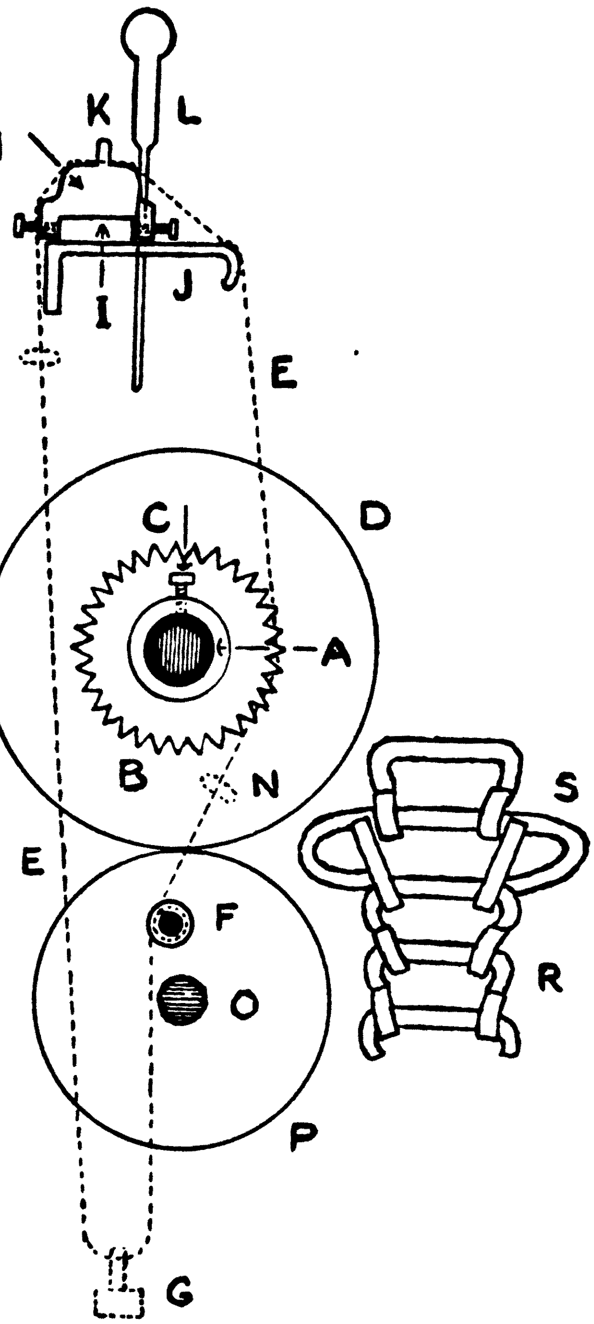


Fig. 372.
Chain Motion.

The chain has two stop links, one at M and the other at N. The actual size and structure of the chain is at R and S. Each link like R is equal to a half inch of cloth.

It is the wider link at S that is the means of stopping the loom, for it cannot pass the groove in the stop bracket H. As the chain is bound to revolve when the loom is running, this larger link forces the weft fork lever back and stops the loom. These links are arranged to stop the loom when the border has to be woven.

The motion is outlined in Fig. 373, and is one of the simplest plans for weaving these goods on a plain loom.

Blue or pink borders on a white ground are the usual colours, but others have a coloured ground with white borders.

The actual blanket, shawl, scarf or towel is indicated by dotted line R, and a knife cuts the cloth at the two dotted lines on arriving at the warehouse. There are various standard lengths and borders. The one given has an 8 inch ground, 8 inch border, 48 inch body, 8 inch border, 8 inch ground, and has a total length of 80 inches.

The chain is indicated on the left at S. Here, the first section has 32 links to weave 16 inches, and then comes the first stop at T for weaving the first border with 16 links to weave 8 inches. Then follows the body width 96 links for 48 inches, and a second stop at U. The final is 16 links to weave another 8 inch border. This makes a total of 160 links for 80 inches of cloth. More elaborate borders are woven in box looms. The chain motion is a decided gain over having to use a tape measure.

Pickles Motion.

This motion is the one generally adopted in the Lancashire cotton trade for the positive take up of the cloth. It is a seven wheel motion, and the pawl is a puller. In this arrangement, the change wheel is driven, so that if a larger wheel is used the speed of take up is reduced and the number of picks per inch are increased, Fig. 374. Referring

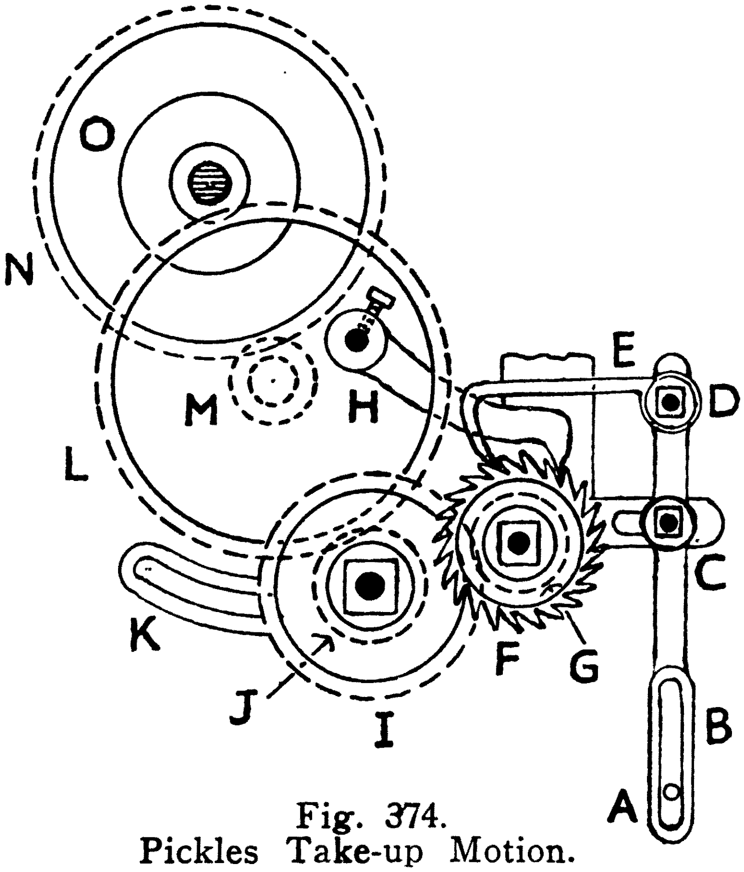


Fig. 374.
Pickles Take-up Motion.

to the sketch, A is the rod attached to the sword, and B the slotted part of the take up lever fulcrumed a C, and at D is the fulcrum for the pulling pawl E. At F is the rack wheel with 24 teeth, and G is the standard wheel with 36 cogs. This turns the change wheel I, and on the same stud is the swing pinion J with 24 cogs. The swing pinion meshes with the carrier wheel L with 89 teeth, and its carrier pinion wheel at M has 15 cogs. This pinion turns the take up roller wheel with 90 teeth, the diameter of the take up roller being 15.05 inches, or 60.2 in $\frac{1}{4}$ inches. The curved slot K accommodates the various diameters of the change wheel or a change in the standard wheel.

For calculation:—

$$\frac{\text{Drivers} \quad 36 \times 24 \times 15 \times 60.2}{\text{Driven} \quad 24 \times \text{C.W.} \times 89 \times 90} = 4.06.$$

To allow for contraction $1\frac{1}{2}$ per cent. is deducted which brings the gauge point to 4 one quarter inches which equals one inch in the cloth. The number of teeth in the change wheel is the number of picks per inch. When the standard wheel is changed to one less, it will give more picks per inch, if it is larger, the picks will be reduced. For example, if a 36 standard wheel gives 60 picks per inch with a 60's change wheel, what will a 30 standard wheel produce?

$$\frac{36 \times 60}{32} = 72.$$

If the standard wheel be changed to 45's cogs, what picks will it give?

$$\frac{36 \times 60}{45} = 48.$$

Medium Weight Duck Loom.—This loom at Fig. 375, and four other makes of duck looms are made by Messrs. Wilson and Longbottom of Barnsley. The one illustrated weaves from 20 to 24 oz. per square yard.

The loom frame is milled so the parts bolted to it have a solid fit. The going part is plated back and front to give a strong beat up to the weft. The shuttle race is made of durable wood. It is a fast reed motion, the frogs being held forward by double springs bolted near the base of the loom. The crank shaft is made of special quality steel with a diameter of two inches. Its supports are of gun metal.

As shown the picking is overpick inside the loom. For additional security, both boss and picking shell are toothed for firmer gripping, and the boss is also firmly secured by a key in a sunk keyway.

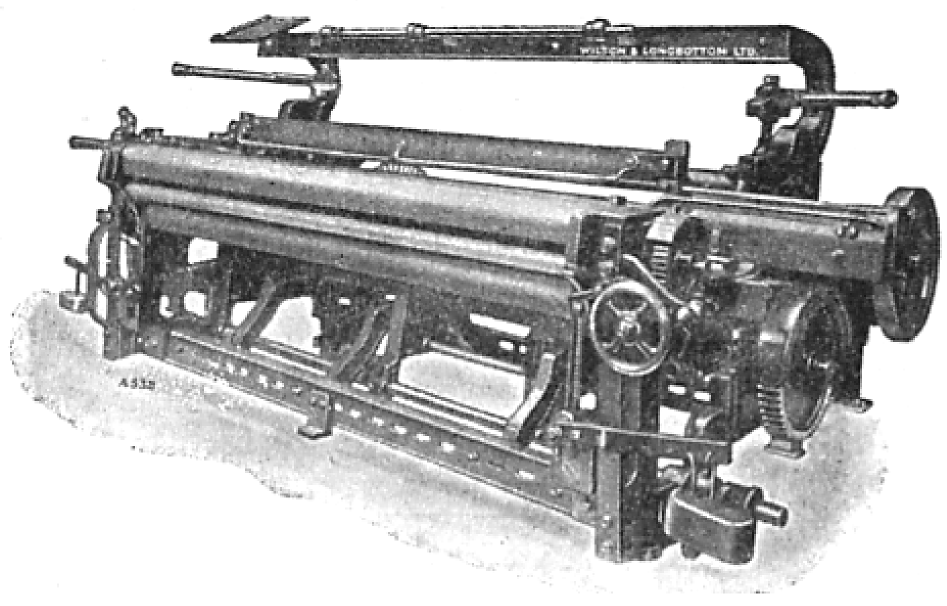


Fig. 375. Wilson & Longbottom's Duck Loom

The healds are controlled by two sets of plain tappets of robust construction. The warp beam is constructed of $4\frac{1}{4}$ inches steel tubing, with special flanges with a diameter of 24 inches. The beam pulleys have a diameter of 9 inches, and thick chains are used to brake it. The brake weight levers are long, and comparatively small weights are used. The take-up motion is a positive worm and wheel type that turns in an oil bath. The take-up roller has a 6 inch diameter of steel tubing covered with coarse perforated steel strip. The cloth roller is in contact with it.

Underneath Utility Tappets.

This motion is demonstrated at Fig. 376. It is shown as fixed to an old type Burnley loom, and reveals its adaptability to almost any kind of loom. There is more

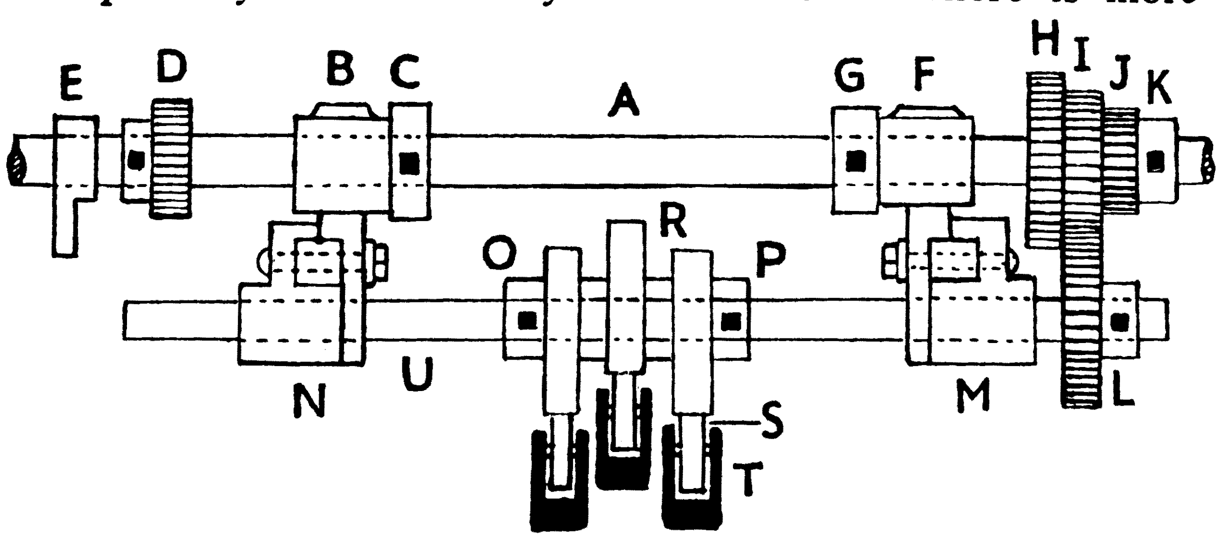


Fig. 376. Underneath Utility Tappets.

need for adaptable looms these days than ever before, owing to the more rapid changes of fashion, and the greater demand for novelties in the home and foreign markets.

The loom has a reed space of 32 inches, but is equally applicable for wider looms. For very wide looms, two motions are desirable, which are timed exactly alike, and equalize shed tension on the healds. The 5-shaft motion is for warp and weft twills, and warp and weft sateens. On the low or picking shaft of the loom on the right is the driving pinion wheel which has 16 teeth, and is the timing wheel for the tappets. It meshes with the wheel below which is on the same shaft as the tappets, and has 40 cogs. The driving wheel only turns 8 cogs for each revolution of the crank and thus completes $2\frac{1}{2}$ revolutions to the tappet shaft once.

Treadle bowls and tappets are set in relation to each other to produce the best working conditions.

On the right, but on the picking shaft is a three decker wheel by which 2, 3, and 4 shafts are woven. The 30 and largest wheel is for 2 shafts; the 24 wheel for 3 shafts, and the 20 wheel for 4 shafts. These wheels mesh respectively with tappet wheels having 30, 36, and 40 cogs. It will be noted that the wheel with 40 cogs does for both a 4 and 5 shaft weave, but the upper or low shaft wheel has 20 cogs for the four shaft weave and 16 cogs for the 5 shaft. The crank shaft wheel has 48 teeth, and the low shaft wheel 96 teeth.

Here is a brief explanation of Fig. 376. A is the picking shaft, with B and F the bearer brackets for casting M and N on the countershaft below. The upper brackets are kept in position by collars C and G. At D is the wheel having 16 teeth for the weaving of five shafts, and E a pedestal bracket. The three decker wheels H, I and J have been explained. K and L are collars for their respective wheels. The tappets for three shafts are at O, P and R, the anti-friction bowls for the tappets being at S, and the upper part of the treadles being at T. U is the counter shaft.

Tappet Easing Motion.

For looms weaving medium plain cotton fabrics, there is usually a tappet on the crank shaft A. Some loom makers fix the tappet with a key, but it is better to have a couple of setscrews, for then, the timing can be altered to suit the warp, and the timing of the shed. Fig. 377.

A lever C rests on the top of the tappets B, which is secured to the bottom back rest of the loom D. On this rest is a setscrewed casting E at either end, each having an open slotted top. In these, the upper oscillating rail is placed at F.

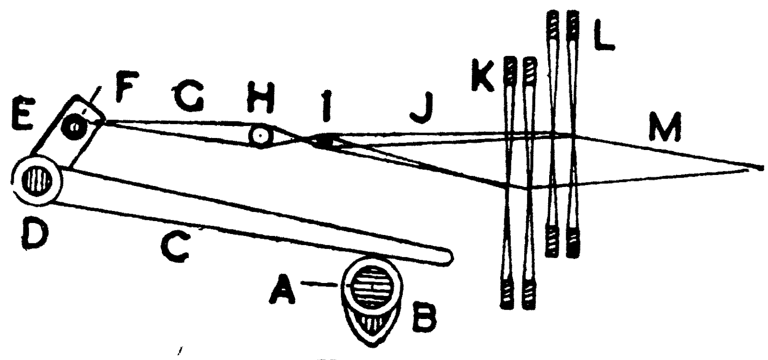


Fig. 377.
Tappet Easing Motion.

The warp is made to pass under the bottom rest and over the top one on its way to the healds.

The tappet is timed so as to lift the easing lever to its full height when the heald shafts are level. This tightens the tension on the warp when the eyes of the healds are passing each other, and slackens it as the healds divide the warp. This is realised in Fig. 378. G is back shed, H and I lease rods, J the open back shed, K the two back shafts on bottom shed, L the two front shafts on top shed and on the open front shed in Fig. 377.

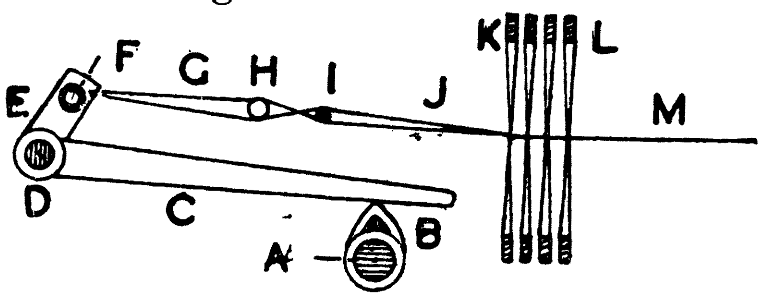


Fig. 378.
Tappet Tightening Warp.

When low quality goods are being woven, the easing motion has to be put out of action as it has a tendency to make uneven cloth.

For heavy goods, the tappet is placed out of service, and the lever left on. The warp is made to pass over the two rails as before, but both are held rigid, and in this way, friction on the warp is increased, and dead weight on the warp beam levers decreased. It produces better cloth, and less ends are broken.

Lease rods are placed in the back shed. The 1st and 3rd shafts have their threads passing over the thick back rod, and the 2nd and 4th shafts threads pass over the front thin rod to equalise the tension on the threads.

Spring Top Motion.

As the tappets here mentioned are negative in action, they work in conjunction with a spring top motion outlined in Fig. 379. The framework is at A, and B are the fulcrums of a pair of levers. At C are the metal fingers which act in unison, for if the lever G on the right is drawn up, its finger descends, and takes its companion with it, and so raises the arm D. The shaft levers are provided with two

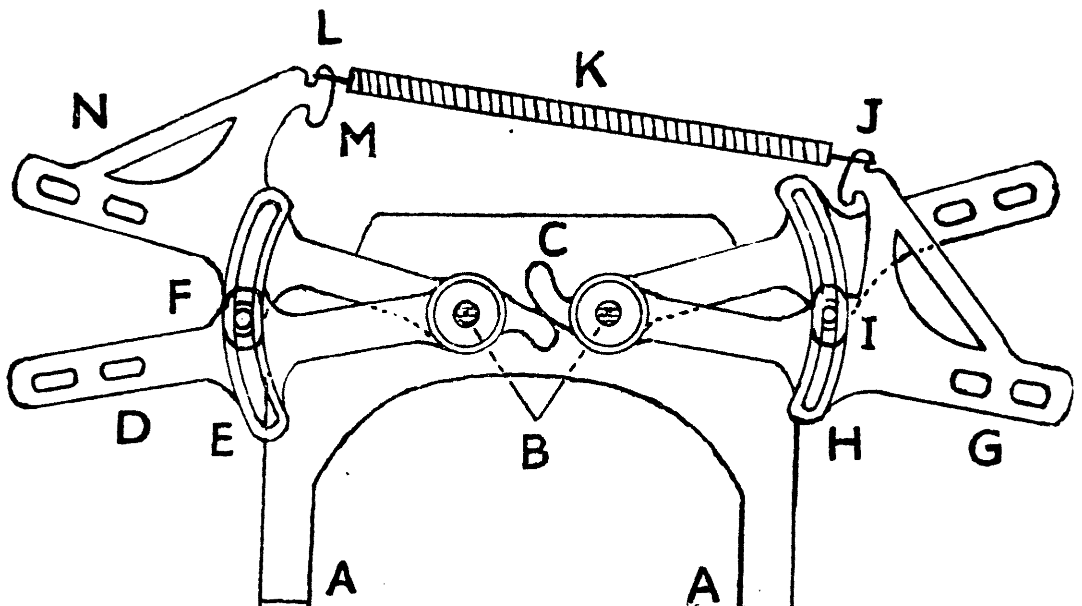


Fig. 379.
Spring Top Motion.

slots each at their outer ends, from which attachment is made to the heald shafts. They are also made with long curved slots at E and H, and are prevented from descending too low or getting out of position by the bars F and I that pass through them. At their upper ends, the larger levers G and N have two hooks, and to these at J and L the spring K is attached. The same spring acts for two pairs of levers. The spring can be attached to the lower hooks M for the weaving of the lighter goods, or as set forth for greater pressure, or two springs can be attached to the same levers for heavier work. The strength of the springs is another source of alteration. It is the small part of the tappet that raises a shaft and the larger part that depresses it. The spring top motion is provided with a hand lever (not shown) for levelling the shafts.

Lupton and Place's " Climax " Super Spring Top Motion.

A later and stronger mechanism is the " Climax Super Spring Top Motion " presented at Fig. 379A. There is only one set of levers to control the heald shafts, but there is a set of pulleys to assist. It is made for 8 shafts. The front top of the levers take charge of the leathers with their attendant bands for the top of the shafts at one end. Behind and near the top are the strong hooks on which the springs are placed to draw the shafts to the top shed. These springs at the opposite end are placed on hooks above the pulleys that guide the straps and bands to another set of hooks on the top heald shafts.

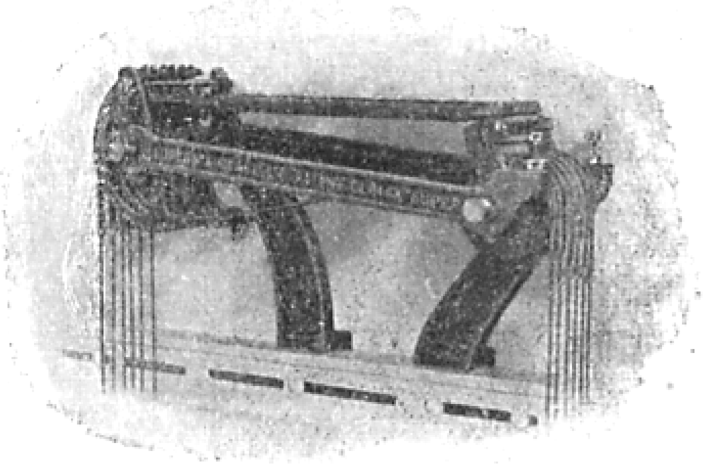


Fig. 379A
Lupton and Place's Spring Top Motion.

The framework bearing the springs can be regulated by locknutted setscrews to adjust the pull of the springs.

At the base of the levers, rods are hooked in that pass forward and upward to take the heald shaft straps for the other end of the shafts.

The heald shafts have to be adjusted in two ways.

1. To see that the threads on each shaft barely touch the shuttle race when on the bottom shed.

2. To make the levers be clear of the top stay bar when the shafts are on the top shed.

There are no menacing teeth; no knuckle joints; no links; no unequal lifts.

Pull of Springs:

8° springs, 48 lbs; 9° springs, 34 lbs.; 10° springs, 20½ lbs.

Butterworth and Dickinson's Tappet Loom with Circular Box.

This loom, Fig. 380, is very substantially made with outside treading motion, and cross rod shedding arrangement, the latter being fitted with cast iron bushes in all their bearings. The working of the tappet loom has been fully explained in Chapter 4. This loom combines the reliability of tappet motion with the advantages of a circular box for weft mixing, check patterns, and fancy coloured effects. The circular box is fully dealt with in Chapter 10. The picking is the cone overpick motion, and the letting-off is the rope friction and weight levers. The take-up is the Pickles motion, the gauge point of the change wheel being a tooth per pick.

It is made in various widths. On average goods with a 48 inches reed space, it is run at approximately 170 picks per minute. The framework is specially constructed that it may have a roller motion for 2 or 4 shafts with inside tappets, the 8-shaft cross rod arrangement as given, or be fitted with a dobby. If a dobby is fitted, it will take 16 shafts and in

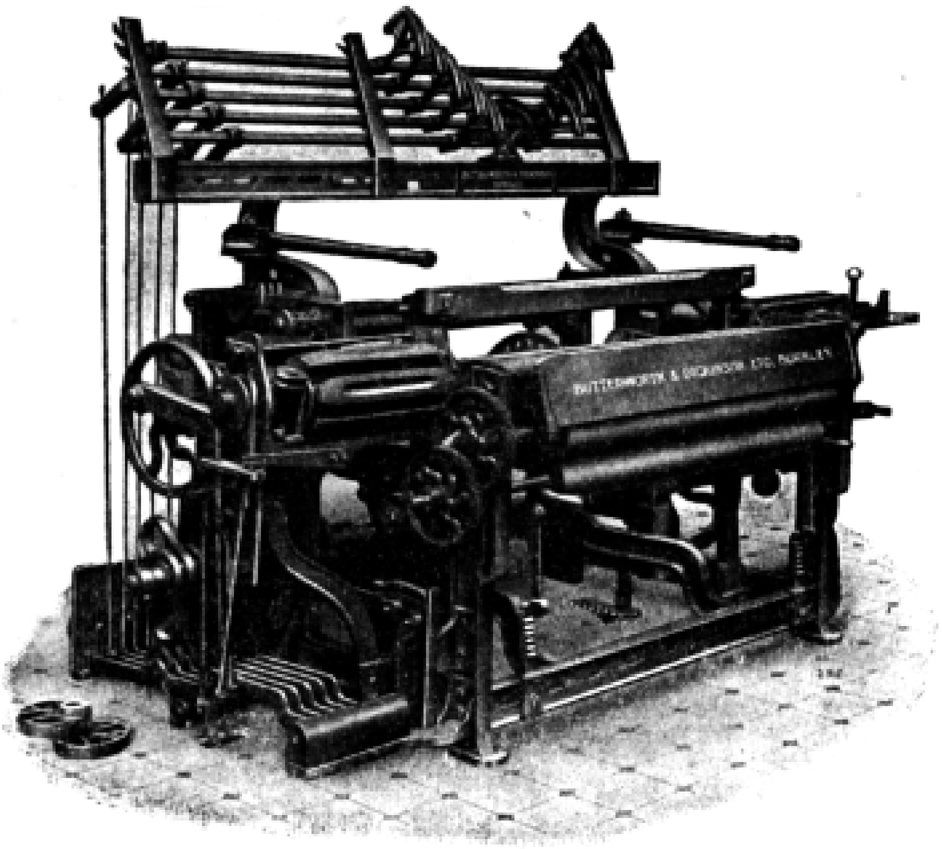


Fig. 380.
Butterworth & Dickinson's Tappet Loom with Circular Box.

addition to good scope for cotton fabrics, a large variety of rayon fabrics can be successfully woven. The dobby jacks, balks, and catches are made on the Lancashire ball and socket principle.

Hall's Woodcroft Tappet Loom.

The loom presented at Fig. 381 is fitted with a Woodcroft tappet motion, and is employed in the weaving of light and medium goods, and particularly such cloths as moleskins, beverteens, corduroys and velvets. The cloths mentioned are usually woven on 6-shafts, but the tappets are constructed to give up to 32 picks to the round.

The loom has a reed space of 46 inches, and a speed of 165 picks per minute. It is fitted with the overpick, the negative chain let-off, and Pickles take-up. What is of particular interest is the Woodcroft tappet motion. This is fitted up at one end and outside the framework, with treadles arching over the top, and fulcrumed at the back. At their centre they carry the bowl, and at the front top are notched to receive the connector casting that links the bottom levers and the bottom of the shafts, to the top levers and the top of the shafts.

The tappet is constructed for centre shed or open shed, and both are positive in action. They are built up by sec-

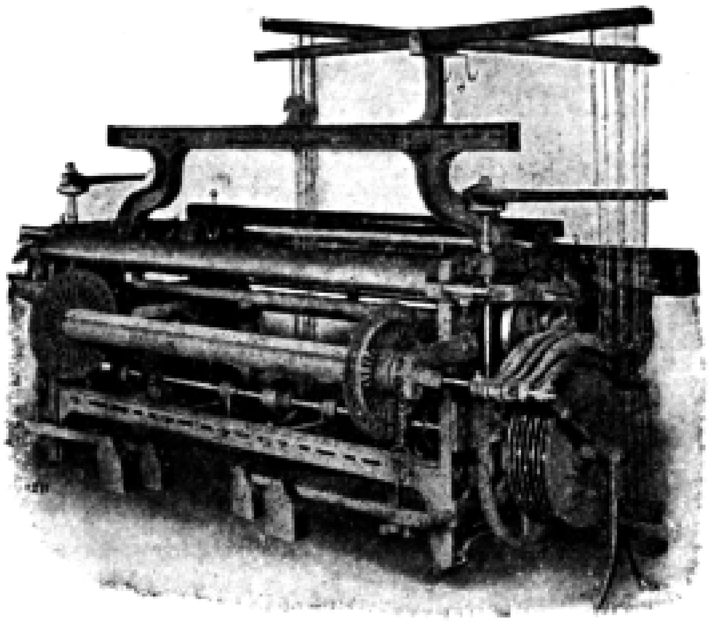


Fig. 381.
Hall's Woodcroft Tappet Loom.

tional risers and sinkers being bolted to a ring plate. There has to be as many active ring plates as there are number of shafts to be used, and there has to be as many sections on each ring plate as there are picks in one repeat, or duplicates of one repeat.

As an example, a 12-section ring plate will weave a 12-pick pattern, but also any design which will divide into 12, such as 2, 3, 4 and 6.

Fig. 382 shows the method of constructing a centre shed ring plate for 8 shafts. The pattern commencing at No. 1 is 3 down, 1 up, 2 down, 2 up. No. 5B is a sinker, because the bowl working outside the metal section pulls the bottom lever upward, and lets the top lever down which is directly fixed to the heald shaft. At A, No. 4 section is the riser, for it controls the bowl the opposite way to No. 1. The circles represented at C are for the fixing bolts which pass through all the plates, so that when bolted up, they are as one solid whole. The parts D and E are for locking with the outer flange. In building the sections, it has to be borne in mind which way it has to revolve—whether for a right or left hand loom.

Fig. 383 is an open shed ring plate, and for the same pattern as Fig. 382. It has the appearance of being more simple in construction, but is more complicated in the parts. There are 8 different plates, 6 of which are seen in the drawing, and are as follow: 1, right hand sinker; 2, sinker dwell; 3, left hand sinker; 4, riser; 5, right hand sinker; 6, left hand sinker; 7, right hand riser; 8, left

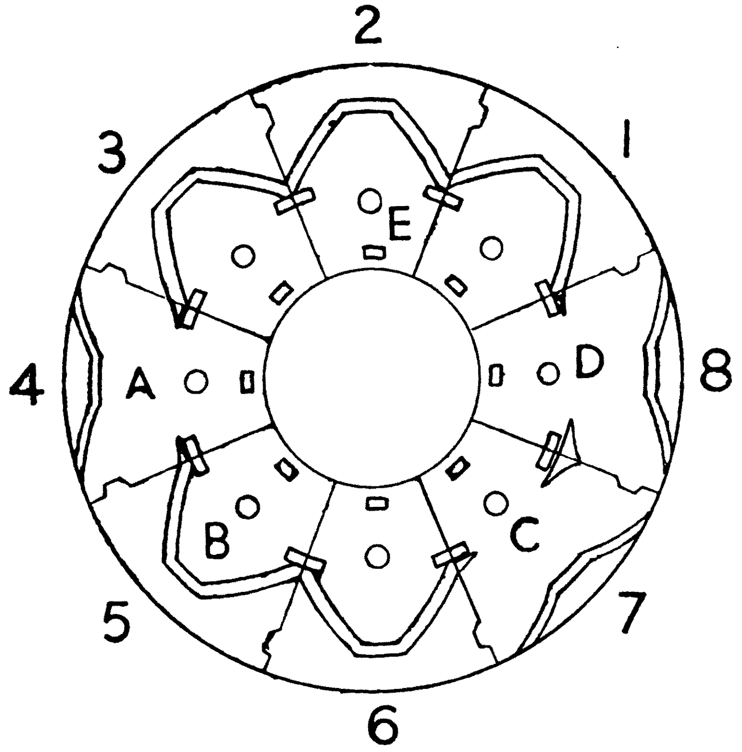


Fig. 382. Woodcroft Centre Shed Tappet.

hand riser. As each section plate is completed, it is best to oil it well, as thoroughness cannot well take place when

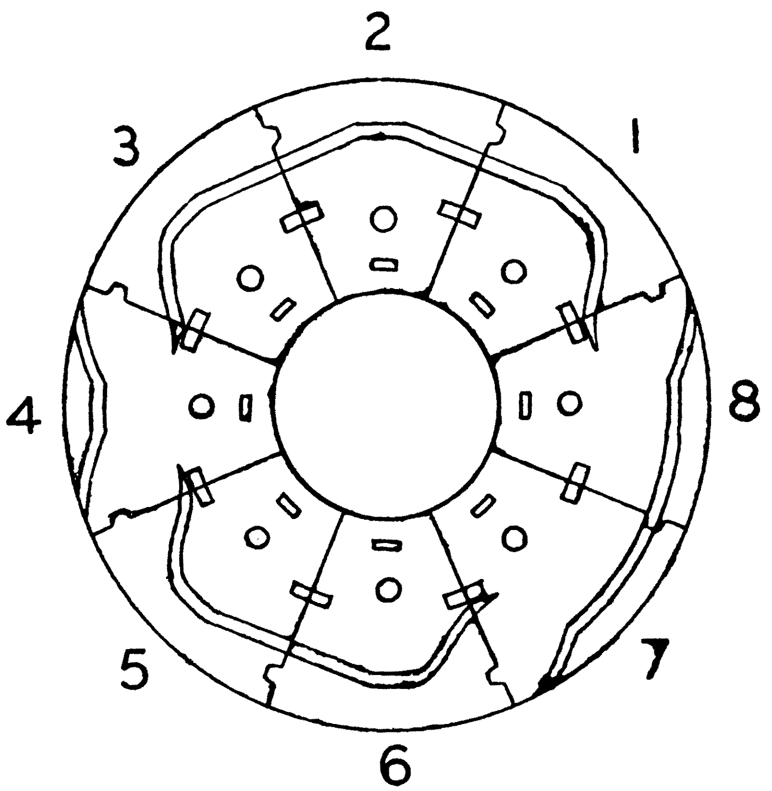


Fig. 383. Woodcroft Open Shed Tappet.

working. The speed of tappet revolution depends on the number of picks in one round, and is on a similar plan to the Yorkshire tappet loom explained. The firm also make whole plate tappets.

Ward Bros. (Blackburn) Dobby.

This set forth in Fig. 384. It is a double draw dobby built on the square. At A is the shedding rod and B the centre arm of the T lever. C is the fulcrum for both T lever and the front main dobby lever, which carries the connecting rods D and E that are coupled to the draw bars. At F is the top slot in which the draw bar moves, a similar one being below. G is the top catch which is fulcrumed at H on the balk M, the back rest for the top of the balk being at I, and the bottom rest at N. At J is the needle that influences the top catch. When a peg in the lags tilts a feeler, the needle descends, and the catch is lowered on the top draw bar, and the corresponding shaft is raised. K is the bottom catch and is moved by a fingered feeler. The

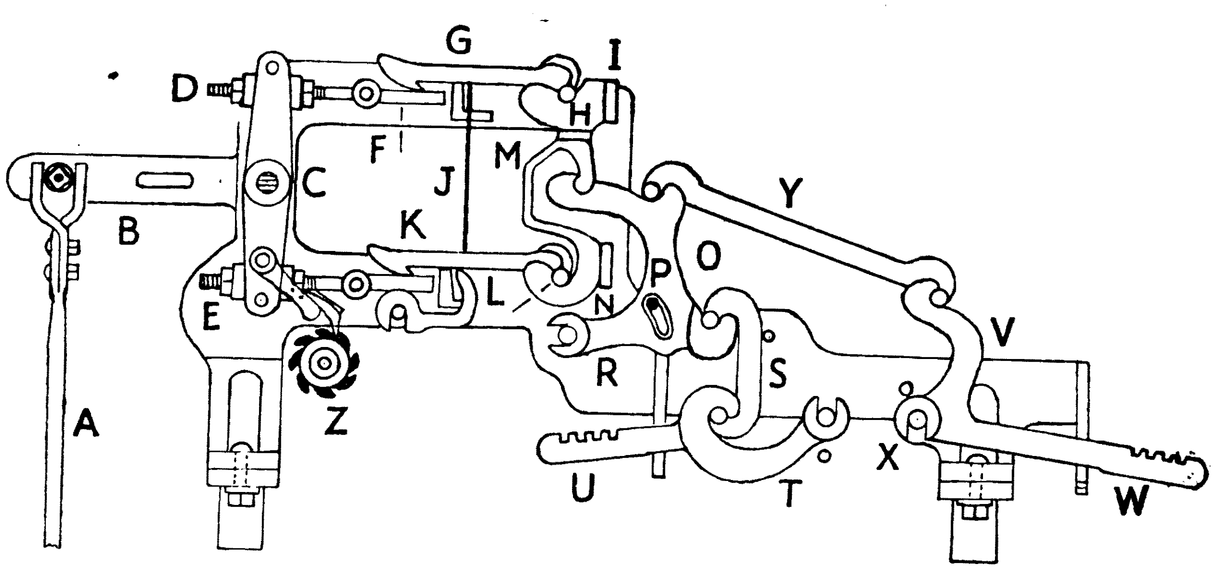


Fig. 384. Ward Bros. (Blackburn) Dobby.

catch is pivoted at L, both being connected to the balk on the ball and socket principle. At O is the peculiarly shaped dobby jack, that oscillates on the bar at R and is prevented from getting out of its working position by the pin P passing through the jack slot. S is the connector from dobby jack to shaft jack U by means of the curved section T. At V is the upper arm of the other shaft jack, the notched lower arm being at W, the jack being fulcrumed at X. Y is the connector from outer jack to balk. The 8 toothed cylinder wheel is at Z. The parts are easily liberated.

Lupton & Place's Four Cylinder Climax Dobby.

The " Climax " dobby made by Lupton & Place of Burnley, is very similar to the one at Fig. 384. The exception is that instead of the independent jack shaft lever on the right, an arched lever takes its place that is cast to the dobby lever.

This particuar kind of dobby is about the most precise used in the cotton industry. Though having four operating cylinders, and also a master cylinder that stops any one cylinder and brings another into play, the same dobby can be made for 1, 2, 3 or 4 cylinders, which are the most suitable for the manufacturer's trade. The one cylinder is limited to the plainer goods, but the four cylinder can give the most varied aspect to the woven structure. For such a dobby, accuracy of workmanship is vital for the establishment of confidence and good results. This confidence has been established, and is the pride of the firm.

The ground weave is taken by the outer cylinder, and the other three contribute their share to the texture as planned by the designer and pegged by the overlooker or lag pegger. Usually, the three inner cylinders only require a small number of lags.

The master cylinder operates four levers, to each of which is attached a rod that controls a cylinder pawl, raising the pawl to place it out of action, and dropping it for service.

The outer roller for the master cylinder is adjustable to the length of the lags. The jack levers for the shafts pass through grates to prevent jacks and shafts catching each other.

For this dobby, the firm claim six points.

1. Simplicity and minimum number of working parts.
2. Each pattern cylinder is worked independently.
3. There is only one ratchet wheel to each pattern cylinder.
4. Ratchet pawls work on the same centre as its own ratchet wheel, and this gives more positive controlled motion to the pattern cylinder.
5. The break-back mechanism of the feelers gives a fool-proof setting to the mechanism.
6. Accuracy and reliability of the registering mechanism.

The usual speed of the loom is 230 picks per minute.

For block of this dobby see advertisement, page 572.

THE WEAVING OF HOSEPIPING.

This class of fabric became of national importance during the World War.

Hosepiping requires a special loom to weave it, and the one presented is made by Messrs. Robert Hall & Sons, Bury, Lancashire.

Yarns Employed.—Cotton is not as suitable for this class of work as flax and hemp. When cotton is very closely woven, it becomes too hard after wetting and pressure, and is difficult to coil.

Flax and hemp swell after wetting, and when closely woven, become water tight. They can withstand pressure up to 500 lbs. per square inch, and after use, are readily coiled, and conveniently carried.

Hosepiping examined, had three strands in one thread of warp, and eighteen strands made one pick of weft. There were 30 threads and 9 picks per inch, and the weave was plain. The texture was 4 inches outside when flat, but had a diameter inside of 2½ inches. Both warp and weft were flax.

Shedding.—This was done by four positive tappets on the right in Fig. 386. Stout levers fitted with anti-friction bowls fit over the tops, and are fulcrumed at the back. The levers vary in length, the outside one being the longest. At the loose end, the levers have three bores each, and here is pinned the swivels to which the connecting rods are hooked. At top and bottom, the rods are hooked to swivels on the strong shedding levers. At their inner ends, there are V-shaped irons put through swivels that are hooked to the metal ends of the heald shafts. The shedding levers are 19 inches long, over and under the loom and 16 inches outside the loom frame

The tappets are turned by a small wheel on the crank shaft that meshes with the wheel below, the ratio being 1 to 4. The tappets are firmly held to the tappet wheel by four bolts.

Wefting.—It is done by a positive tappet seen in Fig. 386, in front of the shaft tappets. The tappet is keyed to the tappet shaft, and at its top front, is the operating lever and

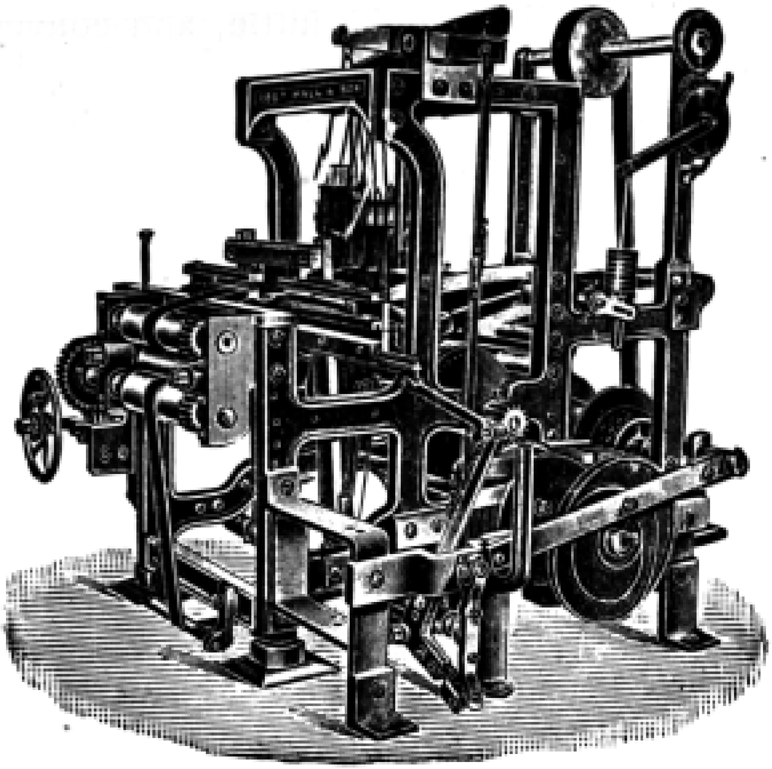


Fig. 386.
Hall's Hosepiping Loom.

bowl. There are a series of castings by which the bowl lever is connected to a lever that does duty as a picking stick. The upper part is seen in Fig. 386, and attached to it is a connecting arm pinned at A. The tappet causes the pick lever to move forward on one pick, and is drawn back the next.

A front view is at Fig. 387. A is the connecting place already mentioned. The rack with its upstanding teeth is at B, and C is the rib that keeps the rack steady and upright. The rack passes through the planed outer parts in the rack rests at D and E.

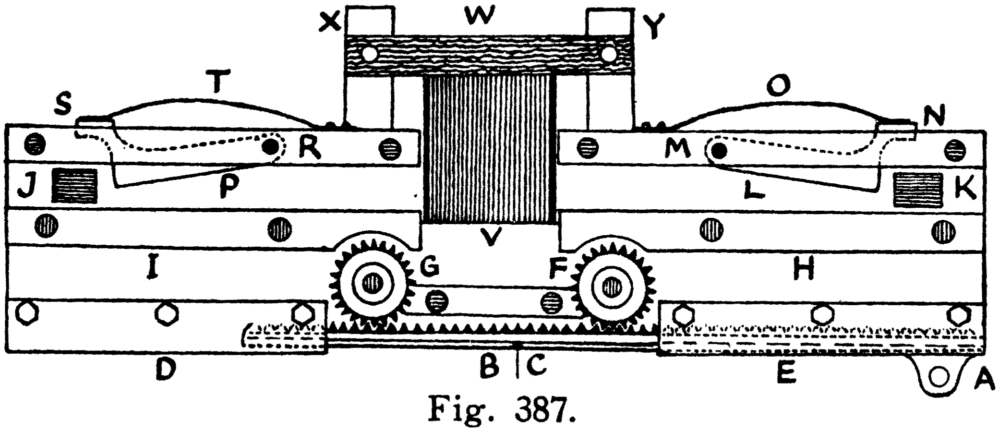


Fig. 387.
Front View of Reed and Shuttle Rack.

The movement turns the pinion wheels F and G, each having a diameter of 4 inches. These mesh with the cogs on the under side of the metal shuttle, and convey it from box to box.

At J and K are the stationary rubbers against which the blunt end of the shuttle contacts at the end of its run.

Box swell L hangs from the box top, and is pinned at M. At N is swell head, and O the curved spring that applies pressure to shuttle.

Though the actual measurements between the swords X and Y is 14 inches, the reed width is only 5 inches. The handrail at W is 20 inches.

Metal shuttle.—Fig. 388 gives a front view. A is the metal plate screwed to the cast part at B and C, and is 11½ inches long. D is a small riveted plate with a flanged roller at its centre, and an opening at either end for the weft to pass half round the roller. The three bores F, and another at G brake the weft, for it has to be held tight after the shuttle has reached its limit in the box. The length of the shuttle is 14 inches.

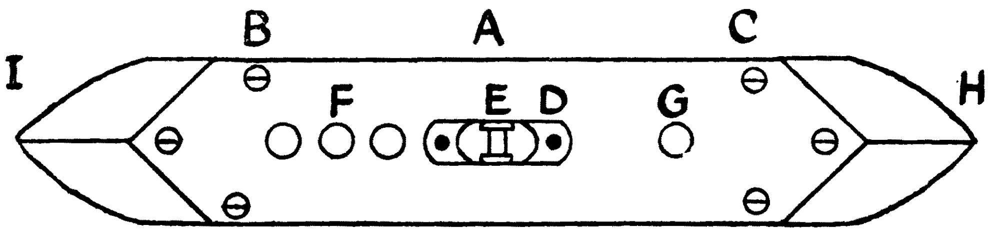


Fig. 388.
Front View of Metal Shuttle.

Fig. 389 is a top view. A is top of front plate, and B the spindle for weft bobbin. The cast part C is shaped to receive the brass casting D that has two bores to let the weft pass through. It is also fitted with two fluted rollers, one at E, and another to brake the weft. The casting D can oscillate a little, but is held by a flexible spring. The ribs F and G are the slides of the shuttle, and at the bottom are its cogs, the shuttle being positively controlled.

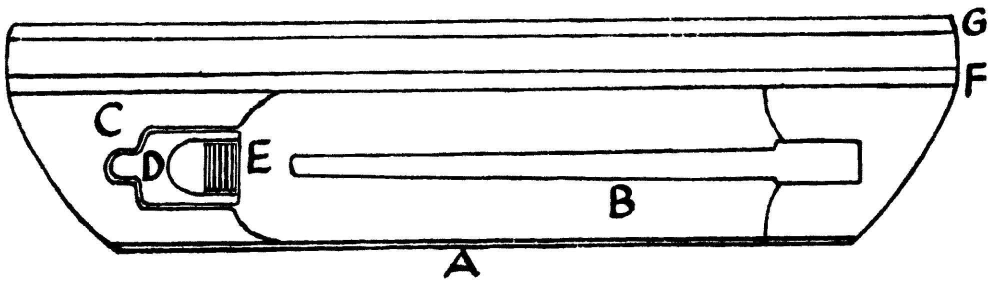


Fig. 389.
Top View of Metal Shuttle.

Beating up.—This is another special part of the loom that gives a double beat-up to the weft. The first beat-up is at Fig. 390. A is the protecting wheel on the outside of the crank, and is an aid to the momentum of the going part, and rotates as arrow R.

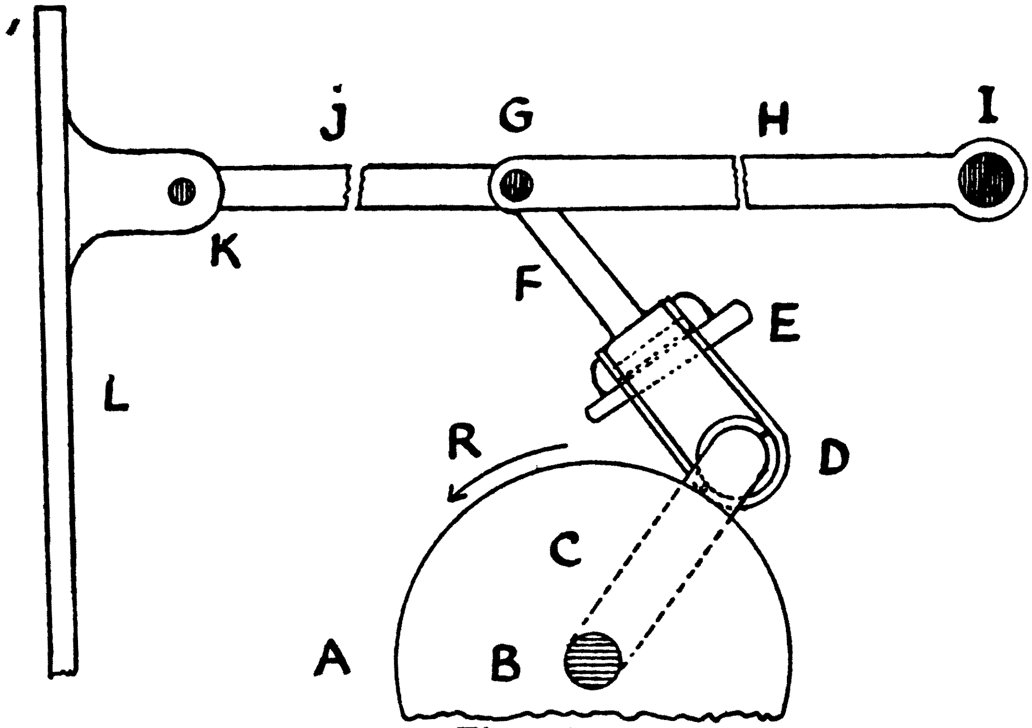


Fig. 390.
Double Beat-up (First Position).

Crank shaft B has a diameter of 2 inches, and crank C is $7\frac{1}{2}$ inches from centre to centre. D are the brass bushes along with their metal band, and cottered at E. Crank arm F is pinned at G to the connecting arms H and J. Long arm H is fulcrumed to strong bar I, and short arm J is secured to the sword L at K. The horizontal arms H and J, along with the sword, are at their full forward movement, but crank C has not yet reached its top centre.

It has done so in Fig. 391, and has pushed up arms H and J above the beat up line N. By so doing, the sword has receded from the beat-up position at O for a distance of $2\frac{1}{4}$ inches (loom measurement). When the crank moves forward to line P in Fig. 391, the connecting arms H and J are then drawn down to the full beat-up line N, and the sword is pushed forward for the second time to O.

Take-up Motion.—This is outlined at Fig. 392, and is at the driving side of the loom. A powerful shaft slants downward from the loom front. The large handwheel is to draw the warp forward, or let off the cloth. Behind it is the worm that meshes with the take-up wheel, having 30 cogs, and turns the spike-covered take-up roller. This roller takes the place of the three cogged wheel rollers in Fig. 386.

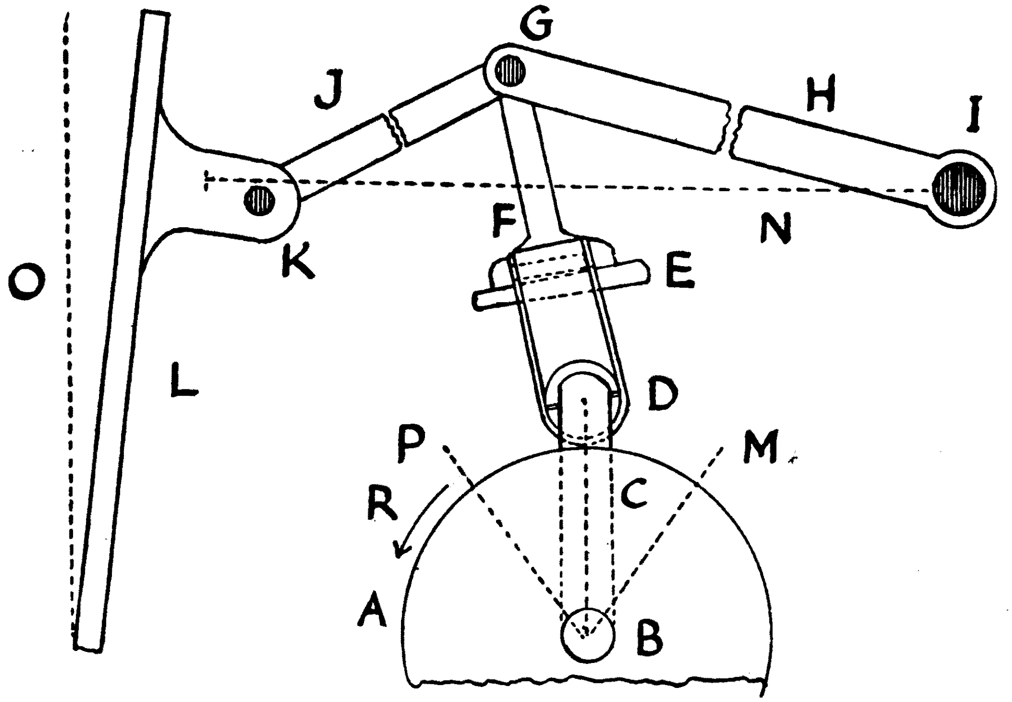


Fig. 391.
Double Beat-up (Second Position).

At the base of the take-up shaft, is the change wheel that is turned by a worm keyed to the crank shaft. The brackets holding the take-up shaft are adjustable to the change wheels. The gauge figures are 943. Suppose 15 picks per inch is required, then 15,000 ÷ 943 = 16.

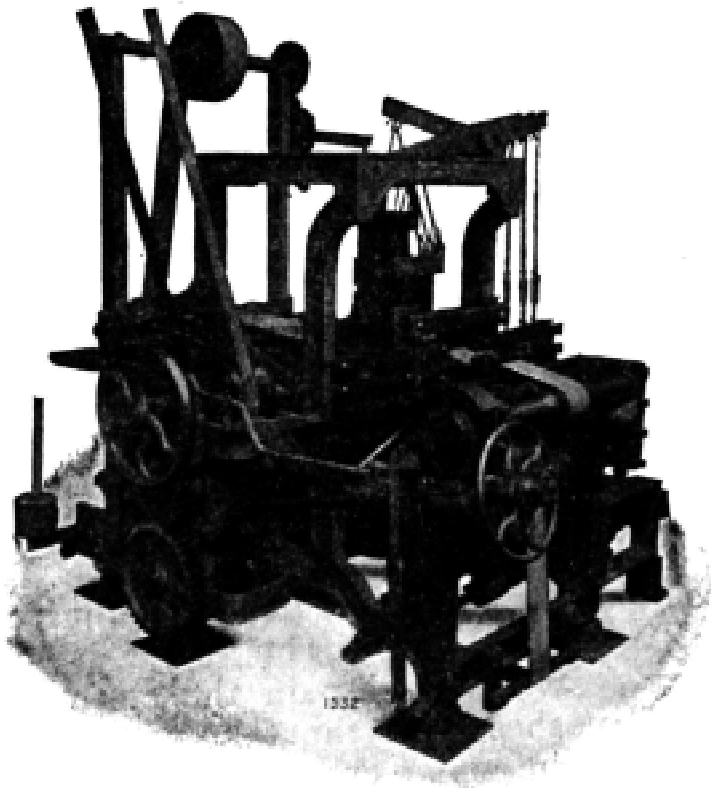


Fig. 392.
Hall's Hosepiping Loom (End View).

Let-off and Take-up.—Hosepiping may be woven from one beam, but is better woven from two, for then braking friction and weights are halved.

The beams are braked by a negative chain motion. fixed to a cross bar in slots in the loom frame. At each end of the bar is an upright rod, and on these are placed the flat and circular brake weights. When the woven piping leaves the spiked roller, it may pass over several smooth bars, but comes to the front again as in Fig. 392. It passes under bars at the front and back of the loom, and is automatically wound on a revolving bar at the top back of the loom as in Fig. 392.

The winding mechanism is better seen in Fig. 386. A cross shaft oscillates, and on it is setscrewed a lever that lifts a weighted rod. The rod drops of its own weight. The top of the rod is fixed to a lever that carries a pushing paul, and a stationary catch prevents a back run of the take-up wheel. The ratchet wheel has a small pinion wheel cast to it, and turns the intermediate wheel that winds the piping on to the roller.

HATTERSLEY'S AUTOMATIC FOR CANVAS AND DUCK CLOTHS.

This is a shuttle changing loom recently made by Messrs. Hattersley's of Keighley, and is built for the weaving of canvas and duck cloths. The one shown in Fig. 393 weaves 20 oz. fabrics, but other looms are constructed to weave them up to 30 oz. per square yard.

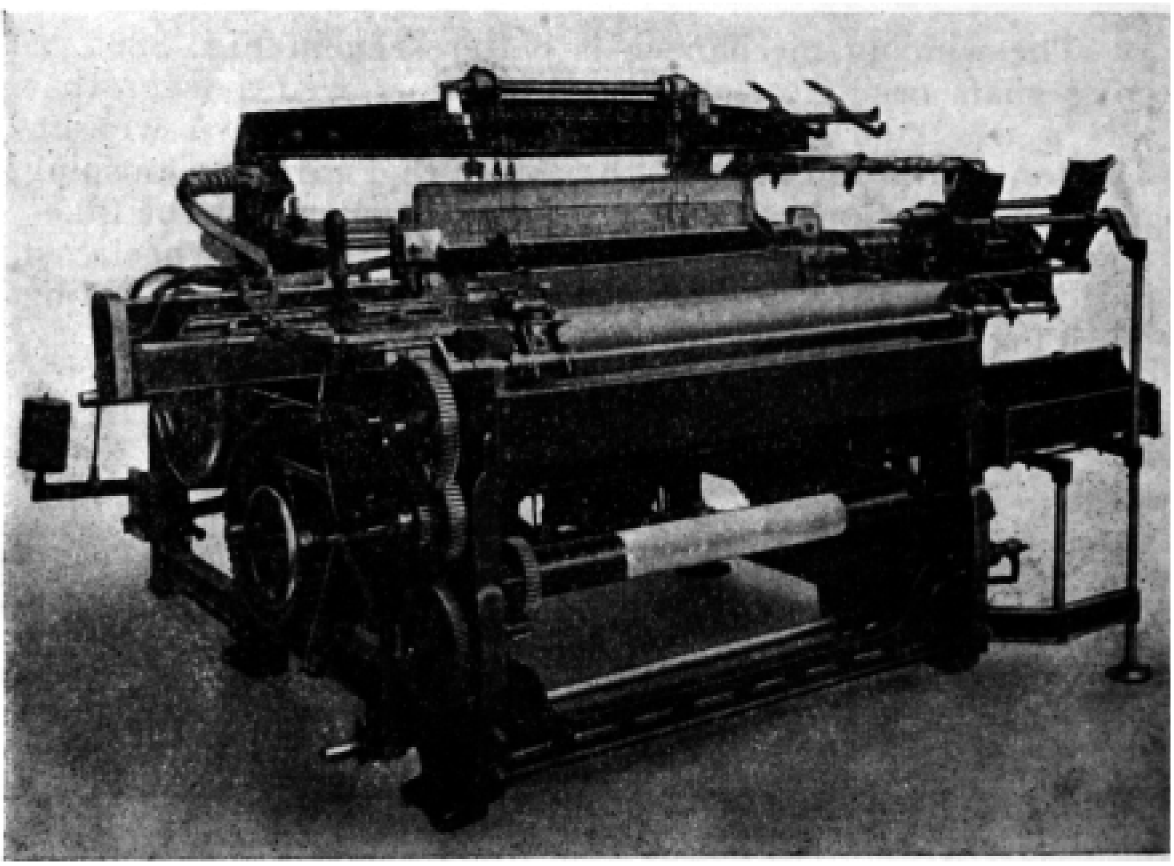


Fig. 393.
Hattersley's Automatic Duck Loom.

Warp Beam.—It is made of steel tubing that slides on to a square part of the supporting shaft. The flanged pulleys also fit on to the square section, and have a diameter of 9½ inches. There are three stationary rollers inside the loom over which the warp is made to pass before mounting the back rest. The rollers decrease brake weight, and increase friction.

Novel Back Rest.—At its centre, the stationary back rest is 6 inches broad, and then gradually tapers off towards either end. This shape prevents sagging at the centre during weaving.

The height at the top is 4½ inches above the breast beam, and this increases the tension on the bottom shed, and decreases it on the top one.

Shedding.—Two pairs of tappets inside the loom control the heald shafts. As a deep shed has to be made for the large shuttles, a special bar is fitted in front of the droppers so the droppers are not interfered with.

The picture shows the ordinary roller motion for top gearing, and the timing of the shafts is to have them level when the reed is a ¼ inch from the cloth fell.

Instead of leather connections to the shafts, there are link chains. The final row of links are threefold, and has a threaded rod. On it a casting is screwed and locknutted. The wing screw attached carries two hooks, and so distributes the weight on the shafts.

Picking.—The picking shafts are fixed outside the loom frame. The picking nose is hooked, and strongly made. Buffalo pickers are made to be used for either hand, or reversed at the same end. Shuttle checking is by buckle and checkstrap, the strap passing *behind* the handrail.

Take-up Motion.—All wheels on the loom have their teeth cut out of solid metal, and give maximum strength and wear. The take-up wheels and circumference of take-up roller are

$$\frac{72 \times 54 \times 51}{\text{C.W.} \times 14 \times 17.09} = \frac{198228}{239} = 830 \text{ gauge figures.}$$

The ratchet wheel inside the loom is turned by a pawl driven by the sword, and takes up one cog per pick. On the same stud as ratchet wheel, is the change wheel that meshes with the intermediate, and the pinion cast to the latter, contacts with the take-up roller wheel. The take-up roller is spiked to prevent cloth slipping. The hand wheel for weaver is on ratchet shaft.

Cloth Beam.—It is not turned by friction, but by preserving the balance between let-off and take-up. Its ratchet wheel is the bottom one outside loom frame, and its pawl is on a lever moved by a casting on the rocking shaft that holds the sword foot. The take-up lever has a closed spiral spring attached, the spring strength regulating the take-up. On the shaft of the take-up ratchet wheel, and seen inside the loom, is a small wheel having 12 teeth, and this turns the wheel on the cloth beam that has 41 cogs. The cloth beam can be removed with piece, and another substituted.

Shuttles.—These have solid bottoms, and shuttles are 18 inches long, 2 inch broad, $1\frac{7}{8}$ inches deep at front and back, and have removable spindles that are held in the weaving position by spring clips at either side. The weft passes through an eye at an obtuse angle, and the weft emerges near the bottom front.

A thick wire shuttle guard is fixed to the metal hand-rail, and can be pushed inward. The first bump of the reed against the cloth, and the guard drops to its weaving position.

Feeler Motion.—It is seen on the left, and "feels" the weft every other pick. To do this, there is a slot in the shuttle front $1\frac{1}{2}$ inches long, and a slot in the front head of the bobbin. When the feeler penetrates the bobbin slot, a finger is dropped behind the hammer head on the tumbler weft fork, and on being pushed back, brings the mechanism into play that stops the loom, changes the shuttles, and restarts weaving.

Shuttle Changing Mechanism.—The magazine on the right holds six shuttles. To change the shuttles, there are four tappets and a clutch motion driven by a link chain on two sprocket wheels, the upper wheel being on the crank shaft.

Commencing from the loom frame, the first tappet stops the changing mechanism if anything goes wrong.

The second tappet restarts the loom after the shuttles have been changed, and the carrier has retreated to its stationary position.

The third tappet controls the carrier to and from the box.

Then comes the friction clutch that turns the tappet shaft for shuttle changing. The fourth tappet operates a double mechanism, for it elevates the box front for the ejection of the spent shuttle, and by the same movement forces the spent shuttle out of the box into the hopper. The ejection is done by a curved and broad pusher that passes over the top of the box swell at the back of the box.

When the shuttles have been changed, the box front is lowered in position, and the shuttle changing mechanism is brought to a standstill.

Automatically, the loom restarts weaving in six seconds.

All the tappets are accurately made to perform their several functions precisely, and may be said to be "fool-proof." The loom is run by an individual electric motor and V ropes. The speed of the loom is 120 picks per minute, and the reed space is 42 inches.

MULTIPLE FABRIC LOOMS.

The loom here presented is made by Messrs. Wilson and Longbottom of Barnsley, Fig. 394. The dobby is the Northrop Leeming dobby. For details of this dobby, reference should be made to the chapter on The Leeming Dobby, Fig. 35.

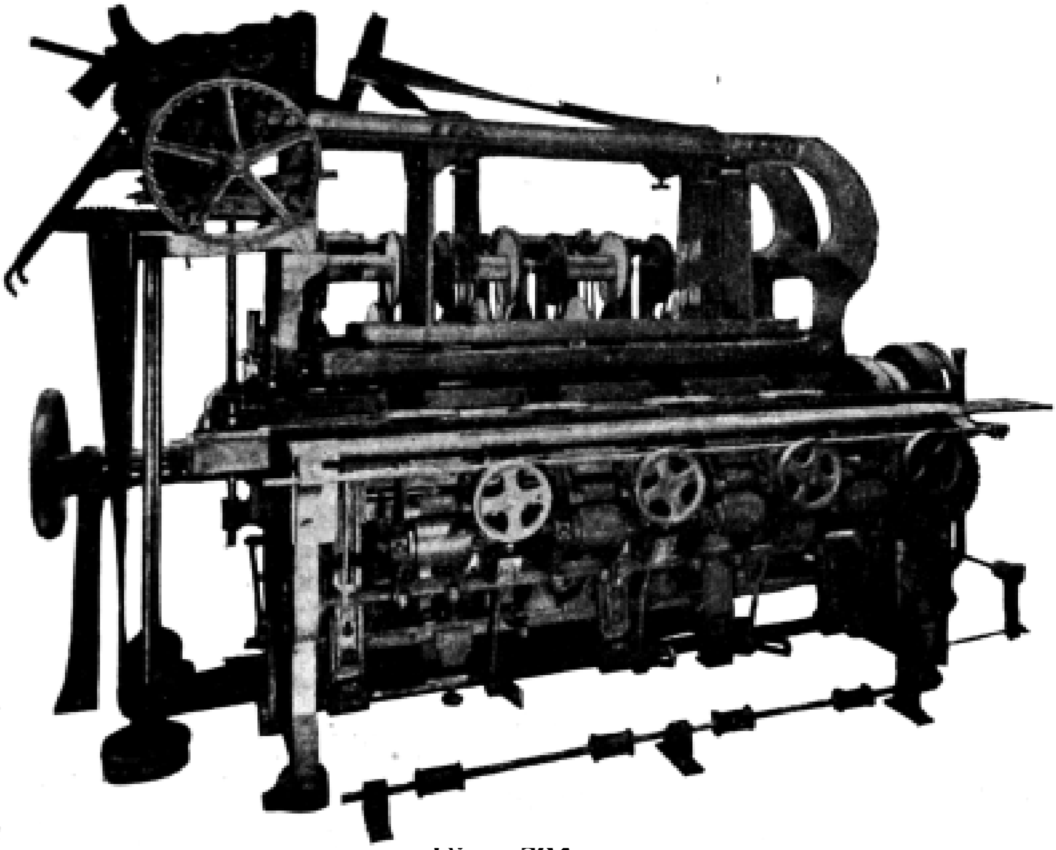


Fig. 394.
Wilson and Longbottom's Multiple Fabric Loom. (Front View).

Design for Pouched Webbing.—Fig. 395 gives the peg plan. It is on 16 shafts and 40 picks. The first 24 picks are to make the pockets on the face of the fabric, and the following 16 picks weave the ground. In the woven structure, the pockets resemble small glove fingers pointing to the centre from either side.

In weaving the pocket sections, four picks are woven with the take-up motion in action, and it is then stopped for two picks so the reed can give a harder beat up to the weft. The stoppage occurs four times in one repeat of the pattern, and is indicated by crosses on the right of the design. The stoppage is made by the lags operating a spare shaft jack which is connected to the pawl that turns the ratchet wheel.

Warp Beams and Drafting.—Behind the loom there are 16 small beams or cheeses. These are used in groups of four each to make one woven webbing. The back bottom cheese is for weaving the pockets; the inner bottom one is

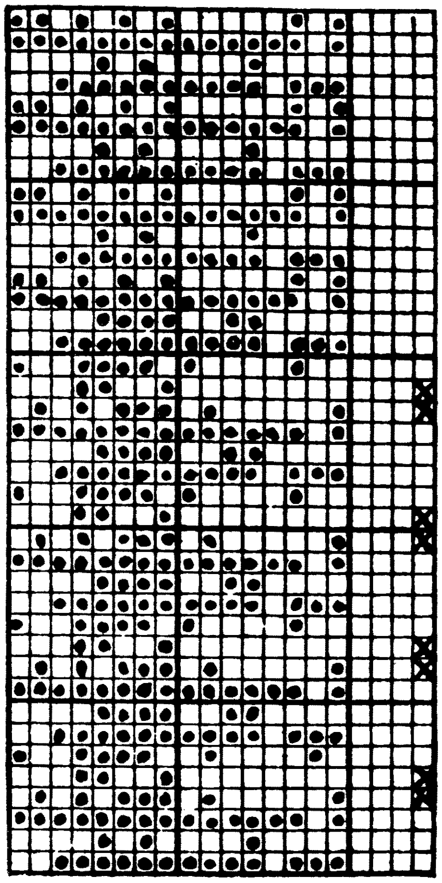


Fig. 395.
Design for Military Webbing.

for the ground; the centre one holds the binding threads; the upper one is for filling. At either side each cheese is braked with chains and weights.

The drafting is very complicated, but the first two shafts are used for binder threads; the next is a filler with double drawn threads; the following five shafts are also double drawn except the starting and finishing threads, and these are for pocket making; the next three are for ground; the last five are drawn double and are for ground = 16 shafts.

The threads are allotted as follows: Binders 21; Fillers 32; Pockets 76; Ground singles 26; Ground double 131; Ground single 2 = total 288 in each of the four fabrics woven at the same time on the same shafts. Each fabric is $2\frac{1}{4}$ inches wide. The warp has 128 threads per inch, and the weft 25 picks per inch.

Shuttle Construction.—The shuttles are made of aluminium, and without bobbin weigh 30 oz. The total length is $11\frac{1}{4}$ inches; depth at back $1\frac{1}{8}$ inches and tapers downward at the front; width at widest $2\frac{5}{8}$ inches.

The top view is at Fig. 396. A is shuttle front that bows well back at either end to the blunt points B and C. Weft bobbin D is on a spindle two inches long, and is divided to act as a spring to hold the bobbin. The spindle block, and the tempered covering spring F is fulcrumed at E. The spring is shown in its weaving position and its loose end is

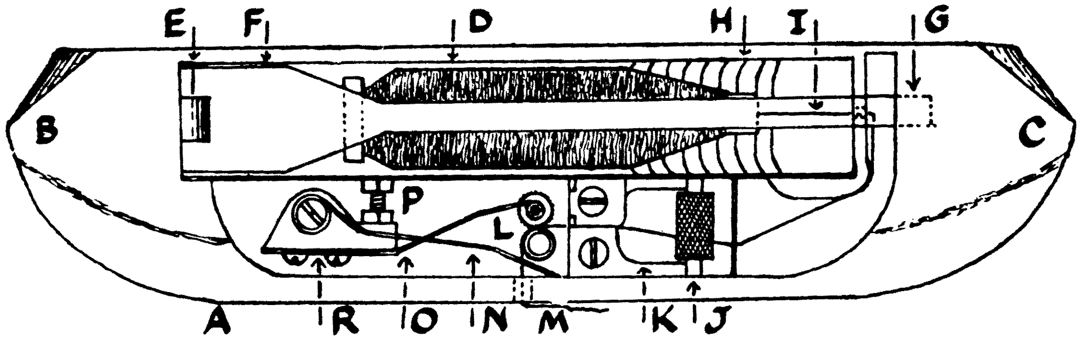


Fig. 396.
Top View of Metal Shuttle.

tucked inside the opening at G. The bottom of the bobbin section in the shuttle is grooved at H, and is handy for weaving cops. The weft is at I. At J is the fluted metal roller under which the weft passes to brake it, and there are stay plates at K.

In the next compartment is another fluted roller fitted vertically at L. Its pressure is against a companion roller regulated by the locknutted screw at P, the spring O being fixed to the brass casting R. Attached to the holding screw on the brass casting, is the guide wire N, that keeps the weft to the brake rollers L. The weft emerges at M, is five-fold cotton, and has to be held tight during weaving.

The shuttles are fixtures on the loom, and the weft bobbins are changed with the shuttle on the shuttle race.

The under side of the shuttle is at Fig. 397. Here again, the back of the shuttle is at A, and the braking plates at K, with L the guide wire. R is the brass casting and

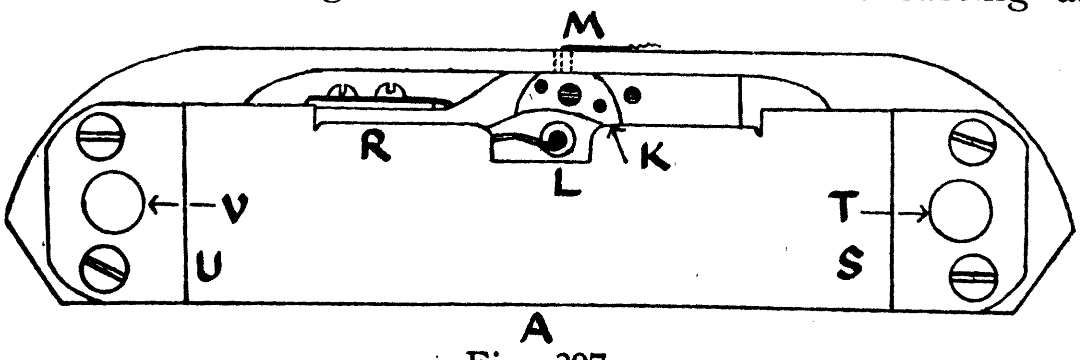


Fig. 397.
Bottom View of Metal Shuttle.

brake spring for vertical roller. The parts S and U are plates screwed and level with shuttle bottom. Through these plates, and into the bottom of the shuttle are the bores T and V that penetrate $\frac{3}{4}$ inch. Into these holes enter the pegs that propel the shuttle in both directions.

Each shuttle makes a forward, and also a backward run of $17\frac{1}{2}$ inches.

There is neither ordinary picking nor shuttle box front. To guide the shuttle, a strip of wood is doubly bolted to the box back, and a similar strip on the front of the shuttle race. The first prevents the shuttle from rising, and the second retains it on the shuttle race.

Rail and Shuttle Movements.—The system is depicted in Fig. 398. The long line A indicates the top of the shuttle race. The race is divided at its centre to allow pegs B and C to pass through, and makes contacts with shuttle bottom The pegs and attendant castings, are mounted on long slide D that moves on the projecting flanges M and N, the rail being below the shuttle race. E is the brass casting set-screwed top and bottom to rail F and G, and in its cavity at J is the pin B, with stud H, on which revolves bowl I.

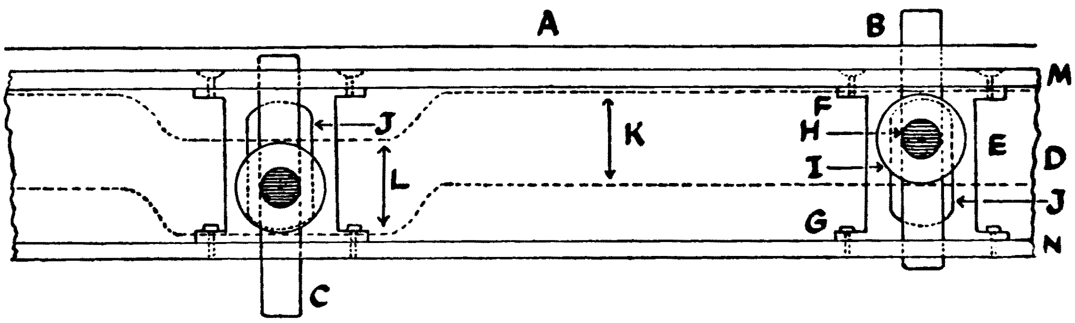


Fig. 398.
Rail and Pins for Shuttle.

Rail D is pushed forward and pulled backward by lengths of link chains, coupled to powerful treadles operated by a pair of half dwell tappets at driving end of loom. The chains pass over pulleys that move with going part. In the front inner part of the going part, is the long groove K for bowl I to run. The groove descends at L, and bowl and pin are lowered so the pin top is below shuttle race. It is above these sunken grooves where the fabrics are woven.

Peg C is shown in the centre of the depressed groove, and out of touch with shuttle, but the shuttle is still held by the uplifted pin B. As rail moves forward, pin C rises, and enters the front bottom hole in shuttle, and pin B is lowered in turn by the sunken part of the groove, and then rises again in the same manner as pin C. When the rail is drawn back, the sinkings and risings of the pegs take place but in reverse order. In this way, the positive control of all four shuttles is maintained. Both pins, bowls, and studs are case hardened. When the top part of a pin is worn, it may be placed at the bottom, for they are standardised.

The total depth of rail is 2¾ inches. The outer treadle moves the shuttle to the left, and the inner one to the right.

Take-up Motion.—The front view is outlined at Fig. 399 It is better than the older make, for being elevated, the overlooker can attend to inner repairs with more freedom. Each fabric has its own take-up motion like Fig. 399. A

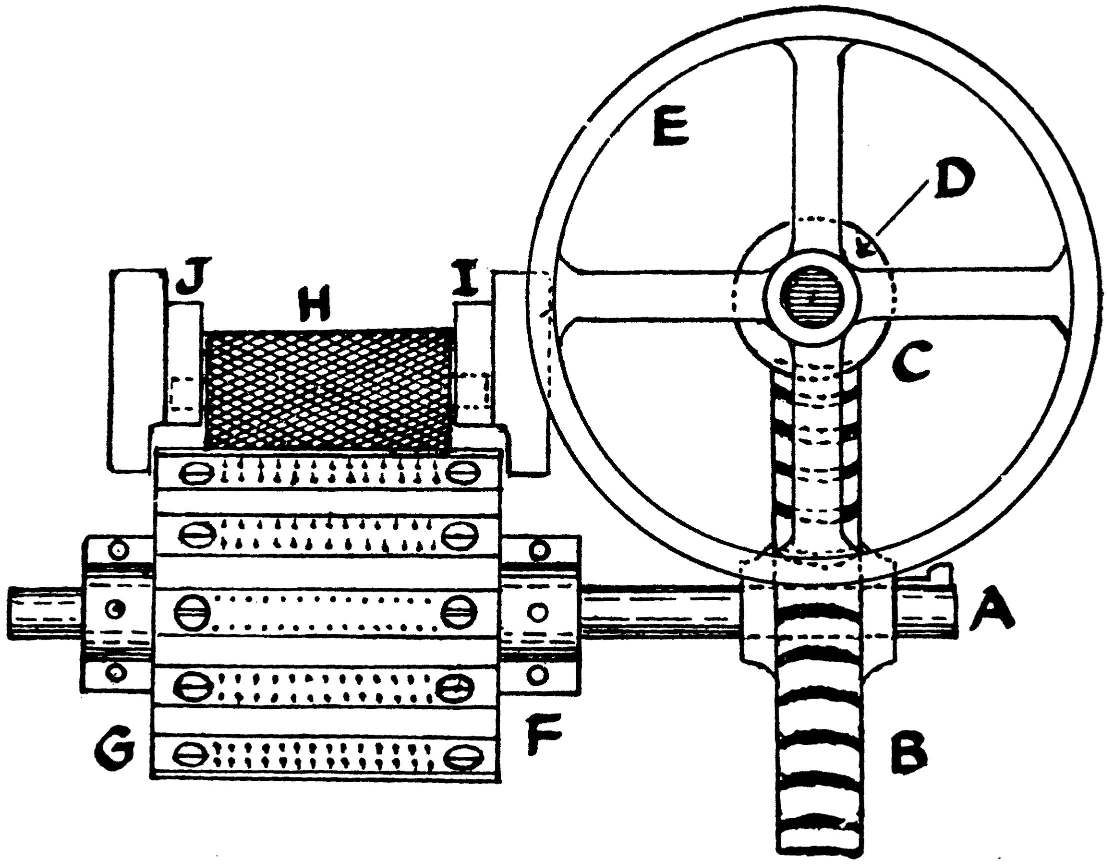


Fig. 399.
Take-up Motion. (Front View).

is the take-up shaft to which wheel B is keyed. At C is the end of the worm, and D the worm shaft. E is the hand-wheel for minor adjustments. The take-up roller is at F, and clamped at either side to the take-up shaft, and readily altered in position, or taken off. It has a width and diameter of five inches, is made of metal and furnished with broad grooves. Into each groove a plate having two rows of spikes is fixed by screws as at G.

Above the spiked roller F, is the iron fluted pressure roller H, the shaft being held by brackets I and J. It has a diameter of 1¾ inches, and a width of 4¼ inches. The open slots in the holding parts are the sides of one casting, the back part of which is heavy, so as to press the woven structure on the spikes. If it be that the pressure roller requires to be removed, the back end of the bracket is raised, and the roller can be taken out. A side view is outlined in Fig. 400.

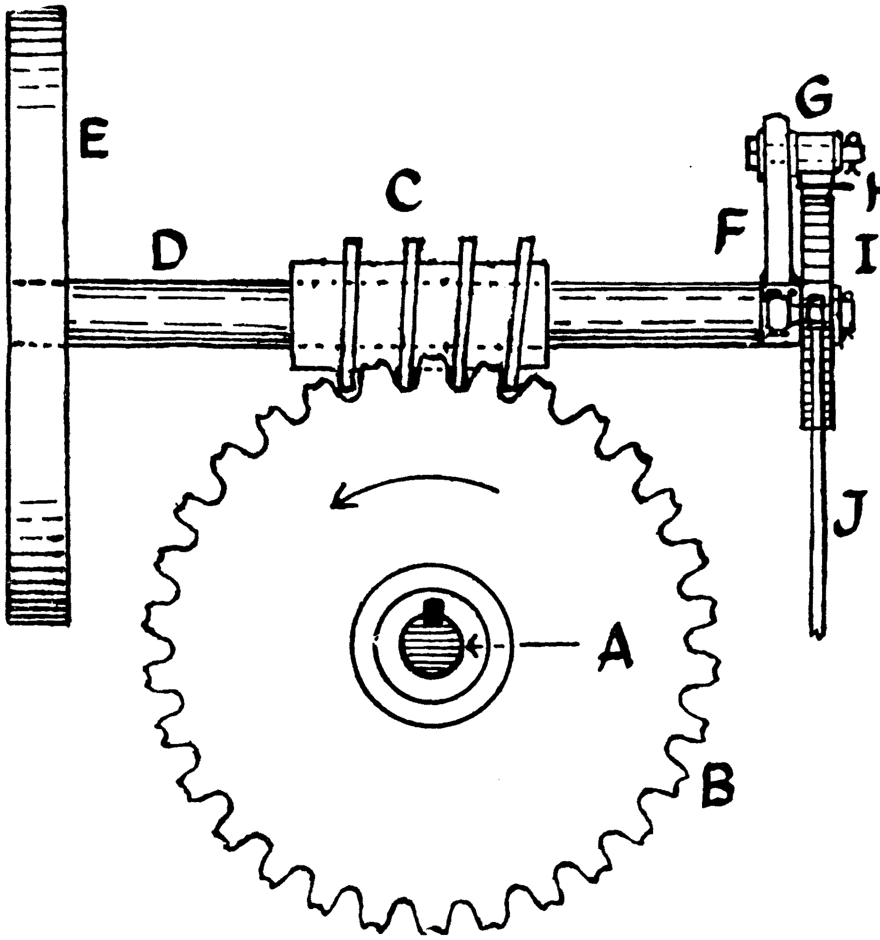


Fig. 400.
Take-up Motion. (Side View).

A is the take-up shaft, with B the worm take-up wheel with 30 cogs, and at C, the worm in contact with the teeth. The worm shaft is at D, with E the smooth wheel affixed. F is the right angled lever, and to its upper arm the ratchet pawl G is attached. On pawl G is finger H that raises the pawl when the take up has to remain stationary for two picks. This too is an improvement, for the ratchet wheel remains stationary, whereas in the former make, the ratchet moved to no purpose.

At I is the ratchet change wheel fixed to the inner end of the worm shaft, and has 40 teeth. The gauge point is a tooth per pick. On the bearer bracket is a pin carrying the holding catch for the ratchet wheel, the catch keeping contact by its own weight. The horizontal arm of lever F has rod J attached. At the bottom, the rod is fixed to a lever on the rocker rail, and by this means, the ratchet wheel and worm shaft are turned.

Path of Webbing.—The woven structure descends from breast beam to the spiked take-up roller, and on passing well at the back, goes over the top of the fluted roller. From here, it descends to the loom bottom, passes underneath, and ascends to the cloth roller at the back top of the loom.

The winding takes place by sword movement actuating a pawl driving a ratchet wheel. By link chains and sprocket wheels, the series of cloth rollers wind up the cloths. Each roller is fitted with friction drive, and by a thumb screw, the webbing can be wound tighter or slacker.

Loom Driving.—The loom is driven by an electric motor of 2.5 h.p., and four V ropes. The loom may be started and stopped at any part of crank movement, for there is no knocking off arrangement, and shuttle movement is positive. The crank arms are of ordinary make but doubly cottered. There are three swords to support the going part. There is also a fourth, but its primary purpose is to hold the revolving inner wheel around which the chains pass that moves the rail that carries the shuttles.

One weaver is in charge of from two to four looms. Fig. 401.

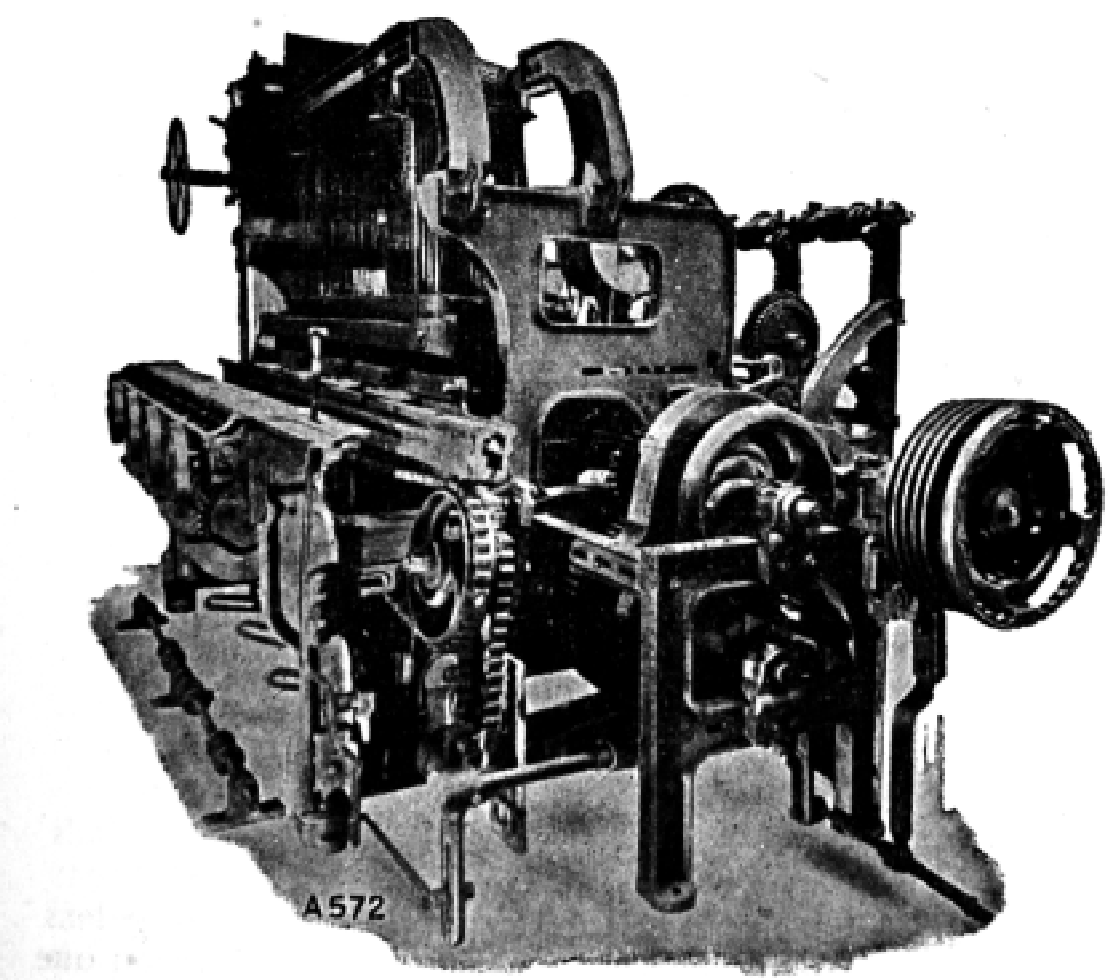


Fig. 401.
Driving End of Messrs. Wilson and Longbottom's Multiple Fabric Loom.

PLATT BROS., NARROW FABRIC LOOMS

These are of different construction to Messrs. Wilson and Longbottom's.

The first is of the heavier type, and the other for lighter fabrics and ribbons. Both are of the Haywood construction. Fig. 402 is a tappet loom that takes 8 shafts.

Warp and Binder Cheeses.—The loom weaves four webbings at the same time. The cheeses are placed in stands at the back of the loom. Their inner width is seven inches and a depth of flange of 16 inches. There are four stands below and underneath the back rests; four more on a frame outside the loom; an additional four above the back rests, and seen on the crossrail in Fig. 402.

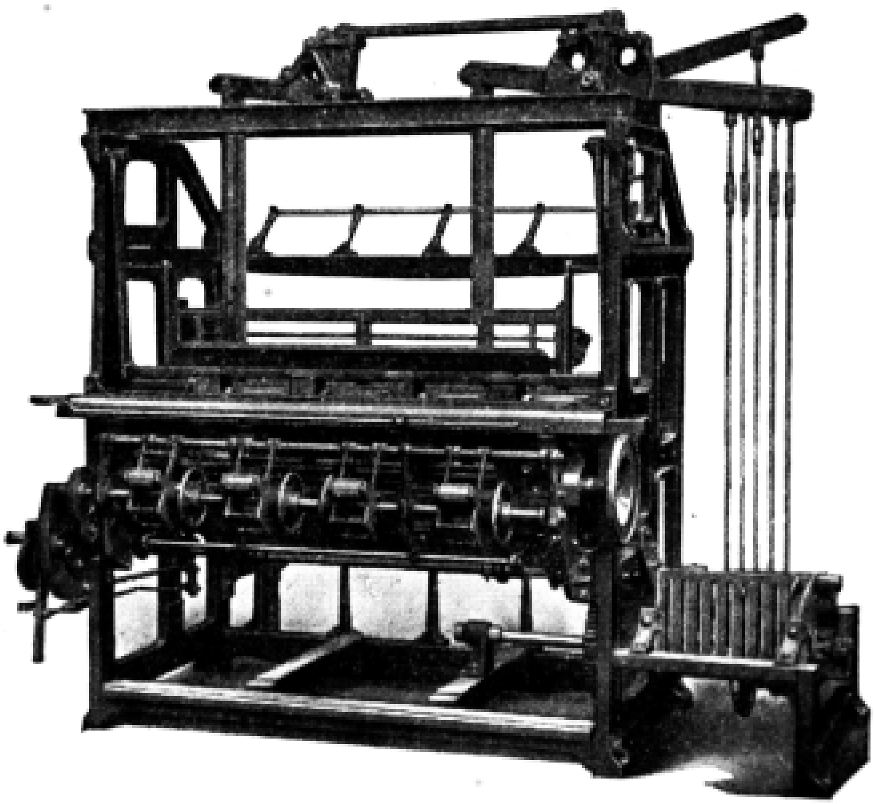


Fig. 402.
Platt Bros. Narrow Fabric Tappet Loom.

The binder cheeses are less in size as they carry less threads. Both sets of cheeses have a circular groove on one side for a brake chain, one end being held by a tension lever. The weights are respectively 18½; 12; and 6½ lbs. For the binder cheese, the weights are 7¼ lbs., and 1 lb. 10 oz.

If both sets of cheeses are near the same length, all the weights can be changed at the same time. In addition there are several back rests over which the warps may have to pass, to reduce dead weight.

Shafts and Healds.—The heald frames are steel, and occupy the ordinary weaving position. A shaft carries four sections of healds, and the ends of the shafts move in metal grooves. The healds are flat steel, the eyes being punched out and turned a little. They are 13½ inches long, and their flat sides are parallel with the warp. The heald shafts have no under motion, but drop of their own weight. The parts are riveted together, and are connected to the top jacks by flat bars. The shafts can be adjusted at one place in Fig. 403. A is the inner shaft adjuster and B the setscrew. C is the outer adjuster with setscrew D, both adjusters being cogged. In setting the shafts, the threads on the bottom shed have to be below the shuttle, but there is no ordinary shuttle race.

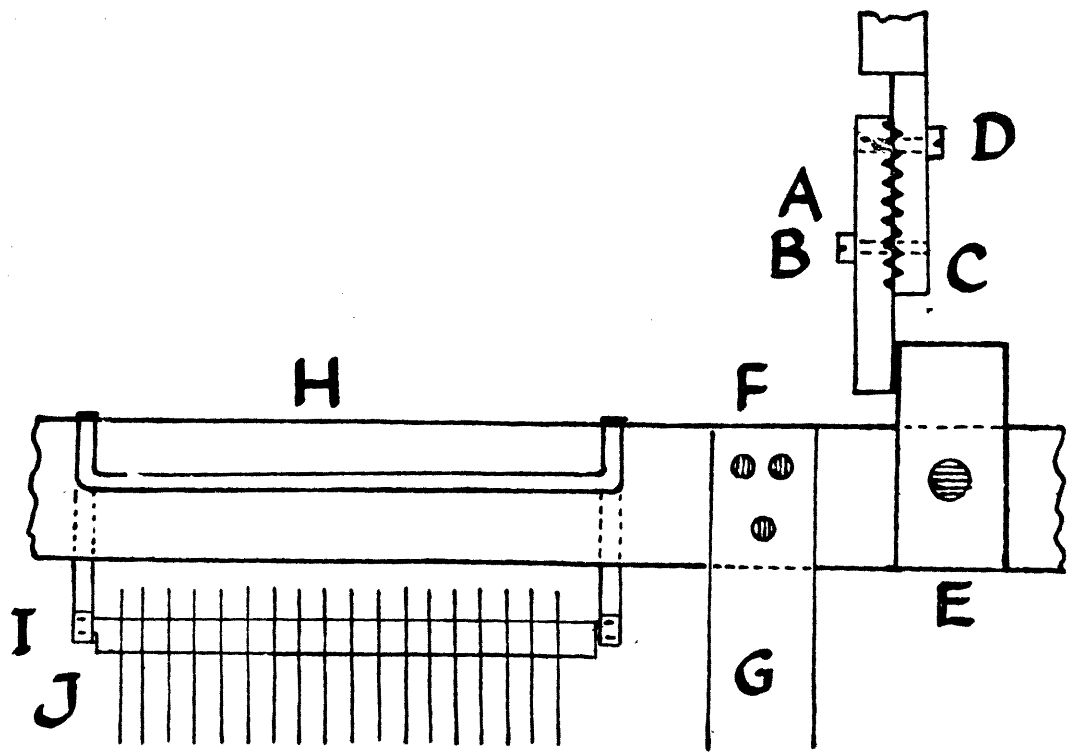


Fig. 403.
Heald Shaft and Adjusters.

At E the inner adjuster A is riveted to the top heald shaft F, and the two vertical bars G are also riveted to the cross bar. H is the hanger over the horizontal bar, and has charge of the small cross bar I, from which is suspended the flat healds J. This is duplicated on the bottom shaft, but in the opposite direction. The toothed part C is part of the vertical bar riveted to one of the three holes in the top jack.

Positive Tappets.—They are constructed to the weave required and are on the right in Fig. 402. They are run from a countershaft. The front of the treadles pass through a grate, and just inside are a series of screw holes for the fixing of connecting rods to the top jacks. The top of the rods are riveted to their respective jacks, but just below, both lengths of rods are held by a turnbuckle.

The loom has three shafts, and the centre one carries the grooved wheel connected to the electric motor by four V ropes. The motor is 1.5 h.p., and has 750 revolutions per minute. On the crank shaft is the tappet that oscillates the take-up motion. Almost at the other end is the sprocket wheel connected by link chain to the upper third shaft. On this are two wheels, the smaller being setscrewed to the boss of the other. The small wheel meshes with the large wheel behind it.

On the inner side of the large wheel is a tappet that moves a shuttle bowl lever below it. At the front end of the shuttling lever is a rod and link chain that turns the wheels that manage shuttle traverse. A similar arrangement is at the opposite end of the loom.

The larger outer wheel gears into a wheel on the same shaft as the handwheel in Fig. 402.

Structure of Shuttles.—An outline is at Fig. 404. With full cop, it weighs 20 oz. Its total length is $8\frac{3}{4}$ inches; width $3\frac{3}{16}$ inches; depth at back 1 1/5 inchs; front, $\frac{7}{16}$ inch.

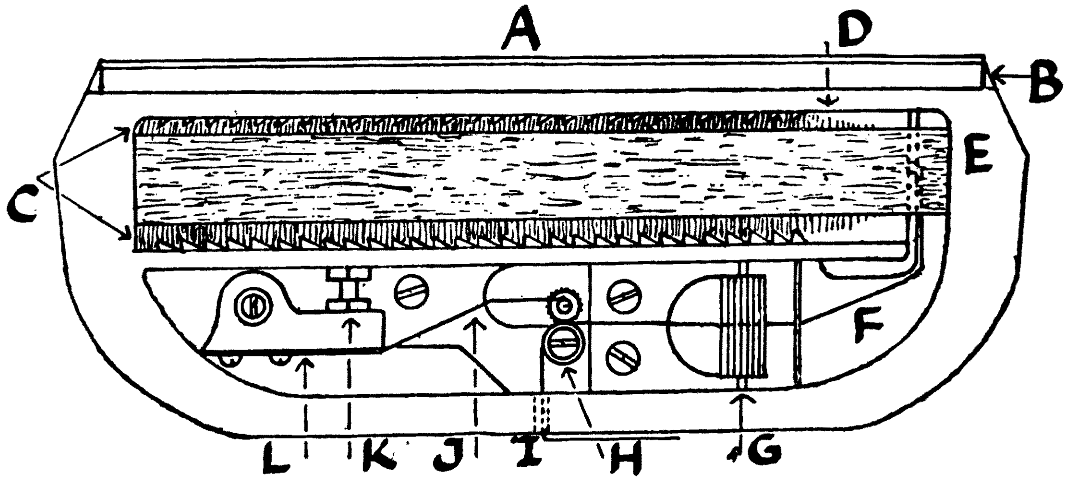


Fig. 404.
Metal Shuttle (Top View).

Fig. 404 is a top view. A is the back plate that is a buttress to the fibre cogs parallel with the shuttle bottom. B is the top groove into which the bottom of a flat bar fits, and keeps it in position. The two lines C are the tops of semicircular grooves that hold the cop D in its weaving position. E is the flat spring that holds the cop down. F is the weft braked by fluted roller G, the pressure opening out snarls. It passes between two small rollers at H, the inner being fluted, and held to the smooth roller by spring pressure J, fixed to casting L, and set by locknut K. The weft emerges through the porcelain eye at I.

Fig. 405 is the shuttle bottom, the special part being 23 fibre cogs at B, supported by the outer plate A. C is the bottom guide groove. The area D is the only flat part on the shuttle bottom, for areas E, F, and G, all slope downward. H is the brake spring and I the porcelain eye for the weft. At J is the long slot through the shuttle bottom.

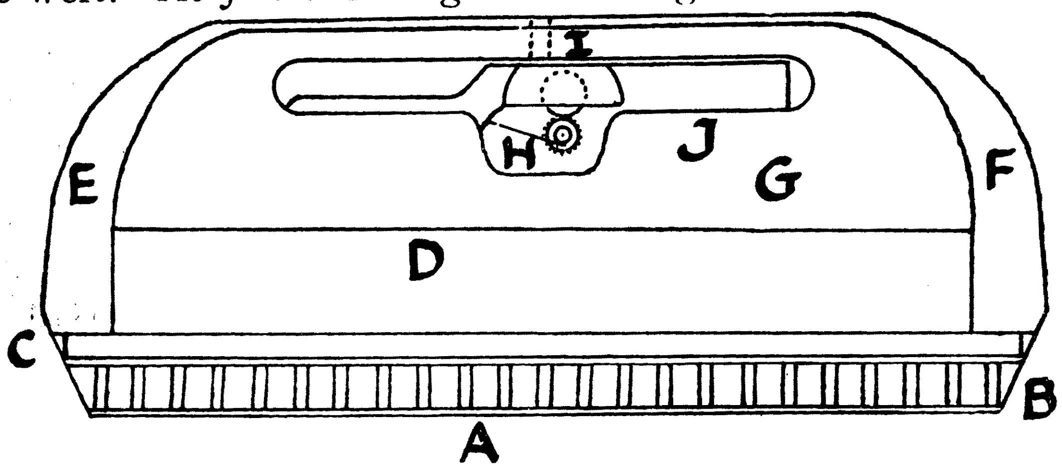


Fig. 405.
Platt Bros. Metal Shuttle (Bottom).

Shuttle and Reed Movements.—The cogs on the shuttle bottom engage with three cogged wheels in each section, and are passed forward to the next series on one pick, and taken back the next. All four shuttles begin to move forward before the beat-up arms reach their back traverse, and have moved forward an inch when the arms have reached their back limit, this being 5¾ inches from the front of the breast beam. The beat-up arms then remain at dwell until the shuttle has got within 1¾ inches of its full traverse, which is 12 inches. The shuttles are returned in a similar manner. The motion of the beat-up arms are actuated by a pin bolted to an ordinary cogged wheel. The pin passes through a die that fits into a half moon slot at the base of each beat-up arm. The effect is a long dwell during the time the shuttles make their run, and is followed by an accelerated movement to the front to make a firm beat-up of the weft, with a slight dwell at the front centre. The reed moves to within ⅛ inch of the breast beam. Contrary to ordinary weaving, the beat-up with handrail and sectional reeds move forward, and leaves the shuttles behind.

Take-up Motion.—The prime mover is a tappet on the crank shaft. The bowl lever contacts with the tappet by spring pull. At the lever bottom, a connecting rod joins it to the lever holding the ratchet catch. The long slot in the pawl lever is used to turn the ratchet wheel from one to four cogs every pick, but when altered, the first cog is chalked, the loom turned over by hand, and repeated until the correct leverage is obtained.

For the majority of heavy fabrics, the setting for four cogs per pick is common.

The standard ratchet wheel has 80 teeth. There is a train of seven wheels, and the last is on the shaft of the spiked take-up roller. The ratchet wheel is served by a weighted holding catch to prevent a run back.

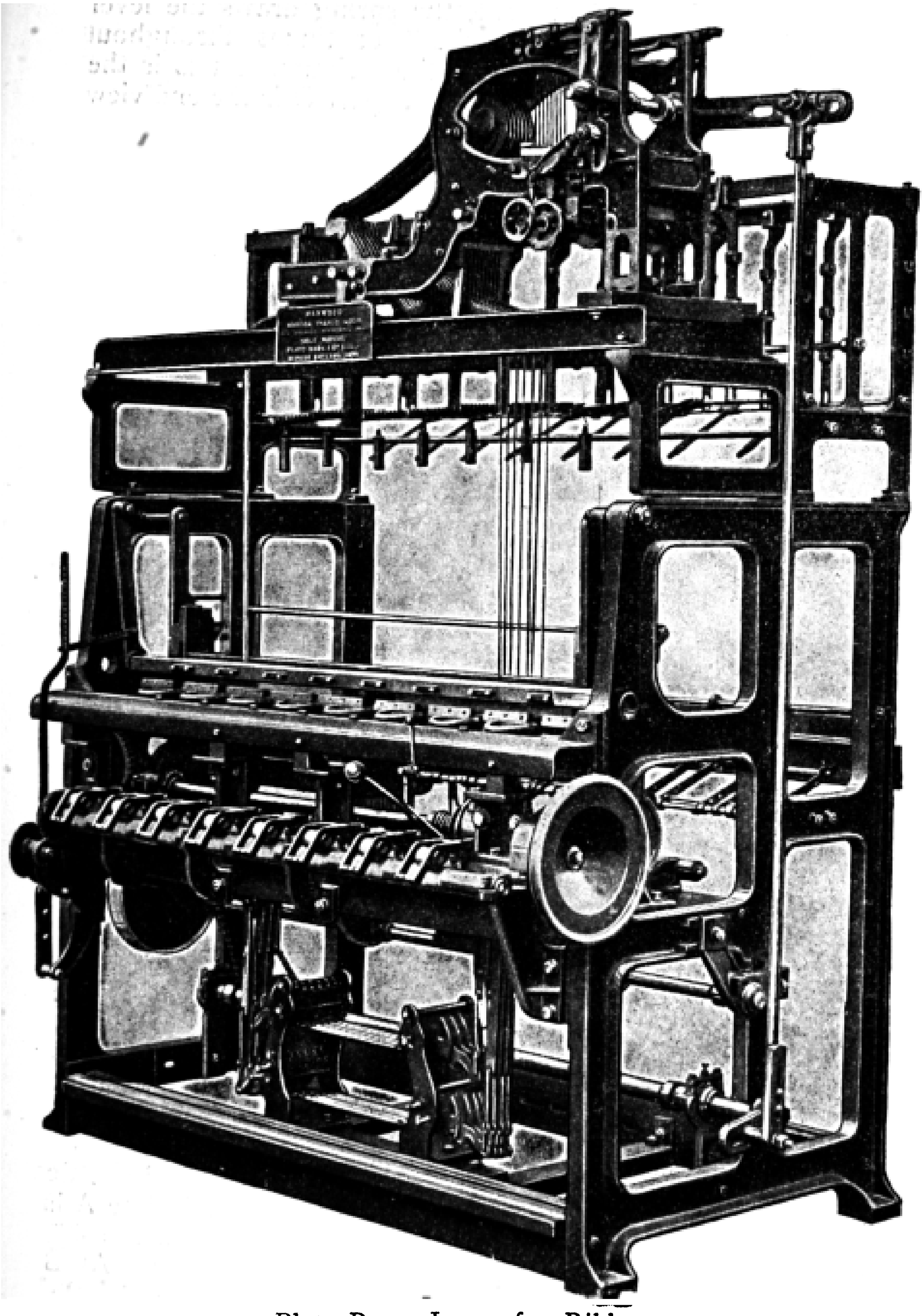
Passage of Webbing.—The woven structure passes underneath a raised bar on the top of the breast beam in Fig. 402. It descends to the spiked roller, and on passing underneath, goes over and under two fluted rollers. The shaft ends of the outer roller is pressed upon by encased springs. The webbing then descends to the receiving box. The handwheel at the side of each spiked roller is to regulate tension on the cloth.

Loom for Light Fabrics or Ribbons.

In this make of loom there are 8 shuttles and in contrast to the 20 oz. for the previous loom, there is one made of boxwood weighing 4 oz. with full bobbin.

Negative Dobby.—In Fig. 406. it is made to take 16 shafts. The shaft lags have two rows of holes for pegs, and two feelers control each shaft. The shaft levers pass through grates, and, being a negative dobby, there is a spring under motion. The lag cylinder has 8 grooves and is turned one lag every other pick by a pawl in front of the dobby. The T lever at the back, is connected to the timing lever on the low shaft by a shedding rod. In Fig. 406. both are level, and this is how equal sheds are formed. The timing of the shed is set by the shedding lever. If the size of the shed is altered at either end of the shedding rod, the connecting rods to the draw bars must be immediately altered. The healds are fitted in the same way as on the previous loom.

Arrangement of Cheeses.—These are placed at the back of the loom. The frame has two rows of 10 each and each set has three places for them. The cheeses have a width of 3½ inches between the flanges, and a depth for yarn of 2½ inches. The flanges have a total depth of 8 inches and are grooved for brake bands. The method of control is outlined in Fig. 407. A is the warp, and B the knurl that holds one end of the brake band. The other is fixed to the brake weight lever D, with weight at E. F is the unwinding rayon



Platt Bros. Loom for Ribbons.

warp that passes under roller G on lever H, fulcrumed at I. Lever H is a compensator arm, for when the tension is greater than the pull of spring J, arm H is drawn to the left.

When the tension is decreased, the spring draws the lever back, and this " give and take " continues throughout weaving, with little alteration to the weights. At L is the back shed, and N the front one. The part O is the end view of the breast beam.

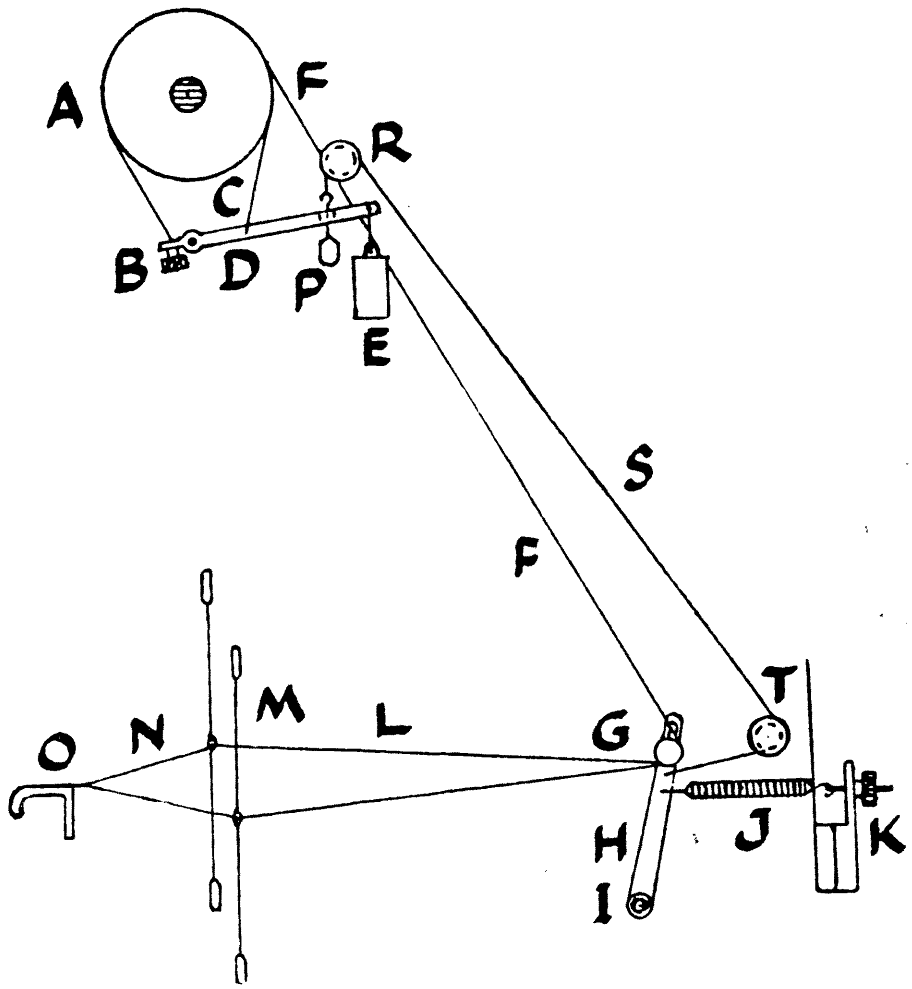


Fig. 407. Method of Un 'erwinding Warp.

There are two bands, the one explained, and the other at S. The weight lever D has a slot, and through it passes a hook with weight P attached. The hook holds band S. which then passes over pulley R, and a lower one at T, and secured to lever H. When H is pulled to the left, band S is also drawn, and lifts weight P and lever D, and relieves pressure on the warp. Spring pressure on H is regulated by knurl K. Collar G can be moved to give the best effect to warp and cloth.

Shuttle Structure and Movement.—The boxwood shuttle is at Figs. 408 and 409. In the first, the back metal plate A is secured by screws. Back depth $\frac{7}{8}$ inch; widest width $4\frac{9}{16}$ inches; across centre from back to front $2\frac{7}{8}$ inches. At B is the broad top groove that assists in keeping the shuttle in position when weaving, for a flat bar is screwed to the box back, and fits into the groove. At C is the coiled spring made of wire, the hooked end going around wire E, and presses the oval porcelain brake D against the weft. Bobbin F has a wire pin passing through it, the pin lodging at either side of the stirrup shaped opening.

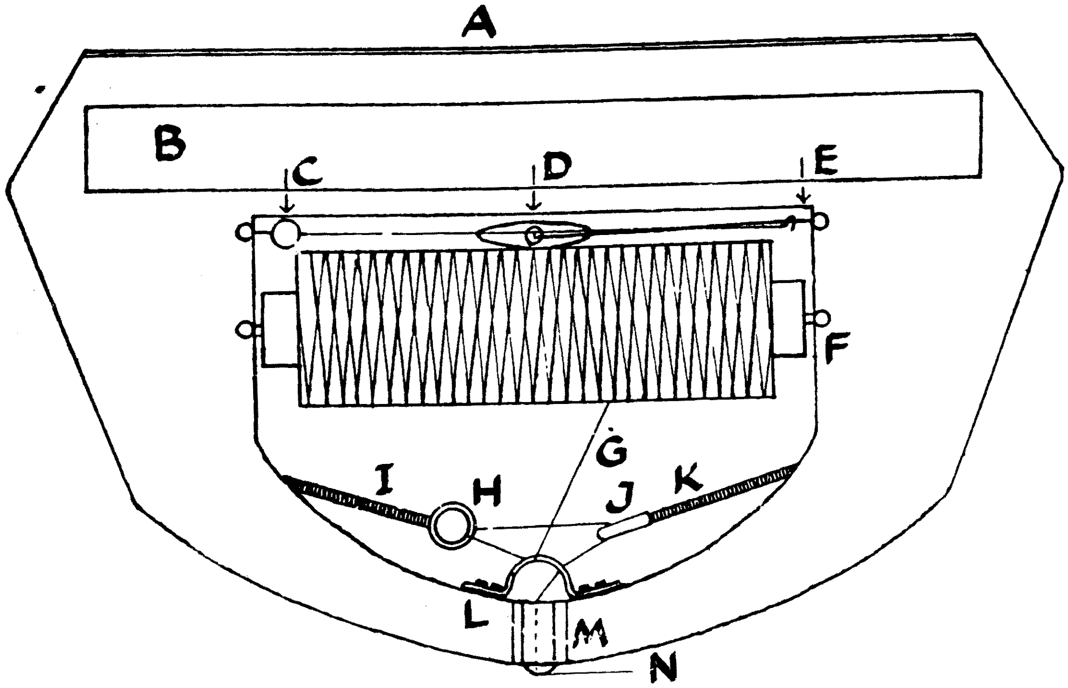


Fig. 408.
Top View of Boxwood Shuttle.

Weft G passes over the metal weft guide L, over glass ring H held by spring I, and across to glass ring J held by spring K, and after passing under guide L, goes through porcelain eye M, emerging from the shuttle at N. The flexible springs that only have a diameter of $\frac{1}{12}$ inch, recede into their cavities when the weft is slack or breaks, but comes near, or touches the metal guide L during the traverse of the shuttle.

Fig. 409 is the under side of the shuttle. A is the metal plate that is thicker at the bottom than at the top. B are fibre cogs that are used by a pair of cogged wheels in one section and by another pair in the next section. There are 17 cogs. C is the bottom guide, and is narrower than the upper one. D is the wire spring, E the porcelain brake. and F the wire holding the brake. G is the bobbin, H the weft, I the glass ring, and J the spring. At the opposite side, K is the glass ring, L the spring, M the weft guide, N the shuttle eye, and O the weft outside the shuttle.

Beat-up Arms.—There is no crank shaft to beat up the weft, but is done by beat-up arms. In Fig. 410, A is the pivot of arm B, and C the connecting plate for the handrail. D is a fixing point for the bottom cross rail holding the base of the reeds. The arm is slotted at F, and the dotted line G indicates the centre of circle H, and proves that the slot is elliptical. In the next diagram, a part is added at

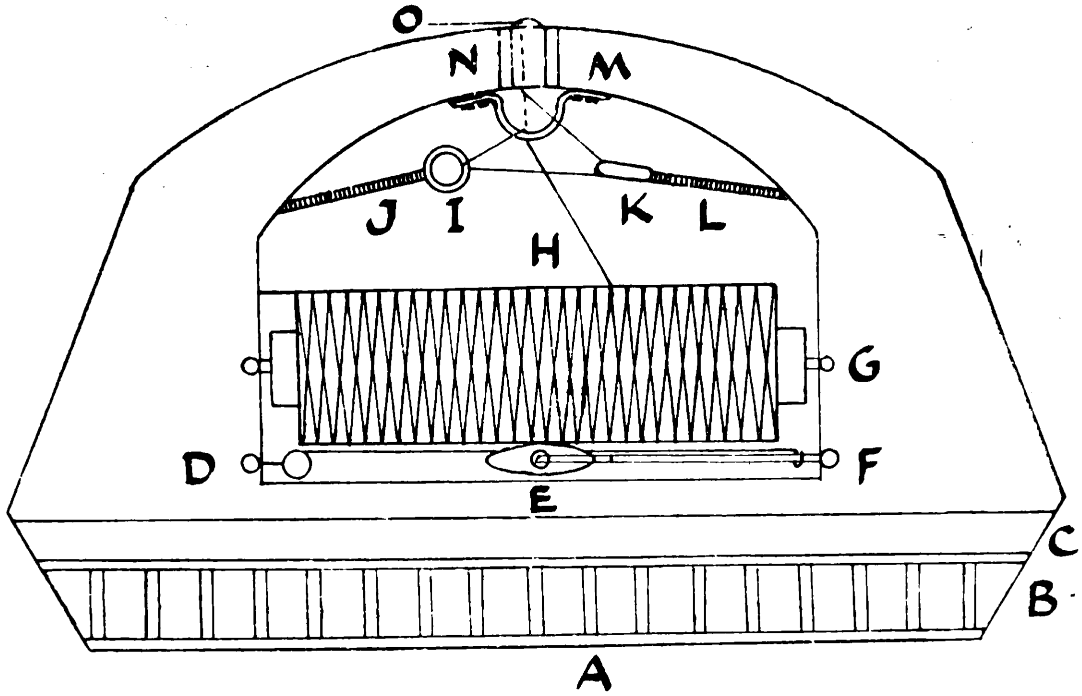


Fig. 409. Bottom View of Boxwood Shuttle.

I, that fits into the curve. It has five bores, but the centre one was in use. On the inner side of the arm is the beat-up disc and the pin from the disc passes through die I, and held in position by a flat-headed nut. The cogged disc turns half way, and then turns back. It beats up the weft going forward, and lets the shuttles pass through the sheds once every full journey.

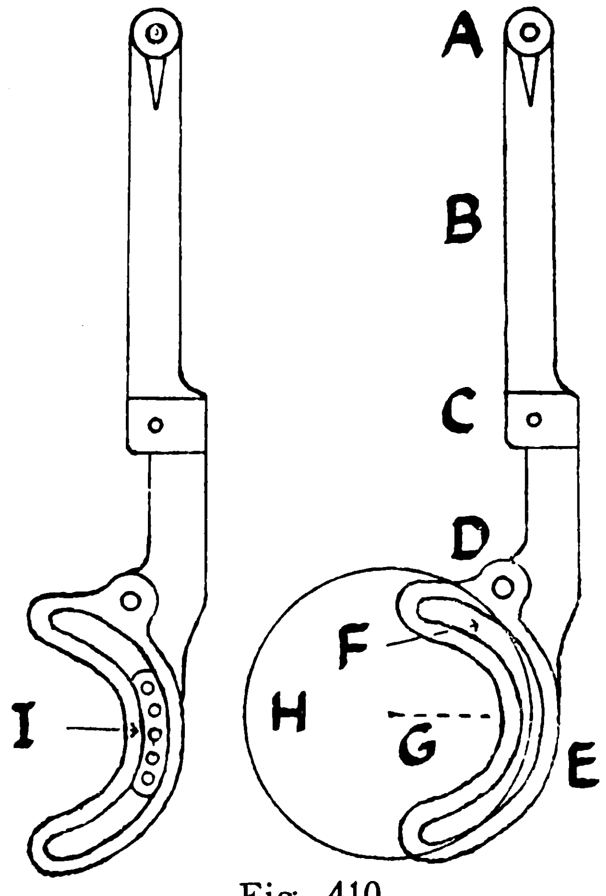


Fig. 410.
Beat-up Arms.

In Fig. 411 both diagrams are lettered alike. The one on the right shows the arm at its back centre, and the die F near the slot bottom. The die moves to within $\frac{3}{8}$ inch of the top and bottom of the slot. At F in the sketch on the left, the die has ascended to almost the limit of the slot.

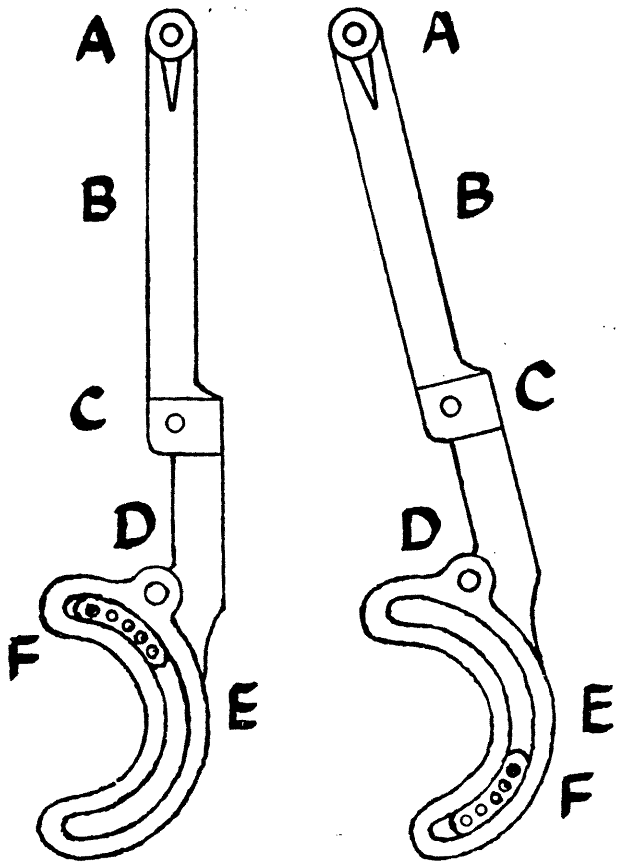


Fig. 411.
Beat-up Arms Showing Movement of Dies.

When the beat-up arm is at its back centre, it is $5\frac{1}{2}$ inches from a breast beam casting, and the shuttle has advanced over an inch. During the back dwell, the shuttle advances over three inches, and when the beat-up arm begins its forward move, the shuttle completes its traverse of six inches. The arm accelerates as it moves forward, but there is little or no dwell at its front centre.

The size of the shed with beat-up arm at back centre is $1\frac{5}{8}$ inches at the reed front. Each reed has only 12 dents.

Take-up Motion.—This is seen on the left in Fig. 406. Attached to the beat-up arm is a connecting bar secured to a long take-up lever three feet long having 15 bores in it. It carries the pushing catch that turns the ratchet wheel, its holding catch being in front. The ratchet wheel has a pinion wheel at its side, and the latter meshes with an intermediate in front. This also has a pinion, and runs the wheel on the take-up emery roller, the latter having a circumference of 6 inches and a length of 50 inches.

Above the emery roller in Fig. 406, are a set of frames, each with a roller covered with emery or paper. They have a diameter of $1\frac{7}{16}$ inches, and a breadth of $1\frac{1}{2}$ inches. By means of a threaded rod and wing screw, pressure is brought to bear on the roller and woven structure. To keep the ribbon flat on the breast beam, a small wooden roller is held down by springs. The ribbon descends from the breast beam to go underneath the long emery roller on its way to the collecting box. The gauge point is the picks per inch. The speed of the loom is 190 picks per minute. The electric motor has 0.5 h.p. and has 750 revolutions per minute.

Hall's Drop Box Loom.

For all fancy checking, a drop box or a "circular" are an absolute necessity. The circular box has a quicker movement and is run usually at a higher speed, but the drop box in a number of ways is more reliable. Four boxes at either end of the loom is equal to almost any emergency. At Fig. 412 is Hall's type of eccentric motion for 4 shuttles. The loom is fitted with inside tappets which have already been explained, and also a top roller motion.

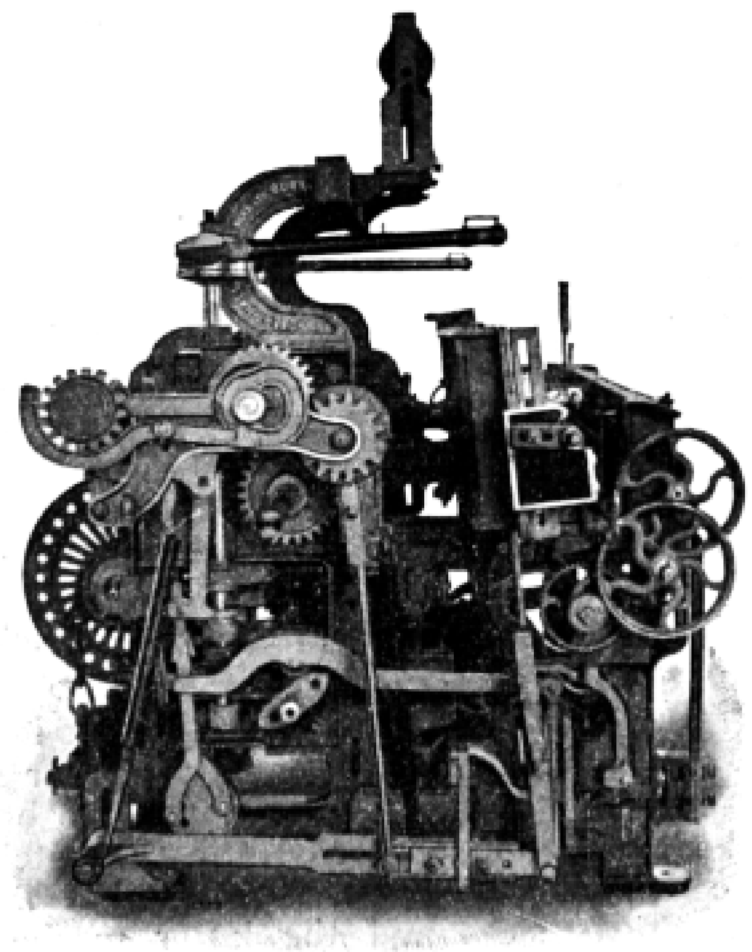


Fig. 412.
Hall's Drop Boxes at Both Ends. Pick and Pick Loom.

The picking is the overpick with a clutch arrangement which is governed by the tappet seen at the end of the low shaft, the bowl lever above it, and the two catches that pass through it. The shaft of the disc passes to the opposite side of the loom where it performs the same service as the one shown.

The picking, like the boxes, is controlled by the box lags. In the circular box loom, it is the perforations that bring about a change in the box, but in this loom it is the blanks. A hole in the cards makes the loom pick from the right, but a blank makes it pick from the left on a right-hand loom. The boxes at either end are independent of each other, and are controlled by their own lags.

There are three positions on the lags, the centre blank being for the picking. The blank on the right of it is for the lifting of the second box, and on the left of it the third box, and when both positions are blank, the 4th box is lifted. The boxes are lifted and lowered by means of segment wheels. One half turn of the back wheel raises the box, and the other half lowers it.

The letting-off is by chains and weight lever, and the taking-up is the Pickles motion. The reed space is 36 inches, and the speed of the loom 110 r.p.m.

Hall's Automatic Cross Border Dobby Loom.

This loom is presented at Fig. 413. The reed space is 36 inches, and the speed of the loom 100 p.p.m. The dobby levers are long ones from the ends of which double

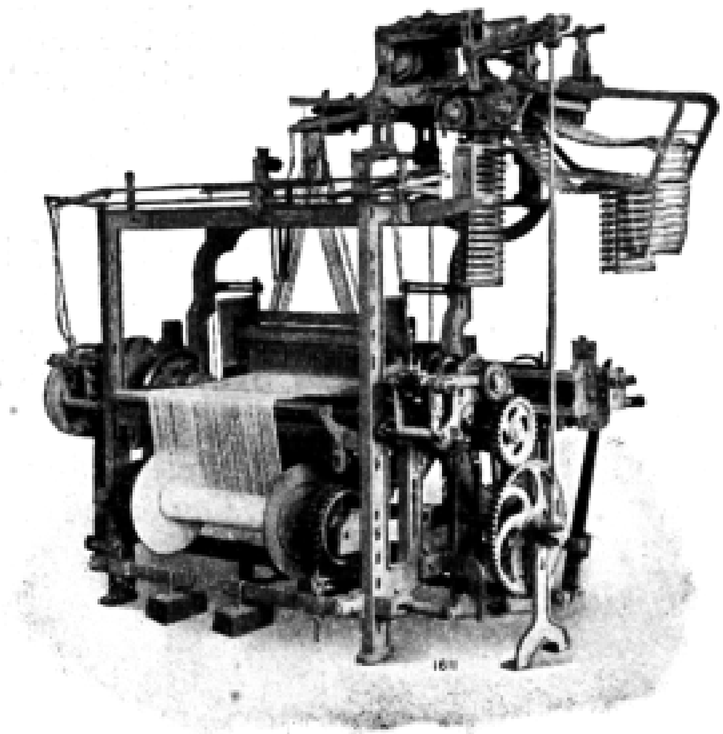


Fig. 413.
Hall's Automatic Cross Border Dobby.

bands connect them to the top of the heald shafts. There are a double set of feelers, the outer ends of the inner ones being **V**-shaped, to allow the front **V**-shaped ends of the outer ones to dovetail into them. There are two barrels for lags to actuate the feelers, the outer one being used to weave the body of the cloth, and the other to weave the cross border. There is also an indicating barrel which actuates a lever that is underneath the pawls that turn the shaft lag barrels. When the lever is made to move forward, the front pawl is placed out of action, and the other comes into play, but when the lever is moved backward, then the inner pawl comes into service, and the outer one is placed out of action. There are a given number of repeats either of the design or lags for the body of the cloth, and a similar arrangement for the cross border, the indicating lags being pegged and set to bring each lot into play at the right time.

The loom has the underpick motion with inside fittings, and has a plain box at one end, and a two or four drop box at the other. The two box is limited for the cross border to have only one colour, but with the four box, it may have three, or different kinds of weft to the ground. There is only one warp beam which is braked by chains and weight levers.

Hall's Turkish Towel Loom.

In some respects, this loom works on a similar principle to the cross border dobby, but the mechanism is more elaborate. At Fig. **414**, the front of the loom is shown, and reveals that the dobby levers and their gearing with the

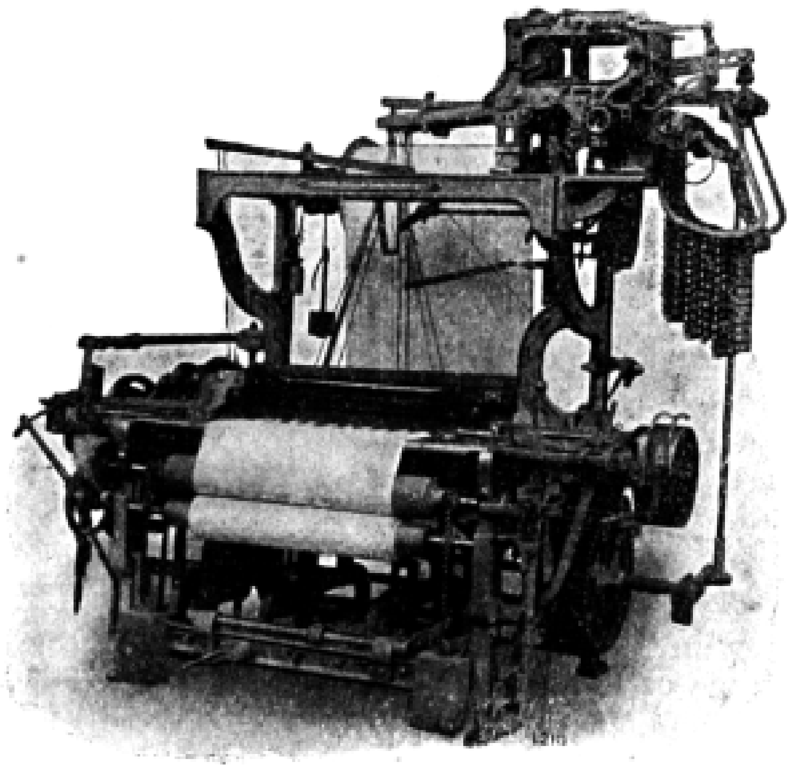


Fig. 414.
Hall's Turkish Towel Loom. (Front View).

heald shafts are the same as the previous example. The lag barrels are also operated the same way, but there is a vital difference in the warp and weaving.

It will be noted there are two warp beams, which are better seen in Fig. **415**. The bottom beam is for the ground, and is kept under good tension. The top one is for the pile, and is only lightly weighted, so as to readily respond to the making of loops in the cloth. These threads destined for loops pass under a smooth steel bar beyond the back rail of the loom. The loops are not formed by pile wires as

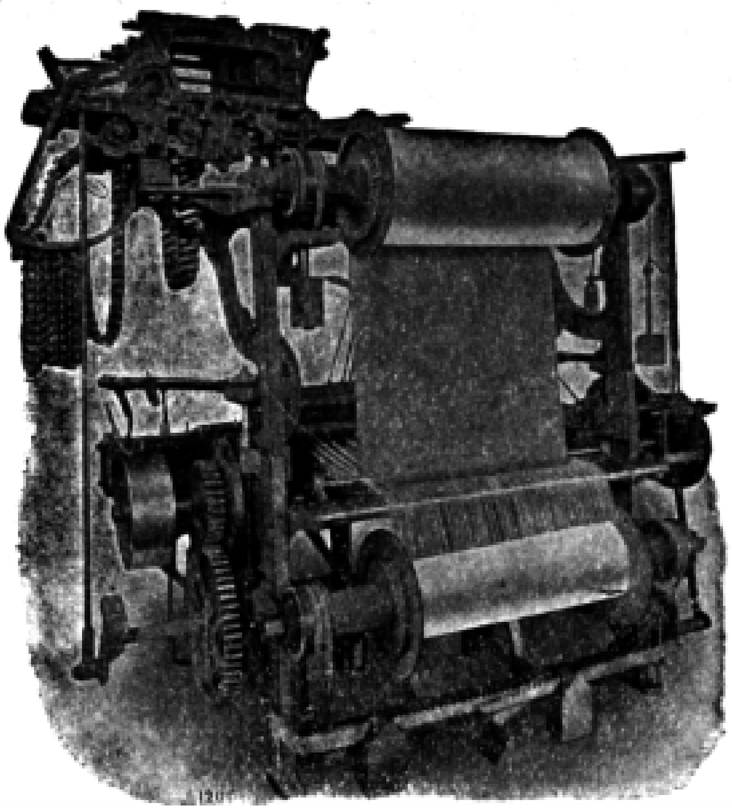


Fig. 415.
Hall's Turkish Towel Loom. (Back View).

is used in the making of plush, but by an arrangement which lets the loose reed go back for a definite number of picks, and leaves a space between the last pick and the next series. When the loose reed is then made secure for the beat up, the space left is closed up, and by being closed up, the pile warp is drawn forward and the loops are formed. These kind of fabrics are classified as 3, 4, 5, or 6 pick terry or Turkish fabrics according to the number of picks made to form one series of loops. The majority of these textures are of the 3 pick order, but those above, have the advantage of making a firmer foundation for the pile.

There may be a drop box at one end, or both ends, but whether one or both, they are governed by flat steel cards somewhat similar to those used for a circular box loom. The reed space is 36 inches, and the speed 145 p.p.m.

Butterworth and Dickinson's Terry Towel Loom.

Fig. 416 gives an excellent representation of the above mentioned loom, and is a concentration of many ingenious ideas. The dobby is the " Globe " make, and the product of the firm. There are three lag barrels to operate the feelers, each set taking a special part in the weaving of a towel. Though a three-barrelled dobby, it will weave with one, or with two, but when all three are brought into ser-

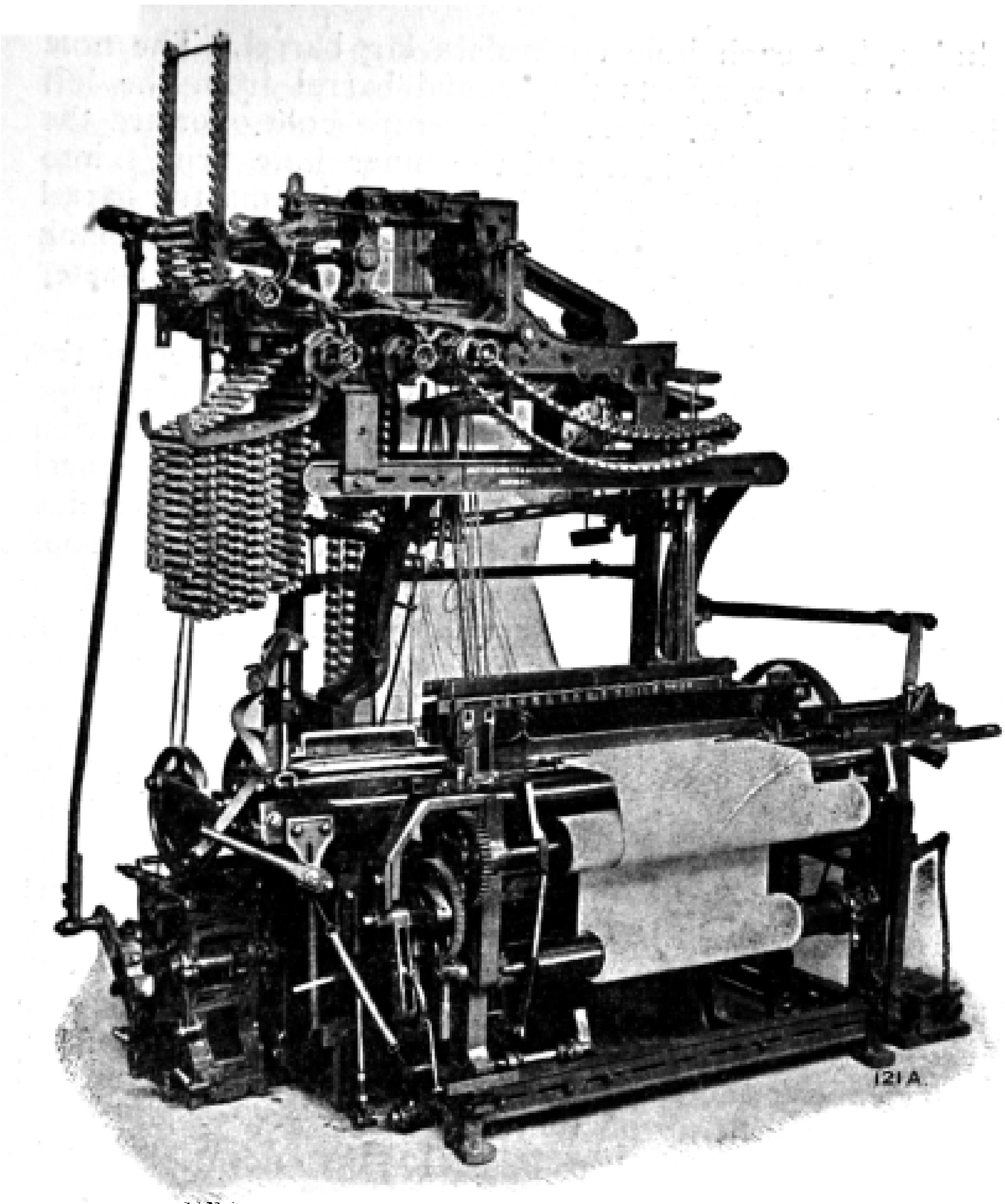


Fig. 416.
Butterworth & Dickinson's Terry Towel Loom with Four Drop Box Motion.

vice, it means the saving of much pegging and many lags The design for a bordered towel is divided into sections, and the one requiring the least number of lags is placed on the top barrel and the upright rack. The largest section weaving the body of the towel is placed on the bottom outside barrel where there is most room, and the third section is placed on the inside barrel. One repeat of each section is pegged, and on the last pick of each section, a peg is inserted to operate the first jack in the dobby. As the bottom catch is drawn forward, the front of the balk comes in contact with a pin on a lever, and on the lever is the catch that turns the master-barrel, this being the one carrying the lags on the loom front. A lag on the master barrel has only three holes, but each hole controls a lag barrel. The hole nearest the weaver affects the second barrel from the left with its long length of lags. The centre hole operates the 3rd cylinder from the left, and the inner hole brings into play the upper outer barrel. A peg on the master barrel lifts a catch, and places its barrel out of action. A blank brings a catch into service. On each lag on the master barrel there must be two pegs.

Each catch wheel is in two sections, the smaller of the two being the one used for turning the barrel. The larger one behind has also a catch which only comes into action when the other is lifted, but all it does is to turn the wheel a half cog distance so the pegs do not touch the under side of the feelers. It so remains until the master barrel drops the other catch on the small wheel.

The pile is formed by means of a swivelling cam just below the breast beam, which operates underneath a bowl on a bell crank lever attached to the loose reed case. The amount of movement imparted to the reed case determines the length of pile, and can be regulated by the height of the cam. When the sley moves forward, the bowl rides over the cam, and the sley is thrown back, which leaves a space between the fell of the cloth, and the pick of weft just inserted. The sley is fixed by raising the swivelling cam, for then the bowl passes under it, and the sley is firmly held, and in pushing the picks up to the fell of the cloth, the gap disappears, and the pile is formed. When producing a three-pick terry fabric, the sley is thrown back for two picks, and makes the firm beat up on the third pick.

This is demonstrated at Fig. 417. A and B shows the sley leaning back at the bottom which makes room for the float pile at I and J. At C, the sley is held firmly as explained,

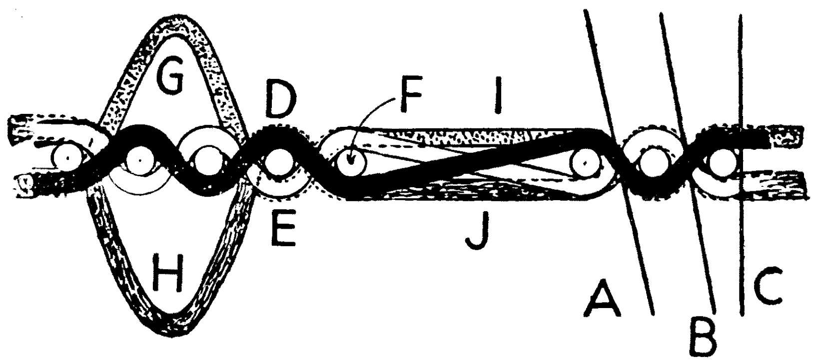


Fig. 417.
Side View Terry Pile Fabric.

and when pushed to the fell of the cloth, the floats I and J are formed into loops like G and H. At D and E are the two ground threads, and at F is the representative pick for the series shown.

When weaving bordered towels, plain or level tabs are often introduced into the border designs. This entails the placing of extra weight on the pile warp beam to bring it to the same tension as the ground warp, and also the fixing of the sley during this process. This is achieved by raising a spring-loaded lever to a stationary position by the dobby. In this way, pressure is placed on an auxiliary weight lever connected to the collar on the warp pile beam. The end of this lever is also connected to the cam controlling the sley, so it is held in its fixed position when weaving these plain portions. On completing the picks required, the extra weight lever is released by the dobby, and the loom automatically resets itself for terry weaving. The pulling catch on the take-up motion can also be lifted by a dobby jack every 2, 3, or 4 picks when required, and in this way, the number of picks in any part of the towel may be increased.

The loom is provided with a fringing motion. This consists of an eccentric on the tappet shaft, and a wrought iron bar connection to a fringing lever carrying a pawl which engages with the taking-up motion. This pawl is held out of contact with a catch wheel by a metal guide controlled through levers from a dobby jack. When a fringe is required, the dobby releases the metal guide, and allows the pawl to engage with the catch wheel which is firmly connected to the double wheel of the taking-up motion. The degree of movement given to the pawl from the eccentric, accelerates the rate of take-up, and the length of fringe is determined by the number of picks through which the lever controlling the guide is raised by the dobby.

Fringing without weft can only take place when only three colours are being used, for the swell of the fourth box is packed out. When the change is made to this box, the loom is kept running without shuttle traverse whilst the fringe is being formed, and during this period, the weft hammer lever is lifted by a dobby jack. A hand fringing arrangement is provided for the convenience of the weaver.

The number of towels woven is registered on a numbered dial on the top rail of the loom, one cog being turned by the dobby on the completion of every towel.

The four box motion is controlled in the same way as the same firm's pick and pick silk loom. Page 514.

Wilson & Longbottom's Terry Towel Loom.

This is a very ingenious loom and has a special motion for regulating the amount of terry warp let-off to make the pile.

Dobby and Outer Lags.—In Fig. **418**, A are the feelers, 16 pairs being used to operate the shafts, and four pairs are used for other service.

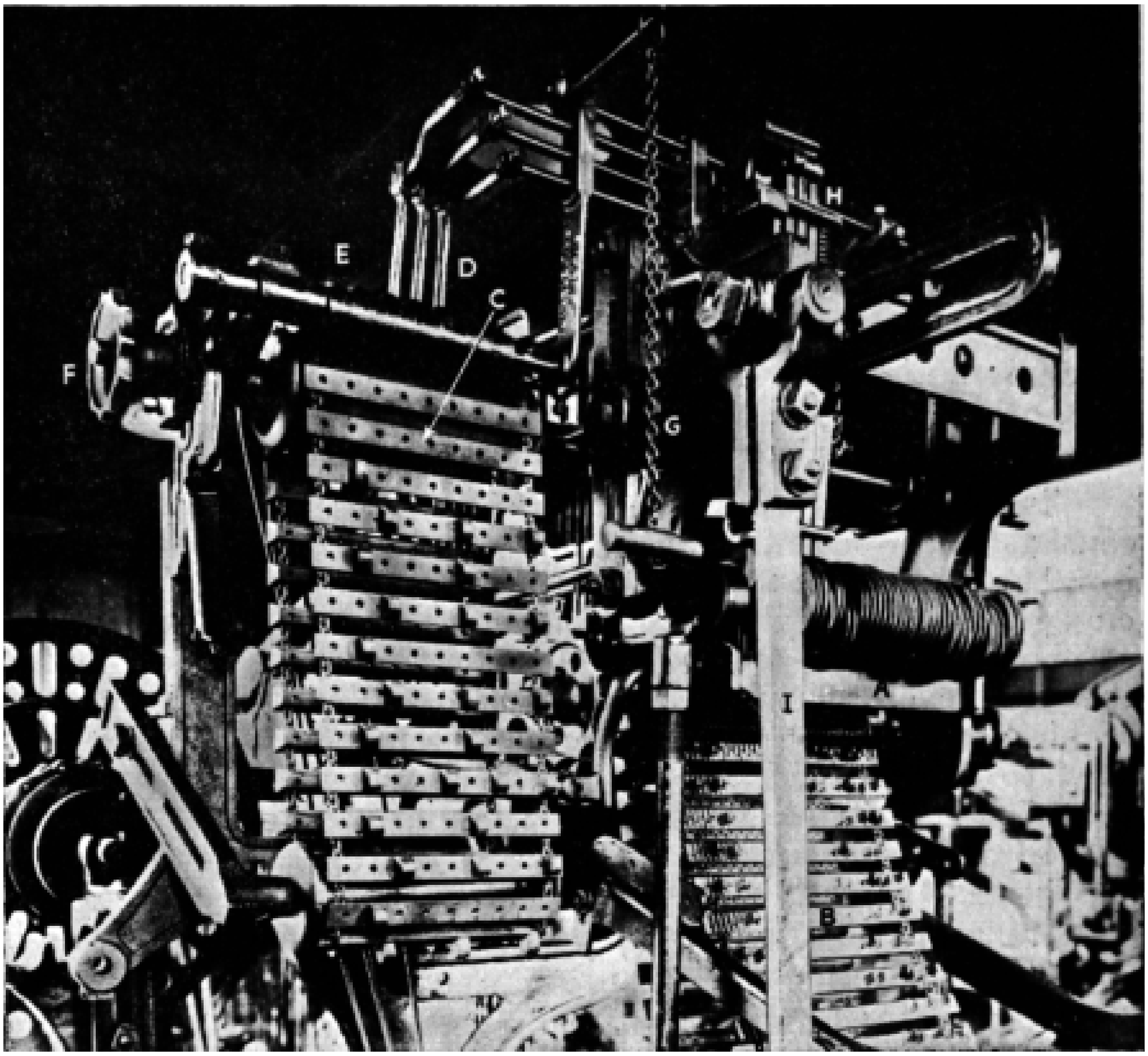


Fig. 418. Wilson & Longbottom's Terry Towel Loom Dobby End.

Two feelers operate each shaft, the odd numbers controlling the bottom catches, and the even ones the top catches.

Shaft lags B are grooved and bored in two rows, the first being for odd feelers and the back row for even ones. The wooden pegs have flat sides and rounded tops.

The cylinder is turned every other pick.

The last eight holes in these lags operate as here detailed.

Action of Back Feelers.—The 17th pair actuate a shaft jack at A in Fig. **419**. This jack has a long wire attached, and at the bottom, is fixed to a lever. When the corresponding dobby catch is drawn forward, the lever turns a cross shaft that is the fulcrum of the lever.

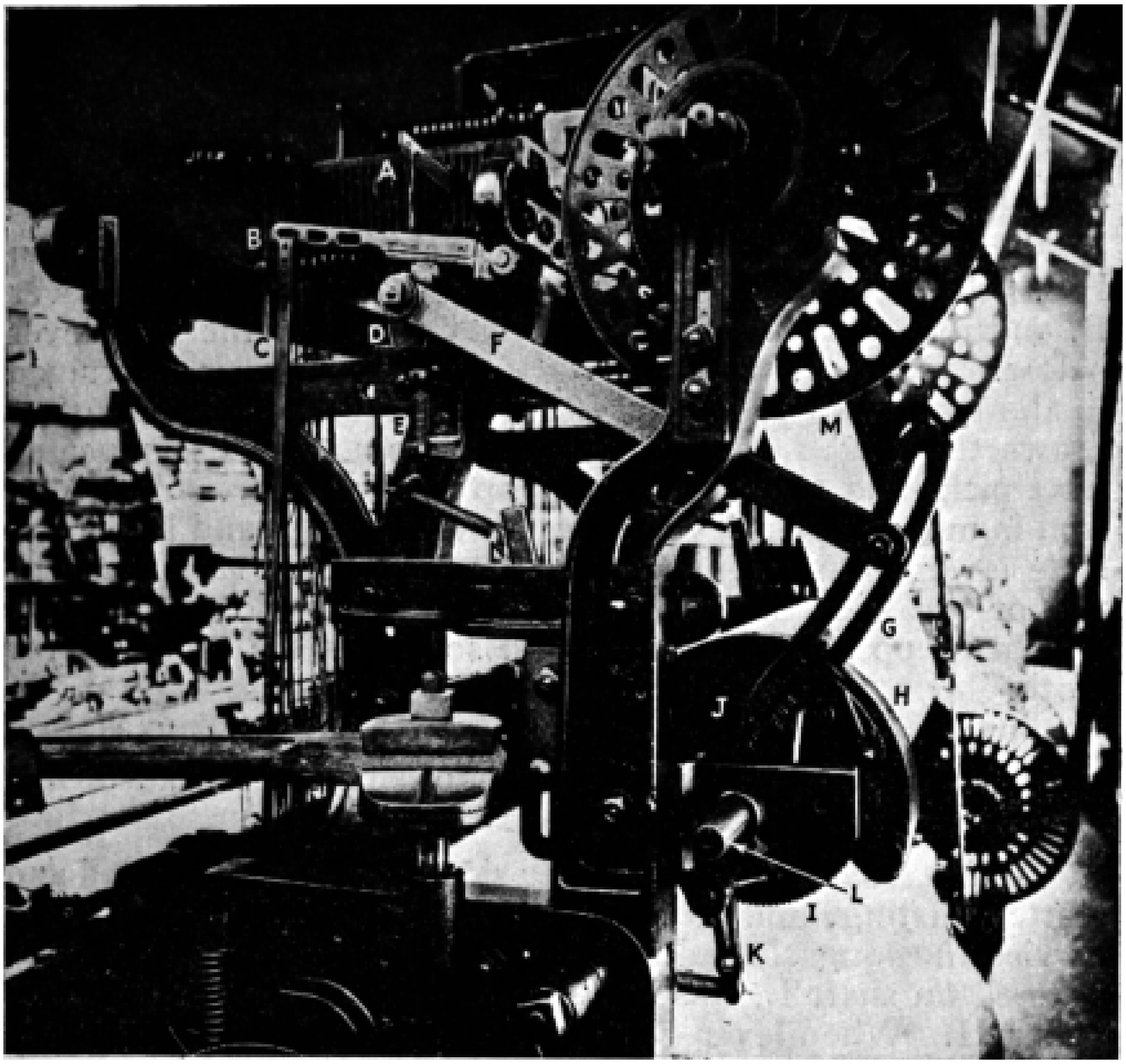


Fig. 419. Baize Covered Roller for Terry Let-off.

At the other end of the crossshaft is a collar with a cut upon it. By the shaft being turned, the collar is brought in contact with a suspended catch on a long lever. Above the lever is a strong spring that is confined by an upper casting. By the lever being lifted, it is against the strong spring, and as the long lever is connected to the brake chain on the ground warp beam, additional force is brought to bear upon it, so that for two picks, it is stationary during the insertion of the pile picks, but is eased for the ground pick.

The 18th pair of feelers lift the pawl from the take-up ratchet wheel, so no winding of the cloth takes place during the insertion of the pile picks.

The 19th set brings into operation the fringe motion, the fringe being made between the woven towel and the one to make. This done by a clutch that is moved in contact with a wheel always in motion when the loom is running. On the sprocket wheel coming in contact with the wheel governed by the clutch, the warp is automatically wound forward without weft for $1\frac{1}{2}$ inches. The clutch wheel is then taken out of contact, the take-up pawl is dropped, and weaving resumed.

The 20th pair of feelers control the cross shaft above the warp. This carries a curved lever with springs attached, the springs pulling the cross shaft back after service.

Towards the end of the cross shaft is a cam at D in Fig. 419. By means of the cam, the cross shaft raises lever B, and its attendant strap C that is coupled to the slide lever below. On being lifted, it causes the bowl lever fulcrumed to the sword, to pass underneath the slide lever, which then draws the reed rack back at the bottom. This is repeated next pick, and there is then a gap in the fabric. When the cam is moved back, lever B and strap C drop, and lower the slide lever. On the third pick, the bowl lever runs over the top of the slide, holds the reed firm in its closed position, and beats up all three picks, and so forms the loops on the cloth.

The cam D under lever B in Fig. 419 is steadied in its service by spring E being applied to a hammer head on the under side of the tappet.

Baize Roller.—On the outer side of cam D is a fluted and slotted casting, and to this is bolted the long lever F, that carries the long slotted lever G. The curved casting is fulcrumed on shaft L, this being the shaft of the baize covered roller H. When lever B is raised by the tappet, the turning of shaft D makes bar F and slotted lever G move downward.

On G is a pin connected with a slide on the outer side of the shield J, that half covers the ratchet wheel I.

Inside the shield are 10 catches that are graded in height, so that only one catch out of the series is a pusher of the ratchet wheel. The grade is so the let-off on the terry beam by the rotation of baize roller H, can be set to a fine pitch. The pitch is set by fixing the connecting lever F to the slotted casting G. After the slide has been moved forward, it is pulled back by a spring attachment to the slide lever G.

On the outer side of the ratchet wheel is the spring brake K, that prevents excess movement of the ratchet wheel. If a deeper pile is needed, the connecting lever F is set lower.

The pile beam is only lightly tensioned, and goes directly to the baize roller from the beam, passes over a steel roller above the baize roller, and then descends to pass under a pressure roller, that rests in a pair of release levers, the top of one being at N, Fig. 419.

After giving way when the pile is pushed forward by the reed, it is brought back by the spring shown.

The Outer Lags.—In Fig. 418, these lags are on the left. They are flat-faced with a single row of holes. Commencing from the right:—

1. This affects a lever that controls a tippler at the loom front. When moved, one cylinder is put out of action, and another brought into play. This is visible in Fig. 420.

2. A peg here influences the 17th pair of feelers, and lift the lever that tightens the ground warp during the insertion of the terry picks, when the bottom of the reed is drawn back.

3. A peg here lifts the pawl for the take-up motion, so that for two picks, cloth winding is suspended.

4. This operates the fringe motion.

5. Here lies the control of the baize covered roller that lets off the required length of terry warp from the beam.

The remaining four places are for the movement of the four boxes, and are on the left.

A peg in the 8th outer hole lifts the 2nd box; the 7th peg raises the 3rd box; the 6th peg pulls up the 4th box. There is a separate mechanism for each box, so that the 9th peg brings the 1st box into play.

The boxes are controlled by tongues somewhat after the Hodgson principle.

Lag Cylinders.—In Fig. 420 is presented a full view of the loom. A is the lag cylinder wheel that turns one lag forward every other pick by the pawl on the dobby lever. This wheel is in charge of both sets of lags at D and E. In addition, there is another set of lags indicated by cylinder wheel B. This only operates when a plain border has to be woven with coloured weft. When this occurs, cylinder A is put out of action and cylinder B comes into play. The lags on B are flat-faced and the wooden pegs actuate the inner set of feelers that dovetail into the outer set.

As soon as the plain coloured border is woven, the tippler is altered in position, the inner cylinder stopped, and the outer one takes charge.

Overpick and Take-up Motions.—The ordinary overpick is applied at both ends of the loom, but the pickers are different. For the plain box on the right, the picker is vertical, but for the drop box it is horizontal.

The take-up motion is at H, and follows the ordinary

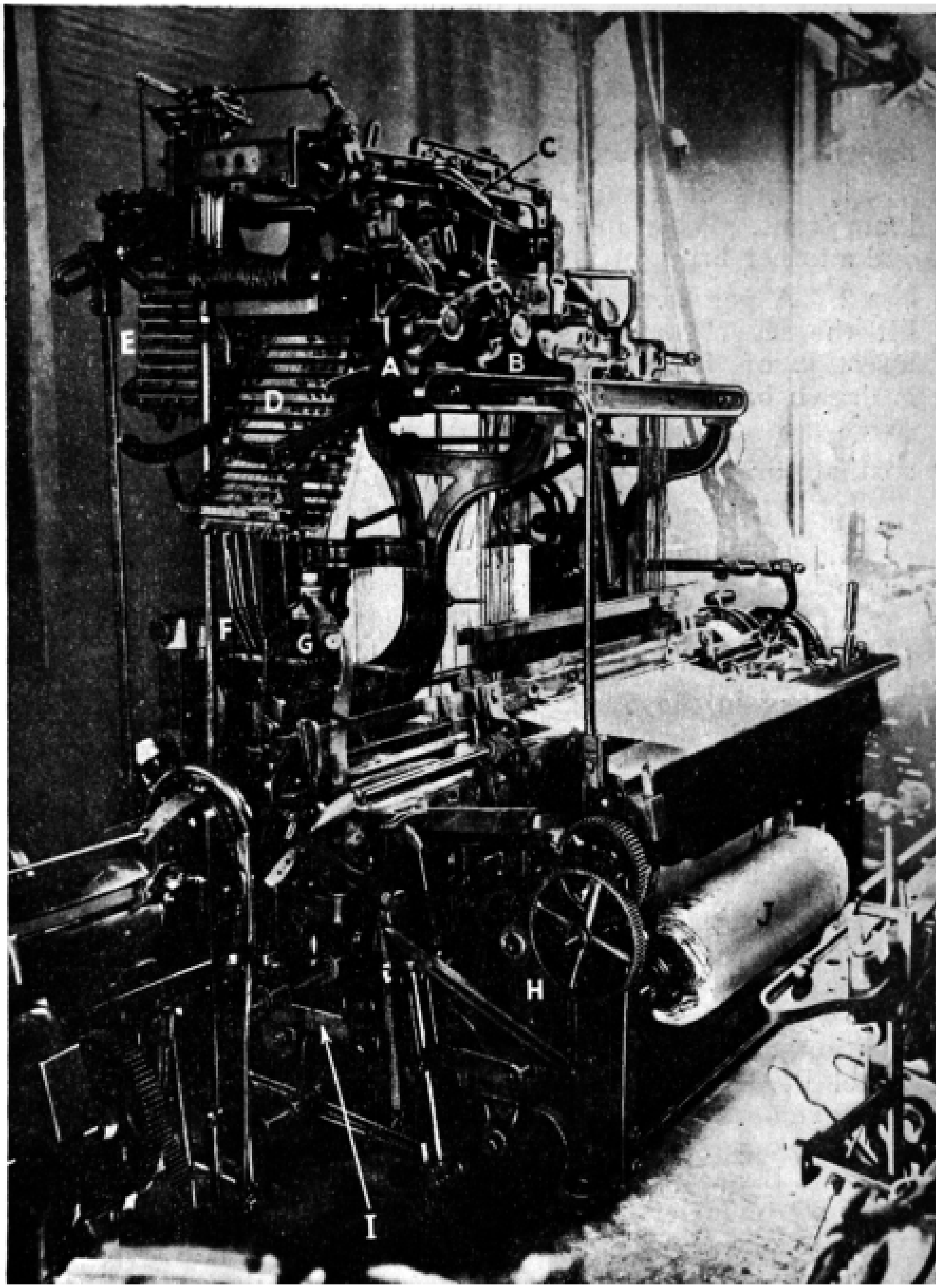


Fig. 420.

pendulum lever worked by a rod from the sword. The gauge figures for change wheel calculation is 1209. The picks per inch are divided into these figures, and the answer is the number of cogs for the change wheel.

At I is the duplicate lever to the one at the opposite side of the loom. Both apply pressure to the ground warp beam during the insertion of the two pile picks.

Width and Winding of Cloth.—The terry pile cloth being woven on the loom was 30 inches wide, but the reed space was 34 inches. In the arrangement for the cotton varnished healds, the front two shafts were limited to the inner border; the 3rd and 4th shafts were for pile, and the other three for ground.

The wound cloth on beam is at J.

The speed of the loom is 175 picks per minute.

CAUSES OF WARP AND WEFT BREAKAGES IN COTTON WEAVING.

When a cotton thread breaks during weaving it is either through weakness or violence. The place of breakage, and the appearance of it are clues to a remedy.

There are four main places. (1) Back shed. (2) Healds. (3) Reed. (4) Front shed.

(1) *Back Shed.*—Full drag on warp leaving beam. Full tension at healds. Weakest threads break near back rest, those stronger in front of lease rods; the stronger still at healds. When broken in this stretch indicates poor materials; inadequate slashing; improper setting of loom parts.

Inadequate Slashing.—Experience the best guide as to quality and quantity of ingredients. Undersized decreases resistance. Reduce picks and tension and time shed late.

Oversized.—Threads stick together, or are too brittle. Eased by damp cloth on back shed. Slasher marks made by breakdown of machine. Sections baked, and others oversized. Paraffin for baked section if weavable, and hot water for oversized.

Defective Lease Rods.—Grooved by thread friction and have cutting action on warp. They hold knots and break threads. Wooden lease rods to be covered with tin.

Mechanical Parts.—Negative brake motion to be free from rust, chains oiled, or powdered with graphite, and ropes rubbed with block blacklead. Back rest conveying threads to healds to be level with breast beam for soft warps and timing late. Rest to be above breast beam for weft faced fabrics woven right side up and below it for warped faced fabrics. For hard wefted fabrics, shed timed soon if possible. Back rests are aids to good weaving.

Fig. 378 gives parts when shed closed, and Fig. 377 represents the open shed. To carry this matter further, Fig. 421 is for weft faced fabrics. Warp A passes in front of lower rail B, over rail C, and then goes forward at D to the lease rods and healds. E and F are the lease rods, and G the back shed. By this arrangement, the most tension is placed where there is most warp this being on bottom shed.

Fig. 422 is for a warp faced fabric. Here again the most pressure is where there is most warp, this being on the

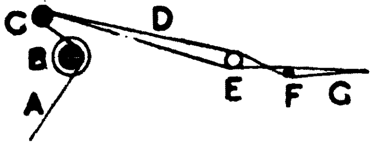


Fig. 421.

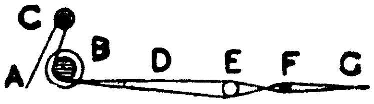


Fig. 422.

top shed. Both fabrics are woven right side up. The lease rode are inserted as experience decides.

Breakages at Healds.—In cotton weaving, the bulk of healds are varnished cotton. The varnish has to be evenly spread and adequately dried, or lumps stick to heald eyes and damage warp.

When healds not deep enough, the insides of shafts chafe warp. This most likely to happen when using a large number of shafts. Shafts of lesser depth take their place.

Breakages increase when weaving terry towelling with soft condenser yarns.

To curtail expenses, a higher set of healds used for a lower set, and healds left vacant. These add friction on threads, and with fancy drafts and colours, add labour and anxiety to weavers. If warp be wider or narrower than width of healds, more tension is placed on outer threads, and much the same applies if the healds are wider or narrower than warp. Inadequate setting of the heald shafts is a fruitful source of warp breakage.

Shed timing is something to be carefully considered. On high setted warps, it is advisable if woven by tappets, to have them so they can be altered in timing, so the healds are not crossing at the same time. This specially applies to poplins with plain weave. The drafting has to be 1, 5, 2, 6, 3, 7, 4, 8. Instead of a $\frac{1}{3}$ dwell it is better with a half dwell.

Chafing by Reed.—A reed pitted with rust wears threads down quickly. It is got rid of by soaking a little waste in paraffin, and applying it to the defective place. Fine emery cloth, looped on each reed, and gently rubbed, improves matters.

When warps are sized, part of the size accumulates on the reed wires and decreases the spacing, and many threads are broken. A moderate dose of paraffin, and rubbing the reed with a piece of carding, scrapes off the sizing.

For long wearing, metal pegs in shuttles are better than wood. If the metal pin works out at the back of the shuttle, it will soon do damage. To prevent pins working through, the punch used to knock pins out should be less in diameter than the pin.

A common practice in the cotton industry is the weaving of fabrics containing say 40 threads per inch. It is woven in an 80's reed, with one thread per dent. When so woven, it adds a smart appearance, but unless in good condition, the friction by so much metal, rubs down the weaker threads.

Breakages in Front Shed.—Usual shed size is that when crank is at back centre, the top shed threads first clear the top of shuttle front. It does not always apply, for in heavy plain cloth, the shed contracts, and has to be increased. To get picks in better with less weight the warp is passed over two stationary back rails.

Heavy sized warps of 120 per cent. are difficult to weave in wet weather, as the size becomes softer and rolls into lumps by the friction of passing shuttles, and some stick to shuttle race. These force shuttle upward, and multiply breakages. In wide cotton looms from 80 to 120 inches wide, and weaving cotton blankets, sheets, etc., with weft from 4's to 9's counts, many threads are broken when hard cops are used. These chafe the warp when the weft is beaten up, but it is eased when timed later.

Threads Broken by Shuttles.—Damage to warp by shuttles is considerable, if they do not run evenly. Right and wrong fittings are shown at Fig. 423. A, handrail, B, reed, C, going part, D, shuttle. Bevel of shuttle not in

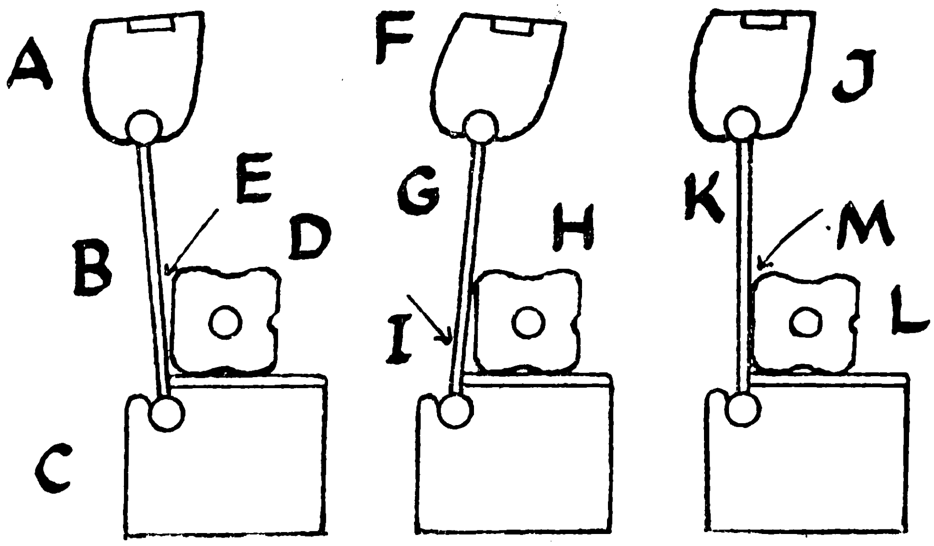


Fig. 423. Fitting Reed to Shuttles.

line with reed, and shuttle race, hence gap at E, and shuttle can be pushed back at top. Leather packing is placed between sword top and handrail. At F, handrail is too far forward. A gap at I, and shuttle can be pushed inward at bottom. The back of handrail cut to give correct bevel as at L and M, with G as handrail and K reed. No loom should run until bevel M is secured.

Worn Shuttles.—The shuttle at Fig. 424 is a non-kiss shuttle. The wearing is common to all shuttles. A and B are original lines of shuttle, but back and front wear off and leave humps C and D.

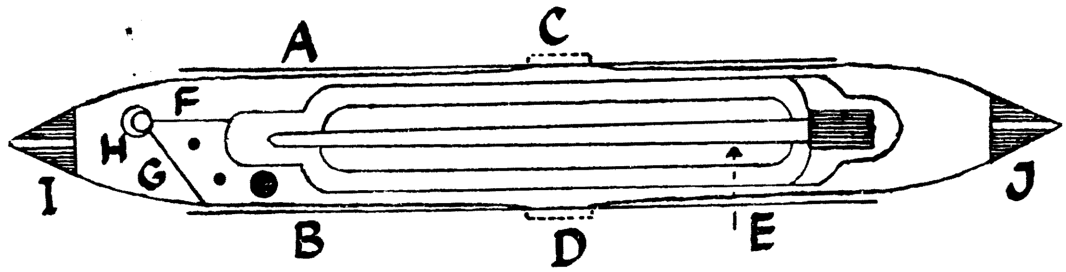


Fig. 424. Shuttle Wearing Back and Front.

The area C has to be carefully filed off to make shuttle run straight. D is seldom interfered with. E is spindle for cops, F and G are cuts for hand threading, and I and J tips.

Fig. 425 shows front of same shuttle. Areas A and B are areas worn, and C the bottom area forming hump. This has also to be filed off to secure good running. D is

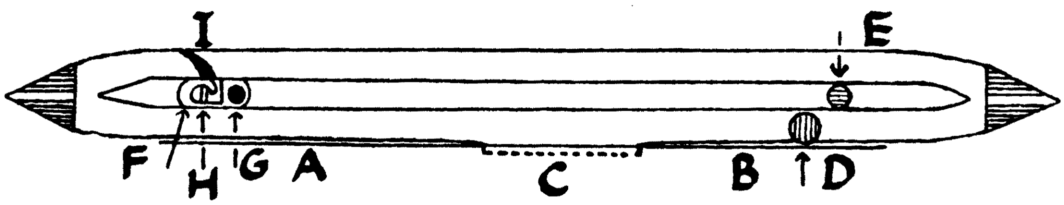


Fig. 425. Shuttle Wearing at Bottom.

hard wooden peg to hold spindle block, and E another peg to hold spindle. F is small plate riveted at G, and H guide pin to aid hand threading. I is sidecut.

Causes of Weft Breakages.

Tender Yarns.—Weft usually less twist than warp, and lower in quality. Weakness due to poor materials, or spun to a too high count, or for lack of twist. Requires minimum drag, and to stop ballooning an extra pin placed across shuttle near eye.

Soft Nosed Bobbins.—In spinning by lifter motion, soft noses made by heart-shaped lifter having point blunted. A new tappet needed. By force of pick, a soft nose collapses, but if not too bad, a decreased picking power on the right will make improvement. A further aid is to bore a small hole through the picker parallel with dent made by shuttle tip. It then acts as a cushion.

Snarls.—Blemishes on weft due to slack winding. Snarls occur most when more twist than ordinary is put in, as for voiles and crêpes. Snarls hinder adjacent coils, and will break or stretch them. If snarls gets into cloth, they are difficult to get rid of. Curls are distinct from snarls. Made by too little drag on weft, defective checking, and too late timing of shed.

Broken Cops.—Some manufacturers purchase weft from spinners, and has to be packed and sent a considerable distance. Careless packing, or violent motion, or severe pressure lead to damaged cops. When not carefully skewered, inner coils may be damaged.

Weavers' Mistakes.

Skewering and Packing.—A too hasty skewering of cops adversely affects the inner coils. A worse habit is the packing of the curved spring on the spindle to keep the cop in position.

Faulty Shuttling.—A tumbler weft fork only requires one knock, and it is out of order. When shuttling, the crank has to be at back centre. In stopping loom, it is foolish to let tongue bang on frog, for that is the way to a shuttle trap.

Oiling Spindle Block.—Only a drop or two is required, for too much soaks into wood and loosens shuttle tip. A loose tip can make a bad smash. As soon as spindle feels weak, it is ready for repair, for a single lift when weaving will cause considerable damage.

Alteration of Brushes.—Most shuttles have a brake brush, and in a pair, the brake has to be equal. The weaver is justified in picking off dirt or stray weft, but not in cutting the brush, for that makes uneven selvedges.

Misfits of Loom Parts.

Weft broken or cut during weaving when certain parts are not fitted properly. This is demonstrated in Fig. **426**.

Plain Box.—Weft cutting is one of the bugbears of an overlooker's calling, and all the more so because it cannot be seen. A blow hole inside box front has to be filed, and emery papered. A worse thing is weft dropping in box. To prevent it, the inside of box front to be made fit to shuttle front.

Fig. **426** illustrates A, wooden shuttle guide; B, box back; C, cuts at end of going part; D, box bottom; E, shuttle. As going part is at front centre shuttle front all about vertical. F is box front leaning outward at top as shown by lines G.

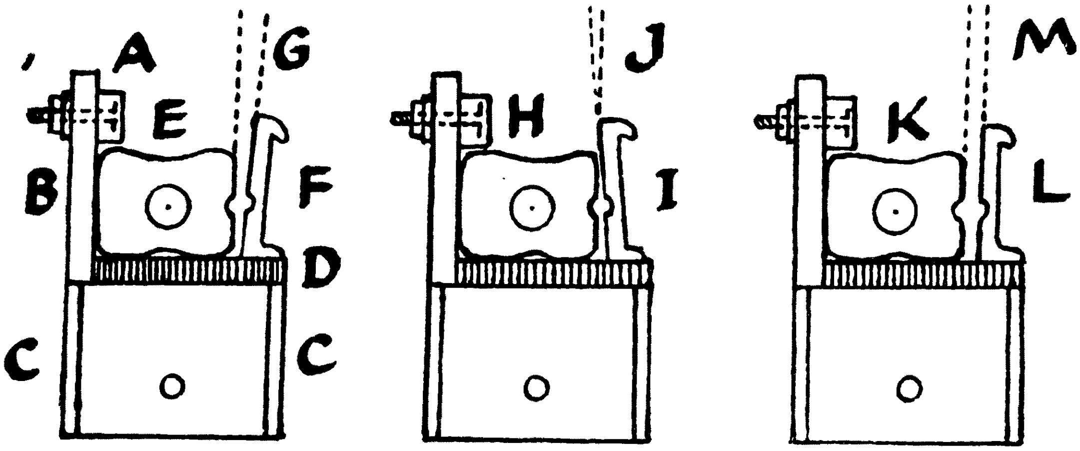


Fig. 426. Fitting Box Front to Shuttle.

In second sketch, box front leans inward at J. Box front altered by tapered cardboard packing under feet of box. In the first, packing inserted at front; in second, at back. Both then fit like K, L and M. This fitting required for both boxes when shuttles are new.

Temples Too Near Reed.—In weaving heavy goods, temple to be well forward, but not to touch reed. The head would wear the wires. It should be examined with crank at dead front centre.

Harsh Picking.—Most usual time when picking noses are new. Curve of nose too prominent, and nose end to be rounded off. Shuttles not to bind in box. If pick too strong, weft sloughs, and cone stud may be broken.

Breakage by Wearing.—On box looms with turned up shelves at front, shuttles worn in different way to those in plain boxes. Fig. 427 shows how weft is severed.

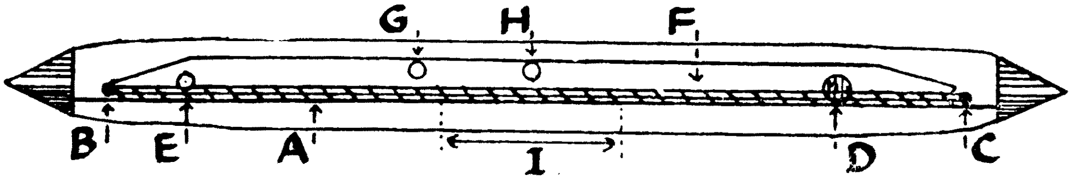


Fig. 427. Preventing Weft Cutting by Band.

The bottom front of the shuttle is cut away for the shelf to hold it. By forcing back the box swell and lifting stop rod, both ends of shuttle outside area I become worn. It allows the weft to drop between shelf and shuttle. To prevent it, two pieces of mule spindle band A are pegged at B and C, so that if weft drops, it is beyond shelf.

In Fig. 428, lettering is same. What is different is that instead of using mule spindle band, a frayed thrum that is twisted, takes its place. It is for stronger weft or weft hard twisted. It is at A, and pegged at B and C.

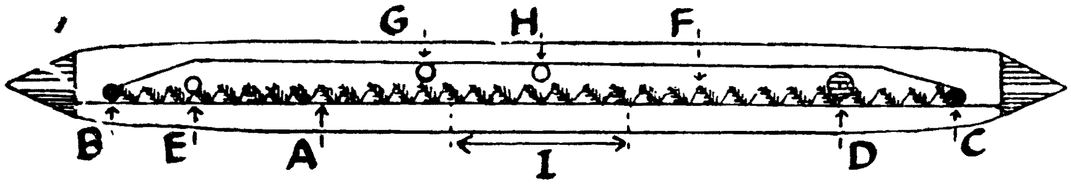


Fig. 428. Preventing Weft Cutting by Thrum.

Cracked Shuttles.—When cracked at back, the weft gets in and is broken. If a straight crack, it may be pressed both

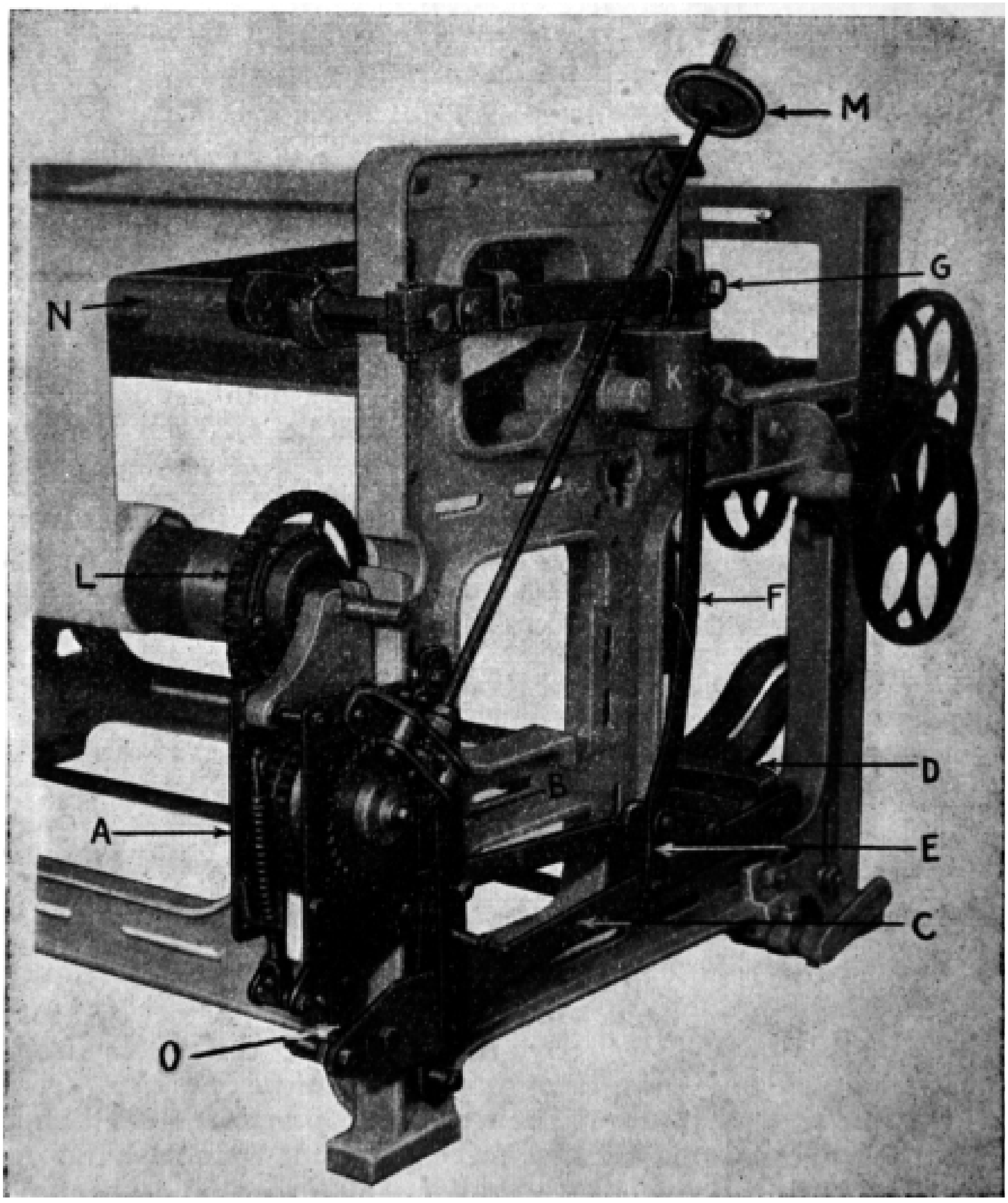


Fig. 428a. Bradley Prize Medal Let-Off Motion.

ways and rubbed with fine sand paper. It is more liable to be cracked after humps are filed off. One way it is cracked is when loom bangs off with shuttle partly in box. A damaged weft feeler will also injure the weft.

The Bradley Warp Controller.—This device consists of the well-known " Gold Medal Kinetic Brake " which is positive in action, and automatically controls the desired tension of the warp from start to finish. It is presented at Fig. 428a. The whole mechanism has recently been improved. All the principal parts are in a self-contained and easily fitted unit. To remove and replace the warp beam, the only requirement is the removal and refitting of a short roller chain and a beam hook. The illustration shows the motion fitted to a test loom.

A is the brake unit containing the brake drum, brake bands, operating levers, load spring and lever, spear lever, beam bracket, and the enclosed beam controlling gears with bevel gear transmission. This is attached by two bolts to the loom frame along with damper unit B.

The reciprocating lever C is attached by a pivot pin to the sley sword bracket D, and is allowed a free traverse of one inch. Midway on C, is the adjustable T lever E, which induces the oscillation of the back bar N, and connects it by drop rod F to the back bar and tension lever G. Adjustment is provided to permit the setting of warp level. The handwheel M on the inclined shaft enables the weaver to operate the warp beam from the front of the loom.

A notched bar lever (not shown) carries a weight which performs a duty similar to the one shown at K on lever G. which determines the tension at which the warp will be woven.

The unit A is provided with a drive sprocket and chain that couples it to a larger chain wheel attached to the warp beam. The other end of the beam is held by a hook and bracket attached to the loom frame.

The only provided adjustments are that of the tension weight, the load spring opposite A, and the T lever E. Full instructions are here briefly summarised.

All moving parts must have free action on assembly.

The reciprocating lever C must move about one inch, and not touch the spear lever when in its lowest position, but give full movement to it when in its highest position. When weaving is in progress, the reciprocating lever C will float about mid position, and is correct. If the lever does not float, the load spring has to be tightened steadily until the desired effect is obtained. The spear lever is moved to and fro every pick, and two movements are transmitted to the beam by means of the interposed kinetic brake, which is a variable self regulating gear that always drives the beam at the correct speed to keep the warp at constant average tension. The actual tension is determined and maintained by the position of weight K. The higher the value of the weight, and the greater the tension on the fabric.

The frictional contact brake L must not be lubricated.

The device can be fitted to suit any kind of weaving, from the finest rayon, to the heaviest asbestos brake linings, and gives equal satisfaction. Full instructions are supplied to purchasers. The patentee is Messrs. William Bradley and Co., Textile Engineers, Beacon Works, Addingham, near Ilkley.

YORKSHIRE AND LANCASHIRE LINEN LOOMS.

The well-known firm of Messrs. Wilson & Longbottom, Nelson Foundry, Barnsley, have recently made two new linen looms. One is for weaving plain cloth, and the other for twills. With the exception of the mechanism for working the shafts, the looms are similar in construction.

Every part has been well studied, and adapted for the work it has to perform.

As a preliminary, the teeth of all the wheels are cut out of solid metal to secure strength, evenness, and long service. The crank, low shafts, top roller motion, electric motor and grooved pulleys all run in ball bearings. Fig. 429.

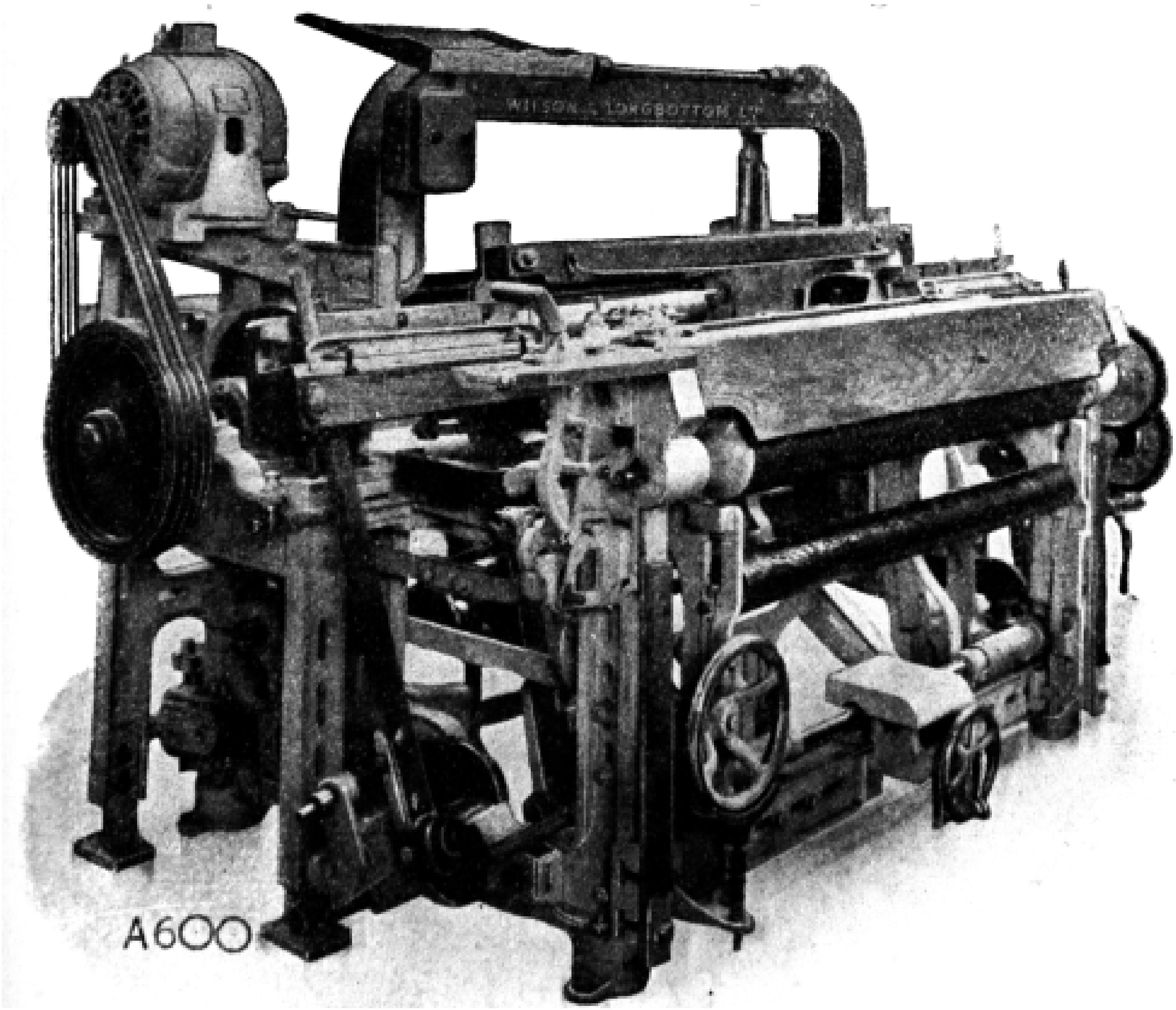


Fig. 429. Wilson and Longbottom's Plain Loom for Linen.

The loom has a speed of 180 picks per minute, and the reed space is 45 inches.

Top Roller and Tappet Motion.—Except for being in ball bearings, the top roller motion is of ordinary make. For plain weave, the threads are drafted on four shafts, 1, 3, 2, 4, the first two being lashed together, and likewise the back two.

The tappet countershaft is below the low shaft, and is run with a pair of equal wheels. The tappet operating the two back shafts is a $\frac{1}{4}$ inch larger in diameter than the other. Though the twilling loom was fit up for the weaving of 2 and 2 twill, it could be made to weave quite a number of other weaves occupying 3 or 4 shafts, either straight gait, drafted, or coloured.

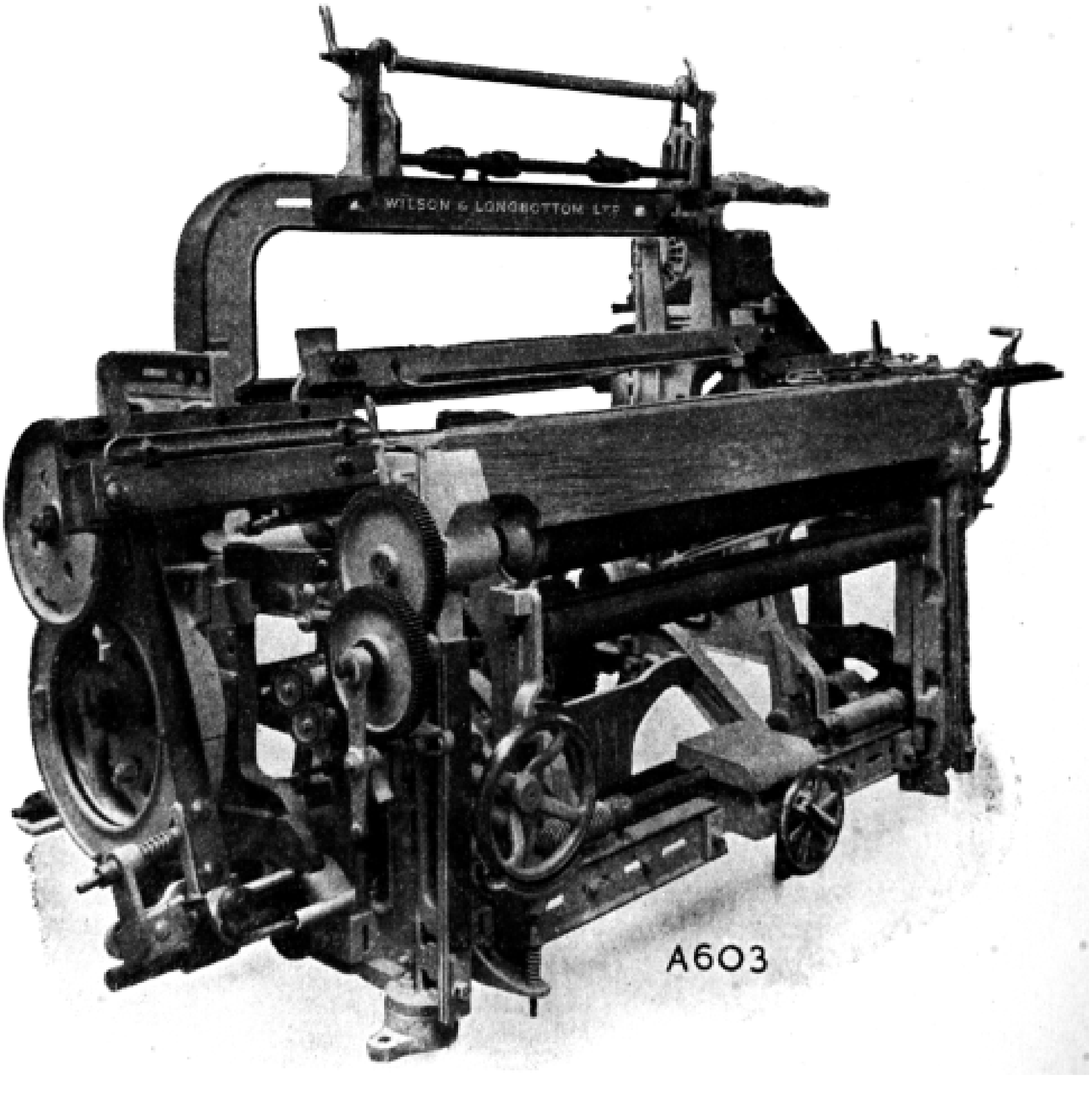


Fig. 430. Wilson and Longbottom's New Twill Loom for Linen.

Outside Underpicks.—This is seen in both Fig. 429 and Fig. 430. The wooden picking shaft is parallel to the outer loom frame.

The metal sheath that embraces the back part, is fulcrumed on a powerful stud bolted to a slotted bracket for adjustment. The picking neb is doubly bolted to the shaft, and is depressed from behind by a picking bowl that has a diameter of $2\frac{3}{4}$ inches. As linen is spoilt by oil, this kind of pick is better than the overpick.

The bottom of the upright picking stick is doubly bolted to a metal sheath, and on the inner side is the projecting arm that is pressed down by the picking shaft for picking. This style is seen on the left in two illustrations. Though not as springy as looped leather, it is more reliable. To check the incoming shuttle, the picking stick is held forward by the pressure of a bulb-nosed spindle, having on it an open spiral spring, the strength of it being regulated by a setscrewed collar seen best in Fig. 430. After picking, the stick is brought back by a leather and spring.

The shuttle begins to move out of the box when the crank has just passed its bottom centre, and its stroke opposite the shuttle guide on the box back is only $2\frac{1}{10}$ inches. It is quick and short, but can be set earlier.

Let-Off Motion.—The warp beam flanges in Fig. 431 have a total depth of 22 inches, and as they hold a long length of warp, it decreases cost of preparatory preparation. The warp beam is tubular steel, with slotted holes for holding starting knots, and has the let-off wheel with 20 cogs. There is no sagging of the warp beam, and there are no gudgeons. The beam is rotated by a worm that is moved by a casting bolted to the foot of the sword. It operates a lever that carries two let-off catches that push a 40 cogged wheel on the let-off shaft. One catch has to be half a cog ahead of the other to give the most equal delivery of warp. The let-off shaft is braked by its handwheel on the left having spring pressure applied to its brake pad.

The casting associated with the let-off catches has a long arm parallel with the let-off shaft. Towards the back, the arm carries two projections. The outer one is thick and acts as a counter weight to bring the casting back after the let-off has taken place.

The inward projection has on it a hooked part that is setscrewed to a vertical rod. At the top, the threaded rod is

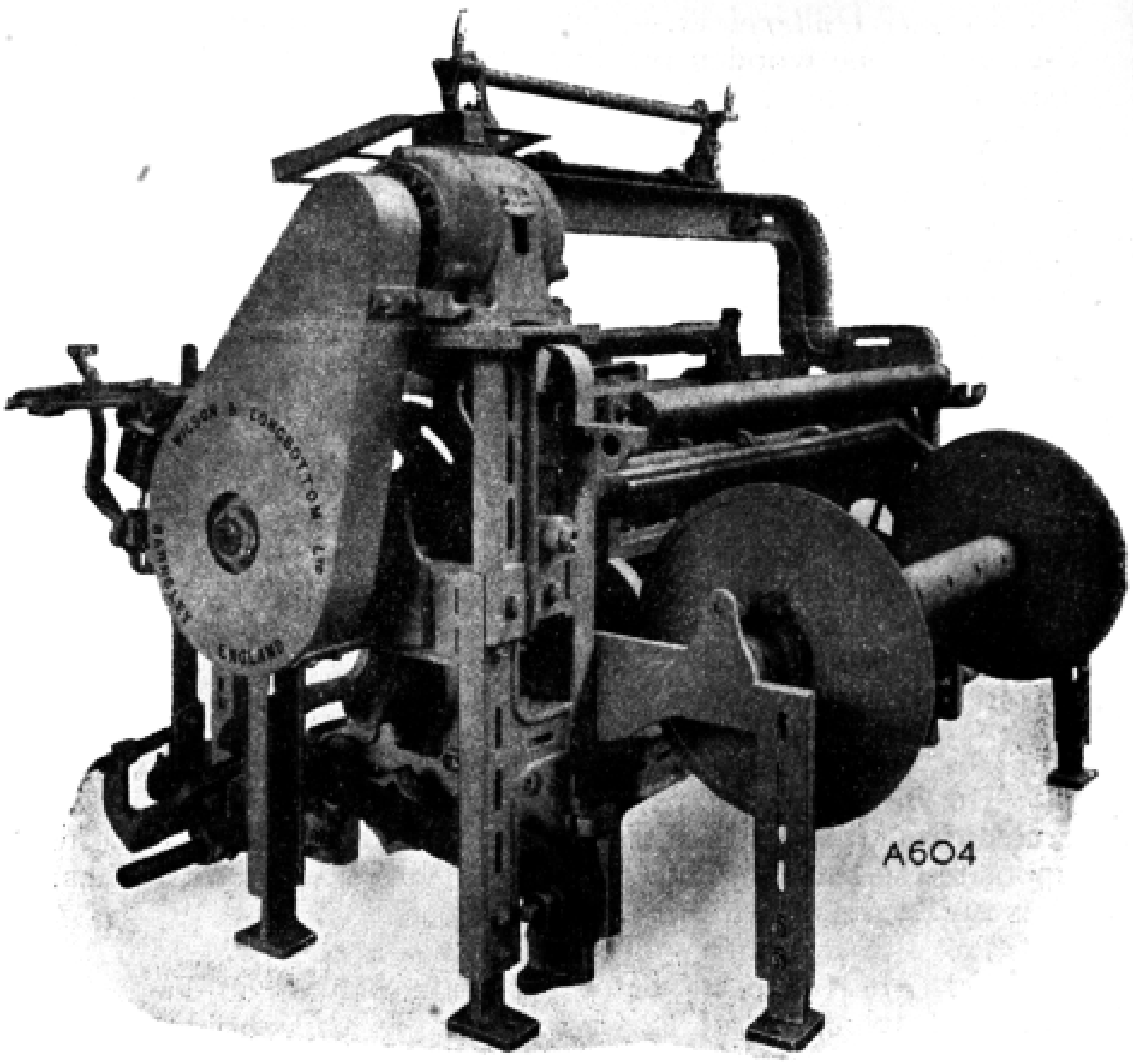


Fig. 431.
Back and Driving End of Wilson and Longbottom's Linen Loom.

connected to the inner rocker back rail of the loom. A pair of locknuts fix the working length of the rod. At the bottom, the rod is hooked round the bottom of the inside weight lever. By the oscillation of the inner back rail, the outer one is responsive.

The outer rail has a short arm projecting towards loom front. It is notched on its under side to hold a spring that assists in bringing the rail back after rocking. The ends of the two rails are circular to make them responsive to the beat up of the weft.

Crank Arms.—The centre of the crank arms are solid, but towards either end are slotted to receive cotters and gibs. There is a short metal strap at either end so that each can receive individual attention.

In weaving plain linen, good cover is difficult to obtain owing to the stiffness of the yarn, and particularly with low counts. The usual way is to elevate the outer back rest to tighten the bottom shed and slacken the top one. The weft is then forced more to the surface.

Burst weft is found more in fine damasks owing partly to the lack of elasticity in the weft, but is improved by using as fine a reed as possible with the wires well bevelled.

Take-up Motion.—This is after the style of the Pickles motion, but with modifications. The prime mover is a rod secured to the sword that passes through a slotted lever and operates the pulling pawl. The pawl pulls the ratchet wheel when the going part advances, and is pushed forward when the going part recedes. The important thing is to get the correct leverage. The usual setting is to have the point of the pawl in the centre of the cog upon which it rests when the crank is at its back centre, and to let the holding catch drop when the reed is a half-inch from the cloth fell. Fig. 429.

On same shaft as ratchet wheel is a standard wheel with 40 teeth, this being used when the loom takes up one tooth per pick. When two cogs have to be taken up every pick, the 40 wheel is substituted by one having 20 cogs. The standard wheel meshes with the change wheel, the last named being on the same stud as standard wheel No. 2 with 20 cogs. As the stud is bolted to a curved and slotted casting, it is readily adjusted to the diameter of the change wheel.

The second standard wheel turns the intermediate wheel having 86 teeth, and on its inner side, the intermediate has a pinion cast to it bearing 15 cogs. This small wheel turns the take-up roller wheel with 90 teeth and so completes the series. The circumference of the steel strip covered take-up roller is 15.7 inches.

Weft Fork Action.—When weft fails, the hammer head connected with the bayonet of the tumbler weft fork, pulls back the fork, but the mechanism associated is different. The shaft holding the weft fork passes through a circular projection on a slide, so that fork and slide are forced back together. At the base of the slide is a lever fulcrumed at its centre, and its inner part is moved back by the slide. On the upper part of this section is a threaded hook, that has charge of another lever in front. The bottom of the front lever is fixed to a cross rod, and at its opposite end, the cross rod has a lever with a projecting pin that elevates the pulling pawl on the ratchet wheel, and prevents the take-up of the cloth at the same time the loom is stopped.

To prevent any excess run back of the ratchet wheel, a run-back catch with a slotted body, holds the wheel after a run-back distance of one cog. When the ratchet wheel takes up two cogs at a time, the run-back catch is set for two teeth.

When necessary, the weaver can use a handle seen on the right in Fig. 429. The bottom arm of the handle carries a chain that contacts with a casting that lifts both take-up pawl and run-back catch out of action, and the cloth can then be let back.

Additional action due to the weft fork is, that when the lever at the base of the weft fork slide moves back the outer part of the lever swings forward. In front of the outer part is a double fingered casting. Its vertical arm is forced forward, and its horizontal arm elevated. As this contacts with a sloping part of the set-on handle seen on the right in Fig. 429, the handle is thrown back and stops the loom. The loom is set in motion when the set-on handle is pulled towards the operative.

The loom brake can be pushed away from the brake wheel by moving a lever in front of the set-on handle. This enables the going part to be easily moved as desired.

Shuttle Boxes and Swells.—The metal box bottoms are cut out to admit the squares on the bolts for nut and bolt fixing of the box front. A prudent overlooker does not " nip " his shuttles in the boxes, and thus makes picking easier, and both parts and shuttles last longer.

The box swells are made of wood, and have a gentler action on shuttle and weft than metal swells. The box swell finger is malleable iron, and its base is on a projection on the stop rod, and quickly altered by its setscrews.

The front of stop rod tongue is exceptionally broad, being 2¾ inches, but tapers towards the back. It prevents buckling and wears much longer. The frogs are held well forward by a strong circular bar that passes through the loom frame, and is held forward by a straight steel plate bolted near the foot of the loom.

Cloth Winding.—The cloth passes from breast beam to the steel strip covered take-up roller, under and over a steel roller on top of the take-up roller and thence to the cloth beam. The last named is turned by frictional contact with the take-up roller. The gudgeons of the roller rest in curved brackets at the top of a pair of cogged racks. The racks are visible in Figs. 429 and 430.

, The cogs on the racks mesh with wheels on a cross shaft. These wheels have circular projections on their inner sides. The wheels and collars have a powerful open spiral spring between them. In the centre of the cross shaft, and seen in Figs. 429 and 430, is a plate that covers a train of wheels, that are operated by a folding handle in front. By this arrangement, the cloth beam is elevated to come in contact with the take-up roller, and automatically forced downward by the increasing diameter of the cloth on the beam. The handwheel is also made use of to lower the cloth beam until its gudgeons are opposite openings in the rack guides. The loaded beam can then be removed, and an empty one take its place.

Safety Measures.—In Fig. 431 the motor wheel and crank wheel are well covered with sheet metal. The loom driving wheels are also protected by a cast iron casting. The temples on the loom were of the two roller type with risen projections. The rollers were 4½ inches long. The temple casting was mounted on a flat bar fixed to curved flat springs bolted to the cross rail of the loom. Both temples were bolted to the same bar. In case the shuttle is ever trapped between reed and temple, the temple and springs give way and prevent damage.

NEW DEVELOPMENTS.

The "Mordale" Bobbin Stripper.

This invention is to assist in meeting the shortage of juvenile labour in the weaving sheds, to reduce the quantity of bobbins, and to promote production. It is the patent of Messrs. E. Gordon Whiteley, Beech Works, Worrall Street, Morley, Leeds. When bobbins are discharged on an automatic loom, a certain amount of waste is left on, and this has to be got rid of before the bobbin is again filled with weft.

As an example of usefulness, a 7 inch bobbin holding 34 skein weft, weaves four inches of cloth, 72 inches wide, the picks per inch being 40. Each full bobbin holds 160 picks of weft, and as the speed of the loom is 130 picks per minute the weft is woven off in $1\frac{1}{4}$ minutes. If loom efficience is 95 per cent. then for an 8 hours day:—

$$\frac{4 \times 60 \times 8 \times 95}{5 \qquad\qquad 100} = 365 \text{ bobbins per day.}$$

This is doing useful service at little cost. The diagrams illustrate the process. When a bobbin is discharged from the shuttle, it falls base first into the hopper at the top in Fig. 432. The hopper fits underneath the shuttle box when the going part is at its front centre, and is therefore quite free from the motion of the picking stick.

The interior of the hopper is lined with cloth to do no injury to bobbin, but to act as drag on weft. The hopper narrows rapidly to its base to guide the bobbin, and is brought in contact with the dabber roller C. After a short pause, the roller C is lifted to the position outlined, and the bobbin then slides down the chute. On roller C descending, the weft is pressed against the bottom nip roller A and is conveyed between nip rollers A and B. From its position at the bottom of the chute, the weft is unwound until exhausted, and then falls into its receiving box. The pulled off weft falls behind and below the nip rollers, and the bobbins are discharged at the front. All three rollers have smooth surfaces, and are 4 inches wide.

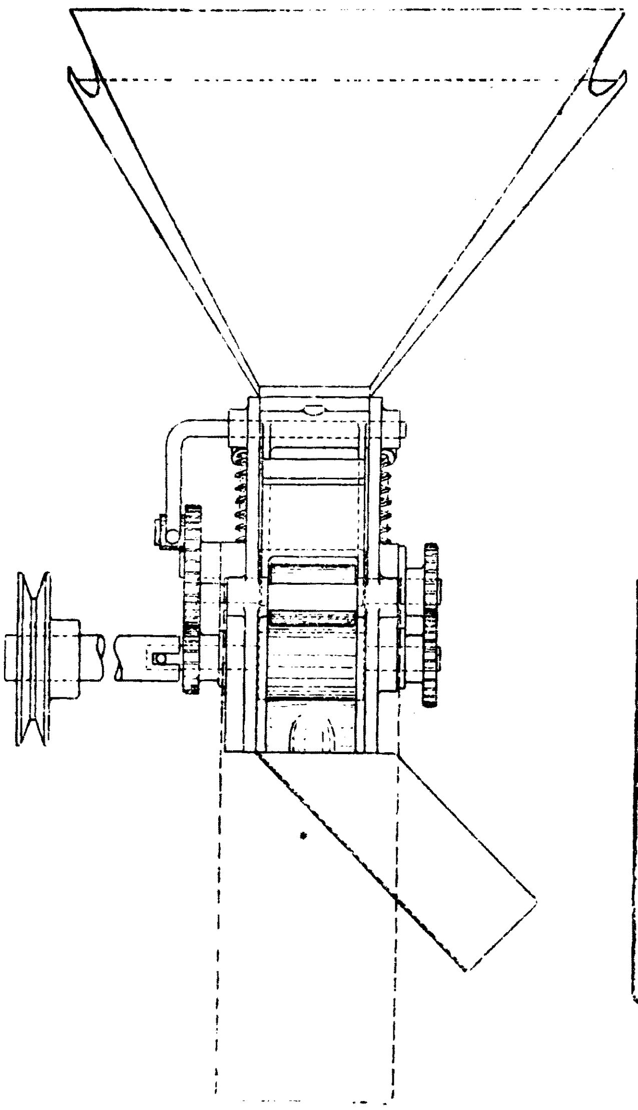


Fig. 432a. Mordale Bobbin Stripper (Front View).

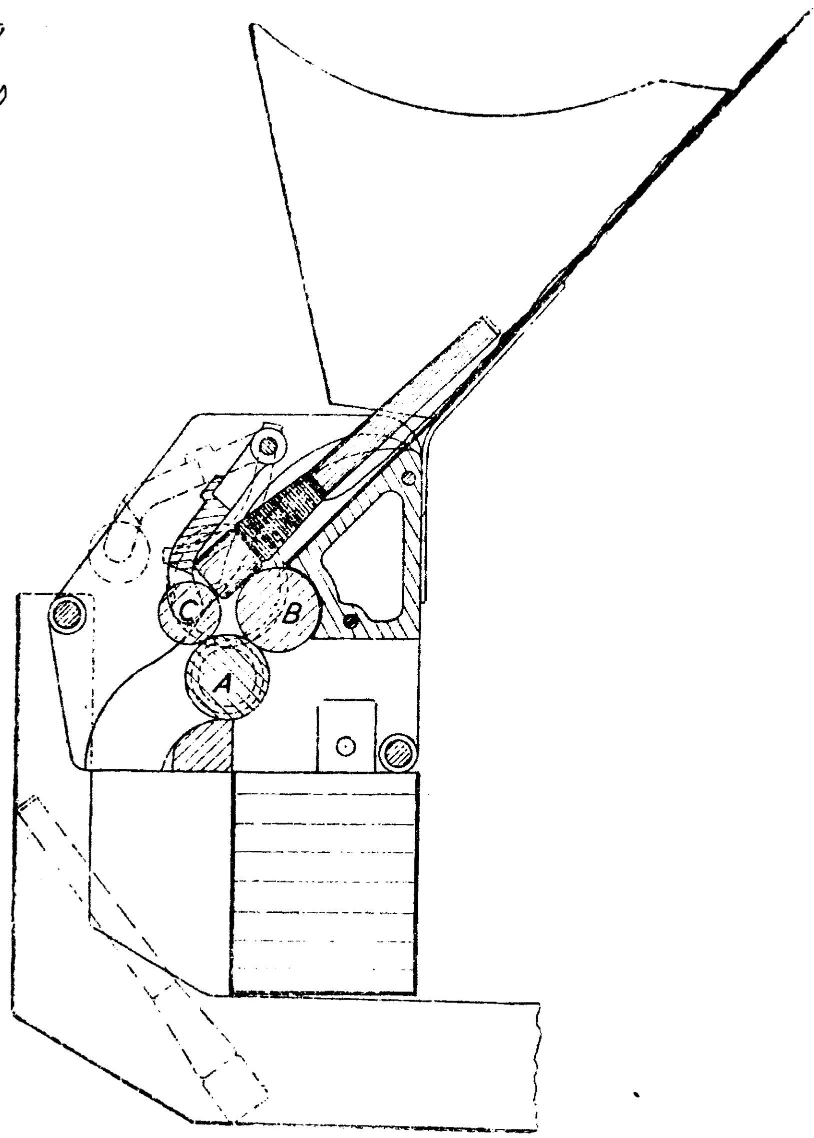


Fig. 432. Mordale Bobbin Stripper (Side View).

Reference may now be made to Fig. 432a. On the left is the grooved driving wheel that is coupled to another driving wheel on the low shaft by means of a link V-rope. The shaft that passes through the grooved pulley holds the bottom nip roller A, and on the left of the roller is the small wheel having 12 cogs that mesh with the larger wheel above having 24 cogs. On the outer side of the larger wheel is lifter that comes in contact with a bowl at the bottom of the cranked shaft shown on the left. The upper straight part passes through the upper part of the machine, and on it are the two arms that hold the dabbing roller C. It is by these means that the dabbing roller is raised every other pick, and the weft bobbin released. On the right are seen the two equal wheels attached to the nip rollers. It will be noticed there is an open spiral spring on the outer sides of the roller box. These springs apply pressure to the shaft of the nip roller B, and in case the weft should coil round either nip roller, the upper nip roller would be lifted. This will seldom occur owing to the smoothness of the rollers, but if so, the lapping is then cut off.

Dracup's Improved Reversing Motion For Jacquards.

In past years, much trouble and expense have been caused by new weavers, and the forgetfulness of experienced ones, trying to reverse the card cylinder when too near the needles. This has caused damage to the cards, cylinder, and points of the needles. A cylinder cannot be safely reversed unless the crank is at or very near its back centre, for then the card cylinder is well away from the needles.

To make the reversing mechanism "foolproof," Messrs. Dracup have invented the new mechanism seen at Fig. 433. Before explaining the patent, it may be as well to mention that the jacquard is run by a roller link chain at B, on the strong toothed wheel A, a similar driving wheel being on the crank shaft. At C is the connecting shaft to the slotted gear wheel that carries the connecting rod to the lever on the griffe shaft. The slotted wheel by means of an intermediate, actuates the ordinary wheel F and the sprocket wheel G that is secured to it.

By a short roller link chain, the sprocket G turns the one at the end of the shaft on which are the eccentrics that move the five sided card cylinder I.

The Reversing Mechanism.

This is seen on the left. At J is the small but broad wheel at the end of shaft H, and has 26 teeth. It meshes with pin wheel K with 52 teeth, and on its inner side, K has two pins at equal distances apart, and two segment ribs.

The pins slide alternately into the slots in the star wheel, and turn it one section, and the ribs keep the star wheel M steady after turning. Fig. 433a.

The star wheel has five sections and is loose on the shaft of the card cylinder. It carries a stud, and on this is a blunt pointed V-shaped holder that drops between pins on a pin cylinder, the latter being secured to the shaft of the card cylinder. It keeps both cylinder and star wheel firm after turning. Above the star wheel is a two armed lever. The sloping up arm N has a wire attached, with a handle at the bottom for the weaver's use.

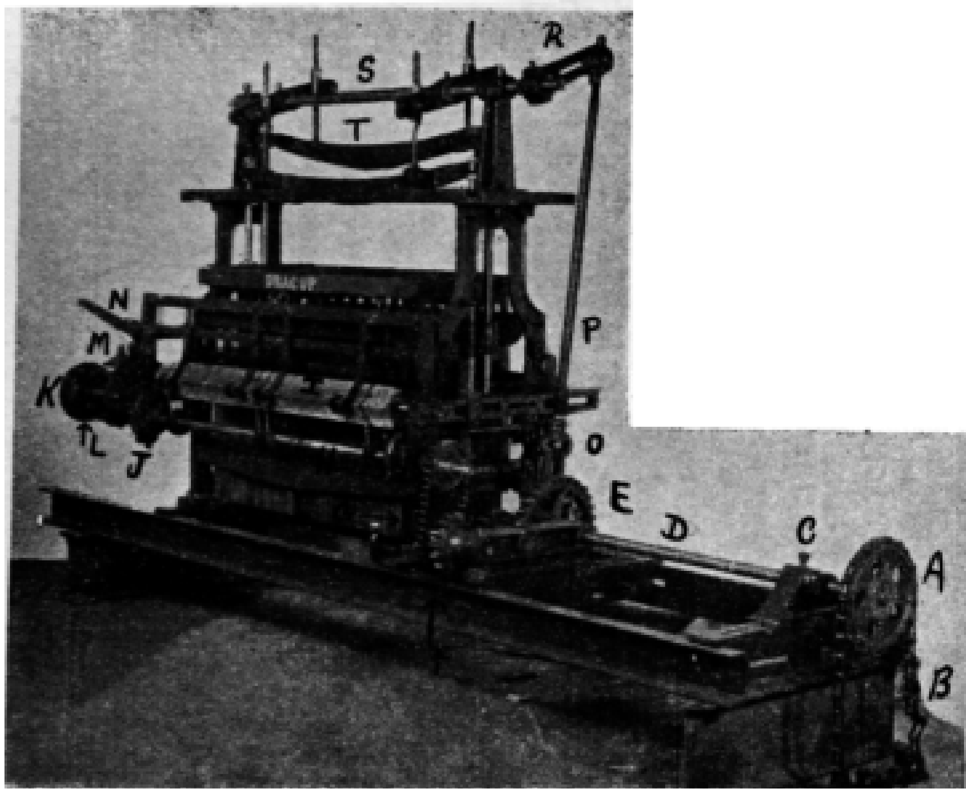


Fig. 433.
Dracup's Improved
Reversing Motion
(From Driving End).

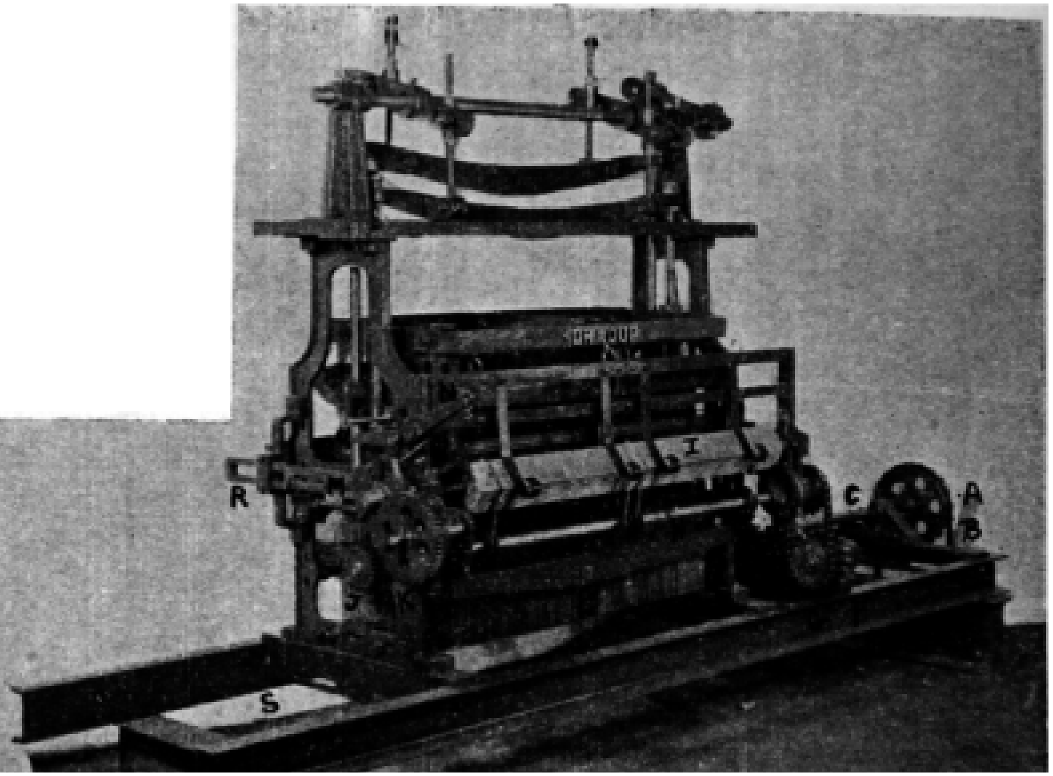


Fig. 433a.
Dracup's Improved
Reversing Motion
(From Reversing End).

At the back of the horizontal arm O is a hooked catch, the hooked end resting on the pin cylinder.

When the weaver pulls the handle mentioned, the hooked catch turns the pin and card cylinder one section backwards, and in this way the weaver can take out the number of picks required.

This cannot take place, however, unless the card cylinder is well away from the needle points, for the stop bar P which is on a fixed part of the jacquard framework prevents the lever from rising, and the hooked catch cannot turn the pin and card cylinder. In this way, much damage is averted, and less time wasted. Occasionally, the overlooker has to set the cards for the weaver, and has also to arrange new sets. This does not require the turning over of the loom, for a split pin through the shaft that carries the pin wheel is taken out, and the pin wheel is pulled out of contact with the star wheel. The card cylinder is then at liberty to be turned in either direction. The small wheel that meshes with the pin wheel is made broad so the pin wheel need not lose contact with it, and the correct timing is thus preserved.

Two other matters may be mentioned. The chief shafts of the jacquard are served with screw cap grease cups. These are filled with grease, and the cap screwed on a little. As the grease becomes worn off at the bottom, the cap is turned down, to make the grease contact with the shaft. This not only saves repeated oiling, but prevents warp and cloth being soiled by oil, for oil is difficult to get rid of in most cloths, but most of all in rayon pieces.

The other idea is, that the jacquard is mounted on a gantry, which can be elevated or lowered to bring the warp into the best position with the shuttle race. This is a much more ready way than having to adjust shedding rods and top levers.

FAULTS AND REMEDIES IN LINEN WEAVING.

In certain aspects, cotton and flax are somewhat similar.

(1) Both are of vegetable origin.

(2) They require a humid atmosphere to weave them.

(3) Warps have to be sized, and some of the ingredients are the same for both.

(4) The preparations for both are carded or combed.

(5) Several beams go to form a weaver's beam.

(6) Many faults in cotton yarns are also in flax.

There is a marked difference between the fluffy bolls of cotton with an average staple length of two inches, and the long and sturdy stalks of flax.

For strength, it is flax; for fineness it is cotton. For healthy humidity in weaving shed, there has to be a difference of four points in the wet and dry bulbs, and the dry has to be higher than the wet. The air cool and moist in summer, and warm and moist in winter.

Strength of Line and Tow Yarns.—Flax divided into two classes, line and tow. Line is fine and longer; tow, coarser and shorter. Line fibres up to 18 inches; tow, 9 inches and shorter. Line will spin to 200's lea; tow to 80's lea. Hackled flax is line; carded flax is tow, but both from same stalks.

Line yarns. 10's lea has breaking strength from 56 to 76 oz.; a 50's lea from 15 to 22 oz.; a 100's lea from 9 to 13 oz.

Tow yarns. 10's lea, 46 to 56 oz.; 30's lea from 20 to 27 oz.; 50's lea from 16 to 19 oz.

Preparations for Weaving.—When in hank form, transferred to bobbins, and these placed in creel, passed through reed, and wound on beam. When yarn not to be dressed, warp passed through starch bath, and after drying, is brushed clean. To make warp stronger, basis of size selected from sago, farina, flour, or maize starch. To one of these is added chloride of zinc, and chloride of magnesium, with addition of tallow.

Faults in Flax Prior to Weaving.—These give a good idea of what overlookers have to contend with.

Beaded Yarn.—(1) When fibres not thoroughly hackled, they curl instead of being straight, and are a hindrance in weaving.

(2) On wet spinning, hot water troughs become dirty by scouring the threads. Extracted gum and loose fibres picked up by threads. To avoid this, troughs systematically cleaned.

(3) Lumps formed when water too hot or too cold. When too hot, too much pectin extracted, and yarn weakened. Threads inadequately prepared if passed through bath.

(4) Worn rollers in spinning fail to hold yarn evenly, and parts pass through without adequate drafting. Lumps are thus formed, and are a weakness, and when tension applied, many break.

Warp breakages in linen more frequent than cotton. One of the things done for improvement is to retain the best trough water, filter it, and dip a clean cloth in it. Surplus water squeezed off gently, and cloth spread on back shed. Water containing pectin bind fibres, and weaving improved.

Dirty Yarns.—Dirty troughs make dirty yarns. Hackling pins soiled by dew-retted flax. Oil smears come from spinning machinery that must be oiled, but surplus wiped off. Ordinary oils turn flax black. During weaving, smearing has to be avoided.

Harsh Yarns.—If starch not properly boiled, particles adhere to threads and have a cutting action. Harshness felt by fingers combing warp. These lumps softened by a wet cloth dipped in clean water and applied to back shed. Wax rollers may be placed where yarn leaves beam.

Neps.—Short fibres in ball form made during carding. Held more firmly by twist. If only slightly held, weaving puts many on floor.

Slubs.—More in tow yarns than line yarns. Thick places that have defied carding and twisting. In quality fabrics, these blemishes removed on back shed during weaving. When in warp and weft, sometimes looked upon as a novelty in lower quality. In the weft many can be caught by tight brushes.

Stiff Yarns.—Poker-like threads made when sizing mixture is too thick, and lubricating part too small. A damp cloth prevents many threads breaking. A good aid is to lash a pair of lease rods on back shed, one above and the other below warp.

Variation of Twist.—Twist in all yarns vary, and increase as diameter decreases. Most twist when thread thinnest, and least where thickest. The two extremes of twist are both against good weaving. A variation from 2 to 3 per cent. not likely to spoil, but danger above it. A soft twisted warp woven better with late timed shed.

Weaving Problems.

Ballooning Weft.—Linen weft has to be confined to the shuttle. Flies out when slowing down in box, and easily smeared with spindle oil. Instead of more brush, another check pin retards it. An additional way is to loop soft cord on check pin, and peg down beyond spindle block, the cord to be towards back of shuttle. Underpick is better for not smearing.

Burst-Weft.—In fine damasks, weft broken or damaged when beaten up. Such places only small but cloth spoilers. An old reed ought not to be used, for edges too sharp for fine linen. Reeds better with a little more bevel. More pectin left in weft to make it more pliable. Less danger when shed timed late when possible.

Looped Selvedges.—Though selvedge cut off when cloth is for personal adornment, if badly woven, it gives impression of poor quality. Loops formed if held when it should be free. More brake in shuttle, or longer length of check, or pick weakened a little. By shedding a little sooner, curls are kept down. If selvedges woven from cheese, it must be adequately braked.

Looped Cloth.—This much worse than loops in selvedge and must be stopped. If shed can be timed early, weft trapped sooner and cannot spring back. If repaired healds or harness leave heald eye higher, when lifted, the drag is against previous pick.

Hard or thick places in weft do not readily bend to the weave, and are forced by the beat up into ugly loops. When such places numerous, the weft is wetted or steamed to make it more pliable.

Poor Cover.—Linen does not lend itself to cover like woollen, for what loose fibres there be, are somewhat parallel with thread. What cover can be obtained is by elevating back rest above pitch of breast beam. Warp tightened on bottom shed and slackened on top. Weft then forced more to surface, and being softer than warp, cloth fuller and cover more pronounced.

THE LURE OF COTTON AND RAYON MIXTURE YARNS.

One of the most effective methods of making ladies' dress fabrics more distinctive, is by the introduction of coloured or novelty yarns.

The more tender yarns are safer used as weft rather than warp, as there is much less danger of any part of them being injured.

When the extra yarns are of solid colour, they are used sparingly, but it is the more common practice to have the coloured yarn twisted with another, as the colour display is then halved after twisting, and about quartered when woven.

Producers of fancy yarns are constantly experimenting to achieve new combinations or novelties, but are influenced by what has become fashionable for the time being.

However well a novelty yarn may look when made, it must be weavable and durable, for if not well constructed, the weakest parts may be ruptured, and spoil the cloth.

Moreover, if the yarn be a knop, slub, boucle, or snarl, it is difficult to make good after been woven. When fancy yarns are smaller or thicker than the ground threads they have to be woven from a separate roller, so the rate of speed in relation to the warp beam can be regulated. If the fancy yarn is too slack, it will hang down in the front shed, and curl in the cloth, but if too tight, they may crack during finishing. Tightness is detected by passing the hand edgewise along the cloth between the breast beam and the cloth fell. When ridges are felt, the tension on the roller has to be decreased.

The chief ideas associated with extra roller work are explained, and commence on Page 366.

When the knops or slubs are large, the eyes of the healds have to be large enough for them to pass through, and usually such healds are better on a separate shaft. Such yarns must also have reeds extracted, or specially made, or they cannot be woven. The missing wires coincide with the warping plan. The necessity for more space is obvious if reference is made to the snarl yarn at No. 8 in Fig. 435.

The set of fourteen yarns, are some of the latest examples from Messrs. William Hutchinson (Yarns) Ltd., Holybrook Mills, Greengates, Bradford.

No. 1 in Fig. 434, is a woollen twist yarn with long cotton knops. It may be used for either yarn dyed or wool dyed goods. The knops are 2/5 inch in length, are four inches apart, and the final twist is nine turns per inch. It is a combination of three threads, with nut brown and white woollen twisted together. The green outer thread is twofold cotton. The knop does not bulge much, so that ordinary healds will suffice. The counts are fours worsted.

No. 2 is a " Fibro " slub yarn with viscose snarls, and is used in fabrics that are to be piece dyed. As it is not over strong, it is used for weft only, and for dress goods. In the structure, there are seven snarls in 3 inches. The white " Fibro " is twofold, and the fine denier viscose yarn makes the snarls. The counts are 6¾ cotton counts.

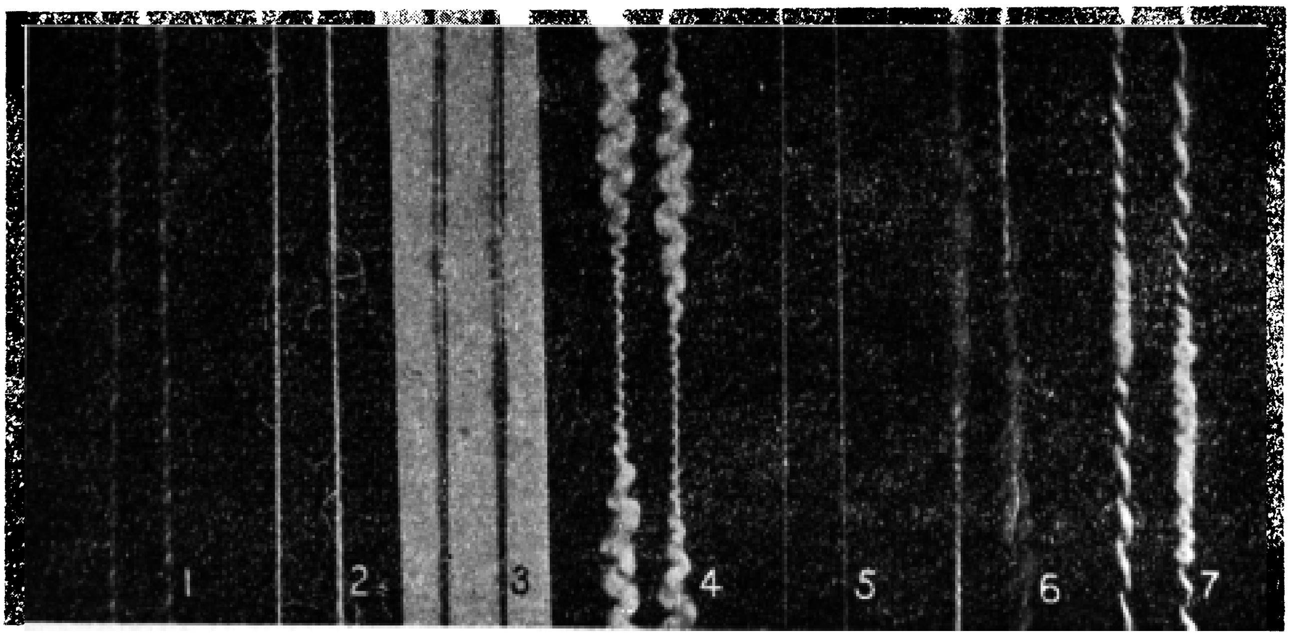


Fig. 434.
Rayon and Cotton Mixture Yarns.

No. 3 is 8's cotton counts. The black cotton carries the white viscose spots, which are consequently well displayed. This yarn is specially made for warp stripe effects for dress goods. The spot is a ¼ inch long, and three inches apart.

No. 4 is a " Fibro " flaked spiral yarn, and used in high class piece-dyed casement fabrics. The flakes taper at either end, and are one inch long, and ¾ inch apart.

In all, there are five threads. Two are twofold cotton, and the other is a single cotton, on which the "Fibro" is placed. It is then held in position by the other two twofold threads. All the threads are white.

No. 5 is an acetate and viscose cloud yarn. It is normally produced undyed, and the two colour effect is obtained by the different dyeing properties of the components. In the combined threads, a section shows all red for $\frac{5}{8}$ inch, owing to the closeness of the wrapping, and similar length of red and white in variable twist. The counts are $8\frac{1}{2}$ cotton.

No. 6 is a worsted and cotton spiral slub yarn. The cotton slubs are fast to cross dyeing with woollen dyes. The slubs are 2 inches long, and taper at each end, and the colours are scarlet and light blue. The distance between the slubs is $5\frac{3}{4}$ inches. The two yarns forming the main structure are twofold worsted and the resultant counts are $3\frac{1}{2}$'s worsted.

No. 7 is 2's cotton counts. It is a cotton spiral yarn with long knops, and yarn dyed before twisting. It is intended as weft for casement fabrics. The knops are 1 inch long, and $2\frac{1}{2}$ inches apart. The red brown twist is twofold cotton, and the other a single twist cotton.

No. 8, Fig. 435, is a cotton group snarl yarn, the snarl being of large size for effects purposes in dress goods. Large heald eyes and missing wires in the reed are required to weave it.

The group snarls are 1 3/10 inches long and 9 inches apart. There are two threads of twofold cotton twisted round a core of two threads of twofold cotton.

When the snarls are pulled out, they are 14 inches long, and made with two threads of twofold cotton. If the combined threads should break the weaver has then to arrange the snarl at about the same place it would have occupied before the breakage. The counts are 1's cotton.

No. 9 has two colours of elongated knops of mercerised cotton, the colours being blue and red. Each knop is $\frac{1}{2}$ inch long, and spaced every three inches. They are made more distinct by being placed on a light background in the illustration. The counts are 10's cotton.

No. 10 is a dull viscose multiple knop yarn. The component yarns are all dyed before doubling, and can be supplied in any colour combination. The colours used are yellow, light blue, scarlet, black and white. A repeat occurs every two inches. There are two threads twisted round each other, one been made with three threads, one being white, another black, and the other light blue. The other is also a combination of three threads, one white, another yellow and the final red, the whole series are rayon, and the counts are 2's cotton.

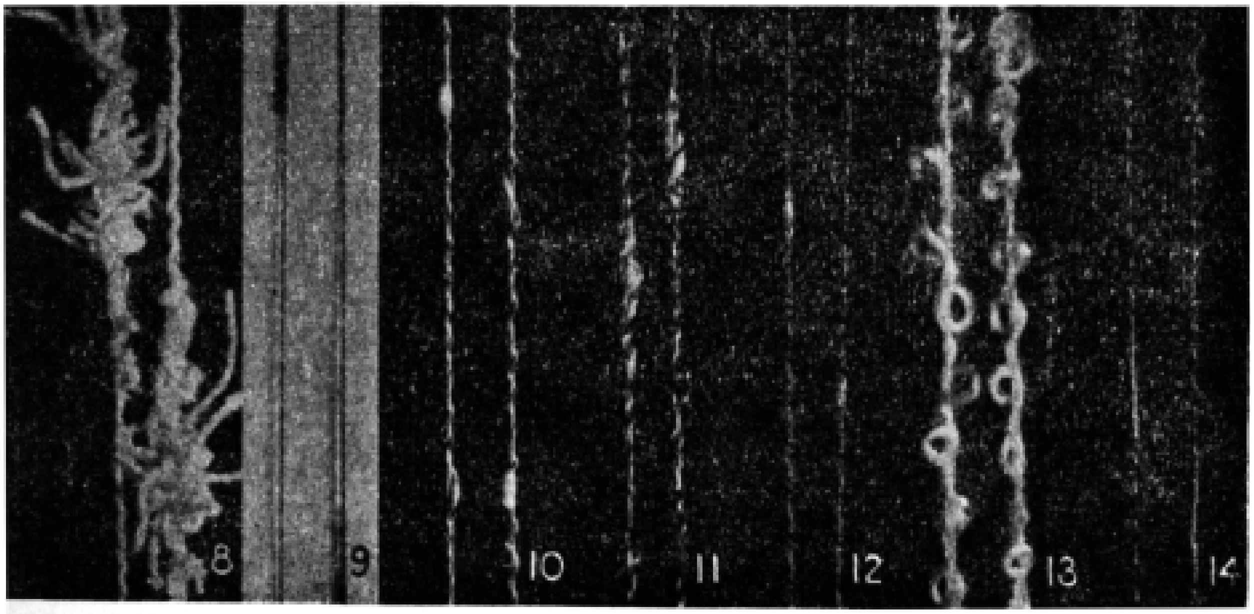


Fig. 435.
Attractive Novelty Yarn.

No. 11 is for machine knitting. It is a viscose knop yarn, the knops alternating red and white, and the distance between each is 1 inch. In all, there are four threads. Two white and a red one form the core, and the knops, and another white one is the binder. All are viscose, and the counts are $2\frac{1}{2}$'s cotton.

No. 12 is a " Fibro " and mohair loop yarn. The looping thread is a mixture of mohair and bright " Fibro " so as to produce a two colour effect after dyeing. This yarn is chiefly used for hand knitting purposes. There are six loops per inch. The binding yarn is twofold worsted, and has 20 turns per inch. The mohair and " Fibro " are very strong, and reliance is placed on the worsted to keep the loops intact. The counts are $1\frac{3}{4}$'s worsted.

No. 13 is a wool spun yarn with a black cotton core and white rayon spots. The cotton is dyed fast to wool cross dyeing before twisting, and the twisted yarn is wool dyed. It is constructed for machine knitting. The distance between the white spots is 3 inches. The black and white twist yarns have 20 turns per inch, and the blue woollen outer thread has 6 turns per inch. The black is twofold cotton, and the white is viscose rayon.

No. 14 is a wool boucle yarn with viscose rayon slubs. The viscose is dyed fast to cross dyeing with wool, and the twisted yarn is wool dyed in hank form for hand knitting. The bright blue knops are a ½ inch and then 7 inches apart. The red is twisted round the blue with 8 turns per inch. Two threads of red form the core, and around the twofold a single yarn is wrapped. The blue viscose yarn is the outer binding thread, and is also used for knop making.

RAYON AND "FIBRO" DEVELOPMENTS.

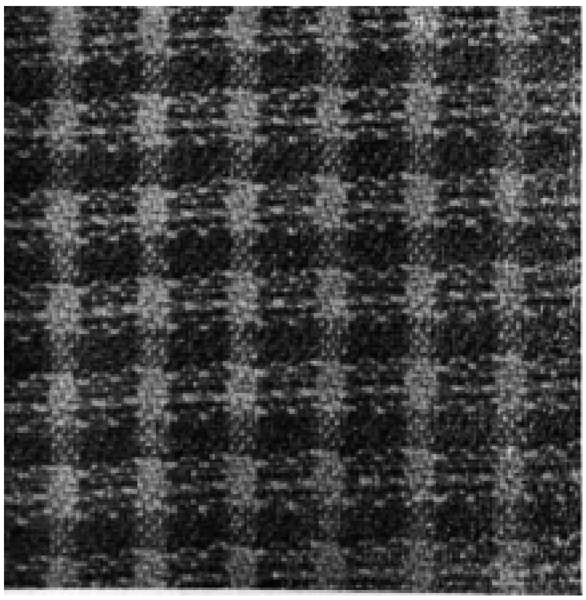
Rayon industry has developed far beyond inventors' intentions. After countless experiments, two chief kinds are viscose and acetate, the former from wood pulp, and the latter wood pulp mixed with cotton linters. Both kinds used separately, for some time, because some dyes did not act alike on both. Within limits, this effect made use of in producing two colour effects in same cloth, and became commercial success.

Formerly, it was considered a spoilation of yarns and cloth if its lustre interfered with. This modified by crêpe twisting, delustring, and making " Fibro."

Mixing " Fibro " with other textile commodities became more popular, when " Fibro " cut to average length of other fibres.

Some of these aspects illustrated in the few patterns displayed by courtesy of Messrs. Courtaulds Ltd.

Fig. 436, is a small, neat, and clean looking fabric in pink and white and piece dyed. Handle rough but durable.



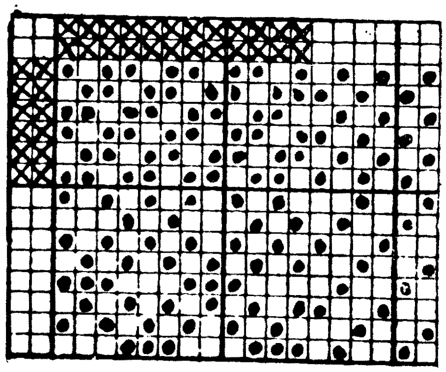


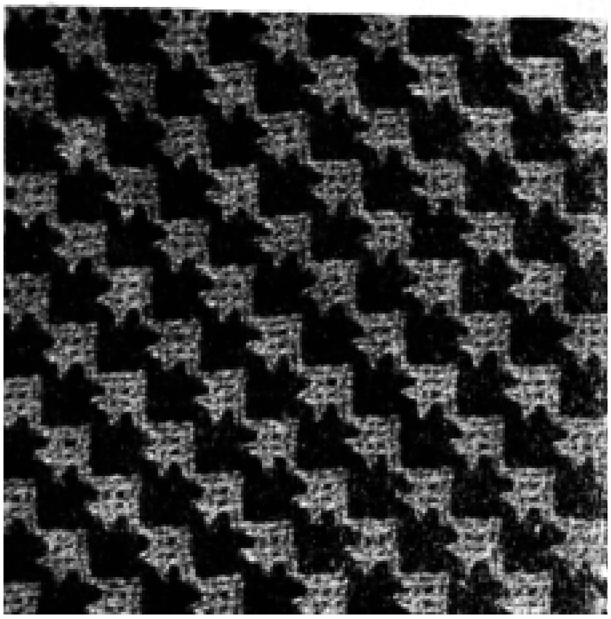
Fig. 436. Fig. 437.

Worsted and " Fibro " Mixture Cloth.

Warp 12 pink, 6 white, 58 threads per inch. Weft 6 pink and white, 44 picks per inch.

Pink yarn 2/40's worsted and made from 80 per cent. wool and 20 per cent. " Fibro " scribbled together. White yarn 2/24's cotton counts and all " Fibro." A repeat of weave and warp and weft plans are given. Design 437.

Fig. 438 is a hopsack effect in brown and white, and cloth has soft handle.



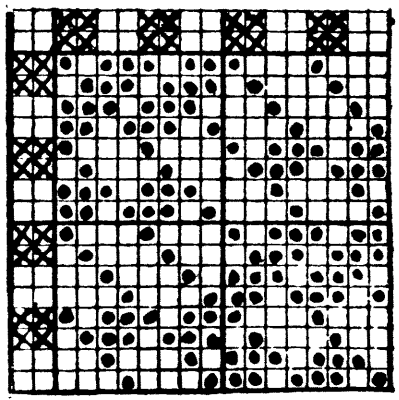


Fig. 438. Fig. 439.

Worsted and Viscose " Fibro " Fabric.

Warped and wefted 2 nut brown, 2 white, with 44 threads and 46 picks per inch. Brown warp and weft 2/36 worsted, and white " Fibro " 2/24's cotton counts, made from viscose staple fibre. Weave given, and cloth and piece dyed. Design 439.

Fig. 440 made from 596 denier viscose ratin yarn and 540 denier seraceta yarn, warp and weft being alike.

Warped 4 white 4 black to 40: 12 white 12 black = 64.

Wefting 16 white, 16 black, 8 white, 8 black = 48. Threads 42 and picks 36 per inch. Warp and weft three-fold. Inner two-fold slackly twisted, for an 8 inch thread of one gives a 13 inch length of the other. A binder thread holds slack twist in position, and gives it a boucle effect. The weave presented, Fig. 441.

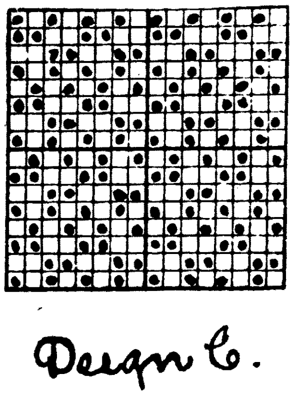


Fig. 440. Fig. 441.
Made with Viscose Ratin Yarns.

Fig. 442 is a much more elaborate cloth than appearance suggests.

Warp. 58 brown, 58 cream with 116 threads per inch.

Weft. 28 brown, 36 cream with 70 picks per inch. Brown warp 100 denier viscose, and cream warp 100 denier seraceta, and cream weft same.

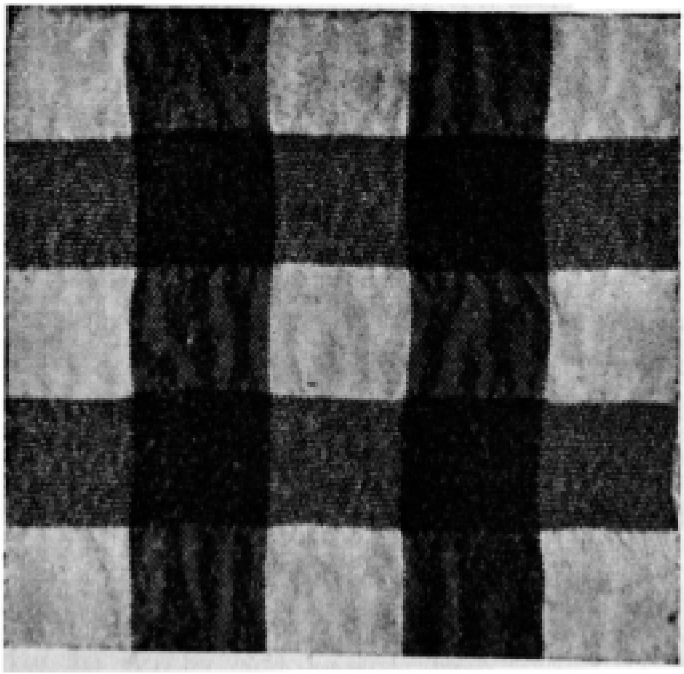


Fig. 442.
Crinkled by Crêpe Yarns.

Brown weft crêpe twisted with 55 to 60 turns per inch. Four picks right twist, 4 picks left twist. Yarns equal to 1/20's cotton counts. Actual proportions in fabric are 37.2 per cent. acetate, 23.5 per cent. viscose, 39.3 viscose staple fibre. Because of crêpe twist and different shrinking qualities the fabric is crinkled. Plain weave and piece dyed.

Fig. 443 is 100 per cent. viscose fabric, and has an elaborate warping and wefting plan.

Warped.

White	65	—	—	—	—	—	144
Saxe blue	12	—	—	—	—	12	
Bright yellow	4	—	—	—	4	—	
Light red	8	8	8	8	—	—	
Peacock green	4	4	4	—	—	—	

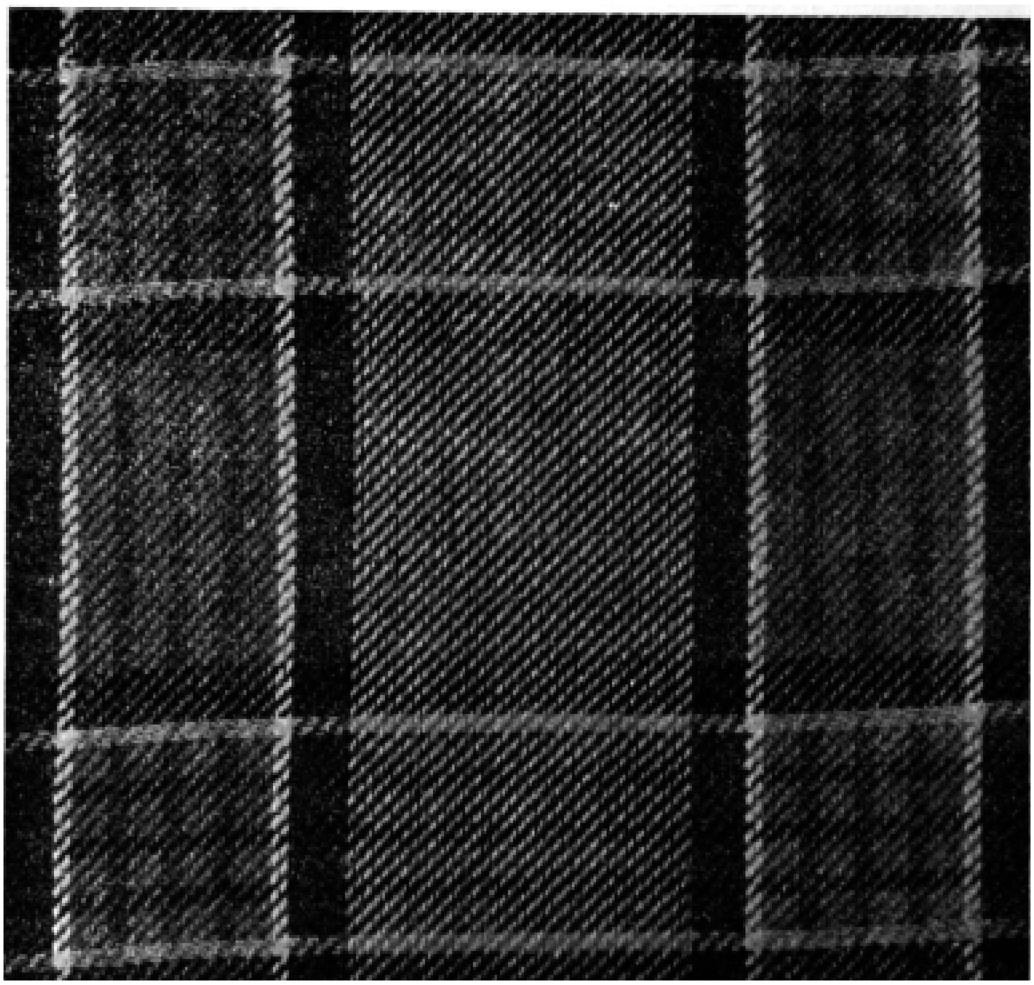


Fig. 443. Viscose Cloth.

In the weft, rose pink takes the place of white in warp, and the wefting is then the same. Threads 54, picks 52 per inch. Yarn dyed. Handle of cloth soft and smooth.

Fig. 444 is built with 100 denier viscose, and 100 seraceta in warp and weft. The proportions are 71.13 per cent. acetate and 28.87 per cent. viscose.

Fig. 444. Viscose and Acetate Texture.

The warp and weft plans are too elaborate to give, for the repeat of the warp is on 334 threads, and the colours are white, black, salmon. There are 130 threads per inch, and 70 picks, the weft having same colours as warp. The yarns were yarn dyed, and very lustrous. The repeat of the weft is on 176 picks.

LANCASHIRE SILK AND RAYON LOOMS.

Butterworth and Dickinson's Drop Box For Silk.

This loom is well represented in the illustration at Fig. **445**. It has a **24** shaft negative dobby, the feelers being served by two lag barrels and a pattern chain in the same way as the terry loom already explained. The picking is

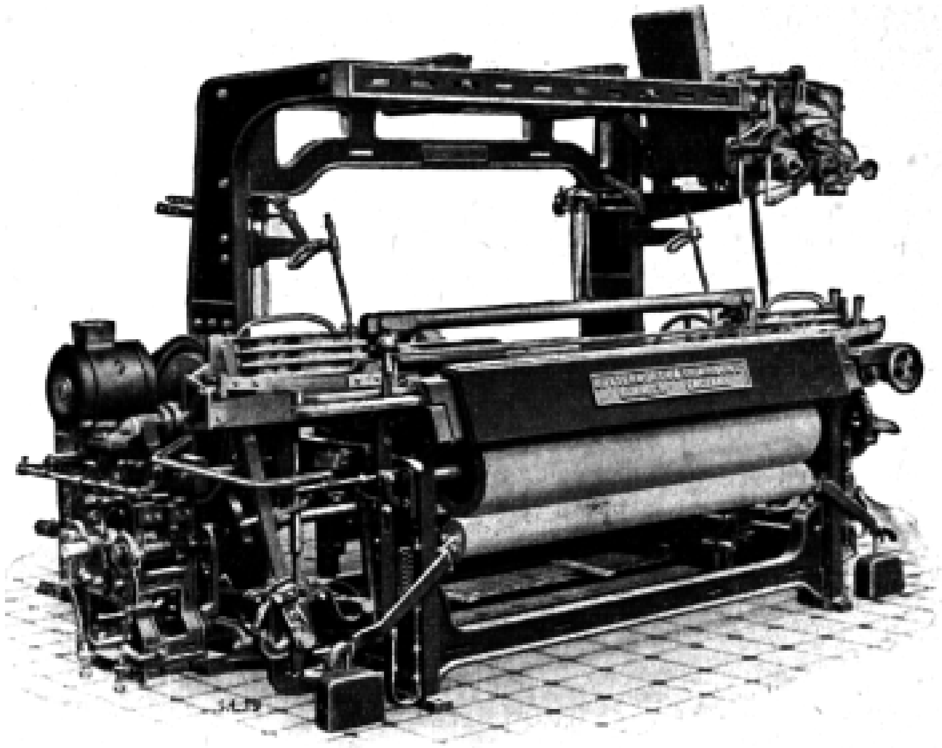


Fig. 445.
Butterworth & Dickinson's Pick and Pick Silk Loom.

the underpick, but has the addition of a safety device. Towards the base, and behind each stick is a catch, these catches being controlled from the swells of the boxes that are level with the shuttle race. If a peg should be broken or missing, or the weaver misplace the lags, it would be possible for two boxes to be level with the shuttle race, each box having a shuttle in it. Under these circumstances, both catches would be raised, and both picking levers lifted at the same time, and when the loom turned over, it would be stopped by the weft fork.

The pickers are of buffalo, work horizontally, are slotted for the picking stick to pass through, and are regulated by a spindle and slide. On the box rod is an escape motion to prevent damage to box and shuttle if the latter is ever trapped between the shuttle board and box. The handle associated with it enables the weaver to bring any box level with the shuttle race. A feature of the box shelves is that the front edges slope back at an angle of 45 degrees, are well rounded off and polished, so as to do no injury to the shuttles. The box back slides are made of brass, and the bearings of the box swells are lined with metal to increase durability.

The boxes are raised and lowered by selection fingers moving segment wheels that mesh with star wheels. One finger and segment wheel controls the second box, and the other the third box, and when both are placed for lifting at the same time, the fourth box is brought into use. Connecting rods couple the star wheels to the lifting lever that holds the box rod. The selection fingers are influenced from the dobby so that healds and boxes work in unison.

The loom is fitted with two weft forks near the selvedges, so that broken picks are detected quicker.

The taking-up motion is indirect, and the cloth beam is pressed to the take-up roller by levers and weights. The take-up roller is covered with fine emery cloth, and is positively driven through worm gearing, and the picks per inch are influenced by the change wheel.

The reed case is constructed of metal, and can be arranged to take any kind of sley. The reed can be oscillated at the beat up to impart a rolling action to the weft instead of a blow. The framework for holding the sley is furnished with adjustable rods. These rods at their upper ends are connected to brackets fixed to the loom frame, and their lower ends to the reed case. As the sley moves forward, the bottom of it is held by the rods at an inclined angle. The amount of reed movement is determined by the working length of the rods. The loom may be driven in various ways, but the one illustrated is by electric motor with fibre pinion for silent running, and geared to a heavy balance wheel mounted on the crank shaft. A clutch plate studded with circular corks slides on keys on the crank shaft when moved by the setting on handle. This method is so efficient, that the loom is started at full speed when the crank is about at its front centre. There is a full pick and no mark left in the cloth.

Butterworth and Dickinson's Rayon Loom.

As will be seen from the illustration at Fig. 446, this loom has a "Globe" 16 shaft, 3 barrel dobby, but the loom

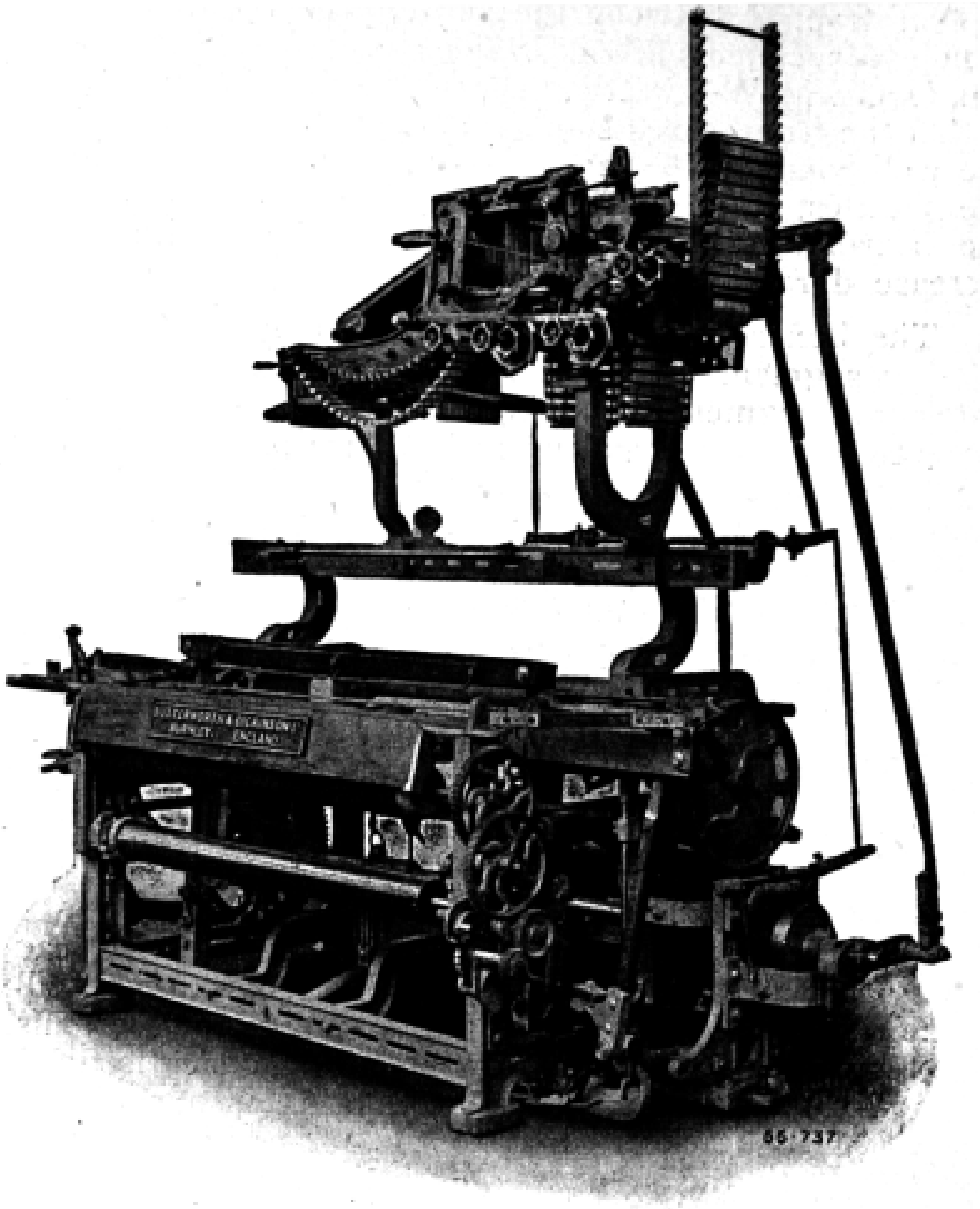


Fig. 446.
Butterworth & Dickinson's Two Box Rayon Loom.

frame is made so it can be fitted with plain roller shedding motion for inside tappets.

The picking is the underpick, all the parts being outside the loom frame, and easy of access. The wooden picking lever extends the full depth of the loom, and is fulcrumed at the back. On its upper surface is a raised bowl which is depressed by the nose of a cam on the low shaft. A canvas or leather strap is fixed to the heel of the picking stick, and encircles the front end of the picking lever. When the lever is depressed by the picking nose, the picking stick is thrown forward, and the shuttle is propelled across the loom. By raising or lowering the fulcrum of the picking shaft by its regulation screws, the amount of pick is adjusted.

Outside Under Pick Motion.—A side view of this is presented at Fig. 447. This kind of picking is employed in weaving jute, flax, cotton, velvet, plush and silk. It has one advantage over the overpick motion, for fabrics are in less danger of contamination by oil. It is also more resilient than the ordinary underpick, the picking shaft being wood instead of steel. At A is the low shaft, to which the picking lever, B is keyed. The picking lever is slotted, so the picking bowl C may be made to pick sooner or later if found necessary. On the same loom, however, the bowl is bolted to the bottom driving wheel, which greatly adds to the labour of the wheel.

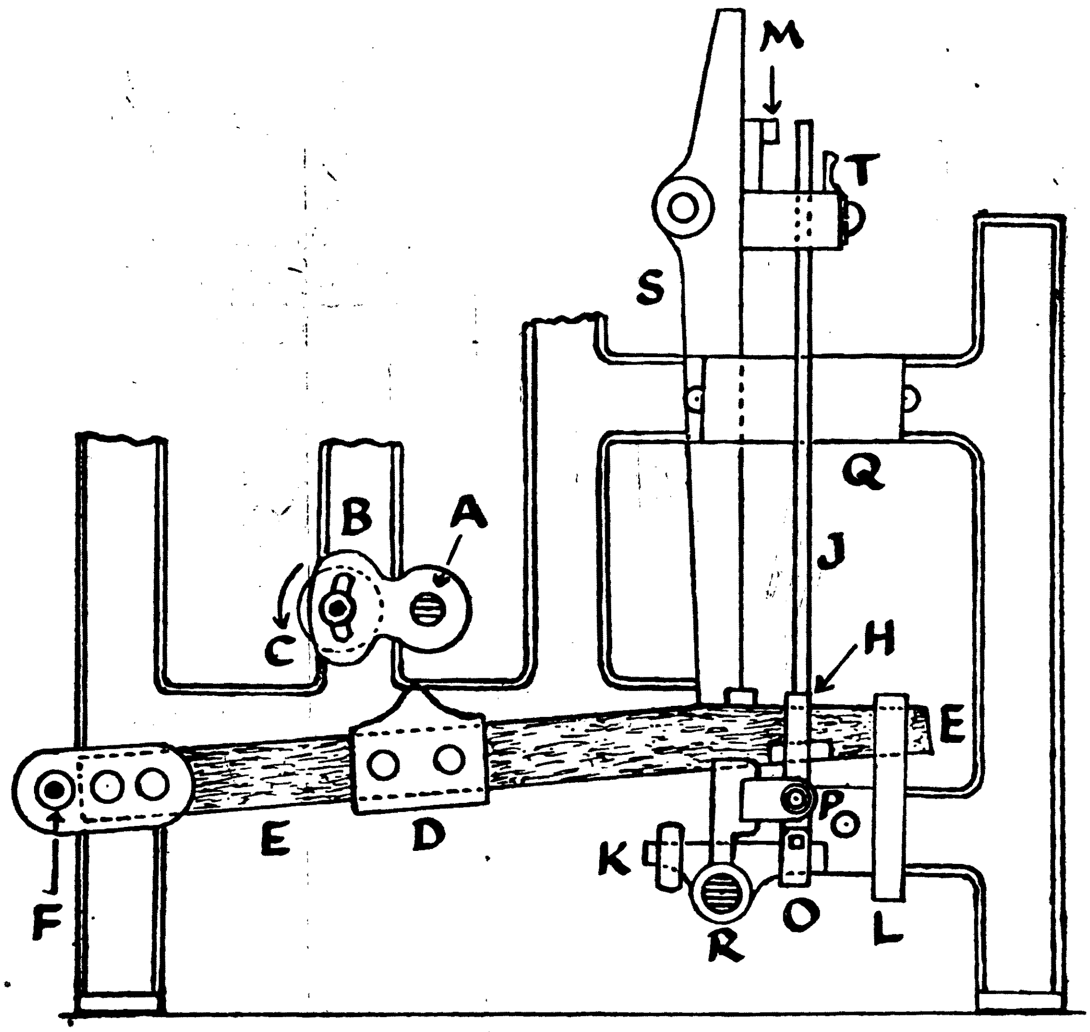


Fig. 447.
Outside Under Pick Motion (Side View).

At D is the picking neb or plate, which is strongly bolted to the wooden picking lever E. Some picking nebs are slotted in their bolt holes, but if so, they should be packed for increased security. The picking lever E is fulcrumed at F, the fulcrum being capable of alteration vertically. For the weaving of the majority of fabrics the fulcrum is fixed opposite the centre of the stroke of the lever. The front of the lever passes through the guide L.

At H is the metal sheath to which the upright picking stick is bolted. At K is the rocking rail. At O is the pulling back strap to bring the picking stick back after picking. At P is the buffer spring that holds the picking stick forward to check the incoming shuttle.

The part Q is a broad strap to check the forward movement of the picking stick. The picker and shuttle guide is at M on the top front of the box back, and T is the box front.

The front view of this arrangement is at Fig. 448. Here again, A is the low shaft, with B the picking lever, and C the bowl. The part D is the top of the picking neb on the wooden lever E.

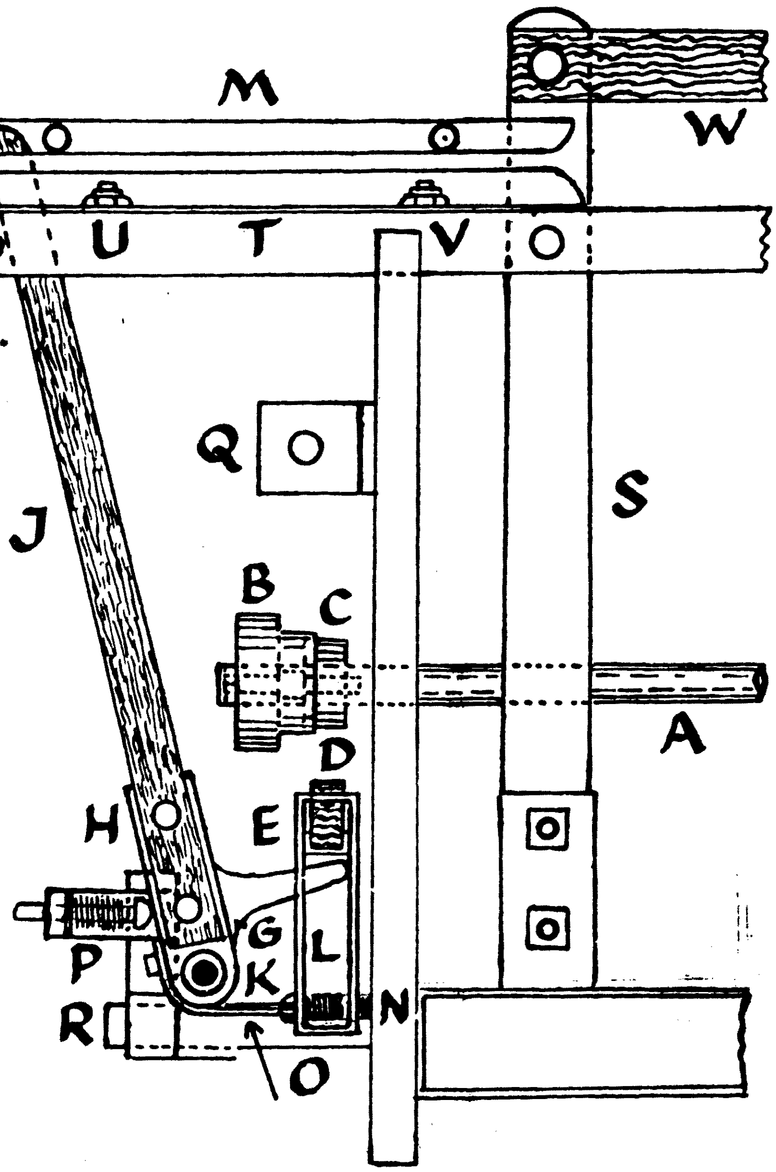


Fig. 448.
Outside Under Pick Motion (Front View).

It will now be better realised, that when the bowl comes in contact with the picking neb, the picking shaft is depressed, and forces down the arm G, and so brings the picking stick forward to throw the shuttle.

The metal sheath H, and stick J, are fulcrumed at K, and spring P holds the stick forward to check the shuttle. The spring N and strap O pull back the stick after picking.

The part Q is the end of the forward check strap. At M is the shuttle and picker guide, and T, the shuttle box front with its feet at U and V, with the handrail at W.

A variation of this kind of picking is to have the front of the picking lever through a looped leather attached to the picking shaft. This gives a " softer " pick, but much more subject to wearing and variation.

The take-up motion is the Pickles type with machine cut wheels. The beam wheel and small pinion may have helical cut teeth as shown, or the more usual type. The cloth is passed round the taking-up roller, which may be covered with either emery cloth, rubber, or steel strip. The fabric then passes over a smoothing bar and goes to the cloth beam, the latter being driven by a frictional arrangement from the taking-up roller. The cloth roller may be taken out, and a fresh one inserted without disturbing the fell of the cloth. The boxes are raised and lowered as detailed for the silk loom. There are, however, two swells to each box. The inner one is the longer of the two, and is held in position by a light flat spring, and lifts the stop rod in the ordinary way, but by means of a wooden bowl on the stop rod finger. When picking is about to take place, the swell pressure is removed. The checking of the shuttle is performed in two ways.

(1) On the outer part of the long swell is the shorter one which dovetails into the other. At the back of it a metal bowl presses against it for a good part of the top traverse of the crank, and is away from it for most of the bottom half.

The easing lever to which the metal bowl is attached extends beyond the inner end of the box, and here, its rounded end goes through a slotted casting, and is fitted with a small bowl that runs on a race behind the sword. This easing lever is fulcrumed on the same stud as the other part of the checking arrangement. A plate which is fixed to the outerside of the crank arm carries the regulation setscrew which curtails the movement of the easing lever, and imparts movement to it. The pressure is applied to the outer box swell when the shuttle enters the box, and withdrawn when the shuttle emerges from the box.

(2) The other part that checks the shuttle is seen on the right in the illustration. It has been named a " posi-

tioner," and is fulcrumed on a stout pin carried on the box fender behind the lay. A rubber fits on its upright shaft, and takes the shock of the shuttle. Above and below the rubber is an angle plate which pushes the shuttle outward when the box moves in changing its position, and thus keeps the tip of the shuttle free from the face of the picker. The positioner is connected by strap and buffalo strips to a stud on the breast beam, the stud being movable. The loom is served with a clutch drive, has a reed space of 47 inches, and an approximate speed of 160 p.p.m.

Messrs. White & Sons Ltd. Silk and Rayon Loom.

As set forth in the illustration at Fig. 449, it is a square dobby with 40 dobby jacks, but the back four are used to control the 4 × 4 drop boxes. It is also made 4 × 1 drop box.

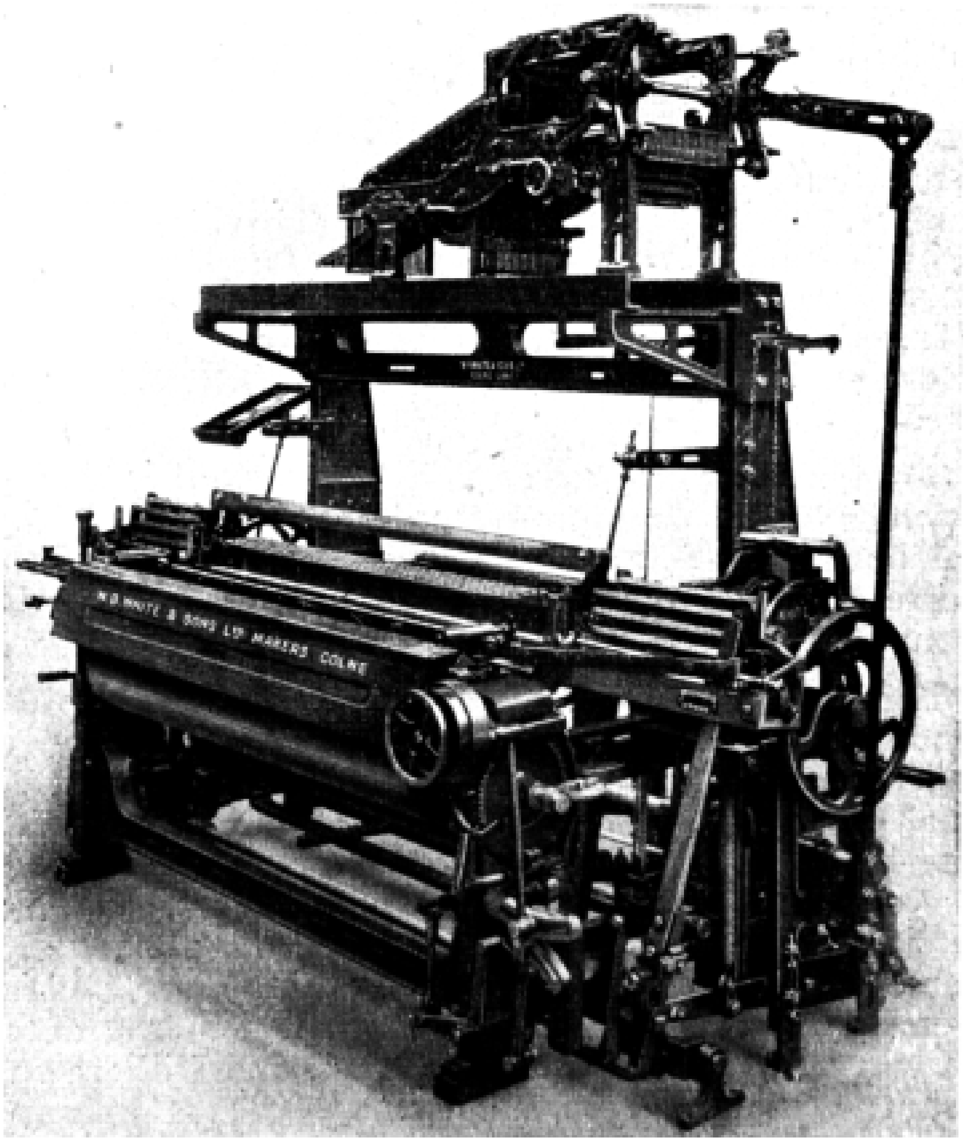


Fig. 449.
Messrs. White and Son's Ltd. Silk and Rayon Loom.

Construction of Dobby.—The dobby jacks are made so that flat rods can be hooked on, and attached to notched shaft jacks that pass through grates.

The balks in the dobby swing on circular projections on the dobby jacks, and the catches associated work on the ball and socket principle. As the dobby is a negative, the catches have only one cut on the under side.

When the draw bars are at their full back traverse, the cut points on the catches should have a clearance from the edge of the draw bar of $\frac{3}{16}$ inch.

The bottom catches are moved by fingered feelers, and the upper ones by needles.

The pegs in the lags, and the height of the cylinder has to deposit the catches fully on the draw bars. The lag cylinder has 8 grooves. It is turned every other pick by a pawl bolted to the lower arm of the main dobby lever. The push of the pawl has not to exceed turning the cylinder beyond bringing the operating lag to its dead top centre.

The draw bars are actuated by the shedding lever seen on the right on the low shaft. It is this lever that sets the timing of the shed. It is timed early to make smart pieces, and get the picks in easier. It is timed late to ease the weft drag on the warp, and prevent excess warp breakages with poorer yarn.

Equal sheds are achieved when the shedding lever and the centre arm of the T lever behind the dobby are both dead level.

Outside Underpick.—The wooden picking shaft is outside the loom frame. On its upper surface is the anti-friction bowl that is depressed by a tappet nose on the low shaft every other pick. The tappets moves clockwise.

For the weaving of silk and rayon, a looped strap at the base of the upright picking stick gives a resilient pick to the shuttle, and has a good effect on the weft. The crank gives a forward sweep to the going part of 5 inches.

On completing the pick, the stick is pulled back by a spring at the base, and the picking shaft is pulled up by a strong spiral spring. The shuttle is given an " up and off " delivery of $\frac{3}{16}$ inch.

Negative Let-Off.—Ropes are used to brake the warp beam, and their frictional sides are given a dressing of French chalk. When the weaver notices any jerky movement of the beam the ropes have to be cleaned, and a fresh dressing of chalk applied by the overlooker.

The warp passes over a wooden back roller, the gudgeons moving in ball bearings. The warp beam brackets are adjustable to suit the kind of cloth being woven.

The more tender warp requires that the top of the roller be at the same height as the breast beam. If it be a warp faced cloth, woven right side up, the roller is placed an inch or more lower than the breast beam to give the most tension where there is most warp. It is placed higher than the breast beam for weft faced cloth. The warp beam has fixed pulleys, and the bearer castings are slotted to take different lengths of warp beams.

Unique Take-up Motion.—This is on the right. It is run by a small tappet on the low shaft that operates a bowl on a horizontal shaft parallel with the outer loom frame. The shaft is given a rocking movement. At the front, it carries a one-armed lever to which is secured an upright rod that is fixed to a double curved lever seen in the illustration. On the upper surface of the top slotted lever is a numbered brass plate which indicates where the upper rod has to be fixed for the loom to put in the required picks per quarter inch. If set at its outer limit, it gives 7 picks per quarter inch, but at its inner limit, it puts in 35 picks per quarter inch.

The upper rod at the top is screwed to a catch plate behind the ratchet wheel. Inside, the plate has a semicircle of 21 radiating teeth that mesh with a full circle of radiating teeth on the ratchet wheel. When the catch plate is drawn downward, the teeth recede, but when pushed up, all the teeth advance, and turn the ratchet wheel to let off the warp. The ratchet wheel is loose on the shaft, but is made a fixture by a pin on the brake wheel entering a bore in the hub of the ratchet wheel. The brake wheel has a smooth surface, and is made a fixture to the shaft by a couple of locknuts. Resting on it is the brake that arrests excess movement of the ratchet wheel.

The brake has a lower leg, and to this is fixed the spring that keeps the brake in contact with the brake wheel. When the cloth needs adjusting, the lower arm is lifted, pushed back a little, and placed on a bowl for the purpose, the brake stud being long enough. Before the loom is set in motion, the brake has to be placed in action. The hand-wheel is on the same shaft as the worm that operates the large wheel on the take-up roller. The worm is covered by a plate to prevent smearing.

A small worm at the end of the take-up roller shaft, turns a numbered indicator plate that registers the amount of cloth woven.

Box Movement.—The boxes are controlled by the back four dobby jacks, the two back ones working the boxes on the right. They influence the two levers seen jutting from the upper loom frame. To these levers, chains are attached that are secured to right-angled levers below. When the inner lever is raised, the end of its vertical arm applies pressure to a plate that has five cogs on its rim. These are made to contact with a wheel in front that has two sets of four teeth and a double tooth between each set, that ends the turning. On turning, they rotate an eccentric connected to the rod that lifts the boxes, and in this way, the second box is raised to be level with the shuttle race.

To lift the third box, a similar mechanism is used, but the cogged plate is moved outwards. The fourth box is lifted when both cogged plates are brought into action at the same time.

If the box has to remain stationary after being lifted, the cogged plate or plates have to be moved out of contact with the front wheels, for the next half turn would lower the boxes.

There is an escape motion on the box rod, so that if the shuttle is caught between shuttle race and dropping box, the box rod is liberated, and damage avoided.

The meshing of the teeth begins when the crank is at its top centre, and ends when the reed has receded $1\frac{3}{8}$ inches from the cloth.

Style of Boxes and Shuttle Checking.—The box shelves are made of mild steel, and are cut diagonally at the box mouth, and are also well rounded off to avoid shuttle chipping. There are two swells to each box, the inner one giving the initial check to the shuttle and lifting the stop-rod tongue. The outer swell assists in the final check, and by means of an attendant easing motion worked from the crank arm, relieves the pressure on the shuttle when the pick is about to start. This easing makes pickers and tappet noses last longer. The shuttle is also given a running check, the amount being regulated by a stud on a slotted casting on the breast beam.

Take-up of Cloth.—Contrary to most looms, the breast beam is wood, but on its outer edge is a steel bar. From here, the fabric passes down to the rubber covered take-up roller, but can be covered with emery cloth if preferred. It has a circumference of 30 inches, and has a good grip of slippery textures. There is only a space of four inches that is bare of cloth. The fabric passes to the back of the roller and then over a steel bar in front. From this, it descends to pass in front of a lesser steel bar and then goes to the cloth beam. The last named is turned by a train of wheels, the driver being on the shaft of the take-up roller. On the inner side of the cloth beam wheel is a strong spring that imparts slip to the beam to prevent a too tight winding.

The reed space is 48 inches, and can be made fast or loose in structure. If the latter then the suspended rods seen in the picture are made use of, and a rolling motion imparted to the beat up of the weft.

The driving can be by fast and loose pulley, or by friction pulley, or by the very popular V-rope drive. The speed of the loom is 160 picks per minute, and the reed space 48 inches.

COMMON FAULTS IN WEAVING RAYON.

Though many improvements have been made in making rayon, it still remains the most sensitive yarn to wind, warp, weave and dye that textile commerce has to deal with.

At every stage, it must be subject to a minimum amount of friction and stretching, though spun rayon has more latitude than filament rayon. Woven rayon has similar faults to other yarns, but others are peculiarly its own. The chief faults are alphabetically arranged.

Barry Places.—These mainly due to erratic turning of warp beam. Collars or pulley to be free from rust, and ropes frictional surface rubbed with French chalk. Pre-treated before commencing last, or last two pieces. Old ropes taboo, as frictional surface much enlarged.

In Fig. 450, and within a cloth space of 1½ inches, are three light marks that cannot be remedied if passed forward. If picks are extracted, a starting mark will be made, and the area of extracted picks liable to take a deeper dye.

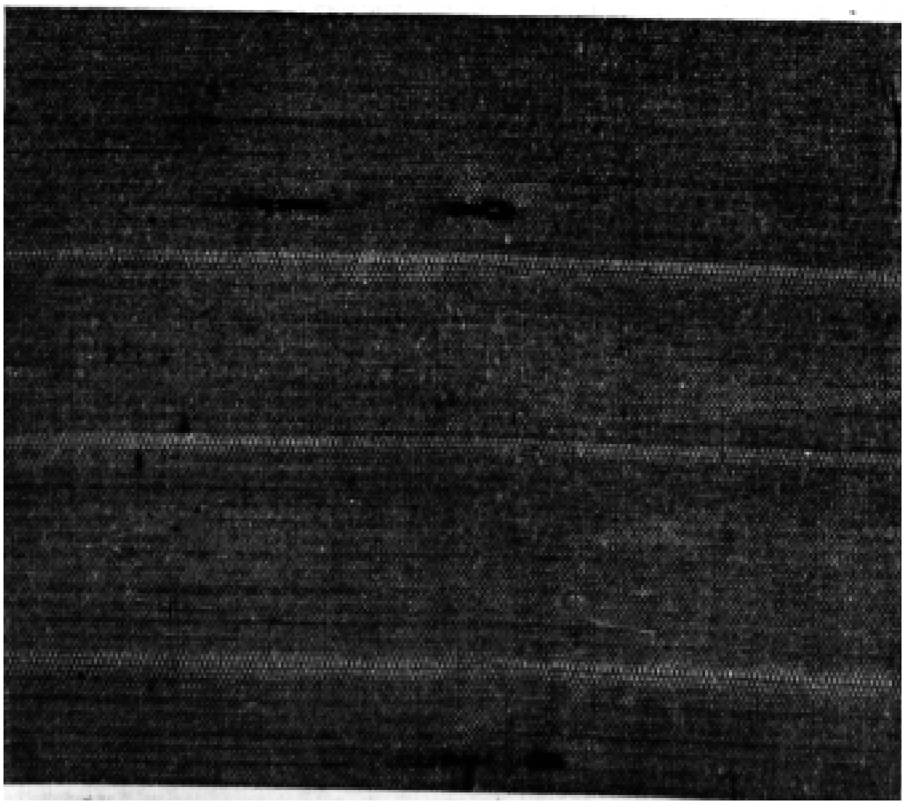


Fig. 450. Light Places.

Bright Picks.—Not all these made in loom. Brightness due to stretching beyond power of recovery. In loom, a spot of glue inside shuttle, or fur a little undone, or knots on yarn catching coils unwinding may unduly stretch yarn. A shuttle spindle too low, or a rough picker are weft stretches.

Broken Threads.—There are singles, groups, and traps. A smash is seen in Fig. 451 and suggests an accident, perhaps due to a weak spring in the shuttle, for in

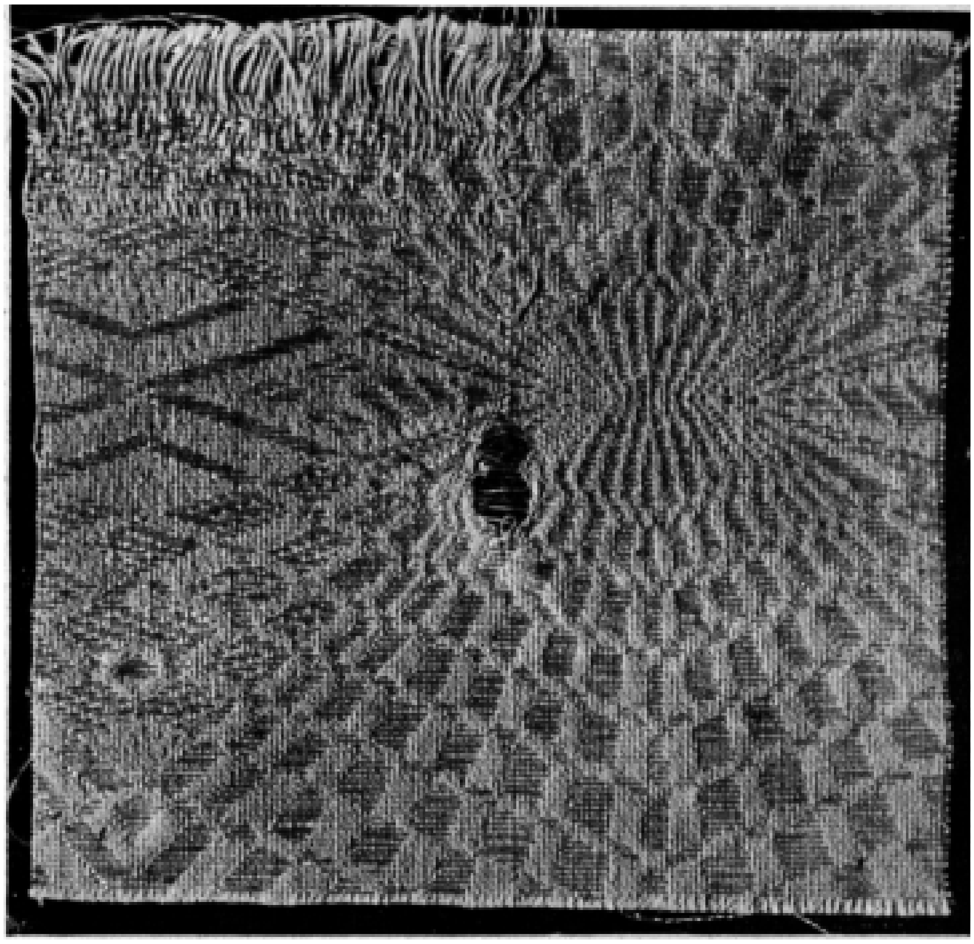


Fig. 451. Shuttle Trap.

centre of cloth, part of a paper tube is embedded. All shuttles to be used should be tested by overlooker before starting to weave a fresh warp. Chipped shuttles, a loose tip, broken picker, worn healds, shaft down, chafed threads, poor grip of temple, weak places in threads, are all damage makers to warp.

Buttons.—Mostly made on filament rayon. By chafing with rough reed, or threads too low on shuttle race, or worn healds, the broken filaments are pushed back by reed, and form lumps on threads. If buttons numerous, the warp has to be drawn forward, and buttons threaded through reed, and a fresh start made. If shafts used, the threads on them to be examined in relation to shuttle race. Worn swansdown or corduroy to be replaced.

Cockled Places.—Some fabrics purposely woven to produce them. Unwanted ones made by sections in jacquard fabrics by weaves closer than others. Others made by stretching, as when strips of cloth or starting canvas wrapped round take-up or other rollers.

Cracks.—These formed by slack crank arms. Left in cloth if weft fork not in order when weft fails. If crank worn oval it cannot be properly cottered, and requires a new one or new ends.

Creases.—Strictly taboo for rayon. Iron breast beams bow forward in centre to spread cloth, and smoother behind take-up roller bows backward for same purpose. This not possible with felt-covered roller. In some looms a wooden roller used over which cloth passes before reaching cloth roller. This thickest in centre.

Curls.—Made when shuttle fails to control weft. Shuttle bouncing back in box. Close weaves timed sooner to trap weft earlier.

Though not very distinct, what appears as black dots in one piece are curls, and 15 defective picks in that small area. Pairs or groups of shuttles to have same amount of tension for same counts of weft.

Dirty Weft.—For rayon, soiled weft not to be used. When dirtied during weaving, shuttle box, or shuttle block had surplus oil. Also by weft contacting with picker spindle or buffer. Weft to be confined to shuttle. Picks of dirty weft in Fig. 452. Buffers on plain looms to be made of layers of dry leather. These absorb oil.

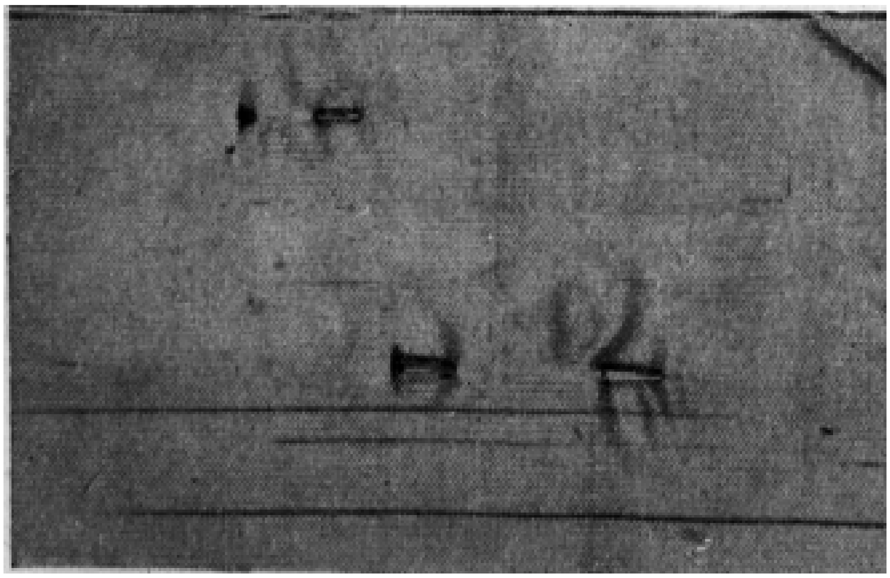


Fig. 452. Dirty Weft.

Oil Stains.—Cross rods in tappet looms, and jacks in dobby looms need tins with waste in to catch surplus oil. Jacquard weavers to wipe off all surplus oil. Overlookers repairing underneath loom have to be cautious. A bad case of soiling is at Fig. 453.

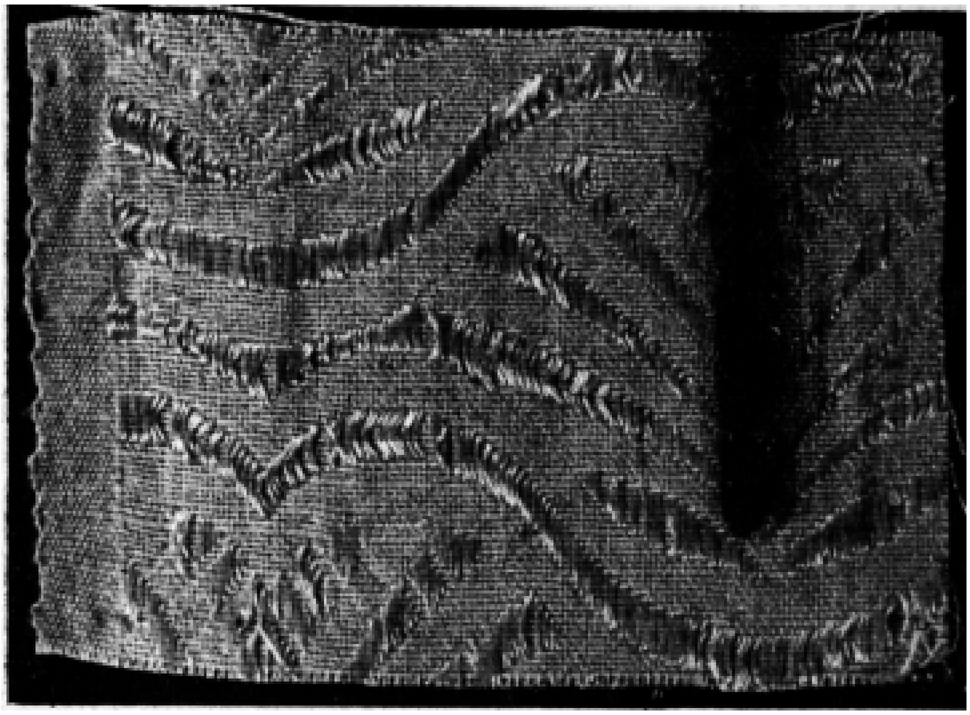


Fig. 453. Oil Stain.

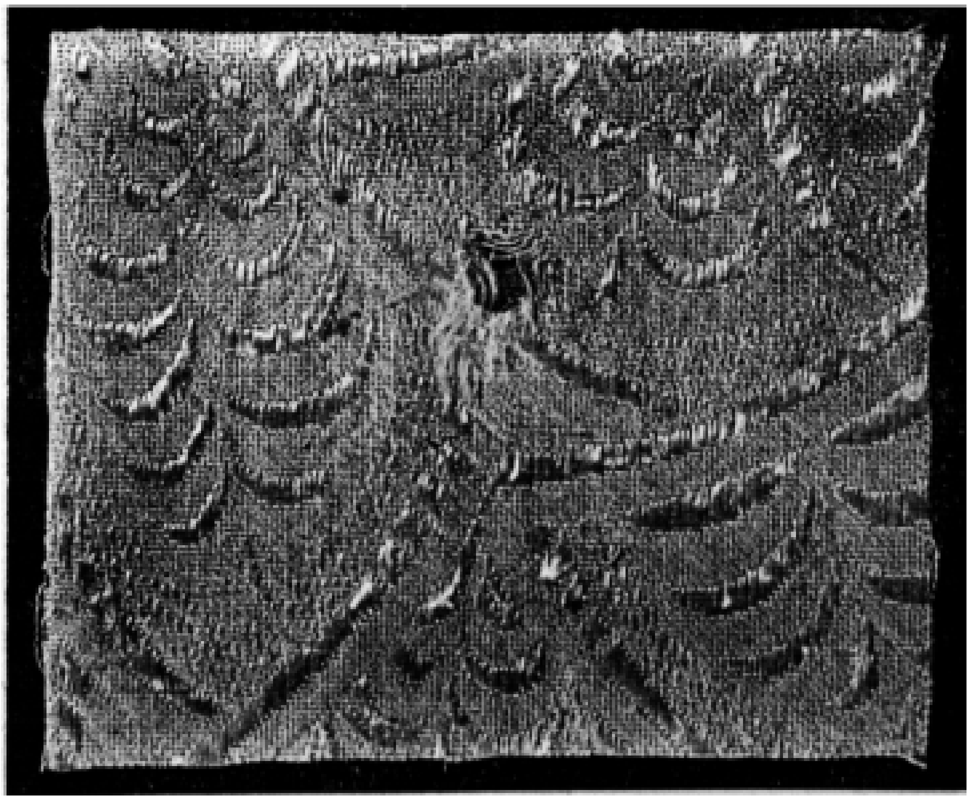


Fig. 454. Perforation.

Perforations.—Piercing of a piece may be made by a dropped shuttle, or bobbin of Northrop type. The bursting of an electric bulb, or the flying out of another weaver's shuttle, or the breaking of a tube or pirn. The example at Fig. **454** is what occasionally happens.

Picks Missing.—In plain weaving, a single missing pick makes a double one. This is seen in Fig. **455**. If weft fork not in order the loom continues to run, and if a long trail of weft is left outside shuttle it may catch, and loom continue to weave. A good working plan for overlooker is to overhaul weft fork when loom awaiting a fresh warp. (*See* Hudson's first pick stop motion). Page **313**.

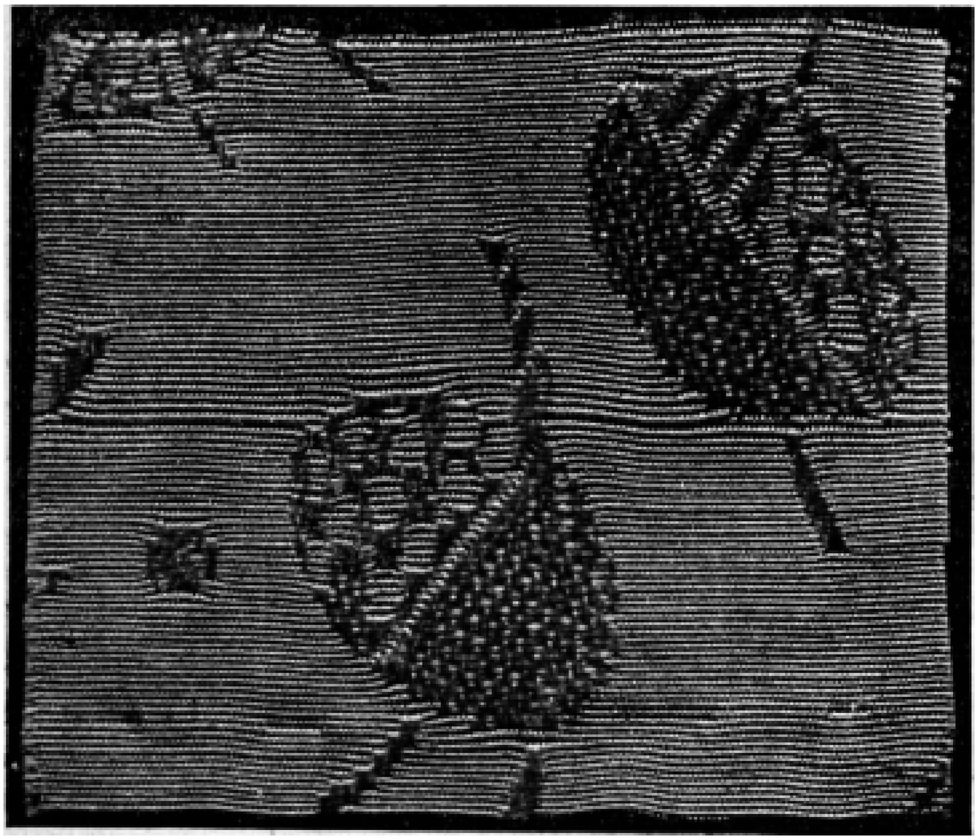


Fig. 455. Missing Picks.

Reed Marks.—Most rayon warps of fine denier woven in all metal reeds. With these the shuttle not to be thrown through shed by hand, but sent through by picking strap and by easing box swell with crank at back centre. Unwise to leave shuttle on cloth, or divide reeds with finger nail. A fine hook for threading. Weavers to beware of dropping bobbins. When reed injured, loom to stand until repairs carried out. Reeds to be protected from rust.

Set-up Places.—These left in cloth after lagging back or combing out. Rayon warps the most difficult in this respect, and only experienced weavers to undertake it.

Difference between correct and incorrect is very small. Both spacing and tension to consider. In try out, the reed not to contact with cloth fell until crank at dead front centre.

Selvedge Faults.—Selvedges may be woven with same weave as ground, and from same beam when it is even like plain, and 2 and 2 twill. If warp or weft faced, threads woven from flanged cheeses, and front separate shafts when possible. The weave different, to make a flat effect as 2 and 2 warp rib. It prevents piece rolling at edges when liberated. Shuttle to be tensioned alike to avoid waviness. Example at Fig. 456.

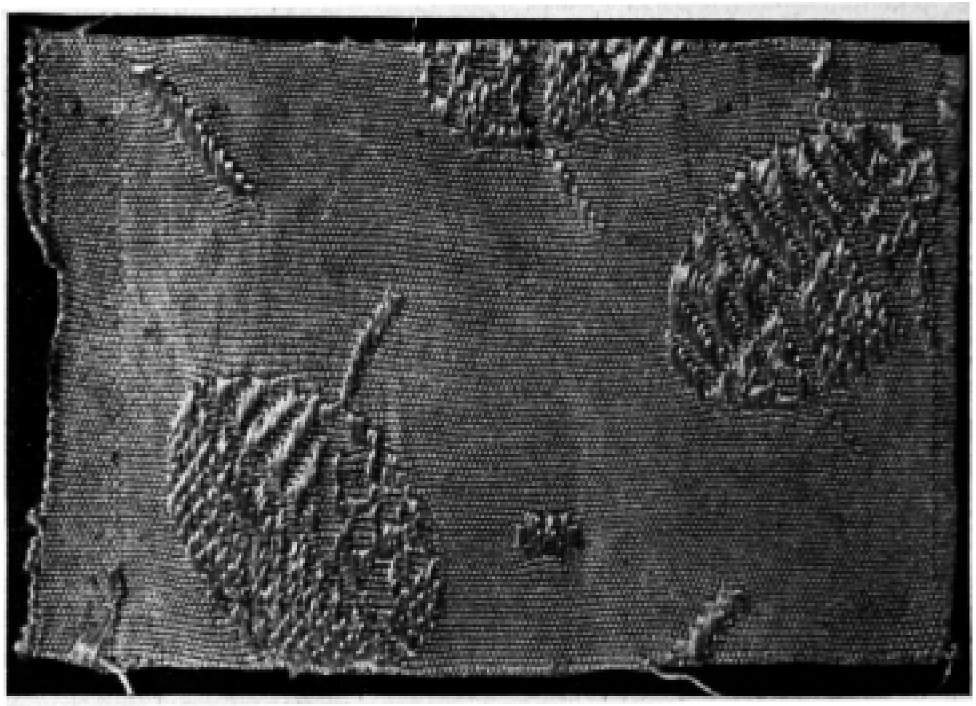


Fig. 456. Selvedge Fault.

Cheese Winding for Special Selvedges.—If selvedge threads are thicker or thinner than ground warp, they are

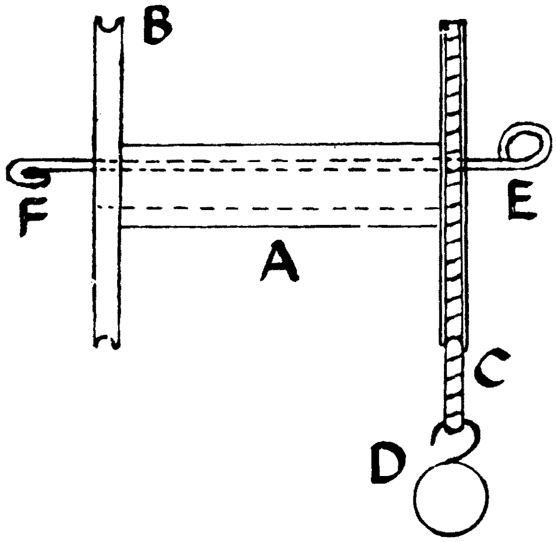


Fig. 457. Selvedge Bobbin Cheese.

wound off a separate cheese and weighted. The most handy kind of cheese is a double flanged bobbin like Fig. 457.

A bobbin, B grooved flange with brake band C and weight D. Looped wire E turned down at F to prevent band slip. Relative speeds of warp and bobbin are calculated. Both sets of threads marked a yard from cloth, and measured when first mark about to be woven in. In winding on cheese, threads have to be moved " to and fro," and so does not give equality of tension in unwinding. Fig. 458 is another

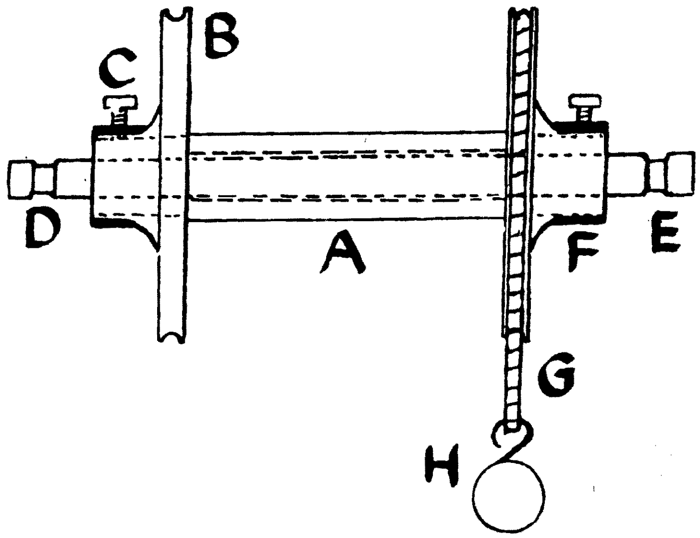


Fig. 458. Metal Selvedge Cheese

style made of metal. A, bobbin shaft, F and B grooved flanges setscrewed at C. They can be set to width required for straight winding and weaving. D and E are grooves in bearer shaft to hold suspension bands. G, brake band, and H, weight.

Edge Threads.—For plain weave the outer thread may be three-fold, and the next two-fold. For 2 and 2 twill, it is much the same, but for 2 and 2 hopsack, a catch thread at the open end is needed. If a thicker count or denier is used, the threads in each reed are decreased. For 8 shaft sateen, the selvedge can be woven

$$\text{Up} \quad \frac{3 \quad 2 \quad 3}{3 \quad 3 \quad 2} \quad \text{Down}$$

Faulty Selvedges.—Fig. 459 is a weft striped fabric. The warp is three-fold acetate and twisted, but the weft is viscose and twistless, with 36 threads and 50 picks per inch. White ground woven plain, and blue stripe is 8 end sateen, and weaves wavy edges. Selvedges weave plain, and woven by a selvedge motion. The four outer threads are double ones. The selvedge is too slack, and is bowed upward.

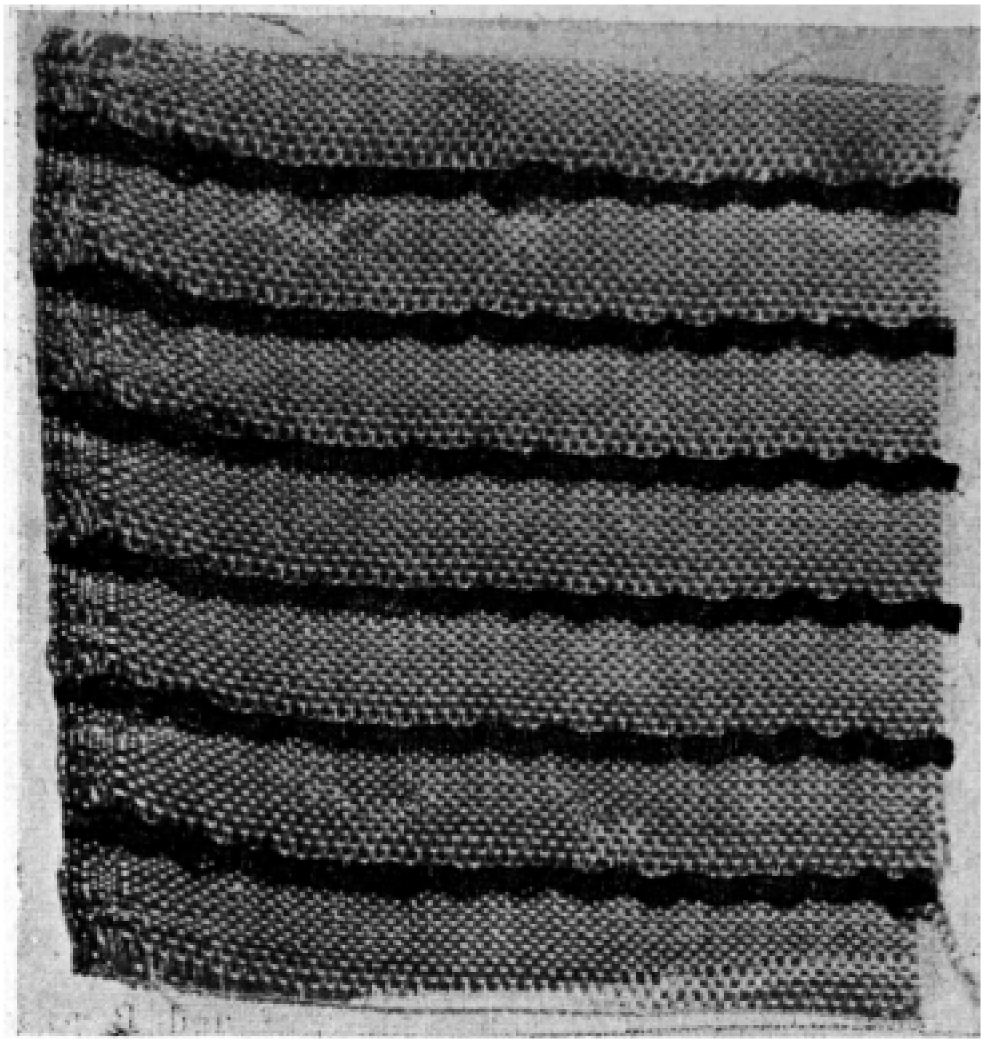


Fig. 459. Slack Selvedge.

Fig. 460 is another weft striped pattern with 36 threads and 50 picks per inch. Warp three-fold acetate, but blue and gold weft twistless. Ground, plain weave, but narrow blue stripes are 3 and 1 weft twill. The fancy weave a diamond pattern. When weft changes, loops form at selvedge. In broad blue stripe, the depth extended, but in broad gold stripe it is contracted owing to weft drag. Construction of selvedge the best of a series of six patterns. Outside thread made with two three-fold threads, the next three are three-fold threads, and those that follow are two-fold.

Shuttle Marks.—These mainly made in rayon crêpe weaving. When shuttle or pickers are worn, or the reed not straight, or delivery of shuttle not correct, the shuttle wobbles through shed. On entering, but more so on emerging, more force is placed on warp, and the increased friction leaves a mark that shows when fabric finished. The faults suggest the remedies.

Snarls.—When weft hard twisted, it is liable to double on itself as soon as slackened, and at worst when new spun.

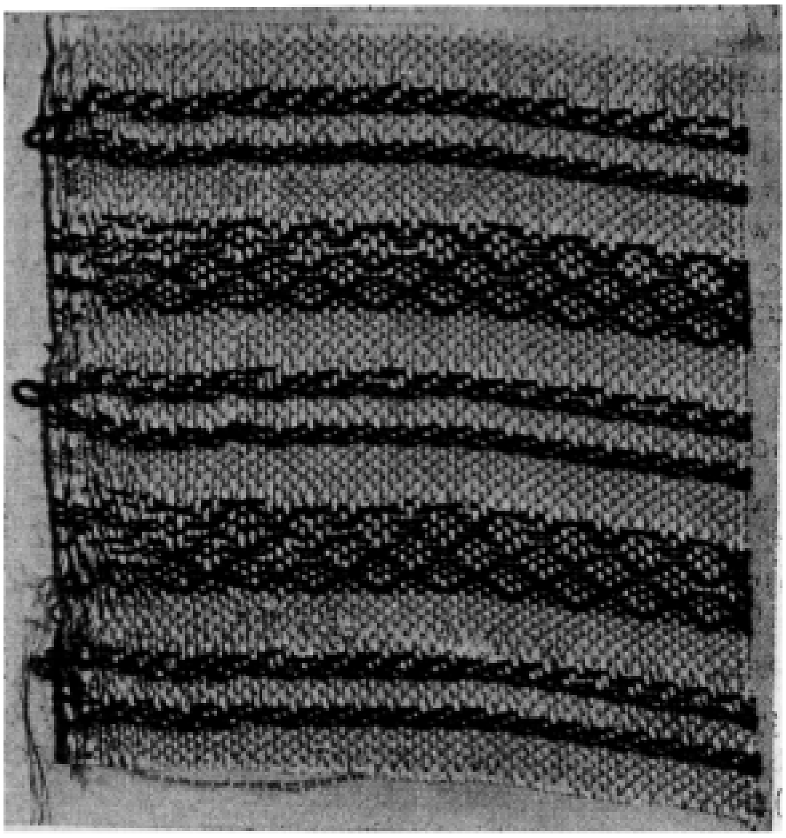


Fig. 460. Looped and Uneven Selvedge.

As a snarl makes three thickness, the measures taken to avoid them are:—

1. By naturally conditioning it in a cool place.
2. By steaming it.
3. By better control in shuttle.

Trailing In.—When right and left twist weft are used, the one essential is to keep them as separate as possible between mouth of box and selvedge. The appropriate placing of swansdown or corduroy will improve matters. In drop

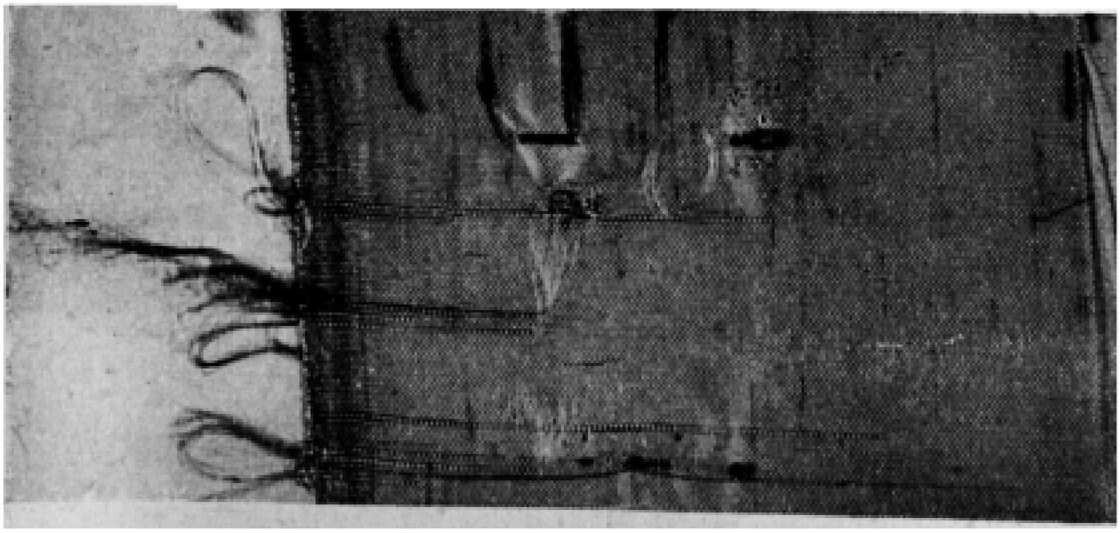


Fig. 461. Weft Trailed into Cloth.

box work, groups of threads are arranged to work midway between selvedge and box mouth. The mess that trailing makes is seen in Fig. 461. *Refer* Page 407.

Wrong Patterns.—When the elasticity of rayon yarns are improved, there will be a greater demand for more elaborate weaves, with a probable increase of mistakes. The beautiful effects of colour and weave, and diamond patterns, artistic jacquard designs, and ingenious crossings of gauze will call forth premature measures against wrong patterns.

Here is an actual wefting plain for a drop box or a circular box.

Rose pink	68	—	—	—	—	—	144
Saxe blue	12	—	—	—	—	12	
Bright yellow	4	—	—	—	4	—	
Light red	8	8	8	8	—	—	
Peacock green	4	4	4	—	—	—	

In lagging back or combing out, it is a very easy matter to have too many or too few picks in the 68 section. (*See* Fig. 443).

DEVELOPMENTS IN NEW YARNS.

NYLON.

By research carried out by *private* enterprise, a number of highly important developments have taken place in recent years. Rayon has already received attention. Weaving overlookers are not interested in the fancy names used in chemistry, but have to take an interest in the yarns placed in the looms under their charge, and the best means of management.

There are great possibilities that nylon will be the most outstanding discovery of the chemical laboratory for a long time ahead.

Its Discovery.—Carrothers was one of the cleverest textile chemists employed by Messrs. du Pont de Nemours and Co., Wilmington Works, Delaware, U.S.A. It was this gifted man who discovered the combination of elements that created nylon, and laid the foundation for its progress.

On February 8, 1935, was the first time that two substances were condensed under his own special conditions that formed the polymer that made the new filaments. The two substances were hexamethylene diamine and adipic acid. The first is a coal tar product, and the second is made from benzene. Nylon is not therefore dependent on wood pulp and linters like rayon, but is dependent on coal, air and water. Carrothers and his staff began their investigations in 1928, but the vital discovery was made seven years later. To attain commercial success, it took another three years.

Process of Production.—Instead of forming a viscous solution and forcing it through a spinneret into a coagulating bath as for rayon, it is made by forcing a molten substance through a stainless steel spinneret with fine bores. The fibres are formed by becoming solid, and are wound on to a bobbin, and later, are drawn out to about four times its original length. This reduces their diameter, but they are permanent.

Its Properties.

Strength and Elasticity.—Nylon used for manufacturing has a dry strength of 5.0 grams per denier, and 4.5 grams per denier wet strength. The chief reason for its strength is its crystal structure. Its recovery after stretching is shown from tests. When stretched and held for 100 seconds, it recovers itself in 60 seconds. When stretched from 2 to 8 per cent. it recovers 100 per cent. When stretched 16 per cent. it recovers 91 per cent.

Inflammability.—When a flame is applied to nylon, it does not burn in the ordinary way, but quickly shrinks into a small hard ball. It is much safer for outer wear than either rayon or cotton. Its melting point is 240° C, which is well ahead of any heat required for laundering.

Water Repellent.—It resists moisture much like a mackintosh, and does it without dope. Dyes used for colouring are those of the acetate type, though others are used in modified form. Nylon is therefore better for outer wear than under wear; as it does not absorb sweat, or very little.

Lustre.—It does not possess the dazzling sheen of rayon, but is more like silk with its pearly appearance. It is kinder to the vision of operatives than lustrous rayon.

Immunization.—It is quite free from bacteria, and mildew does not affect it.

It is also impervious to the attack of moths, and an excellent covering for the storage of expense furs. It is not adversely influenced by household chemicals.

Static Electricity.—It cannot be woven without being sized and lubricated. It is not sized to increase strength, but to bring its static electricity under control. If dry threads or a hank be placed between the hands and then let slack, they balloon remarkably. If the hand be wetted and passed down the threads, they are limp immediately. The sizing and lubrication has to be done before warping, and lubrication gives it a better passage through the loom.

Lack of Warmth.—In keeping with rayon, it is cold to the touch. Though it is likely there will be a great demand for nylon stockings, because they keep their shape, and will be fashionable, they are not suitable to be worn next the skin as they become clammy.

Weaving Conditions.

Nylon is so strong as to have a cutting action on parts over or through which it passes. A wooden back rest would soon be grooved, and also lease rods. A hardened steel roller whose gudgeons turn in ball bearings, and tin covered lease rods are essentials. Heald eyes have to be metal and not wire. The shuttle race to be covered with corduroy, not as a soft bed for warp, but to prevent the grooving of the shuttle race. Owing to the fabric being very slippery, the take-up roller is covered with emery cloth of the coarser kind

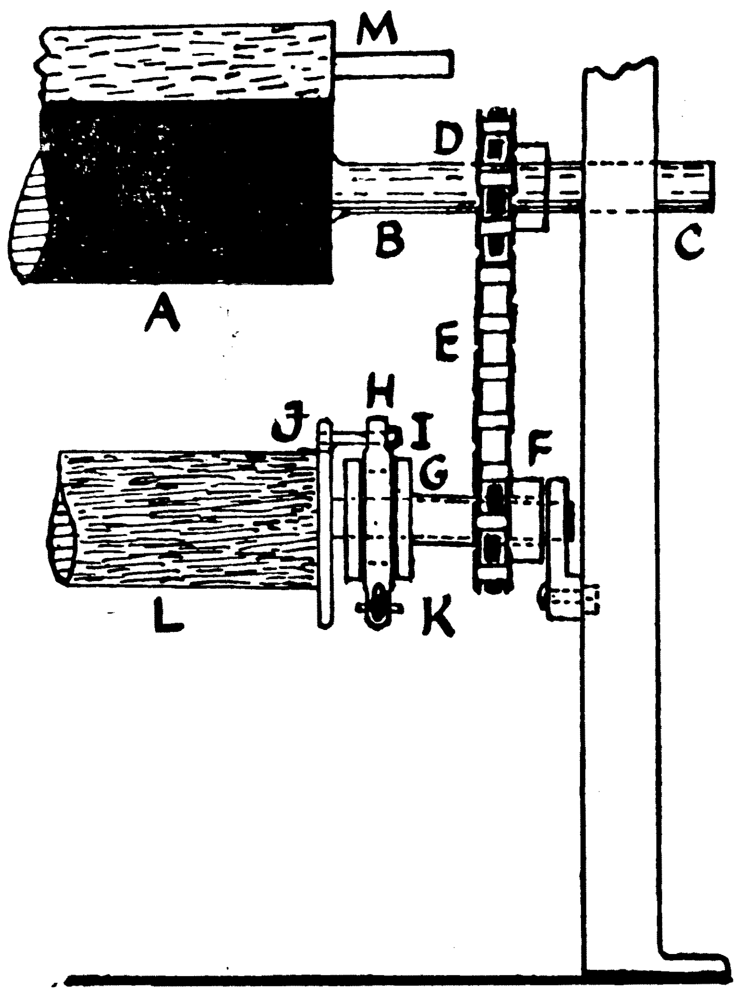


Fig. 462.
Take-Up for Nylon Cloth.

for better grip. It is unwise to have the cloth roller turned by friction, for two layers of slippery fabric are against good cloth winding. The cloth beam is reliably turned by sprocket wheel and link chain provided with a clip motion. This is seen in Fig. 462. A is take-up roller, B shaft, C place for take-up wheel, D sprocket wheel, and link chain E connecting it to sprocket F, fixed to sleeve that carries friction pulley G. On pulley is friction clip H carrying pin I that penetrate a bore in cloth beam flange J. At base of friction clip is wing screw K, to regulate cloth winding on beam L.

To assist grip of cloth, a felt covered roller is placed at M on top of take-up roller A, and cloth passes over it on way to cloth beam. The gudgeons of felt roller turn in open slots so that starting knots can pass underneath.

Wefting.—The slipperiness of nylon weft is modified by its preparation. The interior of shuttles are lined with fur like opossum. Weft trap shuttles made by Messrs. Pilkington of Heywood, and Messrs. James Nelson of Nelson, are both valuable aids for braking weft, but are even more suitable for rayon. (*See* final chapter on " Shuttles for

Lancashire Looms) "). Lupton Bros. of Accrington, have made a special temple for weaving nylon. (*See* " Accessories "). Page 540.

Vinyon.

This is another far reaching discovery. It is made from synthetic resin. About the year 1934, Reid employed by Carbide and Chemicals Corporation, at U.S.A., found the true combination for making this yarn. In 1939, the manufacture of it was handed over to Messrs. Courtaulds branch in America. It is made from chemicals derived from acetylene extracted from the petroleum industry, or from calcium carbide derived from coal and lime. These are formed into vinyl chloride and vinyl acetate. When these two are mixed in certain proportions, and under certain temperature, they form the new fibre.

Process of Development.—At the time of writing, the proportions are 12 per cent. vinyl acetate and 88 per cent. vinyl chloride.

After this blending, the temperature has to be kept from 40 to 60° C for 72 hours. When preparing for spinning, the resin is dissolved in acetone to form the spinning mixture The preparation is then filtered, aerated and pumped through spinnerets. The acetone evaporates, but means are adopted for its recovery.

Threads formed by each spinneret is wound on a suitable bobbin. At this stage it is very weak, but when stretched under high temperature, its strength reaches 4 grams per denier, and are stronger when wet than dry. After stretching, it is set by heating under tension, the heat being from 90 to 100° C.

Properties and Uses.—In several respects it is like nylon, for it resists water, does not mildew, does not burn, is lustrous, and proof against acids. It does not harbour static electricity. When piece-dyed, it needs low temperature. Filter cloths and outer clothing for chemical workers are the nucleus that will be much extended.

Weaving.—It can be spun as fine as 8 denier, and by twisting threads together, can be made as thick as 5's cotton. The fine denier can be woven in a plain silk tappet loom, but the coarser kind would need a canvas loom. The general arrangements are as for nylon.

As an example of a heavier make of fabric the warp is three-fold. Each thread of the three-fold is two-fold, so that each individual thread is made with five threads. The final twist that binds them together has only four turns per inch. The counts are equal to 12's cotton. The weft is five-fold with little twist in each strand, but the final twist has 7 turns per inch. Counts, 5's cotton, and picks per inch 31. Weave plain. Cloth exceptionally strong, and its appearance like canvas.

"Fibro" and Casein Staple Fibre.

"Fibro" is filament rayon cut into definite lengths. Its denier and length is best for blending when it conforms approximately to those with which it has to be blended. Its natural origin is wood pulp, but improved by adding linters.

Casein has a protein base, and obtained by the chemical treatment of skimmed milk, and therefore of animal origin.

In appearance, it is much like wool, and far more so than rayon, nylon or vinyon. It is crimpy, in locks, has warmth, and a silky handle. Unlike wool, it readily catches fire, burns brightly for a short time, and on dying out, leaves a black ash. The smell after burning is like wool.

It has been made into two different deniers and staple lengths. One is 3.5 denier and 5 inches long, and the other 5 denier, and 6 inches long. They have been used in wool blends and also with viscose rayon. With either it has to be well blended. With wool, it increases the lustre, and the handle is smoother and silkier. When blended with rayon, it is more fibrous, but the fibres are so small and smooth as scarcely to be noticed.

When blended with viscose in the same threads, or warped separately, it produces a two colour effect with the same dye bath.

When a thread composed of "Fibro" and casein is flame tested, the "Fibro" rapidly disappears, but the casein fibre leaves a ghost thread of black similar to that of loaded silk.

ACCESSORIES.

Lupton's Temples.

The firm of Messrs. Lupton Bros., temple makers, at Accrington, Lancashire, are widely known, the firm having been founded in 1869. They have the patterns of 1,400 types of temples, many of which are in use, and meet the needs of every kind of woven structure.

At Fig. 463 is the " Revoleze " temple, which is being extensively used in the weaving of both cotton and rayon. There are two rollers, the ends of them being ball-shaped

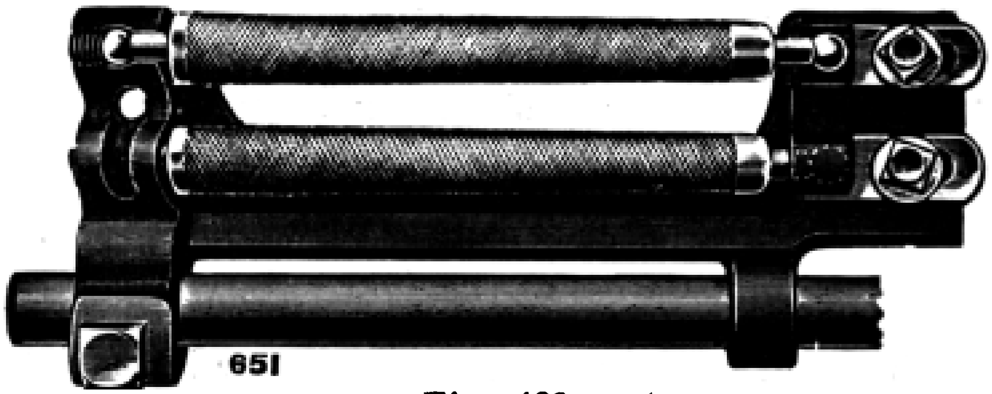


Fig. 463.
Lupton Brothers Double Roller Temple.

to produce the easiest movement. There are 41 small spikes in a row, and as there are 26 rows, there are 1,066 of them on each roller. The rollers at their inner ends rest in adjustable castings, and are set to give rotary freedom, but only give the slightest play laterally.

When found necessary, one or both rollers may be changed for fluted rubber rollers, or others that have spikes only to seize the selvedge. Ten different styles of rollers are made by the firm. The under side of the temple is open, and allows fluff and waste to drop to the floor. As shown, the frame of the temple fits on to a round bar, and is set by a setscrew. Its under side must clear the shuttle race, and the front of it be free from contact with the sley when the crank is in its full forward position. It must also be set so the whole of the spikes be in contact with the cloth as they revolve, without the selvedge turning over. The cap though not shown, covers the two rollers, and forces the cloth on to the spikes, and is held down by a setscrew.

There are right and left hand rollers, and their spikes should point away from the centre of the loom. Old and new rollers do not work well together, but if of necessity, then the new one should be placed nearest the reed. Glaze marks are caused by too much friction.

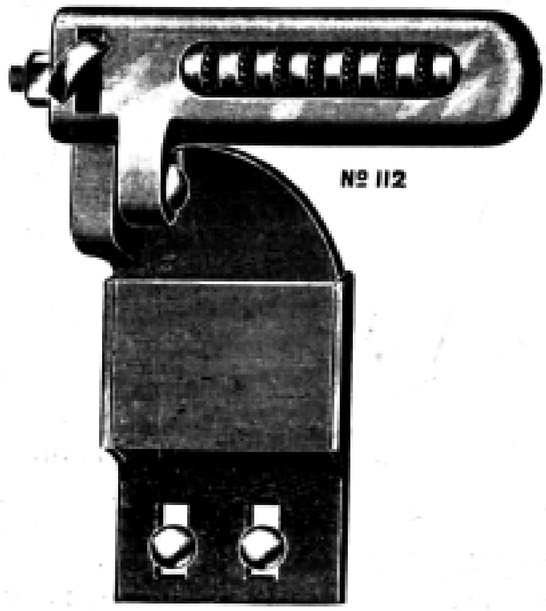


Fig. 464.
Lupton Brothers Ten Ringed Temple.

For stronger work, the 10 ringed temple with its swing cap is used. This is at Fig. 464. Its advantages, function, and setting have been fully explained in the chapter on "Temples." *Starting* Page 286.

Lupton's Nylon Temple.

This is an entirely new kind of temple that takes charge of the whole width of the cloth, and is made by Messrs. Lupton Bros., of Accrington.

Structure of Temple (Under Part).—This is at Fig. 465. The temple is usually made the width of the reed space, and a view of one end is given. A is a fixing plate bolted to a bracket on inner side of breast beam on narrow looms. Two are used, but for wider looms, more are required.

It is countersunk at B to receive the flat head of holding bolt for breast beam bracket. C and D are similar bolts that fix plate to under side of temple.

The rounded part of slot E is for stud to pass through, and slot F takes round body of stud. G is fixing bolt that sets upper part in relation to lower one. It is the round steel rod under which cloth passes after crossing the rounded lip at front of temple The steel rod rotates by the forward

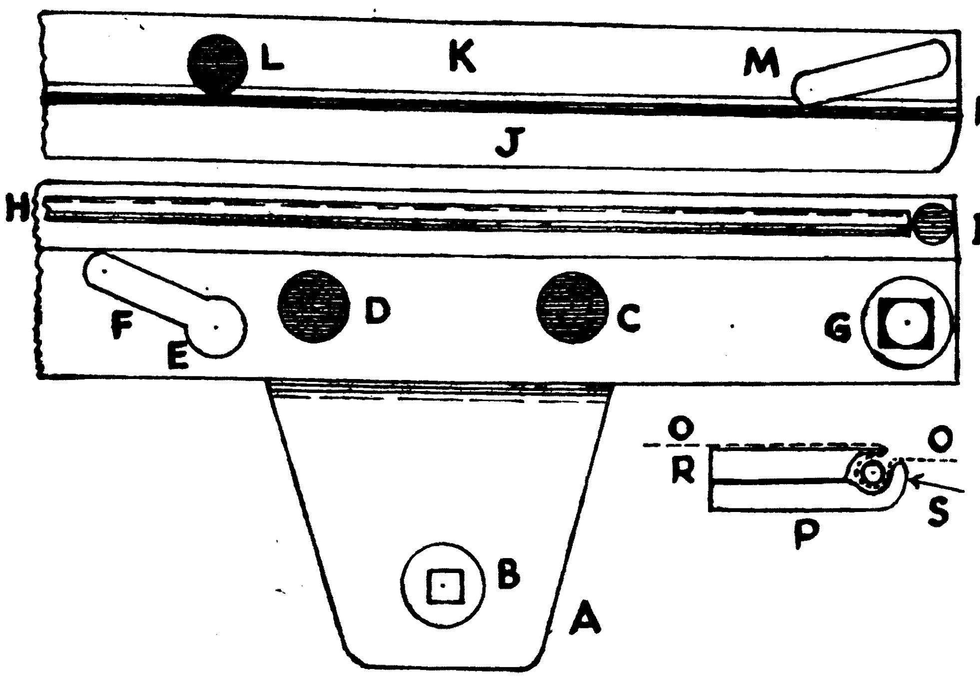


Fig. 465.
Lupton's Temple for Nylon.

movement of cloth. The ends of this part are stopped by plugs like I that keeps rod in position.

When the upper part in Fig. 465 is fixed in position a trough is formed for the steel rod. In all, and for narrow fabrics, there are six slots like the one at E and F, the distance between each being $6\frac{1}{2}$ inches. The total length of temple is 41 inches, and total width, ignoring plate etc. is $1\frac{1}{4}$ inches. The slots incline at 20 degrees and length of each slot is $1\frac{3}{8}$ inches. They enable the upper part or cap to be moved forward.

Structure of Temple (Upper Part).—The under part of upper section is at N, and for fixing, has to be turned over. At J is the thin part that acts as cover for steel rod below. It is only $\frac{1}{16}$ inch thick, but part K is $\frac{1}{4}$ inch thick.

At inner edge of thick section, a series of studs like L are riveted, the heads passing through the rounded part E of slot F in Fig. 465. At M is the slot by which cap N is adjusted. The shaft of setscrew G passes through it, and fixes it in its weaving position. When set, the top of the cap is flat, and both edges are rounded off.

Setting of Pitch (1).—The breast beam brackets must be carefully levelled so the temple itself is level before tightening bolt through plate at B, Fig. 465. If brackets not true the temple is tipped.

(2) The under side must be clear of shuttle race, and the top of tip be about centre of open sheds.

(3) Front of temple to be free of reed when crank at front centre. If set too far forward temple front injures

reed and cuts the warp. After setting, the temple is practically rigid. No run back of temple is needed, for owing to thinness and setting of temple the shuttle will slip over temple top in case of a trap.

Path of Cloth.—On leaving fell of cloth, the fabric O in small drawing, passes over lip of bottom part of temple at P, and around the steel rod S, rotating in groove made by castings P and R. It then goes over breast beam, and down to take-up roller. The roller may be covered with emery cloth or rubber. One made of rubber is 1⅜ inches wide, and its face is like rows of small buttons, and when placed lengthwise, they form twills to right.

To aid the grip on the cloth, a felt covered roller on top of the take-up roller is an advantage, but its gudgeons should be in open slotted castings, to allow starting knots to pass under. If the loom has an ordinary smoother, the cloth passes clear of take-up roller. *See* Page 537.

Additional Remarks.—On starting a warp, the cap and steel rod are taken off until the starting knots are wound beyond temple. The warp is then slackened a little, and the steel rod is then placed in its groove. The cap is then applied, and its nearness to the reed examined. In this make, there are no pins to damage, or cut threads and picks. What friction is applied is equally distributed across the face of the fabric, and is roller friction. The under side of the cloth contacts with smooth metal that does not injure the texture.

Mather and Platt's Weft Feeler Motion.

A weft feeler motion has an advantage over a weft fork because it comes into action before the weft fork can act when the weft is almost exhausted, and so prevents light places being made in the fabric. A weft fork has an advantage over a weft feeler, for it stops the loom when the weft breaks. One motion therefore supplements the other. A weft feeler is needed more than ever with weavers having to attend to more looms.

The following gives a description of Mather and Platt's weft feeler motion. It is perhaps best explained under the following headings.

Preliminaries.—Before the motion is fitted, an oblong hole 1½ inches long and ⅜th inch deep is made in the box and shuttle front, the place being centrally found by placing the shuttle fully in the box. It should then be ⅞th inch ahead of the inner end of the bobbin head. The next move is to take off the weft hammer, and screw in a pin in the outer front part of the head.

Setting.—The tumbler weft fork is then taken off, and the tripping lever is slided on to it. The final fixing of it can be left until the feeler motion at the opposite end has been adjusted. A right angled casting is now bolted to the pivot of the knock-off lever to which the weft fork is attached. The feeler is then set in two ways.

(1) By a steel clamping block which is secured to the vertical part of the right angled lever mentioned, the feeler being placed directly opposite the side centre of the bobbin in the shuttle.

(2) By means of a clamping screw on the shaft of the feeler, it is set just clear of the bobbin in the shuttle when the crank is at its dead front centre.

Having secured these important parts, the tripping lever may now be set so the curved front of it is directly opposite the pin at the side of the weft fork hammer when the feeler is stationary.

Negative Action.—When there is plenty of weft on the bobbin, the feeler is pressed back every time the shuttle enters the box at that end of the loom. On being pressed back, the clamp screw on the shaft of the feeler lifts a curved finger that rests upon it. The curved finger is setscrewed to the connecting rod which is twisted in consequence. As the trip lever is on the same rod, its curved front part is raised above the pin on the side of the weft fork hammer, and the loom continues to weave. The feeler is pushed forward by an open spiral spring attached to the curved finger which presses it against the clamp screw.

Positive Action.—When the weft is almost spent on the bobbin, the feeler remains stationary, and as the other parts also remain inactive, the trip lever is pushed back by the movement of the weft fork hammer, and as this forces the setting on handle out of its notch, the loom ceases to run.

Mather and Platt's Weft Hammer Knock-off Motion.

The latest ideas are revealed in Fig. 466 and 466a. The new knock-off is independent of the weft feeler, and is worked entirely from the warp stop motion.

Bracket 1, Fig. 466, secures the motion to the knock-off lever 2, the two being held together by the nut and set-screw 3. When the knock-off is not in action, lever 4 rests in the socket on the upper part of lever 9. This position keeps the knock-off rod free from the hammer head 7, and

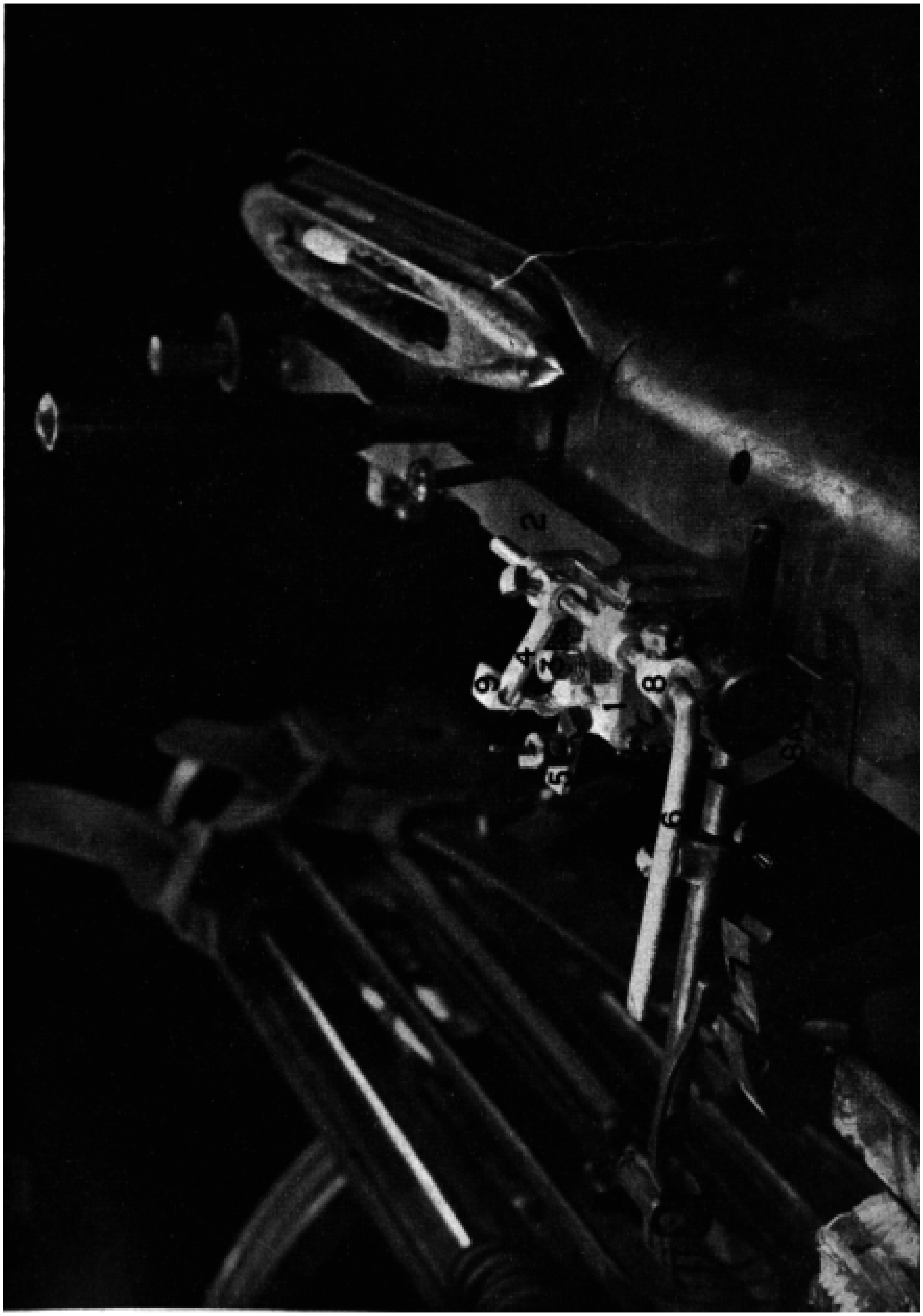


Fig. 466.
Mather and Platt's Weft Hammer Knock-off Motion.
Position for Weaving.

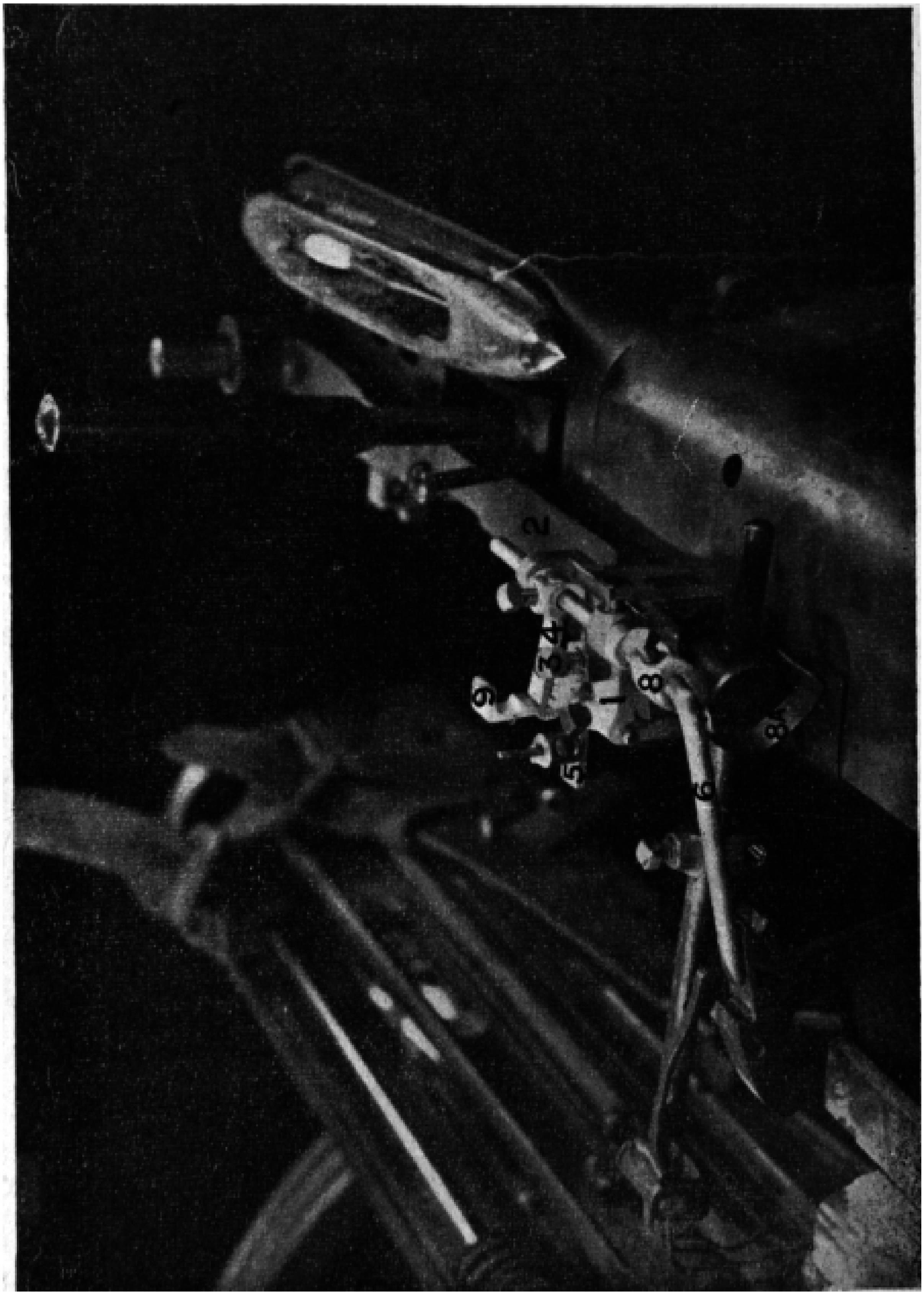


Fig. 466a.
Mather and Platt's Weft Hammer Knock-off Motion.
Position for Stopping Loom.

is the normal working position. When a warp thread breaks, the lifting lever on the warp stop motion operates lever 5, and drops finger 4 from the upper socket on casting 9, and places it in the bottom one. By this movement, rod 6 is dropped on the weft fork hammer as shown in Fig. 466a, and as soon as the hammer moves backward, the setting on handle is forced out of its notch, and the loom ceases to run. When this movement takes place, the boss 8 which is set-screwed to the same bar that forms the knock-off finger 6, comes in contact with the inside of the breast beam by means of the spring 8A. This contact raises rod 6 as soon as the weft fork hammer releases it, and remains free of the hammer until another end is broken.

The new knock-off stops the loom with the shuttle at the starting handle end of the loom. It can be fitted to right or left hand looms.

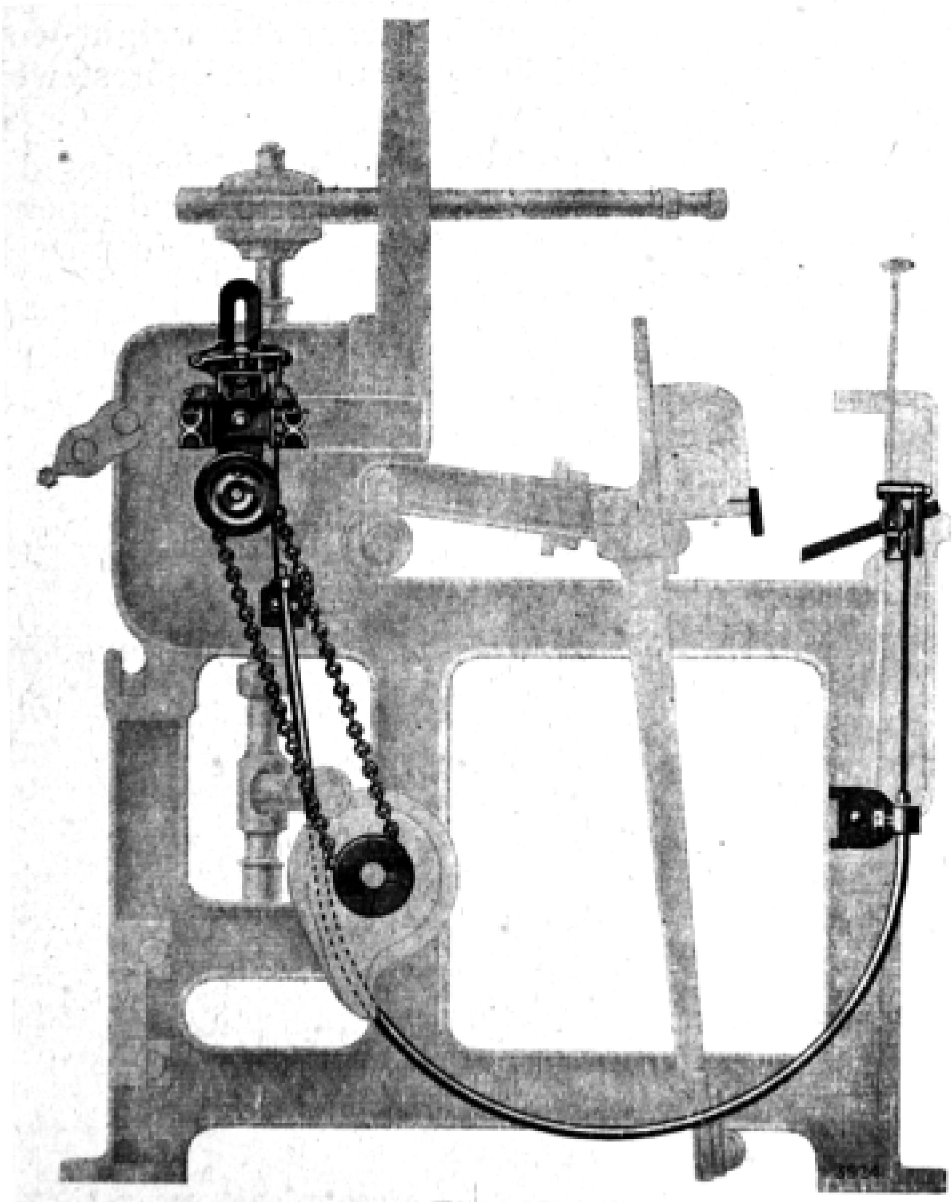


Fig. 467.
Mather and Platt's Mechanical Warp Stop Motion.

Mather and Platt's Warp Stop Motions.

This firm manufacture two types of warp stop motions, one being mechanical, and the other electrical. The former can be driven by either chain, or by belt from the tappet shaft, or from the crank shaft, or electrically driven from tappet shaft only

Fig. 467 shows the chain drive for mechanical action. It consists of a headstock with oscillating mechanism, which actuates a number of notched slide bars that move about $\frac{5}{8}$th inch backwards and forwards. Each moving bar slides in a doubled stationary bar, the upper parts of which are also notched. These bars are fixed above the warp, so that no dust, or fluff, or size can accumulate to hinder the free movement of the sliding bars.

The droppers are made of steel, and are either copper or zinc plated, or unplated and polished. The firm manufacture about 50 varieties which vary in weight to be suitable for the finer or thicker yarns. The lightest weight dropper is ·8 of a gramme.

There are four chief styles, these being the closed and open for mechanical action, and the closed and open for electrical action. When a thread breaks, the dropper falls as shown on the left in Fig. 468.

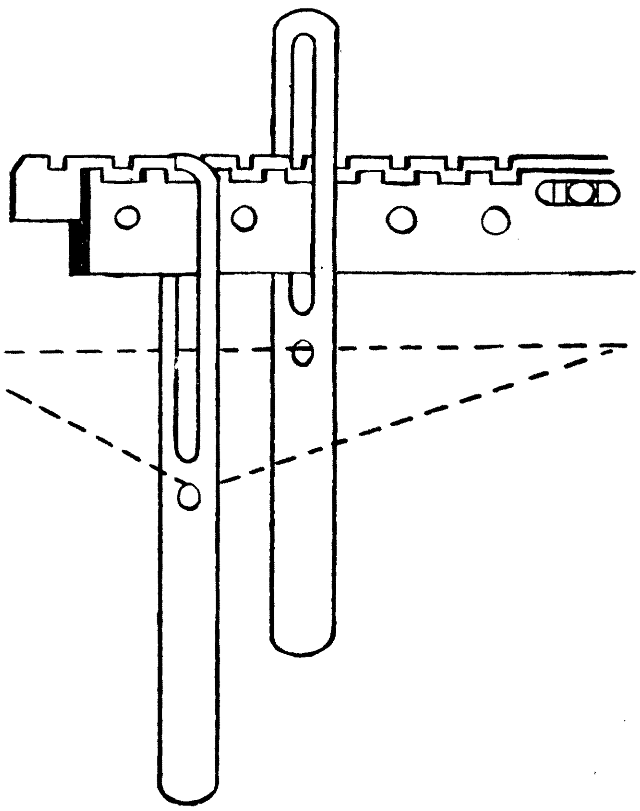


Fig. 468.
Mather and Platt's Mechanical Warp Stop Droppers.

By falling, the dropper is caught between the stationary and moving bars, and arrests the moving notched bars. The arrested movement tightens the cable wire inside the steel tube shown in Fig. 467. The taut wire elevates the finger seen on the setting on handle, which is kept raised for the time being by a small catch. As the going part moves forward, the iron casting shown in black, comes in contact with the raised finger, forces the setting on handle out of its notch, and so stops the loom.

When the warp is "felled out" a fresh one may be twisted to the thrum in the loom without removing heald shafts or droppers, or, if more convenient, then droppers and bars, heald shafts and sley may be conveyed to the twisting frame.

The electric driving for mechanical droppers is given at Fig. 469. The eccentric is timed to begin the push to the

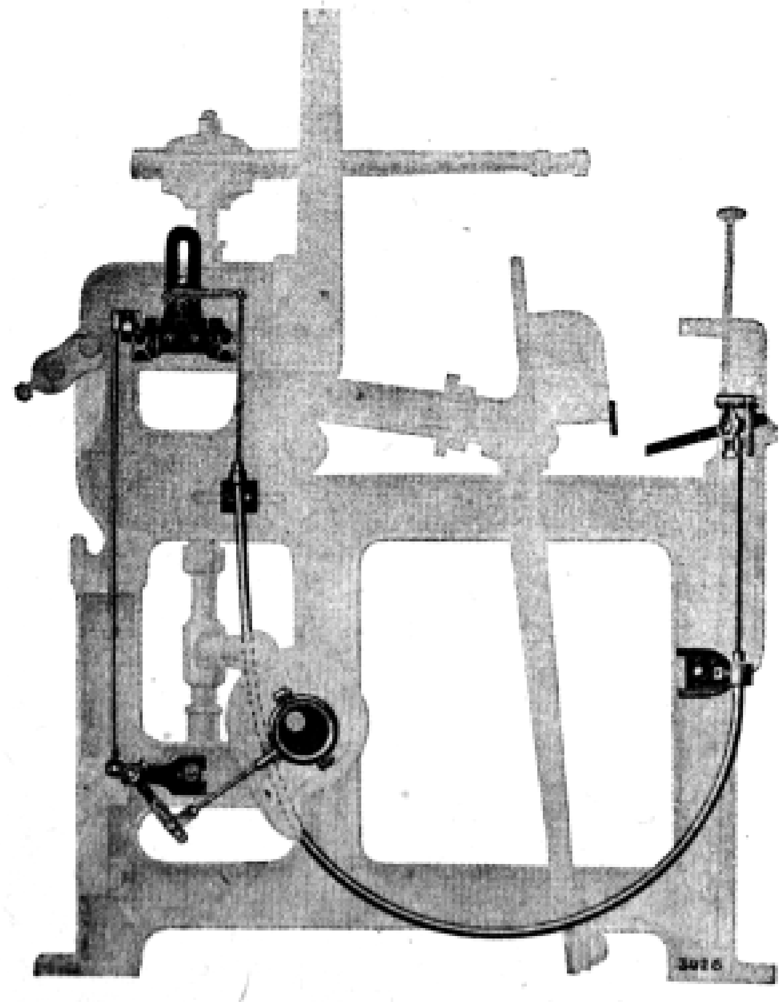


Fig. 469.
Mather and Platt's Electrical Warp Stop Motion.

moving bars when the crank is at or just past its back centre. The leverage imparted to the arm connected by rod to the eccentric must make the bars move at least ⅝th inch.

The electric droppers are presented at Fig. 470. It will be seen that the upper inner part slopes upward. It is astride an electrode, which consists of a body made of steel, and copper plated, and in it is inserted a copper and stationary blade. This blade is insulated from the body by means of a fibre strip. One pole of the battery is connected to the body, and the other pole to the copper blade.

When a dropper falls, the sloping inner top is the means of electrically connecting body and blade. This energises a magnet at the front base of the loom by the

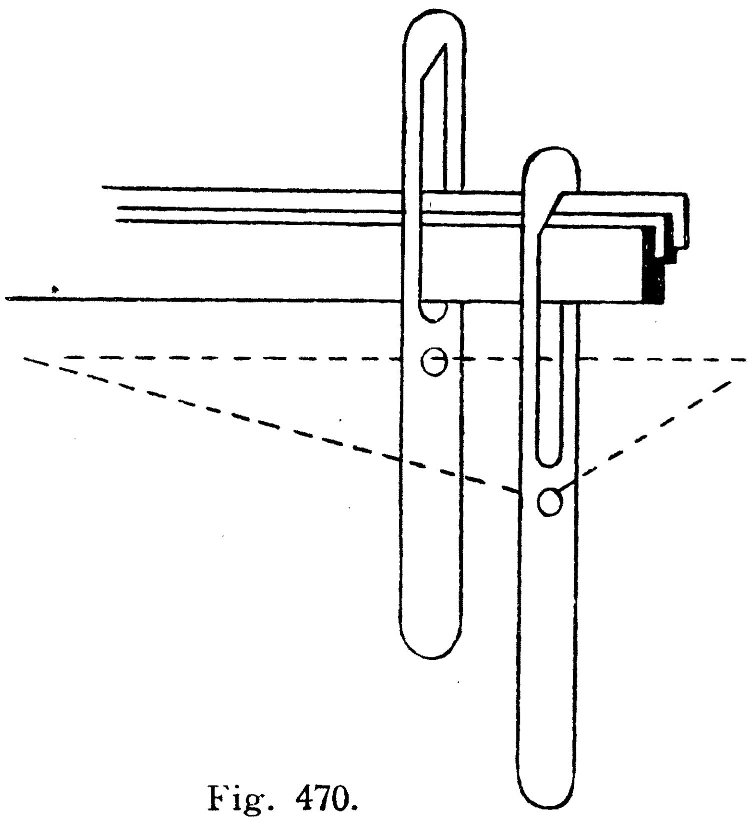


Fig. 470.
Mather and Platt's Electrical Droppers.

setting on handle. The action of the magnet is to raise a finger similar to those shown in Figs. 467 and 468, and the loom is then stopped in the same way. From two to eight electrodes may be fitted to a loom according to the demands of the warp. The current consumption is very small.

Mather and Platt's Humidifier.

For the weaving of most cotton goods, it is essential that there be a humid atmosphere in the weaving shed. Humidity assists in keeping the size on the warps, and makes them more plastic, and the weaving is performed quicker and better. In hard twisted wefts, a dry atmosphere increases the tendency for the weft to snarl, and snarls are difficult to get out of the cloth. Most cotton is made up of fine and small fibres, and by the friction of weaving, many of them are broken off and fly in the air. When the atmosphere is humid, the particles become heavier and drop to the floor more quickly. If humidity has to be maintained within certain limits, it has to be artificially made, and maintained, and tested. The usual standard aimed at is to keep the humidity between 60 and 70 degrees. The amount of humidity is tested by the use of two thermometers, one being for temperature, and the other for moisture. When the records are made from the two bulbs, the nearer they are together, and the more moisture there is in the room, and *vice-versa*.

Messrs. Mather and Platt have made a long and careful study of the whole subject, and after many experiments, have evolved the "Vortex" system of humidification. This is presented at Fig. 471. Briefly, this system consists of a series of cylinders connected together that are served by a pump which delivers drinking water at a pressure of 135 lbs.

Fig. 471.
Mather & Platt's Humidifier.

per square inch. In the upper interior of the cylinder is a nozzle, the latest pattern being made of gun metal. Through this, 960 lbs. of water is pumped per hour at the pressure stated, the jet of the nozzle only being $\frac{1}{16}$th inch. Below the nozzle is the flat head of an adjustable pin which is also made of rustless steel. As the water is forced down upon it, the spray is thrown down the whole width of the tank. This method sucks in the air at about 500 cubic feet, per minute, and the only escape the air can make is through the spray of water. It is in this way that the air of the weaving shed is humidified, cooled or heated by the use of cold or hot water, and the particles of dust and fibre removed.

SHUTTLES FOR LANCASHIRE LOOMS.

The management of shuttles has previously been explained in " Chapter on Shuttles," but new and improved shuttles are made by various firms, and some of these are illustrated herewith and explained.

The Pilkington Shuttle.—Two views given, and is for weaving rayon. It is 15 inches long, $1\frac{9}{16}$ inches wide, $1\frac{1}{8}$ inches deep. Length of pirn spindle $6\frac{5}{8}$, and has a paper pirn with a metallic flanged bottom, held by steel clips by spindle block, the pirn being $5\frac{1}{2}$ inches long. The shuttle is not as deep as the general run, and will work with a less shed. In selecting a pair of shuttles, they must be as near the same size, weight and grain as possible.

Swivel.—The swivel is at D, Fig. 472. It is made of nickel-plated wire, and solder fills up the spaces, and there

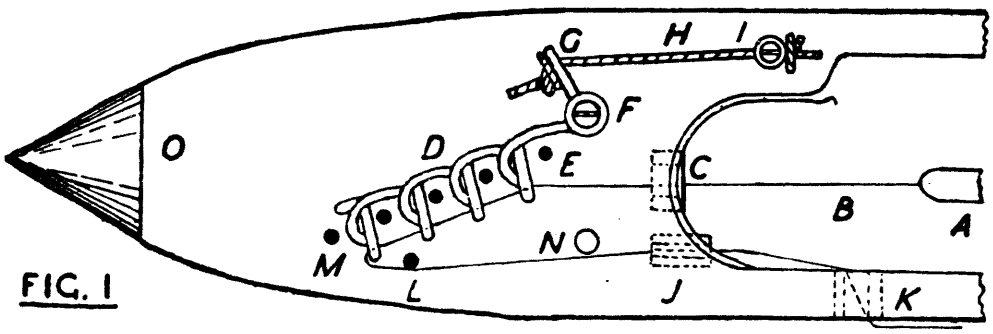


Fig. 472.
Pilkington's Rayon Shuttle (Top View).

is no thread catching when the weft is slack. There are four loops for weft to pass through, and at F, is twisted like a coiled spring, is rotary, and held by a screw that passes through top of shuttle. The bottom ends in an extended loop, and through the loop, thick elastic H, is passed and knotted.

At I is a screw bored through, and takes the other end of the elastic. The screw is turned by a screw driver to tighten the elastic, and holds the swivel more rigidly.

Weft Threading.—To thread the weft the looped end G is pressed forward as in Fig. 472, this pressure taking the loops on the swivel past the vertical steel pins in an oblique row at E. The threading hook then goes through all four

loops, and also the shuttle eye at C, and in this way weft B is conveyed through its forward traverse. The backward part is effected by passing the hook from right to left through the eye, and extending it below pins L and M. The final threading is through eye K at shuttle front.

The shuttle may be threaded in four ways.

(1) As arranged in Fig. 472 by leaving out pin M.

(2) To use all the loops and pins at Fig. 473.

(3) If a very light tension is required, then the weft may be brought down from third pin on right and passed behind pin L.

(4) In case the weft is cut or soiled in the box, instead of being passed through shuttle eyes at J and K, it is threaded through eye N in shuttle top, and passes to the cavity below. The weft then passes over the shuttle top, and does not come in contact with the inner side of box.

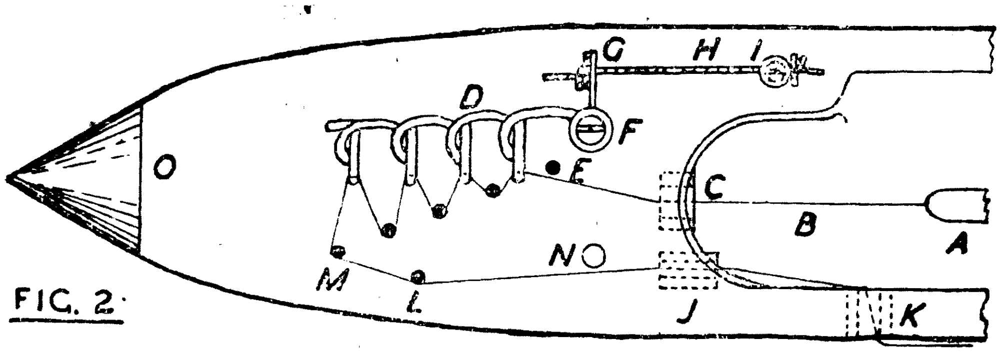


FIG. 2

Fig. 473.
Pilkington's Rayon Shuttle Thread.

Swivel in Weaving Position.—As soon as the weaver releases loop G, elastic H immediately pulls the swivel back to the position at Fig. 473. The weft now makes a zig-zag path through the swivel loops by means of the row of pins E. If the elastic loses power it is easily replaced by taking out screws F and I that liberates swivel and elastic.

If elastic is cut into standard lengths, it can be knotted to satisfaction first time. The inner sides of the shuttles are shaped to the length of the pirn to receive strips of suitable fur. It will be realised that a swivel shuttle is superior to those using mops for rayon weaving, for the swivel is resilient to the amount of drag on the weft. If the spindle has dropped, the swivel eases the drag.

Hand Threading Rayon Shuttle.—The shuttle here demonstrated has been patented by Messrs. James Nelson, Ltd., Valley Mills, Nelson. Its total length is 15⅛ inches to provide room for long pirns, and promotes production.

Front depth 1$\frac{17}{32}$ inches; back depth 1$\frac{5}{16}$ inches, and conforms more to the shape of the front shed than most shuttles. It enables it to enter and emerge with more than ordinary ease, or allows a less shed to be made, Fig. 474. The spindle has a curved spring on its upper surface to hold the pirn. There are also two semi-circular wires between which the metal head of the pirn is made to pass.

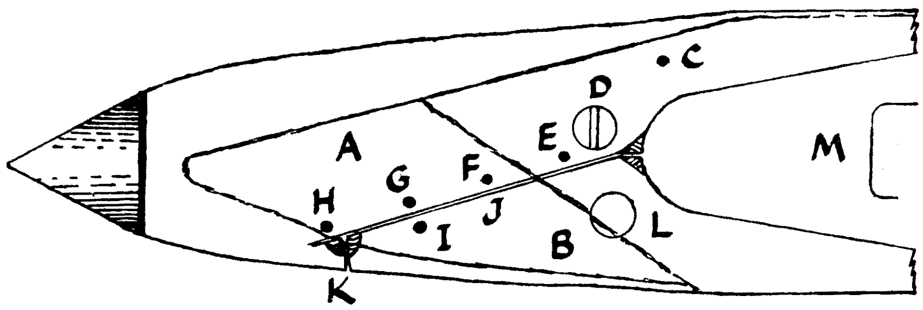


Fig. 474.
Messrs. Nelson's Silk and Rayon Shuttle. (Top View).

The under side of spindle block is **V**-shaped, and rests on a sloping part of the shuttle bottom, and the shaped part of a hard wooden peg. The spindle is kept in its weaving position by the pressure of an open spiral spring at the back of the spindle block. The block is held by a wooden peg. Should this work out at the back it would not do as much damage as a metal peg.

The total length of pirn is 6$\frac{3}{4}$ inches and weft length 6$\frac{1}{4}$ inches.

Top View.—This is at Fig. 474. The spaces A and B are cut away for reasons already explained. This cutting away is a little against the balance of the shuttle, for if the tip ends be swung between thumb nails, it tilts backward to an angle of 30 degrees. Instead of this being against good running, it is really more favourable, for it leans more heavily against the reed, and conforms more to its motion The angle formed by the shuttle race and reed must exactly conform to the angle made by shuttle back and bottom. C is the pin holding one end of the elastic connected to weft trap, and D the screw that forms the trap pivot. The steel pins, E, F and G, brake the weft before it emerges from shuttle. Pin H is for the weft to run against when flight of shuttle is to the right, and pin I does the same for the left run. Cut J is for the hand threading of the weft, and its length is 1$\frac{6}{10}$ inches. From this, a short cut is made at K that leads weft outside shuttle. At L is strong wooden peg that gives support to severed part of shuttle front. The end of pirn is at M, and the distance from end to entrance of tunnel is 1$\frac{1}{2}$ inches, and gives freedom for weft to unwind.

Both inner sides of shuttle are lined with opossum fur for the full length of the weft section on the pirn.

Shuttle Threading.—It is outlined at Fig. **475**. The **shuttle** is held in right hand, and the index finger pressed against weft trap at M. Elastic N is stretched, and trap pushed towards shuttle as shown. The two loops in the trap allow it to pass beyond pins E and F. At I, J and K, the wire is brought upward and forward, and then goes downward, inward, and a little upward. The forward part covers half the distance of the long loops, and is shaped Grecian pattern. The left hand holds weft B, and in going through cut J in Fig. **474**, it enters the short tunnel C in Fig. **475**. The weft then passes down the front sections I, J and K, and then emerges from shuttle at P.

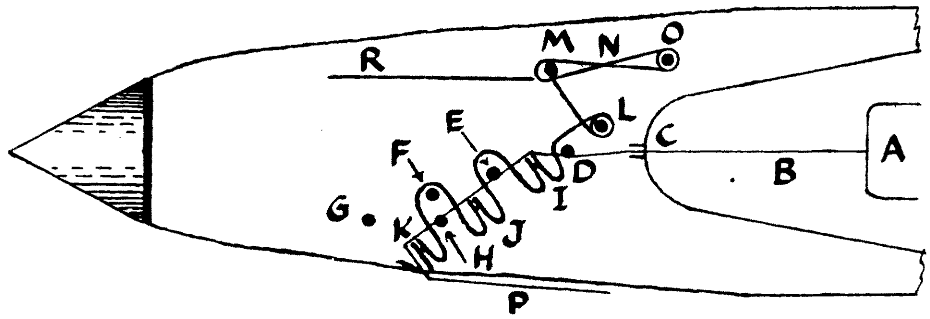


Fig. 475.
Messrs. Nelson's Non-Kiss Shuttle Threaded.

The weft is not properly threaded until the finger frees the trap at M. Then the backward movement of the trap forces the weft underneath the bent ends of the trap, and the results are seen in Fig. 476.

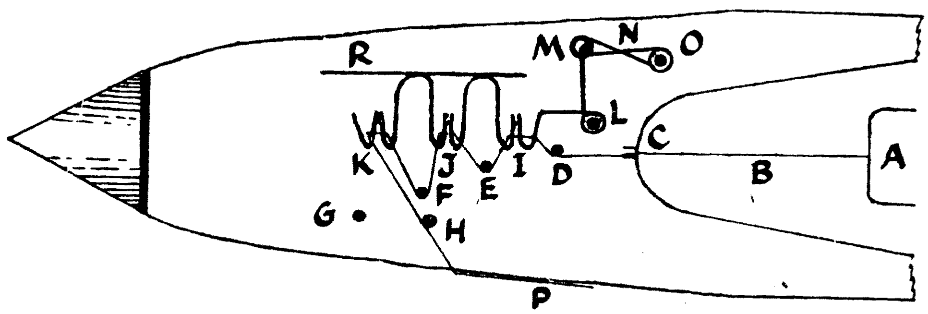


Fig. 476.
Messrs. Nelson' Shuttle Trap Pressed for Threading.

Weft in Weaving Position.—The weft trap comes to rest by the looped ends contacting with cut out part R. The weft now zig-zags between the pins and the trap. It is smallest at D and I, larger at E and J, and largest at E and K. The weft runs against pin G on one traverse and against pin H the next.

No hook is required to thread the shuttle, and no brushes or mops are necessary.

A Non-Kiss Shuttle.—The length of the trap is $1\frac{1}{10}$ inches; width, $\frac{4}{10}$ inch; depth $\frac{5}{20}$ inch. The length of front slot in shuttle where the weft emerges is $1\frac{1}{4}$ inches. The length of the back slot is $1\frac{1}{16}$ inches.

The shuttle has not to be nipped too tightly in the left hand box, so that no injury is done to the cut section of the shuttle.

Where the trap operates, the shuttle is cut through from front to back, but does not interfere with the holding of the shaft of shuttle tip.

A fibre washer is placed between the wood of the shuttle and the inner circle of the shuttle tip. The shuttle is well made, is quickly threaded, and promotes production.

COTTON DESIGNS.

Quite a number of designs are used for cotton goods that are seldom used for other textiles. Some are included in this selection that are extensively used in almost all classes of goods. The same weave with different yarns or finish of cloth is given another name, and there are also local names.

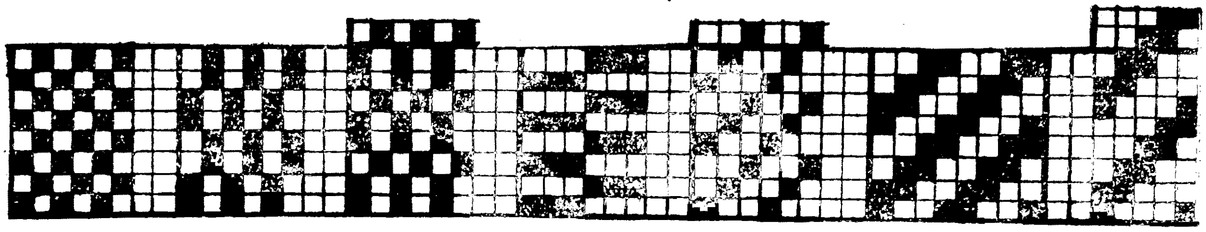


Fig. 477. Fig. 478. Fig. 479. Fig. 480. Fig. 481. Fig. 482. Fig. 483.

Fig. 477. Plain weave. Calico. Tabby. Repp. Sicilian.

Fig. 478. Ordinary warp rib. Poplin.

Fig. 479. Variation of warp rib with unequal ridges weft way.

Fig. 480. Weft rib. Moreen.

Fig. 481. Three shaft weft twill. Cashmere. Jean. Genoa.

Fig. 482. Two and two twill. Shalloon. Harvard. Serge. Sheeting.

Fig. 483. Five end weft twill.

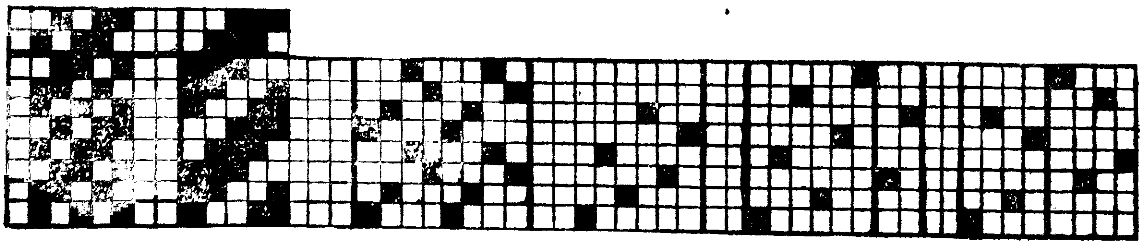


Fig. 484. Fig. 485. Fig. 486. Fig. 487. Fig. 488. Fig. 489.

Fig. 484. Five end contrast twill.

Fig. 485. Venetian.

Fig. 486. Four end sateen (weft). Broken Swansdown.

Fig. 487. Six end sateen (weft).

Fig. 488. Eight end weft sateen.

Fig. 489. Broken 8-shaft weft sateen.

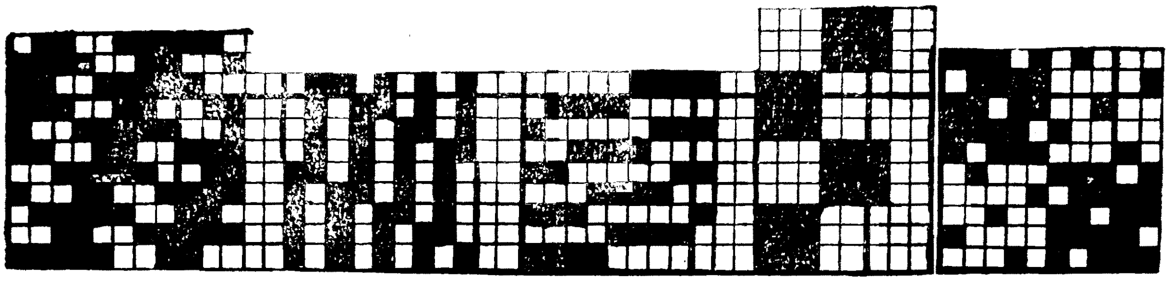


Fig. 490. Fig. 491. Fig. 492. Fig. 493. Fig. 494.

Fig. 490. Stepped twill. Gabardine.
Fig. 491. Nine shaft warp corkscrew.
Fig. 492. Nine shaft weft corkscrew.
Fig. 493. Hopsack. Matt. Basket. Dice.
Fig. 494. Five shaft warp and weft sateen check.

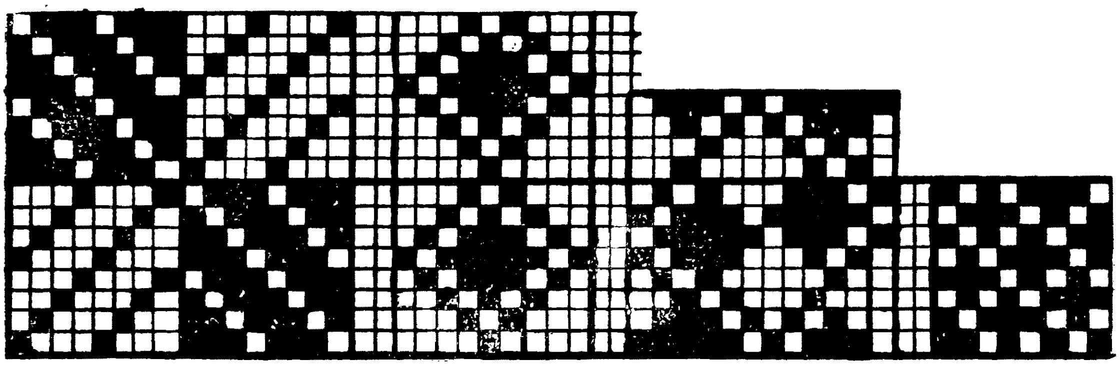


Fig. 495. Fig. 496. Fig. 497. Fig. 498.

Fig. 495. Dice twill counterchange.
Fig. 496. Honeycomb.
Fig. 497. Brighton honeycomb.
Fig. 498. Crépe.

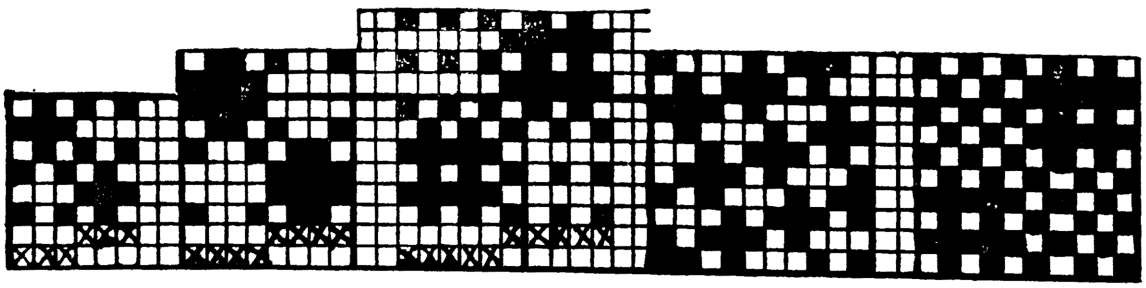


Fig. 499. Fig. 500. Fig. 501. Fig. 502. Fig. 503.

Fig. 499. Mock Leno. Three threads in dent.
Fig. 500. Mock Leno. Four threads in dent.
Fig. 501. Mock Leno. Five threads in dent.
Fig. 502. Sponge cloth.
Fig. 503. Huckaback.

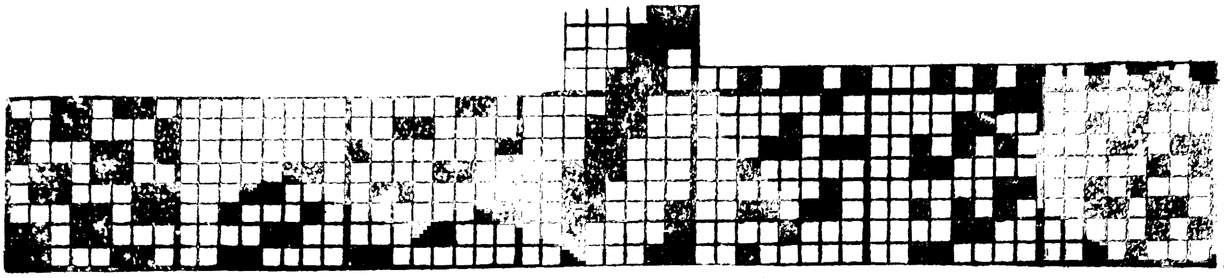


Fig. 504. Fig. 505. Fig. 506. Fig. 507. Fig. 508. Fig. 509. Fig. 510.

Fig. 504. Twilled hopsack. Granite.
Fig. 505. Swansdown.
Fig. 506. Imperial.
Fig. 507. Diagonal. Cantoon.
Fig. 508. Moleskin.
Fig. 509. Bevereen.
Fig. 510. Corduroy.

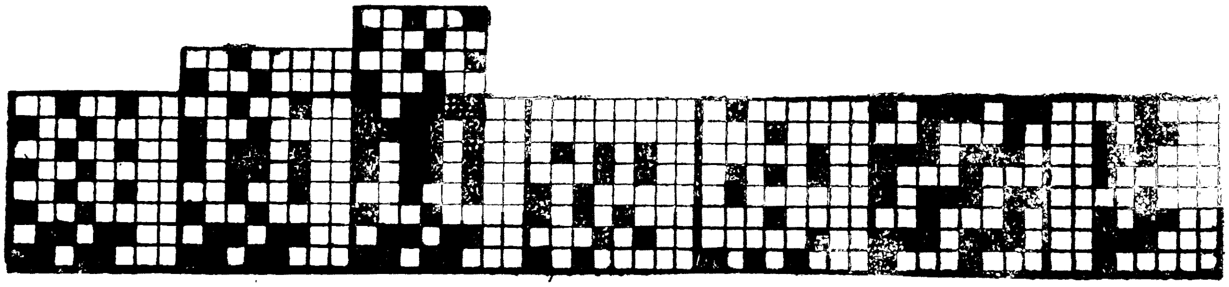


Fig. 511. Fig. 512. Fig. 513. Fig. 514. Fig. 515. Fig. 516. Fig. 517.

Fig. 511. Pique.
Fig. 512. Pique with wadding picks.
Fig. 513. Pique with wadding and backing picks.
Fig. 514. Corduroy with plain back.

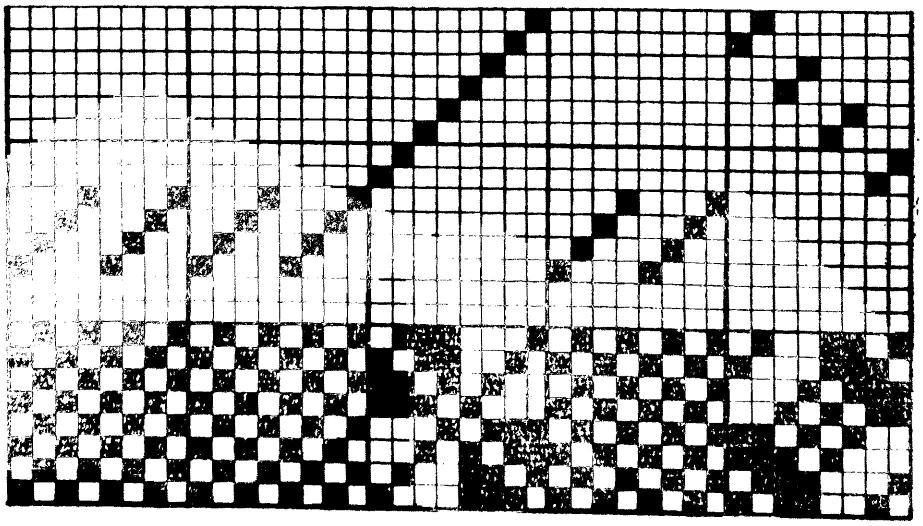


Fig. 518.
Oxford Shirting Drafted on 12 Shafts.

Fig. 515. Velveteen with plain back.
Fig. 516. Double plain weave.
Fig. 517. Two separate cloths.

Fig. 518. *Oxford Shirting.*—These are distinguished by having plain stripes and figured ones. The plain ends are sometimes doubled which then gives the cloth the effect of a weft cord ground. All kinds of small figures are used but those are neatest that fit with the ground weave.

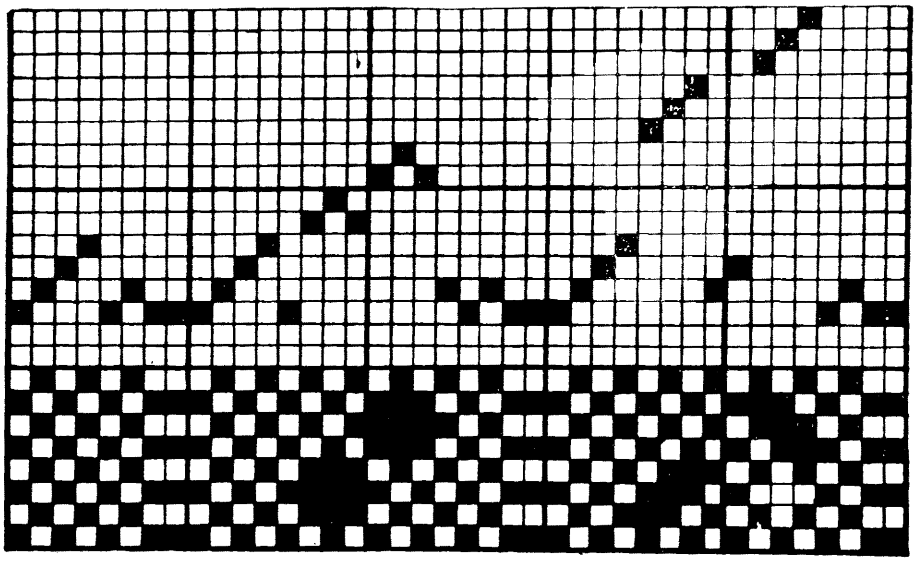


Fig. 519.
Zephyr Shirting Drafted on 14 shafts.

Fig. 519. *Zephyr Shirting.*—These cloths have also a plain ground and figures in stripe formation, but there are also weft cord stripes, which gives more variety than the previous example. Small neat figures are to be preferred to those with long floats.

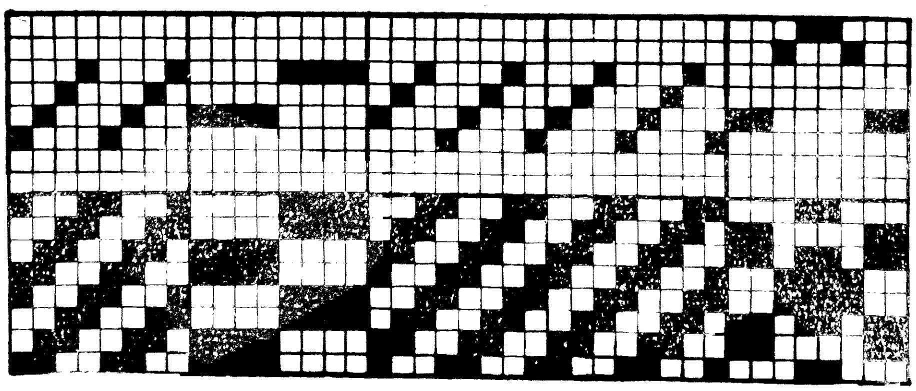


Fig. 520.
Harvard Shirting Drafted on 6 shafts.

Fig. 520. *Harvard Shirting.*—The ground weave is 2 and 2 twill, and the figures in the stripes are usually bolder. When they cut with the ground weave, neatness is added to variety.

INDEX.

ADAPTABILITY OF DESIGNS—409

	PAGE
Alternate Pick Design	419
Backed Cloths	429
Bedford Cords	420
Colour and Weave Effects	414
Crossed Diagonal	412
Diamond Patterns	412
Double Cloth	424
Double Plain Cloths	422
Figured Diagonals	413
Figured Dobby Work	421
Figured Mohair Plan	421
Four End Sateen	412
Hairlines	410
Jacquard Designs (5)	228
Maze Pattern	414
Pick and Pick Effects	418
Sateen Derivative	417
Shaded Effect	418
Spot Designs	417
Stripe Effect	420
Twilled Check	413
Warp Face Cloths	416
Weaving Typical Designs (16)	379

BELTS—237

Belt Repairing	241
Belt Tension	240
Conditioning Belts	240
Correct Lineage	238
Cross Drive	239
Five Special Points	242
Half Cross Drive	238
Long Driving Belts	239
Method of Loom Driving	237
Ordinary Woven Belting	242
Quality of Belts	237
Rubberized Woven Belting	241
Twisting Belts	240

CENTRE SELVEDGE MOTIONS—298

Bobbin and Weight	302
Chain Selvedge	302
Function of Needles	300
Method of Setting	299
Selvedge Threads	302
Setting Rocker Shaft	301
Star Wheel	300
Weaving Positions	303
Wire Grid	302

CIRCULAR BOX LOOM—140

	PAGE
All-Metal Circular Box	146
Box Lags and Cylinder	144
Box Problems	145
Construction of Box	141
Hammer and Box Forks	142
Lifting Catch and Indicating Lever	143
Pin Cylinder and Star Wheel	141
Tappet and Fork Lever	145
Tappet Lever	144
Cotton and Rayon Mixture Yarns (12)	504

COTTON DESIGNS—(44)—558

DOBCROSS WHIP PICK BOX LOOM—115

Automatic Bobbin Changing	138
Beating Up	125
Box Control	130
Box Motion	129
Connector	117
Differential Motion	136
Dobby Jack	116
Driving of Loom	133
Escape Motion	119 130
Function of Lock Wheel	138
Knocking-Off	134
Lag Cylinder and Bracket	118
Let-Off Motion	125
Lock Knife and Cam	118
Low Picked Cloth	136
Making Box Lags	131
Negative Take-Up	134
Picking Arm	123
Picking Shaft and Shoe	123
Pick Jack and Slides	131
Shaft Levelling and Reversing	120
System of Shedding	115
Take-Up Motion	126
Vibrator Wheel and Lever	117
Whip Pick Picking Boss and Tappet	122

DRACUP'S MATTING JACQUARD—232

Comber Board	236
Griffe and Lifting Board	234
Hook Guide Board	234
Hooks and Wires	234
Lingoes and Weights	236
Needles and Press Board	235
Oscillating Shafts	232
Slide Cylinders and Safety Chains	233
Timing of Cylinder	234

ELECTRIC DRIVING OF LOOMS—321

Mather and Platt's Chain Drive for Motor Alley Way	333
Mather and Platt's Group Drive	334
Mather and Platt's Individual Drive	335

	PAGE
Metrovick's Belt Drive	326
Metrovick's Chain Drive	327
Metrovick's Cross Shaft Drive	322
Metrovick's Clutch Gear Drive	328
Metrovick's Individual Drive	323
Metrovick's Line Shaft Drive	321
Metrovick's Three Motors	325
Metrovick's Sections of Motor	324
Metrovick's Switch	329
Wigglesworth's Tex-Rope Drive	330 331
Wigglesworth's Motors for Northrop Looms	332

FAULTS AND REMEDIES IN LINEN WEAVING—501

Ballooning Wefts	503
Beaded Yarn	502
Burst Weft	503
Dirty Yarns	502
Faults Prior to Weaving	501
Harsh Threads	502
Looped Cloth	503
Looped Selvedges	503
Neps	502
Poor Cover	503
Preparations for Weaving	501
Slubs	502
Stiff Yarns	502
Strength of Line and Tow Yarns	501
Variable Twist	503

FAULTS AND REMEDIES IN RAYON WEAVING—525

Barry Places	525
Bright Picks	526
Broken Threads	526
Buttons	526
Cheese Winding	530
Cockled Places	527
Cracks	527
Creases	527
Curls	527
Dirty Weft	527
Edge Threads	531
Faulty Selvedges	531
Oil Stains	528
Perforations	529
Picks Missing	529
Reed Marks	529
Set-Up Places	529
Selvedge Faults	530
Shuttle Marks	532
Snarls	532
Trailing In	533
Wrong Patterns	534

FAULTS AND REMEDIES IN WOOLLEN AND WORSTED FABRICS—386

PAGE

Barry Places 386 387
Broken Threads 388
Cracks and Curls 389
Cockled Pieces 390
Dirty Weft 390
Double Picks and Fleaks 390
Heavy and Light Weight Pieces 390
Loom Stains 391
Misplaced Threads 391
Mixed Weft 391
Pegs Out 391
Picks Missing 391
Selvedge Faults 392
Stitching 392
Temple Marks 393
Torn Places 393
Traps 393
Uneven Colours 393
Wrong Lifts 394
Wrong Patterns 395

HATTERSLEY'S AUTOMATIC BOBBIN CHANGING LOOM—106

Affiliated Levers 110
Battery Latch and Transfer Hammer 113
Checking of Shuttle 114
Connection to Shuttle Feeler and Weft Fork 112
Front View of Picking Parts 108
Inner Part of Magazine and Slides 110
Picking Catch and Slide 107
Picking from Left and Right Hand 107
Prime Mover for Bobbin Changing 109
Shuttle Feeler and Weft Cutter 113
Slide Rod and Lifting Plate 111
Three Legged Tappet Lever 109

HATTERSLEY'S AUTOMATIC SHUTTLE CHANGER FOR SILK AND RAYON—178

Cam and Lever Movements 179
Functions of Tappets 181
Loom Stoppage by Lever Action 180
Setting Loom in Motion 183
Shuttle Changing Tappets (4) 181
Weft Feeler Motion 178

HATTERSLEY'S CIRCULAR BOX FOR SILK AND RAYON—155

Bobbin and Advantages 162
Dobby Structure 155
Letting Cloth Back 158
Needle and Knock-Off Finger 161
Passage of Piece 159
Reversing Mechanism 157
Shedding Levers and Tappets 156
Temples 159
Weft Feeler Motion 160

HATTERSLEY'S DROP BOX LOOM FOR DRESS GOODS—62

	Page
Balks, Catches and Feelers	63
Bottle Neck Casting	65
Box Lag Pegging	68
Box Rod	66
Driving of Loom	68
Engine Jacks	62
Fitting Lag Cylinder	64
Frogs	67
Lags and Cylinder	64
Let-Off and Take-Up	68
Picker and Boxes	66
Picking Clutch	65
Picking and Cone Casting	64
Picking Stick Brackets	65
Pulleys for Top Shafts	63

HATTERSLEY'S DROP BOX FOR SILK AND RAYON—164

Box Motion	172
Dobby	164
Fast and Loose Levers	174
Fast and Yielding Reed	168
Front View of Weft Fork	175
Knock-Off Position	175
Negative Let-Off	169
New Method of Take-Up	169
Outer Take-Up Shaft	172
Picking	165
Picking Stick and Arm	166
Take-Up Drum	171
Tappet Checking	166
Tappet Driven Weft Fork	173
Weft Fork Regulator	174

HATTERSLEY STANDARD MODEL LOOM—70

Alterations When Reversing	103
Balks and Catches	71
Bottle Bracket	79
Box Lags and Feelers	86
Box Vibrator and Wheels	88
Brake and Driving Wheel	94
Breast Beam Castings	98
Checking Motion	96
Cone Casting and Pick Clutch	75
Crank Arms	77
Dobby	70
Dolly Shaft and Gearing	86
Draw and Holding Bars	73
Driving of Loom	93
Eccentric Shedding Wheels	73
Effect on Picking Forks	102
Effect on Reversing Collar	100
Functions of Control Plate	100
Gunmetal Bushes	78
Let-Off Motion	80
Let-Off Wheel and Catches	82
Lifting Lever and Boxes	90

	Page
Lifting Rod Lever	81
Lock Knife	89
Movement of Going Part	78
Movements at Knock-off	80
Needles and Feelers	72
Pick Finder	97
Pick Finder in Action	100
Pick Finder in Weaving Position	100
Picking Shaft	75
Picking Stick, Strap and Picker	76
Picking Stick Castings	76
Planning Box Work	92
Regulation Collar	76
Reversing and Cross Shaft Castings	103
Setting of Cylinder	73
Shaft Lags and Star Wheel	72
Shell Nose	74
Stop Rod and Tongue	78
Styles of Frogs	79
Swing Rail Lever	83
Sword and Shuttle Race	77
Take-Up and Reversing	84
Use of Reversing Handles	102
Weft Forks	97
Wheels and Cylinder	89
Worm and Beam	82

HATTERSLEY "V" DOBBY—56

Dobby Parts	56
Draw Bars	58
Eccentric Wheels	59
Feelers and Cylinder	58
Felt-Covered Roller	61
Timing of Shed	60

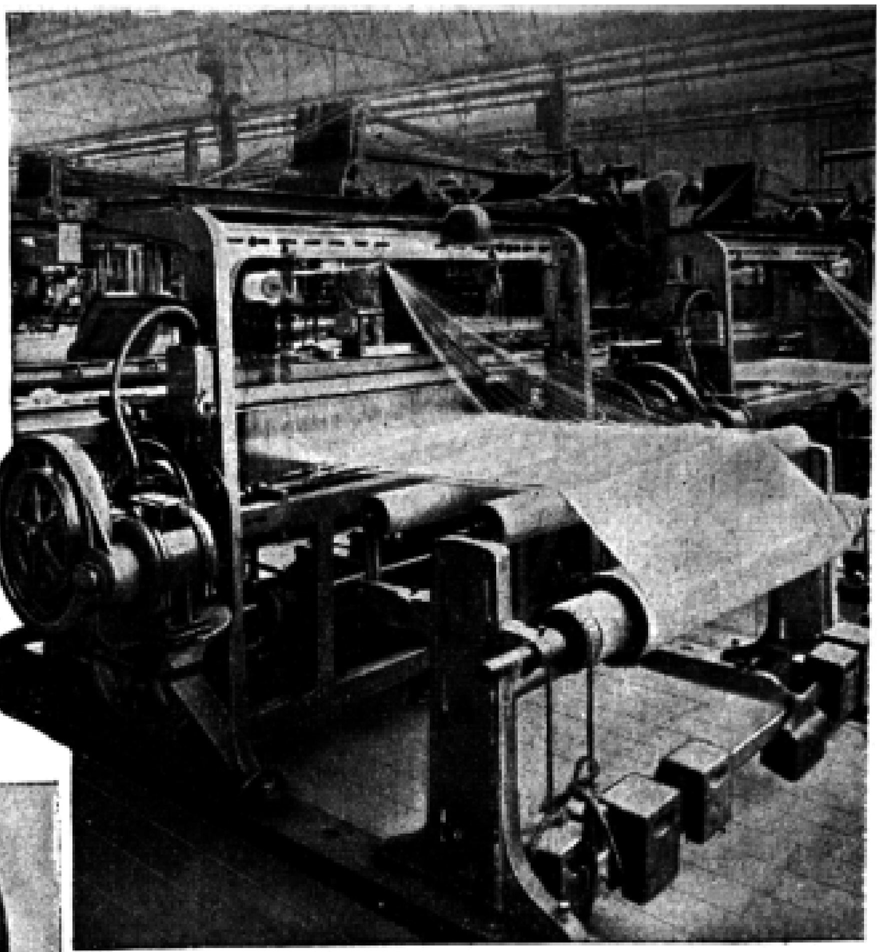
HEALDS—11

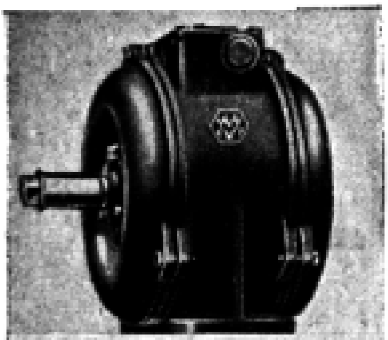
Cotton and Worsted Healds	13
Figured Gauze	23
Flat Wire Healds	13
Grob's Gauze Healds	20
Kartex Plus Frame	24
Knitted Wire Healds	15
Leno Cloth	23
New Heald Frame	18
Slider Wire Healds	11
Smith's Patent Healds	16
Soldered Wire Healds	13
Twisted Wire Healds	11

JACQUARD LOOMS—207

Card Strippers	218
Cylinder and Card Strippers	227
Cylinder Tappet and Slide	226
Double Lift Double Cylinder	231
Double Lift Single Cylinder	215
Dracup's Driving Motion	218
Dracup's Matting Jacquard	232

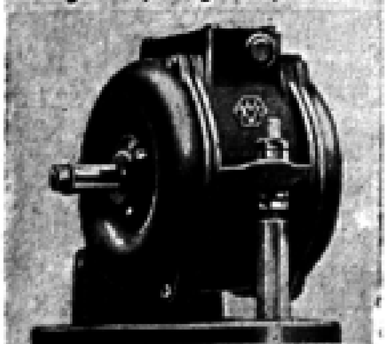
Illustration shows 1 *H.P. motor driving Rüti Silk Loom through gearing.*





Foot-mounted

Hinged Spring Suspension



Hinged Rigid Suspension

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PAGE

Dracup's Selvedge Motion 219
Dwell of Disc and Lever 213
Griffe Hooks and Needles 224
Griffe Rod and Disc 223
Inner Pitch of Cylinder 227
Jacquard Patterns (5) 228 231
London Tie-Up 211
Movable Needle Plate 218
Norwich Tie-Up 207
Reversing Cup and Advantages 227
Reversing Mechanism 211
Shedding Disc and Lever 213
Vincenzi Jacquard 222

LEATHERS—270

Buckles 272
Check Straps 272
Controlling Picking Stick 271
Dobcross Check Strap 273
Dobcross Box Loom Checking 274
Hattersley Box Loom Checking 273
Hattersley Friction Drive Clutch 274
Improved Checking Arrangement 274
Increased Checking 272
Method of Attachment 269
Picking Straps 269
Pitch of Strap 270
Shaft Leathers 272
Under Pick Motion 270

LEEMING DOBBY—49

Bowl Levers 51
Connecting Arms 50
Cylinder and Lags 52
Cylinder Levers 52
Cylinder Segment Wheels 50
Engine Jacks 49
Finding Pick 54
Finger Levers 53
Jack Wheels 50
Lag Making 54
Segment Wheel Cap 51
Standardized Parts 54

NORTHROP LOOMS—184

Battery in Changing Position 196
Battery in Weaving Position 195
Beating Up 191
Bobbin Changing Mechanism 192
Box Swells 201
Brake and Frog 200
Checking Picking Stick 190
Cutting Weft at Temple 199
Dobby 184
Droppers 203
Electric Feeler Motion 206
Individual Drive 205

PAGE
Let-Off Motion 191
Looms per Weaver 205
Magazine 198
Mechanical Box 201
Picking Mechanism 189
Shuttle Eye Weft Cutter 201
Shuttles 199
Speed of Loom 205
Stopping of Loom 204
Take-Up Motion 193
Weft Winding 198

ORME'S PICK COUNTERS—317

Equity of Payment 318
General Construction 318
Incentive 319
Reliability 318
Shift System 320

PICKERS—261

Buffer 265
Dobcross Pickers 266
Hattersley Pickers 265
Ordering 261
Pickers made by British Picker Co. 265 267
Preparations 262
Preparations for Loom 262
Second Drying 262
Stand of Stick 264
Steeping in Oil 262
Working Conditions 263

PRELIMINARIES FOR WEAVING—27

Adjusting Shed 32
Attention to Sley 30
Altering Change Wheel 31
Beginning Weaving 32
Brigg's Let-Off Motion 28
Close Setted Warps 34
Counting Picks 33
Examination of Patterns 33
Examination of Threads 33
Gearing Up 27
Lag Changing 31
Overhauling 34
Temple Setting 30
Weighting Warp Lever 32

PROBLEMS OF THE LOOM—336

Brake of Loom 344
Broken Crank 344
Broken Loom Frame 344
Broken Sword 342
Causes of Knock-Off 340
Cone Stud of Bouncing Stick 348
Defective Picking 346
Dobcross Picking 349

PAGE
Dobcross Timing 339
Dropped Boxes 355
Extra Roller Work 366
Hattersley Catch Pick 348
How Timing is Altered 337
Improved Northrop Shuttle Eye 353
Late Timing 336
Let-Off Motion 361
Ordinary and Early Timing 337
Overpick 346
Positive Shedding 338
Positive Take-Up 362
Quadrant Let-Off 362
Rising of Sword 342
Rope Wrapping 366 367
Shuttle Running 350
Slack Crank Arms 351
Stiff Running Loom 346
Testing Drop Boxes 364
Thread Interceptor 370
Timing Lag Cylinder 359
Timing of Shed 336
" V " Rope Construction 354
Weft Breaking 356
Weft Cutting 355
Weight of Fabrics and Make of Loom 357
Worn Shuttles 355
Worn Sley Rack 357
Wrong Lifting 357

RAYON AND CREPE WEAVING—149

Box Work 154
Breast Beam and Back Rail 150
Construction of Tappets 150
Crossing of Heald Shafts 152
Hattersley Combined Tappets 153
Looming and Tappet Construction 151
Open Shed and Lease Rods 152

RAYON AND "FIBRO" DEVELOPMENTS—509

Patterns and Designs 436 444

REEDS—1

Adjustment of Sley 5
All Metal Reed 9
Construction of Sley 1
Double Sleys 3
False Reed 4
Functions of Sley 2
Grob's False Reed 5
Loose Reed 5
Sley Damage 7
System of Warp Setts 2

SHUTTLES—244

	Page
Brake Brush	254
Delivery of Shuttles	256
Fixing Loose Tips	260
Flight of Shuttle	257
Importance of Shuttles	245
Life of Shuttles	260
Loom Adjustments	254
Progressive Stages	245
Proportions	246
Selection of Shuttles	252
Shuttles for Rayon and Crepes	249
Speed of Shuttles	258
Steeping in Oil	254
The Angles	258
Wearing of Shuttles	259
Weight, Size and Grain	252

SHUTTLE GUARDS—276

Bedford Shuttle Guards	276	277
Ideal Shuttle Guard	278	280

TAPPET LOOMS—35

Altering Timing	46
Back Rails	44
Calculations for Intermediate Wheels	39
Connecting Rods	41
Direction of Tappet Movement	43
Easing Tension by Shed Timing	46
Extra Back Rails	45
Half Moon Levers	42
Matt Weaves	43
Necessary Modifications	38
Range of Fabrics	36
Range of Makes	35
Rope Let-Off	47
Selvedge Tappets	39
Size of Friction Bowl	41
Size of Shed	42
Speed of Tappet	39
Tappet Construction	36
Treadles	39
Wearing of Ropes	48
Weaving Poplins	44

TEMPLES—286

Advantages of Sloping Rings	258
Alterations for Light and Heavy Fabrics	297
Construction of Barrel	295
Construction of Pressure Plate and Lever	295
Construction of Temple	287
Contraction of Pieces	286
Defective Pins	294
Effect of Worn Cap	294
Escape Motion	289
Function of Cap	288
Function of Side Spring	293

PAGE
Inclined and Straight Rings 291
Necessity of Temples 286
Piece Tearing 293
Regulating Barrel 289
Rings same Size and Angle 291
Setting of Temple 292
Setting 296
Slack Sley and Temple 294
Temple Marks 293
Types of Temples 287
Walker and Bennett's "Adaptable" Temple 294

UNDER MOTIONS—281

Additional Strength 285
Difference in Spring Pull 284
Hattersley Construction for Narrow Looms 281
Hattersley Two Tier Make 282
Hook Links 283
Leasing the Warp 285
Spring Levers 282
Spring Tension 284

USEFUL MODIFICATIONS IN WEAVING—396

Bumping Pieces 396
Checking of Shuttles 397
Condition of Warp 402
Condition of Weft 406
False Reed 398
Lease Rods 398
Picking 399
Selvedges 401
Temples 401
Under Motion 401
Uneven Lifts 404
Weaver's Knots 408
Weft Fork 402
Weft Trails 407

WASTE REDUCTION IN WEAVING—372

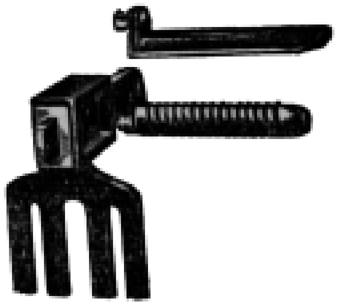
Adjustment of Loom 374
Bulb Nosed Weft 377
Clean Yarn 377
Cracked Bobbins 377
Missing Picks 376
Ravages of Moths 377
Structure of Bobbins 372
Tearing at Temple 377
Warp Waste 378
Weft Fork Assistance 375
Winding of Yarn 374
Wrong Lifts 376

WEAVING OF TYPICAL DESIGNS—379

Angles of Twills 380
Cloths Backed with Warp 384
Cloths Backed with Weft 383
Double Cloths 384

TEMPLES

for Modern Looms



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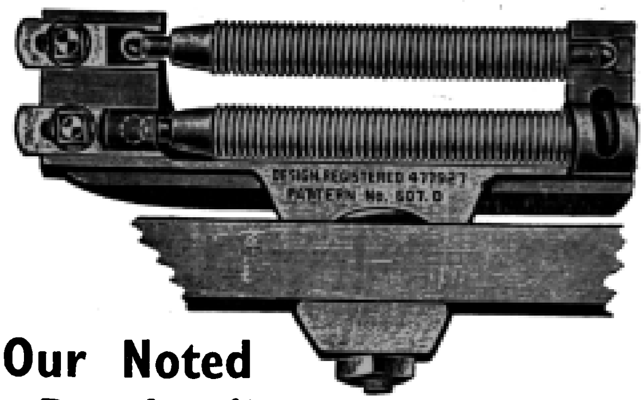
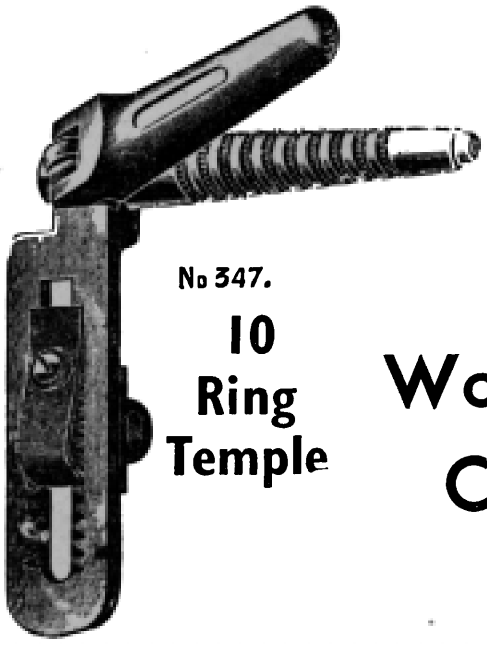
15 Ring Temple



Our Noted "Revoleze" Patent Temple



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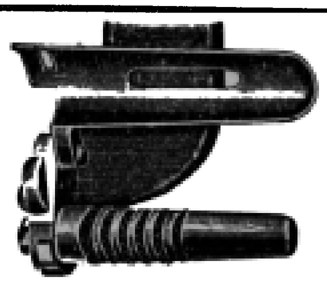

1059

6 Ring Temple

Lupton Bros Ltd

TEMPLES SPRINGS

ACCRINGTON ENGLAND

TELEPHONES: ACCRINGTON 2115 & 2116

PAGE
False Reed and Lease Rods 379
Fancy Draft 382
Floats for Worsteds 379
Good Temples 380
Hopsacks 380
Ordinary and Diamond Twills 380
Sateens 382
Timing of Shed 379
Twills with Heavy and Light Lifts 381
Whipcords and Corkscrew 383

WEFT FORKS—304

Brake Leather and Spring 312
Brake Motion and Spring Rod 314
Centre Horizontal Weft Fork 306
Extension Rod and Finger 312
Framework and Tippler 310
Hudson's Centre Weft Fork 310
Hudson's First Pick Stop Motion 313
Ordinary Brake and Brake Band 315
Pendulum and Slide 313
Release Lever 316
Slide and Brake Rod 311
Tumbler Weft Fork 304
Vertical Centre Weft Fork 308

ACCESSORIES FOR LANCASHIRE LOOMS—540

Lupton Bros. Double Roller Temple 540
Lupton Bros. Nylon Temple 542
Lupton Bros. Ten Ringed Temple 541
Mather & Platt's Electrical Warp Stop Droppers 550
Mather & Platt's Electrical Warp Stop Motion 549
Mather & Platt's Humidifier 551
Mather & Platt's Mechanical Warp Stop Droppers 548
Mather & Platt's Mechanical Warp Stop Motion 547
Mather & Platt's Weft Feeler Motion 545
Mather & Platt's Weft Fork Knock-Off Motion 546
Nelson's Hand Threading Rayon Shuttle 554 556
Pilkington's Hand Threading Rayon Shuttle 553

CAUSES OF WARP AND WEFT BREAKAGE IN COTTON WEAVING—480

Alteration to Brushes 484
Back Shed Breakages 480
Breakages by Shuttles 482
Breakages in Front Shed at Healds 482
Broken Cops 484
Chafed by Reed 481
Cracked Shuttles 486
Defective Lease Rods 480
Faulty Shuttling 484
Harsh Picking 485
Inadequate Slashing 480
Mechanical Parts 480
Misfits of Loom Parts 484
Oiling Spindle Block 484
Oversized 480

PAGE
Skewering and Packing 484
Snarls 484
Soft Nosed Bobbins 483
Special Bradley's Prize Winning Let-Off Motion 486 487
Temples too Near Reed 485
Tender Yarns 483
Threads Broken by Shuttles 482
Worn Shuttles 483

COMMON FAULTS IN WEAVING RAYON—525

Barry Places 525
Bright Picks 526
Broken Threads 526
Buttons 526
Cheese Winding for Selvedges 530
Cockled Places 527
Cracks 527
Creases 527
Curls 527
Dirty Weft 527
Edge Threads 531
Faulty Selvedges 531
Oil Stains 528
Perforations 529
Picks Missing 529
Reed Marks 529
Selvedge Faults 530
Set-Up Places 529
Shuttle Marks 532
Snarls 532
Trailing in 533
Wrong Patterns 534

COTTON AND RAYON MIXTURE YARNS (HUTCHINSON'S)—504

Twelve Varieties.

COTTON DESIGNS AND DRAFTS—558

Forty-three Standard Designs.

DEVELOPMENTS IN NEW YARNS—NYLON—535

" Fibro " and Casein 539
Discovery of Nylon 535
Immunization 536
Inflammability 536
Lack of Warmth 536
Lustre 536
Process of Production 535
Static Electricity 536
Strength and Elasticity 535
Water Repellent 536
Weaving Conditions 536
Wefting 537
Discovery of Vinyon 538
Process of Production 538
Properties and Uses 538
Weaving 538

FAULTS AND REMEDIES IN LINEN WEAVING—501

	PAGE
Ballooning Weft	503
Beaded Yarn	502
Burst Weft	503
Dirty Yarns	502
Faults Prior to Weaving	501
Harsh Yarns	502
Looped Cloth	503
Looped Selvedges	503
Neps	502
Poor Cover	503
Preparation for Weaving	501
Slubs	502
Stiff Yarns	502
Strength of Line and Tow Yarns	501
Variation in Twist	503

HALL'S HOSEPIPING LOOM—440

Double Beat Up	443
Let-Off and Take-Up	445
Metal Shuttles	442
Shedding	440
Take-Up Motion	443
Wefting	440
Winding	445
Yarns Employed	440

HATTERSLEY AUTOMATIC LOOM FOR CANVAS AND DUCK CLOTH—446

Cloth Beam	447
Feeler Motion	448
Novel Back Rest	446
Overpick	447
Shedding	447
Shuttle Changing Mechanism	448
Shuttles	448
Take-Up	447
Tappet Shedding	447
Warp Beam	446

LANCASHIRE DOBBY LOOMS—438

Lupton & Place's "Climax" Dobby	439
Ward Bros. (Blackburn) Dobby	438

LANCASHIRE DROP BOX LOOMS
HALL'S DROP BOX LOOM—466
LANCASHIRE AND YORKSHIRE LINEN LOOMS—489

Mordale Bobbin Stripper	496
Dracup's Improved Reversing Mechanism	498

WILSON AND LONGBOTTOM'S—489

PAGE
Cloth Winding 494
Crank Arms 492
Let-Off Motion 491
Safety Measures 495
Shuttle Boxes and Swells 494
Take-Up Motion 493
Top Roller and Tappet Action 490
Weft Fork and Slide 493

LANCASHIRE TAPPET LOOMS—425

Bordered Cotton Blankets 426
Butterworth and Dickinson's Tappet Loom with Circular Box 434
Chain Motion 426
Construction of Woodcroft Tappets 437
Hall's High Speed Calico Loom 426
Hall's Woodcroft Tappet Loom 435
Lupton & Place's " Climax " Spring Top Motion 434
Pickles Take-Up Motion 428
Pull of Springs 434
Spring Top Motion 433
Tappet Easing Motion 431
Underneath Utility Tappets 430
Wilson & Longbottom's Medium Weight Duck Loom 429

LANCASHIRE TOWEL LOOMS—468

Butterworth & Dickinson's Terry Towel Drop Box Loom 471
Hall's Cross Border Dobby Loom 468
Hall's Turkish Towel Looms 469
Side View of Terry Towel Fabric 472
Wilson & Longbottom's Terry Towel Loom 473 477
Action of Back Feelers 474
Baize Roller 476
Dobby and Outer Lags 474
Lag Cylinders 477
Outer Lags 477
Overpick and Take-Up Motion 477

LANCASHIRE SILK AND RAYON LOOMS—514

Butterworth & Dickinson's Drop Box for Silk and Rayon 514
Butterworth & Dickinson's Two Box Rayon Loom 516
White & Sons Ltd. Silk and Rayon Loom 520
Box Movement 523
Construction of Dobby 521
Negative Let-Off 521
Outside Under Pick 521
Style of Boxes and Checking 523
Take-Up of Cloth 523
Unique Take-Up Motion 522

LANCASHIRE AND YORKSHIRE NARROW FABRIC LOOMS—456

	PAGE
Platt Bros. Tappet Loom	456
Passage of Webbing	460
Positive Tappets	458
Shaft and Healds	457
Shuttles and Reed Movement	459
Structure of Shuttles	458
Take-Up Motion	459
Warp and Binder Cheeses	456

PLATT BROS. RIBBON LOOM—460

Arrangements for Cheeses	460
Beat-Up Arms	463
Negative Dobby	460
Shuttle Structure and Movement	462
Take-Up Motion	465

WILSON & LONGBOTTOM'S MULTIPLE FABRIC LOOM—449

Design for Pouched Webbing	450
Leeming Dobby	449
Loom Driving	455
Path of Webbing	454
Rail and Shuttle Movement	452
Shuttle Construction	450
Take-Up Motion	453
Warp Beams and Drafting	450

RAYON AND "FIBRO" DEVELOPMENTS 509

Six Patterns and Three Designs