SECOND EDITION

THE ART OF LOOM TUNING

by

J. W. Hutchinson

OVER 600 PAGES
520 ILLUSTRATIONS

Author of

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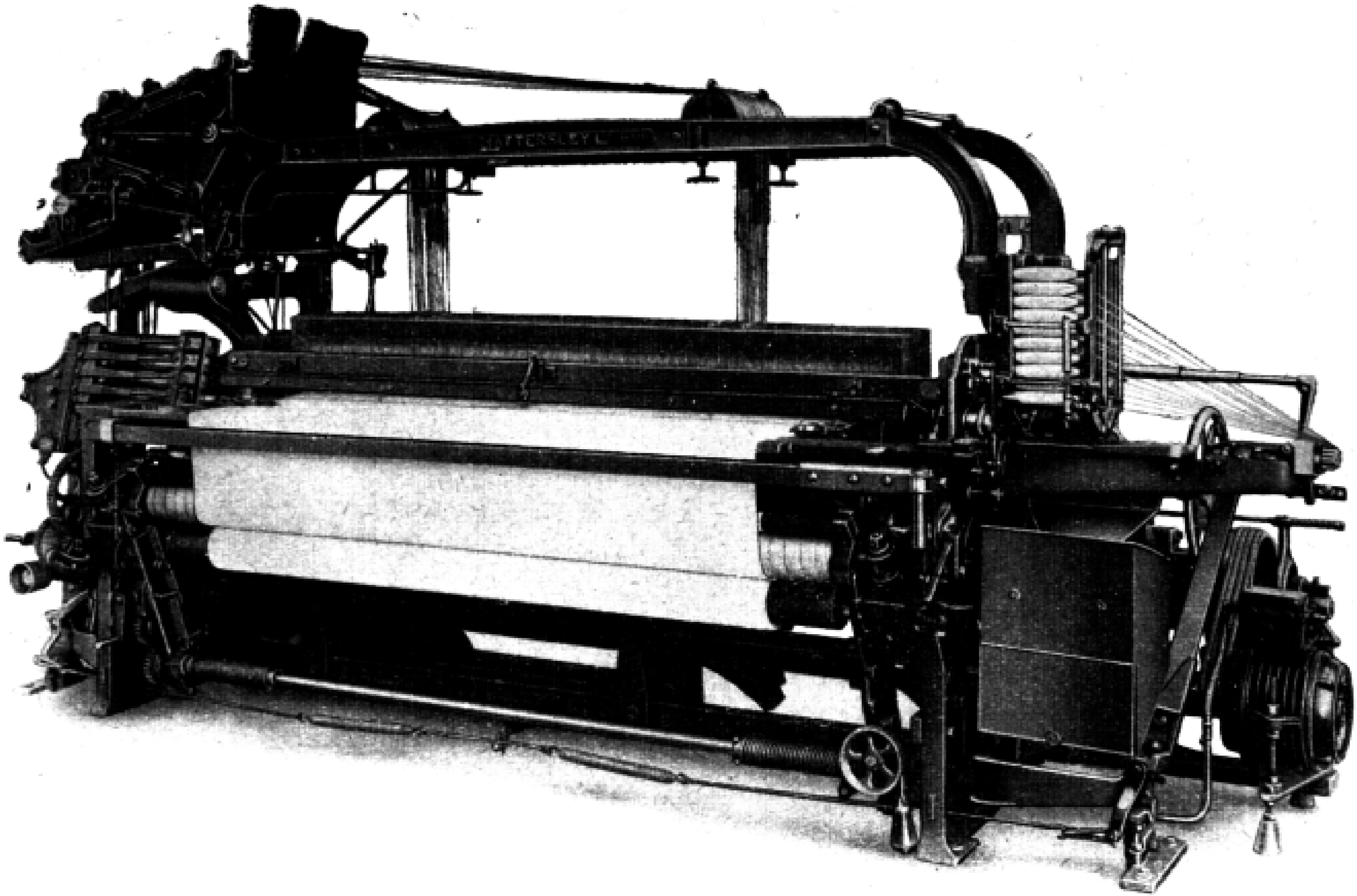

Fig. 1.
Hattersley Standard Model Automatic Bobbin Changing Loom. (Front View).

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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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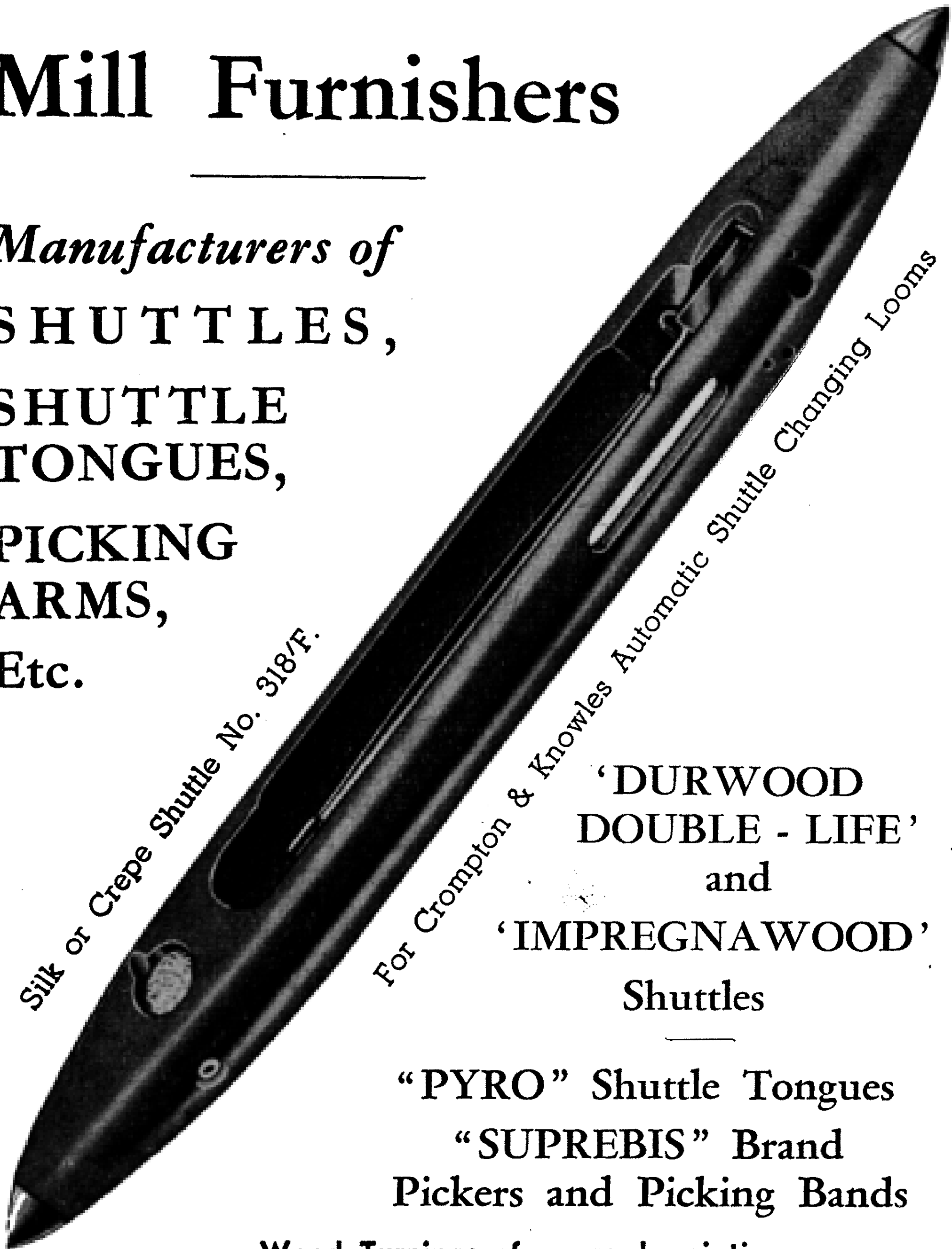

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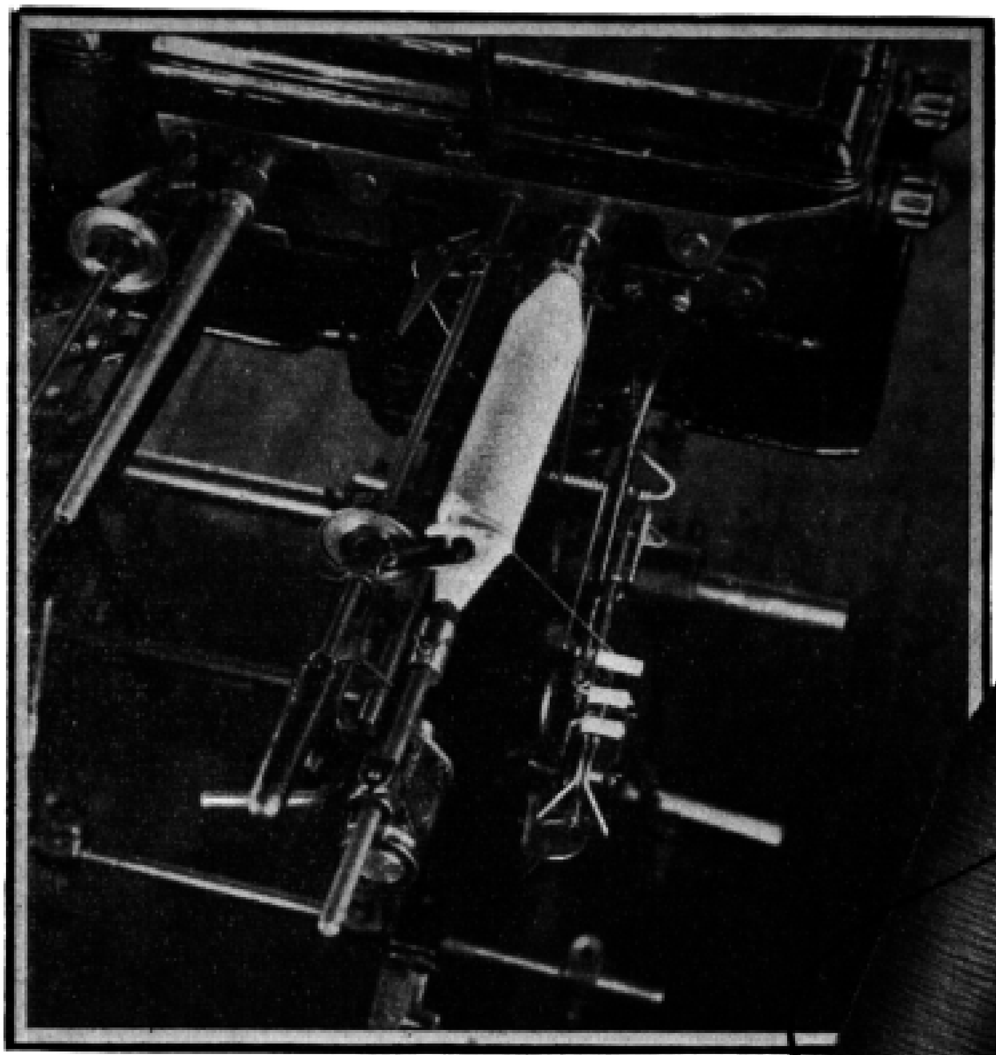

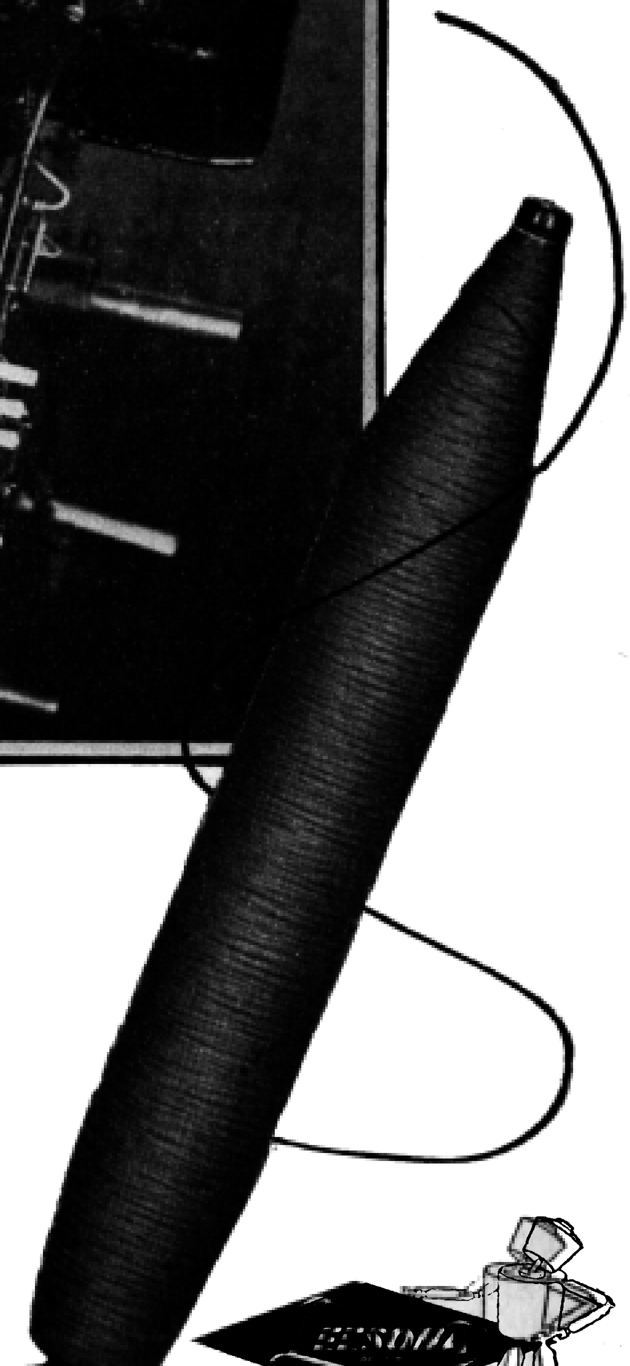

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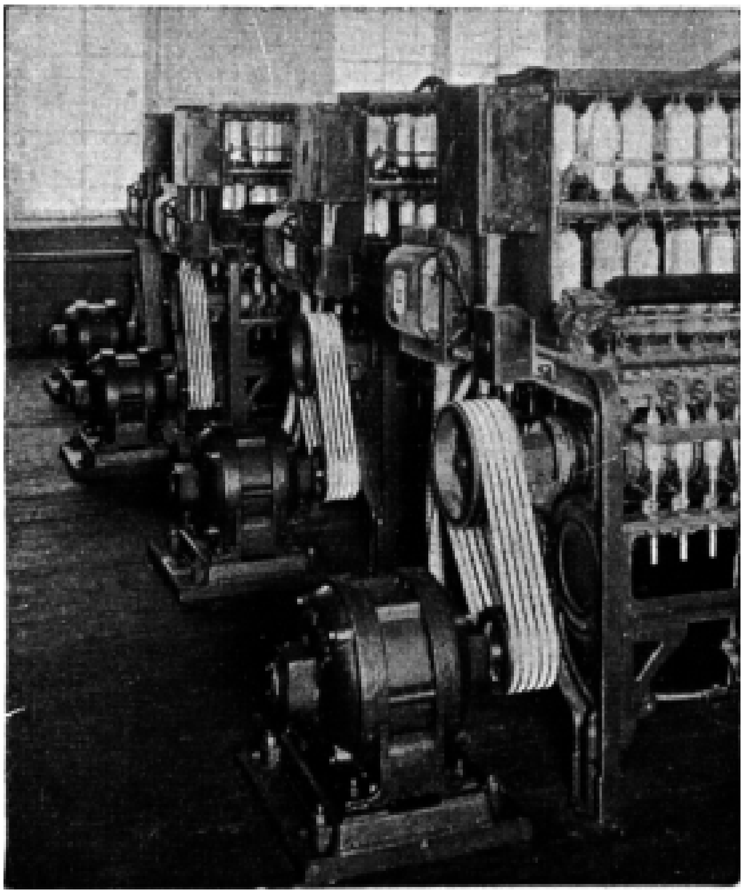

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THE USE OF REEDS.

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

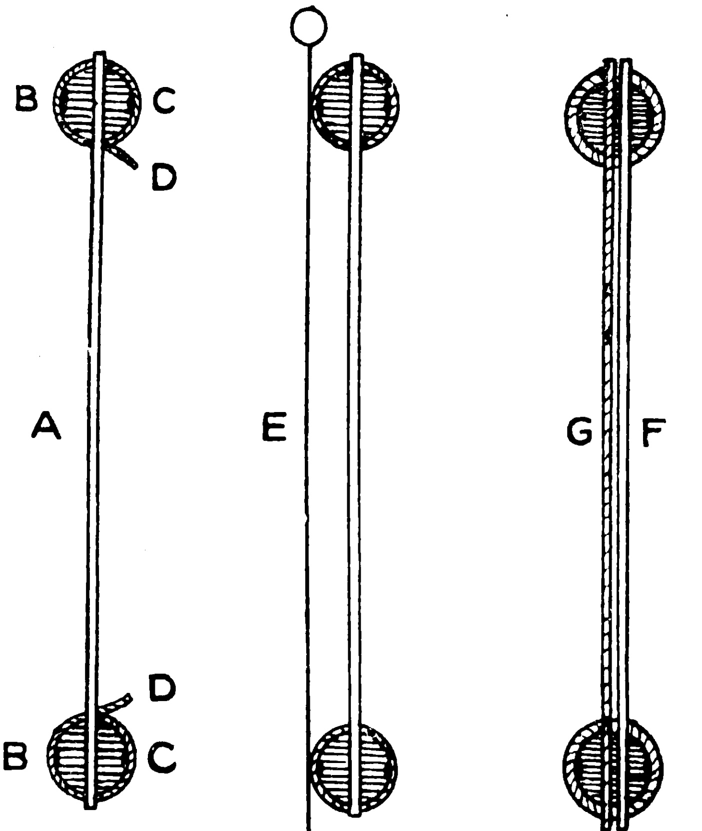


Fig. 2.
Ordinary, False, and Double Sleys.

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.

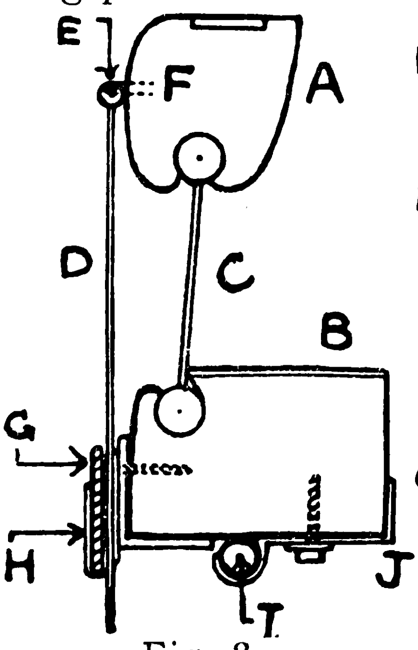


Fig. 3.
Ordinary False Reed.

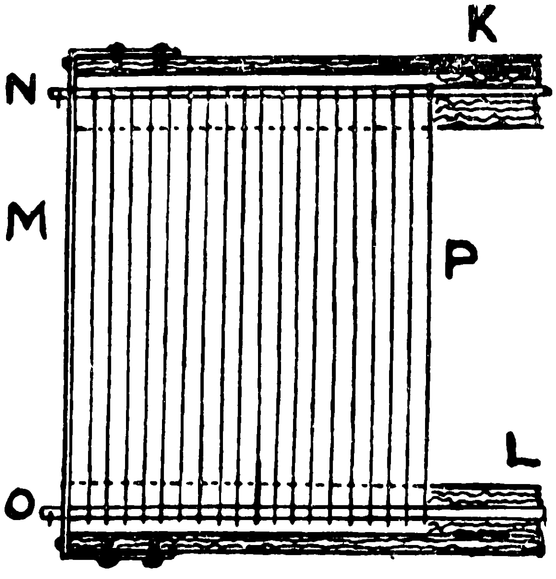


Fig. 4.
Grob's False Reed.

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

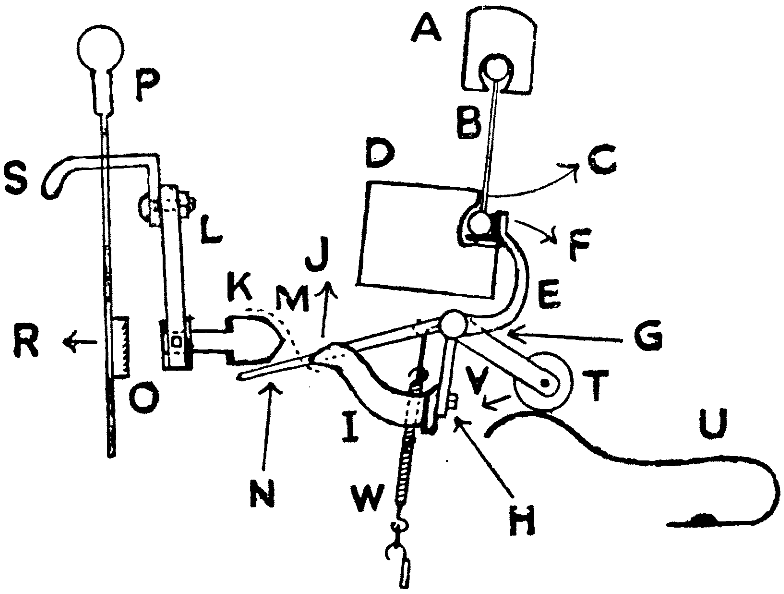


Fig. 5.
Loose Reed.

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,

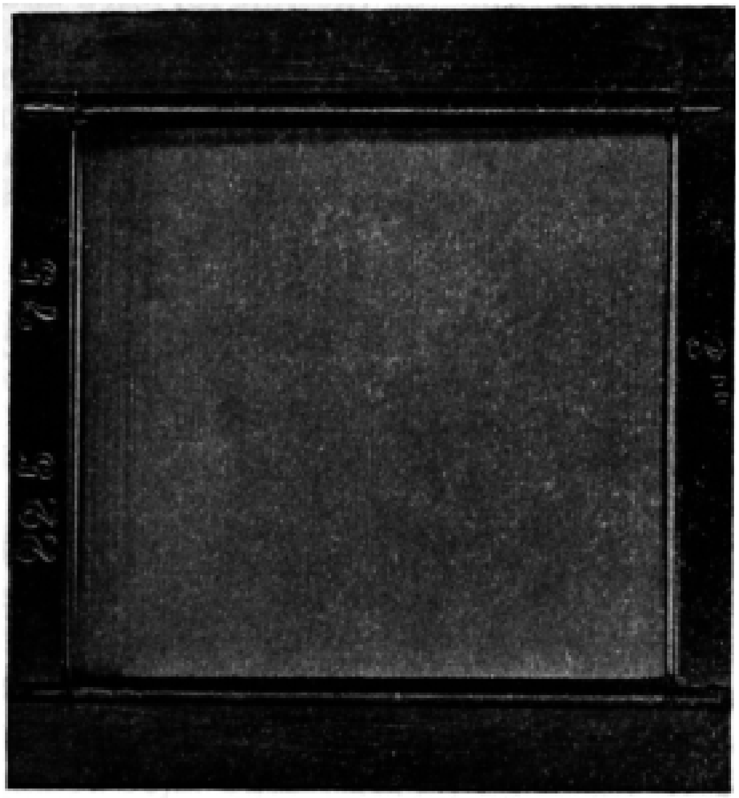


Fig. 6.
All Metal Sley.

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

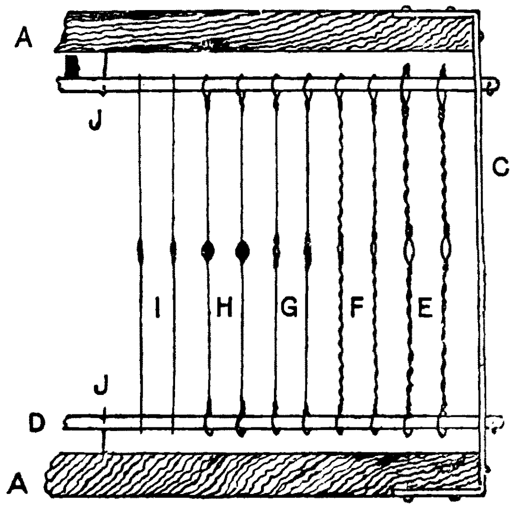


Fig. 7.
Slider Wire Healds.

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

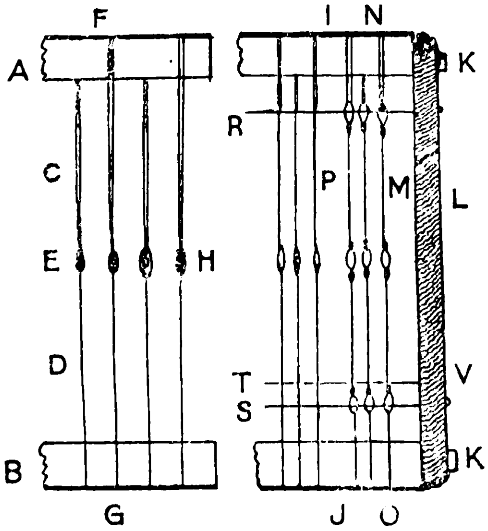


Fig. 8.
Cotton and Worsted Healds.

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,

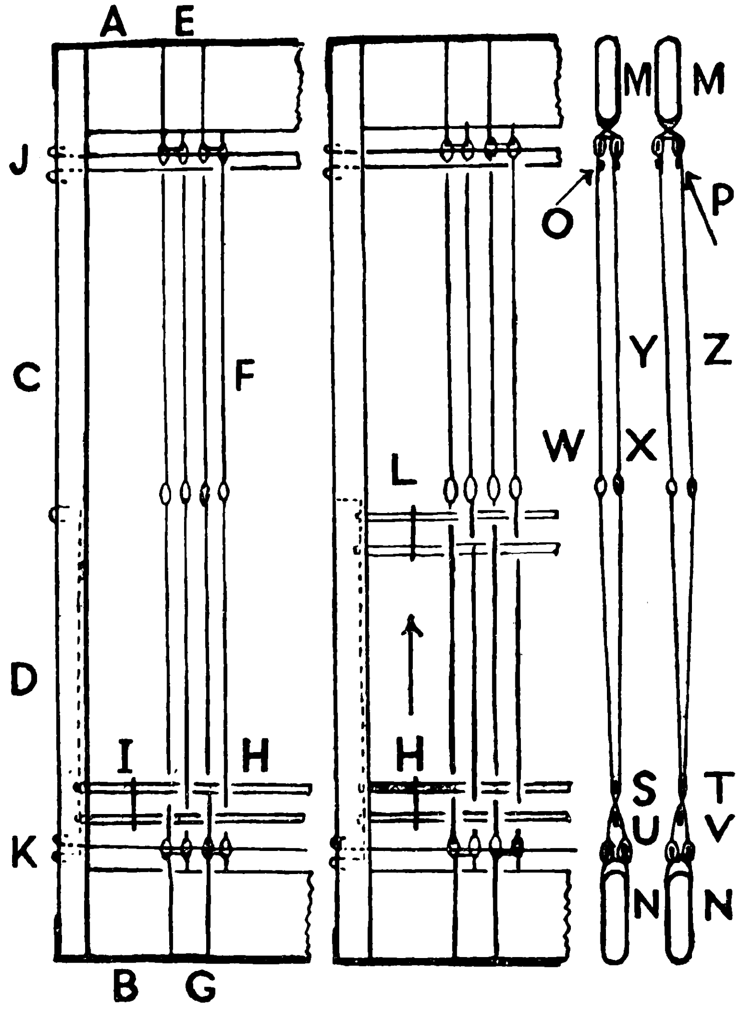


Fig. 9.
Smith's Patent Healds.

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.

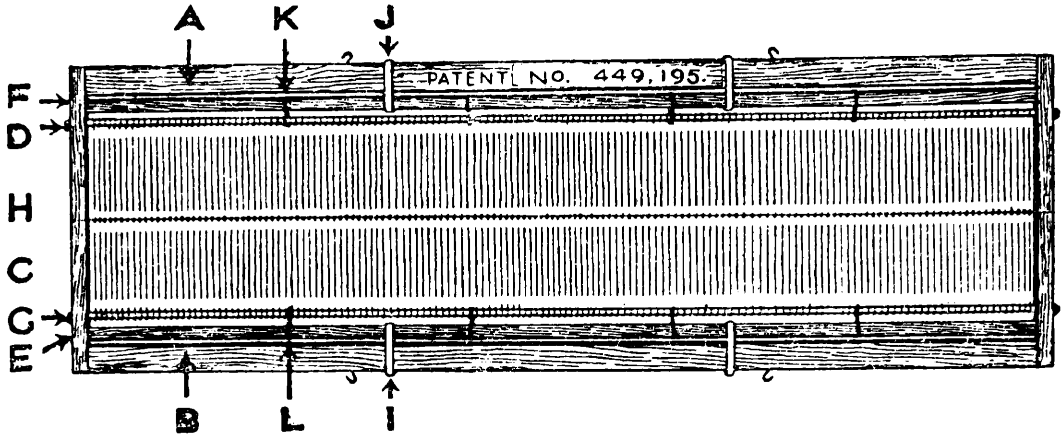


Fig. 10.
Wool Textile Supplies Ltd. New Slider Heald Frame.

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.

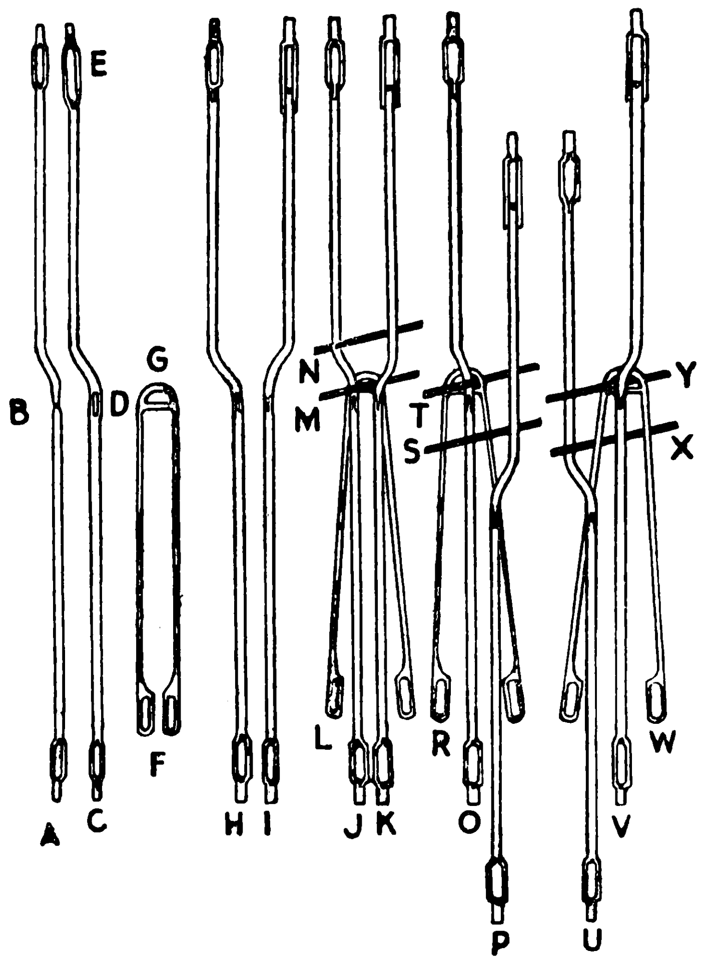


Fig. 11.
Grob's Steel Healds for Gauze and Leno Weaving.

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

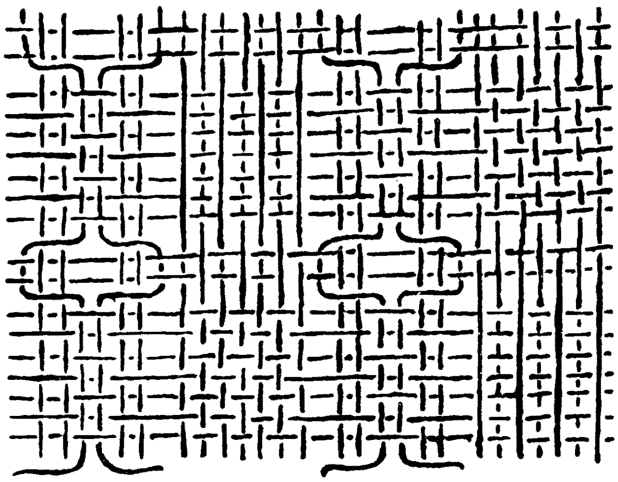


Fig. 12.
Figured Gauze.

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

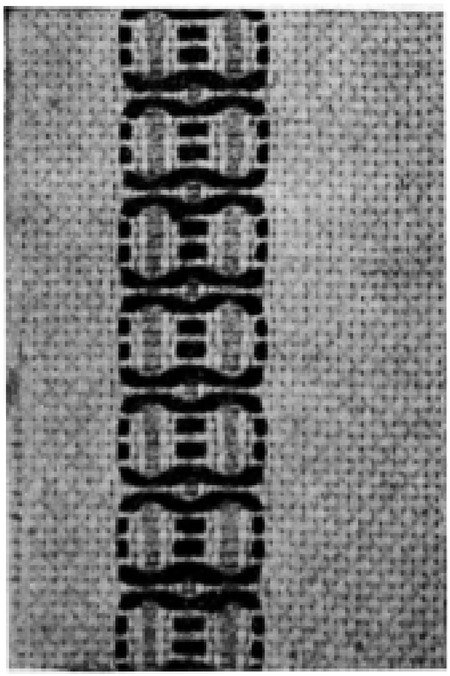


Fig. 13.
Leno Cloth.

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

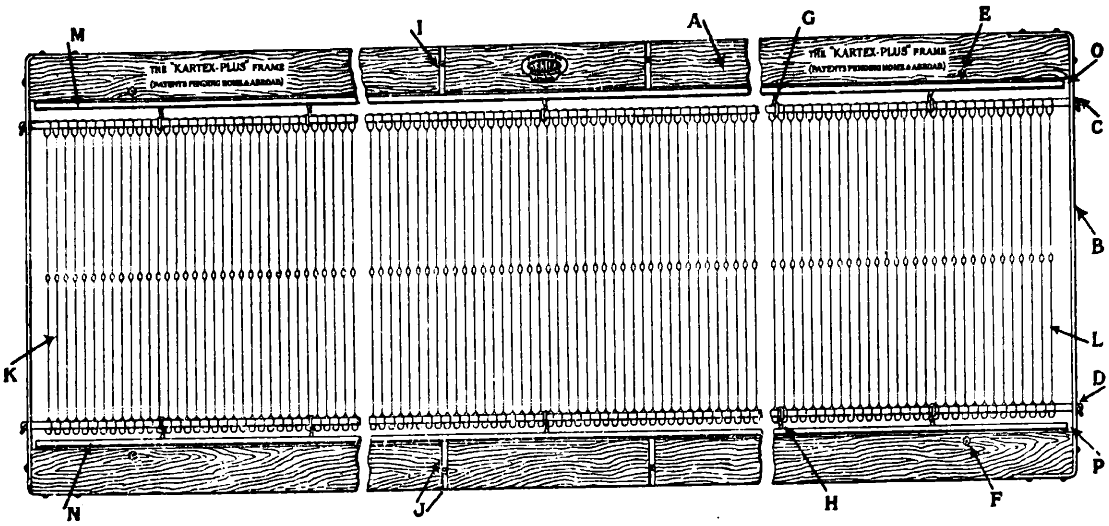


Fig. 14.
The "Kartex" Slider Heald Frame. (Front View).

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.

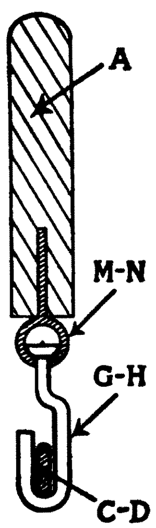


Fig. 15. "Kartex" Frame. (Side View).

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

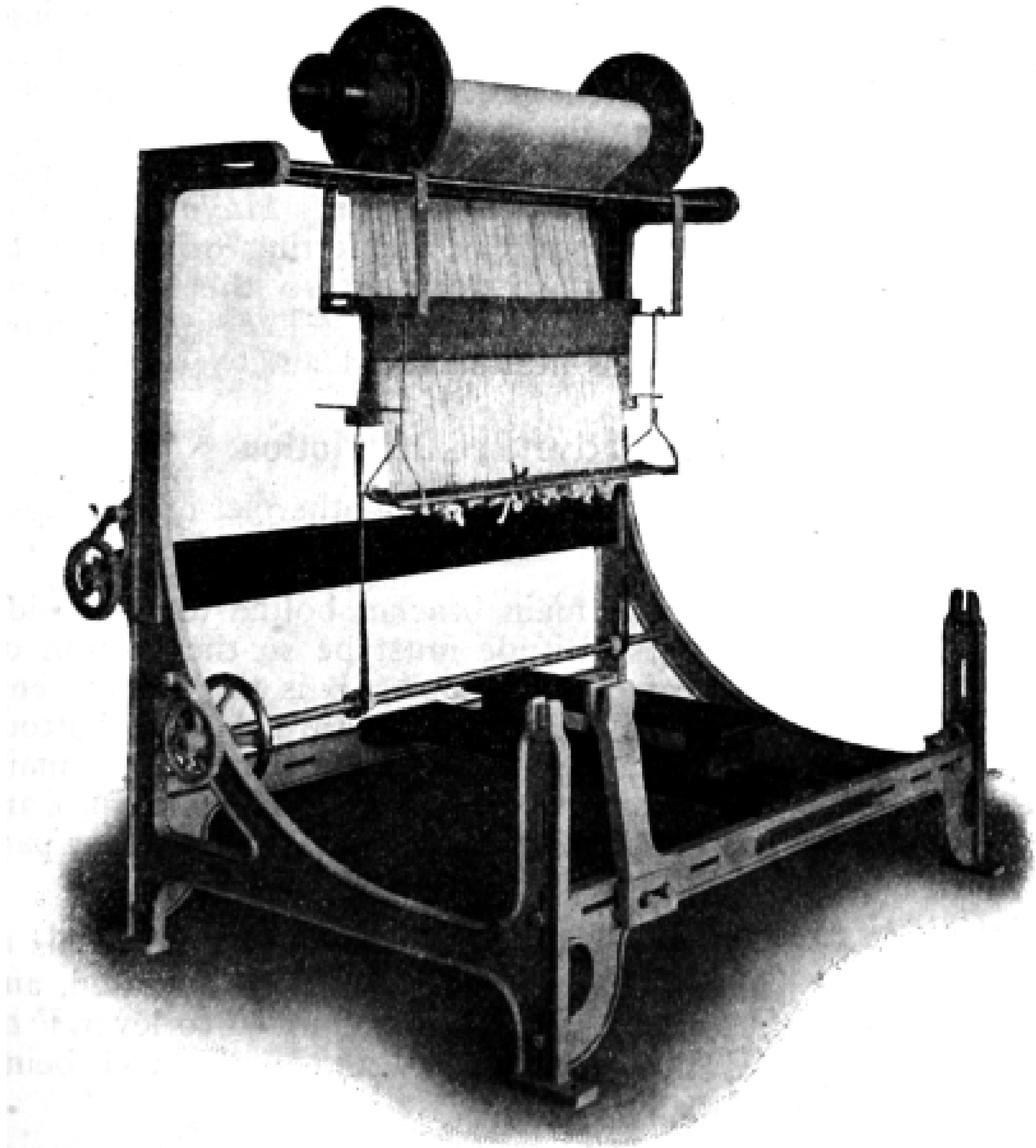


Fig. 16.
Hattersley's Looming and Twisting Frame.

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.

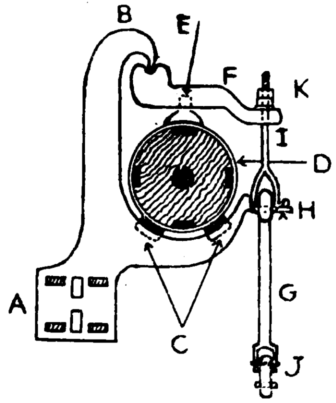


Fig. 17.

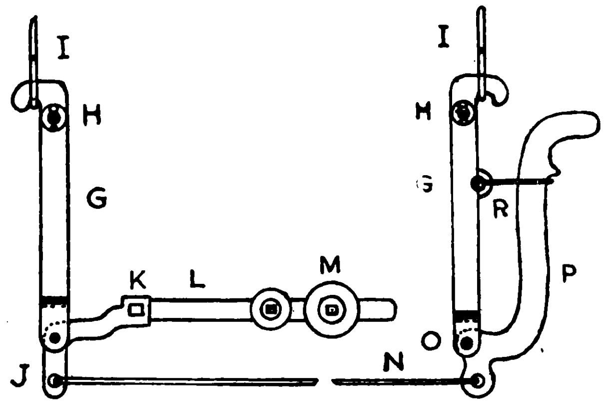


Fig. 18.

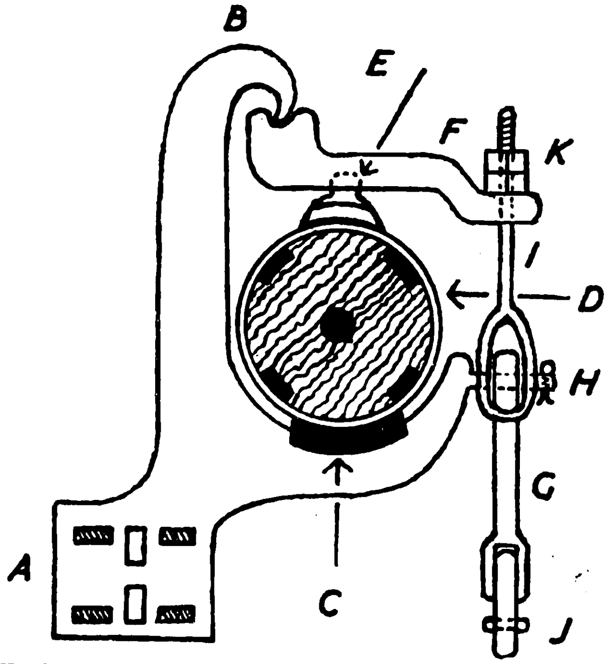


Fig. 19

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

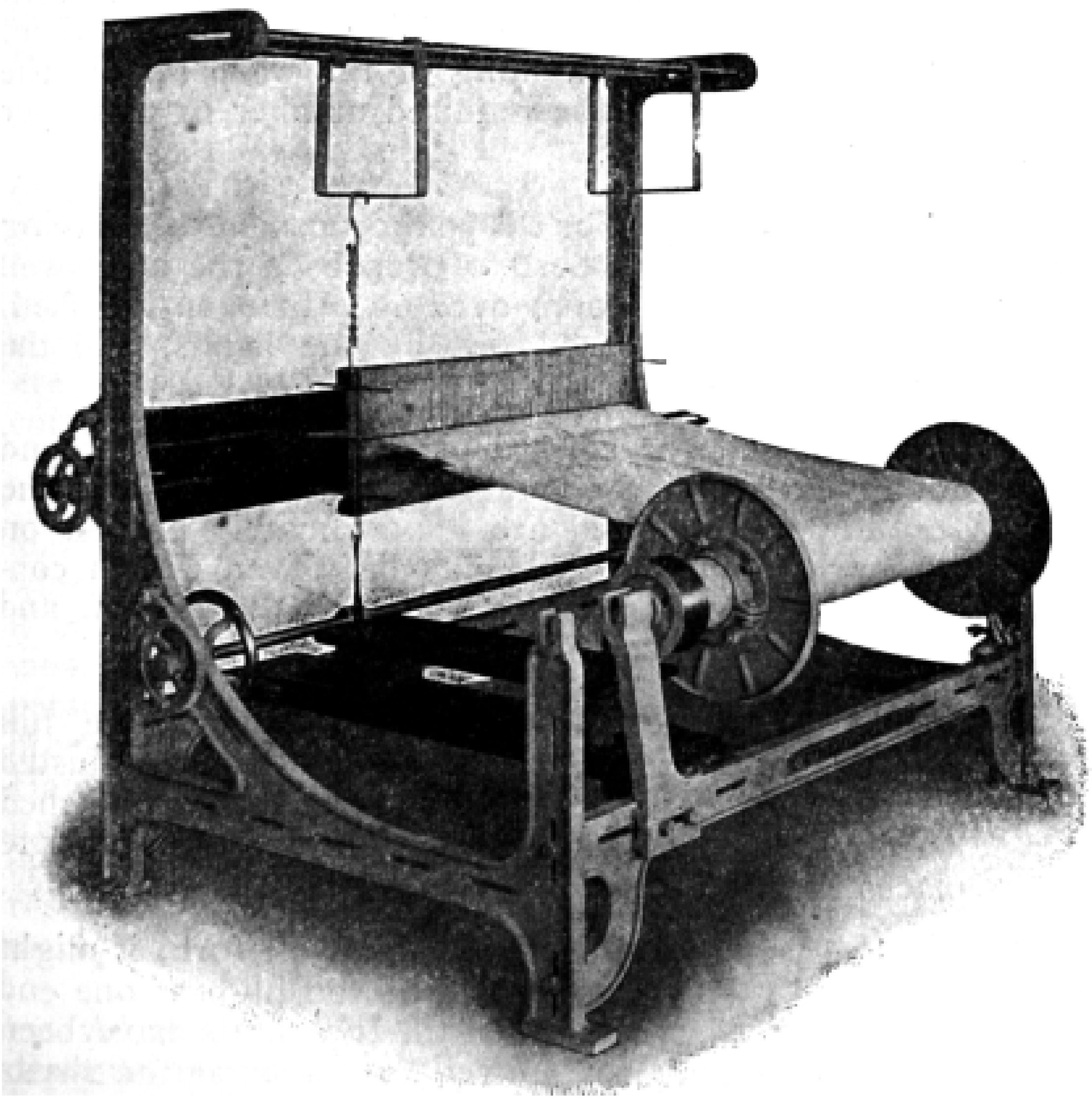


Fig. 20.
Hattersley's Looming and Twisting Frame.

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.

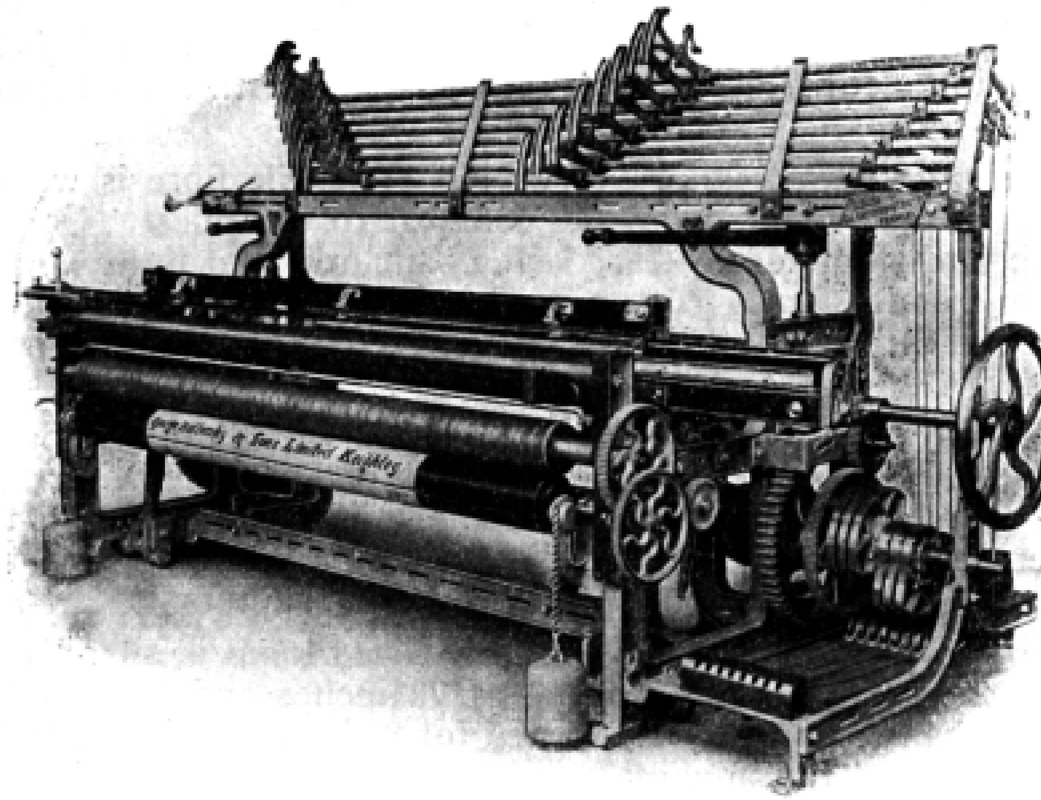


Fig. 21.
Hattersley Tappet Loom.

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

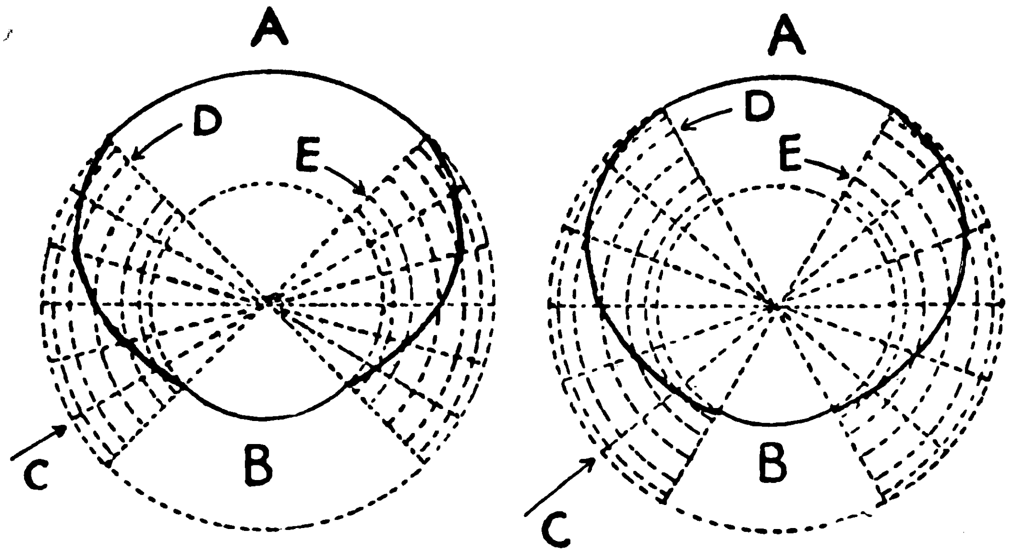


Fig. 22. Tappet for Plain Weave with Half Dwell. (Left).
Fig. 23. Tappet for Plain Weave with one Third Dwell. (Right).

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.

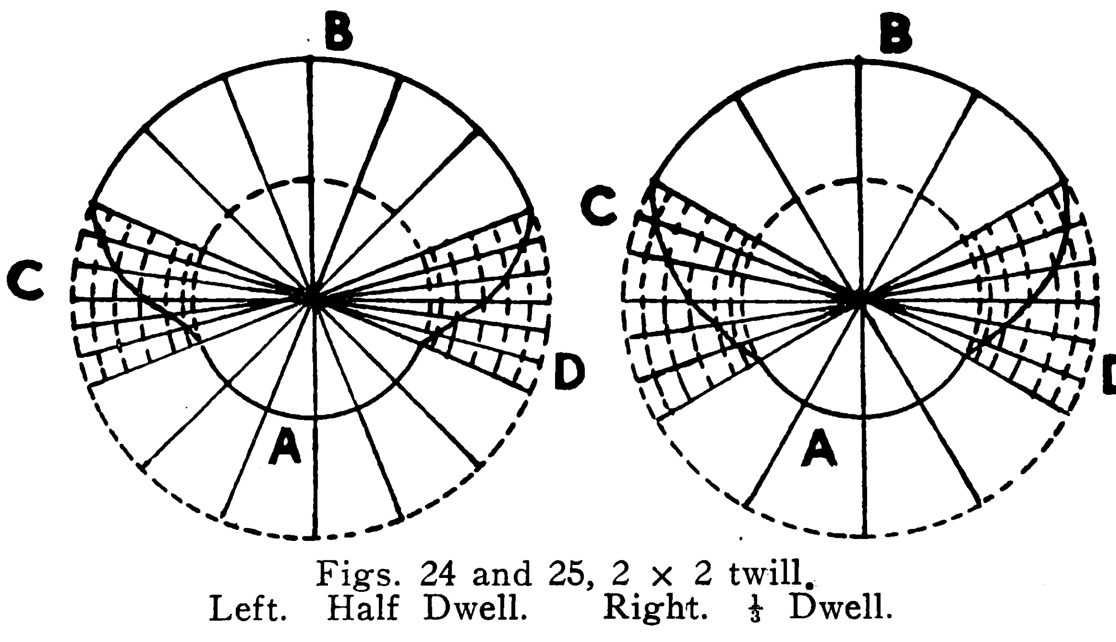
The shed makes the change as the crank moves from the top centre to the bottom one. If the two circles be now divided into eight equal parts, four representing one pick and four the other, it will indicate the eight centres through which the crank passes in two revolutions.

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 x 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.

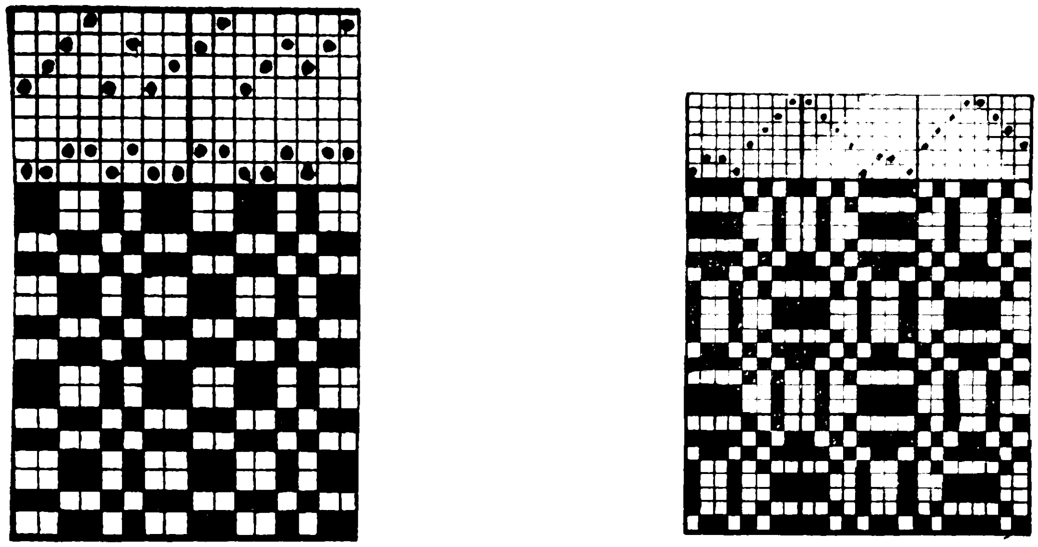


Fig. 26. Matt Weaves.

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.

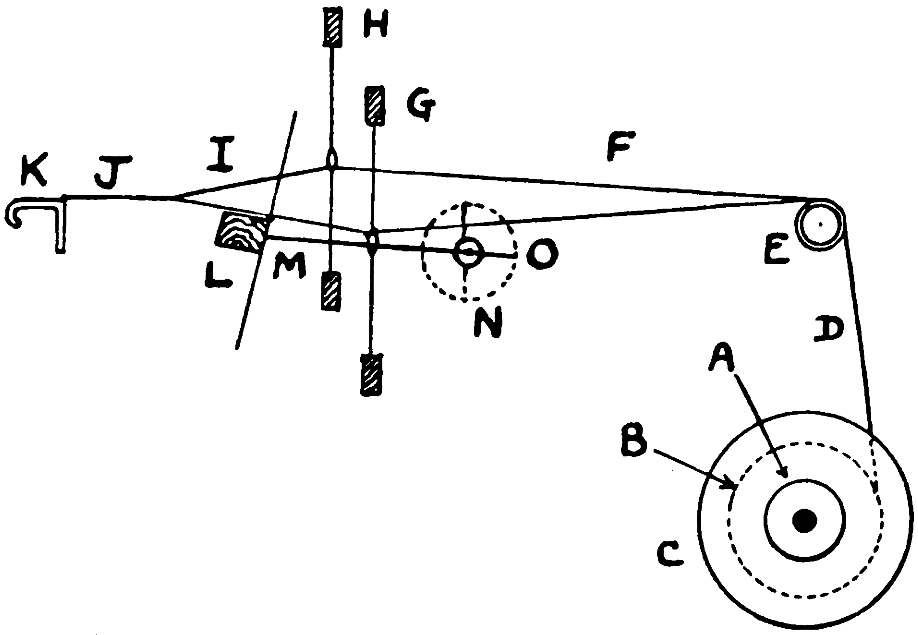


Fig. 27. Outline of Warp from Warp Beam to Breast Beam.

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

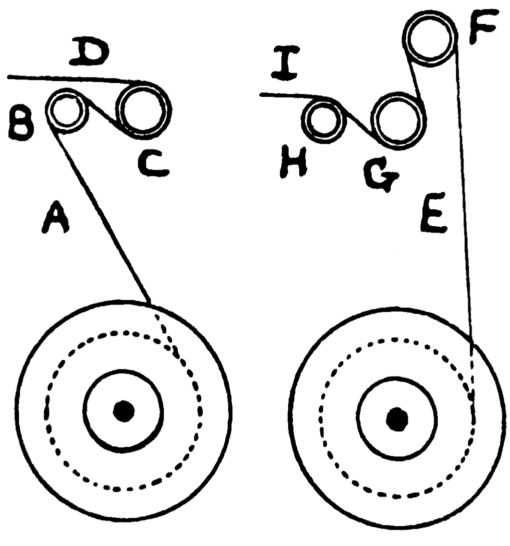


Fig. 28. Extra Back Rails for Warp Tension.

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

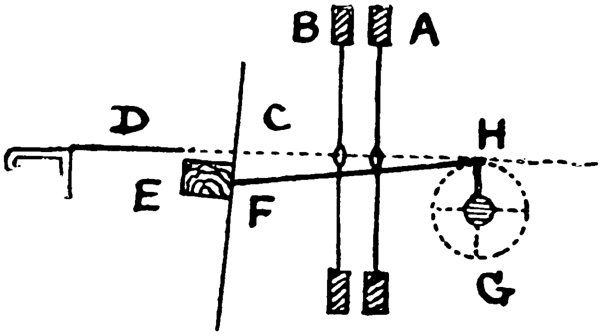


Fig. 29. Shafts with Crank at Top Centre.

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-

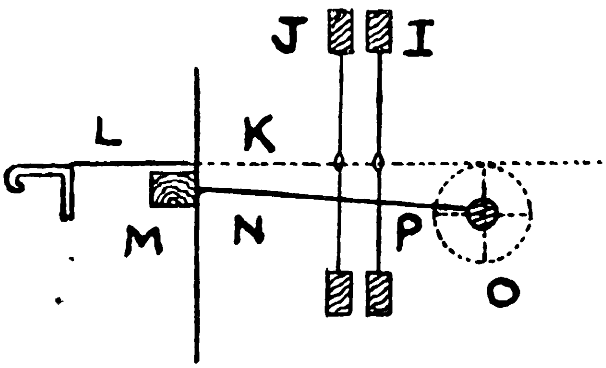


Fig. 30. Late Timing with Crank at Front Centre.

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.

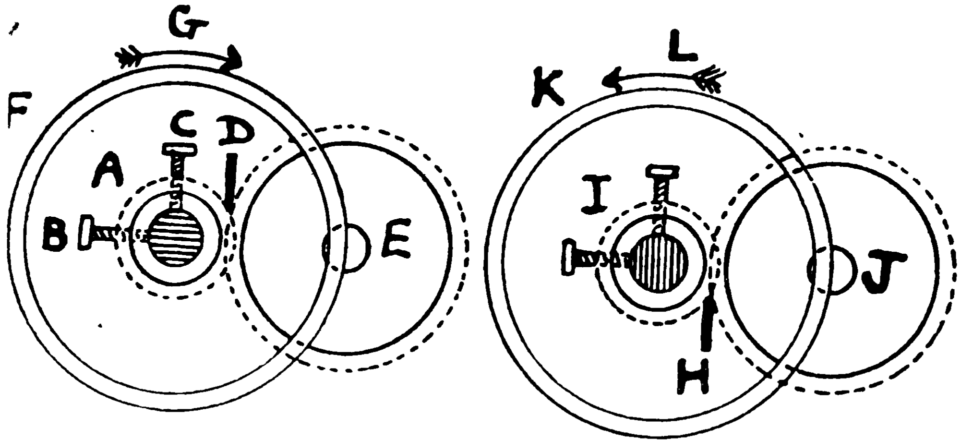


Fig. 31. Alteration of Shed Timing.

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.

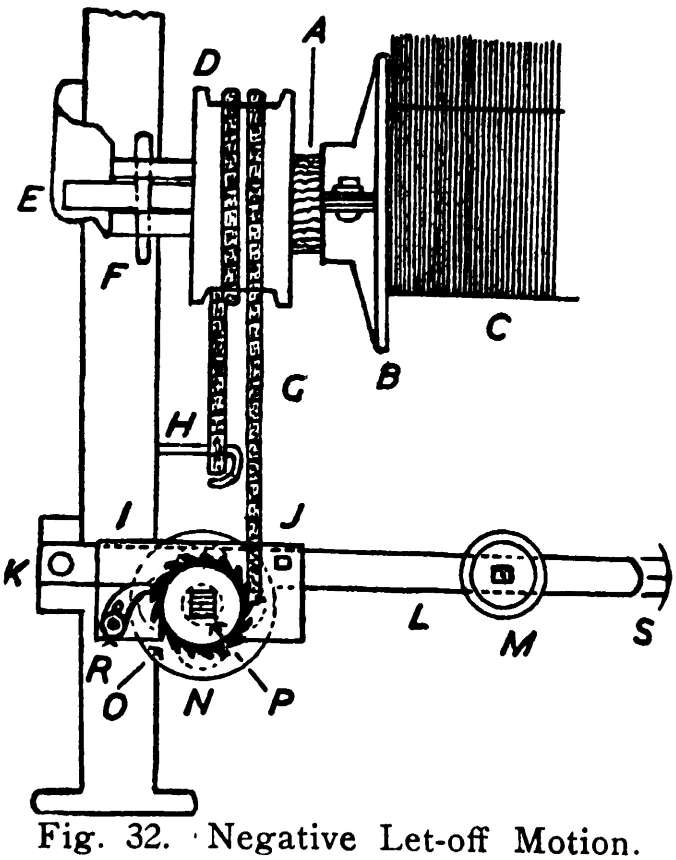


Fig. 32. Negative Let-off Motion.

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.

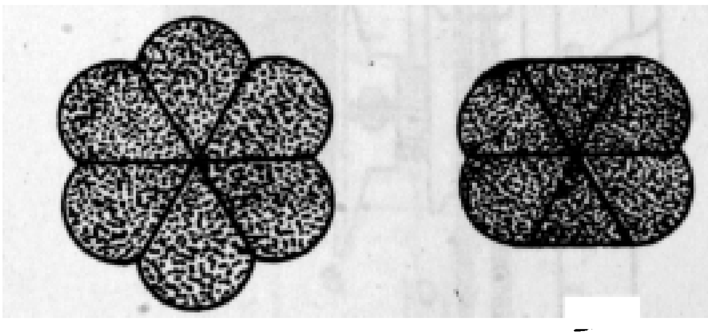


Fig. 33.
New Rope.

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.

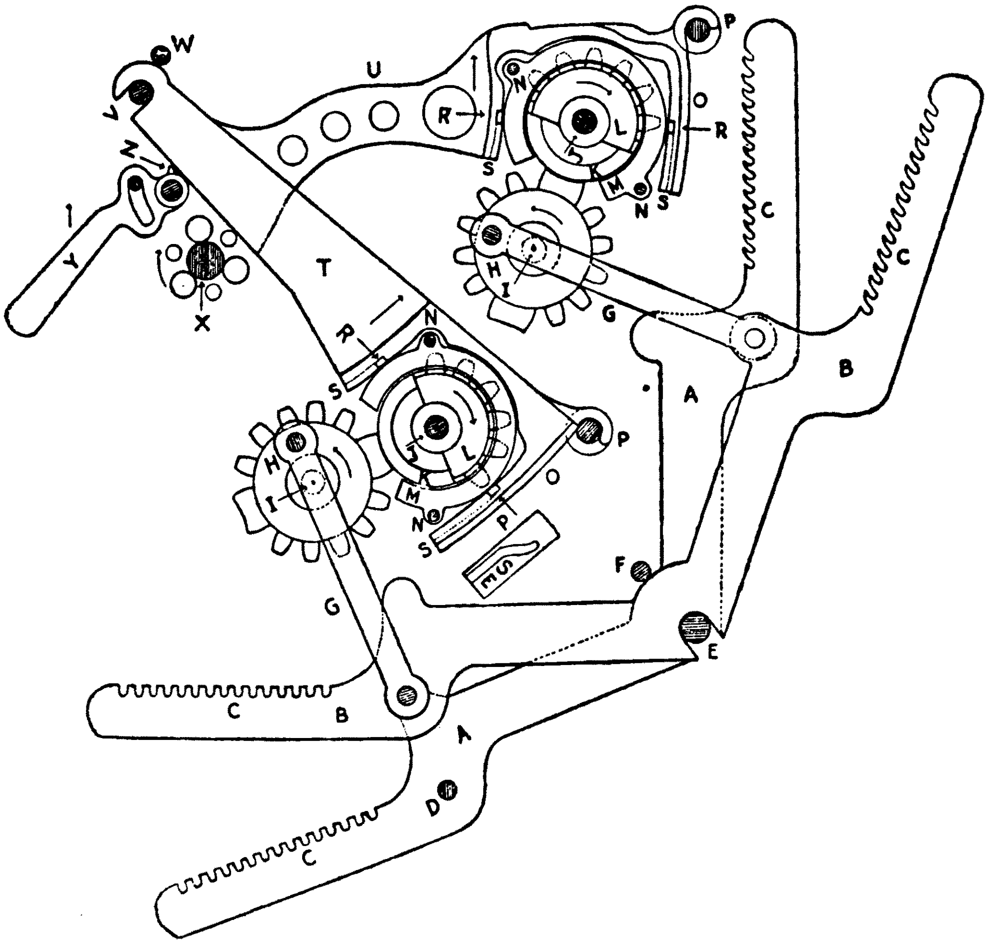


Fig. 35.
Leeming Dobby. (Side View).

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

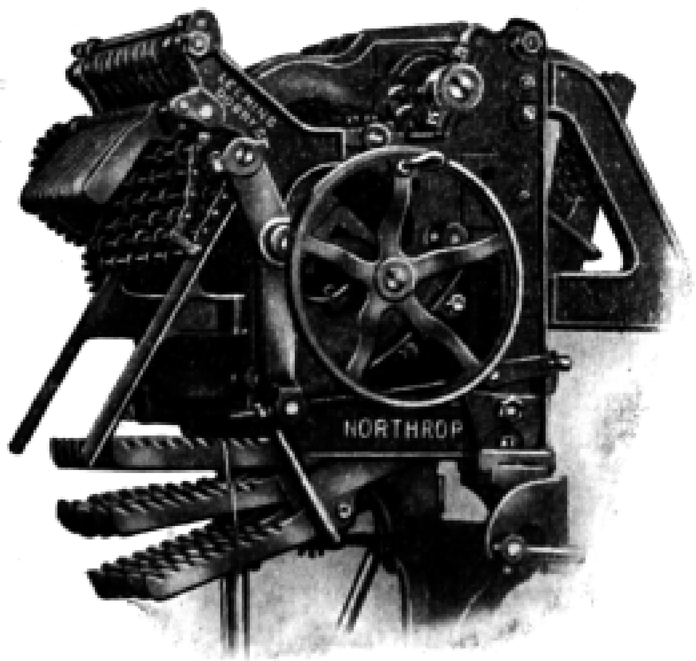


Fig. 36.
Leeming Dobby. (Front View).

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.

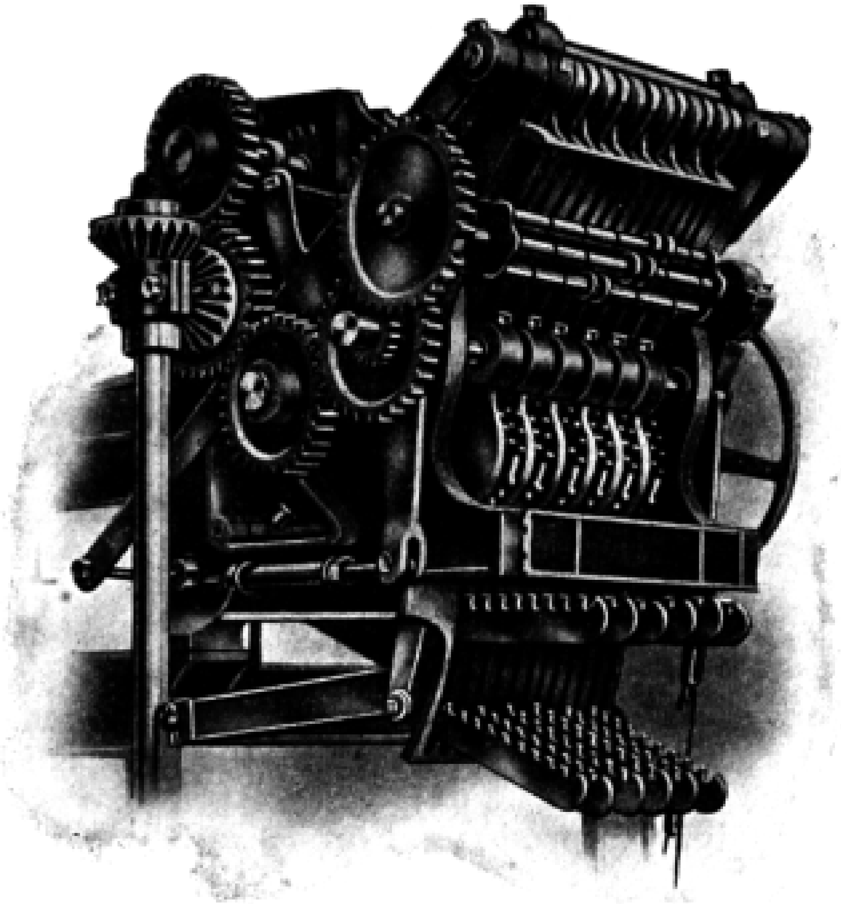


Fig. 37.
Back and End View of Leeming Dobby.

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.