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

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

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

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

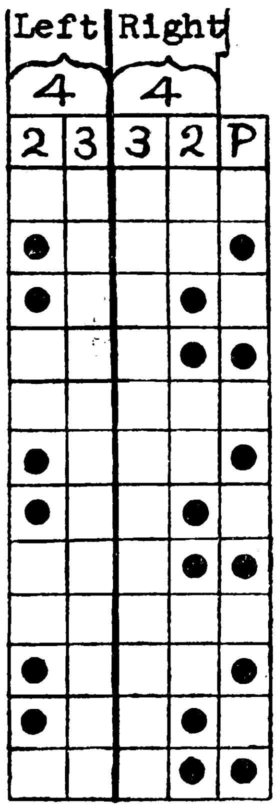


Fig. 104.

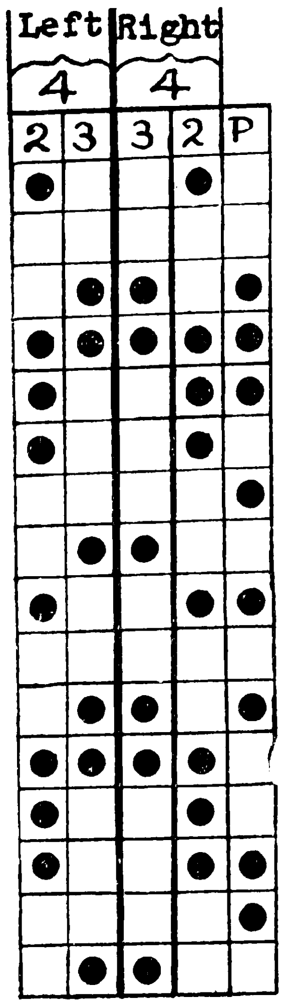


Fig. 106.

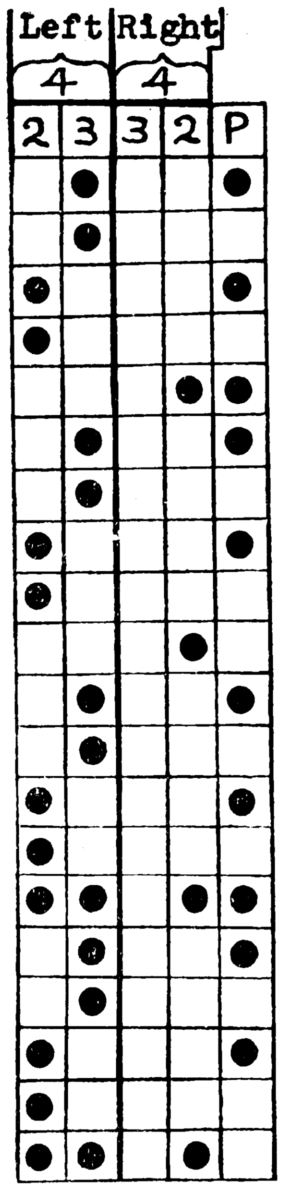


Fig. 105.
Box Plans.

Fig. 106 is one of quick changes.

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

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

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

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

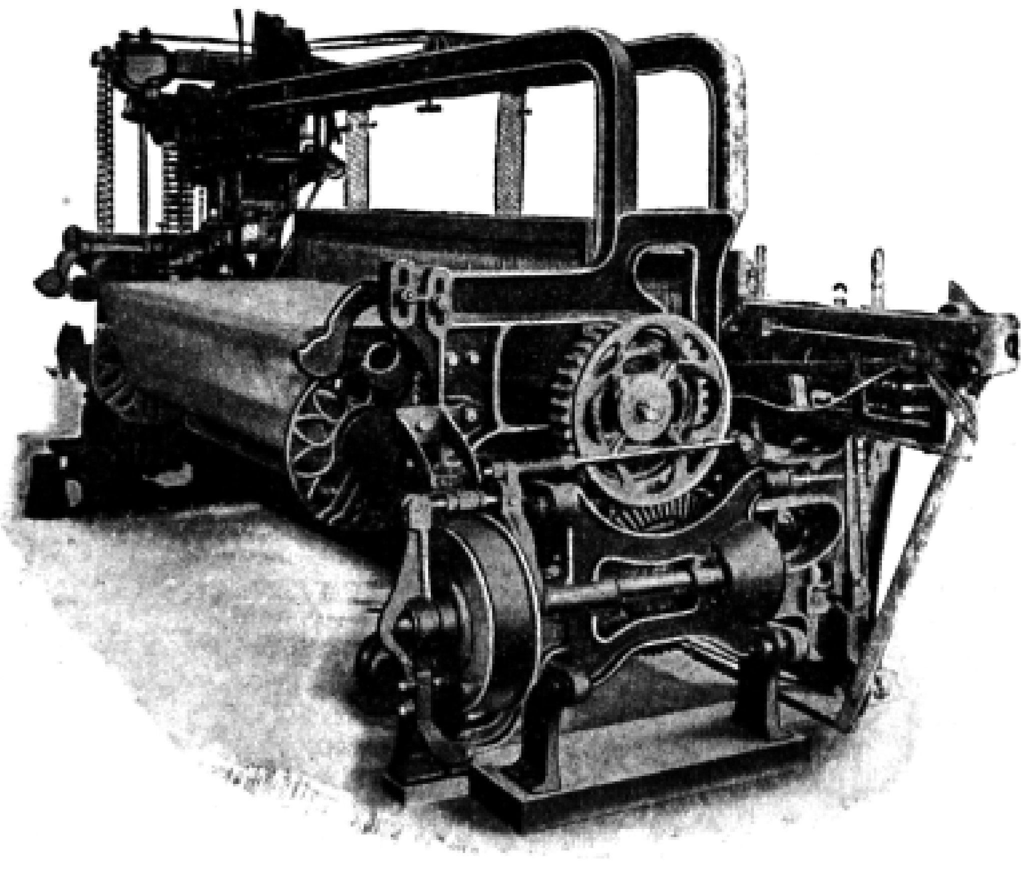


Fig. 107.
Dobcross Drop Box Loom Drive. (Back View).

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

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

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

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

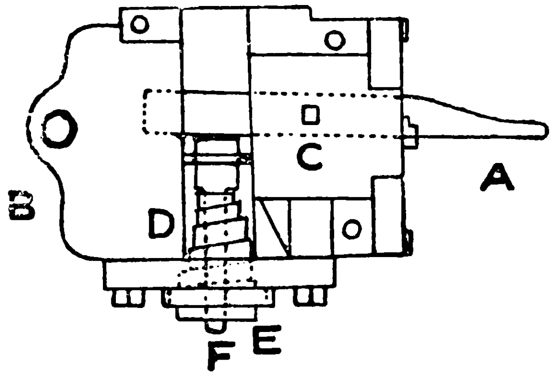


Fig. 108.
Dobcross Frog.

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

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

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

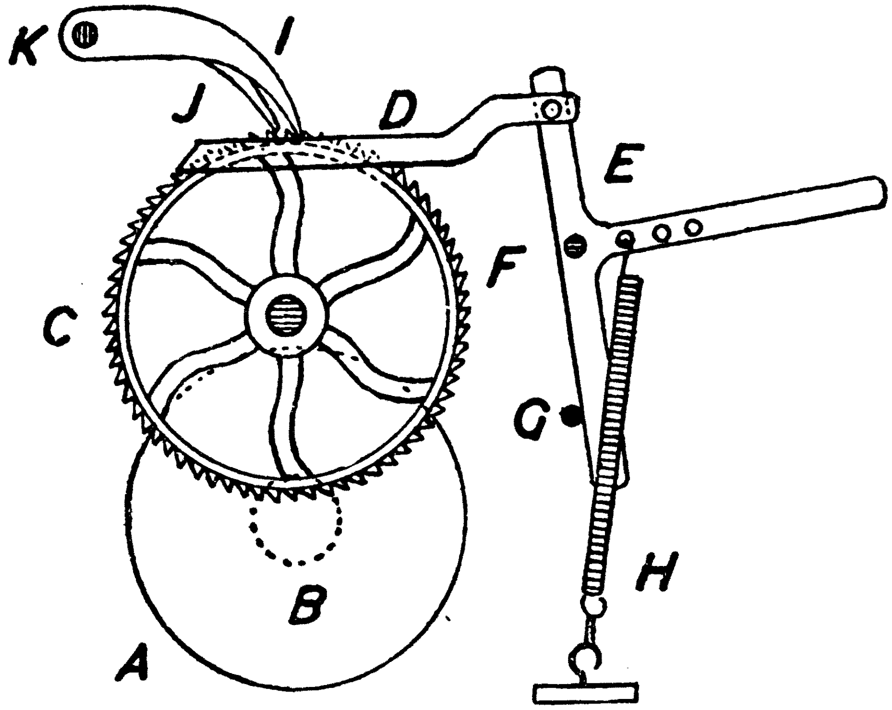


Fig. 109.

Dobcross Negative Taking-up Motion.

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

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

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

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

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

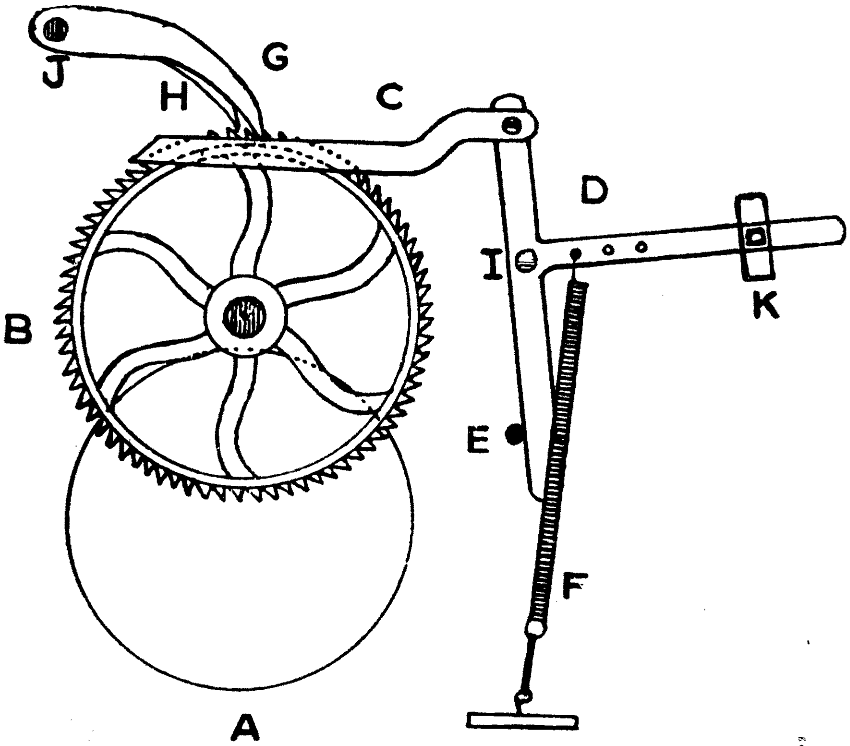


Fig. 110. Negative Take-up for Low Woollens.

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

Differential Motion.

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

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

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

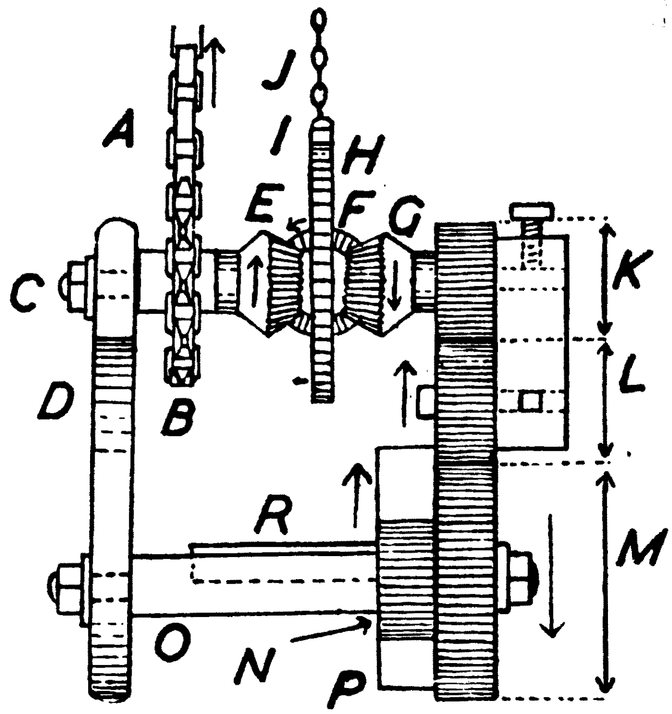


Fig. 111. Differential Motion.

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

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

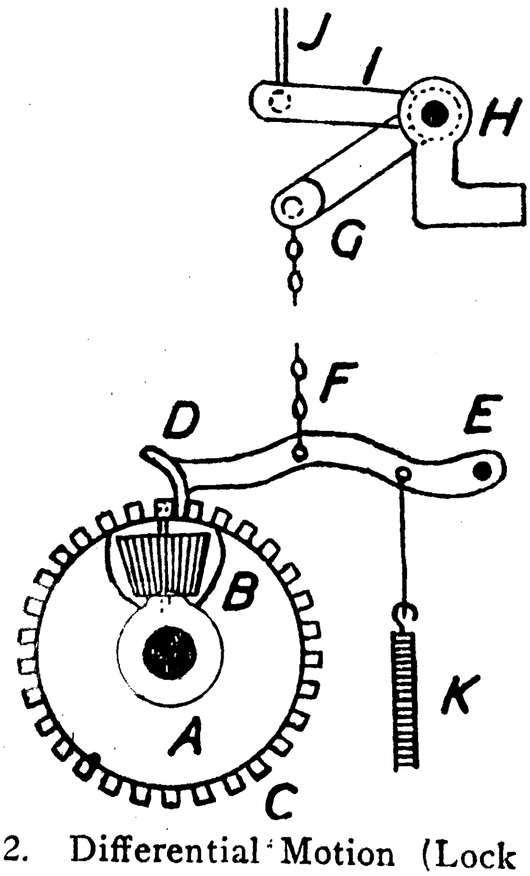


Fig. 112. Differential Motion (Lock Wheel).

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

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

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

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

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

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

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

Automatic Weft Changing.

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

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

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

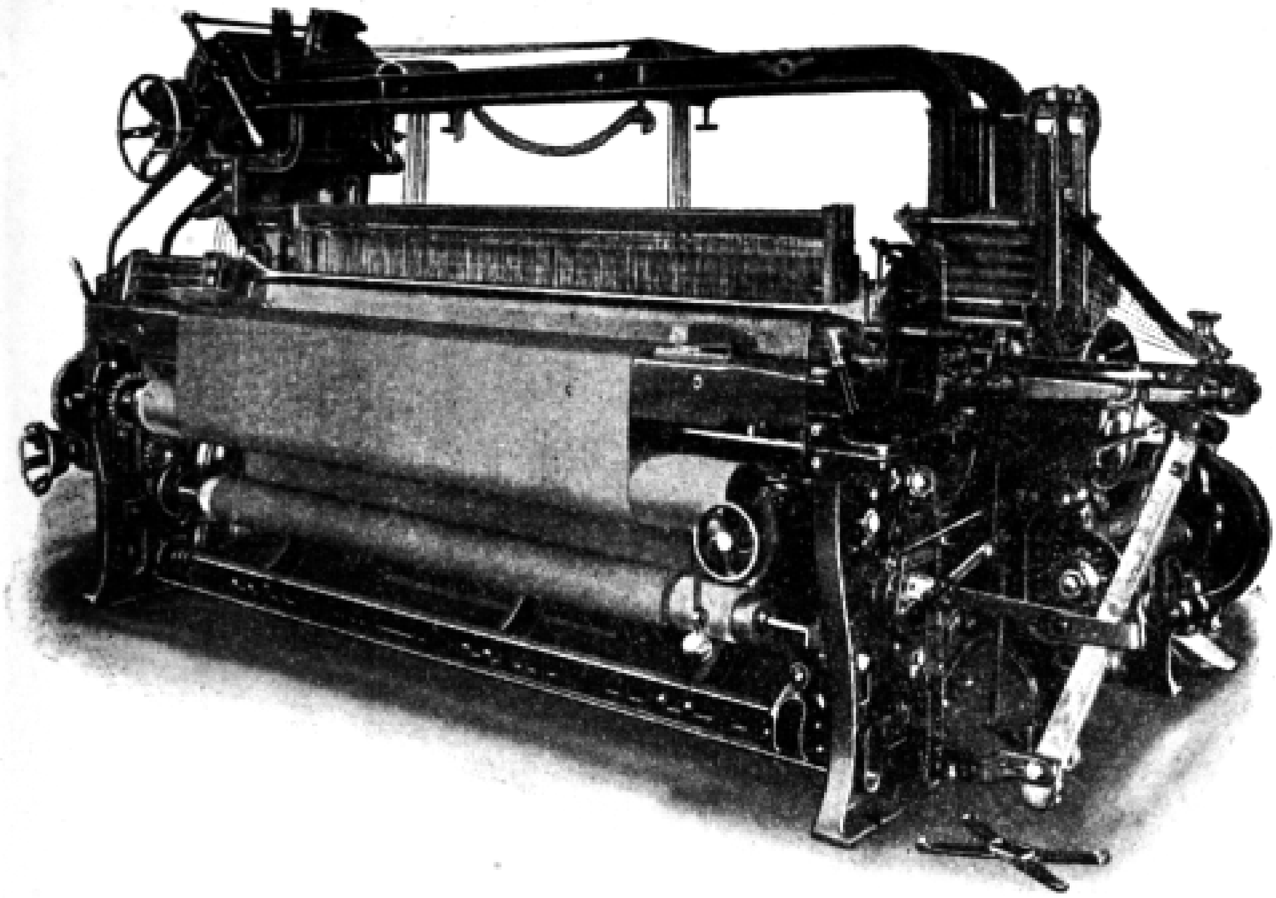


Fig. 113.
Dobcross Automatic Four Box Loom.

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

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

CIRCULAR BOX LOOM.

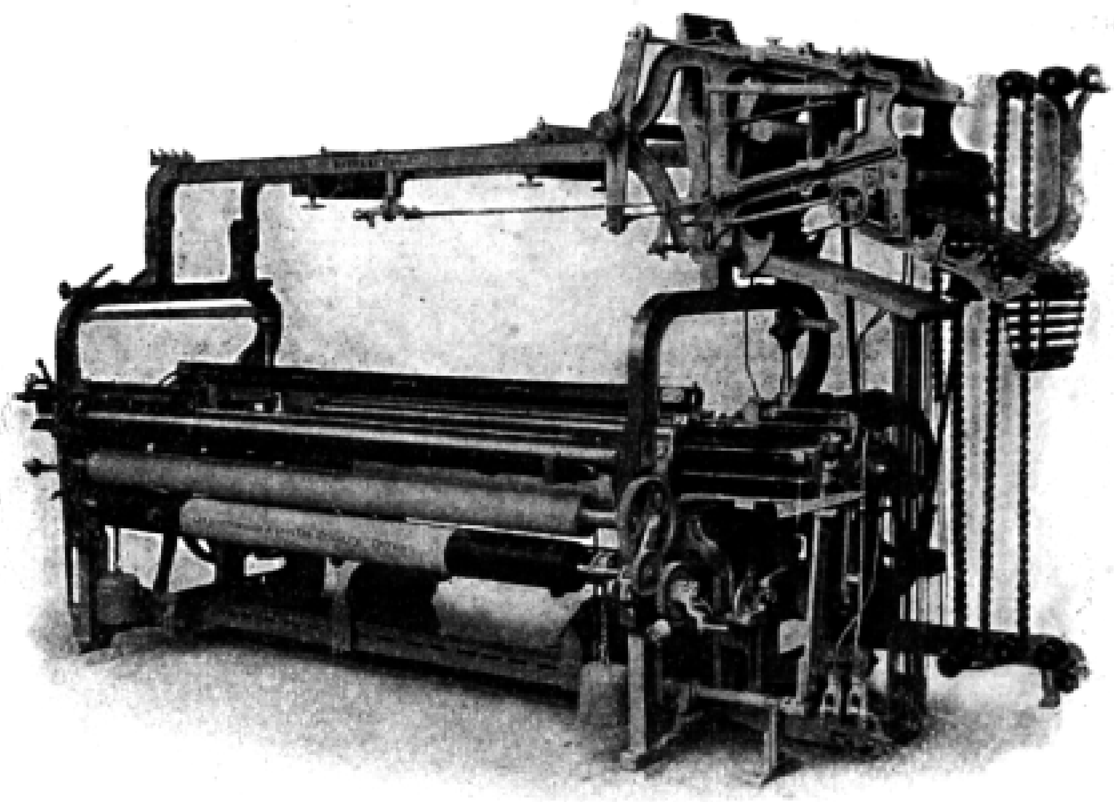


Fig. 114.

Hattersley's Revolving Box for Light and Medium Coatings.

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

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

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

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

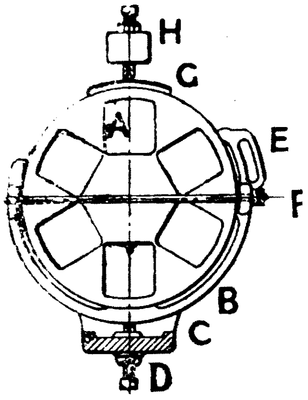


Fig. 115.
Six Cell
Circular Box.

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

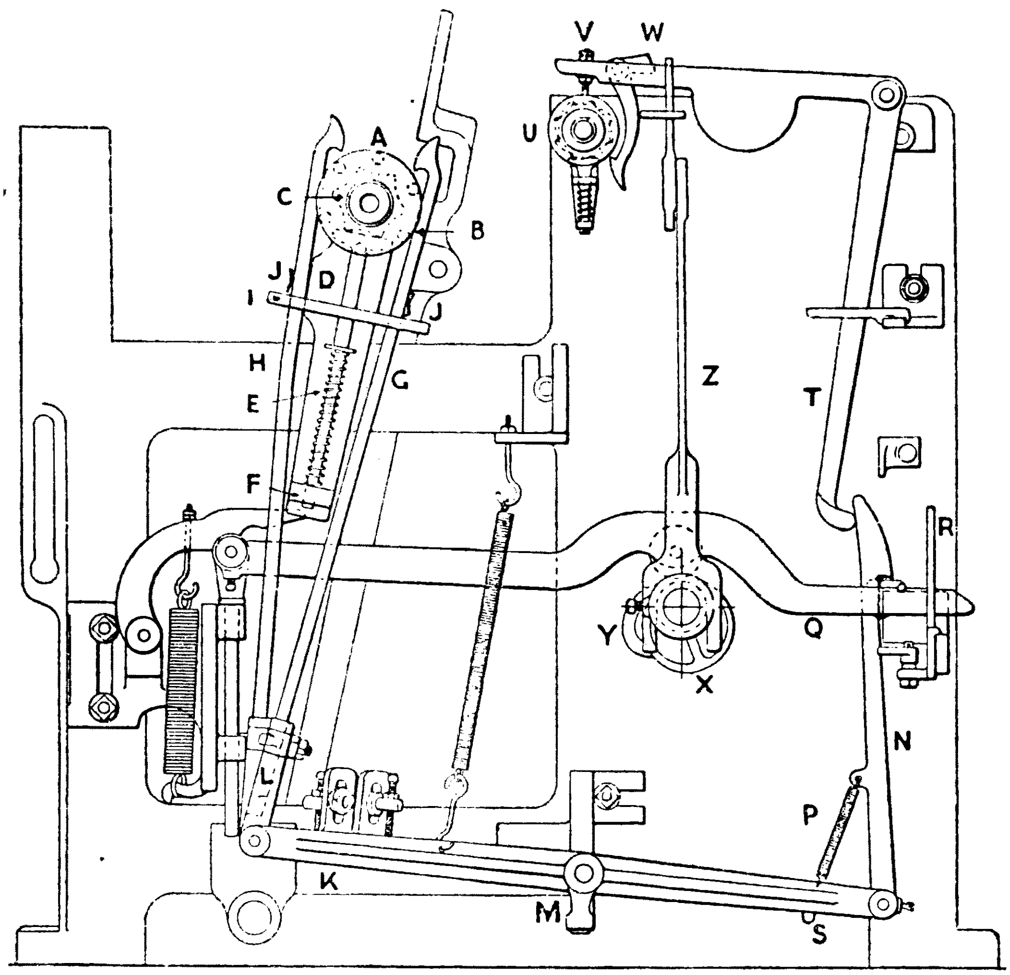
At B is the semi-circular box rest, which has the slotted check strap guide E at the front, and the bracing rod F passing through both ends. As the rest B is malleable, it may be tightened by the rod to prevent too much oscillation of the box. At C is part of the under framework of the box, and through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

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

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

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

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



SIDE VIEW OF CIRCULAR BOX LOOM.

Fig. 116.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

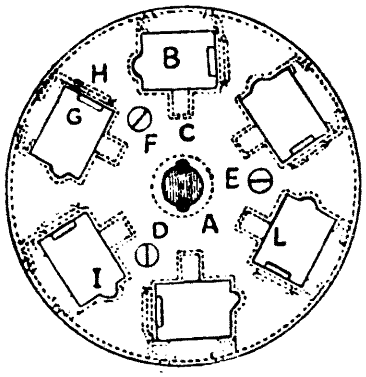
Hattersley's All Metal Circular Box.

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

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

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

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



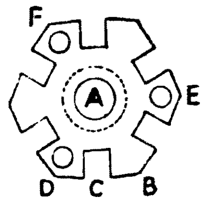


Fig. 118. Fig. 117.
Hattersley's All Metal Circular Box.

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

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

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

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

Fig. 119.

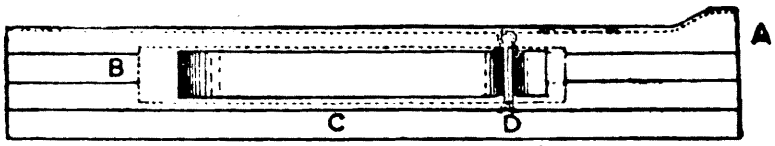
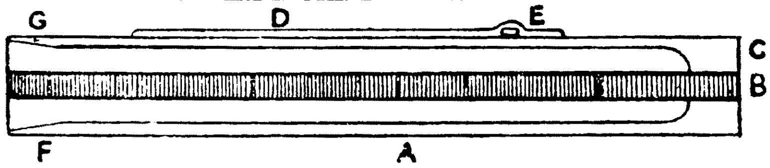


Fig. 120.



Hattersley's All Metal Circular Box.

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

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

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

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

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

This box is another triumph for the Hattersley firm.

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

RAYON AND CREPE WEAVING.

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

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

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

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

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

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

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

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

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

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

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

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

Weaving Rayon Crepes.

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

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

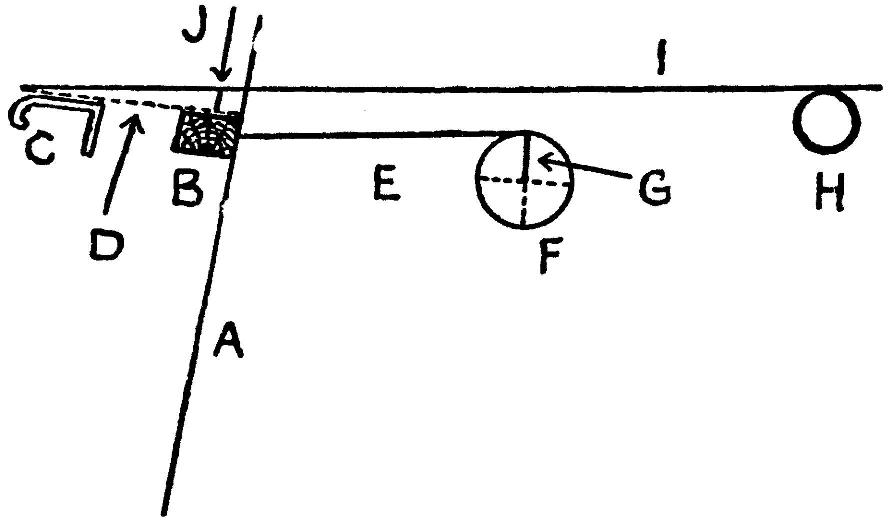


Fig. 121. Setting Pitch of Back Rail.

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

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

The second alteration is to the back rail H.

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

To set for crepe weaving, a band is passed over the rail H from the breast beam C, with a weight at the end. The back rail is then elevated until the band is from 1⅛th and 1¼ inches *above* the shuttle race when the crank is at its top centre. The measurement is made at J. This tightens the bottom shed and slackens the top one, and imparts a better cover to the cloth.

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

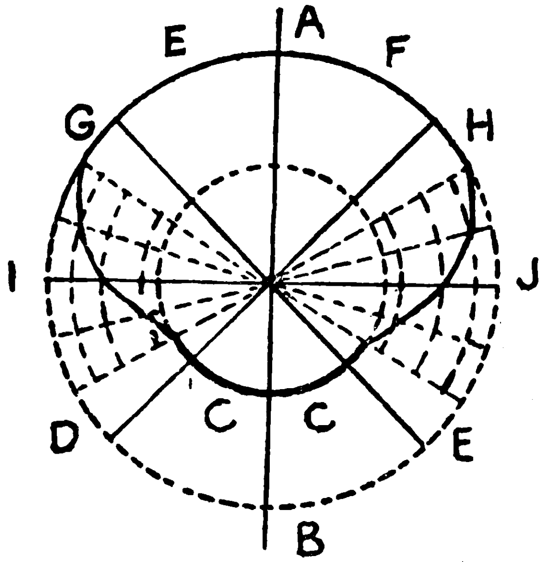


Fig. 122. Tappet for Crepe Weaving.

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

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

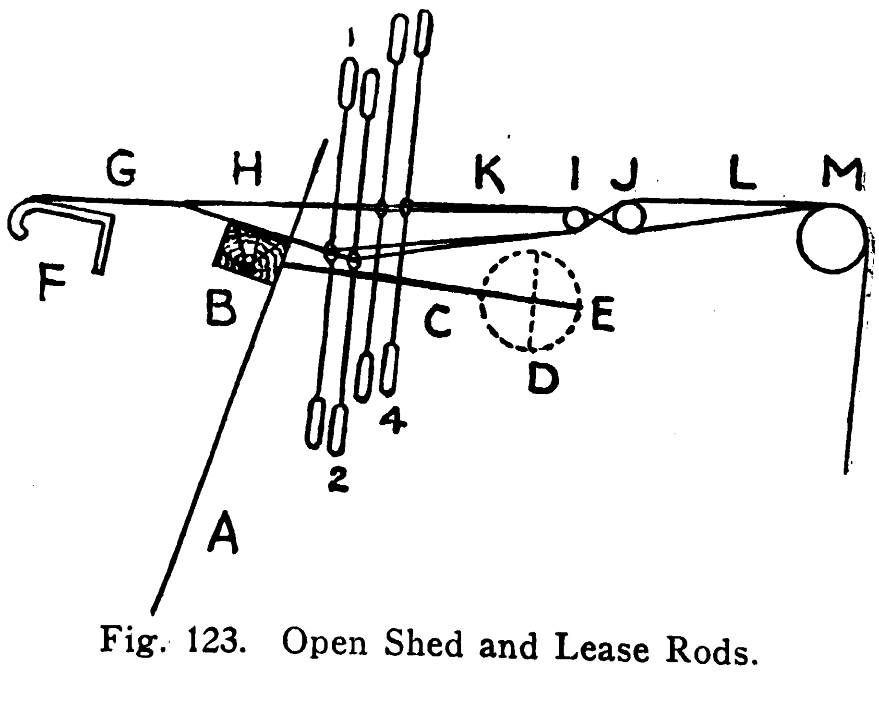


Fig. 123. Open Shed and Lease Rods.

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

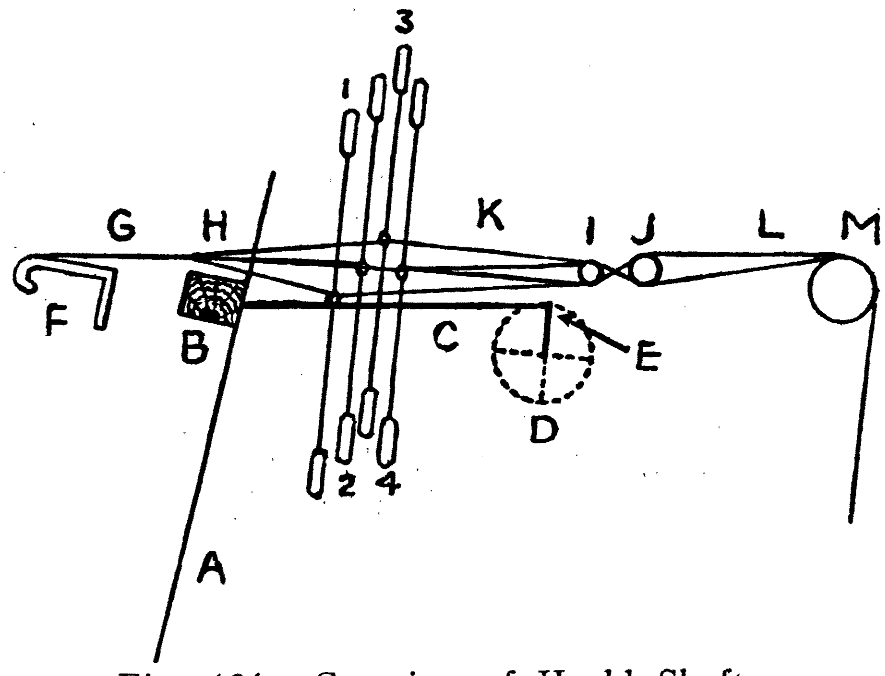


Fig. 124. Crossing of Heald Shafts.

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

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

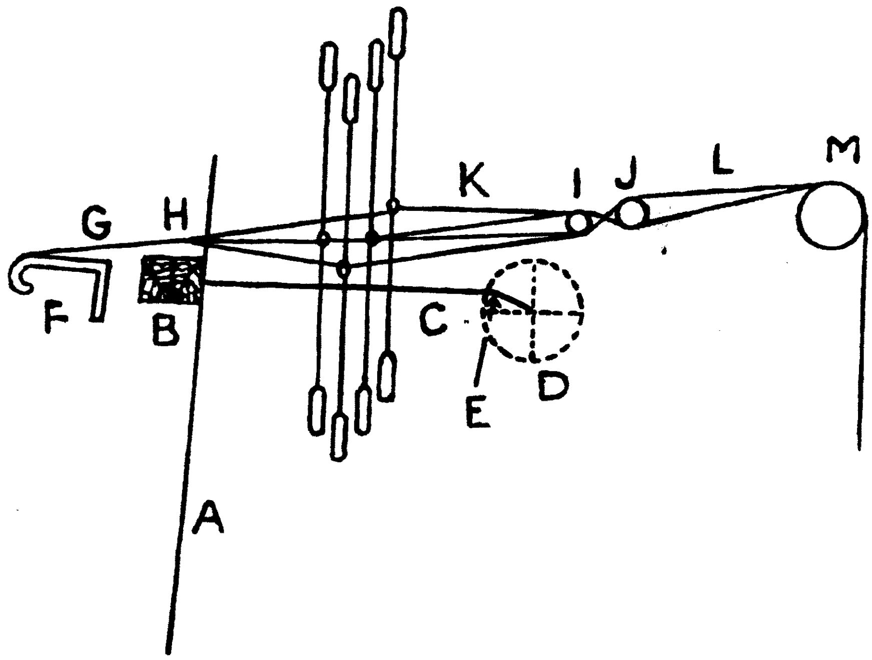


Fig. 125. Position of Healds with Crank at Front.

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

Hattersley's Combined Tappets.

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

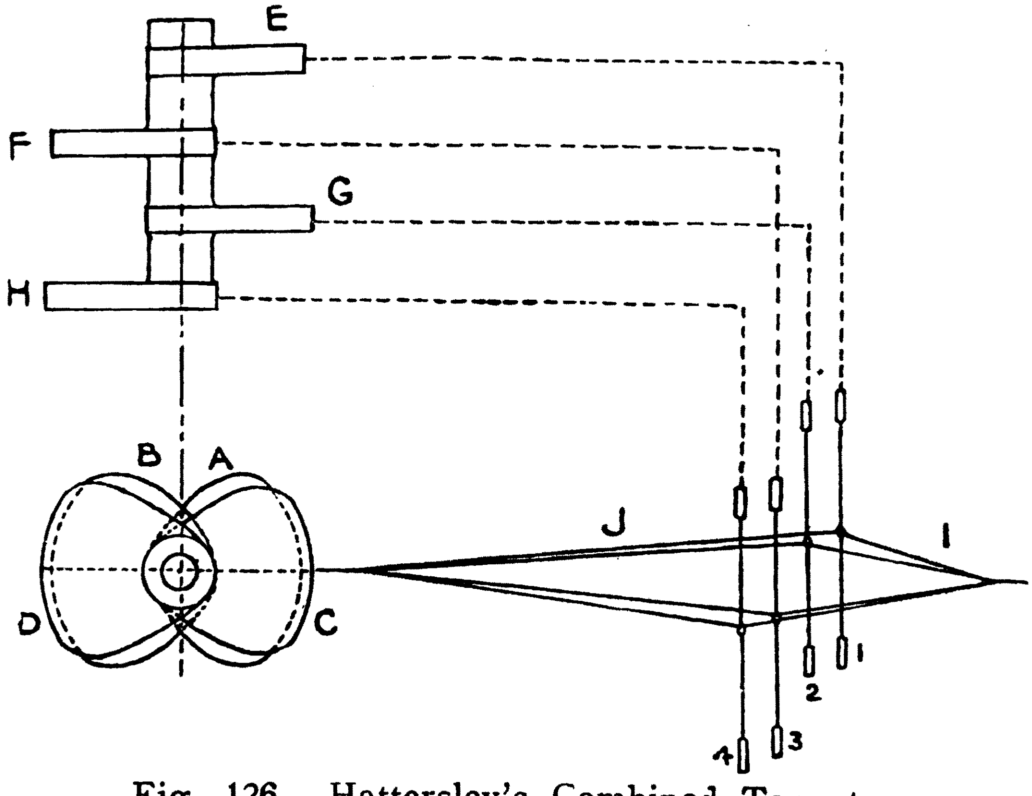


Fig. 126. Hattersley's Combined Tappets.

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

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

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

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

There are a large amount of mixture effects.

THE HATTERSLEY SILK AND RAYON CIRCULAR BOX LOOM.

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

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

The Dobby.

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

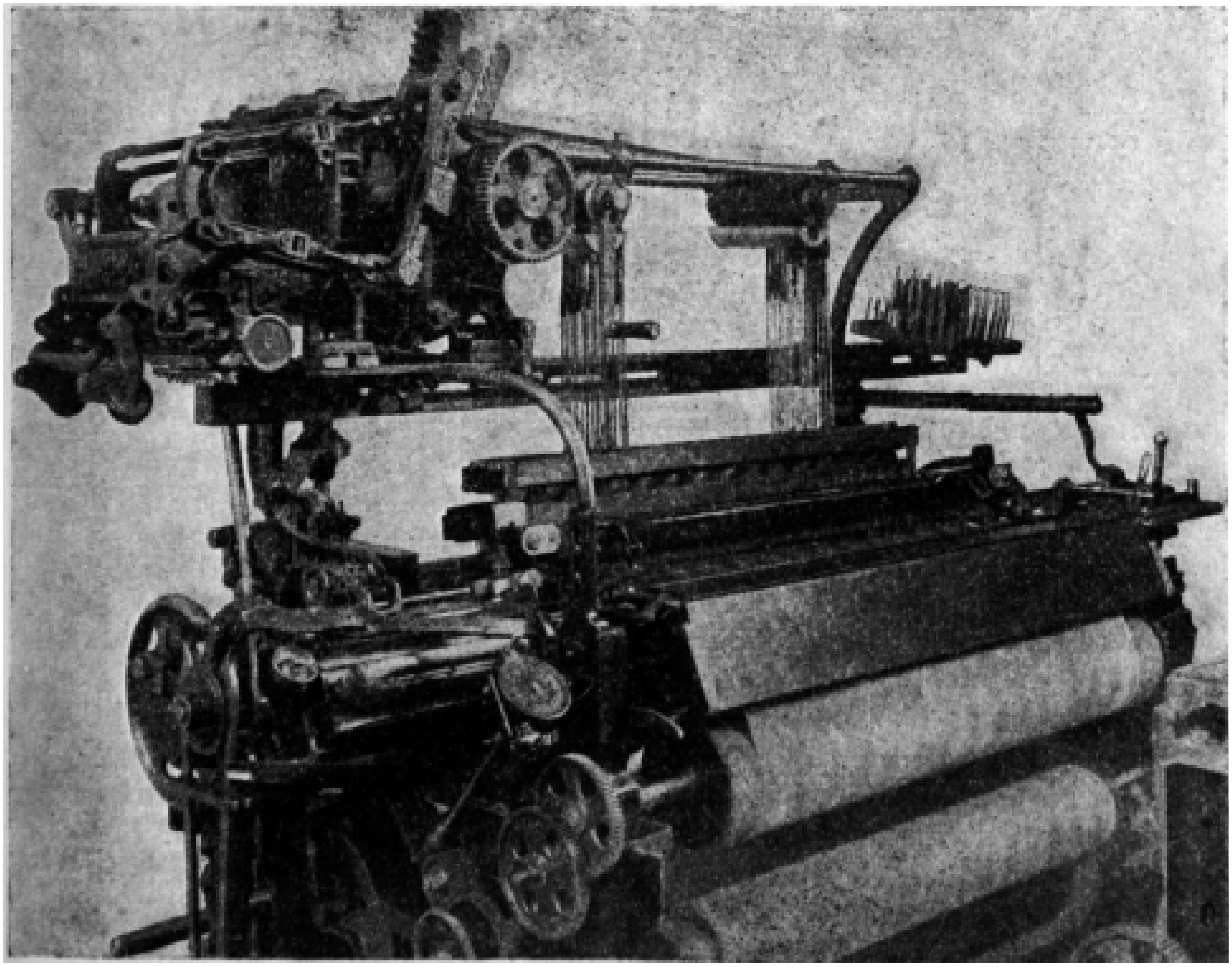


Fig. 127.

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

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

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

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

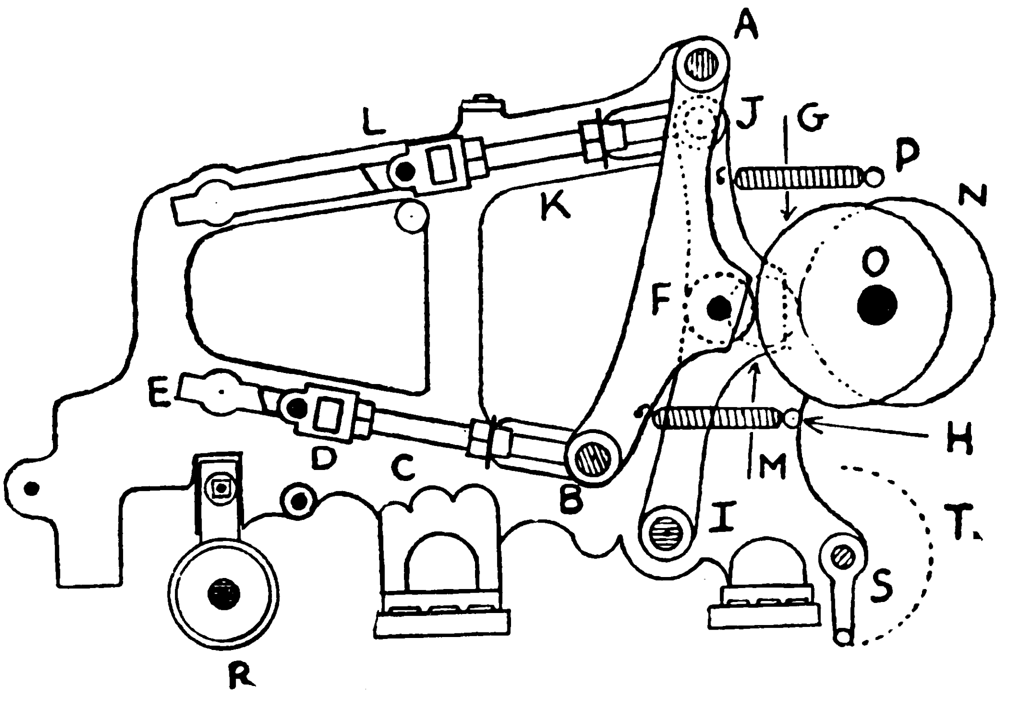


Fig. 128. Tappet Dobby Loom.

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

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

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

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

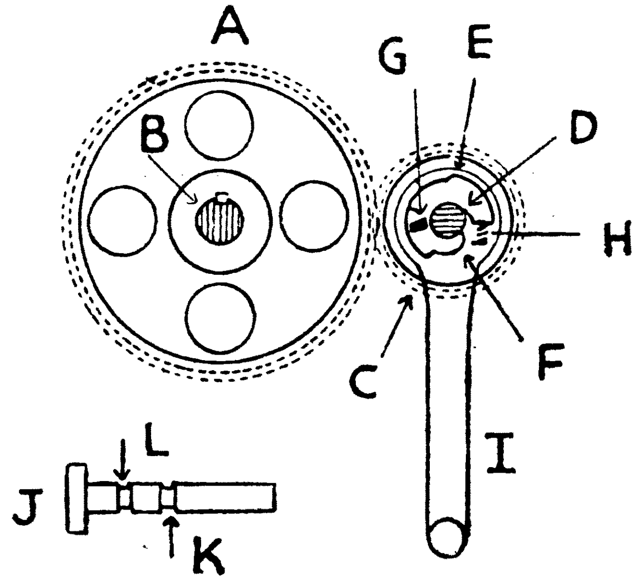


Fig. 129. Reversing Mechanism.

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

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

Letting Cloth Back.

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

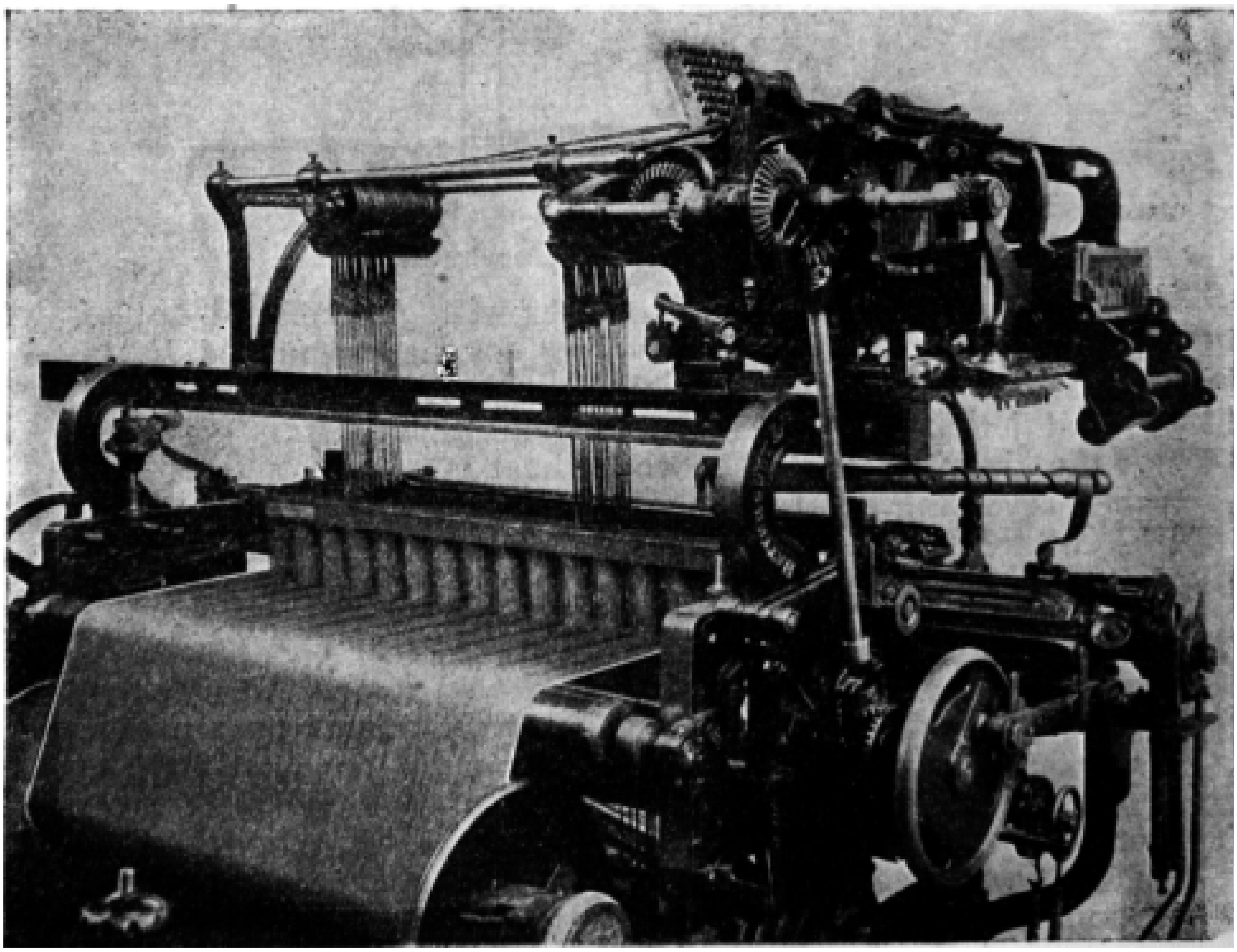


Fig. 130.
Hattersley's Rayon and Silk Loom. (Back View).

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

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

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

Temples.—Cloths are best controlled at the edges by temples specially constructed for the kind of cloth to be woven. Overlookers, however, have to make the best of available material. The temples used on this loom weaving rayon, had two rollers, the casting containing them being setscrewed to a flat bar that passed underneath the cloth. The outer end of the bar passes into the bottom of a right-angled casting, the upper end being held by a threaded rod by which the forward position of the temple is set. At the back, the rod passes through two projections on a bracket bolted to the front of the breast beam. On the rod, and between the projections is an open spiral spring with a set-screwed collar at the front to regulate the power of the spring. The collar is set so the spring is strong enough to hold the temple forward, and yet sensitive enough to readily contract if the shuttle is ever caught between the temple and sley. The bracket bolted to the breast beam sets the altitude of the temple.

Passage of Piece.—After leaving the temple, the piece passes over a steel breast beam which is stationary. It is slightly grooved in opposite directions from the centre to keep the cloth at about the same width as at the fell. The grooves are at an angle of about 75 degrees. The cloth then passes down to the taking-up roller which is covered with emery cloth, and has a circumference of 24 inches.

Mounted well forward on its upper surface is a felt covered roller with a similar one behind it, and round these two the cloth passes on its way to the cloth beam. On the extreme right of the taking-up roller in Fig. 127 is a sprocket wheel and chain, the latter connecting it to another sprocket wheel behind the cloth beam. This latter is a double wheel, the plain one meshing with a similar one on the shaft of the cloth beam.

Track of Warp.—In Fig. 130, it will be observed that the warp passes over a wooden roller, the ends of which are encased in metal. The gudgeons of the beam revolve in ball bearing brackets which makes the roller respond to the lightest touch, and places practically no friction on the warp. The bearer brackets are bolted to the loom frame and can be altered to the requirements of the warp and weave.

Weft Feeler Motion.

This mechanism is applicable to the weaving of rayon weft as well as to woollens and worsteds. It comes into operation before the tumbler weft fork, for it stops the loom before the weft is exhausted. By being brought into action before that of the weft fork, many light places are avoided which show when finished in delicate structures, and weavers who have to attend more looms than formerly, find this mechanism a valuable asset.

The Feeler.—Fig. 131 gives the outer view of the new motion. At A is the main casting which is fulcrumed at B. It is made of brass, and there are flanged guides at C and D

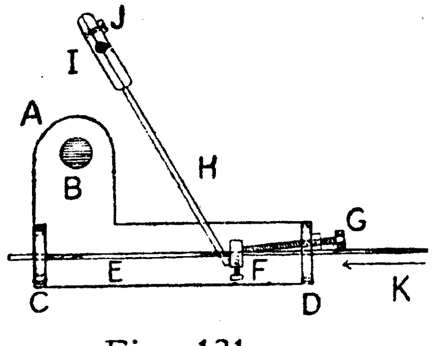


Fig. 131.

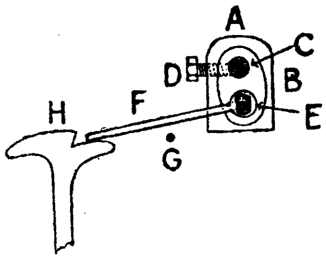


Fig. 132.

Hattersley's Patent Weft Feeler (End View).

through which the circular steel feeler E is made to pass. The feeler tapers a little at the front, the end of it being small and highly polished so as not to injure the most delicate weft. The feeler is long enough to be retained in the guides whatever be the movement imparted to it.

On it is the small setscrewed collar F, and against the front of it is the locknutted setscrew G which regulates the stationary position of the feeler. The setting of the feeler has to be, that when there is a sufficient covering of weft on the bobbin the loom will continue to weave, but as soon as the feeler can penetrate the slot in the bobbin, the loom is brought to a stop.

When the going part is brought forward by the crank, the feeler passes through a slot in the box front and shuttle front, and thus comes in contact with the weft, and is pushed back by it in the direction of the arrow K.

Needle.—Behind the collar is the needle H which is in two parts at the top and embraces the small spring rod I. The two parts are held together by the screw J which thus forms a clamp. By being so constructed, the spring rod can be set to give the best working results.

Knock-off Finger.—Fig. 132 gives in outline the mechanism at the inner end. At A is the casting at the end of the knocker-off bar which passes in front of the setting on handle. At B is a very short lever which is fulcrumed at C, the pin of which is held by the setscrew D. At E is the screw nut, and upon its boss the small finger F oscillates. The inner end of the rod rests upon the back part of the hammer head belonging to the tumbler weft fork.

At G is the inner end of the spring rod that passes underneath the finger F.

When the weft feeler is moved backward by weft pressure every other pick, then the spring rod G elevates

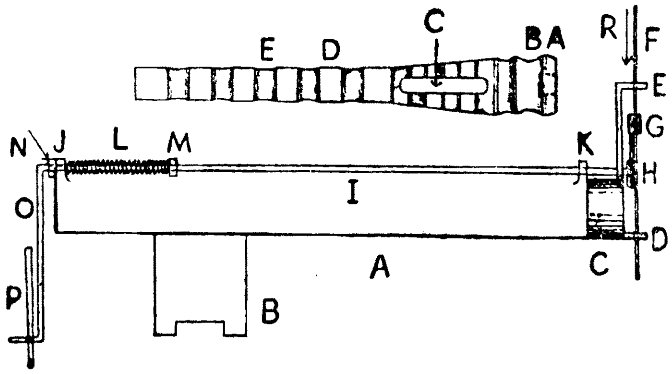


Fig. 133.

Top View of Feeler Motion.

Fig. 134.

View of Bobbin.

the finger F above the hammer head H, and the loom continues to weave.

When, however, the feeler penetrates the slot in the bobbin, the feeler and attendant parts remain stationary. When the hammer head now moves, it forces back the finger F and the knocker-off bar B and so stops the loom.

Fig. 133 gives the top view of the parts involved. At A is the framework of the motion, the part B being bolted to the front of the breast beam. At C, is the top of the brass casting with its guides for the feeler at D and E. At G is indicated the collar on the feeler, but the regulating setscrew is omitted. At F is the feeler with the arrow R showing its backward movement. The clamp that embraces this end of the spring rod is at H. The rod passes through guides J and K and on it is the spiral spring L which is held by the guide J at one end, and at the other by the setscrewed collar M.

It will now be realized that it is the spring L that keeps the feeler forward, for the clamp needle H exerts pressure behind the collar G on the weft feeler. The collar N prevents lateral movement of the spring rod. When the feeler F is forced in the direction of the arrow R, the collar G forces back the clamp needle H, and twists the spring rod I so that the end O raises the finger P above the hammer head, and the loom continues to weave.

When the weft feeler remains stationary, all the other parts do the same, and the hammer head then forces back the finger P and the knocker-off lever and so stops the loom.

Bobbin.—This is shown above the feeler motion, at Fig. 134, its actual size being 6 inches long. The head end A is capped with tin, and grooved top and bottom so as to be held by the solid projections on the spindle block in the shuttle. The bobbin cannot then turn and the groove C is retained at the front. The groove in the bobbin head at B is where the claws of the shuttle hold it. The slot C is 1⅜ inches long and ¼ inch wide, which gives ample scope for any variation in picking and checking of the shuttle.

There is only one slot in the bobbin, and the weaver has to see it is placed at the front in the shuttle. It is easy to tell as the weft is flatter.

Advantages.—The mechanism is remarkable for the lightness of its construction, and its sensitiveness in action.

It is simply made and reliable. As mentioned, the feeler stops the loom when there are only a few picks of weft on the bobbin, this being about equal to the management of a good weaver on an ordinary loom. Only a minimum amount of waste is made, and light places which are often a blemish in delicate pieces are entirely missing.

The new weft feeler motion has a knocker-off bar of its own which fits above the ordinary one attached to the tumbler weft fork.

HATTERSLEY'S DROP BOX LOOM FOR SILK AND RAYON.

This loom is the third which the Hattersley firm have constructed for the weaving of silk and rayon.

It is fitted with four boxes at either end, has a reed space of 57 inches, and has a speed of from 140 to 160 picks per minute and presented at Fig. 135.

Dobby.—The loom has a tappet dobby which has already found much favour. It is the same kind of dobby as the one for their circular box loom for rayon weaving. As this has already been explained, the reader may refer to it. There are, however, two differences (1) The boxes and picking are controlled by the shaft lags. (2) Instead of the shaft lags revolving inward for weaving, they turn outward.

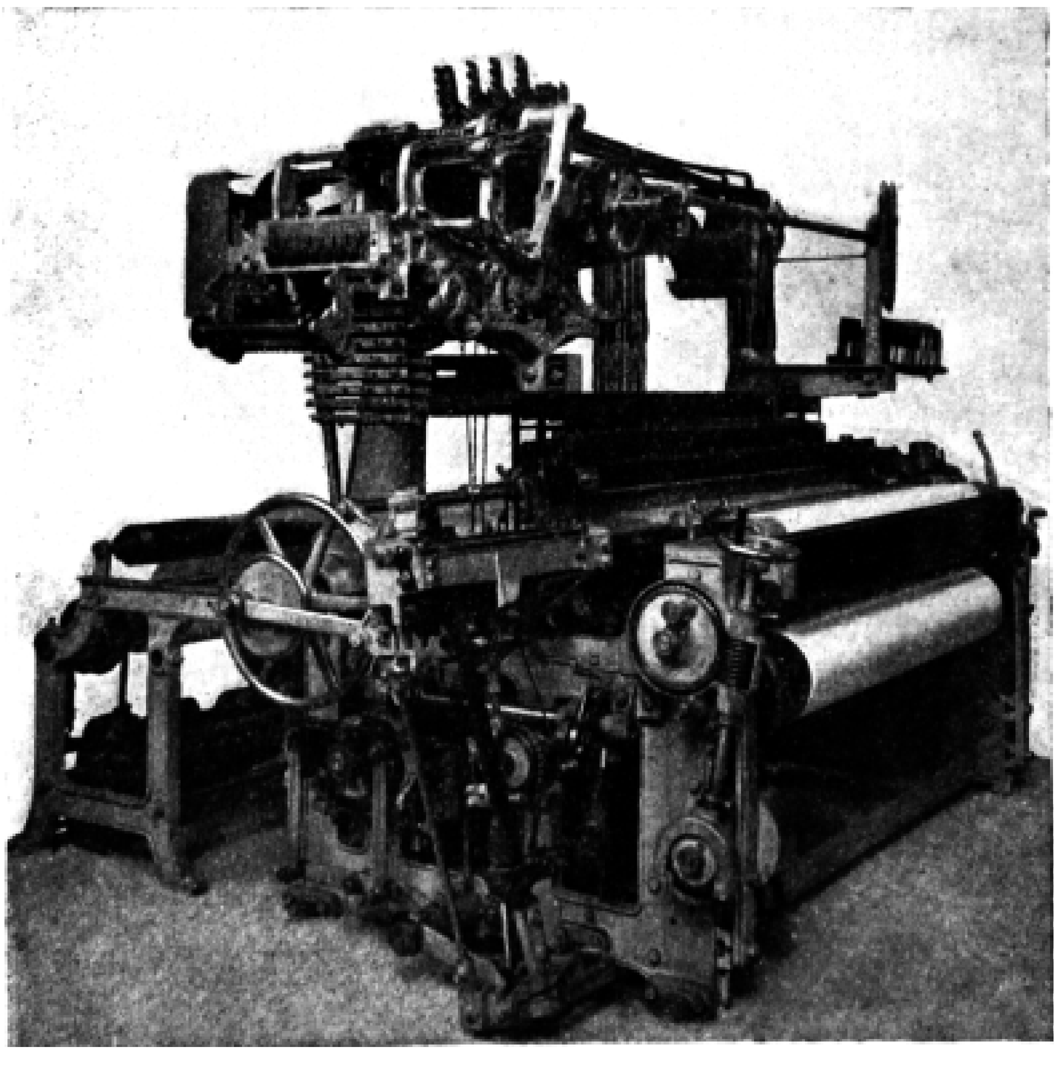


Fig. 135.

Hattersley Drop Box Silk and Rayon Loom. (Front View).

Picking.—An outline is at Fig. 136. A and B are the strong bearer brackets bolted outside the loom frame. C is the horizontal picking shaft, and is flat and bored at D for cone stud E. The cone stud diameter is 1¾ inches to generate a strong pick, for the low shaft is only half the speed of the crank shaft.

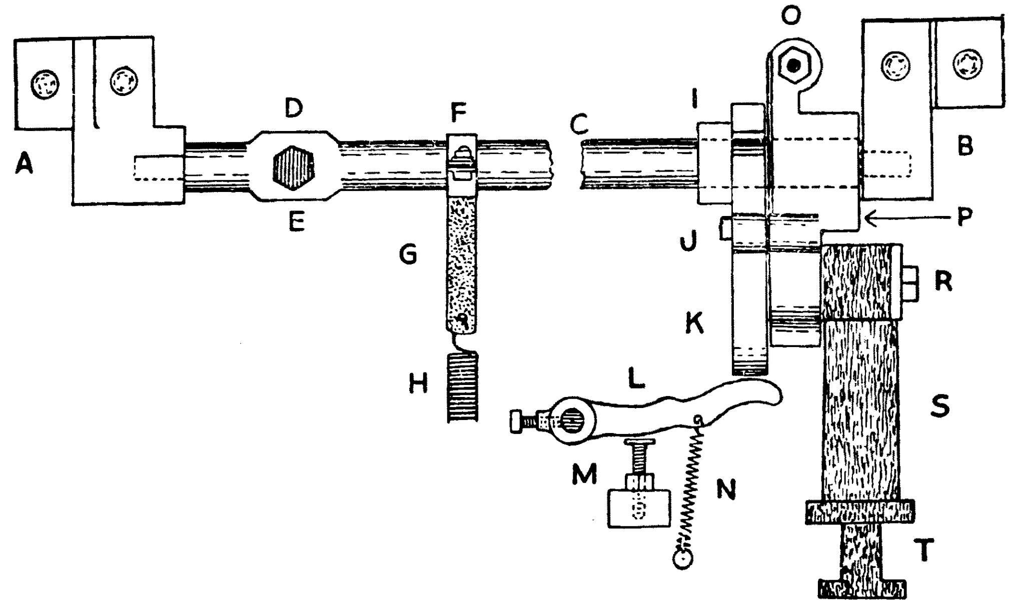


Fig. 136. Outside Horizontal Picking.

There are a pair of tappet noses at each end of the loom, and the picking boss is fixed so the end of the nose is level with the end of the cone. The cone is thrown upward when picking takes place.

F is the clamp on the picking shaft, and to this is attached strap G with spring H to pull the shaft round after picking. I is the boss of the picking cam keyed to the shaft. The larger diameter of the cam has a sloping cut that holds the sloping end of the picking catch when dropped for picking. The catch is fulcrumed at J and its lower curved part at K.

The lifting finger L is controlled from the box swell at the opposite end of the loom. If there be a shuttle in the boxes that are level with the shuttle race, the loom does not pick from either end, and the loom stops. The stationary position of lever L is regulated by the locknutted setscrew M, and is pulled back after action by spring N. When the picking catch is raised, the swing casting P and the wooden picking arm S are stationary, but on the catch dropping, both are brought into play and the shuttle is sent across the loom. The standing position of P is set by setscrew O the head of it contacting with loom frame. On casting P is the strong part R that holds the wooden arm S.

The arm is 9 inches long and 1¾ inches broad, and at T. is grooved to retain the looped picking strap.

Picking Stick and Arm.—At A, Fig. 137, is the pivot of the vertical picking stick. It is held in the cavity of the rocker casting, and has a covering bracket B, fulcrumed at C and held down by spring D. At E is the sheath for the upright picking stick F which is doubly bolted. G and H are bolted together and hold the regulation strap I that has charge of the thick strap J. The latter is bolted at K

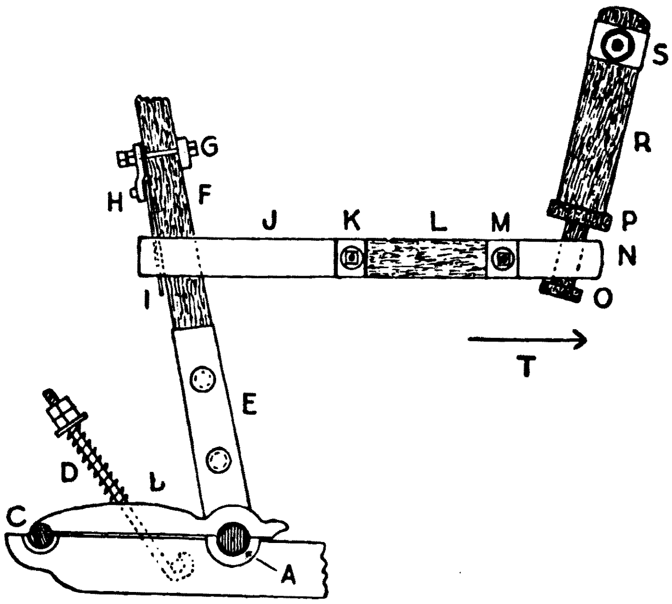


Fig. 137. Picking Arrangement.

to the short wooden arm L, and looped strap M passes at N round picking arm R, and kept in position by the circular projections O and P, the arm being centred at S. This arrangement generates a smooth and steady force very suitable for weaving silk and rayon yarns.

Tappet Checking.—Fig. 138 shows that A is the connecting rod that couples the straight lever C, D on the cross shaft F to a right angled lever near the shuttle boxes. B is the swivel casting.

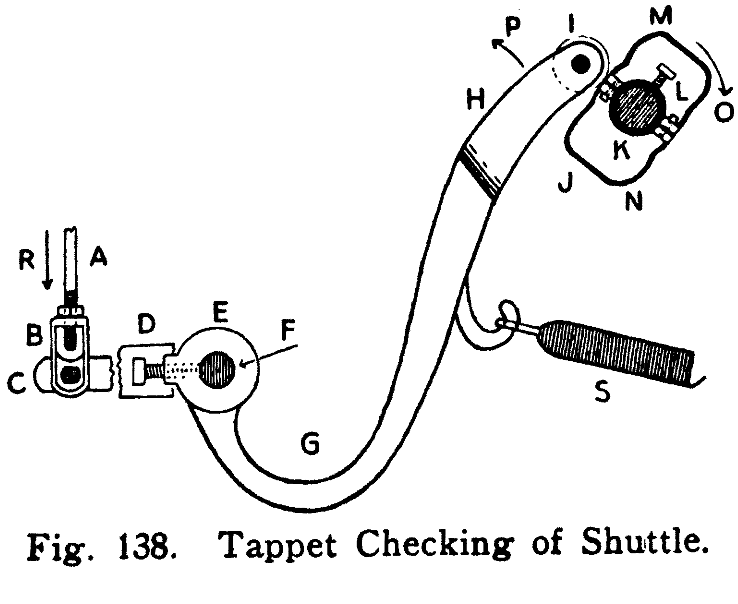


Fig. 138. Tappet Checking of Shuttle.

The curved lever G is the bowl casting with its boss at E on shaft F. It is bifurcated at H to receive bowl I. At J is the tappet clamped to the low shaft K, and timed by set-screw L. It is timed as shown, for when the crank is at its back centre, the bowl I is at or near the centre of the tappet. When the bowl is in this position, the picker and stick are forward for checking. When the tappet forces the bowl lever as arrow P, picker and stick slide back to the box end.

The tappet turns like arrow O, and rotates cross rod F from right to left, and lever C and rod A move downward as at R.

The bowl lever is kept in contact with the tappet by spring S. The corners M and N are more rounded than the opposites, so the bowl lever falls steadier than the ascent.

Spring Rod and Checking Lever.—These parts are at Fig. 139. A is the same rod as in Fig. 138. B is a right angled lever, and holds the spring rod D, the spring being confined by collars C and E. The spring rod passes through the curved casting G, emerges at F, and is held by a third

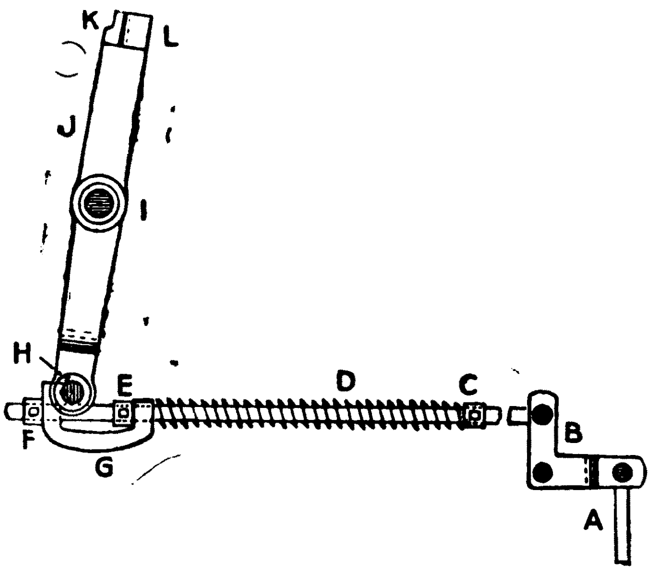


Fig. 139. Spring Rod and Checking Lever.

collar. Casting G rotates on pivot H. The checking lever J swings on stud I, and at its summit is the part K against which the back of the picker rests, and the head of its contacts at L.

When the crank is at its back centre, the picker is drawn forward from $\frac{3}{4}$ to $\frac{7}{8}$ inch to check the incoming shuttle.

The vertical picking stick passes through a slot in the buffalo picker that is blocked with leather at the inner front to protect the stick.

Fast and Yielding Reed.—The handrail visible in both photographs has nothing to do with holding the sley, but is a convenience for the weaver. Below it is the upper part of the reed case which is best seen in Fig. 140. It is converted int6 a fast reed by fixing a strong setscrew into either end of the reed case.

The fast reed is best for the heavier kind of work. By the extraction of the two setscrews, it does not make it an ordinary loose reed, for instead of the reed swinging free from the bottom of the reed case, and being retained at the top, the whole sley moves backward, and is therefore a " yielding " reed.

It is forced back when the shuttle is trapped in the shed. As soon as the going part is moved back by turning the balance wheel, the two powerful springs that are attached to the reed case push the sley back to its normal position. Below the reed case, but attached to it, is a finger towards either end of it. These pass under bowls on adjustable brackets which are bolted to the breast beam.

When the reed is forced backward, the two fingers rise, and ride over the tops of the bowls, this movement con-

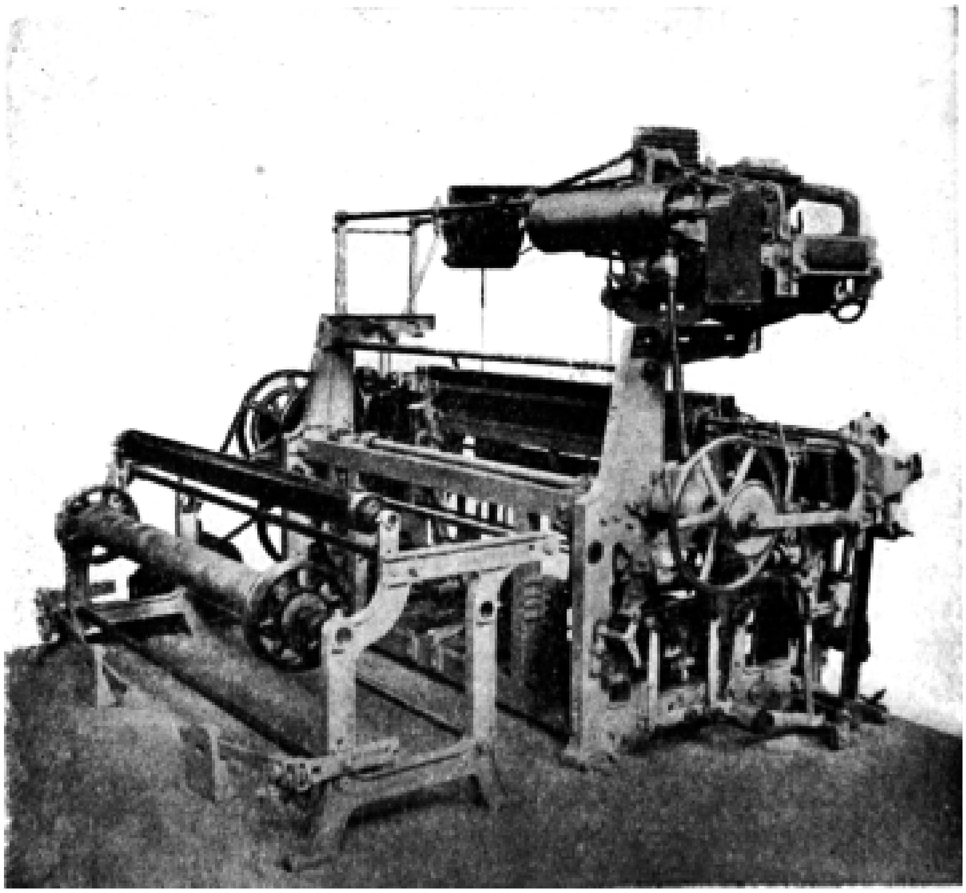


Fig. 140.
Hattersley Drop Box Silk and Rayon Loom. (Back View).

siderably easing the pressure of the shuttle on the warp, and prevents serious damage.

Negative Let-off.—As will be observed in Fig. **140** there is a separate frame for the warp beam and the back roller. This gives a good length of warp behind the healds, and spreads warp tension over a long length. The warp beam is provided with large flanged pulleys which are turned dead true, and are screwed fast to the beam.

The method of braking the beam is by rope and weight lever, the friction side of the rope having French chalk applied.

The gudgeons of the beam as well as those on the back roller over which the warp passes, revolve in ball bearing brackets. The brackets for the roller are adjustable, so as to meet the altering needs of the warps and weaves.

New Method of Take-up.—The back levers which govern the taking-up motion are seen just inside the back of the loom frame in Fig. **141**.

The construction of them is detailed in Fig. **140**. At A is the low shaft on which the tappet B is clamped, setscrewed, and timed. The bowl lever C is fulcrumed at D, and is kept in contact with the tappet by the pull of spring E. At F is the fulcrum of the regulation lever with its curved part at G, and its central open section at H. In this open section is the long rod which is finely threaded, and turned by the small handwheel I at the top.

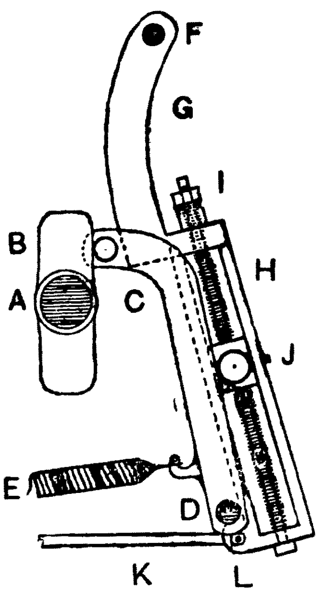


Fig. 141.
Hattersley Take-up Motion Without Change Wheels.

On the rod is the bowl casting J, the bowl coming in contact with the bowl lever C in front of it. The bowl casting J has a small pointer at the front, for on the face side of the lever, it is marked in inches down to quarters to record the position of the bowl casting, and indicate the number of picks which will be put in the cloth.

When the bowl casting J is at the top of the rod, it registers as few as 17 picks to the inch, but when near the bottom, it puts in **200**. That is a very wide range. At the base of lever H is the flat rod K, which is pinned to lever L, and connects the lever to the taking-up drum seen just inside the front of the loom frame in Fig. **135**. Inside the drum are two wheels that are cast together. The inner wheel has its teeth pointing towards the front of the loom, the teeth of the other are the same way but are not as broad.

The inner wheel is served by 31 taking-up catches, that are pinned inside the drum, and are swung backwards and forwards by the action of the flat connecting rod K in Fig. 141.

The outer section of the drum is stationary, and carries 31 catches. These prevent the wheels from running back. If, now, the two groups of wheels be multiplied together, it will be realized that the taking-up motion works almost to a 1,000 part of an inch.

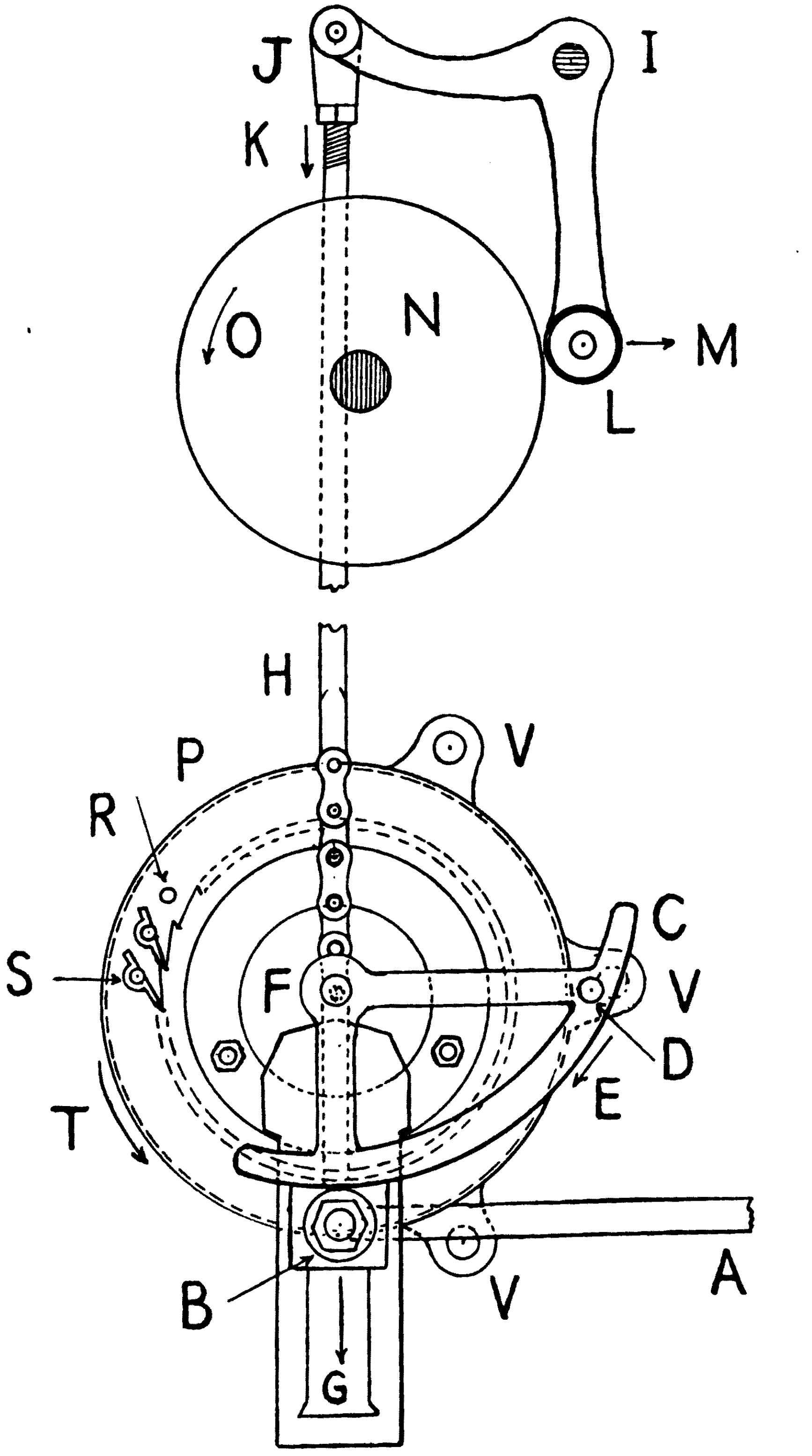


Fig. 142. Take-up Drum Inside Loom.

Take-up Drum.—At Fig. 142, rod A is the same as K in Fig. 140, and is fixed behind bowl B. Drum P has a diameter of 7½ inches, its movable part being innermost, and the back stationary part is bolted to the loom frame at the three projections V. At R are the pivots for the pushing catches S, the catches being held to the drum by special springs. In front of the drum is a compensating lever. The bowl B is on a slide that moves downward as the diameter of the cloth increases, and can move down over 2½ inches as suggested at G.

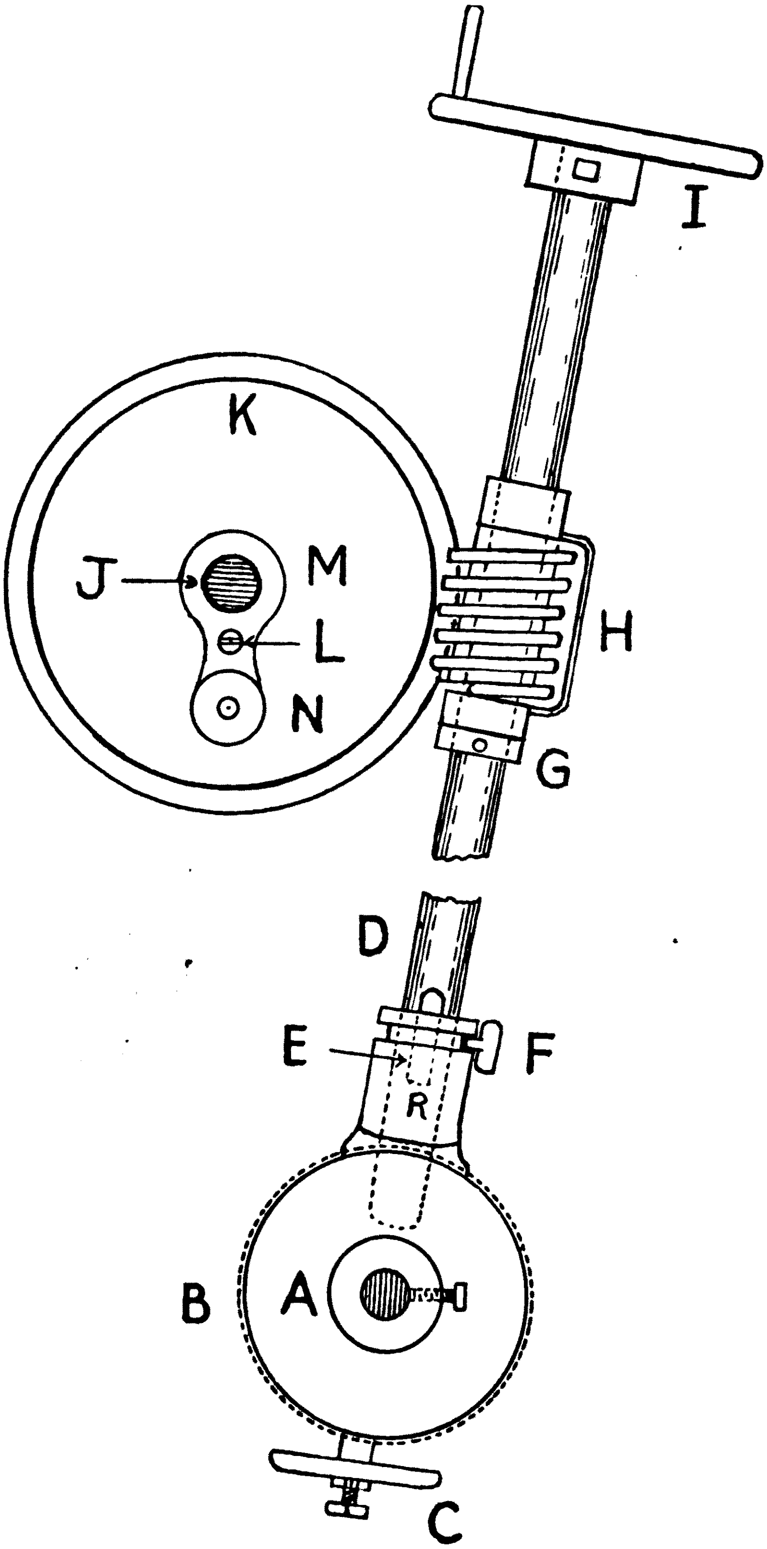


Fig. 143. Take-up Mechanism Outside Loom.

The large cloth roller is at N, turning as arrow O. Behind it is the felt-covered roller L that moves out as arrow M as the cloth wraps increase. The lever holding the felt-covered roller is on stud I, and its horizontal arm holds the swivel J that holds and regulates rod H that descends as the cloth increases in diameter. This influences the curved lever C that rests on the bowl top, and moves like E by means of coiled spring pressure, and keeps it in correct working position. The curved lever is fitted with a small handle at D, fulcrumed at F, and moved by hand when required.

Outer Take-up Shaft.—This diagram is at Fig. **143.** A is the outer end of the drum shaft, to which bevel wheel B is setscrewed. Any surplus oil is caught by the metal holder C. The strong take-up shaft D carries the bevel wheel E at its base. This can be lifted out of contact with bevel wheel B, by clutch fork F that is connected to handles at either end of the loom. Bevel wheel E slides on a saddle key on shaft D. By means of handwheel I, the cloth can be let off or taken up. Shaft D is held in its rotating position by collar G. Worm H is rotated by the take-up drum, and turns the large wheel K that meshes with it. K is loose on shaft J, but arm M is fixed to the wheel by screw L. At the base of arm M is the plunger N, which, when withdrawn, liberated the cloth beam. On short shaft J, but inside loom is a small wheel that meshes with a large cogged wheel that turns the cloth beam. The large wheel has a series of holes used by the plunger N, but is hollow inside. Into it is placed a star wheel having ten parts, and into any two of its gaps which are opposite each other, two projections on the hollow side of the wheel make entrance. As the star wheel is fixed on the shaft of the cloth beam, it rotates by the action of the take-up drum.

At the opposite end of the loom, the shaft of the cloth beam is held by a sleeve, which, when withdrawn, the cloth beam and cloth can be removed and an empty one substituted.

Box Motion.—The segment wheels with their attendant levers are best seen in Fig. **140.** All three segment wheels have two sets of teeth. The centre wheel that turns the others is setscrewed to the low shaft, and by it the movement of the boxes are timed. The boxes begin to move when the crank is at its top centre, and they have changed and come to rest when the crank has reached its bottom centre.

All three wheels are turned every pick, but the boxes are only moved when the legs of a clutch penetrate the plate in front of the small wheels which carry the connecting arm to the lifting lever of the boxes. The clutch forks are influenced by pegs in the shaft lags. The back segment wheel controls the second box, and the front one the third box. When both work in unison for lifting, then the fourth box is brought level with the shuttle race.

But there is a further invention. It will be noted in Fig. 135 there is a drum with a chain attachment about the centre length of the box rod. The lower end of the chain is fixed to a casting on the box rod. Inside the drum is a coiled spring that exerts pressure anti-clockwise to the drum. This makes the lifting of the boxes a very easy matter, for when the escape motion is released from its groove on the box rod, the box immediately rises to at least half its depth.

As may be observed in Fig. 135, there are two weft forks, each being set at an equal distance from the centre of the shuttle race. Each fork has three prongs. The shape and movement of the forks are better understood by an examination of the drawings.

Tappet Driven Weft Fork.—This is at Fig. 144. Tappet A is in two sections, and clamped to the low shaft B. It is timed by setscrew D. The prongs reach their highest when the crank is at its back centre, and the elevation must allow

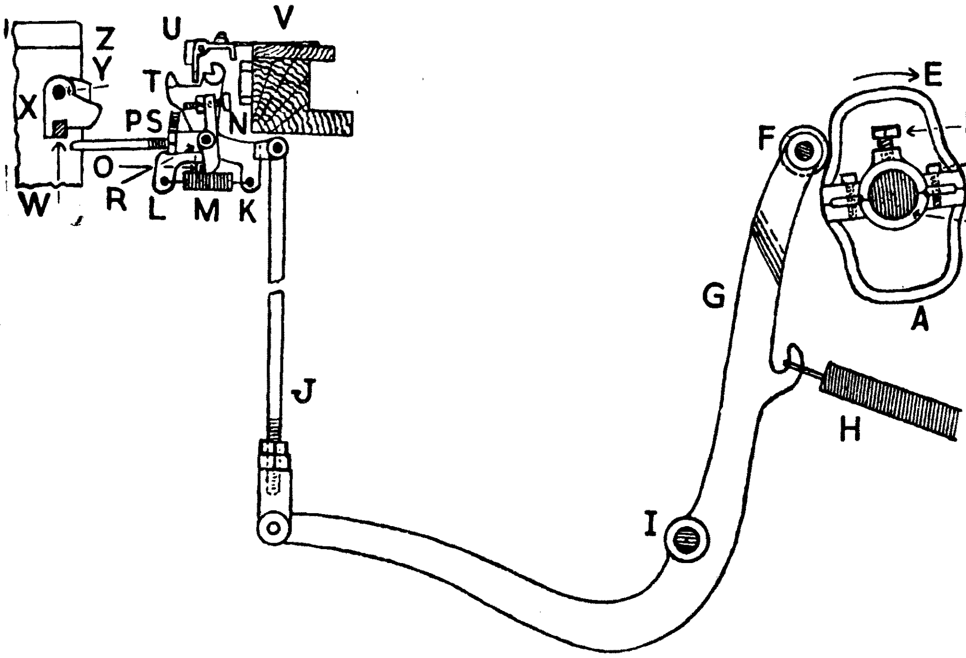


Fig. 144. Tappet Driven Weft Fork.

the shuttle to pass underneath with a quarter inch to spare. The tappet moves as arrow E.

Bowl Lever and Connecting Rod.—The anti-friction bowl is at F, and the long lever at G moves on I. After action, it is brought back by spring H. Connecting rod J is fixed by a swivel to the inner end of bowl lever. The top of the rod is pinned to the short lever K.

Fast and Loose Levers.—Cross rod R, Fig. 145, takes the place of a stop rod. On it are placed both fast and loose castings. Lever K to which connecting rod J is pinned, is a loose casting but its front end comes in contact with the back of the short lever L that is screwed to cross shaft R. They are kept in contact by spring M that is fixed to both levers, so that when the tappet elevates rod J, lever L is moved downward and other fixed castings move with it, and vice versa.

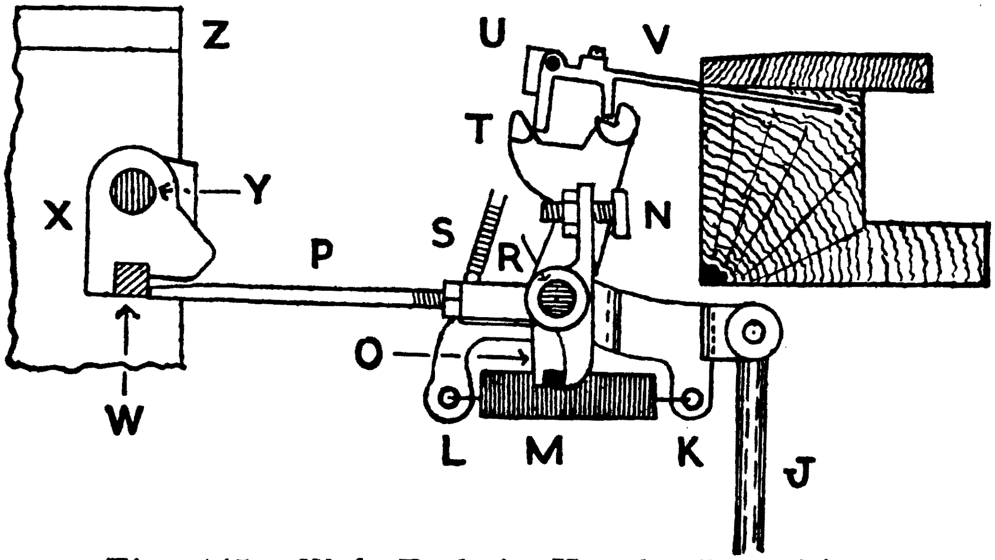


Fig. 145. Weft Fork in Knock-off Position.

Another loose part on the shaft is the casting into which the stop rod tongue P is screwed and locknutted. By being threaded, the working length of the tongue is altered, for on becoming worn, it may be lengthend. Along with stop rod casting P, is the double-armed lever N that works in unison with the stop rod casting. It has a locknutted set-screw, the head of it coming in contact with the lay, and limits the upward movement of the tongue.

Both stop rod P and lever N are moved by the short arm O for it contacts with N.

It is the locknut on N that imparts the correct position to the point on the stop rod tongue in relation to frog W.

Weft Fork Regulator.—This part is at T in Fig. 144 and is screwed to cross shaft R. It has a horn on the left, and a head on the right. The diagram illustrates that the weft is holding up the prongs, and has allowed the head of the regulator to pass clear of the right leg on the tippler, so the loom can continue weaving.

When the connecting rod J descends, the regulator moves to the right, and the horn comes in contact with the leg on the left, and raises the prongs. When the stop rod tongue P contacts with frog W, the stop bracket X swings on its pivot at Y, and releases the setting on handle and stops the loom. The breast beam is at Z.

Knock-Off Positions.—Fig. 145 represents the parts when the weft fails. The lettering is the same as Fig. 144. As there is no weft to hold up the prongs V, they sink into the groove in the shuttle race. The cut in the head of regulator T seizes the short leg on the weft fork and stops the movement of the fixed castings on cross shaft R. As the stop rod tongue does not sink, it strikes frog W on casting X, and the loom ceases to run before the reed contact with the cloth. This prevents light places being made in the fabric. The tappet raises the rod J to the same height, and because the fixed castings do not move, the spring M is extended.

Positions When Crank at Back Centre.—These are illustrated in Fig. 146, rod J is down to its limit, and has moved the weft fork regulator T to the right, and the horn

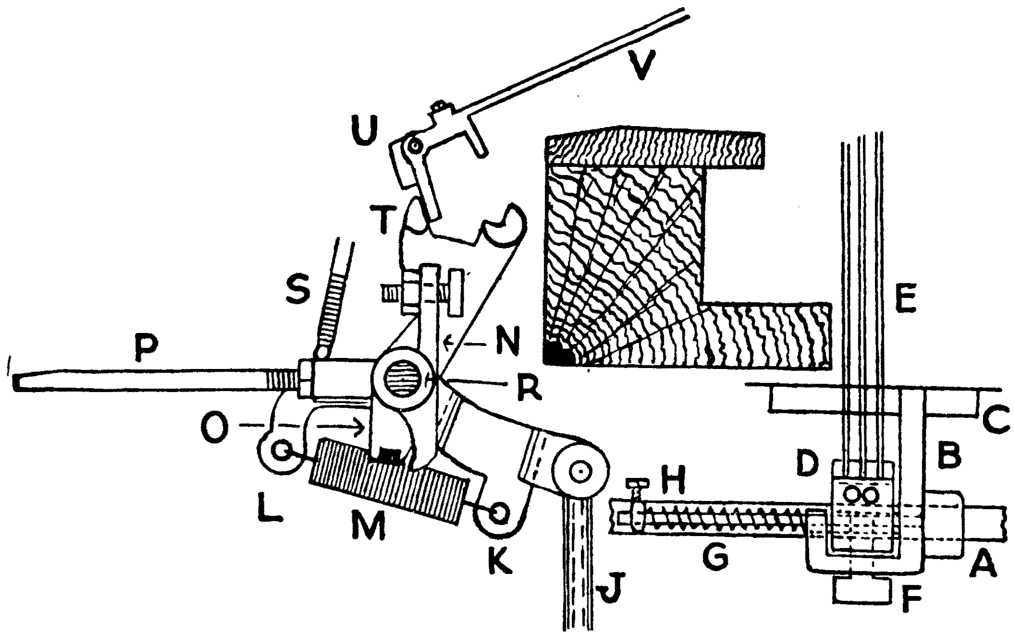


Fig. 146. Weft Fork with Crank at Back Centre.

Fig. 147. Front View of Weft Fork.

has come in contact with the long leg on the weft fork. As the contact parts are case hardened, they last much longer.

Front View of Weft Fork.—Fig. 147 shows A as the cross rod, and is the same as R in the other drawings. B is the casting attached to the lag C, the casting holding the short rod upon which spring G is placed. The spring is straight at either end, and enters a small recess in B and H. By collar H the spring can be made weaker or stronger, and compels the weft fork prongs to begin their descent as soon as the crank leaves its back centre.

At D, the weft fork casting has three grooves and carries three prongs, three being much better than two to hold the slippery weft. The free ends of the prongs are placed at an obtuse angle so as to gradually slide off the weft. A couple of screws hold the plate that retain the prongs in the casting. At F is the upper part of the head of the regulator.

On the same loom is a pick control. The picking is not governed by pegs in the box lags, but by the swells of the boxes. If there be a shuttle in each box that is level with the shuttle race, the loom will not pick from either end. It is a very clever invention.

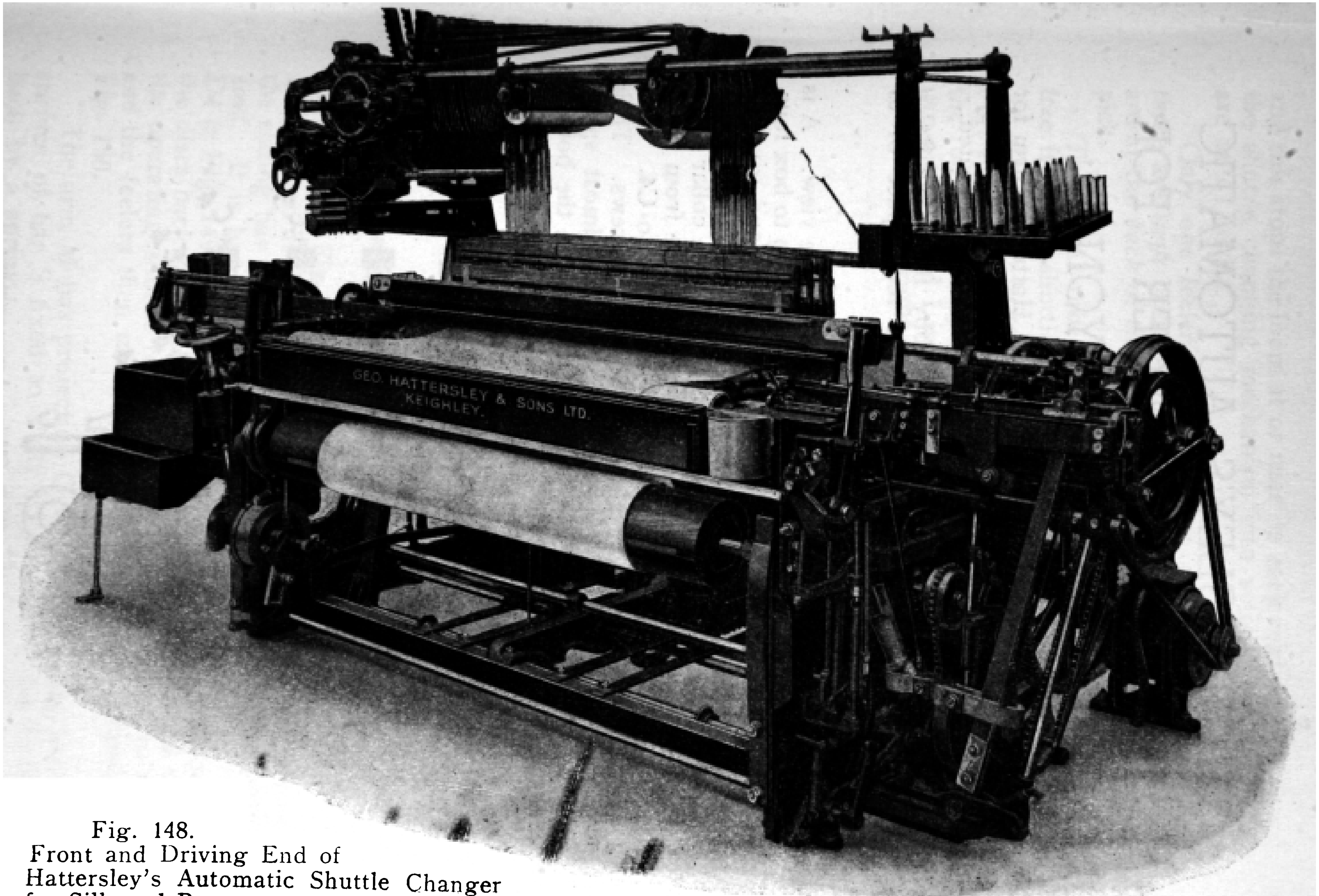


Fig. 148.
Front and Driving End of
Hattersley's Automatic Shuttle Changer
for Silk and Rayon.

HATTERSLEY'S AUTOMATIC SHUTTLE CHANGER FOR SILK AND RAYON.

This is the fourth loom made by the Hattersley firm for the weaving of silk and rayon. Parts of this loom are the same as the 2nd and 3rd looms and need not be repeated.

The loom has a tappet driven dobby for 24 shafts, a speed of 148 picks per minute, and a reed space of 57 inches. Fig. 148.

Weft Feeler Motion.—Fig. 149 gives a side view. A is the shuttle in the first box at B, and others fill up to box four. The box shelves are turned up at the front, and give the weaver good visibility of the weft. At C1 to C4 are the round steel feelers each having two discs and a collar along with an open spiral spring. The front discs are from D1 to D4, and the back discs and collars are at C1 to C4. Each disc is adjustable by a couple of threaded screws. Their positions are set so that when the weft is almost spent, the front of the feeler can penetrate the slot in the bobbin,

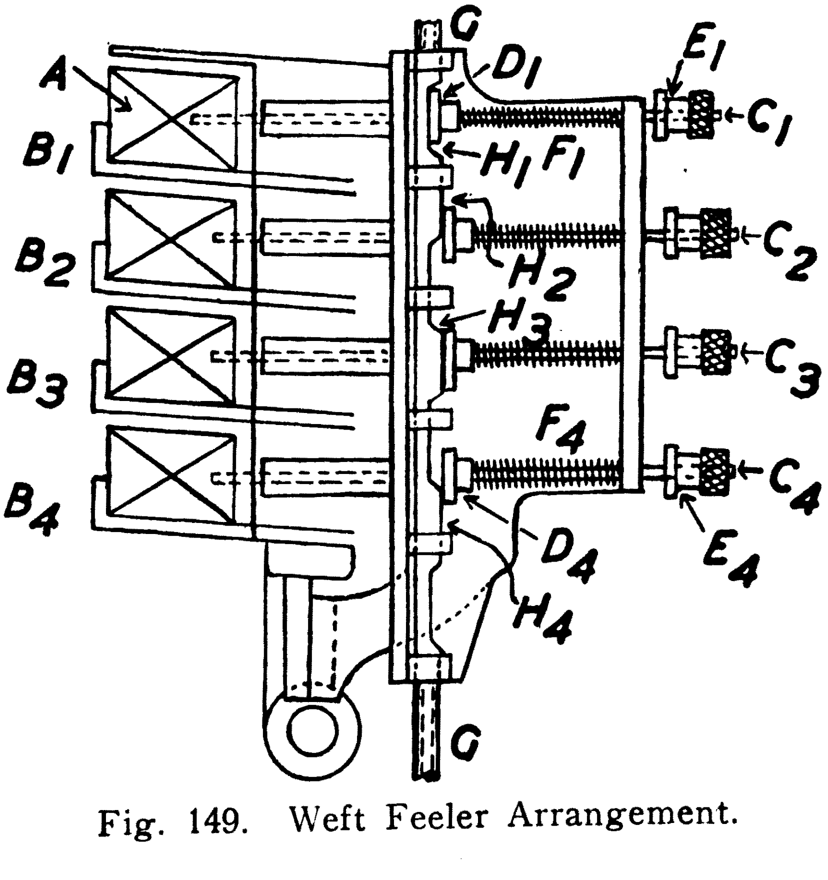


Fig. 149. Weft Feeler Arrangement.

and this stops the loom at or near its back centre, and brings the shuttle changing mechanism into action. The springs are at F1 to F4.

Only one feeler can operate at a time, for the other three are kept back by the turning of rod G. The feelers are at the *back* of the drop box, and only move every other pick.

The metal tubes through which the feelers pass, are free from the shuttles.

Cam and Lever Movements.—These are outlined in Fig. 150, and its lettering continues from Fig. 149. At I is the rod actuated by a cam that makes one revolution every two picks. Rod I is pivoted at J, and at K and M are the two arms of a right angled lever with L the fulcrum. Arm

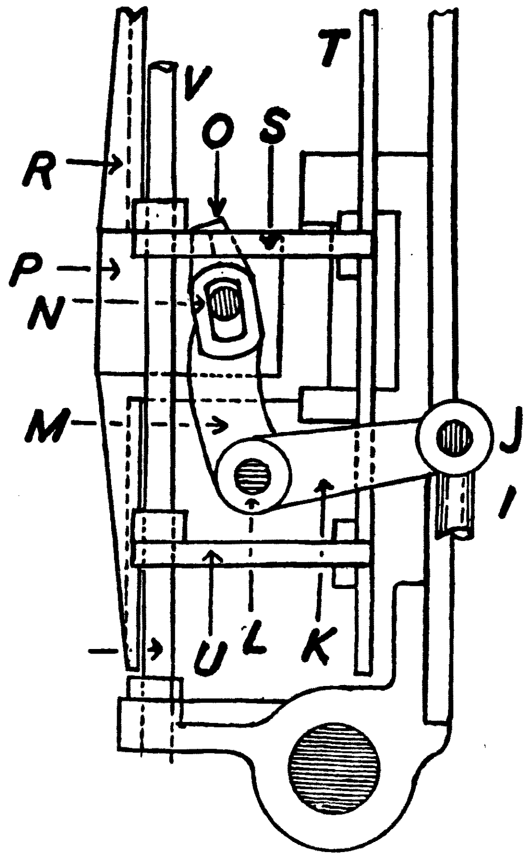


Fig. 150. Cam and Lever Control.

M is slotted at the top to receive pin N. This pin is part of the sliding bar P and has bar R fixed to it in a vertical position. It is bar R that comes in contact with discs D1 to D4 in Fig. 149. When slide P moves horizontally, R moves the discs backward from the shuttles, and are retained until the operating shuttle returns to the box and comes to rest, and the feelers then move forward by rod I being raised in Fig. 150.

The arm M has projection O which affects the inclined surface of bar S fixed to shaft V, the bar being brought back by a spring.

It is when rod I is raised that the fully operating feeler makes contact with the weft on the bobbin, and the whole series are taken away before picking takes place by the downward movement of rod I.

As bars S, T and U are associated, they move at the same time. If now, there be sufficient weft on the bobbin to keep the operating feeler back, the bar T passes in front of the back disc E1 in Fig. 149 and the loom continues to weave.

If, however, the feeler penetrates the bobbin, it moves further forward, and in this way the back disc E1 arrests the movement of bar T, and this leads to the loom stoppage.

Loom Stoppage by Feeler Action.—Fig. 151 is lettered like the two previous diagrams. Here, C1 is again the feeler, with D1 the front disc and B1 the back one. F1 is the spring and G the top part of the rod that controls the front discs. At I is the top of the rod that rises on one pick and falls the next.

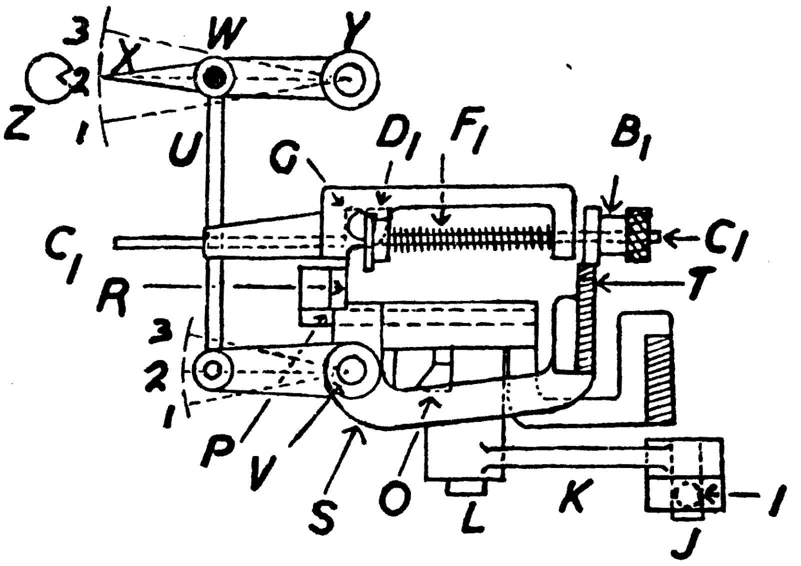


Fig. 151. Feeler Motion in Knock-off Position.

It is this that moves the right angled lever, one arm of which is at K with its fulcrum at L. O is the projection that moves the parts P and R and the lever S, and the attached stop bar T. Levers S and U are fixed to the top of rod V, and thus move together when the rod is turned. The rod U is connected at the top to the stop pointer W and rod V. The front of the pointer is at X, and pivoted at Y.

When weaving, lever U moves from position 1 to 3 in the arc of a circle, and so does pointer W, going forward on one pick, and brought back the next. When feeler C1 penetrates the bobbin, it prevents bar T from completing its movement. Lever U and pointer W are also arrested at half traverse, and pointer X is brought opposite the cut in stop pin Z, and as the going part moves forward, Z is forced back and stops the loom with the crank at or near its back centre.

Shuttle Changing Tappets.

When the stop pin is forced back, it drops a small bar behind the hammer head bolted to a bayonet lifted every other pick by a tappet on the low shaft. The forcing back of the small bar stops the loom and brings the shuttle changing mechanism into play at the opposite end of the loom.

Functions of Tappets.—These are set forth in Fig. 152. There are four tappets, each of which are doubly setscrewed to the tappet shaft A.

Tappet 1.—This is at B, and is shaped like a half moon. On its upper surface it carries the rounded end of a right-angled lever C. Its other leg is at D and at its end there is the locknutted setscrew E. When tappet B raises lever C, setscrew E is brought in contact with lever F fulcrumed at G, and is on the same bar to which the bottom of the picking stick K is secured. The lifting of lever C pushes the picking stick to its outer limit, and makes possible the discharge of one shuttle and the entrance of another.

At H is the checking lever at the back of the picking stick, and makes it stand forward for the picker to receive the incoming shuttle. The amount of resistance is regulated by the strong spring shown. At I is the metal casing that holds the stick. The thick connecting leather J is bolted to a short wooden part L, and the looped leather M connects it to the wooden picking arm. The length of the leathers have to make the shuttle begin to leave the box when the crank is at its bottom centre.

Tappet 2.—The largest tappet of the series is at N, and controls the carrier for the shuttles. The carrier is pivoted at its base but on its shorter arm at O, it carries a bowl that rests on the tappet. There is only one carrier, whether the loom is fitted for two shuttles or four. The carrier has a threefold movement. It is moved outward to be under the shuttle to be dropped; it moves forward to deposit the shuttle in the box; it moves back to its stationary position.

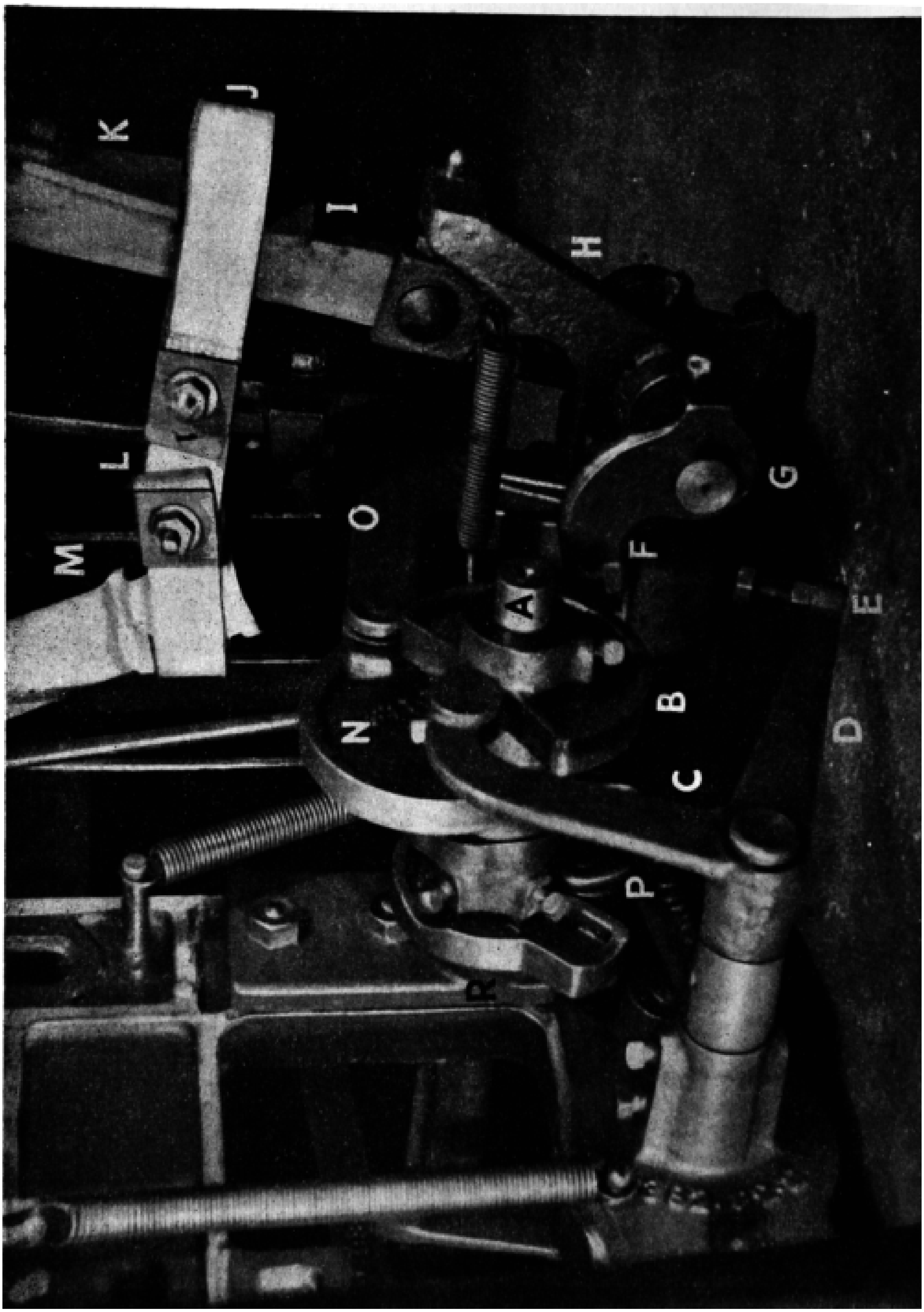


Fig. 152. Shuttle Changing Tappets.

Tappet 3.—This is the smallest of the four, and only a little of it is seen at P. It operates the horizontal lever pinned to the same shaft as the picking shaft lever.

To the front of the bowl lever, a rod is attached to the lever pin, and by lever and rod being depressed, the front of the shuttle box is raised for the ejection of one shuttle and the insertion of another. By the upward movement of the front, there is a forward movement at the back part of the same casting, for there are two vertical rods that move forward, and push out the spent shuttle, that falls into a padded box. As soon as the carrier plate has deposited a fresh shuttle in the box, and makes a clearance, the box front descends, and the two rods return to their grooves in the box back.

Tappet 4.—The inmost tappet is at R, and is the " prevention " tappet, for it arrests all movement if anything goes wrong. The front of the tappet engages a bowl which is pivoted in front of the tappet. The bowl lever has charge of two catches. When the bowl lever is depressed, both catches are thrown forward and are then held and lifted by the lever at its tapered top. Both catches are " safety " catches, and, by means of a rod, are indirectly in contact with the box swell. If the fresh shuttle is not properly in the box, the swell of the box is still in its inner position, and the going part cannot move further forward than the frog allows. The tappet shaft is turned by a link chain that runs three sprocket wheels. One wheel is at the outer end of the tappet shaft at the driving end of the loom; the second is secured to the crank shaft; the third is on the shaft that carries the clutch for driving the tappet shaft.

Setting Loom in Motion.—When the changing of the shuttle has been safely accomplished, the loom is automatically restarted by means of another tappet on the tappet shaft, but at the opposite end of the loom. This is a *positive* tappet that depresses a bowl lever fulcrumed about the centre of its length. At the front, it has a tapered catch on its forward side. This part of the lever is raised, and the catch then comes in contact with a cut on the vertical arm that is secured to a rod, that is on one arm of the set-on handle. The tappet gives sufficient depression to the bowl lever to raise it at the opposite end, and by this lift, the loom resumes weaving. The loom only stops four seconds to change the shuttle, and is a great credit to the inventor.

THE NORTHROP LOOM.

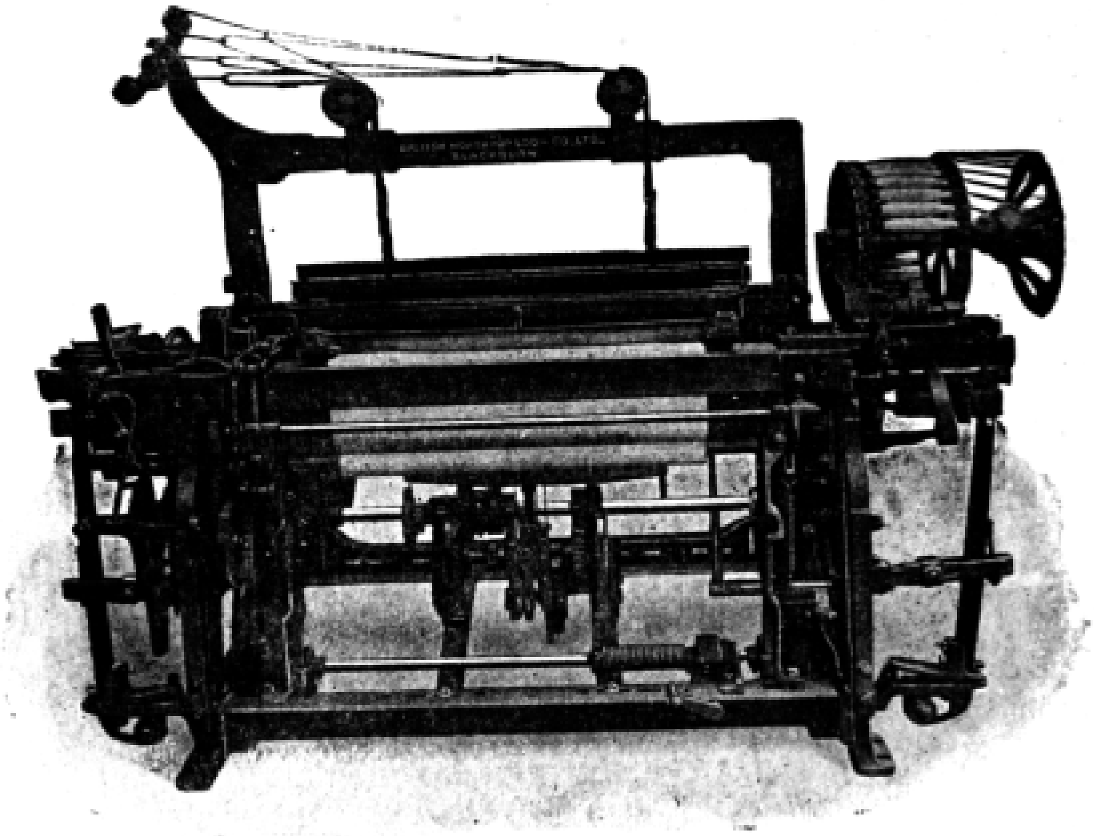


Fig. 153.
Standard Light Weight " T " Model.

The Northrop loom (Fig. 153) is the most successful automatic loom that has yet been invented. Though much slower in being adopted in the British Isles than in most parts of the world, it is gaining ground in the native country of its inventor. The credit of it is due to Mr. J. H. Northrop who was a native of Yorkshire, but emigrated to America. He brought out his patent in 1894 which changed the bobbin in the shuttle without stopping the loom. From this beginning, it has been improved and applied until to-day there are 600,000 of these looms at work in the factories of the world.

There are many makes of this loom engaged in the manufacture of all kinds of goods, both plain and fancy. The Northrop bobbin changing motion is applied to tappet looms, dobby looms, and jacquards, and may be run with one shuttle or up to four.

Dobbies.—There are three chief kinds of dobbies, these being the Lancashire type with ball and socket construction:

the Leeming dobby of positive construction which has previously been explained, and also a special dobby for the weaving of Terry towelling.

One kind of Lancashire negative dobby is the "K" model. This dobby is for 16 shafts. The jack plates front and back are set by three locknutted setscrews which are seldom disturbed, because balks and catches can be taken from the dobby without unloosing the screws. The balk is ball-hooked at its back centre to fit to the dobby jack, and the catches are also ball-hooked to oscillate in the recesses on the balk. The front part of the jack and balk are divided to keep balk and catch in position.

The catches have only one cut on the under side. The top series are actuated by needles which rest on the upper and inner ends of the feelers, but the bottom catches are moved by fingered feelers.

The lag cylinder has 8 grooves, and each lag represents two picks. The cylinder is turned by a pawl, the shaft of it being bolted to the lower arm of the front shedding lever. On the shaft of the pawl is an open spiral spring which is strong enough to pull the cylinder round without contracting, but gives way if ever the cylinder becomes locked. On the cylinder shaft is a wheel with 8 coarse pitched teeth by which the cylinder is turned. In front of it is a small brass handwheel for the use of the weaver.

At the back of the dobby, the cylinder shaft is fitted with a star wheel and a curved check finger by which excess movement is checked, and the cylinder held steady after being turned. No excess movement need be made if the pawl be well set. The cylinder is fixed so the pegs fully meet their respective feelers, and drop their respective catches fully on the drawbars. The pegs have rounded tops to impart a steady rise and fall to the feelers.

Underneath the outer and bottom end of the feelers is a levelling bar, which, when pulled towards the weaver, elevates the whole series, and then by one turn over of the loom, all the shafts are brought to the top shed.

As shown, the draw bars are connected to the shedding levers by adjustable rods that are set in two ways. (1) They are placed in the centres of their slots, so that if anything becomes locked, they can be forced in either direction. (2) When at their dead back centres, the top front of them gives a clearance of $\frac{3}{16}$th inch to the cuts on the catches. The **T** lever behind the engine is in two parts, for the centre arm is hollowed out to pass on to the main shaft of the dobby, and its two wings are setscrewed to the face of the shedding lever. The stirrup at the top of the shedding rod is also in two parts, the shedding rod being bolted to the major one. The bottom of the rod is fixed to a slide bracket and is adjusted so that when at the outward centre of its sweep, the **T** lever is at the centre of its stroke. This produces equality of sheds.

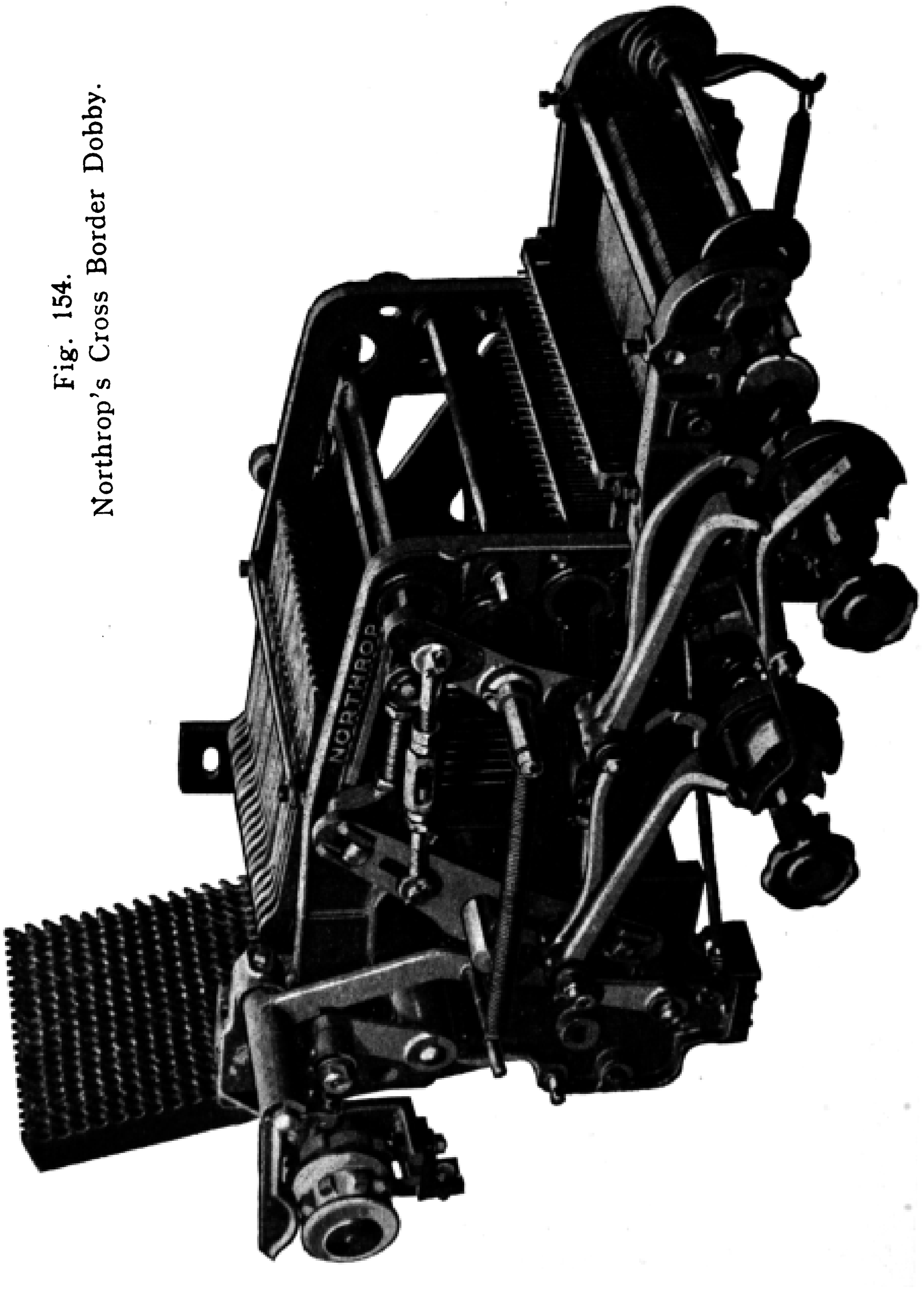


Fig. 154.
Northrop's Cross Border Dobby.

Much of the foregoing equally applies to the Northrop negative two barrelled cross border dobby seen in Fig. 154 that weaves terry towels, etc. This dobby takes 20 shafts. It is fitted with two cylinders that operate the dobby, and a small master cylinder that puts one cylinder out of action, and bring another into play.

The lags on the master cylinder are turned by a catch wheel and pawl behind the small cylinder.

When a peg on the small cylinder operates, it lifts a lever, the under side of which is convex, and above the master cylinder, and turns it inward. In so doing, one of the large cylinders is put out of action, and the other brought into play.

Each of the larger cylinders have two catches, one catch operating the lag cylinder every other pick, and the other turning it half way when not wanted. On not being required, the other cylinder is first given a half turn that brings it into action and then proceeds in the usual way until arrested. All the catches have to be set to give the correct leverage. The lever above the master cylinder is brought back by the long spring seen in the illustration.

Picking.—In a weft mixing loom, there is a plain box at one end, and a mixing box at the other. As this structure employs two kinds of picking it is given preference. It is an underpick loom. The picking boss is held to the shaft by a key in a sunk keyway, and by a couple of setscrews. The shell is fixed to the boss by a couple of bolts, the former having a width of ¾ inch. The two wings of the boss have radiating teeth which mesh with similar teeth on the shell and assist in holding it firmly. If bolted in the centre of the slots, and the driving wheels properly timed, then the shell can be adjusted in either direction to produce the best effect.

As this loom is of the heavier make, the picking shaft is below the tappet shaft. It is the usual practice with this model to have the crank at 25 past when the picking stick is just beginning to move the shuttle out of the box. Modifications are essential when the picking nose is worn.

Whether the picking shaft be above the tappet shaft as in light model looms, or below for heavy makes, the picking shaft in both is held in position outside the loom frame. In the former, Fig. 155 the picking shaft has a flat slab, and to this is bolted the strap casting. The looped strap at this end as well as that which passes round the picking stick, is bolted to a short wooden arm, the total length of the three

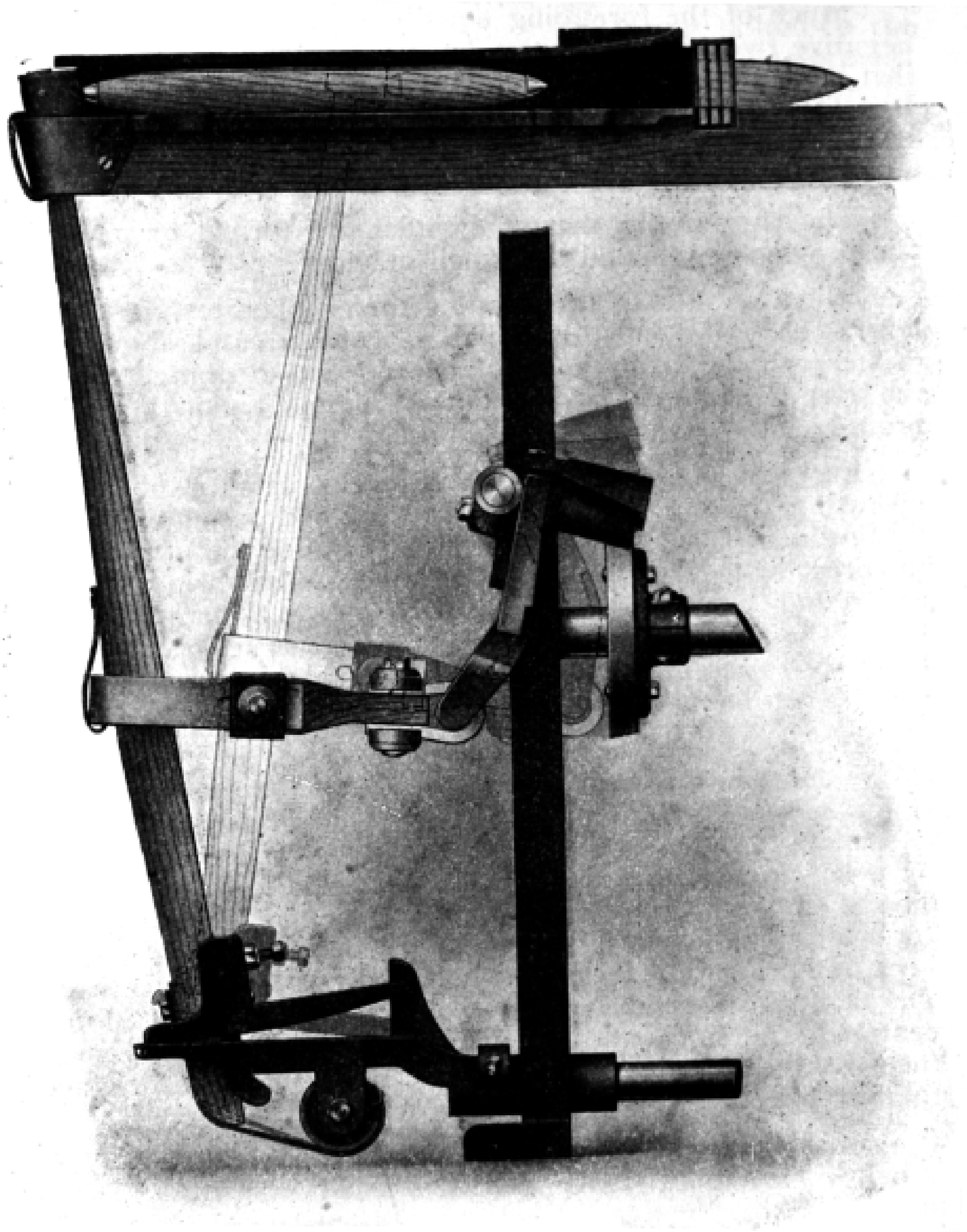


Fig. 155.
Parallel Underpick Motion.

parts being adjusted to make the shuttle begin to move out of the box at the right time. So that no binding can take place between strap connection and stick, there should be at least a finger's breadth allowance between the back of the stick and the strap when the crank is at its top centre, and the stick at the end of its outward traverse. The length of the lug straps have to be set so that a stroke of 7 inches is given to the picking stick for narrow looms, 9 inches on medium width looms, and 11 inches on wide looms.

The stirrup strap that holds up the lug strap is behind the stick, and should place the bottom of the lug strap 9 inches above the parallel, which brings it about level with the fixing at the opposite end. Level working gives the best results. Towards the bottom, the picking stick is bolted to the rocking shoe, and at the top front of the shoe is the regulating screw by which the picking stick may be made higher or lower to give a correct delivery to the shuttle.

When the picking stick is at its full forward traverse, and the shuttle tip in the hole of the picker, the bottom of the shuttle nearest the picker should be lifted $\frac{1}{16}$ inch above the shuttle race. The two toes of the rocking shoe which are elevated in the illustration, fit at either side of an upright projection at the front part of the parallel, and the heel of the shoe at the opposite end rests on the parallel when the stick is at the limit of its outward traverse. The base of the shoe is curved, and when the stick is about the centre of its movement, the shoe is at the centre of its length. The parallel is fixed to the rocking shaft at the foot of the loom by a couple of setscrews. By these screws, the stick should be set in the centre of its movement which the parallel can make when the fixing screws are slack.

After picking, the stick is brought back by the coiled spring underneath the parallel. The projecting iron wedge seen at the front base of the stick has to be well lubricated to prevent unnecessary wearing, as this part affects the throw of the shuttle.

The picker may be made of leather or canvas, and if the latter, they will wear better when stored in a damp place. Canvas is cheaper, but leather lasts longer, and has a better effect on the shuttles.

On placing a fresh picker on the stick, it is first tested for altitude, for whether the stick be at either limit of its traverse, the picker must be a little above the box bottom. The picker is then marked by the shuttle tip at both ends of the stick movement. It is then taken off, and a shallow hole is gouged, the centre of which must lift the shuttle $\frac{1}{16}$th inch above the shuttle race as mentioned. If at any time a further adjustment is essential, it can be done by slackening the binding bolt in the shoe, and adjusting the setscrew at the top of the shoe.

Having attained these points, the picker is screwed to the stick, a gimlet being first used to prevent the stick splitting. The hole in the picker is countersunk to take the head of the screw so as not to catch the weft.

The other style of picking is different. The front end of the picking shaft is turned up at right angles to the shaft, and on it is a setscrewed collar with a sloping top. The inner of the two thick lug straps rests on the top of the collar, and the higher the collar is placed, and the greater is the movement imparted to the stick. In both types of picking, the top of the stick when in the centre of its stroke, must be below the overhanging top of the box back.

At the mixing box end, the picking stick passes through a long slot in a buffalo picker. The part of the picker nearest the weaver has a rib which fits into a slide setscrewed to the front of the box. The slide keeps the picker in a horizontal position, and assists in a correct delivery being given to the shuttle. A spindle passes through the picker in front of the box, the outer end of the spindle being adjustable by the casting through which it passes.

Checking of Picking Sticks.—At the plain box end, a canvas strap passes at either side of the picking stick, both ends being bolted to the bracket below the box. The front part of the strap is upheld by the check strap bracket, and an adjustable regulating finger in front of a gap in the casting, regulates the amount of friction applied.

The forward movement of the stick forces the check strap forward, and the backward movement of the stick draws it back. These straps are made to regulation length. At the drop box end, a coiled leather pad fits behind the stick. This is moved by a tappet on the tappet shaft coming in contact with a lever coupled to the leather pad. The

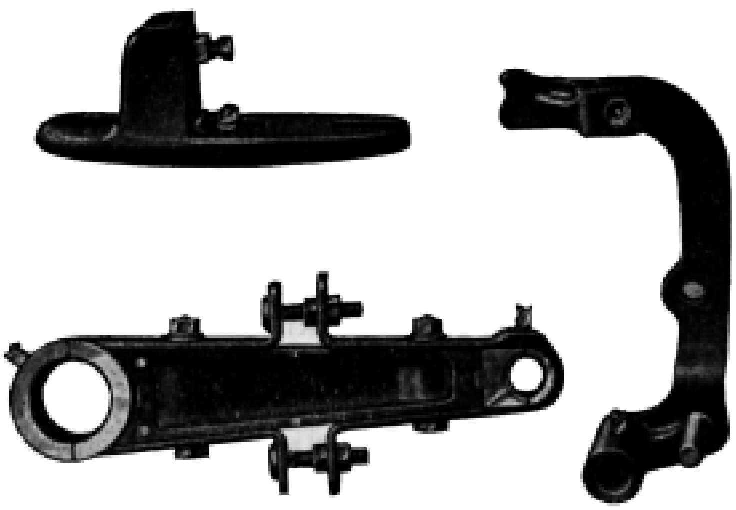


Fig. 156.
Shuttle Protector Picking Shoe and Crank Arm.

movement to the pad is regulated according to the requirements of shuttle checking, the usual distance being 1½ inches.

Beating Up.—(Fig. 156). Crank and sword pin are bushed with brass, and these along with the crank arm are held as one solid whole by a pair of metal straps. Where the straps face each other, they are turned at right angles to their length, and both ends are held by the same bolt, the bottom being likewise. The sword ears are fitted with eccentric pins, the ends being countersunk and held by set-screws. The pins are turned so as to give exact measurements from the front of the breast beam to that of the sley or sword fronts.

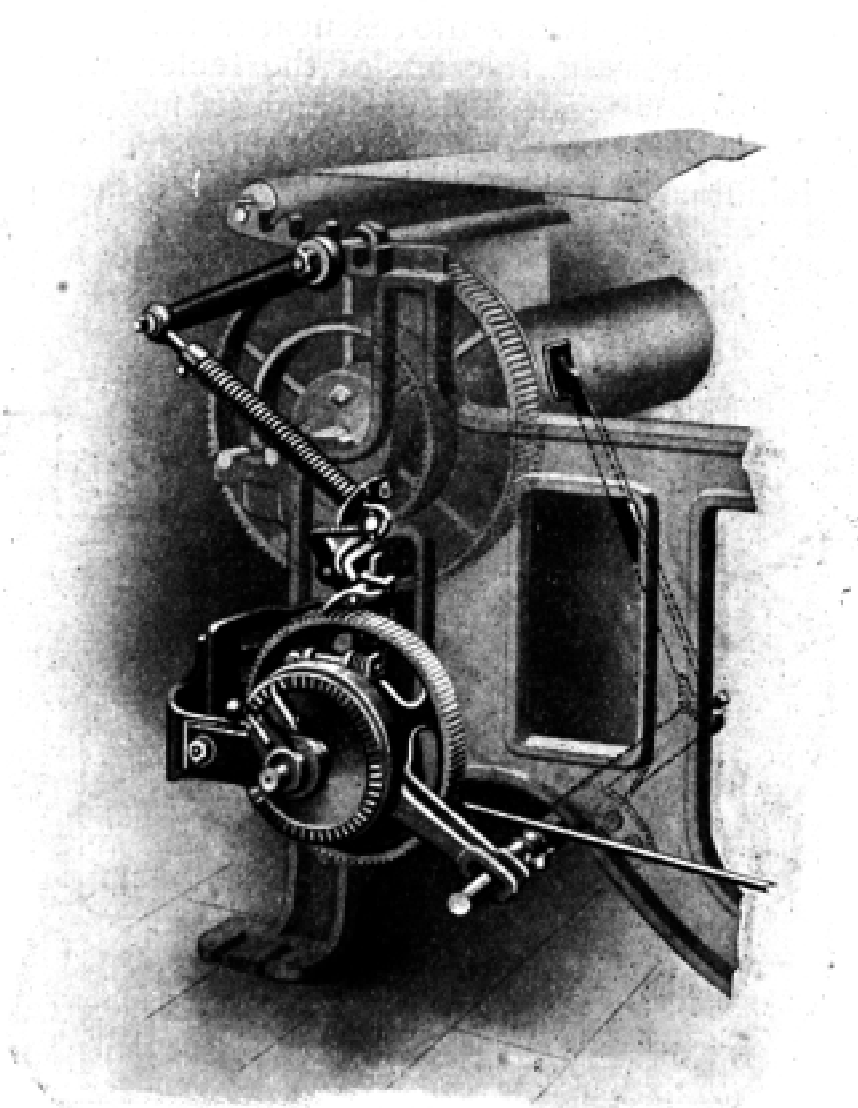


Fig. 157.
Roper Automatic Warp Let-off Motion.

Letting Off.—To dispense with the regulation of weights on the warp beam levers automatic motions are installed. For light and medium weight cloths there is the " Roper " motion, but for wide and heavy cloth the " Bartlett " let off is preferred. As an alternative to the latter, there is a worm let-off motion which is built on a similar plan to the Dobcross letting off motion already described.

The " Roper " mechanism is presented at Fig. 157. It is made in two strengths, one being suitable for a low number of picks, and the other for a large number per inch. The driving force is imparted by the horizontal rod at the loom base which is attached to the loom sword at one end and the pawl lever at the other. The control of the force is vested in the strong spring attached to the back rail lever, for the stronger it is made, and the less movement is made by the rail and the pawl. The other is the warp beam feeler seen pressing against the warp on the beam. As the warp decreases in bulk, the feeler moves nearer the empty beam, and the rod which is the fulcrum of the feeler increases the leverage of the pawl control lever, and so makes the warp beam move quicker. In front is seen the bevel wheel with its folding handle. When the handle is pulled into position,

"BARTLETT" LET-OFF MOTION

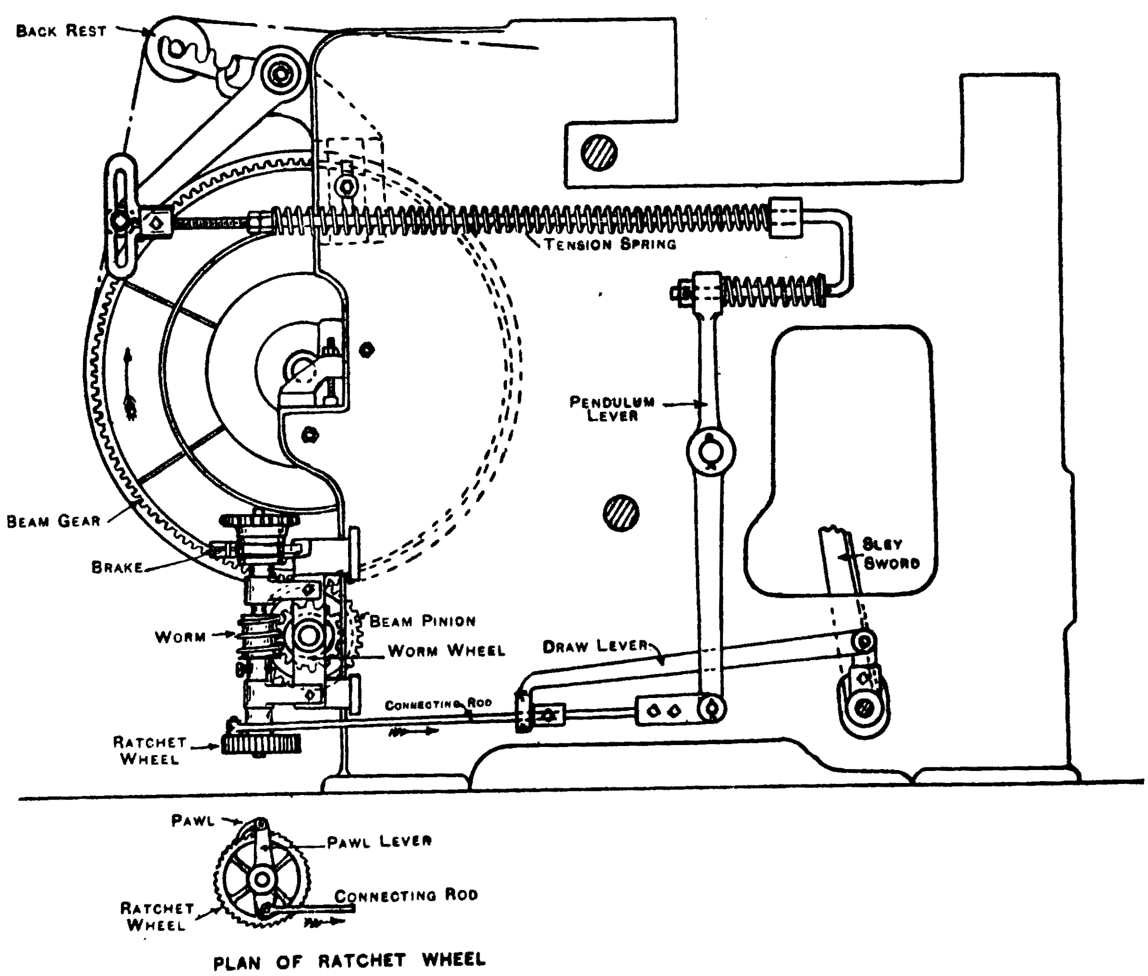


Fig. 158.
Bartlett Let-off Motion.

it releases the holding catch, and the wheel may then be turned either way to let off or wind on the warp. The beam feeler is set so that when resting against an empty beam, the stud in the control pawl lever is $\frac{1}{4}$ inch from the bottom of the lever. When the warp beam has a warp on measuring 22 inches in diameter, then the pin mentioned is almost at the top of the pawl lever. Tables are provided showing the necessary wheel changes for the number of picks per inch required in the cloth.

Fig. 158 is the "Bartlett" let off. In this mechanism, the beam pinion is moved by a worm in the centre of the vertical shaft shown, and the ratchet wheel at the bottom. The hand wheel at the top is for the use of the weaver. The long vertical arm beyond the worm is the pendulum, and this is set vertically when the crank is at its back centre. When the crank is at its front centre, the draw lever attached to the sword, and on the extreme left bottom of the illustration, has drawn the connecting rod so that the pawl lever is in line with the back rail of the loom. When in this position the collar on the connecting rod should now be against the face of the draw lever connected to the swing rail. The tension on the warp is regulated by the long spring on the rod at the base of the swing rail lever.

Taking-Up Motion.—As will be seen from Fig. 159, the ratchet wheel is the bottom of the series and is moved one cog at a time. Behind it is the ratchet pinion having 28

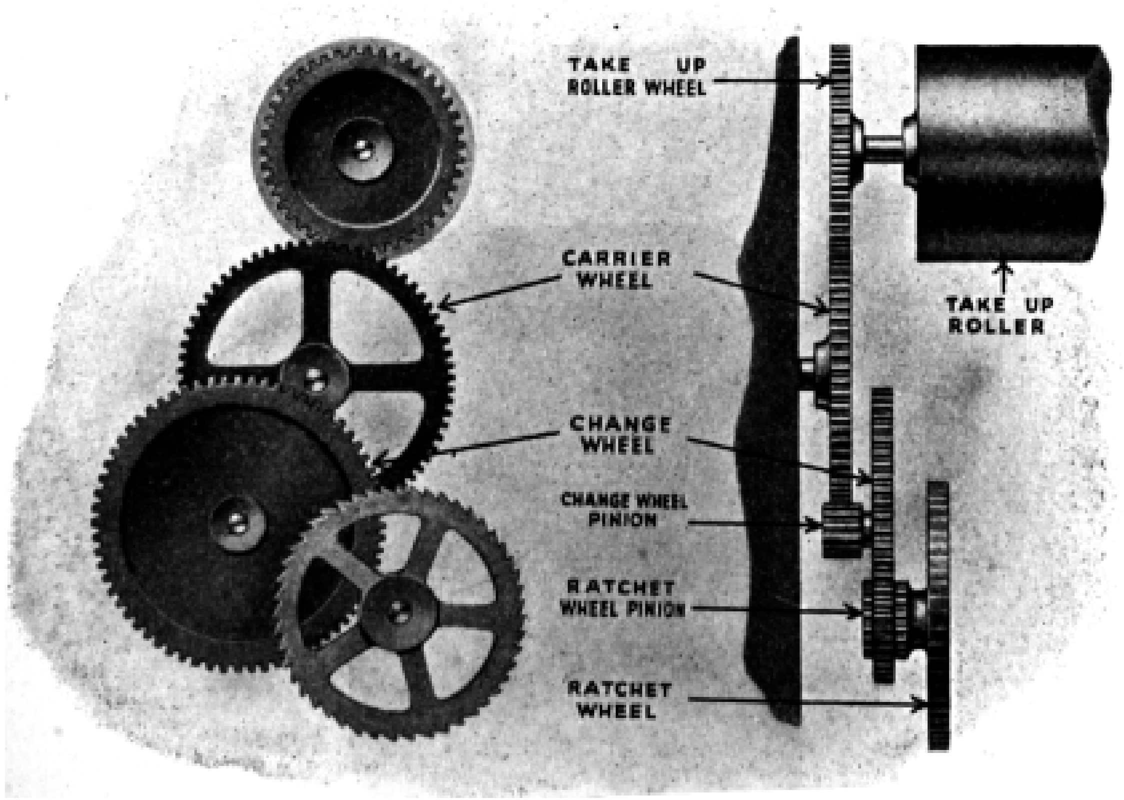


Fig. 159 (Side View). Fig. 160 (Front View).
Ratchet Take-up Motion.

cogs when the picks per inch do not exceed 90, but above that, another wheel is substituted having only 14 cogs which turns the series of wheels at half the speed. The gauge point for the change wheel that meshes with the ratchet pinion is a tooth per pick. The change wheel pinion runs the intermediate wheel, and the intermediate is companion to the wheel on the shaft of the taking-up roller. Fig. 160 gives the front view. The taking-up catch has a long finger by which it is raised by hand, and the holding catch is lifted with it. By both being raised, the cloth can be let back. Below the taking-up catch is a lever by which the cloth may be quickly regulated, or the warp drawn forward.

Bobbin Changing Mechanism.

There are two chief methods by which the bobbin changing mechanism is brought into action, one being mechanical, and the other electrical.

In the first, the "Midget" feeler shown at Fig. 161, is the latest development. In this, a wire with a looped end and a gimped front projects from the box. When this wire

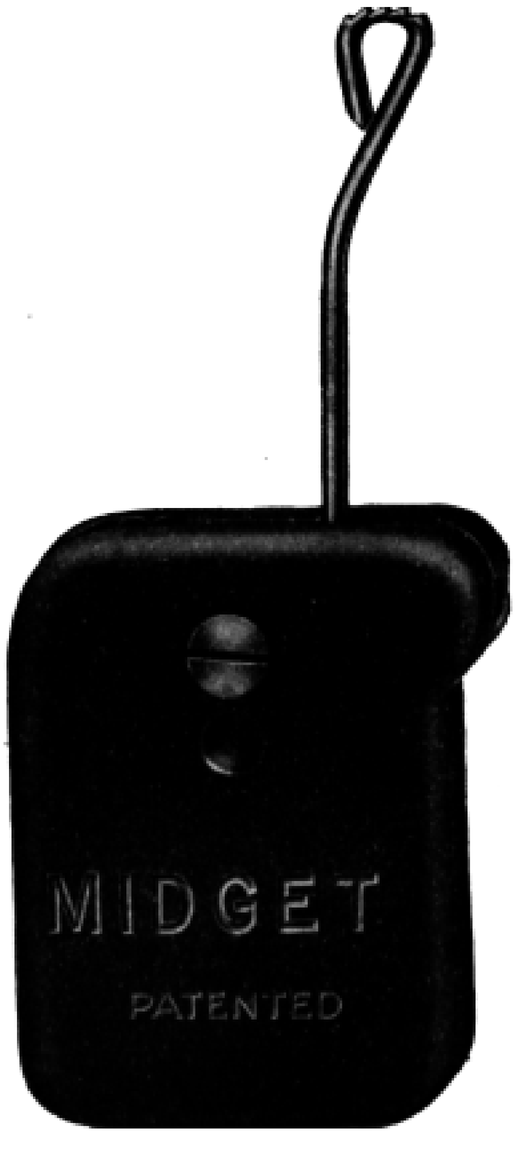


Fig. 161. Midget Weft Feeler Motion.

passes through the box and shuttle front, it comes in contact with the weft. So long as the coils of weft hold the wire straight, the loom continues to weave, but when the coils become scarce, the wire slips on the bobbin, and causes an attached rod not shown to let fall the trip lever. When the trip lever descends, it finds lodgment in the trip heel which is on the outside of the weft fork hammer. When the hammer moves towards the weaver when the trip lever is down, the latter is forced back, and as it is fulcrumed to a strong bar associated at the opposite end of the loom to the bobbin changing mechanism, it is brought into operation.

For the "Midget," it is necessary to have a small bunch of weft wound at the base of the bobbin to prevent undue waste being made.

The parts involved by the trip lever being forced back are as follows:—

Battery in Weaving Position.—Fig. 162 gives details of the parts in their weaving position. When the battery is set correctly, the bottom bobbin in it is horizontally straight with the shuttle box. On the crank reaching its front centre, the battery bobbin is parallel with the bobbin in the shuttle.

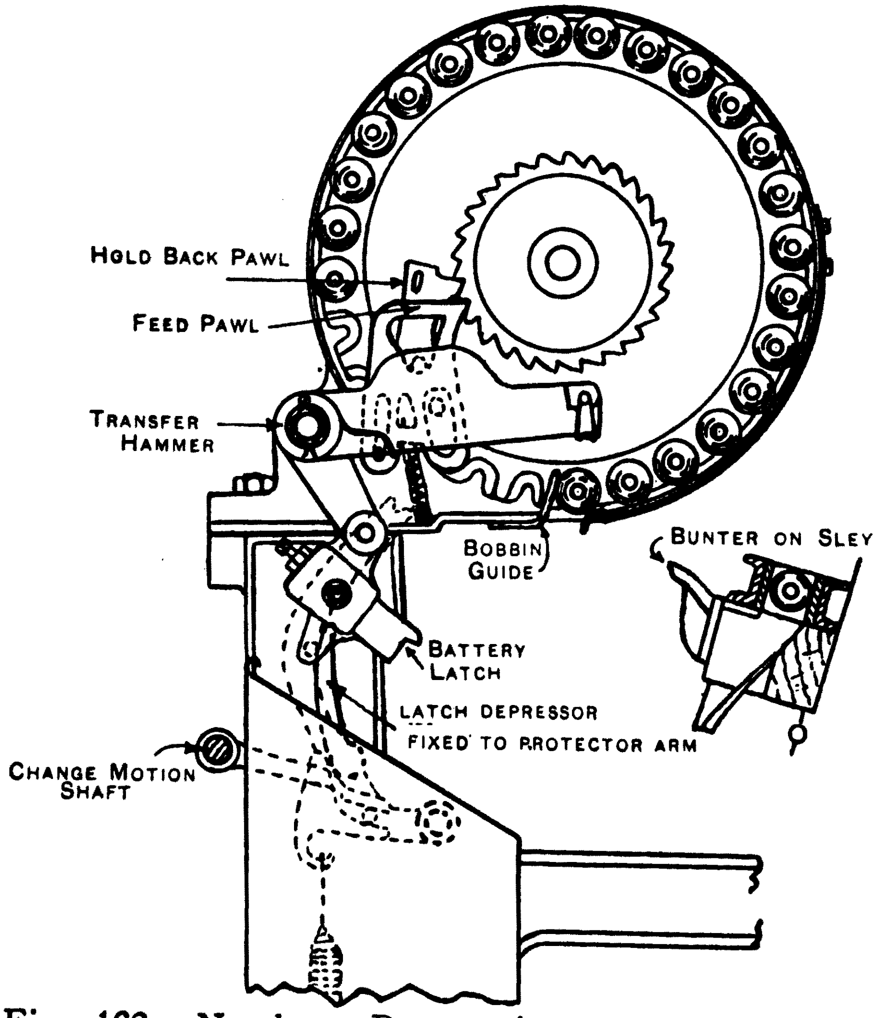


Fig. 162. Northrop Battery in Weaving Position.

During weaving, the transfer hammer is up, and the battery latch is down, and free from the bunter in front of the box. Another thing that the overlooker has to be particular about is the checking of the shuttle in the box so that it comes to rest when fully in the box. As the picker wears, the shuttle advances further into the box, and the grooves in the jaws of the shuttle get a little out of line with the three rings on the bobbin in the battery. As there are only 4 pairs of grooves in the shuttle, and three rings on the bobbin, there is only $\frac{3}{16}$ inch to work on for all three rings to be held. As the shuttle wears the picker, a strip of leather is fixed at the outer end of the picking stick slot to make the stick stand further forward.

In Changing Position.—In Fig. 163, the parts are outlined ready for bobbin transfer. When the weft is almost bare on the bobbin in the shuttle, the " Midget " feeler slips inward and sets in motion the mechanism that turns the change motion shaft in Fig. 162. This causes the shuttle

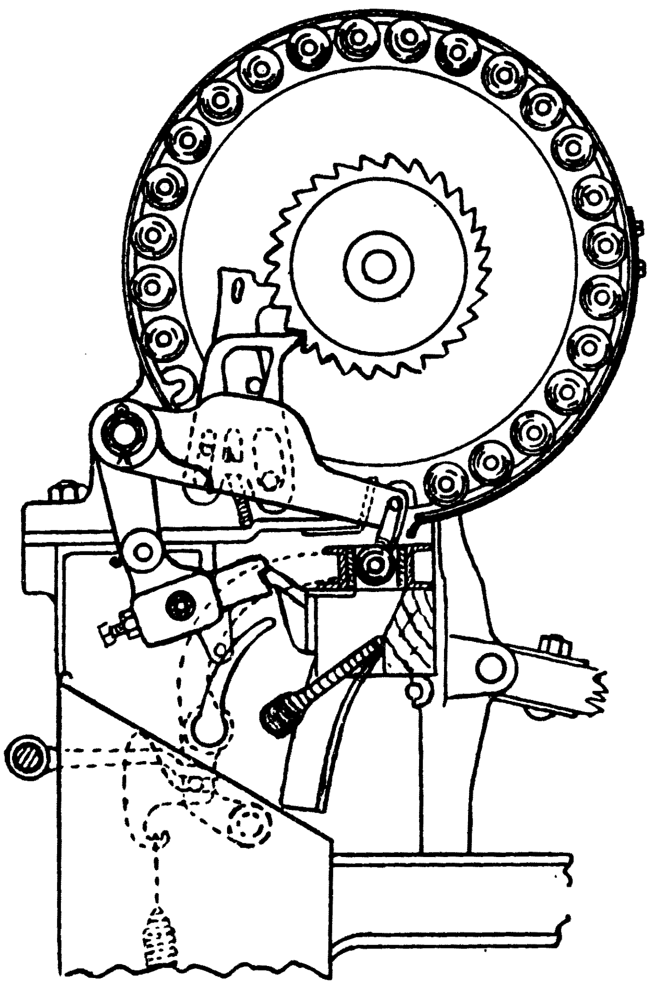


Fig. 163. Northrop Battery in Bobbin Changing Position.

protector arm to go forward to feel if the shuttle is fully in the box. By the same movement, the battery latch is lifted as in Fig. 163, and as the going part is brought forward by the crank, the bunter in front comes in contact with the battery latch, and forces it back.

As the battery latch is connected to the transfer hammer, it is forced down, and carries the bottom bobbin in the battery with it. The depression of the transfer hammer has to be such, that the bobbin in the shuttle is forced through the shuttle bottom, and the bobbin from the battery is weavably placed in the shuttle, and if so, the loom continues to weave.

When the transfer hammer is drawn up by a powerful spring, the feed pawl on the hammer pushes the battery one cog forward, and brings another full bobbin under the transfer hammer.

At the same time that the protector moves forward, the battery latch at the base of Fig. 163 is raised, and as the going part continues to move forward, the **V**-shaped front of the latch comes in contact with the strong

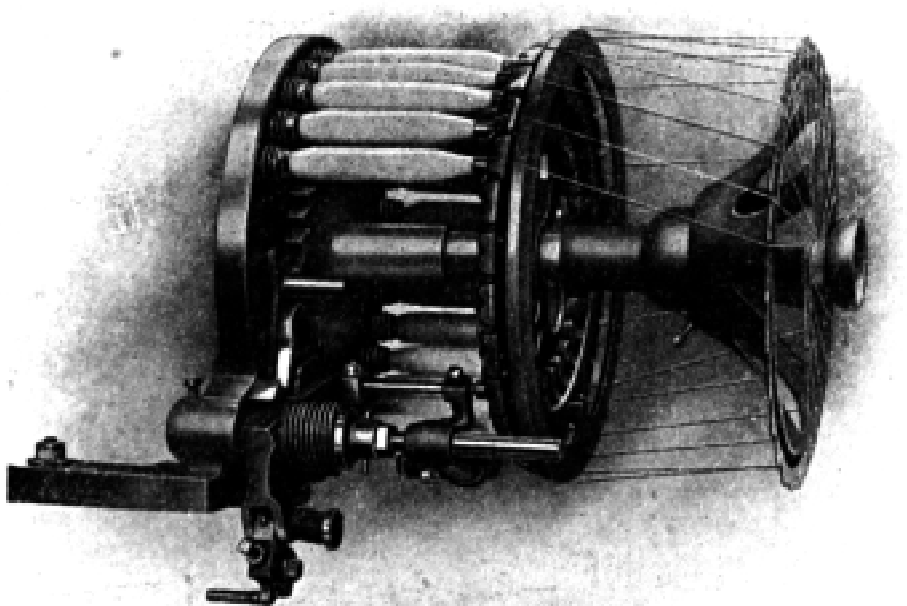


Fig. 164.
Northrop Battery for Ring Weft Bobbins.

bunter in front of the going part. This contact forces back the latch, and as the latch is fixed to the bottom of the transfer hammer, the latter descends. As the hammer rod with its castings fit over the bobbin in the magazine, the bobbin is forced downward, and on coming in contact with the spent bobbin in the shuttle, the spent one is forced out and the full one placed in. There is a sound like " crick," and the transfer has been effected in the fraction of a second when the crank was at its full forward centre.

(4) When the transfer hammer descends, it takes with it the feed pawl on the inner side of the hammer shaft. When the hammer ascends by means of the powerful coiled spring at the left base of the magazine, the feed pawl turns the magazine one cog forward, and brings another full bobbin into its transfer position.

Magazine.—The ring bobbin magazine is given at Fig. 164. It will hold 24 bobbins or cops. The nose of the bobbin is placed on the outer end, its holding clip being held by an open spiral spring. The head of the bobbin has three rings, and these find lodgment in the jaws of the shuttle when the transfer has taken place. As is readily seen, the threads from the bobbin pass over the plate called an arbour, and are then wrapped round the button in front. It is held so following the first pick after the transfer, for the shuttle is not threaded until the second pick is taking place. It is then threaded by the traverse of the shuttle, and the drag on the weft.

Weft Winding.—The twisting and winding of weft on a bobbin is done in two ways. The ordinary way is weft way, which in unwinding goes from top to bottom as seen in the bottom section of Fig. 165.

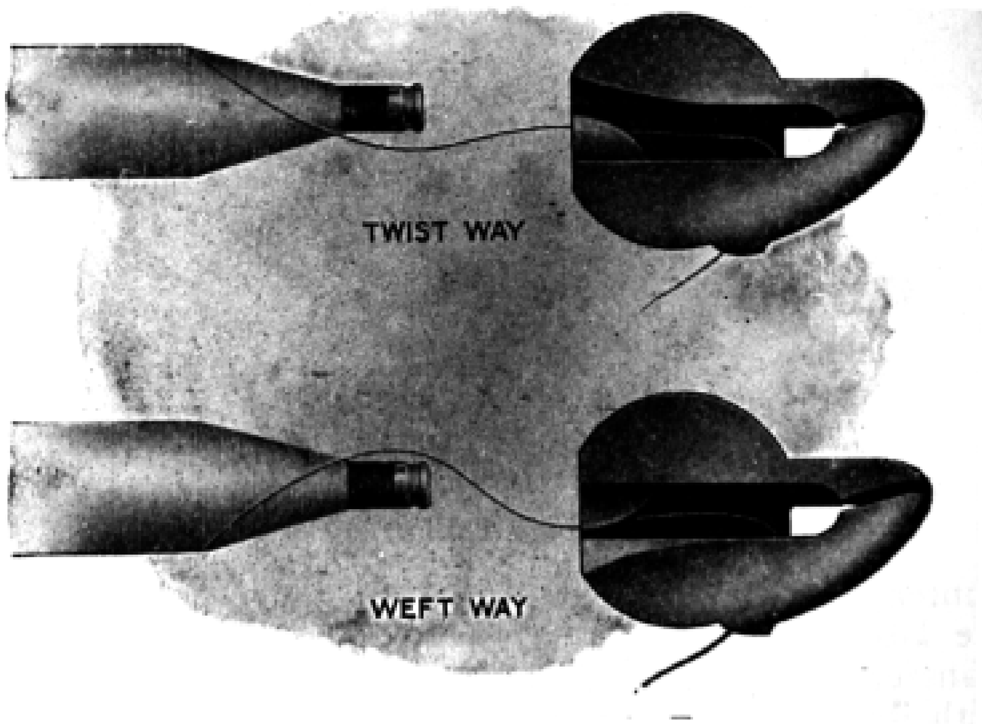


Fig. 165. Structure of Shuttle Eyes.

The other is warp twist way as shown in the upper illustration, and in unwinding goes from bottom to top. The eyes of the shuttle are made so as to meet the unwinding weft so as to be self threaded.

Cutting Weft at Temple.—Though the weft is cut near the eye of the shuttle for the ejected bobbin, there are still two strands to cut, one being that of the ejected bobbin stretching from selvedge to weft cutter, and the other the newly acquired weft stretching from selvedge to arbour. These are severed by a cutter in the head of the right hand temple.

Four styles of Northrop temples are presented at Fig. 166. The one on the left has 9 rings to hold heavy cloth;

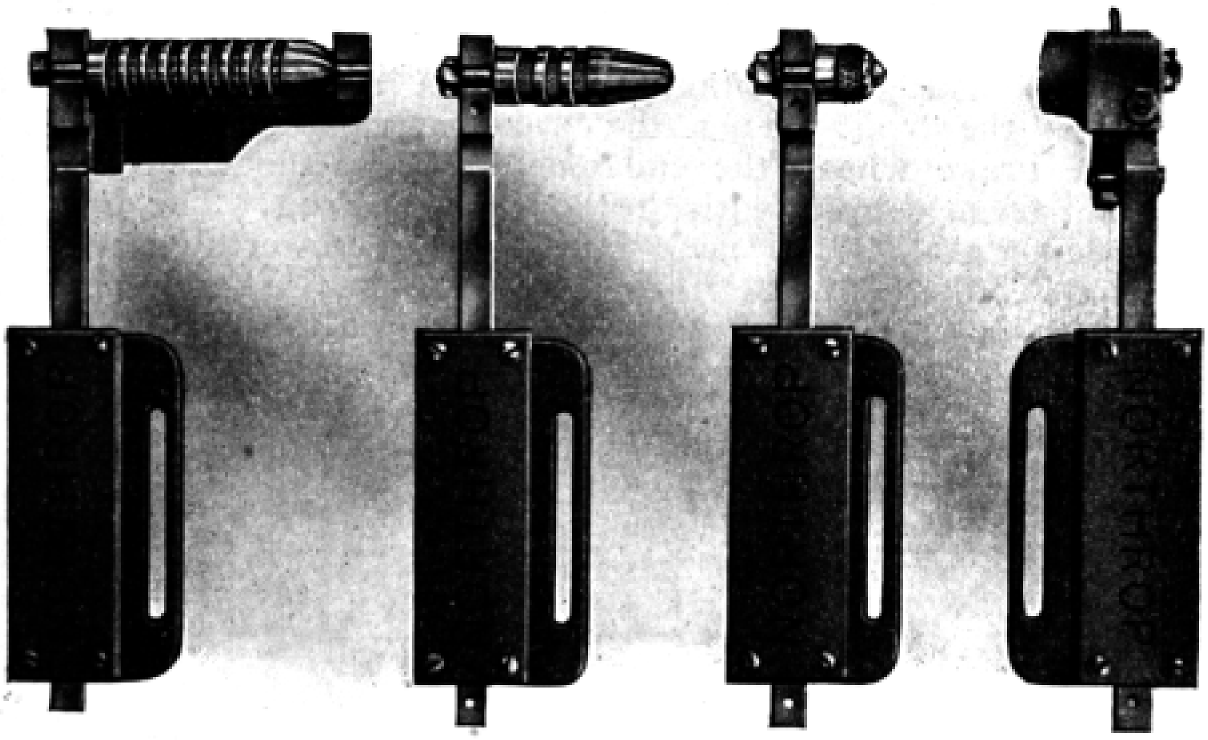


Fig. 166.
Northrop Temples.

the next three rings for lighter fabrics, but the third is just to hold the selvedge. The fourth is the one ringed temple with a weft cutter. The cutter consists of three blades, one being at either side of the cutter in the centre. The cutter is stationary, but the other two are moved by the going part coming in contact with an attached finger on the under side of the temple. When the finger is pressed back, the operating blades make a downward movement to seize the weft, and then a backward movement to sever it. An intermittent cutter is also available.

Shuttles.—The spring jaws in the shuttle have four grooves, three of which seize and hold the rings on the bobbin or cop. The extra groove allows for the wearing of the picker, or any slight variation in the checking of the shuttle. It has two slots at the front, the one near the eye of the shuttle being used by the weft cutter, and the other by the feeler. The shuttles are strongly made to withstand the pressure of bobbin changing.

Brake and Frog.—The loom brake is fulcrumed at the bottom, the stud of it being in a slot for adjustment. The whole leather face has to be in contact with the brake wheel when brought into action. It is best set when free from the brake rod, for one hand can then exert pressure at its centre, while the other tightens the nut. The brake rod passes through the brake centre, and at its outer end is provided with a powerful open spiral spring which gives a certain amount of flexibility when the brake is brought into action. The front part of the brake rod is slotted, and rests on the boss of the frog. When the brake is about $\frac{1}{8}$ inch clear of the brake wheel, the end of the slot in the brake rod should be in contact with the boss on the frog. The frog is pressed to its full back limit by two powerful curved springs bolted to the foot of the loom. These apply pressure to a short rod that passes through the framework and is in contact with the front of the frog. Fig. 166A.

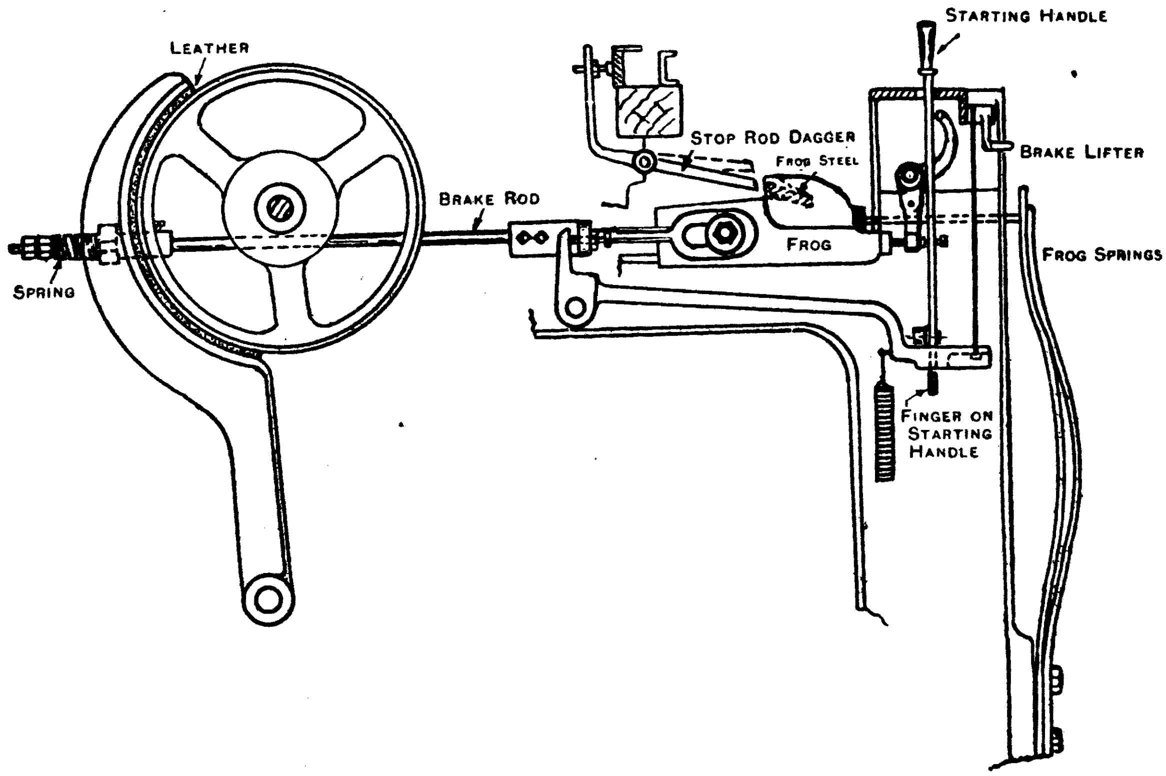


Fig. 166A. Northrop Brake and Frog.

When the setting-on handle is in its weaving notch, the setscrew in the knocking-off lever should be just clear of the nose of the frog, and is then ready for instant action.

The frog at the starting handle end has to have a lead over the other frog of $\frac{1}{8}$ inch to get the power of the drive off as soon as possible. The loom frog steels are reversible. By means of a brake lifter at the end of the breast beam, the brake can be moved clear of the brake wheel so the loom can be moved to the position desired.

Box Swells.—The swells in the shuttle boxes are fitted with adjustable eccentric bushes. When parts are new, the swells are placed as far back as possible, but when the shuttles become worn, they are set further forward. When the shuttle is fully in the box the dagger should clear the top of the frog by $\frac{1}{8}$ inch, and this can be maintained for a lengthy period by means of the eccentric bushes for the swells.

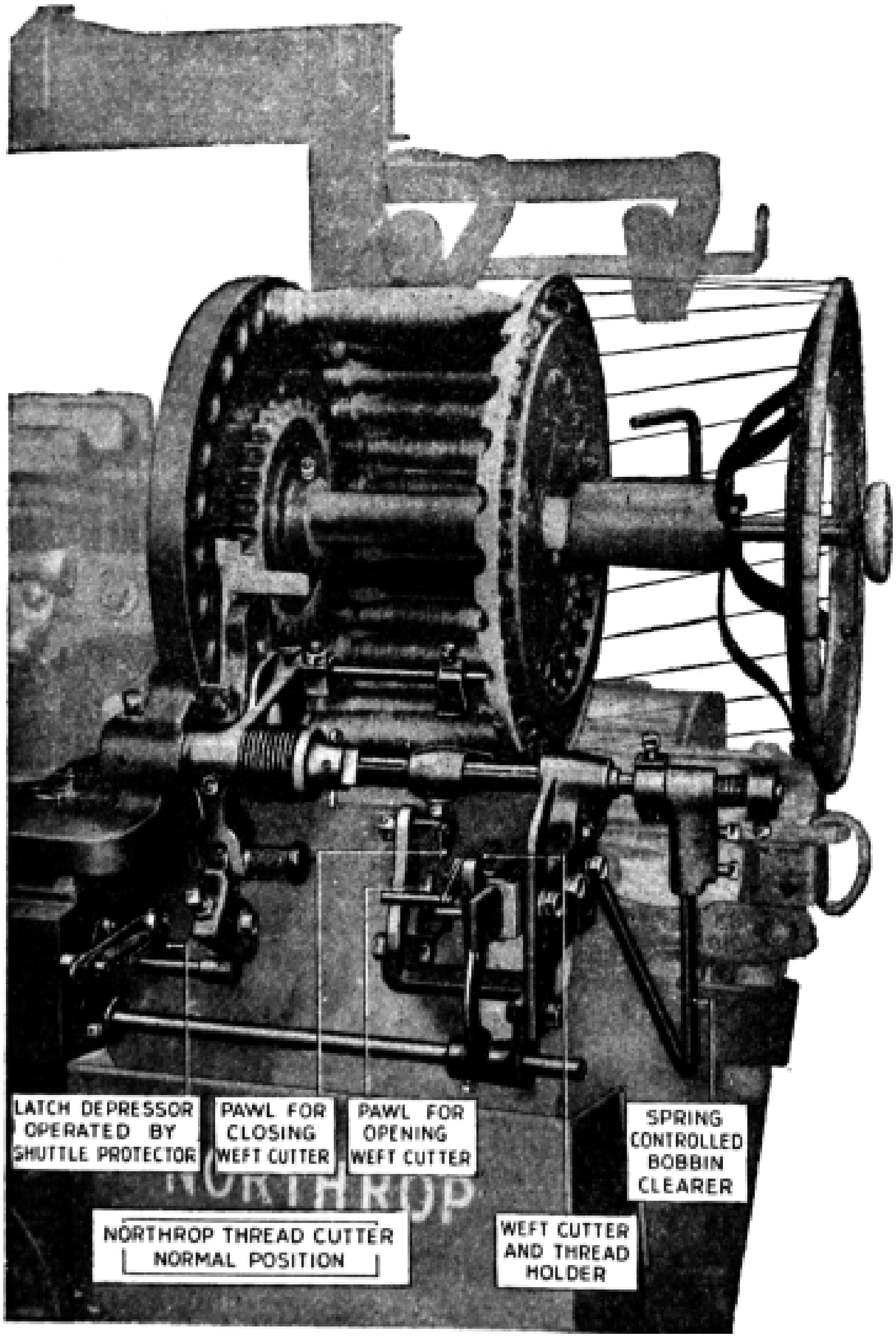


Fig. 167. Northrop Shuttle Eye Weft Cutter.

Shuttle Eye Weft Cutter.—This idea has been a great improvement on the Northrop loom, and has greatly reduced double strands of weft being left in the cloth. A further effective alteration was the obtuse run forward of the weft cutter instead of a straight run, for on receding, the pressure on the held weft was eased. The parts are exceptionally well illustrated in Fig. 167.

When the weft cutter moves forward from its standing position, it comes in contact with a small wedge that pushes up a pin on the weft cutter, and opens the cutter at the front to receive the weft. The box front is cut out to receive the cutter, and so is the shuttle front near to the eye of the shuttle. As soon as the going part begins to recede, the jaw of the cutter is closed by a pin on the back part of the cutter coming in contact with a cranked square bar on the pressure shaft that changes the bobbin. The closing of the jaw cuts the weft near the shuttle eye, but traps and holds the weft at the opposite side of the jaw. The box front is made with a sloping cut, so that as the cutter recedes, the strand of weft is pulled over the box top, and is held until the next forward run when it is dropped as soon as the jaw is opened, Fig. 167.

In Fig. 167 as seen on the right, is a spring controlled spent bobbin clearer. The weft cutter comes next, and one pawl is shown that opens the jaw on its forward run, and another pawl to close it as soon as the return journey commences.

The latch depressor is also shown that is controlled by the shuttle protector. These indicate the latest developments.

Mechanical Box For Warp Stop Motion.—This is one of the indispensable things for the Northrop looms owing to the number of looms that can be attended by one weaver.

It is fixed to the loom by a couple of bolts, and may be operated direct from the crank, or by means of a short belt, or by link chain and sprocket wheel.

The position of the mechanism, as well as the height, can be altered to be the most suitable for the warp to be woven.

If there be need for lease rods, they can be placed in front or behind the warp stop motion.

In Fig 168, the mechanical box is outlined. On the left is the driving pulley, with the cam on the same shaft. The cam moves the plunger to and fro; and as the plunger is fulcrumed at its centre, the top moves in the opposite direction to the bottom. Near the top, the plunger has charge of the arm that moves the serrated bar " to and fro " in front of the stationary serrated bar, the latter being slotted for the pin on the moving bar to have freedom of action.

The position of the two serrated bars have to be fixed so that when the plunger is in its full back position, the centre of the cut on the moving bar is in the centre of the cut on the stationary bar. The forward push given to the moving bar carries it so its centre is opposite the centre of the stationary bar.

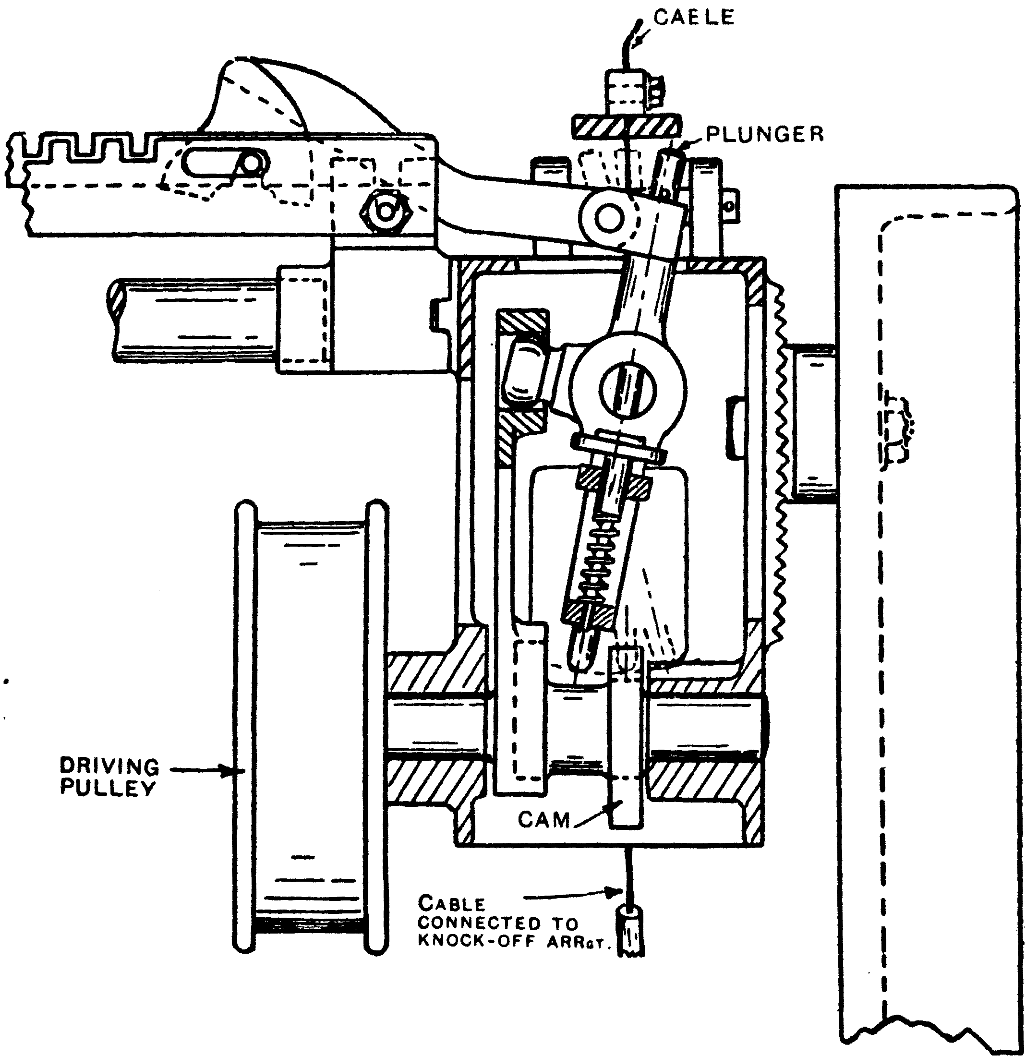


Fig. 168. Mechanical Box for Warp Stop Motion.

Droppers.—These are made of strip steel and are made in many shapes and weights. The standard droppers that are extensively used for most warps, with the exception of very heavy or very light yarns, and are eight thousandths part of an inch thick. This is in demand for warps up to 40 threads per inch on one set of bars, but if there be two sets of bars, then it is 80 threads per inch. The motion can be fitted with 8 bars and so gives a wide range of threads per inch.

The two chief kinds of droppers are the closed ones that have to be threaded at the same time as looming, and the other is open at the bottom, and can be put on the warp in the loom.

There is another division for there are mechanical droppers and those used along with electricity.

Stopping the Loom.—The loom continues to weave until a thread breaks, and the attached dropper falls. As the dropper becomes wedged between the stationary and moving bars, it holds the moving bar, and tightens the cable this brings the trigger attached to the cable opposite the bunter on the front of the going part

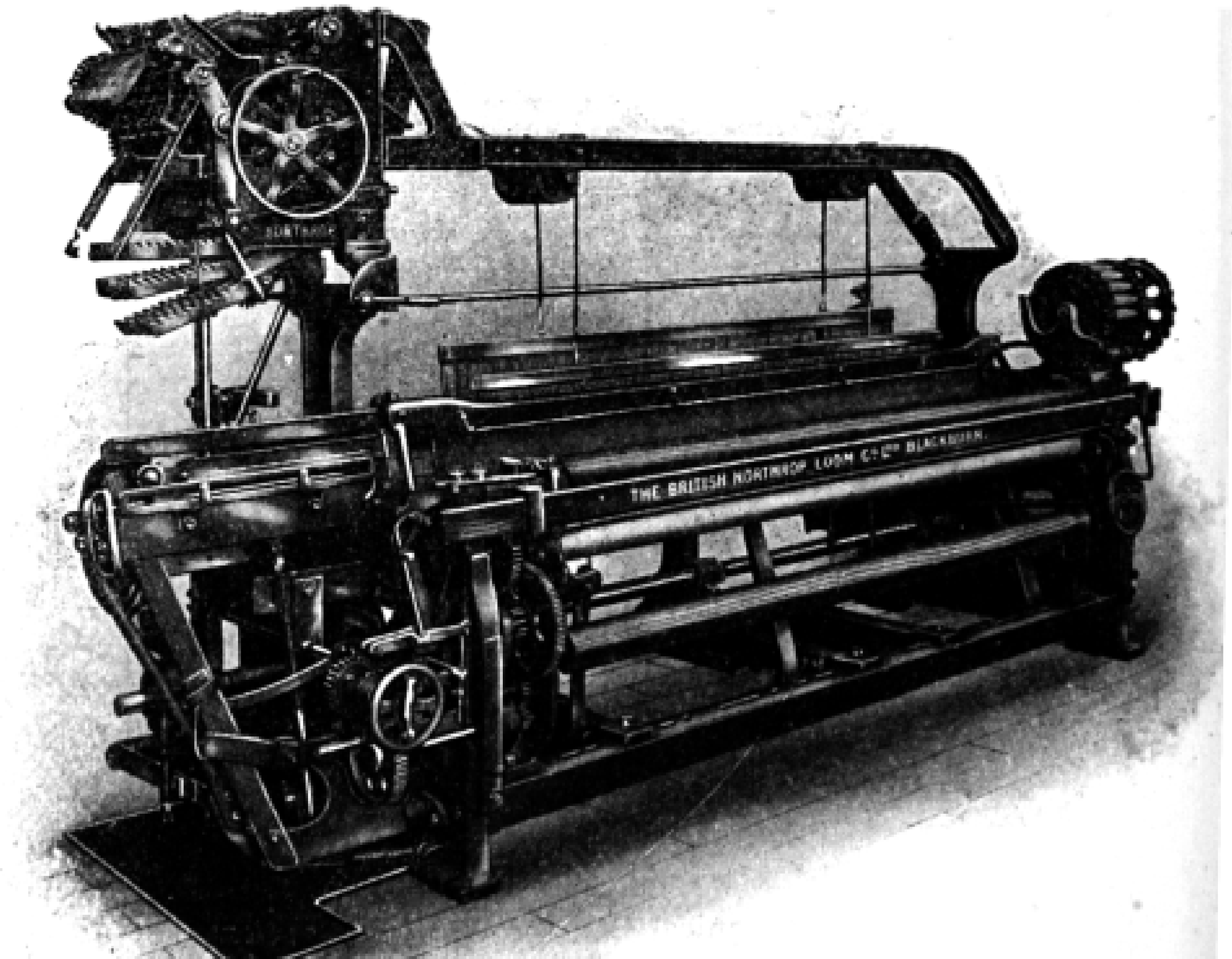


Fig. 169.
Northrop " F " Model Woollen and Worsted Loom with Leeming Dobby.

and as the going part moves forward, the knock off lever is brought into play, forces the set on handle out of its notch, and stops the loom.

Individual Drive.—The best drive for the Northrop loom of any kind is the individual electric drive. Of these there are two main structures, these being the cone clutch drive and the disc drive. For the first, the clutch insertion has not to move more than $\frac{3}{16}$th inch to attain full power for the driving of the loom, and only the same limited movement to stop it. The disc clutch drive is fitted with circular cork insertions, and the power to drive is quickly applied, and as quickly withdrawn. The Northrop system is to have the motor mounted on the loom. The horse power required varies according to the build and width of the reed space. A $\frac{1}{2}$ h.p. will drive a narrow loom; 1 h.p. is sufficient for a loom of medium weight and width; $1\frac{1}{2}$ h.p. will efficiently cope with a wide woollen or worsted loom, but a 2 h.p. is needed for wide looms weaving canvas, duck, and blankets.

There are four methods by which the driving power is transmitted. (1) Belt; (2) Gear; (3) Chain; (4) Rope. Of the four, the **V** Rope is the most silent, clean, reliable, and requires least attention. Further particulars will be found in the chapter on " The electric driving of looms."

Speed of Loom.—The speed varies considerably and is based upon the reed space.

A loom with 24 inch reed space makes approximately 180 picks per minute. A 48 inch reed space inserts 165 picks per minute, and a 95 inch reed space goes at 105 picks per minute. The average rate is the dropping of 5 picks per minute for every increase of 5 inches in reed space.

Looms per Weaver.—No rigid rules can be enforced, for much depends on the quality and kind of work, as well as the width of the loom.

The general run is for an overlooker to attend to from 80 to 100 narrow looms, or from 60 to 70 of medium width, or from 32 to 48 wide and heavy looms. Briefly stated, when a weaver attends to 16 looms, the overlooker has 48 and 3 weavers. When a weaver has 24, the overlooker has to manage 72, and again has 3 weavers. If a weaver follows 48 looms, then an overlooker's share is 96 looms and 2 weavers.

The dropper system for the warp and good rewound weft to take out the weak places are valuable aids for production by the Northrop loom.

Droppers are dealt with in the Lancashire loom section.

Electric Feeler Motion.—This is presented at Fig. 170. It is shown operating horizontally, but can be placed vertically when the loom requires that position. It is of the two prong construction, and in the illustration, has the lid off. When the prongs come in contact with the metal sleeve on

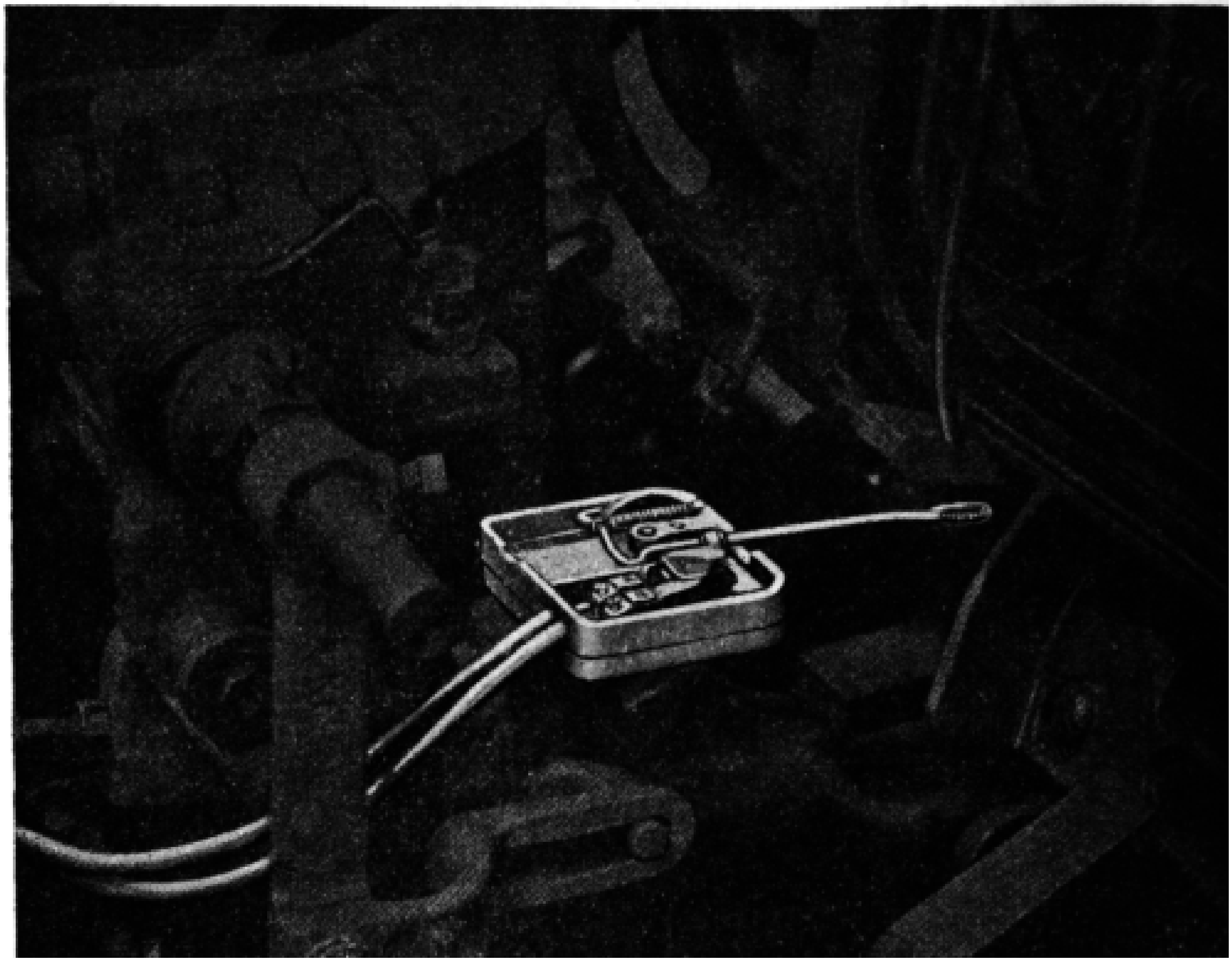


Fig. 170. Electric Feeler Motion.

the bobbin, it is quicker in action than the "Midget" mechanical feeler previously explained. The current generally used is 22 volts D.C., and an output of 16 amps supplies the need of 60 looms.

THE JACQUARD LOOM.

Joseph Marie Jacquard whose name is associated with all jacquard machines was not the inventor, but the skilful improver of Vaucanson's clever conception.

Jacquard was born at Lyons, France on July 7th, 1752 and died August 7th, 1834 at the advanced age of 82 years. Jacquard improved Vaucanson's machine in 1804 when he was 52 years of age, and for it, he was granted a royalty and pension. The jacquard was introduced into England in 1818 and came into popular use in 1824.

Messrs. Samuel Dracup & Sons, of Bradford were the pioneers of the British machine, and have now made them for over a century, commencing in the year 1825.

General Remarks.—The jacquard is the finest machine for making figured cloth that has ever been invented. It does with a single heald what a dobby does with a shaft. Its figuring capacity goes to the limit of the number of hooks the engine contains.

The 400 machine is made in rows of 8: the 500 in rows of 10, and the 600 and 900 in rows of 12.

There are 7 different pitches in the making of the engine, and the cutting of the cards for the various makes, the English pitch being the coarsest and the Verdol the finest.

Full Harness Mounting.—Norwich Tie-up. The principal parts are presented at Fig. 171. At A are the upright hooks, the bent tops being towards the cylinder G. At B are the blades of the griffe which lift the hooks. They lean at an obtuse angle, and just clear the hooks when in the position shown. The griffe is adjustable so the size of the shed can be altered. The usual lift is for the top shed to clear the front top of the shuttle when the crank is at its back centre. The timing of the griffe is set to the motion of the cylinder, for it must be below the points of the hooks when the cylinder begins to push back the needles, and have seized all those that have not been pressed back by the card on the cylinder before the cylinder begins its outward movement. The clearance between top of the griffe when down and edge of hook is $\frac{3}{16}$ or a quarter inch.

Then C is the spring box. At the inner end, it receives the looped ends of the needles, a pin passing through the series of loops to prevent them turning, and to retain them opposite the centre of the springs. The measurement inside

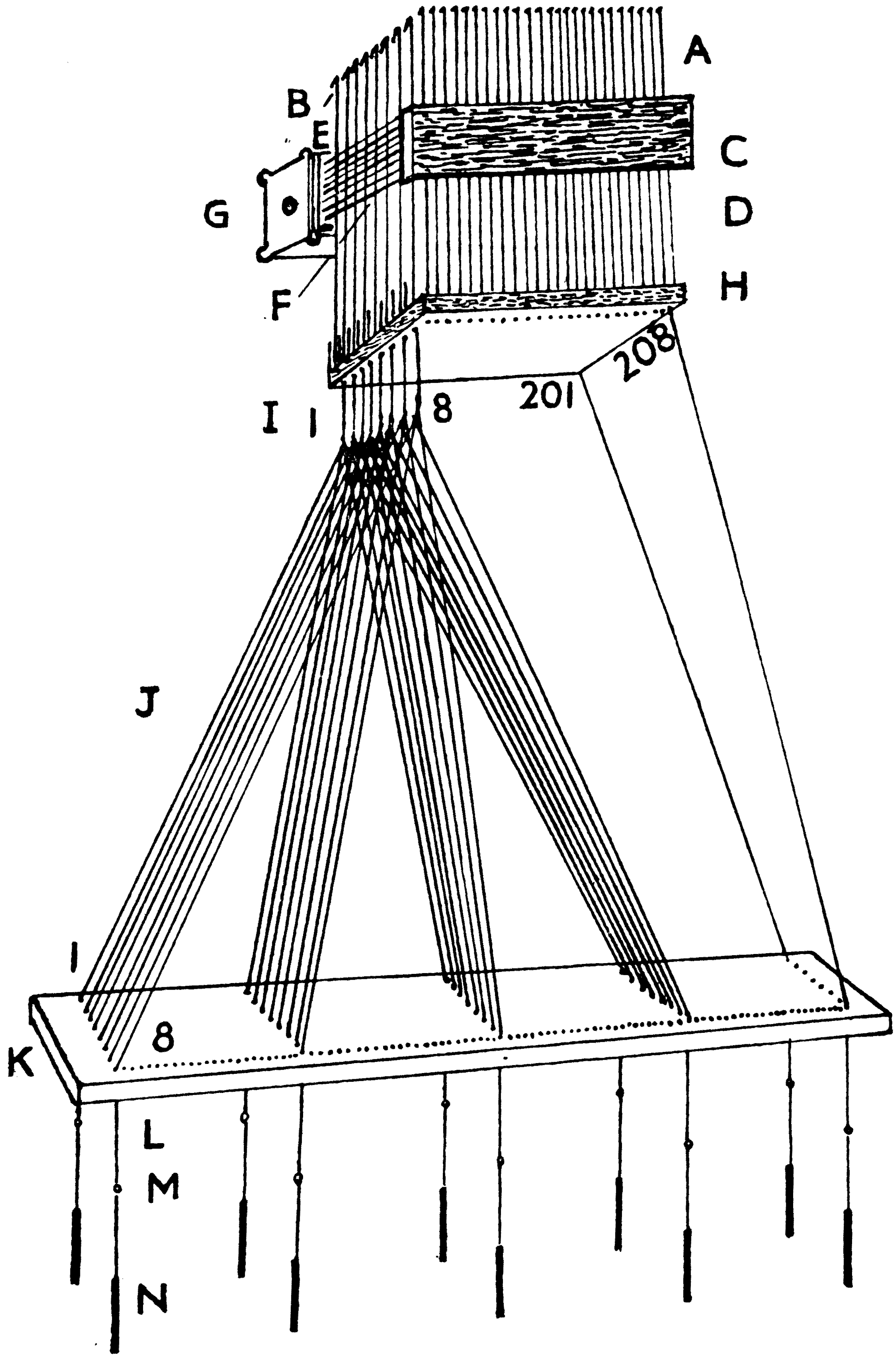


Fig. 171.

Jacquard Loom. Full Harness Mounting. Norwich Tie.

the loop is $\frac{7}{16}$th inch which provides latitude for the blades of the griffe to miss the hook when pressed back by a blank place on the cylinder card. The springs are at the back of the spring box at C; each spring having a place of its own. At the outer end, a vertical series are held by a pin passing down their end centres. If one breaks or has lost its power, the holding pin is extracted to replace it. The needles are at F, and pass through the needle box E, which keeps them straight, and presents them to the cards on the cylinder, the latter being at G. The needles have half loops for the hooks to rest in, and be moved by them.

The cylinder shaft is set in castings that allow of it being set vertically and laterally so that its borings and the holes in the cards may let the needle points pass through their centres. One of the best ways of testing the setting is to have a card punched for plain weave. This is placed on the operating side on the cylinder. The ends of the needles are slightly smeared with oil, and the cylinder with its card brought against the needles. The marks left by the points of the needles indicate which way the cylinder should be adjusted if it needs moving. In the old style, the cylinder was suspended in a batten motion, fulcrumed at the top of the engine, and moved the cylinder in and out in the arc of a circle. The more modern and better idea is to move the cylinder by a dead level slide and turn it by a star wheel.

The hooks A are looped at the bottom, and pass through the grid H which is slotted for each hook, and prevents them turning, and provides a semi-circular rib for the looped end of the hook to rest upon. The altitude of the grid fixes the standing position of the tops of the hooks.

To the bottom loops of the hooks, the neck bands I are attached. Each neckband contains the same number of cords as there are repeats required. These cords are either woven together in plain weave order, or are woven by hand, with one cord passing from the right, and another passing from the left in the same shed, and pressed home by a steel beater.

To these neckbands, the harness cords J are tied, and are then made to pass through the comberboard K. No comberboard is made without being seasoned for seven years. At L they are tied to the upper loops of the wire healds, the eyes of which are at M.

When all the hooks are at rest as shown in the diagram, then the warp through the mail eyes M should be just clear or slightly touching the shuttle race.

The lingoes are at N, and vary in weight to be suitable for the light or heavy weight cloth to be woven.

The upper part of the lingoe is attached to the bottom loops of the wire heald by a small wire loop.

The harness cords pass through the comber board like 1 to 8 and the last row is 201 to 208, and is a 200 jacquard.