It will be observed that the harness cords go straight to the comberboard. This is known as a Norwich tie-up, and is the simplest, and has the least friction on the cords. It is, however, liable to swing more when in action. The harness cords are specially made of 8 ply yarn that are spliced so

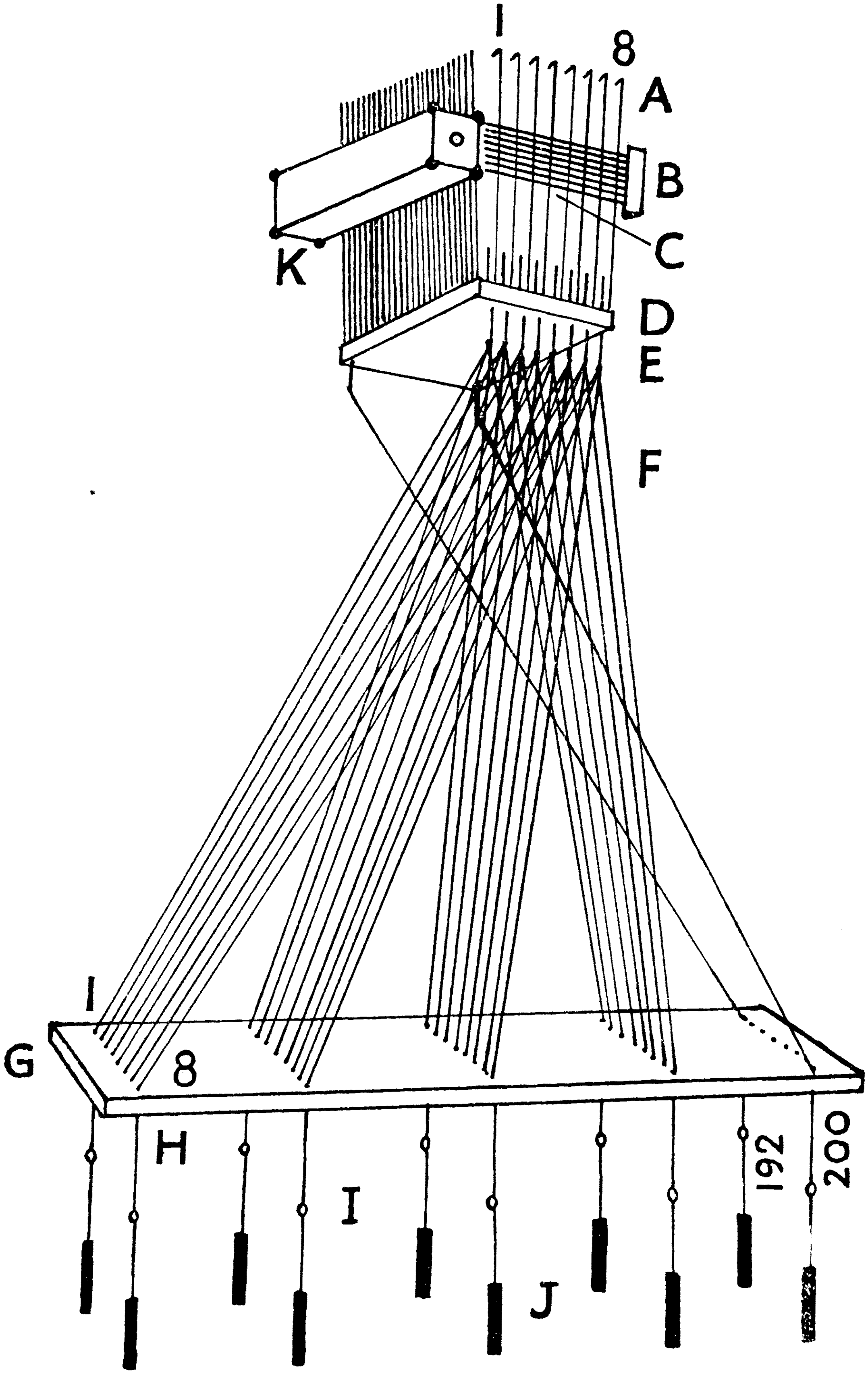

Fig. 172.
London Tie-Up of Harness.

that no twisting of the mail healds takes place. The cords are also well varnished to withstand moisture and give long service.

London Tie-Up.

In Fig. 172 the London method of placing the engine in relation to the comberboard is given. In the Norwich arrangement, the engine is parallel with the comberboard, but in the London tie-up it is at right angles to it. This makes it that the harness cords have a quarter twist. It generates more friction on the cords, but gives a steadier motion when in action. At A are the hooks, and B the spring box, the springs applying pressure to the needles C. At D is the rest board for the turned up ends of the hooks. The neck bands E are attached to the bottom of the hooks, and pass through the rest board, and the harness cords F are tied to them. The harness cords are threaded through the comberboard G, the one at H being typical of all the others. At I is the heald eye and J the lingoe. The weight of the lingoe has to be suitable for the kind of work being woven. The four sided cylinder is at K. The small end of the rest board is parallel with the comberboard, and this gives a quarter twist to the harness cords and curtails swinging

Reversing Mechanism.

In the older build of jacquard, the reversing of the cards have to be done by hand, and this mechanism is outlined at Fig. 173. The shaft A is just above the top rail of the loom, and behind the harness cords.

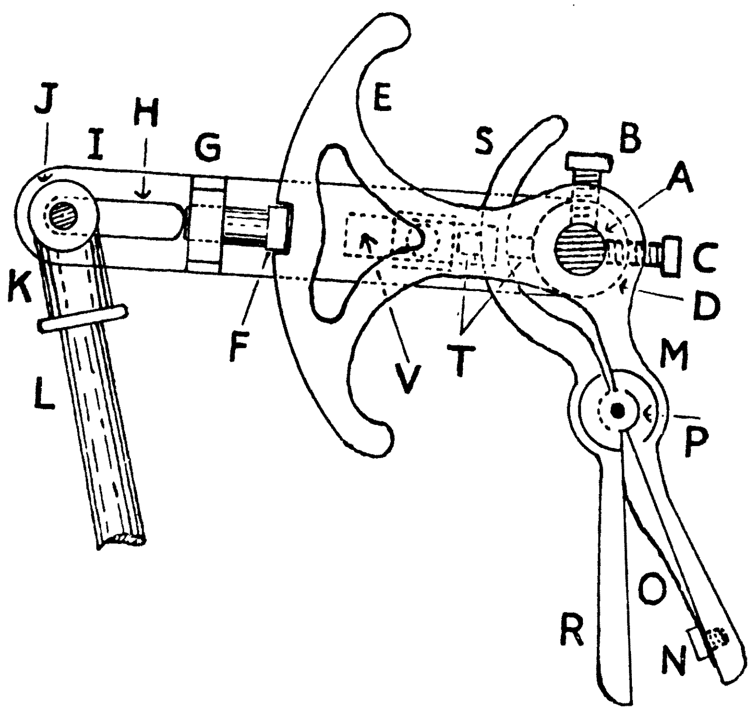

Fig. 173. Reversing Mechanism.

The setscrews B and C hold the crescent-shaped lever E to the shaft A.

At the centre front of lever E, it is cut out to receive the head of the stopper F. The shaft of the stopper passes through the projection G, which is cast to the lever I and fulcrumed at D.

The slot H receives the shaft of the holding pin F when it is pushed forward. At J is the stud for the swivel K, and L the connecting rod from the eccentric motion on the crank shaft that moves the lag cylinder in and out.

Lever E has arm M, and on its lower extremity is set-screw holding curved spring O that presses on inner part of lever R. This lever is fulcrumed at P on arm M. The upper part of lever R is shaped like a sickle at S, and passes between two lugs at T. The movable lug is at the front.

When the weaver has to comb out the picks, she counts the number, and then to find the right card, grasps the two handles M and R. A string connected to two hooks that turn the card cylinder is pulled down. This elevates the top catch and places it out of action, and brings the bottom one into play. When the handles M and R are given a " to and fro " movement, the cards are turned back for several picks beyond the number extracted, so the loom can then be set in motion a pick at a time to find the open pick.

On completing the turning of the cylinder the quadrant E is brought to its central position, and the head of the

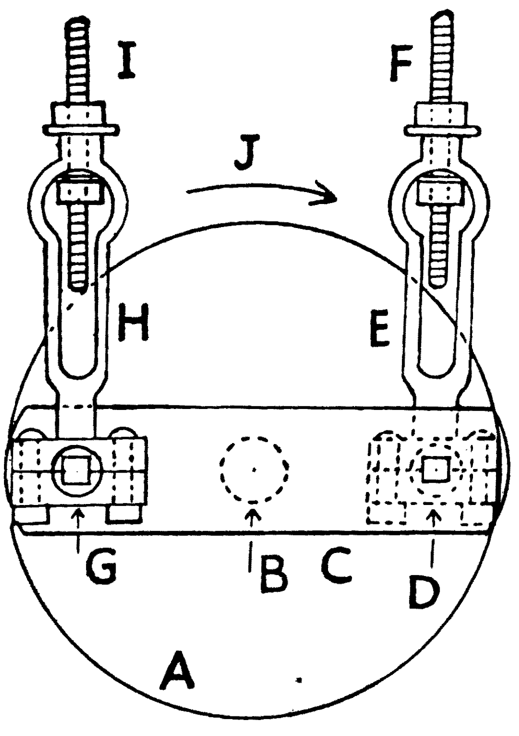

Fig. 174.
Jacquard Shedding Lever and Disc.

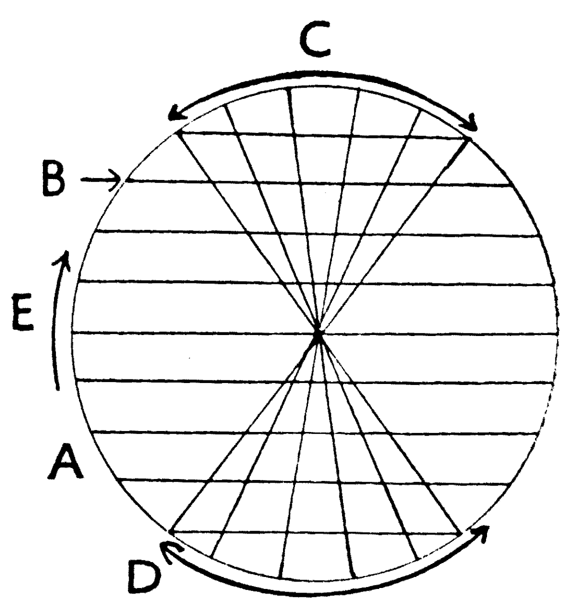

Fig. 175.
Bottom and Top Dwells of Shedding Levers.

spindle enters the cut on it. The hooks are adjusted for weaving by the band. The cloth and warp beam have to be adjusted before weaving can take place.

Shedding Disc and Lever.

These are outlined in Fig. 174. A is the disc, and B the end of the low shaft to which the disc is doubly set-screwed. C is the shedding lever, and behind it on the right is the clamped casting D, doubly bolted to the stud on the disc. E is the slotted part that holds the shedding rod F, the rod at the top being connected to the back head lever connected to the griffe. The rod is locknutted at its base, and is fixed so that when lever C is in the centre of its traverse as shown, the head of the levers and griffes are level.

G is the clamp fixed to lever C only, and at the front of it, H corresponds with E, and I with F. The shedding rod I is pinned to the front head lever, and usually to the outer hole, whereas the other is in the second hole from the end to give a little more lift to the griffe. The traverse of disc and lever follow arrow J. A slot in the disc is 4 inches, and the one in the lever is 5 inches.

Suppose the size of the shed was required to be less, disc and lever would be placed in position shown and the driving wheels blocked. The stud on D is unloosed and tapped inward, and stud on G moved inward too. There should be the same measurement from G to the centre of the low shaft B, as there is from the centre of D to B. Any further alteration is then made to the working length of the shedding rods.

Dwell of Disc and Lever.

This is illustrated in Fig. 175. The circle A is divided into ten equal parts horizontally, and the top and bottom sections are then divided into five equal parts on the top and bottom lines. Radial lines are then drawn from circumference to centre. This reveals the dwell of the shedding rods when passing their top and bottom centres at C and D, and moving as indicated at E. Though not actually a dead stop, the spacing is gradual at both ends, and the downward and upward movement are each only equal to one tenth of the spacing as at B. Jacquards may be divided into four groups, most if not all of them being made by every firm of jacquard makers. Each maker has made improvements which are distinguishing features. The four groups are: (1) Single lift single cylinder; (2) Double lift single cylinder; (3) Double lift double cylinder; (4) Twilling jacquard.

Except for special requirements, the single lift single cylinder is seldom made, being too slow, and involving too much motion in comparison with others. The twilling jacquard is also on the single lift principle with a single cylinder, and may be said to be more of a special jacquard.

The two kinds that are most extensively used are the double lift single cylinder and the double lift double cylinder, and these are given in detail.

Fig. 176 gives an outline of the double lift single cylinder. The hooks are at A, and both griffes are down at

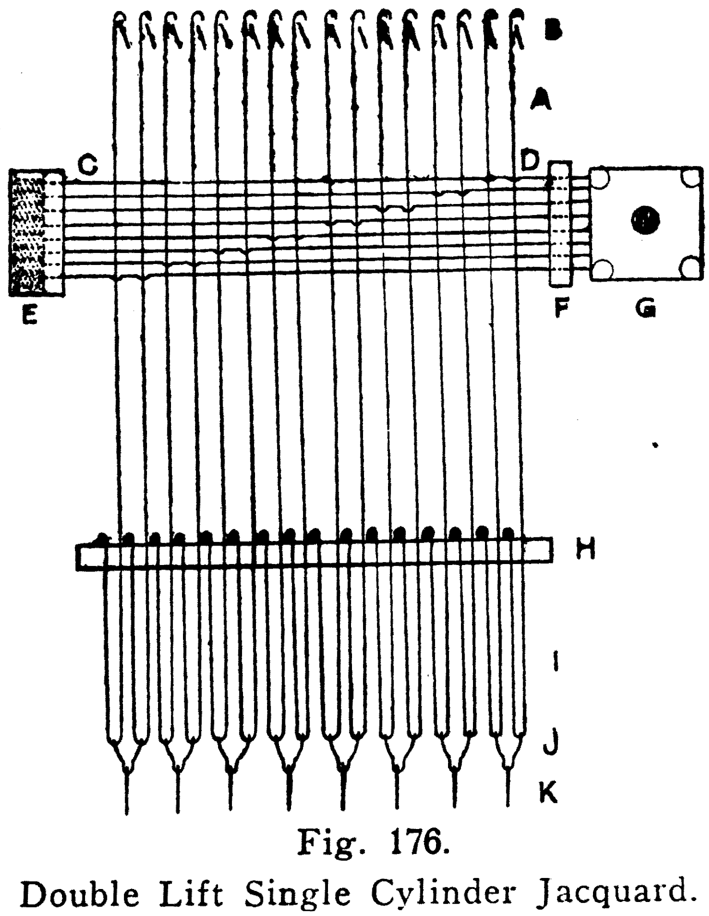

Fig. 176.
Double Lift Single Cylinder Jacquard.

B. The needles are at C, and it will be observed that each needle is made with two bends so that two hooks are affected by the same movement as at D. The spring box previously detailed is at E, and the needle box at F. The cylinder G is built on the square, but some have 5 to 8 sides to give steadier working. Then H is the slotted grid, and I the doubled end of the hooks. At J is the double link that connects each working pair of hooks, and K is the neck band to which the harness cords are tied.

Double Lift Single Cylinder.

Fig. 177 presents Messrs. Samuel Dracup & Sons, of Bradford, patent cylinder motion for their double lift single cylinder jacquard. It is a 400 machine, and has several special features.

The griffes are worked from the crank shaft by means of a coarse cogged wheel having 12 teeth. This wheel is secured by a couple of setscrews, and is the timing wheel for the griffes. It is connected to another coarse pitched tooth wheel above it having 24 cogs to give a lift to each griffe in turn, and complete both in two revolutions of the crank. As the chain becomes slacker by wearing, it is tightened by the pressure of a bowl, the stud of which is in a slotted bracket. At the inner end of the shaft which carries the large chain wheel is the sweep wheel, to which the connecting rod is coupled that governs the griffes. The sweep wheel is slotted so the movement of the griffes may conform to requirements. The ordinary lift of the griffe is to make it lift the healds so the warp on the top shed just clears the top front of the shuttle when the crank is at its back centre. For strong and fibrous warps it may be made to make a larger shed so as to part the loose fibres better.

When the jacquard is a fast reed loom, it should be false reeded to see if it will prevent stitching, for if so, then the griffes need not be molested.

The upper end of the connecting rod mentioned is adjustable by locknuts, and when the sweep is in the lateral centre with the connecting rod, the tops of the griffes should be level to give equal size of sheds. The griffes are at their lowest and highest when the crank is at its back centre, but may be altered a little to give an earlier timing for the shed.

Fig. 177 illustrates the reversing motion. This also is connected to the crank shaft by two open linked chains and sprocket wheels. At the outer end of the connecting shaft is the reversing wheel. It is disconnected with the crank by pulling out a spring rod, and the cylinder can then be turned in either direction. There is no need to have the crank at its back centre when reversing the cards by hand, for the slide which operates the " to and fro " movement of the cylinder comes into action as when weaving. There is no risk of needles being bent, or cards becoming fast or torn.

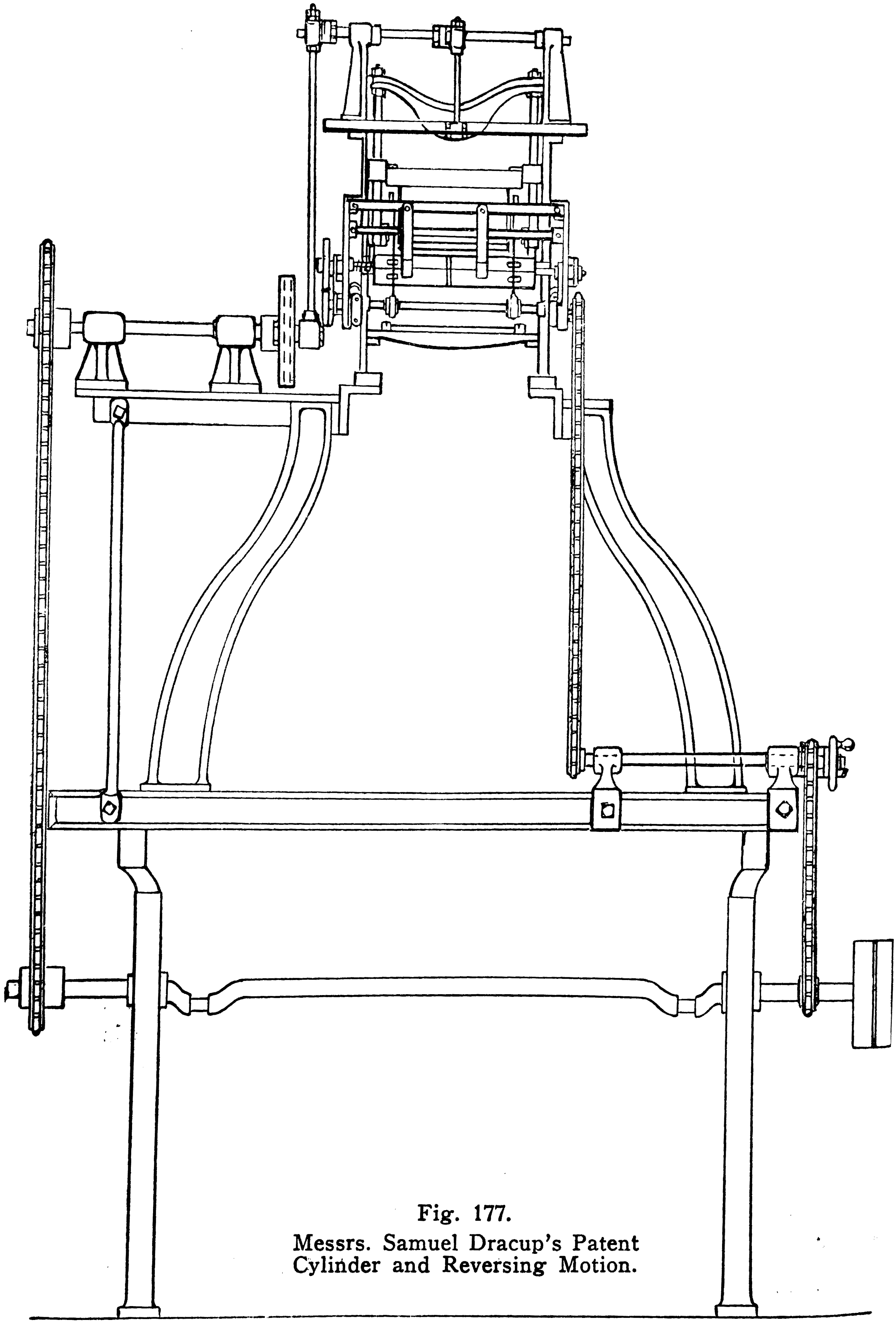

Fig. 177.
Messrs. Samuel Dracup's Patent Cylinder and Reversing Motion.

When the proper card has been placed in position, the spring rod is put back, and the loom is ready for weaving. Fig. 178 gives a good view of the engine. It will now be noticed that the cylinder has 5 sides, which gives a slower

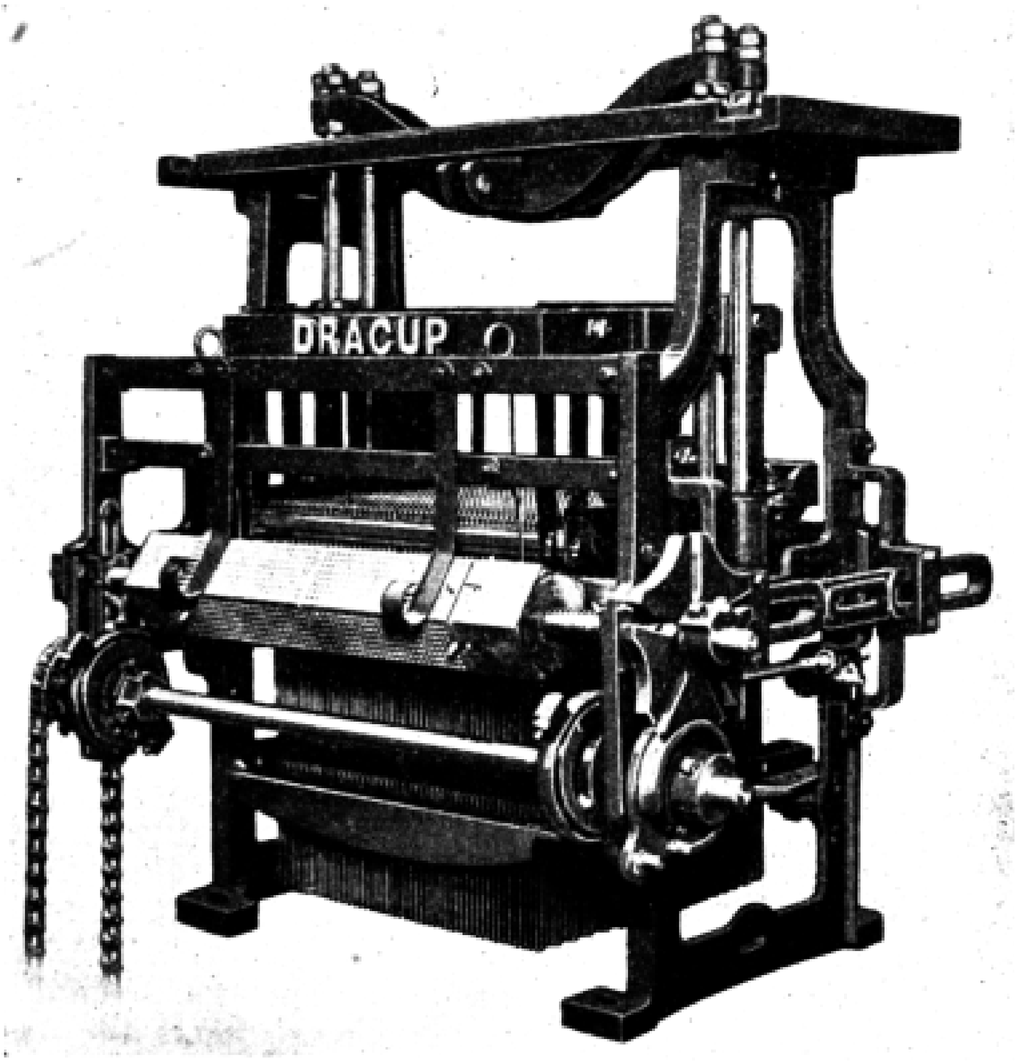

Fig. 178.
Messrs. Samuel Dracup's Patent Cylinder Jacquard Motion.

and steadier motion than one with four. At the outer end of the cylinder shaft is the 5 sectioned star wheel which is turned $^1/_5$ of a revolution for every revolution of the crank shaft. It is turned by the pin wheel below it. The star wheel is not fixed to the shaft, for its inner side has several **V**-shaped projections that fit into the hollows of a casting setscrewed to the shaft. The star wheel is kept in contact with its companion by the pressure of an open spiral spring which acts as an escape motion if the cards ever get out of order.

The pin on the wheel that operates the cylinder star wheel is at its bottom centre when the crank is at its back centre.

On the same shaft as the turning wheel are the two eccentrics which move the cylinder in and out. They are setscrewed to the shaft, both being timed alike. The eccentrics are flanged at either side, and receive the split caps attached to the slides of the cylinder. When the eccentrics have moved the cylinder to its outward limit, the edge of the cylinder when turning, is one inch away from the points of the needles.

Card Strippers.

Though not shown in the illustration, the cylinder is grooved just inside where the tapering pins project from the cylinder that keep the cards in position. In these grooves a chain is placed that passes round a loose flanged bowl on the shaft carrying the eccentrics. These chains effectively prevent the cards ever sticking and getting fast, for as soon as they begin to cling, they are forced off by the chains. Because of the efficiency of this device, the loom may be run from 15 to 20 per cent. faster without fear of the cards wrapping round the cylinder.

Movable Needle Plate.

Another special feature which cannot be seen in the picture is an extra metal needle plate. This is so evenly bored and fixed that the needles do not touch it unless forced out of the straight. It fits in front of the ordinary needle board, and goes almost to the points of the needles. As the cylinder moves in, the needle plate is forced in by the cylinder, and exposes the needle ends to the cards. As soon as the cylinder moves outward, the springs behind the needle plate push it to the limit, and so protects the needle ends. The needle plate does not require much force to move it, so that little extra work is placed on the cylinder mechanism.

As soon as the crank leaves its back centre the cylinder begins its outward traverse, and starts to turn when the crank is within $\frac{1}{8}$th of a revolution from the front centre. The cylinder has fully turned when the crank has made $\frac{1}{8}$th of a revolution after passing its front centre.

Dracup's Driving Motion.

The new style of lifting motion for the griffes is presented at Fig. 179. The long connecting rod on the right is coupled at the bottom to a straight lever with its fulcrum at the centre. At the opposite end of the lever is another rod connection, the bottom end of which is secured to a wheel that meshes with another wheel on the crank shaft, which is the driver of the motion, and times it. The timing wheel

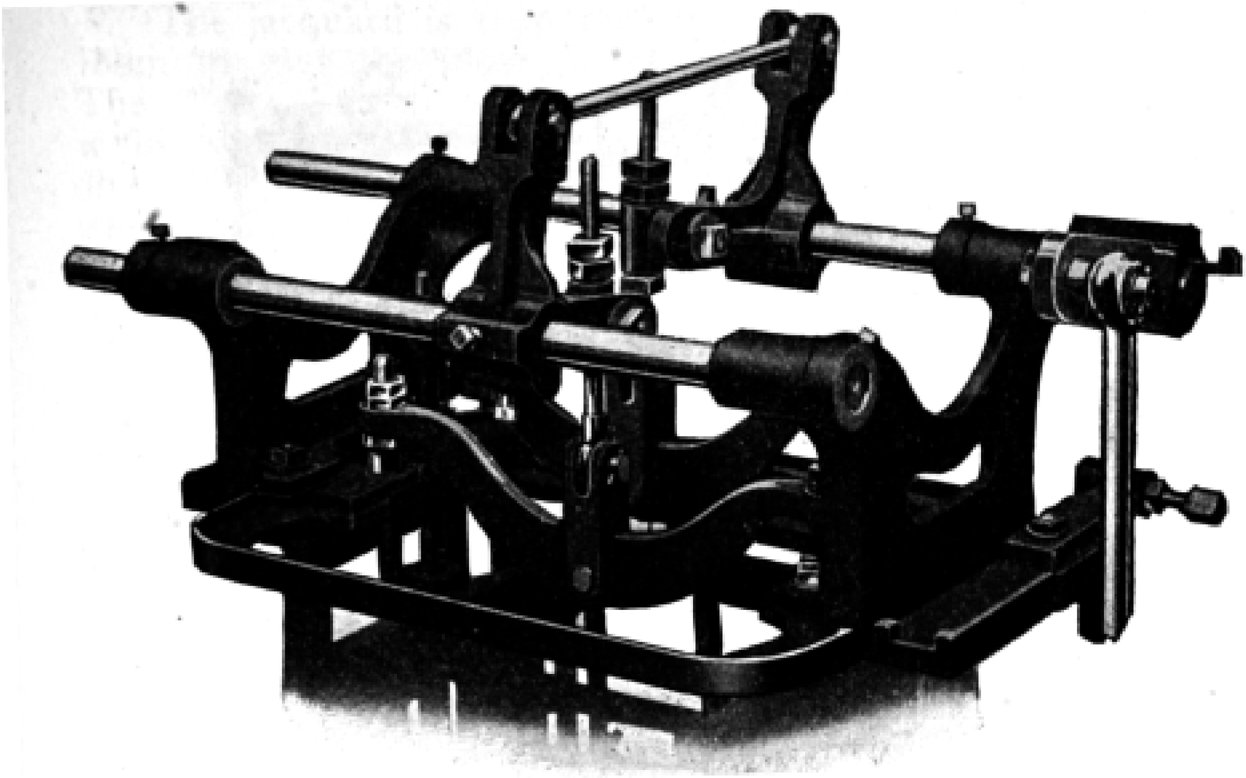

Fig. 179.
Messrs. Samuel Dracup's Patent Driving Top Motion for Jacquard.

has only half the number of cogs of the other. The straight rod lever is slotted at both ends for rod adjustment.

The rod seen in the illustration is secured to a small but strong lever at the outer end of one of the cross shafts, the lever being keyed to the shaft in a sunk keyway.

On the cross shaft is a right angled lever setscrewed to it. Its lower arm carries the swivel that is coupled to the balks that hold the slide rods of the griffes. The upper arm of the right angled lever has the connecting rod that transmits the lever movement to a similar lever in command of the other griffe, the levers facing each other. When the lower arms of the levers are opposite each other, and in the dead centre of their movement the griffes are level. By this means the griffes are given a perfectly straight and central lift, and the upper gantry and pillars are dispensed with.

Dracup's Selvedge Machine.

Many manufacturers these days desire their firm to have their names or badge woven in the selvedges. This guarantees the cloth to the customer, and, to a certain extent, prevents imposition and piracy by others.

The machine is shown at Fig. 180. It is a 96 hook jacquard, and works in the same way as a double lift single

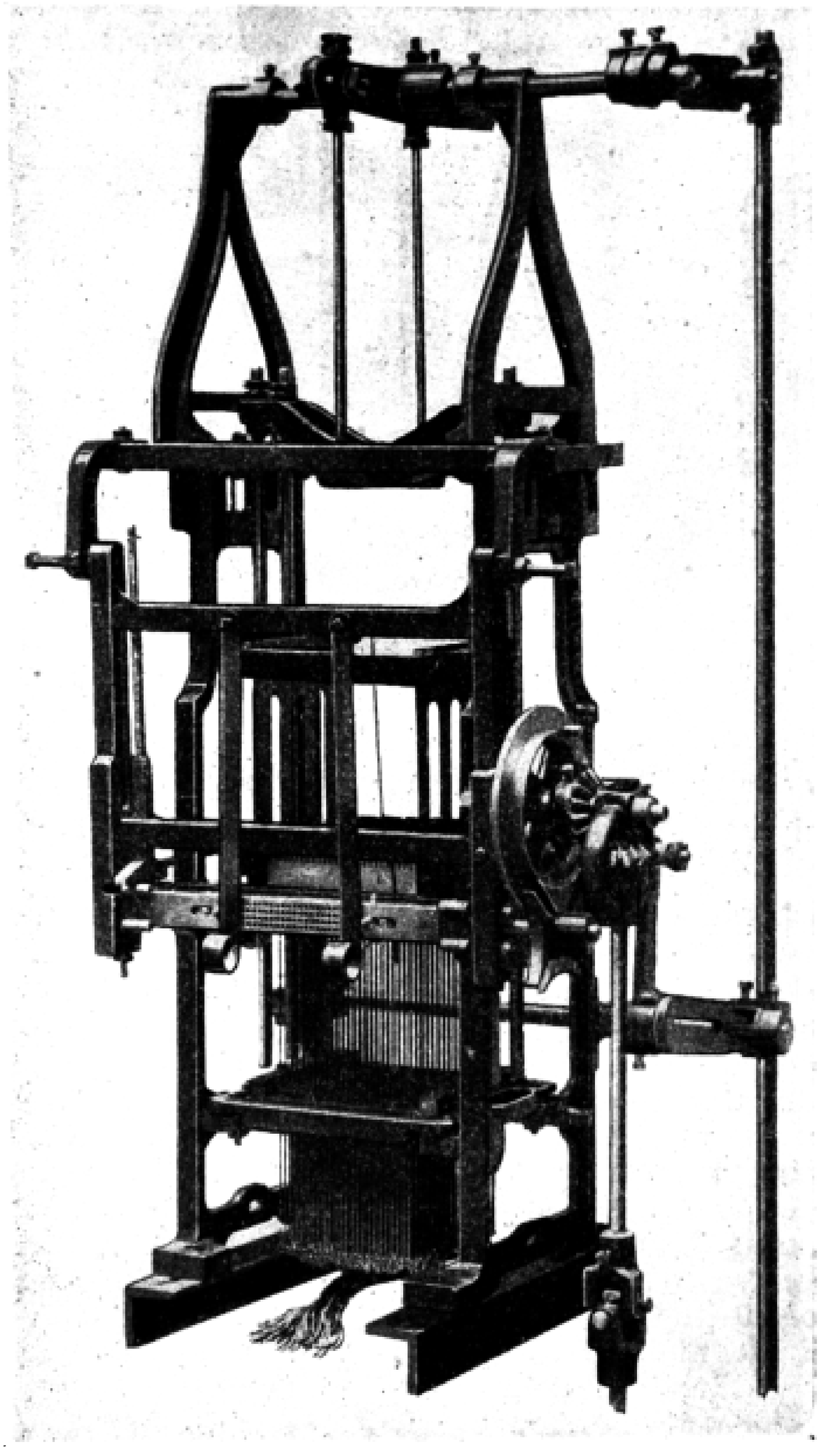

Fig. 180.

Messrs. Samuel Dracup's Jacquard Selvedge Motion.

cylinder machine. The cylinder with its four rows of holes. is made from solid drawn brass tubing, and the harness cords are made from the best Irish linen thread.

The jacquard is supported over the centre front of the loom to give the most direct way to the harness cords. The "non-wear" metallic comber boards are adjustable within certain limits. The jacquard may be fitted with a direct drive from the dobby, or may be run by sprocket wheels and open chain from the crank shaft. The former is much the cleaner. The timing of lifting the griffes has to be in accord with that of the dobby, so the making and changing of the shed is practically identical. The cylinder is moved in and out on the slide principle, and is turned by a four pointed star wheel rotated by a pin wheel above it.

It must be understood, before going further that most jacquard makers construct every kind, or almost every kind of jacquard.

Double Lift Double Cylinder.

An outline of this is given at Fig. 181. This make of jacquard is the best kind of jacquard, for, with having two cylinders, it may go at half speed of that of a single cylinder machine, or may work at a higher speed in the number of picks per minute, and yet go at a much reduced speed as regards the motion of the cylinders as compared with a single cylinder engine.

The hooks A are now turned in both directions, for the bent ends now face their own cylinders, the hook A being the first in the upper section, and the hook B the first in the lower section. There is now only one needle to one hook. At C are the blades of the griff in attendance on all the odd numbered hooks commencing from the left, and at D are the blades of the other griffe that answers the requirements of all the odd numbered hooks commencing on the right. The upper needle box is at E with the looped ends of the needles at F, whilst at the opposite end, G are the protruding ends of the needles, H the needle box, and I the representative eye of the needles. Most of the cylinders for this make of machine are four-sided as given at J and R.

They may be suspended from a batten, or be worked by a slide, made to revolve by shears, or turned by a star wheel. Taking everything into consideration, the slide and star wheel are to be preferred to batten and shears, for lanterns, hammers, springs and shears are not required as the parts are simplified, and the slide and star wheel are steadier and more reliable. At K and S are the respective cylinder shafts. The lower spring box is at L, and the looped ends of the

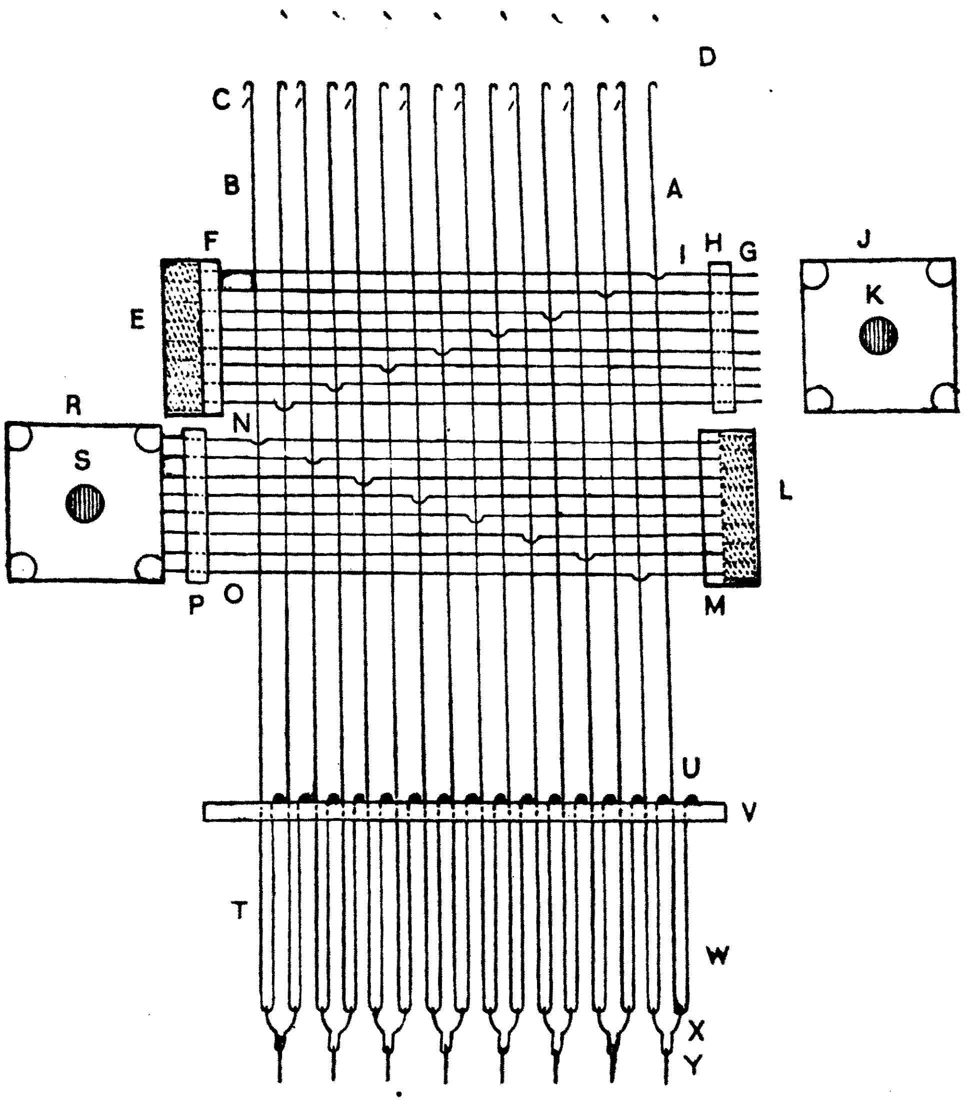

Fig. 181.
Double Lift Double Cylinder Jacquard.

needles at M, whilst N is typical of the bottom series of needle eyes, with O as the bottom needle of the whole series, and P the bottom needle box. The looped ends of the hooks and the ribs on the grid are at U, and V the grid. At W is the doubled section of the hooks, with X as the link connecting two hooks together, with Y as the neck band.

In both the double lift single cylinder, and the double lift double cylinder jacquards, there are all the advantages of the principal of the open shed.

Vincenzi Pitch Jacquard.

This French fine pitch jacquard is given at Fig. 182, this one being a 1,760 hook machine. There are various sizes of this jacquard, for one has 880 hooks and the others 1,320, 1,760, 2,640, and larger if required.

Much of the description of this jacquard may be traced in the illustration.

Griffe Rod and Disc.—On the upper and left hand is the cross bar, and on it is the casting that holds the rod controlling the griffes. Towards its outer end, the griffe rod carries the swivel with a collar at either side to keep it

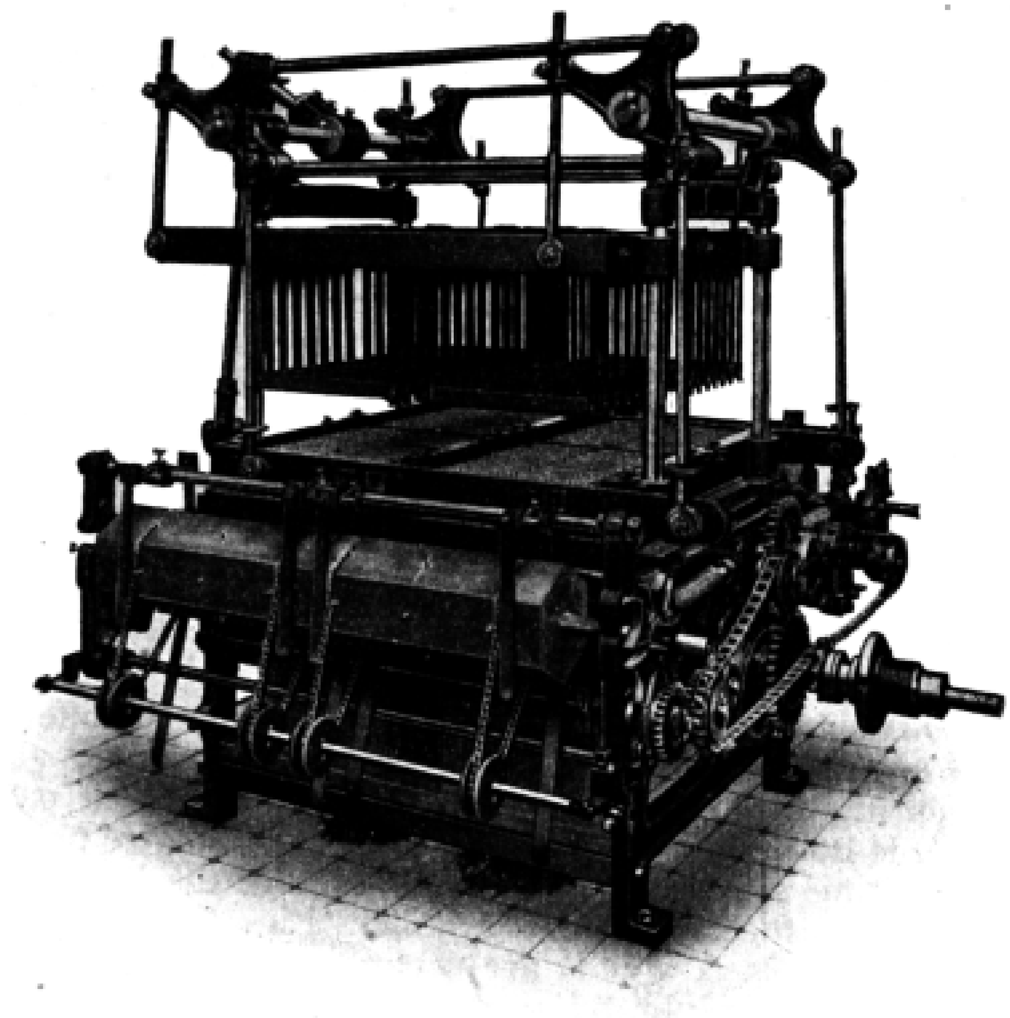

Fig. 182.

Dracup's Vincenzi Jacquard Double Lift Double Cylinder.

in position. The swivel influences the size of the shed, for when pushed nearer the griffes, the shed is made larger, but when set further away, it is decreased. When either alteration is effected, then the adjustment to the griffes must follow, to get the correct pitch.

Through the bottom of the swivel is the pin that holds the shedding stirrup.

An adjustable rod connects the top swivel to the bottom one, the latter being bolted to a disc, the disc being slotted in two places, so it can be set to run clockwise, or anti-clockwise. The slots give scope to secure the best timing of the shed to suit the warp.

The disc is keyed to its shaft in a sunk keyway, and so is the tappet behind it that operates the cylinders.

The disc is for the movement of the griffes, and when the connecting rod is in the centre of its movement, the griffes are set to be level at the top.

Griffes.—It will be noted that the triangular levers at each corner of the jacquard, are connected by adjustable rods to the framework of the griffes, the arms on the left having the shorter rods, and on the right, the longer ones. When these arms are dead level, the tops of the griffes should be the same. The back central arms of the triangular levers are connected by a rod, and the same applies to the front ones.

The blades of the griffes are slanted so as to give room for the ends of the hooks, and are pinned by wire.

The griffe blades are made to fall from $\frac{3}{8}$ths to half an inch below the ends of the hooks, when the bottom of the hooks are resting on the bottom board.

This distance gives time and space for the hooks to change position for the next lift.

Hooks and Needles.—These are constructed differently to the ordinary double lift double cylinder machines. There is no spring box, for the formation of the bottom part of the double hook made from the same length of wire produces all the spring necessary at E. The ends of the hooks made by one wire, face their own cylinder, Fig. 183. Each row of double hooks A and B are separated by rods C and D, and are kept straight by passing through a slotted grate on their way to the bottom board below.

In the loop at the bottom of the double hook is an endless cord G the doubled length of it being $7\frac{1}{2}$ inches long. This cord is made to pass through a hole in the bottom board F. The bottom of the cord has a steel hook attached, the end of the bottom loop L resting in a scooped out place on the down going part of the wire. To this hook is attached the harness cords. The needles H are doubly bent to influence each hook nearest to it, a blank on the card indicating a thread down, and a hole, a thread lifted.

The bends J and K on the needles lean towards each other, so there is no slipping of the hook, and in addition, they lean downward a little in the machine so as to take up less space.

Each needle has also another bend I of a less, but more open shape in the needle box. This bend rests on a flat bar, and prevents the needle from turning. Each horizontal row of needles are separated by flat bars, and each vertical row of needles are separated by vertical and circular pins. If a needle has to be extracted for any cause, then the corresponding pin has to be pulled out. A very small tube

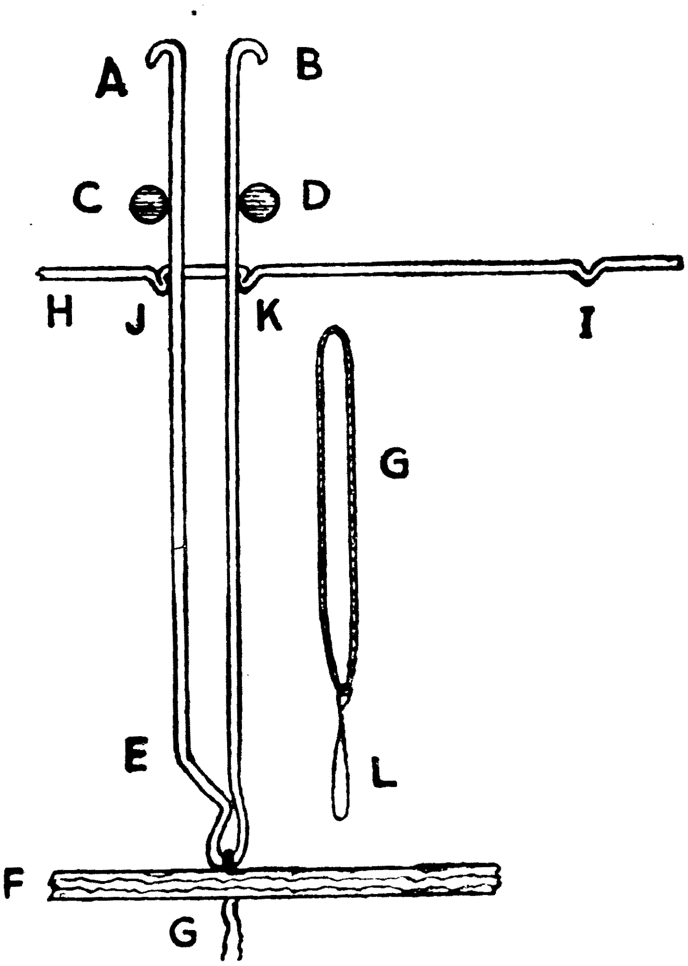

Fig. 183.
Section of Vincenzi Jacquard.

then takes one end of the needle, and is pushed through the machine until it emerges at the opposite side. The fresh needle is then pushed into the tube, and follows it through the machine, and so finds its length and place immediately.

If a hook has to be extracted, the harness cords are uncoupled, and a band is attached to the looped wire.

The double hook is then drawn upward, along with the attached band. The band is then taken off the extracted hooks and placed on the fresh hooks, which are then drawn into position, and the band taken off, and the harness cords coupled up.

The ends of the needles pass through a brass needle plate which has already been explained.

Cylinders and Card Strippers.—In the machine exhibited, the cylinders are hexagonal in shape, and have at least two advantages over square cylinders. (1) They turn slower and steadier, and there is much less danger of them getting out of place. (2) They wear much longer, as there is much less wear and tear. The brass pegs which pass through the perforations in the cards are not held up by springs, but are fixtures.

Each cylinder is set in two ways.

(1) On the right side of the cylinder shaft is an open spiral spring that presses the cylinder forward. The lateral pitch of the cylinder is set by a locknutted setscrew on the outside of the casting that receives the shaft of the cylinder on the left.

(2) The vertical position of the cylinder is obtained by brass castings inside the framework that holds the cylinder. Locknutted setscrews pass through the bottom of the framework, and influence the altitude of the cylinder. The pitch laterally and vertically is, that the needles must penetrate through the centre of the holes in the cards and cylinder.

A brass casting fits over the top of the cylinder shaft.

The card strippers are seen in the illustration. These are chains that pass into grooves in the cylinder, and just outside the outer pegs for the cards. At the bottom, they pass round small flanged pulleys that are loose on their shaft, but are prevented from getting out of line by a split pin at either side. If any card is liable to stick on the cylinder, it is forced off by the chains. Curved and flat springs press the cards on to the cylinder front and back.

Cylinder Tappet and Slide.—Both cylinders are mounted on the same slides, and move by the same tappets.

When one cylinder slides inward, the other moves outward, and *vice versa*. As shown, the cylinders are turned by a six sided star wheel, this wheel being turned by a pin on the arm of a bevel wheel. The pin enters an opening at the side of each section of the wheel, and turns it every other pick when the cylinder is moving outward. The pin bevel wheel meshes with another at the base of an inclined shaft, and at the upper end, the bevel at that place gears into the driver bevel for both cylinders.

Behind the driver bevel is the ordinary wheel that is run by a similar wheel below it, and is on the driving shaft. The shaft carries the driving sprocket wheel on its outer end, which is coupled by link chain to the sprocket wheel on the crank shaft. Another important point must not be overlooked. The tappets that operate the cylinder slides give a dwell of a quarter revolution of the crank shaft to the cylinder when in contact with the needles. This gives time for the hooks to change position, and the griffes to be level with each other before all pressure is withdrawn from the needles. The outer dwell of the cylinder is the same as the inner one, for then the other cylinder is in contact with the needles.

Inner Pitch of Cylinder.—The bearer casting of the cylinder has a stout rod screwed into it. This is seen on the right next the star wheel. The rod passes through two bores in the slide, and in between the bores is a strong and open spiral spring. The strength of the spring is regulated by a nut. A couple of locknuts in front of the back bore sets the pitch of the cylinder when against the needles. When the nuts are screwed towards the cylinder the cylinder exerts more pressure against the needles, and force the hooks a farther distance, but if the nuts are turned in the other direction, the effect is opposite. Both sides must be set exactly alike.

Reversing Cup.—On the inner side of the driving sprocket wheel is the reversing cup. This is made with a long slot at either side.

This cup cannot be made use of unless both cylinders are at about equal distances away from the needles. When so situated, the weaver pulls a pedal lever down, the pedal then being held by a catch. Attached to the pedal lever is a finger which moves into one of the slots mentioned in the cup casting.

The cylinders can then be rotated by a handwheel used by the weaver after a release pin has been pulled out, and the cylinders cannot get out of order with each other.

Inside the cup is a flat plate or disc which is held off from the bottom of the cup by locknutted setscrews. The plate is pressed upon by an open spiral spring which acts as an escape motion. The spring applies pressure to a clutch. The fork that moves the clutch is fulcrumed below, and behind the clutch is a casting that has an inlet V. Into this inlet fits an outstanding V on the sprocket wheel. As shown, this sprocket wheel is connected to another on the right of the illustration. The clutch is made to slide on a saddle key, and the clutch sprocket wheel is connected by chain to the reversing sprocket wheel.

Advantages.—This jacquard may be run with safety at 170 picks per minute. As it is smaller for a similar capacity than the English machine, it is much lighter in weight, and more light is available for the weaver. As the whole mechanism of the jacquard is run by a single chain, and as driving and cylinder motions are simplified, adjustments are made very quickly.

The hexagonal cylinders considerably lengthen the service of the cards.

The cards are three-ply, and are constructed to withstand atmospheric conditions.

As there are only one set of needles, and no needle springs, the mechanism is simplified.

The cylinders are positively rotated so that cylinder hammers, turning catches, and lanterns, are unnecessary. Card strippers prevent the cards from wrapping round the cylinder, and much less power is needed to work the machine.

Jacquard Patterns.

Worsted.—Fig. 184 has all the figuring done by the weft, one figure only being worked out on 104 threads and 94 picks. The figure is formed by two picks float and two picks plain weave, and has a plain weave ground. The plain binding weave is made wavy to cut the long floats in the floral effect. The full pattern is four inches square.

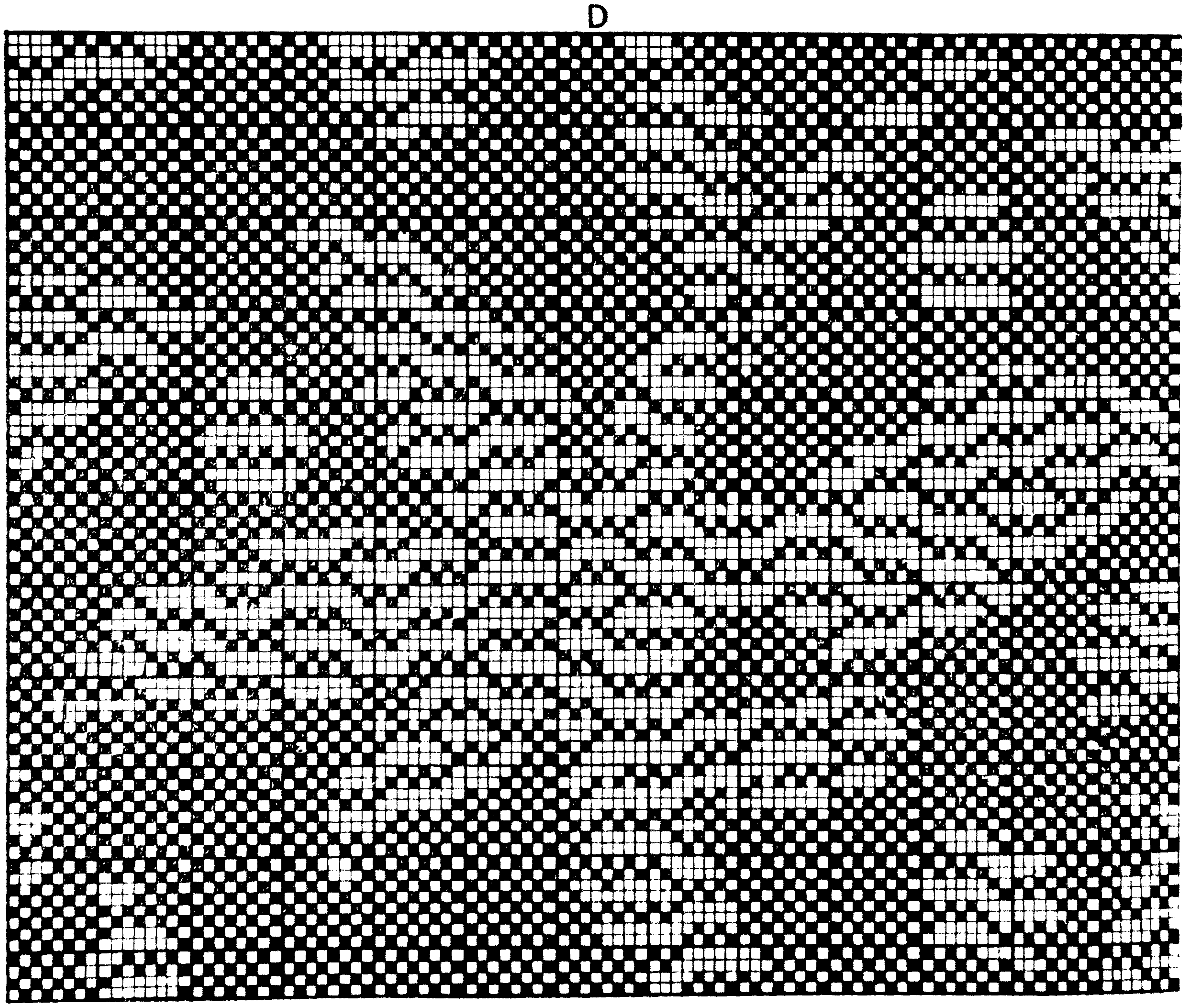

Fig. 184. Worsted Jacquard Cloth.

Warp 34's worsted with 62 threads per inch.

Weft 28's worsted (crepe twisted) with 56's worsted (crepe twisted) the final twist having 14 turns per inch, with 54 picks per inch.

Cotton.—This is a point paper plan of an ivy leaf worked out on a five end sateen ground. The figure may be placed in plain order with the figure leaning in two directions, or in five or eight end sateen order. It is worked out on 55 threads and 80 picks. Such designs are much used in cotton table cloths, Fig. 185.

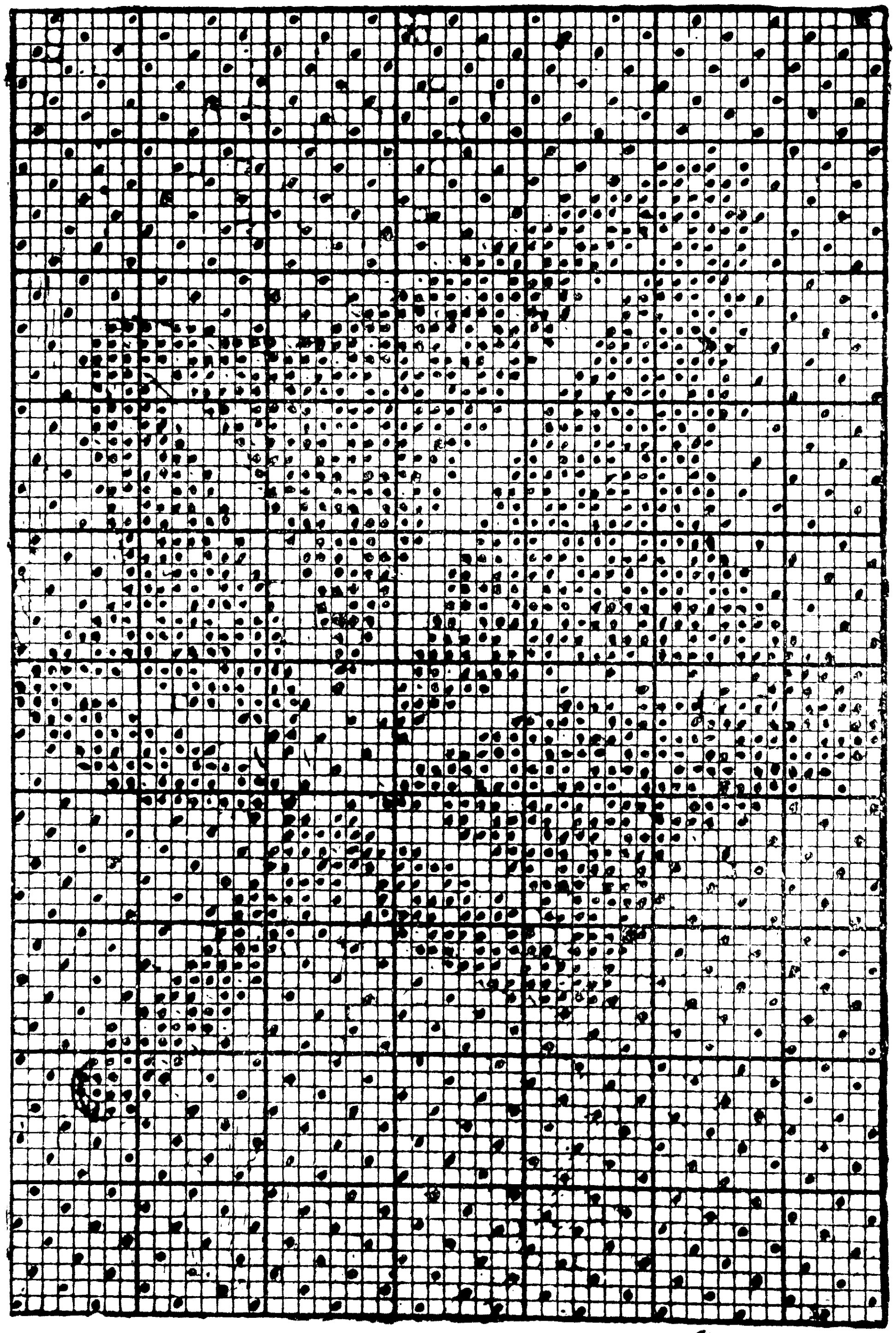

Fig. 185. Cotton Jacquard Pattern.

Rayon.—The pattern at Fig. 186 is a two weft rayon crepe brocade. The warp is 100 denier Lansil acetate rayon with 26 filaments. It has 140 threads per inch, and woven in 140's reed, two threads per dent.

It is woven with 88 picks per inch and is a pick and pick effect. One pick is 2/60 Bemberg with 70 turns per inch in the single yarns, and 12 more turns per inch in the doubling.

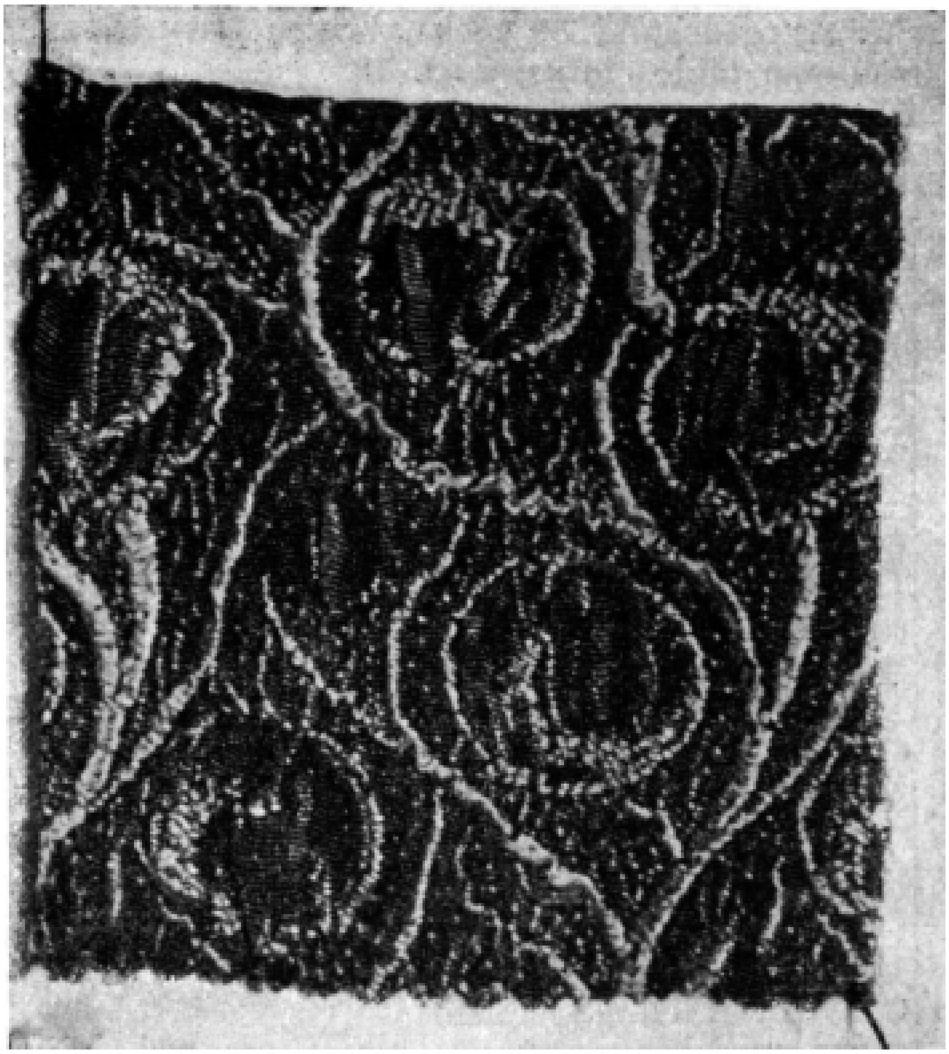

Fig. 186. Prize Winning Rayon Cloth.

The other pick is 30's denier viscose with 26 filaments. It was woven in a 400 Jacquard double lift single cylinder, the full pattern being on 400 threads and 300 picks.

The fabric was cross dyed, the crepe in bronze and the other in gold for figuring.

Silks.—Fig. 187 is a lily pattern, the beauty of it being in the design. It was woven with 180/2 silk with 192 threads per inch. The weft was 80/3 silk with 128 picks per inch. The ground weave is 8 shaft warp sateen. The leaves and

Fig. 187. Choice Silk Brocade.

petals are shaded with various twills and sateens to bring out the effect in light and shade as in nature. The warp is white and the weft one pick pink one pick stained blue.

Fig. 187a.
A Unique Jacquard Silk Texture.

Woven in eight colours. Each colour has 120 threads per inch and brought to surface when needed. Depicts train running, trees waving, flowers blooming, clouds rolling. A little village nestles at foot of hills. Pattern between selvedges 5½ inches, and warp way 2½ inches. Weft in selvedge 200 picks per inch.

DRACUP'S IMPROVED MATTING LOOM JACQUARD.

Dracup's Improved Matting Loom Jacquard.—This Jacquard has a centre shedding motion, is an **800** hook machine, and weaves matting **75** inches width, though the normal width is **72** inches. The speed is **130** picks per minute. It is strongly built for the heavy work it has to do.

It is estimated that when the lifting board is raised every pick, that at the period of hook change, it has to sustain a weight equal to one ton.

A back view is seen at Fig. 188.

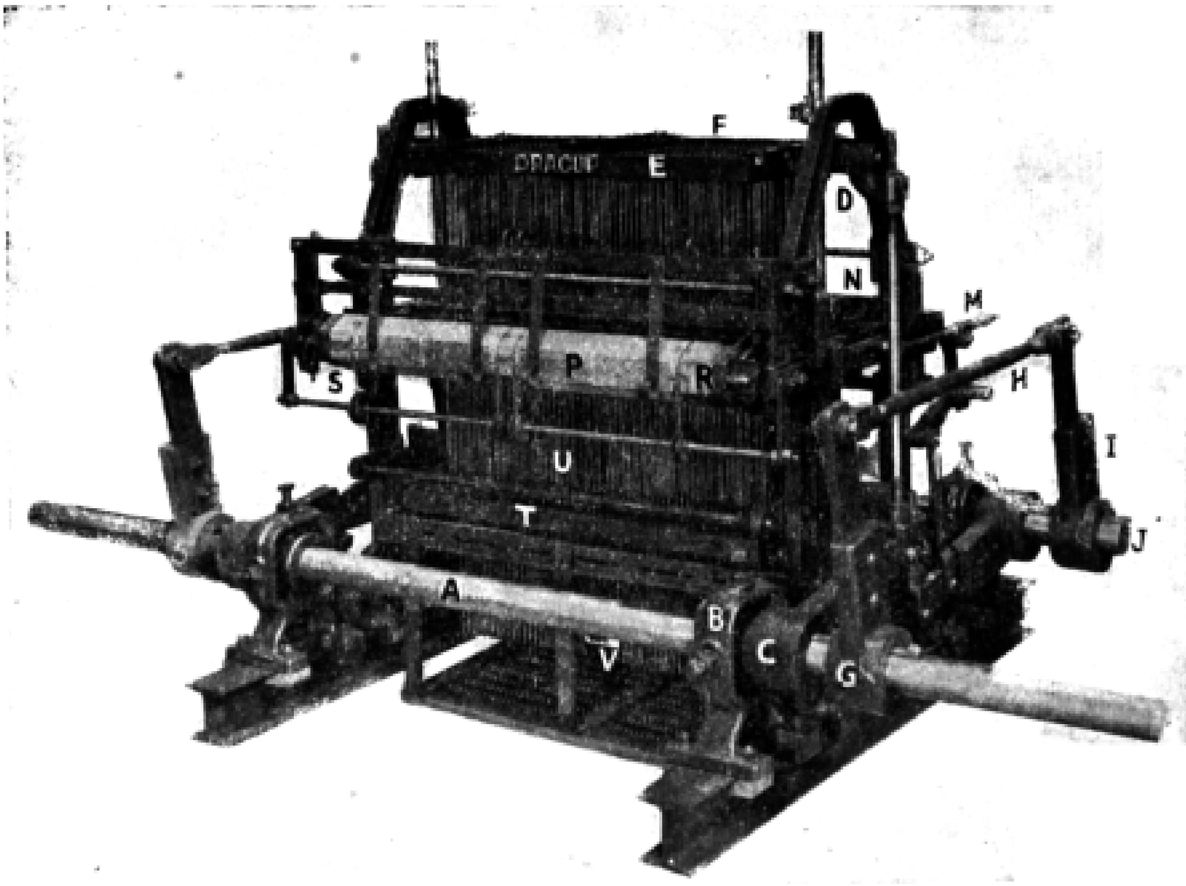

Fig. 188. Dracup's Improved Matting Jacquard Loom.

Oscillating Shaft.—Shaft A has a diameter of three inches, and is at the back of the Jacquard. The shaft passes through two sleeves, each being in a square casting like B, and is fitted with four powerful setscrews to get exact alignment for easy working.

On the shaft is the one-armed lever C, and coupled to it is the rod connection to the griffe casting D. By oscillating shaft A, the griffe rises and falls every pick. On the same shaft is the strong lever G, which, like C, is held by a key in a sunk keyway. At its upper end, lever G carries the stout rod H, and joins it to lever I on shaft J, the latter being a duplicate of shaft A. Shaft J is connected to lever K, and by a short rod is fixed to lifting board T. When shaft A turns toward the back of the loom, lever C raises griffe F, and by lever G being connected to J the lifting board T is lowered by K, and in this manner the shed is formed.

Slide and Cylinder.—Lever K holds the connecting arm L, and the top of it is held by a right angled lever, the upper arm of it carrying the spring rod M. The spring rod is connected to the cylinder slide O that moves the cylinder outward and inward every pick. The cylinder moves outward two inches, but does not begin to turn until it is free from the points of the needles, and is then rotated a sixth part of its circumference.

At each end of the cylinder is casting R with its rounded parts, one of which is made use of by the upper turning catch every pick. The turning of the cylinder is very steady, and there is little danger of the cards being deranged or damaged.

The slabs of wood forming the cylinder are made of seasoned birch, and the grain is arranged so that one is the opposite way to the next, and prevents expansion.

The holes in the cylinder for the needles are made by precision borings, and the setting of the cylinder has to be with exactitude.

To attain it, the ends of the needles are smeared with oil, and when the cylinder is brought forward, with plain weave cards upon it, the oil marks made indicate how it should be altered if not correct.

The cylinder is fitted with brass spring cones that enter the larger punched holes at the outer ends of the cards. The curved and flat vertical springs press the cards to the cylinder.

Safety Chains.—The cylinder is in two sections, each controlling 400 hooks. Each section is grooved in two places to allow an endless chain to fit into it. The chains prevent the cards clinging to the cylinder after they have operated.

One of the hidden things is, that the shaft of the cylinder passes through from one end to the other, and so prevents any sagging in the centre.

Timing of cylinder.—The timing is arranged so the cards begin to press the needles back after the hooks have been liberated from the griffe. Having pushed the needles to the limit set, the cylinder has to dwell until the griffe has a firm hold of the selected hooks. The overlooker can make sure these points have been achieved if he observes the motion while the weaver slowly turns the balance wheel.

The Griffe.—The framework of the griffe E is cast steel to withstand weight and wear. The raised griffe is at F, with hooks on the blades. The griffe has eight steel blades. They have straight backs and sloping fronts. The blades are 1½ inches deep, and 32 inches long, but are supported at their centres by a cross bar. The upright shafts seen in the illustration above the Jacquard, pass through three bores, and keep the griffe steady and reliable.

Griffe and Lifting Board.—The hooks that have to form the bottom shed, fall and rise with the lifting board. Its upper surface has a fibre covering, and has a " cushy " action on the bottom of the hooks. When the griffe descends, the board rises and when at its upward limit, the points on the hooks are about ¼ inch clear of the griffe blades.

The Hooks.—These are at U, and are spring hooks, and do not need a spring box. The hooked part is 20 inches long and the spring length is 18 inches. In between each row of hooks, and at the back of the spring section is a cross-bar that acts in much the same way as a spring box. By exerting pressure, it keeps the needles forward until pressed back by the cylinder card.

Neck Bands and Wires.—The top loop of wire V is on the spring bend of the hook, and the bottom loop has an oblong ring attached. On the ring is a three-play cord that passes through the cord board W, and also the comberboard below which is not shown. Below the comberboard is the wire connected to the cord at the top and the heald eye at the bottom. Below the heald eye is another wire that also carries the lingoe. The connecting wires are over 20 inches long. The rows in cord board W are in alternate rows, and are fitted with porcelain eyes.

Hook Guide Board.—This is not visible in the picture. It is formed by a strip of wood at either side of the whole series of hooks, and another strip passes through the central division. Through these three strips of wood, and also through each row of hooks at their base, a rod passes that keeps the hooks straight.

Attached to the outer woods are wires, which at their tops, are fixed to an appropriate griffe blade. In this way, the hook guide grate travels with the griffe.

When the griffe is down, and the lifting board is raised, the distance between the two is six inches. The cross rods are secured by a split pin.

When from any cause a hook has to be extracted, the split pin is pulled out and the cross rod pulled beyond the damaged hook. The oblong ring is then detached and a band is fastened to the wire at the base of the hook. The hook is then taken out, and a fresh hook attached and drawn into position.

Needles.—These are 22¼ inches long, and on their length they are doubly bent to the position they have to occupy for the hooks they have to serve. To prevent any sagging, steadying cross rods pass underneath each row at their centre length.

The front end of the needles are looped for ½ inch. Through each vertical series, a pin passes to prevent them turning. At the opposite end, the needles pass through a needle plate, the boring being in four sections of eight each.

The needles protrude ⅜th inch.

A hole in the cylinder card indicates a hook lifted, but a blank is for the bottom shed.

Press Board.—The board is indicated at N, and is attached by its pin below spring rod M, to the right angled lever that receives its motion from lever K, on the cross bar J. The press board is moved in and out every pick. Its function is to exert pressure on any needle not responsive to the pressure of the spring hook.

The press board is adjusted to give the required push so that all the needles are level in front of the needle plate.

When a needle requires attention, the press board is taken off, the pin extracted from the needle board, and the needle is ready for extraction. Any replacement is a two-handed job, for the one who pushes it through must have a helper to see that the needle occupies its right place in the needle plate. On pressing the needle forward, it is turned a quarter way so its doubled parts do not catch on the hooks.

Comberboard.—For this kind of loom the comberboard is 72 inches. Its actual length is 75½ inches. The board is built in sections, each section having 72 porcelain eyes for the harness cords to pass through. The eyes are arranged in a slanting position, the back of the same row being a half inch to the right of the front row. There are eleven sections, and as there are 72 eyes in each section, there are 792 harness cords, and only *one* cord for each hook.

Heald Eyes and Lingoes.—As the warp is made with thick threads, the heald eyes have a full depth of 1¼ inches, and the bore for the thread is $\frac{7}{16}$ inch. The lingoe weighs two lbs., is 20 inches long, and a ½ inch thick.

The shed made by the Jacquard is usually 10½ inches, but this can be increased if necessary.

ACCESSORIES OF THE LOOM.

The Use of Belts.

Though electricity is making headway in the driving of looms—both by the group method, and the individual drive—it still holds good, even with electric motors, that the great majority of looms are run by belts. The motor method is much shorter, but the longer one from the mill shaft pulley to those on the loom is not likely to be superseded for a considerable time. The quality and use of belts is a subject well worth consideration.

Quality of Belts.—The quality of a belt may be judged in four ways:—

(1) By the grain at the cut end. If it be coarse, it will stretch the most and give the least wearing, and may be so lacking in strength that a belt fastener can only hold it together for any length of time by being riveted. It might manage for some little time on a light loom, but is a first-class nuisance on a 90 inch box loom.

(2) By the use of a knife. A poor belt when well pressed will offer a moderate resistance to a sharp knife, but good belting will resist still more. One of the best tests is to match a piece of good belting against one that has not been tried, both as regards grain and cutting.

(3) By bending. When a belt is bent several times, and shows prominent creases on the outer side, it has not that resistance that a good belt possesses.

(4) By wearing. A belt that has to be tightened up several times a day when new, will lack durability, and every act of tightening up is a " slimming process " for the belt.

Belts are made up of sectional lengths, each part being tapered off at either end, one being on the face side and the other at the back. As the tapering is usually very accurately done, the joinings fit together very well, and are sewn together by whangs or copper wire. Whangs are the most common form of sewing for loom belts, as there is no danger to the hand when running, and none to the knife when repairing.

Methods of Loom Driving.—There is a right and a wrong way of putting a belt on a loom, for the thin end of the inner tapered part must go last round the shafting pulley. If it takes the lead, it will eventually curl up and tear part of the sewing out. There are three ways of driving a loom, these being the straight, the half cross, and the cross drive. The last named gives the best belt grip as the belt wraps better round the pulleys.

Correct Lineage.—In the straight drive, like that applied to the Hattersley friction box loom, the centre of the mill shaft pulley should be opposite the centre of the loom pulley when out of action.

To give satisfactory results for the half cross drive when the mill shaft pulley runs towards the loom as well as away from the loom, Fig. 189 is introduced. The plumb line A is dropped from the running down side of the mill shaft

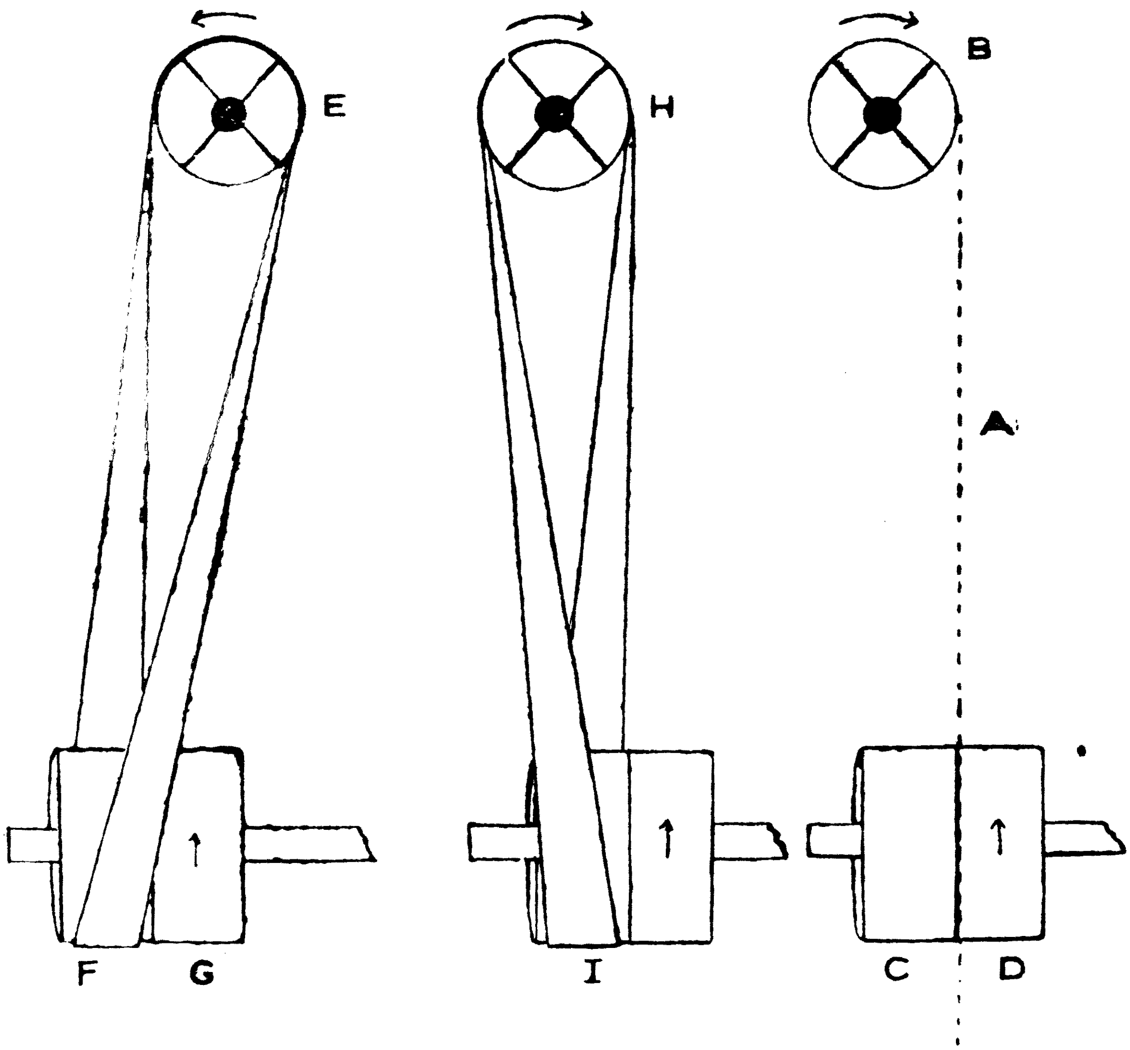

Fig. 189.
Belt and Loom Pulley Setting.

pulley B, behind the loom pulleys C and D. The last named is the fast pulley and the other the loose one. The direction the loom pulleys move as indicated by the arrow. The plumb line should fall about a ¼ inch on the fast pulley. This system of driving is the best possible when the mill shaft pulley runs towards the loom; and is demonstrated in the centre section of the diagram. At H is the mill shaft pulley, and the belt running down to the front of the loom pulleys. On coming behind at I, the belt is drawn *away* from the fast pulley and this greatly assists in the safe running of the loom. When the loom knocks-off from any cause, the belt must be forced off the fast pulley in the least possible time, and it is obtained by this method of driving.

The worst method is shown in the first section. As before, the plumb line is dropped from the running down side of the mill shaft pulley E, and it is an advantage if it rests a little on the loose pulley and behind it. It will now be observed that the belt behind the loom pulleys leans away from the loose pulley F and touches the fast pulley G. This indicates that the belt will remain on the fast pulley the longest possible time when the loom bangs off, and this is a direct menace to the safety of the loom.

Only through sheer necessity should any loom be driven in this manner. The shorter the drive and the more the belt leans over the fast pulley when the loom is stationary.

Cross Drive.—In the Dobcross friction drive, the belt is straight, but in the fast and loose pulley method, the best driving is obtained with a cross belt. In this loom the bottom half of the crank turns first. The mill shaft drum is set so that its centre is opposite the centre of the loose loom pulley. The most effective way of crossing and working the belt is to throw it over the leading on side of the mill shaft, bring the end down *behind* the long length, pass it through the belt guide, and then fasten the ends together. When the loom is set in motion, the back length of the belt pulls the other with it, and transmits the full power in a fraction of a second, and gives the loom a good start. When the belt is pushed off, the back length is pushed off first, and drags the other after it. This reduces the belt power in the quickest possible time, and, in case of the loom knocking-off, the blow on the frogs and loom frame is minimised.

Whether a loom be running or standing, no belt ought to hang over the mill shaft pulley for any kind of drive.

There are different widths of belting. Narrow looms will work comfortably with belts 2¼ inches wide; wide looms need 2½ inches, but Dobcross looms, must have belts from 3 to 3¼ inches.

Long Driving Belts.—Long belts are to be preferred to short ones, and especially in the half cross drive. A good working length is 18 feet, for the pull is distributed over a good area.

When it can be arranged, a fairly large pulley on the mill shaft gives much better results than a small one as it has much better grip, and there is less variation in loom speed. This is chiefly a question of the speed of the mill shaft. It is better management to run the shaft at a reduced speed and have larger pulleys than to have it at a higher speed and have lesser pulleys.

Belt Tension.—When the belt is running on the loose pulley, it should be quite clear of the fast pulley both front and back or otherwise, nasty accidents can easily occur by the simple pressure of the long setting-on handle in the Hattersley loom.

The amount of pull given to the belt by the setting-on handle and belt fork is only sufficient to draw the belt half-way, or a little more than half way on the fast pulley, and this is enough to drive the loom effectively at a proper speed if the belt is in good condition and not too slack.

For belt tension, it is better to err on the side of slackness than tightness, for tightness considerably shortens the service of the belt, puts undue strain on the crank shaft in plain tappet and dobby looms, makes it more difficult to get the belt off the fast pulley when the loom bangs off, and causes the loom to run at an excessive speed, except in the weaving of very heavy cloth.

A slipping belt wears shiny on the inside, and the loom pulleys are bright, but a belt that is doing its work properly is dull in appearance and so are the pulleys.

Twisting Belts.—Belts sometimes twist over when driving the loom on the half cross method. This may be due to having been put on wrong way first after repairing, or through having repaired one section with an unsuitable length from another belt. It may arise from the point of contact with the belt fork being too far away from the loom pulley for this will impart too much leverage to the belt.

There is also another cause. The fast pulley is usually a little larger than the loose one, and sometimes the edge of the fast pulley is too prominent. The edge of it can be rounded off with a good file when the loom is running.

Conditioning Belts.—The heat of the factory, coupled with the friction generated by running the loom, dries the nature out of the belt and makes it liable to crack. Its pliability is restored, and its working hours materially prolonged by the judicious application of castor oil the last thing in the evening, or better still, the last thing before stopping at the week end. When the oil is applied to the inside of the belt when running on the loose pulley the oil can be evenly distributed, and gets well soaked into the leather before starting time. When extra gripping power is needed for the weaving of heavy fabrics, the belt may have to be tightened a little, but its grip will be materially aided by mixing a teaspoon full of powdered resin with three times the quantity of castor oil. It is put on at the times previously mentioned.

Belt Repairing.—In repairing belts of any kind, and especially those run with the half cross drive, the mark of an arrow may be placed with advantage on those pieces that are without sewing. In wearing, the belt is drawn out most on the left-hand side of a right hand loom by reason of its working position, this being the side to run the loom. If a section be held straight out as working, it will be seen to have a distinct curve to the right. In left hand looms the curve is to the left, and as this is opposite to the other, it follows that to get the best wearing results, each hand of belt are better kept for their own repairing. What has been the leading on side of one hand of loom, should be the same on the same hand. This cannot always be adhered to, but results are better when followed.

The slightly concave malleable iron fastener, with its double row of teeth at either side, is a very serviceable means of joining the belt ends together. By hammering, however, the fastener is liable to be made flat if hit too hard. The original shape should be preserved if at all possible, for it conforms to the circumference of the pulleys better, and there is less chance of it parting company with the belt. The smaller the pulley, and the more likely this is to happen. For poor belts, when difficulty is experienced in keeping the belt intact, the outer sides of the ends of the belt which are the most rigid may be pared down. This will make it a little more pliable, and will cause the teeth of the fastener to protrude through the leather. The teeth can then be bruised, and though the fastener is then spoilt, it will keep the belt running.

Rubberised Solid Woven Belting.—This type of belting, manufactured only by the firm of Messrs. J. H. Fenner and Co. Ltd., of Hull, is the result of research extending over a period of years.

The manufacture of this completely new class of transmission belting first began in 1930, and its progressive stages have been marked by seven British patents being taken out, and eighteen foreign ones.

Ordinary Woven Belting.—This is subject to the formation of ridges on the working face as the belt passes over the pulleys. Owing to the recurring pressure on these ridges, they are flattened out, and the threads are cracked. The outer part of an ordinary woven belt is subject to expansion when passing over the pulleys, and by being so stretched, they are subject to cracking.

When ordinary ply type, or solid woven belts are joined by malleable belt fasteners of the Harris type, the fasteners are frequently pulled through the ends of the belt. The edges too, are considerably frayed by the friction of the belt fork.

Ply belting suffers from the rubber or balata breaking away inside, and becomes almost like two belts, one working above the other.

These disadvantages have been overcome by the "Fenatex" type of rubberised belting. Fig. 190.

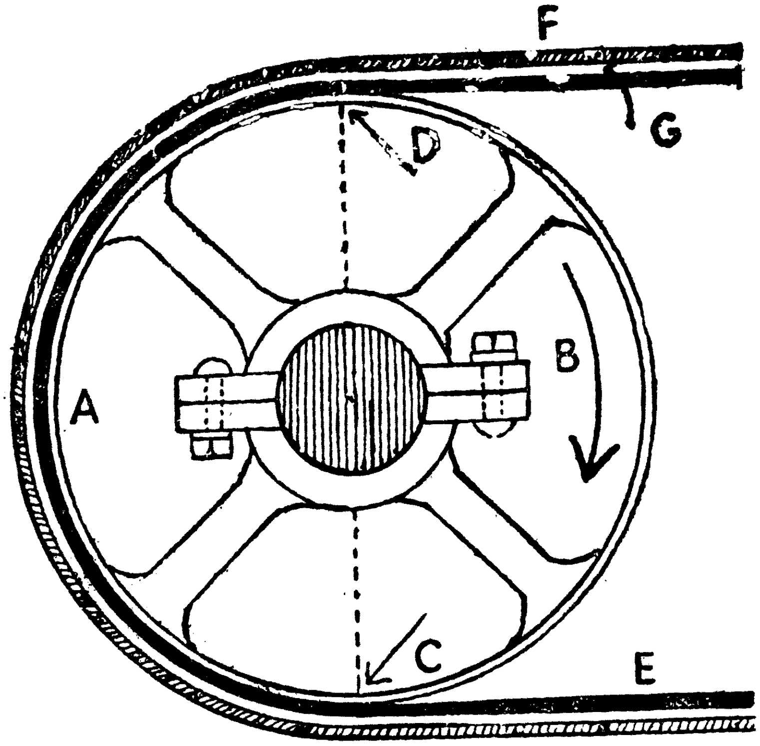

Fig. 190.
"Fenatex" Driving Belt.

Five Special Points.—The advantages of this kind of belting may be set forth as follows:—

(1) The driving face of the belt is woven so it will contract without forming prominent ridges when passing over the pulleys. Small spaces are left which form pockets, and the number of them working out at 25 to the square inch.

These pockets act as vacuum cups when passing over the pulleys, and increase the gripping power of the belt.

(2) The inner pitch line fabric is closely woven, and is the strongest section of the structure. This place in the belt is the "neutral axis," and it is here where the belt expands and contracts the least. The dense fibre structure at this place holds the fastener firmly.

(3) The outer layer of the belt is the most flexible of the three, and of the fourth in a standard $6\frac{1}{2}$ m/m. construction. It is here that the most expansion of the belt takes place.

It has been estimated that when the belt is $6\frac{1}{2}$ m/m. thick, and passes over a 4-inch diameter pulley, that the working face contracts seven per cent., and the outer surface expands five per cent. "Fenatex" belting is correctly designed to withstand the stresses set up by this expansion and contraction.

(4) Both edges of the belt are woven with a double selvedge to withstand the continuous friction of the belt fork.

(5) The belting is solidly woven by special and heavy machinery, and is converted into a homogeneous but flexible whole by the application of patented "Z" rubber impregnation, which imparts strength and durability.

The rubberising makes the belting impervious to atmospheric conditions, but it must be kept reasonably free from mineral oil, as this is injurious to rubber.

During hot weather, or in hot climates, a small quantity of castor oil will keep the belt face in good condition. When employed in a dusty or fluffy atmosphere, the accumulation of dirt on the belt, may be got rid of by the simple agency of soap and water. "Fenatex" beltings have no joinings, are virtually stretchless, and may be obtained in various thicknesses, and up to 1,000 feet in length.

Demonstration.—Fig. 190 gives a good idea of how the belt meets the three-fold requirements explained. The pulley A turns in the direction of the arrow B. At C, the belt comes in contact with the pulley, and is forced into a concave position until nearing its departure from the pulley at D.

The black line of the belt at E indicates the working face which contracts 7 per cent. when passing over the pulley. The central white line G is the "neutral axis" where the belt varies the least. The outer shaded part F is the one that expands 5 per cent.

SHUTTLES.

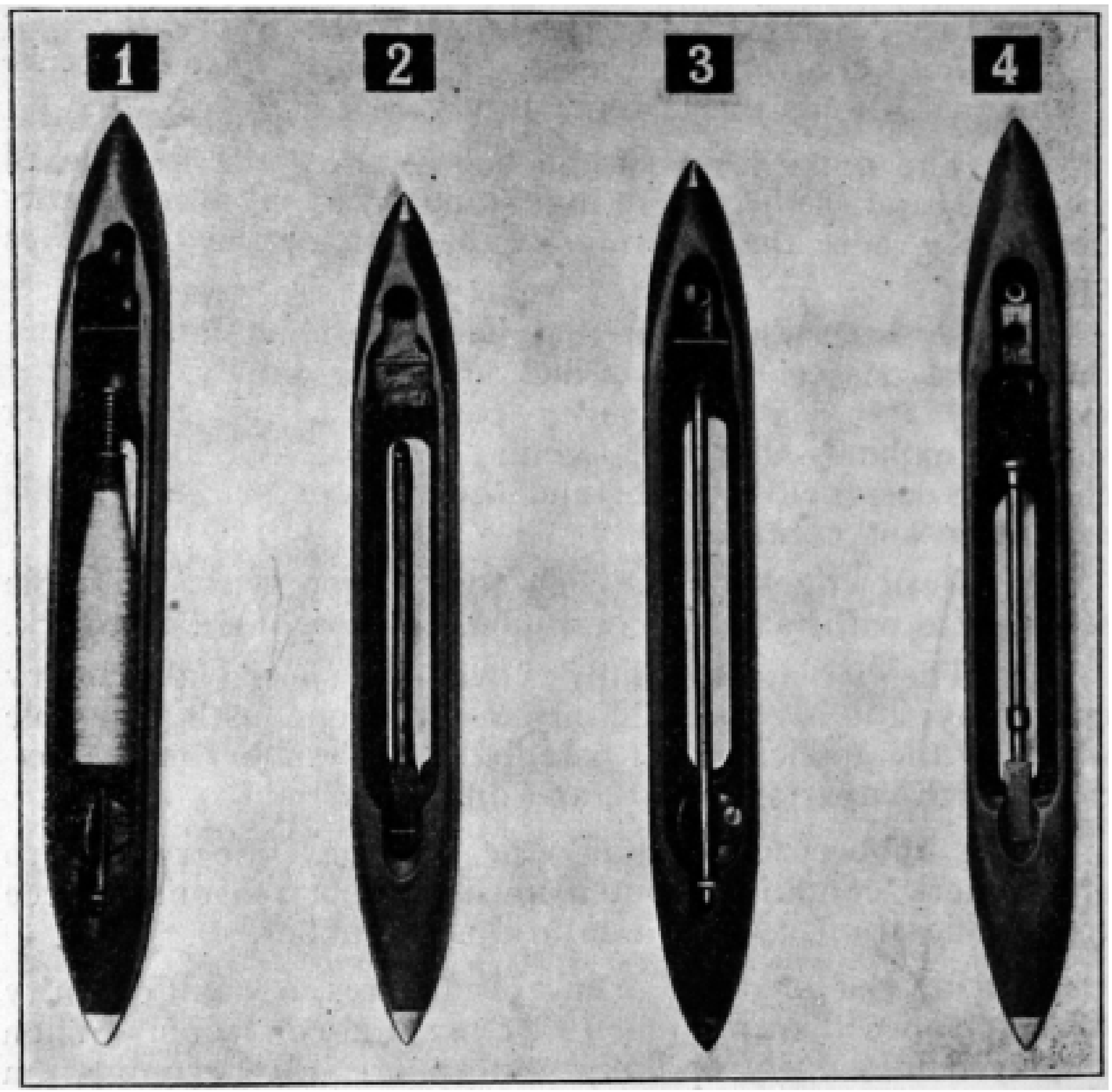

Fig. 191.

Types of Shuttles.

1. Clip Spring Woollen Shuttle.
2. Worsted Shuttle with Fast Spindle.
3. Box Loom Woollen Shuttle with Clip Spring.
4. Box or Plain Loom Woollen Shuttle with Block and Loose Spindle for Worsted Weft.

Since John Kay placed his "fly shuttle" on the market in the year 1753, great strides have been made in shuttle making. Now, there are shuttles constructed to suit every section of the textile trade—from the coarsest sacking to the finest silk. The outward shape is much the same for all, but the size varies considerably, and the internal fittings are a revelation of manifold ingenuity.

Progressive Stages.—Before the advent of the "fly shuttle," the average weaving per minute was 20 picks, and for wide widths, two persons were required to weave the cloth.

By Kay's invention, 40 picks were attained, and only one person required for a cloth of wide width as for a narrow one. Even during the past 60 years enormous strides have been made in cloth manufacturing. Sixty years ago, hand loom weaving was pretty general, but this gradually died out, and was succeeded by the factory system and power looms. In the old type of top swing loom like Pearson and Spurr's, the shuttles ran on wheels at not more than 60 picks per minute. The latest development for a narrow width cotton loom with a reed space of 40 inches, the shuttle makes 230 picks per minute, and the shuttle is changed automatically without stopping the loom. This is the Platt-Toyodo loom.

Importance of Shuttles.—Though numerous ideas have been tried to dispense with the service of the shuttle, none so far have displaced it to any extent. The Gledhill shuttle-less loom is perhaps the most successful at the time of writing, at Bridge Mills, Holmfirth, Huddersfield.

The importance of the shuttle can be estimated from the following remarks. All the motions of the loom are built to serve it. The shed is made to make a passage for its flight, and the picking provides the power to propel it. The beating-up immediately follows after every run it makes, and the letting-off more scope for its services. The taking-up records the work accomplished, and the boxing motion adds a range of colours with which to beautify the fabric. On its flight depends the wages of the weaver, the profits of the master and the adornment of the wearer.

In a fabric made with as many picks as threads per inch, it is responsible for the building of half the woven cloth. No wonder then, that inventors have spent years of hard study to improve its structure, and that new ideas have had to be adopted for new types of weft yarns, and modifications made for new types of looms.

Wood for Shuttles.—As shuttles are subject to hard usage and considerable buffeting, it is a vital necessity that they be composed of strong and reliable material. Shuttles are made from woods that are fine in grain, hard in structure, and capable of taking a very smooth polish. Whatever kind of wood is used has to be well seasoned.

Boxwood is the ideal kind for shuttle making, but owing to its scarcity and high cost, it is almost unknown in the factories. Its dry weight ranges from 52 to 72 lbs per cubic foot, and the grain is extremely close and dense.

An excellent substitute is found in cornel wood which is fine in grain, and capable of withstanding the rigours of the weaving process. What knots it possesses are very small, and, as a rule, the grain is fairly straight. The straightness of grain is what an overlooker values in a shuttle as there is little danger of splitting. Its dry weight per cubic foot is 47 to 50½ lbs., and varies less than boxwood.

Another kind which is cheaper still is persimmon wood. This is dark in colour, coarser in grain, and lighter in weight than cornel, and much more liable to split owing to the grain being more across. Only in rare cases do persimmon shuttles wear as long or as well as cornel shuttles. The dry weight of persimmon wood is from 45 to 53 lbs. per cubic foot. Another species of wood which is an improvement on persimmon, is stone wood, its chief advantage being its greater density. It is very fine in grain, and the dry weight per cubic foot is from 47½ to 58 lbs. It is lighter in average weight than boxwood, but more variable than cornel. If more was grown, it would be a greater rival to persimmon than it is at present.

Proportions.—The size of a shuttle is determined by the kind of material to be woven, the length of the pirn or bobbin to be used, and the make of loom. The longer the bobbin upon which the weft is wound, and the longer must be the shuttle; the wider the loom and the heavier and bulkier the shuttle. The greatest contrast both in the material woven and the size of the shuttle is that between silk and sacking.

Shuttles are made hollow in the centre to allow the cop or bobbin to be placed inside. This implies that a large part of the solid block of wood out of which the shuttle is made is cut away by an ingenious series of machines, and recourse is then made to insert a couple of rivets through the weakest parts to strengthen them.

Fig. 191. *Shuttle* 1.—This is a woollen shuttle with a clip spring for the weft bobbin. The clip spring is a capital idea for the holding of the loose spindle, and very few shuttle traps are made by this arrangement. Even if the open spiral spring breaks, which applies pressure to the movable flap, the spindle almost invariably remains level in the shuttle. If the spring be broken, the weaver instantly knows when taking out or putting in the spindle.

The lower part of the spindle block is held by two pins—one towards either end, and the lip on the opposite side to the movable flap is held by a screw. In shuttle repairing, it is a good plan to unscrew the screw and test the block for firmness. When the holding pins are worn, too much pressure is placed upon the screw. A further point is this. After considerable wearing, the depth of the shuttle is reduced, and as the bottom wears most, the spring block may become too prominent and require taking out and filing. In most shuttles, the block is still wearable when the shuttle is done.

The movable flap of the block is pivoted on a riveted pin towards the base of the block, and on the upper part of its under side is a circular projection, and on this, the upper part of an open spiral spring finds lodgment, and exerts pressure on the flap.

The spindle has two grooves, one being at the top, and the other underneath. These rest on pins which pass through the shuttle. When the spindle is being inserted, the upper groove is placed on the back pin, and the spindle forced downward. This presses the movable flap outward, and as the spindle comes to rest, the spring pushes the flap forward, and holds the spindle in its weaving position. The inner part of the flap and stationary block conform to the shape of the spindle, Waddingon's Patent, Little Horton, Bradford.

In the example given, a 7-inch spindle is being used for a 6-inch bobbin. The difference between the two lengths is spanned by an open spiral spring with a washer at the bottom to prevent damage to the bobbin. This is a very simple but effective remedy for weft sloughing, for the spring responds to the bump of the shuttle against the picker, and so eases the coils of weft.

Shuttle 2.—This is for the weaving of worsted fabrics. The spindle is held in position by a pin passing through it well towards the end of the block. The bobbin is held on by a small brazened on head, and a highly tempered flat spring underneath which is about the length of the bobbin. The spring is curved, and given a small amount of liberty to respond to the contraction of its curve by the pressure of the bobbin. The flat curved spring is a great improvement to the curved tongue, as it prevents bobbin splitting. The under side of the spindle is **V**-shaped, and when lowered to its weaving position, rests on a **V**-shaped block held by one of the shuttle pins. It is of value to have **V**-blocks made for repairing purposes that are a little higher in the **V** from the bottom, so that no packing of the **V** is necessary when the under side of the spindle is worn.

A good worsted yarn brush is passed through the bottom of the shuttle for the braking and control of the weft. Whilst this has to be reduced for single twist weft, it has to be at its maximum for fine twofold worsted. This brush is near the pot eye of the shuttle, and a small pin passes through the top part of the shuttle midway between the eye and the head of the spindle to confine the weft to the shuttle. The spindle is held down by the pressure of a curved spring at the back and under side of the spindle block. A groove passes along the centre front of the shuttle as a safe resting place for the weft when the shuttle enters the box. It is seldom this weft groove needs attention, but it may need deepening in shuttles that wear a long time.

The shuttle tips are made of very hard metal, and the shaft of it is grooved in three places to assist in holding it firmly in the shuttle. After a block of wood has been cut to the shape required for the making of a shuttle, it is then bored at either end just a little deeper than the length of the shaft of the tip, and a little less than the thickness of the shaft. A circular cut is then made round the hole for the reception of a spring, and the tip is then pressed home.

Shuttle 3.—This also is a clip spring shuttle for the weaving of woollens, but differs from Shuttle 1 as it is a box loom shuttle. The interior is practically the same, but the top front of it has small extra pot eyes for the braking of fine twisted weft which is often used for checking purposes. The chief thing is the bottom shape of the shuttle front, for instead of this being flat with the exception of the weft groove, it is cut away to conform to the turned up front of the box shelves in one make of Hattersley box looms.

Shuttle 4.—This is a woollen shuttle extensively used for the Dobcross looms. In this case the spindle is removable, and is inserted in a spindle block. Like the worsted shuttle shown, it is held in its weaving position by the pressure of a highly tempered curved spring at the back and bottom of the block. The spindle block is made to swing on a shuttle pin, and on its under side is cut out so as to repose on another pin.

The spindle is constructed with a flat end to pass underneath the pin that holds the block, and also has a groove on its under side to fit on to the front pin.

An advantage of this shuttle is, that the spindle can be changed to one that is suitable for the weaving of worsted weft. This spindle is shown in the illustration. It is made with two collars to fit the larger interior diameter of worsted bobbins. There are three pot eyes, for there is the ordinary one at the side, but another passes through the bottom of the shuttle as shown, whilst a third is made to slant at an angle of 45 degrees to take the weft when passed through the bottom eye. This arrangement is specially useful for hard twisted weft.

Shuttles for Rayon and Crepe Yarns.

For rayon and crepe yarns, the interior of the shuttles are different to those used for woollen, worsted and cotton. Excessive ballooning and overrunning due to the smoothness of rayon has to be checked, and the tendency to snarl in crepe yarns has to be overcome.

Fig. 192 gives a group of five shuttles, each being fitted up in different ways.

Fig. 1 is fur lined to brake and curtail the ballooning of the weft. It is fur lined mostly at the back, for at the shuttle front is an oblong opening $1\frac{3}{8}$ inches long and $\frac{3}{8}$ inch deep for the use of a weft feeler motion. The paper pirn is well grooved for the holding of the weft, and is also slotted at the front for the weft feeler to penetrate. It has a small slot at the base to pass on to a projecting pin on the spindle, and also a small hole for another pin on a movable part of the spindle to pass through and hold it securely. The movable part of the spindle works in a long slot in the spindle, and when lowered, its under side comes in contact with the head of a one legged elevator, the leg passing through the bottom of the shuttle. When the spindle becomes too low, the elevator is punched out, and a tin washer placed on the leg to elevate the head. Towards the eye of the shuttle, it is tunnelled, and has a narrow slit at the top for weft threading.

A small hole is bored through the back of the shuttle, and a suitable yarn brush is inserted, and is made to pass through the eye of the shuttle to check the weft. The porcelain eye of the shuttle is placed at an obtuse angle to ease the drag on the length of the shuttle, and increase the short one, so as to equalise the pull on the weft.

Fig. 2. In this shuttle, the movable part of the spindle has five spikes on its upper surface. When pressed by the elevator, these spikes rise up and hold the pirn from the inside. Like No. 1, it may be fur lined, but it is shown fitted specially for the weaving of crepe twisted yarns. To prevent snarls, and curtail ballooning, a piece of pliable washleather $4\frac{1}{2}$ inches long, and $3\frac{1}{2}$ inches wide is glued to the inner sides of the shuttle, the sides of the shuttle being shaped to suit it. The washleather passes over two strands

of thick elastic which are held at the eye end of the shuttle by a porcelain eye in the shuttle tunnel. At the opposite end, the shuttle top is grooved to let the elastic sink in, and the strands are then pegged down beyond the spindle block.

The large circular hole is for the use of a yarn brush made from combed top. The eye of the shuttle which allows the weft to pass out is at right angles to the length of the shuttle.

Fig. 3 is a Continental type of shuttle. It is $1\frac{1}{2}$ inches longer than the two previous examples, is slightly less in depth, and about the same width. For weaving, it is lined with fur, but the spindle is shown better without it. As will be seen, the spindle is divided from block to summit, and this exerts spring pressure to the inside of the pirn. The base of the spindle is spirally grooved, one edge of it being left prominent for holding. The weft exit of the shuttle is hollow, the openings at either side being $1\frac{3}{4}$ inches long, and is approached by a small porcelain eye centrally placed. No brush is needed in this part, for the weft is controlled by the internal arrangement.

On the left, and nearest the head of the spindle is a screw which is finely threaded, and bored through for the threading of a piece of elastic. The elastic is passed through the back loop of the weft brake which is held by a second and larger screw. The weft brake has four loops, one, or more, or all can be used, the more giving the greater drag on the weft.

The weft is threaded through the number of loops required by being pressed to the front of the shuttle by the finger, and then when let go, the elastic draws it back. It will be observed in the illustration there are five pin holes which form a high angle. These pins fit to the right of the loops in the weft brake, and thus make the weft zig-zag to the outlet. Two additional pins guide the weft to its exit. In this way, the weft is sensitively tensioned.

The shuttle is constructed for the weft to traverse the outer length of the shuttle, but also to pass over the top of the shuttle if desired, and so prevent the weft being soiled by the box side. When the spindle is in its weaving position, it is held down by the pressure of an open spiral spring at the back end of the spindle block.

Fig. 4 has the same hollow tube with spikes as Fig. 2. The spindle in this case is prevented from moving from side to side when weaving, by passing between a three sided plate, which is pinned near the bottom of the shuttle.

The back end of the spiked part is made with a flat plate, and on its under side, upward pressure is applied by a small open spiral spring which is lodged in a hole in the spindle block. This spring exerts a responsive pressure to the holding requirements of the pirn. The spindle is held down by the pressure of an open spiral spring encased in a tube,

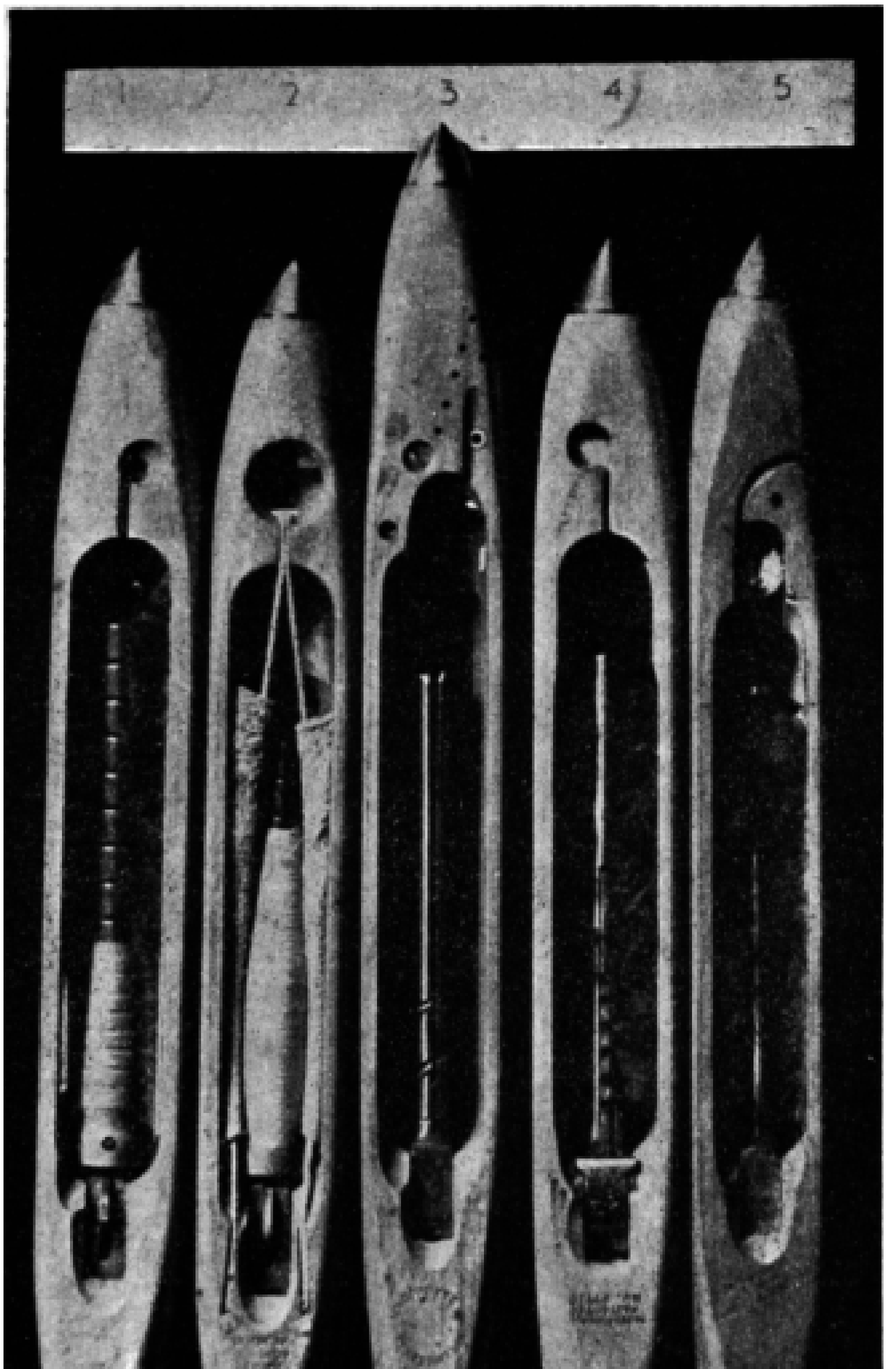

Fig. 192.

English and Continental Shuttles.

the tube being in contact with the back end of the spindle block. The interior of the shuttle is lined with fur, and the eye is at an obtuse angle to equalise weft brakage.

Fig. 5 is specially constructed to weave silk or rayon, and to abolish the health destroying habit of "shuttle kissing." The spindle has a curved, flat spring at the top, which is brazed to the head of the spindle. A spiral twist of metal near the block contributes holding pressure to the pirn.

The spindle is held for weaving by a curved spring exerting pressure on the under side of the block.

As usual, the shuttle is fur lined, and a small yarn brush is threaded through either side of the shuttle to direct the weft centrally to the tunnel. As will be seen, the shuttle is cut in a curve for threading, and a pin passing downward, acts as a guide to the weft.

The special part is a brass plate, which has a circular nipple on the inside. The nipple is hollow, and threaded inside. It is made use of by a screw which enters it from the opposite side of the shuttle.

On the shaft of the screw, a spring washer is placed, which exerts pressure against the head of the screw, and keeps screw and plate secure.

The plate conforms to the contour of the shuttle, and a space is left between the inner side of the plate, and the wood of the shuttle.

A forward and backward move of the hand is all that is required for threading the shuttle.

A leg on the plate on one side, and a pin on the other, directs the weft according to shuttle traverse.

In every one of the shuttles here presented, smoothness, equality of drag, and cleanliness of weft are a trio of requirements that must be attained and maintained for the production of smart and saleable cloth.

Selection of Shuttles.

When new shuttles are needed for a loom, several points have to be considered to secure the best all round results. Though shuttles are of the same make, they are not all the same weight. This difference is largely due to the varying density of the wood even in the same tree.

Weight of Shuttles.—The influence of weight is such that a heavier shuttle travels at a greater velocity than a lighter one, and the amount of checking that would do for one, will not do for both. This is more pronounced in box looms than in plain looms. It therefore follows that a careless selection means increased work for the overlooker and less production by the weaver.

To have well matched pairs or groups, every one should be weighed on a spring balance, and the weight in ounces recorded on the shuttle. Those nearest in weight may then be grouped together. Judging shuttles by lifting them with the hand will give approximate results, but a spring balance ensures accuracy. The weights of shuttles used for the woollen and worsted industry are here appended.

WOOLLENS.

Hattersley plain looms	...	17 to 19 oz. each.
Dobcross plain looms	...	17 to 19 ,, ,,
Dobcross box looms	...	19 to 21 ,, ,,
Hattersley box looms	...	19 to 21 ,, ,,

WORSTED.

Hattersley plain looms	...	17 to 19 ,, ,,
Dobcross box looms	...	19 to 21 ,, ,,

It will be seen from these particulars that there is an average difference of 2 ounces in the same make of shuttles, but those two ounces make all the difference between good and bad working.

Grain.—Whilst grain affects the weight, it also influences the wearing. A fine grained shuttle will wear much longer than one of coarse grain, and in time this would make a difference in the movement of the stop rod tongue. The fine grained one may cause no trouble, but the other with being less, would cause the loom to keep banging off. This can only be remedied in using the same shuttles, by filing the bigger one down to the size of the smaller one, and then adjusting the boxes.

Size.—The same make of shuttles are not all the same size, but the difference is easily detected by the use of a pair of inside calipers. The more exact the shuttles are in this respect, and the more efficiently they run into the boxes, and give a uniform lift to the stop rod tongue.

To sum up the process of selection, first weigh a dozen or more separately on the spring balance, and record the weight on each. Examine the backs of the shuttles of the same weight for grain, taking those out approaching similarity. Cross grained shuttles when possible, should be reserved for the weaving of the plainest work. Measure for size, and pair them as accurately as possible. Time spent in selection is amply repaid.

Steeping in Oil.—Some shuttle makers send new shuttles to the factory in a perfectly dry state, and when they are put into store, they should be kept dry and cool. When new shuttles have been selected, they may be improved by being rubbed over with oil a few times and left to dry, for this prevents cracking.

The best results are obtained by rubbing them instead of steeping them in oil, for steeping them has a tendency to swell the wood and slacken the shuttle tips.

The process of rubbing them has to be repeated for several days for the oil to penetrate, and the surplus oil can be run off into the oil can when the shuttles are suspended for drying.

Brake Brush.—When smooth yarns are woven such as worsted, a brake brush is placed in the shuttle as shown in shuttles 2 and 4. The brushes must exercise the same amount of restraint on the weft, for if one be slacker than the other, it will show in the selvedge by one part being drawn in more than the other. The amount of brake is tested by pulling the weft quickly through the eye of the shuttle, alternate pulls giving the impression if one be stronger than the other. The finer the weft in twofold yarns, and the keener the brush must be.

Loom Adjustments.

Plain Looms.—In a plain loom, the preparation for putting a pair of new shuttles on the loom is carried out as follows. The power of the box swell finger is first removed, and the going part brought forward until the stop rod tongue is almost in contact with the cut on the frog. The wooden shuttle guide E at the top front of the box is raised, and the box end unloosed. The box front D, Fig. 193 may now be liberated, and then set by its setscrews so that it is a little wider at the inner end than the outer one. The height of the stop rod tongue above the frog should not be less than $\frac{3}{16}$th inch. The special point to be aimed at is to make the slope of the inner box side be at the same angle as the shuttle front when fully in the box. It may lean back at the top as at A, or lean forward at the top as at B, but if weft cutting is to be avoided, and the shuttles made to wear well, the angle C will have to be obtained. If the box front leans back as at D, the feet of the box may be packed with tapering cardboard of sufficient thickness at the front. The exact fitting can be seen by looking through the opening between the shuttle and the box side, the shuttle being at F.

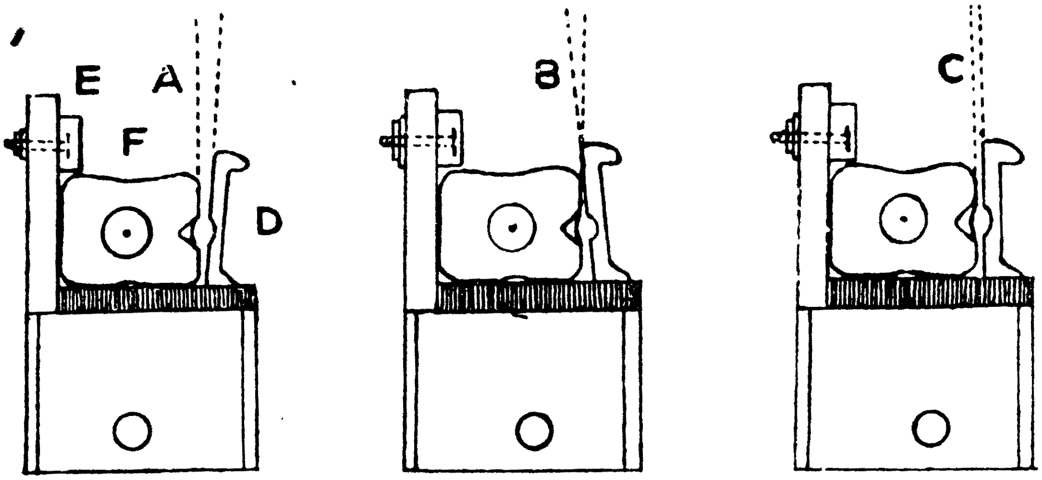

Fig. 193.
Fixing Box Front in Plain Loom.

If the box leans forward as at B, then the packing will be put in at the back. One might get the impression that to file the feet of the box would be to make a permanent job of the business. Unfortunately the bevels of one group of shuttles may be different to the next, and the time spent in fitting is wasted.

If a shuttle is to keep its proper course from box to box, the back of it must be kept in contact with the reed, for the reed provides half its support.

Shuttles are supposed to be made at a particular bevel to suit a certain make of loom, but are not always correct. When not suitable, it is not the shuttle that is altered, but the loom. This is outlined in Fig. 194.

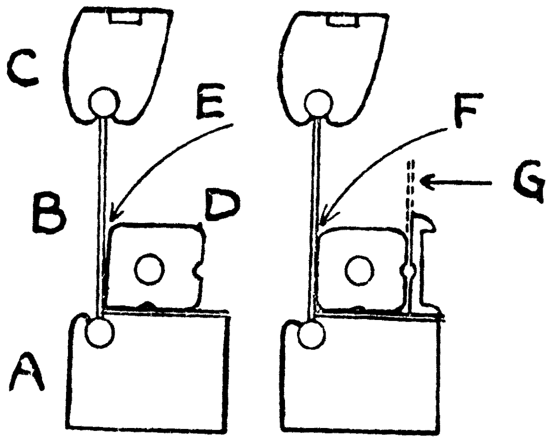

Fig. 194. Fitting Sley to Shuttles.

A is the going part; B the reed; C handrail; D shuttle.

As indicated by arrow E, there is a gap between the top of the shuttle back and reed. The shuttle only contacts with reed at its back bottom. When like this and the finger is applied to the front top of shuttle, it will tilt back, and therefore cannot possibly run steady through the shed. As the shuttle race moves downward with the crank going to its back centre, the shuttle tilts over against the reed, and is then only running on the back part of the bottom. When the going part comes forward, it tilts back, and assumes the position as in the drawing. To make the reed correct, the handrail C is packed with leather, between handrail and sword top to the required thickness.

The other way in which the shuttle fits badly against the reed is when it is off the reed at its back bottom, and to make this correct, the handrail has to be cut to make it lean further back, or the lay itself can be packed where it is bolted to the sword. For good running the shuttle should be as at F, and its front parallel with the inner box front as at G.

Box Loom.—When new shuttles are placed on box looms, the proceedings are different to that for a plain loom. In the Dobcross and the Hodgson looms as well as the Hattersley Standard loom, the box swells which are at the front have to be taken out and the bend in them reduced by hammering. In the Hodgson loom with the box swells at the back, the same thing has to be done.

In the Hattersley box looms with the shelves turned up at the front, the three rods holding the shelves have to be slackened out, and the top shelf then set a little wider at the inner end than the outer one, and without any binding action on the shuttle. Having got one box correct, the others may be set to the same dimensions by means of a pair of inside calipers. The whole is then braced up by the three nuts, and the opposite box then set the same way. The shuttles used for these kind of boxes are those at No. 3, Fig. 191.

Delivery of Shuttle.—The delivery of a shuttle is the same in all kinds of looms, whether " box " or " plain," or a " circular." The picker spindle is so adjusted as to lift the shuttle $\frac{3}{16}$th inch from the shuttle race, and the same distance away from the box back. The elevation of the shuttle is shown at Fig. 195. It will be observed that the picker is at the inner end of its traverse. This is called the

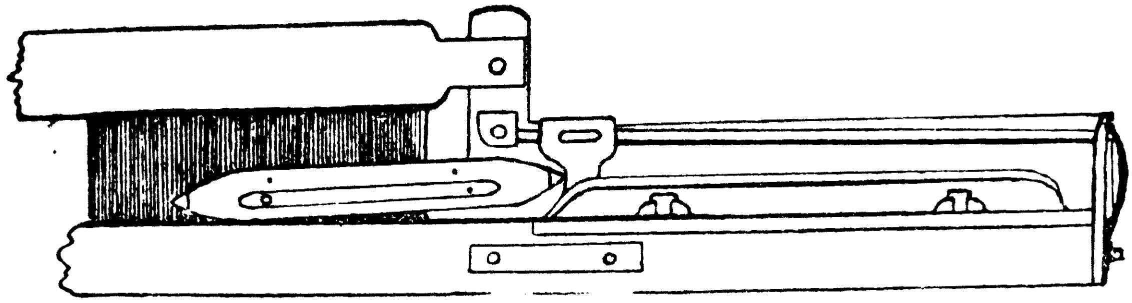

Fig. 195.
The " Up " Delivery of Shuttle.

" up " movement. In Fig. 196 is given the " off " movement. The first presses the shuttle downward on the shuttle race

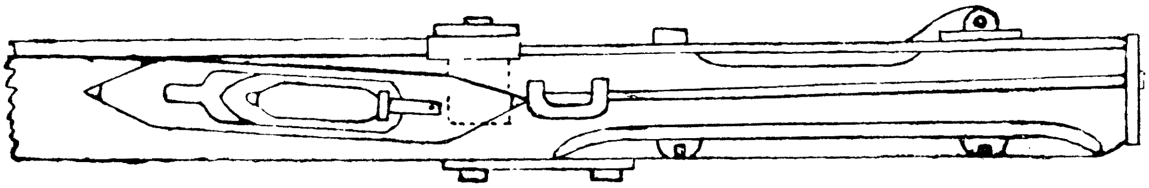

Fig. 196.
The " Off " Delivery of Shuttle.

by being elevated at the back, and the second presses the leading end against the sley by being pulled off the shuttle back.

If the spindle bracket in a plain loom does not give it, then it should be made to do before the loom is allowed to weave. In a box loom like the Hattersley type, there is a picker slide at the front which is used to elevate the picker.

In the Hattersley Standard Loom, the slide is at the back, but whatever be the type of loom, the same double move is demanded. For the weaving of rayon, the distance of the double pull is decreased to $\frac{1}{16}$ inch.

Flight of Shuttle.—In Hattersley looms, the shuttle begins to leave the box when the crank is at its bottom centre as at B, Fig. 197, and must reach the opposite box by the time the top centre of crank traverse has been reached as at E.

For more than half the traverse of the shuttle, the sley is travelling backward from B to C, and for the remainder of the journey, it is moving from D to E, the movement of the going part being indicated by arrows at either side, and commencing from the fell of the cloth on the right of the drawing.

The following pick is demonstrated in the lower section, with the picking taking place from the left hand. The going part commences from the fell of the cloth again at G, and the picking begins at H. The flight of the shuttle as the sley moves backward is shown at I, and as it moves forward at J.

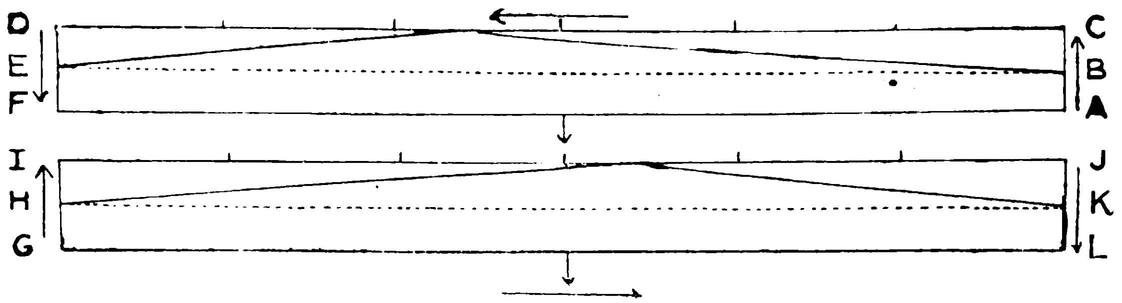

Fig. 197.
Flight of Shuttle.

At K it has fully entered the opposite box, and at L, the reed is again at the fell of the cloth. The two picks are thus completed.

The shuttle is kept in its course by the way the shuttle is thrown; by the top part of the shed at the entrance and exit; by the running board at the bottom, and the sley at the back.

The Angles.—Another factor is the angle formed by the shuttle race and sley. This is not a right angle. When the loom is at its front centre, the running board has a gentle slope downward of $\frac{1}{16}$th of an inch, and the swords which hold the lay or going part are perpendicular. To reach the back centre, the swords and running board describe the arc of a circle, and on reaching the termination of the downward curve, the angle has increased to $\frac{13}{16}$th inch. The angle gradually increases as the going part recedes, and decreases as the lay moves forward, which fairly coincides with the varying speed of the shuttle.

Speed of Shuttle.—The greatest velocity is attained in the first half of the flight, for if the running board be divided into six equal parts as shown at the top of the two sectional drawings in Fig. 197 the shuttle will at least have traversed $3\frac{1}{2}$ of them by the time the back centre has been reached.

The top diagram illustrates the flight from right to left, and the bottom one from left to right.

The speed of the shuttle is governed by the width of the loom, and the revolutions of the crank per minute. To take two typical examples: A Hattersley plain loom with a reed space of 85 inches gives a traverse to the shuttle of 98 inches. As the loom gives 125 picks per minute, the actual distance is:—

98 × 125 = 12,250 inches or 340 yards per minute.

In the Dobcross plain loom with a 91-inch reed space, the shuttle travels 104 inches, and as the loom speed is 100 picks per minute, then, 104 × 100 = 10,400 inches, or 289 yards per minute. In actual time, however, it is traversed in half the time stated, for the shuttle completes its flight in half, or a fraction over half a revolution of the crank.

In box looms, the arrival of the shuttle in the opposite box has to be a little sooner than in a plain loom, for in the latter, the check strap is stationary, but in the drop box it is a running check. To secure a good check in the box loom, the shuttle ought to be well in the box by the time the crank is between its back and top centre.

Wearing of Shuttles.—By the shuttle being given the "up and off" movement, it is worn in time by the sley and shuttle board until the back and bottom, which were slightly hollow at the commencement, have both a pronounced curve downward when a straight edge is applied.

The back and front are also still further reduced by the shuttle having to force back the box swell, and lift up the stop rod tongue. When the downward curving at the back and bottom becomes prominent, the shuttle runs a very erratic course through the shed, and either breaks the warp threads, or makes a cracking noise when it enters the box, or flies out of the loom. This is remedied by filing the back and bottom until the respective sides are slightly hollow, the proper pitch being obtained by the frequent application of a straight edge. If a fair amount has been filed off, then the boxes must be reset to suit the decreased bulk. Only in very rare cases has the shuttle front to be filed, though its groove has occasionally to be deepened. The wearing marks on a shuttle to an overlooker of experience are mute eloquence of the way it is running.

If ridges appear on its back, it is a good indication that the crank arms are slack, and if chafing marks appear in front of the shuttle eye of a right hand shuttle, it is failing to pick straight from the right hand side. If worn underneath at one end, the end worn clearly points to the box bottom not being level, but is above the shuttle race at that side where the worn end first enters the box. If the top part of the shuttle is being rubbed off, either the spindle bracket or the buffer is too low in a plain loom, and rubs is as it is being delivered by the picker. When marks are worn inside the shuttle opposite the spindle head, the block or clip is giving too much freedom to the spindle.

Fixing Loose Tips.—The most difficult thing to repair in a shuttle is a loose tip. The best idea is to find a tip of the same make with a slightly larger shaft, as this will exert a uniform pressure inside the bore of the shuttle when inserted. It could be damped with salts of lemon before being put in, as this will help to rust it fast. But if a tip with a larger shaft cannot be found, the same tip may be made servicable by first inserting two small pieces of tapered cane, tapering both in thickness and width, the thickest and widest part being placed in the bottom of the recess, the two pieces being placed opposite each other.

The recess should be smeared with liquid glue before inserting the cane. The tip is then gently tapped in with a hammer, any holding indicating that the packing is too thick.

The glue should have time to set before the shuttle is used, and the tip end and edge examined before being given to the weaver.

Life of Shuttles.—With ordinary wear, a pair of shuttles on a Hattersley loom, 85 inch reed space, and 125 picks per minute, should last on an average 15 months, though some have run 18 months and over.

In the Dobcross plain loom, the average wear is 18 months, the reed space being 90 inches and the speed 100 picks per minute.

In box looms, a group of shuttles may be safely reckoned at two years with good matching.

The coarser the materials woven, and the quicker the shuttles wear owing to increased friction. In oiling the blocks and spindles of shuttles, a few drops at a time is quite sufficient, for too much soaks into the wood, and loosens the shuttle tip.

PICKERS.

Pickers that are made from buffalo hide are of many shapes and sizes. They may be sent to the factory steeped and dried, and only require boring and trimming to be quite ready for the loom. As is to be expected, they cost more when so sent, so to reduce the cost, and possibly increase their service, they may be ordered in their first drying stage. Some pickers pass through 16 processes in the making.

Ordering.—To prevent any mistake in size and shape it is not without merit to send a sample picker with the order. Both in the making and reading of figures it is so easy to make a wrong impression, whereas a sample is unmistakable, and the checking is quickly accomplished. Some firms have as many as 200 dies for different styles of pickers.

The time for ordering should not be less than twelve months ahead of actual loom needs. The need is based upon the number of looms in use along with the average weekly wastage. What this amounts to per annum ought to be the approximate number of pickers in stock at the time a fresh order is given. This leads to no more stock for a mixed lot of looms than for one with all the same make of loom.

For vertical plain loom pickers, the chief measurements are the length of the leg; the length of leg and body to centre of spindle hole; the width of body; width of slot for strap.

If the leg be too short, the picker will be pulled out of the slot at the bottom of the box. If the spindle bracket be lowered to aid it, such a move might be detrimental to the delivery of the shuttle. On the other hand, if the body be too long, part of the bottom has to be cut away, and the picker is consequently weakened.

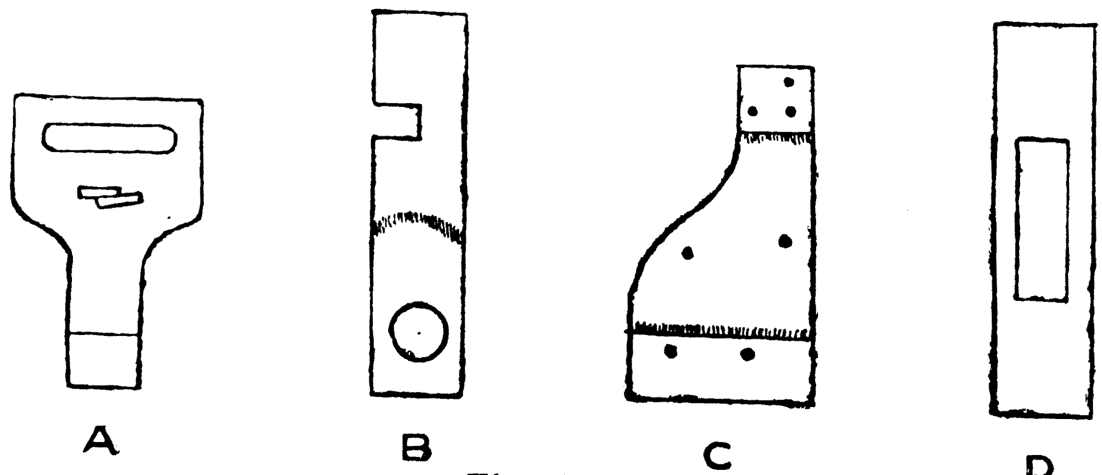

Fig. 198.
Styles of Pickers.

The standard size for a Hattersley plain loom, 81 inch reed space, is as follows:—Length from bottom of proper spindle hole to bottom of body $2\frac{1}{4}$ inches: length from same hole to bottom of leg 3 inches: total length $4\frac{1}{4}$ inches: width across front where picker strikes, 1 inch. The same care as is here detailed is required for every kind of buffalo picker, for in the process of seasoning they dry in a little. The shape of the Hattersley plain loom picker is given at A (Fig. 198).

Preparation.—When pickers are sent to the factory in the first drying stage, they are hung up in a cool and dry place to get rid of the moisture they contain, which is about 10 per cent. This moisture resists the inroad of the steeping oil. The pickers dry all the sooner and better when not overcrowded, and this process ought not to be less than a couple of months.

Steeping and Oil.—The steeping is the most effectively carried out when the strings of pickers are laid in the bottom of a moderately large tank, without overlapping. The oil then has the chance of getting to every part about equally, which is hardly the case when the strings are suspended. Three kinds of oil are used for steeping, these being sperm, Gallipoli, and neatsfoot, their respective merits being in the order given. Sperm is best, for being thinner in density. it penetrates quicker. A mere smearing on the outside is of no use whatever. The steeping should occupy not less than 12 months so as to give time for the oil to penetrate to the core. The usual heat in the factory prevents the fatty matter in most oils from coagulating in winter.

Pickers that have not been well steeped have the faults of wearing very rapidly, cracking, and making elongated spindle holes.

Second Drying.—After being well steeped, they are suspended over the tank to drain off the surplus oil. They may then be moved to a cool, dry place, and at the end of three months are in an excellent state to be made ready for the loom. Such steeping and drying gives resiliency to the picker which would otherwise be soon cut in pieces by the impact of the shuttle and its propulsion.

Preparation for Loom.—The spindle holes are only small when sent to the factory, and these have to be bored out to be suitable for the picker spindle. A spiral drill $^1/_{32}$ inch thicker than the spindle is excellent for the purpose as the bore is then straight, and gives the longest possible wearing along with freedom of action. Rivets or wires have to be made firm, and the whole of the picker then trimmed with a sharp knife so the weft cannot be caught upon it, nor the check strap or buckle injured.

,Every kind of picker can be prepared up to this point so as to be ready at a moment's notice for the loom. As the prepared stock diminishes, others are prepared to keep well up to demand.

Some manufacturers and overlookers prefer the black or brown raw hide pickers as they have not been subject to the liming process. It is safer, however, to have them limed to prevent any possibility of anthrax. The Lanacashire trade generally prefer round foot pickers for the plain loom make, but in Yorkshire the square foot is best.

Working Conditions.

When a new picker takes the place of an old one, there are several things which need adjustment in a plain loom. It is the usual thing to place the new picker on the spindle, and then push it to the outer end of the box. The shuttle is then held down in the box with one hand, while with the other the picker is bumped against the tip of the shuttle. Where the mark is made a shallow piece is gouged out for the shuttle tip to find its delivery place. On replacing the picker on the spindle, an examination is made of three things.

(1) *Screed or Shuttle Guide.*—At the top front of the box back is a screed or wooden shuttle guide. This has to be adjusted so the shuttle is prevented from rising up in the box, and is guided to the same place on the face of the picker. To achieve this purpose, it is fixed just clear of the back part of the shuttle top at the outer end, and the inner one is set a little higher owing to the upward slope of the picker spindle.

If the picker is to wear well, the shuttle tip must be made to come in contact with the centre of the picker face, and anything which hinders it from doing so should be modified to achieve it.

(2) *Tongue Lift.*—The going part is then drawn forward to see if sufficient lift is imparted to the stop rod tongue when the shuttle is fully in the box. The tongue ought to be lifted clear of the frog a good $\frac{1}{8}$ inch, for any excess above this is a waste of power and material. If the lift is found insufficient, the shuttle can be taken out of the box, and the crank turned forward until the tongue is in

contact with the frog. The box swell finger is then examined to see that it is in close contact with the head of the box swell. If not, it is unloosed, tapped forward, and then secured. If found correct, however, the shuttle box front is tapped in a little, for this increases the lift of the tongue, but on no account has the shuttle to bind in the box. It is much to be preferred to alter the box front when the picker is new than any time afterwards, for then, alteration forces the shuttle away from the naturally made hole in the picker, which may lead to the cutting of the weft. Should this occur, the picker may be gouged out a little on that side which is towards the back of the box.

(3) *Delivery of Shuttle.*—If the shuttle is to run well through the shed, it must have a particular delivery. This is, that when the picker is at the inner end of the box, and the shuttle tip is placed in the hole of it, the shuttle should be raised from the shuttle race $\frac{3}{16}$th inch, and be drawn away from the box back for the same distance. The spindle bracket is bored to give the " off " movement, and it is fixed to give the " up " movement. By securing such a delivery, the end of the shuttle which first enters the shed is pushed downward and inward, which coincides with the receding of the going part, and so promotes safe running. Figs. 195-196.

Stand of Stick.—When the picking stick is in its stationary position, it points over the end of the box when the crank is at its back centre. As the picking cone wears, it stands further out, and to make it begin to pick when the crank is at its bottom centre, the picking strap has to be tightened up. This is against a lengthy wearing of the picker, and it is therefore a better way to set the picking stick forward as before, or even a little ahead, by means of the brackets that hold the picking stick. The standing further out than the box end is justified when the picking nose is new, and the force generated by it is too strong.

If the strap is tight when the crank is at its front centre, or in the centre of its swing, or when the picker is against the buffer, all these are against the service of the picker, for any one of them may tear off the top part of it.

There is a further point. When plain loom pickers are constructed so they can be used either way for delivery of the shuttle, it is an advantage to place the hollow side of the picker at the front. The picking stick moves in the arc of a circle, and by placing the picker as stated, the greatest top strength of the picker is then opposed to the motion of the picking stick. So much is this an advantage, that whereas a share of looms required 13 new pickers per week on an average, it was brought down to three per week.

Buffer.—The buffer at the end of the picker spindle which is struck by the picker as it terminates its stroke ought to be made of the most springy leather that can be selected. The harder it is, and the more injury is done to the picker. If a loom goes at 140 picks per minute, then each picker is knocked against its buffer 70 times per minute when the loom is in motion.

Hattersley Box Loom Picker.

This is outlined at B (Fig. 198) and is constructed on an entirely different plan to the one previously explained. The picker runs horizontally instead of vertically, and the chief measurements are from the inner end of the spindle hole to the cut or groove shown on the under side of it,

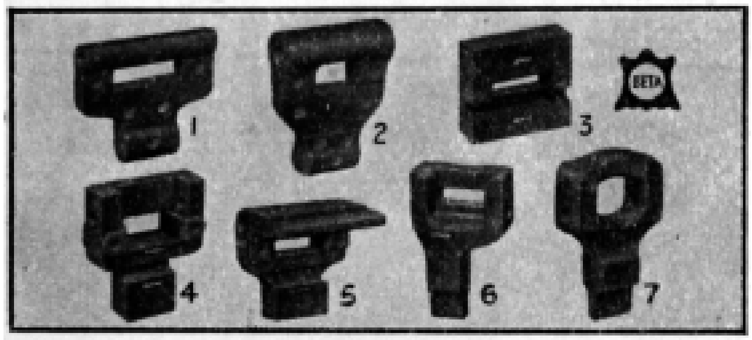

Fig. 199.
British Picker Co. Ltd.
Buffalo Pickers.
(1) Ruti Type Underpick; (2) Crompton and Knowles Underpick; (3) Small Silk Square Box; (4) Continental Loom; (5) Omita Loom; (6) Special "P" Shape; (7) Hattersley & White's Circular Box.

which is $1\frac{1}{8}$th inches. The groove in the picker is for it to work clear of the upturned box shelf. The other measurement is from the same part of the spindle hole to the end of the head which is $3\frac{1}{8}$th inches. The end of the head has to work clear of the box swell, or the picker may hold, and be too late in getting back for the changing of the boxes.

If the under side of it is not level, it will have to be rasped to make it so, for the under side runs on a slide, and if the picker is not level, the recurring friction wears it away and the delivery of the shuttle is adversely affected.

The under part of the picker head has to work clear of the outer end of the box shelf, and at the other end, must lift the shuttle clear of the box bottom by $\frac{3}{16}$th inch. This is obtained by the fixture of the slide. The pull away from the box back for the same distance is got by the outer spindle bracket being further in than the spindle bracket at the buffer end of the spindle. The head of the picker has also to have working clearance of the upper and lower bowls which are bolted to the outer box back, and against which the shuttle tips come in contact when the boxes change position.

Two leathers are attached to the picker. One is secured at the other end to the dolly stick, by which the picker is drawn back after picking by the pull of a strong closed spiral spring. It is better to have two springs, both of which are about equal to the pull of the stronger one. By this arrangement, if one spring breaks, the other can drag the picker back out of the way of the changing boxes, whereas if the only one breaks, it can cause a fair amount of damage.

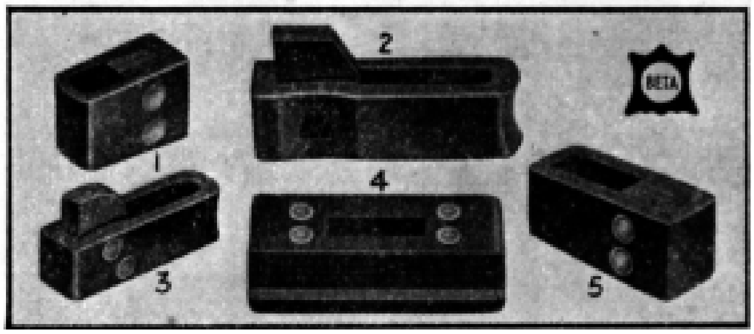

Fig. 200.
Charles Walker & Co. Ltd., Leather Pickers. (1) Northrop; (2) Large Underpick; (3) Small Diederich Underpick; (4) Ruti Underpick; (5) Large Northrop Underpick.

The other leather is the picking strap. This is adjusted so the shuttle begins to move out of the box when the crank is at its bottom centre. The standing place of the picking stick is usually a little in advance of the outer end of the box, but it is set to give the best working results.

Dobcross Pickers.

For the Dobcross box loom, the picker C (Fig. 198) is used for the older make of loom. It is put into position at the back of the box and runs in a long slot in the box framework. The "up" movement in the delivery of the shuttle is obtained by the box fork, which tilts the box a little higher at the outer end than the inner one. The "off" delivery is secured by the picker spindle at the inner end being a little nearer to the box than the outer end.

The picker is riveted in seven places, and the back one nearest to the picking stick is best placed ¾ inch from the outer edge so as to eventually save damage being done to

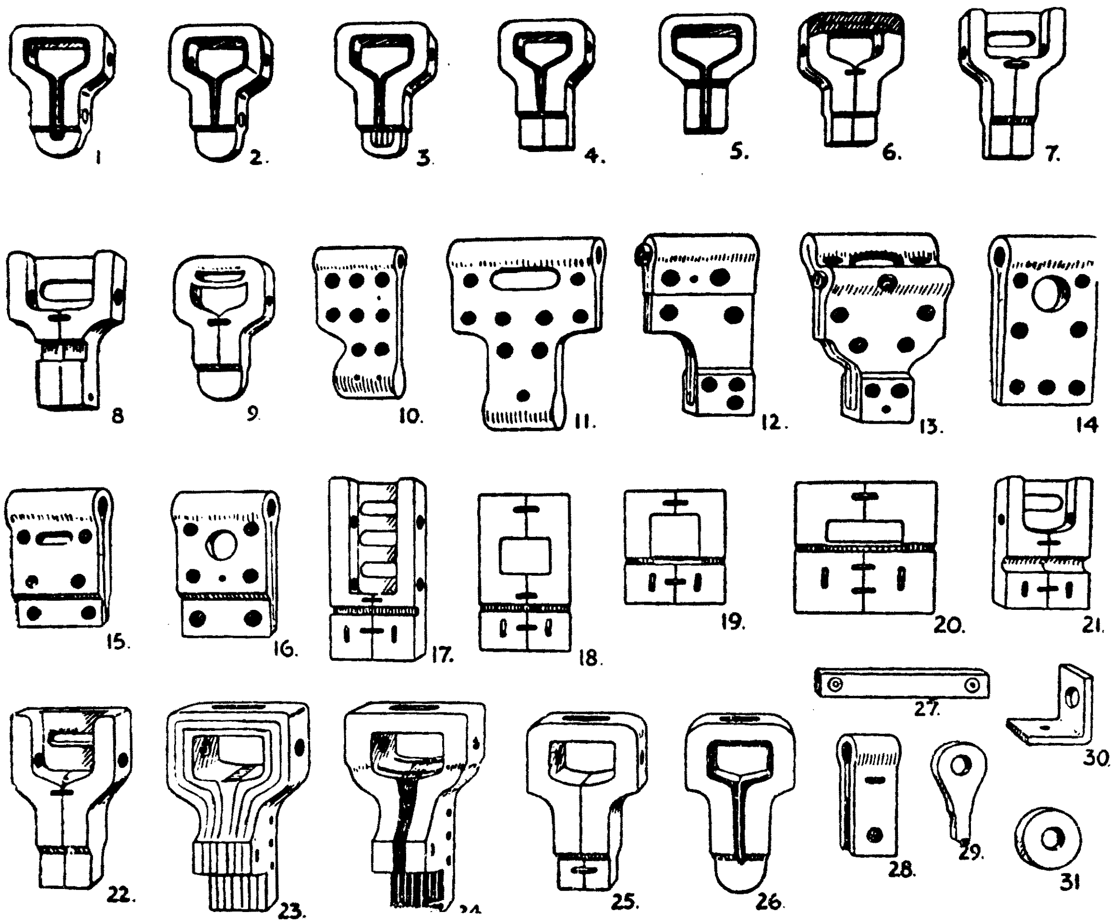

Fig. 201.
British Picker Co., Ltd. Buffalo Pickers and Buffers.

(1) Roundfoot; (2) Dixon Fold; (3) Open Foot; (4) Press Foot; (5) Small Folded Dropbox; (6) Helliwell Squarefoot, for Cotton Looms; (7) Hattersley or Sowden Scoop; (8) Hattersley or Sowden Dropbox; (9) Double Cap Roundfoot; (10) Coiled Yankee; (11) Reversible; (12) Dobcross; Hodgson; (13) Whip Pick; (14) Tapered Jute; (15) Centre Foot Jute; (16) Side Feather; (17) Three Slot Dropbox; (18) Solid Dropbox; (19) Small Square Silk Box; (20) Square Box; (21) One Spindle Dropbox; (22) Hattersley Scoop; (23) Open Side Top Swing; (24) Folded Top Swing; (25) Blanket Loom Squarefoot; (26) Blanket Loom Roundfoot; (27) Stick Bit; (28) Picker Protector; (29) Dobcross Picker Protector; (30) Buffalo Angle Piece; (31) Buffalo Washer.

the strip of buffalo on the picking stick. Before the picker is placed on the loom, all the rivets need to be bruised with the hammer to make the picker firm.

The picker for the whip-pick is a much larger and more costly buffalo picker. It is fitted with a slotted flap, the picking strap taking one slot, and the dolly strap the other.

For the Dobcross plain loom the picker D (Fig. 198) may be made of either leather or canvas. Leather pickers on an average wear three times longer than canvas, for when the loom is run at 100 picks per minute, the average wear is six weeks, but the canvas one is done in a fortnight. Canvas pickers give the best wearing results when stored in a damp place. Both kinds of pickers are made with a slot in the centre 1¾ inches long through which the picking stick passes. Before being placed on the stick, the inner corners of the slots are rounded off with a knife to prevent the picking stick wearing.

To place the picker in position on the stick, the screed or wooden shuttle guide is slackened at the inner end and made free at the other. The screed is then dropped, and the picker and stick moved to their forward limit. The stick is held forward with one hand while the shuttle is bumped against the picker with the other. The picker is now taken off the stick, and with a knife, a shallow hole is made the centre of which has to be a little above and a little towards the box front, to give the correct throw to the shuttle. The screed is then secured so the outer end is just clear of the shuttle top, but the opposite end is placed a little higher.

Extra care has to be taken when the picking stick is worn, for then the picker has much more liberty to move about in the box. A large, but shallow hole is made with the knife so the shuttle may be guided to its proper picking centre.

In case the picker binds at all between the picking stick and the box swell, the swell may be packed back a little with a thin strip of leather being tacked to the place where the inner part of the swell head comes in contact with the box back, but this must be followed by a readjustment of the stop rod casting. If such packing cannot be inserted, then the back of the picker may be pared down.

The chief standard makes of both leather and buffalo pickers are presented at Figs. 199, 200 and 201.

LEATHERS.

Quite a number of things associated with a loom are made of leather, and on their quality and suitability partly depends the working cost of the establishment, reasonable or otherwise.

Picking Straps.—For looms that have the overpick motion, picking straps are the prime leather cost, as they have the greatest amount of service to perform.

They are of two lengths, which are known as butt and hide. The former are the shorter of the two, and are particularly adapted for narrow looms with their shorter picking sticks. But whether short or long, they should be of good quality. This implies a fair resistance to a sharp knife, only a moderate stretch when pulled, and a reasonable thickness at the end which is used by the picker. It must also be pliable, for if too stiff, it would spring off the pin on the picking stick unless tied fast. Bark tanned leather is the best.

Picking straps are usually 1¾ inches wide, and thicker at one end than the other. The thick end is for the picker, and the thin one to wrap round the stick. When of about uniform thickness, they are not quite as serviceable as the tapering kind. In preparing these leathers for the loom, the slit at the thick end should be no longer than will allow the strap to pass through. Some 18 holes are punched at the opposite end so the strap may be set to its best working length on the loom. The strap is well stretched by hand so as to give the least stretch on the loom to avoid knocking off.

Method of Attachment.—Several methods are adopted in fixing the strap to the picker, the most common being to pass the thick end through the slot in the picker, pass the thin end through the cut in the strap, and then wrap the free end round the stick and fix on the pin. If the leather be thin, a much better way is to first loop the leather, and then pass the thin end through the picker, and follow through the loop. It has to be well braced up before being wrapped round the stick. While this takes up more leather, the full width of it does the work instead of half in the previous example.

The third way is to make two slits at the working end one being above the other. After passing through the picker, the thick end is threaded through the second cut, and the thin end put through the first cut, and then wrapped round the stick. This system is better to unloose than the second one but uses more length, and gives quite as good service. It is very handy when the length of strap is too long for the back pin on the stick.

Pitch of strap.—Before the loom commences to weave, either weaver or overlooker ought to test the strap for length. There are two tests. The first is, that the length of it should begin to pull the shuttle out of the box when the crank is at its bottom centre. The second is, that when drawn to its full forward traverse, the picker should then be two inches away from the buffer. The first begins the shuttle movement at the right time, and the second prevents the picker from binding and having the top torn off. When the strap end is seen to be well worn, it is safer to cut it off and make a new slit. Straps that have stretched in working are noted by the increased length between picker and stick, and also by the slower movement of the shuttle when entering the box.

In the Hattersley clutch box loom, the strap is the most accurately set by removing the pressure of the brake, turning the loom over by hand, and making the length so the shuttle begins to move out of the box when the loom has the crank at its bottom centre. Another and handier way but not so accurate, is to place the loom with the crank at its front centre, and then leave the strap just slack. If the shuttle bounces back in the opposite box, it is slackened out a hole to weaken the force.

Under Pick Motion.

The same kind of picking leather is used for the under-pick motion, but in a different way. It is made the regulator strap for the thick picking leather D that passes round the stick. It is looped round the leather, and secured to the back of the stick E. (Fig. 202). The shorter this strap and the lighter the pick: the longer the strap, and the greater the force. As the strap is looped, it would work upward in picking, but another short strap is looped round the thick leather in the opposite direction, and is secured to the stick below the thick leather. The pitch for the screw that secures it is obtained by pulling the stick forward, and then marking the place on the stick. This is the usual method for the Dobcross loom. For the Hattersley under pick (Fig. 203), some overlookers make one strap suffice by securing it above

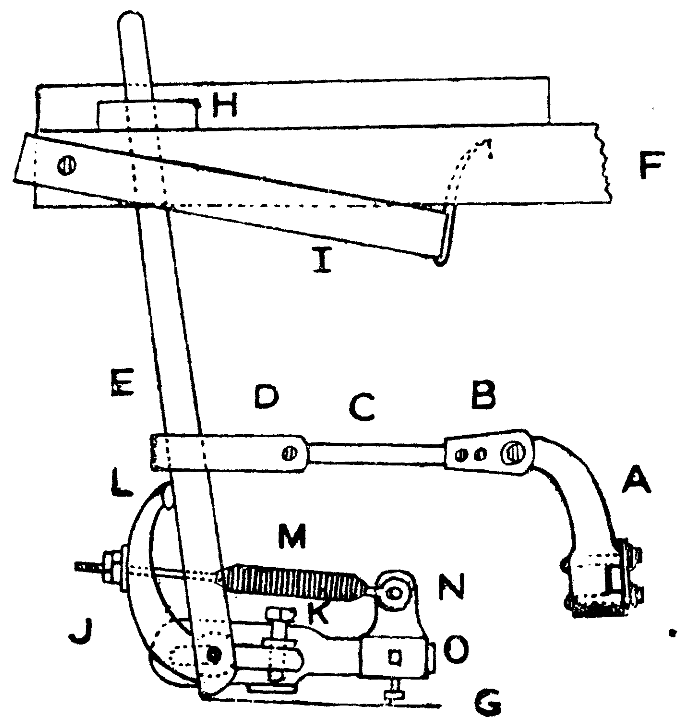

Fig. 202.
Strap Connections on Dobcross Loom.

and below the thick strap on the face of the stick, but the other fixing at J gives much better results.

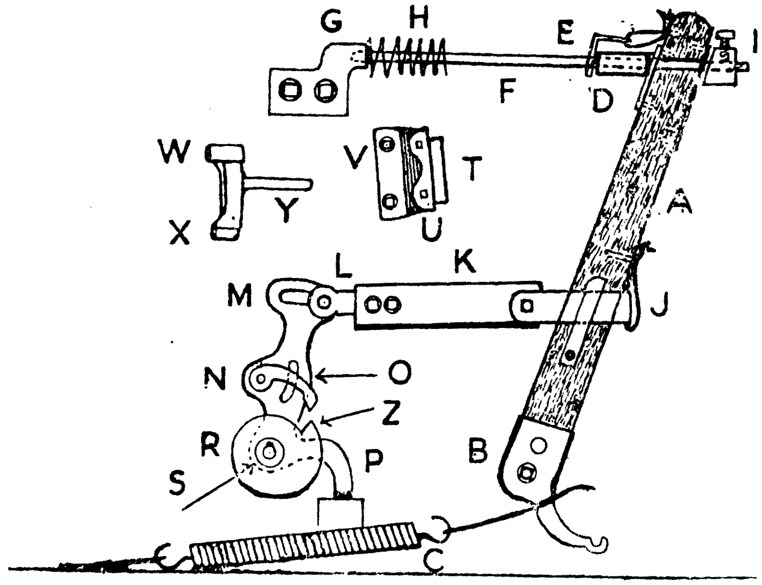

Fig. 203.
Hattersley's Under Pick Motion Strap Connections.

Controlling Picking Stick.—Another useful way in which picking strap lengths are applied, is in being a medium to pull back the picking sticks in the Dobcross loom after picking. Both sticks are attached to the same spring contrivance which consists of a circular iron rod looped at either end to which is attached a pair of closed spiral springs.

The strap G connects the stick bottom to the spring, and should be of thick leather at the stick end. It is a good plan to round-off the stick bottom so as not to cut into the leather, Fig. 202.

Shaft Leathers.—The best end of a picking strap may be made into leathers for the top of heald shafts when pulleys are used. Its width allows of three straps being made for each length cut. Its pliable nature combined with tanning moisture, make it very serviceable for this purpose.

When those are used that are manufactured, and have tinned holes, the smooth side is best placed downward on the pulley, for then the movement is all the smoother, and the leathers last longer.

Check Straps.—In many kinds of tappet, dobby, and harness looms where only one shuttle is in operation, the check strap passes through metal guides in front of the going part, and extends for more than the whole length of it. It is made about 4 inches longer, and the ends are placed at the outer ends of the spindles, and held on by a highly tempered curved spring. An even better way is to terminate the strap a couple of feet from either end, and lengthen it by a good piece of picking strap at either end. The picking strap is much more pliable and durable, and when worn, can be replaced with new. On this extra piece of check strap the checking buckle is placed, which is the means of checking the shuttle.

Buckle.—A cheap and handy buckle can be made from short pieces of old belting 2½ inches wide and cut about 5 inches long. A slot is made at the bottom end for the check strap to pass through. At the other end, a doubled piece of picking strap is nailed on, and a round hole punched through within half an inch of the end. A check pin is then inserted into the belting part, and made to cross the centre of the slot, and project ⅜th inch beyond the bottom of the leather. The end of the check strap is passed through the slot in the buckle, and the buckle pin inserted in one of the holes punched in the strap made for the purpose, and the end of the strap secured as suggested. The buckle in a wide loom is given a run of about 2½ inches. The buckle has not to touch the box end when forced back by the shuttle, or there would be a possibility of the box end eventually being broken.

Increased Check.—When very fine weft is used, a longer check than usual is an improvement, for it then gives a more gradual glide to the shuttle, and assists in keeping up the prongs of the centre weft fork without excessive brush in the shuttle. Too short a check is liable to make the shuttle bounce back in the box, make the weft curl by the selvedge, and also at the weft fork, and cause the loom to slip off.

Dobcross Check Strap.—In the Dobcross plain loom, Fig. 202 the check strap I is entirely different to that described. This strap is 2½ inches broad, and from ¼ to ⅜ inch thick, and 5 feet 5 inches long. This length has the advantage of the strap being used twice without being to sew with whang. The Dobcross loom has the under picking motion, and the picking stick moves in a long slot at the end of the loom. At the inner end of the slot is a narrow looped strap, the loop only allowing the check strap to pass comfortably underneath the box. The check strap is secured by a long bolt passing through the outer end of the going part.

It is most essential to have the proper working length of the checkstrap, for if it be too long, then the stick comes in contact with the end of the box, and is split by the impact. The most effective method is to secure the back length of the check strap by the bolt, pass the strap through the loop, mark the place on the strap opposite the bolt hole, and then cut a hole in the strap 2 fingers breadth in front. This distance is quite safe when the leather stretches little, but with leather that sighs out more, the distance must be increased. These straps should be hand stretched before being placed on the loom. When worn through, the best parts of the strap are kept for "middles," and pieces are sewn on at either end with whangs. The actual checking of the shuttle is done by a semi-circular casting J working on the stout stud that holds the picking stick E the casting being held by a powerful spring M and regulated by a lock-nutted setscrew.

Hattersley Box Loom Check.—The check strap arrangement for this loom is different in every respect from the two already dealt with. In the plain loom, the check strap extends the whole length of the going part, but in the box loom, each end is separate. The inmost length of leather is screwed to the front of the going part, and at the outer end a slit is cut. This stretch of leather passes through a looped leather bolted to the inner side of the breast beam. The looped leather plays an important part in the checking of the shuttle for on its length depends the amount of check imparted to the shuttle.

The second length of leather is secured to the spindle behind the picker while the opposite end is passed through the slot in the first length and secured to it by a bent pin. A further short leather is placed in front of the one on the spindle, and held at the other end by the outer end of the spindle. This short length is to prevent the checking leather from moving too far forward when the loom has picked.

Improved Arrangement.—A much better idea for this make of loom is to have the section made in two parts. The one fitting on the spindle is made from an ordinary picking strap cut down to half its width, except where it is bolted to the continuing leather. It is doubled for the whole of its length, and after being looped round the spindle behind the picker, it is held together by a thin piece of wire passing through it to prevent it from opening out. The following leather is then placed between the two ends of the outer ones, and all three are then bolted together and locknutted. This plan gives excellent working results. The total length of the 3 pieces is made just long enough to extend to the end of the spindle when the loom is at its front centre. The loop through which the check strap passes must be short enough to pull the checkstrap forward from 2½ to 3 inches when the crank is at its back centre, and be long enough to only give a slight action to the check-strap when the loom is about to pick.

Dobcross Box Loom Checking.—Here again is another variety of checking. The check leather is passed round the back of the picking stick and screwed fast as near as possible to the under framework of the box. The inner end is held by a bent wire fixed to a lever attached to the going part at its back centre, one wire being at the top and the other at the bottom of the lever which is fulcrumed at its centre. The lever is worked by a rod which is affected by another in a tube. Near the outer end of the tube a plug pin is placed which bars the operating rod as the crank passes its top centre, and by so doing, imparts movement to the centre lever and draws up both picking sticks to check the shuttle. The amount of check is regulated by the straps screwed to the picking sticks. When the weaver has to find the pick, the plug pin is pulled out of position by the lever which disconnects the crank shaft and the engine, and so liberates the picking sticks.

Another style of checking is the same as the one described in connection with the Hattersley Standard Loom, but for economy of action, the other one is to be preferred.

Hattersley Friction Drive Check.—This check (Fig. 203) is on a somewhat similar principle to the Hattersley clutch box loom already outlined, but as the friction drive has the under-pick motion, the weight of the stick A and the powerful pull of a strong spring C that pulls the stick back have to be taken into account. A right angled strip of buffalo is bolted to the outer end of the check strap and takes its place on the spindle behind the picking stick.

It will now be realised that the checkstrap works in different ways in different looms. In the Hattersley plain loom it pulls up the buckle and picker; in the Dobcross plain loom it prevents the picking stick hitting the inner end of the slot in which it moves; in the Hattersley clutch box loom it has the light service of pulling up the picker only, while in the Dobcross loom and the Hattersley friction drive, it has the heavy task of moving both picking stick and picker.

SHUTTLE GUARDS.

Shuttle guards are attached to the front of the hand rail with the primary object of preventing the shuttle from flying out of the loom. There are four essentials required.

1. The guard must come into play on the first bump of the sley against the fell of the cloth.

2. It must remain rigid during the time the loom is weaving.

3. Readily fold back for the weaver to take ends up or change the shuttle.

4. As far as possible, prevent the shuttle from flying out of the loom.

There are many types of guards, but those herewith explained are the most reliable with which the writer has had to deal.

Bedford Guard (Centre Spring).

Fig. 204 gives the centre mechanism of this guard. At 1 is the casting which is screwed to the handrail, and stands

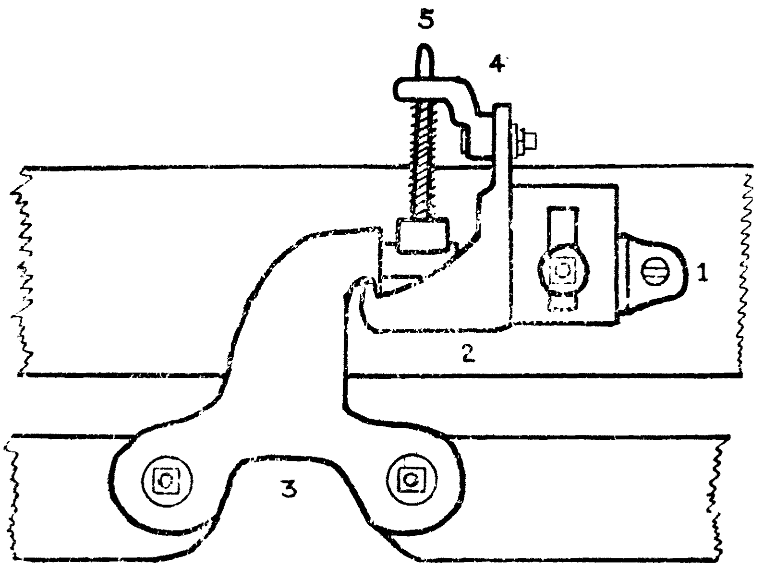

Fig. 204.
Bedford Shuttle Guard. (Centre Section).

forward so a small bolt may pass through it to hold casting 2. As shown, this casting is slotted so it can be placed to the best advantage for weaving. The bottom of it is **V**-shaped to accommodate the rocker casting 3. Part 2 has a lip on the left hand side so the rocker casting cannot get away, and at its upper end is a curved slot which is made use of by the regulator 4. Through the bore of the regulator, the shaft of the spring casting 5 passes.

The position of the regulator has to be, that when the guard is down as demonstrated, that it is firmly held, but it must also hold the guard up when pressed back by the weaver. Its position need not be quite central, for it must be strongest when down for weaving, and the most sensitive when folded back, for it is expected to fall on the first bump of the sley against the fell of the cloth. It is the latter that is the test of efficient fixing. The spring casting 5 is V-shaped at the bottom so as to be astride of the upper part of the rocker casting. When the guard is down, the pressure of the spring is at the front of the rocker casting, but when pressed back, it is at the back. The base of the rocker casting is curved so the prongs of the centre weft fork can work free when the guard is down.

The two pairs of side castings (not shown) along with the spring, all work in unison when the guard is down, and the side castings limit the forward position of the lath, and the top backward movement of casting 3. This is a very serviceable guard.

Fig. 205 is another type of the Bedford Guard. The casting 1 is the same as in the previous example. No. 2 is

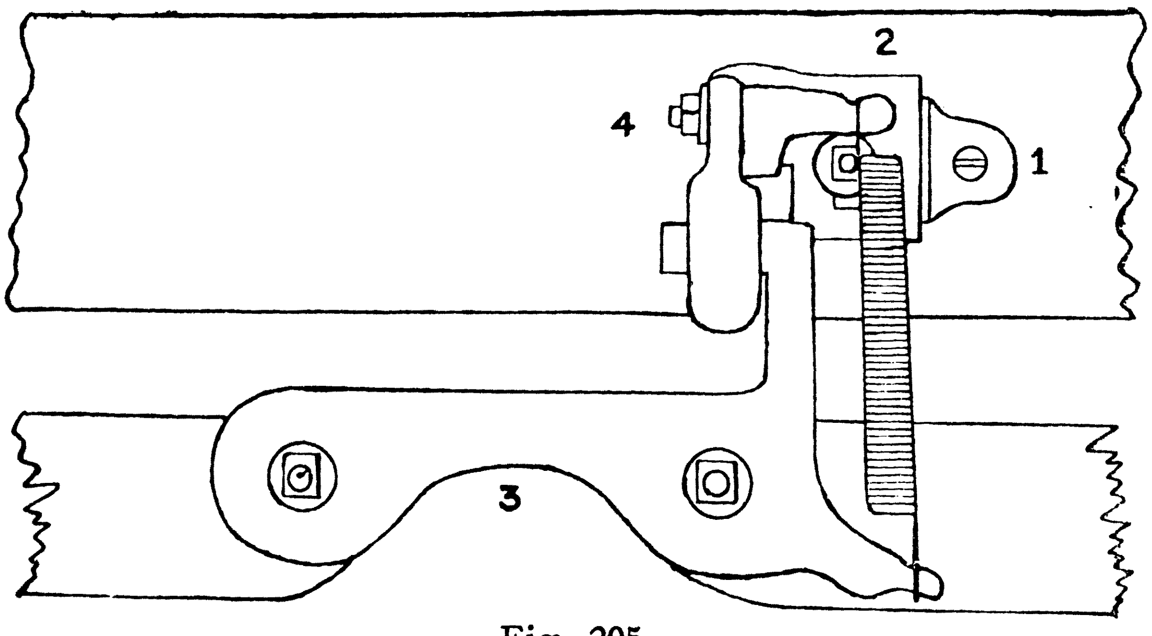

Fig. 205.

Bedford Shuttle Guard. (Side Spring).

of a different shape, and towards the bottom is hollowed out to receive the upper end of No. 3. This part is grooved at the top, and comes in contact with a blunt projection at the top of the opening in No. 2, and is the fulcrum of the movement. At 4 is the small casting held by the bolt shown, and can be moved in the slot of No. 2. No. 4 acts in much the same way as No. 5 in the former example. From a projection on No. 3 a closed spiral spring bridges the distance to No. 4. This acts the opposite way to Fig. 204, for in that the pressure is downward, but in this case it is upward.

The base of No. 3 is curved to miss the prongs of a centre weft fork. This is a rather safer guard than the other, but not quite as good in the wearing owing to the small wearing fulcrum surface of No. 2 casting.

Fig. 206 is another style of guard and gives an added measure of safety. It has been named the "Ideal"

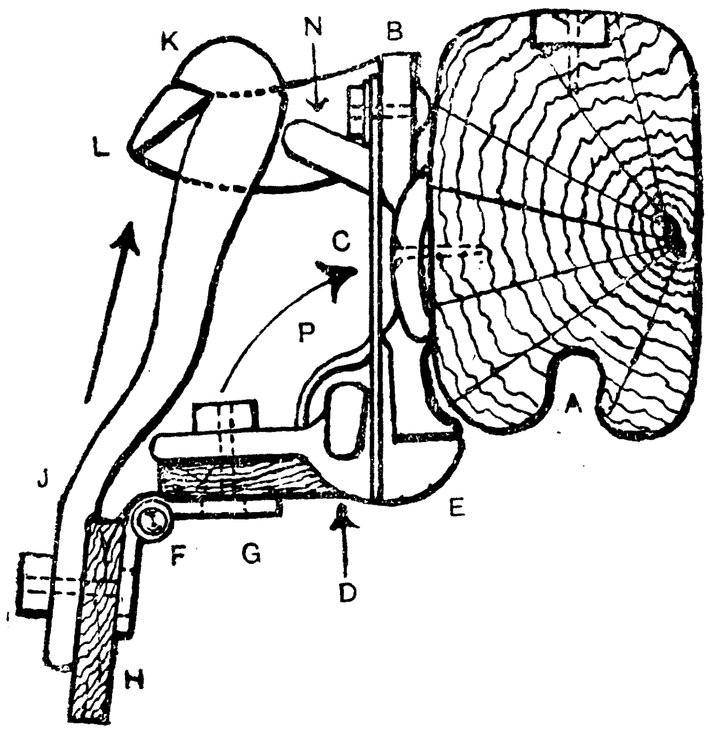

Fig. 206.
Ideal Shuttle Guard. (Centre Side View).

shuttle guard and has strong claim to the title. It is the patent of Gabitass & Coope, Greengates, Bradford, and made for the patentees by Messrs. Lightowler & Keighley, Soho Works, Thornton Road, Bradford.

The centre part is explained as follows. At A is the top rack for the sley, and B is the main casting which is screwed to the front of the hand rail. To B is bolted the highly tempered flat spring C, which exerts pressure at the back of the almost oval lug D, and assists in keeping the guard rigid when weaving. At E is the lip that fits underneath the main casting, each group of three castings having a similar lip which all come to rest at the same time, and creates a solid base for the guard.

In the two former examples there is only one lath, but in this there are two which are held together by the hinge F, the laths being at G and H respectively. The bolts holding the laths have flat heads that sink into the countersunk parts of the hinge, and can thus do no harm to the shuttle in case it tries to get out of the shed. The bottom part of the hinge assists in holding the bottom of the curved catch J. The head of the catch K rests on the triangular shaped part L, and comes to rest when down as shown at the same time as the lip E. The metal prop N which is part of the main casting prevents any vibration of either of the laths when the loom is weaving. The curve of the catch is so it can pass easily between the support L, and the prop N, when the guard is being folded.

When the weaver wishes to fold the guard for any purpose, she can do so by placing her fingers underneath the bottom lath at any part of its length, or if at either end, can use one of the lips best seen in Fig. 208 in an upright position. The catch then follows the arrow in front of it, and the laths fold up in the direction of the arrow P. When this is carried out, the pressure of the flat spring C is transferred from the back of the lug D to the top, and this pressure is sufficient to keep the guard folded until the loom begins weaving. On the first bump of the sley against the fell of

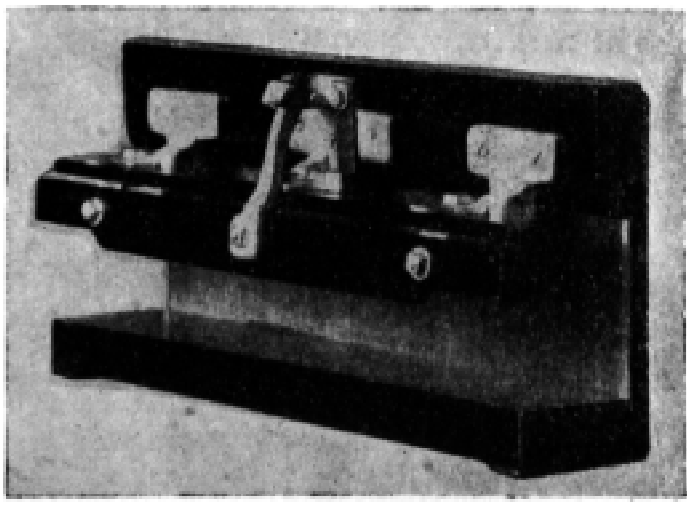

Fig. 207.
Ideal Shuttle Guard. (Weaving Position).

the cloth, the guard automatically falls. In fixing the guard to the handrail, a shuttle is placed at either end of the guard, and the bottom of the lath when down is then set to just clear the top of the shuttles.

It will be noted in Fig. 207 there are three groups of castings, but for narrow width looms there are only two. This photo of the model shows the guard ready for weaving, but Fig. 208 gives it out of action.

By having two laths, the shuttle is prevented from rising up if it attempts to get out of the shed, and the vertical lath prevents it from getting out at the front.

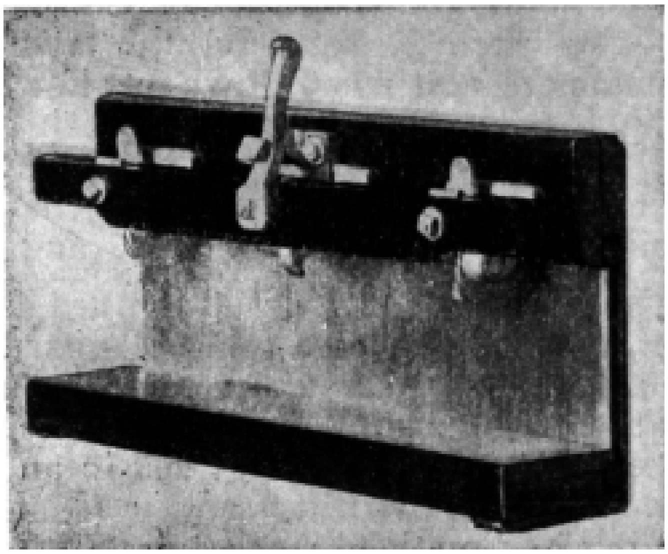

Fig. 208.
Ideal Shuttle Guard. (Closed).

The fulcrums are substantially made, the parts are simple and the castings are rounded off to avoid catching. The cost is light and the service is efficient.

UNDER MOTIONS FOR NEGATIVE DOBBIES.

The Kenyon or under motion for tappet looms and negative dobbies superseded the old stocks and bowls. The latter have been completely outclassed both in the simplicity of parts, the speed of fixing to the shafts, and the number of shafts that can be controlled. Each shaft is on its own, whereas the old stocks and bowls had all the shafts linked together, so that an accident to one usually upset the lot. Fig. 209 is not a Kenyon motion, but the Hattersley spring under motion for narrow looms. The spring levers are fulcrumed on the two cotter pinned rods seen at the top

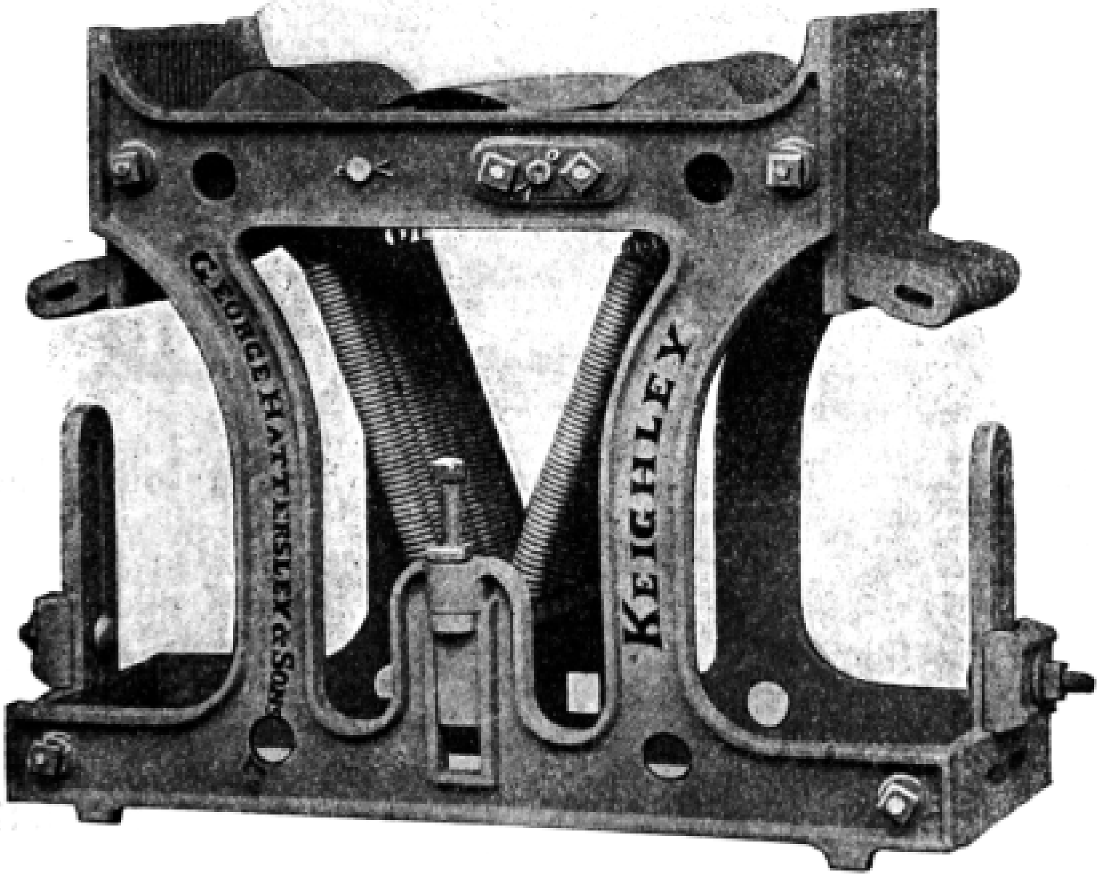

Fig. 209.
Hattersley's Under Motion for Narrow Looms.

of the framework. The levers pass through long slotted grates at either side, and are themselves slotted to receive either wire or strap to connect them to the bottom of the shafts. On the under side, the levers have a hook upon which a closed spiral spring is placed. The bottom of the spring passes on to another hook on a bar which fits into a slotted part of the framework. This bar can be elevated or lowered by the locknutted setscrew at the top of the slot, a similar one being at the opposite end of the bar. This is a very convenient way of meeting the different weights of cloths, for the shafts engaged in weaving a light weight fabric need have little pressure placed upon them, but for heavier goods, more pressure has to be brought to bear to prevent the healds from buckling when on the bottom shed.

The frame is bolted to the cross rails of the loom, the bottom of it resting on the floor.

The one thing to be avoided is to prevent the levers from touching the bottom of the grate when the shafts are down.

Fig. 210 gives the Hattersley motion for wide looms. In this there are two tiers of levers, the upper ones being

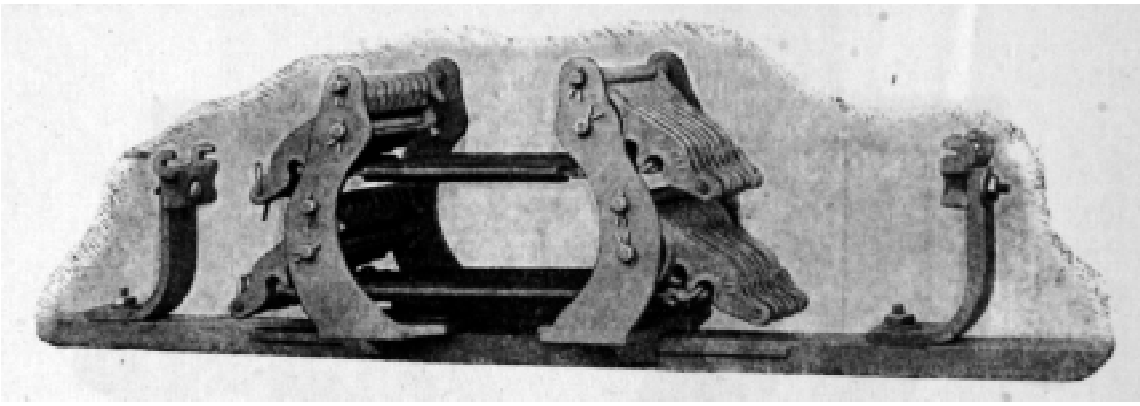

Fig. 210.
Hattersley's Two Tier Under Motion.

two inches further in than the bottom ones, and are so arranged that when an upper one is down and a bottom one is raised, they miss each other. On all shafts destined for use by an under motion, there should be two rows of hooks opposite the ends of the levers so that when the bands are attached, all the shafts work vertically straight, for when so working, much less friction is placed upon the warp.

There are upstanding brackets at either end to attach the spring motion to the cross rails of the loom.

To give working details, reference is made to the sectional drawing given at Fig. 211.

Spring Levers.—The spring lever A is made of malleable iron, so that if a band breaks and the lever suddenly drops, it remains whole. It is fulcrumed on a bar that passes through the framework C. Towards the back of the lever is an opening and into this is placed the switchback casting

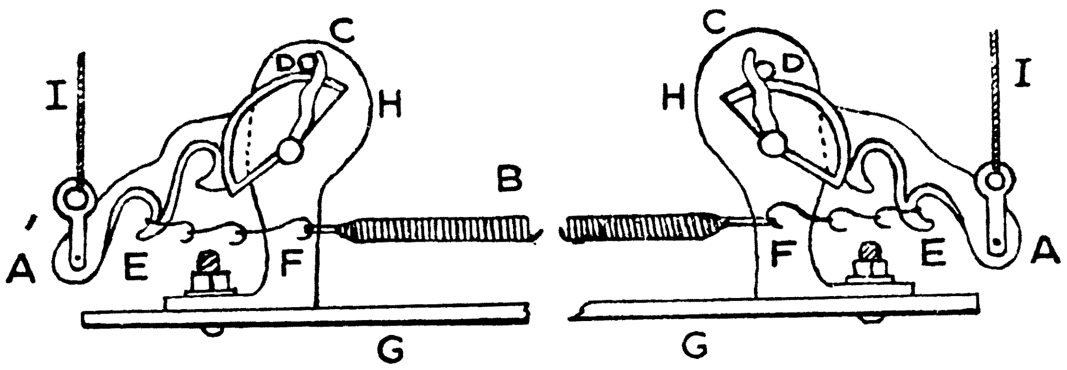

Fig. 211.
Kenyon Spring Under Motion.

C, the upper part of which comes in contact with the stay bar D and limits the downward movement of the lever. This switchback is used in place of the curved lug that is cast to the lever. The spring lever has two hooks underneath, either of which may be used by the hook links. The inner hook gives the least spring pull, and the outer one the greater, both being at E.

In the course of service, the bar upon which the spring levers oscillate becomes worn, and the wearing allows the levers to lean towards the front of the loom. This leads to the hook links catching each other as they pass, and throws additional weight upon bands and healds. If the bar has not previously been turned, it may be twisted half way round by a pair of footprints, and the levers then work straight.

Hook Links.—The spring B is from 6 to 8 inches shorter than the distance between the levers, and this is made up on either side by the hook links F. Some of these are made of malleable iron, but the later ones have an iron strip hook and a square or oblong wire holder. These links are made in four different lengths so as to give the best results in spring tension. The springs are fixed when the levers are down, and the distance to be stretched should not be more than one inch. This allows for the wearing of the parts, does not allow the spring to sag when out of action, and places no unnecessary force upon the levers. If any spring is seen to be slack when changing the healds, a shorter hook link will rectify matters.

If the links next the spring are placed with the hook upward, they are then in a position to have an extra spring attached in case heavier work than ordinary has to be undertaken.

The racks H are bolted to the cradle G, and for wide looms, the inner hooks of the shafts are 19 inches from the centre, and the outer ones 21 inches.

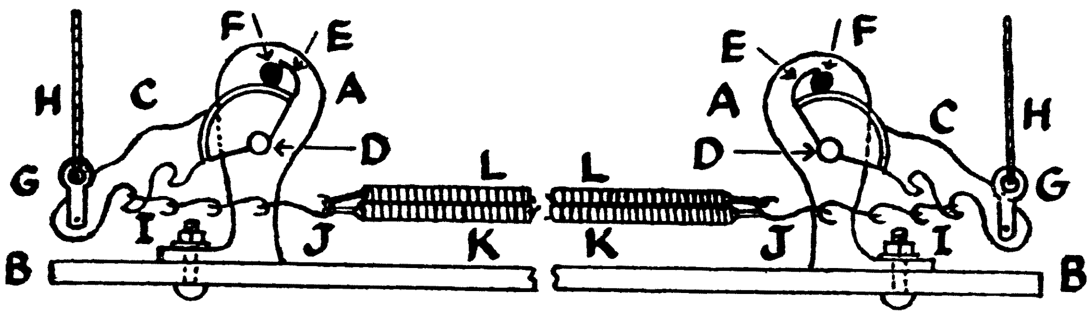

Fig. 212.
Double Springs for Heavier Work.

Spring Tension.—In testing the power of the spring with a spring balance when the hooks were placed on the inner projections of the spring levers, it registered 8 lbs. at the bottom and 5 lbs. at the top. On altering the hook links to the outer projections on the spring levers, and giving the spring a stretch of one inch as before, the pull registered 14 lbs. at the bottom and 6 lbs. at the top. This clearly demonstrated that the inner hooks are adapted for light weight fabrics, and the outer ones for heavier work.

The springs on the outer stretch are sufficiently strong to weave an 18 oz. cloth with one spring to one shaft if the warp is woven on 8 shafts and the weave 2 × 2 twill. If, however, the cloth be 20 oz., then two springs will have to be attached to each shaft to overcome the increased tension on the warp and healds.

The spring power may be altered in the opposite direction. Take the case of a 2 × 2 twill face cloth woven on 4 shafts, and a light backing cloth at the back on 8 shafts. The light backing may be woven with much weaker springs than the face. This reduces the pull on the healds and the work of the engine.

By the pull of the springs, the warp sinks lower much quicker than with a positive dobby, and in consequence has to receive more attention. It also follows that as the weight and work on the engine is greater, that it must be well oiled to prevent rapid wearing.

Difference in Spring Pull.—The reason why the spring pulls the strongest at the bottom and the least at the top is, that when the levers are down, the levers are directly pulling against each other. The levers move in the arc of a circle from bottom to top, and in doing so, they lift the spring 2¼ inches. On passing the centre, the main weight is thrown on to the fulcrum instead of the shaft, though the spring has been stretched two inches.

Leasing the Warp.—Unless the power of the springs is weak it is foolish to drop the engine catches off the draw bar with a pair of pliers. It is much safer, to lift the catches with the fingers if there is only a small number, or thread them on to a foot rule, and then turn the loom over by hand with the balance wheel.

Additional Strength to Spring Motion.—For the heavier kind of work, the ordinary spring motion is not powerful enough, but could be made so by stronger springs. When not strong enough the shed contracts and the shuttle cannot get through, and the loom is constantly banging off.

To save the purchase of stronger springs, and the labour associated, the same kind of spring is made an addition as depicted in Fig. 212. It is done by turning the two inner links with their hooks upward at K and the additional spring then finds accommodation as at L.

TEMPLES.

It is possible that many weaving overlookers these days have never seen a wooden temple as was generally used on the old hand looms. It is only on rare occasions that they are ever required, and only then as an aid to a modern temple weaving very heavy woollens.

By experiments and experience, different kinds of metal temples have been evolved that are suitable for the production of different kinds of cloths, and made of widely different materials. They are scientific, easily adjustable, can be taken to pieces for cleaning, and have the upper hand of the work they have to perform.

Necessity of Temples—Although loom makers have left this field of invention to others, temples are just as necessary for the production of the great majority of cloths as a weft fork, a brake, or a pair of frogs. They are required for at least three reasons: —

(1) To overcome the drag on the selvedge when the shuttle passes from one box to the other.

(2) To counteract the shrinkage of the fabric due to the interlacing of warp and weft.

(3) To keep the fell of the cloth at the same width as the warp in the sley.

Contraction of Pieces.—The following particulars from measurements give the contraction in pieces when various types of yarns are employed.

All Woollen.—Warp 30 skein, 28 threads per inch, 72½ inches wide. Plain weave. Weft 26 skein, 32 picks per inch. Width on cloth beam 66½ inches. Contraction 6 inches.

Worsted Warp: Woollen Weft.—Warp 2/24's worsted (long wool) 40 threads per inch, 76 inches wide. Weave 2 × 2 twill. Weft 12½ skein woollen, 46 picks per inch. Width on cloth beam 72 inches. Contraction 4 inches.

All worsted.—Warp 2/48's Botany, 62 threads per inch, 65½ inches wide. Weave 2 × 2 twill. Weft 1/26's Botany 64 picks per inch. Width on cloth beam 60½ inches. Contraction 5 inches.

Without some contrivance to overcome this shrinkage at the fell of the cloth, it would be impossible to produce a well woven fabric.

Types of Temples.

For the medium and heavy kinds of cloths, three distinct types of temples are employed.

(1) Tapered rings and tapered cap with all the rings inclined.

(2) Inclined rings, all the same size, with semi-circular oblong cap.

(3) Inclined and straight rings on the same shaft, with semi-circular oblong cap.

(4) Roller temples, the rollers being covered with short spikes. The two rollers are covered with a convenient cap.

For the major part of medium and heavy goods, No. 1 is very suitable. This gives a maximum pull at the selvedge and a minimum pull at its inner end. In Dobcross looms that are not fitted with a perforated roller to take the cloth, the stronger make as given at No. 2 is to be preferred.

For medium weight cloths up to 18 oz., No. 3 gives good results.

No. 4 is specially built for the weaving of cotton cloth. In narrow looms for the weaving of dress fabrics, two distinct kinds are used.

(1) A temple built on similar lines which may be on the plan of No. 1 or 2. There are, however, only two, or at most three rings, but these are broader and possess 3 or 4 rows of pins. The cap is short to suit.

(2) The star temple which has no cap. The flat, revolving disc is supplied with rows of pins to seize the piece, the disc being completely hidden by the cloth. In some cases there are two discs, one being below the other. These star temples are far from convenient, and are seldom employed.

Construction of Temple.

With the exception of the star and roller temples, the general structure of the others consists of a series of washers and rings that are placed on the shaft A, Fig. 213, the shaft washers and rings constituting what is known as the barrel. The washers are flat on one side, and are made with a boss on the other upon which the ring revolves. The width of the boss is slightly larger than the width of the ring, and this gives the ring working freedom. The washers are bored while in a slanting position, and make the boss appear eccentric. The outer shape of the washer and the position of the boss is so arranged, that when the ring is placed on the boss, the ring with its pins is exposed at the top and sides,