June 2, 1936. H. DREYFUS ET AL 2,042,704

CIRCULAR LOOM

Filed July 13, 1934 3 Sheets-Sheet 1

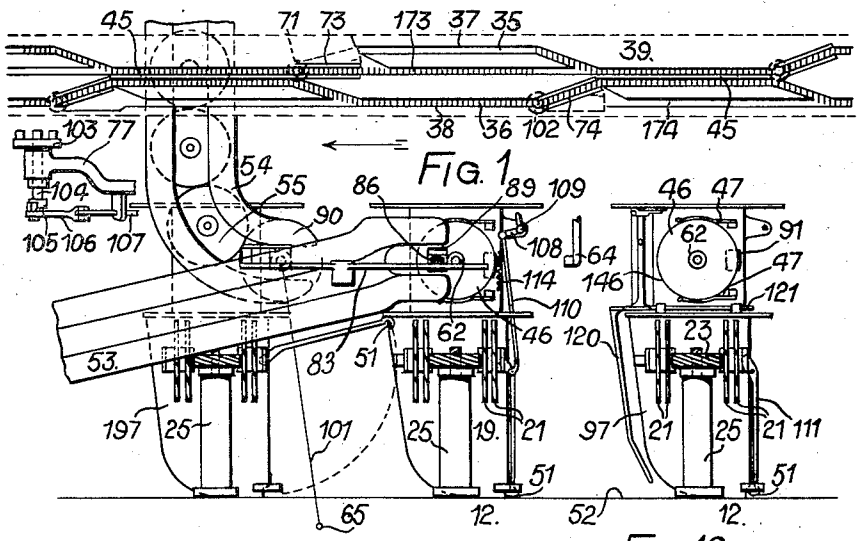


FIG. 1

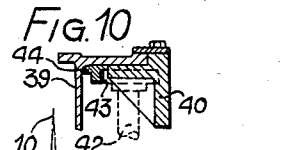


FIG. 10

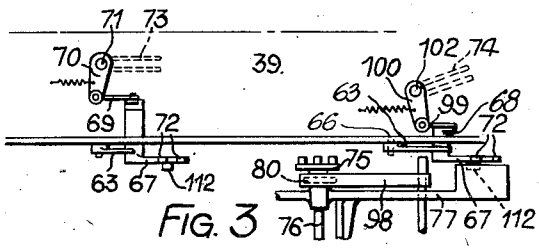


FIG. 3

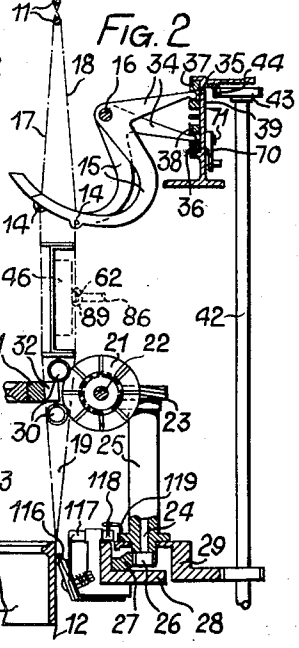


FIG. 2

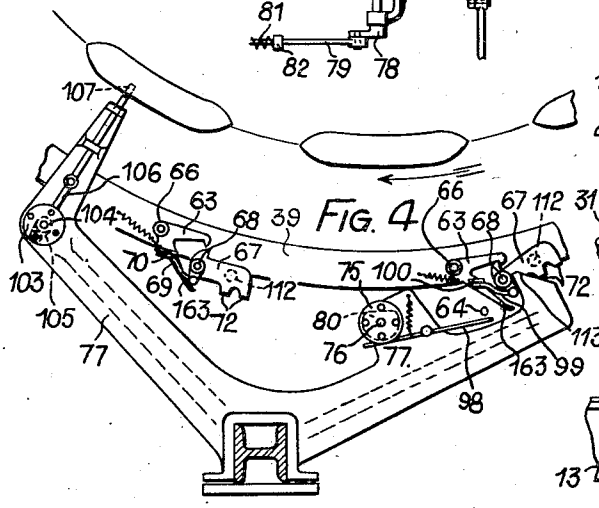


FIG. 4

HENRY DREYFUS
WILLIAM POOL
INVENTORS

ATTORNEYS

June 2, 1936. H. DREYFUS ET AL 2,042,704

CIRCULAR LOOM

Filed July 13, 1934 3 Sheets-Sheet 2

FIG. 5

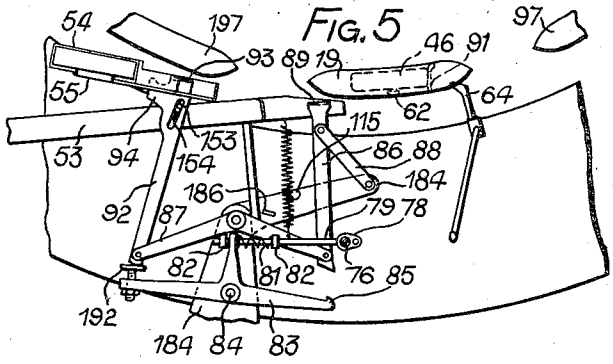


FIG. 8

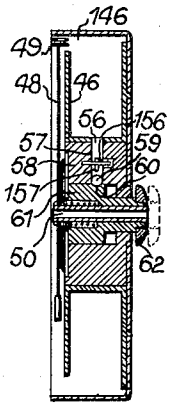


FIG. 6

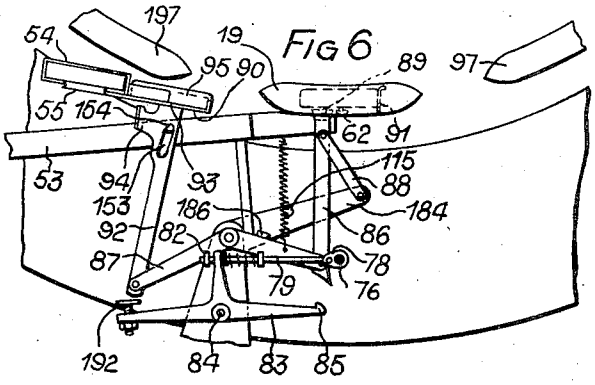


FIG. 9

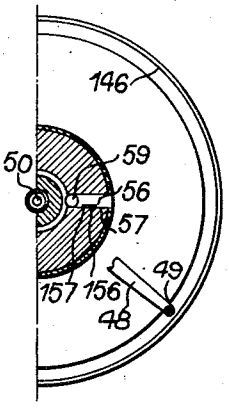
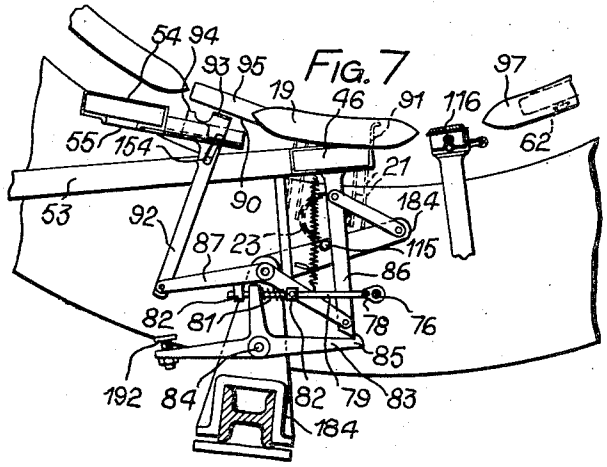


FIG. 7



HENRY DREYFUS
WILLIAM POOL
INVENTORS

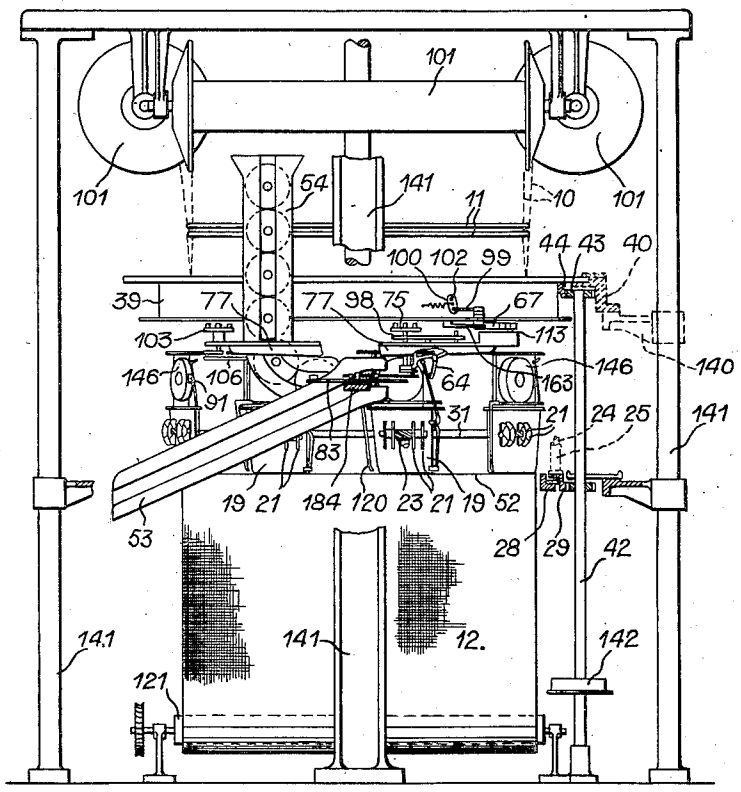
ATTORNEYS

June 2, 1936. H. DREYFUS ET AL 2,042,704

CIRCULAR LOOM

Filed July 13, 1934 3 Sheets-Sheet 3

FIG. 11



HENRY DREYFUS
WILLIAM POOL
INVENTORS

Dreyfus & Pool
ATTORNEYS

Patented June 2, 1936 2,042,704

UNITED STATES PATENT OFFICE

2,042,704

CIRCULAR LOOM

Henry Dreyfus, London, and William Pool, Spondon, near Derby, England, assignors to Celanese Corporation of America, a corporation of Delaware

Application July 13, 1934, Serial No. 734,909
In Great Britain July 21, 1933

18 Claims. (Cl. 139—224)

This invention relates to circular looms, and is concerned more particularly with means for supplying weft in such looms.

The principal object of the invention is to enable circular looms to operate with a continuous weft supply, this being effected according to the invention by replenishing the, or each, shuttle with weft automatically on weft exhaustion, a spool containing the requisite amount of weft being applied to the shuttle in replacement of an exhausted spool. With advantage, the removal of the exhausted spool from the shuttle and the replenishment thereof take place without cessation of the relative circular motion between the shuttle or shuttles and the warp threads.

In this manner delays for weft replenishment are avoided, and the loom requires much less attention than hitherto has been the case. Because of the weft replenishment taking place automatically, spools of large dimensions are not necessary in order to obtain high efficiency. On the other hand, the spools may be of relatively small size with the consequent advantage that the shuttle dimensions may be reduced also, and therefore a large number of shuttles accommodated round the loom. Therefore a large number of picks may be laid at each revolution, resulting in a high output of the loom.

Conveniently, a shuttle containing an exhausted spool is brought to the outside of the warps for replenishment, means being provided in association with each shuttle for controlling the warp shedding mechanism in its vicinity, on weft exhaustion, so that the warp threads are drawn to one side of the shuttle, and the shuttle can emerge from the warps.

Since such replenishment can be effected with advantage without cessation of the relative circular motion between the shuttle or shuttles and the warps, it is preferred to retain the replenished shuttle outside the warps for one weaving revolution of the loom before reinsertion, the remaining shuttles continuing to weave in the normal manner during such revolution.

When weaving plain fabrics such as hopsacks, taffetas and the like, it is preferred, in order to prevent the formation of a double pick in the fabric, to allow an adjacent shuttle also to emerge from the warps, and to allow this shuttle also to remain outside the warps for a weaving revolution of the loom. After the completion of a revolution, both shuttles are admitted into the warps at the point from which they emerged.

Though the mechanism according to the invention may be used for spool replacement on weft breakage, as distinct from weft exhaustion, by the provision of a suitable weft detector, it is generally advisable to bring about stoppage of the loom on such breakage, especially when producing pick-found cloth. Of course, in the event of weft exhaustion, sufficient weft remains on the spool at detection to complete the pick before the spool is replaced.

Apart from the advantages of substantial continuity of operation and high efficiency resulting from the invention, the lighter and smaller shuttles which may be used are of service in enabling a high rate of weaving to be attained and also rapidly operating weft- and warp-stop mechanism to be employed. Thus, when such mechanisms operate to clutch the shuttles and warps together to bring weaving to an end, the lightness of the shuttles enables this to be done in a very short time, thus minimizing the risk of the warp being stretched or broken by the shuttles engaging the jam in the warps resulting from an end breaking and preventing change of shed.

One form of apparatus according to the invention will now be described in greater detail with reference to the accompanying drawings, in which

Figure 1 is a sectional elevation of part of a circular loom of the same general type as that described in U. S. application Ser. No. 655,560, filed February 7, 1933, but having rotating shuttles, showing three consecutive shuttles in the neighbourhood of the weft replenishing mechanism;

Figure 2 is a vertical section of one side of the loom showing the shedding mechanism at weft replenishing position;

Figure 3 is an elevation showing the actuating means for the weft replenishing mechanism and the shed controlling mechanism;

Figure 4 is a plan view of the actuating means for the weft replenishing mechanism shown in Figure 3;

Figures 5, 6 and 7 are plan views showing the weft replenishing mechanism at different stages of its operation;

Figure 8 is a vertical section of a replaceable spool;

Figure 9 is a part sectional elevation of the spool;

Figure 10 is an enlarged sectional view of a detail of Figure 2; and

Figure 11 is a diagrammatic elevation of the circular loom showing the disposition of the weft replenishing mechanism.

Referring to Figures 2 and 11, sheets of warp threads 10 unwinding from warp beams 101 pro-

ceed downwardly in cylindrical form past lease rods 11 to the fabric 12, which is drawn over the edge of a ring 13 by take-up roller 121 disposed at the bottom of the loom.

Between the lease rods 11 and the fabric 12 the warp threads are passed through the eyes 14 of hook-like shedding members 15, which pivot about a stationary ring 16 extending round the loom. The members 15 divide the warp threads into two sheets 17, 18 at intervals round the loom for the reception of a number of shuttles 19, (three shown in Figures 1 and 4), which rotate about the axis of the loom.

Each shuttle 19 is driven round the loom by pairs of vane wheels 21, (Figures 1, 2 and 11), fixed to a shaft 22 which is rotated by gearing 23 driven from a vertical spindle 24. The spindle 24 is encased within an upright bearing 25, and is provided at its lower extremity with a pinion 26 which engages the teeth of a circular rack 27 outstanding from a stationary ring 28. The bearing 25 is secured to a rotatable ring 29, the motion of which carries the pinion 26 around the stationary rack 27 and rotates the spindle 24.

The vane wheels 21 penetrate the warp sheet 18 and by engaging the flanges of rollers 30 rotatably mounted within the shuttle propel the shuttle forwardly through the warp shed. At the same time, the rotation of the vane wheels allows the threads of the warp sheet 18 to pass into the slots between the vanes and so move freely past the shuttle. The shuttles 19 are supported from behind the warp sheet 17 by a ring 31, the edge of which forms a raceway for a roller 32 freely rotatable about an axle fixed in each shuttle. The warp sheet 17 thus passes freely between the edge of the ring 31 and the roller 32.

As shown in Figure 2, each shedding member 15 is formed with an outstanding arm 34, the extremity of which rides in one of two cam channels 35, 36, (see Figure 1), cut in undulating tracks 37, 38 respectively, which are secured to a rotatable ring 39. The ring 39 is freely supported on brackets 40, which are supported in turn by brackets 140 outstanding from pillars 141 (Figs. 10 and 11), and is rotated about the loom axis at the same rate as the shuttles 19 by a shaft 42 and pinion 43, the pinion 43 engaging a rack 44 formed in the ring 39. The shaft 42 is rotated by a belt pulley 142 secured to the shaft near the lower end thereof (Fig. 11).

The rotation of the ring 39, and consequently of the undulating cam tracks 37, 38, causes the shedding members 15 to rock about their pivots 16, and to divide the warp threads into sheds in accordance with the positions of the tracks, Thus, when the tracks 37, 38 are wide apart (see Figure 2) the warp sheet 17 is pushed towards the axis of the loom and the sheet 18 is drawn in the opposite direction, while when the tracks are close together, in the position indicated at 45 in Figure 1, the sheet 17 will be drawn backwardly and the sheet 18 will be pushed towards the axis of the loom, the change-over occurring at the converging and diverging of the tracks, as will be evident from Figure 1.

The extremities of the arms 34 are disposed in the cam channels 35, 36 in accordance with the pattern to be woven. Thus, in the case of a plain weave, alternate arms will be placed in opposite cam channels, while in the case of a 2 and 2 weave, for example, alternate pairs of arms will be placed in opposite cam channels, in a manner which will readily be understood by those skilled in the art. If desired, more than one warp thread may be threaded through each eye 14.

Each shuttle 19 contains a stationary weft spool 46 (Figures 1, 8 and 9) which is fixed in an open-ended case 146, the case being secured in the shuttle by spring clips 47. The weft thread is unwound from the spool 46 by a guide arm 48 arranged to rotate within the case 146 about the axis of the spool, and proceeds from an eye 49 in the extremity of the guide arm through a passage 50 in the centre of the spool to the rear side of the spool. From the rear side of the spool the weft is led downwardly to a guide hook 51 from which it proceeds to the fell 52 of the fabric 12 preparatory to being beaten-up in the fabric by the succeeding shuttle after change-over of the warp threads.

On exhaustion of the weft spool 46 the empty spool is extracted from the shuttle 19 and rolls away from the shuttle down an inclined chute 53 (Figures 1, 5, 6, 7 and 11), a fresh spool from a magazine 54 being inserted in the shuttle in its place. In addition to allowing of purchase by the clips 47, the case 146 containing the spool 46 protects the guide arm 48 from damage during the rolling of the spool down the chute 53.

The initiation of the spool-changing step on exhaustion of the spool is effected by the action of a plunger 56 which is freely housed within a radial bore 57 formed in the barrel 58 of the spool. Weft on the spool holds the plunger 56 in the sunken position shown in Figures 8 and 9, where the lower end of the plunger holds a ball 59 in an annular groove 60 formed in a spring-urged plunger 61, which is disposed co-axially with the spool.

As the last few windings of the weft are being taken from the spool, the plunger 56 is freed from restraint and releases the ball 59, with the result that the spring-urged plunger 61 is allowed to move outwardly for a short distance from the spool. A pin 156 penetrating a slot 157 in the plunger 56 limits the movement of the plunger in the barrel 58.

The outer end of the plunger 61 is formed with a button 62, which, on emergence of the plunger from the spool 46, is pushed outwardly to a point in line with one end of a pivoted lever 64, (Figures 1, 3, 4 and 11), which is disposed close to the warp sheet 18. The threads of the warp sheet 18 slide freely over the curved outer face of the button as the shuttle 19 proceeds towards the lever 64.

The function of the lever 64 is to indicate to the warp shedding mechanism the exhaustion of a weft spool so that the shedding mechanism can operate to allow the shuttle containing the exhausted spool to emerge from the warp shed for replenishment.

The warp shedding mechanism is controlled at a point immediately in advance of each shuttle by a lever 67 (Figures 3 and 4) which is pivoted at 68 on the cam ring 39, and is connected by a link 69 and a spring-urged crank 70 to one end of a spindle 71 which penetrates the cam ring 39 at a point in advance of the shuttle 19. Secured to the other end of the spindle 71 is a track switch 73 which, on rotation of the spindle, operates to change the contour of the cam channel 35 by diverting the cam channel to a new channel 173, with the result that the extremities of the arms 34 of the shedding members 15 are directed to the new channel 173 and push the threads of the warp sheet 18 to the rear of the shuttle 19,

in line with the sheet 17 so as to allow the shuttle to emerge from the warp threads.

The lever 67 is restrained normally against the pull of the spring-urged crank 70 by a spring-urged latch 63 which is pivoted at 66 on the ring 39 and is formed with an arm 163 which projects from the ring 39 to a point closely adjacent to one end of the pivoted lever 64.

On exhaustion of the weft in a spool, the expelled button 62 is carried by the shuttle against the lever 64 which rocks and strikes the projecting arm 163 of the latch 63. The latch is thus rotated about its pivot 66 and releases the lever 67 to rotate about its pivot 68 under the influence of the spring-urged crank 70, with the result that the track-switch 73 is operated and the threads of the warp sheet 18 commence to pass to the rear of the shuttle 19.

The continued rotation of the ring 39 has, by this time, brought outwardly projecting teeth 72 of the lever 67 into engagement with a pin-wheel 75, which is fixed to a rotatable shaft 76 mounted on a stationary supporting bracket 77, (see Figures 3 and 4), to cause the pin-wheel 75 and shaft 76 to make half a revolution.

A crank 78, fixed to the bottom of the shaft 76 is connected by a link 79, spring 81 and collars 82 to a double bell-crank lever 83 (Figures 5, 6, 7 and 11) which is pivoted about a fixed point 84 on a support 184. On rotation of the crank 78 by the pin-wheel 75 the lever 83 is caused to rock in a clockwise direction about its pivot 84, and in so doing releases from a restraining catch 85 a spool extractor member 86 which is pushed towards the shuttle 19 by a spring-urged cranked lever 87, and guided by a link 88.

The extremity of the shuttle extractor member is formed with a claw 89 into the grip of which the expelled button 62 is brought by the continued motion of the shuttle 19. The exhausted spool 46 is thus secured by the extractor 86.

The continued forward motion of the shuttle 19 in its circular path round the loom causes the shuttle to draw away from the extractor 86, and since the claw 89 still retains its grip on the button 62, the spool 46 is withdrawn sideways from the clips 47. A stop 91 positioned in the shuttle 19 at the rear of the spool 46 pushes the spool forwardly, and in doing so, pushes the extractor 86 backwardly, causing the cranked lever 87 to rock in a clockwise direction. The link 88, however, prevents direct backward motion of the extractor and causes the clawed extremity to follow a sweeping path towards the chute 53 where the extractor 86 is brought into contact with a pin 115 upstanding from the support 184. The stop 91 continues to push the spool 46 (Figure 7) which is then expelled from the claw 89 of the extractor, and rolls down the chute 53 to a suitable receiver (not shown).

The clockwise rotation of the lever 87 under the influence of the extractor 86 pushes forwardly a spool injector member 92 which normally rests with its operative extremity near the discharge opening of the magazine 54. The operative extremity of the spool injector member 92 is formed with a claw 93, while outstanding from the left-hand side of the extremity of the injector is a buffer 94 which normally prevents the exit of a fresh spool from the magazine 54.

On forward movement of the extractor 86 the rocking of the cranked lever 87 causes the injector 92 to recede slightly from the magazine 54 with the result that the buffer 94 is withdrawn from the path of the reserve spools and a fresh spool 90 in a casing 95 runs out of the magazine and engages its button 62 in the claw 93 of the injector. The injector 92 is slotted at 153 and is guided by a pin 154 which penetrates the slot. On being pushed forwardly again by the backward motion of the extractor 86 under the influence of the stop 91, the injector 92 places the fresh spool 90 directly in the path of the approaching shuttle 19, the continued motion of which causes the casing 95 to be engaged by the clips 47 which carry the spool out of the claw 93 and away from the injector 92.

The backward motion of the extractor 86 under the influence of the stop 91 causes the extractor again to be engaged by the catch 85 on the lever 83, with its operative extremity out of the line of the warps, ready for further operation, as the occasion demands. A stop 186 on the support 184 prevents the extractor 86 moving too near to the shuttle 19, and an adjustable stop 192 on the lever 83 allows the inoperative positions of the extractor and the injector 92 to be adjusted.

The weft ends from the several reserve spools in the magazine 54 are drawn through an opening 55 in the magazine to an anchoring point 65 to which they are secured. Thus, with the newly inserted spool 90, the end 101 of the weft extending therefrom is secured at 65, and by reason of the continued motion of the shuttle 19, the weft is unwound from the new spool 90 and lies against the warp threads. Weft from the new spool 90 is not inserted in the warps until the shuttle 19 has made one revolution round the loom, as will be explained later.

Since the warp shedding is effected according to the "plain" system, that is to say, all the warp threads lying to one side of one shuttle are changed-over to the other side of the succeeding shuttle, continuously round the loom as in the manufacture of "hopsack" and "taffeta" fabrics, it will be understood that the warp threads occupy identical positions at alternate shuttles. Thus, if the warp shedding operation commences again at the succeeding shuttle 97 after missing one "change-over" at the shuttle 19 the weft thread laid by the shuttle 197 (preceding shuttle 19), will be exposed by what, in effect, will be an unshedding operation, and as a consequence weft from shuttle 97 will be laid on top of the weft laid by shuttle 197, and a double pick will be formed in the fabric.

In order to prevent this, the warp threads 10 are passed to the rear side ofthe succeeding shuttle 97 also, weft from the shuttle being floated round the loom outside the warps. Thus, on the exhaustion of the spool of any shuttle and consequent emerging of the shuttle from the warps for replenishment, the succeeding shuttle also is caused to emerge from the warps.

In this connection a cam 80, (Figs. 3 and 4), secured to the shaft 76 beneath the pin-wheel 75 bears against one end of a pivoted, spring-urged rocking lever 98 on rotation of the pin-wheel by the toothed lever 67 controlling the shedding for the shuttle 19. The other end of the rocking lever 98 is arranged closely adjacent to the upper extremity of the lever 64 and pushes the lever inwardly again, so causing the lever to strike the latch 63 controlling the shedding mechanism for the shuttle 97, which latch has been brought near the lever 64 by the continued rotation of the cam ring 39. The striking of the lever 64 by the rocking lever 98 is shown in Fig. 4.

This latch 63 releases its lever 67 which rotates about its pivot 68 and, through a link 99 and a

spring-urged crank 100 (see Fig. 3) rotates a spindle 102 in the cam ring 39. A track-switch 74 (Fig. 1) is fixed to the inner end of the spindle 102, and, in the manner explained with reference to the spindle 71 and switch 73 diverts the channel 36 to a new channel 174 with the result that the threads of the warp sheet 18 are pushed to the back of the shuttle 97 also. Both the replenished shuttle 19 and the succeeding shuttle 97 then proceed idly round the loom the whole warp sheet 10 passing behind the two shuttles.

In the meantime, the teeth 72 of the second lever 67 have been brought by the rotation of the ring 39 into engagement with the pin-wheel 75 and have rotated the wheel through another half revolution, bringing the wheel into the position it occupied before its engagement by the first lever 67. The shaft 76 and crank 78 are thus rotated again, the rotation occurring just as the spool extractor 86 has engaged the button 62 of the exhausted shuttle, so that the catch 85 of the lever 83 is brought into position again for engaging the extractor 86.

The cam 80 on the shaft 76 is also rotated with the shaft and enables the rocking lever 98 to release the pivoted lever 64 which is then allowed to hang freely with its end clear of the path of the arms 163 of the catches 63.

The continued forward motion in its circular path of the replenished shuttle 19 draws across the fell 52 of the fabric 12, the length of weft 101 (Fig. 1), which extends from the spool 90 directly to the anchorage 65 prior to being depressed to the fell of the fabric.

At this point in the operation of the loom, the teeth 72 of the lever 67 controlling the shedding mechanism for the shuttle 19 are brought against the pins of a second pin-wheel 103 fixed to a shaft 104 which is rotatably mounted in the support 77. On rotation of the wheel 103, a crank 105 secured to the lower extremity of the shaft 104 is caused to operate an articulated push rod 106, the outer extremity 107 of which is pushed partly across the path of the replenished shuttle 19 (Figs. 1, 4 and 11).

Secured to each shuttle 19 in the path of the rod 107 is a cranked catch 108 which pivots about a point 109 and is connected by a link 110 to a pivoted thread guide arm 111. On engagement of the catch 108 by the rod 107 the motion of the shuttle causes the catch to be rotated about its pivot 109 with the result that the guide arm 111 is swung upwardly to the position shown on the left of Fig. 1, where the hook 51, which is formed at the end of the arm 111, engages the weft length 101 extending from the new spool 90 directly to the anchorage 65. The catch 108 quickly passes the rod 107 and drops to its normal position under the influence of a spring 114 so that the guide arm 111 descends to the vertical position shown in the middle of Fig. 1, with the weft thread 101 engaged within the hook. The weft thread thus proceeds from the new spool 90 to the fell 52 of the fabric 12 where it is laid by the shuttle 19 as it proceeds round the loom. On passage of the lever 67 controlling the shedding mechanism for the shuttle 97 past the pin-wheel 103 the crank 105 is again rotated and draws the extremity 107 of the push rod out of the path of the shuttles.

After the replenished shuttle 19 has completed one revolution round the loom, it is admitted into the warp threads at the point from which it emerged, so that it can continue to weave at precisely the same point at which it ceased.

On completion of a revolution round the loom, a pin 112 depending from the lever 67 controlling the shedding mechanism for the shuttle 19 is brought against an inclined cam face 113 formed at the end of the support 77 (Fig. 4) with the result that the lever is rotated in an anti-clockwise direction about its pivot 68 and the track switch 73 is re-set in its original position, the lever 67 being engaged and held by its catch 63. Warp-shedding for the shuttle 19 thus starts again in the normal manner.

The shuttle 97 is similarly admitted into the warps again, a pin 112 on the lever 67 controlling the shedding mechanism for that shuttle being similarly engaged by the cam face 113 to re-set the track switch 74.

If necessary, to preserve the even spacing of the weft during the revolution of the loom immediately following replenishment of a shuttle, in spite of the omission of the two weft threads, the take-up mechanism of the loom may be caused, by any suitable means (not shown), to take up a slightly reduced amount of fabric during such revolution.

At the point beneath which the shuttles enter and leave the warp threads is fixed a toothed weft cutter 116 (see Figs. 2 and 7) arranged so as to operate close to the surface of the fabric. The cutter 116 is actuated by a rotatable spindle 117 having an upstanding extremity 118 which is engaged by a catch 119 projecting from the rotating ring 29 (see Fig. 2). The cutter 116 is thus caused to sever the weft length extending from the fabric to the ejected spool 46, together with the anchored weft 101 and the floated weft ends left on the surface of the warp threads, which ends proceed from, and re-enter the warps at the same point.

Breakage and jamming of the warp threads 10 is detected by a feeler 120 (Fig. 1) which is pivoted at the top of each shuttle and projects forwardly from the lower portion of the shuttle. On encountering a jam of the warp threads, the feeler 120 is pushed backwardly towards the shuttle, and actuates a push-rod 121 which operates to bring to an end relative motion between the shuttles and the warps conveniently in the manner explained in detail in U. S. application S. No. 655,561 filed 7th February, 1933.

What we claim and desire to secure by Letters Patent is:—

1. In a circular loom, a shuttle between which and the warp threads there is relative circular motion with respect to the loom axis, a weft spool in said shuttle, means operable on substantial exhaustion of said spool to manipulate the warp threads in the vicinity of the shuttle so as to stop weaving by said shuttle during a predetermined interval without interrupting said relative circular motion between said shuttle and said warp threads, means to extract the spool from the shuttle, and means to replenish the shuttle with a fresh spool during said interval.

2. In a circular loom, a shuttle between which and the warp threads there is relative circular motion with respect to the loom axis, a weft spool in said shuttle, a plunger in said spool adapted to be restrained in the presence of weft on said spool and released on substantial exhaustion of the weft so as to protrude from a side of said shuttle and to form a protuberance in said relatively moving warp threads, a feeler disposed at the other side of said warp threads in close association therewith and adapted to be moved on contacting with said protuberance, means

under the control of said feeler adapted on movement thereof to manipulate the warp threads in the vicinity of the shuttle so as to stop weaving by said shuttle during a predetermined interval without interrupting said relative circular motion between said shuttle and said warp threads, means to extract the spool from the shuttle, and means to replenish the shuttle with a fresh spool during said interval.

3. In a circular loom, a shuttle, a weft spool in said shuttle, warp-shedding means, means operable on exhaustion of said spool to render said shedding means inoperative so that the shuttle emerges from the warp shed, means to extract the exhausted spool from the shuttle and means to replenish said shuttle with a fresh spool while said shuttle is out of the shed, and means to restore the shedding operation after the replenishment of said shuttle.

4. Circular loom, comprising a shuttle, means for rotating said shuttle about the axis of the loom, weft-replenishing mechanism, warp-shedding mechanism, controlling mechanism for said warp-shedding means operable on exhaustion of weft in said shuttle to render said warp-shedding mechanism inoperative as the shuttle approaches said weft-replenishing mechanism, so allowing said shuttle to emerge from the warp shed for replenishment by the weft-replenishing mechanism, and means to render the warp-shedding means operative after replenishment of the shuttle and to allow the replenished shuttle to re-enter the warp shed.

5. In a circular loom, a shuttle, means for replenishing said shuttle with weft on exhaustion thereof, warp-shedding members, a cam adapted to actuate said warp-shedding members, controlling mechanism for said cam operable on exhaustion of weft in said shuttle to change the contour of said cam to allow said shuttle to emerge from the warp shed, means for operating said weft-replenishing mechanism on emergence of said shuttle from the warp shed, and means operable after replenishment of said shuttle to actuate said cam-controlling mechanism so as to allow said shuttle to re-enter the warps.

6. In a circular loom, a shuttle, means for replenishing said shuttle with weft on exhaustion thereof, warp-shedding members, a cam track adapted to actuate said warp-shedding members, a switch in said track operable on exhaustion of weft in said shuttle to divert said cam track to a different track so that shedding of the warp threads is stopped and the exhausted shuttle emerges from the warp shed, means for operating said weft-replenishing mechanism on the emergence of said shuttle from the warp shed, and means for re-setting said track switch after the replenishment of said shuttle to re-commence the shedding operation so as to allow said shuttle to re-enter the warps.

7. In a circular loom, a shuttle, means for replenishing said shuttle with weft on exhaustion thereof, warp-shedding members, a cam track adapted to actuate said warp-shedding members, a switch in said cam track adapted to divert said track to a different track so that the shedding members are caused to push the warp threads behind the shuttle, a control lever for said switch, means for moving said control lever on exhaustion of weft in said shuttle so as to operate the switch, means to operate the weft-replenishing means on emergence of the shuttle from the warp shed, and means to re-set the track switch control lever to its original position to allow of re-admittance of said shuttle into the warps after the replenishment of said shuttle.

8. In a circular loom, a shuttle, a weft spool in said shuttle, a spool extractor operable on exhaustion of said spool to extract said spool from the shuttle, a chute adapted to receive the extracted spool, a magazine of reserve spools, and a spool injector adapted to carry a fresh spool from said magazine and to place said fresh spool in the shuttle after extraction of the exhausted spool.

9. Apparatus according to claim 8, wherein the spool extractor and the injector are linked so that the movement of the extractor to extract the exhausted spool from the shuttle brings the injector carrying the fresh spool into position for the fresh spool to be engaged by the shuttle.

10. In a circular loom, a shuttle adapted continuously to rotate about the axis of the loom, a weft spool in said shuttle, a lever, a pivot for said lever, a spool extractor pivotally mounted on one extremity of said lever, means operable on exhaustion of said spool to rotate said lever about its pivot so as to bring said extractor to the moving shuttle to engage said spool, a stop disposed in said shuttle and caused by the movement thereof to push said spool after said spool is engaged by said extractor, and by virtue of the continued rotary motion of the shuttle, to expel said spool from the shuttle and out of engagement with said extractor while pushing said extractor and causing said lever to rotate about its pivot in a reverse direction, and a spool injector pivotally mounted on the other extremity of said lever and caused by the reverse motion of said lever to replenish said shuttle with a fresh spool after the extraction from said shuttle of said exhausted spool.

11. In a circular loom, a shuttle, means for rotating said shuttle continuously about the axis of the loom, a weft spool in said shuttle, a feeler adapted to feel weft on said spool, a plunger in said spool restrained by said feeler in the presence of weft on the spool, but released by said feeler on substantial exhaustion of the weft, a button on the end of said plunger adapted to be urged outwardly from said spool on release of said plunger, a lever, a spool extractor pivotally mounted on one extremity of said lever and adapted on weft-exhaustion to approach said moving shuttle and to grip said outwardly urged button, a stop disposed in said shuttle and caused by the movement thereof to push said spool after said button is engaged by said extractor, and by virtue of the continued rotary motion of the shuttle, to expel said spool from the shuttle and out of engagement with said extractor, and a spool injector pivotally mounted on the other extremity of said lever and adapted to replenish said shuttle with a fresh spool after the extraction from said shuttle of said exhausted spool.

12. In a circular loom, a shuttle, means for rotating said shuttle continuously about the axis of the loom, a weft spool in said shuttle, weft feeling means adapted to indicate substantial exhaustion of weft on said spool, warp shedding members, a cam track adapted to actuate said warp shedding members, a switch in said cam track adapted to divert said cam track to a different track so that warp shedding is stopped and the shuttle can emerge from the warps, a lever in connection with said track switch and adapted on rotation to operate said switch, means actuated by said weft feeling means to

rotate said lever on weft exhaustion, a spool extractor, means actuated by said track switch lever to advance said spool extractor to the shuttle to engage the exhausted spool after its emergence from the warps, a stop disposed in said shuttle and caused by the movement thereof to push said spool after engagement thereof by the extractor, and by virtue of the continued rotary motion of the shuttle to expel said spool from the shuttle and out of engagement with said extractor, a spool injector in connection with said extractor and adapted by the movement thereof to replenish said shuttle with a fresh spool, and means to reset the track switch lever after shuttle replenishment.

13. In a circular loom, a shuttle adapted to lay weft at the fell of the fabric, a weft spool in said shuttle, means operable on exhaustion of said spool to extract said spool from the shuttle, means to replenish the shuttle with a fresh spool, means to which the end of the weft on said fresh spool may be secured, a guide carried by the shuttle and movable relatively thereto, means to operate said guide so as to bring said guide into engagement with the weft extending from said securing means to said fresh spool, and means to move the guide and the weft engaged thereby to the fell of the fabric.

14. In a circular loom, a shuttle between which and the warps there is relative circular motion, a weft spool in said shuttle, said shuttle being adapted to lay weft from said spool at the fell of the fabric, means operable on exhaustion of said spool to extract said spool from the shuttle, means to replenish the shuttle with a fresh spool, means to hold the end of weft extending from said fresh spool, a guide on said shuttle, and means to operate said guide to engage the weft length extending between the fresh spool and the weft holding means, and to depress said weft to the fell of the fabric, without cessation of said relative circular motion between the shuttle and the warps.

15. In a circular loom, a plurality of shuttles between which and the warp threads there is relative circular motion with respect to the loom axis, a weft spool in each shuttle, means operable on substantial exhaustion of the weft in any spool to manipulate the warp threads in the vicinity of the shuttle containing such spool so as to stop weaving by said shuttle during a predetermined interval without interrupting said relative circular motion between said shuttles and said warp threads, means to extract the exhausted spool from its shuttle, and means to replenish said shuttle with a fresh spool during said interval.

16. In a circular loom, a plurality of shuttles adapted to lay weft in the fabric, weft replenishing means, warp-shedding means, control means for said warp-shedding means in association with each shuttle, means disposed in each shuttle and controlled by the weft therein adapted on weft exhaustion to actuate the corresponding shed control, means to permit said shuttle to emerge from the warp shed, means actuated by said weft-controlled means for operating said weft replenishing means on emergence of said exhausted shuttle from the warp shed, and means to render the warp-shedding means operative after replenishment of the shuttle and allow the replenished shuttle to reenter the warp shed.

17. In a circular loom, a plurality of shuttles between which and the warps there is relative circular motion, said shuttles being adapted to lay weft in the fabric, weft replenishing means, warp shedding means adapted to divide the warp threads into two sheets for the reception between them of a shuttle and to change over said sheets for each consecutive shuttle, control means for said warp-shedding means in association with each shuttle and adapted on weft exhaustion to actuate the corresponding warp shedding means so as to bring to an end warp shedding at that shuttle to allow said shuttle to emerge from the warp shed, means to actuate said weft replenishing means on emergence of said exhausted shuttle from the warp shed, means to bring to an end warp shedding at a shuttle adjacent the exhausted shuttle to cause said shuttle also to emerge from the warps, so preventing the laying of weft in the fabric by said shuttle, and means to return the warp shed controlling means of both shuttles into operation after the replenishment of the exhausted shuttle.

18. Circular loom according to claim 17, comprising means operable after one revolution of the loom to actuate the means by which the warp-shed controlling means of the exhausted shuttle and the adjacent shuttle are returned into operation.

HENRY DREYFUS.
WILLIAM POOL.