Sept. 1, 1936. W. POOL 2,052,655

SHUTTLELESS LOOM AND WEFT SUPPLY MECHANISM THEREFOR

Filed Dec. 16, 1933 2 Sheets-Sheet 1

FIG. 2.

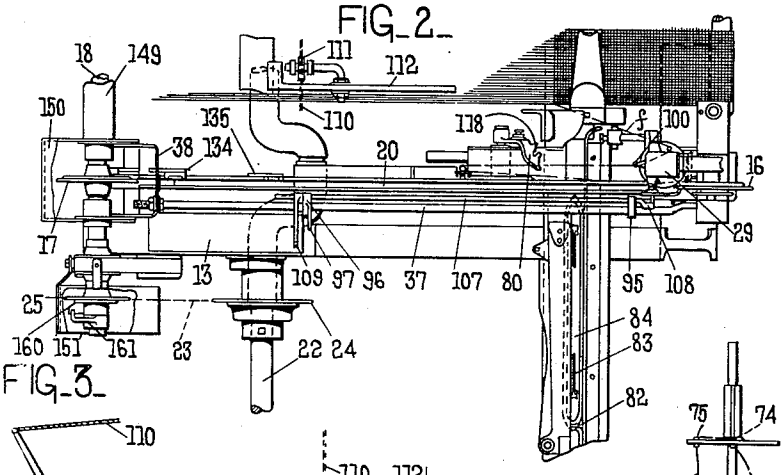


FIG. 3.

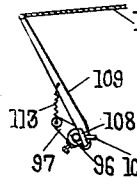


FIG. 1.

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FIG_4_

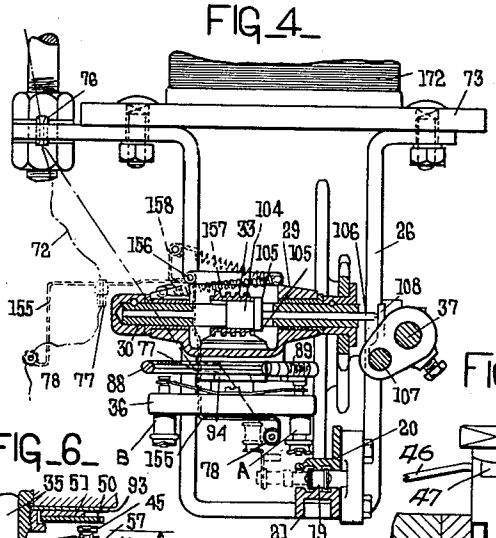


FIG_8_

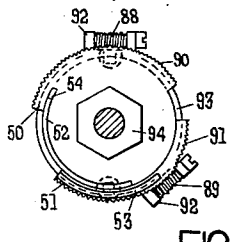


FIG_13_

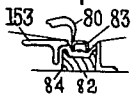


FIG_9_

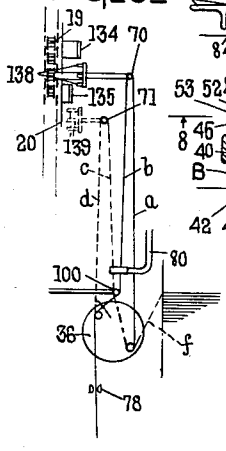


FIG_6_

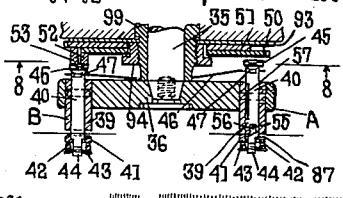


FIG_14_

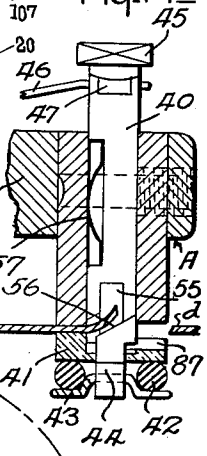


FIG_7_

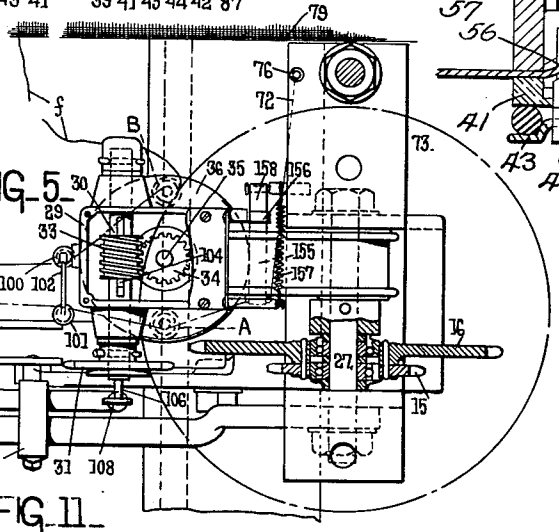


FIG_5_

FIG_10_

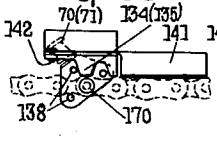


FIG_11_

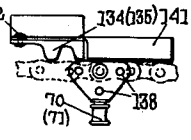
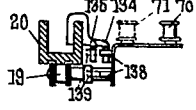


FIG_12_



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Patented Sept. 1, 1936 2,052,655

UNITED STATES PATENT OFFICE

2,052,655

SHUTTLELESS LOOM AND WEFT SUPPLY MECHANISM THEREFOR

William Pool, Spondon, near Derby, England, assignor to Celanese Corporation of America, a corporation of Delaware

Application December 16, 1933, Serial No. 702,763
In Great Britain December 31, 1932

17 Claims. (Cl. 139—126)

This invention relates to shuttleless looms, that is looms in which the weft supply does not pass through the shed, and in particular to shuttleless looms in which the weft is drawn into loop form prior to insertion.

U. S. Patent 2,012,121, describes weft measuring apparatus comprising a plurality of movable trapping devices adapted successively to take up a position in which weft trapped in one of the devices can be drawn into a loop adapted to be inserted into the warps. The present invention is concerned with shuttleless looms of the type employing movable trapping means for bringing the weft into position to be engaged by the loop-drawing means, and has for its object to enable the weft measuring to be effected in a simple manner and one which is particularly advantageous in the weaving of wide fabrics.

The weft measuring according to the invention is effected by movable trapping means by which the weft is carried across the path of loop-drawing means adapted to draw the weft into a succession of loops each substantially equal to a pick length, the loops being freed in turn for insertion into the warps and the weft being severed from the supply after the formation of each successive pair of loops so that the weft can be laid as pairs of picks in separate sheds and connected together at the edge of the fabric. The movement of the trapping means brings about the presentation of weft for the formation of both of the successive pairs of loops to the drawing means, the trapping means conveniently comprising a plurality of movable trapping devices, the movement of one of which serves to carry weft held therein across the path of the drawing means for the formation of one loop, while the movement of the other brings it into engagement with the weft in readiness for a further carrying of the weft across the path of the drawing means for the formation of the next loop.

Release of the weft from the trapping means to free a loop for insertion and re-gripping of the weft are effected by any suitable means, e. g. cams which are engaged by the movement of the trapping means.

Since, for a reason fully explained below, the loop forming the first of a connected pair of picks should be longer than the loop for the second pick, means are provided to compensate the loop lengths. Though, in a manner similar to that described in U. S. Patent No. 1,925,336 in connection with the formation of weft loops each sufficient for two picks, the cutting of the weft after formation of the second loop can be effected at some distance from the trapping device, thus shortening the effective length of the second loop, it is more convenient to cut at the trapping device, e. g. by means of a cutter embodied in the trapping device. In this case, the actual loop lengths must be adjusted, the invention comprising means for this purpose.

Thus, means may be provided to release the loops after the drawing means have travelled different distances. For example, two drawing means may be provided, each adapted to be engaged by its own releasing means positioned at appropriate distances from the trapping means.

A particularly convenient embodiment of the invention comprises an endless chain forming a common carrying member for a pair of loop-drawing carriers, a rotatable member carrying a pair of trapping devices, one incorporating a cutter, and a pair of releasing members spaced apart along the drawing run of the chain. The cutting trapping device carries the end of the weft across the path of one carrier and frees the weft as the appropriate releasing member engages the drawing member after a longer loop has been drawn. The non-cutting trapper device which by its movement has engaged the weft seizes the weft and carries it across the path of the second carrier and the second shorter loop is drawn and released from the carrier and the non-cutting trapping device. Again, the cutting trapping device has engaged the weft and closes to sever the second loop, at the same time seizing the end extending from the supply in readiness for the next loop-forming cycle. Picks inserted from one side of the loom are preferably alternated with similarly drawn picks from the other side of the loom.

The above-mentioned embodiment will now be described in greater detail with respect to the accompanying drawings, in which

Fig. 1 is a side elevation of a loom equipped with the weft presenting and measuring apparatus according to the invention;

Fig. 2 is a plan view of the left-hand side of the loom showing the weft presenting and measuring apparatus;

Fig. 3 shows in elevation a detail of Figs. 1 and 2;

Fig. 4 shows in part-sectional elevation part of the weft presenting and measuring apparatus viewed from the rear of the loom;

Fig. 5 is a part-sectional plan view of the weft presenting and measuring apparatus;

Fig. 6 is a sectional elevation of part of the weft presenting apparatus;

Fig. 7 is a detail of Fig. 6 shown in plan;

Fig. 8 is an underneath plan view taken on the line 8—8 of Fig. 6;

Fig. 9 shows somewhat diagrammatically in plan the weft-loop measuring and releasing apparatus;

Fig. 10 shows in elevation a detail of Fig. 9 on larger scale;

Fig. 11 shows in elevation the same detail as Fig. 10, but in a different position;

Fig. 12 is a sectional elevation of a detail of Fig. 9 on larger scale;

Fig. 13 is a sectional elevation showing the presentation of weft to the dummy shuttle of the loom; while

Fig. 14 shows in part cross-sectional elevation a detail of Fig. 2 on larger scale.

Figs. 1 and 2 show the weft presenting and measuring apparatus extending from the front to the rear of the loom parallel to the side-frame 13, the apparatus including a bracket 14 carrying the weft presenting mechanism. The weft presenting mechanism is driven from a sprocket 15 connected to a sprocket 16 driven from a sprocket 17 mounted on a shaft 18 at the rear of the loom by a chain 19 which is guided along its lower run by guides 20, 21 (see Figs. 1 and 4) attached to the bracket 14. The back-shaft 18 is driven from the crank-shaft 22 by means of a chain 23 and sprockets 24, 25. The shaft 18 extends across the length of the loom to drive similar weft presenting and measuring apparatus (not shown) situated at the right-hand side of the loom.

The weft presenting mechanism (shown in detail in Figs. 4 and 5) is carried on the bracket 14 by a U-frame 26, between the upright limbs of which is provided a bearing spindle 27 for the sprockets 15, 16. The bracket 14 is clamped in position on the loom frame by a bolt 28 (Fig. 1). The U-frame also serves to hold a rearwardly projecting casing 29. A horizontal spindle 30 rotatably mounted in the casing 29 is driven by a sprocket 31 which is driven in turn by a chain 32 from the sprocket 15. A worm 33 mounted on the spindle 30 drives a worm-wheel 34 attached to the upper extremity of a vertical spindle 35, extending downwardly from the casing 29, and carrying at its lower extremity a disc 36. The U-frame 26 is connected by a radius rod 37 to a frame 38, the frame being carried by the back-shaft 18 and bridging the sprocket 17.

The disc 36 carries on its lower face two diametrically-opposed trapping devices A, B (Figs. 4, 6, and 14), which comprise sleeves 39 forming bearings for spindles 40. Each spindle 40 is provided with a fibre pad 41 and a rubber washer 42 held in place by a slotted clip 43 (Figs. 7 and 14) slipping into slots 44 near the lower extremity of each spindle. The upper extremity of each spindle 40 is formed with a head 45 adapted to be engaged by a cam during rotation of the disc 36 so as to depress the spindle and to push the fibre pad 41 away from the projecting end of the sleeve 39, thus leaving a gap into which weft thread can enter.

A spring 46 secured to the disc 36 and having its ends acting in slots 47 under the heads 45 of the spindles normally urges each fibre pad 41 into contact with the end of its sleeve 39, the tendency being for the pad to trap any thread lying between it and the end of the sleeve. The cams operating the spindles 40 are carried by circular plates 50, 51 (Figs. 6 and 8) which are stationarily mounted coaxially with the disc 36. The plates 50, 51 carry curved cam projections 52, 53 respectively, which have a certain amount of angular overlap, the operative portion of the cam thus extending from the free end of the one piece 52 to the free end of the other piece 53. The heads 45 on the spindles 40 are carried by the rotation of the disc 36 into contact with the cams 52, 53, riding up a ramp 54 formed at the free end of the cam 52 and dropping sharply on reaching the square end of the succeeding cam 53.

The spindle 40 of the trapping device A is notched at a point 55 towards its lower extremity so as to form a sharp blade-like edge 56 in the side of the spindle (see Fig. 14). On depression of the spindle 40 the sharp edge 56 is pushed below the lower extremity of the sleeve 39 so that the notch 55 forms part of the gap between the sleeve 39 and the fibre pad 41 into which the weft thread enters. As the corresponding cam permits the spring 46 to retract the spindle 40, however, the upward motion of the spindle causes the sharp edge 56 to sweep against the lower extremity of the sleeve 39 and to sever thread engaged in the gap. A bow spring 57 secured within the spindle urges the spindle laterally against the sleeve 39 and causes the edge 56 of the notch 55 to maintain close contact with the edge of the sleeve to ensure a clean and quick severing action.

On rotation of the disc 36 the trapping devices A, B follow a circular path beneath the cams 52, 53 and are opened and closed successively as the spindle heads 45 meet and leave the cams. Weft carriers 70, 71 pivotally mounted at 170, 171 respectively on the chain 19 are carried by the chain across the lower face of the disc 36 in such a manner as to pass between the trapping devices A, B, the rotation of the disc 36 by the worm 33 being timed so that as either carrier 70, 71 reaches the vicinity of the disc the trapping devices A, B lie on each side of the chain run.

Weft thread 72 unwinds from a large-capacity package 172 mounted on a plate 73 which rests on the U-frame 26 and proceeds through tubular guides 74, 75, 76, 77 and 78 (Fig. 4) to the disc 36. The weft thread is trapped in the trapping device A which for the time being is closed. The last weft guide 78 is suspended in such a position as to direct the weft thread 72 passing therethrough towards the lower face of the disc 36 at a height substantially in line with the jaws of the trapping devices A, B, so that on rotation of the disc the weft thread held by the trapping device A is drawn across the face of the disc, and consequently across the chain run to the trapping device B, which is held open during this part of the rotation of the disc 36 by the cam 52.

In this position the short length of weft extending between the two trapping devices A, B is engaged by the carrier 70, and is drawn thereby in loop form towards the rear of the loom, the end of the weft thread being held securely in the trapping device A, while weft from the supply package 172 runs freely between the opened jaws of the trapping device B into the loop. The length of weft in the loop is substantially equal to the width of the fabric being woven, and the carrier 70 is caused to deflect about its pivot 170 (by means to be described later) at a distance from the trapping devices A, B determined by the loop length required so as to release the bight of the weft loop and leave the loop ready for insertion into the shed.

Consecutive pairs of picks are connected so as to form "hairpins" of weft in the fabric 79, the two limbs of each "hairpin" lying in different sheds, and representing successive and connected loops of weft drawn at the same side of the loom. A loop-pair is illustrated diagrammatically in Fig. 9, the second loop of the pair being shown in dotted line. When the loop being drawn comprises the first of one of such pairs, the end of the weft thread is held in the trapping device A. On release of the bight of the loop from the carrier 70 the trapping device A opens and releases the extremity of the loop limb held thereby (indicated at *a* in Fig. 9), and B closes and traps the limb *b* which is still connected to the supply. After insertion of the pick, weft (indicated at *f* in Figs. 2 and 5) extends from the edge of the fabric 79 to the trapping device B. After the second loop has been drawn the trapping device B opens, thus freeing the point of connection of the length *f* and the limb *c*, and the trapping device A closes and cuts the extremity of the limb *d*, leaving the loop free for insertion into the warps, while still maintaining a grip on the weft extending from the supply.

When the first loop is released, a depresser member 80, pivotally mounted on the slay 81 of the loom descends and depresses one limb of the loop towards the shuttle race 82, where the limb is engaged by a prong 83 upstanding from the body of a dummy shuttle 84 just as the shuttle passes under the loop. The first pick length of weft is thus laid in the warp shed, the free limb *a* of the loop trailing around the prong 83 until the opposite side of the warps is reached, when the free end of the pick slips from the prong and is beaten-up into the fabric 79 by the reed 85 as a single thread of weft. The disc 36 revolves through 180° for each pick, one trapping device gripping the weft thread during one half-revolution, and the other trapping device gripping the weft thread during the other half-revolution, the complementary trapping device in each case being held open during loop formation in order to allow of weft from the supply running freely between its jaws into the loop.

Because of the necessity to provide for the length of weft *f* on insertion of the first pick into the warps, the first loop to be drawn of each pair must contain the extra length of thread. The provision of this extra length is effected by causing the weft carriers 70, 71 to deflect about their pivots 170, 171 on the chain 19 at different points along the chain run. Two carrier-deflecting stops (to be described later) are provided at different distances from the front of the loom, the one furthest away from the front of the loom always engaging the carrier 70, which draws the first, and therefore the larger loop, and the other always engaging the carrier 71, which draws the second loop.

After insertion and beat-up of the first pick, the shedding mechanism (not shown) operates and prepares a shed for the insertion of a similarly formed pick length from the other side of the loom.

In the meantime the continued rotation of the disc 36 has caused the trapping devices A, B to rotate through 180° so that the trapping device B (which now grips the weft thread extending from the fabric 79 to the supply) occupies the position formerly occupied by A, and the trapping device A occupies the position formerly occupied by B. During such rotation the weft thread is caused to extend again across the face of the disc 36, and, being directed by the guide 78, is engaged loosely by the opened trapping device A in the manner described with reference to the commencement of the formation of the first loop. The short length of weft again extending between the trapping devices A, B is engaged by the second carrier 71, and is drawn into loop as explained above.

Substantially simultaneously with the release of the bight of the second loop the trapping device B opens, thus freeing the point of connection of the length *f* and the limb *c* of the loop and the trapping device A closes. In closing, the edge 56 of the notch 55 in the spindle 40 of the trapping device A passes the edge of the sleeve 39 and severs the extremity of the limb *d*, which is allowed to leave the trapping device A freely through a small channel 87 (Figs. 6 and 14) formed in the fibre pad 41. The remaining severed end, however, is trapped between the pad 41 and the lower extremity of the sleeve 39, as shown clearly in Fig. 14, a connection to the supply thus being maintained in readiness for the formation of another loop.

The whole of the second loop is thus freed, and the depresser member 80 again descends and depresses the loop limb *c* towards the shuttle race 82 where it is engaged by the prong 83 of the shuttle 84 (which, in the meantime, has returned from the right-hand side of the loom, laying on its way weft drawn by the measuring apparatus at the right-hand side of the loom), and is laid in the next shed in the manner previously described. A pair of connected picks are thus laid in separate sheds, and the cycle of operations is repeated.

The timing of the deflection of the weft carriers, and the release of weft by the trapping device A (on the first loop), and by B (on the second loop) in relation to the timing of the depresser member 80 is such that the loop limb to be engaged by the prong 83 of the shuttle 84 is maintained under slight tension whilst being depressed, so that accuracy of position of the thread is ensured. The construction of the cams 52, 53 allows of both trapping devices A and B being operated by the same cam, so that the trapping devices are operated at exactly the same time, and at the same point, in every revolution of the disc 36.

In addition to the control thus afforded, the cams are also adjustable as to position relative to each other. Thus, on completion of the drawing of the second loop, the trapping device A closes whilst the weft in the loop is under slight tension, the tension assisting clean and quick cutting of the thread, while the timing of the closing of the trapping device B is such as to operate after engagement of the first loop by the shuttle 84 in order to prevent the possibility of straining the weft thread owing to its rapid entry into the shed. Though the same cam (53) effects the closing of both trapping devices, later closing of the trapping device B may be effected by backwardly extending the head 45 of its spindle so that the spindle 40 remains under the influence of the cam after the cam has passed over it.

The combined length of the cams 52, 53 is adjustable by means of worm gears 88, 89 engaging teeth 90, 91 extending round part of the circumference of the plates 50, 51 respectively. The worms 88, 89 are carried by bearings 92 (Fig. 8) formed by turned-over projections of a plate 93 lying above the cam plates 50, 51. The

plate 93 is secured against the underside of the casing 29 by a nut 94, about which the cam plates 50, 51 can be rotated by the worms 88, 89, the nut 94 engaging the threaded lower portion of a sleeve 99 forming a bearing for the vertical spindle 35 (see Fig. 6).

In order to avoid danger of the ends of the picks slipping from the prong 83 prematurely, the limb *b* (furthest from the warps) of the first loop is engaged by the prong 83, while the limb *c* (closest to the warps) of the second loop is engaged by the prong so that in each case the longer length of each loop trails around the prong on insertion into the warps. This selection of one or the other limb is conveniently effected by drawing the first loop to the right-hand side (in plan) of a peg 100 which is suspended from the casing 29 and depends centrally before the disc 36 so that the limb *b* is guided directly beneath the depresser member 80 (see Fig. 2) and by drawing the second loop to the left-hand side of the peg 100 so that the limb *c* is guided directly beneath the depresser member. A guide 101 on an arm 102 which is suspended from the casing 29 prevents the limb *d* of the second loop fouling or contacting with the edge of the chain guide 20.

In order that the first and second loops of a pair are drawn to the right-hand side, and to the left-hand side respectively, of the peg 100, the carrier 70 (which draws the first loop) extends laterally from the chain 19 beyond the peg 100 to a position substantially centrally disposed with respect to lines parallel to the warps passing through the peg 100 and the trapping device nearest the warps, while the carrier 71 (which draws the second loop) extends laterally from the chain 19 only so far as to cause its line of travel to be centrally disposed with respect to the peg 100 and the guide 101.

The central disposition of the peg 100 with respect to the disc 36 renders it necessary that the trapping devices A and B are in a line substantially perpendicular to the warps at the moment either carrier 70 or 71 is about to pass beneath the disc, in order to prevent collision between the carriers and the trapping devices. Again, the rate of rotation of the disc must not be such as to bring the extremities of the loop limbs into too close proximity prior to the action of the depressing member 80 in order to avoid the danger of depressing two limbs at once.

The rotation of the disc is therefore caused to be of intermittent character, viz., relatively slow during the passage beneath it of a carrier and during the formation of a loop, and relatively quick whilst drawing across its face weft from one trapping device to the other prior to the formation of a loop. Such rotation enables the trapping devices A and B to be set relatively closely together on the face of the disc, and is conveniently effected in the manner dscribed in U. S. Pat. No. 1,965,084. Thus, as shown clearly in Figs. 4 and 5, the horizontal spindle 30 carrying the worm 33 is slotted to receive a slidable key 104 which extends through the spindle and engages corresponding slots in the bore of the worm, shoulders 105 of the key meeting the end of the worm. The right-hand portion of the spindle 30 is hollow, and admits a push-rod 106 which extends from the key 104 to a point outside the spindle. On rotation of the spindle 30 by the sprocket 31, the worm 33 and key 104 rotate solidly with the spindle, and the worm-wheel 34 on the vertical spindle 35, and consequently the disc 36, are driven normally. Just as the weft is due to be drawn across the face of the disc 36 between the trapping devices A and B, however, the push-rod 106 is urged inwardly towards the key 104, the shoulders 105 of which are caused to push the worm 33 bodily along the spindle 30. In addition to being driven by the rotation of the worm 33, the worm-wheel 34 is thus subjected to a further impulse and is rotated relatively rapidly, causing the disc 36 to draw weft across its face sharply from one trapping device to the other. When the pressure on the push-rod 106 is released, the worm 33 screws itself back to the right-hand extremity of the slot in the spindle 30 in readiness for the next impulse. During the return of the worm 33 along the spindle 30 the drive of the disc 36 is correspondingly slowed, and allows of free passage of a carrier between the trapping devices and the peg 100.

The push-rod 106 is operated at the correct intervals by any suitable mechanism (not shown), e. g. the shedding mechanism of the loom, by means of a rod 107 which has a turned-up extremity 108 adapted to contact with the right-hand extremity of the push-rod. An arm 109 (Fig. 3) fixed to the rod 107 is rotated by a cord 110 attached to the shedding mechanism, and which passes over a pulley 111 disposed in the upper framework 112 of the loom. On rotation of the rod 107, the extremity 108 forces the push-rod 106 inwardly. The rod 107 is supported in bearings 95, 96 attached to the radius rod 37, and an arm 97, outstanding from the bearing 96, provides support for a tension spring 113 which returns the arm 109 to normal position.

The depresser member 80 pushes the loop limb in contact with the peg 100 downwardly and out of contact therewith during its descent towards the shuttle-race 82, the extremity of the depresser member being shaped so as to place the weft in the path of the prong 83 of the weft inserter 84 without contacting therewith. A convenient form of extremity for the depresser member is shown in Fig. 13. The depresser member 80 is formed with an inclined slot 118 (Fig. 2) which extends upwardly from the extremity of the member on the side nearest the warps. The slot 118 allows of control of the loop limb *a* of the first loop whilst the loop limb *b* is being depressed. Vibration of the limb *a* is thus prevented, and any tendency for the loop limb to descend under the influence of the limb *b* is prevented by the inclined nature of the slot 118.

As the engagement and insertion of a pick at one side of the loom alternates with the engagement and insertion of a pick from the other side of the loom, the depresser member 80, at each side of the loom, descends only at every other revolution of the loom crank-shaft 22. The depresser member 80 is operated by means of a cam 119, mounted on the half-time shaft 120 of the loom, and engaging a follower 121 rotatably mounted in one extremity of a cranked lever 122 which is pivoted at 123. The other extremity of the lever 122 pivotally engages at 124 an upright rod 125 (seen in dotted line behind the slay-sword 126 in Fig. 1), which is pivotally connected at 127 to the depresser member 80. On rotation of the cam 119 the upright rod 125 is caused to descend by the cranked lever 122, and the depresser member 80 is actuated. The timing of the cam 119 is such as to cause the depresser 80 to descend just before the dummy shuttle 84 is picked through the shed from the left-hand side

of the loom. A compression spring 130 surrounding the lower extremity of the rod 125 and supported by a fixed collar 131 on the rod, acts as a cushioning device.

The deflection of the loop carriers 70, 71 about their respective pivots on the chain 19 is accomplished by toothed stops 134, 135, respectively, which are adjustably mounted on the upper chain guide 20 (Fig. 9) to depend downwardly towards the chain level at the points of release of the first and second loops. Sets of three pegs 138 and 139 project laterally from the carriers 70, 71, respectively, each set of three being arranged on the corresponding carrier as three corners of a square (see Figs. 10, 11, 12). The pegs are engaged from above by the teeth of one of the stops as the chain 19 proceeds towards the rear of the loom and cause their carrier to rotate through 180°, thereby enabling the loop limb being drawn to be released quickly. In order that the respective stops deflect their corresponding carrier only, the stop 134 projects from the chain guide a greater distance than the stop 135, and the pegs 138 of the carrier 70 are relatively short in length so as to miss the stop 135, but are engaged at the stop 134 (see Fig. 9). The pegs 139 of the carrier 71, on the other hand, are relatively long and are engaged by the first stop 135. After inversion of the carrier 71 the long pegs 139 pass freely beneath the stop 134 without contacting therewith.

The normal rate of travel of the chain 19 is such as to cause rapid rotation of the carriers, and to avoid over-running of the carriers each stop 134, 135 is provided with an extension 141 of spring metal, which is secured to the stop by a single rivet 142, and depends at the rear of the stop to the level of the last tooth. On inversion of the carriers, the two lower pegs, in each case, are brought into contact with the extension 141 and are prevented thereby from rotating through too great an angle. The springy nature of the material of the extension 141 acts as a shock-absorber, and preserves the pegs of the carriers. A similar toothed stop 143 (see Fig. 1) placed just in front of the sprocket 17, its teeth projecting upwardly towards the chain run to engage the pegs of both carriers from the under-side, rotates the carriers again back to upright position in preparation for the next loop-drawing operation.

By reason of the facts that the first and second loops of a pair are drawn to different lengths by the carriers 70, 71, respectively, and that the loops must be released from their respective carriers at regular intervals corresponding to the regular insertion of the thread into the warps, the carriers must reach their different points of deflection at regular intervals. The carriers are therefore positioned on the chain 19 in such a manner that the distance between them measured (from 70—71) in the direction of their progression is equal to half the length of the chain plus a distance equal to the distance between the points of release of the first and second loops.

Though this arrangement of the carriers 70, 71 on the chain 19 causes the carriers to pass beneath the disc 36 at irregular intervals during the loop forming cycle, the intermittent nature of the rotation of the disc 36 is such as to place the trapping devices A, B on opposite sides of the chain run (and consequently to present thread for engagement by the approaching carrier) before the arrival of either carrier.

The successive operations of weft-trapping, presenting, re-engaging and severing are thus effected essentially by the movement of the disc 36 bearing the two trapping devices A, B, while the drawing and measuring of the successive loops are effected essentially by the movement of the chain 19 bearing the two carriers 70, 71. The several operations of weft-trapping, presenting, re-engaging, loop-drawing, measuring and severing are thus performed by very few principal moving parts, viz., the disc 36 and the chain 19 which drives the disc. Setting of the mechanism is, therefore, very simply effected, especially as the opening and closing of the trapping devices A, B, the operation of the thread-cutter in the trapping device A, and also the setting and releasing of the loop-carriers are performed by the movements of the disc 36 and the chain 19, respectively.

The entire assembly of the weft presenting and measuring apparatus is adjustably mounted on the loom and can simply be moved towards or away from the side of the loom in accordance with the width of the fabric being woven, in order to keep the length of weft *f*, extending from the first inserted pick to the weft presenting apparatus, to a minimum. This is effected by releasing the bolt 28 holding the bracket 14 to the frame of the loom, and by releasing the sprocket 17 on the back-shaft 18 of the loom. If desired, distance pieces of the type described in U. S. Patent No. 2,005,391 may be employed. Again, the back-shaft supporting bracket 146 can be moved towards or away from the front of the loom simply by releasing the bolts 147, 148, and adjusting the operative length of the radius rod 37 mentioned above.

A tubular guard 149 (Fig. 2) surrounds the shaft 18, and may be telescopic in order to permit of width adjustment, referred to above. Guards 150 and 151 surround the sprockets 17 and 25 respectively, the whole guard assembly preventing danger to the loom operative whilst attending the warps 152. A weft-guard 153 situated over the slay 81 prevents entanglement of thread as the weft loops are being drawn into the warp shed by the shuttle 84.

In order to facilitate threading up the weft guides 77, 78 are held in a support 155 (Fig. 4) which is pivoted at 156 in order to enable the guides to be swung away from the disc 36 and its associated mechanism. A tension spring 157, secured at one extremity to the casing 29, and at the other to an outstanding portion 158 of the support 155 serves to maintain the support, and consequently the guides 77, 78, in the threading, or in the operative position, as required.

As shown in Fig. 2 the sprocket 25 transmits drive to the shaft 18 through a lug 160 outstanding from the sprocket, the lug engaging an arm 161 which is fixed to the shaft. This arrangement enables the loom to be "turned back" for the removal of faulty thread, or like contingency, by a hand-wheel (not shown) attached to the crank-shaft 22 without operating the weft presenting and measuring apparatus. On rectifying the trouble, the loom can be "turned forward" again until the lug 160 again contacts with the arm 161, when the relation between the rest of the loom and the weft presenting and measuring apparatus is automatically correct.

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

1. Weft-measuring apparatus for a shuttleless loom, said apparatus comprising weft-trapping means adapted to hold weft extending from a

supply package, loop-drawing means, means to move said drawing means past the trapping means, means to move the trapping means across the path of the drawing means so that the weft held by the trapping means is engaged by the drawing means and is drawn thereby into a succession of loops, means to release each loop in turn after drawing when there is substantially a pick-length of weft in the loop, for successive insertion of the loops into the warps, and means adapted to sever the weft from the supply after the formation of successive pairs of loops.

2. Weft-measuring apparatus for a shuttleless loom, said apparatus comprising weft-trapping means adapted to hold weft extending from a supply package, loop-drawing means, means to move said drawing means past the trapping means, means to move the trapping means across the path of the drawing means so that the weft held by the trapping means is engaged by the drawing means and is drawn thereby into a succession of loops, means to release each loop from the drawing means when there is substantially a pick-length of weft in the loop, means for releasing the loop-lengths from the trapping means for successive insertion into the warps, and means adapted to sever the weft from the supply after the formation of successive pairs of loops.

3. Weft-measuring apparatus for a shuttleless loom, said apparatus comprising weft-trapping means adapted to hold weft extending from a supply package, a plurality of loop-drawing means, means to move said drawing means successively past the trapping means, means to move the trapping means across the path of the drawing means so that each drawing means in turn engages the weft held by the trapping means and draws it into a loop, means to release each loop from the drawing means when there is substantially a pick-length of weft in the loop, means for releasing the loop-lengths from the trapping means for successive insertion into the warps, and means adapted to sever the weft from the supply after the formation of successive pairs of loops.

4. Weft-measuring apparatus for a shuttleless loom, said apparatus comprising a plurality of weft-trapping means each adapted to hold weft extending from a supply package, loop-drawing means, means adapted to move said drawing means past the trapping means, means adapted to move the trapping means in turn across the path of the drawing means so that the weft held by any trapping means is engaged by the drawing means and is drawn thereby into a succession of loops, means adapted to release each loop in turn after drawing when there is substantially a pick-length of weft in the loop, for successive insertion of the loops into the warps, and means adapted to sever the weft from the supply after the formation of successive pairs of loops.

5. Weft-measuring apparatus for a shuttleless loom, said apparatus comprising a plurality of weft-trapping means adapted to hold weft extending from a supply package, loop-drawing means, means to move said drawing means past the trapping means, means to move the trapping means so that they successively carry across the path of the drawing means weft held in one of the trapping means, the weft thereby being drawn into a succession of loops and engaged by a trapping means after the formation of each loop between the loop and the package, means to release each loop from the drawing means when there is substantially a pick-length of weft in the loop, means to release each loop from the trapping means which brought the weft into loop-drawing position, and cutting means operating to sever the second of each successive pair of loops from the trapping means holding the weft between said second loop and the package so that the loops are freed in turn for separate insertion into the warps to form pairs of connected picks.

6. Shuttleless loom comprising measuring apparatus adapted to prepare weft in the form of loops for insertion into the warps, said measuring apparatus including trapping means disposed near one edge of the warps, loop-drawing means, a common member on which the drawing means are mounted in spaced relationship, means to move said member so that the drawing means pass the trapping means in succession, means to move the trapping means across the path of the drawing means so that weft held by the trapping means is engaged by the drawing means and is drawn thereby into successive loops, means disposed along the path of the drawing means to release the loops from the drawing means, means to insert each loop in turn into the warps, and cutting means adapted to sever the second of each consecutive pair of loops from the trapping means, the loop releasing means being adapted to release the first loop after its drawing means has moved a longer distance than the drawing means of the second loop, so that the first loop contains enough weft to provide a pick together with the length extending from that pick between the edge of warps and the trapping means while the second loop contains an amount of weft which together with said length is sufficient for a second pick.

7. Weft-measuring apparatus for a shuttleless loom, said apparatus comprising an endless flexible member adapted to be mounted alongside the warps, at least one pair of drawing members movably carried on said flexible member, means for driving the flexible member, trapping means disposed near one run of said flexible member, means to move said trapping means so that weft held thereby is carried across the path of said drawing members and drawn into successive pairs of loops, two members mounted at different distances from the trapping means along the run of the flexible member and adapted respectively to deflect alternate drawing members to release the loops therefrom so that the loops of each pair are drawn to correspondingly different lengths, and means to sever the weft from th trapping means after the formation of each shorter loop.

8. Weft-measuring apparatus for a shuttleless loom, said apparatus comprising an endless flexible member adapted to be mounted alongside the warps, a pair of drawing members movably carried on said flexible member, means for driving the flexible member, a rotatable member disposed near one run of the flexible member, two trapping devices carried by said member, means to rotate the member so as to move the trapping devices in turn across the paths of the respective drawing members, weft held in one trapping device being brought by the rotation of said rotatable member against the other trapping device and drawn by the drawing members successively into loops, means disposed along the run of the flexible member to deflect one drawing member so as to release the loop drawn thereby when there is substantially a pick-length of weft in the loop, similar means disposed nearer to the trapping

devices to deflect the succeeding drawing member and to release a shorter loop drawn thereby, cutting means associated with the rotatable member, means operating in conjunction with the rotatable member adapted to actuate the two trapping devices and the cutting means so as successively to release a limb of the longer loop to free the loop length for insertion into the warps substantially simultaneously with the release of the loop from its drawing member and to grip said loop-length at the point of its connection with the thread proceeding from the supply package and, after the insertion of the first and longer loop and the formation of the second and shorter loop, to release the point of connection of the inserted length with the shorter loop and to sever the second loop from the supply for insertion into the warps substantially simultaneously with the release of the loop from its drawing member.

9. Weft-measuring apparatus for a shuttleless loom, said apparatus comprising an endless flexible member adapted to be mounted alongside the warps, at least one pair of drawing members movably carried on said flexible member, means for driving the flexible member, trapping means disposed near one run of said flexible member, means to move said trapping means so that weft held thereby is carried across the path of said drawing members and drawn into successive pairs of loops, two members mounted at different distances from the trapping means along the run of the flexible member and adapted respectively to rotate alternate drawing members about the flexible member to release the loops so that the loops of each pair are drawn to correspondingly different lengths, means to sever the weft from the trapping means after the formation of each shorter loop, and means disposed further along the run of the flexible member adapted to rotate the drawing members back to operative position on the flexible member after release of the loops.

10. Weft-measuring apparatus for a shuttleless loom, said apparatus comprising an endless flexible member adapted to be mounted alongside the warps, at least one pair of drawing members movably carried on said flexible member, means for driving the flexible member, trapping means disposed near one run of said flexible member, means to move said trapping means so that weft held thereby is carried across the path of said drawing members and drawn into successive pairs of loops, two members mounted at different distances from the trapping means along the run of the flexible member and adapted respectively to rotate alternate drawing members about the flexible member to release the loops so that the loops of each pair are drawn to correspondingly different lengths, means to sever the weft from the trapping means after the formation of each shorter loop, means disposed further along the run of the flexible member adapted to rotate the drawing members back to operative position on the flexible member after release of the loops and means disposed near each rotating means adapted to prevent overrunning of the drawing members.

11. Shuttleless loom comprising a rotatable member, two loop-drawing carriers movable along different paths across said member, two trapping devices carried by said member, means to rotate the member so that weft held by the trapping devices is carried by each device in turn across the paths of the carriers, a guide disposed between the paths of the carriers, means to move the carriers in succession past the rotatable member so that one carrier engages the weft held by one trapping device and draws into a loop to one side of the said guide and, after further rotation of the member, the other carrier engages the weft held by the other trapping device and draws it into a loop to the other side of the guide, means to release each loop when it contains substantially a pick-length of weft, weft-inserting means adapted to move across the weft loops, a depressor member movable towards the inserting means and disposed so as to depress the limb of each of the successive loops which lies adjacent to the said guide for engagement of that limb by the inserting means.

12. Weft-measuring apparatus according to claim 8, said apparatus comprising adjustable cam means operating in conjunction with the rotatable member, and means for adjusting the operative length of said cam means.

13. Shuttleless loom comprising weft-measuring apparatus including an endless flexible member mounted alongside the warps, at least one pair of weft-drawing carriers movably carried on said flexible member, means for driving the flexible member, a rotatable member disposed near one run of said endless flexible member, two trapping devices carried by said rotatable member, means to rotate said rotatable member so that weft held by the trapping devices is carried by each device in turn across the paths of the carriers, weft held in one trapping device being engaged by one carrier and drawn thereby into loop form, and weft held in the other trapping device being engaged in turn by the other carrier, after rotation of the rotatable member, and drawn thereby into a second loop, means disposed along the run of the flexible member adapted to release the first loop when it contains substantially a pick-length of weft, further means disposed along the run of the flexible member adapted to release the second loop nearer to the trapping devices than the first loop, and weft-inserting means adapted to pass through the warps at regular intervals and to engage and insert the loop-lengths in turn, the loop-drawing carriers being so spaced on the flexible member that they arrive at their respective releasing means to release their loops at substantially the same instant in every weft-inserting cycle irrespective of the difference in the lengths of the loops.

14. Apparatus according to claim 10 comprising a chain as the endless flexible member on which the weft-drawing carriers are mounted.

15. Shuttleless loom in which weft is drawn in loop lengths prior to insertion in the warps, said loom comprising a driving shaft, weft-measuring apparatus disposed at at least one side of the warps in the form of a substantially self-contained unit, means for mounting said unit in adjustable positions nearer to or further from the side of the loom in accordance with the width of the fabric being woven, a wheel for driving said unit, said wheel being adjustable in position lengthwise of the driving shaft in accordance with the position of said unit; and means for driving said wheel by said shaft in all the adjusted positions of the wheel.

16. Loom according to claim 15, comprising weft-presenting apparatus included in the weft-measuring unit, a chain driven by the driving wheel for said unit and adapted to drive said weft-presenting apparatus, loop-drawing means on said chain, and means for securing said presenting apparatus at the front of the loom in adjusted positions lengthwise of the loom.

17. Shuttleless loom in which weft is drawn in

loop lengths prior to insertion in the warps, said loom comprising weft measuring apparatus disposed at at least one side of the warps in the form of a substantially self-contained unit, weft-presenting apparatus included in said unit, means for mounting said weft-presenting apparatus at the front of the loom in adjusted positions lengthwise of the loom in accordance with the width of the fabric being woven, a driving shaft running lengthwise of the loom, a wheel on said shaft, a chain driven by said wheel and adapted to drive said weft-presenting apparatus, means for adjusting the position of said wheel along said shaft in accordance with the position of said weft-presenting apparatus, loop-drawing means on said chain, means mounted adjacent the chain run between the weft-presenting apparatus and said driving shaft to release the loops from the drawing means on the chain, said releasing means being adjustable along the chain run to determine the loop lengths in accordance with the width of the fabric.

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