

April 10, 1956

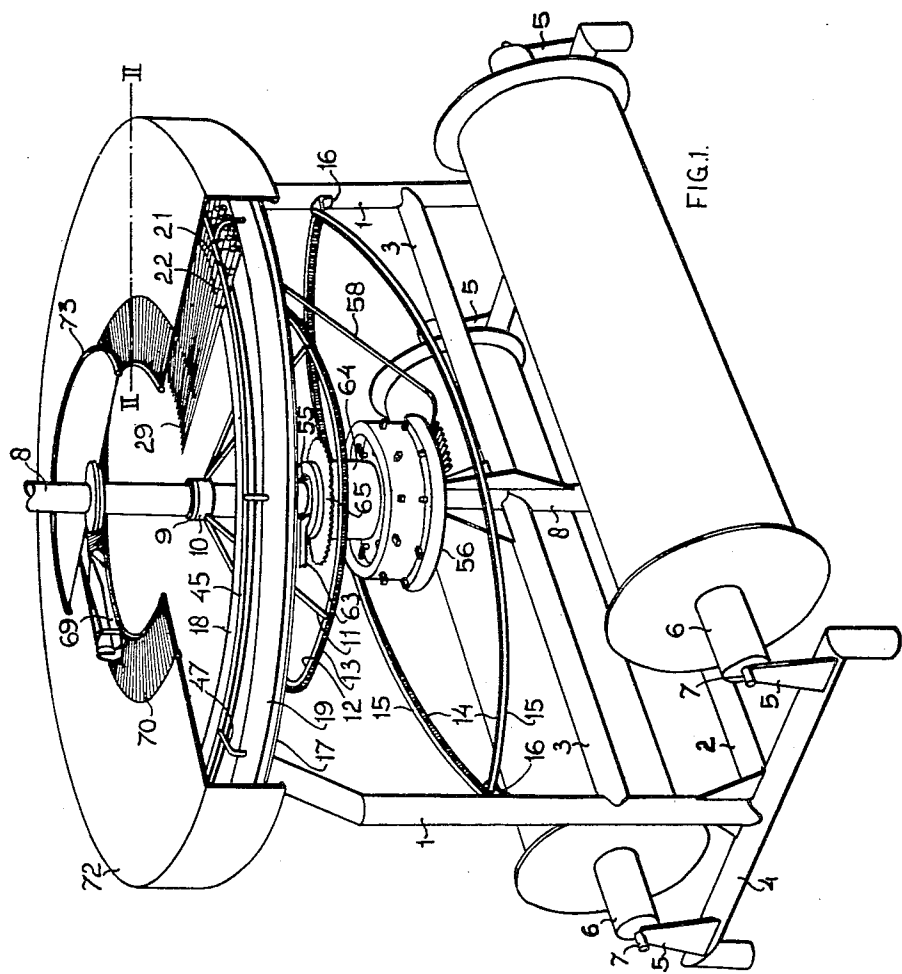
J. B. VAN BURLEIGH

2,741,269

LOOMS

Filed Dec. 27, 1951

7 Sheets-Sheet 1



Johannes Balfour Van Burleigh.
By Draser, Myers & Manley
Attys.

April 10, 1956

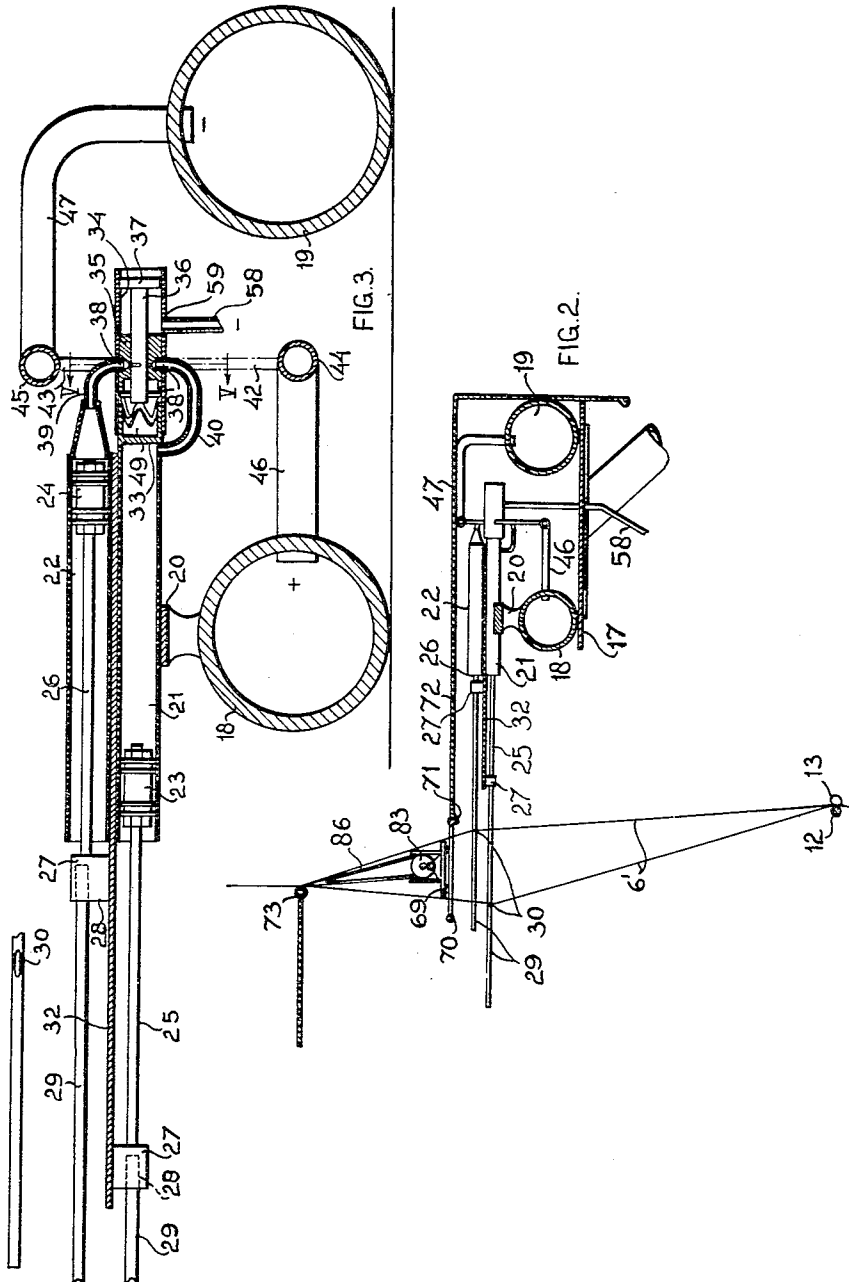
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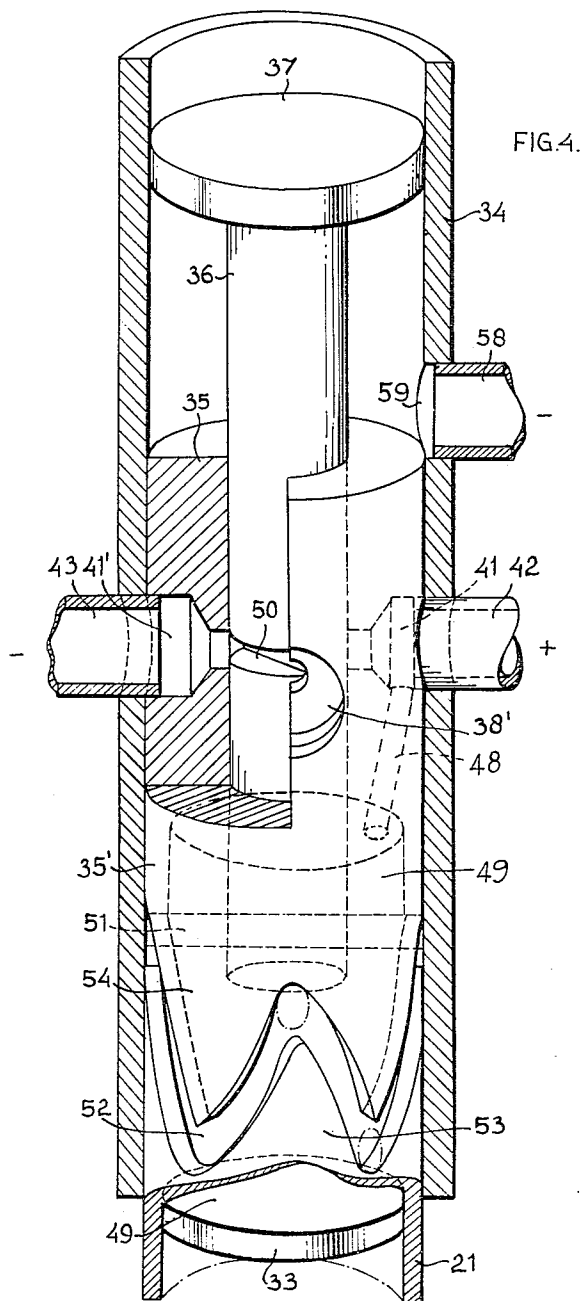
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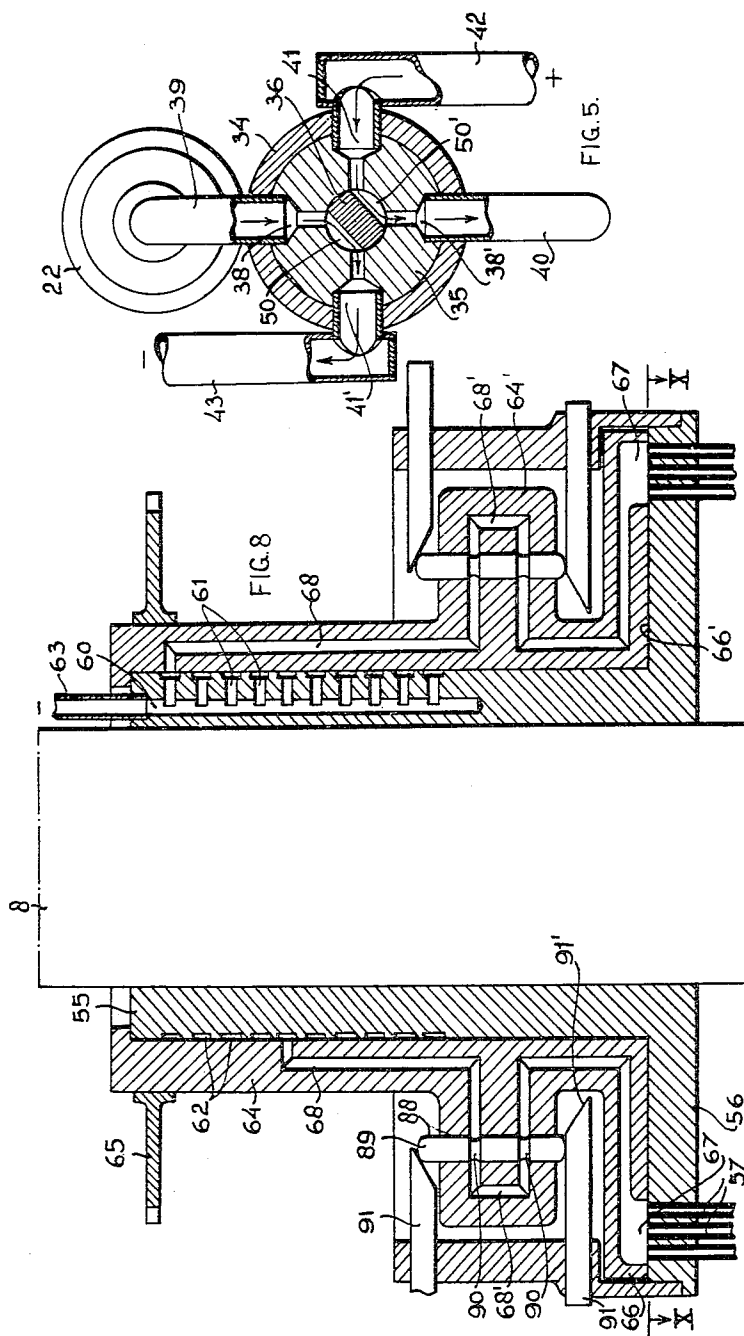
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7 Sheets-Sheet 5

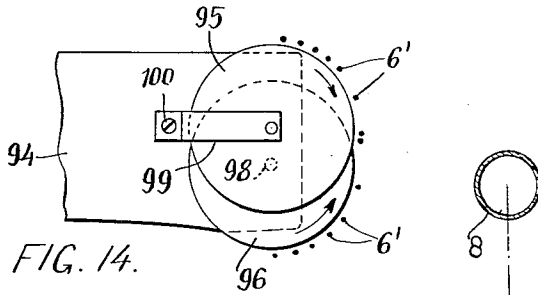


FIG. 14.

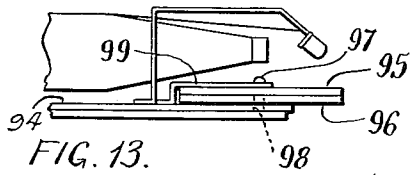


FIG. 13.

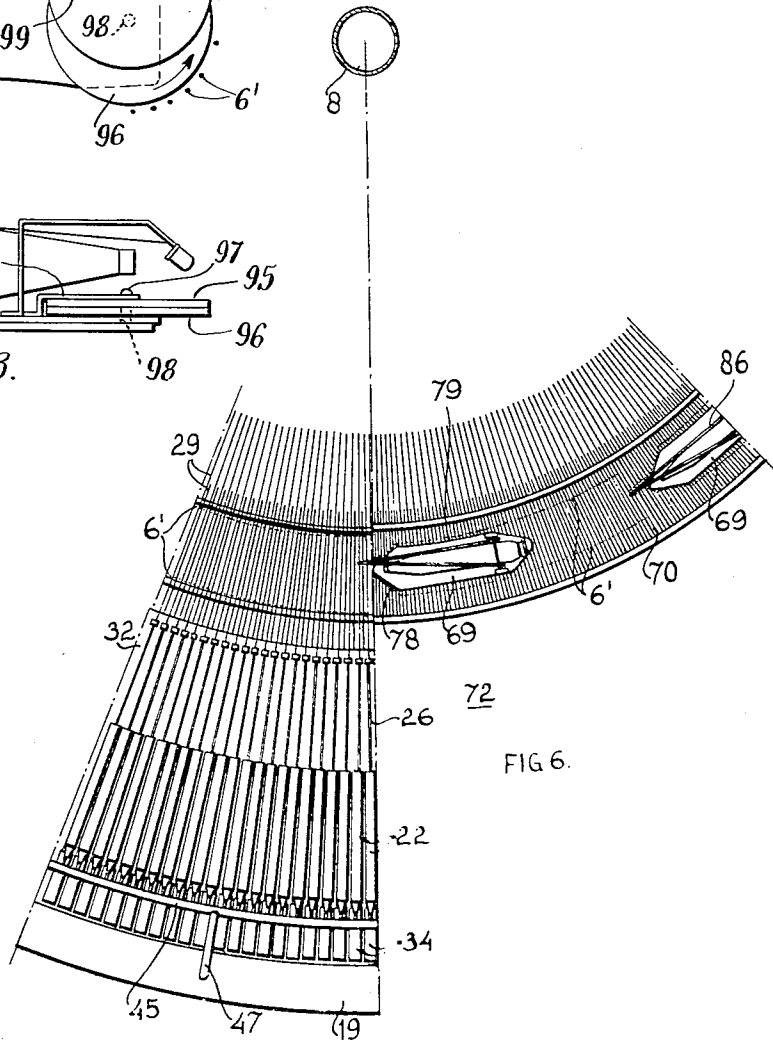


FIG. 6.

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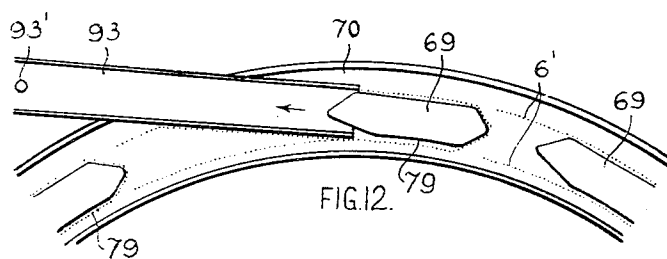
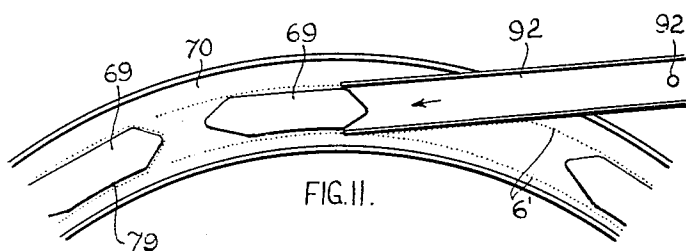
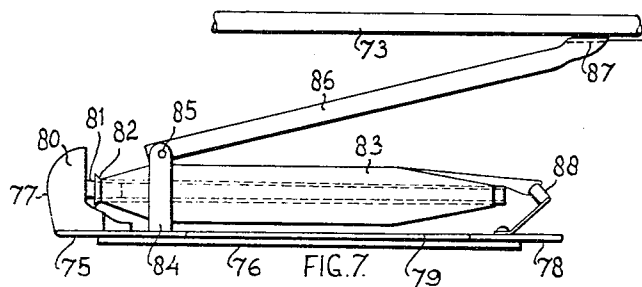
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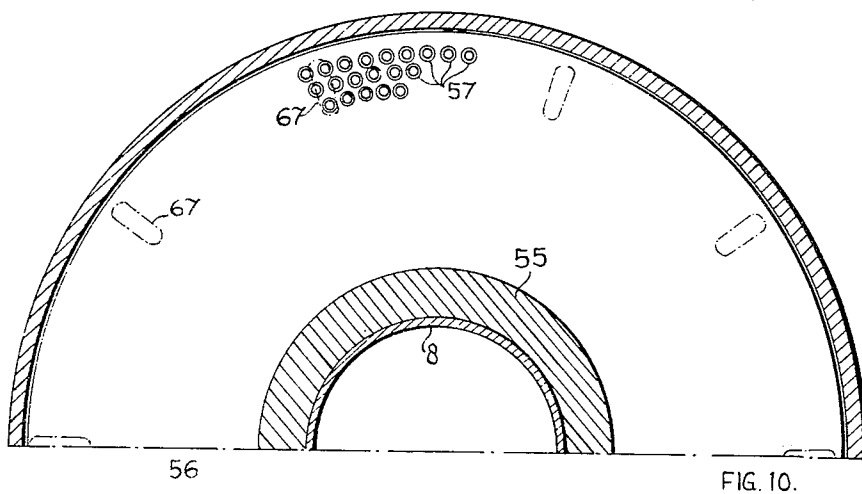
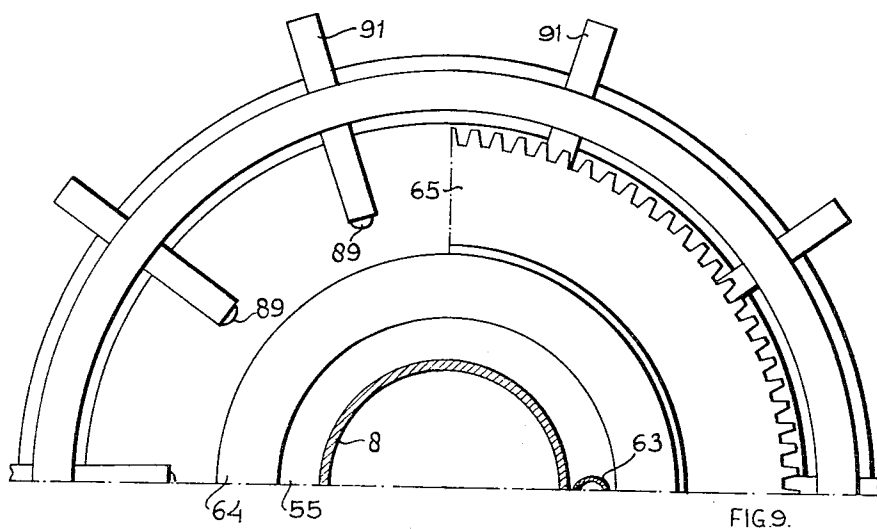
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2,741,269

LOOMS

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Application December 27, 1951, Serial No. 263,533

Claims priority, application Netherlands
December 30, 1950

24 Claims. (Cl. 139—15)

The present invention relates to a loom for weaving fabrics for example of the tubular variety, and of the type comprising a weft carrying and feeding shuttle or a plurality of such shuttles, which is or are propelled—in the latter case simultaneously—through a shed or a shed compartment of one or more warp systems, and shedding units for example arranged in a circle, for progressively shedding said warp system or systems. A loom of this type is known from the U. S. Patent No. 1,813,762.

In this known construction, the shedding units are in the form of pivotably mounted levers, each adapted to feed a warp thread, means being provided for oscillating said levers so that some move in one direction while others move in the opposite direction and in such relation, that a shed is opened and closed for each shuttle progressively, said levers being recessed or notched to provide a track for such shuttle or shuttles, the latter each having a wedge-shaped end portion so designed that the oppositely directed transverse forces simultaneously exerted by oppositely moving pairs of said warp shedding levers on said wedge-shaped end portion during oscillating movement produce a resultant force forwardly propelling said shuttle through its shed.

One object of the present invention is to provide a loom of the above type in which the weft thread or threads at the completion of the shedding operation of a respective shedding unit is or are locked into the fabric immediately on the line of weaving. This assures a completely uniform binding or texture of the fabric and thus enables the density of the fabric to be controlled by simply varying the angle of the warp threads.

A further object of the invention is to provide a loom of the above type in which all elements for beating-up the weft threads at the fell or weave line of the fabric are eliminated so that the threads suffer considerably less wear than in the case of known constructions.

Another object of the invention is to provide a loom of the above type in which the magnitude of the frictional resistance to be overcome by the resultant force propelling the shuttle or shuttles through its or their shed or sheds is small resulting in a considerable economy in expenditure of driving power.

Still another object of the invention is the provision of a loom of the above type in which the propelling of the shuttle or shuttles is effected by a relatively large number of simultaneously operating, flexible elements, namely the warp threads themselves which are concerned in the shedding operation, so that the individual shedding units may be of light construction.

With these and other objects in view, one aspect of the invention is the provision of a loom for weaving fabric comprising at least one warp system, shedding units

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progressively operable for manipulating the warp threads of such system such that a shed is progressively opened and closed, a weft carrying and feeding shuttle freely located within said shed and having its rearwardly directed end portion so constructed that the oppositely directed transverse forces simultaneously exerted by the warp threads on said end portion during such progressive shedding operation produce a resultant force forwardly propelling said shuttle through said shed, the weft feeding outlet of said shuttle being located behind said end portion—considered in the direction of travel of the shuttle—and in close proximity to the line of weaving, so that the weft thread at the completion of the shedding operation of the successive shedding units is locked into the fabric immediately on the line of weaving.

In the case of an open-ended warp thread system, that is to say a system which is not closed on itself, the changing of shuttles is not particularly difficult because replacement may be effected successively outside the shed. Color changing with an open-ended system may be readily augmented by a selecting system in the form of a mechanism for controlling the pattern.

An endless or closed warp system, as in the case of a circular loom, however, presents a special problem, the solution of which is more readily obtained with a loom constructed in accordance with the instant disclosure. As will be described more fully hereinafter the shedding, the propelling of the shuttles, as well as the beating-up and locking of the weft thread, is effected every time by one and the same operation of a respective shedding unit. It is possible to operate the loom with less than the maximum possible number of simultaneously active shuttles (e. g. two or three less than the maximum). For example, two or three successive shuttles can be omitted and the shedding operation arranged so that a long open space or gap is created. A progressing partial shed or compartment is thus formed in the warp system, the length of which is two or three times the length of the remaining compartments, which long compartment may then be used for changing the shuttles. When such compartment reaches a selected point, the warp threads on one side immediately ahead of this point (reckoned in the direction of movement of the shuttles) may be deflected and a fresh shuttle can be shot into the long compartment up to the normal distance from the shuttle preceding said long compartment. The shedding units adjacent the rear end of the new shuttle are then rendered "operative." By again deflecting the warp threads behind said point the next shuttle is enabled to escape from the warp system by its own velocity and along a tangent to its path of travel. Thereafter the long compartment, which by the putting into operation of the shedding units for propelling the newly introduced shuttle has been progressively shortened at its front end, is simultaneously restored to its original length by progressively rendering "inoperative" the shedding units at the rear end of the compartment.

In connection therewith a further characteristic feature of the invention consists in the provision outside the warp system of two aligned shuttle guides having opposing ends. By swinging such guides into the center plane of the long compartment, and thereby pushing away the warp threads on one side of the compartment, they may be successively brought in a position in which they extend substantially tangentially to the shuttle path. Means are then provided for selectively rendering inoperative and

operative the elements for activating one or more change-over mechanisms.

The invention will hereinafter be further described with reference to the accompanying drawings in which:

Fig. 1 is a more or less diagrammatic perspective view of a circular loom according to the invention.

Fig. 2 is a partial, radial cross section on the line II—II in Fig. 1 and shows in elevation a shedding unit of such loom.

Fig. 3 shows on an enlarged scale a longitudinal cross-section through the rear portion of such shedding unit.

Fig. 4 shows in longitudinal section and on a still further enlarged scale, a detail of said shedding unit.

Fig. 5 is a cross-sectional view shown at an enlarged scale and along the line V—V in Fig. 3.

Fig. 6 shows a partially broken away plan view of a portion of the reed-shaped supporting member, with a shuttle resting thereon and together with a number of shedding units.

Fig. 7 shows a shuttle in side elevation.

Fig. 8 shows on an enlarged scale and in vertical cross-section the mechanism diagrammatically shown in Fig. 1, for selectively rendering the shedding unit operative and inoperative.

Fig. 9 is a plan view thereof.

Fig. 10 is a view seen in direction of the arrows X—X in Fig. 8.

Figs. 11 and 12 show in plan view a portion of the shuttle path and the shuttle guides to illustrate the successive steps of the shuttle replacement.

Fig. 13 shows a side-elevation view of the rear portion of a shuttle according to a modified embodiment.

Fig. 14 represents on a somewhat larger scale a plan view of a portion of Fig. 13 showing the disc-like rollers provided on said shuttle portion for cooperation with the warp threads during the shedding.

In the embodiment shown by way of example, the circular loom is mounted on a base, comprising two up-rights 1, interconnected by cross beams 2, 3 and resting on feet 4, to which brackets 5 are welded for rotatably supporting two warp beams 6 by means of trunnions 7.

A central vertical column 8 is connected to said cross beams 2, 3 which column near its upper end is provided with a bond 9 and on which column, by means of a hub 10 and spokes 11, a horizontal ring 12 is secured surrounded by a helically wound wire 13, the windings of which serve as separating elements for the warp threads 6' arriving from the warp beams 6. Two further helically wound wires 14, also serving as separating elements, are arranged on two arched rods 15 which at 16 are connected to the up-rights 1.

The inwardly inclined upper ends of the up-rights 1 carry a ring-shaped plate 17 serving as a support for two annular conduits 18, 19 of which the former has a smaller inner diameter than the latter. Conduit 18 contains air which is constantly under super-atmospheric pressure so as to serve as a pressure air supply source. The conduit 19 is constantly under a vacuum or sub-atmospheric pressure so as to serve as a vacuum supply source or a supply source of sub-atmospheric pressure.

On the above mentioned annular conduit 18 pairs of superimposed radially extending cylinders 21, 22 are mounted, each pair being mounted by means of a bracket 20 (Fig. 2) welded to said conduit. The cylinders 21 and 22 are provided with movable pistons 23 and 24 and piston rods 25 and 26, respectively, the latter at their free ends being provided each with a head 27, having a number of (e. g. six) saw cuts 28 formed therein. A corresponding number of rods 29 are secured in the respective saw cuts.

At some distance away from its free end, each rod 29 is provided with an eyelet 30 for threading therethrough a warp thread 6'. The pairs of cylinders 21, 22 are arranged in a closed circular series around the central axis of the loom, the cylinders of each pair being located

on opposite sides of a platelike annulus 32 stationarily arranged therebetween. The annulus extends radially inwardly beyond the ends of the cylinders and serves as a guide for the above mentioned heads 27 during the relative movement of the pistons 23, 24, effected in a manner to be hereinafter described.

As best seen in Fig. 3 the lower cylinder 21 of each pair is closed adjacent its rear end by a partition 33 whilst an outwardly open sleeve 34 is secured to said rear end of the cylinder 21. The sleeve 34 has a tubular guide element 35 secured therein for guiding an axially slidable rod-like valve member 36. The member 36 is adapted to rotate about its axis with its outer end loosely engaging a piston 37 fitting said sleeve 34. The tubular guide element 35 is provided with two diametrically opposed transverse bores 38, 38' respectively communicating with a conduit 39 leading to the cylinder 22, and a conduit 40 leading from the sleeve 34 to a point on the cylinder 21 to the left of the partition 33.

In a plane at right angles to the bores 38, 38' two further passages 41, 41' (Fig. 4) are formed in the guide element and connected by conduits 42 and 43, respectively, to annular conduits 44 and 45, respectively, (Fig. 3). The conduit 44 communicates through the medium of a conduit 46 with the conduit 18 of over-atmospheric pressure and the conduit 45 is in open communication with the sub-atmospheric pressure conduit 19 through a pipe 47. An axial bore 48 in the guide element 35 connects the chamber 49, between the partition 33 and the forward end face of said guide element 35, with the passage 41, which through the annular conduit 44 and the conduit 46 is connected to said pressure conduit 18, all in such a manner that in said chamber 49 a permanent over-atmospheric pressure reigns.

At two diametrically opposed points the above mentioned rod-like valve member 36 is provided with transverse saw cuts 50, 50' (Fig. 5) so located that in one angular position of the rotatable valve member such saw cuts effect a connection between the passages 38 and 41' respectively 38' and 41, and after rotation of the valve member through an angle of 90° interconnect the passages 38 and 41 respectively 38' and 41'.

The angular displacement of said valve member about its axis required for interchanging the connections is derived from an axially reciprocating movement to be given to said valve member. This valve member is provided with pin-shaped radial projections 51 for cooperation with a specially shaped cam groove 52. Cam groove 52 is formed by teeth 53 which are cut in the end of the cylinder 21 which extends above partition 33 in Fig. 4, said teeth 53 mating with teeth 54 cut in an extension 35' of the tubular guide element 35 (Fig. 4). The cam groove 52 is so shaped that when the valve member is reciprocated up and down as seen in Figure 4, it causes said valve member, through the medium of the pin shaped projections 51, to rotate about its axis in one direction only, through an angle of 90° whereby the connections of the cylinders 21, 22 with the over-atmospheric and sub-atmospheric pressure conduits 18, 19 are interchanged. As a result thereof the pistons 23, 24 are displaced in opposite directions so that the warp threads threaded in the set of rods associated with said pistons are crossed to effect the shedding of the warp.

In Fig. 4 the two teeth-like projections 54 (cut from the bottom end of the tubular extension 35' of the fixed guide element 35) are shown unsectioned so as to come out of the paper for 180° in a semi-cylindrical fashion. The edge surfaces of the teeth constitute the upper surface of the cam groove 52, which groove extends along a tortuous path through 360° inside cylinder 34. The teeth-like projections 53 (cut from the upper end of cylinder 21 which extends as shown in Fig. 4 for a distance of 1 3/4 inches up into cylinder 34) are shown unsectioned so as to come out of the paper for 180° in a semi-cylindrical fashion. The edge surfaces of teeth 53

constitute the lower surface of cam groove 52. The first 180° of groove 52 is shown in Fig. 4 and the other 180° is shown in Fig. 3 where cylinder 21 and extension 35' are shown completely in section. The irregular sectioned portion at the bottom of Fig. 4 represents an irregular transverse section taken through the cylinder 21.

Assume that for the moment the valve member 36 is in its unextended position inside cylinder 34 as shown in Figs. 3 and 4. In this position passage 41' communicates with passage 38' and passage 41 communicates with passage 38. If a vacuum is now applied via conduit 58 to the interior of cylinder 34, the force of the atmospheric pressure bearing against the outside of the large-area piston 37 overcomes the opposing biasing force developed by the super-atmospheric air pressure always present in chamber 49 and hence valve member 36 begins to move axially forward. But as it does so its pair of cam-follower pins 51 are constrained to ride in respective halves of the cam groove 52 thereby imparting a rotary motion to valve member 36 as it moves axially forward. In a manner obvious to one skilled in the cam-cutting art, the groove 52 is shaped so that when the left-hand pin 51 of Fig. 4 has been moved axially forward until it occupies a position in groove 52 which is beneath the tip end of the left-hand tooth 54, such pin will also have received a transverse movement rotating it counter-clockwise through 45° and hence the valve member 36 will also have been rotated through 45° in a counter-clockwise direction.

Upon the removal of the vacuum from conduit 58 and the interior of cylinder 34, air at atmospheric pressure again occupies the interior of cylinder 34 (with leakage past piston 37) and the biasing force developed in chamber 49 now becomes the predominant force. Thus, valve member 36 now reverses its direction of axial movement and starts moving back towards its original position. The tip end of the left-hand tooth 54 is offset sufficiently so that the left-hand pin is unable to return via the same part of groove 52 over which it has just traveled; instead, such pin will be forced to continue further along the cam groove path of 52 which brings the pin eventually to the position illustrated in Fig. 4 by the dotted circle at the junction of the two teeth 54 (i. e., at the top of the center tooth 53 in Fig. 4). This portion of cam groove 52 over which such pin has just traveled is cut so that the pin, in addition to its axial return movement, will have also received a transverse movement rotating it (and valve member 36) counter-clockwise through an additional 45°. Thus, one axial reciprocation of valve member 36 has resulted in rotating it through 90°. The connections between passages 38, 38', 41 and 41' will now be interchanged so that passage 41' communicates with passage 38 and passage 41 with passage 38'. Such interchange of connections causes shedding of the associated warp threads.

When a vacuum is again applied via conduit 58 to the interior of cylinder 34, valve member 36 will begin to move forward again and such pin will continue to move along the tortuous path provided for it by cam groove 52 so as to rotate valve member 36 counter-clockwise through an additional 45° to the 135° point when it arrives (as shown by the dotted circle in Fig. 4) under the tip end of the right-hand tooth 54, the axial return movement of member 36 forcing such pin to continue along groove 52 until it finally reaches a position diametrically opposite its original position (the position assumed at the beginning of this discussion). Of course, in the meantime the other pin 51 has been constrained to move over a similar path in the other half of groove 52 so that it now ends up 180° away from its original position. As a result of the above movement of the pins 51, valve member 36 has now been rotated counter-clockwise through a second 90° so that the connections between passages 38, 38', 41 and 41' are again interchanged to cause shedding of the associated warp threads

again. After two more successive applications of a vacuum to the interior of cylinder 34, valve member 36 will in a similar manner be rotated counter-clockwise through an additional 180° (causing two more shedding operations) to the 360° point so as to be restored to its original rotary position.

The control of valve member 36 as outlined above is effected through the medium of a mechanism constructed as follows.

As shown in Figs. 1 and 8 there is provided between the elements 13 and 14 which separate the warp threads and around the stationary central column 8 a stationary sleeve 55, having a horizontal annular flange 56. As shown in Figs. 8 and 10, near the outer circumferential portion of flange 56 transverse passages 57 are bored, the number of passages 57 being equal to the number of pairs of cylinders 21, 22. In order that each vacuum port 67 in the rotary sleeve 64 may cover for example four passages 57 at any instant, the passages 57 are distributed in three staggered circular series concentric with the circumference of the flange 56 as shown in Fig. 10. In Fig. 10 only a few of the passages 57 have been illustrated for convenience, the relative locations of certain of the ports 67 for instantaneous rotary position of sleeve 64 being shown in dotted lines. Each of said passages is connected by a conduit 58, to a port 59 formed in the sleeve 34 (Fig. 3) immediately behind the rear face of the guide element 35, and therefore between such rear face and the freely movable piston 37 in said sleeve 34. In the wall of the sleeve 55 a longitudinal passage 60 is formed (Fig. 8) from which transverse passages 61 are branched off, each opening into a circumferential groove 62 in the outer face of the sleeve 55. By a conduit 63 passage 60 is permanently connected to the sub-atmospheric pressure conduit 19.

The sleeve 55 is further surrounded by a second sleeve 64 rotatable about said first sleeve and adapted to be driven by a chain and sprocket gear (sprocket 65), not shown in detail, from the main driving mechanism of the loom. Said second sleeve is also provided with a horizontal flange 66, which, with a contact surface 66', engages the flange 56 at the locality of the series of passages 57.

A group of ports 67 are formed in the contact surface 66' so as to be uniformly distributed over its circumference. These ports are equal in number to the number of partial sheds or compartments, which may be formed simultaneously in the warp system of the loom, taking into account the length of the shuttles to be used and the circumferential length of the shuttle path. The ports are so dimensioned that in their successive positions they each cover a group of four passages 57.

Each of said ports 67 connects with a passage 68 formed in the wall of the sleeve 64. The passages 68; for a purpose hereinafter to be described, are provided with a loop-shaped section 68' situated within an annular bond 64' integrally formed with said sleeve 64. The passages 68 at their upper ends open into the inner circumferential face of the sleeve 64, each time at the locality of a circumferential groove 62 in the sleeve 55. The ports 67, therefore, are in permanent communication with the sub-atmospheric pressure. Each port, during the rotation of the sleeve 64, places the passages 57 and, by means of conduits 58 and ports 59, the spaces in front of the pistons 37 (Fig. 3) progressively under vacuum. The pistons push out the respective valve members 36 against the action of the over-atmospheric pressure to interchange the connections of the cylinders 21 and 22 as more fully described above.

The machine so far described operates with a number of shuttles 69 (for instance ten) which lie freely within the warp thread system or systems and rest on a supporting member 70 (Fig. 6) formed as a circular reed without, however, having the usual function of a reed. Said supporting member is secured at its outer circumfer-

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ence in a groove 71, at the inner periphery of an annular cover 72, (Figs. 1 and 2) so that it freely projects inwardly. The warp threads 6' arriving from the warp beams 6 are threaded through said reed-like supporting member and extend to a ring 73, (Fig. 1) secured to the central column 8 above said supporting member, such ring constituting the fell of the fabric. The woven fabric is led off over a guide roller (not shown) also mounted on said central column 8.

The shuttles 69 (Fig. 7) consist of a plate-shaped base 75, to the lower face of which two smooth, rounded strips 76 are secured, such base at its forward end being shaped to form a rounded nose 77, whilst at the rear end, at 78, said base is bevelled on both sides as more particularly shown in Fig. 6. The inner side 79 of said base is arc-shaped.

At the forward end the nose 77 has an upwardly directed extension 80 formed with a tapered projection 81 on which one end 82 of the tubular support of a weft pin 83 is forced so that the pin freely projects rearwardly.

Adjacent its forward end the base 75 has two vertical supports 84 mounted thereon for supporting a transverse shaft 85, about which a triangular brace or arm 86 is pivotally mounted and adapted to swing. In the top of said arm there is provided a passage 87 serving as an outlet for the weft thread which is drawn from the free end of the pin 83, passed through a thread guide 88 to be deflected towards the forward end of the shuttle, and passed around the small shaft 85 to again change its direction towards the passage 87. The top end of the arm 86 has a downwardly tapering profile for a purpose hereinafter to be indicated.

In the modified embodiment shown in Figs. 13 and 14 the shuttle, which for the rest is identical with that shown in Fig. 7, also consists of a flat base 94, which, however, at its rear end is not wedge-shaped, but at its rear portion is provided with two disc-like rollers 95, 96, each freely rotatable about a short trunnion 97, and 98, respectively, the downwardly extending trunnion 97 carrying the first roller 95 being mounted in a bracket 99 overhanging such roller and being secured by means of a screw 100 to the upper face of the rear portion of the base, whilst the upwardly extending trunnion 98 for the roller 96 is secured in the base, in a position somewhat laterally spaced from said first trunnion so that the two rollers 95, 96 overlap one another, the outer circumference of such rollers projecting beyond the respective side edges and the rear edge of the base portion, all as shown in Fig. 14.

It will be clear that during the shedding operations the warp threads 6' engaging the projecting circumferential portions of the rollers will cause such rollers to rotate in opposite directions as indicated by the arrows in Fig. 14. At the same time the threads will produce on the shuttle an axially and forwardly directed resultant force, propelling the shuttle through its shed. Thus, the friction between the warp threads and the shuttle is considerably reduced.

There now remains the description of the means for replacing the shuttles during the operation of the loom, i. e. the means both for successively replacing empty shuttles by full ones and for replacing the shuttles by other shuttles carrying weft material of different color and/or nature.

To enable such shuttle replacement to be effected, the loom is operated with fewer shuttles (e. g. three less) than the total number of compartments which may be formed in the warp thread system. In other words three successive shuttles are removed from the series of shuttles so that in said series an open space or gap is formed traveling with the series of shuttles. Furthermore, according to the invention, the control of the shedding operation is so arranged that no shedding operation occurs within the traveling gap. There is thereby formed in the

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warp system a compartment which is three times the length of the remaining compartments. Such long compartment may then be used for the replacement of the shuttles. To form such compartment the shedding units of the corresponding warp threads have to be inoperative which means that since the compartment travels in a circle the units for shedding the warp threads in front of said long compartment have to be progressively cut out and those behind said compartment have to be progressively rendered active. This may be effected in the following manner.

As stated above, a loop 68' (Fig. 8) of each vacuum passage 68 lies within the bond 64' of the sleeve 64. This bond, at the locality of each loop 68', is provided with a transverse bore 88 in which a rod-like distributing slide 89 is movably positioned. The slide 89 has two passages 90, normally coinciding with the shanks of the loop, such slide being adapted to be operated by two cams 91 having oppositely inclined cam surfaces 91'. The cams are stationary in a circumferential direction relative to the respective slides 89, but are simultaneously movable longitudinally in opposite directions relative to sleeve 64 in such a manner that the connection of the respective port 67 with the vacuum conduit 63 may alternatively be shut off and re-opened, to thereby render the respective shedding units inoperative or operative.

The automatic operation of said cams 91 at the exact moment may be effected in any desired manner, for instance by a mechanism operating in the manner of a dobby-shedding machine and, therefore, with a dobby-card, or rail. Since, however, this does not form a part of the present invention such mechanism has not been shown and will not be described in detail.

The means for enabling the replacement of the shuttles during operation also comprise two channel-shaped shuttle guides 92, 93 (Figs. 11, 12) which are mounted outside the warp thread system in line on the annular cover plate 72. The guides are pivotable about axes 92' and 93' respectively, in such a manner that by swinging said guides in opposite directions and thereby pushing away or deflecting the outer warp threads the adjacent ends of the guides may be alternately placed in a line which at this point is substantially tangential to the shuttle path. This enables the operator, when the long compartment is at this spot, to introduce a fresh shuttle or alternatively to permit a shuttle to escape from the warp system by its own velocity in a manner as will be further described.

The operation of the machine above described is as follows:

The warp threads 6' arriving from the two warp beams 6 and kept apart by the windings of the helically wound wires 13 and 14 are threaded through the eyelets 30 of the groups of rods 29, associated with the successive shedding units. Thereafter such threads run through the gaps between the rods of the reed-shaped supporting member 70 towards the fell of the fabric at the locality of the ring 73.

In this warp system the shuttles 69 are positioned each in its own shed compartment and freely rest with their smooth rounded strips 76 on said supporting member 70, said shuttles being equally spaced in a series except for a gap between the two end shuttles of said series equal in length to three shuttles plus interspaces.

At the moment of starting the machine, the rotatable sleeve 64 is positioned so that the ports 67 communicate with the groups of conduits 53 leading to the shedding units controlling the warp threads which for each shuttle are situated on opposite sides of the bevelled edge 78 of the rear end portion of the shuttle. The shedding units controlling the warp threads momentarily situated opposite the long gap in the series of shuttles are inoperative because their connection through the respective ports with the vacuum conduit 63 is shut off, the corresponding distributing slide 89 being depressed by the upper cam 91 cutting off the passage 68.

Upon starting the machine in this position the shedding units, beginning at the points in which the vacuum ports 67 are situated at this moment, are progressively activated, that is to say connected to the sub-atmospheric pressure, so that the corresponding freely movable pistons 37 impart to the corresponding valve members 36 a forward impulse. This causes rotation of the valve members through an angle of 90° about their axis to interchange the connections of the cylinders of such units with the sub-atmospheric and over-atmospheric pressure and the shedding operation is initiated, that is to say the respective warp threads are crossed beneath the shuttle. The forces which are thus exerted upon the edges of the bevelled end portion of the shuttles produce a resultant force in the longitudinal direction of the shuttles whereby said shuttles are propelled. Because it is the warp threads that do the propelling the shedding operation is completed each time immediately behind each shuttle. The warp threads are therefore crossed on the end of the weft laying arm 86 of the shuttle and force the arm into the apex of the respective shed compartment. Thus the weft thread coming out of said arm at the fell is securely and permanently locked into the fabric, the laying in of the weft thread taking place after the shedding operation is completed.

During such successive activation of the shedding units those units associated with the warp threads which momentarily precede the long compartment—considered in the direction of movement of the shuttles—are rendered successively inoperative by shutting off the connection with the vacuum source and those following said compartment are successively rendered operative so that said long compartment remains existent and moves synchronously with the gap in the series of shuttles.

Use is made of this long compartment in the following manner for replacing the shuttles.

As far as the renewing of the weft supply is concerned, the moment of replacement is not, as is customary, made dependent on the quantity of yarn still present on the tubular weft yarn support, but is determined by the number of revolutions made by the shuttles through the warp, so that all shuttles, independent of the possible differences in their yarn contents are replaced successively at the same time.

When this replacement has to be effected the shuttle guide 92 in front of the point of replacement—considered in the direction of movement of the shuttles—is swung inward (Fig. 11), thereby pushing away the outer warp threads at this point, until at least the forward end of said guide, lies tangentially to the path of the shuttles.

Through this guide, at that moment, a fresh shuttle is shot into the long compartment in the direction of movement of the shuttles and up to the normal distance from the preceding shuttle, whilst immediately thereupon the guide is swung back and the shedding units at the locality of the rear end of the fresh shuttle are rendered operative so that such fresh shuttle is propelled synchronously with the remaining shuttles.

In the meantime the oppositely directed shuttle guide 93 situated beyond the point of replacement is swung inwards—whilst pushing away the respective outer warp threads—into the shuttle path (Fig. 12) so that the shuttle following the long compartment is enabled to escape from the warp thread system by its own velocity and along the tangent to its path of travel. At the same time the long compartment, which by the activation of the shedding units for propelling the fresh shuttle is shortened at its front end, at the rear end is restored to its original length successively by cutting out further units at the rear end of the compartment. By this the compartment is temporarily held stationary in front of the point of replacement so that by repeating the above mentioned manipulations all old shuttles may be successively replaced by fresh ones, after which the former condition is restored.

The above described manipulation of the shuttle guides

is effected by the same mechanism controlling the cams 91 for the distributing slides 89.

The replacement of one or more shuttles by a fresh one carrying weft material of different color and/or nature is effected in the same way, the moment of replacement being controlled by the mechanism operating the cams 91 and therefore determining the pattern.

The introduction of the fresh shuttles in the long compartment may for instance be effected by means of a device in the manner of a catapult, the operation of which is controlled by the said mechanism. Since, however, the structural realization of the entire control means lies within the reach of those skilled in the art, and does not constitute a part of this invention, it need not further be described in detail.

It will be understood that the invention is not limited to the embodiment above described and illustrated in the drawings since various other structural realizations are possible within the scope of the appended claims.

What I claim is:

1. In a loom for weaving fabric, at least one warp system, a plurality of shedding units progressively operative for operating the warp threads of said system progressively to open and close a shed in said warp system, a weft-carrying and feeding shuttle disposed within said shed and having a rear end portion engaged by the warp threads undergoing shedding and shaped such that the oppositely directed forces transverse to the path of shuttle travel simultaneously exerted by the closing warp threads on said rear end portion during said progressive shedding operation produce a resultant force forwardly propelling said shuttle through said shed, said shuttle having weft thread feeding means located rearwardly of said end portion and positioned in close proximity to the line of weaving, said weft feeding means being engaged by the warp threads undergoing shedding whereby the weft thread is beat into the shed by the warp threads and locked into the fabric immediately on the line of weaving.

2. In a loom for weaving fabric, at least one warp system, a plurality of shedding units operative in groups progressively for operating the warp threads of said system so that a plurality of warp sheds are simultaneously opened and simultaneously closed each in a progressive manner, a plurality of weft-carrying and feeding shuttles each disposed within a respective one of said sheds, each shuttle having a rear end portion engaged by the warp threads undergoing shedding and shaped such that the oppositely directed forces transverse to the path of shuttle travel simultaneously exerted on said end portion of each shuttle by the closing of the respective warp threads during said progressive shedding operations produce a resultant force on each shuttle forwardly propelling each shuttle through its respective shed, each of said shuttles having weft thread feeding means located rearwardly of said end portion and positioned in close proximity to the line of weaving, said weft feeding means being engaged by the warp threads undergoing shedding whereby the weft threads are beat into the respective sheds by the warp threads and locked into the fabric immediately on the line of weaving.

3. In a loom for weaving fabric, a warp system, a plurality of shedding units progressively operative for operating the warp threads of said system progressively to open and close a warp shed, a weft-carrying and feeding shuttle freely disposed within said shed and having a rear end portion located to engage the warp threads undergoing shedding as they close during said progressive shedding operation and shaped to derive from the oppositely directed transverse forces simultaneously exerted on said end portion by said closing warp threads a resultant force forwardly propelling said shuttle through said shed, a weft-laying arm mounted for free pivotal movement on said shuttle and rearwardly extending so that its rear end is located beyond the rear extremity of said end portion, said arm having a weft outlet at its rear end and

having a shape so that said rear end is urged by the progressive crossing of the warp threads to a position in close proximity to the line of weaving, whereby the weft thread at the completion of the shedding operation of the successive shedding units is locked into the fabric immediately on the line of weaving.

4. In a loom for weaving fabric, a warp system, a plurality of shedding units operative in groups progressively for operating the warp threads of said system so that a plurality of warp sheds are simultaneously opened and simultaneously closed each in a progressive manner, a plurality of weft-carrying and feeding shuttles each freely disposed within a respective one of said sheds, each shuttle having a rear end portion located to have oppositely directed transverse forces simultaneously exerted thereon by the respective warp threads upon closure thereof during the progressive shedding operations and shaped to produce a resultant force on each shuttle forwardly propelling each shuttle through its respective shed, each shuttle having a weft-laying arm mounted for free pivotal movement thereon and rearwardly extending so that its rear end is located beyond the rear extremity of said end portion, each of said arms having a weft outlet at its rear end and having a shape so that said rear end is urged by the progressive crossing of the warp threads to a position in close proximity to the line of weaving, whereby the weft thread at the completion of the shedding operation of the shedding units is locked into the fabric immediately on the line of weaving.

5. In a loom for weaving fabric, at least one warp system, a plurality of shedding units including warp thread actuating rods progressively operative for operating the warp threads of said system progressively to open and close a warp shed, a reed-shaped shuttle support disposed adjacent the warp thread actuating rods of said shedding units so as to extend along the path of said shed and having the warp threads threaded therethrough, a weft-carrying and feeding shuttle located within said shed and adapted to travel freely upon said support, said shuttle having a rear end portion engaging the warp threads as they progressively close during shedding and translating the oppositely directed transverse forces simultaneously exerted thereon by the closing warp threads during the progressive shedding operation into a resultant force forwardly propelling said shuttle along said support through said shed, said shuttle having its weft-feeding outlet located rearwardly of the rear extremity of said end portion and positioned in close proximity to the line of weaving, whereby the weft thread is beat into the shed by the warp threads and locked into the fabric immediately on the line of weaving.

6. In a loom for weaving fabric at least one warp system, a plurality of shedding units operative in groups progressively for operating the warp threads of said system so that a plurality of warp sheds are simultaneously opened and simultaneously closed each in a progressive manner, a reed-shaped shuttle support having the warp threads threaded therethrough and extending along the path of said sheds so as to lie at least partly within each shed when open, a plurality of weft-carrying and feeding shuttles each located in a respective one of said sheds in contact with said support for free movement therealong restrained laterally solely by said warp threads, each shuttle having a rear end portion in engagement with the warp threads of its respective shed as they progressively close during shedding and shaped to receive an impulse resulting from the oppositely directed transverse forces simultaneously exerted on said rear end portion by the respective warp threads closing during said progressive shedding operation which impulse forwardly propels each shuttle along said support through its respective shed.

7. In a loom for weaving fabric, a warp system extending substantially around a circular path, shuttle support means extending around said circular path, at least one weft-carrying and feeding shuttle disposed on said sup-

port means for travel around said circular path, the rear end of the main body of said shuttle having rearwardly sloping side surfaces extending toward the longitudinal axis of said shuttle, a plurality of warp thread-actuating elements grouped in pairs substantially around said circular path and extending in a direction transverse to said circular path, a piston operatively connected to each element, a cylinder in which each piston operates, means for supplying a gas under superatmospheric pressure, means for supplying a vacuum, means for connecting the cylinders associated with each pair of elements simultaneously to said pressure supply means and to said vacuum supply means respectively so that the pistons of each pair of pistons work in opposite directions to close and then open their associated warp threads, and means for altering in a predetermined sequence the connecting means for the pairs of cylinders to interchange the connections between the pairs of cylinders and the pressure and vacuum supply means in a predetermined sequence to open progressively a shed for said shuttle and to close said shed progressively by progressively closing those warp threads which are adjacent to said sloping surfaces thereby exerting a forwardly directed resultant force thereagainst to propel said shuttle through its shed along said circular path.

8. A loom according to claim 7 wherein the connecting means for each pair of cylinders to the pressure and vacuum supply means comprises a valve member mounted for reciprocal axial movement, and stationary guide means disposed in the path of axial movement of each said valve member and shaped to convert each reciprocation of said valve member into a rotary movement of said valve member about its axis through a predetermined angle to effect said interchange of connections, said means for altering said connecting means comprising a rotary vacuum distribution valve the rotor of which has at least one distribution port which rotates around the central axis of the loom synchronously with the progressive opening and closing of said shed to effect in a predetermined sequence the reciprocation of the valve members and interchange of the connections for their respective pairs of cylinders.

9. In a loom for weaving fabric, a warp system, a plurality of warp thread-actuating elements positioned in pairs along the warp system, control means operable to move the elements of each pair simultaneously in opposite directions transverse to the direction of said warp system, means for progressively actuating the control means for said pairs of elements to open and close a warp shed progressively in said system, a weft-carrying and feeding shuttle located within said shed and having a rear end portion in engagement with the warp threads as they progressively close during said progressive shedding and shaped to receive a forward impulse from the closing warp threads forwardly propelling said shuttle through said shed.

10. In a loom for weaving fabric, at least one warp system, a plurality of warp thread-actuating rods grouped in pairs along said warp system, a piston operatively connected to each rod, a cylinder in which each piston operates, means for supplying a gas under super-atmospheric pressure, means for supplying a vacuum, means for connecting the cylinders associated with each pair of rods simultaneously to said pressure supply means and to said vacuum supply means respectively, means for altering said connecting means to interchange the connections between the pairs of cylinders and the pressure and vacuum supply means in a predetermined sequence progressively to open and close a warp shed, means for connecting the cylinders associated with each pair of rods simultaneously to said pressure supply means and to said vacuum supply means respectively so that the pistons of each pair of pistons work in opposite directions, means for periodically altering said connecting means to interchange periodically

the connections between the pairs of cylinders and the pressure and vacuum supply means in a predetermined sequence so that a plurality of warp sheds are simultaneously opened and simultaneously closed each in a progressive manner, a plurality of weft-carrying and feeding shuttles each freely located within a respective one of said sheds, each shuttle having a rear end portion in engagement with the warp threads of its respective shed as they progressively close during the progressive shedding and adapted to receive a forwardly directed impulse from the closing warp threads of its respective shed forwardly propelling each shuttle through its respective shed.

11. In a loom for weaving fabric, at least one warp system a plurality of warp thread-actuating rods grouped in pairs along said warp system, a piston operatively connected to each rod, a cylinder in which each piston operates, means for supplying a gas under super-atmospheric pressure, means for supplying a vacuum, means for connecting the cylinders associated with each pair of rods simultaneously to said pressure supply means and to said vacuum supply means respectively so that the pistons of each pair of pistons work in opposite directions, means for periodically altering said connecting means to interchange periodically the connections between the pairs of cylinders and the pressure and vacuum supply means in a predetermined sequence so that a plurality of warp sheds are simultaneously opened and simultaneously closed each in a progressive manner, a plurality of weft-carrying and feeding shuttles each freely located within a respective one of said sheds, each shuttle having a rear end portion in engagement with the warp threads of its respective shed as they progressively close during the progressive shedding and adapted to receive a forwardly directed impulse from the closing warp threads of its respective shed forwardly propelling each shuttle through its respective shed.

12. In a loom for weaving fabric, at least one warp system, a plurality of warp thread-actuating rods grouped in pairs along said warp system, a piston operatively connected to each rod, a cylinder in which each piston operates, means for supplying a gas under super-atmospheric pressure, means for supplying a gas under sub-atmospheric pressure, means including a valve member for connecting the pair of cylinders associated with each pair of rods simultaneously to said super- and sub-atmospheric pressure supply means respectively so that if the connections are interchanged the pistons of each pair of pistons move in opposite directions to cause shedding of their associated warp threads, each said valve member being mounted for reciprocal axial movement, stationary guide means disposed in the path of axial movement of each said valve member and shaped to convert each reciprocation of said valve member into a rotary movement of said valve member about its axis through a predetermined angle to interchange the connections between its associated pair of cylinders and the super- and sub-atmospheric pressure supply means, and means for periodically reciprocating in a predetermined sequence the valve members for the pairs of cylinders progressively to open and close a shed in said warp system, whereby a weft-carrying and feeding shuttle may be driven within said shed along said warp system.

13. In a loom for weaving fabric, at least one warp system, a plurality of warp thread-actuating rods grouped in pairs along said warp system, a piston operatively connected to each rod, a cylinder in which each piston operates, means including a valve member for connecting the pair of cylinders associated with each pair of rods simultaneously to said pressure supply means and to said vacuum supply means respectively so that if said connections are interchanged the pistons of each pair of pistons move in opposite directions to cause shedding of their associated warp threads, each said valve member being mounted for reciprocal axial movement, stationary guide

means disposed in the path of axial movement of each said valve member about its axis through a predetermined angle to interchange the connections between its associated pair of cylinders and the pressure and vacuum supply means, means for periodically reciprocating in a predetermined sequence the valve members for the pairs of cylinders so that a plurality of warp sheds are simultaneously opened and simultaneously closed each in a progressive manner, and a plurality of weft-carrying and feeding shuttles each freely located within a respective one of said sheds, each shuttle having a rear end portion in engagement with the warp threads of its respective shed as they progressively close during the progressive shedding and adapted to receive a forwardly directed impulse from the closing warp threads of its respective shed forwardly propelling each shuttle through its respective shed.

14. In a loom for weaving fabric, a warp system, shuttle support means through which the warp threads of said system pass, at least one weft-carrying and feeding shuttle disposed in contact with said support means and arranged to be driven therealong, said shuttle having a weft-feeding outlet located rearwardly of the rear end of the main body portion of the shuttle, and shedding means disposed adjacent said support means on the side remote from said shuttle and operative to open progressively a shed for said shuttle and to close progressively said shed by crossing those warp threads which are in the vicinity of said rear end portion and ahead of said weft-feeding outlet, whereby shedding of the warp threads takes place before the laying-in of the weft thread so that beating-up of the weft thread is unnecessary.

15. In a circular loom for weaving tubular fabric, at least one warp system arranged in a circle to present an endless weaving line, a plurality of shedding units distributed around said circle for groupwise operating the warp threads of said system, control means for actuating said shedding units in a predetermined sequence so that a series of warp sheds of predetermined equal length are simultaneously opened and closed each in a progressive manner along said circle followed by a long warp shed of at least twice said predetermined length, a series of weft-carrying and feeding shuttles each disposed within a respective one of said sheds of said predetermined length, said shuttles each having its rear end portion in engagement with those warp threads of its respective shed which are closing during said progressive shedding and shaped to derive from said closing warp threads a resultant force forwardly propelling each shuttle through its respective shed, a shuttle replacement guide pivotally mounted at a first point outside said warp system so that when said long shed approaches said point the shuttle outlet end of said guide may be swung toward said warp system to push away the adjacent outer warp threads of said long shed until the longitudinal axis of said guide lies substantially in a plane tangential to the center line of the path of travel of said shuttles whereby a new shuttle may be shot into the front portion of said long shed and said guide swung back outside said system, a shuttle removal guide pivotally mounted at a second point outside said warp system so that after the outlet end of said shuttle replacement guide has been swung back outside said warp system the inlet end of said shuttle removal guide may be swung toward said warp system to push away the adjacent warp threads of said long shed until the axis of said shuttle removal guide lies in a plane substantially tangential to the center line of the path of shuttle travel, whereby the leading shuttle of said plurality of shuttles may escape into said shuttle removal guide and said removal guide swung back outside said warp system before the arrival of the next shuttle, and means operable to render operative the shedding units adjacent to said new shuttle and to render inoperative the shedding units formerly adjacent to said removed shuttle.

16. A loom according to claim 15 wherein each shuttle

has its weft-feeding outlet located rearwardly of the rear extremity of said end portion.

17. In a loom for weaving fabric, a warp system including warp threads, shedding means positioned along said warp system for progressively opening and closing a shed in the warp threads, a shuttle support extending along the path of said shed so as to lie at least partly within the shed when open, a weft-carrying and feeding shuttle located in said shed in contact with said support for free movement therealong restrained laterally solely by said warp threads, the rear end of the main body member of said shuttle being provided with a sloping surface on at least one side thereof which extends in a generally rearward direction toward the longitudinal axis of said shuttle, some of the warp threads of the shed as they progressively close during shedding engaging said sloping surface of the shuttle and exerting a resultant force thereon whereby said shuttle is forwardly propelled along said support and through said shed under the sole influence of said warp threads.

18. In a loom for weaving fabric, a warp system including warp threads, a plurality of shedding units distributed along said warp system, control means operative to actuate progressively said shedding units for progressively opening and closing a shed in the warp threads, a shuttle support extending along the path of said shed so as to lie at least partly within the shed when open, a weft-carrying and feeding shuttle located in said shed in contact with said support for free movement therealong restrained laterally solely by said warp threads, the rear end of the main body member of said shuttle being provided with rearwardly sloping side surfaces extending toward the longitudinal axis of said shuttle, the warp threads of the shed as they progressively close during shedding engaging said sloping surfaces of the shuttle and exerting a resultant force thereon whereby said shuttle is forwardly propelled along said support and through said shed under the sole influence of said warp threads.

19. In a loom for weaving fabric, a warp system including warp threads, a plurality of shedding units distributed along said warp system, control means operative to actuate progressively said shedding units for progressively opening and closing a shed in the warp threads, a shuttle support extending along the path of said shed so as to lie at least partly within the shed when open, a weft-carrying and feeding shuttle located in said shed in contact with said support for free movement therealong restrained laterally solely by said warp threads, the rear end of the main body member of said shuttle being provided with a pair of freely rotatable rollers having their axes of rotation located respectively on opposite sides of the longitudinal axis of the shuttle, the warp threads of the shed as they progressively close during shedding engaging said rollers of the shuttle and causing them to rotate in opposite directions respectively while exerting a resultant force thereon whereby said shuttle is forwardly propelled along said support and through said shed under the sole influence of said warp threads.

20. In a loom for weaving fabric, a warp system including warp threads extending substantially around a circular path, shedding means disposed substantially around said circular path for progressively opening and closing a shed in the warp threads, a shuttle support extending substantially around said circular path so as to lie at least partly within the shed when open, a weft-carrying and feeding shuttle located in said shed in contact with said support for free movement therealong around said circular path restrained laterally solely by said warp threads, the rear end of the main body member of said shuttle being provided with a sloping surface on at least one side thereof which extends in a generally rearward direction toward the longitudinal axis of said shuttle, some of the warp threads of the shed as they progressively close during shedding engaging said sloping surface of the shuttle and exerting a resultant force there-

on whereby said shuttle is forwardly propelled along said support and through said shed under the sole influence of said warp threads.

21. In a loom for weaving fabric, a warp system including warp threads extending substantially around a circular path, a plurality of shedding units distributed substantially around said circular path, control means operative to actuate progressively said shedding units for progressively opening and closing a shed in the warp threads, a shuttle support extending substantially around said circular path so as to lie at least partly within the shed when open, a weft-carrying and feeding shuttle located in said shed in contact with said support for free movement therealong around said circular path restrained laterally solely by said warp threads, the rear end of the main body member of said shuttle being provided with rearwardly sloping side surfaces extending toward the longitudinal axis of said shuttle, the warp threads of the shed as they progressively close during shedding engaging said sloping surfaces of the shuttle and exerting a resultant force thereon whereby said shuttle is forwardly propelled along said support and through said shed under the sole influence of said warp threads.

22. For use in a loom for weaving fabric, a weft-carrying and feeding shuttle comprising a substantially flat-bottomed elongated base, a pair of smooth runners secured to the flat bottom of said base substantially parallel to the longitudinal axis thereof, means secured to the upper surface of said base for mounting an elongated weft pin thereon with its longitudinal axis substantially parallel to said base, said base extending rearwardly beyond the extremity of said pin for a short distance and having its side surfaces sloping rearwardly and inwardly toward the longitudinal axis thereof, a weft-laying arm, and means mounting said arm at one end near the front of said shuttle for free pivotal movement in a plane passing substantially through the longitudinal axis of said base and at right angles to the bottom thereof, the free end of said arm extending rearwardly beyond the rear extremity of said base and being provided with a downwardly tapering profile, whereby the shuttle may be propelled along a shuttle support within a warp shed with the weft-laying arm urged into the line of weaving by the warp threads when said warp threads engage the inwardly sloping side surfaces of the base and the downwardly tapering free end of the weft-laying arm of said shuttle during progressive shedding.

23. For use in a loom for weaving fabric, a weft-carrying and feeding shuttle comprising an elongated base, said base being provided with a smooth running surface on the bottom thereof, means secured to the upper surface of said base for mounting a weft pin thereon, said base extending rearwardly beyond the extremity of said pin for a short distance and having its side surfaces sloping rearwardly and inwardly toward the longitudinal axis thereof, a weft-laying arm, and means mounting said arm at one end near the front of said shuttle for free pivotal movement in a plane passing substantially through the longitudinal axis of said base and at right angles to the bottom thereof, the free end of said arm extending rearwardly beyond the rear extremity of said base and being provided with a downwardly tapering profile, whereby the shuttle may be propelled along a shuttle support within a warp shed with the weft-laying arm urged into the line of weaving by the warp threads when said warp threads engage the inwardly sloping side surfaces of the base and the downwardly tapering free end of the weft-laying arm of said shuttle during progressive shedding.

24. For use in a loom for weaving fabric, a weft-carrying and feeding shuttle comprising an elongated base, said base being provided with a smooth running surface on the bottom thereof, means secured to the upper surface of said base for mounting a weft pin thereon, a pair of freely rotatable rollers mounted on the upper surface of said base at the rear thereof with their axes of rotation located

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respectively on opposite sides of the longitudinal axis of said base and with their peripheries extending rearwardly and laterally beyond the boundaries of said pirn and base, a weft-laying arm, and means mounting said arm at one end near the front of said shuttle for pivotal movement in a plane passing substantially through the longitudinal axis of said base and parallel to the axes of rotation of said rollers, the free end of said arm extending rearwardly beyond the rear extremities of said rollers and being provided with a downwardly tapering profile, whereby the shuttle may be propelled along a shuttle support within a warp shed with the weft-laying arm urged into the line of

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weaving by the warp threads when said warp threads engage the rollers and the downwardly tapering free end of the weft-laying arm of said shuttle during progressive shedding.

References Cited in the file of this patent

UNITED STATES PATENTS

1,723,426	Jones	Aug. 6, 1929
2,425,676	Hindle	Aug. 12, 1947
2,553,284	Whitaker	June 26, 1951
2,601,358	Ancet	June 24, 1952