ABSTRACT: A shuttleless loom having two filling thread carriers which move inwardly from the opposite sides of the weaving section of the loom to a medial filling thread transfer location, with one thread carrier being arranged to pick up a selected filling thread from one of a plurality of relatively fixed thread supplies and transport the selected filling thread to the medial transfer location and with the other thread carrier being arranged to pick up the filling thread from the first carrier and complete the filling.
SHUTTLELESS LOOM

The present invention relates generally to weaving looms, and in particular to an improved shuttleless cloth-weaving loom.

In a conventional weaving loom, individual shuttles are disposed in a shuttle-positioning mechanism which is periodically moved to bring a particular shuttle into a position to deliver its filling to the weft of the fabric. The pattern of the fabric is determined by the substance, color and picks of the weft or filling thread. Such shuttle looms are of complicated structure and involve the movement of relatively large masses, and thus are costly to manufacture and maintain. Often, they are more costly to operate since they are not particularly suitable for high-speed and continuous operation.

Through the years, a number of different shuttleless looms have been proposed in which filling thread carriers are moved through the shed or weaving section of the loom from the opposite sides of the weaving section, with one of the carriers picking up a selected weft or filling thread and carrying it from one side of the weaving section to the center of the shed and with the other of the thread carriers being arranged to pick up the weft thread at the center of the shed and complete the filling. Thereupon, the loom, operating in a conventional fashion, heats the filling into the shed of the cloth. In looms of this type, the weft of filling threads are wound on a number of relatively fixed bobbins or spools which are disposed at one side of the loom, with provision, as under the control of a perforated card, for selectively presenting a selected one of the several filling threads for pickup by the first carrier for movement to the medallion pick-transfer location. The handling of the weft of filling thread for completing successive picks involves the initial positioning of the thread for selection as the filling, the pickup of the thread by the first carrier and the transfer of the picked up thread from the first carrier to the second carrier. Each of these manipulative operations must be performed every time a filling is placed into the cloth and literally thousands of such fillings are required in the weaving of a length of cloth. The equipment problem is further complicated by the fact that the mechanisms must be capable of handling filling threads of different diameters and of differing materials, from very coarse threads of natural fibers to finer threads of synthetic fibers, often in the very same fabric. Numerous suggestions have been made in the prior art for the construction of a loom of this type. Representative prior art patents are U.S. Pat. No. 2,151,085 of Mar. 21, 1939, U.S. Pat. No. 2,187,344 of Jan. 16, 1940 and U.S. Pat. No. 3,092,150 of June 4, 1963, all of which deal with the same general type of loom and the many problems presented in their construction for successful operation.

Broadly, it is an object of the present invention to provide an improved shuttleless weaving loom. Specifically, it is within the contemplation of the present invention to provide a shuttleless weaving loom which is capable of reliable operation over a prolonged period of time and is suitable for weaving a wide variety of fabrics including fillings of different size, texture and other physical characteristics.

More particularly, it is within the contemplation of the present invention to provide a shuttleless loom construction which may either be built as a new loom or may be employed to convert existing looms which have become outdated and outdated such that the investment in such obsolete looms may be in part recaptured. Advantageously, in accordance with the present invention, it is possible to convert a number of different types of existing looms including a four-by-four box loom (Knowles) for operation on a shuttleless basis with a high order of reliability and loom efficiency.

In accordance with an illustrative embodiment demonstrating objects and features of the present invention, there is provided a shuttleless cloth-weaving loom which includes a frame having a weaving section and a warp-forming means in the weaving section having plural warp threads defining a fall which is adapted to have successive filling thread beat therein to complete the fall of the cloth. My improved loom includes a combined lay and carrier assembly which is movable through a beating stroke and is operable to selectively present picked filling threads in the shed for beating into the fall. This assembly includes first and second carriers which are movable from respective first and second clearance positions at the opposite side of the weaving section to a medial pick-transfer location relative to the weaving section. The first and second carriers each include cooperating thread-gripping jaws and means normally biasing the jaws into a closed position relative to each other. First jaw-actuating means are operatively arranged relative to the first carrier when in the first clearance position at one side of the weaving section for opening its thread-gripping jaws to receive a picked filling thread for advance to the pick-transfer location. Filling-selector and presenting mechanisms are provided at the one side of the loom for presenting a pick thread to the open and advancing thread-gripping jaws of the first carrier. The open thread-gripping jaws of the first carrier close in response to movement of the first carrier from the clearance position at the one side of the loom toward the pick-transfer location. The thread-gripping jaws of the first and second carriers are constructed and arranged to coact with each other in the pick-transfer location to transfer the pick-filling thread from the first carrier to the second carrier. The thread-gripping jaws of the second carrier are effective to complete the lay of the pick-filling thread into the shed as the second carrier moves from the pick-transfer location to the second clearance position. Second jaw-actuating means are operatively arranged relative to the second carrier when in the second clearance position at the other side of the weaving section for opening its thread-gripping jaws to release the picked filling thread for beating into the fall. Coordinated drive means are provided for moving the combined lay and carrier assembly through the beating stroke and for moving the first and second carriers relative to each other in timed relation such as to progressively weave the cloth. Advantageously, the thread-gripping jaws of the first and second carriers are constructed and operated in a manner to assure positive pickup and transfer of the filling thread. Preferably means are provided at the pick-transfer location for opening the closed jaws of the second carrier as the carriers approach the medial pick-transfer location such that the open jaws of the second carrier will receive the picked filling thread from the first carrier.

The above brief description, as well as further objects and features of the present invention will be more fully appreciated by reference to the following detailed description of a presently preferred loom and several alternative constructions in the loom, when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a plan view of a loom embodying features of the present invention, with the assembly of the lay and pick carriers being shown in operative or beating position and with the inoperative or retracted position thereof being illustrated by the dot-dash lines;

FIG. 2 is a side elevational view of the loom taken from the right of FIG. 1;

FIG. 3 is a fragmentary front elevational view of the loom showing the details of the right section and first pick carrier assembly, there being a substantially identical but mirror image left section and pick carrier assembly on the other side of the loom;

FIG. 4 is an enlarged fragmentary plan view showing details of the filling-selector mechanism in its inoperative position;

FIG. 5 is a sectional view taken substantially along the lines -5-5 of FIG. 4 and looking in the direction of the arrow showing details of the filling-selector mechanism, with the parts thereof in the inoperative position;

FIG. 6 is a vertical sectional view similar to FIG. 5 but showing the filling-selector mechanism actuated for presenting a particular filling thread for a pick by the loom mechanisms;

FIG. 7 is a horizontal section through the first carrier of the loom which picks up a selected filling thread and advances the same to a medial pick-transfer location,
FIG. 8 is a sectional view taken substantially along the line 8—8 of FIG. 7 and looking in the direction of the arrows showing details of the first carrier with a selected thread being illustrated as being gripped by the closed first carrier jaws;

FIG. 9 is a transverse sectional view taken substantially along the line 9—9 of FIG. 8 and looking in the direction of the arrows showing the camming mechanism for opening the first carrier jaws to receive a selected filling thread;

FIG. 10 is a transverse sectional view through the second carrier of the loom which picks up a picked thread at a medial pick-transfer location and which serves to complete the lay of the picked filling;

FIG. 11 is a vertical sectional view taken substantially along the line 11—11 of FIG. 10 and looking in the direction of the arrows showing further details of the second carrier;

FIG. 12 is a fragmentation plan view, with parts broken away and in section, showing the coaction between the first and second carriers of the filling arrangements shown on the medical pick-transfer location during transfer of a picked thread from the first or right carrier to the second or left carrier;

FIG. 13 is a view similar to FIG. 12 after transfer of a picked thread from the first or right carrier to the second or left carrier and showing the carriers as they are moving away from each other from the medial pick-transfer location;

FIG. 14 is a fragmentation plan view taken along the right side of the loom and showing the mechanisms for presenting a picked thread for temporary holding, cutoff and presentation to the first carrier of the pick-filling mechanism, with the loom in its open position wherein the assembly of the lay and first and second carriers are retracted from the full formed by the ends or warp of the cloth;

FIG. 15 is a sectional view substantially along the lines 15—15 of FIG. 14 and showing the relative position of the mechanism in the open position of the loom;

FIG. 16 is a fragmentation plan view of a portion of the loom shown in FIG. 14 but in the closed position wherein the assembly of the lay and first and second carriers have moved substantially through the beating stroke and showing the mechanisms for presenting a thread for engagement by the advancing first carrier of the filling mechanism;

FIG. 17 is a vertical section taken substantially along the line 17—17 of FIG. 16 and looking in the direction of the arrows;

FIG. 18 is a sectional view taken substantially along the line 18—18 of FIG. 14 showing the side of the thread transfer mechanism opposite from that illustrated in FIG. 15;

FIG. 19 is a view similar to FIG. 18, but showing the mechanisms at the completion of the beating stroke wherein the reed is in the fell of the cloth contiguous to the breastbeam of the loom;

FIG. 20 is a fragmentation elevational view of a typical thread-tensioning system employed in the present loom;

FIG. 21 is a plan view of the thread-tensioning system shown in FIG. 20;

FIGS. 22-25 inclusive are progressive diagrammatic and schematic showings in plan of the basic mechanisms of the loom progressively illustrating a typical operating cycle;

FIG. 26 is a fragmentation plan view of a typical selvage-binding mechanism incorporated in the present loom;

FIG. 27 is a fragmentation plan view showing the manner in which the selvage-binding mechanism of FIG. 26 binds the selvage of the woven cloth;

FIG. 28 is a fragmentation plan view of a loom having a modified carrier and carrier-actuating arrangement in accordance with further features of the present invention;

FIG. 29 is a fragmentation elevational view at the medial pick-transfer location of the modified loom illustrated in FIG. 28;

FIG. 30 is a fragmentation sectional view taken substantially along the line 30—30 of FIG. 28 showing details of the lay of the loom having the carrier-actuating cam thereon, with the full lines showing the lay in the retracted position and the dotted lines showing the lay in the beating position in the fell of the cloth;

FIG. 31 is a plan view, with parts broken away and in section, of a modified first carrier embodying further features of the invention which carrier is useful in the modified loom illustrated in FIGS. 28-30;

FIG. 32 is a plan view of a modified second carrier for use in the loom illustrated in FIGS. 28-30;

FIG. 33 is a plan view, with parts sectioned, showing the coaction of the first and second carriers at the medial pick-transfer location wherein the pick which has been laid halfway across the cloth and is being transferred from the first carrier to the second carrier;

FIG. 34 is a view similar to FIG. 33 but showing the first and second carriers moving away from the medial pick-transfer location, the pick having been transferred to the second carrier;

FIG. 35 is a plan view of a modified selvage-binding mechanism embodying further features of the present invention;

FIG. 36 is a plan view taken substantially along the line 36—36 in FIG. 35 and looking in the direction of the arrows; and

FIG. 37 is a fragmentation plan view, on an enlarged scale, and with parts broken away, showing the mounting arrangement for the thread-twisting tubes incorporated in the modified selvage-binding mechanism illustrated in FIGS. 35 and 36.

Referring now specifically to the drawings, and in particular to FIGS. 1-3, there is shown a typical loom 30 embodying features of the present invention which includes a main frame 32 having opposite side frame members 34, 36 interconnected at their forward end by a breastbeam 38 over which the finished cloth C passed, as indicated by the directional arrow, towards a conventional takeup. As is generally understood, the filling or weft F of the cloth C is composed of successive picks of thread which are beat into the fell formed by the ends of warp E of the cloth. To this end, the loom 30 includes a lay 40 which extends transversely of the loom intermediate the side frame members 34, 36 and is movable between the open position shown by the dotted lines in FIG. 1 and the operative or beating position shown by the full lines in FIG. 1.

As seen best in FIGS. 3 and 14-17 inclusive, the lay 40 includes a plurality of parallel and vertical reeds 42 which extend between a reed support 44 and a reed cap 46. The reeds 42 extend through to the cloth or goods C and serve to beat successive picks of the filling F into the fell of the cloth. At locations outwardly of the margins or selvages of the goods C, the reed support 44 and reed cap 46 are interconnected by end plates 48, 50 (see FIG. 1). The lay 40 is mounted on the rocker shaft 52 by depending mounting arms 54 welded or otherwise secured to the end plates 48, 50 and terminating in hubs 54e which are attached to the lay rocker shaft 52 (see FIG. 3). Rocking motion is imparted to the lay 40 from the main drive motor 56 of the machine, seen in FIG. 1. Specifically, the main drive motor 56 includes the usual speed reduction and control gearing and has its output shaft 56a connected to a main shaft 58 which extends from side to side of the machine and is journaled in the side frame members 34, 36. Outwardly of the side frame member 36, the main shaft 58 carries a main drive gear 60 which engages a crankshaft drive gear 62 carried on a crankshaft 64 which is likewise journaled on the side frame members 34, 36 at a location somewhat forwardly of and above the main shaft 58 (see FIGS. 1 and 2). The crankshaft 64 includes crank arms 64a, 64b which are connected by respective connecting links 66, 68 to the end plates 48, 50 of the lay 40. Thus, the rotary motion of the crankshaft 64 will be translated into the requisite rocking motion of the
lay 40 for moving the latter through the requisite bearing stroke.

Projecting outwardly from the opposite sides of the machine 30 are first and second carrier assemblies, generally designated by the reference numerals 76, 74. The carrier assemblies 78, 72 are of substantially identical construction, except for the details of the first and second carriers 74, 76 and their respective functions. Accordingly, it will suffice to generally describe these structures by referring to the carrier assembly 70 in conjunction with FIGS. 7 to 12 inclusive and to separately describe the details of the first and second carriers 74, 76. The carrier assembly 70, seen best in FIGS. 1 to 3 inclusive, includes an upstanding subframe 78 of U-shape which is mounted and extends horizontally to rock back and forth with the lay 40. Specifically, the lower leg 78b of the subframe 78 is connected to the lay rocker shaft 52 while the upper leg 78b is connected to the lay 40. The terminal section 78c of the upper leg 78b of rockable subframe 78 is provided with lateral guides 78d, 78e (see FIG. 15) to appropriately confine the first carrier 74 in its retracted 74a position on the side of the lay 40 prior to its passage from the one side of the locus toward a medial pick-transfer location wherein the first carrier 74 coacts with the second carrier 76 to transfer a thread pick. The first carrier 74 is mounted on a flexible flyer strap 80 which is guided by the U-shaped subframe 78 serving as a track. As illustrated, a major portion of the flexible flyer strap 80 is received within an elongated curved guideway formed by the tunnel-forming member 78f and the contiguous right portion 78g of the subframe 78.

 Provision is made for imparting drive to the flexible flyer strap 80 to propel the first carrier 74 from its retracted starting position outwardly of the side frame member 34 to first pick up a fiber from thread T and to then carry the picked filling thread to the medial pick-transfer location and finally to return the first carrier to its starting position for pickup of the next filling thread. In similar fashion, provision is made for reciprocating the second carrier 76 via its flexible flyer 80' to bring the second carrier to the medial pick-transfer location wherein it picks up the filling thread and completes the operation of placing the picked filling thread. Thereupon, the picked thread is beat into the fill of the cloth C by the vertical reeds 42 of the lay 40, as is generally understood. The construction of the identical and symmetrically disposed flyer drives at the opposite sides of the machine will be best understood by reference to FIGS. 1 to 3 which shows the flyer drive associated with the first carrier assembly 70. Specifically, a rapi er-actuating shaft 82 is journaled transversely of the machine at a location forwardly of and somewhat below the main shaft 58 (see FIGS. 2 and 3). The opposite ends of the rapi er-actuating shaft 82 are journaled on the side frame members 34, 36 as by the provision of an appropriately sized bearing 84 mounted on the outer face of the adjacent side frame member 34 (see FIGS. 2 and 3). Drive is imparted to the rapi er-actuating shaft 82 by a main shaft sprocket 86 connected to the main shaft 58 and coupled via chain 88 to an intermediate double-decked sprocket 90. Sprocket 90 is mounted on stub shaft 92 which in turn is coupled via chain 94 to the driven sprocket 96 on the rapi er-actuating shaft 82. The rapi er-actuating shaft 82 carries a crank arm 82a which extends parallel to the lateral pick-transfer portion 78h of the subframe 78. The supporting post 78b has slidably mounted thereon a vertically extending rack 98 which is driven from the crank 82a by an appropriate connecting rod 100 which is pivotally connected at its extremities to the crank arm 82a and to the rack 98. Journalled on the post 78b is a pinion shaft 101 which carries at its rearward side pinion 102 which is engaged by rack 98. At its forward side, the pinion shaft 101 carries a driving sprocket 104 which is coupled via chain 106 to a driven sprocket 108 which in turn is journaled on post 78b via pinion shaft 110. Pinion shaft 110 carries a pinion 112 which is journaled within a housing 114 mounted on the post 78b. The pinion 112 engages and reciprocates upper and lower racks 116, 118 which actuate the rapi er 80. Specifically, the racks 116, 118 impart rocking motion to the output pinion 120 which is journaled on pinion shaft 122 mounted via bracket 124 on the outer extremity of a lateral support 54a which is integral with and projects outwardly of the lay-supporting arm 54. Mounted on the output pinion shaft 122 is a rapi er-driving sprocket 125 which has radial driving pins 125a extending through corresponding holes 80a in the flexible flyer strap 80 for imparting reciprocal motion thereto. The driving pinion 125 is effective to drive the flexible flyer strap 80 through the requisite pick-transfer stroke to displace the first carrier 74 from the retracted starting position at the side of the machine, removed from the lay 40, to the medial thread-transfer position centrally of the lay 40.

Reference will now be made to the filling-selector mechanism 126 which is disposed at the right side of the machine 30 and in position for cooperation with the first carrier 74 to present a particular thread or pick T to the carrier 74 to be pulled approximately halfway across the lay for medial transfer to the second carrier 76 which then completes the corresponding pick. The illustrative filling-selector mechanism 126 has been shown with the capability of selecting any one of four threads, specifically designated at T1, T2, T3 and T4. It will be appreciated that a greater or lesser number of threads T may be provided for the selection of picks of different colors, materials, thicknesses, etc. to provide a great variety of cloth patterns, as is generally understood by those working with looms of this general type. As seen best in FIGS. 1 and 2, the filling-selector mechanism 126 includes a filling indicator tape 128 which has four side-by-side longitudinal tracks of appropriate punchings which are read transversely, row by row, to select successive picks for the filling in accordance with the hole pattern in the tape 128. The tape 128 passes about a drum 130 having appropriate lateral flanges thereon, guide roller 132 and a floating blister roller 134 and then over a readout platen 136. The tape 128 is indexed stepwise past a transverse readout location on platen 136 by an indexing rack 138 on the drum 130. The indexing rack 138 is driven by a vertically reciprocable pawl 140 slidably mounted on the adjacent side frame member 34 of the machine. The pawl 140 carries a depending cam follower 142 which engages the tape-indexing cam 144 mounted on the end of the crank shaft 64 outwardly of side frame member 34.

Overlying the filling indicator tape 128 (which, as described is indexed stepwise for signalling successive picks) are four parallel readout levers 146. The levers extend fore and aft of the machine and are each pivoted intermediate their ends on shaft 148 fixed to the adjacent side frame member 34. The rearwardly projecting arms 146a of the readout levers 146 carry depending pins or fingers 146b which ride along the appropriate tracks of the filling indicator tape 128. In response to the selection of a particular thread the corresponding readout pin 146c fall such that the forwardly projecting arm 146c of the selected readout levers is raised. In the illustrative showing, the readout lever 146 for the thread T2 has been selected for the next pick to illustrate a typical operating condition. After each readout, pawl 140 operates lift member 149 to clear the depending pins 146b from the filling indicator tape 128 to permit tape index in response to the upward stroke of the pawl 140.

The forward ends of the readout levers 146 are each connected to a corresponding intermediate connecting lever 150, with the four connecting levers 150 being mounted on pivot 152 on side frame member 34. Specifically, each of the forwardly projecting arms 146c of the readout levers 146 are received within somewhat oversized bearing holes in corresponding rearwardly projecting arms 150a of the intermediate connecting levers 150. The forwardly projecting arms 150 of the intermediate connecting levers 150 carry respective depending selective coupling members 154, seen best in FIGS. 1 and 4-6 inclusive. As may be appreciated by progressively considering FIGS. 5, 6, the lowering of any one of the selective coupling members 154 (such as the one corresponding to thread T2) will bring about a selection of that
thread for the next pick, as will be fully understood by considering the following description. Specifically, a rectangular open frame 156 (see FIG. 6) is mounted on the main frame 32 of the machine by appropriate bracketing. Frame 156 carries a pivot shaft 158 extending fore and aft of the machine on which there is pivoted four thread-selection fingers 160. The fingers 160 project downwardly and forwardly toward the cloth or goods C (see FIGS. 5 and 6), with the selected finger (i.e., finger for thread Tz) moving in the counterclockwise direction as indicated in FIG. 6 under the control of filling indicator tape 128. The several thread-selection fingers 160 are urged against the position stop 164 by individual springs 162 connected between the fingers and the finger frame 156.

Projecting from the side of the finger frame 156 remote from the thread-selection fingers 160 are a pair of spaced and parallel guide rods 166, 168 on which is slidable mounted an actuator block 170. The actuator block 170 is normally biased to the retracted position illustrated in FIGS. 4 and 5 against the enlarged ends 166a, 168a of the guide rods 166, 168 by coil springs 172, 173. As seen in FIG. 5, the coupling members 154 are each formed with an enlarged coupling head 154a which is selectively disposed at a level either opposite the surface 170a or the surface 170b. When a coupling member 154 is in its unactuated position the corresponding head 154a is unaffected by the actuator block 170 in that there is sufficient clearance between the surface 170a and the coupling head 154a such that the forward thrust of the actuator block 170 (compare FIGS. 5 and 6) imparts no motion to the coupling member 154. However, when a particular coupling member 154 is lowered such that the coupling head 154a thereof is opposite the surface 170b of the actuator head 170, forward thrust of the actuator block 170 will be effective to impart motion to the corresponding selected thread-selection finger 160 via the motion transfer member 175. As seen in FIGS. 4 to 6 inclusive, the motion transfer members 175 for the thread-selection fingers 160 are pivotally connected to such fingers and slidable mounted on the finger frame 156 to be displaced in response to movement of the actuator block through its operative stroke.

Provision is made for driving the actuator block 170 through its operative stroke toward the finger frame 156 by an L-shaped drive plate 174 which has its short leg 174a fixed to the actuator block 170 and its long leg 174b guided in the finger frame 156. As seen best in FIG. 2, reciprocal motion is imparted to the drive plate 174 from a rocker shaft 176 which is journalled on the side frame member 34 by bearings 178, 180. The rocker shaft 176 has its offset arm 176a engaged within a cutout 174c formed in the long arm 174b of the drive plate 174 (see FIGS. 5 and 6). The rocker shaft 176 is driven by crank arm 182 which is pivotally connected to a vertically reciprocating cam follower 184 slidable mounted on the side frame member 34 and engaging actuating cam 186 on crankshaft 64. The development of cam 186 and the timing of its actuation is such that rocking motion is imparted to the rocker shaft 176 at the appropriate time in the operating cycle to present the thread (i.e., thread Tz) associated with a particular thread-selection finger 160 to the first carrier 74 as determined from the filling indicator tape 128 and the selection chain 146, 152, 154, 172 and 160 of the filling-selector mechanism 126. At the end of any particular selection, the actuator block 170 returns to its retracted position (see FIG. 5).

During the next thread selection interval, an appropriate one of the coupling members 154 is lowered to position its corresponding thread for selection as the filling for the cloth C.

Reference will now be made to FIGS. 7 to 9 inclusive for a description of the construction of the first carrier 74 which is mounted on the flexible arrows in FIG. 70. The first carrier 74 includes a carrier body 188 which is fixed to the rapier 80 and is formed at its forward end with a laterally flared open mouth 190 which gradually merges into a reduced thread-receiving throat 190a. The open mouth 190 and its throat 190a are defined and bounded by opposed tips 188a, 188b formed on the carrier body 188 and having confronting and outwardly flaring thread-guiding surfaces. Extending at one side of the reduced throat 190a is a stationary carrier jaw 192 which is fixed (as by rivets) to the carrier body 188. Extending at the opposite side of the reduced throat 190a is a movable carrier jaw 194 which is pivoted at pin 196 for movement into and out of closing relation to the stationary carrier jaw 192. The pivoted carrier jaw 194 is normally biased into a closed position against the stationary carrier jaw 192 by the internal bias spring 198.

Provision is made to hold the movable jaw 194 in the open position illustrated in FIG. 7 both when the first carrier 74 is in its retracted starting position outwardly of the side frame member 34 of the loom 30 and when the first carrier moves through the location in which it picks up the thread for the selected filling. The selected thread is then advanced by the first carrier 74 into the medial pick-transferring location, shown by the dot-dash lines in FIG. 1. Control of the first carrier 74 is accomplished by providing a fixed cam 200 which overlies the first carrier 74 in its retracted starting position (see FIGS. 1 and 3). The fixed cam 200 engages a vertically movable cam follower 202 which is mounted transversely of the carrier body 188 in position to engage the movable jaw 194 and pivot the same to the open position illustrated in FIG. 7 against the bias of the spring 198. As may be best appreciated from FIG. 3, the lateral position and longitudinal extent of the cam 200 is such as to present open carrier jaws 192, 194 at the opposite sides of the mouth and throat 190, 190a for thread reception. When the first carrier is moved inwardly of the cam 200 to a position wherein the follower 202 is released, carrier jaws 192, 194 close to grip the selected thread.

The second carrier 76 is seen in FIGS. 10 and 11 to include a carrier body 204 mounted on the flexible rapier strap 80. Projecting forwardly of the carrier body 204 are a fixed carrier jaw 206 and a movable carrier jaw 208. The leading end of the fixed carrier jaw 206 terminates in a hook 206a while the leading end of the movable jaw 208 terminates in a jaw-closing finger 208a which is engageable within the hook 206a. Carrier jaw 208 is slidable longitudinally relative to carrier jaw 206 and is normally biased by spring 210 into a position where the finger 208a is engaged within the hook 206a to form a releasable spring-biased keeper for the thread. In this illustrative embodiment, the selected pick is forced into the keeper defined by the coating elements 206a, 208a at the medial pick-transfer location, with provision being made at the end of the placement of the selected pick or filling to open the second carrier 76 as it returns to the retracted starting position outwardly of the side frame member 36. To this end, a fixed cam 212 (see FIGS. 1 and 11) is arranged to overlie the path traversed by the second carrier 76 as it is retracted to the retracted starting position outwardly of the side frame member 36. The fixed cam 212 actuates a vertically movable cam follower 214 which is mounted on the carrier body 204 and engages the reciprocable jaw 208 of the second carrier 76.

Reverting now to FIGS. 12, 13, there is shown the manner in which the first and second thread carrier 74, 76 cooperate with each other in achieving a pick transfer at the medial pick-transfer location. As you see in FIG. 12, the carrier 74, 76 approach each other, as indicated by the directional arrows. Prior to transfer, the thread T is held between the closed first carrier jaws 192, 194 in the restricted throat 190a of the open mouth 190. Continued movement of the carriers 74, 76 into interengagement brings the spring-biased keeper 206a, 208a into the open mouth 190a of the first carrier 74 and behind the thread T. Thus, after the first and second carriers reach the inner limit of their respective strokes and begin to move away, as indicated by the directional arrows in FIG. 13, the hook 206a engages the thread T and presents the same to the spring-biased keeper such that in response to continued return movement of the second carriers 76, the pick is stripped from between the closed carrier jaws 192, 194 of the first carrier 74 and gripped by the spring-biased jaw 206, 208.
of the second carrier 76. In this illustrative embodiment, pick-transfer is achieved by utilizing closed pairs of spring-biased carrier jaws, with the tension being exerted on the selected thread or pick T being sufficient to achieve release from the first carrier 74, transfer to the second carrier 76 and retention by the second carrier 76 at the completion of the pick. However, when working with heavier threads, it is preferable to employ a different pick-transfer technique, as will be subsequently described.

Reference will now be made to FIGS. 14 through 19 for a description of the mechanism by which the selected thread or pick (i.e., thread T2) is presented for pickup by the first carrier 74 as the lay 40 and carrier assembly 70, 72 move toward the breastbeam 38 of loom to beat the previous pick into the fell. More specifically, these coating devices include a thread-orienting mechanism 216 on the breastbeam 38 which positions a selected thread substantially horizontally for engagement by transfer mechanism 218 on the lay and carrier assemblies 40, 70 and 72 wherein the appropriately presented thread is picked up, oriented in a substantially vertical attitude for engagement by the first carrier 74 and then cut off so that the selected pick may be laid into the fell by cooperating carriers 74, 76 for beating in response to the next operative stroke of the lay 40.

Considering first the thread-orienting mechanism 216 on the breastbeam 38, an upstanding U-shaped carrier support 220 is fixed to the breastbeam transversely thereof and contiguous to the thread-selection fingers 160. The carrier support 220 includes upstanding forward and rearward arms 220a, 220b, which serve as bearings for a reciprocating carrier 222. Carrier 222 includes two arms 222a, 222b (see FIG. 14) which are disposed in space parallel relation to each other and are interconnected by a cross piece 222c. Arm 222a carries a pivoted thread-engaging nose 222d on the forward end thereof which is oriented at the arm 222a at pivot 222e, as will be subsequently described in conjunction with FIGS. 18 and 19, pivoted thread-engaging nose 222d swings through a downward arc to manipulate the selected thread (i.e., thread T2) into a position for transfer to mechanism 218 on the approaching lay and carrier assembly 40, 70, 72. Arm 222b of carrier 222 terminates in a curved nose 222f which overlies the selected thread and coats with the pivoted nose 222d in orienting the selected thread. The pivoted nose 222d is retained in its upstanding position by pull link 222g which has its forward end pivotally connected to the nose 222f at 222h and is operatively connected at its rearward end (after passing through guidepost 222i) to a biasing spring 222j. As may be appreciated best by progressively inspecting FIGS. 18 and 19, as the carrier 222 is moved forwardly on breastbeam beam 38 in the direction of the approaching lay and carrier assemblies (to the right in FIGS. 18 and 19), the pull link 222g will swing the pivoted nose 222d in the clockwise direction about pivot 222e for the desired thread-orienting function in conjunction with the nose 222f.

The carrier 220 is reciprocated through its forward stroke to present the selected thread to the mechanisms 218 by a reciprocating drive which includes a rocker shaft 224 journalined on pillow block 226 on the end of the breastbeam 38 contiguous to the side frame member 34. The rocker shaft 224 terminates in an offset arm 224a which is coupled via pivot link 228 and connecting pin 230 to the carrier 222. As seen best in FIG. 2, at its extreme remoteness from offset arm 224a, the rocker shaft 224 carries a slotted crank arm 222. Rocking motion is imparted to the crank arm 222 from a double arm follower lever 234 which is pivotally connected on the side frame 34 at 236. The forwardly projecting arm 234a of the follower lever 234 carries a pin to a roller 2540 which rides in the slot in the crank arm 222 while the rearwardly projecting arm 234b rides on cam 238 on crankshaft 64. Thus, at the requisite time in the operating cycle, carrier 222 is thrust toward the approaching transfer mechanism 218 against the bias of spring 222j for the required thread-orienting function.
ing members 240, 242 and is finally in position for presentation to the first carrier 74 upon transfer from the temporary holding members. Thereupon, the first carrier 74 traverses its half of the loom to present the leading end of the selected thread to the second carrier 76 at the medial pick-transfer location. This is achieved in this illustrative embodiment by the provision of a hooked needle 278 which is journaled by its shaft 278a on the end plate 48. The hooked end 278b of the needle 278 rocks from the position illustrated in the full lines in FIGS. 16 and 17 to the position illustrated by the dotted lines in FIG. 17 (corresponding to the position shown in FIGS. 14 and 15) to lift the selected thread from beneath the presenting fingers 222, 222/ and hold the same in the vertical position (shown by the dotted lines in FIG. 17 for the selected thread T2). Thus, as the first carrier 74 is driven forward beneath the hooked-shaped needle 278, the same has swung to the clearance position illustrated in FIGS. 14 and 15, the selected thread is oriented to enter the open mouth 190 and then the restricted throat or neck 190a of the first carrier 74, as previously described.

Drive is imparted to the hooked-shaped needle 278 for presentation of the selected thread to the first carrier by the mechanisms seen in FIGS. 2 and 3 which include a subframe 280 fixed to the frame of the first carrier assembly 70 at a location removed from the hooked-shaped needle 278. The subframe 280 supports a vertically reciprocating rack 282 which engages a pinion 284 at its upper end. The pinion 284 is on a shaft 286 which is journaled on subframe 280 which shaft carries a driving sprocket 288 connected via a chain 290 to driven sprocket 229 (see FIGS. 15-17) on needle shaft 278a. At its lower end, rack 282 carries a follower 294 which rides in cam track 296 fixed to the side frame member 34 by bracket 298. The development of the track 296 of the fixed cam member 296 is selected such that as the lay and carrier assemblies 40, 70 begin to retract from the breast beam 38, the requisite upward motion is imparted to rack 282 to rock the hooked-shaped needle 278 to complete the thread presentation for the first carrier, as seen best by the full unbroken lines in FIG. 17.

Having completed the detailed description of the essential mechanism incorporated in the loom 30, there now follows in conjunction with FIGS. 22-25 inclusive a description of a typical sequence of operations with the present loom:

In the FIG. 22 position, the lay is in its beating position having a pick beat into the fell formed by the ends E of the cloth C. The first and second carriers 74, 76 are at their respective retracted starting positions outwardly of the opposite sides of the weaving section of the loom in position for making the next pick of the filling of the cloth F which is to be laid into the fell during the next beating stroke. As may be appreciated progressively comparing FIGS. 22 and 23, and as indicated by the directional arrows in FIG. 23, the rock assembly of the lay 40 and the first and second carrier mechanisms 70, 72 is starting to move through the return stroke from the beating position (shown in detail in FIGS. 1, 16, 17). As seen in FIG. 22, the last pick beat into the fell corresponded to thread T1 while the previous pick was from thread T2. In FIG. 22, there is illustrated the start of the sequence by which thread T1 becomes the next pick, as heretofore described for illustrative purposes. By the sequential operation of the described mechanisms, thread-selection finger 164 for thread T1 is lowered and reciprocating carrier 222 of the thread-orienting mechanism places thread T1 between the temporary holding members 240, 242. When so held by the temporary holding members 240, 242, the thread T1 is cut off from the previous fill employing that thread by the coating stationary and movable cutters 260, 262, and 264. With the thread T1 held by the temporary holding members 240, 242, and cut away from the previous fill employing that thread, the hooked-shaped lifting needle 278 engages thread T1 intermediate holding members 240, 242 and the carrier 222. Thereupon, the first carrier 74, in carrier control of rapier 80, receives the picked thread T1 which held in a vertical orientation between the holding member 240, 242 and the needle 278 for engagement by the coating carrier jaws 192, 194 of the first carrier 74, as described in conjunction with FIGS. 7-13 inclusive. While the first carrier 74 is in its retracted starting position and during its initial traverse toward the central weaving section of the loom and until the picked thread is engaged, the fixed cam 200 is operative through cam follower 202 to maintain the carrier jaws 192, 194 in the open position. As the cam follower 202 moves from beneath the overlying fixed cam 200, the coating first carrier jaws 192, 194 close on the thread under the influence of the carrier spring 198 and the leading end of the picked thread T1 is firmly gripped for advance toward the medial pick-transfer location. The initial advance of the first carrier from the FIG. 23 position to pull the free end or tail of the picked thread T1 from the temporary holding members 240, 242. As shown diagrammatically in FIG. 23, and as indicated by the directional arrows, the first and second carriers 74, 76 move toward each other for the medial thread transfer function. It will, of course, be appreciated that during such motion, the rocking assembly of the lay 40 and the first and second carrier mechanisms 70, 72 are moving through the return stroke. During such return motion, a number of interrelated functions occur including movement of the movable cutter 264 away from the stationary cutters 260, 262, return of the thread carrier 222 to its starting position, openning of the temporary holding members 240, 242, return of the hooked-shaped needle 278 to its starting position; and of course, the thread-selection functions for the next pick go forward.

In the simplified and diagrammatic showing of FIG. 24, the assembly of the lay 40 and the first and second carriers 74, 76 have completed the return stroke and are at the maximum displacement from the fall of the cloth C while the rapiers 80, 80′ have brought the first and second carriers 74, 76 into the medial pick-transfer location wherein the cloth is as illustrated and described in conjunction with FIGS. 12 and 13 to transfer the leading end of the picked thread T1 from between the jaws 192, 194 of the first carrier 74 to the jaws 206, 208 of the second carrier 76. In this illustrative embodiment, the medial transfer takes place as the result of the coaction between and orientation of two sets of closed jaws, 192, 194 and 206, 208, with the leading end of the picked thread T1 being forced between the hook 206a and the finger 208a. Although this thread transfer technique has been found perfectly satisfactory for a number of applications, there will be described hereinafter a further technique for thread transfer which has been found to be particularly advantageous when employing heavier filling materials.

Next, by referring to FIGS. 24 and 25, it will be seen that the return stroke of the first and second carriers 74, 76 is effective to complete the pick employing thread T1 as the filling. Concurrently, as indicated by the directional arrow in FIG. 25, the assembly 40, 70, 72 moves forwardly toward the fell of the cloth through the next beating stroke such that the picked filling will be beat into the fell of the cloth when the loom returns to the position illustrated diagrammatically in FIG. 22 and actually in FIGS. 1, 16 and 17. As the beating stroke is being completed, and for the illustrative condition shown in FIG. 25, the thread carrier 222 has been engaged by the thread-selection finger 164 for filling thread T1 which is to be the next pick as determined by the punchings of the tape 128 of the filling-selector mechanism 126. Of course, in the FIG. 25 position, the temporary holding members 240, 242 are in the open position to receive the selected thread T1, and likewise the movable cutter 264 is in its clearance position relative to the stationary cutters 260, 262 such that after the selected thread T1 is held it is automatically positioned for cutoff from the previous utilization thereof as a filling thread. The showings in FIGS. 22-25 is on a greatly simplified and exaggerated scale and is intended to supplement the detailed showing in the previous figures and their accompanying description. Further variations in loom details will be readily apparent to those skilled in this art.
In a typical working loom, provision must be made for binding the opposite selvages of the cloth as it is woven. Various mechanisms are suitable for twisting a plurality of binding threads along the opposite selvages of the cloth as the latter is formed. Referring to FIGS. 1-5, 26 and 27, there is illustrated a representative selvage-binding mechanism which includes identical right and left selvage-binding mechanisms 300, 300' mounted respectively on the side frame members 34, 36 toward the rear of the loom. Since the selvage-binding mechanisms 300, 300' are of identical construction and function, except for their orientation with respect to the right and left selvages of the cloth C, it will suffice to only describe mechanism 300 which is seen to be mounted on the side frame member 34 by mounting bracket 302. Bracket 302 provides an inclined platform extending downwardly and forwardly, as seen in FIG. 2. Bracket or platform 302 is provided with bearings 304, 306 which journal a combined turntable shaft and hollow feed tube 308. At its rearward end, tube 308 carries a turntable 310 having mounted thereon two spindles 312, 314 receiving spools of the selvage-binding thread 316, 317. The selvage threads S1 and S2 pass from the spools 316, 317 into the hollow feed tube 308 and egress from the tube at exit openings 308c close to but spaced rearwardly from the forward end of tube 308. On the forward end of tube 308, there is mounted two forwardly projecting thread-twisting tubes 318, 320. The thread-twisting tubes 318, 320 cross over each other intermediate their outer ends and have their trailing ends 318a, 320a fixed to the forward end of feed tube 308 and positioned to receive the selvage-binding threads S1, S2. Their forward ends 318b, 320b are positioned to deliver the selvage-binding thread S1, S2 along the opposite selvages of the cloth being woven, with the selvage-binding threads being twisted about successive picks or fills F. The twisted binding threads S1, S2 define the opposite margins of the woven cloth and serve in relation to the filling much in the same way as the warp of the cloth proper. It is, of course, understood that the selvages and the selvage-binding threads S1, S2 are cut away when the cloth is utilized. The selvage-binding mechanisms 300, 300' are subject to a latitude of modification, change and substitution; and an alternate arrangement which finds useful application will be subsequently described in conjunction with FIGS. 35-37 inclusive.

Some details of the loom have not been illustrated, while others are subject to a latitude of modification, change and substitution. Details such as drives, guides, etc., require only a passing comment. For example, in FIGS. 20 and 21 there is illustrated in detail a typical guiding and tensioning arrangement for the filling for threads providing the successive picks or fills F, the illustrative showing of the machine, the filling thread supply (see FIG. 3) is taken from cones, such as indicated at 324, mounted on a cone spindle 326 supported with a thread-dispensing box or housing 328. The inner sidewall of the housing 328 is provided with an appropriate number of exit holes 328a for the corresponding filling threads which threads pass through the thread-guiding and tensioning arrangement, generally designated by the reference numeral 330 and seen detailed in FIGS. 21 and 22. The thread-tensioning arrangements 330 is mounted on an appropriate bracket 332 fixed to the inner side of the housing 328 and includes a series of upstanding posts 334 each of which has mounted thereon a resilient thread guide 336. The resilient thread guide 336 includes an intermediate coil spring 336a which is mounted on a pin 338, an upper and forwardly directed arm 336b which terminates in a thread guide or eye 336c and a lower and forwardly directed arm 336d which likewise terminates in a thread guide or eye 336e. Mounted on pin 338 inwardly of guide 336 is a thread-guide-tensioning spring 340 which has an intermediate coil spring 340a and has one arm 340b hooked over thread guide arm 336b and its other arm 340c engaging post 334 to appropriately anchor spring 340. The thread T passes from cone 324 about an appropriate guide, through exit opening 328a, then through eye 336c and then through eye 336e and then to the eye in the forward end of the corresponding thread selection finger 160. The spring 340 normally biases the thread guide and tensioning arrangement in the counterclockwise direction about mounting post 334 to exert the necessary back tension on the corresponding filling thread. Alternative or additional thread-tensioning arrangements may be employed on the loom wherever required to facilitate loom operation, as is generally understood by those skilled in the art.

Reference will now be made to FIGS. 28 to 34 for description of an alternate arrangement which may be employed in the loom for transferring a pick or filling thread T at the medial transfer location from the first carrier to the second carrier of the loom. The alternate arrangement will be described only to the extent necessary for an understanding of this particular feature, it being appreciated that the remaining details of the loom are identical to that described in the principle embodiment.

Accordingly, identical reference will be employed wherever possible and reference numerals as a part of a "400" series will be employed for modified components of the loom. As seen in FIG. 28, the modified loom still includes two rapiers 80, 80' which reciprocate at right angles to the opposite side frame members 34, 36 rearwardly of the breast beam 38 of the loom. The rapiers 80, 80' are part of the lay 40 and first and second carrier mechanisms 70, 72 of the loom which move between the retracted position illustrated by the full lines in FIG. 28 and the operative or beating position shown by the full lines in FIG. 28. In this modification, the first raper 80 carries a modified first carrier 400 (shown in detail in FIG. 31) while the second raper 80' carries a modified second thread carrier 402 (shown in detail in FIG. 32). The coaction between the modified first and second thread carriers 400, 402 at the medial transfer location is progressively illustrated in FIGS. 33 and 34. The first carrier 400 is actuated to its open position to receive a carrier thread contiguous to the right side frame member 34 of the loom by a stationary side cam 404 which is in a general vertical orientation as compared to the cam 200. A comparable side cam 406 is provided contiguous to the left side frame member 36 and except for its vertical orientation functions like the cam 212 illustrated in the principle embodiment. Cam 404 serves to open the first carrier to receive a filling thread while cam 406 serves to open the second carrier after the fill has been completed to release the picked filling thread. Additionally, there is provided contiguous to the medial transfer location, a third cam 408 which coacts with the second carrier 402, as shown in detail in FIGS. 33 and 34, to open the second carrier to receive a picked filling thread from the first carrier at the medial transfer location. Cam 408 is mounted on the reed stud 66 of the lay 40 and includes a plurality of depending fingers 408a which project down between the ends E of the cloth, with the fingers being interconnected by a transverse bridge 408b. The cam fingers 408a fit between the ends E as the lay moves through its beating stroke (compare the full and broken lines shown in FIG. 30). In the retracted position of the lay 40, the depending fingers 408a of the cam 408 are positioned for actuating the second carrier 402, as it will be subsequently described, while in the beating or operative position of the lay 40 (as shown by the dot-dash lines in FIG. 30), the fingers 408a are in a clearance position above the woven cloth C wherein they do not interfere with the vertical reeds 42 beating a pick into the cloth.

Reference will now be made to FIG. 31 for a description of the first carrier 400 which is mounted on the raper 80. The first carrier 400 includes a carrier body 410 which is fixed to the raper 80 and is formed at its forward end with a laterally flared open mouth 412 which gradually tapers to a thread-receiving throat 412a. The open mouth 412 and its throat 412a are defined by opposed lips 410, 410 formed on the carrier body 410 which provide confronting thread-guiding surfaces for directing the picked thread into the throat 412a. Extending along one side of the thread-receiving throat 412a and rearwardly within the body 410 is a stationary carrier jaw 414 which is fixed, as by rivets, to the carrier body 410. Extending at the opposite side of the thread-receiving throat.
15 412 and rearwardly of the body 410 is a movable carrier jaw 416 which is pivoted at pin 418 for movement into and out of closing relation to the stationary carrier jaw 414. Rearwardly of the pin 418, there is provided a fixed guide pin 420 which is accommodated within an elongated guide slot 422 formed in the pivoted carrier jaw 416. A flat leaf spring 423 bears against the rearwardly projecting face 416 of jaw 416 and normally biases jaw 416 against jaw 414. An arm 416c terminates in an enlarged head 416d which is engaged by a cam follower 424 which is pivoted at 426 and includes a follower head 424a projecting through a cutout 410c formed in the adjacent side of the carrier body 410.

As seen in FIG. 28, it is at this side that cam 404 is arranged, with cam 404 serving to hold the movable jaw 416 of the first carrier 410 in the open position when the first carrier is in its retracted starting position outwardly of the side frame member 34 of the loom and while the first carrier moves through the location in which it picks up the thread for the selected filling. Thereupon, cam follower 424 passes out of contact with cam 404 and the closed carrier jaws 414, 416 serve to advance the picked thread to the medial pick-transfer location.

As seen in FIG. 32, the second carrier 402 which is mounted in upper 80' includes a carrier body 428 to which is fixed, as by rivets, a forwardly projecting fixed carrier jaw 430, the leading end of which terminates in a rearwardly directed thread-engaging hook 430a. Extending next to the fixed carrier jaw 430 is a movable carrier jaw 432 which is pivoted at pivot pin 434 and arranged such that its leading end, serving as a finger 432a, coacts with hook 430a for the thread retention function. The movable carrier 432 includes a rearwardly projecting arm 432b which terminates in an enlarged head 432c which is engaged by leaf spring 436 which normally biases finger 432a against hook 430a. Rearwardly of the jaws 430, 432 is a cam follower 438 which is pivoted at 440 and includes a follower head 438a projecting to one side of the carrier body 428 to be engaged by the cam 408 at the medial pick-transfer location and to be also engaged by the side cam 406. Specifically, at the medial transfer location, cam 408 contacts follower 438 to swing finger 432a away from hook 430a to open the second carrier to receive the advancing filling thread on carrier 400. As the second carrier 402 moves through its return traverse from the medial transfer location to its starting position outwardly of the weaving section of the loom, cam follower 438 moves out of contact with cam 408, virtually at the beginning of the return stroke thereby permitting jaws 430, 432 to close under the influence of spring 436 to pick up the picked thread to complete the transfer from the first carrier. The position shown in FIG. 34 for the first and second carriers 400 and 402 is just prior to disengagement of cam follower 438 from cam 408 and closing jaws 430, 432. When the second carrier moves outwardly of the loom to bring the cam follower 438 into contact with the side cam 406, jaws 430, 432 are again engaged to release the picked thread which has been laid into the fell of the cloth. The remainder of the loom operates as previously described.

Referencing now to FIGS. 35-37 inclusive, there is shown a modified selvage-binding mechanism, generally designated by the reference numeral 441, which may be substituted for that described and illustrated in connection with FIGS. 26 and 27. Once again the selvage-binding mechanisms include identical right and left units mounted respectively on the left and right side frame members 34, 36 of the loom and rearwardly thereof outwardly of the weaving section. Since the modified selvage-binding mechanisms for the left and right sides of the loom are of identical construction, it will suffice to describe only one such mechanism in detail. The selvage-binding mechanism 441 includes a combined turntable shaft and hollow feed tube 442 which is similar in construction and function to the tube 308 and carries at its rearward end a turntable and two spindles for the selvage-binding threads S₁ and S₂ as illustrated in detail in FIGS. 1 and 26. Contiguous to its forward end the tube is provided with opposed egress openings 442a, 442b through which the threads S₁ and S₂ fixed to the forward end 442c of tube 442 is a mounting block 444 for thread-twisting tubes 446, 448 which respectively receive the threads S₁, S₂. Mounting block 444 is provided with the through bores 444a and 444b which are shaped to permit the tubes 446, 448 to move toward and away from each other as they are rotated with the feed tube 442. Thread-twisting tube 446 is mounted on a block 444c at bore 444d by spaced collars 446a, 446b, and in a similar fashion tube 448 is mounted in through bore 444b by spaced collars 448a and 448b. On the rearwardly projecting ends of tubes 446, 448 immediately behind the mounting collars 446a, 448a is a coil spring 450 which normally biases the twisting tubes 446, 448 to the outwardly diverging position illustrated in these figures. Disposed forwardly of the mounting arrangement for the twisting tubes and surrounding the same is a camming member 452 which is provided with an elliptical cutout 452a having its major axis extending vertically. The camming member 452 is mounted on the frame of the machine at any convenient location by bracket 454. The cutout 452a is configured to cam the thread-twisting tubes 446, 448 from the diverging position illustrated by the full lines in these figures to the converged and substantially parallel position illustrated by the dot-dash lines such that the thread-twisting tubes substantially follow the movement of the warped threads in response to opening and closing of the shed. This facilitates operation of the modified thread-binding mechanism illustrated in FIGS. 35-37 which is effective to produce a binding selvage of the type generally illustrated and described in conjunction with FIG. 27.

 Provision is made with the selvage-binding mechanisms 300, 300', illustrated in FIGS. 26 and 27 or with the modified selvage-binding mechanisms 441 in FIGS. 35 to 37 for imparting drive to such mechanisms from the main shaft 58 of the machine. Referring specifically to FIG. 2, it will be seen that the turntable shaft 308 (and the comparable turntable shaft 442) is connected via appropriate chains and sprockets 454 to a Geneva shaft 456 which is journaled upon the machine frame 32 at a location rearwardly of and directed toward the main shaft 48. At its forward end, Geneva shaft 456 carries radially projecting arms 458 which are engaged by a drive segment 460 fixed to shaft 58. The chain and sprockets 454 are selected such that the shaft 456 has a two to one gearing ratio relative to turntable shaft 308 (or comparable turntable shaft 442). Thus, a quarter turn of the Geneva shaft corresponds to a half turn of the turntable shaft 308 and a complete reversal of the relative positions of the selvage threads S₁, S₂. The timing for this illustrative embodiment is such that two filling threads F are placed into the cloth between each twist imparted to the selvage threads S₁, S₂. Obviously, other timings are contemplated and can be readily achieved as is generally understood by those skilled in the art.

 From the foregoing, it will be appreciated that there has been provided in accordance with the present invention improved shuttleless loom mechanisms suitable for converting existing looms or for the manufacture of new looms. The loom mechanisms are such that a wide variety of patterns may be created and various types of fillings may be utilized with the loom rendering the same highly versatile for the creation of a wide variety of fabrics of different textures and patterns. The control of the loom is perfectly compatible with existing control mechanisms and changeover of filling threads is readily accomplished. Additionally, the loom exhibits all of the attributes and advantages of a shuttleless loom and is capable of operation over long periods of time without the necessity of replacement of the filling threads. A latitude of modification, change and substitution is intended in the foregoing disclosure and accordingly it is appropriate that the appended claims be construed broadly and in a manner consistent with the spirit and scope of the present invention.

1. In a shuttleless cloth-weaving loom including a frame having a weaving section and shedding means in said
weaving section having plural warp threads converging at a fall into which successive filling threads are beat to form the cloth, the improvement comprising a combined lay and carrier assembly movable through a beating stroke and selectively presenting picked threads in said shed for beating into said fall, said assembly including first and second carriers movable from respective first and second clearance positions at the opposite sides of said weaving section to a medial pick-transfer location relative to said weaving section, said first and second carriers each including cooperating thread-gripping jaws and means normally biasing said jaws into a closed position relative to each other, first jaw-actuating means operatively arranged relative to said first carrier when in said first clearance position at one side of said weaving section for opening its thread-gripping jaws to receive a presented filling thread for advance to said pick-transfer location, filling-selector and presenting mechanisms at said one side for presenting a selected filling thread to the opened thread-gripping jaws of said first carrier, the thread-gripping jaws of said first carrier being constructed and arranged to coat with each other in said pick-transfer location to transfer the filling thread from said first carrier to said second carrier, the thread-gripping jaws of said second carrier being effective to complete the lay of the filling thread into said shed as said second carrier moves from said pick-transfer location to said second clearance position at the other side of said weaving section for opening its thread-gripping jaws to receive and gripping the selected filling thread, transfer means movable relative to said thread-selection fingers and operable to place a selected filling thread in said temporary holding means, a thread cutter operable after the selected filling thread is held by said temporary holding means for cutting the selected and held filling thread from the previous fill formed with such thread and means for orienting the selected, held, and cut-off filling thread to be engaged within the open thread-gripping jaws of said first carrier.

4. A loom according to claim 3 wherein said temporary holding means includes a stationary surface against which the selected filling thread may be pressed, an elastomeric holding head movable relative to said abutment, a spring normally biasing said holding head against said abutment and latch means for maintaining said holding head in spaced relation to said abutment such that the selected filling thread may be engaged by said temporary holding means, said latch means being operable in response to movement of said combined lay and carrier assembly through said beating stroke.

5. A loom according to claim 3 wherein said thread-cutter includes a cutting blade and blade-actuating means operable in response to movement of said combined lay and carrier assembly through said beating stroke.

6. A loom according to claim 3 wherein the orienting means includes a thread lifter cooperating with said temporary holding means for positioning the selected held and cut filling thread in a substantially vertical attitude for engagement by said first carrier.

7. In a shuttleless cloth-weaving loom including a frame having a breastbeam and a weaving section and shed-forming means in said weaving section having plural warp threads converging at a fall into which successive filling threads are beat to form the cloth, the improvement comprising a combined lay and carrier assembly movable through a beating stroke and selectively presenting picked threads in said shed for beating into said fall, said assembly including first and second carriers movable from respective first and second clearance positions at the opposite sides of said weaving section to a medial pick-transfer location relative to said weaving section, said first and second carriers each including cooperating thread-gripping jaws and means normally biasing said jaws into a closed position relative to each other, first jaw-actuating means operatively arranged relative to said first carrier when in said first clearance position at one side of said weaving section for opening its thread-gripping jaws to receive a presented filling thread for advance to said pick-transfer location, filling-selector and presenting mechanisms at said one side for presenting a selected filling thread to the opened thread-gripping jaws of said first carrier, the thread-gripping jaws of said first carrier being constructed and arranged to coat with each other in said pick-transfer location to transfer the filling thread from said first carrier to said second carrier, the thread-gripping jaws of said second carrier being effective to complete the lay of the filling thread into said shed as said second carrier moves from said pick-transfer location to said second clearance position, second jaw-actuating means operatively arranged relative to said second carrier when in said second clearance position at the other side of said weaving section for opening its thread-gripping jaws to release the filling thread for beating into said fall, coordinated drive means for moving said assembly through said beating stroke and for moving said first and second carriers relative to each other in timed relation such as to progressively weave said cloth and said filling-selector and presenting mechanisms including plural thread-selection fingers adapted to be moved by a tape control for initially orienting a selected filling thread for presentation to said first carrier, temporary holding means for receiving and gripping the selected filling thread, transfer means movable relative to said thread-selection fingers and operable to place a selected filling thread in said temporary holding means, a thread cutter operable after the selected filling thread is held by said temporary holding means for cutting the selected and held filling thread from the previous fill formed with such thread and means for orienting the selected, held, and cut-off filling thread to be engaged within the open thread-gripping jaws of said first carrier.
thread-gripping jaws of said first and second carriers being constructed and arranged to coact with each other in said pick-transfer location to transfer the picked filling thread from said first carrier to said second carrier, the thread-gripping jaws of said second carrier being effective to complete the lay of the picked filling thread into said shed as said second carrier moves from said pick-transfer location to said second clearance position, second jaw-actuating means operatively arranged relative to said second carrier when in said second clearance position at the other side of said weaving section for opening its thread-gripping jaws to release the picked filling thread for beating into said fell and coordinated drive means for moving said assembly through said beating stroke and for moving said first and second carriers relative to each other in timed relation such as to progressively weave said cloth.

8. A loom according to claim 7 wherein the thread-gripping jaws of said first and second carriers are closed at said pick-transfer location and include coating means which cooperate with each other at said pick-transfer location for transferring a picked filling thread from the closed jaws of said first carrier to the closed jaws of said second carrier.

9. A loom according to claim 7 including a combike cam disposed at said pick-transfer location for opening the closed jaws of said second carrier as said carriers approach said pick-transfer location, such that the open jaws of said second carrier will receive the picked filling thread from said first carrier.

10. A loom according to claim 9 wherein said first and second carriers include first and second cam followers operatively connected to the respective jaws thereof and wherein said first and second jaw-actuating means include first and second cams fixed to said assembly at the opposite sides of said weaving section for opening said carriers when disposed outwardly of the opposite sides of said weaving section.

11. In a shuttleless cloth-weaving loom including a frame having a breastbeam and a weaving section and shed-forming means in said weaving section having plural warp threads converging at a fell into which successive filling threads are beat to form the cloth, the improvement comprising a combined lay and carrier assembly movable through a beating stroke relative to said breastbeam and selectively presenting picked filling threads in said shed for beating into said fell, said assembly including first and second carriers movably from respective first and second clearance positions at the opposite sides of said weaving section to an intermediate pick-transfer location relative to said weaving section, said first and second carriers each including cooperating thread-gripping jaws and means normally biasing said jaws into a closed position relative to each other, first jaw-actuating means operatively arranged relative to said first carrier when in said first clearance position at one side of said weaving section for opening its thread-gripping jaws to receive a presented filling thread for advance to said pick-transfer location, filling-selector and presenting mechanisms at said one side for orienting and presenting a selected filling thread to the opened thread-gripping jaws of said first carrier, said mechanisms including temporary holding means contiguous to said one side of said weaving section for temporarily gripping and holding a selected filling thread, a cutter for cutting the selected and held filling thread from the previous fill formed with such thread and thread-lifting means for engaging the held filling thread and imparting a prescribed orientation thereto, the open thread-gripping jaws of said first carrier closing in response to movement of said first carrier from said clearance position toward said pick-transfer location, the thread-gripping jaws of said first and second carriers being constructed and arranged to coact with each other in said pick-transfer location to transfer the picked filling thread from said first carrier to said second carrier, the thread-gripping jaws of said second carrier being effective to complete the lay of the picked filling thread into said shed as said second carrier moves from said pick-transfer location to said second clearance position, second jaw-actuating means operatively arranged relative to said second carrier when in said second clearance position at the other side of said weaving section for opening its thread-gripping jaws to release the picked filling thread for beating into said fell and coordinated drive means for moving said assembly through said beating stroke and for moving said first and second carriers relative to each other in timed relation such as to progressively weave said cloth.

12. A loom according to claim 11 wherein the thread-gripping jaws of said first and second carriers are closed at said pick-transfer location and include coating means which cooperate with each other at said pick-transfer location for transferring a picked filling thread from the closed jaws of said first carrier to the closed jaws of said second carrier.

13. A loom according to claim 11 including a combike cam disposed at said pick-transfer location for opening the closed jaws of said second carrier as said carriers approach said pick-transfer location such that the open jaws of said second carrier will receive the picked filling thread from said first carrier.

14. A loom according to claim 13 wherein said first and second carriers include first and second cam followers operatively connected to the respective jaws thereof and wherein said first and second jaw-actuating means include first and second cams fixed to said assembly at the opposite sides of said weaving section for opening said carriers when disposed outwardly of the opposite sides of said weaving section.

15. A loom according to claim 11 wherein said filling-selector and presenting mechanisms include plural thread-selection fingers adapted to be moved by a tape control for initially orienting a selected filling thread for presentation to said first carrier temporary holding means for receiving and gripping the selected filling thread, transfer means movable relative to said thread-selection fingers and operable to place a selected filling thread in said temporary holding means, a thread cutter operable after the selected filling thread is held by said temporary holding means for cutting the selected and held filling thread from the previous fill formed with such thread and means for orienting the selected, held and cut filling thread to be engaged within the open thread-gripping jaws of said first carrier.

16. A loom according to claim 15 wherein said temporary holding means includes a stationary abutment providing reaction surface against which the selected filling thread may be pressed, a holding head movable relative to said abutment, a spring normally biasing said holding head against said abutment and means for maintaining said holding head in spaced relation to said abutment such that the selected filling thread may be engaged by said temporary holding means, said last-named means being operable in response to movement of said combined lay and carrier assembly through said beating stroke.

17. A loom according to claim 15 wherein said thread cutter includes a cutting blade and blade-actuating means operable in response to movement of said combined lay and carrier assembly through said beating stroke.

18. A loom according to claim 15 wherein the orienting means includes a thread lifter cooperating with said temporary holding means for positioning the selected, held and cut filling thread in a substantially vertical attitude for engagement by said first carrier.