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G. PIAZZOLLA ET AL

3,519,029

NEEDLE LOOM

Filed July 30, 1968

5 Sheets-Sheet 1

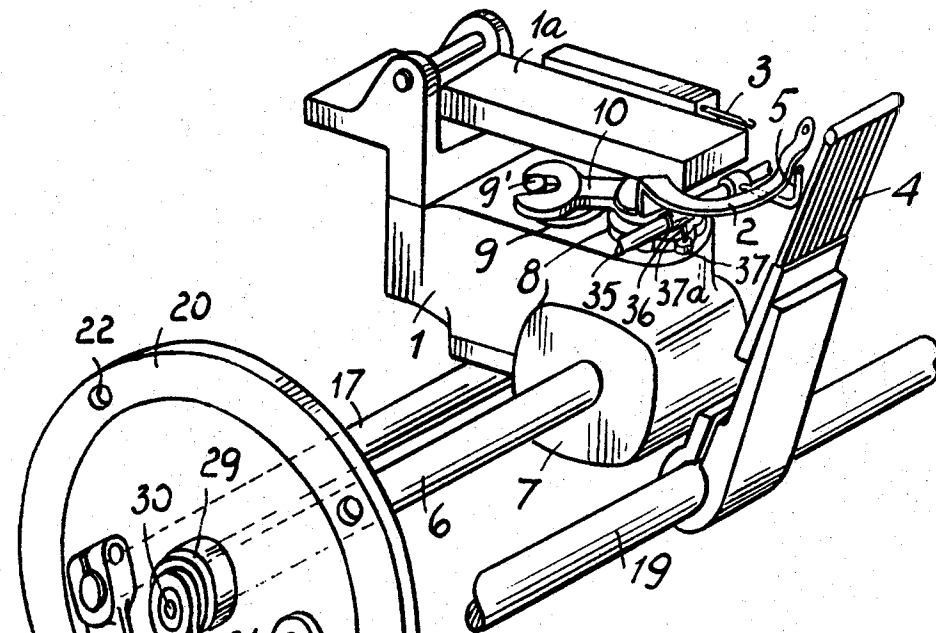


FIG. 1

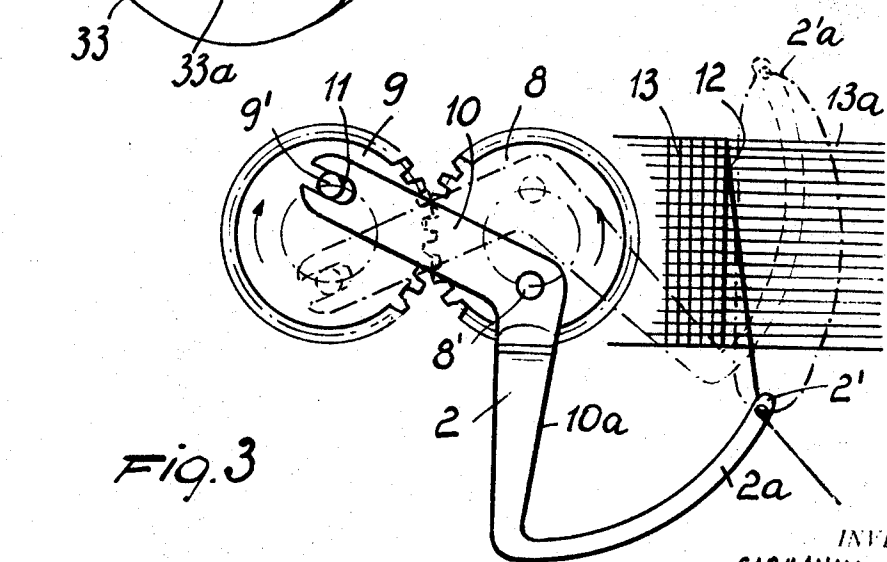


FIG. 3

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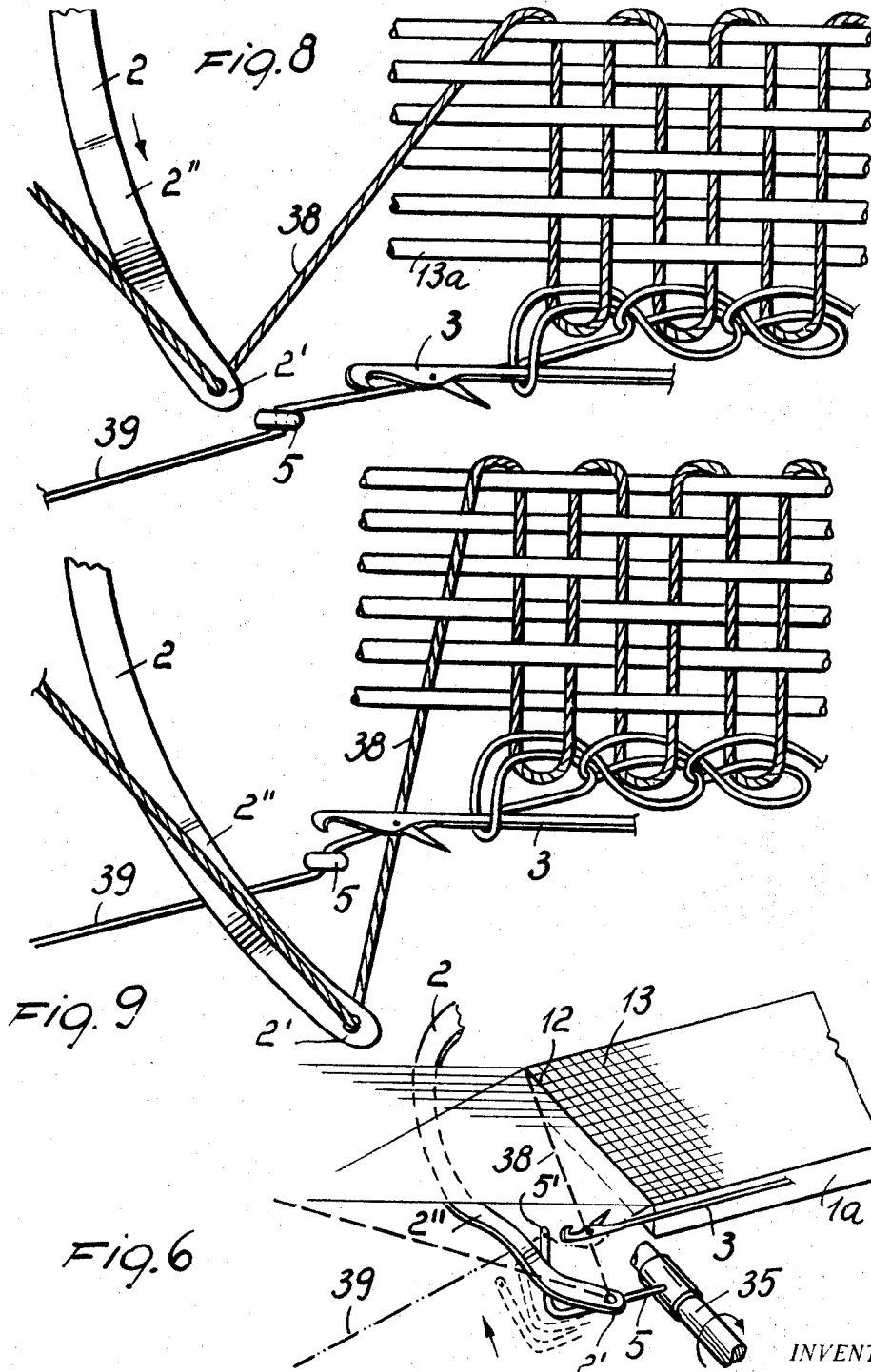
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NEEDLE LOOM

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5 Sheets-Sheet 3



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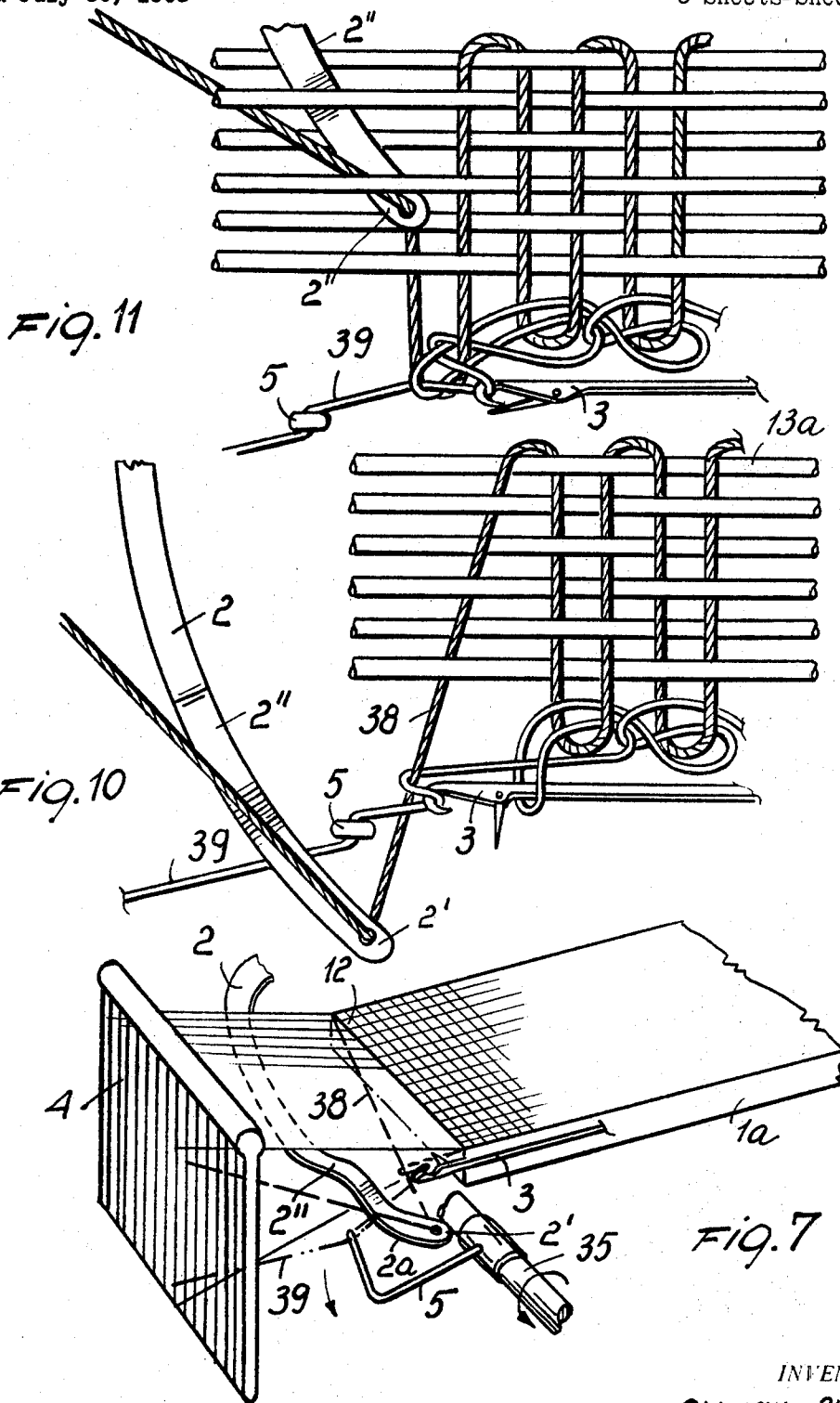
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NEEDLE LOOM

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NEEDLE LOOM

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5 Sheets-Sheet 5

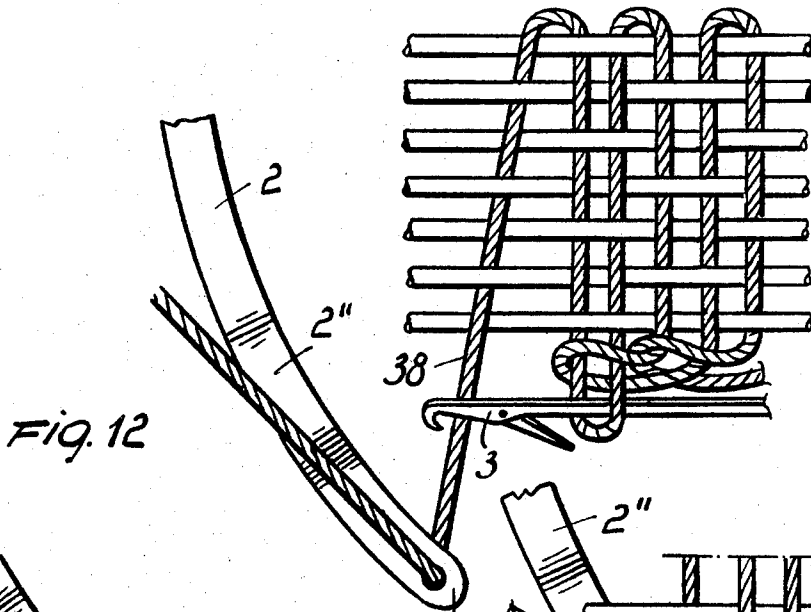


FIG. 12

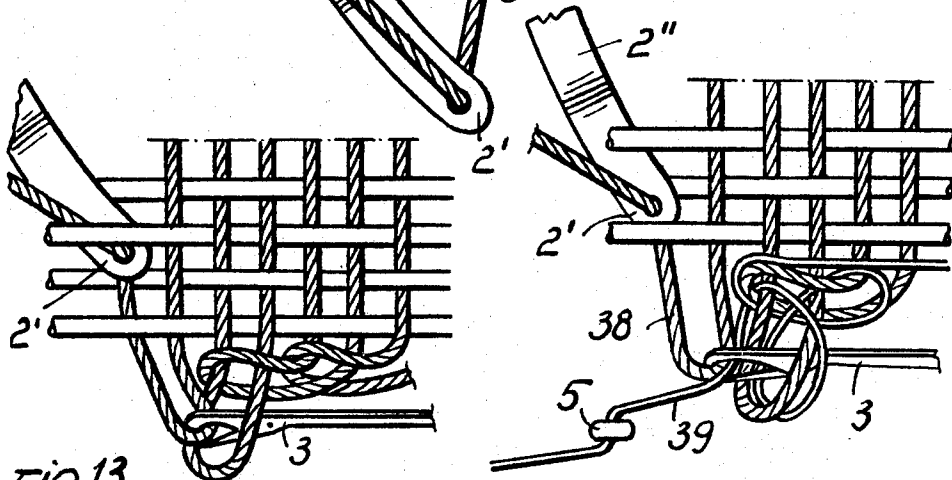


FIG. 13

FIG. 15

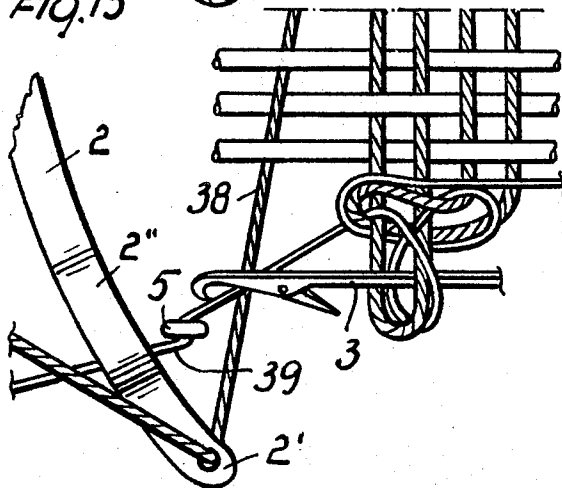


FIG. 14

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3,519,029
NEEDLE LOOM

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Int. Cl. D03d 47/06, 47/44

U.S. Cl. 139—124

15 Claims

ABSTRACT OF THE DISCLOSURE

The weft-inserting needle of a needle loom is connected at two points to pivots carried by meshing gears at a phase displacement of 180° so that the weft-inserting needle is oscillated during each revolution of the gears, and its eye moves the weft thread in weft direction a greater distance and at a higher speed than in warp direction while moving along a flat annular path.

BACKGROUND OF THE INVENTION

Needle looms are known in which a weft inserting needle inserts a weft thread from one side of the fabric to the other side through a warp shed, whereupon the inserted weft is tied at the other side of the warp shed, and the needle withdrawn for the next weft-inserting operation. Looms of this type are particularly used for weaving bands, belts, ribbons or like narrow fabrics.

In needle looms according to the prior art, comparatively great masses have to be oscillated together with the weft-inserting needle. Due to the inertia of the masses, the operating speed of needle looms according to the prior art is limited.

SUMMARY OF THE INVENTION

It is one object of the invention to overcome this disadvantage of needle looms according to the prior art and to provide a needle loom capable of operating at very high speed, for example more than 2000 strokes of the weft-inserting needle per minute.

Another object of the invention is to operate the weft-inserting needle in such a manner that its eye moves along an oblong annular path which is elongated in weft direction and flat in warp direction.

Another object of the invention is to combine the weft-inserting needle and the operating means thereof in a unit which, together with corresponding units, can be attached to a conventional loom.

An object of the invention is to provide operating means for the reed of the loom which accelerate the reed to its highest speed when the same beats up the inserted weft thread.

Another object of the invention is to provide a needle loom with a tying needle and a thread guide for automatically placing a selvage tying thread in a position for being caught by the hook of the tying needle. With these objects in view, a needle loom according to one embodiment of the invention comprises a weft-inserting means having an eye for a weft thread, and actuating means for moving two spaced parts of the weft-inserting means in opposite directions along two annular paths spaced in the warp direction. As a result, the weft-inserting means is oscillated between a retracted position and a weft-inserting position. During the oscillatory movement, the eye through which the weft thread passes, moves in weft direction a greater distance and at a higher speed than in warp direction, and along a flat annular path.

In the preferred embodiment of the invention, the

actuating means include first and second gears meshing with each other and rotating in opposite direction, and having first and second pivots connected with the weft-inserting means and being disposed at a phase difference of 180°. The weft-inserting means includes a needle portion with the eye for the weft thread, and a carrier portion for the needle portion having a slot for guiding the first pivot and a bearing for the second pivot. The needle portion is slightly curved, and projects at an angle from the carrier portion, which is preferably angular.

The axes of rotation of the two actuating gears are preferably located in a plane of symmetry of the fabric extending in warp direction.

The same drive shaft from which the rotation of the actuating gears is derived, also drives an operating means for reciprocating a tying needle which forms a selvage of loops formed either of the weft thread, or of a separate tying thread, or of both. The tying needle is preferably mounted on a member connecting the free ends of a pair of parallel rocking levers so that the path of movement of the tying needle is arcuate whereby the catch of the thread by the tying needle is improved.

The same drive shaft also drives operating means including a rocking shaft for rocking the reed in such a manner that a reed moves at a gradually increased speed toward the newly inserted weft, and beats the same into the fell of the fabric when moving substantially at its highest speed.

Two long rocking shafts, and one long drive shaft extending parallel along a loom structure are advantageously provided for supporting a plurality of loom units, each of which includes a reed mounted on one rocking shaft, an oscillating lever arm for reciprocating the tying needle mounted on the other rocking shaft, and gear means for transmitting the motion of the drive shaft to the actuating means of the weft-inserting needle.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary perspective side view of a needle loom according to the invention;

FIG. 2 is a fragmentary perspective side view of a needle loom viewed from the other side as compared with FIG. 1;

FIG. 3 is a fragmentary plan view on an enlarged scale illustrating actuation of a weft inserting needle;

FIG. 4 is a diagram schematically indicating a linkage between the rotary drive shaft and a rocking shaft by which the reed is carried;

FIG. 5 is a schematic diagram illustrating the fell of the fabric, and the variation of the angular speed of the reed during a beat up stroke;

FIG. 6 is a fragmentary perspective view illustrating a first operational position of selvage tying means;

FIG. 7 is a fragmentary perspective view illustrating a second operational position of selvage tying means;

FIGS. 8-11 are fragmentary plan views illustrating on an enlarged scale successive operational positions of the selvage tying means when a selvage tying thread is used;

FIGS. 12 and 13 are fragmentary plan views on an enlarged scale illustrating operational position of the selvage tying means when the selvage is formed of loops of the weft thread; and

FIGS. 14 and 15 are fragmentary plan views on an

enlarged scale illustrating operational positions of the selvage tying means when the selvage is formed of loops of the weft thread and of loops of a separate tying thread.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIGS. 1 and 2, two supporting end members 20 and 21 which may be secured to a loom frame by screws passing through bores 22, have bearings for supporting three shafts 6, 17 and 19. Shaft 19 is a rocking shaft carrying a reed 4, shaft 17 is a rocking shaft having a fixed rocking lever arm 15 for reciprocating a tying needle 13, as will be explained hereinafter, and shaft 6 is a drive shaft carrying a gear or pulley 23 by which drive shaft 6 is rotated. Drive shaft 6 passes through a gear casing 7 mounted on supporting means 1. Gear means in casing 7 connect drive shaft 6 with the shaft of an actuating gear 8 which meshes with another actuating gear 9 whose shaft is turnably mounted in supporting means 1 which includes a plate 1a for guiding a narrow fabric 13 formed of warp threads 13a, and weft threads 38, as shown in FIGS. 6 and 7. The warps of which the fabric is formed are operated by heddle frames in the usual manner to open and close warp sheds into which the weft thread 38 is inserted by the needle 2. The tying needle 3 is simultaneously operated to form, with the aid of guide 5, selvage loops as shown in FIGS. 8 and 9, as will be explained hereinafter in greater detail.

It is possible to mount a plurality of units as shown in FIG. 1 on the three shafts 6, 17 and 19 so that a plurality of narrow fabrics are simultaneously woven.

Referring now to FIG. 3 the two meshing gears 8 and 9 carry pivots 8' and 9' radially spaced from the respective axis of rotation so that pivots 8' and 9' rotate along circular paths in opposite directions. Weft-inserting needle 2 has a needle portion 2a formed with an eye for a weft thread 38 which is supplied from a supply reel and an angular carrier portion composed of two arms 10 and 10a. Needle portion 2a extends at an angle to carrier portion 10a and is slightly curved. A bearing of the carrier portion 10, 10a receives pivot 8' while pivot 9' is guided for sliding movement in a slot 11 in the free end of arm 10. The axes of rotation of the two gears 8 and 9 are parallel and vertical and are located in the plane of symmetry of the fabric 13 in warp direction. Pivots 8 and 8' are disposed at a phase difference of 180° so that the pivots change place during one revolution of gears 8, 9 for oscillating weft-inserting needle 2 between the retracted position shown in solid lines, and the weft-inserting position shown in broken lines in FIG. 3.

In two other positions, the pivots are spaced the distance between the axes of the gears, and place the needle eye in two intermediate positions which are spaced a distance corresponding to the diameter of the circular paths of the two pivots.

Consequently, the needle eye 2' moves along a flat annular path 2'a. Due to the opposite movement of the pivots 8' and 9', the needle eye 2' moves a greater distance and at a higher speed in the weft direction than in the warp direction.

The oscillating movement of the weft-inserting needle 2 takes place about an imaginary axis located between the pivots 8' and 9' in a plane of symmetry connecting the axes of gears 8 and 9. While the extension of the endless path 2'a in warp direction corresponds to the diameter of the circular paths of the pivots 8' and 9', the extension of the path 2'a in the weft direction is determined by the ratio between the distance of the imaginary axis and pivot 9' on one hand, and by the distance between pivot 9' and eye 2' on the other hand so that the speed of the weft eye in weft direction is greater than the speed of each pivot in weft direction.

Both actuating gears 8 and 9 apply power to the needle

carrier 2, although only the shaft of gear 8 is driven from drive shaft 6.

Since the extension of the endless paths 2'a in warp direction is small, it is possible to place the reed a small distance from the fell 12 of the fabric.

The kinematic construction of the actuating means shown in FIG. 3 permits the use of much smaller weft-inserting needles than prior art constructions, and has the additional advantage that the reed can be disposed a small distance from the fell of the fabric during the weft-inserting operation, resulting in a shorter reciprocating stroke of the reed.

The high operating speed obtained by the weft-inserting arrangement of the invention must be matched by the selvage tying device of the loom.

As best seen in FIG. 2, a tying needle 3 is mounted on a connecting member 16 connecting a pair of pivots at the forked free ends of a pair of parallel lever arms 14 and 15. Lever arm 14 is mounted for rocking movement on a pivot 18 supported on casing 7, while lever arm 15 is fixed on rocking shaft 17 so that connecting member 16 and tying needle 3 are moved along an arcuate path during rocking of shaft 17.

Tying needle 3 is mounted in a bore of connecting member 16 and can be adjusted in the same about its longitudinal axis, and secured in adjusted positions by a clamping screw 15a. Depending on the tying operation which is to be performed, the hook of tying needle 3 can be placed in the position shown in FIGS. 8 and 12, respectively.

The end of rocking shaft 17 is supported in a bearing in an end member 20, see FIG. 1, and carries a fixed arm 34 which is pivotally connected with a forked link 33 pivoted by pivot 33a to the end of a lever arm 31a which is articulated to the forked end of a crank arm 31 whose pivot 30 is eccentrically supported by a flange 29 secured to drive shaft 6. Pivot 33a is also connected with an arm 32 pivotally mounted on a pivot 32a on end member 20.

During rotation of drive shaft 6, which causes oscillation of the weft-inserting needle 2, eccentric crank arm 31 oscillates the linkages 32, 33, 34 so that shaft 17 is rocked together with lever arms 14 and 15 so that connecting member 16 is reciprocated with tying needle 3 along the edge of fabric 13 at which the eye 2, is located when needle portion 2a has inserted a weft thread into the warp shed as shown in FIGS. 6, 7 and 9.

The kinematic construction of the operating means 31-34, 14-17 for the tying needle 3, is compact and permits higher working speed than the prior art which uses cams for reciprocating the carrier of the tying needle. Another disadvantage of cams is the great wear to which they are subjected.

In the preferred embodiment of the invention, a tying thread 39 is looped by the tying needle 3 to form a selvage along the edge of the fabric. In accordance with the invention, an angular guide 5 has a needle eye 5' for placing the tying thread 39 in a position to be caught by the hook of tying needle 3, as shown in FIGS. 6 and 7. The guide 5 is secured to a shaft 35 which is mounted on support 1 for angular movement, and carries a fixed sleeve with an arm 37a on which a cam follower roller 37 is mounted for cooperation with a cam 36 overlying actuating gear 8. When the drive shaft 6 rotates gear 8 and cam 36, shaft 35 is oscillated about its axis for moving the angular guide 5 between the position shown in solid lines, and the positions shown in broken lines in FIG. 6.

Referring now to FIGS. 6 and 7, the shape of cam 36 effects raising of guide 5 at the moment in which weft-inserting needle 2 is in a weft-inserting position located in the warp shed and projecting from the same into the proximity of the tying needle 3. The inserted weft 38 has an angular position since it passes from the weft thread supply means through the eye 2' to the fell 12 of the fabric. When guide 5 is raised from the positions shown in broken

line to the position shown in solid lines in FIG. 6, the tying thread 39 is raised by eye 5' in the area bounded by weft thread 38 to a level slightly higher than the same so that tying thread 39 can be easily caught by the hook of tying needle 3 and formed into a loop, as shown in FIGS. 7 and 10. At the same time, shaft 35 is turned to lower guide 5 to the position shown in FIG. 7 so that it is no longer located in the path of the return movement of weft-inserting needle 2.

In order to facilitate the movement of guide 5, the needle portion 2a of weft-inserting needle 2 has a curved portion 2'' which in the weft-inserting position of weft-inserting needle 2, is located directly above the guide 5 whose end moves in the recess formed by the downwardly concave curved portion 2''. This construction permits a very rapid oscillation of guide 5 while the weft-inserting needle is in its end position illustrated in FIGS. 6 and 7.

FIGS. 8-11 show successive positions of the tying needle 3 and guide 5. In FIG. 8, needle 2 approaches its end position for inserting the weft thread 38, guide 5 is lowered, as shown in broken lines in FIG. 6, and hook 3 has advanced in open condition. In FIG. 9, needle 2 is in the end position, guide 5 has been raised above the level of the weft thread 38 and the hook of tying needle 3, and is located in the triangular area bounded by the inserted weft thread 38. In the position of FIG. 10, the tying needle 3 has been retracted to first catch tying thread 39, and to then form a loop of the same, which is pulled in the position of FIG. 11 through a previously formed loop while guide 5 has been lowered to permit the return movement of the weft-inserting needle 2. The loops of tying yarn 39 form a selvage along the edge of the fabric and retain the inserted weft loops.

As shown in FIGS. 12 and 13, it is possible to form a looped selvage of the weft thread 38 without the use of a separate tying thread. Tying needle 3 is first adjusted in connecting member 16 so that its hook points downward. When the weft-inserting needle 2 is in its end position the advanced hook is withdrawn to pull a loop of the weft thread 38 through the loop formed by the two preceding inserted portions of the weft thread 38 as shown in FIG. 13.

It is also possible to form a selvage of loops of the weft thread 38 and the tying thread 39, as shown in FIGS. 14 and 15. Tying needle 3 is adjusted so that the hook is slanted and downwardly open to catch tying thread 39 and weft thread 38 in the position of FIG. 14 while guide 5 is raised and operative. When tying needle 3 is retracted through previously formed loops of the weft thread and tying thread, the same close the latch so that the new loops can be pulled through the old loops and the same knocked over while weft inserting needle 2 performs its return stroke after guide 5 has been lowered, as shown in FIG. 15.

The rocking shaft 19 on which reed 4 is mounted, is supported in a bearing in the end member 21, see FIG. 2. A rocking arm 28 is adjustably secured to rocking shaft 19. Drive gear 23 of drive shaft 6 has an eccentric pivot 24 on which a crank arm 25 is mounted. An angular lever 26, pivotally supported at 26a by end member 21, is pivotally connected with the forked end of crank arm 25, and with one arm of a link 27 whose other end is pivotally connected with the free end of rocking arm 28. The linkage 24-28 transforms the rotary motion of drive shaft 6 into rocking motion of shaft 19 with reed 4.

The linkage is schematically shown in FIG. 4.

During the rotation of the drive shaft 6, eccentric pivot 24 moves from the position 24' to the position 24'' so that levers 25, 26, 27 are displaced from the position shown in solid lines to the positions shown in broken lines, and rocking arm 28 with rocking shaft 19 and reed 4 is turned the angular distance α . However, while rocking arm 28 turns half of the angular distance α , pivot 24 moves the larger angle α' , while during movement of locking lever 28 the second half of the angular distance

α , pivot 24 moves a smaller angle α'' to the position 24''. Consequently, the speed during the second half of the angular oscillation of rocking arm 28 will be far greater than the speed during the first half of the oscillation.

The graph d of FIG. 5 illustrates the speed variation of the reed 4 as the same performs a beat up movement toward the fell of the fabric 12. Since the angular speed of the reed is the same as the angular speed of the rocking arm 28, during the first half $\alpha/2$ of the reed movement the speed gradually increases. During the second half of the reed movement, the speed reaches its maximum shortly before arriving in the beating position P at which the speed of the reed is v . This speed is still very high so that the reed beats the weft thread with a considerable force into the fell so that the previously inserted portions of the weft thread near the fell of the fabric are pushed together and a tighter fabric is obtained with a greater number of weft threads for the length of the fabric.

When pivot 24 moves beyond position 24'', the motion is reversed and the speed of the reed 4 quickly reduced while the inserted weft thread is beaten into the fabric.

Since the beating action of the weft is carried out at a very high speed, it is far more effective than the beat up action of the reeds according to the prior art in which the speed follows a sinusoidal function and engages the inserted weft at substantially reduced speed.

Shafts 6, 17 and 19 may have a considerable length and support not only one loom unit as shown in FIGS. 1 and 2, but a plurality of such units operating in synchronism, each unit having a reed attached to rocking shaft 19, an arm 15 attached to rocking shaft 17, and a gear casing receiving drive shaft 6 for transmitting the drive motion to the actuating means 8 and 9.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of needle looms differing from the types described above.

While the invention has been illustrated and described as embodied in a high speed needle loom including a weft-inserting needle having an eye moving along a flat annular path at a higher speed in weft direction than in warp direction, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. A needle loom for making a fabric having a longitudinal warp direction and a transverse weft direction, comprising in combination, a weft inserting needle having a needle portion formed with an eye for a weft thread, and a carrier portion; first and second actuating means having first and second actuator parts, respectively, directly connected with first and second carrier parts of said carrier to form first and second joints with the same, respectively; mounting means mounting said first and second actuating means for rotation so that said first and second actuator parts rotate along first and second circular paths about first and second axes spaced in the warp direction; and drive means for rotating said first and second actuating parts in opposite directions at a phase difference of about 180° whereby said weft inserting needle oscillates about an imaginary axis located between said first and second axes between a retracted position and a weft inserting position, and said eye moves in the weft direction in a greater distance and at a higher speed than in the warp direction along a flat annular path.

2. A needle loom as claimed in claim 1 wherein first and second actuating means include first and second

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meshing gears; and wherein said drive means include a shaft driving one of said gears so that rotation is transmitted to the other gear.

3. A needle loom as claimed in claim 2 wherein said first and second actuating parts are first and second pivot means on said first and second gears, respectively; wherein one of said first and second carrier portions forms a bearing bore for one of said pivot means, and the respective other carrier portion forms a slot for slidingly guiding the respective other pivot means; and wherein said first and second gears have the same diameter.

4. A needle loom as claimed in claim 2 wherein said first and second actuator parts are first and second pivot means on said first and second gears, respectively; wherein said first carrier part is located at the free end of said carrier portion and forms a slot slidingly receiving said first pivot means, and wherein said second carrier part forms a bearing bore for said second pivot means.

5. A needle loom as claimed in claim 1 wherein said first and second axes of rotation are located in a plane of symmetry of the fabric extending in the warp direction.

6. Needle loom as claimed in claim 1 wherein said eye of said weft inserting means moves a weft thread from one edge of the fabric through a warp shed to the other edge; and comprising a tying needle located in the proximity of said other edge; operating means for reciprocating said tying needle to make loops forming a selvage on said other edge of said fabric; and wherein said drive means drive said actuating means and said operating means in timed relation.

7. Needle loom as claimed in claim 6 wherein said operating means include a pair of parallel levers and a connecting member supporting said tying needle and connecting the free end of said levers, one of said levers being pivotally supported, and a rocker shaft carrying the other lever so that said levers oscillate and said tying needle reciprocates when said rocker shaft rocks; and wherein said drive means include a drive shaft for driving said actuating means and an articulated linkage connected with said rocker shaft and including an eccentric arm driven by said drive shaft.

8. Needle loom as claimed in claim 6 comprising a guide member for a selvage tying thread, a control shaft supporting said guide member, a cam follower on said control shaft, and means supporting said control shaft with said guide member for angular movement; and wherein said drive means include a drive shaft for driving said actuating means and said operating means, and a cam driven from said drive shaft and cooperating with said cam follower for angularly moving said guide member in timed relation with the reciprocating movement of said tying needle and with the oscillation of said weft inserting means so that said guide member supplies the selvage tying thread to said tying needle when said weft inserting means is in said weft inserting position and when moves out the path of said weft inserting means whereby said tying needle forms loops of said selvage tying thread binding the inserted weft thread.

9. Needle loom as claimed in claim 8 wherein said carrier portion and said needle portion of said weft inserting needle are located in a common plane in which

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the fabric is located, and wherein said needle portion has a part curved and concave in a direction transverse to said plane and disposed over said guide member in said weft inserting position of said weft inserting needle for providing a space for movement of said guide member.

10. Needle loom as claimed in claim 9 wherein said needle portion is curved in said common plane, and defines an angle with said carrier portion.

11. Needle loom as claimed in claim 6 wherein said tying needle has a hook; wherein said operating means include a reciprocating support supporting said tying needle for turning movement between adjusted angular positions in which said hook is angularly displaced for matching a weft thread in said weft inserting position of said weft inserting means, and a selvage tying thread, respectively, and means for securing said tying needle in said adjusted positions to said support.

12. Needle loom is claimed in claim 1 comprising a reed means; a rocking shaft carrying said reed means for movement to and from a beating position for beating a weft inserted by said weft inserting needle into the fell of the fabric; wherein said drive means include a drive shaft; and comprising articulated linkage means connecting said drive shaft with said rocking shaft and transforming rotary motion of said drive shaft into an angular oscillating motion of said rocking shaft and reed means, said linkage means including means for moving said rocking shaft during the first part of the rocking motion of said reed means at a lower angular speed than during the second part of the rocking motion of said reed means whereby said reed means moves at a high speed into said beating position.

13. Needle loom as claimed in claim 12 wherein said linkage means include a rocking arm fixed on said rocking shaft, a wheel on said drive shaft, a crank arm eccentrically mounted on said wheel and articulated linkage connecting said crank arm with said rocking arm.

14. Needle loom as claimed in claim 12 wherein said articulated linkage includes an angular lever having one end pivotally connected with said crank arm, and a link pivotally connected with the other end of said angular lever, and with said rocking arm.

15. Needle loom as claimed in claim 1 wherein said actuating means include first and second gears meshing with each other and rotating in opposite directions and having first and second pivot means connected with said parts of said weft inserting means and being disposed at a phase difference of 180°; comprising a gear casing filled with oil; parallel shafts supporting said first and second gears for rotation therewith and mounted in said gear casing spaced in warp direction; a drive shaft projecting into said gear casing at an angle of 90° to said parallel shafts; and gear means in said casing for connecting said drive shaft with one of said parallel shafts.

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