ABSTRACT: In a chainstitch sewing machine having a loop-taker moving along an elliptical operating path during a stitch-forming cycle, drive mechanism to produce component oscillating movements of the loop-taker at right angle and parallel, respectively, to the stitching direction, comprises a first carrier rotatively mounted upon the frame of the machine about an axis being at right angle to the stitching direction, and a second carrier supporting said loop-taker and rotatively mounted upon said first carrier about an axis parallel to the stitching direction. The first carrier is oscillated via first motion-transmitting and conversion means operably connecting the same with the drive shaft of the machine and the second carrier is oscillated via second motion-transmitting and conversion means operably connecting the same with said shaft and including a double-arm lever pivoted upon said first carrier and having an input arm forming part of the respective motion transmitting means and an output arm forming a knuckle joint together with a link connecting the same to a point of said second carrier.
LOOPTAKER DRIVE MECHANISM FOR CHAINSTITCH SEWING MACHINES

The present invention relates to chainstitch sewing machines of the type having a hook or looper moving along an elliptical operating path composed of a lengthwise needle loop-seizing and shedding oscillating component at right angles to the stitching direction and a crosswise needle-avoid oscillating component parallel to the stitching direction, to produce chainstitches in cooperation with a reciprocatory needle in the work being operated on.

The invention is more particularly concerned with looper operating devices of the general type operated from the main drive shaft of the sewing machine, wherein a looper carrier is oscillated in the crosswise or needle-avoid coordinate direction via a first motion-transmitting and conversion mechanism operably connecting said carrier with the drive shaft, on the one hand, and wherein said carrier is simultaneously oscillated in the lengthwise or needle loop-seizing and shedding coordinate direction of said path via a second motion-transmitting and conversion mechanism operably connecting said carrier with said shaft, on the other hand, said second motion-transmitting mechanism including a double-arm intermediate connecting lever having an arm thereof linked to said looper carrier.

Looper operating devices of the foregoing type are especially suited for use in cooperation with sewing machines having a plurality of individually driven stitching needles cooperating with a single looper common to all the needles. The provision of a special link for the application of the lengthwise looper movements from the respective motion-transmitting mechanisms including an eccentric upon the drive shaft makes it possible, provided a suitable design of the transmitting mechanism, to operate the looper carrier in such a manner as to accelerate its movement for the safe and ready seizing of the needle thread loop at the beginning of the looper carrier operating cycle, on the one hand, and to decelerate or delay the looper carrier at the end of its loop seizing movement until after the needle or needles have safely penetrated the thread triangle formed by the needle thread loop and looped threads, on the other hand. This operation, while rendering it possible to provide a close difference between the adjusting heights or positions of the needles in the case of a multiple needle machine, has the further advantage of ensuring a safe and positive penetration of the thread triangle by the needles.

An important object of the present invention is the provision of motion-transmitting and operating mechanism for a looper of the referred to type designed to assume a relatively high initial velocity for the ready and safe seizing of the needle thread loop or loops, on the one hand, and to decelerate or retard the looper carrier at the end of its needle thread-seizing movement, whereby to enable the needle or needles to safely penetrate the thread triangle, on the other hand, said mechanism being both simple in design and characterized by the use of a minimum of oscillating parts as well as relatively short motion-transmitting paths between the driving eccentrics upon the main drive shaft of the machine and the carrier supporting the looper, whereby in turn to enable the employment of relatively high sewing speeds without interfering with or impairing the stitch-forming operation.

The invention, both as to the foregoing and ancillary objects as well as novel aspects thereof, will be better understood from the following detailed description, taken in conjunction with the accompanying drawings forming part of this disclosure and in which:

FIG. 1 is a front view of a chainstitch sewing machine embodying the improved looper drive mechanism constructed in accordance with the principle of the invention;
FIG. 2 is a perspective view of the improved drive mechanism embodied in FIG. 1;
FIG. 3 is a front view of the drive mechanism of FIG. 2, shown in the starting position of a looper operating path; and
FIG. 4 is a view similar to FIG. 3 and showing the device in the end position of the loop-seizing movement of the looper.

Like reference numerals denote like parts in the different views of the drawings.

With the foregoing object in view, the invention involves essentially the provision of motion-transmitting mechanism for the operation of a single loop looper, the referred to type, wherein a first carrier supporting the looper and the intermediate lever of the transmitting mechanism are both rotatively mounted upon a second carrier which serves to impart needle-avoid movements to the looper via the first carrier, and wherein the link connecting the output arm of said lever with said first carrier forms a knuckle joint with said arm. This results in a most simple and effective operating mechanism for the looper requiring a minimum of mounting space. Moreover, with said mechanism being designed or adjusted such as to cause said joint to move slightly beyond the stretched position of said arm and link at the instant of the looper reaching the end of its loop-seizing movement, the looper movement is sufficiently decelerated or retarded, to ensure a reliable and positive penetration of the thread triangle by the needle or needles, respectively, of the sewing machine.

According to an improved feature of the invention, the input arm of the intermediate lever is constructed for adjustment of its effective length, to adapt the machine to varying operating conditions or requirements. An especially simple embodiment for the adjustment of the effective length of arm consists in the use of a releasable clamping device to secure the arm in varying relative positions to the associated motion-transmitting and conversion mechanism, in a manner as will become further apparent as the description proceeds in reference to the drawings.

Referring more particularly to FIG. 1, the numeral 1 denotes the frame or casing of a conventional sewing machine comprising a cloth plate, an upright and an overhead arm and within which are mounted the main drive shaft 2 of the machine, the needle rockshaft 3 connected with the needle frame 4 through a crank 5, the drive shaft 6 of the looper, and the rockshaft 9 supporting the carrier 7 of a work feed dog 8 of conventional construction. The looper drive shaft 6 is operably connected with the main drive shaft 2, carrying a hand wheel 10, via a chain belt 11 and chainwheels 12 and 13 fast upon the shafts 2 and 6, respectively.

Rockshaft 9 is operated by shaft 6 via an eccentric stitch controller 14 mounted upon shaft 6 and a link connection 15, whereby to impart to the shaft 9 oscillating or rocking movements which are in turn applied, to the feed dog 8 via the carrier 7, on the one hand, and to the crank 5 of the needle frame 4 via a link 16 and the needle rockshaft 3.

Mounted upon the frame 4 is a needle bar 17 which carries, in the example shown, three needles 18 for the sewing of a multiple cross-connected chainstitch seam in the work being operated on, in a manner well known. The needle bar 17 is vertically reciprocated in the frame 4 by the main drive shaft 2 via a conventional crank and link connection 19, 20.

While the sewing machine shown and described in the foregoing is equipped with both lower and upper feed devices, that is, the feed dog 8 and oscillating needle frame 4, it will become evident that a single feed may be employed without affecting the improvement and operation according to the invention.

Adjustably secured to the front end of the looper drive shaft 6, FIG. 2, is an eccentric 21 which serves to produce the needle-avoid oscillating component of the looper movement, said eccentric being embraced by an eccentric arm 22 the free end of which is linked to an arm or extension 23 of a first carrier member 24 rotatively mounted upon the frame of the sewing machine about an axis being at right angle to the stitching direction or parallel to the lengthwise oscillating component of the looper operating path, respectively. For this purpose, the carrier 24 is rotatively mounted, in the example shown, upon a shaft 25 extending from a support 26 forming part of a bracket 27 upon the frame 1 of the sewing machine. Carrier 24 is secured against axial displacement upon the shaft 25 by means of a locking ring 28.
Further mounted upon the loop-taker drive shaft 6 is a spur gear 29 which meshes with a similar gear 30, FIGS. 2-4, mounted upon a shaft 31 being parallel to the shaft 6 and jour-
nailed in the frame or brackets 27. The front end of shaft 31 carries a further eccentric 32 which serves to produce the need-
dle loop-seizing and shedding oscillating component of the loop-
taker, eccentric 32 being embodied by section 33 of a
linked pulley bar 24 the cooperating section 35 of which is
linked with section 33 and embraces the spherical end of a
connecting rod 36 forming a ball joint together with the link or
section 35. Rod 36 of the ball joint is adjustably mounted in a
bore of the split input arm 37 of an intermediate angular con-
necting lever 38 and secured in position by means of a nut 40.
The intermediate lever 38 which has an upwardly extending
output arm 42 is rotatively supported upon the carrier 24 by a
pin 42 connected to a fork-shaped extension 41 of said carrier.
The output arm 39 of the intermediate lever 38 is con-
nected, via a relatively short link 43, with a second carrier 46
supporting the loop-taker 47 and being in turn rotatively
mounted upon the first carrier 24, about an axis parallel to the
stitching direction, by means of a gear 45 and pin 46 in a fork-
shaped extension of carrier 24. The loop-taker 47 sup-
ported by the carrier 43 cooperates in a known manner with the
needles 15, to produce a multiple cross-connected chain-
stitch seam in the work being operated on.
The link 43 and output arm 39 of the intermediate lever 38
is also employed to form a knuckle joint for the production of a non-
uniform oscillating movement of the loop-taker 47 in the loop-
taker shaft 10 from the eccentric 21, to result in the composite elliptical path or
movement 48 of the loop-taker during a stitch-forming opera-
tion or cycle of the sewing machine.

In operation, rotation, via the wheel 10, of the shaft 2 by the
drive-elevator (not shown) of the sewing machine causes the
needles bar 17 and needles 18 to be reciprocated in the vertical
direction via the crank 19 and link 20. At the same time, the
loop drive shaft 6 and shaft 31 are driven via the chain belt
11 and the gear pair 29, 30, respectively. As a consequence, oscillating
movement is imparted, via the eccentric stitch con-
nection 21, to the rockshaft 13, and
transmitted, via the crank 5, to the
needle frame 4, to cause a synchronous intermittent feed of the work
both by the feed dog 8 and the needles 18, in a manner well
known with sewing machines equipped with both lower and
upper feed devices.
The loop-taker 47, being supported by the carrier 46 and
cooperating with the needles 15 to produce multiple chain-
stitches in the work operated on, has applied to it, via link 34;
lever 30 and link 43, lengthwise loop-seizing and shedding
movements derived from the eccentric 32 upon which are su-
perimposed the crosswise or needle-avoid movements derived
from the eccentric arm 21 via the eccentric arm 22 and oscillating
carrier 24 which latter rotatively supports both the loop-
taker carrier 46 and the intermediate connecting lever 38.

By a suitable design of the knuckle joint formed by the link
43 and the driven or output arm 39 of the intermediate lever
38, the loop-taker has imparted to it a relatively high initial
velocity upon leaving the starting position, FIG. 3, whereby to
ensure a ready and safe seizure of the needle thread loop or
loops, respectively. This in turn enables the height or position of
the needles 18 to be adjusted to relative-close distances,
while at the same time preventing a "collapse" of the loop or
loops prior to being penetrated or seized by the loop-taker.

At the end of the loop-seizing movements of the loop-
taker, that is, upon reaching of its extreme point of the elliptical
operating path 48, FIG. 4, the link 43 and lever arm 39 assume
their stretched position, in which case the movements of the
loop-taker 47 is practically equal to zero. Where the link 43
and arm 39 pass beyond the stretched position of FIG. 4, the
loop-taker 47 performs an oscillating about said point, in such
a manner as to retard or delay the loop-taker movement at the
end of the loop-seizing movement until after the loop-taker is
subjected to its crosswise or needle-avoid movement derived from the eccentric 21 and the needles 18 have been able to
penetrate the thread triangle at points adjoining the
respective loops, wherein to return the loop-taker to its
starting position, FIG. 3, is initiated at a relatively low
velocity. The varying velocities of the loop-taker depend upon
the design of the knuckle joint, that is, the maximum angle
enclosed by the link 45 and lever arm 39.

The extent of the oscillating movements of the loop-
taker may be varied by adjusting the relative position of the ball-
jointed arm or link 36 and the input arm 37 of the lever 38,
that is, varying the effective length of the arm 39. This enables
a control of the loop-taker operating path 48, to adapt the
machine to varying operating conditions or requirements,
such as stitching length, needle size, type of thread, etc.

In the known loop-taker operating devices referred to
hereinabove, the intermediate lever operably connected with
the eccentric upon the main drive shaft serving to produce the
lengthwise loop-taker movements, on the one hand, and with
the loop-taker carrier via a connecting link, on the other hand,
is rotatively mounted upon the frame of the machine about an
axis spaced at a relatively great distance from the loop-taker
carrier. Inasmuch as the loop-taker carrier is rotatively sup-
ported by the carrier subject to the needle-avoid movements,
while the intermediate lever is rotatively supported about a
stationary axis upon the frame of the machine, the link con-
necting both parts must be an equalizing connection, such for
instance in the form of a ball-jointed arm or link.

Due to the relatively great distance between the axes of the
loop-taker carrier and the intermediate lever, the known loop-
taker operating devices require a considerable mounting space for their operating parts. Besides, the transmission parts
between the driving eccentric and the loop-taker carrier and,
in turn, the oscillating masses of the mechanism are such as to
make it impossible to operate the machine so equipped at the
speeds required in practice, without affecting or impairing
the stitch formation.

On the other hand, in the case of the improved loop-taker
drive mechanism according to the present invention, the
mounting of the loop-taker carrier 46 and intermediate lever
38 upon the same member, that is, the carrier 24, of an oscillating
in accordance with the needle-avoid movements of the loop-
taker, results in relatively short transmission paths and
reduced dimensions of the transmission parts or elements. As
a consequence, no disturbing oscillations result even at rela-
tively high sewing speeds when using driving mechanism ac-
cording to the invention. This in turn forecloses any impair-
ment of or interference with the stitch formation. The reli-
bility of the stitch formation is further increased by the loop-
taker 47 being practically at standstill or zero speed at the
instant of penetration of the needles 18 into the thread triangles.
Besides, as already pointed out, adjustment of the effective
length of the lever arm 37 makes it possible in a most simple
and efficient manner to adapt the drive mechanism for use
with varying stitch-forming and other operating conditions or
requirements.

To this end:
1. In a chainstitch sewing machine having a frame, a drive
shaft mounted in said frame, a reciprocatory needle, a thread-
carrying loop-taker, and drive mechanism to operate said loop-
taker over an elliptical path in synchronism with said needle,
to sew chainstitches in a workpiece being operated on, said
elliptical operating path being composed of lengthwise needle
loop-seizing and shedding component movements at right
angle to the stitching direction and crosswise needle-avoid
component movements parallel to the stitching direction, the
improvement consisting in said drive mechanism comprising:
   1. a first carrier rotatively mounted upon said frame;
2. first motion-transmitting and conversion means operably connecting said carrier with said drive shaft, to impart periodic oscillating movements to said carrier;

3. a second carrier supporting said looptaker;

4. means rotatively supporting said second carrier by said first carrier, to impart needle-avoid component movements to said looptaker by said first carrier;

5. a two-arm angular intermediate lever having an input arm and an output arm and pivotally mounted upon said first carrier about an axis being at right angle to the axis of said first carrier;

6. second motion-transmitting and conversion means operably connecting said input arm with said drive shaft, to impart oscillating movements to said lever; and

7. a link connecting said output arm with an intermediate point of said second carrier, to impart loop-seizing and shedding component movements to said looptaker.

2. In a chainstitch sewing machine as claimed in claim 1, including means to adjust the effective length of the input arm of said lever.

3. In a chainstitch sewing machine as claimed in claim 1, said second motion-transmitting means including a ball-jointed link having its free end adjustably secured to said input arm, to vary the effective length of said arm.

4. In a chainstitch sewing machine as claimed in claim 3, wherein said ball-jointed link is slidably connected in a bore of the said input arm of said lever, and releasable locking means securing said link and arm.

5. In a chainstitch sewing machine as claimed in claim 1, wherein said output arm and link form a knuckle joint designed to pass slightly beyond its stretched position at the end of the loop-seizing and beginning of the loop-shedding movements within said looptaker operating path.

6. In a chainstitch sewing machine having a frame, a drive shaft mounted upon said frame, a reciprocatory needle operable connected with said shaft, a looptaker cooperating with said needle, and drive mechanism to operate said looptaker along an elliptical operating path in synchronism with said needle, to sew chainstitches in a workpiece being operated on, said elliptical path being composed of a lengthwise needle loop-seizing and shedding oscillating component at right angle to the stitching direction and a crosswise needle-avoid oscillating component parallel to the stitching direction, the improvement consisting in said drive mechanism comprising:

1. a first carrier rotatively mounted upon said frame about an axis being at right angle to the stitching direction;

2. a second carrier supporting said looptaker and rotatively supported by said first carrier about an axis parallel to the stitching direction;

3. first motion-transmitting and conversion means operably connecting said first carrier with said shaft, to cause said first carrier to oscillate and to thereby impart needle-avoid component movements to said looptaker;

4. a two-arm intermediate lever having an input arm and an output arm and rotatively mounted upon said first carrier about an axis parallel to the stitching direction;

5. a link connecting said output arm with a point of said second carrier, to provide a knuckle joint by said arm and link; and

6. second motion-transmitting means operably connecting said input arm with said shaft, to oscillate said lever and to impart loop-seizing and shedding component movements to said looptaker.

7. In a chainstitch sewing machine as claimed in claim 6, including means to adjust the effective length of the input arm of said lever.

8. In a chainstitch sewing machine as claimed in claim 6, said knuckle joint designed to slightly exceed the stretched position of its link and arm at the end of the loop-seizing and the beginning of the loop-shedding movements within said looptaker operating path.