ABSTRACT: A drive arrangement for sewing machines, especially buttonhole-stitching machines, having a needle drive shaft and a stitch-former drive shaft to be independently rotated. The drive arrangement comprises an electric motor whose countershaft is provided with belt drive sheaves at axially spaced locations thereon. The countershaft is pivoted relating to the motor assembly below the fabric feed table of the machine about an axis laterally offset from the shaft axis but parallel thereto and against a spring establishing belt tension. The machine arm or head is tiltable about a horizontal axis and entrains the countershaft with it to eliminate the need for disconnecting the belts passing around the needle-drive shaft pulley and one of the sheaves.
DRIVE ARRANGEMENT FOR SEWING MACHINES

My present invention relates to a drive assembly for sewing machines and, more particularly, to a drive arrangement for buttonhole-stitching machines of the type in which a needle drive shaft is rotated independently from, or is not directly coupled in the machine with a stitch-forming mechanism located beneath the fabric feed table of the machine.

In my U.S. Pat. No. 3,376,837 and in the commonly assigned application Ser. No. 762,387, filed 28 Sept. 1968, there are described buttonhole-stitching machines which may be automatically or manually operated to tilt the border of a closed area which may be cut through to constitute an eyelet or buttonhole.

Such machines can be generically described as buttonhole-stitching machines even though the formations produced in the fabric may be eyelets or have other functions than that of receiving a button.

In structural terms, such machines have a fabric feed table and a post upstanding therefrom. A horizontal arm extends from the post in a cantilever structure and defines at the end of this arm, remote from the post, a sewing machine head in which an upright needle is reciprocable toward and away from the fabric feed table. The head may also include a pressure foot, a camshaft arrangement for driving the needle, a zigzag drive arrangement or the like.

The post of the machine is usually provided with a needle drive carrying a pulley (needle drive pulley) which may be connected to an electric motor or to a shaft in common with a number of such machines which, in turn, is driven by an electric motor.

Below the fabric feed table, is a socket-shaped base upon which the sewing machine arm and table are mounted. In this base, it is known to provide a stitch-forming mechanism which is designed to grip the thread through the fabric by the needle to form the stitch, which may be a chainstitch, double-chainstitch or the like. The stitch-forming means may include a gripper adapted to form loops in the threads below the worktable, means for feeding a gimp cord or fillet into the stitching location for incorporation in the stitch as a reinforcing or filler member.

Additionally, the drive beneath the table may operate cutter means or the like for severing the cord or thread, cutting the fabric etc. Such systems are generally described in the aforementioned copingending application and U.S. Letter Patent.

Generally speaking, the stitch-forming mechanism below the worktable includes a drive shaft (stitch-former drive shaft) mounted in the base or housing of the sewing machine and driven independently of the needle drive shaft. When "independent operation" of the stitch-former drive shaft and the needle drive shaft is discussed, it is intended to indicate thereby that within the machine housing or base there is no direct connection between these shafts. They may, of course, be operated by a common drive source without diminishing the independent relationship under discussion.

It is common practice in such machines to render the arm and fabric-feed table or at least the thereof on which the post is mounted, swingable about a horizontal axis to afford access to the mechanism below the sewing machine arm. Such access is necessary for repair or inspection of the mechanism for threading the gripper blade, for feeding the gimp thread to the stitching location, etc.

In earlier machines of this general character, it has almost invariably been necessary to cast off the drive belt connected with the needle-drive pulley to permit tilting of the arm about its horizontal pivot as indicated. When the arm is returned to its operating position, the belt must be returned to the groove of the pulley from which it was dislodged. Such activities may be dangerous to operating personnel, sometimes are time consuming and are always an inconvenience.

It is, therefore, the principal object of the present invention to provide an improved drive assembly for sewing machines of the character described in which casting off of the belt from a pulley is no longer required when the arm is to be tilted.

Another object of this invention is to provide an improved drive mechanism for a buttonhole-stitching machine of the general character described.

These objects and others which will become apparent hereinafter, are attained in accordance with my present invention, in a sewing machine system in which the drive for both the stitch-forming mechanism (gripper blade, etc.) and the upwardly open housing of the machine, surmounted by the arm and fabric feed table, and the needle drive mechanism on the arm are connected by respective belts to pulleys driven by a drive motor below the base.

The drive motor is flexibly coupled, according to an essential feature of the present invention, with a countershaft mounted for swinging movement relative to the motor shaft, and carrying a drive pulley which is connected to the needle drive pulley by a respective belt. The pivotal axis of the lever carrying the countershaft and the axis of rotation thereof do not deviate substantially from directionality with the shaft of the needle drive assembly. Thus, when the arm is swung to allow access to the mechanism within the base of the machine, the belt draws the countershaft upwardly and need not be cast off. In other words, the countershaft follows the swinging movement of the lever.

According to a feature of this invention, the countershaft is connected at one end via a compensating coupling, flexible coupling or universal joint with the drive motor and at the other end is journaled in a lever which is fulcrumged upon a pivot rod or axle extending parallel to the countershaft. The swinging stroke of the lever is, moreover, advantageously established between a pair of stops and a spring is provided to urge the lever downwardly to apply the desired tension to the belts. The spring, moreover, is set to yield before the tensile limit of the belt is reached, thereby precluding breakage of the belt when the sewing machine arm is swung upwardly.

The countershaft is, therefore, swingable about its coupling at the motor side thereof, the compensating coupling being constituted, for example, as a flexible joint permitting alignment or disalignment of the motor shaft with respect to the countershaft. Between this coupling and the motor proper, the motor shaft may be keyed to a drive pulley which is connected by a further belt to the drive member of the mechanism within the base of the machine.

Preferably, the needle drive shaft and its pulley and the stitch-former drive shaft and pulley have horizontal axes lying in different vertical planes. The pulleys on the countershaft and motor shaft, according to the present invention, lie directly below the needle drive pulley and the stitch-former drive pulley, that is, "independently" of the needle drive shaft and the pivot axis thereof running athwart the base of the machine and substantially diagonally with respect to the two shafts of the machine and at an inclination to the vertical planes thereof.

The above and other objects, features and advantages of the present invention will become more readily apparent from the following description, reference being made to the accompanying drawing in which:

FIG. 1 is a front view of a buttonhole sewing machine provided with the drive of the present invention;

FIG. 2 is a cross-sectional view taken along the line II-II of FIG. 1, but illustrating with dot-dash lines portions lying behind the plane of the section;

FIG. 3 is a left-side elevational view of the machine assembly of FIG. 1;

FIG. 4 is a right side elevational view thereof;

FIG. 5 is a view similar to FIG. 4 showing the machine arm in another position; and

FIG. 6 is a detail view of a portion of the machine.

As can be seen from FIG. 1, the sewing machine of the present invention comprises an upwardly open base 2 containing a stitch-forming mechanism driven by the stitch-former drive shaft 4 extending laterally to the left and having a horizontal axis as shown in FIG. 2. The base 2 is mounted upon a support table 19 and receives a pivotal worktable 1' surmounted by an upright post 1" carrying the arm 1 whose
head 1" receives a vertically reciprocable needle assembly 1a which, via the drive unit 9a is operated by the needle drive shaft 9. The arm assembly 1 is pivotally mounted on the support 2 at a horizontal pivot 3 which extends parallel to the vertical axis of the shafts 4 and 9.

The shaft 4 lies in a lower horizontal plane than the axis of pivot 3 and carries a V-belt pulley 5 which, in turn, is connected by the crossed V-belt 6 with the V-belt sheave 7 on the countershaft 8. At the front portion of the machine assembly 1, the needle drive shaft 9 extends laterally to the right (Fig. 4); and in a vertical plane different from that of pivot 3 or the axis of shaft 4 (Fig. 3) and in a horizontal plane above the pivot 3. The shaft 9 carries a handwheel 9b which may be rotated by the operator to manually raise or lower the needle assembly, and a V-belt pulley 10 connected by an uncrossed V-belt 11 with a V-belt sheave secured to the countershaft 8.

As can best be seen from FIG. 2 in which the dot-dash lines represent portions of the machine above the drive assembly, the pulleys 5 and 10 lie in different vertical planes and the pulleys 7 and 12 are disposed directly beneath them, so that the belts 6 and 11 lie substantially in vertical planes. Thus the crossed belt 6 of the belt drive 5, 6, 7 do not have its upwardly and downwardly extending stretches in contact at the crossover point and V-belts can be used without stress which would cause deterioration of these belts. The drive is turned on, the shafts 4 and 9 of the buttonhole-stitching machine are driven continuously and the machine may be assembled in batteries with other similar machines and/or controlled automatically by a programming system as described in the aforementioned patent and application and machines of the same class.

The shaft 8, carrying the V-belt pulley 12, has a journaled extremity 8a projecting axially beyond the pulley 12 and rotatable within a spherical roller bearing 13 of the type illustrated and described at page 13-2 of Mechanical Design and Systems Handbook, Rothbart, McGraw-Hill Book Company, N.Y., 1964.

The bearing 13 is held in place by a washer 8b on the shaft and 8a and is received in the free end of a lever or arm 14. Arm 14 has a split hub 14a (see also Fig. 6) which releasably receives a bushing 22 whose head 22a is constituted by an outwardly extending flange at the outer end of this bushing forming a shoulder which rests against the hub 14a. A nut 28 is threaded onto the right-hand end of a fixed pivot axle 15 which is supported in a pair of journal blocks 20, 21 depending on respective arms from the underside of the support table 19 (see Fig. 1). The nut 28 clamps a washer 28a axially against the end 22a a sleeve 22 completed, which in turn is not rotatably seated against the bearing block 21 to permit the hub 14a, which is split at 14b, to rotate about the axis of the shaft 15 as represented by the arrow A, i.e. counterclockwise in Fig. 5 when the arm assembly 1 is swung in the clockwise sense (arrow B) to afford access to the underside of the table 1' and to the interior of the base 2.

The slot 14b also facilitates removal of the arm 14 from the shaft 15 to permit changing of the belt adapted to pass around the sheave 12. In the belt-changing process, the nut 28 is removed and the bushing 22 and the lever 14 withdrawn from shaft 15. A locking collar 27 anchors the shaft 15 against lateral movement to the right (Fig. 2) and rests against the left-hand flank of the block 21.

The upwardly counterclockwise movement of the lever 14 (Fig. 5) is restricted by a spring suspension for this lever which maintains the tension in belt 11 during machine operation.

A bolt 24 has its head 24a pivotally connected at 24b to the lever 14 at a location intermediate the fulcrum and free ends of the lever and extends through an opening in an eye 25 whose pivot can be seen at 25a in Fig. 1 as affixed to the bearing block 21 above the shaft 15. Between the head of the bolt 24 and the eye 25, I provide a helical compression spring 26 under precompression to surround the bolt 24. The stiffness of this spring is dimensioned such that the yield force of the spring is smaller than the force which would over-tension the belt 11. To adjust the belt tension, one need only use the nuts 27 provided at the threaded end of the bolt 24 emerging from the pivot eye 25. For example, to increase belt tension, the nuts 27 are backed off, whereas a tightening of the nuts on the bolt reduces the belt tension. In all cases, the compression of the spring 26 should be such that it yields before the tensile limit of the belt is achieved.

At the other end of shaft 8, I provide a flexible coupling of the compensating type to allow swinging movement of the shaft 8 about a horizontal pivot which is represented at C in Fig. 5, the coupling 16 forming a flexible universal joint accommodating swinging movement of the end of shaft 8 and the end of motor shaft 17a when the lever 14 is swung upwardly. The flexible coupling may be of the type described at pages 27-19 ff. of Mechanical Design and Systems Handbook, Rothbart, McGraw-Hill Book Company, N.Y., 1964.

As can be seen from Fig. 2, this coupling has a pair of coupling halves 16a and 16b respectively connected to the end 8c of shaft 8 and to the stub of shaft 17a which projects to the right beyond the V-belt sheave 7. The shaft 17a forms part of an electric motor 17 which is fixed on an arm 18, the latter being in turn clamped by a pinned collar 49 against the support block 20. Arm 18 is adjustable (arrow D) about the shaft 15 and can be locked in place by the tightening of a nut 29 and the left-hand end of the shaft 15.

The grooves of the pulley 5 and the sheave 7 are covered over the sections about which the belt 6 is slung, with protective shields or covers 30 and 31 respectively anchored to the table 1 and to the shaft 15 and which closely fit the respective pulleys to prevent the belt 6 from jumping from the pulley and sheave in the event of a reduction in the interaxial distance between the motor 17 and the shaft 4.

In the normal driving operation of the machine, motor 17 is driven and directly entrains its sheave 7 while the shaft 8 is driven by this motor via the flexible coupling 16. The weight of motor 17 holds the belt 6 at the desired tension. Similarly, the spring 26 biases the lever 14 in the clockwise sense (Fig. 5) and maintains tension on the belt 11 which is driven by the sheave 12 keyed to the shaft 8.

When the upper portion 1 of the machine is tilted about its axis 3 in the clockwise sense (arrow B), the belt 11 of the belt drive 10, 11, 12, is first stretched and then draws the lever 14 against the force of spring 26 in the counterclockwise sense about its pivot shaft 15. The interaxial distance between the pulley 10 and the machine drive shaft 9 and the sheave 12 carried by the shaft 8 is then no longer increased. The belt 6 may loosen somewhat during this operation but is held in the grooves of the pulley 5 and the sheave 7 by the hoists or plates 30 and 31. Upon return of the upper part of the machine 1 in the counterclockwise sense, the machine is again prepared for operation. The bearing 13 in the arm 14, which swings in a vertical plane perpendicular to the axis of shaft 15 and the parallel axis of shaft 8, allows swiveling of the shaft 8 about an axis E parallel to the axis C.

The improvement described and illustrated is believed to admit of many modifications within the ability of persons skilled in the art, all such modifications being considered within the spirit and scope of the invention except as limited by the appended claims.

I claim:

1. A sewing machine assembly comprising a support; a needle-actuating upper machine portion pivotally mounted on said support for swinging movement about a generally horizontal axis and provided with at least one drive shaft offset therefrom; a motor, a countershaft driven therein and located below the pivotal axis of said upper portion; a belt drive interconnecting said shaft; and means enabling swinging movement of said countershaft to follow the movement of said upper portion upon the displacement thereof about its axis said electric motor being mounted on said support and including a motor shaft in axial alignment with said countershaft, said means enabling swinging movement of said countershaft including a
5. A device connecting one end of said countershaft with said motor shaft and permitting relative flexing movement of the other end of said countershaft; and means supporting said countershaft remote from said device on said support while permitting said flexing movement of the end of said countershaft whereby said belt drive remains interconnected during said movement of said upper portion.

6. The assembly defined in claim 5 wherein said device is a flexible coupling interconnecting an end of said countershaft with said motor shaft.

7. The assembly defined in claim 2 wherein said supporting means includes a lever fulcrumed about an axis parallel to the axis of said motor shaft but axially spaced therefrom and a spherical self-aligning bearing on said lever rotatably receiving said countershaft.

8. The assembly defined in claim 2 wherein said belt drive includes a V-belt sheave anchored to said countershaft close to said lever, a V-belt pulley anchored to said drive shaft and a V-belt connecting said pulley with said sheave.

9. The assembly defined in claim 4 wherein said drive includes a V-belt sheave anchored to said countershaft close to said lever, a V-belt pulley anchored to said drive shaft and a V-belt connecting said pulley with said sheave.

10. The assembly defined in claim 5 wherein said spring means includes a bolt articulated to said lever, a pivotal eye mounted on said support and slidably receiving said bolt, and a helical compression spring surrounding said bolt and received under precompression between said support and said lever.

11. The assembly defined in claim 6, further comprising adjustable stop means threaded onto said bolt for varying the resisting force of said spring to movement of said countershaft to follow the movement of said upper portion.

12. The assembly defined in claim 6 wherein said support is provided with a pair of spaced-apart support blocks, a horizontal pivot shaft received in said blocks and defining the fulcrum for said lever, and a support arm angularly adjustable on said pivot shaft and carrying said motor.

13. The assembly defined in claim 8 wherein said support is provided with a second drive shaft parallel to the first-mentioned drive shaft, said drive shafts lying in respective vertical planes, said pivot axis including a shaft lying in a vertical plane at an inclination to the vertical planes of said drive shafts, said motor shaft being provided with a V-belt sheave, said second drive shaft being provided with a V-belt pulley, and said assembly further comprising a V-belt interconnecting the pulley of said second drive shaft and the sheave of said motor shaft.

14. The assembly defined in claim 5 wherein said support is provided with a second drive shaft parallel to the first-mentioned drive shaft, said drive shafts lying in respective vertical planes, said pivot axis including a shaft lying in a vertical plane at an inclination to the vertical planes of said drive shafts, said motor shaft being provided with a V-belt sheave, said second drive shaft being provided with a V-belt pulley, and said assembly further comprising a V-belt interconnecting the pulley of said second drive shaft and the sheave of said motor shaft.

15. The assembly defined in claim 5 wherein said support is provided with a second drive shaft parallel to the first-mentioned drive shaft, said drive shafts lying in respective vertical planes, said pivot axis including a shaft lying in a vertical plane at an inclination to the vertical planes of said drive shafts, said motor shaft being provided with a V-belt sheave, said second drive shaft being provided with a V-belt pulley, and said assembly further comprising a V-belt interconnecting the pulley of said second drive shaft and the sheave of said motor shaft.