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WHEEL-FEED MECHANISM FOR SEWING MACHINES

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The present invention relates to work feeding mechanism for sewing machines, more particularly to the wheel-feed class of such mechanisms comprising continuously operating wheel-feed means in conjunction with a needle being oscillated in line with the feed of the work, in addition to its work-penetrating reciprocating motion in synchronism with the cooperating stitch-forming tools of the machine. Such feed means normally comprise a lower and an upper feed wheel or roller of which either or both may be driven to feed the work inserted therebetween, in a manner well known in the art.

Sewing machines of the above general type have become known comprising a laterally oscillating needle and a pair of work-feed wheels being driven continuously at a constant speed. Such machines possess the disadvantage that a differential speed exists between the substantially constant peripheral speed of the feed wheels, on the one hand, and the practically sinusoidal speed changes of the oscillating needle, on the other hand. This, in turn, involves a relative movement between the sewing material or work piece being operated on and the needle while moving in the forward or work-penetrating direction of its oscillating cycles. The result of this relative movement may be a damage to the material, needle breakage, and other defects well known, especially in connection with sewing machines designed for high speed operation.

In order to avoid the afore-mentioned drawbacks and difficulties, other machines have become known, wherein both feed wheels are driven or operated intermittently and synchronously with the needle movements, that is, with both the needle and the work moving sinusoidally to prevent any differential motion therebetween during the work-penetrating half-cycles of the needle oscillations. Such machines have the disadvantage, among others, of greatly impeding or interfering with the proper guidance and observation of the work during a sewing operation, as a result of the step-by-step or intermittent feed movements and complete stoppage of the work during the work-disengaging or return half-cycles of the needle oscillations. These disadvantages are of an especially serious nature in the case of fancy or decorative stitching on account of the extreme accuracy required and the rapid fatigue of the eyes of the operator caused by the intermittent work feed movements.

Accordingly, an important object of the present invention is the provision of improved operating mechanism for the work-feed wheel or wheels of a wheel-feed sewing machine which, while substantially avoiding any relative motion between the oscillating needle and the work during the work-penetrating oscillating half-cycles of the needle, will provide the impression or illusion of a continuous or uninterrupted work feed movement or operation.

Another object of the invention is the provision of wheel-feed operating mechanism of the type referred to which, while substantially preventing relative movement between the work and the needle, will enable the attainment of an adjustable relative motion between the separate plies of sewing material during the work-disengaging oscillating half-cycles of the needle, in an effort to produce special effects, such as stretching, gathering, etc. of the work being sewn.

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Still another object of the invention is the provision of improved feed-wheel operating mechanism for a sewing machine of the type referred to to prevent relative motion between the needle and the work during the work-penetrating oscillating half-cycles of the needle, while maintaining a practically continuous or uninterrupted work feed movement, said mechanism being both simple in design and construction, as well as reliable and efficient in operation, and capable of being readily embodied in existing wheel-feed sewing machine constructions.

The invention, both as to its ancillary objects and novel aspects, will be better understood from the following detailed description of a preferred practical embodiment, taken in conjunction with the accompanying drawing forming part of this specification and wherein:

FIG. 1 is an elevational view of a sewing machine embodying improved wheel-feed mechanism shown diagrammatically and constructed in accordance with the principles of the invention; and

FIG. 2 is an enlarged perspective view more clearly illustrating the construction of the wheel-feed operating mechanism embodied in the previous figure.

Like reference numerals denote like parts in both views of the drawing.

With the foregoing objects in view, the invention, according to its preferred embodiment, involves generally the provision of operating mechanism for at least one of the feed-wheels of a wheel-feed sewing machine comprising essentially an oscillating driving or actuating member, such as in the form of a rockshaft or the like, being synchronized with the lateral needle oscillations in the line of the feed of the work by said wheel or wheels. Said mechanism further comprises means to derive a pair of oscillating drives from said member which serve to combinedly operate or rotate a feedwheel through a pair of suitable motion-transmitting means each including a one-way coupling or clutch, such as a ball or roller sprag clutch or the like. The phase relationship of the forces provided by said drives or applied, respectively, to said wheel by said transmitting means is such as to cause said wheel and with it the work to be rotated or advanced in the feeding direction by a series of substantially uninterrupted half-wave sinusoidal feed movements in synchronism with the alternate work-penetrating and work-disengaging half-cycle oscillations of the needle. In this manner, there is prevented a relative movement between the work and the needle in the work-penetrating position, or during the forward oscillating half-cycles of the needle, while the wheel will be additionally rotated in the feeding direction during the work-disengaging positions or return oscillating half-cycles of the needle, in such a manner as to create the impression or illusion of a continuous work feed movement with the work being stopped only instantaneously during the positions of transition of the needle from its work-penetrating to its work-disengaging half-cycle oscillations, and vice versa, respectively.

In the practical realization of the invention, either the oscillating driving forces may be in phase opposition in which case the wheel is driven in the same direction by the transmission or coupling means, or alternatively, the driving forces may have the same phase with the transmission or coupling means acting in an opposite direction or sense on the wheel being driven thereby. In either case, the wheel will be advanced by a series of consecutive sinusoidal half-wave movements in the same or feed direction, as will become further apparent from the following description.

In other words, there is provided by the invention an arrangement, wherein each of two oscillating drives of a work-feed wheel includes a one-way coupling such as to cause both couplings to alternate in their effect of applying torque or rotary motion to the wheel in the feed direction.

More specifically, one of the one-way couplings is effective during the half-cycles while the needle penetrates or is engaged with the work and the other coupling is effective during the half-cycles while the needle is out of or disengaged from the work, while each of said couplings will be ineffective or free-wheeling during the periods of effectiveness of the other coupling, as will become further apparent as the following description proceeds. As a consequence, the stoppage of the work is reduced to the instants of transition from one of the intermittent sinusoidal half-wave movements of the work to the next intermittent movement, and vice versa, whereby, on account of the relatively high repetition frequency of the transition or change-over points, the momentary stoppage of the work will be invisible to the operator, thus providing the illusion or impression of a practically continuous work feed movement or operation.

Basically, therefore, the invention relates to a work-feed arrangement by which the total feed movement during a complete-stitch-forming cycle is divided into two substantially sinusoidal steps in synchronism with the work-engaging and work-disengaging oscillating half-cycles of the needle, respectively.

If both feed wheels are driven simultaneously and synchronously, the invention, according to an improved feature thereof, provides a simple and efficient means for the control of the feed movement or amplitude of one of the wheels relative to the other wheel for the production of special effects, such as stretching, gathering, etc. of the work being sewn. For the latter purpose, simple control means may be provided to vary the feed movement of one of the wheels during the operating half-cycles while the needle is disengaged from the work, while maintaining the synchronous needle and work movement during the operating half-cycles while the needle is engaged with or penetrates the work being sewn. The control of the feed movement of one of the wheels may be effected simply and efficiently and within relative small limits by varying the length of one of the connecting links of the motion-transmitting means or linkage between the respective oscillating drives being effective during the half-cycles of disengagement of the needle from the work.

Referring more particularly to FIG. 1 of the drawing, there is shown a sewing machine of the wheel-feed class comprising a bedplate 1, a sewing column 2, and a base 3 for an upright 4 supporting an overhanging arm 5 which terminates in the sewing head 6, in a manner well known in the art. Mounted within the arm 5 of the machine in conventional fashion is the armshaft 7 being driven by the main drive shaft 9 mounted in the base 3 through a cord chain 8, or by any other suitable driving means. Item 10 denotes the needle bar being mounted within the head 6 and operatively connected in known manner to the shaft 7 for imparting reciprocating movement to the needle, said bar being in turn mounted within a needle bar frame 51, FIG. 2, for imparting lateral oscillating movements to the needle in the line of feed of the work by the upper and lower work-feed wheels 80 and 44, respectively.

The main drive shaft 9, which at its end projecting from the machine carries a belt wheel or pulley 11, furthermore drives, through a cord chain 12 or the like, the loop taker shaft 13, FIG. 2, of the sewing machine being mounted within or underneath the bedplate 1 and carrying an eccentric 14 fitted with an extending arm or lever 15, the latter being, in turn, pivotally connected to one arm 16 of a double lever or crank 17. The latter is secured to one end of a rockshaft 19 also mounted underneath the bedplate 1, the opposite end of said shaft having secured thereto a second double lever 20 having a pair of lever arms 21 and 22 extending diametrically from the shaft 19 and having their free ends pivotally connected to a pair of, preferably adjustable, links or connecting rods 23 and 24, respectively. The end of the rod 23 is pivoted to the radial extension 25 of the outer or

driven member 27 of a first ball-type sprag or the like one-way clutch or coupling 29, and the link 24 is similarly connected to the radial extension 26 of the outer member 28 of a further one-way clutch or coupling 30.

Mounted in the bedplate 1 is a vertical shaft 31 being encircled by a rotating sleeve 32 to which are secured the inner members 33 and 34 of the clutches 29 and 30, said members being provided in a known manner with suitable wedge-shaped recesses 35 and 36 for the reception of gripping balls or rollers 37 and 38, respectively, whereby to cause the inner clutch members to run freely in one driving direction of the outer members and to grip instantly, or to establish effective coupling connection, in the other direction, in a manner well known and understood. As will be understood from the following, any equivalent one-way coupling or clutch device, in place of the sprag clutches shown for illustration, may be employed for the purpose of the invention, the function and operation of which is substantially independent of the special type of one-way clutch or coupling used.

Secured to the sleeve 32 connecting the driven clutch members 33 and 34 is a gear 39 which meshes with a gear 41 mounted upon a further vertical shaft 40 supported by the plate 1 and extending through the column 2. Shaft 40 carries at its upper end a bevel gear 42 meshing with a bevel gear 43 which is secured to the lower feedwheel 44 of the sewing machine having a shaft 45 and projecting above the upper face of the column 2, in the manner shown and customary with conventional wheel-feed sewing machines.

Pivotally connected to the remaining arm 18 of the double lever 17 of the rockshaft 19 is a connecting rod 46 having its upper end linked to an arm 47 being secured to one end of a further rockshaft 48 mounted in the overhanging arm 5 of the machine in a position parallel to the main drive shaft 7. Secured to the opposite end of the rockshaft 48 is a crank 49 having a crank pin 50 arranged to engage a guide slot 51 of the needle bar supporting frame 51, whereby to cause the needle to oscillate in the line of feed of the work during each revolution of the drive or arm shaft 7.

Secured to the rockshaft 48 is a further lever arm 52 linked to a crank 54 through a connecting arm 53. The crank 54 is in turn secured to still another rockshaft 55 arranged parallel to the rockshaft 48, or to the arm shaft 7, respectively. Rockshaft 55 carries a two-part lever 56 being connected through a, preferably adjustable, link 58 with the radial extension 60 of the outer or driving member 62 of a one-way sprag clutch 64. The inner or driven member 66 of the clutch 64 being provided with recesses 70 for the reception of balls 68, is connected with the drive shaft 75 for the upper feedwheel 80 mounted within the head 6 of the sewing machine.

Secured to the rockshaft 55 is a further lever 57 being linked through a, preferably adjustable, connecting rod 59 to the radial extension 61 of the driving member 63 of a further one-way clutch or coupling 65 whose inner or driven member 67, being provided with recesses 71 for the reception of balls 69, is connected to the shaft 75 in a manner similar to the clutch 64.

In order to achieve a stretching, gathering or the like effect in the feeding direction of the material being sewn, the connecting lever 56, in the example shown, is composed of two relatively adjustable parts in an effort to vary the effective length of the lever and, in turn, the amplitude of the feed movements of the upper feedwheel 80, or of one of the plies of material being stitched during the half-wave operating cycles coinciding with the work-disengaging positions of the needle. For this purpose, the lower part of the lever 56 is formed as a guide 72 for the upper part which latter may be secured in a desired adjusting position by the aid of a set screw 73. The upper part of the lever 56 may be provided with a suitable scale 74 to indicate the differential adjusting position of the speed between the two feedwheels. In

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the arrangement shown, the extensions 60 and 61 of the two one-way clutches 64 and 65 are displaced by an angle of 180°, while the recesses 70 and 71 of the driven members 66 and 67 are shaped in a manner as to cause the outer members 62 and 63 to grip with the inner members in the desired rotating direction only being common to both clutches by way of the balls 68 and 69, respectively, in such a manner as to drive the shaft 75 by consecutive sinusoidal partial movements in the forward or work feeding direction, in a manner readily understood. The shaft 75 is supported at its lower end in a frame or carrier 77 and carries a bevel gear or friction wheel 78 cooperating with a bevel gear or wheel 79 connected to or being integral with the upper feedwheel 80 also rotatably supported in the carrier 77.

The operation of the wheel-feed mechanism shown and afore-described will become further apparent from the following. During each revolution of the drive shaft 9, a complete oscillating movement will be imparted to the rockshaft 19 by way of the eccentric 14, arm 15 and the lever or crank 17. As a consequence, the connecting rod 23 linked to the arm 21 of the lever 20 operates the outer member 27 of the clutch 29, while the connecting rod 24 linked to the arm 22 of the lever 20 operates the outer clutch member 28 during the work-penetrating positions or oscillating half-cycles of the needle. Under these conditions, the member 23 is in effective coupling connection with the inner member 34 through the balls 36, whereby to cause the sleeve 32 and, in turn, the gear 39, to rotate the shaft 40 which, in turn, causes a rotation of the lower feedwheel 44, in the feed direction and in synchronism with the needle movement, by way of the bevel gears 42 and 43. At the same time, that is, during the work-penetrating positions of the needle, the outer member 27 of the clutch 29 is disconnected or decoupled from the inner clutch member 33, whereby to cause the outer member to freewheel about said inner member without transmitting any torque to the sleeve 32. On the other hand, during the work-disengaging positions of the needle, the connecting rod 24 moves the outer member 28 in a direction opposite to the preceding movement or operation, whereby the clutch member 28 will be decoupled from the clutch member 34 so as to rotate freely about the latter without transmitting any torque to the sleeve 32. At the same time, that is, during the work-disengaging positions of the needle, the connecting rod 23 also moves in a direction opposite to the preceding movement, whereby the outer clutch member 27 will be in effective coupling connection with the inner clutch member 33 through the balls 37, to thereby rotate the sleeve 32 by way of the gear 39 and to again advance the wheel 44 by a sinusoidal partial movement in the feed direction, in the manner understood from the foregoing.

The oscillating motion imparted to the arm 18 of the crank 17 is transmitted to the rockshaft 48 by way of the connecting rod 46 and lever 47. As a consequence, the rockshaft 48, during the work-engaging positions of the needle, imparts to the needle a movement in the feed direction and returns the needle in the opposite direction during its work-disengaging positions or oscillating half-cycles, by means of the crank 49 and pin 45 engaging the guide slot 51' of the needle supporting frame 51.

The oscillating motion of the rockshaft 48 is transmitted to the rockshaft 55 by way of the connecting lever 53 and the crank 54. During the work-penetrating periods of the needle, lever 57 rotates the one-way clutch 65 in the direction indicated by the arrow in the drawing through the connecting rod 59 and extension 61. As a consequence, the outer clutch member 63 is in effective coupling connection with the inner member 67 through the balls 69, whereby to rotate the driving shaft 75 and the upper feedwheel in the feed direction by way of the friction wheels 78 and 79. During the same or work-penetrating periods of half-wave cycles of the needle, the outer clutch member 62 of the clutch 64 being moved by

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the connecting rod 58 by way of the extension 60 in the same direction indicated by the arrow is decoupled from the inner clutch member 66 or the drive shaft 75 by rotating freely about the member 66 without any torque being transmitted thereto. On the other hand, in the work-disengaging needle positions, the operation of the one-way clutches 64 and 65 is exchanged as far as the effectiveness of the clutches in transmitting torque to the shaft 75 is concerned, that is, the outer member 62 moved by the levers 56 and 58 and the extension 60 will be in effective coupling connection with the inner member 66 by way of the balls 68, to impart rotary motion to the shaft 75 which is, in turn, transmitted to the feedwheel 80 by the friction wheels 78 and 79. During the same operation, that is, while the needle is in the work-disengaging position, the movement of the outer member 63 of the clutch 65 is ineffective upon the inner clutch member 67, whereby to result in freewheeling and prevention of torque being transmitted to the driving shaft 75.

In brief, the oscillating driving or operating mechanisms as described for the upper and lower feedwheels function alternately in such a manner that, with the needle being in the work-penetrating position or forward oscillating half-cycle, the lower feedwheel 44 is driven by the one-way clutch 30, while the upper feedwheel 80 is driven by the one-way clutch 65 in synchronism with the needle movements. On the other hand, during the work-disengaging needle positions or return oscillating half-cycles of the needle, the one-way clutch 29 drives the lower feedwheel 44, while the one-way coupling 64 drives the upper feedwheel 80, and so on during the following needle oscillating movements or operations.

By varying the effective length of the lever 56, controlling the amplitude of the upper feedwheel movements, a variable stretching, gathering or the like effect during the work-disengaging half-cycles may be achieved, in the manner pointed out in the foregoing. For the same purpose, the lever 21 operating the one-way coupling 29 may be made adjustable to obtain a similar effect by controlling the movement or amplitude of the lower feedwheel during the work-disengaging positions, as will be readily understood from the foregoing.

In the example shown by the drawing, the operation of the lower feedwheel 44 is by way of a pair of oscillating drives being in phase opposition as provided by the arms 21 and 22 of the lever 20. In this case, the driving forces are applied to the outer clutch members 27 and 28 in the same direction, that is, with the arms or extensions 25 and 26 including a zero angle. According to the alternative arrangement as shown for the operation of the upper feedwheel 80, equi-phased driving forces are provided by the arms or levers 56 and 57 and in this case the forces are applied to the outer clutch members 62 and 63 in opposite directions, that is, with the arms or extensions 60 and 61 including a 180° angle, to result in the desired unidirectional sinusoidal work feed movements in accordance with the underlying principle of the invention.

In the foregoing, the invention has been described in reference to a specific illustrative device. It will be evident, however, that variations and modifications, as well as the substitution of equivalent parts and elements for those shown and disclosed herein for illustration, may be made in accordance with the broader scope and spirit of the invention as set forth in the appended claims. The specification and drawing are accordingly to be regarded in an illustrative rather than in a restrictive sense.

We claim:

1. In combination with a sewing machine of the type having a work-feed wheel, a needle and operating means for imparting to said needle combined work-penetrating reciprocating motion and lateral oscillating motion in the line of feed of the work by said wheel, operating mechanism for said wheel comprising actuating means to provide a pair of oscillating drives synchronized with said needle, and a pair of motion-transmitting means including

one-way coupling means and each connecting one of said drives with said wheel, whereby to alternately rotate said wheel by said drives in the work-feeding direction by a series of substantially uninterrupted half-wave sinusoidal feed movements in synchronism with the alternate work-penetrating and work-disengaging oscillating half-cycles, respectively, of said needle.

2. In wheel-feeding mechanism as claimed in claim 1, each of said coupling means being comprised of a sprag clutch running freely in one direction and gripping instantly in the opposite direction.

3. In wheel-feed mechanism as claimed in claim 1, said drives being comprised of a rockshaft synchronized with said needle operating means, a pair of actuating arms projecting transversely to and in opposite directions from said shaft, and said motion-transmitting means being comprised of first linkage means connecting the end of one of said arms with said wheel through one of said one-way coupling means, and second linkage means connecting the end of the other of said arms with said wheel through the other one-way coupling means.

4. In combination with a sewing machine of the type having a work-feed wheel, a needle and operating means for imparting to said needle combined work-penetrating reciprocating motion and lateral oscillating motion in the line of feed of the work by said wheel, said needle in the work-penetrating position moving in the feed direction and said needle in the work-disengaging position moving oppositely to the feed direction, operating mechanism for said wheel comprising actuating means to provide a pair of oscillating drives synchronized with said needle, first motion-transmitting means including a first one-way coupling and connecting one of said drives with said wheel, and second motion-transmitting means including a second one-way coupling and connecting the other of said drives with said wheel, said couplings being effective to rotate said wheel in the feeding direction by substantially uninterrupted successive sinusoidal movements by the work-penetrating driving force half-waves of one of said drives and by the alternate work-disengaging driving force half-waves of said other drive, respectively.

5. In wheel-feed mechanism as claimed in claim 4, wherein each of said couplings is comprised of a ball sprag clutch running freely when driven in one direction and gripping instantly when driven in the opposite direction.

6. In wheel-feed mechanism as claimed in claim 4, said machine having a pair of cooperating lower and upper feed wheels for passing a work piece therebetween and each being driven by operating mechanism described and designated to rotate said wheels by substantially

equal amplitude movements during the work-penetrating oscillating half-cycles of said needle and to rotate said wheels by differential amplitude movements during the work-disengaging oscillating half-cycles of said needle, and means associated with one of said mechanisms to control the amplitude differential of said wheels during the work-disengaging oscillating half-cycles of said needle.

7. In combination with a wheel-feed sewing machine having a work-feed wheel, a needle and operating means for imparting to said needle combined work-penetrating reciprocating motion and lateral oscillating motion in the line of feed of the work by said wheel, said needle in the work-penetrating position moving in the feeding direction and said needle in the work-disengaging position moving oppositely to the feeding direction, operating mechanism comprising first means to rotate said wheel in the feed direction by a first series of spaced intermittent unidirectional half-wave sinusoidal feed movements in synchronism with the work-penetrating oscillating half-cycles of said needle, and further means to rotate said wheel in the feed direction by a second series of spaced sinusoidal half-wave feed movements interlocking with said first series of feed movements and in synchronism with the work-disengaging oscillating half-cycles of said needle.

8. In wheel-feed mechanism as claimed in claim 7, said machine having a pair of cooperating lower and upper feed wheels each being driven by operating mechanisms of the type described in the preceding claim in synchronism with the needle oscillations, and means associated with at least one of said mechanisms to vary the relative amplitude of said wheel feed movements during the work-disengaging oscillating half-cycles of said needle.

9. In wheel-feed mechanism as claimed in claim 1, said drives being comprised of a rockshaft synchronized with said needle operating means, a pair of actuating arms projecting transversely to and in the same direction from said shaft, and said motion-transmitting means being comprised of first linkage means connecting the end of one of said arms with said wheel through one of said one-way coupling means, and second linkage means connecting the end of the other of said arms with said wheel through the other one-way coupling means.

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