Jan. 10, 1961 S. M. COHEN 2,967,499

NEEDLE POSITIONER

Filed Oct. 5, 1959 3 Sheets-Sheet 1

Fig. 1.

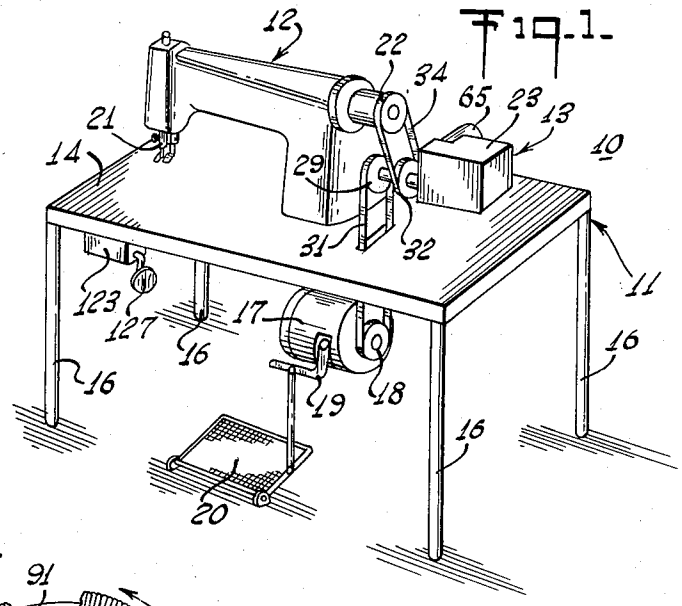


Fig. 6.

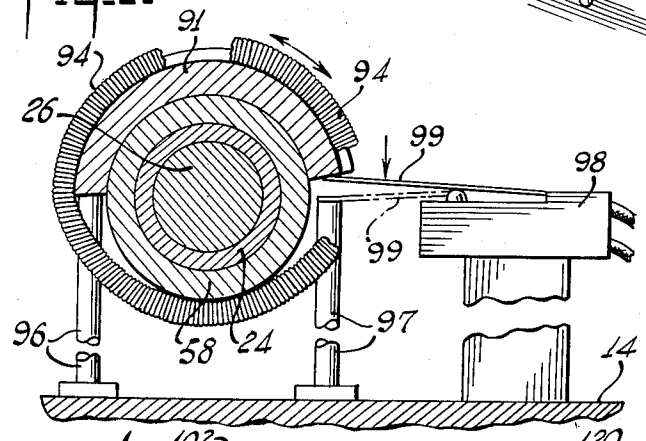


Fig. 8.

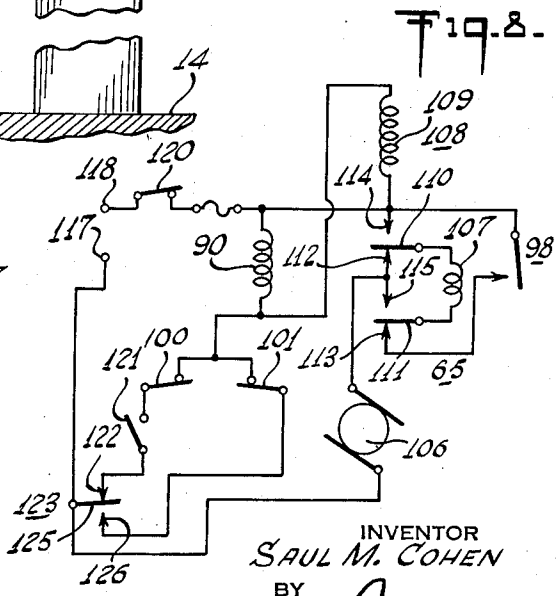
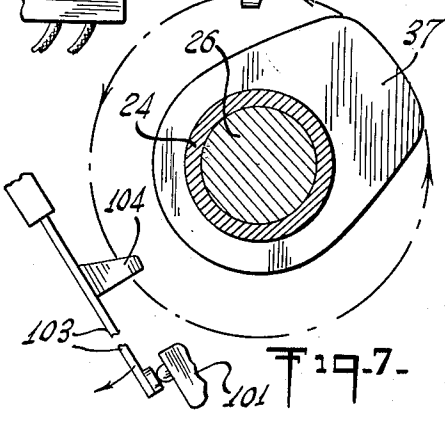


Fig. 7.



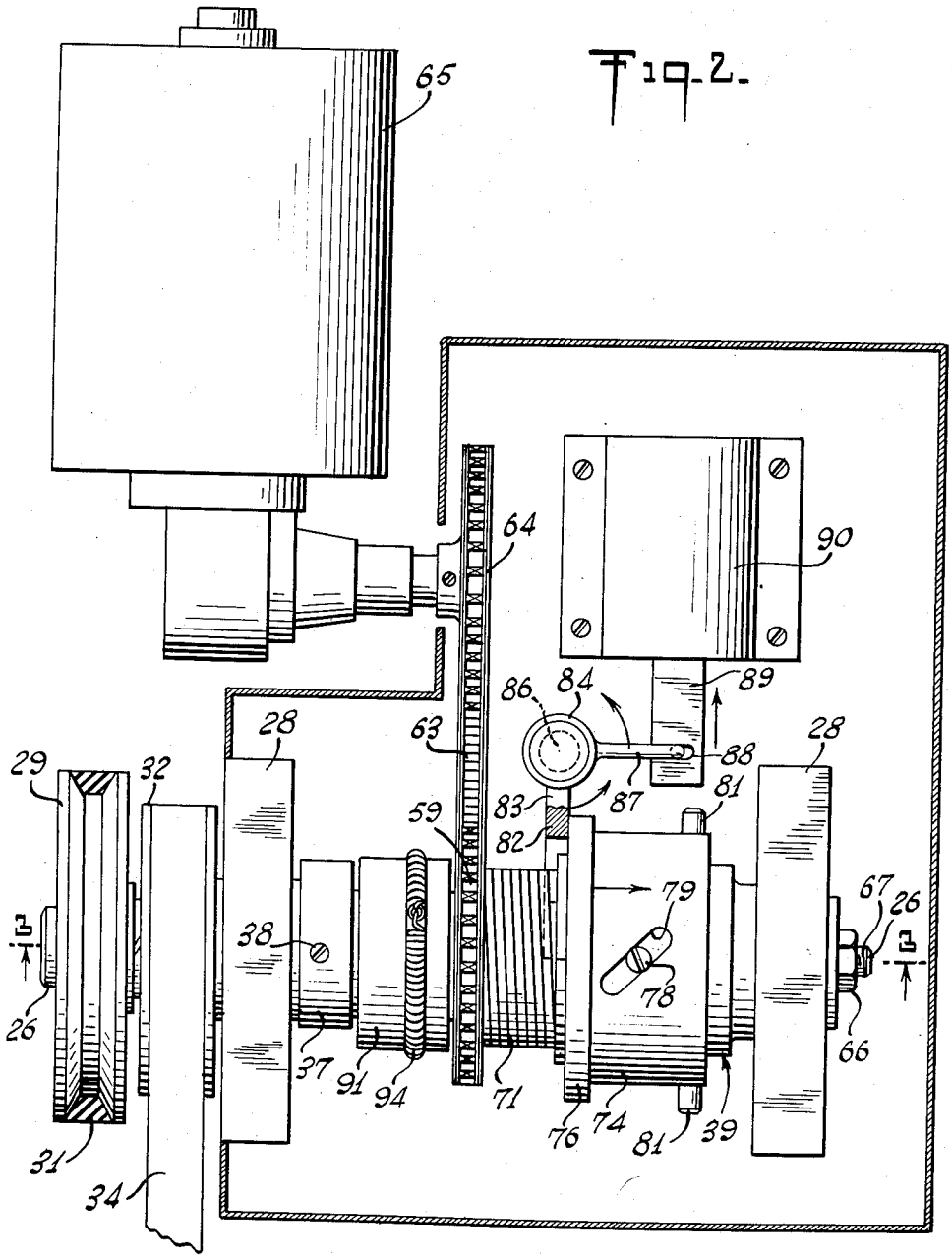
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Fig. 2.



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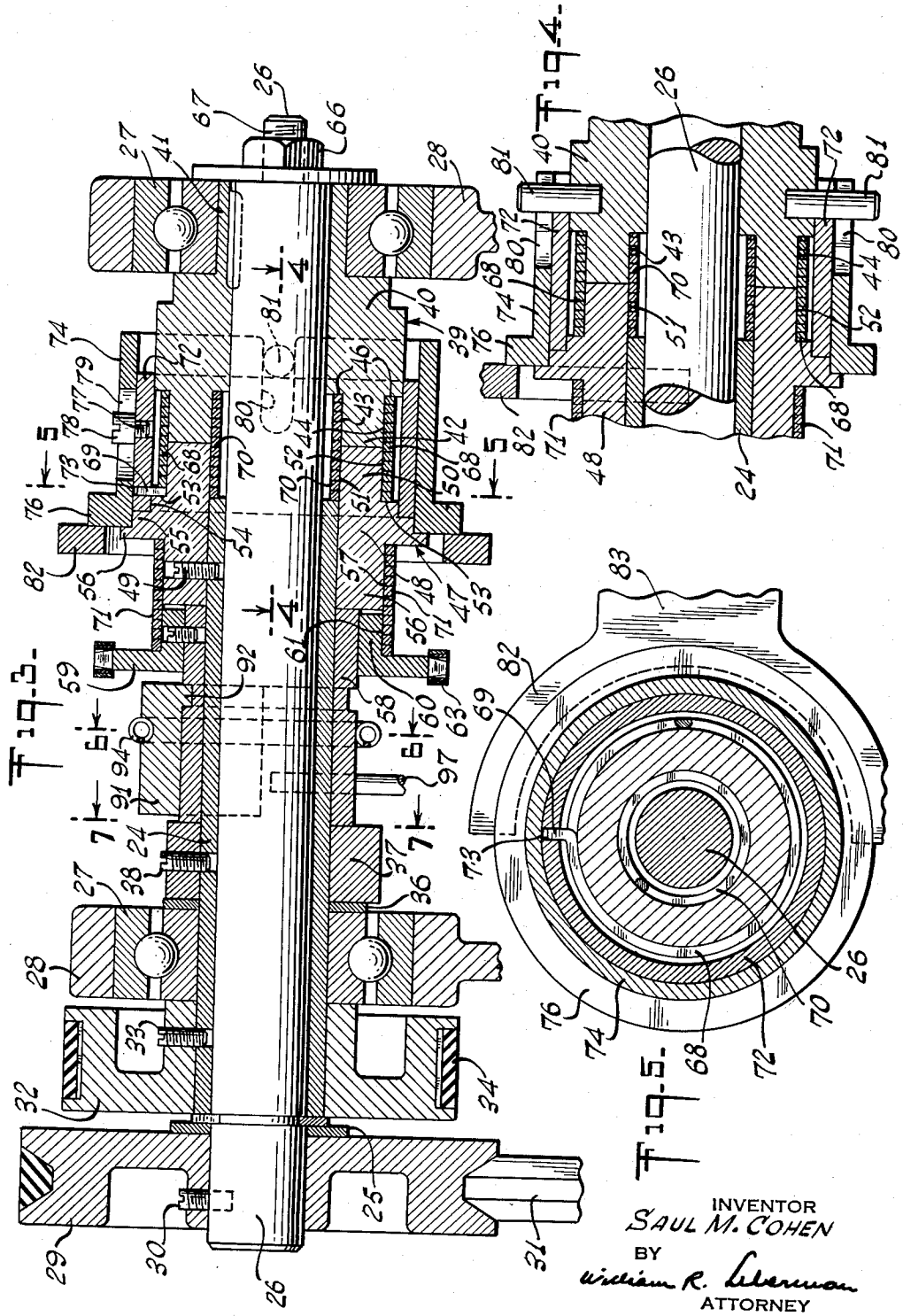


FIG. 3.

FIG. 4.

FIG. 5.

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2,967,499

NEEDLE POSITIONER

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14 Claims. (Cl. 112—219)

The present invention relates generally to improvements in sewing machines. In particular, it relates to an improved mechanism for automatically bringing or halting the needle supporting bar of a sewing machine in any desired preselected positions.

In commercial and industrial sewing operations, stopping of the sewing machine with the needle in its raised or depressed position is a very frequent requirement. Since it is necessary, in operation of conventional sewing machines, to stop or to slow down the sewing machine and then to manipulate it in order to bring the needle to the desired position, the needle-positioning operation consumes a substantial part of the total sewing operation thereby to increase materially the overall cost of the item being sewn. Automatic needle-positioning mechanisms have been heretofore proposed and employed, but these have possessed numerous drawbacks and disadvantages. They are awkward, costly and complex mechanisms subject to frequent malfunctioning. In addition, they are difficult to attach to the conventional sewing machine, requiring considerable modification of the sewing machine, and otherwise leave much to be desired.

It is thus a principal object of the present invention to provide an improved sewing machine.

Another object of the present invention is to provide an improved mechanism for automatically bringing the needle of a sewing machine to preselected positions.

Still another object of the present invention is to provide an automatic needle-positioning mechanism which may be simply and readily attached to a conventional sewing machine.

A further object of the present invention is to provide an improved automatic needle-positioning mechanism of the above nature which is characterized by its structural ruggedness, simplicity of operation, reliability in performance, and of low cost.

Still a further object of the present invention is to provide an improved shaft-coupling device of novel properties.

The above and other objects of the present invention will become apparent from a reading of the following description taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a perspective view of a sewing machine employing the improved automatic needle-positioning mechanism according to the present invention;

Figure 2 is a top plan view of the improved automatic needle-positioning mechanism, partially broken away and partially in section;

Figure 3 is a sectional view taken along line 3—3 of Figure 2;

Figure 4 is a sectional view taken along line 4—4 of Figure 3;

Figure 5 is a sectional view taken along line 5—5 of Figure 3;

Figure 6 is a sectional view taken along line 6—6 of Figure 3;

Figure 7 is a sectional view taken along line 7—7 of Figure 3; and

Figure 8 is a schematic view of the electrical network employed with the automatic needle-positioning mechanism.

A feature of the present invention resides in the provision of a novel coupling mechanism between the sewing machine per se and the main drive motor, which coupling comprises a driven shaft connected to said sewing machine, a drive shaft connected to said motor, first and second oppositely sensed unidirectional rotary coupling devices connecting said shafts, and means selectively disabling one of said coupling devices. In order to position the sewing machine needle bar automatically, there is provided an auxiliary positioning motor which is connected to the coupling mechanism driven shaft by way of an over-running clutch which effects a forward drive to couple the disabling means, being solenoid actuated and associated with the backward drive coupling between the shafts. A selectively operable first switch means connects the auxiliary motor and the disabling solenoid to a source of current through a normally closed second switch actuated by an element carried by the driven shaft to open the latter switch when the needle bar is in a preselected positon. Means are also provided for momentarily reversing the auxiliary motor to assure the prompt stopping thereof.

In effecting the automatic positioning operation, the machine operator merely stops and brakes the main drive motor and closes the first switch to energize the auxiliary motor and disable the shafts rearward drive coupling to permit the advance of the driven shaft while the drive shaft is stationary. The driven shaft advances the needle bar to its desired position, whereupon the second switch is automatically opened to stop the needle bar in said position. Switch means are also provided permitting moving of the needle bar automatically to a plurality of selected positions.

In accordance with a preferred embodiment of the present invention, the driven shaft is a hollow shaft telescoped by the drive shaft. Two sets of end-to-end axially arranged cylindrical clutch surfaces are carried by the shafts, one set of surfaces being concave and the other convex. Similarly sensed helical coupling springs tightly register with the clutch surfaces whereby one set is coupled in a forward drive and backward slip direction and the other set is coupled in a backward drive and forward slip direction so that the shafts are normally rigidly coupled. Means are provided to disable the backward drive coupling spring by partially unwinding the same. The auxiliary motor is coupled to the driven shaft by a forward drive coupling of a similar construction. Disabling the shaft backward drive coupling permits the advance of the driven shaft by the auxiliary motor while the drive shaft is braked.

Referring now to the drawings which illustrate a preferred embodiment of the present invention, reference numeral **10** generally designates a sewing machine employing the improved automatic needle-positioning mechanism which includes a support table **11**, a sewing machine head **12** and needle-positioning mechanism **13**. Table **11** comprises a top or platform **14** supported on legs **16** and having mounted on its top face sewing machine head **12** and positioning mechanism **13**, and on its bottom face a main drive motor **17**. Drive motor **17** is of conventional construction, provided with a shaft-mounted drive pulley **18** and controlled through an arm **19** connected to a foot treadle **20**, and being of the type which is automatically braked upon declutching of the motor upon release of the suitably supported foot treadle **20**. Sewing machine head **12** is likewise of conventional construction, including a reciprocating needle bar **21** con-

nected by way of any well known motion-translating mechanism to sewing machine drive pulley 22.

The automatic needle-positioning mechanism is partially housed in a casing 23 and comprises a tubular driven shaft 24 and a drive shaft 26 telescoping the shaft 24 and extending beyond the opposite ends thereof. Shafts 24 and 26 are rotatable relative to each other and the assembly thereof is rotatably supported by a pair of longitudinally spaced ball bearings 27 which are carried by upright brackets 28 and which engage shafts 24 and 26 respectively.

A pulley 29 is mounted on an end of drive shaft 26, designating the inner end thereof, and is affixed thereto by means of a set screw 30 engaging a tapped radial bore in the pulley hub and a shaft recess. A V-belt 31 connects pulley 29 to drive motor pulley 18. A second pulley 32 is affixed to the end of driven shaft 24 adjacent pulley 29 and is affixed thereto by a hub carried set screw 33. Pulley 32 is, in turn, connected to the sewing machine drive pulley 22 by slip-proof belt 34. A pair of separator washers are carried by the shaft 26 between the pulley 29 and the confronting end of shaft 24, one of said washers 25 engaging a corresponding peripheral groove in shaft 26 to limit the relative longitudinal movement of said shaft 24. The inner race of the corresponding ball bearing 27 is embraced by a hub end face of pulley 32 and a washer 36 which is positively positioned by a collar 37 affixed to the shaft 24 by a set screw 38, the collar 37 having a cammed peripheral surface to define a switch actuating member.

In order to effect a drive coupling between the shafts 24 and 26, a first clutch member 39 is provided, defined by a collar 40 located at the opposite, outer end of drive shaft 26 and affixed thereto by key-engaging corresponding key ways. Collar 40 is provided with an outwardly directed sleeve flange 41 registering with the bore of the corresponding ball race 27 and having a peripheral shoulder at its base abutting the ball bearing inner race. Projecting inwardly from the collar 40 and formed integral therewith is a clutch cylinder 42 having inner and outer clutch surfaces 43 and 44 respectively, coaxial with shafts 24 and 26, inner clutch surface 43 being spaced from the surface of shaft 26. Annular shoulders 46 project radially from the bases of clutch surfaces 42 and 43.

A second clutch member 47 is provided, and is defined by a collar member 48 affixed to the outer end of tubular shaft 24 by means of set screw 49 engaging a tapped radial bore in collar 48 and an aligned bore in shaft 24. Clutch 47 includes a cylinder 50 extending outwardly beyond the outer end of the shaft 24 and terminating in a flat end face closely abutting the corresponding inner end face of first clutch cylinder 42. Clutch cylinder 50 is provided with inner and outer cylindrical clutch surfaces 51 and 52 respectively, which are in coplanar alignment with corresponding first clutch surfaces 43 and 44. The base of clutch surface 52 terminates in an annular shoulder 53, the outer edge of which joins a cylindrical shoulder 54 connected by way of an annular step 55 to an inner peripheral lip 56. Clutch 47 also includes a third cylindrical portion 56*a* having an outer axial cylinder clutch surface 57 and an inner end surface abutting the outer surface of shaft 24.

Rotatably engaging tubular shaft 24 is a sleeve 58, entrapped between and abutting confronting end faces of collar 37 and clutch cylinder 56*a*. A sprocket wheel 59 is mounted on sleeve 58 and includes a cylindrical hub 60 registering with the outer end of sleeve 58 and affixed thereto by means of a suitably engaged set screw. The outer surface of the hub 60 defines a cylindrical clutch surface 61 which is in coplanar end-to-end alignment with clutch surface 57. Sprocket wheel 59 is connected by way of a sprocket chain 63 to a sprocket wheel 64 mounted on the driven shaft of a suitably mounted, reversible, auxiliary positioning motor 65 of the gear reduction type. Shafts 24 and 26, and the various members carried thereby, are locked in assembled position by a washer and nut 66 engaging a threaded shank 67 extending axially from the outer end of shaft 26.

A first helical coupling spring 68 is wound about and tightly engages the outer clutch surfaces 44 and 52 extending from shoulder 46 to shoulder 53, and terminating at its inner end in a radially outwardly directed leg 69. A second helical coupling spring 70 is tightly embraced by the inner clutch surfaces 43 and 51 and extends from shoulder 46 to the outer end face of the tubular shaft 24. In addition, a third helical coupling spring 71 is wound about and tightly embraces the cylindrical clutch surfaces 57 and 61 and extends from the end face of sprocket wheel hub 60 to the confronting face of collar 48.

In the embodiment illustrated, helical springs 68, 70 and 71 are each right handed, and the forward drive direction is clockwise as viewed from the right hand end of Figure 3. Thus, helical spring 70 effects only a forward coupling of drive shaft 26 to driven shaft 24 and defines a forwardly sensed over-running clutch with clutch surfaces 43 and 51, since upon forward rotation of shaft 26 relative to shaft 24, spring 70 is partially unwound to expand and tightly engage and rotatably couple clutch surfaces 43 and 51, and upon backward rotation of shaft 26 relative to shaft 24 the spring 70 is partially wound and contracted so as to loosen the engagement between the spring 70 and the clutch surfaces, and to cause mutual slippage therebetween.

On the other hand, helical spring 68 effects only a backward coupling of drive shaft 26 to driven shaft 24 and defines, with clutch surfaces 44 and 52, a backwardly sensed over-running clutch, since upon backward rotation of shaft 26 relative to shaft 24 spring 68 is wound and closely contracts about clutch surfaces 44 and 52 to effect a tight interengagement therebetween, and upon forward rotation of shaft 26 relative to shaft 24 spring 68 is partially unwound and expanded so as to loosely engage clutch surfaces 44 and 52 and permit slippage therebetween. Moreover, spring 71 effects only a forward coupling from sprocket wheel 59 to driven shaft 24 and defines, with clutch surfaces 57 and 61, a forwardly sensed over-running clutch, since forward rotation of sprocket wheel 59 relative to shaft 24 results in a winding and contraction of spring 71 and a tight interengagement between spring 71 and clutch surfaces 57 and 61, and a backward rotation of sprocket wheel 59 relative to shaft 24 results in an expansion and loosening of spring 71 and slippage between spring 71 and surfaces 61 and 57. As a consequence of the above-described over-running clutch arrangement, shafts 24 and 26 are normally rigidly coupled in both directions so that shaft 24 may be driven by shaft 26, and upon disabling coupling spring 68 shaft 24 may be rotated only in a forward direction by sprocket wheel 59 through spring 71.

The mechanism for disabling backward coupling spring 68 includes a first collar 72 rotatably carried by clutch collar 48 and engaging shoulder 54 and opposite cylindrical surface of collar 48. Spring leg 69 registers with an opening 73 formed in collar 72. A second collar 74 encircles collar 72 and is longitudinally slidable relative thereto, being provided with a peripheral flange 76 at its inner end which is movable into abutment with collar step 56. A screw 77 engages the wall of collar 72 and is provided with a head 78 which slidably registers with a helical slot 79 formed in collar 74, see Fig. 2. Also formed in collar 74 are a pair of oppositely disposed longitudinally extending slots 80 (see Fig. 4) which are slidably engaged by corresponding pins 81 extending radially from clutch collar 48 to limit collar 74 to relative longitudinal movement. Thus, movement of collar 74 to the right as seen in Fig. 3 of the drawings causes a relative backward rotation of collar 72 by way of slot 79 and screw 77 partially to unwind and to disable coupling spring 68 and open the correspondingly defined backwardly sensed clutch. It should be noted that collar 74

is normally in its retracted position, with collar 72 in advanced position and spring 68 in its normally wound position.

In order to effect selective movement of collar 74 and the disabling of spring 68, there is provided a yoke or fork member 82 straddling collar 48 and having a face abutting the inner face of collar flange 76. Projecting rearwardly from yoke 82 is an arm 83 which terminates in a knuckle 84 rotatably engaged by a suitably supported vertical pin 86. A leg 87 projects from knuckle 84 in a longitudinally extending direction and terminates in a depending pin which engages a slot 88 formed in a reciprocable armature 89 which is spring urged to an advanced position as illustrated in Fig. 2, and is drawn to a retracted position upon the actuation of an associated solenoid 90 to disable coupling spring 68 by sliding collar 74 outwardly by reason of the advancement of yoke 82.

Straddling sleeve 58 between sprocket wheel 59 and cam 37 is a semicylindrical yoke 91 having an inwardly directed lip 92 engaging a corresponding peripheral groove in sleeve 58. A circular helical tension spring 94 rests in a groove formed in yoke 91 and engages the opposite surface of sleeve 58 to effect a friction slipping engagement between yoke 91 and sleeve 58. Rotary motion of yoke 91 is limited to a slight rocking by a pair of oppositely disposed abutment members 96 and 97 (see Fig. 6) having upwardly directed faces confronting the downwardly directed end faces of yoke 91. Located adjacent yoke 91 is a suitably mounted, normally open switch 98, having an upwardly sprung resilient actuating arm 99, the free end of which arm engages the leading end face of the yoke 91. Switch 98 is closed by the forward rotation of sleeve 58 and sprocket wheel 59, and returned to its normaly open position upon backward rotation thereof.

A pair of circumferentially spaced switches 100 and 101 are suitably mounted (see Fig. 7) in the vicinity of switch actuating cam 37, each switch having respectively associated therewith a resilient actuating arm 102 and 103. Arms 102 and 103 are suitably supported and normally engage the respective switches 101 and 100 to keep them in closed position. Each of arms 102 and 103 is provided with a cam follower element 104 disposed in the path of cam 37, the raised surface of cam 37 opening the corresponding switch when engaging a respective cam follower 104. Cam follower 104 and cam 37 are so located and disposed that switch 100 is opened when the sewing machine needle bar 21 is in raised position and switch 101 is opened when the needle bar is in depressed position.

Referring now to Figure 8 of the drawings, which illustrates the electrical network of the automatic needle positioner of the present invention, the reversible motor 65 includes a rotor 106 and a field winding 107. There is provided a relay 108 including an actuating solenoid 109, a pair of arms 110 and 111 normally engaging contacts 112 and 113 respectively, and upon energization of solenoid 109 engaging contacts 114 and 115 respectively and disengaging contacts 112 and 113. The terminals of motor field 107 are connected to relay arms 110 and 111, and the motor will be driven in reverse when relay 108 is deactivated and arms 110 and 111 engage contacts 112 and 113 and forward when relay 108 is actuated and arms 110 and 111 engage contacts 114 and 115. Relay contacts 112 and 115 are connected together through motor armature 106 to a first terminal 117 of a suitable source of current including an opposite terminal 118. Relay contact 113 is connected through switch 98 and a main switch 120 to current source terminal 118, and relay contact 114 is connected to the current terminal 118 through the switch 120. Solenoids 90 and 109 are parallel-connected between current terminal 118, by way of switch 120, and a terminal of each of the switches 100 and 101, which are interconnected. The opposite terminal of switch 100 is connected through a switch 121 to a normally closed contact 122 of a double throw switch 123, the arm 125 of which is connected to current terminal 117, and the opposite terminal of switch 101 is connected to the normally open terminal 126 of switch 123. Switch 121 is selectively operable, and is preferably coupled to foot treadle 20 so as to close switch 121 when treadle 20 is raised and main motor 17 braked, and to open switch 121 upon depression of treadle 20. Switch 123, on the other hand, may be so located as to be operable selectively by a knee lever 127 carried on the underface of table top 14.

The operation of the automatic needle positioner is apparent from the above description. When the machine is actuated for normal sewing operation, foot treadle 20 is depressed and knee lever 127 released; the main motor 17 being energized thereby and driving the machine by way of pulley 29, shaft 26, clutch members 39 and 47 and coupling spring 70, shaft 24 and pulley 32. Solenoids 90 and 109 are deenergized by reason of switch 121 and contact 126 being open, and the auxiliary motor 65 is deenergized by the automatic opening of switch 98 in the manner previously described, and contacts 114 and 115 being open. When it is desired to stop the sewing machine in the needle-raised position, foot treadle 20 is released, deenergizing and braking main motor 17 and stopping the sewing machine by way of shafts 24 and 26, which are reverse-coupled by spring 68 as earlier set forth to prevent over-running of the sewing machine. The release and raising of treadle 20 also completes the power circuit to solenoids 90 and 109 by way of switch 100, energizing solenoid 90 and disabling spring 68 thereby to permit the advance of shaft 24 relative to shaft 26 and energizing solenoid 109 to bring relay arms 110 and 111 to the controls 114 and 115 connecting the motor field and armature across to the power source in a forward drive sense. The energized advancing auxiliary motor closes switch 98 and drives the sewing machine by way of sprocket wheel 59, forwardly sensed coupling spring 71, shaft 24 and pulley 32 until the needle bar reaches its raised position, at which point cam 37 opens switch 100 to deenergize the solenoid 90 and return spring 68 to coupling position and lock needle bar in raised position, and to deenergize relay solenoid 109 returning relay arms 110 and 111 to the field-reverse position, the auxiliary motor 65 being connected to the current source by closed switch 98. Motor 65 is thus rapidly stopped and run in a reverse direction a short distance sufficient to permit the opening of switch 98 by yoke 91 as aforesaid. The motor can freely run in a reverse direction by reason of the slippage of coupling spring 71. Furthermore, the forward rotation of shaft 24 is not transmitted to motor 65 by reason of said coupling spring slippage. When it is desired to bring the machine to a needle depressed position, switch 123 is actuated by knee lever 127 and treadle 20 released. This substitutes switch 101 in the circuit for switch 100 thereby to stop the needle bar in its depressed position upon the opening of switch 101 by cam 37. The sequence of operation is otherwise similar to that previously described in connection with the stopping of the machine in the needle bar-raised position.

While there has been described and illustrated a preferred embodiment of the present invention, it is apparent that numerous alterations, omissions and additions may be made without departing from the spirit thereof.

What is claimed is:

1. An improved sewing machine of the character described, comprising a reciprocable needle bar, a main drive motor, a driven shaft connected to said needle bar, a drive shaft connected to said main motor, first and second oppositely sensed overrunning clutches connecting said shafts, means for disabling one of said clutches, an auxiliary positioning motor, and means including a third overrunning clutch connecting said auxiliary motor to said driven shaft.

2. An improved sewing machine of the character described, comprising a reciprocable needle bar, a main drive motor, a driven shaft connected to said needle bar, a drive shaft connected to said main motor, a first overrunning clutch connecting said drive shaft to said driven shaft in a forward coupling sense, a second overrunning clutch connecting said drive shaft to said driven shaft in a backward coupling sense, means for selectively disabling said second clutch, an auxiliary positioning motor and means including an overrunning clutch connecting said auxiliary motor to said driven shaft in a forward coupling sense.

3. An improved sewing machine of the character described, comprising a reciprocable needle bar, a main drive motor, a driven shaft connected to said needle bar, a drive shaft connected to said main motor, a first overrunning clutch connecting said drive shaft to said driven shaft in a forward coupling sense, a second overrunning clutch connecting said drive shaft to said driven shaft in a backward coupling sense, means for selectively disabling said second clutch, an auxiliary positioning motor, means including an overrunning clutch connecting said auxiliary motor to said driven shaft in a forward coupling sense, and means selectively substantially concurrently actuating said clutch disabling means and energizing said auxiliary motor.

4. An improved sewing machine of the character described, comprising a reciprocable needle bar, a main drive motor, a driven shaft connected to said needle, a drive shaft connected to said main motor, a first overrunning clutch connecting said drive shaft to said driven shaft in a forward coupling sense, a second overrunning clutch connecting said drive shaft to said driven shaft in a backward coupling sense, means for selectively disabling said second clutch, an auxiliary positioning motor, means including an overrunning clutch connecting said auxiliary motor to said driven shaft in a forward coupling sense, means selectively substantially concurrently actuating said clutch disabling means and energizing said auxiliary motor, and means responsive to the position of said needle bar for deenergizing said auxiliary motor and deactivating said clutch disabling means.

5. An improved sewing machine in accordance with claim 4, wherein said auxiliary motor is a reversible type motor, and including means for momentarily reversing said motor following the energization thereof and said needle bar reaching said predetermined position.

6. An improved sewing machine in accordance with claim 4, wherein said auxiliary motor deenergizing means is responsive to said needle being in a raised position.

7. An improved sewing machine in accordance with claim 4, wherein said auxiliary motor deenergizing means is selectively responsive to said needle bar being in its raised and depressed position.

8. An improved sewing machine in accordance with claim 4, including automatically operable means braking said main motor upon deenergization thereof.

9. An improved sewing machine in accordance with claim 4, wherein said auxiliary motor deenergizing means comprises series-connected, selectively operable first switch and normally closed second switch means connecting said auxiliary motor to a source of current, and switch activating means mounted on said driven shaft and urging said second switch to an open position upon said needle bar reaching a predetermined position.

10. An improved sewing machine comprising a reciprocable needle bar, a main drive motor, a tubular first shaft, a second shaft telescoping said first shaft, means connecting one of said shafts to said needle bar, means connecting the other of said shafts to said main drive motor, said first shaft having a first pair of axially cylindrical surfaces and said second shaft having a second pair of axially cylindrical surfaces, each of said second pair of surfaces being in substantially end-to-end coplanar alignment with a corresponding one of said first surfaces thereby to define first and second sets of clutch surfaces, a first and second helical coupling spring registering with each of said sets of clutch surfaces and affording forwardly and backwardly sensed uni-directional connections respectively between said shafts, one of said shafts having a third axial cylindrical surface, a collar rotatable on said latter shaft and having a cylindrical surface in end-to-end coplanar alignment with said third surface to define a third clutch surface set, a third helical spring registering with said third clutch surfaces, and an auxiliary drive motor connected to said collar.

11. An improved sewing machine in accordance with claim 10, including means for partially unwinding said first helical spring to effect decoupling of said first set of clutch surfaces.

12. An improved sewing machine of the character described, comprising a reciprocable needle bar, a main drive motor, a driven shaft connected to said needle bar, a drive shaft connected to said main motor, a first overrunning clutch connecting said drive shaft to said driven shaft in a forward coupling sense, a second overrunning clutch connecting said drive shaft to said driven shaft in a backward coupling sense, solenoid actuated means for disabling said second clutch, an auxiliary positioning motor, means including a third overrunning clutch connecting said auxiliary motor to said driven shaft in a forward sense, a normally closed first switch connecting said disabling solenoid to a source of current, a switch-actuating element carried on said driven shaft and opening said first switch when said needle bar is in a predetermined position, and a relay having a set of normally open contacts connected between said auxiliary motor and a source of current and having an actuating solenoid connected to a source of current through said first switch.

13. A sewing machine in accordance with claim 12, including a second selectively-operable normally open switch in series circuit with said first switch.

14. A sewing machine in accordance with claim 13, wherein said motor is of the reversible type and said relay includes a second set of normally closed terminals and including a normally open third switch, said motor being connected for reverse operation through said normally closed relay contacts and said third switch to a source of current, and means closing asid third switch upon forward rotation of said auxiliary motor.

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