

Sept. 22, 1959

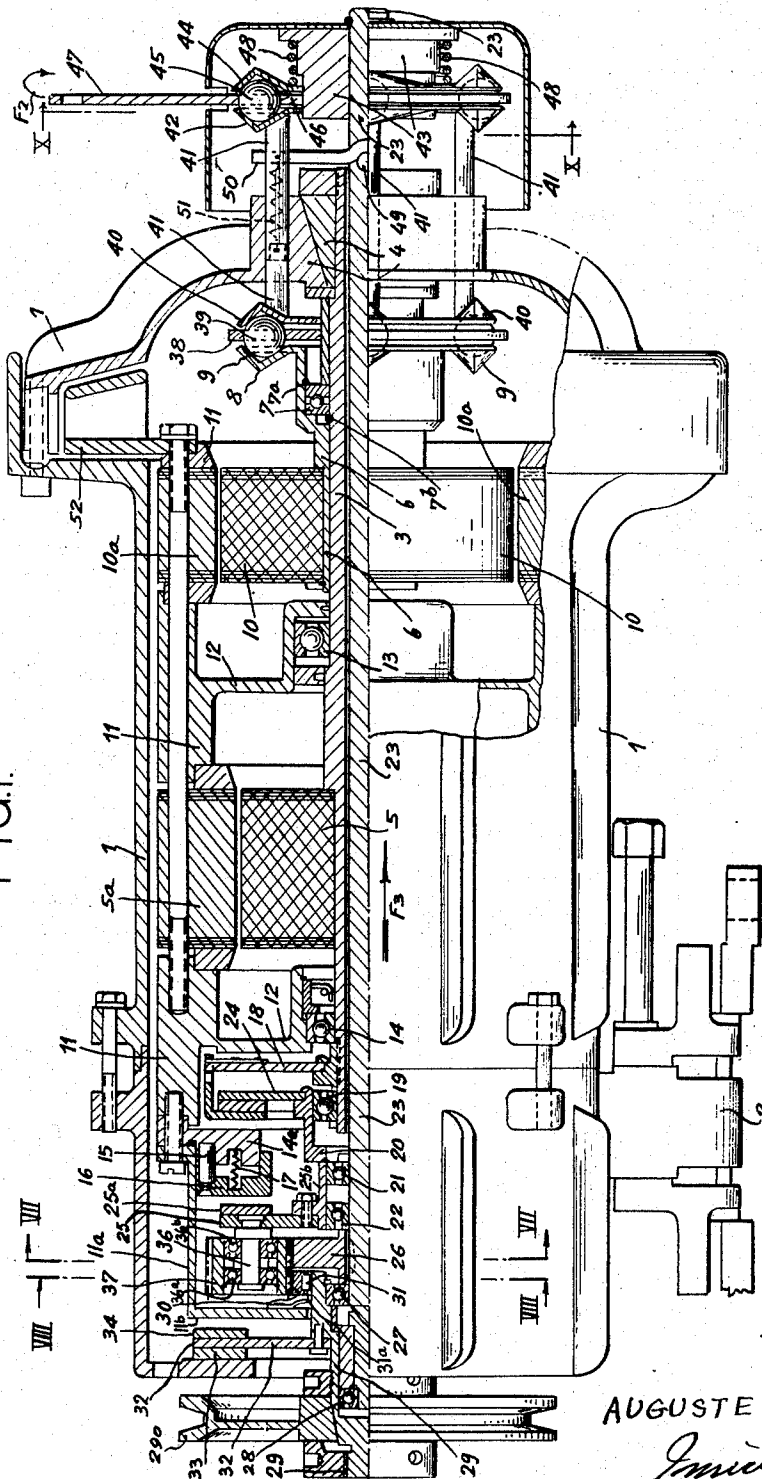
A. H. GERBAUD
DEVICE ENABLING THE NEEDLES OF SEWING MACHINES
TO BE STOPPED IN ONE OF THEIR TOP OR BOTTOM
DEAD CENTRE POSITIONS

2,905,121

Filed Dec. 13, 1954

4 Sheets-Sheet 1

FIG. 1.



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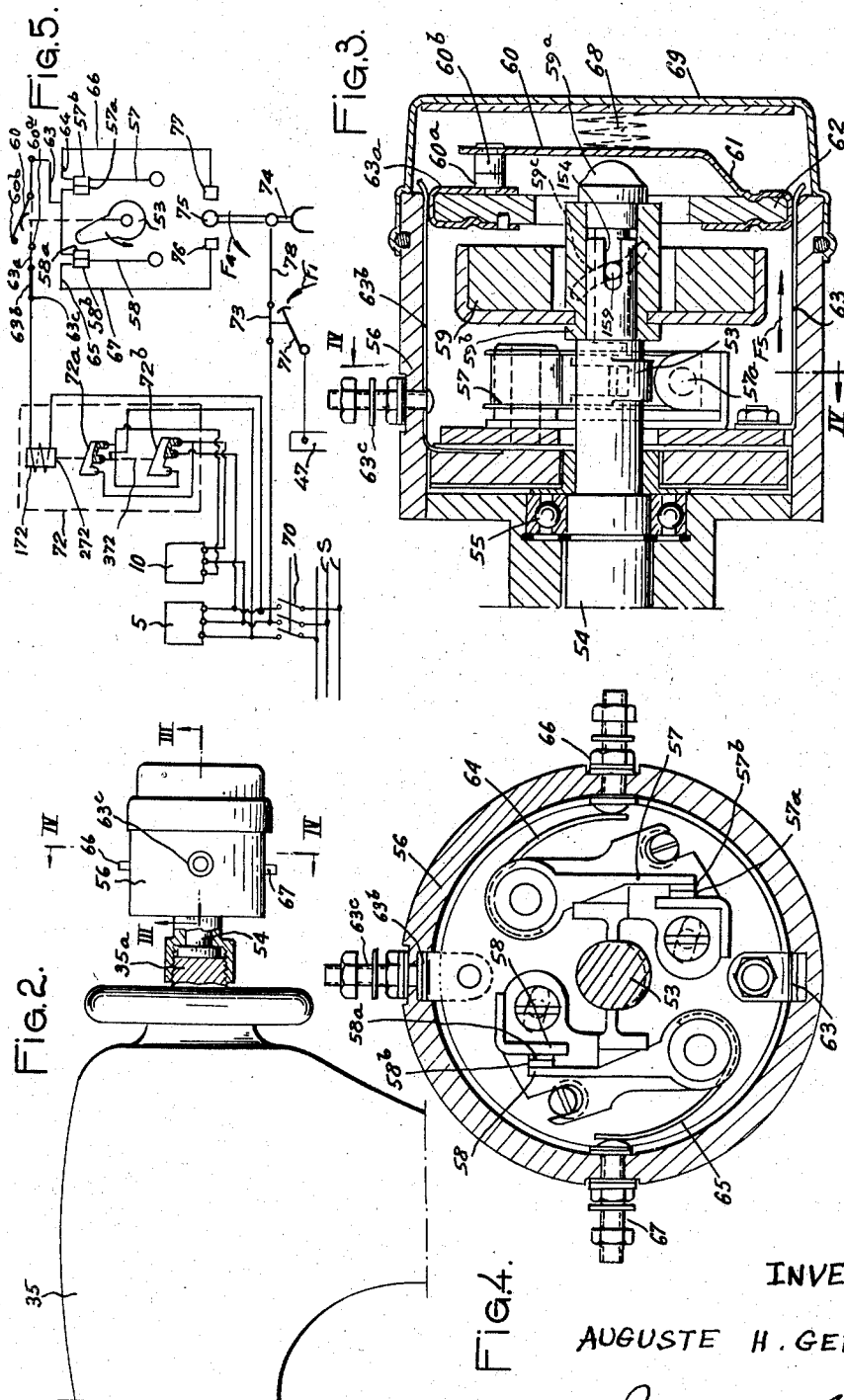
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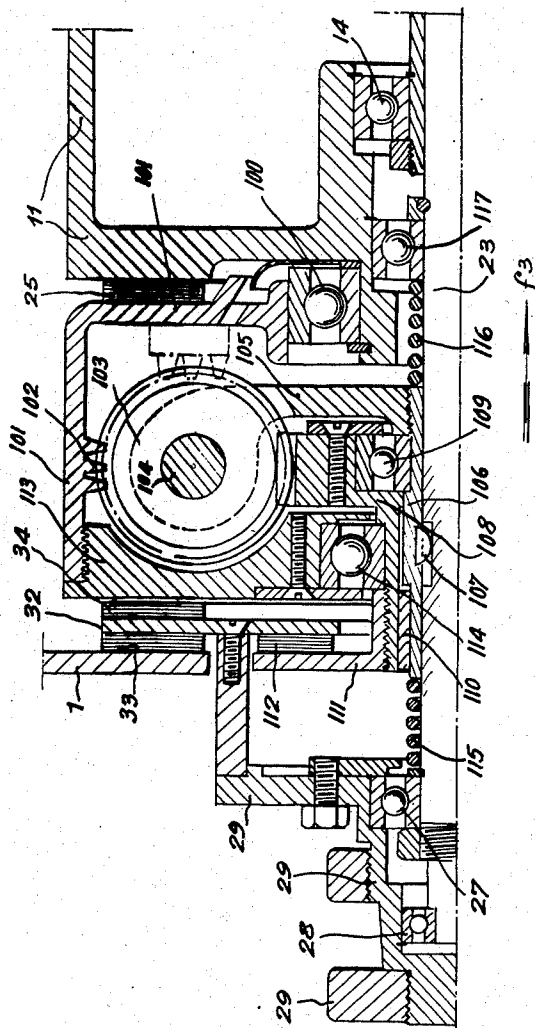
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DEAD CENTRE POSITIONS

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Fig. 7

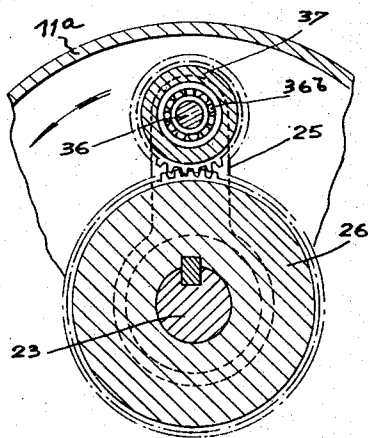


Fig. 8

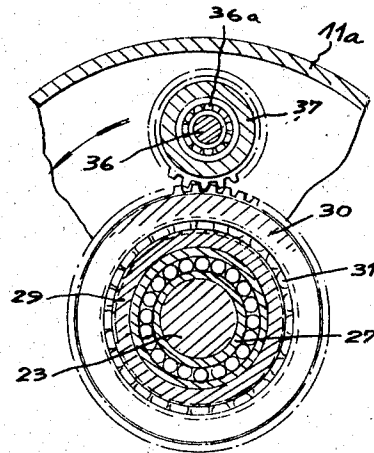
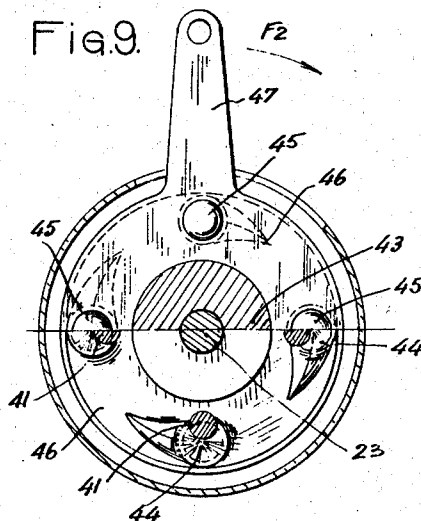


Fig. 9



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2,905,121

DEVICE ENABLING THE NEEDLES OF SEWING MACHINES TO BE STOPPED IN ONE OF THEIR TOP OR BOTTOM DEAD CENTRE POSITIONS

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Application December 13, 1954, Serial No. 474,750

Claims priority, application France December 15, 1953

10 Claims. (Cl. 112—219)

This invention relates to a device enabling the needles of a sewing machine to be stopped in the top or bottom dead-centre position, in which two motors are employed whose rotors are integral, whereas the stators placed on the same axle each have an independent electric feed circuit for effecting the reversing of the rotation direction of one of the motors when the needle is positioned.

The operating device is provided with an inertia circuit-breaker which enables the operator to choose her needle position and control it before the sewing machine stops.

According to the invention, the axle on which the stators are mounted is hollow and contains a shaft which can slide transversally, on which are fixed, on the one hand, a double clutch and a double brake, and on the other hand, a reducing gear device allowing an inertia block disc to be driven at reduced speed operating a circuit-breaker controlling a relay causing the circuit-breakers to reverse the direction taken by the current passing into one of the motors at the moment when the needle of the sewing machine is positioned.

Various other features of the invention will furthermore be revealed by the detailed description which follows.

One form of embodiment of the purpose of the invention is shown, by way of example, in the attached drawing.

Figure 1 is a longitudinal sectional view of the drive mechanism;

Figure 2 is an elevational view, partly in section, of the drive portion of a sewing machine;

Figure 3 is a horizontal sectional view taken substantially along the plane defined by line III—III of Fig. 2;

Figure 4 is a vertical sectional view taken substantially along the plane defined by lines IV—IV of Figs. 2 and 3;

Figure 5 is an electrical circuit diagram of the device;

Figure 6 is a sectional view of another embodiment of the drive portion of the device;

Figures 7 and 8 are vertical sections taken substantially along the planes defined by lines VII—VII and VIII—VIII, respectively, of Fig. 1, and showing the gear reduction device, and

Figure 9 is a sectional view taken substantially along the plane defined by line X—X of Fig. 1.

In Figure 1, the motor comprises an external casing 1 resting on a pedestal 2 enabling the motor to be fixed either on the sewing machine or on the table holding the sewing machine. A hollow axle 3 is fixed on the casing 1 by a tapered sleeve joint 4. The stator 5 of a first motor is fixed on the hollow axle 3 and a sleeve 6 carrying the stator 10 of a second rotor is rotatably mounted on said axle to permit an angular displacement of the stator 10 to obtain the necessary motion for the translation of an axially movable shaft 23 within the axle 3, as hereinafter described. The sleeve 6 bears against a thrust bearing 7 and is extended to a cam disc 8 having a circular series of spaced cam sockets or holes 9.

A rotary cage 11 can revolve with regard to the hollow axle 3 by the interposition of ball bearings 13, 14 between

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the arms 12 of the rotary cage 11 and the hollow axle 3.

5a designates the rotor co-operating with the stator 5, while 10a designates the rotor co-operating with the stator 10. The rotary cage 11 is extended by a hood 11a on which a crown 14a is fixed carrying guides 15. A second crown 16 can slide on the guides 15. 17 designates springs interposed between the crown 14a and the crown 16. A drum 18 is fixed on the hollow axle 3 which carries a ball bearing 19 on which a sleeve 20 can slide, resting on bearings 21, 22 mounted on a shaft 23 housed inside the hollow axle 3.

A brake 24 and clutch 25 are mounted on the sleeve 20 and co-operate, one with the drum 18, and the other with the sliding crown 16. A pinion 26 is mounted on the shaft 23 which also carries two ball bearings 27, 28 on which a sleeve 29 rests; this sleeve is integral with one of the rings of an overrunning clutch 31. A disc 32 provided with a brake 33 and a clutch 34 is fixed on the sleeve 29. This latter is connected by any suitable means such as a pulley 290 with the driving shaft of the sewing machine 35. An axle 36, integral with the clutch 25, carries a pinion 37 meshing with the pinions 26 and 30. The pinion 37 is loosely mounted by means of bearings 36a, 36b on the shaft or axle 36. The clutch 25 is provided with a friction lining 25a and is associated with a sleeve 25b mounted on the bearings 21, 22. The overrunning clutch 31 is mounted on the sleeve 29 which carries the driving pulley 290. The sleeve 29 is loosely mounted on the end of the shaft 23 through the intermediary of the bearings 27, 28. Referring now to Fig. 1, a perforated disc 38, carries balls 39 near its periphery, placed in the holes 9 of the inclined disc 8, and in the holes of the second inclined disc 40 connected by rods 41 to an inclined disc 42 fixed to a hub part 43, integral with the shaft 23. The hub part 43 also carries an inclined disc 44 holding balls 45 between it and the disc 42 placed inside the holes drilled in a disc 46 provided with a control lever 47. The disc 44 is thrust against the balls 45 by a spring 48 mounted on hub part 43.

A pin 49 is integral with the shaft 23 and has a cross bar 50 attached thereto. Springs 51 are mounted on the end of cross bar 50 and also mounted on the casing 1. Blades 52 are mounted on the rotary cage 11 inside the casing 1 and form a fan for cooling the interior of the motor with an air current. The rotation of the motor which is transmitted to the shaft 35a of the sewing machine 35 rotatively drives a cam 53 mounted on a shaft 54, integral with the shaft 35a. Referring to Figs. 3 and 4, the shaft 54 which rests in a bearing 55 placed inside a casing 56 containing circuit-breakers 57, 58 supports an inertia disc 59 able to slide on the shaft so as to come into contact with a blade 60 hinged at 61 on a disc 62 fixed in the casing 56. The studs 57a and 58a of the circuit-breakers 57, 58 are electrically connected by the blades 63, 60, the contacts 60a and 60b, the blades 63a and 63b, to a terminal 63c, whereas the movable contacts 57b, 58b of the circuit-breakers 57, 58 are electrically connected by blades 64, 65 to terminals 66, 67.

A spring 68 is interposed between the blade 60 and the cover 69 of the casing 56.

The motor formed by the rotor 5a and the stator 5 is fed with three-phase current from a source S through a circuit-breaker 70, which is hand operated; the motor formed by the rotor 10a and the stator 10 is fed with three-phase current through a relay 72 which enables the direction of two phases of the current feeding this motor to be established or reversed, so as to put the motor into concordance or opposition with the motor formed by the rotor 5a and the stator 5. The relay 72 may be actuated by any suitable means which will time the actuation thereof to take place after the sewing machine is stopped. Thus, the relay actuating means should be

set into operation when the device receives a signal to stop. Then this relay actuating means should have a delay approximately equal to the delay between the actual time the machine is stopped and the time it receives the signal to do so. One method of accomplishing this is described below. Another method is described in my copending application Serial No. 660,674, filed May 21, 1957, and there are other structures for accomplishing this function which will be obvious to a worker skilled in the art.

The device works in the following manner:

When the pedal 71 is depressed in the direction of the arrow F¹ (Fig. 5) a circuit-breaker 73 is opened. The hand circuit-breaker 70 being closed, the motors 5 and 10 both revolve in the same direction. The lever 47 being connected with the pedal 71, by pressing on the latter the lever 47 is turned in the direction of the arrow F² (Fig. 9), which has the effect of moving the balls 45 between the inclined discs 42 and 44. Inclined disc 42 is fixed because the rods 41 are fixed on disc 40, maintained by balls 39 and disc 8 which is a part of the sleeve 6. The sleeve 6 is blocked by stop 7. When lever 47 is pivoted in the direction of arrow F², balls 45 are caused to roll and move the disc 44 in the direction of the arrow F³ (Fig. 1) and, at the same time, they activate the hub part 43 and the shaft 23. The sleeve 20, the brake 24 and clutch 25 are moved in the direction of the arrow F³ (Fig. 1). Thus, the clutch 25 encounters the crown 16 which presses against the crown 14a, whereas the brake 24 disengages from the drum 18. At the same time, the clutch 34 of the disc 32 bears against the hood 11a which revolves with the rotary cage. The clutch 25 and the clutch 34 thus form a double clutch rotatively driving the terminal part of the sleeve 29 integral with the pulley 290 connecting the motor to the sewing machine. In this high-speed rotation, the pinion 37 revolves on the fixed pinion 26 and the pinion 30. For one revolution of the pinion 37 round the pinion 26, the pinion 30 advances by one tooth, but as it is blocked on an overrunning clutch 31, the latter compensates for the speed difference. The assembly of pinions 26, 27 and 30 is not new and is known by the name of "Fergusson Reduction System." In this case, one of the pinions 30 is mounted with the overrunning clutch 31, as shown in detail in Figs. 7 and 8. In revolving, the sewing machine 35 drives the shaft 54 which transmits movement to the inertia disc 59. The latter then assumes the position shown in Fig. 3. If the operator releases the pressure on the pedal 71, the lever 47 pivots in the opposite direction to the arrow F² (Fig. 1) owing to the action of the springs 51 the latter being attached to the cross-bar 50 integral with the shaft 23. The balls 45 then assume a position so that the plates 42, 44 come closer together and the shaft 23 recoils in the opposite direction to the arrow F³.

From that moment, the clutch 25 and brake 24 also go slightly backward, the clutch 34 is then freed from the hood 11a. Only the clutch 25 is still in contact with the crown 16 which has been thrust along the guides 15 by the springs 17. The pinion 37 is then rotatively driven round the fixed pinion 26. For one revolution of this pinion round the pinion 26, the pinion 30, which has one more tooth than the pinion 26, advances by one tooth. We thus have a speed reduction corresponding to the ratio of the teeth between the pinion 30 and the pinion 26. The pinion 37 turns on the fixed pinion 26 and at the same time on the overrunning clutch 31. For each turn of the pinion 37 on the pinion 26, the pinion 30 of clutch 31 advances by one tooth. As clutch 31 is mounted on the sleeve 29, the latter is driven at low speed. From there, the movement is transmitted by the pulley 290 to the transmission belt which drives the pulley associated with the sewing machine. We thus obtain the stitch-by-stitch movement on the sewing machine. For high speed rotation, by sliding shaft 23, the clutch 34

is in contact with 11b of the extension 11a of the rotary cage 11. The sleeve 29, which carries the disc 32 associated with the clutch 34, turns at high speed in synchronism with the rotary cage 11. This movement at high speed is transmitted to the central ring 31a of the overrunning clutch 31. The outer ring or pinion 30 of clutch 31 turns always at low speed. This is analogous to the movement of a bicycle down hill; the rear wheel turns at high speed with the inner ring of the over-running clutch associated with the hub of the rear wheel and the cyclist can pedal slowly without hindering the movement of the hub of the rear wheel.

Should the operator wish to place the needle either in the high position or the low position when the sewing machine is running at high speed, she pivots the lever 74 (Fig. 5) in the direction of the arrow F⁴ or in the opposite direction to the arrow F⁴, so that the contact 75 engages either the stud 76 or the stud 77, according as to whether she has chosen the high or low position. As soon as the sewing operation is finished, she releases the pressure applied to the pedal 71. The circuit-breaker 73 is then closed and the lever 47 returned to its first position; the balls 45 assume the position shown in Fig. 1, in which the shaft 23 is thrust towards the left of the drawing. The brake 24 is in contact with the drum 18, whereas the brake 33 of the disc 32 presses against the casing 1 of the motor. The sleeve 29 is thus sharply braked and the sewing machine 35 tends to stop. At this moment, the inertia block-disc 59, which revolves at high speed, is braked, but its inertia causes it to move owing to a slipping along an incline in the direction of the arrow F⁵ (Fig. 3) and its end 59a presses against the blade 60 which moves in the direction of the arrow F⁵ (Fig. 3). The contacts 60a, 60b are separated and the current transmitted by means of the conductor 78, the lever 74, the contact 75 and the studs 76 or 77 does not reach as far as the relay 72. The latter is not excited. The relay 72, as shown in Fig. 5, comprises a coil 172, an armature 272 and a rod 372 connecting the armature with two pivotally mounted switches 72a, 72b. The shaft 54 having now completely stopped, the inertia of the inertia block-disc 59 is absorbed and the latter returns to its first position owing to the pressure of the spring 68. The contacts 60a, 60b bear one against the other, the current excites the relay 72 which causes the circuit-breakers 72a, 72b to pivot. Two of the phases feeding the motor are inverted and the stator 10 of the latter tends to revolve in the opposite direction to the rotary direction of the motor 5. During a fraction of a second, the stator 10 turns for a few degrees, and owing to this fact, through the intermediary of the sleeve 6, drives the inclined disc 8 which thrusts the balls 39, the inclined disc 40, the rod 41, the inclined disc 42, the balls 45 and the inclined disc 44. The shaft 23 recoils in the direction of the arrow F³ (Fig. 1). At this moment, the brake 24 separates from the drum 18, the clutch 25 contacts the crown 16. Owing to this fact, the reducing gear device, formed by the pinions 26, 30 and 37, revolves and drives the pulley operating the sewing machine 35. The cam 53, integral with the shaft 54, which extends from the shaft 35a of the sewing machine, also revolves and moves one of the circuit-breakers 57 or 58. The relay 72 being no longer excited returns to its original position. The motor is normally fed again. The stator 10 assuming its normal position ceases to exercise pressure on the sleeve 6. The springs 51 return the shaft 23. The assembly of the members of the device resume the position shown in Figs. 1 and 3. The sleeve 29 supporting the pulley 290 driving the machine 35 is abruptly stopped. In this manner, we find once more the needle of the sewing machine 35 stopped in its high or low position, according to the way in which the circuit-breaker is operated. It is to be noted that the inertia member 59 is mounted freely on shaft 54 which follows the shaft 35a of the sewing machine by means of a sleeve 59b provided with an in-

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clined groove 59c. The projecting end 59a is provided with a stud 159 (Fig. 3) projecting through a slot 154 in the shaft 54 and enters the groove 59c. Thus, while braking strongly the shaft 35a of the sewing machine 35 and the shaft 54, the inertia member 59 continues to rotate and the groove 59c causes the end portion 59a to move by means of the stud 159 in the direction of the arrow F_5 , the blade 60 is pushed back against the action of spring 68 thereby separating the contacts 60a and 60b.

In the modification shown in Figure 6, the rotary cage 11 sustains, through the intermediary of a ball bearing 100, a cup-shaped member 101 which has a helical gear 102 extending entirely around the inner periphery thereof to engage with a pinion 103 mounted freely on an axle 104, integral with a support 105, fixed on a keyed sleeve 106, sliding at 107 on the shaft 23. A worm wheel 108, mounted freely, on the one hand, on a ball bearing 109 centered on the sleeve 106, and on the other hand, on a ring 110, is integral with a plate 111. 112 designates a lining integral with the disc 32. A plate member 113 is fixed on the cup-shaped member 101 and rests on a ball bearing 114 mounted on the worm wheel 108. Two springs 115 and 116 are interposed, one between a ball bearing 117 sustaining the rotary cage and the sleeve 106, and the other between the sleeve 106 and the ball bearing 27.

When the sewing machine is driven at high speed, the shaft 23 is moved back in the direction of the arrow F^3 (Fig. 6). At this moment, the sleeve 29 is moved in the same direction and the lining 33 disengages from the casing 1. The lining 112 is engaged with the plate 111, since the assembly of the units integral with the sleeve 106 has followed the movement. The lining 25 bears against the rotary cage 11. Owing to this fact, the cup-shaped member 101 revolves at high speed. Through the intermediary of the helical gear 102, the pinion 103 and the worm 108 revolve, which moves the plate 111 and, by the lining 112, the sleeve 29. The assembly revolves at reduced speed. In other words, when the shaft 23 is moved back in the direction of arrow F^3 under the action of lever 47 (Fig. 1) the elements supported by shaft 23 are also displaced in the direction of arrow F^3 . These elements are sleeve 106, ring 110, worm 108, plate 111, ball bearings 114, plate member 113 and cup-shaped member 101. This movement causes lining 25 to bear against the cage 11 and, consequently, rotation in low speed of the sleeve 29 is obtained by helical gear 102, pinion 103 and worm 108. The displacement movement of the shaft 23 in the direction of the arrow F^3 (Fig. 6) continues. Since the lining 25 is already against the cage 11, continuation of the sliding movement of cup-shaped member 101, sleeve 106 and cheek 111 is not possible in the direction of arrow F^3 and the shaft 23 will slide along the key 107. The lining 112 is thus separated from the cheek 111, but the lining 34 comes into contact with the plate member 113; thus the sleeve 29 supporting the pulley is driven at high speed.

When the operator wishes to make one stitch at a time, she slightly releases the pressure on the pedal 71 and, as in the preceding example, the shaft 23 moves back in the opposite direction to the arrow F^3 . The lining 25 is always in contact with the rotary cage 11, but the sleeve 29 having followed the movement of the shaft 23, the lining 112 is brought into contact with the plate 111. The lining 34 no longer pressing on the part 113, the sleeve 29 takes its movement from the plate 111 driven at low speed by the helicoidal gear 102, the pinion 103, and the worm 108. A stitch at a time is thus made.

Should the operator completely release the pedal, the shaft 23 is abruptly thrust in the opposite direction to the arrow F^3 (Fig. 6). The lining 33 presses against the casing 1 thus locking the sleeve 29, which brings about the stoppage of the sewing machine.

In the description, reference has only been made to

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the drive of sewing machines, but embroidering, trimming and similar machines can also be driven by means of the device.

Various modifications can, moreover, be applied to the shape and purpose of the invention, without going outside its scope.

I claim:

1. An electric power system for operating a driven shaft, comprising a casing, a double electromotor with two rotors in said casing, a rotary cage on which said rotors are rigidly mounted within the casing, two stators mounted on a hollow axle within the casing, one stator being fixed and the other having a limited rotary movement, two electric circuits for the stators for effecting the reversing of the rotary direction of one of the motors when the driven shaft is positioned, mechanism including manually operated means connected with said movable stator for transmitting rotation of a few degrees thereto, a shaft within the hollow axle connected with said mechanism to be moved axially thereby, a sleeve journaled on the shaft and positioned opposite said mechanism, brake means in said casing, clutch means connected with said rotary cage, brake means and clutch means mounted on said sleeve for selective engagement with said casing, brake means and said rotary cage clutch means in accordance with the movement of the shaft by said mechanism, and driving means on said sleeve positioned outside the casing for operating the driven shaft.

2. An electric power system for operating a driven shaft, comprising a casing, a double electromotor in said casing and including two rotors rigidly mounted, a rotary cage on which the two rotors are rigidly mounted within the casing, a hollow axle within the casing, two stators mounted on said axle, one stator being fixed and the other stator having a limited rotary movement, two electric circuits for the stators, a shaft movable axially within the hollow axle, means within the casing for moving said shaft, drive means journaled on said shaft for operating the driven shaft, said drive means being axially movable with said shaft, clutch means on said drive means, clutch means driven by said rotary cage and respectively cooperative with said first dual clutch means for selectively operating said drive means at high and low speeds, mechanism including a manually operated lever for closing the circuit to the movable stator to cause it to rotate a few degrees and operate the drive means at low speed.

3. An electric power system for operating a driven shaft, comprising a casing, a double electromotor in said casing and including two rigidly connected rotors, and two stators with main circuit means for normally energizing both motors simultaneously, one of said stators being mounted for limited rotary movement, clutch means driven by said rotors, an axially movable support in said casing, driven means journaled on said support and axially movable therewith, said driven means including a drive element externally of said casing for driving the driven shaft, clutch means on said driven means cooperatively engageable with said rotor clutch means upon axial movement of said support, mechanism including a manually operable control element for moving said support axially to engage said clutch means to operate the driven shaft, auxiliary circuit means connected with the movable stator to energize only that stator and effect rotary movement of said stator, and means connected with said mechanism and actuated by movement of said stator to move said support to engage said clutch means and drive the driven shaft at a slow speed.

4. An electric power system for a sewing machine having a drive shaft, comprising a casing, motor means including a rotor and a stator in said casing, a hollow spindle fixed in said casing, a shaft slidably mounted within said hollow spindle, a rotary cage on which said rotor is rigidly mounted within the casing, said cage

and rotor being journaled on said spindle, said stator being mounted on said spindle for limited rotary movement, drive means journaled on said shaft for connection with said drive shaft on the sewing machine, clutch means on said rotary cage, brake means on said casing for braking said drive means, control means in said casing including said slidable shaft for controlling actuation of said clutch and brake means, electric circuit means for normally energizing the motor means to operate the sewing machine when said clutch is engaged, selective driving means within the casing in selective operative relation with said clutch means for driving said drive means selectively at high and low speeds, auxiliary circuit means connected with the stator to effect rotary movement of the stator and operative when the brake means is actuated, and means within the casing operated by the rotation of the stator to temporarily release said brake means by causing an axial movement of the shaft for operating the drive means at a low speed.

5. The power system of claim 4, comprising means operatively associated with said drive shaft when operating at low speed to open said auxiliary circuit at a predetermined angular position of said drive shaft whereby said drive shaft may be stopped in a predetermined position.

6. The power system of claim 4 wherein said selective driving means includes a gear reduction mechanism selectively connectible between said rotary cage and said drive means when said clutch means is disengaged for driving said sleeve at a slow speed.

7. In a sewing machine adapted to be stopped in a preselected position, a double electromotor with two rotors, a rotary cage on which said rotors are mounted, two stators in said motors, one of said stators being fixed and the other having a limited rotary movement, two electric circuits for feeding the two stators, a reversing switch in the feeding circuit of the movable stator to reverse the current and thus cause said stator to rotate, relay means controlling said reversing switch, a shaft projecting from the sewing machine, a cam mounted at the end of said shaft, a switch in the circuit feeding said relay means mounted on the sewing machine and opened by said cam when the latter is in a predetermined angular position, a mechanism connected with the movable stator and actuated thereby when said reversing switch is actuated, a shaft connected with said mechanism to be moved axially thereby, a sleeve mounted at the end of the shaft opposite from said mechanism, ball bearings disposed between said sleeves and said shaft, a brake and a clutch mounted on said sleeve for selective engagement with brake and clutch means on said casing and rotary cage, respectively, according to the axial movement of said shaft, driving means on said sleeve and driven by said motor to drive the sewing machine, inertial switch means in the relay means circuit operated by said sewing machine shaft for holding said circuit open until said shaft stops, and control means for actuating said mechanism independently of said movable stator for moving said shaft to control said clutch and brake means selectively for stopping rotation of said sleeve.

8. The device of claim 7, comprising gear reduction means selectively operatively associating said rotary cage and said sleeve when said clutch means is disengaged for driving said sleeve at a slow speed.

9. An electric power system for selectively stopping a driven member in a preselected position, comprising a casing, a hollow spindle fixed at one end in said casing,

a shaft slidably mounted within said hollow spindle for movement between two extreme positions, a stator on said hollow spindle, a rotor surrounding said stator and journaled on said hollow spindle, clutch means on said rotor, brake means on said casing, drive means journaled on said shaft in axially fixed relation thereto and extending beyond said casing for connection with the driven member, a carrier connected with said drive means and disposed within said casing between said rotor clutch means and said casing brake means, brake means on said carrier cooperative with said casing brake means when said shaft is at one extreme position to hold said drive means stationary, clutch means on said carrier for cooperation with said rotor clutch means when said shaft is slid axially to its other extreme position to drive said drive means in synchronism with said rotor, reduction gear means in said casing in driving relation with said rotor, an overrunning clutch driven by said reduction gear means, additional clutch means operatively associated with said overrunning clutch and reduction gear means to drive said drive means at a lower speed from said rotary cage, means connected with said shaft for displacing said shaft axially, electric circuit means controlling said latter means, and a relay adapted to be actuated by the driven member to control said electric circuit means.

10. An electric power system, comprising a casing, motor means including a rotor and stator in said casing, an electric circuit for feeding the motor, auxiliary circuit means connected with the stator to effect rotary movement thereof when actuated, a hollow spindle fixed in said casing, a shaft slidably mounted within said hollow spindle, a rotary cage on which said rotor is rigidly mounted within the casing, said cage and rotor being journaled on said spindle, said stator being mounted on said spindle for limited rotary movement, a sleeve journaled on said shaft, a driven shaft, means on said sleeve for driving said driven shaft, three-position transmission means between said casing and said sleeve for selectively: braking said sleeve, driving said cage and sleeve synchronously at high speed, and driving said sleeve at a lower speed than said cage; a mechanism in said casing for moving said slidable shaft axially, said slidable shaft being connected to and controlling the positions of said transmission, said mechanism being operated upon rotary movement of said stator to move said slidable shaft to an intermediate position to move the transmission into its third mentioned position, control means for actuating said mechanism independently of said movable stator for moving said slidable shaft to any of its three effective positions, relay means in said auxiliary circuit for actuating said stator when said control means moves said transmission to its first named position, means for delaying actuation of said relay means until said driven shaft is stopped, and means actuated when said driven shaft is in a predetermined angular position to open said auxiliary circuit whereby said driven shaft may be stopped in a predetermined position.

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