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[33] **Japan**
[31] **43/32360**

[54] **CLUTCH MOTOR**
4 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **310/76,**
310/74, 310/83, 192/3.56, 192/18.2
[51] **Int. Cl.** **H02k 7/10**
[50] **Field of Search** 310/76, 74,
66, 68, 77, 78, 83, 153, 98, 108; 192/18.2, 12.2,
3.56; 74/365

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Assistant Examiner—R. Skudy
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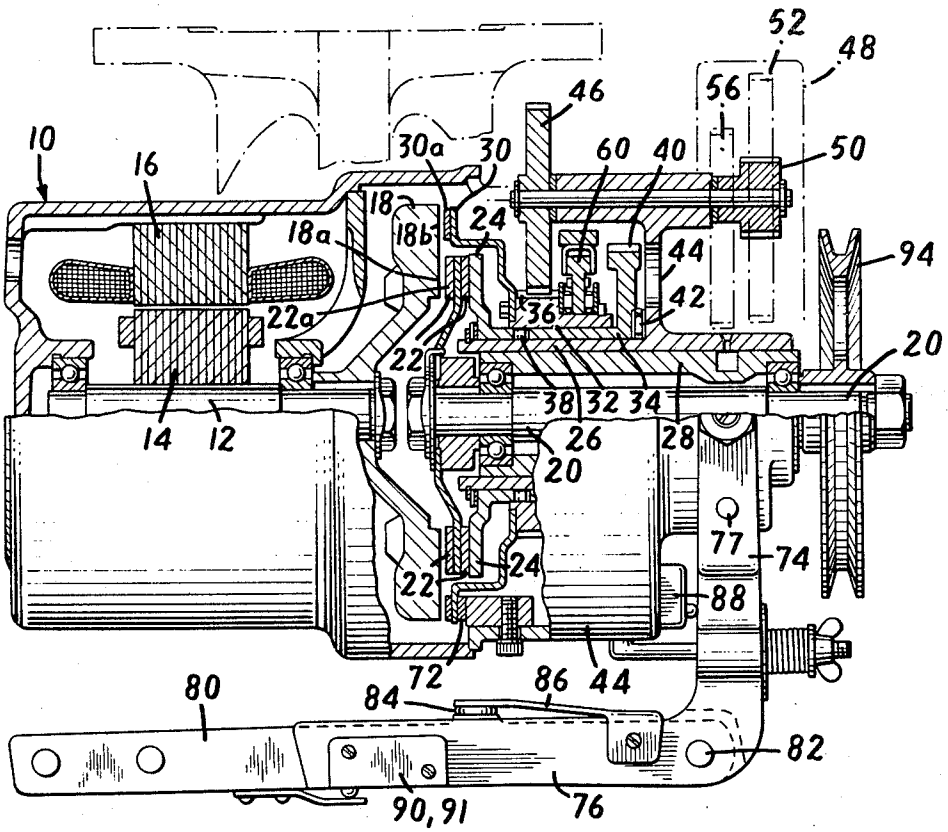
ABSTRACT: A clutch motor for a sewing machine comprising a flywheel on the motor shaft and two concentric clutch wheels connected with one another through reducing gearing and alternatively engageable with the same face of the flywheel. One of the clutch wheels being on an output shaft which is thereby driven at a speed dependent on which clutch wheel is engaged. A lever arrangement makes it possible to stop the sewing machine selectively in different positions as desired.



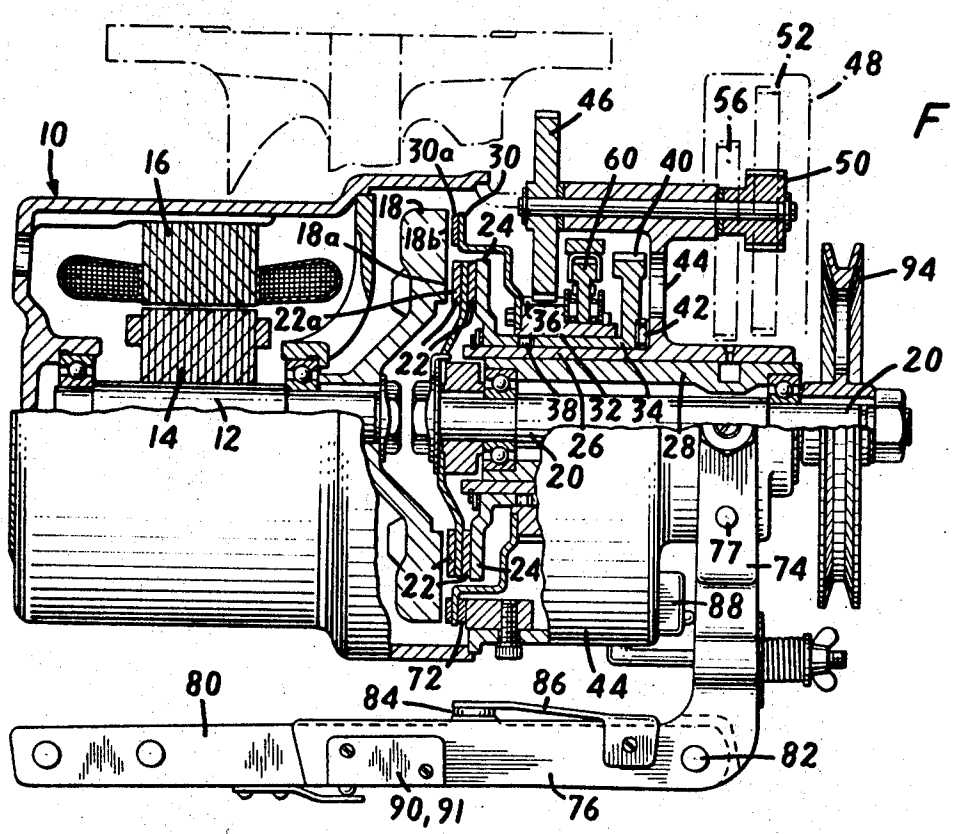

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FIG. 1

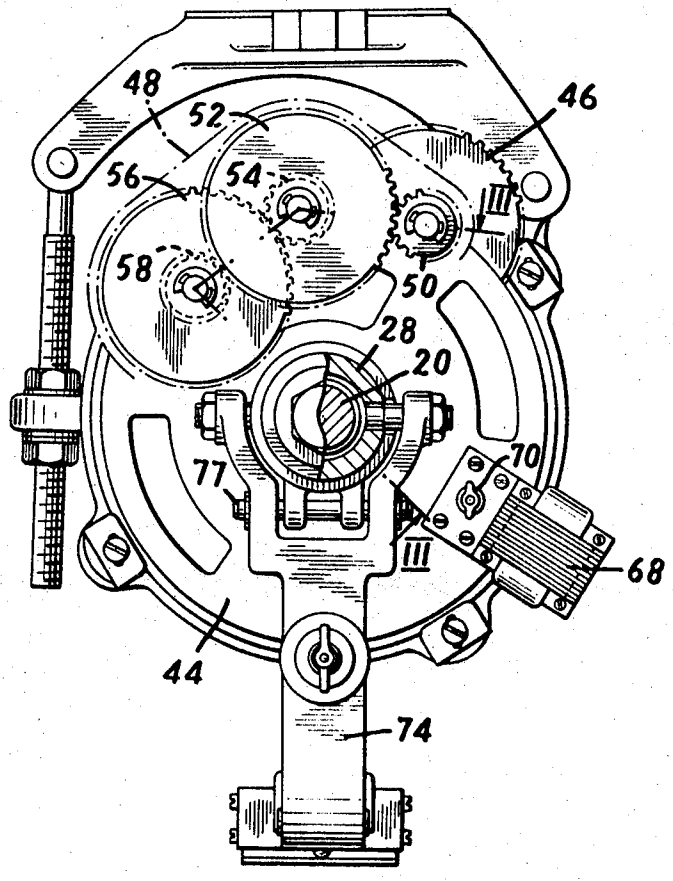
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FIG. 2

FIG. 3

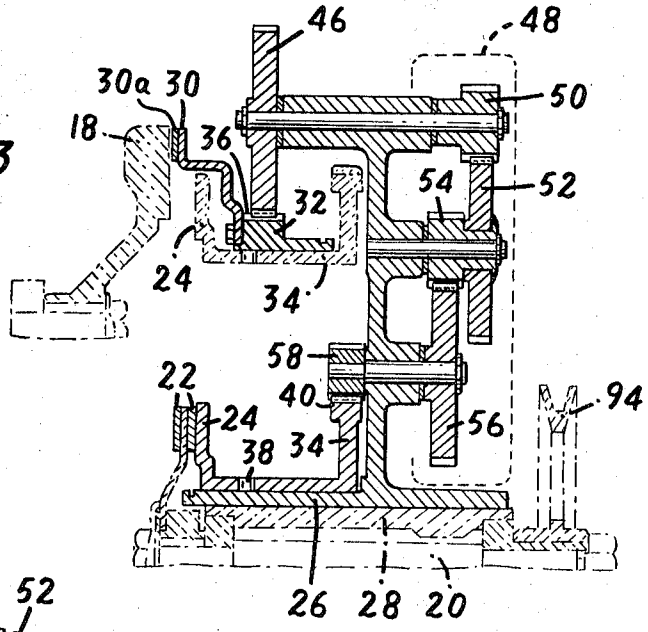


FIG. 4

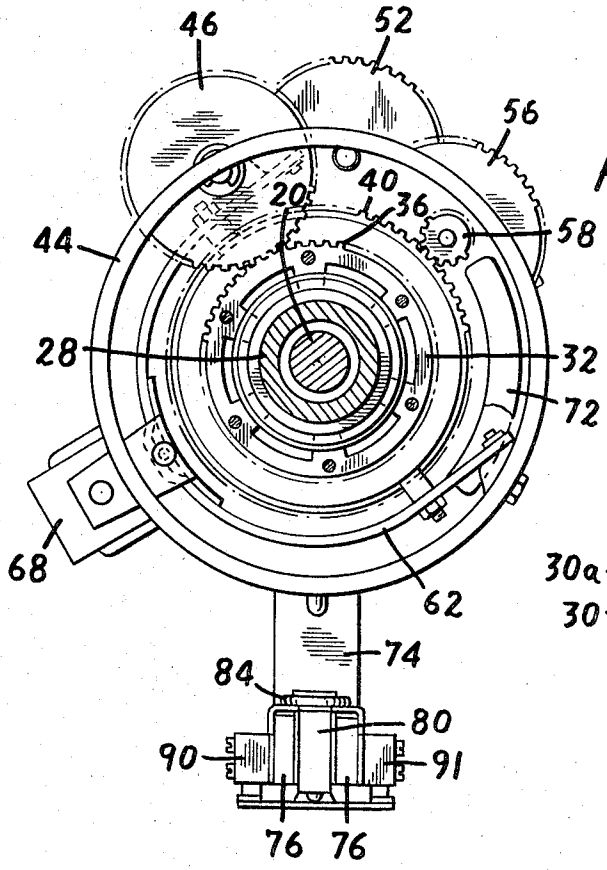


FIG. 5

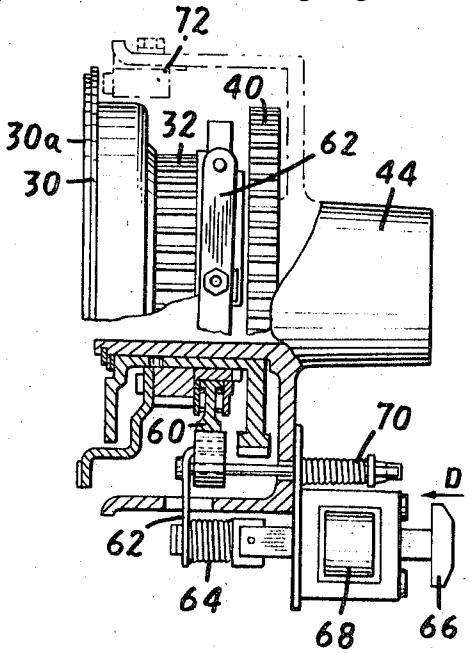
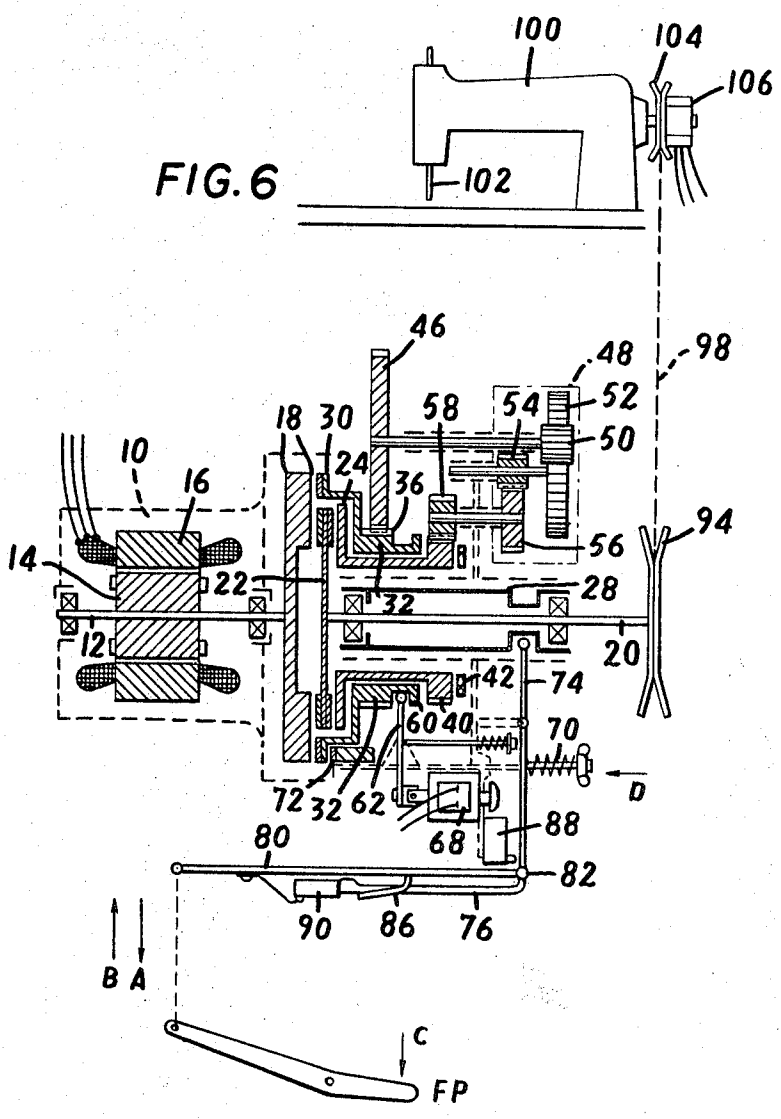


FIG. 6



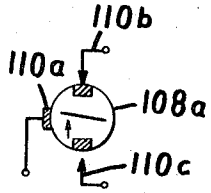


FIG. 6A

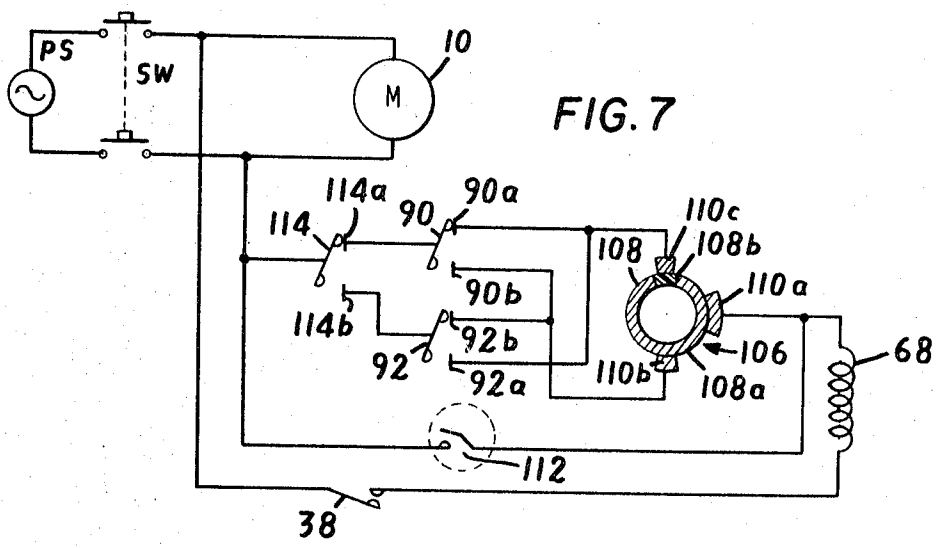


FIG. 7

CLUTCH MOTOR

BACKGROUND OF THE INVENTION

This invention relates to a clutch motor, and more particularly to such a motor including a fixed point stop mechanism.

In the general type of clutch motors for use, for example, with sewing machines including the fixed point stop mechanism, the operating lever functions to operatively couple the clutch plate to the flywheel on the motor thereby to drive its load such as a sewing needle and to disengage the clutch plate from the flywheel to stop the load at its predetermined position. If a position where the load is to stop was preliminarily established prior to the operation of the load then that position has been impossible to change even though a change in position would happen necessarily to change during that operation. In other words, the position where the load is to stop was predetermined prior to its operation, the termination of the particular operation has inevitably resulted in the stoppage of the load at that predetermined position. Actually the operator will frequently encounter the necessity that a stopping position for the load predetermined prior to its operation be changed during that operation. For example, in sewing machines, the user frequently desires to change, in operation, the sewing needle from its position where it is, for example, in engagement with the associated cloth, predetermined prior to the operation to its position where the needle is located above the cloth and vice versa. Under these circumstances, the conventional type of clutch motors with a fixed point stop mechanism has been very inconvenient.

SUMMARY OF THE INVENTION

Accordingly it is an object of the invention to eliminate the inconvenience just described.

It is another object of the invention to provide a clutch motor including an improved clutch unit having its radially projecting portion small in dimension and capable of being easily mounted on and dismounted from the associated electric motor.

The invention accomplishes the above cited and other objects by the provision of a clutch motor comprising a flywheel mounted directly on a rotary shaft of an electric motor at one end, a main clutch wheel capable of engaging that side of the flywheel remote from the electric motor, electromagnetic means capable of being energized when the main clutch wheel is not operatively connected to the flywheel, an auxiliary clutch wheel responsive to the energization of the electromagnetic means to be operatively connected to the flywheel thereby to be rotated, the auxiliary clutch wheel disengaging from the flywheel when the electromagnetic means remains deenergized, speed reduction means operatively connected to the auxiliary clutch wheel to decrease the number of rotation of the latter, and a braking plate operatively connected to the speed reduction means to transmit the rotational movement of the latter to the main clutch wheel, characterized in that the main clutch wheel and the auxiliary clutch wheel are disposed in concentric relationship and face that surface of the flywheel remote from the electric motor.

In order to selectively stop the associated load at predetermined different positions, the clutch motor may preferably comprises fixed point stop means for stopping the auxiliary clutch wheel in order to stop the load at one of the predetermined positions, a first lever operative to engage the main clutch wheel with the flywheel, and a second lever pivotably mounted at one end to the first lever to be rotatable in a predetermined direction along with the first lever, the second lever being also rotatable in the direction opposite to the predetermined direction independently of the first lever, the last-mentioned rotational movement of the second lever causing the load to stop the load at another predetermined positions.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a side elevational view, partly in longitudinal section of a clutch motor constructed in accordance with the principles of the invention;

FIG. 2 is an end face view of the motor as viewed on the side of the output thereof with parts omitted;

FIG. 3 is a schematic developed sectional view of the speed reduction and drive unit shown in FIGS. 1 and 2 with the section taken along the broken line III and viewed in the direction of the arrows of FIG. 2;

FIG. 4 is an end face view of an operating mechanism for the speed reduction and drive unit as viewed on the side reverse from in FIG. 2;

FIG. 5 is a side elevational view, partly in section of the operating mechanism shown in FIG. 4;

FIG. 6 is a skeleton diagram useful in explaining the principles of the invention; and

FIG. 7 is a schematic diagram of an electrical control circuit which may be used with the invention.

Throughout several FIGS. like reference numerals designate the identical or corresponding components.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and FIGS. 1 and 2 in particular, there is illustrated a clutch motor constructed in accordance with the principles of the invention. The arrangement illustrated comprises an electric motor unit generally designated by the reference numeral 10 and including a rotary shaft 12 rotatably supported at both ends by its housing through the respective ball bearings, rotor means 14 rigidly secured on the rotary shaft 12 and stator means 16 disposed around the rotor means 14. The motor unit 10 further comprises a flywheel 18 rigidly secured to the inner end of the rotary shaft 12 as by a nut and provided on that surface remote from the rotor and stator means 14 and 16 and substantially normal to the axis of the rotary shaft 12 with a friction surface divided into a pair of outer and inner annuli 18*a* and *b*.

An output shaft 20 is disposed so as to be slightly spaced from and axially aligned with the rotary motor shaft 12 and has a main clutch plate or wheel 22 rigidly mounted to that end thereof near to the rotary shaft 12 as by a nut. The main clutch wheel 22 includes an annular friction disc 22*a* facing the friction surface portion 18*a* of the flywheel 18 to form normally a small gap therebetween. A braking disc 24 is disposed on that side of the main clutch wheel 22 opposite to the flywheel 18 and has a hub rotatably fitted onto a sleeve-type bearing member 26 having a movable hollow cylindrical bearing member 28 fitted into the same. Then the output shaft 20 extends through and is supported at both ends on the bearing member 28 through a pair of ball bearings. The bearing member 28 is adapted to be longitudinally movable to a limited extent by an operating lever as will be described later whereby the output shaft 20 and therefore the main clutch wheel 22 is moved axially of the shaft 20 for the purpose of putting the frictional clutch 22*a* in engagement and disengagement with the flywheel portion 18*a*.

An auxiliary clutch plate or wheel 30 in the form of a flanged cup is rigidly connected to a cylindrical rotary block 32 as by screws and generally encircles the main clutch wheel and braking plate 22 and 24 respectively. The auxiliary clutch wheel 30 is concentric with the main clutch wheel 22 and includes an annular friction disc 30*a* on the flange of the cup facing the friction surface portion 18*b* of the flywheel 18. The rotary block 32 is fitted onto a driving drum 34 for both limited sliding movement and rotational movement and provided on that portion of the outer periphery with external teeth 36. The driving drum 34 is rotatably fitted onto the sleeve-type bearing member 26 and substantially flush with the hub of the braking plate 24. The drum 34 is integrally cou-

pled to the braking plate 24 through meshing teeth 38 disposed on the opposite ends of the plate and drum and provided on that end remote from the braking plate 24 with a flange having disposed on the extremity external teeth 40. A thrust bearing 42 is interposed between the driving drum 34 and an end wall of a housing 44 integral with the sleeve-type bearing member 26 to tend to bias the driving drum and braking plate 34 and 24 respectively toward the main clutch wheel 22.

As shown in the developed sectional view of FIG. 3, the rotary block 32 meshes a gear 46 through the teeth 36 which gear is coupled as an input gear to a speed reduction gear mechanism generally designated by the reference numeral 48. The speed reduction and drive mechanism 48 may be of the conventional construction and includes in this example, a first gear 50 rigidly mounted on the same shaft as the gear 46, a second gear 52 meshing the first gear 50, a third gear 54 integral with the second gear 52 and a fourth gear 56 meshing the third gear 54. An output pinion 58 rigidly mounted on the same shaft as the fourth or last gear 56 meshes the external teeth 40 on the driving drum 34. Thus it will be appreciated that the rotational movement of the auxiliary clutch wheel 30 and hence of the rotary block 32 is transmitted through the gear 46 to the speed reduction mechanism 48 where the number of rotation is divided by a predetermined number and thence to the braking plate 24 through the pinion and driving drum 58 and 34 respectively.

In order to move both the auxiliary clutch wheel 30 and the rotary block 32 toward and away from the flywheel 18, a thrust bearing 60 is rigidly disposed around the rotary block 32 and connected on the diametrically opposite portions to a yoke 62 having the central portion connected through a buffer spring 64 to a plunger or an armature 66 operatively associated with an electromagnet device 68 (see FIGS. 4 and 5). When energized, the electromagnet device 58 attracts the armature 66 in the direction of the arrow D shown in FIG. 5 to move the rotary block 32 and therefore the auxiliary clutch wheel 30 toward the flywheel 18 until the wheel abuts against friction surface portion 18*b* of the flywheel 18. As long as the electromagnet device 68 is in its energized state the auxiliary clutch wheel 30 is in engagement with the flywheel 18 but the deenergization of the device 68 causes the auxiliary clutch wheel 30 and the associated components to be returned back to their original positions as illustrated in FIGS. 1 and 5 by the action of a resetting spring 70 connected to the yoke 62.

A pair of spaced brake shoes 72 (only one of which is illustrated in FIGS. 1, 4 and 5) is disposed on the internal peripheral surface of the housing 44 so as to be capable of abutting against the auxiliary clutch wheel 30 to brake and stop the latter.

In FIGS. 1, 2 and 4 an operating lever unit is generally designated by the reference numeral 74 and includes a first lever 76 of substantially L-shape having one arm rockably supported at a fulcrum 77 to the housing 44 to be substantially vertical to the axis of the longitudinal axis of the output shaft 20, and the other arm bifurcated and substantially perpendicular to the one arm. The one arm of the first lever 76 has a pair of opposite pins 78 (one of which is illustrated in FIG. 2) disposed on the free forked end portions thereof and engaging a peripheral groove on the bearing member 28 for the purpose as will be apparent hereinafter. A second lever 80 is disposed between the bifurcated arm portions of the first levers 76 and pivotably mounted at one end to the first lever adjacent the bent portion by a pivot pin 82. The second lever 80 is provided on that edge thereof near to the housing 44 or the upper edge as viewed in FIG. 1 with a pusher member 84 normally maintained in engagement with the adjacent edge of the first lever 76 by the action of a pushing spring 86 fixed to the first lever.

The one arm of the first lever 76 is operatively associated with a microswitch 88 secured on the housing 44 and the other arm thereof is provided with a pair of microswitches 90 and 92 controlled by the second lever 80.

If the free end of the second lever 80 at its position it is longitudinally aligned with the other arm of the first lever 76 is moved downwardly as viewed in FIG. 1 the pusher member 84 is maintained abutting against the first lever 76 to cause the latter to be similarly moved downwardly along with the second lever 80. Contrary, if the free end of the second lever 80 is moved from its position as illustrated in FIG. 1 upwardly as viewed in the same figure, the second lever can be rotated about the axis of the pivot pin 82 against the action of the spring 86 and independently of the first lever 76, that is, while maintaining the latter immovable.

As shown in FIG. 1, the output shaft 20 is provided on that end portion thereof remote from the motor unit 10 and projecting beyond the housing 44 with a driving pulley 94 slidable along the shaft to a limited extent.

The clutch motor thus far described can be used to drive a load such as a sewing machine. To this end, the clutch motor can be suspended from the lower side of a bed of a sewing machine through a bracket such as shown at broken line 96 in FIG. 1.

The operation of the clutch motor will now be described in conjunction with FIGS. 6 and 7. In FIG. 6, a sewing machine generally designated by the reference numeral 100 includes a sewing needle 102 and a driven pulley 104 adapted to engage the driving pulley 94 through an endless belt such as diagrammatically shown at dashline 98 in FIG. 6. A position-sensing device generally designated by the reference numeral 106 is attached to the driven pulley 104.

FIG. 7 shows an electrical control circuit for use in selectively stopping the sewing needle 102 at a pair of predetermined positions. In FIG. 7 the motor unit 10 is electrically connected to a source PS of alternating current through a two-pole switch SW. The position sensing device 106 also diagrammatically shown in FIG. 6 includes a rotatable circular annulus 108 includes an electrically conductive segment 108*a* forming a substantial portion thereof and a narrow electrically insulating segment 108*b*, and three spaced brushes 110*a*, 110*b* and 110*c* of electrically conductive material in contact with the annulus 108. The annulus 108 is adapted to be rotated about its own axis while maintaining a predetermined correspondence thereof to the sewing needle 102 during the operation. The brush 110*a* is larger in circumferential dimension than the insulating segment 108*b* while the two remaining brushes 110*b* and 110*c* are equal to each other and smaller in circumferential dimension than the insulating segment 108*b*. The smaller brushes 110*b* and 110*c* are angularly spaced from each other by an angle of substantially 180° and disposed symmetrically with respect to the radial axis of the larger brush 110*a*.

An energizing winding for the electromagnet device 68 also designated by the same reference numeral as the device is electrically connected across the motor 10 through the microswitch 88 and another switch 112. The switch 112 then is shunted across the position-sensing device 106, the microswitch 90 or 92 and a selection switch 114, serially connected to each other. More specifically, the larger brush 110*a* is connected to the junction of the energizing winding 68 and the switch 112, the smaller brush 110*b* is connected to one of the stationary contact 90*a* of the microswitch 90 and to one of the stationary contacts 92*a* of the microswitch 92 and the brush 110*c* is connected to the other stationary contacts 90*a* and 92*b* of the microswitches 90 and 92. The microswitches 88 and 90 include the respective transfer contacts connected to the stationary contacts 114*a* and 114*b* of the selection switch 114 respectively. The switch 114 has a transfer contact connected to the junction of the motor 10 and the switch 112.

The microswitches 90 and 92 have their normal positions as illustrated in FIG. 7 where the respective transfer contacts engage the contacts 90*a* and 92*a* and are responsive to the movement of the second lever 80 from its position illustrated in FIG. 6 in the direction of that arrow B shown in FIG. 6 to be moved to the contacts 90*b* and 92*b* respectively. This movement of the second lever 80 is effected independent of the first lever 76 as previously described. The switch 88 is controlled

by the first lever **76** such that it is open when the second lever **78** is moved in the direction of the arrow A shown in FIG. **6** and closed when the second lever **80** is moved in the direction of the arrow B shown in FIG. **6**.

The switch **112** is of a centrifugal type responsive to the rotational movement of the sewing machine **100** at speeds above a predetermined magnitude to be closed and responsive to the rotational movement thereof at speed below that magnitude to be open. Thus it will be appreciated that with the machine driven at a speed below the predetermined magnitude either of the smaller brushes **110***b* and **110***c* comes on the insulating segment **108***b* to deenergize the electromagnets winding **68**. The centrifugal type switch is preferably disposed within the position sensing device **106** as diagrammatically shown at line **112** within a circle **106** in FIG. **6**. The selection switch **114** serves to select which of predetermined positions where the associated load, in this case, the sewing needle **102** is to stop. For example, the sewing needle has a pair of predetermined stop positions one of which puts it in engagement with the associated cloth and the other of which puts it above the cloth. The switch selects either of these two positions.

It is now assumed that the second lever **80** has been moved from its position illustrated in FIG. **6** in the direction of the arrow A shown in FIG. **6** through the operation of a foot pedal FP as shown on the lower portion of the same figure. Then the switch **88** is closed through the movement of the first lever **76** due to the second lever **8** but the microswitches **90** and **92** remain in their positions as shown in FIG. **7**. That is, their transfer contacts engage the stationary contacts **90***a* and **92***a* respectively. Also it is assumed that the selection switch **114** is closed on the side of the contact **114***a*.

Under the assumed condition the closure of the switch SW causes the motor unit **10** to be rotated at a high speed and the main clutch wheel **22** is mechanically connected to the braking plate **24** as shown in FIG. **1**. Further the electromagnet device **68** is deenergized while the braking shoes **72** abut against the auxiliary clutch wheel **30**. Then the lever unit **74** can be moved in the direction of the arrow A shown in FIG. **6** to force the friction disc **22***a* of the main clutch wheel **22** against the friction surface portion **18***a* of the flywheel **18**. Therefore the main clutch wheel **22** receives a rotational force from the flywheel **18** to drive the output shaft **20** which, in turn, drivers the load or sewing needle **102** through the components **94**, **98** and **104**. At that time it is noted that the electromagnet device **68** remains deenergized.

After the sewing needle **102** has been driven a certain distance in the manner as above described, the lever unit **74** is moved in the direction of the arrow B shown in FIG. **6**. This movement of the lever unit **74** causes the main clutch wheel **22** to disengage from the flywheel **18** while the main clutch wheel **22** remains connected to the braking plate **24**. At that time or at a time point when the lever unit **74** has been moved in the direction of the arrow B shown in FIG. **6**, the switch **88** is closed to permit the electromagnet device **68** to be energized from the source PS through the centrifugal switch **112** and the now closed switch **88**. Thus the armature or plunger **66** is pulled in the direction of the arrow D shown in FIGS. **5** and **6** thereby to move the rotary block **32** and the auxiliary clutch wheel **30** toward the flywheel **18** through the yoke **62**, and the thrust bearing **60** until the auxiliary friction disc **30***a* abuts against the friction surface portion **18***b* of the flywheel **18**. Thereafter the auxiliary clutch wheel **30** is maintained in engagement with the flywheel **18**.

Therefore the rotational force provided by the flywheel **18** is transmitted through the auxiliary clutch wheel **30**, the rotary block **32** and the gear **46** to the speed reduction and drive mechanism **48** where the number of rotation reduces to a low magnitude while the direction of rotation is appropriately adjusted. Then the output from the speed reduction mechanism **48** is transmitted through the pinion **58** to the driving drum **34** which in turn, rotates, at an extremely low speed, the braking plate **24** coupled to the driving drum **34** through the meshing teeth **38**. As a result, the main clutch wheel **22** connected to the braking plate **24** is rotated at a very low speed to provide a low speed output for the output shaft **20**. In other words, the disconnection of the main clutch wheel **22** from the flywheel **18** is immediately accompanied by a decrease in rotational speed of the output shaft leading to the latter being rotated at an extremely low speed. Therefore the sewing machine **100** is also driven at a very low speed.

In the low speed operation of the machine just described the centrifugal switch **112** previously closed is now open but the electromagnet's winding **68** is permitted to be energized from the source PS through the position sensing device **106** and its associated components. Under these circumstances, the winding **68** is deenergized upon the smaller brush **110***c* engaging the insulating segment **108***b*. This causes the auxiliary clutch wheel **30** to disengage from the flywheel **18** whereupon the wheel **30** is braked by the braking shoes **72** leading to the immediate stoppage thereof. This means that the sewing needle **102** has stopped at the particular position preset by the selection switch **114** prior to the operation of the sewing machine **100**. That is, the sewing needle **102** has stopped while it is positioned above the associated cloth.

It is assumed that while prior to the operation the selection switch **114** was operated to preset the sewing needle **102** to its stopping position corresponding to the position of the insulating segment **108***b* contacted by the smaller brush **110***c* as shown in FIG. **7**, it has happened necessarily to stop the needle **102** at its stopping position corresponding to the position of the insulating segment **108***b* contacted by the smaller brush **110***b* for some reason. In other words, the sewing needle **102** should stop while it is in engagement with the associated cloth.

Under the assumed condition, the foot pedal FP is required only to be released to reset the second lever **80** in the direction of the arrow B shown in FIG. **6** followed by the strong depression of the pedal in the direction of the arrow C shown in FIG. **6**. This causes the second lever **80** to be further rotated in the direction of the arrow B against of the action of the spring **86** with the result that the second lever **80** actuates the microswitches **90** and **92** to cause their transfer contacts to be separated from the contacts **90***a* and **92***a* and engage the contacts **90***b* and **92***b* respectively. This means that the circuit for energizing the winding **68** has been transferred from the brush **110***c* to the brush **110***b*. Therefore the process as previously described is repeated until the sewing needle **102** stops at its position different from its position preset prior to the operation. Namely the needle will stop while it is in engagement with the associated cloth.

The invention has several advantages. For example, the single clutch motor can selectively and at will provide a rotational speed identical to that of the motor and another rotational speed modified. The auxiliary driving mechanism is maintained in its suspended state except for the electromagnet device **68** being in its energized state leading to eliminating the necessity of providing always the structure withstanding the continuous operation. Therefore the auxiliary driving mechanism is not required to be high in both accuracy and durability. Further the main and auxiliary clutch wheels are disposed in concentric relationship and also coaxial with the flywheel while at the same time both clutch wheels include the respective friction surfaces facing that surface of the flywheel remote from the electric motor. This permits the clutch unit to be mounted on and dismounted from the motor unit without the necessity of disassembling the clutch unit resulting in a great increase in productivity. Also the auxiliary driving mechanism less projects beyond the lateral surface of the motor unit. In addition, the clutch and transmission mechanism along with the auxiliary driving mechanism is of a package disposed in a single housing separated from the motor unit. This permits the mounting of such a package independent of the motor unit while the operating lever unit can be adjust in position at will through the rotation of the same along with the housing.

While the invention has been illustrated and described in conjunction with a sewing machine it is to be understood that it is equally applicable to other loads.

I claim:

1. A clutch motor comprising an electric motor unit, a clutch unit for transmitting an output from the electric motor unit to the load, fixed point stop means operatively coupled to both the clutch unit and the load to stop the clutch unit so as to stop the load at a predetermined position, a first lever member for engaging and disengaging the clutch unit from the electric motor unit, a second lever member pivotably mounted at one end to the first lever member and movable in a predetermined direction along with the first lever member and also movable in the direction opposite to the predetermined direction independently of the first lever member, and means responsive to the movement of the second lever member independent of the first lever member for stopping the load at its position different from the predetermined position.

2. A clutch motor comprising an electric motor having a shaft, a flywheel mounted directly on one end of said shaft, an output shaft disposed at said one end of said motor shaft in alignment with said motor shaft, a main clutch wheel disposed on and rotatable with said output shaft in facing relation with that face of the flywheel remote from said motor, said main clutch wheel being engageable with and disengageable from said flywheel, an auxiliary clutch wheel rotatably mounted concentric with said main clutch wheel, said auxiliary clutch wheel being engageable with and disengageable from said face of said flywheel, speed reduction means operatively connected to the auxiliary clutch wheel to reduce the speed of rotation of the latter, a braking plate operatively connected to said speed reduction means to transmit the rotational movement of the latter to said main clutch wheel and electromagnetic means for alternatively engaging said main clutch wheel and said auxiliary clutch wheel with said flywheel.

3. A clutch motor according to claim 2, in which said electromagnetic means is energized when said main clutch wheel is disengaged from said flywheel and upon being energized engages said auxiliary clutch wheel with said flywheel.

4. A clutch motor according to claim 2, further comprising means connecting said output shaft with a rotary load, means for sensing the rotational position of the load, means controlled by said sensing means for disengaging said clutch wheels from said flywheel and applying braking force to stop said load in a selected position and means for selectively changing the position in which said load is stopped.