May 27, 1952 D. C. REEK 2,598,440

DIRECTIONAL SWITCH

Filed July 5, 1951

Fig. 1

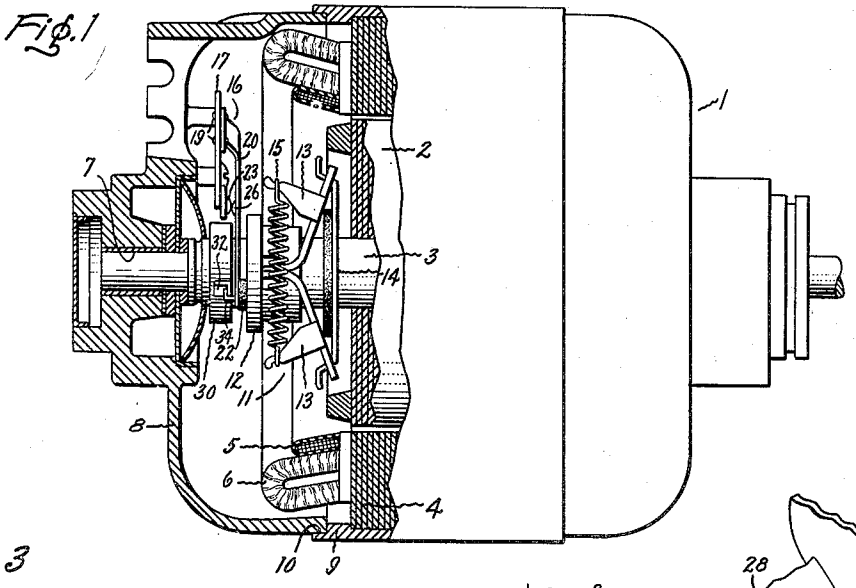


Fig. 3

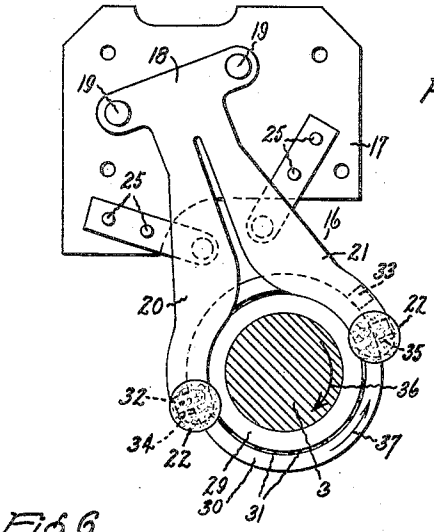


Fig. 2

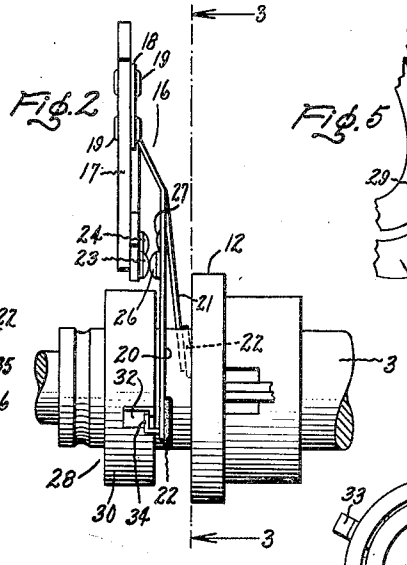


Fig. 5

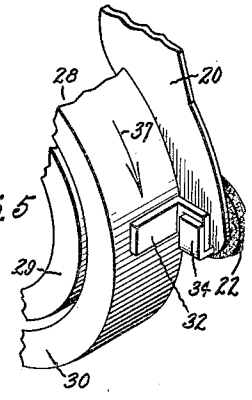


Fig. 6

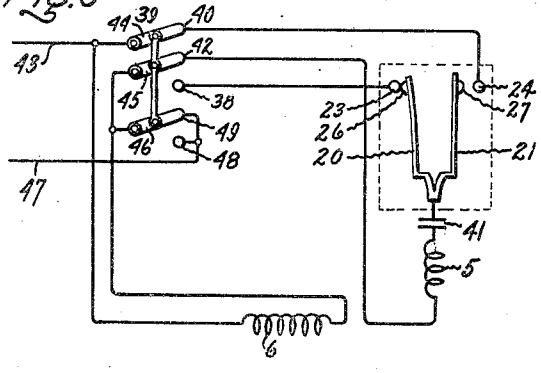
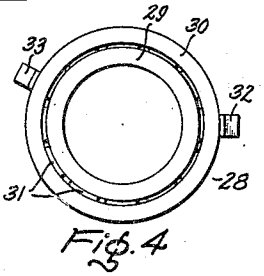


Fig. 4



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DIRECTIONAL SWITCH

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4 Claims. (Cl. 200—80)

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This invention relates to switches actuated by centrifugal mechanisms and more specifically to a directional switch for use in and instantly reversible, single-phase, alternating current motor.

In the design of single-phase, alternating current motors for certain applications, for example door actuators, it is desirable to provide for instant reversal of the motor. In the past, in order to provide for instant reversal of a single-phase, alternating current motor, it has been necessary to incorporate a number of relays in the circuit which adds appreciably to the cost and requires some type of external enclosure to house the auxiliary control devices. It is therefore desirable to provide means for instantly reversing a single-phase alternating current motor without the necessity for utilizing auxiliary relay devices and which can be incorporated in the motor structure itself.

An object of this invention is, therefore, to provide a directional switch for use particularly in securing instant reversal of single-phase alternating current motors.

Further objects and advantages of this invention will become apparent and the invention will be better understood by reference to the following description and the accompanying drawing, and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In accordance with this invention, there is provided a clutch member, such as a ball bearing, having a first element mounted on a shaft and a second element adapted to slip with relation to the first element when restrained. A switch is provided having a mounting member and a pair of independently movable arms mounted thereon and respectively arranged on either side of the shaft. Stationary contacts are provided on the mounting member and movable contacts are respectively arranged on the arms cooperating respectively with the stationary contacts. A speed responsive device is mounted on the shaft and arranged to bias the switch arms into a first position with the contacts respectively closed below a predetermined speed. The speed responsive means is operable responsive to the predetermined speed to permit the switch arms to move so that the contacts are opened. Means are provided on the second element of the clutch for holding one of the arms so that the contacts associated therewith are closed in one direction of shaft rotation and for holding the other arm so that the associated contacts are closed in the other direction of shaft rotation. Thus, the switch arm so held does not move and the associated contacts do not open when the speed responsive device operates. The two switch contacts are respectively connected to the two positions of a reversing switch and to the starting winding. When the motor comes up to speed, the speed responsive means opens one of the contacts, while the other is held in the closed position. The contact which is held closed is determined by the direction of rotation, and is connected to the selector switch position associated with the opposite direction of rotation. Thus, the contacts which are allowed to open are connected to the line and the circuit of the motor starting winding is opened when the predetermined speed is reached. However, when the selector switch is thrown to the other position for the other direction of rotation, the contacts associated therewith are already closed, so that the starting winding is immediately energized in the opposite sense to secure instant reversal. In this way, the motor may always be instantly reversed since one contact of the starting switch is always closed for one rotation and open for the opposite rotation.

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In the drawing, Fig. 1 is a side elevational view, partly in section, illustrating a motor equipped with the improved directional switch of this invention; Fig. 2 is a fragmentary view illustrating the switch and a portion of the centrifugal mechanism; Fig. 3 is a fragmentary end view of the switch taken along the line 3—3 of Fig. 2; Fig. 4 is a view of the antifriction bearing utilized in this invention; Fig. 5 is a fragmentary view showing the operation of the ears on the antifriction bearing in engaging the switch arms; and Fig. 6 is a schematic illustration of the circuit utilizing the improved directional switch of this invention.

Referring now to the drawing, there is shown a motor 1 having a rotor 2 mounted on a shaft 3. A stator 4 is provided having a starting winding 5 and a running winding 6 arranged in suitable winding slots therein (not shown) Shaft 3 is journaled in a suitable bearing 7 carried by endshield 8, which is secured to frame 9 in any suitable manner, as by a rabbet fit 10. A centrifugal mechanism 11 is mounted on the shaft 3 adjacent rotor 2, and includes a push collar 12 and weight members 13 mounted on a backplate member 14 and biased by a spring 15. A centrifugal mechanism of this type is more fully shown and described in Patent 2,149,108 of A. F. Welch issued February 28, 1939 and assigned to the assignee of the present application.

A switch assembly 16 is mounted on the endshield 8 and includes a mounting member 17 and a spring member 18, secured to the mounting member in any suitable manner, as by rivets 19. The spring member 18 has two independently movable resilient arms 20 and 21, depending therefrom and respectively arranged on either side of the shaft 3, as shown in Fig. 3. Wear pads 22 are respectively provided on the ends of the arms 20 and 21 for engagement with the push collar 12, as will be hereinafter described. Sta-

tionary contacts 23 and 24 are respectively mounted on the mounting member 16 in any suitable manner, as by rivets 25, and movable contacts 26 and 27 are respectively mounted on the arms 20 and 21, and cooperative respectively with the stationary contacts 23 and 24.

As will be seen in Fig. 1, when the motor is at rest or below a predetermined speed, the push collar 12 of the centrifugal mechanism 11 will be positioned toward the left and engages the wear pads 22 to bias the switch arms 20 and 21 to close the contacts 23 and 26, and 24 and 27. When the motor reaches a predetermined speed, however, the weight arms 13 of the centrifugal mechanism 11 will move the push collar 12 toward the right, as shown in Fig. 2, so that the switch arms 20 and 21 tend to spring outwardly to open the contacts.

In order to provide the directional feature, an antifriction bearing 28 is mounted on the shaft 3, intermediate the endshield 8 and the centrifugal mechanism 11, and includes an inner race 29 mounted on the shaft 3 and an outer race 30 with antifriction bearing elements 31 arranged therebetween. The outer race 30 is provided with two ears 32 and 33 projecting radially therefrom. Each of the switch arms 21 and 22 has a hooked member 34 and 35 respectively, arranged at its outer end. The ears 32 and 33 on the outer race 30 are so spaced, as shown in Figs. 3 and 4, that they will respectively engage only one of the hooks 34 and 35 on the switch arms 20 and 21 when the arms are in their normally closed position. It will readily be apparent that the antifriction bearing 28 operates as a slipping clutch so that when the shaft 3 rotates in the direction shown by the arrow 36, the outer race 30 will rotate in the direction shown by the arrow 37, unless restrained. Thus, when the motor starts from rest with the shaft rotating in the direction 36, the outer race 30 will rotate in the direction 37 until the ear 32 engages the hook 34 of the arm 20. The outer race 30 will now be restrained and the shaft and inner race 29 will continue to rotate freely. When the motor reaches the predetermined speed, the centrifugal mechanism 11 will operate to move the push collar 12 to the right, as viewed in Fig. 3, tending to allow arms 20 and 21 to spring outwardly to open the contacts. However, it will be observed that arm 20 is now restrained from moving by engagement of the ear 32 with the hook 34, so that the contacts 23 and 26 are held closed, while the arm 21 being unrestrained will move outwardly as shown in Fig. 3, opening the contacts 24 and 27. It will readily be apparent that when the shaft 3 reverses, the centrifugal mechanism 11 will again move the push collar 12 to the left to bias the arm 21 to close the contacts 24 and 27, and as the shaft starts to rotate in the opposite direction, the outer race 30 will move in the direction opposite from that shown by the arrow 37, so that ear 32 disengages hook 34 and ear 33 will engage hook 35. It will be readily apparent that while an antifriction type bearing has been shown, it may be replaced by any clutch device having a slight frictional or magnetic coupling with the shaft 3.

Referring now to Fig. 6, there is shown a circuit for the improved directional switch described above. Here, in which like elements are indicated by like reference numerals, stationary contact 23 is connected to position 38 of reversing switch 39, while stationary contact 24 is connected to position 40. The movable spring switch arms 20 and 21 are both connected to starting winding 5 through capacitor 41 and the other end of the starting winding is connected to switch position 42. External line 43 is connected to movable element 44 of switch 39 and one side of running winding 6 is connected to the external line 43. The other side of the running winding 6 is connected to movable elements 45 and 46, while the other external line 47 is connected to switch positions 48 and 49.

In operation, with the motor at rest, the spring arms 20 and 21, which are formed of resilient material and are normally biased so that the contacts 23 and 26, and 24 and 27 are open, are biased by the push collar 12 of centrifugal mechanism 11, so that both sets of contacts are closed, as shown in Fig. 1. Assuming now that the selector switch 39 is moved to the position shown in Fig. 6, the motor will now start with the shaft 3 rotating in the direction shown by the arrow 36, so that the outer race 30 rotates in the direction shown by the arrow 37. Since the spring switch arm 20 is in its biased position, ear 32 on outer race 30 will engage hook 34 on the end of arm 20, thus locking arm 20 in the biased position and the contacts 23, 26 in the closed position. When the predetermined speed is reached, the centrifugal mechanism 11 will move the push collar 12 to the right, allowing arm 21 to spring outwardly as shown in Fig. 2, opening the contacts 24 and 27, as shown in Fig. 6. Since the starting winding 5 is energized through contacts 24, 27 and switch position 40, the opening of these contacts opens the circuit of starting winding 5, and the motor continues to run on the running winding 6 alone. It will be observed, however, that the engagement of the ear 32 with the hook 34 of arm 20 retains the contacts 23 and 26 in the closed position, no circuit being established, however, since the switch position 38 is not connected for energization, as shown in Fig. 6. Assume, now, that the reversing switch 39 is moved to the other position so that the movable element 44 contacts the position 42, the movable element 45 contacts the position 38, and the movable element 46 contacts the position 48. The motor will still be operating in the direction of rotation 36, however, the starting winding 5 will now be energized in the opposite sense through switch position 38 and contacts 23 and 26 which were held closed by ear 32 engaging hook 34 on arm 20. The motor will now be plugged and at the predetermined speed, the centrifugal mechanism 11 will move the push collar 12 to the left, biasing arm 21 to its closed position with contacts 24 and 27 closed. The motor will then pass through zero speed and will start to rotate in the opposite direction, so that outer race 30 of bearing 28 also starts to rotate in the opposite direction. As described above, ear 32 will then disengage hook 34 and ear 33 will engage hook 35 to hold contacts 24 and 27 in the closed position. When the motor again reaches the predetermined speed in the opposite direction of rotation, the centrifugal mechanism 11 will allow the push collar 12 to move to the right, this time permitting spring switch arm 20 to spring outwardly, opening contacts 23 and 26. It will be observed that starting winding 5 is now energized through contacts 23, 26 and, its circuit being open, the motor will now run on running winding 6 alone. The contacts 24, 27 it will be observed are held closed and ready for instant reverse energization of the starting winding 5 whenever the switch 39 is again moved to the position shown in Fig. 6.

It will now be readily apparent that this invention provides an improved arrangement for securing instant reversal of single-phase alternating current motors without the necessity for utilizing auxiliary relays. The action of this arrangement is instant, and regardless of the direction of rotation, the device is preset for reversal and operation in the opposite direction.

While I have shown and described a particular embodiment of this invention, further modifications and improvements will occur to those skilled in the art. I desire it to be understood, therefore, that this invention is not limited to the particular forms shown, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination with a rotatable shaft, an antifriction bearing having an inner race mounted on said shaft and an outer race with antifriction bearing elements arranged therebetween, a switch assembly having a mounting member, a pair of independently movable arms respectively mounted on said mounting member and arranged on either side of said shaft, a pair of stationary contacts mounted on said mounting member, and a pair of movable contacts respectively mounted on said arms and respectively cooperating with said stationary contacts; means responsive to the speed of said shaft for biasing said arms to a first position with said contacts closed and for permitting said arms to move to a second position with said contacts open above said predetermined speed, and means on said outer race for holding one of said arms in said first position when said shaft is rotating in one direction and for holding the other of said arms in said first position when said shaft is rotating in the other direction whereby the contacts respectively associated with the arms so held are not opened above said predetermined speed.

2. In combination with a rotatable shaft, an antifriction bearing having an inner race mounted on said shaft and an outer race with antifriction bearing elements arranged therebetween, a switch assembly having a mounting member, a pair of independently movable arms formed of resilient material mounted on said mounting member and respectively arranged on either side of said shaft, a pair of stationary contacts mounted on said mounting member, and a pair of movable contacts respectively mounted on said arms and respectively cooperating with said stationary contacts; said arms being normally positioned so that said contacts are open; speed responsive means on said shaft engaging said arms and biasing the same to close said contacts below a predetermined speed, said speed responsive means being operable responsive to said predetermined speed to release said bias on said arms so that said contacts are opened, and means on said outer race for holding one of said arms in said biased position when said shaft is rotating in one direction and for holding the other of said arms in said biased position when said shaft is rotating in the other direction whereby the contacts respectively associated with the arms so held are not opened when said speed responsive means removes the bias thereon.

3. In combination with a rotatable shaft, an antifriction bearing having an inner race mounted on said shaft and an outer race with antifriction bearing elements arranged therebetween, a switch assembly having a mounting member, a pair of independently movable arms formed of resilient material mounted on said mounting member and respectively arranged on either side of said shaft, a pair of stationary contacts mounted on said mounting member, and a pair of movable contacts respectively mounted on said arms and respectively cooperating with said stationary contacts, said arms being normally positioned so that said contacts are open; speed responsive means on said shaft engaging said arms and biasing the same to close said contacts below a predetermined speed, said speed responsive means being operable responsive to said predetermined speed to release said bias on said arms so that said contacts are opened, each of said arms having retaining means formed thereon, said outer race having means for engaging the retaining means of one of said arms when said one arm is in the biased position and said shaft is rotating in one direction of rotation so that said arm is held in said biased position, said outer race having other means for engaging the retaining means of the other of said arms when said other arm is in the biased position and said shaft is rotating in the other direction of rotation so that said other arm is held in said biased position whereby the contacts respectively associated with the arm so held are not opened when said speed responsive means removes the bias thereon.

4. In combination with a rotatable shaft, an antifriction bearing having an inner race mounted on said shaft and an outer race with antifriction bearing elements arranged therebetween, a switch assembly having a mounting member, a pair of independently movable arms formed of resilient material mounted on said mounting member and respectively arranged on either side of said shaft, a pair of stationary contacts mounted on said mounting member, and a pair of movable contacts respectively mounted on said arms and respectively cooperating with said stationary contacts, said arms being normally positioned so that said contacts are open; speed responsive means on said shaft engaging said arms and biasing the same to close contacts below a predetermined speed, said speed responsive means being operable responsive to said predetermined speed to release said bias on said arms so that said contacts are opened, each of said arms having a hook formed thereon, said outer race having a pair of ears formed thereon arranged so that one of said ears engages the hook of one of said arms when said one arm is in the biased position and said shaft is rotating in one direction and the other of said ears engages the hook of the other of said arms when said other arm is in the biased position and said shaft is rotating in the other direction whereby the contacts respectively associated with the arm so held are not opened when said speed responsive means removes the bias thereon.

DONALD C. REEK.

REFERENCES CITED

The following references are of record in the file of this patent:

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