

Nov. 7, 1950

C. E. SPRAGUE
CENTRIFUGAL SWITCH

2,528,845

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2 Sheets-Sheet 1

FIG. 1.

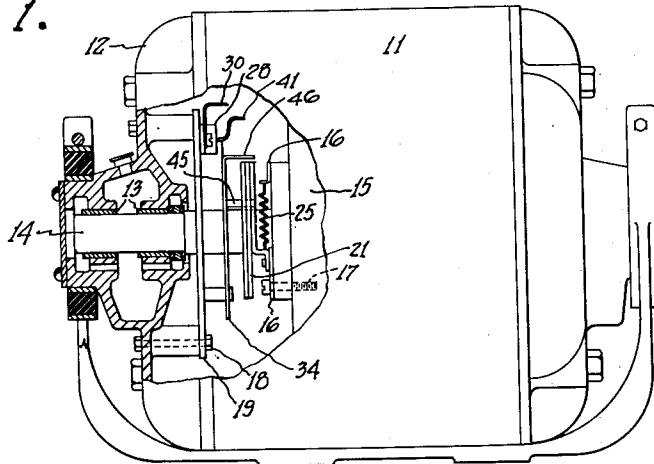


FIG. 2.

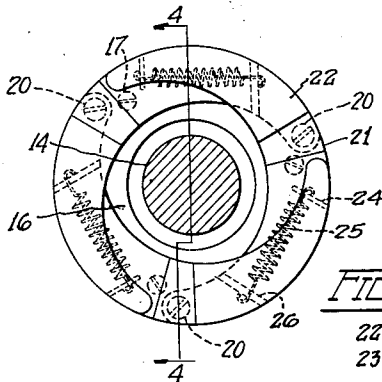


FIG. 3.

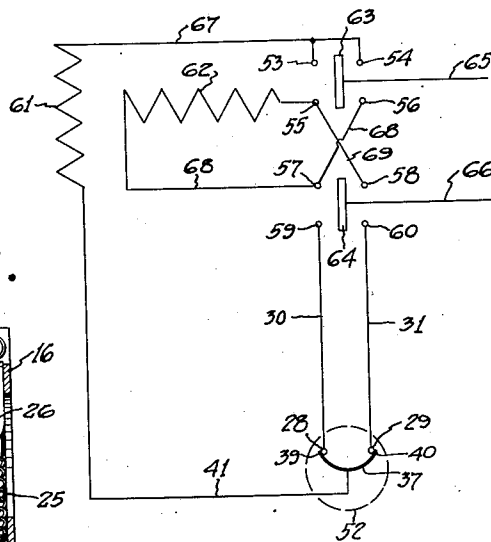


FIG. 4.

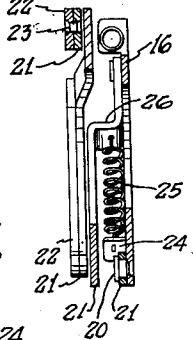
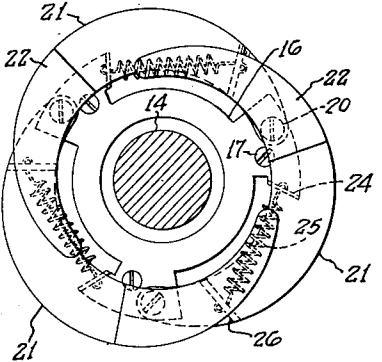


FIG. 5.



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FIG. 6.

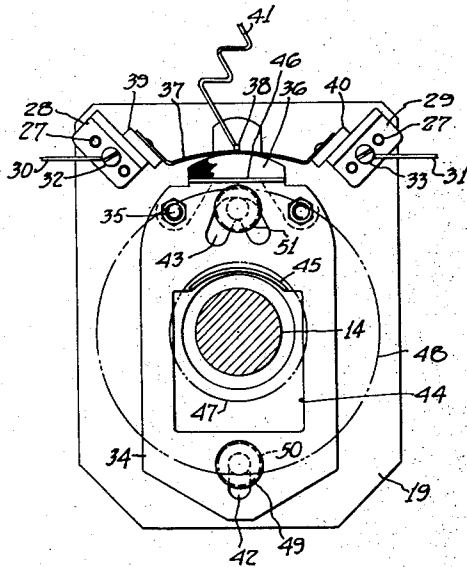


FIG. 7.

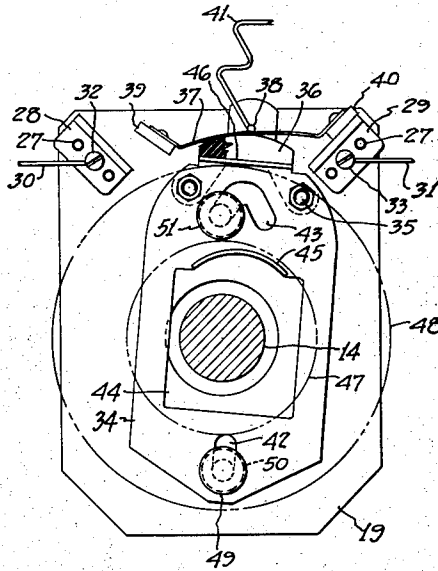


FIG. 8.

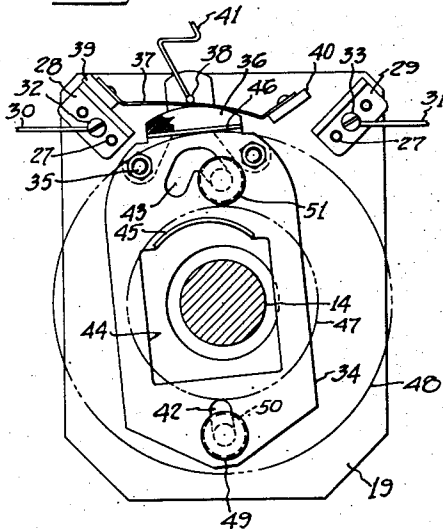
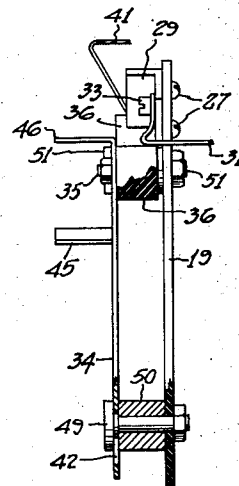


FIG. 9.



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CENTRIFUGAL SWITCH

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4 Claims. (Cl. 200—80)

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This invention relates generally to electric switches and particularly to electric switches of the type adapted to be actuated by an operator responsive to the direction and rate of rotation of the operator about an axis.

Attention is called to my United States Patent No. 2,382,827 covering some of my earlier work in this field.

It is the principal object of this invention to provide an improved type of combined selector and starting switch to be used in connection with the starting winding of a split-phase electric motor and to be discriminately operated by an actuator carried on the rotor of the motor.

A second object is to provide such a switch requiring only a limited space and which will be both reliable in operation and inexpensive to produce.

I accomplish these and other objects in the manner set forth in the following specification as illustrated in the accompanying drawings, in which:

Fig. 1 shows a side view of a typical split-phase motor with the motor frame partially broken away to show my switch and switch operator in place.

Fig. 2 is a face view of a common type of centrifugal operator for a split-phase motor starting switch.

Fig. 3 is a wiring diagram showing how the windings of a split-phase motor are connected to a power source with my improved internal switch and an external controller.

Fig. 4 is a section along the line 4—4 of Fig. 2 and together with Fig. 2 shows the relation of the parts of the centrifugal operator when the motor is at rest.

Fig. 5 is a face view of the centrifugal operator showing the parts in expanded position as when the motor is operating above a pre-set speed.

Fig. 6 is a face view of my switch showing the relation of the parts when the motor is not running.

Fig. 7 is a face view of my switch showing the relation of the parts when the motor is rotating in one direction.

Fig. 8 is a face view of my switch showing the relation of the parts when the motor is rotating in the other direction.

Fig. 9 is a side view in partial section of my switch as shown in Fig. 6.

Similar numerals refer to similar parts throughout the several views.

Referring to Fig. 1, at 11 is shown a motor stator with one end bell 12 cut away to show one

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end bearing support with bearing liners 13 supporting a shaft 14 on which is pressed a rotor 15 to which concentric with shaft 14 is mounted centrifugal switch operator base member 16 by means of machine screws 17. Mounted on the inside of end bell 12 by means of bolts 18 is insulated base plate 19 of my internal switch. It is to be noted that the centrifugal switch operator rotates with the motor rotor and that my internal switch mounts on the inside of the end bell of the motor and does not rotate with the rotor.

Figs. 2, 4, and 5 show a common type of switch operator which is combined in my invention and is shown and will be briefly described because my internal switch is particularly adapted to be used with such a switch operator and an understanding of the cooperation of my switch with this type of operator is essential to the understanding of my invention. On base member 16 of the switch operator are pivoted by means of headed and shouldered screws 20 three equally spaced crescent-shaped flying members 21 each of which has fixed to it a weighting member 22 by means of rivets 23. Turned up on base member 16 are three equally spaced ears 24 each perforated to receive a hooked end of one of three tension springs 25. Each flying member 21 is offset as at 26 and in the offsetting portion is perforated to receive the other hooked end of one of the springs 25. The design of springs 25 is so balanced with the design of the weights 22 and flying members 21 that at about two-thirds full speed of the motor rotor, the centrifugal force of the flying members overcomes the closing force of the springs and the positions of the parts suddenly change from the lower speed positions of Fig. 2 to the higher speed positions of Fig. 5. The construction, not particularly illustrated, is such that there are definite inner and outer limits to the motions of the members 21.

Figs. 6, 7, 8, and 9 show a preferred construction of the internal switch of my invention which switch combines the function of a so-called starting switch with the special selector switch function of my invention. Mounted on insulating base plate 19 by screws 27 are stationary contacts 28 and 29 to which are attached respectively conducting wires 30 and 31 by means of terminal screws 32 and 33. Spaced from base plate 19 is metal switch plate 34. Near the top of switch plate 34 and secured to its back by screws 35 is insulator 36 to which resilient spring arm 37 is flexibly mounted at its mid-point by pin 38. Mounted respectively on the ends of spring arm

37 are contacts 39 and 40. Also connected to spring arm 37 by pin 38 is conductor 41.

Switch plate 34 on its vertical center line is perforated to form radial slot 42 near its lower end and inverted V-shaped slot 43 near its upper end. Also switch plate 34 is perforated near its center to form large shaft clearance hole 44. Formed to stand forwardly on switch plate 34 are operating ears 45 and 46 which, as shown in Fig. 1, are mounted in the plane of action of, and straddling, flying members 21 of the centrifugal switch operator.

Shown on Figs. 6, 7, and 8 are broken line circles showing the inner limit 47 and the outer limit 48 of flying members 21 at the speed conditions shown, Fig. 6 corresponding to Fig. 2, Fig. 7 corresponding to Fig. 5 in one direction, and Fig. 8 corresponding to Fig. 5 in the other direction of rotation of shaft 14.

Switch plate 34 is pivotally supported on base plate 19 by headed and shouldered bolt 49 and spaced from base plate 19 by spacer 50. Switch plate 34 is guided in its movement under the action of flying members 21 by headed and shouldered bolt 51 fixed in base plate 19. Bolts 49 and 51 penetrate switch plate 34 through slots 42 and 43 respectively.

Referring to Fig. 3, broken circle 52 includes generally my internal switch and operator described above. Small circles 53, 54, 55, 56, 57, 58, 59, and 60 represent the insulated stationary contacts of a controller external to the motor of Fig. 1 of which 61 represents the starting winding, and 62 represents the running winding. Controlled rotor contact bridging bars 63 and 64, shown in the neutral or off position of the controller, are shown connected to electric supply lines 65 and 66 respectively. Conductor 41 connects to one end of starting winding 61, the other end of which is connected to contacts 53 and 54 by conductor 67. Running winding is connected at one end to contacts 56 and 57 by conductor 68 and at the other end to contacts 55 and 58 by conductor 69. Conductors 30 and 31 connect to contacts 59 and 60 respectively.

To further explain my invention, assume that a split-phase motor is equipped with my internal switch and operator as above described and is connected to a suitable power source through a simple drum controller according to the diagram of Fig. 3. With the controller in the neutral position shown, no movement of the motor occurs. Now assume that the controller handle (not shown) is pressed to the right so that controller bar 63 bridges contacts 54 and 55 and connects them with power line 65. Similarly, controller bar 66 bridges contacts 58 and 60 and connects them to power line 66. Assume now that current flows through the motor system from power line 65 to power line 66. It is seen that current traverses the motor running winding in the direction of elements numbered 65, 63, 56, 57, 68, 62, 55, 53, 64, and 66. Current will traverse the starting winding in the direction of elements numbered 65, 63, 54, 67, 61, 41, 37, 40, 29, 31, 60, 64 and 66. Since both windings are energized, the motor will start in the direction determined by the physical arrangement of the winding. Let us assume it starts to rotate in a counter-clockwise direction. In a very short time the motor will attain approximately two-thirds of its full speed and the flying members of the internal switch operator suddenly fly outward or from the position of Fig. 3 to the position of Fig. 5. As this occurs, the flying members of the operator exert a quickly

applied radial force and a frictionally applied tangential force on operating ear 4 of the internal switch, thus throwing the internal switch quickly from the position of Fig. 6 to that of Fig. 8, thus disconnecting contact 40 of switch arm 37 from stationary contact 29 but leaving contact 39 of switch arm 37 from stationary contact 28. It should be noted that as the flying members of the operator react on operating ear 46 and switch plate 34 is urged upwardly and to the left, an added flexure is given to spring switch arm 37 and the shape and location of inverted V slot 43 is such that switch plate 34 is stable in its new position with switch ear 46 just out of reach of flying members 21 which, as above noted, have stops to limit their outward travel. It is seen that the circuit to the starting winding has been opened and the motor continues to run at rated speed in a counter-clockwise direction.

Now, if the controller handle is returned to neutral position, power is cut off from the motor and due to the load to which it is applied or to its own friction and windage or both the motor slows down and stops. While it is slowing down, at about two-thirds speed, springs 25 overcome the centrifugal force on members 21 and 22 and the flying members return to their rest positions. In doing this, they contact operating ear 45 and in further closing they overcome the forces holding the switch plate in the position of Fig. 8 and the switch plate returns to the position of Fig. 6 with contacts 29 and 40 again in contact.

Now, if the controller handle is pressed to the left so that controller bar 63 bridges contacts 53 and 56 and controller bar 64 bridges contacts 57 and 59, it is seen that current will traverse the starting winding in the same direction as before but the direction of current flow through the running winding is reversed and the motor starts up in the opposite or clockwise direction. This time in attaining about two-thirds speed the flying members will again suddenly spread out and exert a quick radial force on operating ear 46 but the tangential force will be clockwise so that while the operator changes from the position of Fig. 2 to the position of Fig. 5 the switch plate will change from the position of Fig. 6 to the position of Fig. 7.

It is thus seen that with my invention, the motor can be operated from rest to either direction of rotation. But the great advantage of my invention is that with it when the motor is running in one direction a quick reversal of the controller will just as quickly reverse the direction of current flow through the running winding and thus add the full magnetic reaction of the motor windings to the normal load reaction to bring the motor to a quick and complete stop. And if the controller is not returned to neutral position when the motor stops, it will immediately start up in the reverse direction. It is this ability to reverse the current reaction to quickly stop the motor and, if desired, to start the motor in the opposite direction which is the principal functional object of this invention, as well as of my previous patent above noted. Above is fully described the circuit and mechanisms of this invention which attain this object.

I am aware that changes could be made to mechanisms shown without departing from the general design of my invention and, therefore, while I make no claim to every means for accomplishing the functions of my invention, I do intend to reserve to myself the full compass of

those variations of mechanisms and circuit which come within the spirit of my invention. I claim:

1. In combination with a rotatable centrifugal switch operator, having radially flying members biased to a position of lesser radius but movable under the influence of centrifugal force to a position of greater radius, of a combined selector and centrifugal starting switch for a split-phase motor, comprising a plate having a center hole loosely surrounding the shaft of said motor, said plate being perforated with a slot radial of said motor shaft and at one side of said shaft and said hole, said plate being perforated with a V shaped slot pointing away from said shaft and at the opposite side of said shaft and said hole, a first fixed pin extending through said radial slot and pivoting said plate, a second fixed pin extending through said V shaped slot and guiding said plate as it slides along and pivots on said first pin in said radial slot, a first stationary contact spaced from said plate, a second stationary contact spaced from said plate, resilient means carried by said plate and carrying movable contacts for cooperating with said first and said second contacts, and means carried by said plate for engaging said switch operator whereby when said switch operator flying members are in their position of lesser radius said first and said second contacts will each be engaged by its cooperating movable contact and when said switch operator flying members are in their position of greater radius in one direction of rotation only the first stationary contact will be engaged by its cooperating movable contact and when said switch operator flying members are in their position of greater radius in the other direction of rotation only the second stationary contact will be engaged by its cooperating movable contact.

2. In combination with a rotatable centrifugal switch operator having flying members movable in a plane normal to the axis of rotation and biased to a position of lesser radius below a pre-set speed, a non-rotating combined selector and starting switch for a split-phase motor comprising a first single pole switch having a fixed contact and a movable contact, a second single pole switch having a fixed contact and a movable contact, and intermediate means movable only in a plane normal to the axis of rotation for

engaging said flying members and throwing said switches, whereby below a pre-set speed of said operator in either direction both of said switches will be closed and above said pre-set speed in one direction only one of said switches will be closed while above said pre-set speed in the other direction only the other of said switches will be closed.

3. A combined selector and starting switch for a reversible split-phase motor comprising a plate fixed in a plane normal to the shaft of said motor and having a center line, two spaced pins fixed to said plate on said center line and parallel to said shaft, a movable plate parallel to said fixed plate, said movable plate being perforated to form and elongated slot and a spaced V-shaped slot, said pins guidingly engaging said movable plate in said slots, two spaced insulated contacts carried by said fixed plate, two spaced movable contacts carried by a resilient member rockably carried by said movable plate, and two spaced operating members fixed normal to said movable plate.

4. A combined selector and centrifugal starting switch for a split-phase motor comprising a plate having a center hole loosely surrounding the shaft of said motor, said plate being perforated to form a vertical slot below said hole and an inverted V-shaped slot above said hole, a first fixed pin extending axially of said motor through said vertical slot, a second fixed pin extending axially of said motor through said V-shaped slot, fixed abutting means at each side of said plate and spaced therefrom, and resilient means carried by said plate and cooperating with said abutting means, whereby when said plate is moved to position said second pin at the apex or at either end of the V-shaped slot said plate will be stable in that position.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
771,269	Reist	Oct. 4, 1904
2,382,827	Sprague	Aug. 14, 1945
2,389,381	McLennan	Nov. 20, 1945
2,406,430	Mason	Aug. 27, 1946