

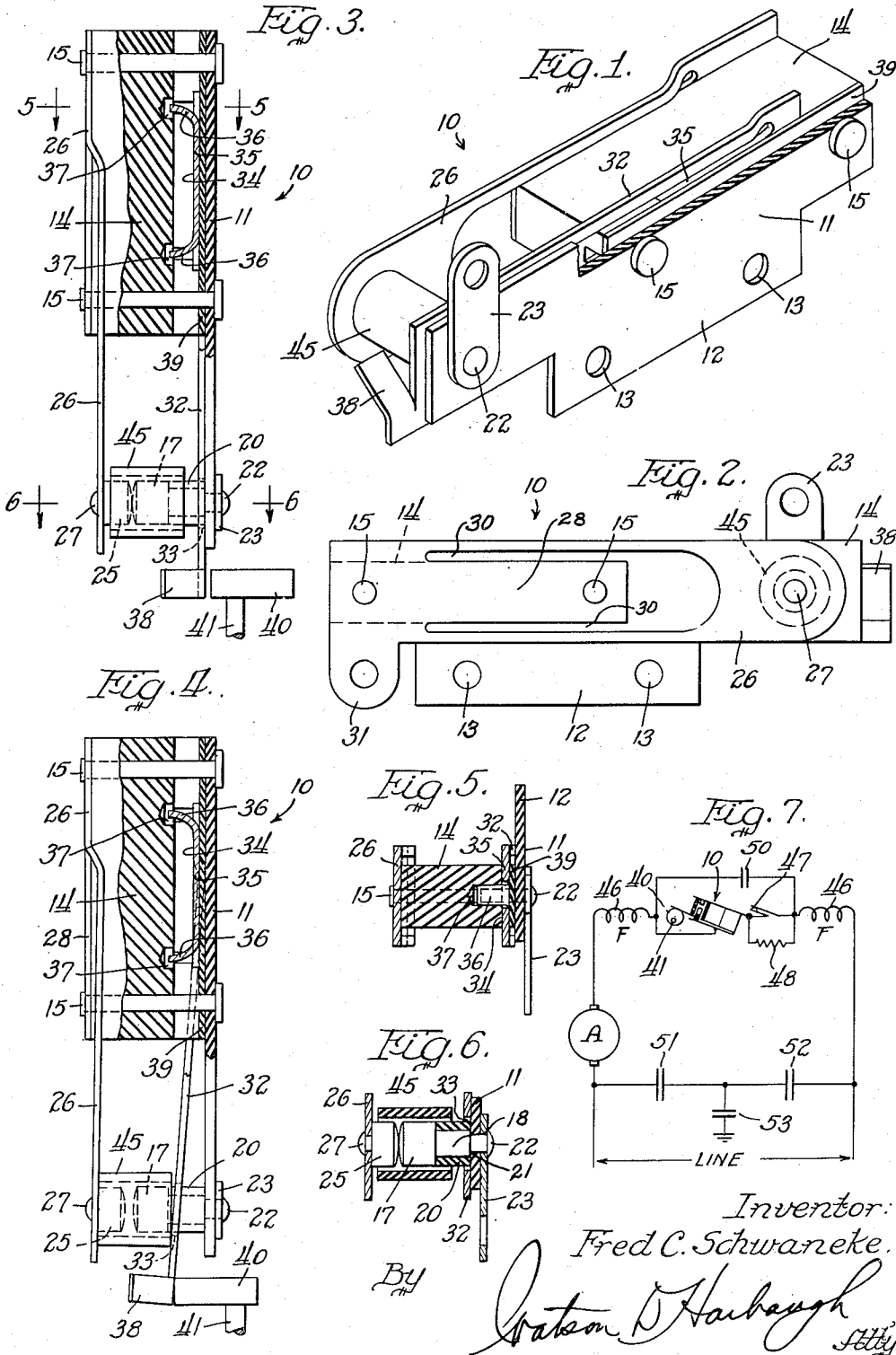
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SWITCH

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SWITCH

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This invention relates generally to electrical switches and more particularly to an improved nonarcing slow acting switch.

The switch of this invention is particularly well adapted for use in the line circuit of fractional horse power motors equipped with variable centrifugal speed governors, but it may also be used for any other purpose where similar mechanical limitations make the use of a quick acting snap switch impossible or undesirable.

One object of this invention is to provide a slow acting switch which may handle relatively heavy alternating or direct currents without appreciable arcing at the make and break contact points.

A second object is to provide a switch in which the contact points are enclosed in a hollow sleeve member which excludes oxygen therefrom and reduces arcing.

Another object is to provide a switch in which the contact points are open to the atmosphere while the switch is closed and sealed therefrom during the opening of the contacts and after they are opened.

A further object of the invention is to provide a switch arrangement in which the member moved to break contact is heat insulated from the arc bearing contact so that a low melting point unbreakable thermoplastic such as polystyrene can be used to actuate the switch.

A further object is to provide a novel switch in which the contact points are enclosed in a hollow sleeve, which sleeve serves the dual purpose of quenching the arc formed and forming a mechanical link between the actuator member and the movable contact.

Another object is to provide a switch arrangement wherein either a rotating or sliding cam surface may be employed to actuate the switch.

Another object is to provide a novel switch and condenser arrangement whereby the condenser serves to absorb the surge of current as the switch is opened to aid in the snuffing or arc quenching action of the contact enclosing sleeve.

A further object is to provide a novel arrangement wherein a line switch and a centrifugal governor switch are connected between the two halves of the field of a series motor, a condenser being shunted across both switches, the condenser having a capacity of such value that in combination with the inductive reactance of the series field it produces an explosive arc of short duration which aids in separating a pair of switch contacts within a sleeve as the switch is opened.

Other objects and advantages of this invention will present themselves to those familiar with the art on reading the following specification in conjunction with the drawing and the appended claims.

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In the drawing:

Fig. 1 is a perspective view of the switch of this invention viewed from a point below and to one side;

Fig. 2 is a top view of the switch;

Fig. 3 is a side view partly in section;

Fig. 4 is a view of a portion of the switch similar to Fig. 3 but with the switch in the opened position;

Fig. 5 is a section taken on line 5—5 of Fig. 3;

Fig. 6 is a section taken on line 6—6 of Fig. 3; and

Fig. 7 is a wiring diagram of the preferred electrical circuit.

The switch 10 is assembled on a base plate 11 of insulating material such as laminated phenolic. A projection 12 on the base plate 11 is provided for attachment of the switch 10 to any convenient surface such as a motor frame (not shown). Two holes 13 are provided for the mounting screws or bolts (not shown). The base plate need not have the shape shown but may be made in any convenient shape according to the installation requirements.

The base plate 11 in turn supports the rest of the various elements which make up the switch 10. A spacer block 14 also formed of insulating material is secured to the base plate 11 by a pair of rivets 15 and supports the elements in the spaced relationship.

The stationary contact point 17, preferably of silver, is supported on the extending end of the plate 11 as shown in Fig. 6. The shank portion 18 of the contact 17 is of lesser diameter than the rest of the contact and is surrounded by a hollow cylinder 20 of phenolic material which serves as a heat insulating spacer between the end of the contact 17 and the mounting plate 11 and also reduces the quantity of silver required. The end of the shank portion 18 is provided with a shoulder 21 and peened as at 22 to fasten it to the plate 11 and to a lug 23 which forms the terminal of the switch 10.

The other contact point 25 is supported on a spring member 26 by peening its shank portion 27. The spring member 26 is supported on the spacer block 14 by the rivets 15 which hold the switch 10 together. The member 26, which is formed of an elastic current conducting material such as beryllium copper or bronze, is slotted as shown in Fig. 2 to provide a centrally disposed mounting portion 28 the same width as the spacer 14. The side portions of the member 26 are offset slightly as shown in Fig. 3 near the ends of the slots 30. An integral lug 31 on one side of the member 26 forms the second switch terminal.

A second elastic member 32 similar in shape to the spring member 26 is secured between the spacer block 14 and the base plate 11. The actu-

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ator member 32 instead of carrying a contact point is provided with a hole 33 (best shown in Fig. 6) through which the contact 17 extends. This hole 33 is preferably made as small as manufacturing tolerances will allow so as to just clear the sides of the contact 17.

A recess 34 is provided in the bottom of the block 14, spaced from the rivets 15, for receiving the central portion 35 of the member 32. A pair of small projecting lugs 36 integral with the central portion 35 project into a pair of holes 37 in the spacer block 14 to anchor the member 32 against lateral displacement. A thin rectangular piece of insulating material having the same cross section as the spacer block 14 is riveted between the member 32 and the base plate to form a separator 38.

The end of the member 32 projects beyond the base plate 11 and is slotted and bent to provide a cam follower surface 39 to move the end of the actuator member 32 away from the base plate 11 when rotated to the position shown in Fig. 4.

The shaft 41 for the cam 40 is preferably journaled in the stationary member (not shown) to which the base plate 11 is attached so that movement of the cam 40 relative to the switch 10 occurs as the shaft 41 is rotated.

In some instances it has proved desirable to employ a sliding rather than a rotating cam to actuate the switch, depending on the manner in which the switch 10 is installed. In one application where the switch was employed as a line switch for a motor having a variable speed centrifugal governor the cam element for setting the governor was provided with an additional cam surface or lug which bore against the surface 39 to open the switch 10 when the governor cam was rotated to the off position adjacent the lowest speed setting.

Disposed around the contact points 17 and 25 is a cylindrical sleeve 45 of insulating material. The sleeve 45 is preferably formed of red or black fiber but may be of phenolic material such as Bakelite or of ceramic. The only requirements are that the material have sufficient mechanical strength, be resistant to the high temperatures which are encountered, and be nonconducting.

The inside diameter of the sleeve is slightly larger than the diameter of the contact points to allow them to become slightly cocked with respect to each other when opened and to provide sufficient manufacturing tolerance. The ends of the sleeve are slightly beveled or chamfered in order to remove burrs and prevent binding against the contact points.

The length of the sleeve 45 is slightly less than the distance between the members 26 and 32 so that either, or both, ends are open to the atmosphere when the switch is closed; the sleeve 45 being loose and free to move with respect to the contacts 17 and 25.

The mechanical operation of the switch 10 is as follows: In the closed position the elements are positioned as shown in Figs. 1 and 3. As the cam 40 is rotated to the position shown in Fig. 4 it strikes against the follower surface 39 on the end of the actuator member 32 and moves the actuator member 32 away from the plate 11. The end of the member 32 moves freely until it strikes against the end of the sleeve 45 and moves it toward the member 12. At this point the movement is transmitted through the sleeve 45 to the member 12 causing it also to be moved away from the base plate 11. Since the contact 17 is attached to the base plate 11 and the con-

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tact 25 is attached to the member 12, the two are separated, breaking the electrical circuit.

Since the breaking is relatively slow as compared with a snap switch, arcing occurs between the silver contact points 17 and 25 when appreciable current is being carried by the switch 10. But the arc formed is confined to the small annular space within the sleeve 45 for the ends of the sleeve 45 are tightly pressed up against the members 12 and 32 with little, if any, opening to the atmosphere. Thus the enclosed chamber around the contacts is of minimum size and virtually sealed off so that oxygen is prevented from getting to the contact points to cause sustained oxidation of silver which may be vaporized. Any vapor generated merely recondenses on the contact points to, in effect, plate them with a new clear surface of silver.

Although it is difficult or impossible to determine what actually occurs as the contacts break, the fact that the presence of oxygen around the contacts is greatly minimized and influx of atmosphere is virtually sealed out there is a combination of snuffing out the arc and some acceleration of contact separation due to the explosive effect of gas formed assisting the cam in opening the contacts.

By making the sleeve 45 shorter than the distance between the members 26 and 32 several advantageous results are obtained. First, opening of the switch contacts does not occur until the cam 40 has been turned through a considerable arc with sufficient force to move the spring actuator member 32. This insures that a faster speed of break between the contacts 17 and 25 will occur than if the contacts started to separate as soon as the cam 40 was rotated. This is particularly true where the cam 40 is manually moved since starting friction will already have been overcome. Secondly, the contacts 17 and 25 are opened to the air during the time when the switch is closed and hence cool more rapidly, particularly if a fan is running, than if they were always confined within the sleeve.

As stated previously, the switch 10 is particularly well adapted for use in conjunction with small motors. A typical circuit diagram for such an installation is shown in Fig. 7.

The switch 10 is preferably connected between the two halves of the series field 46 of the motor in series with the centrifugal governor switch 47. A load resistor 48 is shunted across the centrifugal switch 47, and a condenser 50 is shunted across both switches 10 and 47. The motor armature is connected to one end of the series field 46 and to the line while the other end of the field is connected to the other side of the line. A T pad of condensers 51, 52 and 53 is connected across the line and to the motor casing for purposes of eliminating radio interference from the motor and switches 10 and 47 while the appliance is being handled.

The location of the switches between the halves of the field 46 and the shunted condenser 50 eliminates a large proportion of the radio interference, but the addition of the T pad of condensers has proved desirable in most instances to further minimize it.

The use of a shunted condenser across the switch where the switch is used to control a universal series motor achieves a novel result which serves to greatly increase the life of the switch.

When the proper sized condenser is provided for a given switch and motor combination, the time of discharge of the condenser can be so

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adjusted that, as the contacts are separated, the condenser charges, absorbing the inductive reactance of the series field. This serves to reduce the arcing to a minimum value during the first stages of the separation of the contacts. As soon as the contacts have separated a predetermined distance and the condenser has been sufficiently charged, an explosive arc occurs which drives the movable contact away from the stationary contact and completely breaks the circuit. This action is made possible by the cylinder and piston-like arrangement of the sleeve and contact.

For a fractional horse power governor controlled series motor which drew .4 of an ampere at 115 volts D. C. under load a condenser having a capacity of .06 mfd. was used to achieve the above result. This motor and switch combination successfully stood up under a series of over one hundred openings and closings of the line switch with the armature of the motor blocked against rotation and a voltage of 120 volts D. C. applied. The successive makes and breaks of the switch were spaced six seconds apart in this test.

Various changes or modifications such as will be readily apparent to those familiar with the art may be made without departing from the spirit of this invention whose scope is defined by the following claims.

What is claimed is:

1. A switch comprising a fixed contact, a cooperating movable contact, resilient means for urging said movable contact towards said fixed contact, a resilient actuator for separating said contacts disposed adjacent to said fixed contact, and an insulating sleeve element enclosing said contacts, the ends of said sleeve bearing against the actuator and the resilient member to open the contacts when the actuator is moved toward the movable contact.

2. A switch comprising an elongated insulating base plate, a contact supported on one end of said plate, a resilient actuator member supported on the opposite end of said plate and extending parallel to said plate to a point beyond the end thereof, an opening in said actuator through which the contact extends, a resilient member supporting a second contact in cooperating relation with said first mentioned contact, a bearing surface on said second member near the contact, and an insulating cylindrical sleeve element closely surrounding said contacts for quenching the arc formed as said contacts are separated and for imparting motion of said actuator to said resilient member to separate said contacts when the end of said actuator is moved away from said plate, said sleeve element bearing against said bearing surface to move said resilient member.

3. In a switch the combination including a fixed contact, a cooperating movable contact carried by a flexible member, a loose fitting sleeve member surrounding said contacts and being shorter than the combined length of said contacts and an actuator surrounding the base of said fixed contact and being movable with respect thereto for bearing against one end of said sleeve member to move it along the axis of said fixed contact, the other end of said sleeve bearing against said flexible member to open said contacts as said actuator is moved.

4. In a switch the combination including a pair of contacts, a cylindrical loosely fitting sleeve enclosing said contacts and being shorter than the combined length of said contacts, and an actuator surrounding the base of one of said contacts and

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movable with respect thereto, said actuator bearing against one end of said sleeve to seal the opening between the side of the sleeve and said contacts when said switch is in the open position.

5. A switch comprising a fixed contact, a cooperating movable contact, a movable actuator for separating said contacts surrounding the fixed contact, and an insulating movable sleeve enclosing said contacts, said actuator member bearing against one end of said sleeve member and closing the opening in the end of the sleeve when said contacts are separated.

6. In a switch the combination including a fixed contact supported on a base plate, a cooperating movable contact carried by a flexible member, a loose fitting sleeve member surrounding said contacts, and an actuator surrounding the base of said fixed contact for bearing against one end of said sleeve member to move it along the axis of said fixed contact away from said base plate, the other end of said sleeve bearing against said flexible member to open said contacts as said actuator is moved.

7. In a device of the class described the combination including a pair of cooperating contacts, a cylindrical loosely fitting sleeve shorter than the combined length of said contacts and surrounding a portion thereof, and a resilient member having a movable end surrounding the base of one of said contacts and being supported at the other end, said member bearing against one end of said sleeve to seal the opening between the side of the sleeve and said contacts as said switch opens.

8. A switch comprising an elongated plate, a fixed contact carried by one end of said plate, a resilient member supported at one end on said plate on the same side as said contact, the other end extending to a point beyond said contact, a cam cooperating with the extending end of said member, a second resilient member spaced from the first mentioned member and carrying a second movable contact, cooperating with said first mentioned contact, an insulating sleeve surrounding said two contacts and serving to transmit motion from said first mentioned resilient member to the other resilient member to open the switch.

9. A switch comprising a movable contact and a fixed contact, a sleeve open at each end enclosing said contacts, said sleeve being shorter than the combined length of said contacts, and an actuator surrounding the base of the fixed contact and movable with respect thereto, said actuator bearing against one end of the sleeve to seal the opening between the side of the sleeve and the fixed contact when said switch is in the open position.

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