Sept. 18, 1951 W. F. WEIRICH ET AL 2,568,476

CUTOUT SWITCH FOR MOTORS

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FIG. 1.

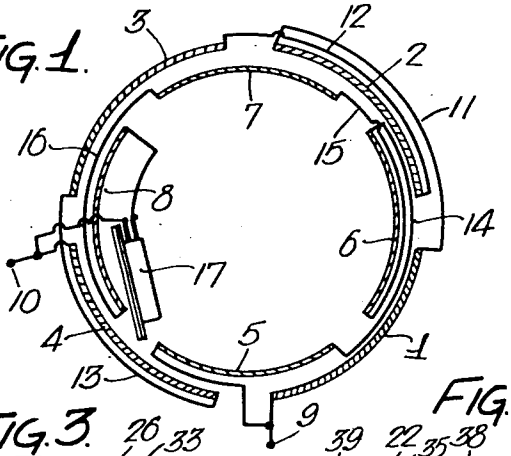


FIG. 3.

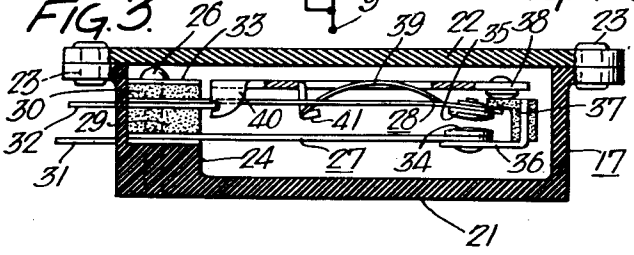


FIG. 4.

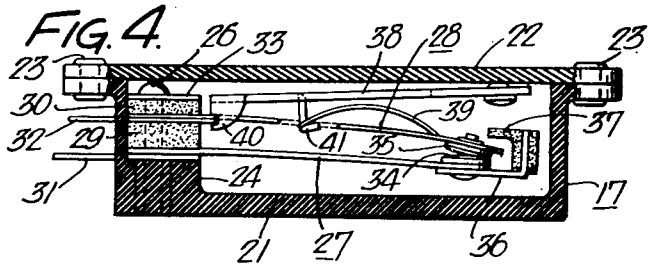


FIG. 5.

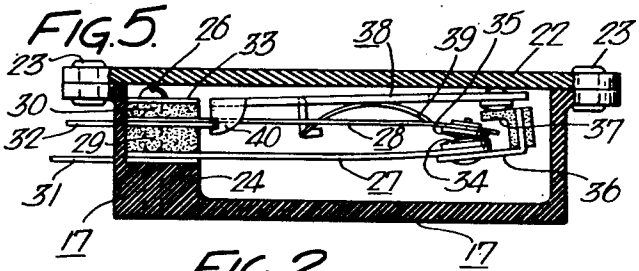


FIG. 2

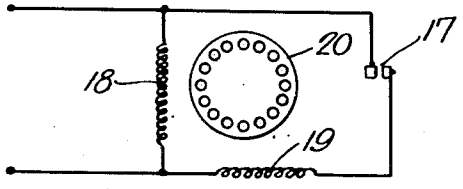
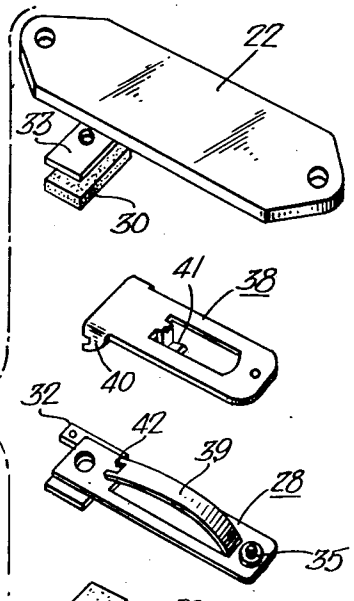
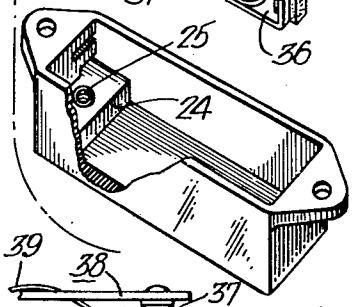


FIG. 7.





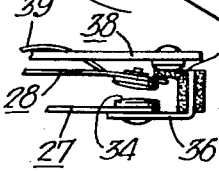


FIG. 6.

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CUTOUT SWITCH FOR MOTORS

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4 Claims. (Cl. 200—88)

1

This invention relates to cut-out switches for single-phase electric motors employing main or running windings and starting windings. As is well known, the purpose of such a switch is to cut out the starting windings after the motor has attained its running speed.

Prior switches of this type have not been entirely satisfactory. Some of them have required modification of the motor structure which is undesirable. Moreover, they have been of such character that there has been a pronounced tendency for the contacts to burn and pit due to the current flowing therethrough. This has greatly shortened the life of such devices.

The present invention has for its principal object the provision of a novel cut-out switch which is free of the objections of prior devices of this general character.

A more specific object of the invention is to provide a device wherein the switch contacts are closed and opened with a snap action which substantially eliminates burning and pitting of the contacts.

Another object of the invention is to provide a device of this character which may be easily associated with a motor and which does not require any modification whatever of the motor structure.

A further object of the invention is to provide a device of simple construction which can be manufactured at low cost and can be sold at a low price.

The device of the invention is novelly characterized in that it embodies a combination of magnetically-operable means and thermally-operable means which serve respectively to close and open a switch through the medium of a spring element which effects snap action in both directions of operation. Thus, the switch is under joint control of the magnetically-operable means and the thermally-operable means, and it is subjected to snap action in both directions by virtue of the spring element.

The invention may be more clearly understood by reference to the accompanying drawing, wherein

Fig. 1 is a diagrammatic illustration of the stator windings of a motor with which the device of the present invention is associated;

Fig. 2 is a simple circuit diagram showing the electrical arrangement of the switch;

Fig. 3 is a sectional view of the switch with the contacts in open position;

Fig. 4 is a sectional view of the switch with the contacts in closed position;

2

Fig. 5 is a sectional view of the switch showing the position of the elements when the contacts are about to open;

Fig. 6 is a fragmentary illustration showing the position of the elements after the contacts have opened; and

Fig. 7 is an exploded perspective view showing the various parts of the device.

Referring first to Fig. 1, there is illustrated the stator windings of a single-phase, four-pole motor, e. g. a squirrel-cage induction motor. The main or running windings are represented at 1, 2, 3 and 4, while the starting windings are represented at 5, 6, 7 and 8. The main or running windings are connected in series between the terminals 9 and 10 through connections 11, 12 and 13. The starting windings are serially connected by means of conductors 14, 15 and 16, and these windings are included in a branch circuit in parallel relation with the main circuit through the main windings. The switch device 17 of the present invention is also included in the branch circuit in series with the starting windings.

Fig. 2 is a simple representation of the electrical circuit. In this illustration, the main or running windings are represented as a single coil 18 while the running windings are similarly represented by a single coil 19. The rotor of the motor is represented at 20. It will be seen that the switch device 17 of the present invention is included in the branch circuit of the starting windings.

As indicated in Fig. 1, the device 17 is adapted to be disposed in cooperative relation with the motor so as to be actuated by the excess magnetism produced during starting. The association of the switch device with the motor will be described more particularly following a detailed description of the structure of the device 17 as shown in Figs. 3 to 7.

Referring to the latter figures, a casing 21 and its associated cover 22, both formed of insulating material, serve to house the parts of the switch device. The cover 22 may be secured to the casing 21 by means of hollow rivets 23. The casing 21 has a mounting portion 24 to accommodate the various elements, said portion being provided with a threaded metal insert 25 which is adapted to receive a mounting screw 26. The screw serves to support a bimetal contact arm 27 and an associated contact arm 28, there being insulating spacers 29 and 30 associated with said arms. Bimetal arm 27 has an associated terminal element 31 which projects through the casing wall

to the exterior thereof, and the contact arm 28 has a similarly-arranged terminal member 32. A clamping plate 33 serves to hold the stacked elements securely in place on the mounting portion 24 of the casing.

The bimetal member 27 carries a contact button 34, and the associated contact arm 28 carries a contact button 35. The bimetal arm 27 also carries an angular extension 36 at its end, on which there is provided an insulating element 37, the purpose of which will be seen presently.

A magnetic arm 38 is pivotally mounted on the contact arm 28 and is operatively interconnected with said arm through the medium of a bowed leaf spring 39. The spring may be formed separately from the arm 28 and may be secured thereto at the contact end of the arm. Alternatively, the spring may be struck out from the resilient arm 28 so as to be integral therewith adjacent the contact button 35. The magnetic arm 38 has depending notched ears 40 at one end thereof and it also has an L-shaped element 41 struck out therefrom. The notched ears 40 engage the terminal plate 32 which effectively forms shoulders in association with the contact arm 28, and the L-shaped element 41 is engaged by the notched end 42 of the leaf spring 39. It will be seen that the spring 39 holds the magnetic arm 38 in pivotal relation with the contact arm 28. However, the primary purpose of the spring 39 is to effect snap action of the switch contacts, as hereinafter described.

Referring again to Fig. 1, the switch device 17 of the present invention is adapted to be associated with a single-phase motor so that the magnetic arm 38 will be actuated by the strong magnetism produced during starting of the motor. During starting of such a motor, the excess magnetism due to strong currents at that time results in what may be called stray magnetic flux in the areas of coaction between the stator and rotor. This flux disappears as the motor approaches its running speed. In the use of the device of the present invention, the device is preferably arranged so that the magnetic arm 38 will be actuated by the strong magnetic flux of one of the main windings during the starting of the motor. As shown in Fig. 1, the device is arranged so that the free end of the magnetic arm 38 is in the vicinity of the strongest part of the magnetic flux of one of the main motor windings. Of course, the device can be arranged in any suitable manner which will enable utilization of the magnetic flux to actuate the device as hereinafter described. In practice, it has been found that the device can simply be suspended adjacent the motor stator by means of suitable fastening elements passed through the hollow rivets 23 and secured to the motor windings. For example, pieces of cord or wire may be used to hold the device in place. With the device suitably positioned, it is electrically connected in the branch circuit of the starting windings as above mentioned.

Considering the operation of the device, normally the elements are disposed as shown in Fig. 3, the contacts 34 and 35 being open. The spring 39 is so disposed in relation to the other elements that it urges the end of contact arm 28 against the insulating element 37, and the spring also urges the magnetic arm 38 against said element.

When the associated motor is started, the strong magnetic flux attracts the magnetic arm 38 and causes it to move against the cover 22,

as shown in Fig. 4. This movement of the arm 38 shifts one end of the spring 39 and produces snap closure of the contacts 34 and 35, the contact arm 28 being actuated by the spring. With the switch closed, the current flowing through the bimetal arm 27 causes heating thereof, and this arm flexes upward, as shown in Fig. 5. This upwardly flexing movement of the arm 27 shifts one end of the spring 39 and tends to produce snap opening of the switch contacts. Since the magnetic flux, which attracted the arm 38, will have practically disappeared as above mentioned, when the bimetal arm 27 flexes to a certain extent, a snap opening of the switch takes place. Fig. 5 shows the parts just prior to the snap opening of the contacts, and Fig. 6 shows the parts immediately following the opening of the contacts. As the bimetal arm 27 cools, the elements return to the normal condition shown in Fig. 3, the magnetic arm 38 being held against the insulating element 37.

In order to prevent the bimetal arm 27 from being influenced by the heat of the motor, this arm is preferably constructed so that a portion thereof acts as a compensator. Near its supported end, the arm tends to flex downward (as viewed in Figs. 3 to 5), but the remainder of the arm tends to flex upward. This result may be achieved by forming the arm in two parts, with the metals of one part in reversed relation to those of the other part. By virtue of the reverse action of the two parts of the arm, the affect of the motor heat is nullified as far as the switch contacts are concerned. It will be seen in Fig. 7 that the bimetal arm 27 has a slot in its main portion. This increases the electrical resistance of said portion and produces a greater heating action in response to current flowing through said arm. The main portion, which tends to flex upward (as viewed in Figs. 3 to 5), includes the entire length of the slot, while the compensating portion is beyond the slot at the support end of the arm.

From the foregoing description, it will be seen that the invention utilizes the magnetism of the associated motor to effect closure of the starting winding circuit, and it utilizes the thermal effect of current flowing in said circuit to open the circuit when the motor has attained its running speed. Moreover, the device of the invention effects snap closing and opening of the switch contacts and minimizes the tendency of the contacts to burn and pit. This greatly increases the life of the device.

It will be noted further that the device is simple in construction, and it does not require any modification of the motor structure, being in the form of a simple accessory which can be easily mounted in association with a motor for operation as above described. Moreover it will operate in any position.

It will be understood, of course, that the invention is not limited to the structural details shown in the illustrated embodiment but is capable of various modifications and further embodiments.

We claim:

1. A switch device, comprising a pair of adjacent resilient arms supported at one end and carrying contacts at their other ends, the contacts being normally open, one of said arms being formed of bimetallic material so as to flex in the direction of the second arm under the influence of heat caused by current flow when the contacts are closed, a magnetic arm pivotally

supported at one end on said second arm and having its opposite end free, and a bowed leaf spring having its ends engaging said second arm and said magnetic arm so as to effect snap closing and opening of said contacts in response to the respective actuations of said magnetic arm and said second arm.

2. A switch device, comprising a pair of adjacent resilient arms supported at one end and carrying contacts at their other ends, the contacts being normally open, one of said arms being formed of bimetallic material so as to flex in the direction of the second arm under the influence of heat caused by current flow when the contacts are closed, a magnetic arm adjacent said second arm, said magnetic arm being supported at its end adjacent the supported end of said second arm, the other end of said magnetic arm being free, and a bowed leaf spring having its ends engaging said second arm and said magnetic arm so that the ends of the spring are shifted by movements of the latter two arms to cause snap closing and opening of said contacts in response to magnetic actuation of said magnetic arm and thermal actuation of the bimetallic arm.

3. A switch device, comprising a pair of adjacent resilient arms supported at one end and carrying contacts at their other ends, the contacts being normally open, one of said arms being formed of bimetallic material so as to flex in the direction of the second arm under the influence of heat caused by current flow when the contacts are closed, a magnetic arm adjacent said second arm, said magnetic arm being supported at its end adjacent the supported end of said second arm, the other end of said magnetic arm being free, an insulating element on the free end of said bimetallic arm, said element being engageable by the free ends of said second arm and said magnetic arm, and a bowed leaf spring having its ends engaging said second arm and said magnetic arm so that the ends of the spring are shifted by movements of the latter two arms to cause snap closing and opening of said contacts in response to magnetic actuation of said magnetic arm and thermal actuation of the bimetallic arm.

4. A switch device, comprising a pair of relatively movable switch arms supported at one end and carrying contacts at their other ends, one of said arms being formed of bimetallic material so as to flex under the influence of heat caused by current flow when the contacts are closed, a magnetic arm supported at one end and having its opposite end free, and a bowed leaf spring having its ends engaging said magnetic arm and one of said switch arms so that the ends of the spring are shifted by movements of the latter two arms to cause snap closing and opening of said contacts in response to magnetic actuation of said magnetic arm and thermal actuation of the bimetallic switch arm.

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HENRY WEIRICH.

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