Oct. 17, 1961 J. ELLENBERGER 3,005,075

POLYPHASE MOTOR PROTECTING SWITCH

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FIG. 1

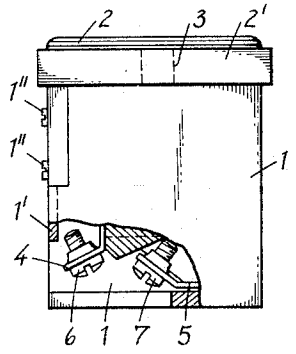


FIG. 2

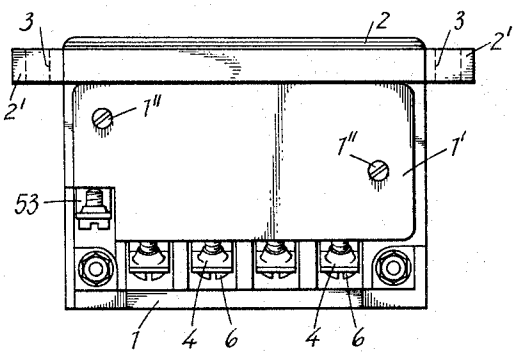


FIG. 3

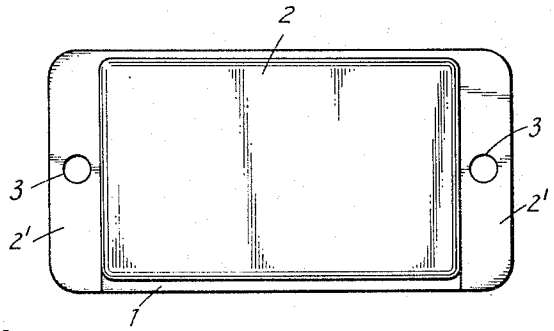
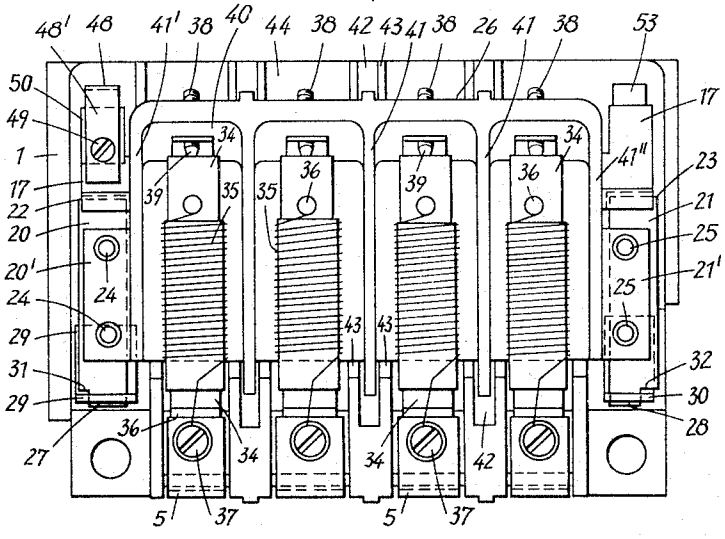


FIG. 4



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FIG. 5

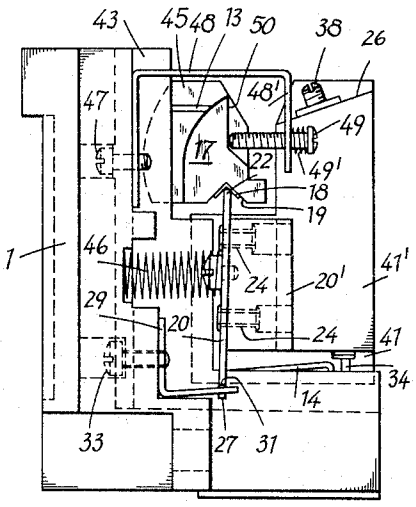
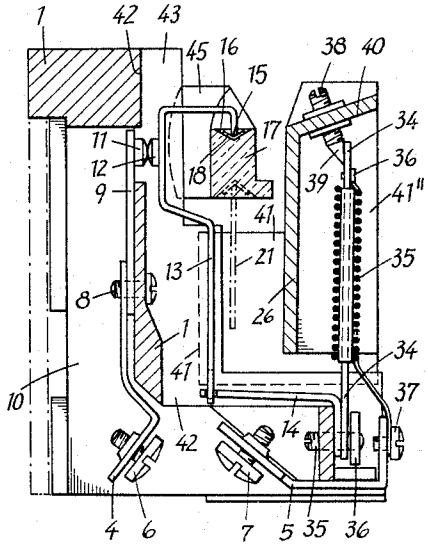


FIG. 6



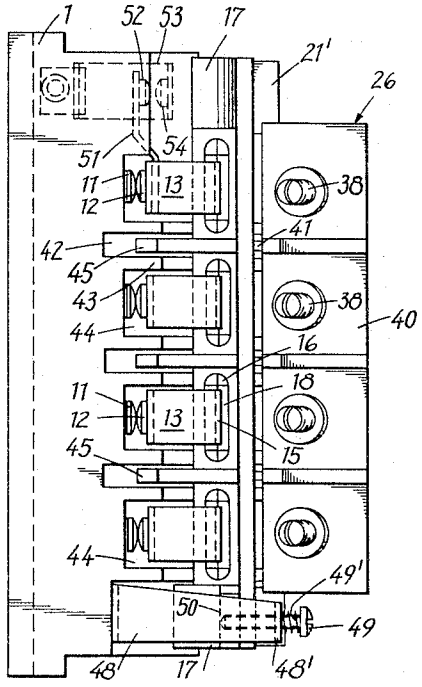


FIG. 7

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POLYPHASE MOTOR PROTECTING SWITCH

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The present invention relates to a polyphase motor protecting switch which is provided for each circuit with a separate bimetallic strip which acts upon a common pivotable control element for separating the switch contacts of each circuit, the movable contact of which is mounted on a contact spring.

There has been a prior proposal of a motor protecting switch of this type in which the common pivotable control element consisted of a disconnecting shaft which acted upon a trip-free release mechanism. Such a mechanism is, however, always a rather complicated device which requires additional space both for its placement and its operation. Furthermore, the trip-free release mechanisms of the known types do not act as quickly as desired.

It is an object of the present invention to provide a motor protecting switch of the above-mentioned general type which is designed so as to be as simple and space-saving as possible and in which the distance of the disconnecting movement and the contact pressure of the switch is as small as possible so that all circuits will be opened when an excess current occurs in one of the circuits.

This object is attained according to the invention primarily by providing a common rocking member for all of the contact springs which has V-shaped recesses at opposite sides by means of which the rocking member is supported at one side on the ends of contact springs and on the other side on the pivotable control element. The switch elements for the individual circuits therefore form a quick-action or snap switch. It is thus possible to adjust the motor protective switch so as to insure that it will be disengaged very quickly and the switch contacts will thereafter remain open for a relatively long time.

In order to attain a motor protective switch of this design of the smallest possible proportions, the free ends of the contact springs are bent at an angle. Furthermore, the knife-shaped ends of the contact springs engage into the V-shaped recesses of the rocking member under an initial tension as a result of which the switch will be very quickly disengaged when the rocking member tilts beyond a certain point. In order to attain the greatest possible initial tension, the contact springs are pivotably mounted on leaf springs which extend vertically thereto and are preferably provided at their pivoted ends with claws which pivotably engage in suitably shaped slots in the leaf springs.

In order to facilitate the production of the switch and to insulate the different parts thereof which lie in different circuits safely from each other, the pivotable control element is made of insulating material and provided with ribs which extend vertically to the pivoting direction and enter into suitable slots in the housing which is likewise made of insulating material. By means of these ribs on the control element and their insertion into the slots in the housing, individual chambers are formed which separate the bimetallic strips as well as the different pairs of switch contacts from each other.

For pivotably mounting the control element, the same is provided with lateral metal strips and a knife edge on one end of each strip which engages into one of the

V-shaped recesses of the rocking member. The other end of each of these metal strips is recessed and engages loosely into a slot-shaped aperture in the housing, while the edge of the recessed part is supported on the housing adjacent to the aperture. Adjacent to the bimetallic strips the ribs of the pivotable control element are connected to each other at the free end of the latter by means of an obliquely inclined wall so that the individual bimetallic strips are surrounded on all sides by insulating material.

In order to adjust the control element in an exact predetermined position relative to the bimetallic strips, the invention further provides the inclined wall of the control element with setscrews with conical tips, each of which engages with one of the bimetallic strips. When these setscrews are screwed further into the inclined wall, the control element and thus also the rocking member will be adjusted so that the contact pressure as well as the distance of the movement of the contacts will be reduced. This construction of the switch according to the invention insures that, if an excess current occurs in only one phase and the bimetallic strip in that phase is thereby bent, the entire switch will be disconnected. This disconnecting movement then occurs against the action of a spring which maintains the setscrews in engagement with the bimetallic strips.

For limiting the disconnecting movement of the rocking member, its is another feature of the invention to provide an adjustable stop, for example, in the form of a setscrew, which is held arrested in the adjusted position by a compression spring thereon and is adjusted so that the distance of travel for connecting the switch contacts is considerably greater than that required for disconnecting them. The switch contact will thus remain open for a considerable length of time during which the bimetallic strips can cool off and return to their original position.

The rocking member may be very easily produced by making it of a suitable plastic. The V-shaped recesses therein are preferably provided with metal reinforcements in order to insure that the rocking member will tilt easily and to prevent the V-shaped surfaces from being worn by the knife edges which engage therein.

According to a further feature of the invention, a pair of contacts which may be connected to a signal circuit may also be provided at one side of the switch contacts. These contacts are closed when the switch is in the disconnected position and the movable contact thereof is connected to one contact spring of the switch contacts.

The above-mentioned objects, features, and advantages of the present invention will become further apparent from the following detailed description thereof, particularly when the same is read with reference to the accompanying drawings, in which—

FIGURE 1 shows an elevation of the enclosed protective motor switch according to the invention;

FIGURE 2 shows a view of the switch as seen from the left of FIGURE 1;

FIGURE 3 shows a top view of FIGURE 2;

FIGURE 4 shows a rear view of FIGURE 2, but with the switch being in the open position;

FIGURE 5 shows a view of the switch as seen from the left of FIGURE 4;

FIGURE 6 shows a vertical section of the switch according to FIGURE 5 taken at one of the bimetallic strips; while

FIGURE 7 shows a top view of the switch according to FIGURE 5.

As illustrated in the drawings, the polyphase motor protecting switch according to the invention comprises a housing base 1 on which all of the parts of the switch are mounted and which is surrounded by a housing cover

2 into which base 1 may be slipped and in which it may be held by suitable guiding means. For mounting the switch, cover 2 is provided with a pair of bores 3 in flange 2'. The part of base 1 underneath cover 2 is covered by a plate 1' which is inserted into a corresponding recess in base 1 and secured thereto by screws 1''.

For electrically connecting the different circuits of the switch, terminal strips 4 and 5 with connecting screws 6 and 7 are provided. In order to permit an easy access to connecting screws 6 and 7, terminal strips 4 and 5 are bent at a suitable angle. Terminal strips 4 are connected to contact springs 9 and are also secured to base 1 by means of screws 8. Each terminal strip 4 and its associated contact spring 9 are inserted in a separate recess 10 in base 1. The free end of each contact spring 9 carries a contact 11 which is associated with a movable contact 12 on a contact spring 13 which is pivotably connected to a connecting strip 14 which forms a leaf spring. For this purpose, the pivoted end of contact spring 13 is claw-shaped and inserted into a slot in leaf spring 14 so as to be easily pivotable therein. As illustrated particularly in FIGURE 6, the free end portion of each contact spring 13 is bent substantially to a U-shape and its end forms a knife edge 15 which engages into a V-shaped recess 16 in a rocking member 17 which consists of insulating material and is reinforced in recess 16 against wear by knife edge 15 by a metal liner 18. The opposite side of rocking member 17 is also provided at each end thereof with a V-shaped recess 19 which is likewise reinforced by a metal liner 18. Into each of these V-shaped recesses 19 a metal strip 20 or 21 engages with its knife-edge end 22 or 23, respectively. These metal strips 20 and 21 are riveted at 24 and 25 to the lower side of flangelike projections 20' and 21', respectively, on a control element 26 which consists of insulating material, while the other ends 27 and 28 of strips 20 and 21 engage loosely into suitable slots in angular parts 29 and 30 which are secured by screws 33 to base 1. Strips 20 and 21 are provided with lateral recesses forming shoulders 31 and 32 on which the strips are supported on the angular parts 29 and 30. In this manner, metal strips 20 and 21 and control element 26 thereon are pivotably mounted on the angular parts 29 and 30, as shown particularly in FIGURE 5.

Leaf springs 14 together with bimetallic strips 34 are secured by means of screws 35 and nuts 36 in suitable apertures in base 1. Each bimetallic strip 34 carries a heating coil 35 which is electrically connected thereto at one end at 36, while the other end is connected to terminal strip 5 by a screw 37.

The free end of each bimetallic strip 34 is acted upon by the conical end 39 of a setscrew 38. All of these setscrews 38 are screwed into the inclined wall 40 of control element 26. The adjacent bimetallic strips 34 are separated by ribs 41 which are integral with control element 26 and extend between strips 34 toward the left, as shown in FIGURE 6, and enter into slots 42 in webs 43 on base 1. At both sides of control element 26 and parallel to ribs 41 additional ribs 41' and 41'' are provided, as shown in FIGURE 4. The adjacent webs 43 are separated by recesses 44 into which the contact springs 13 and leaf springs 14 are inserted.

Rocking member 17 is also provided with ribs 45 which likewise engage into slots 42. Thus, the individual circuits are safely insulated from each other also in the vicinity of rocking member 17.

A compression spring 46 which acts at one end upon base 1 and at the other end upon the metal strip 20 tends to pivot control element 26 in the clockwise direction, as seen in FIGURE 5, and this pivotal movement of control element 26 is prevented by the engagement of the conical ends 39 of setscrews 38 with the bimetallic strips 34.

As shown at the upper part of FIGURE 5, a U-shaped bracket 48 is secured to base 1 by a screw 47 and carries in its free vertical end 48' a setscrew 49 which acts upon the surface 50 of rocking member 17. A compression spring 49' prevents setscrew 49 from being accidentally turned.

The motor protecting switch as illustrated in the drawings is provided with four bimetallic strips 34. If desired, for example, the right outer bimetallic strip 34, as shown in FIGURE 4, may be omitted, and, as shown in FIGURE 7, the associated contact spring 13 may be provided with a cross strip 51 which carries a contact 52 on its end which is operatively associated with a contact 54 on a contact spring 53. The two contacts 52 and 54 will be closed whereby, for example, a signal lamp may be lit to indicate such a disconnection.

The operation of the motor protecting switch according to the invention, as illustrated in the drawings, is as follows:

If an excess current occurs in one circuit of the switch, the respective bimetallic strip 34 in this circuit will be heated by heating coil 35 and bent. The free end of this strip 34 then presses upon the associated setscrew 38 so that control element 26 will be pivoted in the counter-clockwise direction, as seen in FIGURES 5 and 6. As soon as knife edges 22 and 23 on strips 20 and 21 move beyond the line of connection between knife edges 15 on contact springs 13 and the pivot points on the opposite ends of contact springs 13, rocking member 17 will tilt in the clockwise direction about knife edges 22 and 23, as seen in FIGURES 5 and 6, whereby contact springs 13 will be suddenly pivoted in the clockwise direction so that their contacts 12 will be separated from the stationary contacts 11. At this pivoting movement, surface 50 of rocking member 17 will engage against setscrew 49. When the switch is again engaged after the bimetallic strips 34 have cooled off, and when it is thus again in the position as shown in FIGURE 6, it is possible to adjust the extent of the pivoting movement of rocking member 17 and thus also the distance between contact springs 13 by an adjustment of setscrew 49.

Simultaneously with the opening movement of contacts 11 and 12, contact 52 will also engage with contact 54 so that the signal circuit will be energized.

After bimetallic strips 34 have cooled off, control element 26 will return under the action of compression spring 46 to its original position as shown in FIGURE 6, whereby due to the initial tension of contact spring 13 the movable contacts 12 will be suddenly engaged with the stationary contacts 11 as soon as the rocking member tilts beyond a certain point.

By means of setscrews 38 and 49 it is possible to adjust the switch in such a manner that the contact pressure and the distance of movement of the contacts will be small when the switch is being disconnected so that the disconnection will occur very quickly, while the distance and thus also the length of time for engaging the switch will be relatively long.

Although my invention has been illustrated and described with reference to the preferred embodiments thereof, I wish to have it understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed my invention, what I claim is:

1. A polyphase motor protecting switch comprising a plurality of bimetallic strips, each mounted in a fixed position at one end and a heating coil on each strip, a pair of contact members associated with each of said bimetallic strips and each having a contact thereon, one of said contact members of each pair forming a contact spring and mounted at one end and movable about said end relative to the other contact member to open and close said contacts, each of said movable contact springs and the associated heating coil being adapted to be connected to one side of one of several circuits, each of said other contact members being adapted to be connected to the other side of said circuit, a common pivotable control element,

each of said bimetallic strips being in engagement at its other end with said control element, a common rocking member having V-shaped recesses in two opposite sides thereof, each of said movable contact springs engaging with its free end into one of said recesses and forming a pivot point for said rocking member, and a pivot member on and movable with said control element and engaging into the opposite recess in said rocking member so as to form a second pivot point for said rocking member, said rocking member being adapted suddenly to tip over in one direction about said two pivot points and thereby suddenly to separate all of said contacts when an excess current occurs in one of said circuits and the heating coil in said circuit is thereby heated so that the associated bimetallic strip is bent and thereby pivots said control element so as to shift said pivot member and said second pivot point of said rocking member.

2. A switch as defined in claim 1, in which the free end portion of each of said movable contact springs is bent so as to be U-shaped and terminates in a knife edge, said movable contact springs engaging under initial tension with said knife edges into one of said V-shaped recesses in said rocking member.

3. A switch as defined in claim 1, further comprising means for pivotably mounting said first end of each of said movable contact springs.

4. A switch as defined in claim 3, further comprising a leaf spring associated with each of said movable contact springs and mounted at one end in a fixed position and the other end extending substantiailly at a right angle to said movable contact spring and having a slot-shaped recess in said other end, said first end of said movable contact spring having a clawlike shape and pivotably hooked into said slot-shaped recess.

5. A switch as defined in claim 1, further comprising a housing of insulating material enclosing all of the parts of said switch, all of the fixed parts of said switch being mounted on said housing, said housing having slots therein, said control element also consisting of insulating material and having ribs thereon extending substantially at right angles to the direction of the pivoting movement of said element and into said slots in said housing so as to form the walls of chambers separating the individual bimetallic strips and also the individual pairs of contact members and contacts thereon from each other.

6. A switch as defined in claim 5, further comprising metal strips having opposite ends secured to both sides of said control element, one of said ends of each of said metal strips forming a knife edge and engaging into one of said V-shaped recesses in said rocking member, the other end of each of said metal strips being recessed and engaging loosely into a slot-shaped aperture in said housing, the edge of the recessed part of said metal strip resting on and supported by said housing adjacent to said aperture.

7. A switch as defined in claim 5, in which said control element further comprises an obliquely inclined wall connecting said ribs to each other on the free end of said element, and a plurality of setscrews screwed into said inclined wall and having conical ends engaging with the free ends of said bimetallic strips.

8. A switch as defined in claim 7, further comprising a spring acting upon said control element for maintaining said setscrews in engagement with said bimetallic strips.

9. A switch as defined in claim 1, further comprising an adjustable stop member for limiting the movement of said rocking member in one direction in which said contacts are being separated.

10. A switch as defined in claim 9, in which said adjustable stop member comprises a setscrew, and a compression spring on said setscrew for arresting the same in the adjusted position.

11. A switch as defined in claim 1, in which said rocking member consists of plastic, and metal liners within said V-shaped recesses for reinforcing the surfaces thereof.

12. A switch as defined in claim 1, further comprising a further pair of contacts for operating a signal circuit, one of said contacts being secured to one of said movable contact springs and adapted to engage with the other contact when said contacts on said contact members are being separated.

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