

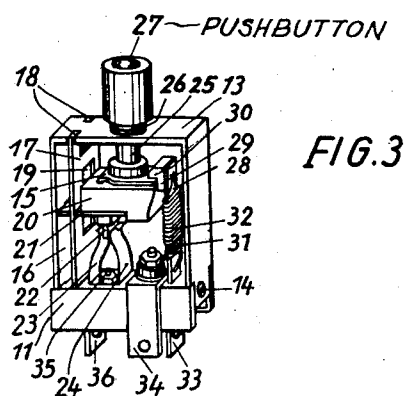
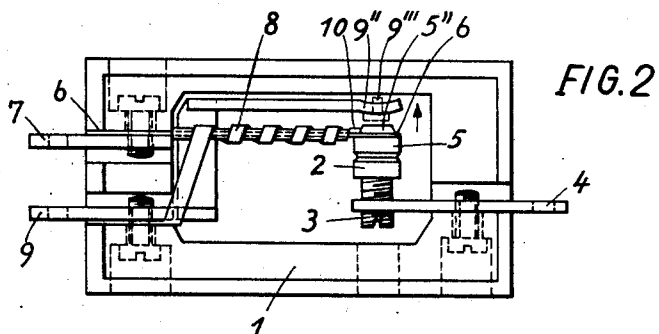
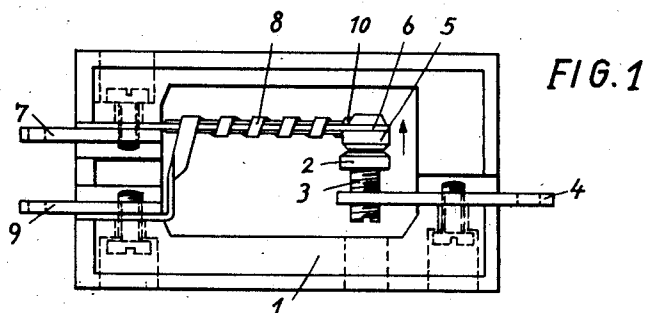
March 25, 1958

J. ELLENBERGER
BIMETALLIC SWITCHES

2,828,389

Filed July 13, 1954

3 Sheets-Sheet 1



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BIMETALLIC SWITCHES

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3 Sheets-Sheet 2

FIG. 4

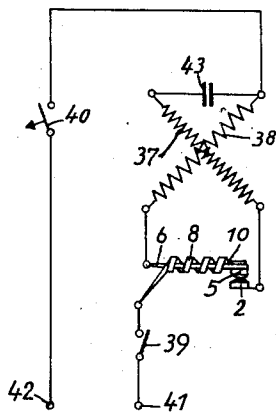


FIG. 5

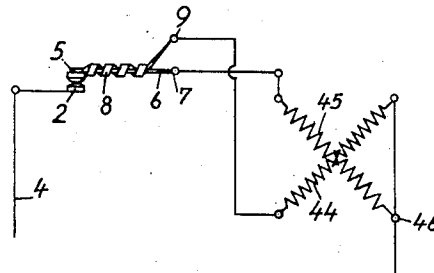
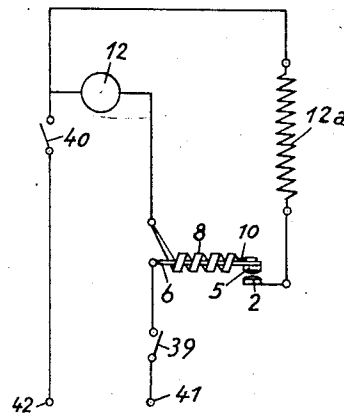


FIG. 6

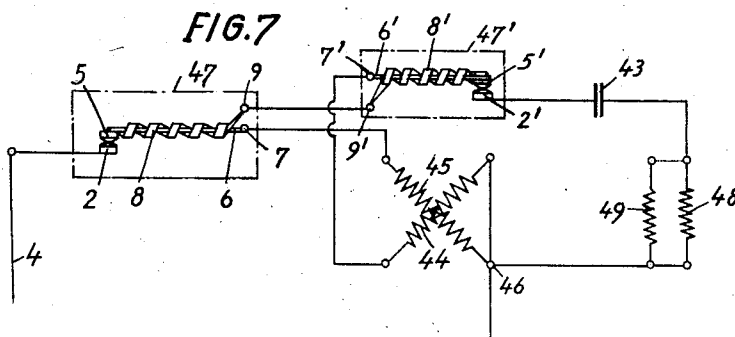


FIG. 7

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3 Sheets-Sheet 3

FIG. 8

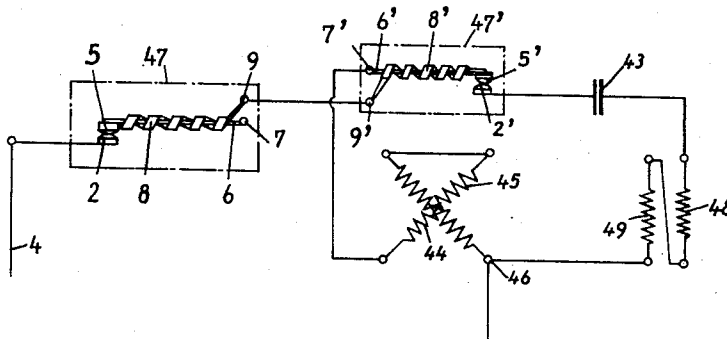


FIG. 9

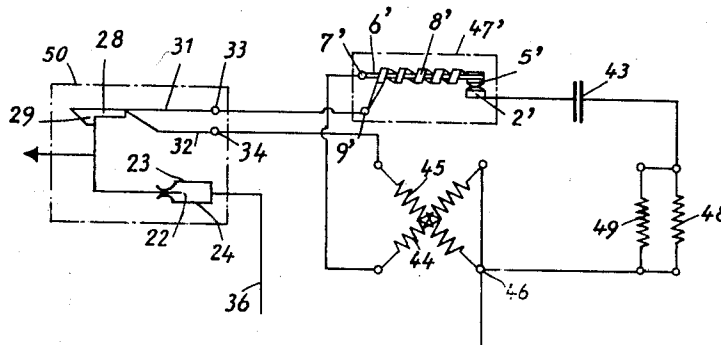
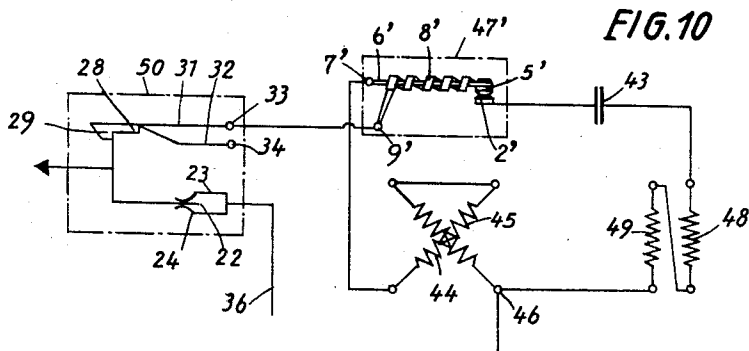


FIG. 10



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1

2,828,389

BIMETALLIC SWITCHES

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Claims priority, application Germany July 29, 1953

3 Claims. (Cl. 200—122)

The present invention relates to improvements in bimetallic switches.

Prior to this invention, overload switches have been known which principally consist of a bimetallic strip which bends when the operating current of the respective apparatus to be protected is passed therethrough and when it is overloaded either electrically or thermally, thereby opening a switch contact at its movable end to interrupt the current. Since such a bimetallic strip generally has a low resistance, it is suitable for use only in connection with apparatus having a high current consumption. For applying such bimetallic switches also to apparatus using only a low operating current, the bimetallic strip has also been heated indirectly by means of a heating coil wound around such strip. Thus it has previously been necessary to build different types of bimetallic switches in accordance with the current consumption of the apparatus to be protected thereby, and necessarily resulting in an increased cost of production thereof.

The above mentioned disadvantages are being effectively avoided by means of a bimetallic switch as disclosed by the copending application, Serial No. 371,880. The control element of such an overload switch consists of a bimetallic strip which is provided with a terminal for direct heating of the strip, as well as with a heating coil separate from such terminal for heating the strip indirectly. Further, the bimetallic strip carries on its movable end at least one contact which in at least one of its two end positions engages a stationary contact the position of which is preferably adjustable. An overload switch of this type may be used not only for protecting apparatus in which the operating currents are variable but, when utilizing both independent heating circuits, also for operating many consecutive circuit components which previously required a much larger number of circuit breakers.

It is the object of the present invention to design an overload switch of the general type as described in the copending application above referred to which permits such relatively small bimetallic switch to be overloaded considerably. The principal feature of the invention for carrying out such object resides in limiting the movement of the heated bimetallic strip by providing opposite therefrom a contact element which is electrically connected with the bimetallic strip and/or the heating coil thereof in such a manner that either the heating coil or the bimetal strip, or both, are at least partly short-circuited. Thus, the bimetallic strip is safely protected from being overloaded thermally, for example, by a short circuit.

Further objects, features, and advantages of the invention will be apparent from the following detailed description of several embodiments thereof and the accompanying drawings, in which:

Fig. 1 shows a top view of a bimetallic switch according to the invention;

2

Fig. 2 shows a similar view of a bimetallic switch with short-circuit contact;

Fig. 3 shows a bimetallic switch according to the invention provided with means for resetting the switch manually;

Fig. 4 diagrammatically illustrates the application of the new switch for automatically disconnecting the starting coil of an alternating-current motor;

Fig. 5 similarly illustrates the automatic connection of the heating coil of an electric hot-air blower by means of a switch according to the invention;

Fig. 6 diagrammatically illustrates a protective switch according to the invention cooperating with an alternating-current motor having two groups of windings;

Fig. 7 shows the application of two bimetallic switches according to the invention for protecting an alternating-current motor which is provided with two parallel groups of windings, as well as for automatically disconnecting the starting coil thereof;

Fig. 8 shows substantially the same circuit as illustrated in Fig. 7, wherein the two groups of windings are, however, connected in series;

Fig. 9 also shows a circuit similar to that illustrated in Fig. 7, in which, however, a modified form of the new switch is used to carry out the function of the motor-protective switch; while

Fig. 10 shows a system similar to that illustrated in Fig. 9 in which, however, the two groups of windings of the motor are connected in series.

Referring to Figs. 1 and 2 of the drawings, the housing 1 of the switch contains the stationary contact 2 which is mounted directly on the terminal arm 4 by means of the adjusting screw 3 and cooperates with the movable contact head 5 secured to the end of the bimetallic strip 6 which is mounted on the terminal arm 7. Wound around the bimetallic strip 6 and connected with a terminal 9 is a heating coil 8 the end of which is conductively connected at 10 with the bimetallic strip so as to provide an electric connection from the terminal 7 through the bimetallic strip 6 and the heating coil 8 to the terminal 9.

When the bimetallic strip 6 is being heated, it will move in the direction indicated by the arrow, the extent of such movement being the greater the higher the thermal load will be. In order to protect the bimetallic strip 6 from being overloaded, the switch illustrated in Fig. 2 is provided with a stationary contact 9" opposite the contact head 5, such stationary contact 9" being electrically connected with the end of the bimetallic strip and secured to the terminal 9 for indirectly heating the strip. If the bimetallic strip is excessively heated, it bends to such an extent that its contact head 5" engages the stationary contact 9", the heating coil 8 one end of which is connected to the contact 5 thereby being short-circuited so that the amount of heat supplied to the bimetallic strip will be considerably reduced.

The stationary contact 9" and the part 5" of the movable contact engaging the same may be produced very simply and inexpensively since these two contacts only have to bear the small load received by the short-circuiting part of the bimetallic switch. A preferred feature of the invention consists in designing the stationary contact 9" and the terminal 9 for heating the bimetallic switch indirectly so that both together form a single unit, preferably by making them of a single piece of material. When applying such a construction, it will not be necessary to provide the end of the extension of the terminal arm 9 opposite the stationary contact 9" with a plating of any special contact metal.

The stationary contact 9" may be designed so that it may be adjusted as by being made in the form of a contact screw 9"', as well as locked in a fixed position. It

may also be made slightly resilient so that the bimetallic strip will not be materially affected by the mechanical stresses occurring during the switching operation.

If the switch should be able to withstand very high short-circuit currents, the stationary contact 9" may, however, also be provided in a known manner with a coating of heat-resistant contact metal such as silver, or with a contact head 9" made of solid silver.

The bimetallic element as designed according to the invention may also be applied to a bimetallic switch the movable contact of which when in connecting position holds a contact bridge forming the opposite contact and being acted upon by a disconnecting spring. Such a switch, as shown, for example, in Fig. 3, does not return automatically into its connecting position like the switch shown in Figs. 1 and 2, but the contact bridge must be manually returned into the connecting position by depressing a suitable push button. Switches of this type may especially be used as a motor-protective switch because they are able to withstand a relatively high load and do not permit the motor again to be connected automatically and unintentionally. The details of construction of the switch shown in Fig. 3 are as follows:

The base 11 of the overload switch has secured thereto a U-shaped yoke 13 by means of screws 14. The yoke 13, on the one hand, forms a partial casing of the switch, and, on the other hand, serves as a bearing element for supporting the contact bridge 15. A supporting member 17 is provided parallel with the side wall 16 of the yoke 13, and this element is fitted in the base 11 in a manner not particularly shown in the drawing by means of a suitable lug thereon and is inserted in suitable cutout portions in the yoke 13 by means of two lugs 18 so that it will be held in fixed position. This supporting member 17 has a window-like cutout portion 19 within which an element 21 is slidably guided which, in turn, is rigidly connected with the insulating element 20. The latter carries the contact bridge 15 which is made of an angular piece of metal which passes through the insulating element 20 and the lower end 22 of which extends within the range of two contact springs 23 and 24. The insulating element 20 is also connected with a rod-shaped member 25 which is electrically insulated from the contact bridge 15 and slidable within the yoke 13 against the action of a spring 26. The push button 27 is provided for depressing the rod 25.

On the side of the switch opposite the supporting member 17 a bimetallic spring 28 is provided the free end of which carries a contact 29 which, when the overload switch is in connecting position, is in engagement with the contact bridge 15. The contact 29 has a projection 30 which is adapted to engage the contact bridge 15 to hold the same in the connecting position as illustrated. The bimetallic spring 28 carries a coil 31 and superimposed thereon a coil 32. One end of the two coils 31 and 32 is connected with the bimetallic spring 28, while the other end of the coil 31 is connected with the terminal 33, and the other end of the coil 32 is conductively connected with the terminal 34. The screw 35 not only serves to secure the two contact springs 23 and 24 in a fixed position but also to mount the terminal 36 on the base 11, the terminal being conductively connected with the contact springs 23 and 24.

By providing two separate heating circuits which act upon the bimetallic strip it is possible to apply the switch for operating various types of consecutive circuits which could previously be accomplished only by numerous circuit components. For example, the switch may be used to effect in a simple manner a delay in the connection of a second load circuit caused by the connection of a first load circuit in such a manner that the current for the first circuit flows through the heating coil and the bimetallic element, whereas the current for the second circuit is

passed through the second heating coil or the bimetallic element and the switch contact thereof.

Fig. 4 illustrates the application of a switch according to the invention for producing an automatic delayed disconnection of the auxiliary phase 37 of an alternating-current motor as a function of the connection of the main phase 38. After engaging the switch 39, 40, the current will then flow from the terminal 41 of the source of current through this main switch, the heating coil 8 and the bimetallic strip 6, through the main phase 38 and then back through the other switch 40 to the second terminal 42 which is connected to the source of alternating current. The auxiliary phase 37 with the condenser 43 is also supplied with current through the heating coil 8 of the bimetallic strip and the contacts 5 and 2 thereof. When a certain predetermined length of time has elapsed during which the operation of the motor has been properly started, the bimetallic strip has bent under the influence of the heat of the current to such an extent that the auxiliary phase will be disconnected by opening the contacts 5 and 2. By interrupting the auxiliary phase current flowing through the heating coil 8, the thermal load on the bimetallic switch is relieved and the switch is heated only to the extent necessary to hold the contacts 5 and 2 open while the motor is in normal operation.

In the embodiment of the invention shown in Fig. 5, the current is again supplied to the terminals 41 and 42, and also in this case a switch 39, 40 is provided. The bimetallic strip 6 is connected to the conduit coming from the terminal 41, and the current flows through this strip and then through the coil 8 to the armature of the ventilator motor 12 and then back to the terminal 42.

The contacts 5 and 2 are at first spaced from each other. When a certain length of time has elapsed, the bimetallic strip will be bent to such an extent that the contacts 5 and 2 will be closed, whereby the heating coil 12a is also connected into the circuit. By this manner it is possible to prevent the coil from ever being heated to too high a temperature inasmuch as in this particular case the ventilator motor 12 will always first be started.

Fig. 6 illustrates the application of the new switch as a motor protective switch. The motor has two electrically separate groups of windings 44 and 45 for different operating currents, as this is the case, for example, in the field winding and the armature winding of a shunt-wound electric motor. Nevertheless it is possible to control both windings reliably by a single switch by connecting the smaller winding 44 to the main circuit through the switch contacts 2 and 5 and the heating coil 8 of the bimetallic strip, and the larger winding 45 through the switch contacts 2 and 5 and the bimetallic strip 6.

In the wiring system as shown in Fig. 7, the two half windings 44 and 45 of the motor are in parallel and connected to the 110 volt mainline, on the one hand, through the terminal 46 and, on the other hand, through the contact 2 and line 4. One of the motor circuits consists of the main power line, stationary contact 2, movable contact 5, bimetallic strip 6, terminal 7, motor winding 45, and line terminal 46, while the other motor circuit consists of the main line 4, stationary contact 2, movable contact 5, heating coil 8, terminal 9 leading to terminal 9', heating coil 8', movable contact 5', bimetallic strip 6', motor winding 44, and line terminal 46. The auxiliary phase consisting of the parallel auxiliary phase windings 48 and 49 and the condenser 43 lies, on the one hand parallel with the terminal 46 and, on the other hand, the stationary contact 2' of the second thermal switch 47'.

The circuit illustrated in Fig. 8 is substantially similar to the one shown in Fig. 7. The motor windings 44 and 45 lie in series and, in turn, parallel with the auxiliary phase through the terminal 46 and the contact 2'. The auxiliary phase also in this case comprises the two windings 48 and 49 and the condenser 43, both auxiliary phase windings being connected in series.

5

The switches as illustrated in Figs. 7 and 8 operate as follows: If the motor is connected to the current, the switches remain in closed position during the starting period. At the end of that period, the auxiliary phase is disconnected by the heating coil of the auxiliary-phase switch 47' being heated through such operation, thereby opening the contacts 5' and 2'. Since the auxiliary-phase switch lies in the circuit of the motor windings, it remains in open position during the entire operation. If the motor is being overloaded, it will cause additional heating of the heating coil 8 of the motor-protective switch so that the latter will also open and again close when cooled. These switching operations, however, do not affect the auxiliary phase since the auxiliary-phase switch is designed accordingly.

Figs. 9 and 10 illustrate the use of the switch shown in Fig. 1 as an auxiliary-phase switch and the switch shown in Fig. 3 as a motor-protective switch as applied to an alternating-current motor connected to a main line of either 110 or 220 volts.

In both circuit diagrams the numerals 44 and 45 indicate the two motor windings, 50 the motor-protective switch, 47' the auxiliary-phase switch, and 43, 48 and 49 the auxiliary phase consisting of the two auxiliary-phase windings 48 and 49 and the condenser 43.

In the diagram shown in Fig. 9, the motor circuit extends from the main line 36 through the switch contacts 22, 23, 24, the switch contact 29, to the bimetallic strip 28, and then, on the one hand, through the heating coil 32, the terminal 34 and one half of the motor winding 45, and, on the other hand, through the heating coil 31, the terminals 33 and 9', the heating coil 8', the movable contact 5', the bimetallic strip 6' and the other group of motor windings 44 to the second main-line terminal 46. The auxiliary phase circuit, however, extends from the stationary contact 2' of the auxiliary phase switch 47' through the condenser 43 and the two parallel auxiliary phase windings 48 and 49 to the terminal 46 and hence to the second main line. In the circuit shown in Fig. 9 as well as in that shown in Fig. 10, the bimetallic strip 28 may replace the second heating coil 32 and form the second path of the current. In the diagram shown in Fig. 10, the motor circuit extends from the first main line 36 through the switch contacts 22, 23, 24, the make contact 29, the bimetallic strip 28, and the parts 31, 33, 9', 8', 5', 6', 7', 44, and 45 to the second main line 46. The auxiliary phase circuit, on the other hand, again extends from the stationary contact 2' of the auxiliary phase switch 47' through the condenser 43 and the two auxiliary phase windings 48 and 49 which are connected in series to the terminal 46, and hence to the second main line.

The circuits illustrated in Fig. 9 and 10 operate similar to those shown in Figs. 7 and 8, except for the fact that the motor-protective switch 50 must in each case be manually engaged by means of the push button 27, as shown in Fig. 3.

While the foregoing description sets forth in detail

6

what I regard as the preferred embodiments of my invention, it is to be understood that numerous changes may be made therein without departing from the spirit and scope of the invention as defined in the appended claims.

Having thus described my invention, what I claim as new is:

1. A current depending switch comprising a bimetallic strip which is stationary at one end and carries at its free end a first and second contact piece at opposite sides thereof, a first counter-contact which is stationary and confronts the first contact piece, the free end of the bimetallic strip upon being heated, being moved from the first counter-contact, a second stationary counter-contact confronting the second contact piece and against which the free end of the strip is moved upon heating, a heating coil mounted on the bi-metallic strip, the coil being connected at one end electrically with the strip in the vicinity of the contact piece thereon, the other end of the coil being electrically connected with the second contact piece, the strip in its idle position having its first contact piece engaged with the first counter-contact while the second counter-contact is spaced from the second contact piece and wherein the first contact piece and first counter-contact are spaced when the strip is heated and the second contact piece and second counter-contact are in engagement.

2. A current depending switch in accordance with claim 1 further including a pair of supports, and means for mounting a said counter-contact on each support for adjustment in the direction of motion of the contact pieces.

3. A current depending switch in accordance with claim 2 and including a housing, said supports extending through the wall of the housing and carrying terminals outwardly thereof, a further terminal extending from the housing, means securing an end of the bi-metallic member to said terminal and housing and means securing said first named terminals to said housing.

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