May 9, 1950 L. BODDY 2,507,365

TEMPERATURE RESPONSIVE SWITCH

Original Filed Feb. 13, 1942

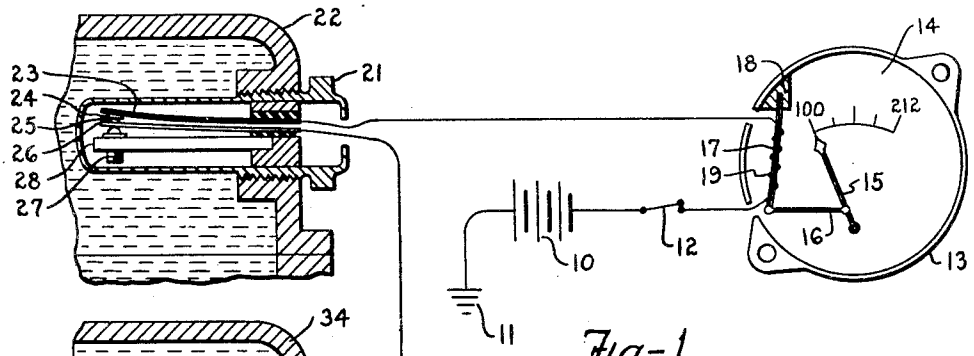
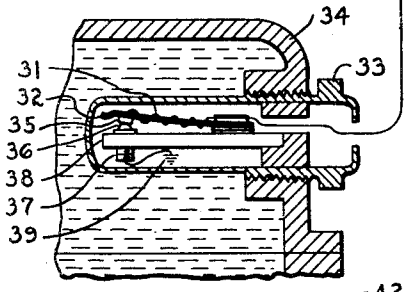


Fig.-1.



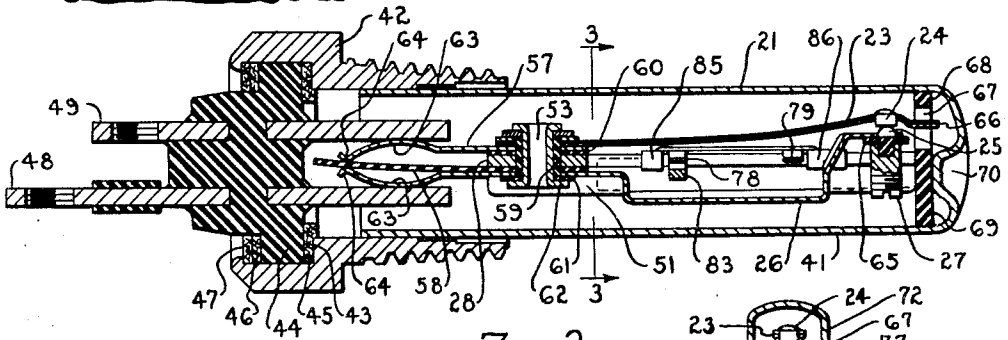


Fig.-2.

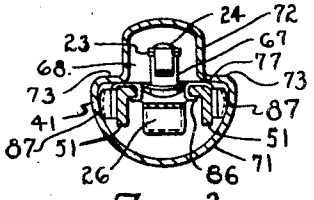


Fig.-3.

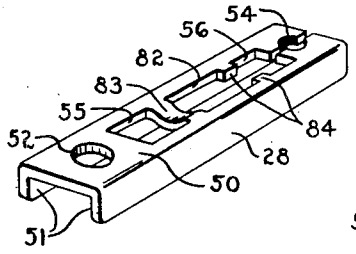


Fig.-5.

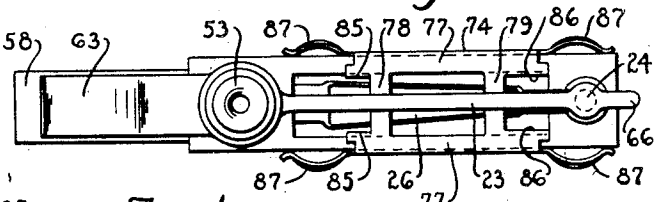


Fig.-4.

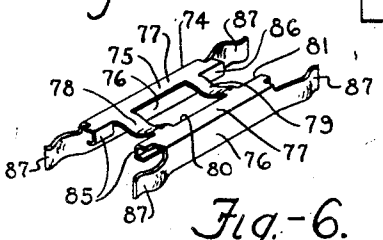


Fig.-6.

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TEMPERATURE RESPONSIVE SWITCH

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Original application February 13, 1942, Serial No. 430,785. Divided and this application January 5, 1946, Serial No. 639,263

12 Claims. (Cl. 200—138)

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My invention relates generally to electrical switches and particularly is directed to a switch responsive to temperature changes.

It has been found in internal combustion engines having a plurality of cylinder blocks that, even though a common cooling system or radiator is provided, one of the blocks may exceed a safe temperature. For example, in an internal combustion engine of the V-type it has been common to connect the water jackets of the two cylinder blocks to a common radiator and to provide forced circulation of the cooling fluid. In one of the motor blocks there has been placed a temperature responsive device for transmitting current to an indicating instrument located on the dashboard or instrument panel of the motor or vehicle. This provides an indication of the general operating temperature of the motor, but it is not sufficiently sensitive to respond to an abnormal condition occurring in the other motor block. In accordance with the disclosure I provide means in one of the motor blocks to obtain an indication of the temperature during normal operation and means in the other cylinder block which will be responsive to any abnormal condition to provide an indication on the same instrument. In a broader view, the system is applicable to any multi-unit device and includes means responsive to one of the units to give a relative indication of the operating temperature of all of the units, and to give an accurate indication of the operating temperature of that particular unit, and which further includes means responsive to each of the other units and effective whenever the temperature of the associated unit exceeds a predetermined amount to produce an indication on the instrument that at least one of the units has exceeded a safe or predetermined temperature.

The system above referred to is described in my copending application Serial No. 430,785, filed February 13, 1942, now abandoned. The present application is a division of that copending application.

The primary object of the present invention is to provide a switch embodying improved principles of design and construction whereby the switch may be employed in conjunction with various systems, including the one referred to.

A particular object of the invention is to provide a temperature responsive unit in which improved means are provided for positioning and resiliently supporting the operating mechanism of the unit.

An important object is to provide a switch

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structure embodying a switchback carrying terminal means and operating means provided with contact means adapted for cooperation with the terminal means in a predetermined manner.

An additional object of the invention is to provide a switch comprised of few parts which can be easily and quickly assembled together on a production basis.

Another object of the invention is to provide a switch which is very sensitive, yet positive and efficient in operation.

Other and further objects of the invention will become more readily apparent by reference to the following description taken in connection with the accompanying drawing, wherein:

Figure 1 is a fragmentary, largely schematic representation of the devices and the circuit comprising the electrical indicating system of said copending application;

Figure 2 is a cross-sectional view of the switch or temperature responsive unit, constituting the subject invention, illustrated in the upper left portion of Figure 1;

Figure 3 is a transverse section taken substantially on line 3—3 of Figure 2;

Figure 4 is a top view of the operating mechanism of the unit depicted in Figure 2;

Figure 5 is a perspective view of the frame part which supports the operating mechanism; and

Figure 6 is a perspective view of the resilient means employed for positioning and resiliently mounting the operating mechanism in the housing or casing of the switch.

In order to obtain a clear understanding of the application of the temperature responsive unit or switch constituting the present invention, substantial portions of the disclosure in the said copending application are submitted in the present application.

Accordingly, Figure 1 of the drawing shows a source of power or voltage such as battery 10, one side of which is connected to the ground 11. The source of voltage 10 may comprise a storage battery in a vehicle and, as is well known, this voltage source is subject to variations in voltage. The other side of the source of electrical power 10 is connected through a switch 12 to an indicating instrument 13 which is of the cumulative responsive type. This instrument is provided with a dial 14 having indications thereon for cooperation with an indicating hand 15. The indicating hand 15 is actuated through a member 16 by a bimetallic element 17 suitably mounted at 18 upon the frame or case of the instrument 13. An electrical heating element 19 is provided

for heating the bimetallic element 17, and this heating element is connected in series between the switch 12 and a temperature responsive device 21.

The temperature device 21, constituting the subject invention, is shown located in an opening provided in a water-cooled motor block 22. The temperature responsive device includes a casing secured in a suitable opening in the motor block 22. Operating mechanism is disposed within the casing and, among other things, comprises a bimetallic element 23 suitably insulated and supported, a contact 24 supported adjacent the end of and by the bimetallic element 23, a cooperating contact 25 mounted upon a suitable adjustable support and conductor 26 which is positioned by an adjustable screw 27 mounted in a fixed frame or support 28. The adjustable screw 27 mounted in the fixed support 28 is provided for adjustment of the position of the lower contact 25 so as to accurately predetermine the temperature at which the bimetallic element 23 will open the contacts 24 and 25. The contact 25 is positioned so as to cause interruption of the electrical circuit whenever the temperature of the cooling medium within the block 22 exceeds a predetermined amount. The lower contact 25 and the supporting conductor 26 are electrically connected to a heating element 31 surrounding a bimetallic element 32 supported within a temperature responsive device 33 which is supported within a suitable opening in the water jacket in the other motor block 34. The temperature responsive device 33 has the heating coil 31 for the bimetallic element 32 connected to an electrical contact 35 mounted on the end of the bimetallic element 32. The electrical contact 35 is arranged to cooperate with an electrical contact 36 adjustably supported by a screw 37 from a fixed support member 38. The adjustable contact 36 is connected to ground 39 through the adjustable screw 37 and the support 38. It therefore becomes apparent that there is provided a series circuit which may be traced from the ground 11 through battery 10, switch 12, heating coil 19 of the instrument 13, bimetallic element 23, contacts 24, 25, and the conductor 26 of the heat responsive device 21 and through the heating coil 31, the contacts 35 and 36 to the ground 39 in the heat responsive device 33.

The indicating instrument 13 is of the type which has the indicating hand 15 positioned adjacent the highest temperature on the scale whenever a minimum amount of current or no current at all is being received by the heating coil 19 of the indicating instrument. The elements within the heat responsive device 33 in the block unit 34 of a motor or other device operates to transmit a series of impulses through the elements of the heat responsive device 21 to the indicating instrument 13. The action of the bimetallic element 32 of the transmitting device 33 is such that the contacts 35 and 36 are alternately opened and closed at a relatively high rate so as to transmit impulses varying in frequency and in duration. Irrespective of the condition of the source of power 10 the transmitting device 33 requires that for each temperature or each condition of the variable factor to be indicated there must be supplied a certain amount of heat to the bimetallic element 32. As the amount of heat received by the transmitting device 33 from the surrounding medium or from the motor block 34 increases, less electrical power is required to produce periodical opening and closing of the contacts 35 and 36 so that a decreased amount of

power is received by the heating coil 19 located about or adjacent to the bimetallic element 17 of the indicating instrument 13. When this occurs the indicating hand 15 is moved toward a higher indication. If the electrical circuit is interrupted by the opening of the switch 12, no power is received by the heating coil 19 of the indicating instrument so that the bimetallic element cools to move from the warped position shown in the drawing to a substantially straight position thereby moving the hand 15 to the highest indication on the dial 14. If, while the switch 12 is closed, the heat responsive device 21 reaches a temperature beyond a predetermined amount which has been considered the limit to which the motor block 22 may be safely heated, the bimetallic element 23 will open the contacts 24 and 25 thereby causing an indication to be produced on the instrument 13 showing that in one of the units of the motor the safe predetermined temperature has been exceeded.

From the circuit arrangement shown and described it will be noticed that the bimetallic element 23 of the heat responsive unit 21 serves as a conductor for the impulses being transmitted through the circuit. This produces an operation which is deemed to be desirable. If it is assumed that an abnormal condition is developing in the motor block unit 22, the temperature thereof is rapidly increasing. Due to the heating effect of the current passing through the bimetallic element 23 of the heat responsive device 21, the contacts 24 and 25 will be opened at a temperature which is slightly below, by a few degrees, the temperature which should not be exceeded for any length of time in order to prevent damage to the operation of the motor. Since the temperature of that unit of the motor is increasing, more and more heat is being transmitted to the temperature responsive device 21 so that the bimetallic element 23 will continue to remain in a position where the contacts 24 and 25 will remain open thereby preventing an operating condition for a period wherein these contacts might open and close several times while the temperature of the motor unit is passing through the upper limit of the predetermined safe temperature. Thus, the switch contacts 24 and 25 will not have a period of operation which might be in step with the opening and closing of the contacts 35 and 36 of the unit 33 thereby delaying the indication of the abnormal condition on the instrument 13 since this instrument is responsive to the cumulative effect of current transmitted through the circuit. While for purposes of illustration Figure 1 shows but one unit 21 responsive to a temperature in excess of a predetermined amount, it of course will be apparent that in a multi-unit device having more than two units, a plurality of series connected devices corresponding to device 21 will be employed. Each unit except one will have a device corresponding to device 21 and the remaining unit will be provided with a temperature responsive device corresponding to the device 33 which provides a continuous accurate indication of the operating temperature of that unit and also provides a relative indication of the operation of all units so long as there is no abnormal operation of any one of the individual units.

Thus the aggregate power transmitted by a series of impulses by the temperature responsive device 33 will vary inversely with respect to increases in the temperature or variable factor to be indicated. Since the indicating instrument 13

is one which in respect to the aggregate power received in the form of current impulses to produce an indication of decreased value upon an increase in the aggregate power received it is apparent that when a minimum amount of power or no power is received by the instrument that the indication is a maximum value. This maximum value is equal to or in the vicinity of the temperature value above which it is unsafe to continue the operation of the motor.

In Figure 2 there is shown a cross-sectional view of a temperature responsive device such as 21 shown in Figure 1. This device comprises a tubular casing 41 suitably soldered or secured to a support member 42 which is provided at one end with threads for cooperation with the threads in the opening of the motor block, and at the other end with suitable surfaces which may be gripped by a wrench of tool to insure that the temperature responsive device is properly mounted in the motor block so as to prevent leakage of the cooling medium. The inside of the supporting member 42 is suitably recessed at 43 so as to receive a switchback or block of insulating material 44 which is disposed against suitable packing 45 and retained in position by a washer 46, ring 47, and peening over the support member. The insulating member 44 completely closes the passage to the interior of the casing or housing 41, and provides means for conducting current to and from the interior by relatively rigid terminal contact means 48 and 49. These terminals 48 and 49 are preferably flat and extend through the insulating material 44 in spaced apart parallel relation.

The operating mechanism of the switch as illustrated in Figures 4 through 6 constitutes an assembly or unit that is adapted for disposition in the casing or housing prior to fastening the switchback in place. This assembly, among other things, includes the frame 28. This frame is preferably elongated and channel-shaped, comprising a generally planar top wall 50 and side walls 51. The top wall is provided with a hole 52 at one extremity for the reception of a rivet 53 and a threaded aperture 54 at its other extremity for the screw 27. The top wall is also provided with openings 55 and 56.

The inner extremity of resilient contact means 57 is secured in lapped engagement with the outer end of the bimetallic strip 23 by the rivet 53. This rivet also serves to secure the conductor 26 and a flexible elongated flat tongue 58 of insulation to the frame 28. The strip 23 and the conductor 26 are insulated from each other except at 24 and 25 and with respect to the frame 28 by suitable insulation. More specifically, in this respect, an insulator sleeve 59 surrounds the rivet 53 and passes through an insulating washer 60 disposed on one side of the frame, through the tongue 58 engaging the opposite side of the frame, and through an insulating washer 61 disposed between the head 62 of the rivet and the conductor 26. The outer resilient extremity of the conductor 26 and the outer extremity of the resilient contact means 57 are preferably substantially identical in character. Each includes a lateral curved or bowed portion 63 and an onturned end portion 64. The curved portions 63 are adapted to be received between and resiliently engage the terminal portions 48 and 49, when the switchback 44 is secured in place. The end portions 64 of the contact means are insulated from each other by the insulator tongue 58 which is preferably of a width greater than the width of the resilient portions of the contact means and extends an appropriate distance in advance of the ends.

The contact 24 adjacent the inner free extremity of the bimetallic strip or element 23 normally engages the contact 25 carried by the inner end of the conductor 26, as alluded to above. The contact 25 and the conductor 26 are insulated from the screw 27 by an insulating washer 65. The screw enables the contact 25 to be adjusted so as to determine accurately the temperature at which the element 23 will open or break the circuit between the contacts 24 and 25. It will be noted in Figure 5 that the top wall 50 of the frame is split through the aperture 54. This arrangement causes the material defining the aperture to resiliently grip the screw and automatically lock the same to any position to which it may be adjusted. The end 66 of the element 23 is guidingly received in a generally rectangular opening 67 provided in the upper extremity 68 of an insulating part 69. The part 69 is seated in a transverse position against an indentation 70 formed in the end wall of the housing 41, and consequently is spaced inwardly from the remainder of the end wall to provide sufficient clearance for the operating end of the element 23. Thus, when a predetermined temperature has been exceeded to cause the element 23 to open the contacts 24 and 25 the element will be limited in its movement by the engagement of its end 66 with the upper marginal edges of the opening 67 to prevent the element from contacting the housing 41.

The housing 41 is preferably provided with a pair of corresponding longitudinally extending grooves constructed and arranged whereby to form generally curved and square channel portions 71 and 72, respectively, which are joined together by shoulder portions 73, as illustrated in Figure 3. The upper extremity 68 and the lower extremity of the insulator part 69 are disposed in the square and curved channels, respectively, of the housing.

As stated above, one particular object of the invention is to resiliently support the operating mechanism in the housing. This in part is accomplished by associating a resilient mounting 74 with the frame 28 as clearly illustrated in Figures 2, 3, 4 and 6. The mounting is preferably generally channel in shape and, among other things, includes a base wall 75 and side walls 76 which engage the top wall 50 and side walls 51 of the frame, respectively. The base wall 75 preferably includes a pair of longitudinally extending portions 77 connected together by bridge portions 78 and 79, the portions being formed by suitable cutouts or openings 80 and 81 which register with an opening 82 and the opening 56 in the frame, respectively. The frame 28 is provided with an indented cross-portion 83 and a pair of oppositely disposed spaced lugs 84. The bridge portion 78 of the mounting is also correspondingly indented and the same is true of the bridge portion 79 which projects into the space between the lugs 84, all of which serves to provide clearance for the operation of the element 23.

The mounting 74 is preferably affixed to the frame 28 by providing the mounting with two pairs of locking projections 85 and 86 which extend into the cutouts 55 and 56 and are bent over against the under surface of the top wall 50 of the frame. The side walls 76 of the mounting are preferably provided with curved resilient end continuations 87 which are adapted to resiliently bear against the inner surface of the curved

channel portion 71 and the longitudinally extending portions 77 are adapted to normally bear against the shoulders 78 joining the curved and square channel portions of the housing or casing 41.

Accordingly, it will be apparent that the operating mechanism is resiliently supported in a predetermined position within the casing or housing and is suitably insulated therefrom. It will also be evident that it is a simple matter to secure the switchback 44 in place so that the terminal contact means 48 and 49 carried thereby receive and are resiliently engaged by the resilient contact means; and that the operating means is sealed within the confines of the housing. Moreover, it will be manifest that the insulating part 69 provides a stop for the inner extremity for the frame 28 for limiting movement of the mechanism in one direction and that the free end of the tongue 58 may engage the carrier or block 44 for limiting the movement of the mechanism in another direction. The resilient mounting provides means whereby the switch mechanism may be gradually eased into the housing without in any way affecting the set positions of the sensitive parts.

While for the purpose of simplicity in illustration and to facilitate the description of the operation of my invention, there has been shown the application of my invention to a water-cooled motor having two cylinder blocks, it of course will be apparent that my invention may be applied to any other devices having the same or a greater number of units in which it is desired to obtain an indication of the operating temperature of one of the units and an indication whenever a predetermined temperature is exceeded in any of the other units. For example, the invention is applicable to a multi-cylinder air-cooled engine in which case a device corresponding to the temperature responsive device 33 is provided for one of the cylinders, and a plurality of devices corresponding to the device 21 are provided for the remaining cylinders. All of these devices are then connected in series with the source of power and the indicating instrument. Under normal conditions the one device 33 will give an accurate indication of the operating temperature of its cylinder, and a general indication of the normal operating temperature of all of the cylinders. Upon abnormal operation of any other cylinder in excess of a safe temperature its device 21 will interrupt the circuit to produce an indication on the instrument telling the observer that an abnormal condition exists.

It therefore will become apparent that I am not to be limited by the specific disclosure or description since it is apparent that modifications may be made in the instruments, in the number of instrumentalities employed, and in the circuit arrangement without departing from the spirit and scope of my invention as set forth in the appended claims.

I claim:

1. Operating mechanism for an electric switch including, a frame, an elongated contact, disposed substantially on one side of the frame, a resilient contact and a bimetallic element disposed adjacent the opposite side of said frame, fastening means passing through said frame, through an intermediate portion of said elongated contact, said resilient contact and through said element in a manner whereby said frame is insulated therefrom, an insulator, and means whereby said insulator may be moved to direct a portion of said elongated contact in a predetermined plane.

2. Operating mechanism for an electric switch comprising, a frame provided with an opening, an elongated resilient contact connected at one end to one extremity of the frame, a flexible elongated contact secured adjacent one end to the said one extremity of said frame, the other end of said flexible contact projecting into said opening for engagement with the other end of said resilient contact, and means for moving one contact with respect to the frame.

3. Operating mechanism for an electric switch comprising, a frame provided with an opening, an elongated resilient contact connected at one end to one extremity of the frame, a flexible elongated contact secured adjacent one end to the said one extremity of said frame, the other end of said flexible contact projecting into said opening for engagement with the other end of said resilient contact, and means for simultaneously moving the other ends of said contacts in a predetermined plane.

4. An operating mechanism for an electric switch including a frame, a movable contact having a portion disposed at one side of the frame, another contact and a bimetallic element disposed at the other side of said frame, means securing and insulating said movable contact, said another contact, and said element with respect to said frame, and means whereby the movable contact may be adjusted relative to said another contact.

5. An operating mechanism for an electric switch including a frame, a movable contact having a portion disposed at one side of the frame, another contact and a bimetallic element disposed at the other side of said frame, means securing and insulating said movable contact, said another contact, and said element with respect to said frame, means whereby the movable contact may be adjusted relative to said another contact, and means carried by said frame arranged to provide a yieldable support for said operating mechanism.

6. An operating mechanism for an electric switch including a metal frame, an elongated contact member having a portion disposed at one side of the frame, another contact member and a bimetallic member disposed at the other side of said frame, fastening means passing through all of said members, means insulating the frame from such members, and means insulated from the contact members for effecting relative adjustment therebetween.

7. An operating mechanism for an electrical switch including a metal frame, an elongated contact member having a portion disposed at one side of the frame, another contact member and a bimetallic member disposed at the other side of said frame, fastening means passing through all of said members, means insulating the frame from such members, means insulated from the contact members for effecting relative adjustment therebetween, and means carried by said frame arranged to provide a yieldable support for said operating mechanism.

8. An operating mechanism for an electric switch comprising a frame, an elongated contact having yieldable extremities, means for connecting an intermediate portion of this contact with respect to one side of the frame, contact means mounted on and insulated with respect to another side of the frame and having yieldable portions disposed opposite the yieldable extremities

of said elongated contact, an insulator arranged to prevent electrical engagement between one of the yieldable extremities of the elongated contact and an adjacent yieldable portion of the contact means and between the elongated contact and said frame, and means provided adjacent the other yieldable extremity of the elongated contact and the other adjacent yieldable portion of the contact means for effecting relative adjustment therebetween.

9. An operating mechanism for an electric switch comprising a frame, an elongated contact having yieldable extremities, means for connecting an intermediate portion of this contact with respect to one side of the frame, contact means mounted on and insulated with respect to another side of the frame and having yieldable portions disposed opposite the yieldable extremities of said elongated contact, an insulator arranged to prevent electrical engagement between one of the yieldable extremities of the elongated contact and an adjacent yieldable portion of the contact means and between the elongated contact and the frame, and means carried by said frame arranged to provide a yieldable support for said operating mechanism.

10. An operating mechanism for an electric switch comprising a metal frame, a flat insulator member engaging one side of the frame, an elongated contact member engaging said insulating member and having yieldable extremities, an insulating washer engaging the outer surface of said elongated contact member, a pair of insulator members disposed at the opposite sides of the frame, a pair of overlapping contact members arranged between said pair of insulator members and having portions located adjacent the yieldable extremities of said elongated contact member, fastening means extending through the frame, contact members, and insulator members for holding the same assembled, means insulating the fastening means from the frame and contact members, and one of said insulator members

being provided with a part arranged between a yieldable extremity of the elongated contact member and an adjacent portion of one of the pair of contact members whereby to prevent electrical contact therebetween.

11. An operating mechanism for an electric switch including a frame, a movable contact having a portion disposed at one side of the frame, another contact and a bimetallic element disposed at the other side of said frame, means securing and insulating said movable contact, said another contact, and said element with respect to said frame, and means whereby one contact may be adjusted relative to the other.

12. An operating mechanism for an electric switch including a frame, means on said frame providing a resilient support for said operating mechanism, a movable contact having a portion disposed at one side of the frame, another contact and a bimetallic element disposed at the other side of said frame, means securing and insulating said movable contact, said another contact, and said element with respect to said frame, and means whereby one contact may be adjusted relative to the other contact.

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