July 28, 1953 E. J. POITRAS 2,647,188

ELECTRICAL SWITCH CONTACT MEANS

Original Filed April 19, 1946

Fig. 1

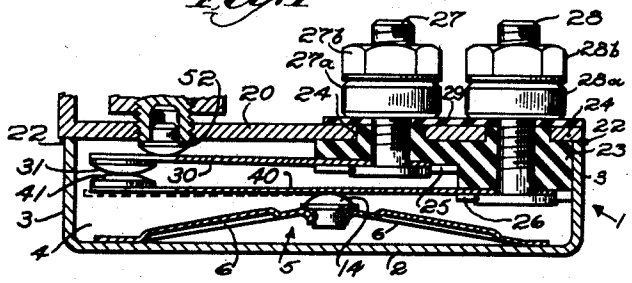


Fig. 2

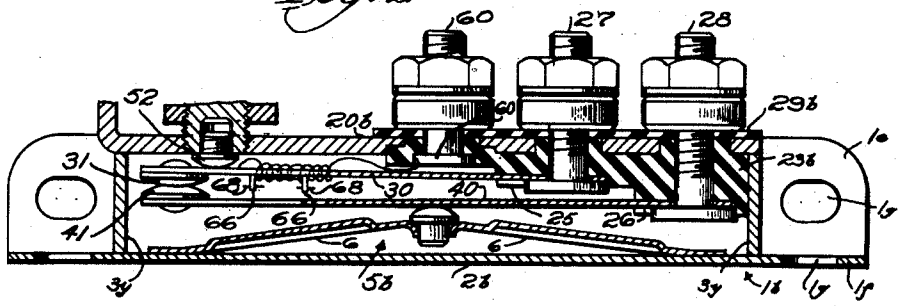


Fig. 3

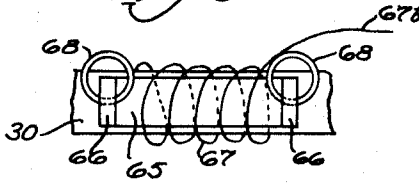
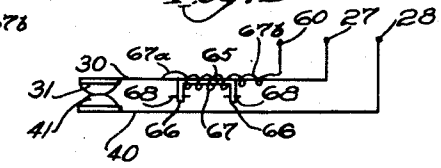


Fig. 4



INVENTOR.

Edward J. Poitras

BY

Emery, Booth, Townsend, Miller & Weidner

Att'ys.

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ELECTRICAL SWITCH CONTACT MEANS

Edward J. Poitras, Holliston, Mass.

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5 Claims. (Cl. 200—122)

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This invention relates to electrical circuit makers and breakers. More particularly it aims to improve the construction, arrangement and operation of contact elements or means having general utility in connection with electrical switches of various types and including especially those of the thermal responsive class.

This application is a division of my copending application Serial No. 663,281, filed April 19, 1946, now Patent No. 2,496,917.

In the drawings illustrating by way of example certain embodiments of the invention:

Fig. 1 is a longitudinal sectional view of a switch embodying the contact means of the invention, the switch in this instance having a thermally responding actuator;

Fig. 2 is a generally similar view of a further embodiment of the invention including additional features which are applicable also in connection with the embodiment of Fig. 1; and

Figs. 3 and 4 are respectively an enlarged and partly schematic bottom plan view of a portion of one of the contact leafs of Fig. 2, and a wiring diagram pertaining to Fig. 2.

As above noted the invention here is particularly concerned with novel construction, arrangement and manner of operation for the contact elements proper, such as the pair of leafs **30**, **40** of Figs. 1 and 2 having electric contacts or buttons **31**, **41** respectively riveted or otherwise fastened in normal opposed relation at or adjacent the leaf ends remote from the supported ends. These contacts proper **31**, **41** may be of silver or other conductive material as preferred for the purpose.

The switch leafs **30**, **40** are formed of metals or alloys of good electrical conductivity, the materials, construction and arrangement being such as to provide for substantial columnar stiffness lengthwise the leafs and for transverse springiness (vertical in Figs. 1 and 2) adequate for efficient spring action under the expected operating temperature conditions. The leafs preferably have an initial spring bias, respectively away from each other in the illustrated example; that is, the longer leaf **40** for example is biased downward, while the upper and shorter leaf **30** is oppositely spring biased against a reference element **52**.

In addition to the properties of electrical conductivity, longitudinal rigidity and lateral spring bias for the respective leafs **30** and **40**, and as a main feature of the present invention, the materials thereof are also selected to provide a distinct expansion differential as between the two leafs, taking into account the coefficient of expansion of the ceramic or other insulating locator **23**. The lower leaf **40** preferably has the higher expansion coefficient.

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The locator or precision mounting element **23** is in the example of Fig. 1 fixed at the inner face of a cover **20** for the metallic case or body of the switch, designated generally at **1** and including a bottom **2** and a peripheral wall **3** defining a cavity or compartment **4** within which several operating parts are enclosed.

The leaf mounting element or locator **23** is of electrical insulating and heat resistant material, preferably a ceramic. This locator **23** is positioned and aligned on and relative to the cover **20** and hence also to the case **1** as by bosses **24** at the upper face of the locator **23** and fitted into apertures provided for the purpose on the cover **20**. Further positioning of the locator **23** relative to the case body may be had by abutment with the adjacent end portion of the peripheral wall **3**.

The inner or lower portion of the locator **23** of the examples has two levels respectively presenting vertically spaced aligned longitudinal positioning channels **25** and **26** for the pair of switch leafs **30** and **40**. These extend lengthwise of the case in the portion of the cavity **4** above a button **14** of the actuator or bridge **5**, again referred to later. The two leafs **30**, **40** and the corresponding channels **25**, **26** of the locator **23** are relatively proportioned in width and length for firm fitted reception of the corresponding ends of the leafs in the channels. The leafs **30**, **40** are thus keyed against lateral swinging or misalignment and are further held against displacement by individual threaded studs **27**, **28** headed at their lower ends and extending through apertures in the respective leafs and in the locator **23** centrally of the bosses **24** thereof. At the outside of the cover **20** the studs **27**, **28** project through insulation **29** and are held by lock nuts **27***a*, **28***a*. The projecting portions of the studs constitute terminals for connecting electric conductors, being provided for the purpose with washers and hex nuts as at **27***b*, **28***b*. As above noted the switch leafs **30**, **40** are constrained from angular motion about their respective studs **27**, **28** by reason of the channels **25**, **26** of the locator, thus precluding them from inadvertent shorting or grounding against the sides of the case as might otherwise occur under the turning torque attendant on screwing down the hex nuts **27***b*, **28***b* in attaching lead wires when installing the device. The studs **27**, **28** rigidly hold the locator **23** with respect to the cover **20** and hold the leafs **30**, **40** in the channels of the

locator. On assembly of the parts, with the cover held on the case end walls and abuttively between the side wall margins and with the case and cover interwelded as at **22** the entire enclosure and contained parts become in effect a unitarily rigid structure. Also as noted, the locator **23** is of a ceramic or other insulating material preferably adapted to withstand both high temperatures and high voltages.

The described construction of the leafs **30, 40** of materials selected to provide a distinct expansion differential as between the two leafs affords a differential weld-shearing action for and at the contacts **31, 41**. This is obtained through the novel structural combination as illustrated and described, including the longitudinal stiffness of the contact-bearing leaf members **30** and **40** and the differential expansion provided for them through the use of metals having differing coefficients of expansion. Hence when the switch heats up a relative movement of the contacts **31, 41** takes place in the direction lengthwise of the leafs. This produces a shearing motion at the contact points and separates any weld that may have occurred between them. Such shearing motion is one of substantial force as applied by the differential change of length of the longitudinally stiff leafs **30, 40**. Otherwise the only force to break contact welds would be the spring force of the longer leaf **40** coming into play when the button **14** the strut **5** withdraws from the leaf under expansion of the case, and such spring force is generally inadequate to insure separation of the contacts.

In accordance with the invention, however, the differentially expanding leafs **30, 40**, being substantially straight and longitudinally rigid members, without offset, exert a shearing force which is substantial even for relatively small temperature excursions above the setting. This shearing force is additive to the spring force at the contacts resultant from the initial spring bias of the leaf **40** and insures a clean opening of the contacts, in spite of welding at the contacts. This markedly contrasts with prior devices in which the only separating force at the contacts is had by spring gradient of the contact carrying strips, under which relatively large temperature excursions above a set point may occur without separative opening of the contacts. The described weld-shearing action at the contacts is indicated in Fig. 1 by the dotted lining representative of a longitudinally shifted as well as lowered position of the under contact **41**.

As stated, the novel contact elements **30, 31** and **40, 41** having the self-shearing action by reason of the expansion differential as between the respective leafs may be employed in connection with various actuating means of switches of different types. The actuator means here illustrated by way of example comprises the bridge or strut element **5** previously referred to and which is more fully described in my parent application above identified. It is sufficient here to note that the strut **5** comprises opposed levers or arms **6** united in lengthwise angular relation at a peak where the insulator button **14** is mounted, the strut arms having the opposite ends fixed flatwise upon the case bottom **2**. Adjacent the fixed ends and at the central peak the strut **5** has flexure hinges whereby the button **14** receives transverse motion as the angle at the central peak region of the strut is increased or decreased under differential thermal action as between the strut **5** and the bottom **2** of the case, these parts being fabricated from materials chosen for a substantial differential in characteristic thermal expansion. In the examples of Figs. 1 and 2 the switches are illustrated in a form for circuit breaking on heating and with the peak of the strut **5** directed toward the contact leafs. For such operative arrangement the material of the strut **5** is selected for a relatively low thermal expansion while the material of the case **1** has a relatively higher expansion characteristic. Thus in the presence of a critical high temperature expansive lengthening of the case bottom **2**, greater than that of the strut, tends to hinge the latter toward a flatter position and to move the peak button **14** toward the case bottom **2**. As explained in the parent application, an inverse application of the actuator means may be had, to provide a switch which normally is open and which is closed in response to a predetermined temperature rise, either by reversing the relative expansibility of the strut and the case, making the strut of the more expansive material and the case of a material of lower expansion coefficient, or the similar result may be had by inverting the strut itself. In the latter instance, with the peak of the strut **5** pointed downwardly heat-effected motion of the latter will be away from the bottom **2** of the case when the latter is of the more expansible material. Or a reverse inverse action of circuit-breaking in response to temperature rise may be had by interchanging the case and the strut materials with respect to their expansibility, similarly as in the instance of the upwardly inclined strut as in Figs. 1 and 2.

Fig. 2 shows a further embodiment of the invention in which the general construction may be regarded as similar to that of Fig. 1. For illustration the switch is here shown as of the normally closed type designed to break the circuit on heating, as in Fig. 1, but it may be of any of the types previously mentioned. In this instance the case *1b* is represented as fabricated from sheet metal stock shaped to a generally rectangular enclosure form including upturned side walls, one of which has end portions bent transversely to provide end walls *3y*. Two mutually perpendicular walls, herein the bottom *2b* and one of the side walls are extended to form mounting ears *1e, 1e* and *1f, 1f*, having mounting apertures *1g*. These latter, providing for either side or bottom mounting of the switch device, desirably are elongated for ease in attachment and to allow for shift of the case relative to the supporting means in the course of thermal expansion and contraction. Similar integral or other mounting ears may be provided for the switch of the preceding figure.

In the instance of Fig. 2, the switch body including the case *1b* and the cover *20b* are longitudinally proportioned to accommodate an additional and alternatively available terminal stud **60**. The contact-bearing leafs **30, 40** and the displacement-magnifying strut element *5b* are correspondingly proportioned. The third terminal **60** of Fig. 2 provides for alternative electrical connection of certain auxiliary means providing the switch with either or both features of a snap action and of an anticipatory action compensating for "process lag" in the system or apparatus for circuit control of which the switch is to be employed.

Referring still to Fig. 2, leafs **30, 40** may be in all respects not otherwise mentioned the same as in Fig. 1, including the differential expansion

capacity and resulting weld-shearing function as already described. One of the contact-carrying leafs, herein the upper and shorter leaf **30** carries an electro-magnetic device comprising an inverted U-shaped piece **65** of magnetic material at the inner face of this leaf and having the legs **66** extended toward the other leaf **40**. A coil **67** of fine insulated conductive wire is wrapped about the yoke of the magnetic U-piece **65** and also about the leaf **30** itself, the construction desirably being such that this entire electro-magnetic device may be adjustably shifted lengthwise of the leaf **30**.

The number of turns and the resistance of the coil **67** is determined in accordance with the desired magnitude of two characteristics, namely the magnetic field desired and the heat-creating capacity desired from the coil as a resistive element. One end of the coil is flexibly connected electrically to the leaf **30** as at **67***a*. The other end of the coil is flexibly extended and connected as at **67***b* to the stud **60** as by anchorage and electrical union beneath the riveted end **60'** thereof, the stud being insulated from the cover **20***b* as by extensions of the locator **23***b* and of the exterior insulation **29***b*. For A. C. installations to smooth the magnetic force fluctuation otherwise tending to cause chatter of the contacts **31**, **41**, the electromagnetic device **65** may be provided in known manner with shading rings **68** each encircling about a one-half portion of the respective leg **66** of the magnetic piece or core **65**.

When the described electro-magnetic means is to be employed the connections for the circuit in which the switch is installed are made at the end terminal stud **28** and the auxiliary stud **60**, with no connection at the terminal stud **27**. Thus the coil **67** of the electro-magnetic device is placed in series with the switch contacts **31**, **41**, the circuit being through the stud **60**, the coil **67**, the leaf **30**, the contacts **31**, **41** and the leaf **40** and via it to the outer terminal stud **28**.

In operation, with the contacts **31**, **41** closed, the coil **67** is energized. The resulting magnetic flux in piece **65** and the immediately adjacent portion of the opposite leaf **40**, which in this instance also is of magnetic material, tends to maintain the contacts closed against force conditions acting in the separating direction. When the operative force condition overcomes the magnetic holding force sufficiently to compel a break of the electric circuit the magnetic field is destroyed. Consequently the previously magnetically held leaf **40** snaps open under the extreme force unbalance. Conversely, at the moment of establishment of the magnetic field upon circuit-closing engagement of the contacts **31**, **41** the supplemental magnetic holding force thereof tends to seal the electric circuit. Thus as illustrated in Fig. 2 a snap action is afforded in a thermostat having capacity for temperature differential as to the selective temperature setting. Further, through the described electro-magnetic means and herein by utilizing one and the same coil **67** a pre-heating lag-compensating anticipatory effect is had. During the period of contact closure and magnetic field energization the current passing through the coil **67** causes resistance heating within the thermostat case **1** and effective upon the latter and the strut **5**. The result is an effect known in other connections in this general art as "anticipation," that is, an operative preparation of the thermostat to take into account a time lag in the associated system or apparatus. Further, by shifting the position of the electro-magnetic means **65**—**68** lengthwise of the leafs **30**, **40** the thermal differential action is modified, as a function of the position of the magnetic circuit along the contact leafs.

My invention is not limited to the particular embodiments thereof illustrated and described herein, and I set forth its scope in my following claims:

I claim:

1. An electrical switch having in combination with an insulating support a pair of electrical contact-carrying metallic leafs of longitudinal columnar rigidity, said leafs relatively movable laterally to and from each other to close and to open the contacts, actuating means external to the leafs controlling said leaf movement, said leafs respectively being of such markedly different thermal expansibility as to effect a shearing action between the contacts under heat change at and commonly ambient alike to both leafs.

2. In a thermostatic switch, electrical contact-carrying spring metallic leafs relatively movable to and from each other to close and to open the contacts, thermal-responsive means for effecting said leaf movement, one leaf having a portion of magnetic material, the other leaf carrying opposite said portion a dual function electro-magnetic element including a magnetic core piece and a surrounding coil connected to energize the electro-magnetic element when the contacts are closed thereby to afford a holding action and also a resistance heating action modifying the operational temperature status at the thermostatic switch.

3. An electrical switch having in combination with an insulating support a pair of electrical contact-carrying metallic leafs of longitudinal columnar rigidity, the leafs respectively of such different thermal expansibility as to effect under heat change thereat a shearing action between the contacts, and electro-magnetic holding means on and in series connection with the leafs and correlated with said shearing action.

4. An electrical switch according to claim 3 wherein the electro-magnetic means is variably positionable lengthwise the leafs for adjusting the effective extent of the shearing action.

5. An electrical switch according to claim 3 wherein the electro-magnetic means includes a coil which is also constituted as a heater element.

EDWARD J. POITRAS.

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