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3,254,183

ELECTRICAL SWITCH PANEL HAVING THERMALLY
RESPONSIVE ACTUATING MEANS

Filed Feb. 11, 1963

2 Sheets-Sheet 1

FIG. 1

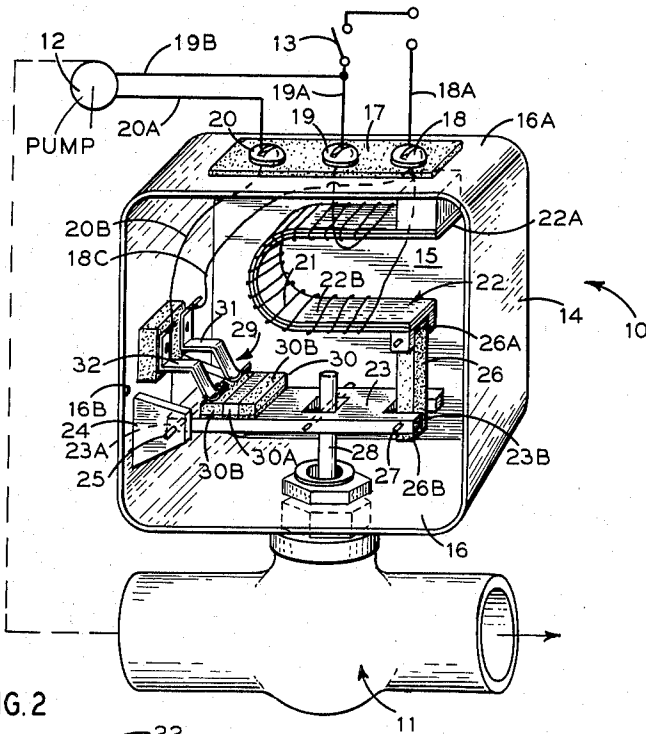


FIG. 2

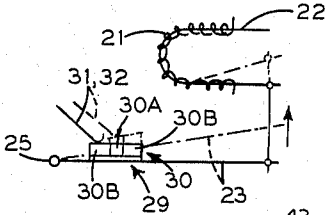
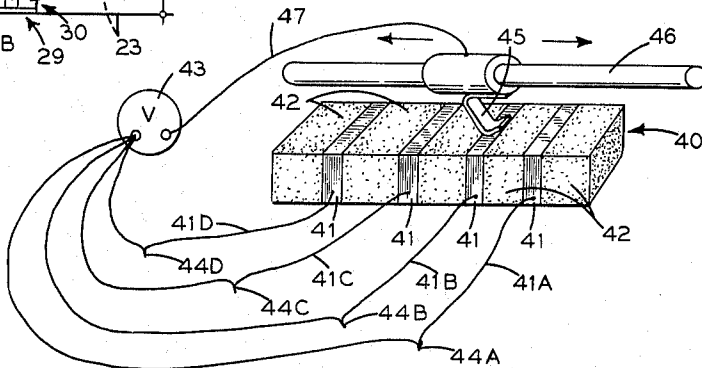


FIG. 3



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FIG. 2A

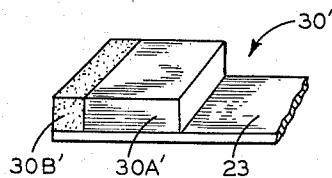


FIG. 3A

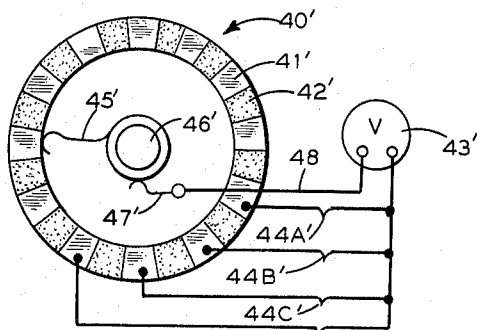


FIG. 4A

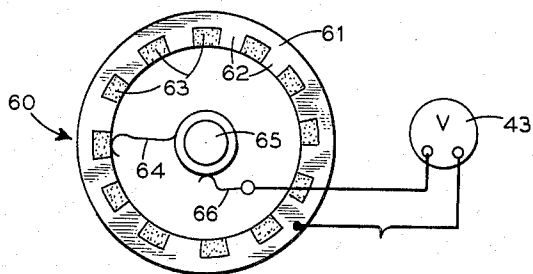
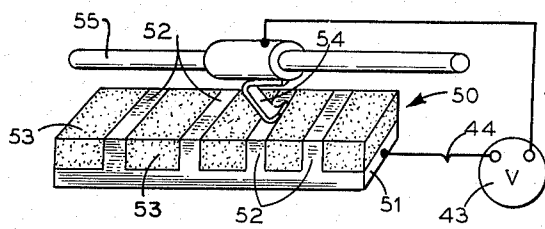


FIG. 4



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ELECTRICAL SWITCH PANEL HAVING THERMALLY RESPONSIVE ACTUATING MEANS

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6 Claims. (Cl. 200-122)

This invention relates to an actuating device, and more specifically to an electrically controlled actuating device including switching means for energizing and deenergizing a circuit in response to the operation thereof.

An object of this invention is to provide a novel actuator for electrically controlling the operation of a mechanism, e.g. a valve and the like in circuit with a fluid pump whereby the latter is actuated only when the valve has opened a predetermined amount.

Another object is to provide an actuator which can be readily coordinated electrically to operate a given circuit only when a predetermined condition has been established.

Another object is to provide an actuator with novel switching means for conditionally energizing a given circuit.

Still another object is to provide a novel actuator means readily adapted for chopping or pulsating constant voltage, or for taking multiple voltmeter readings and the like.

Still another object resides in the provision wherein the actuator embodying the invention is relatively simple in construction, relatively inexpensive to manufacture, and positive in operation.

Other objects, features and advantages will become more readily apparent when considered in view of the drawings and description thereof in which:

FIG. 1 is a perspective view of the actuator device of this invention operatively connected to a valve controlled thereby and a fluid pump for circulating a fluid through the valve.

FIG. 2 is a fragmentary detail side view illustrating the switching means of the actuator in open and closed position, the latter position being indicated by the dash lines.

FIG. 2A is a slightly modified switch means.

FIG. 3 is a modified selector switch construction.

FIG. 3A is a rotary type selector switch.

FIG. 4 is a segmented panel construction utilized as a voltage chopper.

FIG. 4A is a modified construction of FIG. 4.

Referring to the drawings, FIG. 1 illustrates an actuator 10 embodying the instant invention. The actuator 10, as shown, is operatively connected to a valve 11, e.g. a valve of the type disclosed in a copending application Ser. No. 231,097, filed October 17, 1962; now Patent No. 3,107,894 and in circuit with a fluid pump 12 which is adapted to be energized by the actuator 10 when the valve 11 is opened thereby.

Accordingly, the actuator 10 has particular application in a fuel burning system, for example, wherein a fuel valve 11 is intermittently operated in response to a heating demand, e.g. through a thermostat switch 13 or the like, and a fuel pump 12 for pumping a fuel through the valve 11 when the latter is opened a predetermined amount. The actuator 10 comprises a housing 14 which is defined by a back plate 15 and a circumscribing end wall 16 disposed normal to the back wall 15. Connected to the upper end wall portion 16A is a terminal bar or board 17 to which three electrically insulated terminals 18, 19, 20 are attached. Terminals 18 and 19 are connected by conductors 18A, 19A and through

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a switching device 13 to a suitable source of electrical energy whereas terminals 19 and 20 are connected in circuit to fluid pump 12 by conductors 19B and 20A.

Disposed in line 19A is a switch means 13, e.g. a thermostat or the like, which when closed will energize a heating coil 21 that is disposed about a bimetallic element 22 disposed within the housing. It will be noted that heating coil 21 is connected to terminals 18 and 19.

As shown, the bimetallic element 22 comprises a U-shaped bimetal strip which has one end 22A connected to the end wall portion 16A, and has its other end 22B spaced therefrom and free to flex when heated by the coil 21 wrapped therearound.

Included in the actuator 10 is a lever 23 which is cantileverly pivoted at one end 23A to the end wall portion 16B. The lever 23 is pivotally connected thereto by means of a pair of spaced bracket lugs 24 which support therebetween the pin 25 about which lever 23 pivots. The other end 23B of the lever 23 is connected to the free end 22B of the bimetallic strip 22 through a linkage 26. As shown one end 26A of the linkage 26 is pivotally connected to the bimetal strip, and the other end 26B thereof to the end of lever 23 by a pin 27.

Intermediate the ends of the lever 23 there is connected thereto an operator 28, which in turn, is connected to or forms the extension of the valve stem of valve 11. It will thus be apparent that as the heating coil 21 is heated when power is applied thereto through conductors 18A, 19A, e.g. as upon the call for heat by the operation of the thermostat or switch 13, that the free end 22B of the bimetallic strip 22 will tend to flex in an upward direction as indicated in the dotted lines of FIG. 2. When this occurs the lever 23 is pivoted upwardly along therewith thus causing the operator 28 to be vertically displaced to open the valve 11.

In accordance with this invention a novel switching means 29 is included for energizing the pumping circuit when the valve 11 opens. Accordingly a flat switching panel 30 is mounted in the lever 23 so as to be electrically insulated therefrom. The switch panel 30 comprises a conductor segment 30A sandwiched between a pair of non-conductor segments 30B. The conductor segment 30A is provided with an exposed face or surface which is made flush with the upper surfaces of the insulator segments 30B. For the method of making such flat switch panels 30 reference is made to a copending application Ser. No. 241,594, filed December 3, 1962, now Patent No. 3,182,217.

Operatively associated with the switching panel 30 are a pair of spring contact fingers 31, 32 which are connected on the end wall portion 16B of the housing 16. Accordingly the respective fingers 31, 32 are electrically insulated one from the other, and are arranged so that they are normally biased into sliding contact with the switch panel 30. The respective fingers 31, 32 in turn are electrically connected to terminals 18 and 20 by conductors 18C and 20B.

In their normal disposition the spring contact fingers 31, 32 rest on the insulated segment 30B of the switch panel 30. Thus with the valve 11 in closed position, as shown in FIG. 1, the circuit to the pump is open.

In operation when the demand for heat is made, or when the valve 11 is opened by the pivoting of the lever 22 in following the movement of the bimetal strip 22, the switching panel 30 will slide under the respective spring fingers 31, 32 to move the conducting element 30A of the switch plate into contact with the fingers 31, 32. See FIG. 2, dotted lines. When this occurs, the fingers 31, 32 are shorted out, thus closing the circuit to the pump 12. As a result the pump 12 is actuated only when the valve 11 has opened a predetermined amount. When the circuit

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to the heating coil 21 is opened, the bimetallic strip 22 is permitted to cool, thus causing it to return to its normal position of FIG. 1. When this occurs the circuit to the pump 12 is opened by return of the spring fingers 31, 32 into engagement with the non-conducting segment 30B of the switch panel.

It is to be noted that the conductor 30A sandwiched between two non-conductors 30B, as described, is particularly applicable in those situations where it is desirable to have a high temperature limit cut-off for the fuel pump 12. With the sandwich switch construction 30 described, it will be observed that when a limiting temperature has been reached, the additional upward movement of lever 23 will cause the contact fingers 31 and 32 to slide from the conductor segment 30A to the non-conductor 30B to the right thereof, as best viewed in FIGS. 1 and 2. Thus, by properly proportioning the respective segments of the switch panel 30, the desired operating and limiting temperature can be readily calibrated.

However, for many other applications a modified switch panel 30' construction may be satisfactorily used. As shown in FIG. 2A, the modified switch panel 30' is made up of only two segments, a conducting segment 30A' and a nonconducting segment 30B' which are carried on the lever 23. The operation of the modified panel 30' is similar to that hereindescribed, with the exception that the limiting temperature cut-off is not provided for. However, in many applications the limiting temperature cut-off is not required.

FIG. 3 illustrates a modification. In this form the switching panel 40 is utilized as a selector switch. It comprises a plurality of conducting elements 41 alternately interconnected between a series of non-conducting segments 42. Each of the conducting segments 41 are connected up to a voltmeter 43 by a series of conductor wires 41A, 41B, 41C, 41D, each of which is connected to separate thermocouples 44A, 44B, 44C, and 44D, respectively.

Operatively associated with the switching panel 40 described, is a reciprocating spring finger contact 45 which is slidably connected on a slide bar 46. With the arrangement described the voltmeter 43 can read a plurality of thermocouple readings as the finger contact 41 is reciprocated back and forth across the switching panel, the finger being connected to the voltmeter by conductor 47.

FIG. 3A illustrates a modified ring type selector switch arrangement 40'. In this form the conducting segments 41' and non-conducting segments 42' are alternately disposed in a ring formation, the conducting segment 41' being insulated one from the other. Operatively associated therewith is a rotatably journaled brush or slider 45' which is fixed to a rotating shaft 46'. Each of the conducting segments 41' are shown connected up to a voltmeter 43' by a series of conductors 41A', 41B', 41C', etc., and each conductor has connected thereto a thermocouple 44A', 44B', 44C', etc., respectively. A slip ring and contact 47' in turn is connected to the voltmeter 43' by a conductor 48. Accordingly the voltmeter 43' can read a plurality of thermocouple readings as the slider 45' rotates over the conductors 41' of the selector ring 40'.

FIG. 4 illustrates a modified construction in which the segmented panel 50 is utilized as a voltage chopper. As shown the panel 50 is constructed of a base 51 of a conducting material having connected thereto a plurality of spaced apart conducting contact segments 52. Sandwiched between the spaced contact segments 52 are insulating segments 53 arranged to slide over the panel 50 and a spring contact 54 which is reciprocally mounted on a slide bar 55. Thus by connecting the panel 50 described to a source of D.C. power, the constant voltage thereof may be chopped or transformed to a pulsating voltage by sliding the spring contact 54 over the panel 50. In the illustrated embodiment a voltage meter 43 is connected between the slider 54 and the base 51.

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FIG. 4A illustrates a modified chopper construction 60. In this form the panel comprises a stationary ring 61 of conducting material having spaced conducting contacts 62. Sandwiched between adjacent pairs of contacts 62 is an insulating segment 63. The arrangement is such that the face of the segments 63 and the contacts 62 are flush. A brush or slider 64 is fixed to a rotating shaft 65, the brush 64 being arranged to alternately make contact with the contacts 62 and segments 63 disposed therebetween. A slip ring and contact 66 offset axially from the brush 64 is provided. Therefore, by connecting the panel 60 described to a source of D.C. power, the constant voltage thereof may be chopped or transformed into a pulsating voltage as the slider 64 is rotated over the alternate surfaces of contacts 62 and the non-conducting segments 63 disposed therebetween. A voltmeter is shown connected between slip ring 66 and ring 61.

While the instant invention has been disclosed with reference to several embodiments thereof, it is to be appreciated that the invention is not to be taken as limited to all of the details thereof as modifications and variations thereof may be made without departing from the spirit or scope of the invention.

What is claimed is:

1. In combination, an actuator comprising

- (a) a housing,
- (b) a heat sensitive member having one end connected to said housing and having its other end free to flex,
- (c) an electrical heating coil wrapped about said strip to impart heat thereto to effect displacement of said free end when said coil is energized,
- (d) a lever pivotally mounted at one end to said housing and having its other end spaced from the free end of said strip,
- (e) a linkage pivotally connected to and between the other end of said lever and said free end of said bi-metallic strip so that said lever pivots about its connected end as said strip flexes when heated whereby said free end of said lever is displaced in a given direction as said heat sensitive member flexes,
- (f) an operator connected to said lever intermediate the ends thereof, said operator being adapted to operate a mechanism connected thereto,
- (g) and a switch means operatively associated with said lever for energizing a circuit when said operator is actuated,
- (h) said switch means including a plurality of sandwiched conducting and non-conducting elements carried on said lever,
- (i) and an energizing circuit,
- (j) said circuit including a pair of contacts whereby movement of said lever in said given direction causes said contacts to energize said circuit when said contacts engage the conducting elements of said switch and to deenergize said circuit on a continued movement of said lever in a given direction whereby said contacts engage the non-conducting elements of said switch.

2. An electrically controlled actuator comprising:

- (a) a housing,
- (b) a bi-metallic strip having one end connected to the end wall of said housing and having its other end free to flex,
- (c) means for flexing said strip to effect displacement of said free end,
- (d) a lever,
- (e) means pivotally connecting one end of said lever to said housing,
- (f) said lever having its other end spaced from said free end of said strip,
- (g) a linkage pivotally connected to and between the free end of said strip and said other end of said lever so that said lever pivots about its pivoted end when said strip flexes,

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- (h) an operator pivotally connected to said lever, said operator adapted to actuate a mechanism operatively connected thereto,
- (i) a circuit,
- (j) a switch means connected in said circuit to energize the same when said mechanism is actuated,
- (k) said switch means including a flat switching panel connected to said lever adjacent the pivoted end thereof,
- (l) said panel including a conducting segment sandwiched between a pair of non-conducting segments,
- (m) said conducting segment having a smooth exposed surface flush with the surface of said non-conducting segments,
- (n) a pair of spring contacts connected in said circuit insulated one from the other, said contacts being normally urged into sliding contact with said switching panel so that upon flexing of said strip the movement of said lever in response thereto causes said conducting segment of the switching panel to short out said contacts thereby energizing the circuit when said mechanism is actuated.

3. In combination, an electrically controlled actuator comprising:

- (a) a housing,
- (b) a series of terminals insulated from one another connected to said housing,
- (c) a bi-metallic strip having one end connected to said housing and having its other end free to flex,
- (d) an insulated heating wire connected to a pair of said terminals, said wire being coiled about said strip for heating the same to effect displacement of said free end,
- (e) a lever,
- (f) means pivotally connecting one end of said lever to said housing,
- (g) said lever having its other end spaced from said free end of said strip,
- (h) a linkage pivotally connected to and between the free end of said strip and said other end of said lever so that said lever pivots about its pivoted end when said strip flexes,
- (i) an operator pivotally connected to said lever intermediate the ends thereof, said operator adapted to actuate a mechanism operatively connected thereto, and
- (j) an electrical circuit,
- (k) a switch means connected in said circuit to energize the same when said mechanism is actuated,
- (l) said switch means including a flat switching panel connected to said lever adjacent the pivoted end thereof,
- (m) said panel including a conducting segment sandwiched between a pair of non-conducting segments,
- (n) said conducting segment having a smooth exposed surface flush with the surface of said non-conducting segments,
- (o) a pair of spring contacts connected in said circuits, said contacts being insulated one from the other, said contacts being normally urged into sliding contact with said switching panel so that upon flexing of said strip, the movement of said lever in response thereto causes said conducting segment of the switching panel to electrically connect and disconnect said contacts thereby energizing the circuit when said mechanism is actuated and deenergizing the same at a predetermined condition.

4. In combination, an electrically controlled actuator comprising

- (a) a housing having a back plate and enclosing end walls disposed normal to said back plate and extending about the periphery of said back plate,
- (b) a terminal board connected to an end wall of said housing,

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- (c) a series of terminals connected to said board,
- (d) a U-shaped bi-metallic strip having one end connected to the end wall of said housing and having its other end free to flex,
- (e) a heating wire connected to a pair of said terminals, said wire being coiled about said strip for heating the same to effect displacement of said free end,
- (f) a lever,
- (g) means pivotally connecting one end of said lever to an end wall of said housing,
- (h) said lever having its other end spaced from said free end of said strip,
- (i) a linkage pivotally connected to and between the free end of said strip and said other end of said lever so that said lever pivots about its pivoted end when said strip flexes,
- (j) a valve and an operator therefor, said operator pivotally connected to said lever intermediate the ends thereof, said operator operating to open and close said valve,
- (k) an electric circuit including a pump, said circuit being energized to operate said pump when the valve is opened,
- (l) a switch means connected in said circuit to energize the same when said valve is open,
- (m) said switch means including a flat switching panel connected to said lever adjacent the pivoted end thereof,
- (n) said panel including a conducting segment sandwiched between a pair of non-conducting segments,
- (o) said conducting segment having a smooth exposed surface flush with the surface of said non-conducting segments,
- (p) a pair of spring contacts insulated one from the other, said contacts being normally urged into sliding contact with said switching panel so that upon flexing of said strip the movement of said lever in response thereto causes said conductor of the switching panel to electrically connect said contacts thereby energizing the pumping circuit when said valve is opened and whereby continued movement of said lever in said direction causes said switch to function as a high-temperature cutoff switch for deenergizing said pump.

5. The invention as defined in claim 1 wherein said switch means includes

- (a) a non-conducting segment and a conducting segment, and
- (b) a spring contact connected to said housing and normally urged into contact with said segments to make and break the circuit including said conducting segment.

6. The invention as defined in claim 1 wherein said switching panel includes

- (a) a conducting segment,
- (b) a pair of non-conducting segments disposed on either side of said conducting segment,
- (c) and a contact operatively associated to slide over said segments.

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