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THERMOSTATIC CONTROLS

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FIG. 1

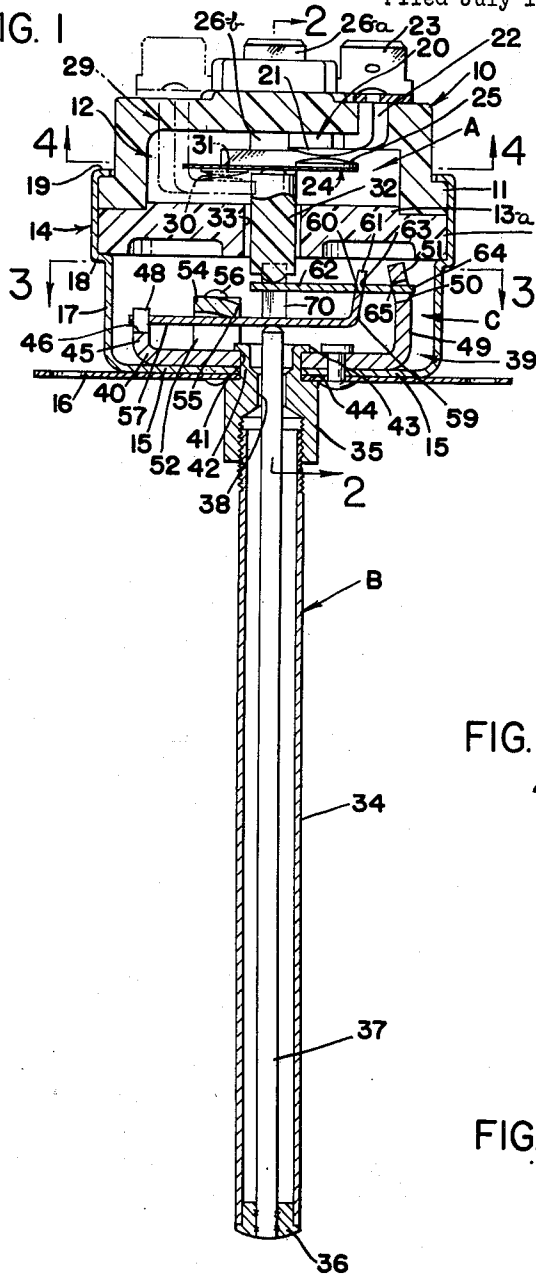
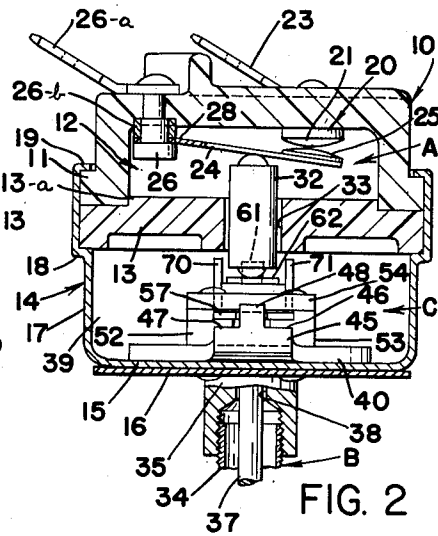


FIG. 3

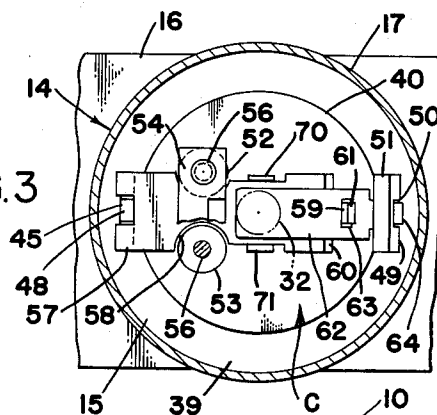
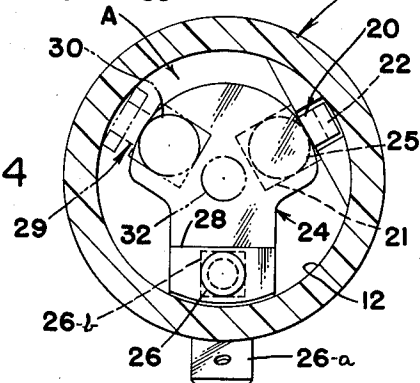


FIG. 4



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THERMOSTATIC CONTROLS

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9 Claims. (Cl. 200-137)

This invention relates generally to a heat sensitive device and more particularly to an improved heat responsive switch, which may be used in heating appliances, such as furnaces, ranges and clothes dryers.

Various types of switches have been proposed heretofore which are intended to operate in response to the presence or absence of flame in a heating appliance, such as a furnace, range or clothes dryer. In general, such previously proposed devices have been relatively complex and expensive in construction, as well as lacking the sufficiently high sensitivity which is quite desirable for many applications of such devices. The present invention is directed to a novel device embodying a switch mechanism responsive to a heat sensitive element which is free of these disadvantages and is capable of reliable operation in a wide variety of applications, particularly in gas burning appliances.

Accordingly, it is a general object of this invention to provide a novel and improved heat sensitive device embodying a switch mechanism.

It is also an object of this invention to provide a novel flame switch having improved sensitivity.

Another object of this invention is to provide a novel control device embodying a switch in which a relatively slight movement of the heat sensing member will produce an amplified movement in the switch proper for operating the switch contacts.

A further object of this invention is to provide a novel flame switch which is characterized by simplicity of construction, and economy and ease of manufacture.

These and other objects and advantageous features of the invention, not at this time more particularly pointed out, will become more apparent as the nature of the invention is better understood from the following detailed description taken in conjunction with the accompanying drawing, wherein like reference characters denote corresponding parts and wherein:

FIGURE 1 is a longitudinal sectional view of the present device with an additional normally open stationary switch contact shown in phantom,

FIGURE 2 is a sectional view taken along the line 2-2 of FIGURE 1 centrally through the switch mechanism,

FIGURE 3 is a sectional view taken along the line 3-3 of FIGURE 1 and looking down on the linkage mechanism for actuating the switch, and

FIGURE 4 is a sectional view taken along the line 4-4 of FIGURE 1.

With reference to FIGURE 1, in its overall assembly the control device of the present invention embodies a switch proper "A," which includes at least one fixed contact and a movable contact which is adapted to either engage or disengage from the fixed contact, a temperature sensitive probe "B" and linkage "C" which operates the switch proper in response to temperature changes sensed by the probe "B." In accordance with the present invention the switch proper "A" and the probe "B" in themselves are of conventional construction, while the linkage "C" constitutes a novel and improved arrange-

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ment for amplifying the movement which takes place in the probe "B" in response to temperature changes and for imparting such amplified movement to the switch proper, so that the control device unit is highly sensitive in its operation.

The switch proper "A" which, as stated, is of conventional construction, is embodied within a housing 10 of suitable insulating material. The housing 10 is generally cup-shaped, having a closed upper end as shown in FIGURES 1 and 2 and at its lower end presenting a laterally outwardly protruding peripheral flange 11. As shown in FIGURES 1 and 2, the housing 10 presents a generally cylindrical downwardly facing switch chamber 12. A separate end wall member 13 of suitable insulation material, extends across the lower open end of the housing 10, providing an arc shield or closure for the lower end of the switch chamber 12. This lower end wall 13 has a reduced diameter central portion 13-a which projects up into the chamber 12 and has a snug fit therein against the interior side wall of the housing 10 to provide effective insulation from grounding.

The switch housing 10 and the bottom end wall 13, therefore, are supported by a cup-shaped metal case 14. As shown in FIGURES 1 and 2 this metal case has its bottom wall 15 secured to a metal mounting plate 16 which is adapted to be assembled on the appliance with which the device is used. The metal case 14 presents a generally cylindrical side wall 17 which extends up from the bottom wall 15 and presents a laterally inturned flange 19, which snugly overlies the peripheral upwardly facing shoulder of the flange 11 on the switch housing 10. Between its outturned portion 18 and its inturned flange 19 the metal case 14, snugly engages the respective peripheries of the flange 11 on the switch housing and the bottom wall 13 for the housing.

A stationary switch contact member 20 presents a downwardly facing, rounded contact surface 21 inside the switch chamber 12. This stationary contact member extends laterally across the underside of the closed upper wall of the switch housing 10 and has an upwardly extending stem 22 which extends up through the housing wall for connection to a terminal 23 disposed outside the switch housing.

A movable contact carrying arm 24 carries an upwardly facing mobile contact 25 which engages the stationary contact 20 when the movable contact arm is in its normal position as shown in FIGURE 1. As best seen in FIGURE 4, this movable contact arm 24 is a generally flat, resilient metal leaf which is approximately T-shaped in outline. The contact arm 24 is cantilever-mounted at one end by means of a rivet 26 which extends up through the top wall of the switch housing 10 for connection to an externally mounted terminal 26-a. A rigid metal spacer ring 26-b is disposed between the top of the cantilever-mounted end of the contact-carrying arm 24 and the top wall of the housing 10. The enlarged head on the rivet engages the bottom face of the contact-carrying arm 24 at its cantilever-mounted end and holds it tightly up against the spacer ring 26-b. Along the inner edge of its cantilever-mounted end, the contact-carrying arm 24 is formed with a bend as at 28, so that beyond its cantilever-mounting the contact arm extends downwardly at a slight angle when in its unstressed position as is best shown in FIGURE 2.

If desired, a second stationary contact 29 may be provided, as shown in phantom in FIGURE 1, having an upwardly facing contact surface 30 which is positioned

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below the contact-carrying arm 24 for engagement by a downwardly facing contact button 31 on this arm. With such an arrangement, when the contact-carrying arm 24 is in its lower-most position, the mobile contact 31 will engage the lower fixed contact 29. In the alternative, in the upper-most position of the contact-carrying arm 24 the mobile contact 25 carried thereby will engage the upper fixed contact 20.

For operating the contact-carrying arm 24, there is provided a bumper member 32 of suitable insulating material which has a rounded upper end adapted to engage beneath the contact-carrying arm 24 at the center thereof, as will be best seen in FIGURE 4. This bumper member 32 is slidably received loosely in a central opening 33 formed in the bottom wall 13 of the switch housing. The bumper member 32 has a rounded lower end which is disposed below the bottom wall 13 of the switch housing. The lower end of the bumper member 32 is positioned to be engaged and be actuated by the novel linkage mechanism "C" of the present invention, as described in detail hereinafter.

The probe in the present control comprises an elongated tube 34 which has a threaded upper end, which is threadably mounted in a fitting 35 carried by the metal case 14. A plug 36 is secured in the lower end of the tube 34. An elongated rod 37 is welded to the plug 36 and extends upwardly therefrom through the tube 34 in concentric relation with the tube. The rod 37 extends up loosely through a central bore 38 formed in the fitting 35. The upper end of the rod 37 is disposed in the chamber 39 which is located inside the metal case 14 below the bottom wall 13 of the switch case. Preferably the rod 37 is of Invar, while the tube 34 is of stainless steel or other suitable metal having an appreciably different coefficient of expansion than the Invar rod. With this arrangement, which is a conventional construction for probe type controls of this general design, when the probe is heated the inner rod 37 will expand less than the outer tube 34 so that the upper end of the rod 37 will withdraw within the chamber 39.

In accordance with the present invention, such movement of the rod 37 is amplified by the linkage "C," and when such amplified movement is translated to the bumper member 32 which normally engages the lower surface of the movable contact arm 24 for actuating the same.

The linkage "C" includes a rigid anchor base 40 which presents a flat bottom wall arranged to seat on the bottom wall 15 of the metal case 14 from which the switch case is supported. As shown in FIGURE 3 the bottom wall of the anchor base 40 is circular in outline. This flat bottom wall of the anchor base is formed with a central opening 41 which receives the reduced diameter upper end 42 of the fitting 35 on which the probe tube 34 is threadably mounted. The upper extremity of this fitting is turned over as at 43 to snugly overlie the bottom wall of the anchor base. The fitting 35 also presents an upwardly facing shoulder 44 which engages beneath the mounting plate 16 (see FIGURE 1), so that the parts are securely retained in assembled relationship as shown in the drawings.

At its left end in FIGURE 1 the anchor base 40 presents an upstanding leg 45 which defines a pair of upwardly facing shoulders 46 and 47 (see FIGURE 2) and a central projection 48 which extends up beyond these shoulders.

At its right end, looking at FIGURE 1, the anchor base presents an upstanding leg 49 which has a rectangular opening 50 therein. The opening 50 is located well above the shoulders 46 and 47 at the opposite end of the anchor base. At the opening 50 the upstanding leg 49 of the anchor base is formed with a bend so that the upper extremity 51 of this leg extends laterally inwardly toward the bumper member 32 as best seen in FIGURE 1.

At a location on the anchor base, between its upstanding left leg 45 and its central opening 41, a pair

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of metal bushings 52 and 53 (see FIGURE 3) are provided which rests on the top of the flat bottom wall of the anchor base 40 and extend upwardly therefrom. A fulcrum plate 54 is seated on top of these bushings and extends across the space between them, in spaced, substantially parallel relationship to the flat bottom wall of the anchor base 40. As best seen in FIGURE 1, at the middle, this fulcrum plate is deformed downwardly at one side to present a downwardly facing fulcrum edge 55. Rivets 56 or other suitable fastening means are provided for securing the fulcrum plate 54 to the bushings 52 and 53 and for securing the bushings to the anchor base 40.

A first linkage arm 57 overlies the upper end of the rod 37 in the probe. This linkage arm also has its top face engaged by the fulcrum edge 55 on the fulcrum plate 54. At its left end, as shown in FIGURE 1, the linkage arm 57 is bifurcated as shown in FIGURE 3 to straddle the upper extension 48 of the anchor base. As best shown in FIGURE 3, the linkage arm 57 has semi-circular cutaway portions 58 at its opposite side edges which pass the bushings 52 and 53 supporting the fulcrum plate 54. At its right end, as shown in FIGURE 1, the first linkage arm 57 has an upwardly extending extremity 59 which presents a pair of upwardly facing shoulders 60 (FIGURE 3) and an upwardly projecting finger 61 between these shoulders. Midway along its length, the first linkage arm 57 is formed at its opposite side edges with upstanding fingers 70 and 71 which are disposed on opposite sides of the lower end of the bumper member 32.

A flat second linkage arm 62 is provided, having a rectangular opening 63 which receives the upwardly projecting finger 61 on the first linkage arm 57. The second linkage arm 62 rests on top of the shoulder 60 on the first linkage arm 57, as shown in FIGURES 1 and 3. At its left end as shown in FIGURES 1 and 3, the second linkage arm is received between the upstanding fingers 70 and 71 on the first linkage arm 57 and engages beneath the rounded lower end of the bumper member 32. At its right end in these figures, the second linkage arm 62 is formed with a reduced extension 64 which extends through the opening 50 in the upstanding leg 49 on the anchor base 40. The upper edge of this opening 50, at the inner side, presents a downwardly and inwardly facing edge 65 which engages the top of the second linkage arm 62.

In the operation of this linkage mechanism, in the normal unactuated position of the parts, the first linkage arm 57 and the second linkage arm 62 both extend substantially horizontal, as is shown in FIGURE 1. The first linkage arm 57 rests on top of the upper end of the rod 37 in the probe and the top face of this linkage arm engages the downwardly facing edge 55 on the fulcrum plate 54. As shown in FIGURE 1, the bifurcated left end of the first linkage arm straddles the upper extension 48 on the left end of the anchor base 40 and the space above the shoulders 46 and 47 on the anchor base. The upwardly facing shoulder 60 on the right end of the first linkage arm 57, engages the underside of the second linkage arm 62. The left end of the second linkage arm engages the rounded lower end of the bumper member 32, while at its right end, the upper face of the second linkage arm, engages the downwardly facing fulcrum edge 65 on the anchor base. At this time the mobile contact 32 is engaged with the stationary contact 20, as is shown in FIGURE 1.

When the probe "B" is exposed to a suitable temperature the tube 34 will expand lengthwise downwardly, as in FIGURE 1. Such downward movement of the tube 34 will withdraw the rod 37 and relieve the force of the rod on the first linkage arm 57 to the right of its fulcrum which is defined by the edge 55 on the fulcrum plate 54. The first linkage arm 57 will pivot clockwise about its fulcrum edge 55. The upwardly projecting

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extension 48 on the anchor base 40 insures that the first linkage arm 57 will not have any substantial undesirable movement laterally. The upwardly facing shoulder 60 on the first linkage arm 57 will move downwardly, causing the second linkage arm 62 to pivot counterclockwise about the fulcrum edge 65. Such movement of the second linkage arm releases the upward force on the bumper member 32 which permits the mobile contact-carrying arm 24 to move its mobile contact 25 out of engagement with the stationary contact 20. The upwardly extending fingers 70 and 71 on the first linkage arm 57 insures that the free end of the second linkage arm 62 will not have any appreciable lateral movement.

It will be noted that the compound linkage arrangement constituted by the first and second linkage arms 57 and 62 produces an appreciable amplification or multiplication of the movement of the rod 37. That is, a relatively slight movement of the rod will produce a greatly amplified movement of the bumper member 32 which controls the operation of the switch. For this reason, the present switch is quite sensitive in operation. Moreover, the movable contact-carrying arm 24 moves through an appreciable distance between its extreme position. This is highly desirable from the standpoint of the operation of the switch proper, to avoid arcing and burning of the contact members.

In addition to these advantages, the present arrangement is relatively simple in construction and may be readily assembled on a mass production basis, at a relatively low cost.

While there has been described herein and illustrated in the accompanying drawing, a presently preferred embodiment of the present invention, it is to be understood that various modifications, omissions, and refinements which depart from the disclosed embodiments may be adopted without departing from the spirit and scope of this invention as defined in the appended claims.

I claim:

1. A heat sensitive control device comprising means defining a hollow housing, an arc shield separating said housing into first and second chambers, switch means mounted in said first chamber, a slidable member supported by and traversing said arc shield for actuating said switch means, said switch means including a flexible contact-carrying arm anchored at one end in said first chamber, one side of said arm having a bend therein to position the outer free end thereof at an acute angle to the anchored end, a contact on the free end of said arm, a fixed contact positioned to be engaged by said mobile contact and a probe with a movable heat responsive member projecting into said second chamber linkage means mounted in said second chamber acting between said movable member in the probe and the said slidable member and arranged to amplify the movement of said movable member and to impart such amplified movement to the switch means to effect movement of the mobile contact with respect to the fixed contact and rock said mobile contact on said fixed contact when in engagement therewith.

2. A heat sensitive control device, comprising means defining a hollow housing, an arc shield separating said housing into first and second chambers, a switch mounted in said first chamber having a stationary contact, a mobile contact for engagement with the stationary contact and a movable contact-carrying arm which carries the mobile contact anchored at one end and having a bend in one side thereof to position the contact-carrying end of said arm at an angle to the anchored end, and an elongated probe having an elongated tubular member which is movable in response to heat changes adopted to project into said second chamber, compound linkage mounted in said second chamber acting between said elongated movable member and said contact-carrying arm and operable to amplify the movement of said elongated movable member and a slidable bumper carried by said arc shield

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engaged between said linkage and said movable contact carrying arm to impart such amplified movement to the contact-carrying arm for moving the latter and separating the contacts by rocking the mobile contact on the fixed contact and then moving the mobile contact away from the fixed contact.

3. A heat sensitive control device, comprising means defining a hollow housing, an arc shield separating said housing into first and second chambers, a switch mounted in said first chamber having a stationary contact, a mobile contact for engagement with the stationary contact, a movable contact-carrying arm anchored at one end upon which is mounted said mobile contact said arm having a bend therein to position the outer free end at an acute angle to other end, a probe which includes a member projecting into said second chamber movable in response to heat changes, means defining a first fulcrum edge, a first linkage arm engaged between said first fulcrum edge and said movable member in the probe, said first linkage arm having a movable portion, means defining a second fulcrum edge, a second linkage arm engaged between said second fulcrum edge and said movable portion of the first linkage arm, said second linkage arm having a movable portion and means including a slidable bumper carried by said arc shield engaged between said movable portion of the second linkage arm and the contact-carrying arm for imparting the movement of the second linkage arm to said contact-carrying arm so as to move the mobile contact with respect to the fixed contact and rock said mobile contact on the fixed contact and then move the mobile contact away from the fixed contact.

4. The switch of claim 3 wherein said movable portion of the first linkage arm is positioned at the same side of said first fulcrum edge as said movable member in the probe and at a greater distance from said first fulcrum edge than said movable member in the probe, whereby said movable portion of the first linkage arm amplifies the movement of said movable member in the probe, and said movable portion of the second linkage arm is positioned at the same side of said second fulcrum edge as said movable portion of the first linkage arm and at a greater distance from said fulcrum edge than said movable portion of the first linkage arm, whereby said second linkage arm amplifies the movement of the first linkage arm.

5. A heat sensitive control device, comprising means defining a hollow housing arc shield separating said housing into first and second chambers, a switch mounted in said first chamber having a stationary contact, a mobile contact for engagement with the stationary contact, a movable contact-carrying arm anchored at one end which carries said mobile contact and which is biased in one direction, one side of said arm having a bend therein to position the end upon which the contact is mounted at an angle to said anchored end and a probe spaced from said contact-carrying arm in said one direction including a heat responsive member projecting into said second chamber which is movable toward and away from said contact-carrying arm in response to heat changes, linkage means in said second chamber engaged between said probe and said contact-carrying member, said linkage comprising means defining a fixed first fulcrum edge which faces in said one direction and which is disposed at one side of the line of movement of said heat responsive member in the probe, a first linkage arm engaged between said first fulcrum edge and said heat responsive member in the probe and having a movable free end at the opposite side of said heat responsive member, means defining a fixed second fulcrum edge which faces in said one direction and which is disposed at said opposite side of the heat responsive probe member beyond said free end of the first linkage arm, a second linkage arm engaged between said second fulcrum edge and said free end of the first linkage arm and having a movable free end at the opposite side of the free end of the first linkage arm from said fulcrum edge, and a slidable bumper mounted in said arc shield en-

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gaged between said free end of the second linkage arm and said movable contact-carrying arm for imparting the movement of said free end of the second linkage arm to the movable contact-carrying arm and separating the contacts by rocking the mobile contact on the fixed contact and then moving the mobile contact away from the fixed contact.

6. The switch of claim 5 wherein there is provided an anchor base which carries said first and second fulcrum edges.

7. The switch of claim 6 wherein said anchor base supports a fulcrum member which defines said first fulcrum edge, and said anchor base has means for guiding the movement of the first linkage arm to restrain the latter against lateral displacement.

8. The switch of claim 6 wherein said anchor base has a portion with an opening therein which receives the second linkage arm and which defines said second fulcrum edge at said opening.

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9. The switch of claim 5 wherein one of said linkage arms has means for restraining the other linkage arm against the lateral displacement.

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