

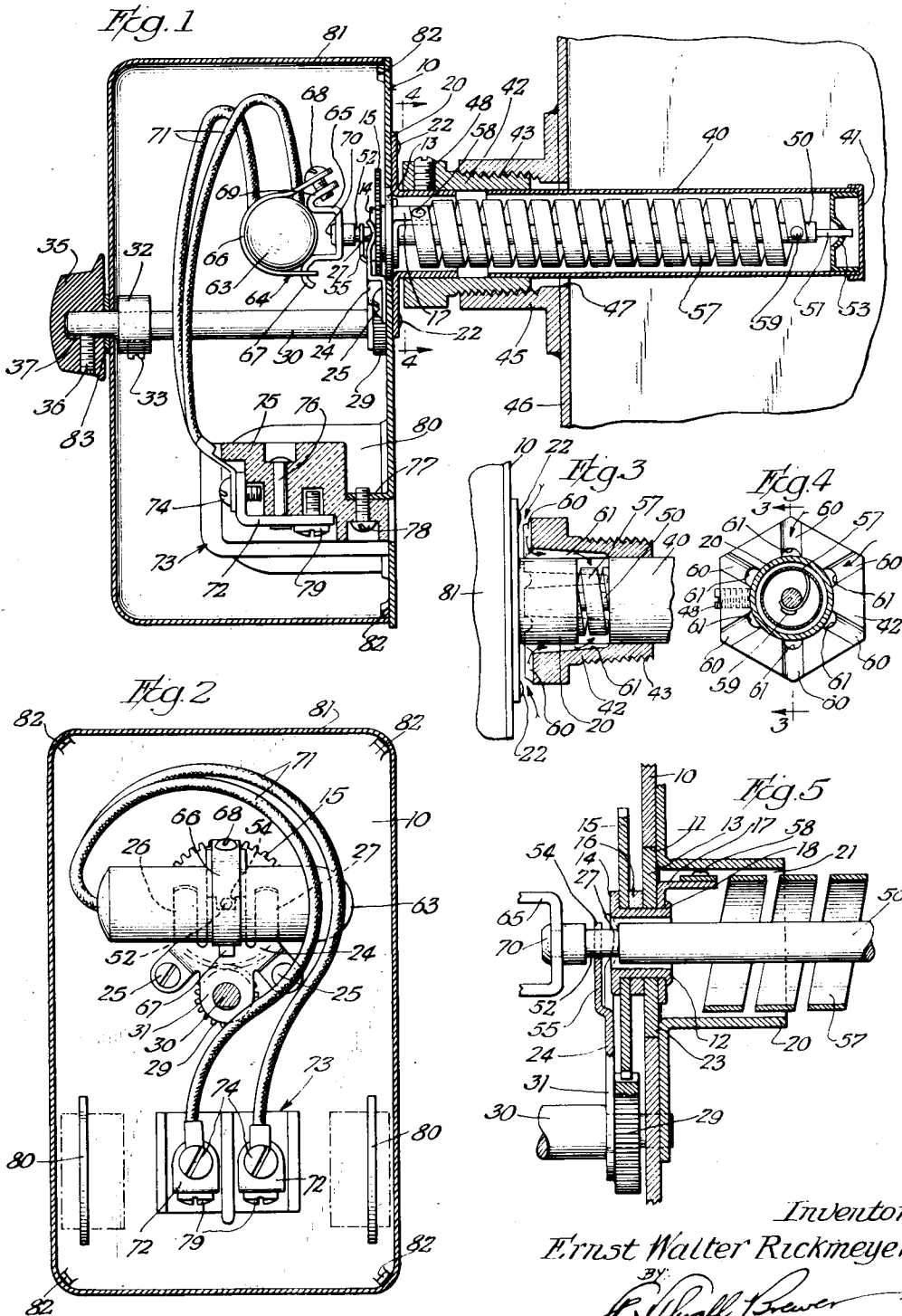
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SWITCH

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SWITCH

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This invention relates to switches, and more particularly to adjustable automatically operated switches.

It is an object of my invention to provide a switch for automatically controlling the temperature of a fluid in a tank or housing.

Another object of my invention is to provide a thermal responsive switch adapted to be secured to the outside of a tank or housing and having an enclosed temperature responsive controlling element extending into the tank or housing for actuating the switch in accordance with the temperature of a fluid or liquid within the housing.

Another object of my invention is to provide a switch having a temperature responsive controlling element enclosed with respect to the fluid medium the temperature of which is to actuate the switch, and open to the influx and efflux of air to and from the enclosure for the temperature responsive element.

Another object of my invention is to provide a switch including a shaft for actuating a switching element and having a bimetallic thermal responsive element helically disposed about the shaft for controlling the movements thereof, and support means for the shaft which tend to eliminate friction and binding to rotary movements thereof.

Another object of my invention is to provide switch operating mechanism including a shaft supported for rotary movement by a plurality of bearings and a temperature responsive element adjustably anchored at one end and connected to the shaft at the other end for effecting rotary movement thereof, said bearings and shaft being constructed and arranged to permit endwise and angular movements of the shaft to reduce friction and binding to rotary movements.

Another object of my invention is to provide a switch including a temperature responsive control mechanism for actuating a mercury switching unit, which control mechanism is adjustable to effect operation of the switching unit at various temperatures and the temperature responsive controlling element for which is separated by an enclosure from the medium which provides the controlling heat.

Other objects and advantages of my invention will be apparent from a consideration of the following specification and accompanying drawing wherein,

Fig. 1 is a side elevation of a preferred embodiment of my invention having parts thereof shown in section.

Fig. 2 is a front elevation of the switch shown in Fig. 1 with a part thereof shown in section.

Fig. 3 is a fragmentary view of a portion of the switch shown in Figs. 1 and 2, with a part thereof shown in section, the section being taken substantially on line 3-3 of Fig. 4 and in the direction of the arrows.

Fig. 4 is a sectional view of a portion of the switch shown in Fig. 1, with the section taken substantially on line 4-4 of Fig. 1 and in the direction of the arrows.

Fig. 5 is a fragmentary sectional view of a portion of the switch structure shown in Fig. 1.

With particular reference to the drawing the switch has a base 10 which provides a main support for the parts. The base 10 has an opening 11 therein in which a tubular member 12 is rotatably supported by a collar or bearing member 13 that is pressed onto the tubular member and secured thereto. The tubular member 12 has a flange 14 at one end thereof and in addition to the collar or bearing member 13 a gear 15, a spacing washer 16, and an arm or anchoring lug 17 are secured by milling or riveting the other end of the tubular member as at 18. Axial movement of the collar or bearing member 13 in one direction with respect to the base 10 is prevented by a flanged collar 20 having an opening 21 therein that is smaller than and substantially concentric with respect to the opening 11. The flanged collar 20 is secured to the base 10 by rivets such as 22 or other suitable fastening means, and provides a shoulder or bearing surface at 23 which engages the collar or bearing member 13. The collar or bearing member 13 is urged toward the surface 23 and held in position by a friction yoke 24 that is secured to the base 10 by screws 25 or other suitable fastening means and has fingers 26 and 27 that press against the surface of the gear 15.

A pinion gear 28 meshes with the gear 15 and is pressed onto a shaft 30 which is rotatably supported by the base 10 and a projecting portion 31 of the friction yoke 24. A shaft extension or adapter 32 is secured to the end of the shaft 30 by a set screw 33 and has a knob 35 mounted thereon and secured thereto by set screw 36 which engages a flattened surface 37 of the extension or adapter 32. Manual rotation of the knob 35 rotates the tubular member 12 and arm 17 with respect to the base 10 through the driving means provided by the gears 15 and 28.

A substantially tubular housing 40 is closed at one end by a cap 41 and has its other end

fitted and preferably soldered into one end of a hollow plug or adapter 42. The plug or adapter 42 has a portion 43 of its outer surface threaded, preferably with a pipe thread, that fits into a flanged fitting 45 on a tank, boiler or other desired housing indicated at 46 so that the tubular housing 40 extends through an opening 47 and into the tank, boiler or housing 46. The hollow plug 42 fits onto the flanged collar 20 and is secured thereto by a set screw 48. The hollow plug 42 preferably has channels 60 in the end surface thereof communicating with channels 61 in the inner surface thereof, which channels 61 are longer than the flanged collar 20 and provide louvers or passages for the influx and efflux of air to and from the inside of the tubular housing 40, as indicated by arrows in Figs. 3 and 4. The movement of air through the channels 60 and 61 prevents the formation of a dead air space within the tubular housing 40 and improves the heat conductivity through the air therein.

A switch-actuating shaft 50 has a portion 51 of reduced section at one end thereof and a portion 52 of reduced section near the other end thereof. The shaft 50 is rotatably supported at one end by a bearing 53 that is secured within the closed end of the tubular housing 40, which bearing engages the portion 51 of the shaft. The other end of the shaft 50 is rotatably supported in an open slot bearing 54 that is preferably provided by an integral projecting lug 55 on the friction yoke 24. The slot 54 is preferably wider than the portion 52 of the shaft so that the shaft has freedom for limited transverse movement and so that an anti-friction bearing is provided to reduce resistance to rotation of the shaft. The bearing 53 is preferably thin and the section of the portion 51 of the shaft is preferably small so that limited pivotal movement of the shaft is permitted by the bearing 53 without binding. The portions 51 and 52 of the shaft are sufficiently long to permit some axial movement of the shaft. The shaft 50 extends through the tubular member 12 and the opening in the tubular member 12 is larger than the diameter of the shaft so that the shaft is normally spaced therefrom and the movement of the shaft permitted by the bearing is not hampered.

A bi-metallic temperature responsive element 57 which preferably has helically wound turns surrounding a portion of the shaft 50 has one end secured to the arm or anchoring lug 17 by a rivet 58 and the other end secured to the shaft 50 by a rivet 59.

It will now be apparent that manual adjustment of the knob 35 adjusts the position of the anchoring lug or arm 17 and the normal position of the shaft 50. It will also be apparent that flexure of the temperature responsive element 57 rotates the shaft 50. Freedom for some endwise or axial movement of the shaft is desirable since flexure of the bi-metallic element tends to draw the turns thereof together when tightening and separate the turns when loosening. Freedom from friction and binding are, of course, desirable and the freedom for transverse movement of the shaft in the slot 54 is desirable to prevent binding due to distortion or angular force that may be effected by the flexure of the bi-metallic element.

A mercury switch unit 63 of a standard type in which a circuit is made or broken by the movement of a quantity of mercury is secured to the end of the shaft 50 by a clamp 64 com-

prising a bracket 65 and a strap 66. The bracket 65 has a lug 67 on one side thereof that extends through an opening in the strap 66 and a screw 68 extends through the strap 66 and is threaded into a lug 69 on the other end of the bracket 65 to clamp the mercury switch unit 63 in position. The end of the shaft 50 preferably extends through the bracket 65 and is riveted at 70 to secure the bracket to the shaft. Electrical connections are made to the mercury switch unit 63 by lead wires 71 that are sufficiently flexible to offer only very slight resistance to the movement of the mercury switch unit. The lead wires 71 are preferably anchored to terminals 72 on a terminal block 73 by screws 74. The terminals 72 are secured to an insulating body 75 of the terminal block 73 by a rivet 76 and the insulating body is secured to a lug 77 on the base 10 by screws 78. Screws 79 that are threaded into the terminals 72 provide binding posts for anchoring suitable lead wires that extend to an external circuit that is controlled by the switch. Brackets 80 are secured to the base for anchoring the conduit which encloses the wiring to the external circuit.

The housing or cover 81 that encloses the mercury switch unit 63 and terminal block 73 and covers the front of the switch is located with respect to the base 10 by lugs 82 that are preferably integral with the base 10, and is held in position by the knob 35. A spacing washer that is preferably made of fibrous material is preferably put on the shaft extension or adapter 32 between the knob 35 and the housing or cover 81.

In the manufacture and assembly of the switch, certain of the parts are preferably made up into sub-assemblies, which sub-assemblies are then assembled to complete the switch. One sub-assembly preferably comprises the base 10, terminal block 73, flanged collar 20 and brackets 80. Another sub-assembly preferably comprises the shaft 30, pinion gear 29, and the shaft extension or adapter 32. Another sub-assembly preferably comprises the tubular member 12, collar or bearing member 13, anchoring lug or arm 17, spacing washer 16, gear 15, switch-actuating shaft 50, temperature responsive element 57, mercury switch unit 63, and the clamp 64. Still another sub-assembly preferably comprises the tubular housing 40, cap 41, and hollow plug 42.

With the switch thus divided into sub-assemblies, the final assembly is easily accomplished. The sub-assemblies, including the shafts 30 and 50 and the gears 15 and 29, are secured in position with respect to the sub-assembly including the base 10 by the friction yoke 24 which is secured to the base 10 by the screws 25. The assembly of the rest of the switch including the placement of the tubular housing 40 and the cover or housing 81 and the mounting of the switch with respect to a tank, boiler or housing such as 46 are apparent from the foregoing description.

In considering the operation of the switch, it will be understood that the angular position of the mercury switch unit 63 controls the making and breaking of a circuit by that switch unit by controlling the position of a quantity of mercury therein. It will, therefore, be understood that adjustment of the knob 35 and the consequent adjustment of the position of the anchoring lug or arm 17 and the shaft 50 and temperature responsive element 57 controls the normal position of the mercury switch 63 and the necessary movement of that switch for effecting

circuit making or breaking operation thereof. This adjustment controls the temperatures at which the switch unit 63 will make or break an electrical circuit.

Since the tubular housing 40 covers the end of the temperature responsive element 57, and is sealed by the cap 41, and since the hollow plug 43 cooperates with the tubular housing 40, the temperature responsive element 57 is completely enclosed with respect to the fluid or liquid within the tank, boiler or housing 46. The tubular housing 40 is preferably made of metal or of material having good heat conductivity. The transmission of heat from the tubular housing 40 to the temperature responsive element 57 is improved by the movement of air within the tubular housing 40 and through the louvers provided by the channels 60 and 61. The channels 60 and 61 are sufficiently small that the circulation of air therethrough is not sufficient to materially influence the action of the temperature responsive element by virtue of the temperature of the air.

While I have shown and described certain embodiments of the improvements for the purpose of illustration, it will be apparent that various detailed changes may be made therein without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. A switch comprising, in combination, a base, a tubular member rotatable with respect to the base, a gear and an arm secured to the tubular member, means spacing the gear and the arm from the base, a shaft extending through the tubular member, a pinion gear secured to a manually operable drive shaft and rotatable with respect to the base for driving the first mentioned gear, a friction yoke secured to the base and holding the gears in place, said friction yoke having a slot therein wider than the shaft diameter for rotatably and movably supporting one end of the shaft, a tubular housing closed at one end and having its other end secured to the base, said housing covering one end of the shaft and having means therein providing a bearing rotatably supporting the enclosed end of the shaft, a helically wound bi-metallic temperature responsive element having one end secured to said arm and movable therewith and the other end secured to the shaft, and a mercury switching unit carried by the shaft for movement therewith.

2. A switch comprising, in combination, a base having an opening therein, a tubular member, a gear, an arm and bearing means secured to the tubular member with the bearing means intermediate the gear and arm and rotatably mounted in said opening, means for manually rotating the gear to effect corresponding rotation of the arm, a shaft extending through the tubular member and normally spaced therefrom, a yoke secured to the base adjacent the gear and having a resilient portion engaging the gear for holding the gear in place, means providing a bearing for supporting one end of the shaft, a housing closed at one end and having its other end secured to the base, said housing covering one end of the shaft and having means therein providing a bearing supporting the enclosed end of the shaft, means limiting axial movement of the shaft, a bi-metallic temperature responsive element having one end secured to said arm and the other end secured to the shaft, and switch

means actuated by movement of the shaft effected by the temperature responsive element.

3. A switch comprising, in combination, a first sub-assembly including a base having an opening therein and a flanged collar secured to the base with the collar adjacent the opening; a second sub-assembly including a switch-actuating shaft having a plurality of bearing surfaces, a tubular member through which the shaft extends and having an outer bearing surface adapted to fit said opening in the housing, an arm secured to the tubular member on one side of said outer bearing surface, a gear secured to the tubular member on the other side of the outer bearing surface, a helically wound bi-metallic temperature responsive element having one end secured to the end of the shaft and the other end secured to said arm; a third sub-assembly including a friction yoke having an opening therein, an adjusting shaft extending through the opening in the friction yoke and rotatable therein, and a pinion gear secured to the shaft; and a fourth sub-assembly including a tubular housing closed at one end and open at the other end, a hollow plug secured to the open end of the tubular housing and having an opening therein adapted to fit said collar and louvers therein for passage of air to and from the tubular housing, and a bearing within the tubular housing; said sub-assemblies being assembled with the outer bearing surface of said tubular member in the opening in said base, the hollow plug secured to said collar so that the switch shaft and temperature responsive element extend into the tubular housing, the friction yoke being secured to the base so that the gears mesh and so as to hold said tubular member in place, and said switch-actuating shaft being supported by said bearing.

4. A switch comprising, in combination, a first sub-assembly including a base having an opening therein; a second sub-assembly including a switch actuating shaft, a tubular member through which the shaft extends, an arm secured to the tubular member, and a helically wound bi-metallic temperature responsive element having one end secured to the arm and the other end secured to the shaft; a third sub-assembly including a friction yoke; and a fourth sub-assembly including a tubular housing closed at one end and open at the other end, and a bearing within the tubular housing; said sub-assemblies being assembled with means securing the tubular housing to the base with the open end thereof in alignment with the opening in the base, means securing the friction yoke to the base, means including the friction yoke for rotatably holding the tubular member in said opening in the base, and means including said bearing rotatably supporting the shaft; and switch means actuated by rotary movement of the shaft.

5. A switch comprising, in combination, a sub-assembly including a shaft, a tubular member through which the shaft extends, said shaft and tubular member being joined together by means including a temperature responsive element, and a mercury switch actuated by the shaft; support means rotatably supporting the tubular member; a friction yoke removably secured to the support means and having resilient fingers for holding the sub-assembly in place with respect to the support means, said friction yoke providing a bearing for rotatably supporting one end of the shaft; and means for manually adjusting

the position of the tubular member with respect to the support means to vary the normal angular position of the mercury switch.

6. In a switch, an actuating mechanism comprising, in combination, a shaft having spaced portions of reduced section, a bi-metallic element having spaced turns extending along and surrounding a portion of the shaft, said bi-metallic element being anchored at one end and secured to the shaft at the other end, and means engaging the said portions of reduced section to support the shaft for rotary and limited axial movement, the last mentioned means including a bearing in which pivotal movement of the shaft occurs and a bearing wider than the shaft diameter in which limited transverse movement of the shaft occurs.

7. In a switch, the combination comprising a temperature responsive actuating member, a shaft actuated by the temperature responsive member, a tubular member through which the shaft extends, bearing means and temperature responsive element anchoring means secured to the outer surface of the tubular member, a support having an opening in which the bearing means is rotatably mounted, a flanged member retaining the bearing means on one side of the support, means including a removable friction yoke retaining the bearing means on the other side of the support, means accessible from the said other side of the support for removably securing the friction yoke in place, and means for adjusting the position of the tubular member.

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