Sept. 6, 1938. L. L. YOUNG 2,129,484

TEMPERATURE CONTROL DEVICE

Filed July 10, 1935

Fig. 1

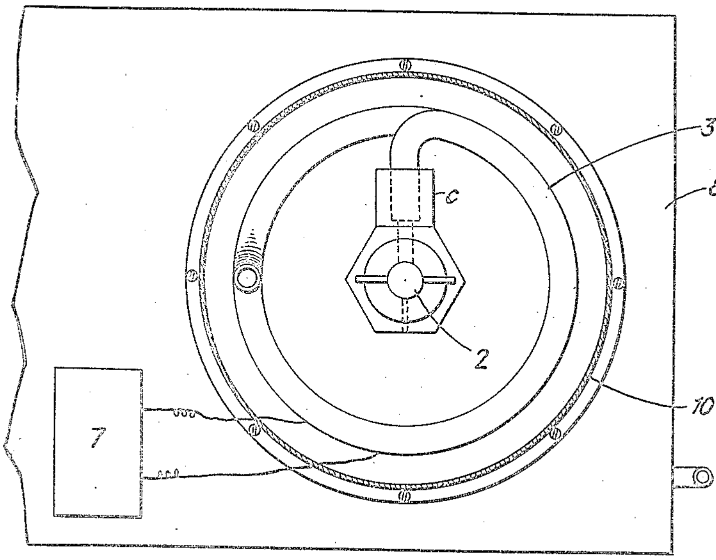


Fig. 2

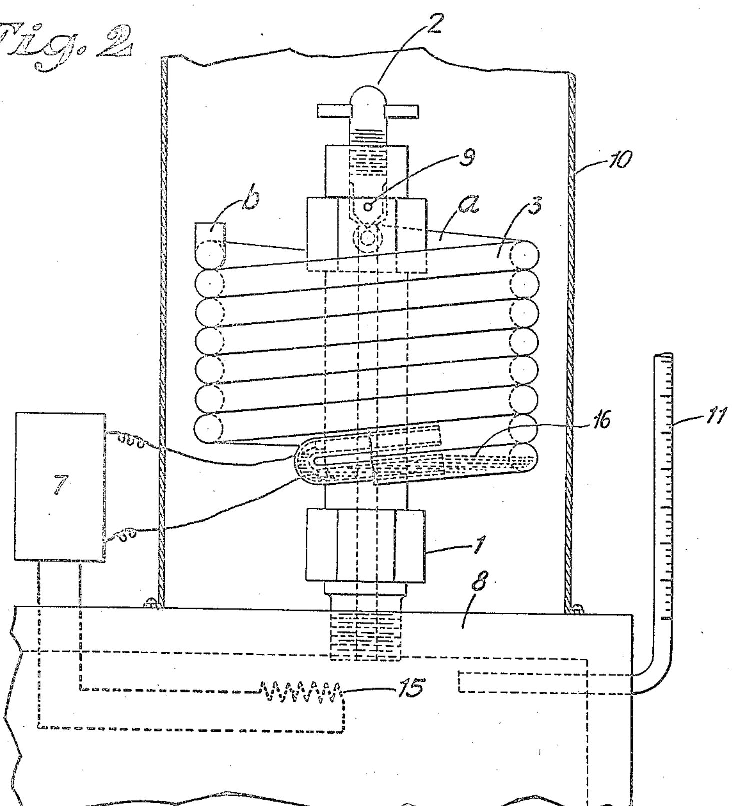
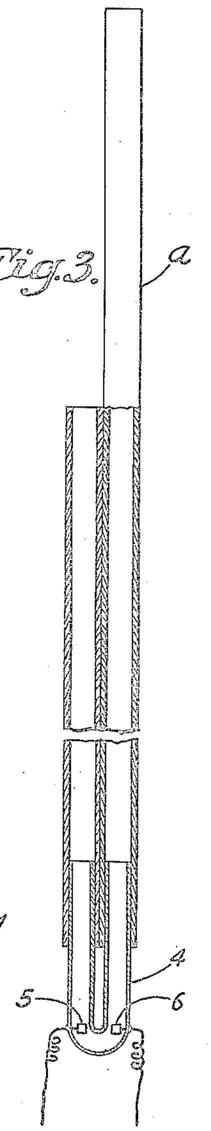


Fig. 3.



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TEMPERATURE CONTROL DEVICE

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9 Claims. (Cl. 200—140)

This invention relates to a temperature control device and deals more particularly with a switching means for opening and closing an electric circuit which controls a heating current.

This invention is an improvement over the United States Patent No. 1,994,740, patented March 19, 1935, issued to L. L. Young and J. L. Finch, for improvements in Piezo electric crystal holders, filed Oct. 15th, 1931.

An object of this invention is to simplify and improve fluid expanding temperature control devices or switches of the mercury type as applied to radio apparatus or other devices requiring substantially constant temperature maintenance. The fundamental principles of this improved thermostat are based upon the open tube manometer or syphon gauge.

In the prior art practice, insensitivity of the thermoregulator used for temperature control has hindered the maintenance of constancy of temperature. Mercury contacting devices in prior use do not utilize the positive driving force derived from expanding fluids in which is submerged the heating element. The temperature control device of this invention is sensitive and employs the positive driving force of the expanding fluid, and also has the advantage of making and breaking an electrical circuit at the surface of a body of mercury under oil, and therefore offers great reliability, ruggedness and freedom from mercury corrosion.

This invention may be best understood by referring to the drawing, in which

Fig. 1 is a plan view of the device of this invention;

Fig. 2 is a side elevation of Fig. 1; the casing being in section to show the functional elements; and

Fig. 3 is a developed detail partly in section of the temperature control element.

Referring now to Figs. 1 and 2, the central support tube 1 is threaded into the heater block 8 which may be a part of any apparatus desired to be controlled. The long arm or tube *a* of element 3 is sealed by soldering or other suitable means into a bushing or lug *c* on one side of and near the upper end of support tube 1. The thermostatic element 3 is composed of two small iron tubes *a* and *b* approximately 1/8 inch inside diameter, both of different lengths and located within a housing 10. The short tube *b* is open at one end to atmospheric pressure. The tubes *a* and *b* are placed parallel to each other, joined and wound together into a close helix approximately 2½ inches in diameter. The lower ends of these two iron tubes meet together and are connected by a heavy walled glass U tube 4 having two electrical contacts 5 and 6, securely sealed within the glass tube on each side of the bend.

The glass U-shaped tube 4 is sealed into the ends of the iron tubes by means of a suitable cement, such as glycerin and litharge, so as to be air and oil-tight.

The top portion of the central support tube 1 contains an adjustable needle valve 2 which shuts off the upper portion of tube *a* of element 3 and also prevents the atmosphere entering through aperture or opening 9 in tube 1.

The heating element 15, which may be located in the heater block 8, also the connections between the heating element and control relay 7 are shown by dotted lines. The temperature control relay 7 comprises any suitable relay device such as the well-known thyratron relay which is not shown in detail. Inside the element 3, and normally located in the lower turns of the tubes *b* and 4, is a quantity of mercury 16 of about a four-inch column which normally makes electrical contact between contacts 5 and 6 which are located in tube 4. The block 8, central support tube 1, and the tube *a* of element 3 are filled with oil as transil oil. A protective housing 10 is desirable to protect the control device. A thermometer 11 indicates the temperature of the heating block 8.

The operation of the device is as follows:

Assume that the complete unit is at room temperature when the device is to be first started in operation, and that the desired operating temperature is 45° C.

The needle valve 2 is first opened, then heating current is turned on so that the heating element 15 is energized or heated. As soon as the oil inside the block 8 is heated sufficiently by element 15, it will expand and the oil will flow up through tube 1 and out of opening 9, and this overflow is allowed to continue until the temperature of the block rises to 45° C., as indicated by thermometer 11. Then the needle valve 2 is closed by the operator. Thereafter the expanding oil can only flow into tube *a* of control element 3, and upon any further expansion of the oil the mercury will be moved toward the tube *b* of control element 3. As soon as the mercury has been moved in the glass U-shaped tube 4 enough to break contact at contact 5, the relay 7 will interrupt the heating current, and due to the rapid dissipation of heat from the block 8, the temperature of the oil drops. An increment of temperature change in the oil is accompanied by a corresponding increment change in volume, so that the flow of oil in tube 1 is reversed by the weight of the mercury which again makes contact with contact 5 and the heating current is then re-established.

This cycle is repeated in very short time periods. Since the volumetric change within the tubes *a* and *b* is large, compared with the area of section of the inside of the glass U tube 4 for a small change in temperature, and since only a minute movement of the mercury is required to make and break the electrical contact at contact 5, the heat will be supplied to the block 8 in such rapid "pulses" that the actual temperature change will be inappreciable.

If tubes *a* and *b* were reversed from the position shown in Fig. 2, that is if tube *b* were to be attached to the top of support tube 1, instead of tube *a*, the operation of relay 7 would also be reversed. The relay control circuit 7 would then cut off the heating current when contacts 5 and 6 are short-circuited electrically by the mercury, or in other words, the mercury column will be in the *b* tube if the heating current is cut off when contacts 5 and 6 are not short-circuited by the mercury. Briefly, an increase of pressure causes the mercury to move from tube *a* into tube *b* and the critical pressure, which corresponds to the desired temperature, will place one end of the mercury column in the vicinity of one of the contacts, the other being covered by mercury. The mercury column must be long enough so that it will not pass the contacts and start regulating at the wrong end of the column, which would cause regulation at a temperature much different from that desired.

This invention can be made in a variety of physical forms or shapes, such as straight parallel tubes properly connected, or in a square spiral, etc.

Other materials may be used provided so that no chemical action will be set up with the mercury, as glass tubes or nickel tubes with glass for sealing in contacts. Likewise, vitrified material other than glass may be used to secure the contacts. In another form only one contact may be used in the glass and the metal tube may be used for the other electrode.

This invention is not to be limited to the modifications shown, except such limitations as are clearly imposed by the appended claims.

Having thus described my invention, what I claim is:

1. A temperature control switch for controlling the temperature of a device, said switch comprising a spiral wound tube located above said device, a central support tube located within said spiral wound tube and in fluid communication with said device, said spiral wound tube comprising two parallel tubes, the lower end of said tubes having a tubular glass member connecting said tubes together in fluid communication, a pair of contacts retained within said glass tube to break an electrical circuit when a desired temperature changes within said device.

2. A fluid expanding thermostat switch comprising a coil of parallel arranged tubes, a chamber containing a device located below said thermostat switch and fluid communication between said chamber and said coiled tubes, an insulating unit connecting the lower portion of said tubes in fluid communication, electrical contacts located within said tubes so as to break an electrical circuit to control the temperature of said device located within said chamber.

3. A fluid expanding thermostat switch comprising a coil of parallel arranged tubes, a metallic housing surrounding said tubes, a chamber containing a device located below said thermostat switch, and fluid communication between said chamber and said coiled tubes, an insulating unit connecting the lower portion of said tubes in fluid communication, electrical contacts located within said tubes so as to break an electrical circuit to control the temperature of said device located within said chamber.

4. A temperature control switch for controlling a device, said switch comprising a central support element located above said device and in fluid communication with said device, a coil of parallel arranged tubes supported and in fluid communication with the central support, a chamber containing the device located below said switch, and fluid communication between said chamber and said coiled tubes, an insulating unit connecting the lower portion of said tubes in fluid communication, electrical contacts located within said tubes so as to break an electrical circuit to control the temperature of said device.

5. A temperature control switch for controlling a device, said switch comprising a central support element located above said device and in fluid communication with said device, a valve located above said central support element, a coil of parallel arranged tubes supported and in fluid communication with the central support, a chamber containing said device located below said switch, and fluid communication between said chamber and said coiled tubes, an insulating unit connecting the lower portion of said tubes in fluid communication, electrical contacts located within said insulating unit so as to break an electrical circuit to control the temperature of said device.

6. A fluid expanding thermostat switch comprising a coil of parallel arranged tubes, a chamber containing a device located below said switch, and fluid communication between said chamber and said coiled tubes, an insulating unit connecting the lower portion of said tubes in fluid communication, electrical contacts located within said insulating unit to break an electrical circuit to control the temperature of said device.

7. A temperature control switch for controlling a device, said switch comprising a helical wound tube located above said device, a central support tube located within said helical wound tube and in fluid communication with said device, said helical wound tube comprising two parallel tubes, the lower end of said tubes having a U-shaped glass tube member connecting said tubes together in fluid communication, a pair of contacts retained within said glass tube to break an electrical circuit when a desired temperature changes within said device.

8. A temperature control switch for controlling the temperature of a fluid within a container, said switch comprising a vertical support element located on the top of said container and in fluid communication therewith, a coil of two parallel arranged tubes supported at the upper portion of said vertical support, at least one of said tubes being in fluid communication with the fluid in said container, an insulating member connecting the lower ends of both tubes together, electrical contacts located within said insulating member and arranged to break an elec-

trical circuit to control the temperature within said container.

9. A temperature control switch for controlling the temperature of a fluid within a container, said switch comprising a vertical support element located on the top of said container and in fluid communication therewith, a needle valve, an aperture adjacent said needle valve at the upper portion of said vertical support element, a coil of two parallel arranged tubes supported at the upper portion of said vertical support, at least one of said tubes being in fluid communication with the fluid in said container and being partially filled with mercury, an insulating member connecting the lower ends of both tubes together, and electrical contacts located within said insulating member and arranged to break an electrical circuit to control the temperature within said container.

LLOYD L. YOUNG.