Nov. 14, 1939. L. L. YOUNG 2,179,838

TEMPERATURE CONTROL DEVICE

Filed April 28, 1938

Fig. 1a

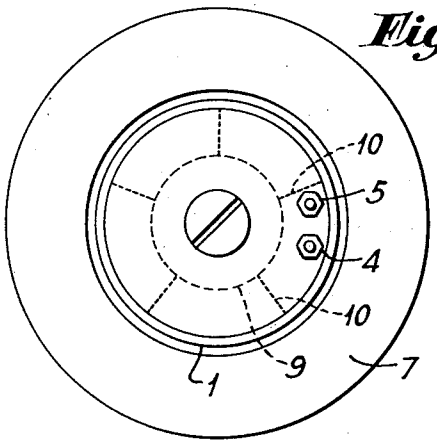


Fig. 2

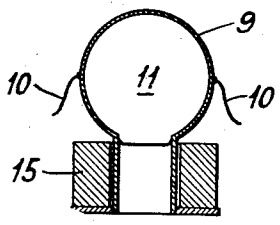


Fig. 1

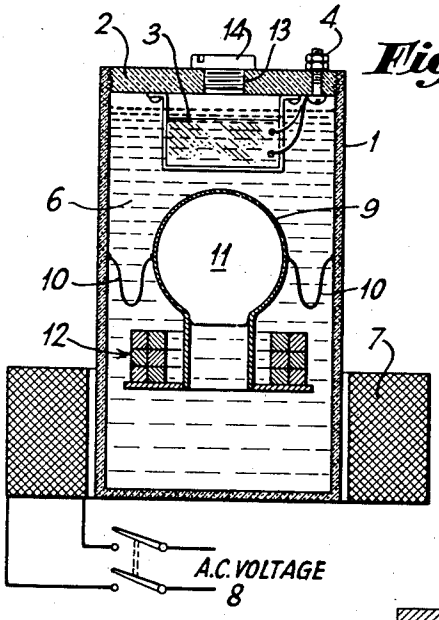
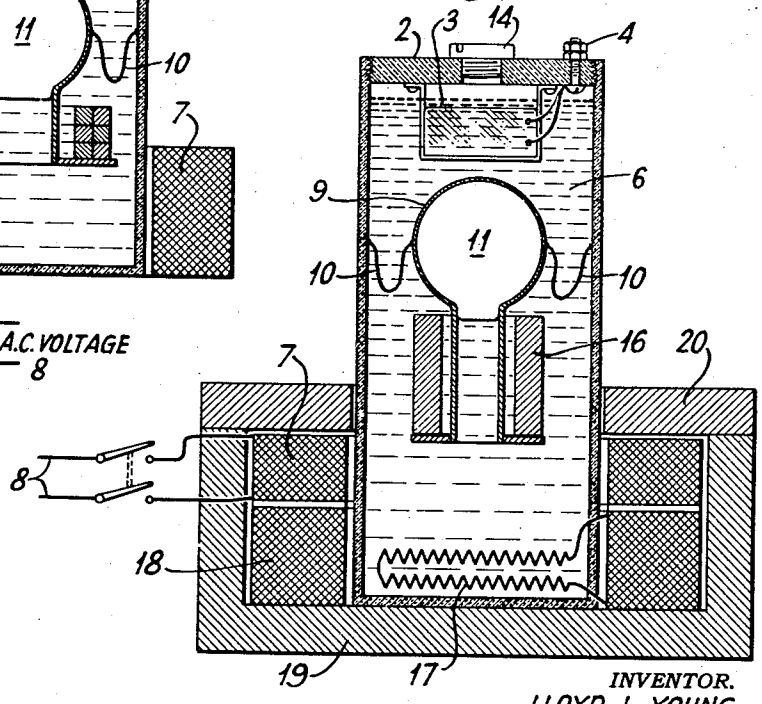


Fig. 3



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TEMPERATURE CONTROL DEVICE

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Application April 28, 1938, Serial No. 204,918

12 Claims. (Cl. 219—38)

This invention relates to a new and novel method of temperature control and deals specifically with a device for the control of self-contained heat generation and/or control of electric current for any purpose.

An object of this invention is to simplify and improve temperature control devices and to maintain more accurate control of the temperature of a liquid.

Another object of this invention is to provide a temperature control device which operates an electrical control circuit with the use of movable contacts.

A further object of this invention is to provide smooth temperature regulation to such devices as a piezo-electric crystal employed for accurate control of frequency in a radio circuit.

The features of this invention are based upon the principle of Archimedes as illustrated by the well known "Cartesian devil" and also upon the principle of Faraday's law of electro-magnetic induction.

This invention is particularly directed to two forms, one form in which the heat is generated by Foucault currents, or eddy currents, the other form being arranged such that heat is generated by electric currents flowing through high resistance conductors.

In the prior art practice, the current generating heat in high resistance conductors was generally controlled by means of contact electrodes with or without complicated vacuum tube circuits and also employed mechanical electro-magnetic relays or mercury circuit breakers. By my invention, all such circuit breakers and contact electrodes are eliminated. Furthermore, the use of all thermostats or like devices is dispensed with, thus materially reducing the cost of the temperature control system.

A feature of this invention is that it provides a smooth continuous regulation instead of in steps, as many of the prior art devices.

Another feature of this invention is that it may be used as a pressure regulator.

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

Fig. 1 is a section through a simple form of temperature control device;

Fig. 1a is a plan view of Fig. 1;

Fig. 2 is another modification of the floating assembly of Fig. 1; and

Fig. 3 is another embodiment in which the device is surrounded by two windings.

Referring now in detail to Figs. 1 and 1a, an insulating container 1 is provided with a removable cover 2, the under portion of which may be provided to retain a suitable oven or container 3, within which may be located a piezo-electric crystal holder (not shown) or any other device in which the temperature is desired to be maintained substantially constant, suitable electric connections being made to the device whose temperature is to be controlled by means of leads 4 and 5.

Within casing 1 is located a fluid 6 such as, for example, a light grade of oil or any other suitable material. Surrounding the lower portion of insulating casing 1 is a coil winding 7 which is arranged for setting up a strong magnetic field by being connected to a suitable source of alternating current voltage 8. Located approximately within the central portion of the casing, a Cartesian devil 9 is secured by means of fine threads 10, which prevent the floating assembly from touching the sides of the container, but permit ample freedom of vertical movement. Within element 9 there is maintained an air pocket 11 which responds to changes in temperature and pressure by volume changes. Member 9 is weighted down by a plurality of weights 12 which are in the form of continuous metallic ring-like conductors, the number and size being maintained such that the displaced oil nearly balances the weight of member 9. An opening 13, which is closed by means of a threaded stud 14, permits inspection of the oil level and its replenishment when necessary.

In the operation of this device, when the liquid 6 is cold, the air in space 11 is contracted and the buoyancy of element 10 is decreased so that the floating element 9, with the associated rings 12, sinks and the five threads 10 suspend the floating element 9 inside of the coil 7. When power is applied to coil 7, a strong field of magnetic flux is set up around the shorted turns 12, causing large currents to flow which, because of the resistance in the shorted turns 12, generates heat, thus heating the oil 6. When the oil becomes sufficiently heated and the air within chamber 11 is warmed, the air expands, permitting the float 9 to rise gradually, leaving the zone of the strong magnetic field. As the float causes the turns 12 to recede from the magnetic field, the currents in rings 12 become smaller and by the process of slow "hunting," the float 9 will come at rest to a point where the field strength is just enough to induce currents in shorted conductor 12, which generates sufficient heat as is dissipated, so that the temperature of the oil is then maintained constant. By adding

weights or additional rings 12, the operating temperature may be raised and finer adjustments may be made by raising or lowering the position of coil 7 with respect to casing 1.

The modified device shown in Fig. 2 is substantially similar to that of Fig. 1, except that shorted conductors 12 are substituted by a metal shell 15, which may or may not be of magnetic material, and the action of the device of Fig. 2 is the same in operation as that described above with reference to Fig. 1, except that the heat is generated in the metal shell 15, by eddy currents set up in the shell by the alternating magnetic field from the winding 7, which in this case is energized by alternating currents of suitable frequency.

Referring now to Fig. 3, part of the heat is produced by means of eddy currents occurring in a shell 16 which is preferably composed of magnetic material acting as a booster heater, and part by the heater resistance member 17 which is energized by a secondary winding 18 which forms part of a transformer, having an external core or cup 19 and cover 20, which aids in the operation of the device. The operation of Fig. 3 is such that when the float 9 is in the lower position, the shell 16 is in such a position that the strong magnetic flux from coil 7 threads or cuts the turns of coil 18, strongly inducing a current to flow, causing a decrease in the reluctance of the magnetic circuit. As floating element 9 rises, the magnetic material of 16 is withdrawn from the field and the flux is not so strong through and around coil 18, so that the heating current in 17 is decreased. The float 9 will then seek a position of rest as in the cases of the devices described in Figs. 1 and 2, wherein the heat generated just equals the heat dissipated and the temperature of the device becomes substantially constant. The application of these devices may vary, as, for instance, if the current in coil 18 of Fig. 3 is passed through a meter (not shown) it may be calibrated to read in terms of temperature. Various devices requiring close and smooth temperature control may utilize the devices of this invention. Also, another application of a device similar to that of Fig. 3 is that there is connected in the circuit of coil 18 a relay, polarized so that a pressure pump may be controlled as, for example, in a refrigerator.

There are various other modifications that could be made in the above devices, such as causing movement of the float 11 to make and break the electrical circuits; also, to change the reluctance in a magnetic circuit. Therefore, this invention should not be limited to the precise devices shown.

What is claimed is:

1. A temperature control device comprising an insulating casing, a coil surrounding said casing, a liquid whose temperature is maintained constant within said casing, a floating element in said liquid, a ring-like metallic member secured to said floating element, and means for passing an alternating current through said coil whereby eddy currents set up by said ring-like member heat said liquid to a desired constant temperature.

2. A temperature control device comprising an insulating casing, a coil surrounding said casing, an oil-like liquid within said casing, a floating element in said liquid, a ring-like metallic member secured to said floating element, and means for passing an alternating current through said coil whereby eddy currents set up by said ring-like member heat said liquid to a desired constant temperature.

3. A temperature control device comprising an insulating casing, a coil surrounding said casing, a liquid whose temperature is maintained constant within said casing, a floating element having a space filled with air the volume of which changes with the temperature of said liquid, a ring-like metallic member secured to said floating element, and means for passing an alternating current through said coil whereby eddy currents set up by said ring-like member heat said liquid to a desired constant temperature.

4. A temperature control device comprising an insulating casing, a coil surrounding said casing, a liquid whose temperature is maintained constant within said casing, a floating element in said liquid, a metal shell member secured to said floating element, and means for passing an alternating current through said coil whereby eddy currents set up by said metal shell member heat said liquid to a desired constant temperature.

5. A temperature control device comprising an insulating casing, a coil surrounding said casing, a liquid whose temperature is maintained constant within said casing, a floating element in said liquid, a metal shell of magnetic material secured to said floating element, and means for passing an alternating current through said coil whereby eddy currents set up by said metal shell heat said liquid to a desired constant temperature.

6. A temperature control device comprising an insulating casing, a coil surrounding said casing, a liquid whose temperature is maintained constant within said casing, a floating element in said liquid, a long narrow metallic shell of magnetic material secured to said floating element, and means for passing an alternating current through said coil whereby eddy currents set up by said metallic shell heat said liquid to desired constant temperature.

7. A temperature control device comprising an insulating casing, a plurality of coils surrounding said casing, a liquid whose temperature is maintained constant within said casing, a floating element in said liquid, a ring-like metallic member secured to said floating element, and means for passing an alternating current through at least one of said coils whereby eddy currents set up by said ring-like metallic member heat said liquid to a desired constant temperature.

8. A temperature control device comprising an insulating casing, a plurality of coils surrounding said casing, a heating coil located within said casing and connected to a source of power, a liquid within said casing, a floating element in said liquid, a ring-like metallic member secured to said floating element, means for passing alternating current through at elast one of said coils whereby eddy currents are set up by said metallic member causing heat which maintains said liquid at a desired temperature.

9. A temperature control device comprising an insulating casing, a coil surrounding said casing, a liquid whose temperature is maintained constant within said casing, a piezo-electric crystal element surrounded by said liquid, a floating element in said liquid, a ring-like metallic member secured to said floating element, and means for passing an alternating current to said coil whereby eddy currents set up by said ring-like member heat said liquid to a desired constant temperature.

10. A temperature control device comprising an

insulating casing having a cover, a piezo-electric crystal secured to said cover, a liquid whose temperature is to be maintained constant within said casing, a floating element in said liquid, a ring-like metallic member secured to said floating element, and means for passing an alternating current through said coil whereby eddy currents set up by said ring-like member heat said liquid to a desired constant temperature.

11. A temperature control device comprising an insulating casing, a transformer having a core and a plurality of coils surrounding said casing, a heating coil located within said casing and connected to one of the coils of said transformer, a liquid within said casing, a floating element in said liquid, a ring-like metallic member secured to said floating element, means for passing an alternating current through at least one of said coils whereby eddy currents are set up by said metallic member causing heat which maintains said liquid at a desired temperature.

12. A temperature controlling device comprising a container filled with liquid, a body having a gas filled space floating in said liquid, a member adapted to have heating currents induced therein carried by said body, and means relatively fixed in position with respect to said container inducing currents in said member whereby the induced currents flowing in said member cause heating of said liquid thereby changing the volume of gas in said body and thereby causing said body to float to a position such that the heat generated by said member substantially equals the heat dissipated by the liquid.

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