June 11, 1929. F. C. REEDER 1,717,261

TEMPERATURE REGULATOR

Filed Jan. 2, 1925

Fig. 1.

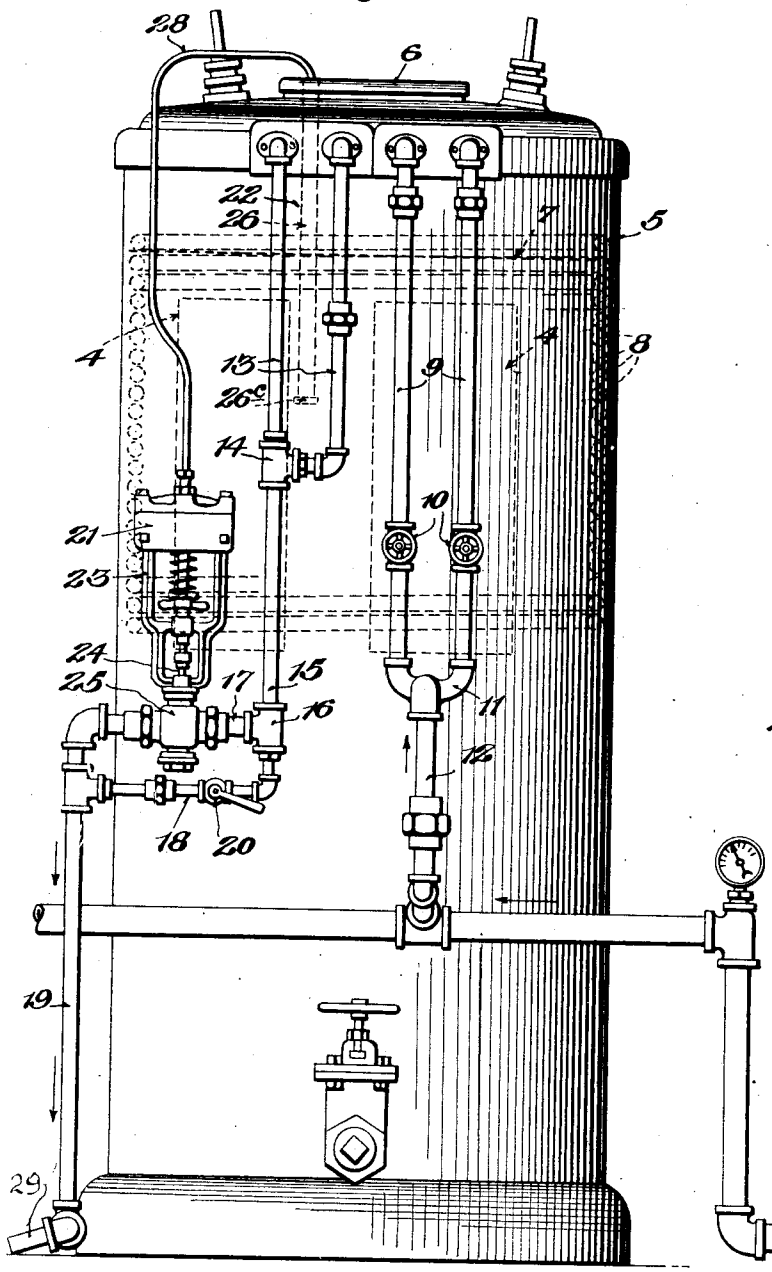


Fig. 2.

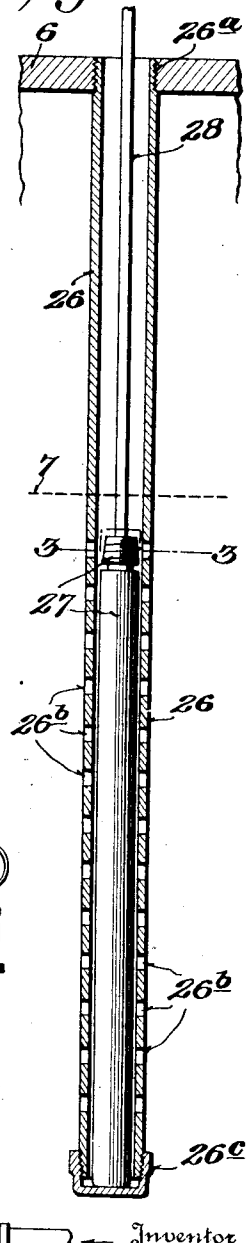
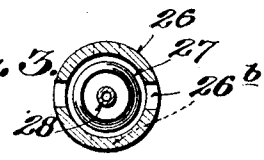


Fig. 3.



Inventor

Frank C. Reeder

By Mauro, Cameron, Lewis & Kirkham

Attorneys

Patented June 11, 1929. 1,717,261

UNITED STATES PATENT OFFICE.

FRANK C. REEDER, OF KNOXVILLE, TENNESSEE, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE FULTON SYLPHON COMPANY, OF KNOXVILLE, TENNESSEE, A CORPORATION OF DELAWARE.

TEMPERATURE REGULATOR.

Application filed January 2, 1925. Serial No. 248.

This invention relates to temperature regulators, and more particularly to apparatus for regulating the temperature of electrical transformers of the type employing liquid conveying cooling coils immersed in an insulating fluid which surrounds the transformer windings.

Transformers cooled entirely by the flow of a liquid, such as water, require a considerable supply of water when running full load and when running at a very slight load the water circulation should be correspondingly decreased. If too great an amount of water is supplied the transformer will be over-cooled and moisture from the atmosphere will condense inside the transformer, thus reducing the dielectric strength of the insulating fluid, usually oil, surrounding the transformer windings. Moreover, the cost of the cooling liquid is a considerable item in the operation of transformers and should be reduced to a minimum by providing only the amount actually required for proper cooling.

It has heretofore been proposed to provide temperature regulators for transformers of the cooling coil type by employing a regulator comprising a thermostatic element and a controller element for regulating the flow of the cooling medium. This thermostatic element includes a tubular receptacle containing heavy oil and a corrugated metal tube. The controller element includes a tubular member having its upper end connected by a tube of small diameter to the upper end of said tubular receptacle. A corrugated metal tube, capable of being compressed when an increase of temperature causes the heavy oil in said receptacle to expand, is positioned in the tubular member. When the temperature of said oil increases, the pressure thus developed is transmitted to the tubular member to effect compression of the corrugated tube therein. As a result, a piston is actuated to open a valve controlling the supply of cooling liquid for the cooling coils, said valve being positioned on the inlet side of the coils. The tubular receptacle of the thermostatic element is embraced by a heating coil connected in circuit with the secondary winding of a small transformer, the primary windings of the latter being connected with the secondary of the main transformer to be cooled.

This proposed arrangement has proven unsatisfactory in that the heat dissipated per unit of volume by the heating coil must be the same as that of the transformer windings, and the emissivity of the oil must likewise correspond to that of the transformer windings. Moreover, the auxiliary transformer and the connections therefor to the main transformer, together with the above heat requirements, renders it practically impossible to install the device in transformers other than those particularly designed and built with that object in view.

Another serious defect in the above type of regulators results from the placing of the control valve on the inlet side of the cooling coils. When so positioned the coils will not remain filled with water after the valve is closed. Consequently, when the valve is opened the coils are immediately filled with cold water which over-cools the transformer.

An object of the present invention is to overcome the above difficulties by providing a temperature regulator which is actuated solely by the change in temperature of the insulating fluid, no heating coil or electrical connections to the transformer windings being required.

Another object of the invention is to provide a novel temperature regulator comprising a temperature control valve which is positioned on the discharge side of the cooling coils for preventing undesirable fluctuations in the temperature.

A further object of the invention is to provide a novel temperature regulator of rugged construction which may be readily and inexpensively installed in transformers now in use. Other objects will appear as the description proceeds.

The invention is capable of receiving a variety of mechanical expressions, one of which is illustrated in the accompanying drawings but it is to be expressly understood that the drawings are for purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had to the appended claim for this purpose.

In the drawings:

Fig. 1 is a somewhat diagrammatic side elevation illustrating one embodiment of the present invention;

Fig. 2 is an enlarged detail sectional view of one form of a thermo-sensitive bulb that may be employed; and

Fig. 3 is a section taken on the line 3—3 of Fig. 2.

Referring to the drawings wherein like ref-

erence numerals refer to like parts throughout the several views, diagrammatically illustrated transformer coils or windings 4 of any suitable type are mounted in any desired way in a surrounding casing 5 which is provided with a removable cover plate 6 preferably positioned in the upper end of said casing. A body of insulating liquid of any suitable character, such as oil, is contained in casing 5, the level 7 of the oil being such as to completely immerse the transformer windings 4. Preferably, a pair of concentric, parallel cooling coils 8 are mounted within the casing adjacent the inner periphery thereof, and in a position to surround the transformer windings 4. Discharging into the coils 8 and connected thereto in any suitable manner are a pair of pipes 9 which are preferably disposed exteriorly of the casing 5 and which are provided with hand valves 10. A Y-coupling 11 is preferably employed for connecting the pipes 9 to a cooling water supply pipe 12. Connected to the discharge end of the coils 8 are a pair of pipes 13 which may be connected by means of a T-coupling 14 to a common discharge 15. In the form shown, a T-coupling 16 is employed for dividing pipe 15 into two parallel branches 17 and 18 connected with a common waste pipe 19. Preferably a manually operable valve 20 of any suitable type is provided in branch 18.

Suitable means are provided for automatically controlling or regulating the flow of the cooling liquid through the branch pipe 17, and said means are controlled by the temperature of the insulating liquid contained in casing 5. As shown, the regulating means are of the type illustrated and described in the patent to Fulton, No. 1,328,277, dated January 20, 1920, and comprise a valve structure 21 operatively connected to the branch pipe 17 together with a thermo-sensitive unit 22 that is immersed in the insulating liquid closely adjacent the transformer windings 4.

The valve structure 21 includes a frame 23 in which is mounted an expansible and collapsible corrugated vessel operatively connected to a valve stem 24 for actuating a suitable valve positioned in valve casing 25 interposed in the branch pipe 17. Suitable regulating means of any known type are provided for controlling the expansion of said vessel.

The thermo-sensitive unit comprises a tube 26 which is preferably threaded at its upper end 26^a into the cover plate 6 and is provided with a plurality of openings 26^b in the lower portion of its side walls. A removable cap 26^c may be threaded onto the lower end of the tube. Positioned in the lower portion of tube 26, below the level 7 of the insulating liquid, and preferably in engagement with cap 26^c, is a bulb 27 which is partially filled with a volatile liquid of any suitable character, as chloroform for example. A tube 28 of small diameter connects the interior of the bulb 27 with the interior of the corrugated vessel of the valve structure 21. A drain 29 may be provided for the casing 5.

In operation, pressure is maintained at all times on supply pipe 12 and the cooling coils 8 are always filled with the cooling liquid. As the load on the transformer increases, the resulting heat raises the temperature of the insulating oil, and the latter in turn volatilizes the liquid in bulb 27. The pressure thus generated in the bulb is transmitted through pipe 28 to the corrugated vessel and the valve structure 21, expanding said vessel and forcing valve stem 24 downwardly to open the valve in valve casing 25 and permit the cooling liquid to circulate in coils 8. The adjusting means of the valve structure is such that the valve will be opened a suitable amount to control the flow of cooling liquid and maintain the transformer windings at the desired temperature. The openings 26^b in tube 26 permit free circulation of the insulating liquid around the bulb 27. Since the control valve is placed on the discharge side of the cooling coils the latter will always be filled with water and sudden changes in temperature will be avoided, thus materially increasing the efficiency of the transformer. If desired, valve 20 may be opened a predetermined amount to provide a continuous circulation of cooling water. In this instance the temperature regulation will be only partially automatic. Valve 20 may also be employed for draining the cooling coils 8, the valves 10 being closed.

There is thus provided a regulator which is automatic in operation and which at all times supplies only the amount of water required for maintaining the transformer windings at the desired temperature, thereby controlling the amount of water used and reducing the cost of the same to a minimum. The device may be readily installed in transformers now in use without the necessity of altering electrical connections. The amount of cooling liquid supplied varies directly with the temperature of the insulating liquid.

While only one embodiment of the inventive idea has been illustrated in the accompanying drawings, it is to be understood that the invention is not limited thereto since the invention is capable of being carried out in a variety of ways, some of which will now readily suggest themselves to those skilled in the art, while changes may be made in details of construction and arrangement without departing from the spirit of the invention. Reference is therefore to be had to the claim hereto appended for a definition of the limits of the invention.

What is claimed is:

The combination of a transformer and a casing therefor containing an insulating liq-

uid, a cooling coil in said casing and liquid and having inlet and outlet connections, a valve in the outlet connection of said coil whereby the flow of cooling medium may be stopped while maintaining said coil full of said medium, a perforated tube depending in said insulating liquid from the top of the casing, a bulb containing a volatile fluid inserted within said tube, an expansible and collapsible vessel operatively connected to said valve, and a pipe connecting said bulb and vessel.

In testimony whereof I have signed this specification.

FRANK C. REEDER.