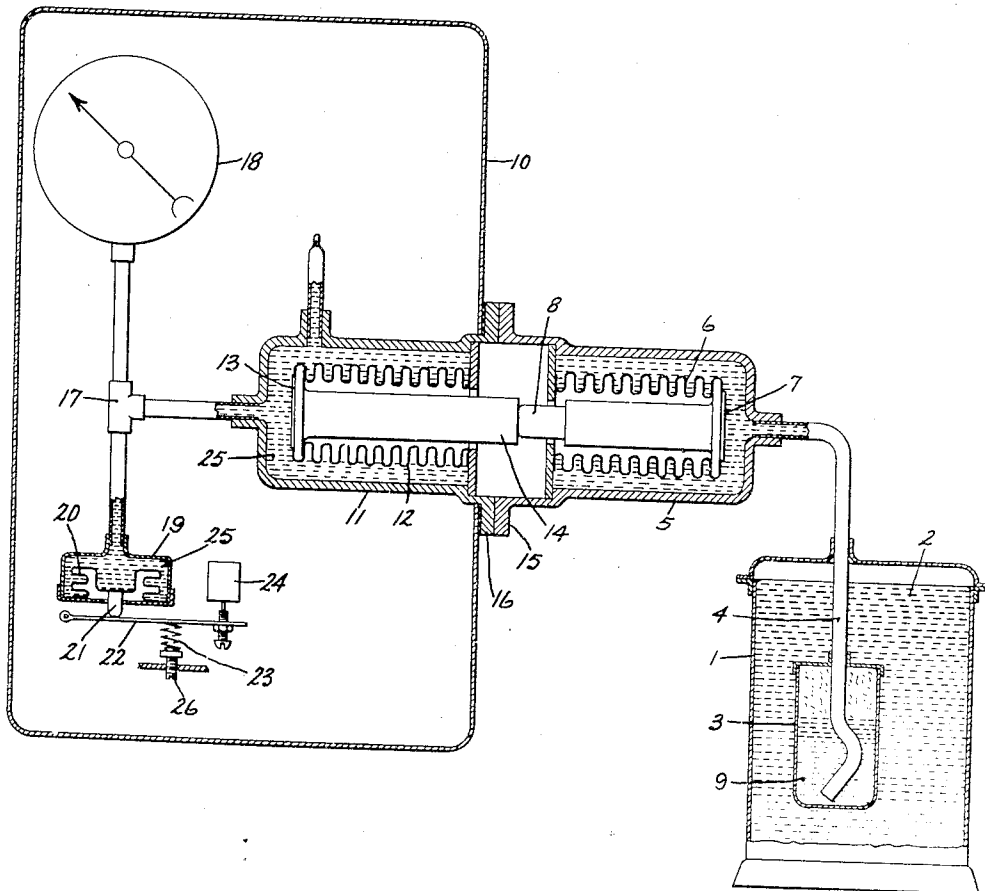


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THERMAL RESPONSIVE SYSTEM

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THERMAL RESPONSIVE SYSTEM

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1 Claim. (Cl. 297—5)

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This invention relates to thermal responsive systems and more particularly to improvements in thermal relays and temperature indicators for electric induction apparatus.

The commonest example of an electric induction apparatus is a transformer. Power transformers are usually mounted in a steel case which is substantially filled with a liquid which serves both as an insulating medium and as a cooling medium. It is very often desirable and even necessary to indicate the internal temperature of the apparatus. In addition, it is often necessary to have automatic means, such as a thermal relay, which will operate contacts for tripping a circuit breaker so as to de-energize the transformer in case it becomes overheated.

A common type of thermal relay and indicator for such apparatus consists of a sealed vapor pressure system comprising a bulb mounted inside the transformer tank, usually near the top surface of the liquid, which is connected by means of a capillary tube to a bellows or its equivalent for actuating an indicating device or a switch. In such a system the top of the bulb is filled with the vapor of the liquid and the rest of the system is filled with the liquid. The internal pressure throughout the entire system is therefore the vapor pressure in the top of the bulb and this pressure is almost entirely proportional to the temperature of the bulb.

The bellows or the apparatus actuated thereby must be carefully calibrated in order that a correct indication or response will be given by the system. Experience has shown that most failures in this system occur at the bellows end of the system. Whenever there is such a failure the entire system has to be replaced because of the fact that the system is completely sealed and calibrated so that any changes or openings in the system will destroy its calibration and reliability.

In accordance with this invention there is provided an improved arrangement in which the indicating or relay end of the system is made a separate and readily detachable unit from the rest of the system. This unit can be calibrated by itself and can readily be replaced by a duplicate unit which does not require additional calibration.

An object of the invention is to provide a new and improved thermal responsive system.

Another object of the invention is to provide an improved thermal relay for electrical apparatus.

An additional object of the invention is to provide a new and improved temperature indicating

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and control device suitable for use with power transformers.

The invention will be better understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claim.

Referring now to the single figure of the accompanying drawing, there is shown therein diagrammatically an embodiment of the invention comprising a transformer tank 1 which is substantially filled with an insulating and cooling liquid 2 of any suitable type. The actual core and coils of the transformer, which may be of any suitable and well known type, have not been shown. Mounted inside the tank and under the surface of the liquid is a closed bulb 3 to which is sealed a capillary tube 4 which enters through the top of the bulb and extends to near the bottom. The capillary tube connects with a sealed element or casing 5 having a bellows 6 or other equivalent expansive and contractive element. This bellows has a movable wall 7 to which is attached a plunger 8. As shown, the bulb 3 is partially filled with a liquid 9, such as methyl alcohol, and the remaining or top portion of the bulb is filled with the vapor of this liquid. The capillary tube 4 and the member 5 are entirely filled with the liquid.

The gauge or relay end of the system comprises a casing 10 in which is mounted a chamber 11 having a diaphragm or bellows 12 or its equivalent which is provided with a movable wall 13 to which is attached a plunger 14, the end of which normally engages the end of the plunger 8. The member 5 is shown as having a flange 15 which is engaged by a complementary flange 16 on the chamber 11 and these two flanges may be held together in any suitable manner, such as by screws or bolts. The inside of the chamber 11 connects by suitable tubing and fittings 17 to a thermometer 18 which is in reality a pressure gauge calibrated to read temperature. This piping 17 also connects to a chamber 19 including a bellows or diaphragm 20 having a movable member 21 which operates a lever 22 against the opposing force of a biasing spring 23 so as to actuate any suitable device, such as a micro switch or switchette 24.

The inside of the chamber 11 and of the piping 17 and of the gauge 18 and the chamber 19 are completely filled with liquid 25, there being no vapor in this part of the system. Good results have been obtained with turpentine.

In the operation of the system shown in Fig. 1 changes in temperature of the liquid 2 in the main transformer tank 1 will vary the pressure

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of the vapor in the bulb 3 and this pressure will be transmitted throughout the entire system and through the abutting plungers 8 and 14 to the gauge 18 and the switch 24.

By reason of what may be described as the dry connection between the meter case 10 and the rest of the system, which connection consists merely of the abutting or mechanical engagement of the plungers 8 and 14 and the similar engagement of the flanges 15 and 16, any failure of the apparatus in the relay case 10 will not affect the sealed vapor pressure system which includes the bulb 3 and the bellows 6. Consequently, the relay case can be removed and be replaced by a duplicate very simply and easily.

Furthermore, it is not necessary that the different relay units or cases be exact duplicates, that is to say, the physical relationship between the end of the plunger 14 and the face of the flange 16 is not critical. This is because the pressure throughout the entire system is determined entirely by the vapor pressure of the liquid 9 in the bulb 3 so that substantial variations in length of the plunger 14 in different relay units will merely cause slight compression or expansion of the vapor in the bellows 9, but as the pressure of the vapor is entirely a function of its temperature and not of its volume, it will be seen that the system is self-compensating. It is therefore only necessary to calibrate each relay unit so that its device 18 will indicate correctly the pressure of the liquid 25 and so that its switch 24 will be operated at the same value of pressure of the liquid 25. This latter is controlled by an adjusting screw 26 for varying the force of the spring 23.

While there has been shown and described a particular embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications can be made therein without departing from the invention and, therefore, it is aimed in the appended claim to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

In combination, a closed tank for electrical apparatus having a temperature to be responded

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to, a sealed vapor pressure system having a bulb located in said tank so that its temperature has a predetermined relation to said temperature to be responded to, a hollow expansive and contractive element having a movable wall accessible from outside said tank, a capillary tube interconnecting the bottom of said bulb and the interior of said expansive and contractive element, a liquid filling all of said system except the top part of said bulb which is filled with the vapor of said liquid whereby the pressure in said system is the vapor pressure of said liquid, a liquid pressure system wholly outside said tank having a hollow expandable and contractable member with a movable wall in effective contact with the wall of said expansive and contractive element which is accessible from outside said tank, a second hollow expandable and contractable member having a movable wall for actuating a responsive element, a conduit interconnecting said expandable and contractable elements, a liquid entirely filling said second system, a main spring for determining the liquid pressure at which said second hollow expandable and contractable member actuates said responsive element connected to the movable wall of said second expandable and contractable member, and a liquid pressure responsive device connected to said conduit, said device having a movable pointer whose position is directly proportional to the pressure of said liquid.

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