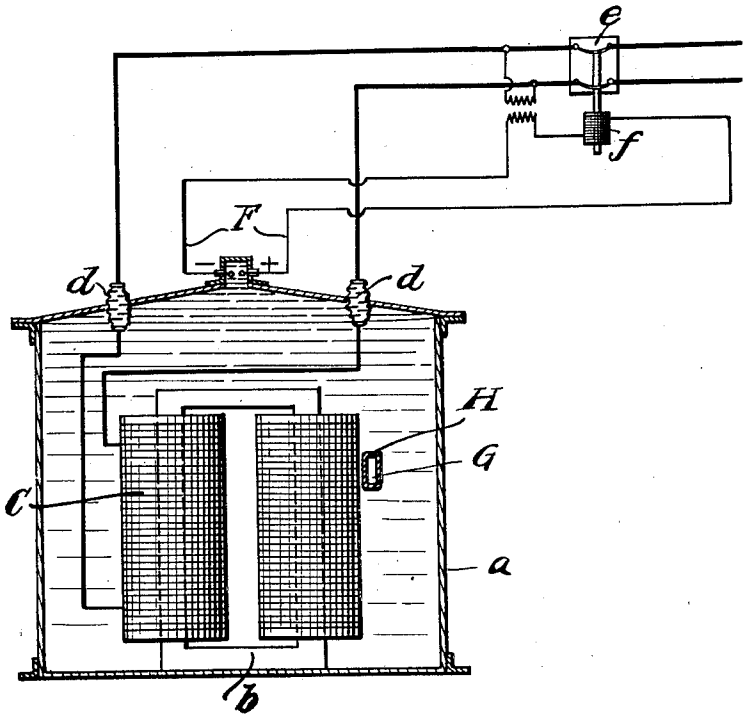
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CONTROL OF LIQUID INSULATED ELECTRIC APPARATUS

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UNITED STATES PATENT OFFICE.

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CONTROL OF LIQUID-INSULATED ELECTRIC APPARATUS.

Original application filed September 15, 1922, Serial No. 588,457, and in Germany January 19, 1922. Divided and this application filed April 16, 1925. Serial No. 23,674.

My invention has reference to a method and means for protecting electric apparatus operating in an insulating liquid, such as oil transformers, oil switches, grounding throttling coils, resistances and the like, and it is one of the important objects of my invention to provide a device of very simple construction and great reliability, and adapted to operate before extensive injuries to the apparatus to be protected can occur by sparking, overloading or other disturbances.

My invention is particularly based on the fact that in the case of disturbances in the operation of the apparatus to be protected or in the case of sparking or other irregularities of operation, or whenever such irregularities are imminent a rise of temperature will occur which can be utilized for operating a suitable protective means, this application being a division of my copending application Serial Number 588,457 filed September 15, 1922.

I may for instance utilize a supply of gas, such as air, enclosed in a container of metal, glass or other suitable material mounted in the oil filled vessel in close vicinity to the apparatus to be protected, such gas being liberated and allowed to ascend in the insulating liquid whenever a predetermined temperature of the oil is exceeded, owing to an unnormal operation of the apparatus. The ascending bubbles of air or other gas may then be made to bridge the gap between two terminals of a protective circuit, thereby effecting the switching out of the apparatus or some other protective operation.

The temperature at which the gas is set free should be so selected as to cause the safety device to be operated before the occurring of sparking or of other disturbances. The gas container may be provided with one or a plurality of openings which are closed by readily fusible metals, resins or the like. The gas container may be replaced by a hollow wire or wires which may form part of the electric outfit of the apparatus to be protected. Upon the melting of the closure of the openings in the container, part of the air or other gas enclosed therein under normal or increased pressure, being expanded by the heat of its surroundings, will escape and ascend. Instead of air or a gas, a solid substance or a liquid of low boiling point may be stored in the container and the gases or vapors set free from these substances at an elevated temperature will then act on the protective circuit. I may even use a plurality of such containers disposed at different points within the vessel, whereby I am enabled to watch the temperature of the insulating liquid at these points. I may even dispense with a container and replace it by some substance capable of remaining unchanged, while being submerged in the insulating liquid under normal conditions, but becoming volatilized or emitting gases or vapors at an elevated temperature, such substances being either freely arranged in the oil or hidden in the insulation of the wires.

A protective device embodying this invention is illustrated in the drawings annexed to this specification by way of example in a purely diagrammatic manner in elevation.

In the drawings, *a* is a transformer casing, *b* is the transformer, *c* are the windings, *d* are the leading-in insulations for the conductors, *e* is an oil switch with a releasing coil *f* comprised in the protective circuit, two terminals of which F are arranged in the casing *a* to form a spark gap above the gas container G mounted near the windings *c* of the transformer and closed by a fusible plug H. The container G is filled with air which, on the fusing of the plug H, being expelled by the heat generated by an abnormal working of the apparatus, will rise in bubbles bridging the spark gap F, whereby the protective circuit is set operating so as to open the oil switch *e* and cut out the transformer.

The contacting device according to this invention may be arranged at different places, either in the interior of the main oil receptacle or, in the case of transformers, in combination with expansion vessels contained therein, or special spaces, tubes or similar instrumentalities may be provided adapted for the reception of the contacting devices. The closing of the circuit may be effected both within as well as outside of the liquid.

The circuit to be controlled by the contacts referred to may excite either directly or by the medium of an intermediate relay the releasing coil of an oil switch which interrupts the endangered circuit. In the case of apparatus the circuit of which does not include an oil switch, as frequently occurs, for instance in the cases of transformers mounted in the field at wide distances apart,

other provisions should be made for the purposes of this invention.

Besides the form of construction herein shown and described, the invention is susceptible of a variety of other modifications and forms of application of the principle of my invention all of which operate substantially in a similar manner. The means of connecting the contacting device with the releasing circuit and the switching means are open to changes and alterations without any material importance for the operation of the apparatus according to my invention which in its broad aspects comprises the operation of safety devices for electric apparatus or the like, adapted for operation by vapors, fumes, gases or similar emanations liberated and expelled from the insulating medium, and means adapted to be operatively influenced by such emanations, and connected to fuses or equivalent safety means, the instrumentalities shown and described in this specification as embodiments of these principles being susceptible of modifications without deviating from the spirit of my invention as set forth in the claims.

In the claims the term "gases" is meant to comprise also vapors and fumes.

I claim:—

1. A protective system for liquid insulated electric apparatus comprising a container and a supply of insulating liquid surrounding the apparatus to be protected, a protective circuit, a spark gap inserted in said circuit and submerged in said liquid, and means for causing gas bubbles to come in contact with said spark gap.

2. A protective system for liquid insulated electric apparatus comprising a container and a supply of insulating liquid surrounding the apparatus to be protected, a protective circuit, a spark gap inserted in said circuit and submerged in said liquid, and a sloping guide surface near said spark gap.

3. Protective system for liquid insulated electric apparatus comprising a container and a supply of insulating liquid surrounding the apparatus to be protected, protective means associated with said apparatus, and a source of gas below said means in close vicinity to the apparatus to be protected, said gas on release being adapted to render effective said protective means.

4. Protective system for liquid insulated electric apparatus comprising a container and a supply of insulating liquid surrounding the apparatus to be protected, protective means associated with said apparatus, and a gas filled container below said protective means in close vicinity to the apparatus to be protected, the gas in said container being releasable in consequence of abnormal conditions in said apparatus and upon release to render the protective means effective.

5. Protective system for liquid-insulated electric apparatus comprising a container and a supply of insulating liquid surrounding the apparatus to be protected, gas supplying means submerged in said insulating liquid, and a protective circuit including means adapted to be rendered operative when gas is released from said supplying means.

6. Protective system for liquid insulated electric apparatus comprising a container for said apparatus, a supply of insulating liquid in said container surrounding said apparatus, a gas receptacle immersed in said liquid, and a protective circuit including means rendered operative by gas adapted to be released from said receptacle and rising in the liquid.

In testimony whereof I affix my signature.

MAX BUCHHOLZ.