July 25, 1933. K. TÄUBER 1,920,037

HEAT DIFFERENTIAL SAFETY DEVICE FOR TRANSFORMERS AND THE LIKE

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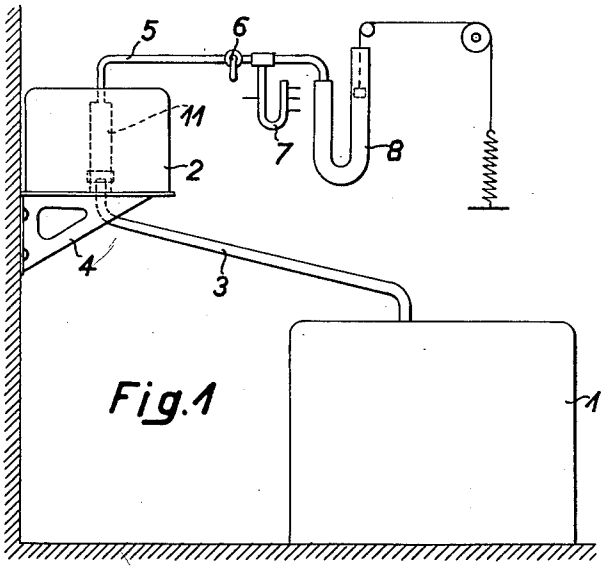
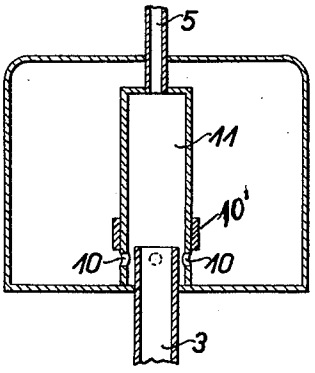


Fig.1

Fig.2



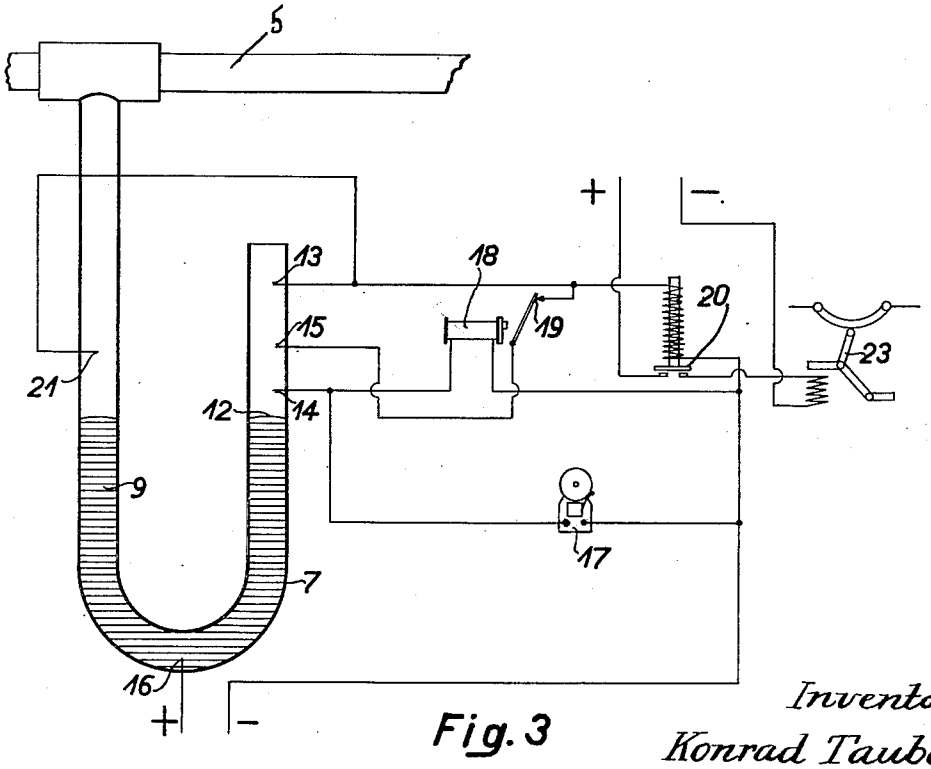


Fig. 3

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UNITED STATES PATENT OFFICE

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DIFFERENTIAL SAFETY DEVICE FOR TRANSFORMERS AND THE LIKE

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The present invention relates to an apparatus for the protection of oil transformers and like electrical equipment, having amongst its principal objects to provide a device which will immediately and accurately respond to any increase in temperature, pressure or volume of the insulating fluid such as oil employed, and in fact every alarming irregularity occurring in a transformer fraught with damage in order that such irregularities will be announced, recorded, and when necessary, the transformer to which the device is applied will be disconnected from use to prevent extensive injury thereto.

Various methods and means have heretofore been employed for protecting electric apparatus operating in an insulating liquid such as oil transformers, which protective means indicate or announce minor as well as serious disturbances occurring in the transformer or switch off the circuit of the apparatus so protected. Such devices work either in dependence of the temperature of the oil, of the oil-level, of the development of gases or of the relation between the primary and secondary current or the primary and secondary capacity of the transformer.

All these protective devices present, however, imperfections, as they do not protect the transformer-winding against inadmissible overloads nor indicate at all or sufficiently quickly smaller defects in the transformer. Where a high sensitiveness of these devices is aimed at there often occurs a faulty working of the protective apparatus through the circumstance that, when interruptions occur outside the transformer, the latter becomes disconnected.

The present invention is based upon the fact that every irregularity in the transformer fraught with danger, either by an overload or by a defect in the transformer, is accompanied by a production of heat which communicates itself to the oil and causes a change of volume of the oil contained in the transformer, it being unnecessary that the local increase in temperature should become so great as to cause the formation of gases. To the heat which passes into the oil through the normal working-current (ohmic loss and iron losses) and causes changes of volume, new quantities of heat are therefore added in the case of interruptions or overloads which result in a further increase of volume. The changes of volume are at all moments in equal proportion to the difference between the heat produced in the transformer and the heat again emitted by the transformer as well as the oil.

The object of the present invention is shown by way of example in the accompanying drawing in which

Other important objects and advantages of the invention will be in part obvious and in part pointed out hereinafter.

In order that the invention and its mode of operation may be readily understood by those persons skilled in the art, I have in the accompanying drawing and in the detailed description based thereupon, set out a possible embodiment of the same.

In this drawing:

Figure 1 is an elevation showing the casing of an oil insulated transformer with the apparatus embodying the present invention connected thereto;

Figure 2 is a detail sectional view through the expansion tank or vessel, and

Figure 3 is a detail diagrammatical view of the electric circuits employed in carrying out the invention.

Referring now more particularly to the accompanying drawing wherein like and corresponding parts are designated by similar reference characters throughout the several views, I have herein shown an ordinary transformer comprising a casing 1 which is completely filled with an insulating fluid such as oil. An expansion vessel 2 is supported by means of the bracket 4 at a position above the transformer but is in communication with the interior of said transformer by means of the conduit 3. Leading from the expansion vessel 2 is a second conduit or tube 5 having a three-way valve 6 arranged therein which latter permits at times, atmospheric air to enter this tube 5, and at other times, permits the tube 5 to

be in communication with one end of a U-shaped tube 7 as well as with one end of the U-shaped tube 8 which latter is sealed by a liquid such as oil. Positioned within the expansion vessel 2 and in communication with the conduits 3 and 5 is a pressure chamber 11. This pressure chamber 11 has formed adjacent its lower end a plurality of openings 10 whereby communication may be had between the interior of the expansion vessel 2 and said pressure chamber 11. A closure 10' which is slidably mounted on said pressure chamber 11 acts to control the area of the openings 10 for a purpose which will be later described.

As the transformer casing 1 is completely filled with oil or similar insulating fluid and the expansion vessel 2 partly filled with oil, the tube or conduit 3 will also be necessarily completely filled with oil, thereby hermetically sealing the lower end of the pressure chamber 11. When the valve 6 is opened atmospheric air may enter the tube 5 and the chamber 11. When the valve 6 is closed to exclude the atmospheric air from entering the tube or conduit 5, the outer end of the tube 5 is sealed by the mercury 9 contained within the tube 7 and the oil contained within the tube 8, thereby completely sealing the pressure chamber 11 in order that any variations in volume of the oil contained within the transformer casing 1 will be immediately taken up by the trapped air within the pressure chamber 11 whereby such variations will be transmitted by this trapped air to suitable annunciating and signalling devices or recording devices which will be later set forth.

One branch or column of the U-shaped tube 7 is in communication with the tube 6 in order that the air trapped within said tube may act upon the mercury 9 contained therein and positioned at suitable points on each of the columns of the tube 7 are the terminals 13, 14, 15, 16 and 21. These terminals are each included in a signalling circuit as is better illustrated in Figure 3 of the drawing, and also included in this signalling circuit is a bell or any other suitable annunciator indicated by the numeral 17, a coil 18 adapted to actuate a switch 19 and the coil of a release switch 20.

The switch 20 is included in a protecting circuit which latter has means arranged therein for releasing the normally closed switch 23 of an endangered circuit in which the transformer 1 is included. Should this protecting circuit be broken, the switch 23 will be released whereby the endangered circuit will be disrupted and the transformer switched out of use to prevent any further injury to the latter. Should the pressure within the tube 5 and the chamber 11 fall below atmospheric pressure, the mercury 9 will rise in that branch or end of the tube 7 connected to the tube 5 until the mercury makes contact with the terminal 21 whereupon the signalling circuit will be closed, and the protecting circuit having the switch 20 therein will be broken; consequently, the transformer will also be switched out of circuit. On the other hand, should the pressure of the trapped air within the tube 5 and the chamber 11 be increased, the mercury 9 will rise in the free opened end or branch of the tube 7 until the mercury meniscus 12 contacts with the terminal 14 whereupon the signal circuit will again be closed and the bell or similar annunciator 17 brought into play. The coil 18 which is also electrically connected with the terminal 14 will be energized for opening the switch 19 whereupon the switch 20 will be temporarily disconnected from the signal circuit. With the continual rise of the mercury within the free opened end of the tube 7, contact will be made with the terminal 15, but as the switch 19 at this time, is open, current will still be prevented from passing through the coil of the switch 20. However, with further rise of the mercury within the free open end of the tube until contact is had with the terminal 13, the coil of the switch 20 will at that time be energized and the protecting circuit disrupted. Should the pressure within the chamber 11 increase to such a degree as to cause the rapid rise of the mercury 9 within the opened end of the tube 7, and contact with the terminals 14 and 15 to close the circuit signal, the annunciator 17 will be jointly operated with the switch 20 and the later momentarily retained in its open position, or until the coil 18 is energized, whereupon the switch 19 will be opened and that portion of the signalling circuit in which the switch 20 is included will be again closed whereupon the transformer will be only temporarily disconnected from its circuit. The transformer will continue to operate until the mercury rises further within the free opened end of the tube 7 and contact is had with the terminal 13. It will therefore be understood from the foregoing, that there is a selective action between the slow volume change and a quick volume change in the transformer.

By the arrangement herein set forth, it is obvious that should any irregularities or disturbances above the average, occur within the transformer as to generate heat therein and increase the volume of the insulating fluid, this latter will act directly upon the trapped air contained within the pressure chamber 11, and the vibrations set up by such action upon this entrapped air, will act upon the mercury switch included in the signalling and control circuit. Should a leak occur, occasioning the insulating fluid to escape from the sealed transformer or

casing 2, the mercury switch will be brought into play as previously described, whereupon the circuit in which the transformer is included will be disrupted. Should, however, disturbances arise within the transformer so as to cause the volume of insulating fluid to be increased over normal working conditions, then this mercury switch will be again brought into play whereupon the required signal will be given. Should the volume of oil be rapidly increased, the mercury switch will be caused to close the signalling circuit as well as momentarily open the circuit in which the transformer is included and upon the further rise of volume of the insulating fluid or oil, the endangered circuit in which is included a transformer, will be disrupted until such irregularities have been cured.

The average disturbances within the transformer 1 need not be announced or recorded, and by varying the area of the openings 10 within the pressure chamber 11, through the medium of the closure 10', the action of the insulating fluid upon the entrapped air within the pressure chamber 11 can be controlled or set before placing the apparatus in operation so that these average disturbances occurring within the transformer will not act upon this air transmitter or the recording, signalling, or controlling devices brought into use. Therefore, the quadratic relation existing between the current and the current strength follows sharply the volume change by normal operative changes, without sacrificing the higher sensitivity of the apparatus.

Manifestly, the construction shown and described is capable of many modifications and those modifications which come within the scope of the claims, I consider within the spirit of the invention.

I claim:

1. A heat differential safety device for oil transformers or other oil insulating electrical apparatus, comprising in combination, an expansion vessel, a chamber sealed within said vessel and having apertures establishing communication between said vessel and chamber, a conduit leading from said apparatus and opening in said chamber forming means of communication between the latter and the oil contained in the apparatus, a second conduit communicating with said chamber and extending outwardly of said vessel, and signalling and controlling means associated with said second conduit whereby any irregularities occurring within the insulating oil of said apparatus may be transmitted through said chamber and second conduit to the signalling and controlling means.

2. A heat differential safety device for oil transformers or other oil insulating electrical apparatus, comprising in combination, an expansion vessel, a chamber sealed within said vessel and having apertures establishing communication between said vessel and chamber, a conduit leading from such apparatus and opening in said chamber forming means of communication between the latter and the oil contained in the apparatus, a mercury switch associated with said chamber and actuated by the differences in pressure transmitted thereto through said chamber, and signalling and controlling circuits acted upon by said switch.

3. A heat differential safety device for oil transformers or other oil insulating electrical apparatus, comprising in combination, an expansion vessel, a pressure chamber having means establishing communication between said vessel and chamber, a conduit leading from said apparatus and opening in said chamber forming means of communication between the latter and the oil contained in the apparatus, a second conduit communicating with said chamber, and signalling and controlling means associated with said second conduit whereby any irregularities occurring within the insulating oil of said apparatus may be transmitted through said chamber and second conduit to the signalling and controlling means.

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