Aug. 13, 1929. T. A. E. BELT 1,724,870

SAFETY DEVICE FOR ELECTRICAL APPARATUS

Filed Feb. 1, 1927

Fig. 1.

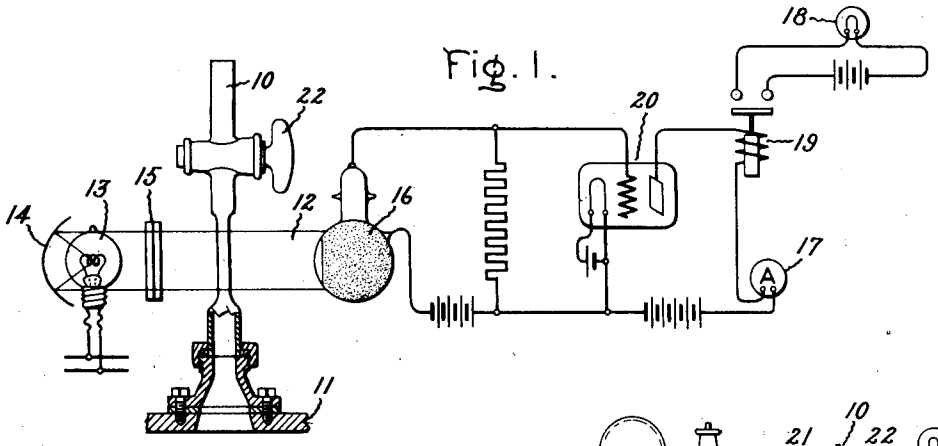
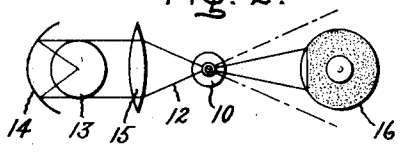


Fig. 2.



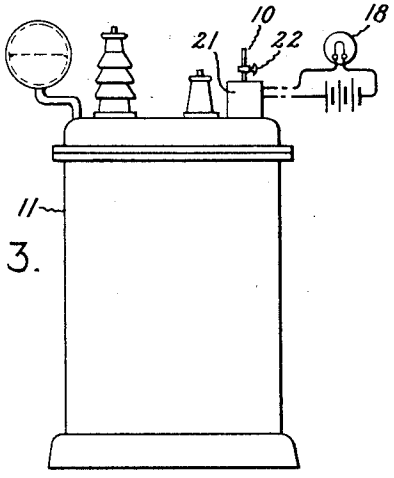


Fig. 3.

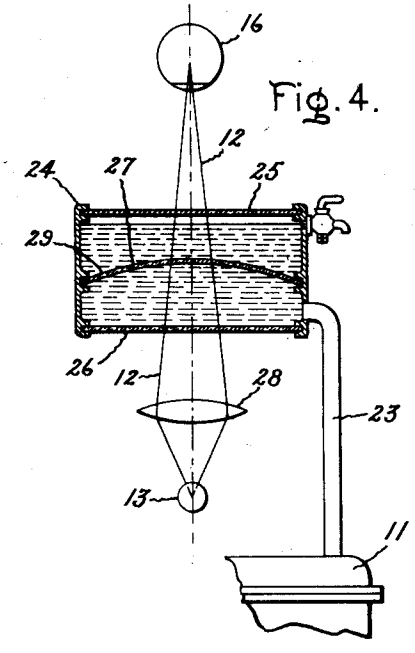


Fig. 4.

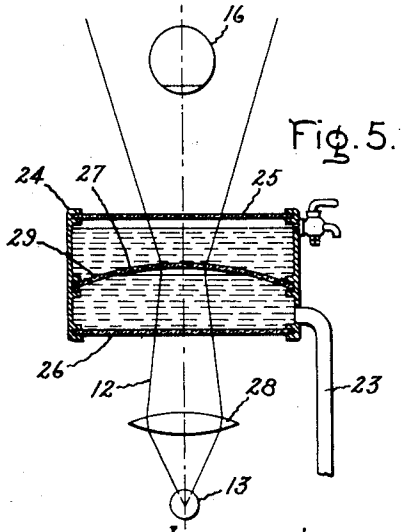


Fig. 5.

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Patented Aug. 13, 1929. 1,724,870

UNITED STATES PATENT OFFICE.

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SAFETY DEVICE FOR ELECTRICAL APPARATUS.

Application filed February 1, 1927. Serial No. 165,235.

My invention relates to safety devices for encased oil immersed electrical apparatus. Trouble in a transformer, reactor or other piece of electrical apparatus which is immersed in oil may develop from defects in the apparatus itself such as defective insulation, or it may result from other causes such as excessive voltage due to lighting or heat due to overloading. An evolution of gas is usually produced by such troubles in the apparatus, due to disintegration of the oil or other insulating material, and some gas frequently appears before a trouble has developed to a serious extent. Various arrangements and devices have been proposed which are responsive in various ways to the effect of the gas and which may be used to operate signals to indicate the presence of the trouble or to operate disconnecting devices to prevent further development of the trouble. The general object of the invention is to provide an improved arrangement of this general character.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which Fig. 1 shows one arrangement of the invention; Fig. 2 shows a detail sectional plan view of a portion of the arrangement shown in Fig. 1; Fig. 3 indicates the invention applied to an encased oil immersed transformer; Fig. 4 shows a modified form of the invention, partly in section; and Fig. 5 is similar to Fig. 4 but indicates the effect of gas on the device.

Like reference characters indicate similar parts in the different figures of the drawing.

In the form of the invention shown in Figs. 1, 2 and 3, a pipe or receptacle 10 is connected to the upper part of the casing 11 of an oil immersed transformer. The transformer in the casing 11 is immersed in a body of insulating oil which extends up into the pipe 10 so that any gas produced in the casing as a result of trouble in the transformer will rise through the oil and pass up through the pipe 10. This pipe 10, or at least a section or portion of it, is of transparent material such as glass and is disposed in the path of a beam of light 12 coming from a suitable source such as a lamp 13. The beam of light is directed by a reflector 14 and a lens 15 through the transparent section of the pipe 10 and the oil contained therein and is then concentrated through the window and into the light sensitive surface of a photo-electric cell 16 as indicated by the full lines which define the normal limits of the beam of light in Fig. 2.

Now, if any gas is produced in the casing 11 due to any trouble in the apparatus, the gas will rise through the oil and pass up through the pipe 10. As this gas comes into the transparent section of the pipe and into the path of the beam of light 12, it will displace the oil at that point and change the refraction of the beam of light to enlarge or widen it at the photo-electric cell 16 as indicated by the broken lines in Fig. 2. A smaller proportion of the beam of light and therefore less light now reaches the sensitive surface of the cell so that the resistance of the cell is changed.

The photo-electric cell 16 is connected to control a suitable safety device shown as an ammeter 17 or a signal lamp 18, the latter being operated by a relay 19. The nature of a photo-electric cell is such that the current through the cell is necessarily very small and in order that the operation of the controlled safety device, such as the ammeter 17 or signal lamp 18 and its relay 19, may be positive and satisfactory a simple current amplifying system including a three element vacuum tube 20 is connected into the safety circuit to assure a proper supply of current to operate the safety device. The signal lamp 18 or the ammeter 17 may be located at the station switchboard or at any other desired convenient point. The other parts which have been described may be compactly arranged and mounted on the casing 11 with a common cover 21 as shown in Fig. 3.

By providing a valve 22 in the pipe 10 at a point above the beam of light 12, any gas coming from the casing 11 will collect in the pipe under this valve. As the gas continues to collect, the oil level in the pipe 10 will fall so that finally the gas which has collected will extend more and more into the path of the beam of light. This causes a continually decreasing amount of light to reach the sensitive surface of the photo-electric cell 16 and a corresponding progressive movement of the indicator in the ammeter 17. The ammeter indication thus changes approximately in proportion to the rate at which the gas is collecting in the beam of light so that the rate at which the

ammeter indication changes is a good indication of whether the trouble which is producing the gas is developing rapidly or slowly. This feature is of advantage because if a trouble is not serious and is not rapidly becoming serious as indicated by the ammeter indication, the load on the transformer may be maintained until it may be more convenient to disconnect the transformer for inspection and any necessary repairs.

The gas which comes from the casing 11 into the pipe 10 is the result of disintegration of the insulating oil or some of the various solid insulating materials used in the transformer. This gas may be colorless and transparent or it may be colored and more or less opaque depending upon the substance from which it was formed. If at all opaque, it will shut off some of the light in addition to its refractive effect in dispersing or widening the beam of light at the photo-electric cell and thus assist its refractive effect in controlling the safety device.

A modification of the invention is shown in Figs. 4 and 5. Here, the gas from the casing 11 will rise from the casing 11 through a connecting pipe 23 into a receptacle 24 which has a transparent top 25 and bottom 26 and a transparent downwardly concave partition 27 spaced between the top and bottom. The pipe 23 is connected to this receptacle below the partition 27 and both contain oil so that any gas rising from the casing 11 will collect under the partition 27 shown in Fig. 5. The beam of light 12 from the lamp 13 is directed by a lens 28 upwardly through the receptacle and through the highest part of the partition 27 where the gas must collect, thence being concentrated onto the light sensitive surface of the photo-electric cell 16 if no gas has collected in its path. Any gas from the casing 11 will collect in the shape of a plano-convex lens due to the curvature of the partition 27 and this will act by refraction to disperse or widen the beam of light 12 at the photo-electric cell 16 with the same effect as already described in connection with the pipe or receptacle 10 of Figs. 1, 2 and 3. The gas may be removed and the device reset for detection of further trouble by tipping the receptacle 24 until the gas has risen through one or more openings 29 near the outer edge of the partition 27.

The invention has been explained by describing what are now considered its preferred embodiments but various changes may obviously be made within the scope of the invention as defined by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. The combination with an encased oil immersed electrical apparatus, of means for producing a beam of light, means for causing gas produced in said apparatus casing to disperse said beam of light by refraction, and safety means responsive to said dispersal of the beam of light.

2. The combination with an encased oil immersed electrical apparatus, of means for producing a beam of light, means for causing gas formed in said apparatus casing to collect in the path of said beam of light, and indicating means responsive at a rate substantially proportional to the rate at which said gas collects.

In witness whereof, I have hereunto set my hand this 31st day of January, 1927.

THOMAS A. E. BELT.