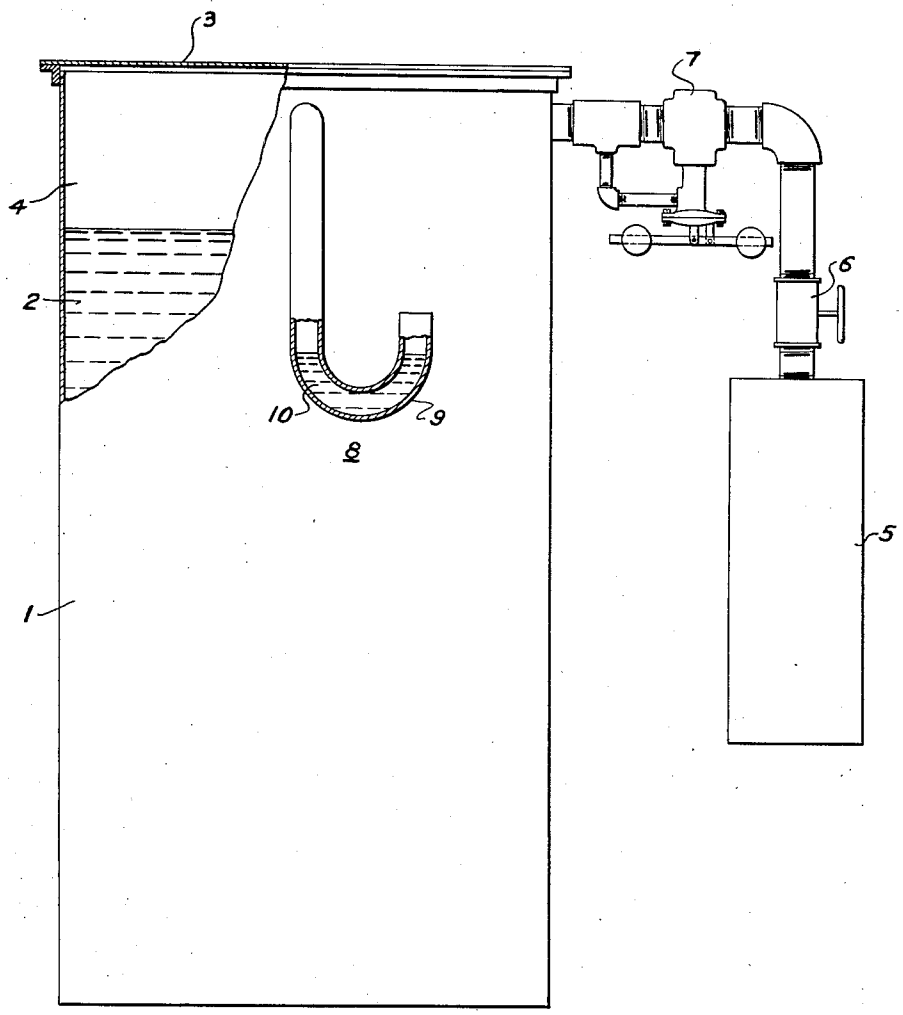
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1,671,492

M. E. SKINNER

PROTECTIVE APPARATUS

Filed Feb. 8, 1923



WITNESSES:

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Patented May 29, 1928. 1,671,492

UNITED STATES PATENT OFFICE.

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PROTECTIVE APPARATUS.

Application filed February 8, 1923. Serial No. 617,887.

My invention relates to protective apparatus, and it has particular relation to such apparatus as may be employed in connection with containers for oil or other materials in connection with which explosive mixtures or other undesirable mixtures may be formed.

My invention has for one of its objects to provide a simple arrangement whereby inert gas may be supplied to a container at a substantially constant pressure.

A second object of my invention is to provide means whereby inert gas may be supplied at any desired lower pressure from a tank under relatively high pressure.

Another object of my invention is to provide means for insuring that the pressure within a container does not fall below a predetermined value or exceed a second and higher predetermined value.

A further object of my invention is to provide means whereby inert gas is supplied to a container when the pressure therein falls to a predetermined value above atmospheric pressure and gas is permitted to escape therefrom when the pressure therein exceeds a second and higher predetermined value.

In the operation of electrical apparatus such, for example, as transformers, circuit breakers and the like, in which insulating oil is employed to surround the electrical devices, it has been found that the oil deteriorates rapidly when it is in contact with air, causing the formation of sludge, the absorption of moisture, and the loss, to a certain degree, of the insulating properties of the oil. It has been found also that, when faults in the electrical apparatus occur, below the surface of the oil, the molecular composition of the oil is broken down and explosive mixtures may be formed when the liberated gases unite with the air in the space above the oil.

In accordance with the present invention, I provide means whereby a blanket of inert gas is maintained at a substantially constant pressure in the space above the oil in a casing or container for electrical or other apparatus. In the preferred form of my invention, a tank of inert gas such, for example, as nitrogen, carbon dioxide, or other suitable gas, under relatively high pressure, is connected to the space above the insulating oil. The transfer of gas from the tank to the casing or container is controlled by means of a reducing valve and a pressure-regulating valve of well-known type. A relief valve operates to relieve the pressure within the tank when it exceeds a desired predetermined maximum value.

The single figure of the accompanying drawing is a view, partially in section and partially in elevation, of an oil-containing casing with my invention applied thereto.

A container or casing 1, which may be, for example, that of a transformer, circuit breaker or other apparatus (not shown) is filled with oil, indicated at 2, to any desired level. A cover member 3 is fitted to the body of the container 1 in any suitable gas-tight manner to enclose a space 4 above the level of the oil. A tank 5, which may be filled with inert gas, such, for example, as nitrogen, carbon dioxide, or other suitable gas, under high pressure, is connected to the space 4 through a reducing valve 6, and a differential valve 7, which operates in a well-known manner in accordance with the pressure within the space 4.

The space 4 is provided with a relief valve 8, which may be of any suitable character, but which is illustrated, by way of example, as having the form of a U-tube 9 that is filled with mercury, indicated at 10, to any desired level in accordance with the pressure at which it is desired to operate. In practice, I prefer to employ the valve mechanism constituting the subject-matter of the application of L. H. Hill, Serial No. 608,791, filed Dec. 23, 1922, and assigned to the Westinghouse Electric & Manufacturing Company.

It may be assumed that the apparatus is operatively connected, as shown and described. It may be assumed further that the valves 6 and 7 have been temporarily adjusted to such values as to supply inert gas under pressure to force the air out of the space 4 through the relief valve 8 or through any suitable opening that may be provided in the container 1 or the cover member 3. It may be assumed, also, that the pressure within the gas tank 5 is 250 pounds per square inch.

The reducing valve 6 and the pressure-regulating valve 7 are adjusted to supply inert gas to the space 4 at a pressure that is slightly above atmospheric pressure, for example, two pounds per square inch. The relief valve 8 may be arranged to operate,

for example, at a pressure within the container of five pounds per square inch above atmospheric pressure.

In case the apparatus within the container 1 is of such nature that its temperature varies, the volume of oil 2 varies correspondingly and thereby causes an increase or a decrease in the pressure within the space 4. In case the pressure increases, the pressure-regulating valve 7 cuts off the flow of gas when the pressure within the space 4 exceeds the value of two pounds per square inch above atmospheric, for which it is adjusted. The quantity of gas remaining within the space 4 remains constant while its volume diminishes until the pressure reaches the value of five pounds, for which the relief valve 8 is adjusted. The gas is then permitted to escape through the column of mercury 10 in the latter.

When the temperature within the container 1 falls and the volume of the oil 2 diminishes correspondingly, the pressure within the space 4 falls at a corresponding rate and, when it reaches the value of two pounds per square inch above atmospheric pressure, inert gas is then supplied from the tank 5, whereby the pressure in the tank does not fall to a value approximately equal to atmospheric pressure. Accordingly, there is no possibility of air entering or leaking into the transformer through any small openings that may develop during its operation.

It will be understood that no gas is supplied to the container 1 or escapes therefrom so long as the pressure within the space 4 is within the limits for which the pressure-regulating valve 7 and the relief valve 8 are adjusted. It is obvious, also, that the pressure at which gas is supplied to the space 4 may be regulated, as desired, by varying the adjustment of the reducing valve 6 and the regulating valve 7. The maximum pressure that may exist within the space 4 may be adjusted by suitably varying the quantity of mercury within the valve 8.

If desired, a relief valve of the spring-controlled type, may be substituted for the U-tube, which is shown by way of example only in order that the principle of operation may be clearly understood.

Any suitable means, such, for example, as a pressure gauge (not shown) may be employed in connection with the space 4 to indicate a pressure therein that is below the normal operating pressure to inform the operator that the supply of gas in the tank 5 is approaching depletion.

The advantages in employing protective apparatus of the character described above are that the oil is never in contact with air, and all oxidation of the oil and its deterioration by reason of sludging is avoided. In case faults develop in the electrical apparatus and arcing occurs below the level of the oil with the resultant "cracking" or disintegration of the latter, the gases thus liberated are not dangerous because no explosive mixture is formed in the space 4. This arrangement effectually prevents also the entrance of air which contains moisture that may be absorbed by the oil. It has been found also that any air and moisture originally in the oil are gradually removed therefrom by diffusion and that the oil absorbs a certain amount of inert gas which increases its insulating properties.

While my invention is particularly adapted for use in connection with electrical apparatus, it will be understood that its application is not limited other than is specified in the accompanying claims.

I claim as my invention:—

1. The combination with a container having a space therein, of means for supplying inert gas to said space at a substantially constant pressure, said means comprising a tank for said gas and a reducing valve, and a differential valve between said tank and said container.

2. The combination with a container having a quantity of oil therein and a space adjacent to said oil, of means for maintaining a substantially constant quantity of inert gas in said space when the pressure therein is within predetermined limits, and means for varying the range between said limits.

3. The combination with a container having a quantity of oil therein and a space above said oil, of a tank of inert gas under relatively high pressure connected to said space, a reducing valve and a pressure-regulating valve between said tank and said container whereby inert gas is supplied to the latter at a relatively low pressure and means for relieving the pressure within said container when it exceeds a predetermined value.

4. The combination with a casing, of an insulating liquid medium partially filling said casing, an electrical translating device immersed in said liquid medium, means for passing inert gas into the region above said liquid medium, and means directly responsive to the pressure of the gas in said region for controlling the rate of flow thereof.

5. The combination with a casing, of an insulating liquid medium partially filling said casing, an electrical translating device immersed in said liquid medium, means for passing inert gas into the region above said liquid medium, and means comprising a differentially controlled valve directly responsive to the pressure of the gas in said region for controlling the rate of flow thereof.

6. The combination with a casing, of an insulating liquid medium partially filling said casing, an electrical translating device

immersed in said liquid medium, means for passing inert gas into the region above said liquid medium, means directly responsive to the pressure of the gas in said region for controlling the rate of flow thereof, and means responsive to the pressure of the gas in said region for controlling the passage thereof from said casing upon occurence of excessive pressure.

In testimony whereof, I have hereunto subscribed my name this fifth day of February 1923.

MERRILL E. SKINNER.