Detector apparatus or a moisture detection device is disclosed as having an electrode rod extending from the exterior of an enclosure containing insulating oil into the interior of the enclosure and a hollow electrode positioned coaxially around the rod electrode within the enclosure. The rod electrode is electrically insulated from the enclosure and hygroscopic material is positioned between the hollow electrode and the rod electrode and contacted by the insulating oil through at least one opening in the hollow electrode so that any moisture in the fluid will be taken up by the hygroscopic material. The rod electrode, the moisture in the hygroscopic material and the hollow electrode form an electrically conductive circuit connected to a power source and to sensing instrumentation that will indicate, for example, current conducted by the circuit to thereby indicate the amount of moisture in the hygroscopic material and thus the amount of moisture in the insulating oil.

10 Claims, 2 Drawing Figures
LIQUID MOISTURE DETECTOR

BACKGROUND OF THE INVENTION

This invention relates to devices for detecting the presence of moisture in fluid in which it is undesirable to have such moisture, and more particularly to a device for detecting moisture in electrically insulating oil within the housing of electrical apparatus such as transformers.

Moisture in the insulating oil in electrical apparatus such as a transformer considerably reduces the dielectric strength of the oil to a minimum below its minimum safe value. If sufficient water is present in the insulating oil, an electrical explosion can occur. When the bushing assembly is threaded onto the flange, the electrode engages the wall so that the electrode is exposed to insulating oil. However, known devices are relatively complicated in construction and are not readily portable or removable so that they can be used in making periodic checks of a number of different electrical apparatuses.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a device for detecting moisture in fluid which is simple in construction and economical in manufacture and is easilyremovable from the enclosure containing the insulating fluid. The objects of the invention are accomplished by providing means for detecting moisture in the insulating fluid a hygroscopic material which when dry is electrically insulative and which is positioned between two coaxially supported electrodes. One of the electrodes extends through an insulated bushing out of an enclosure containing the insulating fluid. The electrodes are connected to a power source and to sensing instrumentation which senses an electrical energy level and transmits the signal to an instrument. The level of moisture in the hygroscopic material can be determined by measuring the electrical characteristics of the insulating fluid.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates the detection apparatus of the invention mounted on a portion of an enclosure containing insulating fluid; and

FIG. 2 is a cross-sectional elevation view of FIG. 1;

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, a moisture detection device is shown mounted on an enclosure which may comprise a pipe having an opening and a bushing flange contiguous to the opening. The pipe, being concentrically located with a fluid such as insulating oil 8. The pipe also includes a support wall 10 on which the bushing flange 5 is mounted and another wall 12 positioned opposite the support wall 10. The insulating oil 8 may be flowing or relatively stationary within the pipe. However, where the pipe is connected to another fluid filled container, a greater portion of the fluid in the container will be sampled if the fluid is flowing in and out of the pipe 2.

The moisture detection device includes a rod electrode 16 positioned within and supported on the pipe 2. The rod 16 extends out of the pipe through the opening 4 to the exterior of the pipe. A bushing assembly 20 is mounted on the flange of the support wall 10 and includes a member 22 threadably connected to the flange and an insulator 24 affixed to the member. An opening 25 in the rod electrode 16 and extending out of the exterior of the rod electrode 16. The rod electrode 16 also has a threaded terminal end 18 projecting out of the exterior of the rod electrode 16.

Within the pipe 2, a hollow electrode 30 having a tubular cross section is coaxially positioned around the rod electrode 16. When the bushing assembly 20 is threaded onto the flange 6, the electrode 30 engages the wall 12 so that the electrode 30 is maintained in position around the electrode 16 by the wall 12. The electrode 30 is shown in FIGS. 1 and 2 as being a helical spring, however, other types of hollow electrodes such as a tubular perforated cylinder are also suitable. The hollow electrode 30 as shown in FIGS. 1 and 2 has an outer surface 32, an inner surface 34, and an opening 36 between the surfaces 32 and 34. In the case of a helical spring electrode, the opening 36 is continuous and runs along the entire length of the electrode 30. A wrapping of hygroscopic material 40 is positioned around the rod electrode 16 between the hollow electrode 30 and the rod electrode 16, as shown in the Figures. An insulating washer 26 is also fitted over the electrode 16 between the electrodes 30 and 16 and also between the hygroscopic material 40 and the electrode 16, as shown in FIG. 2. The insulating washer 26 is positioned adjacent the opening 4 and provides further control of spacing between the electrodes 16 and 30. As also shown in FIG. 2, the electrodes 16 and 30 are spaced apart and this spacing is maintained by the hygroscopic material 40 between the electrodes 16 and 30. The hygroscopic material 40 may be of any material that possesses high dielectric strength when dry and which will readily take up and absorb water on contact therewith, even when saturated with and immersed in another fluid such as oil.

An electrical power source 42 may be connected via leads 46 and 48 to the terminal end 18 of the electrode 16 and to the pipe 2 where the pipe 2 is electrically conductive. The power source may be connected directly to the hollow electrode 30 if the pipe 2 is not conductive. Thus, there is an electrically conductive circuit between the terminal end 18 and the pipe 2 which comprises the rod electrode 16, moisture in the hygroscopic material 40 and the hollow electrode 30. The amount of moisture in the hygroscopic material 40 will determine the level of current conducted through the circuit and also the extent to which the space between the electrodes 16 and 30 acts as a capacitive element in the circuit. By connecting suitable and well known sensing instrument 44 in the circuit, the amount of moisture in the hygroscopic material 40 and therefore in the insulating oil 8 may be determined by measuring electrical values such as current or power factor.

While only the preferred embodiment of the invention has been shown herein, it will be realized that many modifications thereof are feasible without departing from the spirit and scope of the invention. It is accordingly intended that the scope of the invention is not to be limited to the specific embodiment disclosed.

1. In a device for detecting moisture in an electrically insulating fluid within an enclosure, detector apparatus comprising: a first electrode supported on said enclosure in insulating relationship therewith, a second electrode within said enclosure and positioned coaxially and out of said enclosure, a fluid body within said enclosure, a fluid body within said enclosure in contact with said insulating fluid whereby moisture in said fluid is taken up by the hygroscopic material, and said electrodes and moisture comprise an electrically conductive circuit.

2. The combination according to claim 1 wherein said enclosure has an interior surface and said second electrode has an end engaging said interior surface whereby said coaxial position of the second electrode is maintained.

3. The combination according to claim 1 wherein said second electrode has a wall and at least one opening therefor whereby said fluid contacts the hygroscopic material.

4. The combination according to claim 1 further comprising an insulator bushing mounted on said enclosure, said bushing being between the enclosure and said first electrode.

5. The combination according to claim 4 wherein said detector apparatus is removable from said enclosure.

6. In a device connected to a source of electrical power for detecting moisture in a fluid electrically insulating fluid within an enclosure and including a support wall and a hole in the support wall, a detector probe comprising: a bushing mounted on the...
the support wall and enclosing said opening, said bushing having an electrically insulating portion positioned along the longitudinal axis of the bushing, a rod electrode within said enclosure and extending out of the enclosure through said hole and through the insulating portion of said bushing, said rod being supported by said bushing and being electrically connected to said power source, a hollow electrode positioned coaxially around said rod electrode within said enclosure, said hollow electrode including an interior and exterior and an opening between the interior and exterior, said hollow electrode being connected to said power source, and hygroscopic material positioned between the rod electrode and hollow electrode, said hygroscopic material contacting said insulating fluid whereby moisture in the fluid is taken up by said material and said moisture conducts current between the rod electrode and hollow electrode.

7. The combination according to claim 6 wherein said hollow electrode has an end extending away from said hole and said enclosure includes a second wall positioned opposite and engaging the end of said hollow electrode whereby the hollow electrode is maintained around the rod electrode.

8. The combination according to claim 6 wherein said hollow electrode comprises a helical spring.

9. The combination according to claim 7 wherein said enclosure comprises a pipe and said rod electrode is positioned transversely of the length of said pipe.

10. The combination according to claim 6 further comprising circuit means electrically connected to said electrodes for sensing the level of current flowing between the rod and hollow electrodes.