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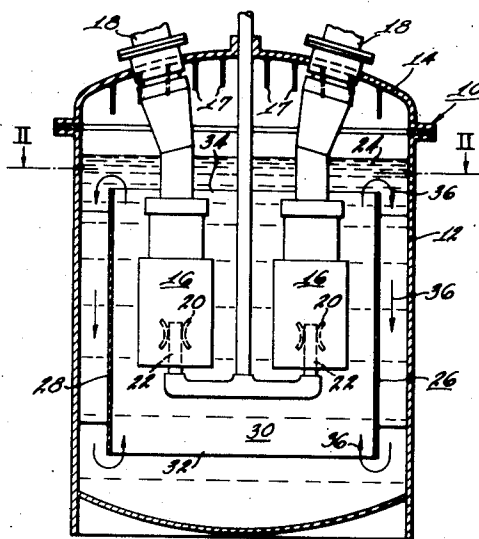
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[54] **MEANS FOR CIRCULATING LIQUID COOLANTS**
9 Claims, 2 Drawing Figs.

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[50] Field of Search..... 165/105,
106; 174/15 R, 17 R, 17 LF; 336/58; 200/150 A

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ABSTRACT: An electric circuit interrupter comprises a tank in which arc-interrupting devices are located. The tank contains a cooling liquid comprising oil and liquid freon in which the devices are submerged. A tubular baffle completely submerged in the cooling liquid and spaced from the tank wall surrounds the devices. Heat generated by current flow through the devices causes heating of the cooling liquid and vaporization and bubbling of some of the liquid freon within the baffle. This, in turn, causes the cooling liquid to flow upward inside the baffle, over the top edge of the baffle, downward outside the baffle, and around the bottom edge of the baffle. The vaporized freon recondenses on exposed surfaces inside the tank and flows back into the cooling liquid. Thus, circulation of the cooling liquid is achieved and more efficient cooling of the devices results.



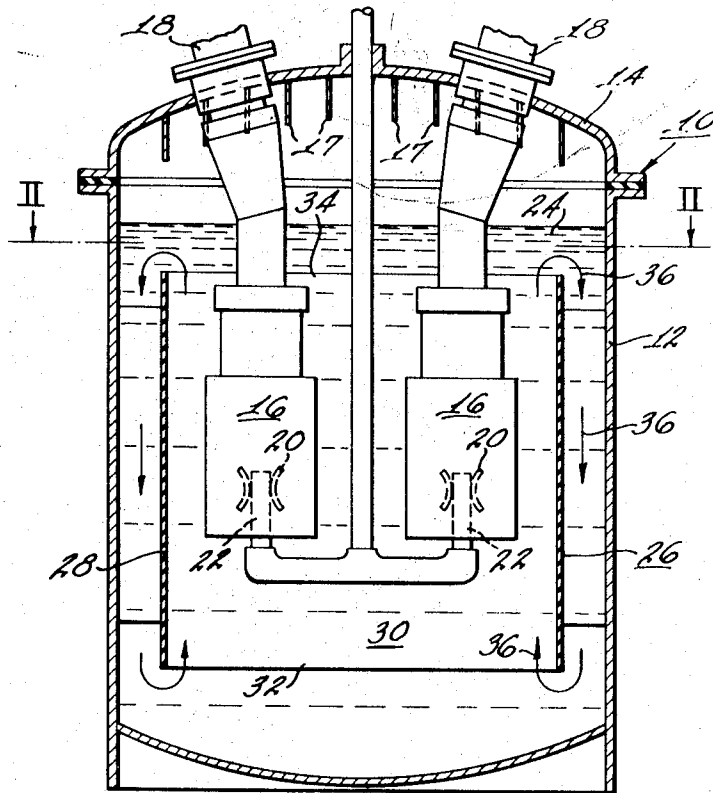


Fig. 1

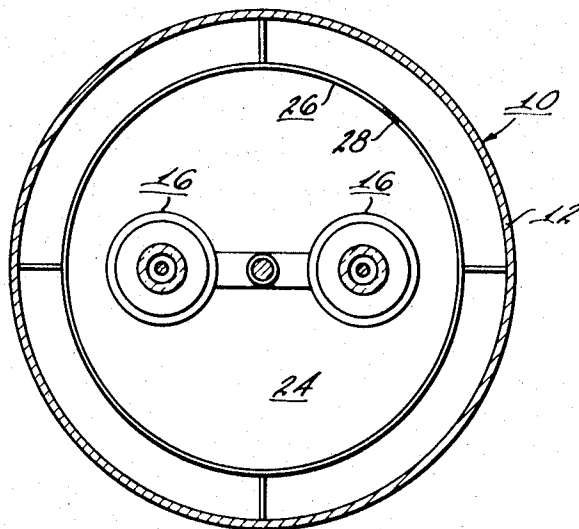


Fig. 2

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MEANS FOR CIRCULATING LIQUID COOLANTS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to means for circulating liquid coolants. In particular it relates to circulating such coolants by means of vaporization of a constituent liquid in the coolant.

2. Description of the Prior Art

Presently, some types of equipment, such as electrical circuit interrupters, transformers and the like, comprise a tank in which a device or component is located which generates heat during operation and which is cooled by a liquid coolant such as insulating oil contained in the tank. The liquid is an electrical insulator and also acts as the medium by which heat is transferred from the device or component to the tank wall or to radiator apparatus associated externally thereof. It is known that cooling efficiency can improve if the liquid coolant is not stagnant but is kept moving or in circulation by suitable means. In some equipment, such as circuit interrupters, for example, it is undesirable for various reasons to employ mechanical pumps or other complicated auxiliary apparatus to effect liquid circulation. Furthermore, thermally induced convection currents in the liquid coolant are sometimes not sufficient to provide desirable or necessary cooling characteristics. Use of readily volatilizable cooling liquids such as halogenated hydrocarbons (i.e., freon) in undiluted or pure form as coolants is known but in some applications use of such materials is neither physically nor economically practical. Therefore, it is desirable to provide improved means for effecting circulation of liquid coolants in various types of apparatus which use relatively small quantities of such halogenated hydrocarbons but achieve maximum results.

SUMMARY OF THE INVENTION

In accordance with the present invention a piece of equipment, such as an electrical transformer or circuit breaker, comprises a tank in which a heat-emitting device or component, such as a coil assembly or arc interrupter, is located. The tank contains a body of liquid coolant in which the device or component is at least partially immersed or submerged. The liquid coolant comprises at least two liquids, one of which is substantially more volatile than the other, such as insulating oil and freon. A baffle means comprising a chamber and an inlet means and an outlet means is located in the liquid coolant so that the chamber is filled with coolant and at least the inlet means is in direct communication with the liquid coolant. The baffle means is further located so that the coolant in the chamber is adapted to be heated by the device thereby causing vaporization of the more volatile liquid and circulation of the coolant through the baffle means and through the tank. Preferably, the baffle means comprise a tubular baffle member which is immersed in the body of liquid and is spaced from the tank wall and surrounds the device or component. Heat generated by current flow through the device or component causes heating of the liquid in the baffle means and vaporization and bubbling of some of the volatile liquid within the baffle. This causes upward liquid flow inside the baffle and downward flow outside the baffle thereby effecting improved circulation of the liquid. The vaporized substance condenses on exposed surfaces inside the tank and flows back into the body of liquid.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide improved cooling means for liquid cooled apparatus or equipment.

Another object is to provide improved means for circulating liquid coolants in such equipment.

Another object is to provide improved means for effecting such circulation which do not employ movable or electromechanical devices such as pumps or the like.

Another object is to provide improved means of the aforesaid character which are particularly well suited for use

with electrical equipment or apparatus such as circuit breakers, transformers and the like.

Another object is to effect circulation of cooling liquids by means of more volatile liquids mixed with less volatile liquids.

Another object is to provide an arrangement whereby a less expensive liquid media serves as a holding media for more expensive vaporizable liquids which enhance the circulatory effect.

Other objects and advantages of the invention will hereinafter appear.

DESCRIPTION OF THE DRAWING

The accompanying drawing illustrates a preferred embodiment of the invention but it is to be understood that the embodiment illustrated is susceptible of modifications with respect to details thereof without departing from the scope of the appended claims.

In the drawing:

FIG. 1 is a side elevational view of apparatus in accordance with the invention; and

FIG. 2 is a view taken along line II—II of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2 of the drawing, the numeral 10 designates a piece of liquid-cooled apparatus or equipment such as an oil-type electrical circuit breaker. Circuit breaker 10 comprises a tank 12 having a removable top or cover 14 in which circuit breaker components such as arc interrupter devices 16 are located. If preferred, the inside of cover 14 may be provided with condensing fins 17 as shown in FIG. 1. The devices 16 are suspended from insulating bushings 18 which extend through the top 14 of tank 12 and house electrical stationary contacts 20 which cooperate with reciprocally movable bayonet contacts 22. It is to be understood that electric current flow through or arcing between the contacts 20 and 22 causes heating thereof and heating of the associated devices 16.

Tank 12 contains a body of liquid coolant 24 in which the heat-emitting devices 16 are submerged. In the embodiment shown in FIGS. 1 and 2 it is further required that coolant 24 have electrical insulating and arc extinguishing properties. In accordance with the invention liquid coolant 24 is understood to comprise at least two liquids, one of which is substantially more volatile than the other, such as insulating oil and a type of halogenated hydrocarbon which liquifies at normal ambient temperatures and vaporizes or boils at temperatures on the order of 117° F. at one atmosphere of pressure. Freon-113 which is trichlorotrifluoroethane ($\text{CCl}_2\text{F}-\text{CClF}_2$) is an example of a suitable freon for mixture with well-known commercially available insulating oils for use in circuit breakers or transformer tanks.

In further accordance with the present invention, baffle means 26 are provided to utilize the behavioral characteristics of liquid coolant 24 to effect improved circulation of the coolant in tank 12. Baffle means 26 takes the form of a tubular member 28, preferably made of electrical insulating material, which defines a chamber 30 which has inlet means and outlet means such as its lower and upper end openings 32 and 34, respectively. Member 28 is spaced from the wall of tank 12 and surrounds the heat-emmanating devices 16. The outlet means or upper end opening 34 of baffle means 26 is located below the surface of liquid coolant 24.

The embodiment of the invention shown in FIGS. 1 and 2 operates as follows. Assume that circuit breaker 10 is energized and that electrical current flow through the contacts 20 and 22 thereof causes heating of the interrupting devices 16. The heat therefrom is transferred or absorbed by liquid coolant 24 and, when the temperature of the body of coolant within tubular member 26 reaches or exceeds the temperature of the freon vapor in the space above the body of liquid, then additional freon vaporizes or boils and freon bubbles ascend to the surface and the vapors ascend into the space above the

liquid. This action causes an upward movement of liquid coolant 24 within tubular member 26 and a downward movement of the liquid coolant outside of the tubular member, as shown by the arrows designated 36 in FIG. 1. Thus, circulation of all the liquid coolant in tank 12 is assured and no stagnant liquid pockets exist. Such complete and more rapid circulation results in more efficient cooling of the devices 16 and more efficient transfer of heat to the wall of tank 12. The vaporized freon which ascends from the surface of liquid coolant 24 condenses on the relatively cooler inside surface of tank cover 14 and drips back into the body of liquid coolant. The cooling fins 17 provide additional surface area for condensation and also tend to overcome any thermal insulating barrier which may be formed by trapped uncondensable vapors from the nonfreon constituent of the liquid coolant 24. Experience has shown that a very small percentage of oil vapors collect at the top of the tank in electrical devices and this must either be dispersed or circumvented as by the fins 17 to achieve most efficient condensation of the other vaporizable liquid constituent of the liquid coolant.

It is to be understood that, although baffle means 26 takes the form of a tubular member 28, it could have other configurations and dispositions with respect to the heat-emitting device 16. For example, baffle means 26 could take the form of one or more tubular members disposed along side or in direct physical contact with a device 16, provided the liquid coolant encompassed in the chamber thereof was readily heatable by heat from the device so as to be set in motion before other portions of the body of liquid. Furthermore, the outlet means of the baffle means could be disposed above the surface of the body of liquid coolant while the latter was in the arrest condition. Then too, the two liquids comprised in the body of liquid coolant may be miscible or nonmiscible, provided in the latter case that the more volatile liquid tends to settle out below the other liquid.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In combination,

a tank,

a heat-emmanating device in said tank,

a body of liquid coolant in said tank in which at least a por-

tion of said device is immersed,
said coolant comprising at least two liquids,
one of said liquids being more volatile than the other,
and baffle means comprising a chamber and inlet means and outlet means communicating therewith,
said chamber containing a portion of said body of said liquid coolant and at least said inlet means being in direct communication with the remainder of said body of said liquid coolant,
said baffle means being disposed so that heat emanating from said device effects vaporization of at least some of said one liquid in said chamber thereby effecting flow of said liquid coolant through said inlet means, said chamber and said outlet means and movement of said body of liquid coolant in said tank.

2. A combination according to claim 1 including cooling means on said tank to condense that portion of said one liquid which volatilizes and to effect its recombination with said body of liquid coolant.

3. A combination according to claim 1 wherein said device is an electrical device and said liquid coolant comprises electrical insulating liquids.

4. A combination according to claim 3 wherein said one of said liquids comprises a volatile halogenated hydrocarbon and the other comprises oil.

5. A combination according to claim 1 wherein said outlet means is located below the surface of said body of liquid coolant.

6. A combination according to claim 2 wherein said tank comprises a cover and said cooling means comprises at least a portion of said cover.

7. A combination according to claim 6 wherein said cooling means comprises means which project from said cover toward said body of liquid.

8. A combination according to claim 1 wherein said chamber of said baffle means surrounds at least a portion of said device.

9. A combination according to claim 8 wherein said baffle means comprises a tubular member having its upper edge located below the surface of said body of liquid when the latter is at rest.

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