April 18, 1950 G. CAMILLI 2,504,647

ELECTRIC INDUCTION METER SYSTEM

Filed Dec. 6, 1947

Fig. 1.

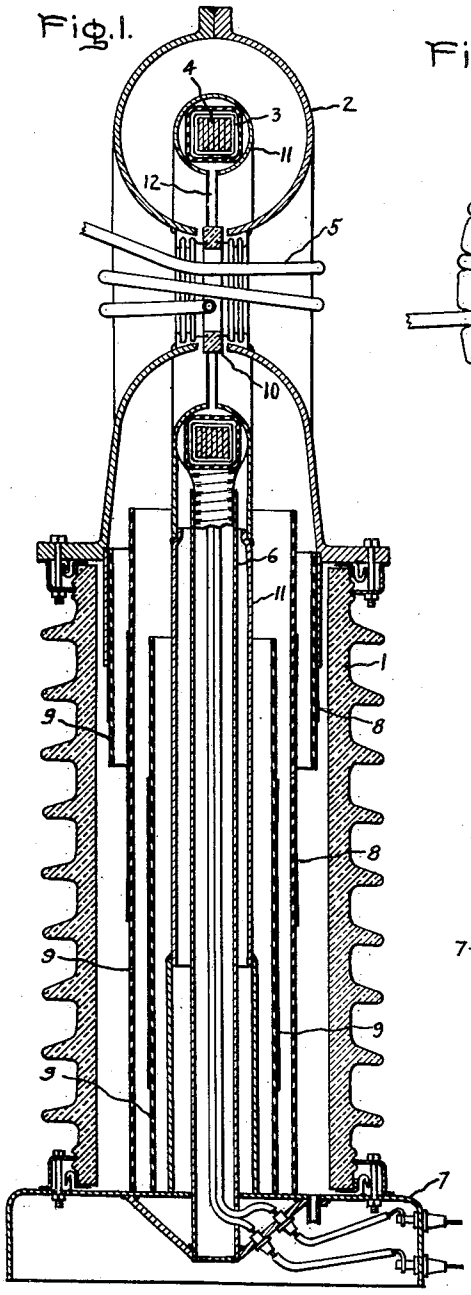


Fig. 2.

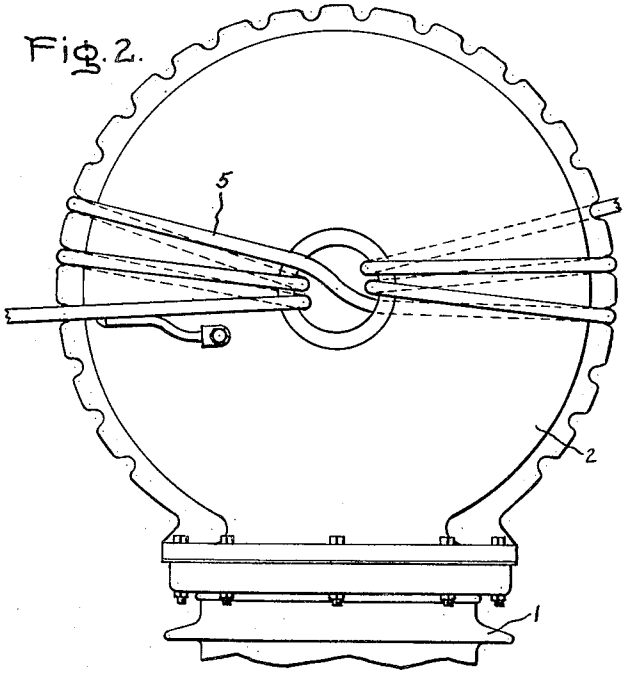


Fig. 3.

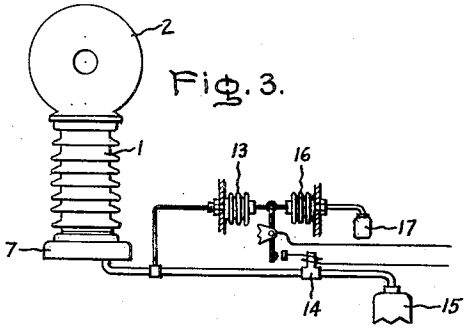


Fig. 4.

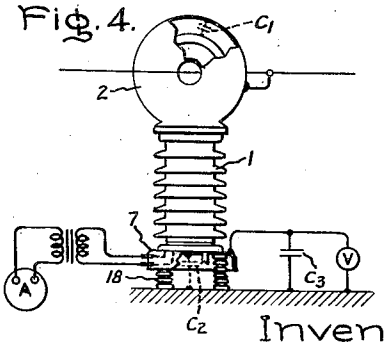
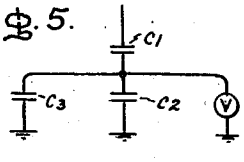


Fig. 5.



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ELECTRIC INDUCTION METER SYSTEM

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6 Claims. (Cl. 171—95)

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The present invention relates to electric apparatus such as transformers, and although not limited thereto it has application to high-voltage current transformers.

Instrument current transformers for use with higher voltages are generally enclosed within relatively large sealed tanks which are liquid-filled.

Such transformers are inherently large and heavy so that they must be mounted on sturdy foundations resting on the ground. This in turn necessitates that the high potential leads be brought down from the overhead transmission line for connection thereto, which entails considerable expense in the way of bus bars and superstructure for supporting the high potential leads. Liquid-insulated transformers require additional non-useful space within the tank or in the bushings of such a size that the liquid may expand freely with variations in temperature. In case of internal failures the pressures developed in the liquid-filled transformers are extremely high and in many cases tanks and bushings are disrupted with considerable forces endangering life and property. In some cases fire follows the internal failures of such transformers.

Current transformers for use in the higher voltages are generally built in such a manner that the high voltage winding bears a fixed ratio with that of the secondary winding. For this reason a given transformer can be used only on one specific application.

It is a general object of the present invention to provide a new and improved high voltage current transformer which overcomes the above difficulties.

Another object of the invention is to provide a new and improved current transformer so constructed, and primarily so insulated between its windings without either solid or liquid insulating material, as to eliminate the difficulties generally encountered in the drying and filling of high voltage apparatus.

A further object of this invention is to provide a gas-insulated transformer which is provided with an arrangement that distinguishes between change in pressure due to changes in temperature and reduction of pressure due to actual leakage of gas. Changes in pressure due to changes in temperature do not affect the insulation strength of the transformer, and these changes are allowed by the arrangement to be described. The arrangement also automatically replaces leakage of gas and keeps the pressure at the required level.

An added object of this invention is to provide

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a current transformer which by means of a slight modification can be used for both current and voltage measurements.

Further objects and advantages of my invention will become apparent from the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In the drawing, Fig. 1 is a sectional side elevation of a current transformer which is provided with an embodiment of my invention; Fig. 2 is a view of the high voltage metallic casing around which is wound the high voltage winding of the current transformer; Fig. 3 shows the pressure regulating arrangement; Fig. 4 is a view of the arrangement when the same unit is used for both current and potential measurements, and Fig. 5 is the equivalent circuit of Fig. 4.

Referring to the drawing and in particular to Fig. 1, I have illustrated a current transformer having a casing or porcelain shell 1, a generally toroidal shaped hollow metal member 2, a low voltage winding 3 which is wound over a wound core 4, and a high voltage winding 5 which links the core and the low voltage winding. One terminal of the high voltage winding is connected to the casing 2, and the other terminal needs to be insulated from the casing for very low voltage (impedance voltage of the unit). The high voltage winding may consist therefore of a cable having a small amount of insulation.

The accuracy (ratio and phase angle) of the current transformer depends on the product of the primary current and the primary turns and therefore the ratio of the current transformer can be changed by a suitable selection of the primary turns. In the present invention this change in the number of turns can very conveniently be made by winding a cable over the metallic shell 2. Ordinarily the rated secondary current of a current transformer is 5 amperes and as long as the total ampere-turns is unchanged the secondary turns are unchanged. In any case the secondary winding can be provided with suitable taps to re-establish the equality between the primary and secondary turns.

Referring again to Fig. 1, the core 4 and the low voltage winding 3 are supported by a metal pipe 6 which is welded to the base 7 of the transformer.

To improve the voltage distribution of the porcelain 1 the unit is provided with conduction

voltage equalizers 8 which are supported by insulating cylinders 9.

Compressed gas is used as the principal insulating medium between the windings. Any suitable gas may be used but at present sulphur hexafluoride is preferred. The transformer is therefore built to withstand pressure higher than atmospheric without appreciable gas leakage. For this purpose the top and bottom of the porcelain are preferably soldered to the metallic end closures 2 and 7.

To avoid a short-circuited turn on the core the metallic chamber 2 is provided with an insulating ring 10. This is preferably made of glass with flexible metal inserts which are soldered to the metal chamber 2.

It has been found that in order to obtain the highest dielectric strength with a gaseous insulating medium it is necessary that the electrodes (high voltage and low voltage) be absolutely smooth and polished. For this reason the low voltage winding is shielded with a metallic sheath 11 which extends over the supporting metallic pipe 6. To avoid a short-circuited turn on the core the shield 11 is provided with a sealed gap 12.

In the foregoing it is mentioned that the unit just described is preferably insulated with a compressed gas. Also, it is mentioned that changes in pressure due to changes in the internal temperature do not affect the insulation strength of the transformer. The dielectric strength depends on the number of gaseous molecules and therefore the unit must be protected from leakages of gas. If the internal pressure should drop due to drop in temperature no additional gas should be introduced in the unit. Otherwise the pressure may become dangerously high at the higher temperatures.

Fig. 3 shows an arrangement which distinguishes between loss of pressure due to drop of temperature and loss of pressure due to leakage of gas.

Referring to Fig. 3, the interior of the transformer is connected to a bellows 13 and through an electrically operated valve 14 to a gas reservoir 15. This valve is controlled also by the action of a bellows 16 which is connected to a small reservoir 17.

The small reservoir 17 can be placed either inside the main transformer or exposed to the action of the ambient temperature. Let us assume that the reservoir 17 is placed inside the main transformer. Let us assume also that the loading of the transformer is such that its temperature is lowered. In this case the action of bellows 13 is balanced by the pressure of the bellows 16 with no resultant action on the valve 14.

In case of gas leakage from the main transformer the action of the bellows 16 will overcome that of bellows 13; the valve 14 will be opened and will remain open until the equilibrium between the two bellows 13 and 16 is reestablished.

Fig. 4 shows an arrangement whereby the current transformer of Fig. 1 can be used also for voltage measurements. In this figure the base 7 is insulated from ground by means of post insulators 17. With such an arrangement the base 17 assumes a potential from ground depending on the ratio of the two capacitances C_1 and C_2 shown schematically in Fig. 4. This system of capacitances is diagrammatically shown also in Fig. 5. To obtain the desired voltage on a voltmeter V an additional capacitor C_3 is placed in parallel to the capacitance C_2. If C_3 is liquid filled it should be automatically maintained at constant temperature by a well known thermostatic arrangement.

In this scheme the potential of the core 4 and secondary winding 3 is at the same level as that of base 7 and will be at higher potential than ground and therefore in order to obtain readings of the current at a meter A (which normally should be at ground potential) an insulating transformer 18 will be used.

Capacitance potential devices have been used in the past for voltage measurements. However, when the required capacitances were provided with liquid as the insulating medium the capacitances were changed by a change in temperature. This disadvantage will not occur in the present invention where capacitances C_1, C_2 and C_3 have gaseous medium.

Although I have shown and described particular embodiments of my invention, I do not desire to be limited to the particular embodiments described and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of my invention.

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

1. A pair of coaxial and concentric generally toroidally shaped hollow metal members, a toroidally shaped core within the inner toroidally shaped member, a winding on said core, and a dielectric gas filling the space between said toroidally shaped members.

2. An electric apparatus including a pair of different size generally toroidally shaped metal members, means including a solid dielectric attached to the sides of said metal members for insulating them from each other and for supporting the smaller one inside the larger one so that the two are coaxial and concentric, a magnetic core and winding inside the smaller toroidal member, a winding around the outside of the larger toroidal member, and an insulating gas filling the space between said toroidal members.

3. An electrical apparatus including a core and a winding thereon having a plurality of turns, said core and winding being enclosed in a toroidal metal container which is normally maintained at ground potential, said toroidal container being evenly spaced from and enclosed in a second toroidal container which is normally maintained at higher than ground potential, said toroidal metal containers being substantially concentric and coaxial, and an insulating gas filling the space between said containers.

4. An electrical apparatus including a core and a winding thereon having a plurality of turns, said core and winding being enclosed in a toroidal metal container which is normally maintained at ground potential, said toroidal metal container being enclosed in a second toroidal metal container which is normally maintained at higher than ground potential, a coil wound on the outer toroidal metal container and electrically connected thereto, means extending from the sides of said containers for maintaining them coaxial and concentric and for sealing the spaces between them, and a gaseous dielectric medium filling the space between said containers and constituting the primary insulation between said coil and winding.

5. A transformer including a pair of coaxial and concentric generally toroidally shaped metal members, means extending from one side of each member for sealing the space between them and for supporting the inner member coaxially and

concentrically with respect to the outer member, a primary winding linking the outer member, a toroidal core and a toroidal secondary winding thereon being enclosed in the inner member, said primary winding being electrically connected to said outer member, a dielectric gas filling the space between said members and gas pressure responsive means for automatically maintaining a constant amount of said gas between said members regardless of slow leaks while permitting gas pressure changes due to temperature variations.

6. A current transformer having a primary winding mounted and electrically connected to a higher voltage metal container, a low voltage metal container within the high voltage metal container, a magnetic core and low voltage secondary winding thereon mounted within said inner container, solid dielectric meas for positioning said containers relative to each other, common supporting means for said containers, a dielectric gas filling the space between said containers, a solid dielectric support between ground and said common supporting means for said containers, and a volt meter connected between ground and said common supporting means.

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