March 21, 1961 J. G. EVERHART 2,976,503

TRANSFORMER CONSTRUCTION

Filed July 5, 1957 2 Sheets-Sheet 1

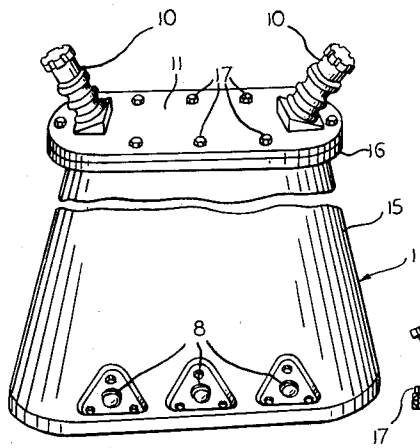


Fig. 1

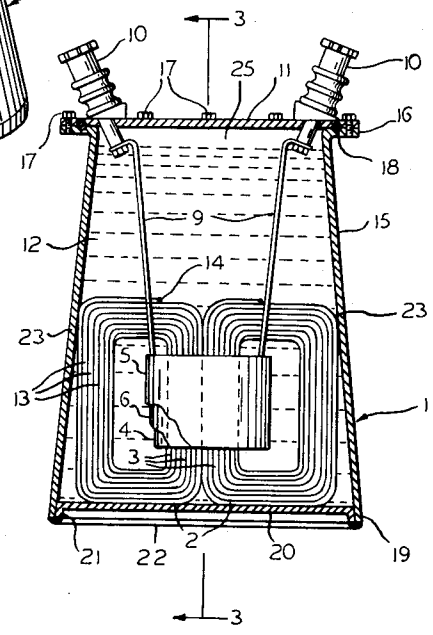


Fig. 2

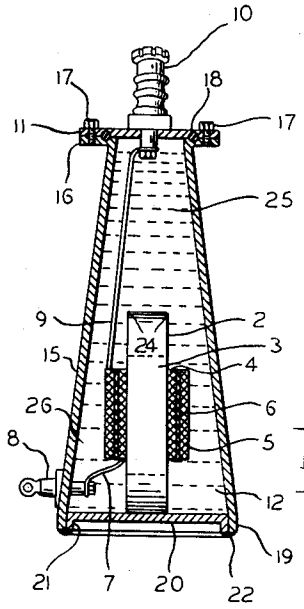


Fig. 3

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TRANSFORMER CONSTRUCTION

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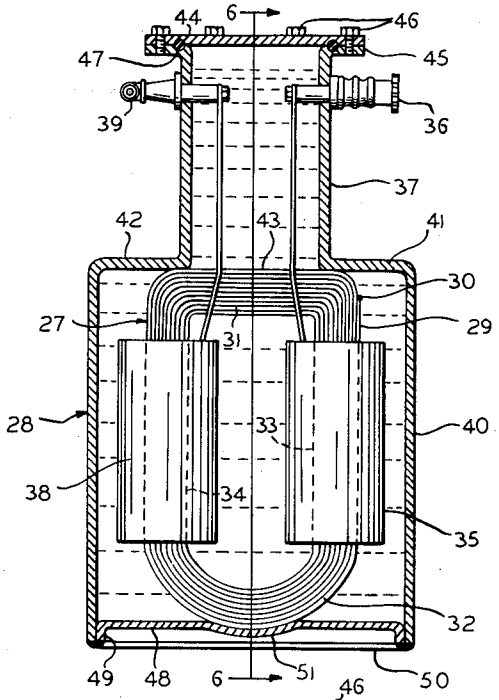


Fig. 4

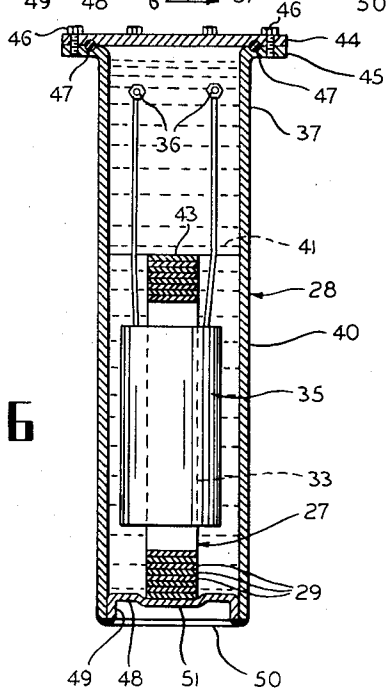


Fig. 6

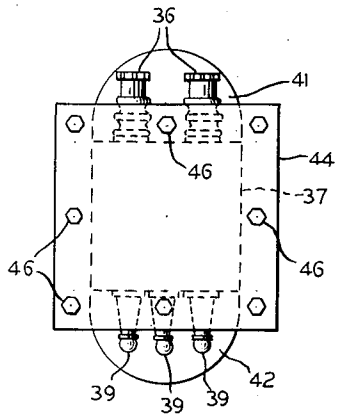


Fig. 5

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2,976,503

TRANSFORMER CONSTRUCTION

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9 Claims. (Cl. 336—94)

This invention relates to a transformer construction and particularly to a totally enclosed transformer having the electrical components immersed in a cooling and insulating liquid.

Generally, totally enclosed liquid immersed transformers employ a separate attachment support for the core and coil assemblies. The separate supports include interlocking coupling means on the core and on the interior tank wall to rigidly secure the transformer core and coil in a predetermined position relative to the tank wall. The support must be sufficiently strong to withstand the stresses established during shipping and during short circuit conditions which may be established during operation of the transformer. Presently known support constructions are relatively complicated and costly.

Further, in the manufacture of totally enclosed transformers there is some unavoidable nonuniformity in construction due to manufacturing tolerances which require slight adjustment and rearrangement in the supporting structures. This is very difficult with the more complicated coupling means.

In accordance with the present invention, the transformer coil is disposed within a housing having an upper interior wall which engages an upper end of the core and a bottom wall having a central portion which engages a lower end of the core to rigidly wedge or clamp the core within the tank. The housing itself is the only means provided to hold the core structure and windings thereon against movement within the housing. A shell type core with the axis of the transformer coil disposed in a vertical direction presents a minimum of insulating difficulties.

The accompanying drawings illustrate the best mode presently contemplated by the inventor for carrying out the invention.

In the drawings:

Figure 1 is a perspective view of a totally enclosed transformer;

Fig. 2 is a sectional view taken on a central vertical plane through the transformer shown in Fig. 1;

Fig. 3 is a sectional view taken on line 3—3 of Fig. 2;

Fig. 4 is a sectional view similar to Fig. 2 of another embodiment of the invention;

Fig. 5 is a plan view of the transformer tank shown in Fig. 4; and

Fig. 6 is a view taken on line 6—6 of Fig. 4.

Referring to the drawings, and particularly to Figs. 1–3, a transformer tank 1 houses a pair of generally rectangular closed magnetic cores 2 of the wound strip type with each core having a longer or major dimension disposed in a vertical plane and a minor dimension in a horizontal plane. Side legs 3 of the cores 2 are disposed in abutting relation to form the central leg of a shell type core. A secondary winding 4 is wound on the central leg and a primary winding 5 is wound around the secondary winding 4 with suitable electrical insulation 6 interposed therebetween. Suitable coil supporting means, not shown, are disposed between the end faces of the

windings and the adjacent ends of the core to maintain the positioning of the windings under short circuit conditions.

Three low voltage leads 7 extend from the secondary winding 4 and are connected to three low voltage terminals 8 which are secured within suitable openings in a lower portion of the tank 1. A pair of incoming high voltage leads 9 extend from the primary winding 5 to a pair of high voltage terminals 10 which are secured within suitable openings in an upper cover 11 of the tank 1.

Oil or other suitable liquid 12 generally fills the tank 1 to cool and insulate the windings 4 and 5 and the terminals 8 and 10.

Each core 2 is an endless strip wound upon itself to provide a closed laminated core including a series of integrally connected metal laminations or convolutions 13 as shown in Fig. 2. This provides an inherently strong core structure without the necessity of securing the separate laminations together. A small weld 14 is provided to secure the end of the final convolution to the adjacent surface in each of the cores 2 and overcomes any tendency of the core to unwrap.

The tank 1 is generally in the shape of an elliptical cone having circular ends and having the upper portion of the cone removed. The tank 1 includes a tapered side wall 15 establishing a relatively large bottom opening and small top opening. An annular flange 16 is provided on the top of the tank 1 and the upper or top cover 11 is secured to the flange in any suitable manner such as by a plurality of bolts 17. An annular sealing gasket 18 of suitable gasproof and oil-resistant material is disposed between the flange 16 and cover 11 to establish a hermetically sealed joint.

A vertical wall 19 integrally depends from the lower end of the tapered side wall 15 and receives a cup-shaped bottom cover 20 having a depending flange 21 telescoped within the wall. The cover 20 opens outwardly and is secured to the bottom of the tank wall 15 by a weld 22 which joins the lower edges of the wall 19 and the flange 21 to establish a hermetic junction therebetween and provide a bottom wall for the tank.

The taper in the tank wall 15 is such that with the cores 2 resting on the bottom cover 20, the upper side edge of each core 2 engages an intermediate portion 23 of the tank wall 15 on each end of the tank 1. The cores are then tightly wedged or clamped between the cover 20 and the wall portion 23. As shown in Fig. 3, the upper side edges 24 of each core 2 adjacent the upper longitudinal surfaces of the tank wall are suitably spaced therefrom to allow extension of the high voltage leads 9 from the primary winding 5 to the high voltage terminals 10 without breakdown between the high voltage leads and the tank or core.

The wedge construction rigidly supports the core and coil assembly during transporting, storage and short circuit conditions that may arise during operation of the transformer.

The tapered wall portion 15 of the tank 1 extends upwardly above the cores 5 on a continuing taper as shown, or in any other suitable configuration, to establish an upper chamber 25 which accommodates the incoming high voltage terminals 10 and provides a reservoir for the cooling medium 12.

Referring particularly to Fig. 3, the lower portion of the tapered wall 15 establishes a triangular cross-sectional space or chamber 26 between the tank wall and the cores 2 which provides adequate spacing of the primary winding 5 from the tank wall and which also houses the low voltage terminals 8. This space 26 may also be employed for the necessary low voltage circuit breakers, tap changers and the like, not shown.

Referring to Figs. 4–6, a second embodiment of the invention is shown wherein a single core 27 is clamped within a transformer tank 28. The core 27 is similar to one of the cores 2 of Fig. 1 and comprises a series of convolutions 29 of thin metal stock with the last one secured to the adjacent convolution by a weld 30. The core 27 is generally rectangularly shaped with a flat horizontal upper yoke portion 31 and an arcuate horizontal lower yoke portion 32 respectively joining the upper and lower ends of a pair of vertical winding legs 33 and 34.

A primary winding 35 is wound on the one leg 33 and connected to a pair of high voltage terminals 36 which are secured within suitable openings in one side wall of an upper tank portion 37 of tank 28. A secondary winding 38 is wound on the other vertical leg 34 and is connected to three low voltage terminals 39 secured within suitable openings in the upper side wall portion 37 opposite the high voltage terminals 36.

The primary winding 35 and the secondary winding 38 wound on the separate legs 33 and 34 would result in extremely poor linkage between the windings and are shown only for simplicity of description. In practice, the primary winding and the secondary winding each include separate coils disposed on each leg with the corresponding coils suitably connected to each other and connected to the high voltage terminals 36 and the low voltage terminals 39, respectively.

The transformer tank 28 includes a main body portion 40 having a generally elliptical cross-section or configuration within which the core 27 is disposed. Horizontal ledges 41 and 42 each extend inwardly from the opposite end or side wall portions of the main body portion 40 of tank 28 to the upper tank portion 37 which has a reduced cross-section to form continuous side wall portions. The ledges 41 and 42 extend sufficiently inwardly to engage each end of the upper surface 43 of the core yoke 31.

An upper cover 44 is secured to a horizontal flange 45 on the upper wall portion 37 by a plurality of bolts 46 and allows access to both the high voltage terminals 36 and the low voltage terminals 39 disposed within the tank. A suitable sealing gasket 47 is disposed between the cover 44 and the flange 45.

A bottom cover 48 is provided having an inverted cup-shape to establish a depending annular leg 49. The cover 48 telescopes into the lower portion of the tank body 40 and the lower edges of the leg 49 and the tank body 40 are welded as at 50 to hermetically seal the cover 48 to the tank body.

An arcuate depression 51 is provided in the central portion of the bottom cover 48 and is shaped to conform with the arcuate lower yoke 32 of the core 27. When the bottom cover 48 is assembled with the body portion 40, the yoke 32 rests within the depression 51 and the core 27 is then tightly wedged between the lower cover 48 and the horizontal ledges 41 and 42 of the tank 28. This locks the core 27 is place and maintains the relative spacing of core 27 and tank 28 during transportation and operation.

The present invention provides an easily fabricated transformer construction having a strong rigid support for the core and coil with the tank. The transformer construction also permits simple adjustment in the core and coil support to allow for manufacturing tolerances and the like.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. In a transformer, a generally rectangular magnetic core structure, transformer windings disposed on one or more vertical legs of the core structure to leave the upper and lower portions of the core structure unobstructed, a housing having opposed side wall portions spaced inwardly from the bottom portion of the housing and adapted to engage upper portions of said core structure

in vertically spaced relation to said windings, and a bottom wall having a central surface portion matching the configuration of the lower end of the core structure and engaging the core structure in vertically spaced relation to said winding, said housing being wholly spaced from said transformer windings, and means to secure the bottom wall to the housing to wedge the core structure between said side wall portions and the central portion of said bottom wall to provide the housing and bottom wall as the sole support of the core structure and transformer windings within said housing.

2. In a transformer, a tank having tapered side walls and a bottom wall, a magnetic core, a coil assembly disposed on said core, and said core being arranged within said tank with the axis of the coil assembly lying in a vertical plane and with the core wedged between the upper portions of the tapered side walls and the bottom wall of the tank to thereby provide the side walls and the bottom wall as the sole support for the core within the tank against movement therein.

3. In a transformer, a tank having an upper surface portion disposed inwardly of the lower end of the tank, a closed magnetic core having a series of tightly wound integrally connected convolutions, said magnetic core being disposed within the tank and having a major axis lying longitudinally of the tank and a minor axis lying transversely of the tank, a coil assembly disposed on portions of the core lying parallel to the major axis with the coil assembly arranged in completely spaced relation to the walls of the tank, a bottom cover having a central portion engaging the lower portion of the core with the bottom cover secured in place, and means to rigidly secure the bottom cover to the tank to tightly wedge the core between said inwardly spaced upper surface portion of the tank and the central portion of said cover to support the core within the tank.

4. A fluid insulated and cooled distribution transformer, which comprises a tank having opposed tapered side walls, a cover removably secured to the bottom of the tank to seal the tank at the bottom, a cooling and insulating fluid confined within the tank, a generally rectangular core arranged within the tank with the upper edge surfaces of the core engaging the tapered side walls and with the core resting on the bottom cover to maintain the core wedged in place within the tank, transformer windings disposed on the vertical legs of the core with said tapered walls establishing a spacing between said windings and said tank wall, and low voltage terminal means secured to the lower portion of the tank and extending into the space in the lower portion of the tank.

5. A transformer, comprising a metal housing having a removable top and a removable bottom secured to a body portion having a major axis and a minor axis, opposed tapered wall portions beginning at a lower body portion and extending upwardly and inwardly, a spirally wound laminated core having a major axis and a minor axis, said core being disposed within the housing and resting on the removable bottom with the major axis extended in a vertical direction and with the upper core edges engaging said opposed tapered wall portions to wedge the core within the housing, high voltage terminals secured within the upper portion of the housing, and low voltage circuit components secured within the lower portion of the housing.

6. A distribution transformer, which comprises a metal tank having an eliptical frusto-conical configuration with the larger cross-section being at the lower end of the tank to provide the tank with a tapered wall, a closed magnetic core of the wound strip type having a major dimension lying in a vertical direction and a minor dimension lying in a horizontal direction, said core being disposed within said tank with the major core dimension lying in a vertical direction and with the upper side edge surfaces engaging the tapered wall, a bottom cover adapted to engage said core to wedge said core between the cover and the tapered wall, said cover having a depending

portion adapted to lie contiguous with said tank depending portion, and a weld hermetically joining the ends of said depending portions to secure the cover to the tank and to allow subsequent opening and reclosing of the tank.

7. A distribution transformer, which comprises a tank having a tapered sidewall, said tank having the major dimension of the tapered sidewall substantially greater than the minor dimension, a pair of generally rectangular cores disposed within the tank with the major dimension in a vertical plane and arranged with one leg of each core in abutting relation to form a shell type core, said cores having the upper edge surface of each non-abutting vertical leg engaging the tank wall and having the axial faces of the cores in spaced relation to the tank wall, a high voltage winding and a low voltage winding disposed on the abutting legs, high voltage terminals secured to the upper portion of the tank in vertically spaced relation to said cores, high voltage leads extending from the high voltage winding upwardly to the high voltage terminals through the space between an axial face of the cores and the tank wall and in spaced relation to the axial face and the tank wall, low voltage terminals secured to the lower portion of the tank in horizontally spaced relation to the cores, and low voltage leads connecting the low voltage winding to the low voltage terminals.

8. In a transformer, a tank having an upper side surface disposed inwardly from the lower end of the tank and adapted to be mounted in a vertical direction, a closed magnetic core comprising a series of tightly wound integrally connected convolutions and being disposed within said tank, said magnetic core having a major axis lying parallel to the vertical axis of the tank and a minor axis lying transversely of the tank, a coil assembly wound on the portion of the core lying parallel to the major axis, a bottom cover having a central portion adapted to engage the lower portion of the core, said central portion having

a depression adapted to receive said lower core portion to support the core, and means to secure the bottom cover to the tank to tightly wedge the core between said inwardly spaced upper surface of the tank and the central portion of said cover to support the core within the tank.

9. A distribution transformer, which comprises an elliptical shaped tank having upper inwardly projected opposed ledges joining a main body portion and a top portion, said ledges starting from the ends of the major dimension of said body portion, a generally rectangular core having an upper horizontal yoke and a lower arcuate yoke connecting a pair of vertical legs, a high voltage winding disposed on said vertical legs, a low voltage winding disposed on said legs, said core being disposed within said tank with the opposite ends of the upper horizontal yoke engaging the opposite ledges, a generally inverted cup-shaped bottom telescoped into the lower end of the tank and hermetically secured thereto, an arcuate depression in the central portion of the cover to receive the arcuate yoke portion of the core and position the core within the tank, said core being tightly wedged between said ledges and said bottom cover to rigidly support and to maintain said core in the tank, said main body portion being sufficiently large to provide spacing of the tank wall from the core and windings, an insulating and cooling liquid substantially filling said tank, and a removable top cover secured to the top portion of the tank to hermetically seal the tank.

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