Sept. 16, 1969 C. E. DERBYSHIRE ET AL 3,467,929

DRY TYPE TRANSFORMER AND IMPROVED ENCLOSURE ASSEMBLY THEREFOR

Original Filed April 6, 1967

Fig. 1

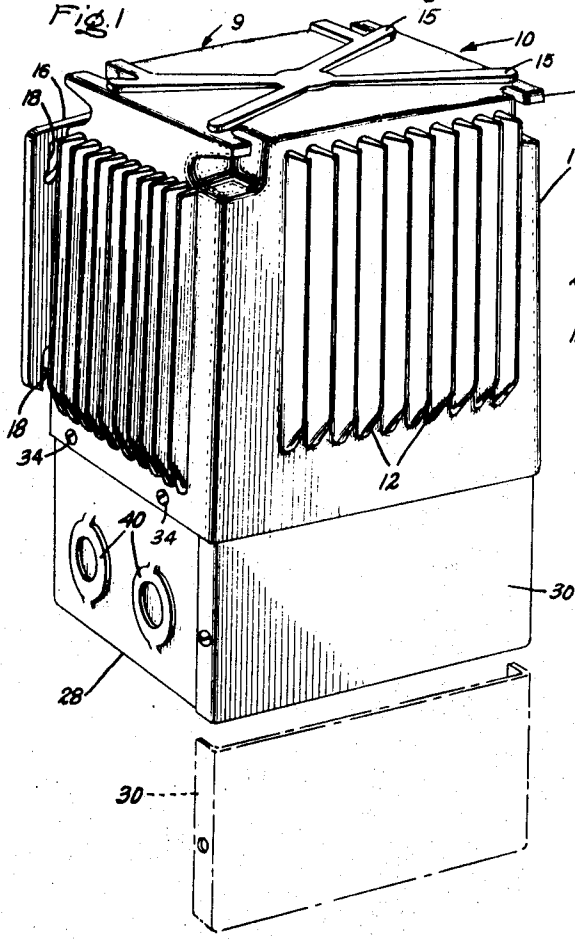


Fig. 2

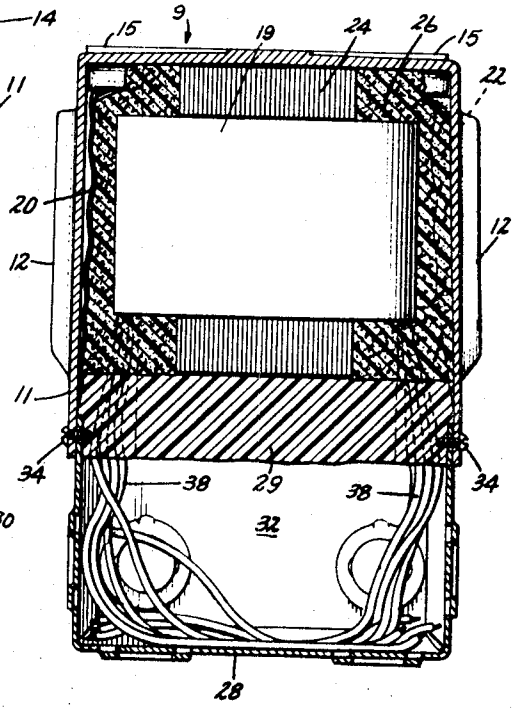


Fig. 3

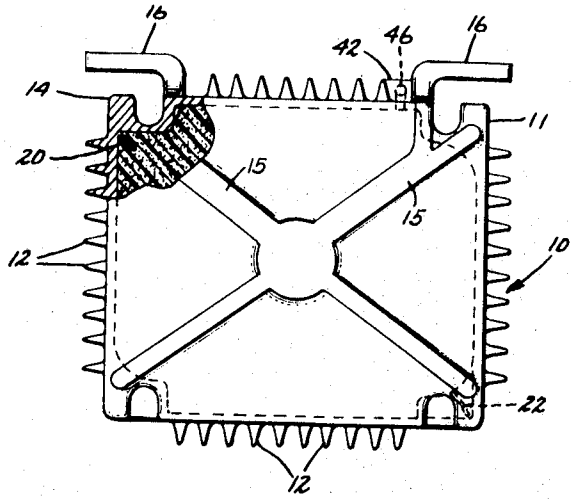
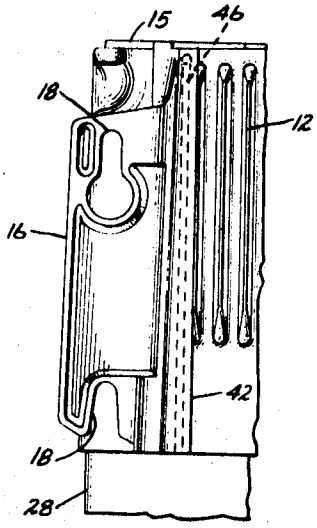


Fig. 4



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DRY TYPE TRANSFORMER AND IMPROVED ENCLOSURE ASSEMBLY THEREFOR

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Continuation of application Ser. No. 628,949, Apr. 6, 1967. This application Sept. 18, 1968, Ser. No. 768,595
Int. Cl. H01f 27/08, 17/00, 27/02
U.S. Cl. 336—61 3 Claims

ABSTRACT OF THE DISCLOSURE

The electrical coil and magnetic core of the dry type transformer are encased by a thermally conductive material disposed within a cover portion of an enclosure assembly. The cover portion is formed with at least one interlock projection extending into the thermally conductive material to prevent displacement of the thermally conductive material relative to the cover portion and thereby positions the thermally conductive material and the electrical coil and magnetic core within the enclosure assembly. Also, the interlock projection arrangement eliminates the need for bolts and clamps to mechanically hold the electrical coil and magnetic core within the enclosure assembly. The wiring compartment portion of the enclosure assembly is telescopically disposed at an edge thereof within the cover portion to provide an essentially waterproof housing for the electrical coil and magnetic core and to permit the transformer to be replaced without need for breaking all of the conduit connections to the wiring compartment portion.

This application is a continuation of application Ser. No. 628,949, filed Apr. 6, 1967, now abandoned.

Background of the invention

This invention relates to inductive devices, such as dry type transformers, and more particularly to an improved construction of an assembly thereof.

The transfer of electrical energy is transformers is generally accompanied by the evolution of heat. To prevent this heat from damaging the coil and leads of transformers it is desirable, if not necessary, to provide suitable heat transfer paths so that the heat can be dissipated to the ambient environment. In commonly used prior art constructions, the magnetic coils of dry type transformers have been at least partially exposed to the ambient environment. Such representative constructions are shown in the Hodges et al. Patent 3,161,843 and the Antalis et al. Patent 3,163,838.

In practice, dry type transformers are generally air cooled, and the rate of heat dissipation from the transformer is one of the principal factors that determines the physical size of a transformer for a given kilovolt ampere (kva.) rating. For a particular insulation system the safe operating temperature will also in part determine the maximum permissible kva. rating of the transformer. If a transformer exhibits relatively poor heat dissipation characteristics, it is generally necessary to lower the kva. rating of the transformer in order to insure operation within the desirable temperature range recommended by the transformer manufacturer. It will thus be appreciated that if the heat dissipation characteristics of a transformer are improved, it would be possible to either reduce the size of the transformer or to increase the kva. rating of a specific transformer design. It is desirable therefore to provide a dry type transformer construction having improved heat dissipation characteristics.

It has been the practice in the past in many dry type transformers to use bolts or clamps to hold the magnetic

core laminations in assembled relation and to position the core assembly within the transformer enclosure. Where the laminations are held together too tightly, the core will be stressed with the result that the core losses will increase during operation. Of course, increased core losses result and as a consequence the heat evolved by the transformer is increased. Accordingly it will be appreciated that it is desirable to provide a transformer with a magnetic core that is not unduly stressed by bolts or clamps.

In some applications of dry type transformers problems have been encountered as a result of water coming in contact with the parts of the transformer. This problem exists in outdoor applications where the transformer is subjected to wide range of weather conditions and in indoor installations such as dairy and food processing factories where the interior of the building must be frequently washed with water. Therefore, it is desirable to provide a transformer enclosure wherein the electrical coil and other parts of the transformer are adequately protected from water.

In many of the prior art dry type transformers, it has been necessary for a user of the transformer to disconnect all wiring conduits and connections to the transformers lead compartment when it was necessary to replace one unit with another unit having a different voltage rating or tapped secondary arrangement. This breaking of connections was required even though the replacement transformer was of the same physical size as the original transformer. It will thus be appreciated that it is desirabe to provide a transformer which can be replaced by a transformer of a different voltage rating or secondary arrangement without need for removing all electrical conduits and connections already in place.

Accordingly, it is an object of the invention to provide an air-cooled dry type transformer characterized by improved heat dissipation characteristics.

A further object of the invention is to provide a dry type transformer enclosure assembly having an improved arrangement for holding an electrical coil and magnetic core in position within the transformer enclosure without unduly stressing the laminations.

It is another object of the invention to provide an improved transformer wherein the coil and magnetic core are effectively protected from damage by water.

It is an object of this invention to provide an improved dry type transformer wherein different transformers can be interchanged without necessitating the disconnection of all electrical conduits previously installed.

Still another object of the invention is to provide an improved transformer enclosure assembly arranged so that it can be used as a pressure vessel during manufacturing operations.

Summary of the invention

In accordance with one form of our invention we have provided an improved dry type transformer having an electrical coil and magnetic core formed of laminations of magnetic material, an enclosure assembly, and thermally conductive material essentially encasing the electrical coil and magnetic core. The enclosure assembly is comprised of a cover portion formed with external heat radiating fins for promoting the dissipation of heat from the electrical coil and magnetic core and with at least one interlock projection extending into the thermally conductive material to prevent displacement of the thermally conductive material relative to the cover portion and thereby to position the thermally conductive material and the electrical coil and magnetic core within the enclosure assembly. The enclosure assembly also includes a wiring compartment portion with an end thereof telescopically disposed within the cover portion.

The subject matter which we regard as our invention is set forth in the appended claims. The invention itself, however, together with further objects and advantages thereof may be understood by referring to the following description taken in connection with the accompanying drawing.

Brief description of the drawing

In the drawing:

FIGURE 1 is a perspective view of a dry type transformer embodying one form of the present invention;

FIGURE 2 is a sectional view, with parts broken away, of the transformer of FIGURE 1;

FIGURE 3 shows a plan view of the transformer of FIGURE 1; and

FIGURE 4 is a partial rear elevation, with parts broken away, of the transformer of FIGURE 1.

Description of the preferred embodiment

Referring now to the drawing, the invention as shown is embodied in a dry type transformer **9**. The transformer is housed in an enclosure assembly **10** which includes an upper cover portion **11** with fins **12** to facilitate dissipation of heat to the ambient environment. For the purpose of mounting transformer **9**, pads **16** are formed integrally on the cover portion **11** and are provided with mounting openings **18**.

As shown in FIGURE 2, the transformer **9** includes an electrical coil **19** and magnetic core **24** fabricated of laminations of magnetic material. Substantially encasing the electrical coil **19** and core **24** within the cover portion **11** is a thermally conductive material **26** which desirably provides a path for the transfer of heat from the magnetic core **24** and coil to the surface of the cover **11**. Any suitable thermosetting resin with a filler, such as sand, may be used. A thermally insulating wall **29** is provided between the magnetic core **24** and lead compartment **32** to retard the flow of heat into the lead compartment. The insulating wall **29** may be a foamed resin of the type disclosed in the Antalis et al. Patent 3,163,838.

It will be noted that there are no clamps or assembly bolts holding the laminations of the magnetic core **24** in position relative to the cover portion **11**. Interlock projections **20, 22** have been provided to insure retention of the magnetic core **24** and thermosetting material **26** within the cover portion **11**. In the exemplification the interlock projections **20, 22** used were corrugated ribs which, as is best seen in FIGURE 3, were located in diagonally opposite corners of the cover portion **11**.

After hardening, the thermally conductive material **26**, a thermosetting resin, forms a good mechanical interlock with the ribs **20, 22** to position the electrical coil **19** and core **24** within the cover portion **11**. Also, during the process of manufacture this interlock arrangement prevents the coil **19** and magnetic core **24** from dropping out or being displaced from the cover portion **11**.

Again having reference to FIGURES 1 and 2, it will be seen that we have provided a detachable wiring compartment **28** with a removable cover **30**. The wiring compartment **28** and cover **30** are telescopically disposed within the cover portion **11** and held in position relative thereto by conventional fasteners such as screws **34**. In the wiring compartment **28**, connections are made between leads **38**, and leads (not shown) for connection to the user's equipment. Preferably, knock out plugs **40** are formed in the wiring compartment **28** to provide openings for electrical conduit fittings.

Turning now to FIGURES 3 and 4, it will be seen that an L-shaped passageway or aperture **46** is provided in the cover portion **11** inside web **42**. When the transformer **9** is encapsulated and impregnated, the passageway **46** may be useful as an exhaust header for drawing a vacuum inside the cover portion **11** without requiring a separate evacuation tube.

In the preferred embodiment the cover portion **11** was made of die cast aluminum because of the good mechanical and thermal properties of aluminum. It will be appreciated, however, that the cover could be fabricated from aluminum or various other materials having desired characteristics. The wiring compartment **28** and cover **30** were fabricated from sheet steel. In order to position transformer **9** when inverted, level support means in the form of ribs **15** are cast into the top of the cover portion **11**. Four lifting lugs **14** are formed at the corners of and in the plane of the top of the cover portion **11**, as is clearly shown in FIGURE 1.

Comparisons were made of the amount of core steel required in a 25 kva. dry type transformer constructed in accordance with the present invention and a 25 kva. transformer constructed in accordance with the prior at. It was found that the prior art transformer required approximate- 290 pounds of core steel whereas a transformer constructed according to the exemplification required only about 187 pounds of core steel. This large reduction in the amount of core steel required for a 25 kva. transformer is believed to be largely due to the improved heat dissipation characteristics of transformers embodying the present invention and the elimination of clamps and lamination bolts.

From the foregoing description it will be apparent that we have provided an improved dry type transformer with improved heat dissipation characteristics and an improved enclosure assembly that protects the unit from water even when subjected to hose-down conditions. It will also be apparent that the provision of a separate lead compartment **28** facilitates the replacement of one core and cover unit by another transformer of the same size without requiring the disconnection of electrical conduits and other hardware previously installed. Thus, in the improved dry type transformer the enclosure arrangement facilitates both the initial installation of a transformer and the subsequent installation of replacement transformers having the same general physical size. Further, with the improved enclosure arrangement it is possible to eliminate clamps or lamination bolts to hold a core and coil assembly in position relative to the case.

It will be apparent that many modifications may be made in the parts used to construct the exemplified transformer assembly. However, it is to be understood that we intend by the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

We claim:

1. A dry type transformer comprising an electrical coil and magnetic core formed of laminations of magnetic material, and enclosure assembly, and a thermally conductive material surrounding the electrical coil and magnetic core within the enclosure assembly for conducting heat from the electrical coil and magnetic core and for maintaining said laminations in assembled relation, said enclosure assembly including a cast aluminum portion integrally formed with a top end and sidewalls extending downwardly therefrom to form an open bottom end opposite said top end, such that the only opening in said cast aluminum portion is at the bottom end, said cast aluminum portion being integrally formed with external heat-radiating fins for promoting the dissipation of heat from the electrical coil and magnetic core and with at least one interlock projection extending into said thermally conductive material to prevent displacement of said thermally conductive material relative to said cast aluminum portion and thereby to position said thermally conductive material and said electrical coil and magnetic core within said cast aluminum portion, said enclosure assembly also including a wiring compartment, an end of said wiring compartment portion being received in telescopic relation therewith within said open end of said cast aluminum portion, and forming an essentially waterproof cover for said electrical coil and magnetic core.

2. A dry type transformer comprising an electrical coil and magnetic core formed of laminations of magnetic material, thermally conductive material substantially encasing the electrical coil and magnetic core, and an enclosure assembly including a metallic cover portion with four sidewalls and a top wall forming a housing for said thermally conductive material and said electrical coil and magnetic core, said housing having an opening only at the bottom end, said four sidewalls and said top wall of said metallic cover portion being integrally formed of case aluminum with integrally formed external fins on at least two of said walls to increase the heat transfer relationship with the ambient environment, said cover portion having at least one integrally formed interlock projection embedded in said thermally conductive material to hold said thermally conductive material and said electrical coil and magnetic core in position within the enclosure assembly, and said enclosure assembly further including a wiring compartment removably attached within the open bottom end of said metallic cover portion whereby said metallic cover portion and said electrical coil and magnetic core may be removed from said wiring compartment without disturbing external conduit connections to said wiring compartment.

3. The dry type transformer set forth in claim 2 wherein lifting lugs are integrally formed at four corners of said cover portion to facilitate handling of the transformer.

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U.S. Cl. X.R.

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