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Colangelo et al.

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[54] TRANSFORMER HAVING AN EXTERNALLY OPERABLE NO-LOAD TAP CHANGER

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[52] **U.S. Cl.** .....**336/94**, 200/11 TC, 336/150

[51] **Int. Cl.** **H01f 21/12**

[58] **Field of Search** .....200/11 TC; 336/105, 107, 94, 336/150

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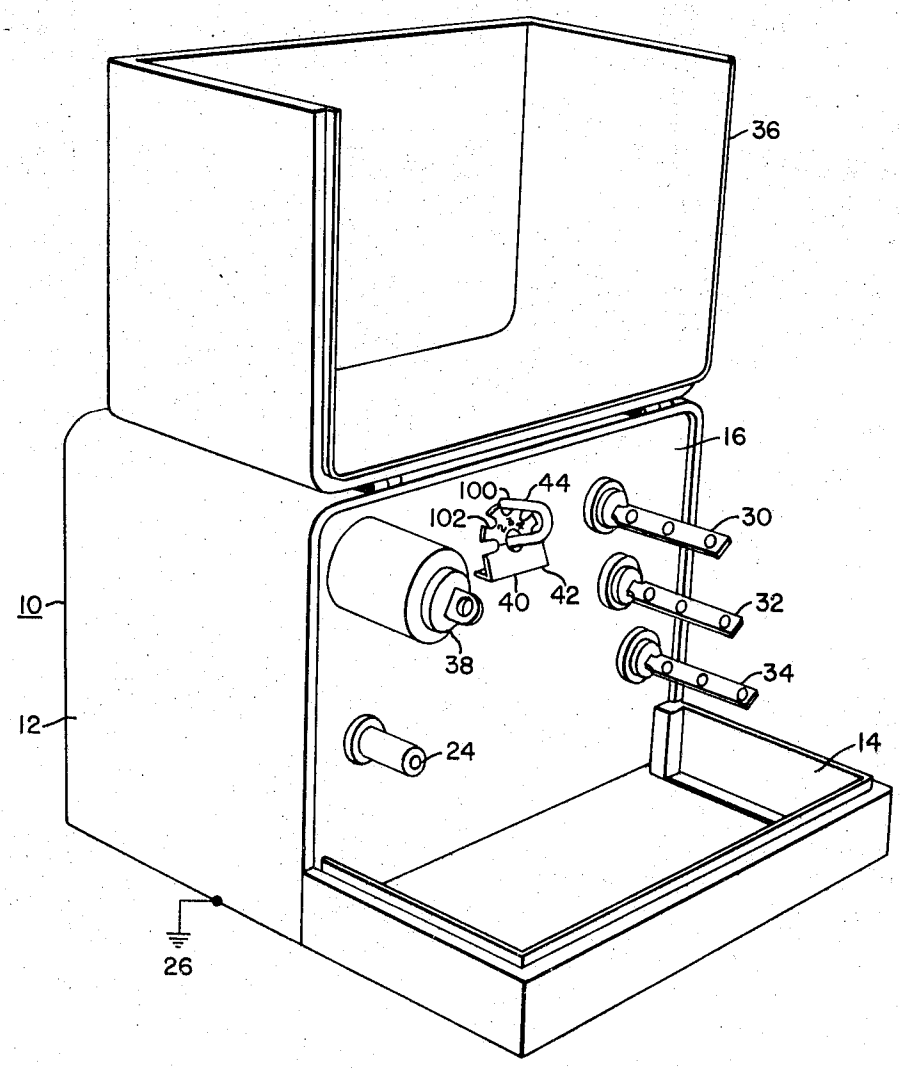
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[57] **ABSTRACT**

A distribution transformer having a metallic casing comprising a fluid compartment and a terminal compartment separated by a common wall. Core-winding means including a low-voltage coil and a high-voltage coil having a plurality of taps thereon located in the fluid dielectric compartment. A tap changer attached to the fluid dielectric compartment side of the common wall. The tap changer has a shaft extending through the common wall with an O-ring seal to prevent fluid dielectric from seeping into the terminal compartment. An operating member is attached to the shaft and located in the terminal compartment for operating the shaft to move a movable contact member to engage fixed contacts located inside the fluid dielectric compartment to selectively connect the taps on the high-voltage coil to the casing. An indicator is located in the terminal compartment to indicate which terminal in the fluid dielectric compartment is connected to the movable contact element.

6 Claims, 5 Drawing Figures



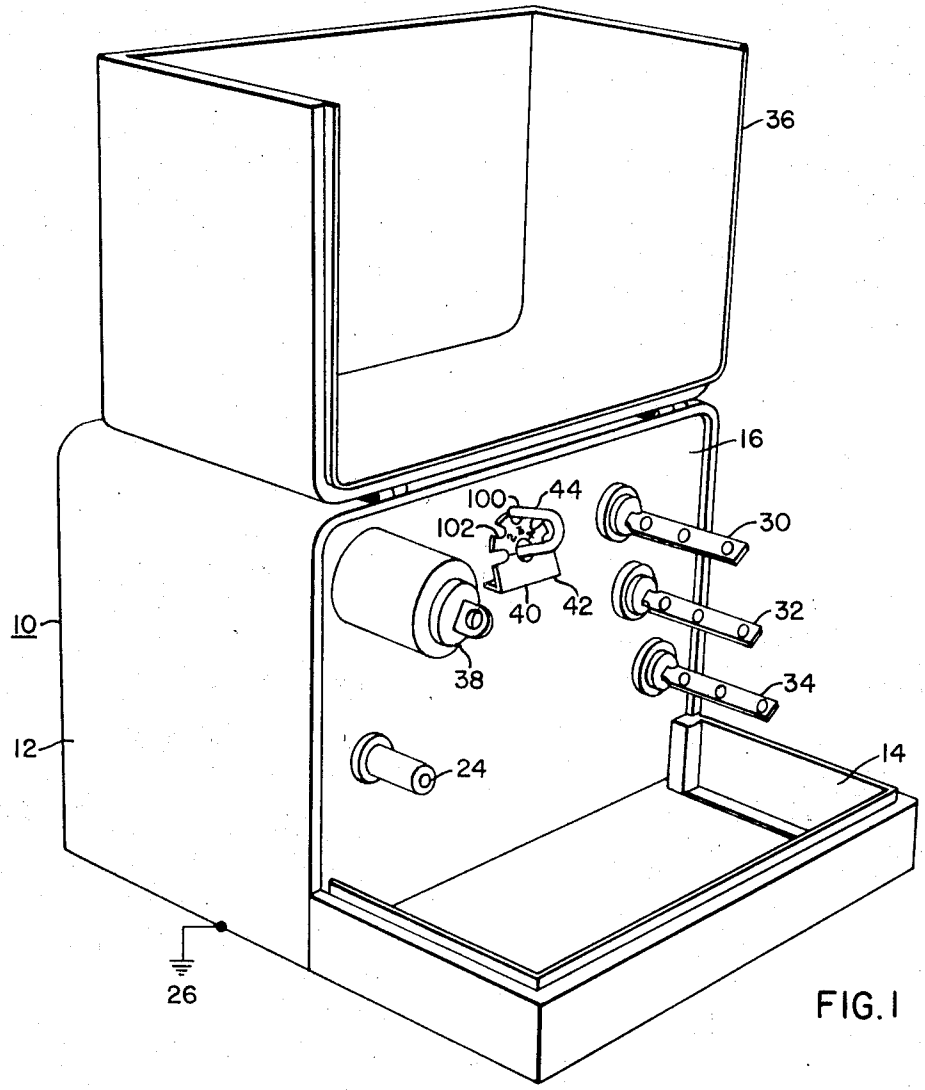


FIG. 1

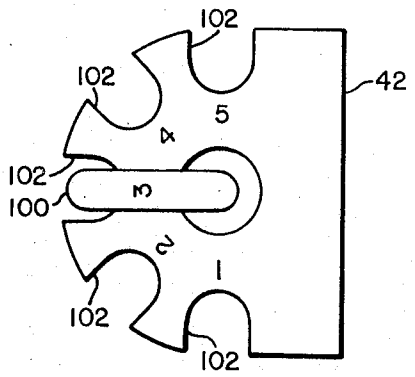


FIG. 5

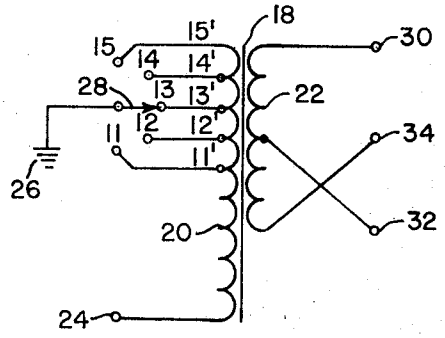


FIG. 2

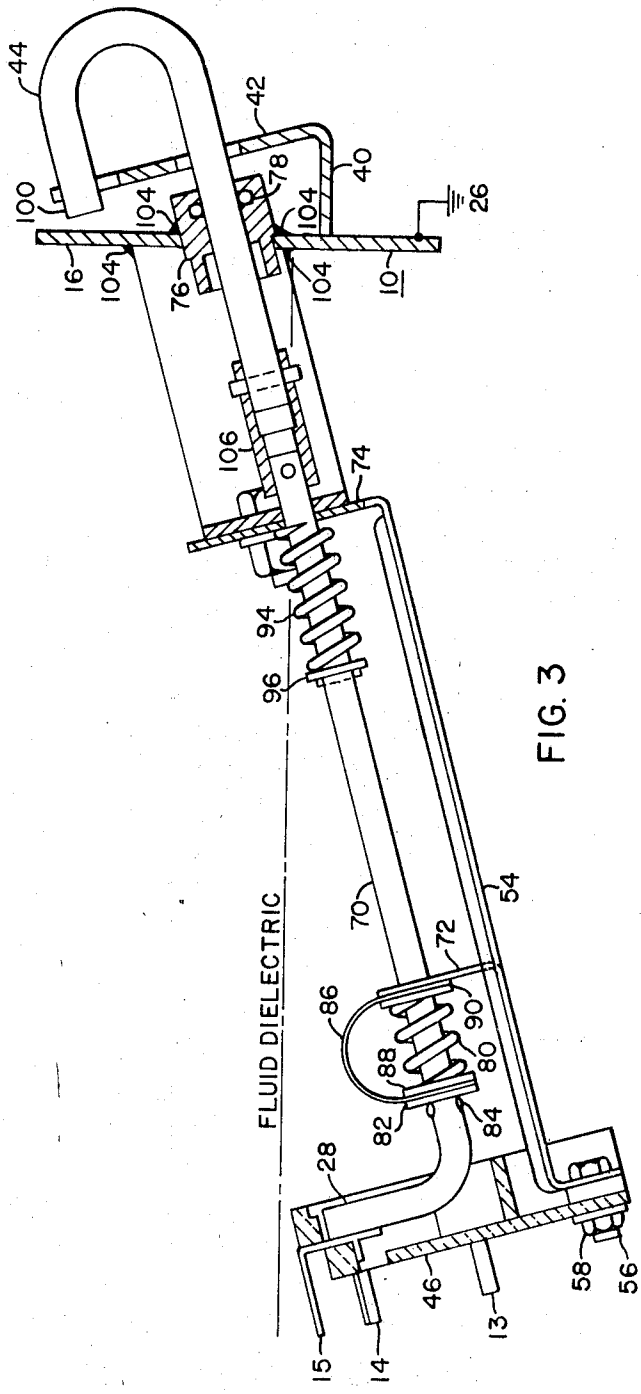


FIG. 3

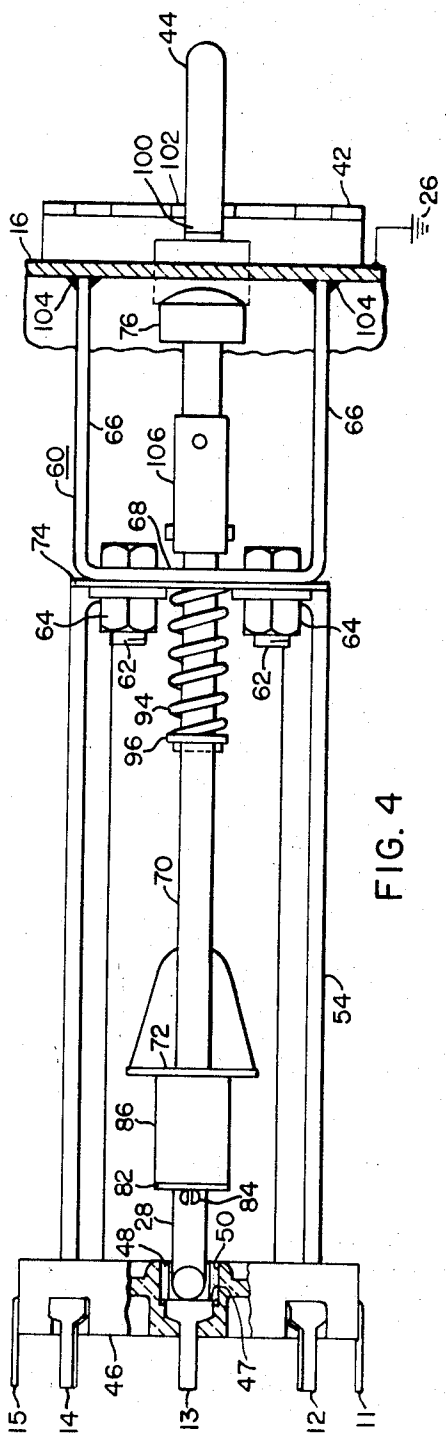


FIG. 4

TRANSFORMER HAVING AN EXTERNALLY OPERABLE NO-LOAD TAP CHANGER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to fluid-cooled transformers and more particularly to fluid-cooled distribution transformers of the Pad-mounted type comprising a casing having a fluidtight compartment and a terminal compartment with a no-load tap changer positioned in the fluidtight compartment and having an operating member positioned in the terminal compartment for operating the tap changer to different tap positions.

2. Description of the Prior Art

In the prior art of which we are aware no-load tap changers for distribution transformers of the pad-mounted type are usually mounted with the operating member inside the fluid dielectric compartment. This system has the disadvantage of having to open the fluid dielectric compartment to operate the tap changer. This method of operation contributes to contamination of the fluid dielectric and the operator usually gets fluid dielectric on his hands and clothing. This type of installation also usually requires an additional electrical connection from the movable contact element to complete the electrical circuit. In addition the prior art devices usually requires special mounting, support, and bracing to the core-winding assembly. This objection to the prior art installation is eliminated by this invention which provides a tap changer supported entirely on the transformer wall with the tap-changing mechanism located in the fluid dielectric compartment of the transformer casing, which is usually sealed to atmosphere, and with an operating member or handle outside the fluid dielectric compartment for operating the movable member of the tap changer to change the tap connections on the high-potential coil located inside the fluid dielectric compartment. The operating shaft connecting between the movable contact of the tap changer and the operating member is sealed through the common wall between the fluid dielectric compartment and the terminal compartment with an O-ring seal to prevent fluid dielectric from seeping out of the fluid dielectric compartment. This O-ring seal also partially electrically isolates the shaft from the casing wall or at least provides a high resistance between the shaft and the casing wall therefore a good electrical circuit other than the operating shaft must be provided from the movable contact member to the casing wall. This circuit is provided in the present invention by the metallic support member which mounts the tap-changing mechanism on the fluid dielectric compartment side of the common wall dividing the fluid dielectric compartment and the terminal compartment.

SUMMARY OF THE INVENTION

This invention provides an improved distribution transformer of the pad-mounted type. The transformer has a metallic casing divided into a fluid dielectric compartment and a terminal compartment. A core winding assembly is installed in the fluid dielectric compartment. The high-voltage coil of the winding assembly has a plurality of taps. A tap changer is mounted on the fluid dielectric compartment side of the common wall dividing the fluid dielectric compartment and the terminal compartment. The tap changer comprises an insulator member having a plurality of stationary contacts for connecting to the taps on the high-voltage coil and a movable contact for engaging the stationary contacts. The movable contact is attached to one end of a shaft. The shaft extends through the common wall and has an operating member or handle on the other end for moving the movable contact. The operating member or handle is located in the terminal compartment. The shaft is sealed through the common wall between the fluid dielectric compartment and the terminal compartment by means of an O-ring seal. The stationary and movable contacts are located below the fluid dielectric level in the fluid dielectric compartment and the point where the shaft passes through the common wall is above the fluid dielectric level. First and second coil springs surround the shaft to provide force for maintaining the movable contact in good electrical contact making arrangement with the fixed contact. The first spring is located in the main current path from the movable contact to the casing but this spring is shunted with an electrical shunt which carries most of the current around the first spring. The second spring is located outside of the main current carrying path from the movable contact to the casing. It is important that as much of the load current as possible be prevented from passing through these springs, since if the springs are maintained at a continuous high temperature they will eventually lose their force characteristics and will not maintain the movable contact in good contact maintaining relationship with the fixed contacts of the tap changer. The metallic support for the tap changer provides the main current path from the movable contact to the metallic casing. The metallic casing is connected to ground potential. The operator or handle may be operated from the terminal compartment of the casing to change the tap connections to the taps on the high-voltage coil located in the fluid dielectric compartment. An indicator means is provided in the terminal compartment of the casing to indicate the particular tap to which the movable contact is connected on the inside of the fluid dielectric compartment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a transformer provided by this invention with a cover for the terminal compartment in open position;

FIG. 2 is a schematic of the core-winding assembly and tap changer installed in the fluid dielectric compartment of the transformer shown in FIG. 1;

FIG. 3 is a longitudinal sectional view, with parts broken away, of the tap changer used on the transformer of FIG. 1;

FIG. 4 is a top view of the tap changer shown in FIG. 3; and

FIG. 5 is a partial front view showing the indicator and the operating handle for the tap changer used on the transformer of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Throughout the description which follows like reference characters indicate like parts in all of the various figures of the drawing.

FIG. 1 is a perspective view of a pad or ground-level-mounted transformer as provided by this invention. The transformer comprises a casing or housing **10** which is divided into a fluid dielectric compartment **12** and a terminal compartment **14** by means of a common wall **16**.

The fluid dielectric compartment **12** houses a core-winding assembly, which assembly comprises a magnetic core **18**, a high-voltage winding **20** and a low-voltage winding **22**. The high-voltage winding **20** has an input terminal **24** and a plurality of taps **11'**, **12'**, **13'**, **14'** and **15'** which are adapted to be selectively connected to terminals **11**, **12**, **13**, **14** and **15** on a tap changer for grounding as indicated at **26**, by means of a tap changer having a movable contact element **28**. The voltage between the input terminal **24** and the first tap **11'** is roughly set to 7,200 volts and the voltage between the respective taps **11'**, **12'**, **13'**, **14'** and **15'** is approximately 144 volts between each pair of taps, with the total voltage between tap **11'** and tap **15'** adding up to approximately 720 volts. This tap arrangement permits approximately 10 percent voltage adjustment for the high-voltage winding. The taps **11**, **12**, **13**, **14** of the tap changer may be selectively connected to ground potential to insert this voltage adjustment into the secondary winding by manipulating the movable contact **28** of the tap changer, which will be explained in more detail hereinafter.

The secondary winding **22** has three terminals **30**, **32** and **34**. The voltage between adjacent terminals is approximately 120 volts and the voltage between terminals **30** and **34** is approximately 240 volts.

The core-winding assembly of FIG. 1 is mounted inside the fluid dielectric compartment **12** and the compartment **12** is

filled with a fluid dielectric such as a good grade of mineral oil, or a synthetic fluid dielectric, to a predetermined level to cover the core-winding assembly.

The terminal compartment 14 is provided on the opposite side of the common wall 16 from the fluid dielectric compartment 12. The terminal compartment 14, when the transformer is in operation, is closed by a locked cover member 36. The cover member 36 is shown in open position in FIG. 1 so that the terminals located in the terminal compartment may be readily seen. The terminal compartment 14 houses the high-voltage input terminal 24 to the primary winding 20 of the core-winding assembly. The low-voltage output terminals 30, 32 and 34 are also housed in the terminal compartment 14. A drawout load-break fuse member 38 is also mounted on the common wall 16 of the casing and is accessible from the terminal compartment 14.

A tap-changing mechanism 40 for connecting the taps 11, 12, 13 and 14 of the high-voltage winding 20 to the casing 10, which casing 10 is grounded at 26, has an indexing or tap-indicating member 42 mounted on the front of the common wall 16 of the casing. Also shown in position in FIG. 1 is a handle or operator 44 for moving the movable contact member 28 of the tap changer 40. The manner of operation of the tap changer 40 to selectively connect the taps 11, 12, 13, 14, 15 to the casing 10 will be described hereinafter.

Referring to FIG. 3 for a detailed description of the tap changer mechanism 40, the tap changer 40 comprises an insulating member 46 which has the taps 11, 12, 13, 14, 15 spaced circumferentially thereon. The taps 11, 12, 13, 14, 15 are connected to the tap points 11', 12', 13', 14' and 15' shown on the high-voltage coil 20 in FIG. 2. Each of the tap members 11, 12, 13, 14, 15 is set into the insulating member 46 so that a slot 47 is defined by wall members 48 and 50 of the slot directly over each tap member. The insulating member 46 carrying the tap members 11, 12, 13, 14, 15 is connected to a metallic frame member 54 by means of bolts 56 and nuts 58. The frame member 54 is in turn connected to a U-shaped member 60 by means of bolts 62 and nuts 64. The U-shaped member 60 has a pair of leg members 66 connected by an end member 68 through which the bolts 62 extend to rigidly connect the metal frame member 54 to the U-shaped member 60. The legs 66 of the U-shaped metal member 60 are welded to the fluidtight compartment side of the common wall 16 between the fluidtight compartment 12 and the terminal compartment 14. The metallic frame comprising the member 54 and the U-shaped member 60 is of rigid construction and large cross section to provide very little resistance to current flow because the frame 54 and the U-shaped member 60 must provide the current path from the movable contact member 28 to the casing member 10. It is also pointed out that the U-shaped member 60 having the frame member 54 attached thereto provides the entire support for the tap-changer member from the common wall 16 of the casing 10.

A movable contact high-voltage 28 is provided for making electrical contact with the fixed contact members 11, 12, 13, 14 and 15 to connect the fixed contacts 11, 12, 13, 14, 15 to the tap points 11', 12', 13', 14' and 15' on the high-voltage coil 20. The movable contact 28 is attached to a shaft member 70. This shaft member 70 is supported by a lug 72, which lug is stamped out of the frame member 54, and by a lug 74 which is turned up from the end of the frame member 54, and by a bearing member 76 which passes through the common wall 16 between the terminal compartment 14 and the fluid dielectric compartment 12.

To carry the shaft 70 through the common wall 16, a bearing member 76 is welded through the common wall 16. This bearing member 76 is provided with an O-ring seal 78 which prevents fluid dielectric from seeping up the shaft 70 and into the terminal compartment 14 of the transformer.

To provide the necessary force for maintaining the movable contact member 28 in good contact making relationship with the fixed contact members 11, 12, 13, 14, 15 of the tap changer, a first spring 80 is provided near the lower end of the shaft 70. This spring 80 is maintained between the lug 72 and a washer 82, which washer 82 is held in place by a raised portion 84 on the shaft 70. The spring 80 is shunted by a good electrical shunt of copper, aluminum, or the like 86. This shunt 86 is held in good electrical contact between washers 82 and 88 and between the lug member 72 and a washer 90. The purpose of the electrical shunt 86 is to prevent as much of the load current as possible from passing through the spring 80. If the spring 80 is continuously maintained at a high temperature by the load current passing therethrough it will eventually lose its force and the movable contact 28 will not maintain good electrical contact with the fixed contacts.

A second spring 94 is provided adjacent the lug 74. This spring is held in position between the lug 74 and a fixed washer 96 on the shaft 70. It is emphasized that the spring 94 is outside of the main current path from the movable contact member 28 and the fixed contact members of the tap changer. This spring is strong enough to maintain adequate electrical contact between the movable contact member 28 and the fixed contacts of the tap changer.

It is seen that the main electrical current path from the fixed contacts 11, 12, 13, 14, 15 to the casing 10 is through the movable contact member 28, the shunt 86, the lug 72, the frame member 54, the lug 74, and from the lug 74 through the U-shaped member 60 to the grounded casing 10.

To operate the tap changer 40 to connect the movable contact member 28 to a selected one of the fixed contacts 11, 12, 13, 14 or 15 the operator merely places a hook stick in the eye of the operating member or handle 44 and pulls forward to remove the end portion 100 of the operating member 44 from the slot 102 in the indicator 42, then the operator or handle member 44 is rotated until the desired tap position is located. In FIGS. 1, 2, 3 and 5 of the drawings the tap changer is shown in position connecting the movable member 28 to the fixed tap member 13. As soon as the correct tap position has been selected by the operator the operating member 44 is released and the force of the springs 80 and 94 forces the movable tap member 28 into the slots 47 provided by the wall members 48 and 50 in the insulating member 46 and the end member 100 of the operator 44 snaps into the corresponding indicating slot in the indicator 40. As seen from the drawings, the indicator position number 1 corresponds to fixed tap 11, the position number 2 corresponds to the fixed tap 12, the position number 3 corresponds to the fixed tap 13, the position number 4 corresponds to the fixed tap 14 and the position number 5 corresponds to the fixed tap 15. With the slots 47 provided by the walls 48 and 50 in the insulating member 46 and with the aligned slots 102 in the indicating member 42, it is easy for the operator to make the desired tap connections to the high-voltage coil inside the fluid dielectric compartment by manipulating the handle or operating member 44 in the terminal compartment 14 of the transformer.

It is observed from FIG. 3 of the drawings that all of the fixed contacts 11, 12, 13, 14, 15, the movable contact 28 and the springs 80 and 94 are located below the fluid dielectric level in the transformer; however, the bearing member 76 and the O-ring seal 78 are positioned above the liquid dielectric level on the common wall 16 of the casing.

The U-shaped member 60 and the bearing member 76 are attached to the common wall 16 of the casing by weld beads as indicated at 104.

The shaft 70 is comprised of two parts, an upper part and a lower part connected by a pinned sleeve 106. The shaft 70 is constructed in two parts in this manner merely for simplicity of installing the shaft through the common wall 16.

From the foregoing descriptions, taken in connection with the drawings, it is seen that this invention has provided an improved transformer of the type that is usually mounted at ground level having a fluid dielectric compartment housing a core-winding assembly and a terminal compartment. The fixed tap-changing contacts are located inside the fluid dielectric compartment and the operator or handle member for operating a movable contact member for connecting to

selected fixed tap-changing contacts is accessible in the terminal compartment. The movable contact element is held in good electrical contact making relationship with the fixed contact elements by coil springs which are located outside of the main current path from the movable contact elements to the casing. The casing is maintained at ground level potential. This invention has provided a simple economical tap changer supported solely on the common wall between the fluid dielectric compartment and the terminal compartment for easily and accurately changing the tap connections to the high-voltage coil inside the fluid dielectric compartment without opening or entering the fluid dielectric compartment. The arrangement of the tap changer also permits changing the taps inside the fluid dielectric compartment without having fluid dielectric leak into the terminal compartment.

We claim as our invention:

1. A transformer casing comprising a fluidtight compartment and a terminal compartment, said fluidtight compartment and said terminal compartment having a common wall, said casing being constructed of electrically conductive material, core-winding means positioned in said fluidtight compartment, said winding means comprising; a high-voltage coil and a low-voltage coil, said high-voltage coil having an input terminal and a plurality of taps, fluid dielectric filling said fluidtight compartment to a predetermined height to cover said core-winding assembly, tap-changing means mounted on said common wall between said fluidtight compartment and said terminal compartment, said tap-changing means comprising a shaft extending through said common wall above the level of said fluid dielectric and having an operating member extending into said terminal compartment and accessible in said terminal compartment to operate said tap-changing means, said tap-changing means comprising fixed contact means extending into said fluidtight compartment and positioned below the level of said fluid dielectric, means connecting said fixed contact means to said taps on said high-voltage coil, a movable contact member connected to said operating member by said shaft extending through said common wall, said movable contact member being operable by said operating member in said terminal compartment to selectively electrically connect each of said taps on said high-voltage coil through said fixed contacts to said casing, and means connecting said casing to ground potential.

2. Apparatus as specified in claim 1 wherein said fixed contact means comprises a plurality of electrical contacts in spaced relation on an insulating member, electrical conducting means attached to said insulating member and to the common wall between said fluidtight compartment and said terminal compartment for supporting said tap-changing means, and said movable contact means making electrical connections with said metallic support means to provide a current conducting path from said fixed contact through said support means to said fluidtight casing.

3. Apparatus as specified in claim 1 wherein said shaft extending through said common wall between said fluidtight compartment and said terminal compartment is sealed with an O-ring to prevent fluid dielectric from traveling up said shaft and through said wall into said terminal compartment.

4. Apparatus as specified in claim 2 wherein first and second coil springs surrounds said shaft to provide force to maintain said movable contact in good contact making relationship with said fixed contacts, said first spring being located in the main current path between said movable contact and said metal support, and said second spring being spaced from said first spring and remote from the current path from said movable contact through said metal support to said metallic casing.

5. The apparatus of claim 4 wherein said first coil spring is shunted by a current-conducting member, said current-conducting member making good contact with the shaft carrying said movable contact and with said metallic support member so as to carry most of the current around said first spring to said fixed metallic support.

6. The apparatus of claim 1 wherein said tap-changing means is supported from the common wall between said fluidtight compartment and said terminal compartment by means of a U-shaped bracket which is in the current-carrying path between said movable contact means and said stationary contact means and said metallic casing.

* * * * *