

SUBMERSIBLE DISTRIBUTION TRANSFORMER

TECHNICAL FIELD

Engineering related to a submersible distribution transformer

BACKGROUND OF THE INVENTION

5 The distribution transformer being used nowadays is installed such that it is disposed on a concrete column or placed on a concrete base above the ground which only support the overhead cables.

 Today, there is a project to take the overhead cables underground in many locations for the purpose of reliability in electricity distribution, safety and environmental and landscape
10 improvement. Nevertheless, the transformers are still required to be installed on public footpaths which causes problems such as public pathway obstruction in the installation area. Most of the currently used distribution transformers are not waterproof as the components are assembled together using compression method which leaves gaps in the joining region as the components are not completely merged; the water therefore can flow into the transformer.
15 When such transformer is used in a submerged manner, it will be damaged due to water pressure or water ingress which cause a short circuit and prevent electricity distribution.

 The inventor conducted a research and found exemplary documents related to waterproof transformers which were previously disclosed as follows.

 US patent no. US 8614614 B2 discloses a single-phase or three-phase distribution
20 transformer, solid insulation for using in aerial installation, in platforms or pedestals, or installation in underground distribution network for operation in air environment, semi-submerged or submerged. Such transformer comprises at least one high voltage winding and at least one low voltage winding concentrically assembled around a core column, the low voltage and high voltage windings being electrically isolated from a solid material, a core window
25 being defined as a space between two core columns, the transformer comprising at least one electrical insulation sheet assembled on at least a core window of said transformer, the assembly of the electrical insulation sheet being defined in the longitudinal direction of the transformer. Such sheet avoids the formation of spiral around the core by immersion water or conductive dust.

30 Chinese utility model no. CN 208173358 U discloses a submersible transformer. Such transformer is provided with a waterproof covering structure including a waterproof housing, a

terminal surface having a rubber strip before the waterproof housing. The outer wall of the covering structure has a waterproof membrane and the inner wall of the covering structure has a supplementary waterproof layer.

Chinese utility model no. CN 208111230 U discloses a transformer waterproof case. Such case consists of a transformer case, a drain bar installed to both sides of the case, the intermediate position of the drain bar being installed to a heating panel, a heat-absorbing plate pipe installed to the outer side of the heating panel, a bracing element installed at the top of the case, a top cap installed to the top side of the bracing element, a first waterproof baffle installed to both sides of the top cap, a wiring stick installed at the top of the top cap, and a second waterproof baffle connected to a rod between the first waterproof baffle by means of a hinge.

The previously disclosed inventions above still contain defects that should be improved, i.e., the improvement which would render the transformer waterproof requires a large number of additional elements to be assembled to the transformer. This takes a long time and requires high cost to produce those additional elements. Also, the installation and the use of such transformer and related elements are complicated.

SUMMARY OF THE INVENTION

The present invention is intended to overcome the aforementioned problems and defects of the transformer by providing an improved transformer with the outer components of the transformer being assembled to the transformer tank by welding so that those components are joined together as a single piece and completely sealed without gaps. The transformer according to the present invention is therefore robust and capable of effectively preventing water from entering the transformer. It can be installed in a submerged manner without any damage or short circuit.

The submersible distribution transformer according to the present invention comprises a stainless steel tank, a stainless steel cover assembled to the stainless steel tank, high-voltage bushings and a plurality of low-voltage bushings assembled to the stainless steel cover. The stainless steel cover is assembled to the stainless steel tank and the high-voltage bushings and plurality of low-voltage bushings are assembled to the stainless steel cover by welding.

The submersible distribution transformer according to the present invention is designed to provide a sealed assembly so that it can be installed in an underground transformer wet

vault, does not cause any problem to people nearby, and is capable of distributing electricity in a submerged condition.

Moreover, the main components of the transformer, such as tank and tank cover, are made of stainless steel which has high strength and durability and does not become rusted upon exposure to water; therefore enhancing the durability of the transformer.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a perspective view of the submersible distribution transformer according to the present invention in an embodiment with stainless steel tank surrounding parts.

Figure 2 shows a perspective view of the submersible distribution transformer according to the present invention in an embodiment with stainless steel cooling fins.

Figure 3 shows a perspective view of the stainless steel tank of the submersible distribution transformer according to the present invention in an embodiment with stainless steel tank surrounding parts.

Figure 4 shows a perspective view of the stainless steel tank of the submersible distribution transformer according to the present invention in an embodiment with stainless steel cooling fins.

Figure 5 shows a perspective view of the stainless steel cover of the submersible distribution transformer according to the present invention.

Figure 6 shows a perspective view of the tap changer stainless steel housing of the submersible distribution transformer according to the present invention.

Figure 7 shows a perspective view of the high-voltage bushing of the submersible distribution transformer according to the present invention

Figure 8 shows a perspective view of the low-voltage bushing housing of the submersible distribution transformer according to the present invention.

Figure 9 shows a perspective view of the plurality of low-voltage bushings of the submersible distribution transformer according to the present invention which is attached with the stainless steel sheet.

DETAILED DESCRIPTION

The aspects of the invention will now be further described with reference to the accompanying drawings.

Figure 1 and 2 show a perspective view of the submersible distribution transformer according to the present invention in an embodiment with no cooling fins but with stainless steel tank surrounding parts (shown in Figure 1) and an embodiment with cooling fins (shown in Figure 2).

Figure 3-9 show the aspects of various components of the submersible distribution transformer according to the present invention.

As shown in Figure 1 and 2, the transformer according to the present invention comprises a stainless steel tank (1), a stainless steel cover (2) assembled to the stainless steel tank (1), high-voltage bushings (3,4,5), and a plurality of low-voltage bushings (15) assembled to the stainless steel cover (2) with the stainless steel tank cover (2) being assembled to the stainless steel tank (1) and the high-voltage bushings (3,4,5) and the plurality of low-voltage bushings (15) being assembled to the stainless steel cover (2) by welding.

The welding is preferably performed by seal welding, metal inert gas welding or laser welding. For example, the laser welding is performed with laser power of 500 to 1000 watts. However, the laser power applied can be varied, depending on the thickness of the stainless steel to be welded.

According to the above embodiment, welding the components together gives rise to a water-impermeable assembly which allows the transformer to be used underwater. Additionally, the laser welding allows two stainless steel sheets to be melted together, produces a smooth welding joint, and does not alter the stainless steel properties.

According to the present invention, the submersible distribution transformer further comprises a tap changer stainless steel housing (17) assembled to the stainless steel cover (2) by welding to prevent the tap changer from being exposed to water.

Figure 6 shows a preferred embodiment of the tap changer stainless steel housing (17) which is designed to have a base that is assembled to the stainless steel cover (2) by welding and a cover which is screwably assembled to the base for ease of use when the tap changer needs to be adjusted.

The submersible distribution transformer according to the present invention further comprises a low-voltage bushing housing (6) assembled to the stainless steel cover (2) by welding.

According to Figure 8, the low-voltage bushing housing (6) comprises waterproof low-voltage cable conduits (7, 8, 9, 10, 11, 12, 13, 14) assembled to the low-voltage bushing housing (6) by welding.

The cable conduits (7, 8, 9, 10, 11, 12, 13, 14) are preferably assembled to the side wall of the low-voltage bushing housing (6).

According to the above embodiment, the low-voltage cable conduits (7, 8, 9, 10, 11, 12, 13, 14) are waterproof and assembled in a completely welded manner; therefore, effectively preventing water from entering the low-voltage bushing housing (6).

As shown in Figure 1 and 3, in an embodiment, the transformer according to the present invention comprises stainless steel tank surrounding parts (18, 19) assembled to the stainless steel tank (1) by welding. Also, as shown in Figure 2 and 4, in another embodiment, the transformer according to the present invention comprises stainless steel cooling fins (20, 21, 22) assembled to the side wall of the stainless steel tank (1).

According to the above embodiment, the stainless steel tank surrounding parts (18, 19) and the stainless steel cooling fins (20, 21, 22) are used to release the heat so that the transformer is not overheating.

As shown in Figure 9, the low-voltage bushing (15) according to the present invention is attached to the stainless steel sheet (16). Preferably, the stainless steel may be chosen from grade 304 or grade 316 stainless steel.

However, the material used can be any other possible materials which is known to those of ordinary skill in the related art.

Any modifications may be made by those of ordinary skill in the related art. Such action can be taken without departing from the object of the present invention.

BEST MODE OF THE INVENTION

Best mode of the invention is as described in the detailed description of the invention.

CLAIMS

1. A submersible distribution transformer comprising:

a stainless steel tank (1),

a stainless steel cover (2) assembled to the stainless steel tank (1),

high-voltage bushings (3,4,5) and a plurality of low-voltage bushings (15)
assembled to the stainless steel cover (2)

characterized in that

the stainless steel cover (2) is assembled to the stainless steel tank (1) and the
high-voltage bushings (3,4,5) and the plurality of low-voltage bushings (15) are
assembled to the stainless steel cover (2) by welding,

the transformer comprises a low-voltage bushing housing (6) assembled to the
stainless steel cover (2) by welding and waterproof low-voltage cable conduits
(7,8,9,10,11,12,13,14) which are assembled to a side wall of the low-voltage bushing
housing (6) by welding.

2. The submersible distribution transformer according to claim 1 further comprising a
tap changer stainless steel housing (17).

3. The submersible distribution transformer according to any one of claims 1 or 2
further comprising stainless steel tank surrounding parts (18,19) assembled to the
stainless steel tank (1) by welding.

4. The submersible distribution transformer according to any one of claims 1 to 3 further
comprising stainless steel cooling fins (20,21,22) assembled to a side wall of the
stainless steel tank (1) by welding.

5. The submersible distribution transformer according to claim 1 wherein the plurality of
low-voltage bushings (15) is attached to a stainless steel sheet (16).