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2,430,224

METHOD AND APPARATUS FOR MOISTUREPROOFING ELECTRICAL DEVICES

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2 Sheets-Sheet 1

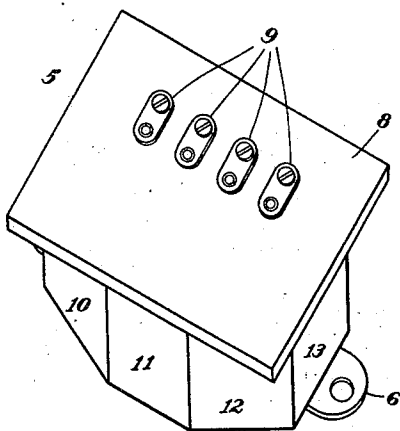


Fig. 1

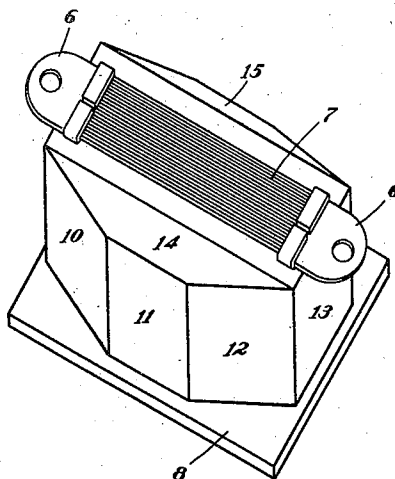


Fig. 2

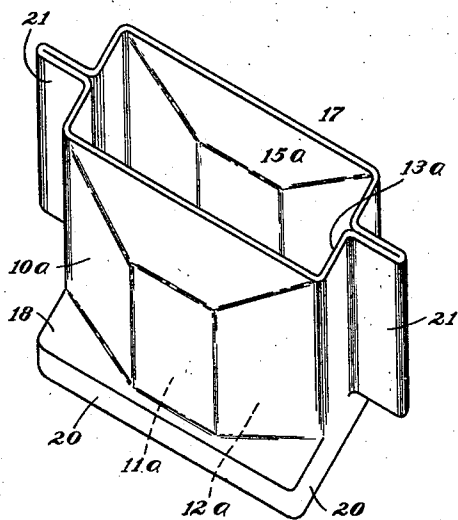


Fig. 3

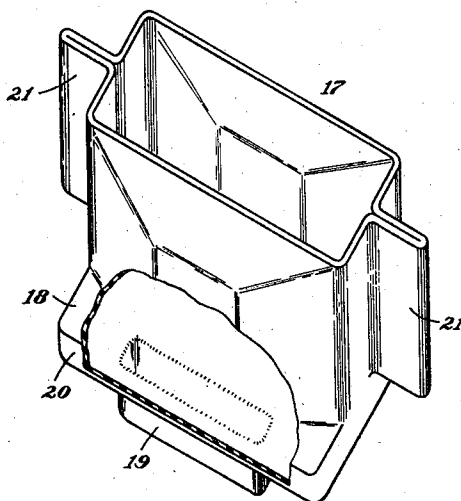


Fig. 3a

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2 Sheets-Sheet 2

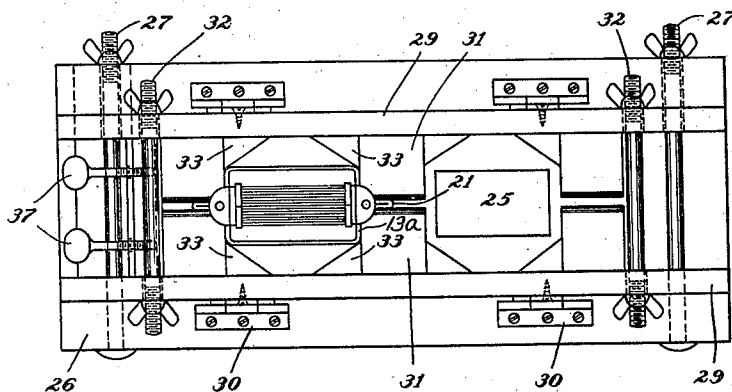


Fig. 4

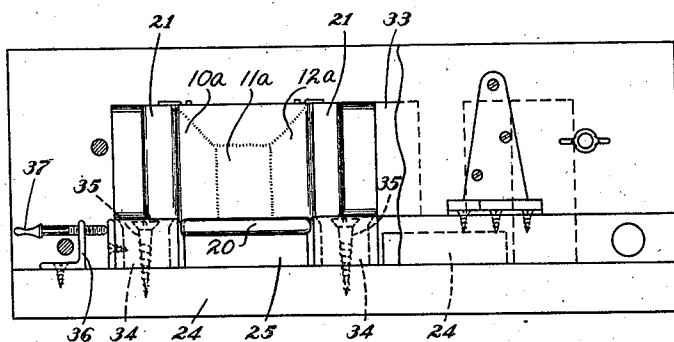


Fig. 5

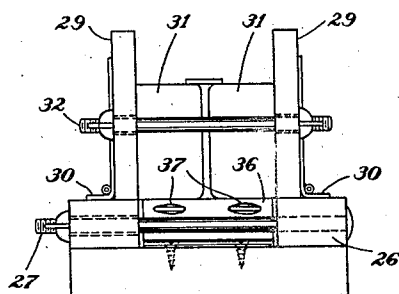


Fig. 6

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METHOD AND APPARATUS FOR MOISTURE-PROOFING ELECTRICAL DEVICES

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5 Claims. (Cl. 18-34)

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This invention relates to a method of and to apparatus for moisture-proofing electrical units, such as transformers, induction coils, condensers and the like.

Certain electrical devices, such as transformers are protected by being embedded in waterproof material, such as synthetic resin which is applied to the device in a liquid state. Thereafter, the device and the surrounding liquid material are baked to render the material solid and impervious. It is essential that the solidified material be of such thickness as to afford ample protection to the device and yet this material must be of such shape as to conform generally to the many-surfaced contour of the device in order to avoid excess material with its undesirable weight. The problem is further complicated by the requirement that although the device must be embedded in the material, the terminal block with its terminals must not be smeared with the material. Since the device in its finished state is not "potted," that is, the device and its protective material are not cast in permanent containers, it has been difficult and costly to manufacture such devices.

In accordance with the present invention, there is provided a novel method whereby an unpotted electrical device can have liquid protective material cast thereabout and then cured into solid form.

In accordance with another feature of the invention, novel apparatus is provided for molding protective synthetic resin or the like around an electric device.

For a clearer understanding of the invention, reference is made to the drawings in which:

Fig. 1 is an isometric view of a finished transformer and Fig. 2 is an isometric view of the transformer in its inverted position;

Fig. 3 is an isometric view of a flexible removable container herein referred to as a "boot" to hold the unfinished transformer and the protective material during the time that the material is poured until it has been solidified by baking in a suitable oven and Fig. 3a is an isometric view of a modified boot adapted to be used on transformers having prominent terminals;

Fig. 4 is a plan view of a fixture arranged to process two transformers simultaneously al-

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though as illustrated only the left hand portion of the fixture has a transformer therein;

Fig. 5 is a side elevation of the fixture of Fig. 4 with a portion of its hinged side wall broken away; and

Fig. 6 is an end view of this fixture.

In Figs. 1 and 2, there is illustrated a transformer 5 finished in accordance with the novel process and by the novel apparatus of the present invention. The bottom of the transformer is provided with the usual mounting metal ears 6, 6 suitably mounted on the laminations 7. The top of the transformer is provided with a rectangular terminal block 8 of sheet insulating material having terminals 9 mounted therein. The portion of the transformer between the terminal block and the mounting ears is embedded in a mass of impervious material such as synthetic resin. This material is applied in liquid form which is then solidified by baking. It is essential that the mass generally conform to the contour of the parts of the transformer so that there will be no unnecessary weight. Thus, the material has eight sides of which four, designated 10, 11, 12 and 13 are shown in Fig. 2. In addition, the material has two inclined panels 14 and 15 which slope toward the mounting ears. It should be pointed out that the terminal block 8 with its terminals are not covered with the material.

The required shape and disposition of the material on the transformer present a real problem in manufacture. In accordance with the method of the present invention the untreated transformer 5 is placed upside down in a so-called boot or temporary container 17 made of extensible material such as rubber. This boot has been molded so that it normally assumes a predetermined contour with its interior surfaces including 10a, 11a, 12a, 13a, 14a, 15a, etc., defining the shape of the several panels including those designated 10 to 15, etc., inclusive, on the transformer. The bottom portion 18 of the boot is made to conform closely to the terminal block 8 and may be provided with an extension 19 as in the modified boot (Fig. 3a) if the block is equipped with projecting terminals (not shown). While in use, the edges 20 of the boot portion 18 are tightly squeezed against the sides of the terminal block to protect it against being smeared by the synthetic resin. The ends of the boot are

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made with overlapping flaps 21 provided by folding over upon itself adjacent portions of the material and by which the boot is supported and which permit the boot to be opened up while it is being stripped from the finished transformer.

In accordance with the method of the present invention, the transformer is first enclosed upside down in the boot. Thereafter, synthetic resin or like material in liquid form is poured into boot until only the mounting ears 6 and preferably only the lower edge of the core laminations 7, are exposed. Then the boot with the transformer and the liquid material are baked in a suitable oven until the material has solidified. Thereafter the flaps 21 of the boot are opened and the boot itself is stripped from the transformer leaving the mass of material molded thereabout.

In practicing the method, there is employed in addition to the boot, a fixture (Figs. 4, 5 and 6). This fixture, as illustrated, is adapted to process two transformers simultaneously although, of course, it can be made of a size to treat any convenient number of transformers at one time. The fixture comprises a base or bottom 24 on which there are mounted supports 25 for the bottoms of the several boots and along each side of the base, a strip 26. One of these strips has limited lateral movement so that bolts 27 passing therethrough and provided with butterfly nuts, can draw these strips tightly against the sides of portion 20 of the boot. These sides of the mentioned portion of the boot prevent the liquid material from smearing the sides and top of the terminal block 8. The strips 26 have the side boards 29 mounted to swing thereon on hinges 30. These boards carry pairs of blocks 31 spaced to embrace the ends of a boot and adapted to receive and to grip between the blocks of a pair, the flaps 21 of the boot. The bolts 32 with their butterfly nuts enable the sideboards with their blocks 31 to be drawn together so that the flaps of the boot are gripped to hold the boot in position. Bevelled corner inserts 33 conform to the shape of the panels, such as 10 and 12 of the transformer.

It has been mentioned how the sides of portion 20 of the boot are forced against the sides of the terminal block 8 to form a seal. The base of the fixture is provided with spaced end blocks 34 which are slotted to receive the mounting screws 35 to enable the blocks to have limited lateral movement into a position to contact the ends of the portion 20 of the boot, thereby sealing off the remainder of the terminal strip. A bracket 36 mounted at the left end (Fig. 5) of the base, carries a pair of set screws 37 to force the left hand block 34 against the boot and the terminal block of the first transformer which in turn forces the second block 34 against the end of the second boot and the terminal block of the transformer therein. The set screws 37 can be tightened until the ends of the several terminal blocks 8 are sealed against the adjacent surfaces of their respective boots. With the boots and their enclosed transformers supported therein the liquid material is poured into each boot to immerse its inverted transformer to the desired level. Then the fixture and the boots with their immersed transformers are baked until the material solidifies. The fixture can then be opened up by unloosening the several bolts and screws. This permits the removal from the jig of each transformer with its enclosing boot. The boot is then

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stripped from the transformer after spreading apart the flaps 21.

While the invention has been particularly described in connection with transformers, it is also applicable to choke coils, condensers and like electrical devices.

While reference has herein been made to curing the synthetic resin by baking, it will be understood that other methods of curing the same, may be used.

What we claim is:

1. The method of molding a mass of solid material about certain portions of an unpotted electrical device while preserving another portion of the device uncovered which method comprises inserting a substantial portion of the device in an extensible container having its inner surfaces shaped to define the molded surfaces of said mass, applying external pressure to certain parts of said container to compress said parts against said device to seal off that portion thereof to be preserved uncovered, pouring the material in liquid form into the container to a predetermined level, and stripping off the container after said material has solidified.

2. The method of molding a mass of solid material about certain portions of an unpotted electrical device which method comprises inserting the device in a flexible container provided with a mouth and having a volume substantially greater than the final volume of the device as molded in said mass of solid material, gripping said container in a manner to reduce the volume thereof such that its inner surfaces are shaped to define the desired molded surfaces of said mass, pouring the material in liquid form into the container to a predetermined level, stripping off the container after said material has solidified.

3. In apparatus for casting material about a portion of an electrical device, a one-piece flexible container having an opening therein and adapted to enclose at least a portion of the device, said container having portions of its margin at said opening in folded relation to define flaps, and a fixture having parts movable to engage the sides of said container, certain of said parts carried by said fixture gripping said flaps during said engagement, and other of said parts carried by said fixture engaging at least one other portion of said container to force said other portion against a predetermined surface of said device to effect a seal therebetween and prevent contact of said casting material with said surface.

4. Apparatus for casting material about an object including a container formed from a flexible material and having an opening to receive at least a portion of said object, said container normally having a volume substantially greater than the final volume of the object as molded in said casting material, and a fixture having parts movable into and out of engagement with said container and disposed to engage a portion of said container in the movement thereof toward said container and to gather said portion into folded relationship in order to reduce the volume of said container to the desired final volume and to maintain said reduced volume during the molding process, whereby after completion of the molding process, said fixture parts may be moved out of engagement with said portion to facilitate removal of the molded object.

5. Apparatus for casting material about an object including a container formed from a flexible material and having an opening to receive at least a portion of said object, said container nor-

mally having a volume substantially greater than the final volume of the object as molded in said material, said container having at least one portion adapted to be folded over upon itself to reduce the volume of said container to the desired final volume, and a fixture having parts disposed to grip said folded over portion in order to maintain said reduced volume during the molding process.

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