Aug. 19, 1969 M. G. LEONARD 3,462,645

ELECTRICAL TRANSFORMER SUITABLE FOR POLE OR VAULT MOUNTING

Filed June 9, 1967 2 Sheets-Sheet 1

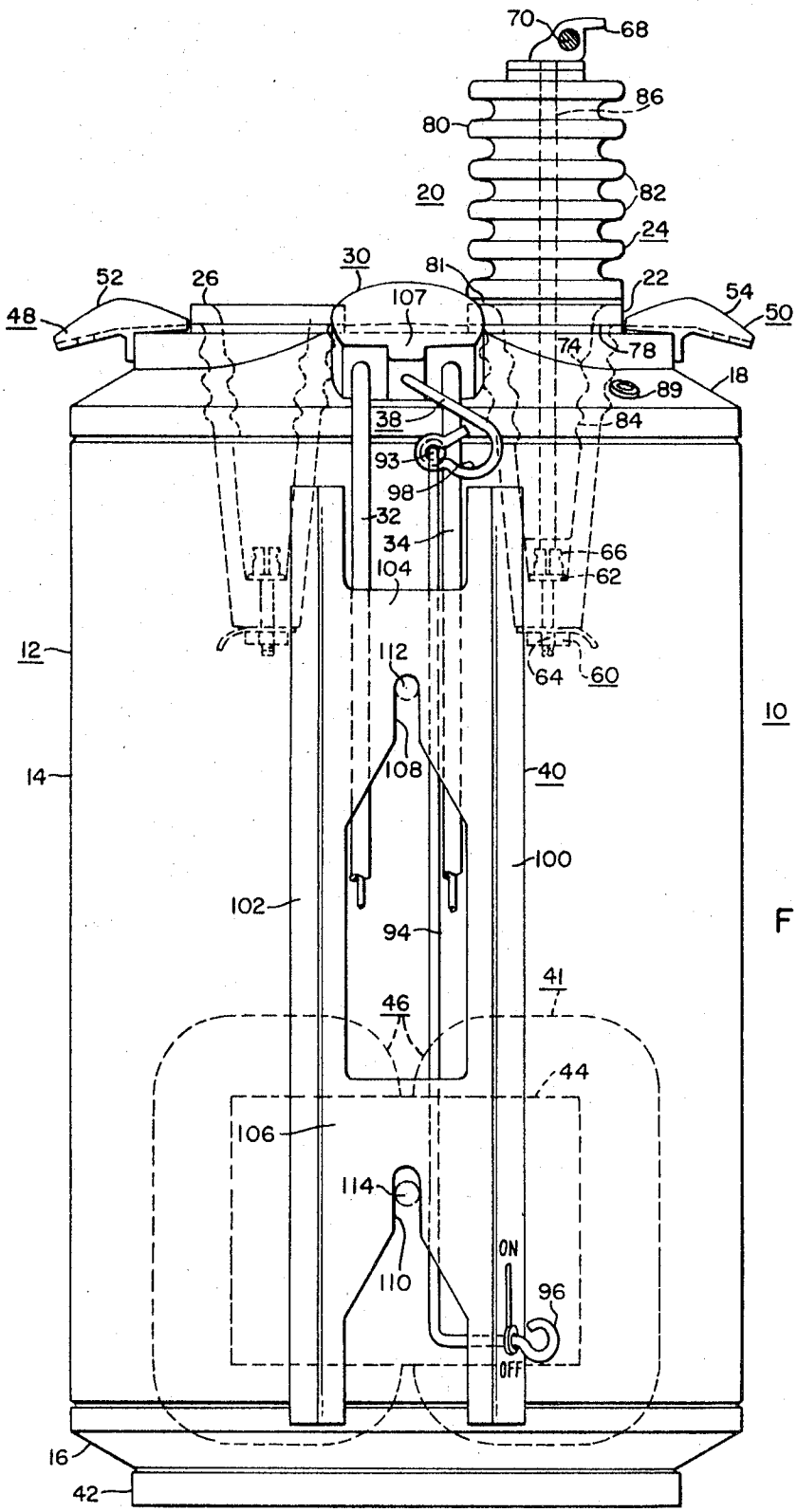


FIG. 1

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ELECTRICAL TRANSFORMER SUITABLE FOR POLE OR VAULT MOUNTING

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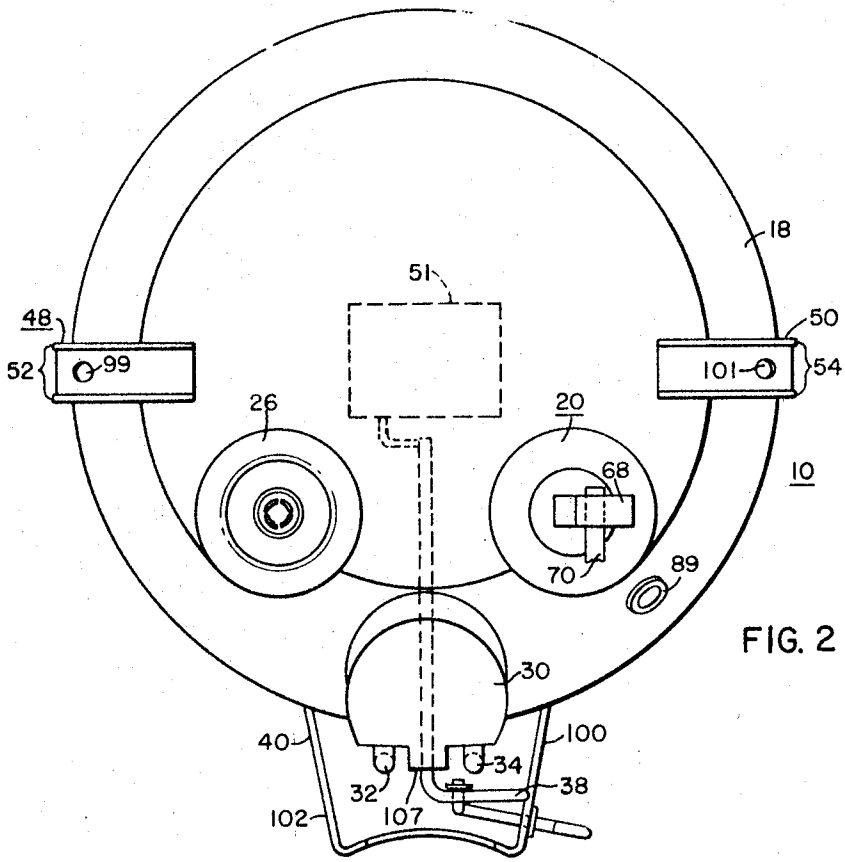


FIG. 2

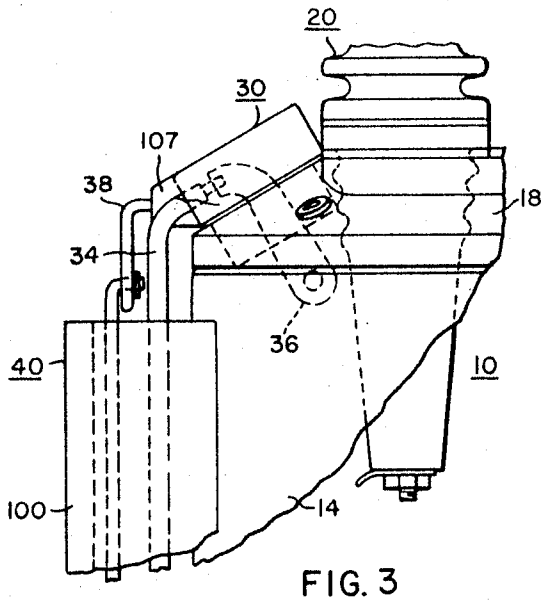


FIG. 3

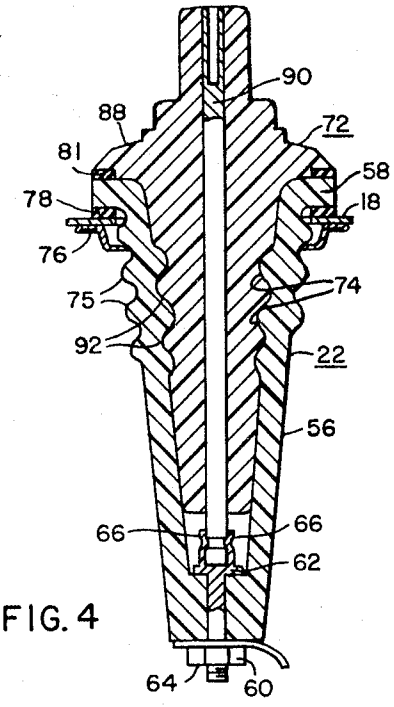


FIG. 4

United States Patent Office 3,462,645
Patented Aug. 19, 1969

3,462,645

ELECTRICAL TRANSFORMER SUITABLE FOR POLE OR VAULT MOUNTING

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Filed June 9, 1967, Ser. No. 644,948
Int. Cl. H02h 7/14
U.S. Cl. 317—15 6 Claims

ABSTRACT OF THE DISCLOSURE

An electrical distribution transformer which facilitates either pole or vault mounting. The high voltage terminals are recessed, and allow either pole type or vault type bushings to be used therewith. A channel type hanger lug for pole mounting also provides the functions of concealing and protecting the interconnections between the low voltage leads of the transformer and the secondary circuit, and conceals and protects a rod which is connected to the actuator of the transformer protective circuit breaker.

Background of the invention

Field of the invention.—The invention relates in general to electrical distribution type transformers, and more specifically to distribution type transformers which are suitable for either pole or vault mounting.

Description of the prior art.—In the prior art, distribution transformers for underground or vault use are quite different in their finish and hardware, from distribution transformers for pole mounting. This distinction in the transformers for the different environments, not only adds to the complexity of manufacturing distribution type transformers, but creates stocking problems for both the manufacturer and user. Further, it requires that transformers now in service on poles, be replaced when the service is changed to the underground type. It would, therefore, be desirable to provide a new and improved electrical distribution type transformer which is suitable for pole mounting, or for vault mounting, and should be easily convertible in the field from one type mounting to another. However, this object should not be accomplished at the expense of making the versatile unit non-competitive price-wise with prior art single purpose type apparatus.

Summary of the invention

The invention is a new and improved distribution type transformer which may be pole or vault mounted, and once pole or vault mounted, may be easily converted by field personnel from one type mounting to the other. The transformer includes a substantially U-shaped channel type hanger or mounting lug for pole mounting, which also functions to conceal the connections between the transformer's secondary leads and the overhead line drop, when pole mounted, and which also allows the secondary leads to be lifted therefrom when the transformer is vault mounted. The low voltage bushing is disposed on the cover of the transformer, directly above the hanger lug, and contains a plurality of secondary leads which are long enough to extend into the hanger lug. Also, disposed through the low voltage bushing is the actuating mechanism for operating the transformer's protective circuit breaker. This actuating mechanism includes a rod member which is disposed vertically downward through the hanger lug, and is accessible from below by hook-stick, if pole mounted. The actuating mechanism also contains a portion which may be operated by hook-stick from above, in the event the transformer is vault mounted.

The high voltage bushing, or bushings, consist of two

separable parts. The first part comprises a hollow tapered sleeve, which is sealed in the cover of the transformer, and extends inwardly into the transformer casing, and a second part which is removably insertable into the first part, with electrical contact being made between the first and second parts within the hollow body portion of the first part. If the transformer is to be pole mounted, the second part is a bushing assembly containing the necessary hardware for connection to an open line. If the transformer is to be vault mounted, the second part is a bushing assembly adapted for connection to shielded cable.

The transformer also includes a stainless steel mounting base, which enables it to withstand rough handling without scraping and scuffing its protective finish, which would cause corrosion problems, especially if the transformer is vault mounted.

Brief description of the drawings

Further advantages of the invention will become more apparent when considered in view of the following detailed description and drawings, in which:

FIGURE 1 is a front elevational view of a transformer constructed according to the teachings of the invention;

FIG. 2 is a plan view of the transformer shown in FIG. 1;

FIG. 3 is a fragmentary, side elevational view of the transformer shown in FIG. 1; and

FIG. 4 is a cross-sectional view of a high voltage bushing assembly which may be used by the transformer shown in FIG. 1.

Description of the preferred embodiments

Referring now to the drawings, and FIGS. 1, 2 and 3 in particular, there is shown front, plan and side views, respectively, of an electrical distribution type transformer **10** constructed according to the teachings of the invention. In general, transformer **10** includes a tank or casing **12** which includes side wall portion **14** joined and sealed by bottom portion **16**, and a top portion or cover **18**. A high voltage bushing assembly **20** is mounted in sealed engagement with the cover **18**, through a suitable opening therein. High voltage bushing assembly **20**, as will hereinafter be described in greater detail, includes first and second parts or portions **22** and **24**. The first portion **22** is sealingly mounted through the cover **18**, and the second portion **24** is removably inserted into portion **22**, making electrical contact with each other within the body of portion **22**. Also shown in FIGS. 1 and 2 is the first portion **26** of another high voltage bushing assembly, without the second portion being shown.

A single, molded type low voltage bushing **30** is disposed in sealed engagement through an opening in cover **18**. Low voltage bushing asembly **30** includes secondary leads **32** and **34**, which are molded or cast into bushing **30**, and which extend outwardly from a first portion of the low voltage bushing. The secondary leads **32** and **34** are electrically connected, within the body portion of the bushing **30**, to mounting studs or terminals **36**, shown in phantom in FIG. 3, which extend from a second portion of the bushing **30**, into casing **12**. As shown most clearly in FIG. 3, the direction in which the secondary leads **32** and **34** extend from low voltage bushing **30**, is substantially perpendicular to the direction in which the terminals **36** extend from the bushing.

Low voltage bushing **30** also contains an actuating mechanism **38**, which extends through the molded or cast low voltage bushing **30** to operate the transformer protective circuit breaker **51**, shown in FIG. 2, if a circuit breaker is used. The actuating mechanism **38** may be made rotatably actuable while retaining a seal through the bushing **30**, by using the teachings disclosed in co-pending application Ser. No. 595,698, filed Nov. 21, 1966, by A. Keto,

which application is assigned to the same assignee as the present application. The low voltage bushing **30** is disposed adjacent one edge of the cover **18**, on a portion of the cover which makes an angle of substantially 30° with a line perpendicular to a vertical axis through the transformer **10**. This allows the actuating mechanism **38** to be disposed through bushing assembly **30** in a direction perpendicular to the vertical axis of the transformer **10**, it allows the terminals **36** to be easily accessible within the transformer casing **12** for connection to the winding assembly, and by bringing out the secondary leads **32** and **34** in a direction which is substantially 90° to the direction of bringing out the terminals **36**, the secondary leads may be directed along the side wall portion **14** of the casing **12**, for purposes which will be hereinafter explained.

Transformer **10** also includes a new and improved substantially U-shaped channel hanger lug member **40**, with the leg portions of the hanger lug being fixed to the side wall portion **14**, directly below the low voltage bushing assembly **30**. The hanger lug **40**, in addition to being used for mounting the transformer **10** on a utility pole, has many other functions which will be hereinafter explained.

Transformer **10** also has a stainless steel bottom support structure **42**, which protects the bottom portion **16** of the transformer **10** from scrapes and abrasions due to handling of the transformer. It is important that the protective finish on the transformer casing be protected, as any scrapes or abrasions may start corrosion, especially if the transformer is mounted underground. The stainless steel support will take the handling abuse, without damage to the protective coating on the side wall portion **14** and bottom portion **16**, of the transformer **10**.

Transformer **10** includes a magnetic core-winding assembly **41**, comprising a winding assembly **44**, which includes both the high and low voltage coils, disposed in inductive relation with magnetic core assembly **46**, with the assembly being shown in phantom in FIG. 1. The magnetic core-winding assembly **41** is disposed within casing or tank **14**, and the tank **14** may contain a suitable insulating and cooling fluid, such as oil, for cooling and insulating the magnetic core-winding assembly **41**. The winding assembly **44** includes a plurality of high and low voltage leads or conductors (not shown), which are connected to the high and low voltage coils of the winding assembly, and to the internal mounting terminals of the high and low voltage bushing assemblies. The number of high voltage bushings and low voltage secondary leads shown in the figures is for purposes of example only. It will be understood that the invention applies to any number of high voltage bushing assemblies, and low voltage secondary leads.

Casing **12** also includes lifting lugs **48** and **50**, attached to the cover **18** by any suitable means, such as by welding. The lifting lugs extend outwardly from cover **18**, with their projecting portions cooperating with a sling for either lifting the transformer **10** to a pole position, or lowering the transformer into a vault. The lifting lugs **48** and **50** have channel shaped upper portions **52** and **54**, respectively, shown most clearly in FIG. 2, with the channels of the two lifting lugs being aligned with one another. Thus, the lifting lugs **48** and **50** provide fixed channel shaped guides for receiving a banding strap, when the transformer is fixed to a shipping pallet. The projecting portions of the lifting lugs **48** and **50** may also include suitable openings **99** and **101**, respectively, which may cooperate with a bolt to secure a grounding lead. If it is not desirable to continue the banding strap across the top of the transformer, the projecting portions of the lifting lubs **48** and **50** may also contain suitable slots through which banding straps from the shipping pallet may be looped.

As best shown in FIG. 2, a suitable fitting **89** may be secured to the cover **18** for attaching a valve or expulsion type lightning arrester (not shown).

The high voltage bushings of transformer **10**, such as high voltage bushing assembly **20**, must be able to receive either a conductor from an open wire circuit, when pole mounted, or a shielded cable when vault mounted. This is accomplished by constructing the high voltage bushing assembly of first and second portions **22** and **24**, respectively. The first portion **22** of bushing assembly **20** is standard for either pole or vault mounting, and, as shown in cross-section in FIG. 4, includes a hollow cylindrical body portion **56**, formed of an electrical insulating material, such as an epoxy resin system. Body portion **56** has first and second ends, with the first end defining an opening in the body portion, and which also includes an outwardly extending flange portion **58**. The second end of body portion **56** is closed, and contains terminal means **60** which extends coaxially through the closed or blind end. Terminal means **60** includes a terminal **62** disposed within body portion **56**, of a type which will receive the conductor from the second portion of the bushing. Terminal **62** may have a plurality of projecting finger like members **66** which flexibly engage the conductor of the second portion, when the conductor of the second portion is axially advanced, or rotated into position. Inwardly extending projections on the finger like members **66** may provide a slight interference fit with the conductor of the second portion, and may cooperate with a groove in the mating conductor to "lock" into the desired position. The inner surface of the body portion **56** may be threaded, such as thread **74**, for removably securing the second or insert portion of the high voltage bushing assembly **20**. The external surface of the body portion **56** may also be threaded, having threads such as thread **75**, for cooperating with a locking nut **76**, which will secure body portion **56** to the cover **18**. A gasket member **78** may be disposed between flange portion **58** and the cover **18** to provide a seal between the body portion **56** and cover **18**.

As shown in FIGS. 1, 2 and 3, the second portion **24** of high voltage bushing assembly **20** may be of the type which contains hardware **68** for receiving an open line **70**, when transformer **10** is mounted on a utility pole, or, as shown in FIG. 4, the second portion may be an insert **72** adapted for receiving a plug-in shielded cable connector (not shown). If the second or insertable portion of the high voltage bushing assembly **20** is of the type for receiving an open overhead line, insert **24** may have the appearance of a conventional outdoor bushing, having a cylindrical body portion **80** formed of an electrical insulating material, such as an epoxy system, and having a plurality of weather sheds **82** on the weather end of the insert. The end of the insert **24** which extends into the opening in the first portion **22** contains threads **84** on its external surface which cooperates with the threads **74** on the inner surface of the first portion **22**. A gasket member **81** may be used to seal the first and second portions of the high voltage bushing assembly **20**, when the second portion is threadably engaged with the first portion. In the event the creepage path from terminal means **62** to the grounded casing is not long enough to prevent flashover through the air film between the two portions of the bushing, silicone grease may be used to drive out the air between the two portions as the insertable portion is placed into position; or, a resilient sleeve may be disposed between the two portions of the bushing assembly, with a bayonet type construction being used to secure the two portions in assembled relation, instead of a plurality of threads.

A cylindrical rod-like conductor **86** extends coaxially through the insert **24**, which is connected to hardware means **68** at the weather end of the insert **24**, and extends outwardly from the opposite end of the insert **24**, with the outwardly extending end being adapted for making an electrical connection with terminal means **62**.

If the insertable portion of the high voltage bushing assembly **20** is of the type for receiving a shielded cable, it may be formed similar to the insert **72** shown in FIG. 4. Insert **72** includes a cylindrical body portion **88** formed of an electrical insulating material, such as an epoxy

system, and has a conductor portion **90** which extends coaxially therethrough. Conductor portion **90** terminates at the first end of the body portion, which end may be a cylindrical projection for cooperating with a shielded cable connector, and is hollow for receiving a projecting conductor portion of the shielded cable connector. Conductor portion **90** extends outwardly from the opposite end of insert **72**, and is adapted for making an electrical connection with terminal **62**. Insert **72**, like insert **24** shown in FIG. 1, may have threads **92** on its external surface for threadably engaging the internal threads of the first or fixed portion **22** of the bushing assembly **20**.

Removable insert **72**, instead of being of the type for receiving a shielded cable connector, may also be the end of the shielded cable itself, which contains means for adapting the cable end to fit the fixed or first portion of the bushing assembly. For example, means may be slipped over a prepared cable end which terminates the cable shield in a stress cone, and which also contains means for securing itself within a first portion **22**, and for firmly anchoring the shielded cable therein.

Low voltage bushing assembly **30** has a molded body portion formed of a cast resinous insulating material, such as an epoxy resin system, and includes a plurality of low voltage secondary leads, such as leads **32** and **34**, which extend outwardly from one side of the bushing, and a plurality of terminals, such as terminal **36**, which extends from one end of the bushing assembly **30** into the casing **12**. The connection between the low voltage secondary leads and the low voltage terminals is shown in phantom in FIG. 3. As shown in FIG. 1, the length of the secondary leads **32** and **34** should be sufficient to extend well into the hanger lug **40**. Bringing the secondary leads **32** and **34** from a side wall portion of low voltage bushing assembly **30**, instead of from the end opposite terminals **36**, allows the low voltage bushing **30** to be disposed on a sloping portion of the cover **18**, and the bringing of the low voltage secondary leads into the hanger lug **40**, with only a slight bend.

Low voltage bushing assembly **30**, between the secondary leads **32** and **34**, or otherwise disposed on the same side of the bushing assembly as the low voltage leads **32** and **34**, contains a projecting portion **107**, having an outer surface which is substantially parallel with the side wall portion **14** of the tank **12**, when the low voltage bushing assembly **30** is in its mounted position. Actuating means **38** is disposed completely through low voltage bushing assembly **30**, starting at this projecting portion **107**, and extending through the body portion of the bushing assembly **30** into the inner portion of casing **12**. The actuating mechanism **38** engages an operating linkage within the transformer casing for operating the circuit breaker **51**. The external portion of the operating mechanism **38** includes a first portion **93** in which an operating rod **94** is inserted, which extends downwardly through the hanger lug **40**, and ends in a curved portion **96**, shown in FIG. 1, which may be reached by operating personnel from below with a hook-stick when the transformer is pole mounted. Curved portion **96** may extend through a slot in the hanger lug **40**, with the upper end of the slot being labeled "on," and the lower end of the slot being labeled "off," so that the operating personnel can tell at a glance the position of the internal protective circuit breaker. The actuating mechanism **38** also includes a portion **98**, which forms an opening which may be operated by a hook-stick from above the transformer, when the transformer is vault mounted.

Hanger lug **40** is fixed to the side wall portion **14** of the casing **12**, directly below the low voltage bushing assembly **30**, and it provides the functions of mounting the transformer **10** on a utility pole, when pole mounted, and also for protecting the connections between the secondary leads **32** and **34** and the line drop conductors, when pole mounted. It also houses the rod **94** for operating the actuating mechanism **38** for the protective circuit breaker, and serves as a guide and indication for the operating rod to indicate the position of the circuit breaker.

Hanger lug **40** is substantially channel shaped, as shown most clearly in FIG. 2, having first and second leg members **100** and **102** which are fixed to the side wall portion **14** of transformer **10**, and with the sides of the leg members opposite to the side wall portion **14** being joined by back portions **104** and **106**. Back portions **104** and **106** have slotted portions **108** and **110**, respectively, for receiving mounting bolts, shown in phantom at **112** and **114**, when the transformer is pole mounted. The back portions **104** and **106** are vertically spaced apart, in order to allow secondary leads **32** and **34** to be brought out from the hanger lug, when the transformer is vault mounted, for connection to the underground secondary circuit, and also to allow room for connections to be made to the secondary leads by the line drop when pole mounted. When pole mounted, the interconnections between the secondary leads **32** and **34** and the line drop are placed within the protective confines of the hanger lug **40**. long enough to extend to the secondary distribution line. If desired, the secondary leads **32** and **34** may be made in which case the hanger lug **40** serves to conceal the secondary leads.

Thus, during manufacturing and assembly of transformer **10**, the basic transformer may be assembled without the insertable portion of the high voltage bushing assembly **20**, and therefore without regard to whether the transformer is to be pole or vault mounted. The user may also order and stock the basic portion of the transformer without regard to its intended environment. Then, when the transformer is placed in service, it is only necessary to select the type of insert for the high voltage bushing assembly demanded by the particular application. Once installed in a particular application, the transformer **10** may be easily converted to another environment, by merely replacing the high voltage bushing insert with the type demanded by the new environment.

In summary, there has been disclosed a new and improved electrical transformer of the distribution type, which may be either pole or vault mounted, and once installed, may be easily converted from pole to vault mounting, or from vault to pole mounting, by field personnel. By combining many functions into certain components, the transformer is able to provide excellent service, as well as operating convenience, while either pole or vault mounted, without deleteriously affecting the cost of the versatile unit, as compared with a single purpose unit. For example, the hanger lug not only provides pole mounting means which is pleasing to the eye, but it protects and encloses the interconnections between the secondary leads and the line drop, it allows the removal of the ends of the secondary leads from the protective enclosure when the transformer is to be vault mounted, and it protects and serves as a guide for the operating rod for the circuit breaker actuating mechanism, which operating rod is accessible from below.

The high voltage bushing assembly includes a fixed universal portion mounted in the transformer, which allows quick assembly with an insertable portion containing the necessary hardware for receiving the type of incoming line the transformer is to be connected to.

The low voltage bushing assembly is a one-piece molded assembly which includes secondary leads, terminals for connection to the internal secondary circuit of the transformer, and an actuating mechanism for the protective circuit breaker which may be operated from above or below the transformer.

The transformer tank **12** includes a stainless steel bottom portion which prevents the protected portion of the casing from being damaged during handling, and thus enables the corrosion resistant finish on the transformer casing to perform its function without danger of its being impaired due to the handling of the transformer. When

vault mounted, the stainless steel mounting support provides an excellent mounting ring for supporting the transformer within the vault.

Finally, the lifting lugs on the transformer facilitate handling for either pole or vault mounting, and additionally allow the transformer to be banded to a shipping pallet without danger of damaging the finish of the casing **12**. The lifting lugs may also provide a convenient grounding point for grounding the transformer casing.

Since numerous changes may be made in the above described apparatus and different embodiments of the invention may be made without departing from the spirit thereof, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. An electrical transformer suitable for either pole or vault mounting, comprising:

a casing having side wall, bottom, and cover portions, magnetic core means,

a winding assembly disposed in inductive relation with said magnetic core means, said magnetic core means and winding assembly being disposed within said casing,

a low voltage bushing assembly including a body portion having a plurality of electrical leads extending outwardly from a first portion thereof, and a plurality of electrical terminals extending outwardly from a second portion thereof, said low voltage bushing assembly being fixed to the cover portion of said casing, with its electrical leads depending therefrom, its second portion extending into said casing and its electrical terminals being connected to said winding assembly,

at least one high voltage bushing assembly having first and second separable portions, said first portion being fixed to said cover portion and extending through an opening therein, said first portion having terminal means connected to said winding assembly, said second portion including a conductor, one end of which has terminal means removably engaged with the terminal means of said first portion, and the other end of which is adapted for connection to an external conductor,

and a substantially U-shaped channel hanger lug having first and second spaced leg members joined by a back portion having first and second spaced slotted portions which are adapted to receive means for mounting the transformer on a utility pole, the first and second spaced leg members being fixed to the side wall portion of said casing and circumferentially oriented to receive and provide a partial enclosure for the depending leads from said low voltage bushing assembly, the depending leads from said low voltage bushing assembly entering said hanger lug, with the opening between the spaced slotted portions allowing the leads to be lifted therefrom when the transformer is to be vault mounted.

2. The electrical transformer of claim **1** wherein the second portion of said at least one high voltage bushing includes terminal means suitable for connection to an open line conductor.

3. The electrical transformer of claim **1** wherein the second portion of said at least one high voltage bushing includes a cylindrical projection surrounding a conductor portion suitable for co-operating with a plug-in type shielded cable connector.

4. An electrical transformer suitable for either pole or vault mounting, comprising:

a casing having side wall, bottom, and cover portions, magnetic core means,

a winding assembly disposed in inductive relation with said magnetic core means, said magnetic core means and winding assembly being disposed within said casing,

a low voltage bushing assembly including a body portion having a plurality of electrical leads extending outwardly from a first portion thereof, and a plurality of electrical terminals extending outwardly from a second portion thereof, said plurality of electrical leads being connected to certain of the plurality of electrical terminals within said body portion, said low voltage bushing assembly being fixed to the cover portion of said casing, with its second portion extending into said casing and with its electrical terminals being connected to said winding assembly,

at least one high voltage bushing assembly having first and second separable portions, said first portion being fixed to said cover portion and extending through an opening therein, said first portion having terminal means connected to said winding assembly, said second portion including a conductor, one end of which has terminal means removably engaged with the terminal means of said first portion, and the other end of which is adapted for connection to an external conductor,

a substantially U-shaped channel hanger lug having first and second spaced leg members joined by a slotted back portion adapted to receive means for mounting the transformer on a utility pole, the first and second spaced leg members being fixed to the side wall portion of said casing, forming a partial enclosure for the secondary leads from said low voltage bushing assembly,

a circuit breaker disposed within said casing,

and an actuating mechanism for operating said circuit breaker, said actuating mechanism extending in sealed operable relation through said low voltage bushing into said casing, the end of said actuating mechanism within the casing being connected to operate said circuit breaker, and its external end being operable from above and below the transformer.

5. The electrical transformer of claim **4** wherein said low voltage bushing is disposed adajacent the side of said cover means directly over said U-shaped channel hanger lug, said secondary leads extending into said U-shaped channel hanger lug, and rod means having a first end connected to a first portion of said actuating mechanism, said rod means extending into said U-shaped channel hanger lug, and having a second end which is adapted to be engaged and vertically operated from below the transformer, said actuating mechanism having a second portion operable from above the transformer.

6. The transformer of claim **1** including first and second lifting lugs disposed on opposite edges of said cover portion, said first and second lifting lugs having upwardly extending portions which define channels in said lifting lugs which are aligned with one another, the channels in said first and second lifting lugs being adapted to receive a banding strap when said transformer is strapped to a shipping pallet.

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U.S. Cl. X.R.

174—18, 153; 336—107, 67, 90; 339—126