May 23, 1944. K. WETHMÜLLER 2,349,782

CURRENT TRANSFORMER

Filed Aug. 1, 1941

Fig. 1.

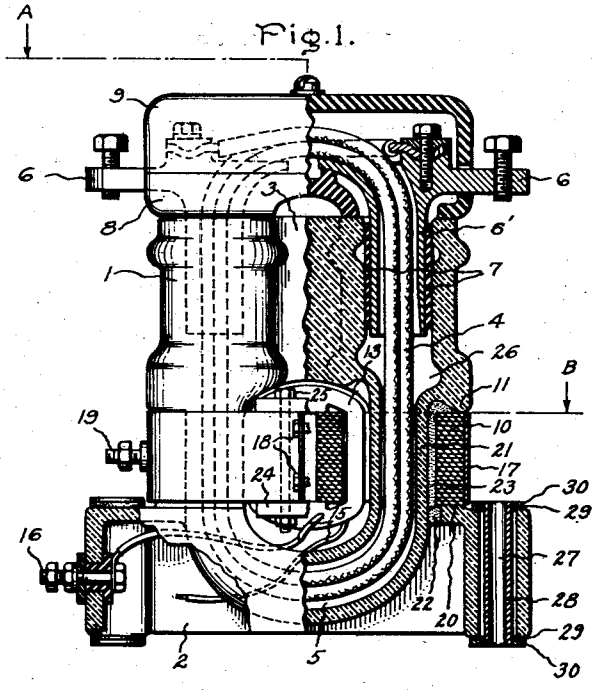


Fig. 2.

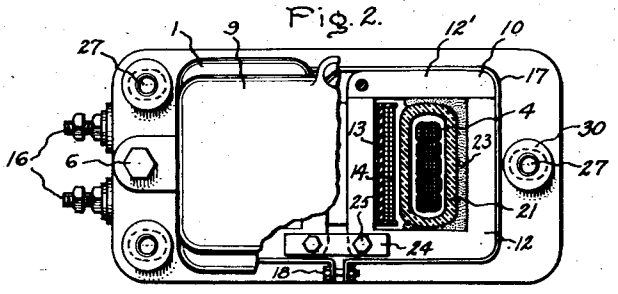
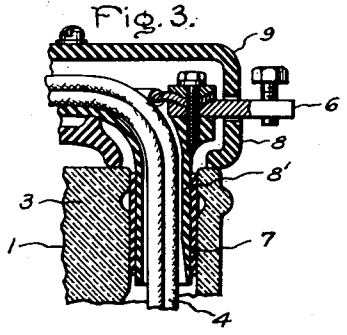


Fig. 3.



Inventor:
Karl Wethmüller,
by Harry E. Dunham
His Attorney.

Patented May 23, 1944

2,349,782

UNITED STATES PATENT OFFICE

2,349,782

CURRENT TRANSFORMER

Karl Wethmüller, Berlin-Baumschulenweg, Germany, assignor to General Electric Company, a corporation of New York

Application August 1, 1941, Serial No. 405,091
In Germany March 29, 1940

5 Claims. (Cl. 175—358)

The present invention relates to transformers and more particularly to current transformers for high voltage application.

In a well known and frequently employed design for high tension current transformers, the high tension insulation of the primary winding is formed of a U-shaped insulating body, usually of porcelain, which consists principally of a tube of round or rectangular cross section open at both ends of the two legs, and in the passage of which tube the primary winding is arranged. While this type of insulation is desirable from an electrical standpoint, its mechanical strength is low so that special precautions must be taken in order that the insulating body will be able to withstand short circuit stresses and strains imposed thereon through the support or the primary terminal lugs. To provide for sufficient mechanical strength, special metal bracing means and bases have usually been employed but such arrangements inherently result in a high cost unit.

It is an object of the present invention to provide a new and improved transformer of the type referred to which is mechanically strong and low in manufacturing cost.

It is a further object of the present invention to provide a current transformer suitable for use in high voltage circuits having the primary winding arranged within a tubular body of molded insulating material which is so constructed and arranged that it will be able to withstand stresses resulting from short circuit conditions of primary current.

It is a still further object of the invention to provide a new and improved current transformer of the type referred to having a magnetic core structure so arranged around the insulating body as to reinforce the same against stresses arising from the enclosed winding.

Another object of the present invention is to provide a new and improved current transformer having an insulating body of the type referred to which may be readily secured to a suitable support without imposing severe strains upon the insulating body.

A further object of the invention is to provide a current transformer of the type referred to having a new and improved primary terminal structure.

In accordance with one form of the invention, the U-shaped tubular insulating body, within which the primary winding is arranged, has an integral web connecting together the upper ends of the U legs for strengthening these portions against the outwardly directed forces arising from short circuit primary current conditions. The primary winding terminals have tubular portions extending into the upper open ends of the insulating body so as to distribute the stresses which may be transmitted through the terminals. The magnetic core structure is snugly clamped or cemented against the lower portion of the insulating body in a manner as to reinforce these portions against the likelihood of breakage under short circuit stresses. The lower portion of the insulating body is furthermore provided with an integral base structure which is so constructed and arranged that the transformer may be readily mounted upon a suitable support in a manner so that no strains likely to cause breakage of the insulating body may be transmitted through the support to the transformer proper.

Further objects and advantages of the invention will appear from the following description and the claims appended thereto taken in connection with the accompanying drawing.

In the drawing Fig. 1 is a view, half in longitudinal section and half in elevation, of a transformer constructed in accordance with one form of the invention; Fig. 2 is a view of the transformer showing half of it in cross section along the line A—B of Fig. 1 and half of it in a plan view; and Fig. 3 is a fragmentary view illustrating a modification of the invention.

The transformer comprises a U-shaped tubular body of a suitable solid insulating material, such as porcelain, having an integral base portion **2**. If the body is made of porcelain, it can be molded as a unit, or the U-shaped part and the base part may be molded separately and then be joined together prior to the baking of the porcelain. The insulating body has between its two legs a strong connecting web **3** which braces effectively the legs with respect to each other, and which constitutes an integral part of the insulating body, so that the parts **1**, **2** and **3** form a single unit. Within the insulating body a passage, preferably of rectangular cross section, is provided which follows the curve of the U, and through which extends the primary winding **4** which may be introduced into the open ends of the U legs. In order to facilitate the introduction of the winding, the cross section of the winding space in the U curve may be increased as indicated at **5** in Fig. 1. The primary winding is provided with terminal lugs **6** which, for the purpose of effectively fastening to the insulator even without cementing, are provided with tubular extensions **6'** which

are inserted into the ends of the legs. The upper ends of the U legs are suitably enlarged for cooperatively receiving these tubular extensions. It is advantageous to place between the inserted tubular parts of the terminals and the inner walls of the insulator, yielding or elastic intermediate layers 7, such as pressboard, which permit a tight fitting of the terminals and will prevent metal from resting against the solid insulating material of the U body. This arrangement will distribute over a considerable area of the insulating body any strains which may be transmitted through the leads and reinforce the transformer against stresses caused by the winding in the case of short circuit. As illustrated by the modification of Fig. 3, both terminal lugs 6 may be secured to a common support 8 of a suitable insulating material and which support is provided with a pair of tubular extensions 8' for insertion into the ends of the U legs. This supporting member, which may be suitably stiffened, will increase the effect of the cross member 3 that braces the two legs of the insulator and will increase the mechanical strength of the transformer against short circuit and other stresses. Both the primary terminals and the winding are covered by a lightweight cap 9 which is preferably made of molded insulating material and which is horizontally divided to facilitate assembly thereof.

The laminated iron core 10 of the current transformer is arranged between the base 2 and the beads 11 of the insulating bushings. It is, therefore, supported directly by the insulating body and compressed thereby at right angles to the plane of the laminations. In the physical embodiment, the core comprises two equal stacks, each of which surrounds a leg of the insulator and consists of U-shaped laminations 12 and straight yoke strips 12' which are alternately stacked. However, other methods can be applied for making the core; for instance, the core may be built as a shell constituting a single part, which is made up of E-shaped laminations and straight yoke pieces. The spool 13 for the secondary coil with the secondary winding 14 lies in the center between the two U legs of the insulating body and surrounds the two central legs of the core stacks. In the case of a shell-type transformer, it surrounds the center leg. The leads 15 of the secondary winding extend into the base part 2 of the insulator and are connected to the secondary terminals 16 which are directly secured to the base, and which may be protected by a suitable cover. The core may be covered by a metal band, for instance an iron band 17, the ends of which can be fastened together by means of screws 18. A terminal 19 may be secured to the band 17 for grounding the core. If the outer surface of the U part of the insulator is given a conductive coating, a well known procedure, for the purpose of eliminating the dielectric stresses set up by the high-tension field in the surrounding air, it is advisable that the slightly raised surfaces 20 be also provided with the same conducting coating and, in this manner, the latter can be easily grounded without it being necessary to adopt special means. The surfaces of the beads 10 of the bushings contacting the core may also be coated for the same purpose.

In the event of a short circuit, the primary winding exerts an outward force mainly against the parts of the insulator wall which are indicated at 21. In order to give the insulator maximum mechanical strength against short circuits, it is advisable to brace these parts of the wall particularly well. In accordance with the invention, cement 23 is injected, for instance from the bottom of the base through the openings 22 provided for that purpose, between the insulating body and the lamination stacks so that the core has a good, positive, mechanical contact with the parts of the wall that are to be braced.

Adjacent legs of the two lamination stacks are secured together by means of clamping plates 24 and bolts 25 on opposite sides of the insulator. With this construction any short circuit forces arising in the primary winding, which react externally, are effectively absorbed by the iron core, and a considerable mechanical strength against short circuit stresses is attained. However, other arrangements may be employed to obtain a rigid connection between the stack of laminations and the walls of the insulating body which are to be braced. For example, the lamination stacks may be clamped snugly against the outer walls of the insulating body by means of the band 17 and omitting the cement 23. If desired, the outer walls of the insulating body may be given plane surfaces, as by grinding, if necessary, in order that the core will fit smoothly thereagainst. It will be obvious that in such case, the bolts 25 will be tightened after the band 17 is tightened around the core. The parts of the insulator wall which are above the core and which are not supported by the latter, are protected against the forces set up in the primary winding by recesses 26, so that at these points the winding is not in contact with the insulator and the short circuit forces are transmitted to other parts of the wall that are supported by the core.

The base 2 of the insulating body may be utilized for fastening the transformer to a suitable support. For this purpose, bolt holes 27 may be provided in the base. The holes are preferably made elongate in cross section in order to allow for manufacturing tolerances which may be necessitated due to the properties of the insulation material used. In the case of brittle insulating material such as porcelain it is not desirable that the bolts and nuts engage directly with and tightly against the insulator for the reason that localized strains might cause a breakage of the insulator. In order to prevent this effectively, steel tubings or bushings 28 are provided in the holes. These steel tubings are riveted at their protruding ends, with suitable elastic washers 29, such as pressboard, fiber, rubber, etc. and metal washers 30, whose holes may be suitably beveled, inserted between the insulating body and the steel tubing prior to the riveting of the latter. In this manner the steel tubing is secured firmly in the bolt holes without exerting any excessive pressure on the insulating body. The elastic or yielding disks 29 lie between the insulating body and the metal washers 30 so that no metal contacts the porcelain. As regards the bolts, these are passed through the bushings and, when they are tightened, their pressure is taken up by the bushings and not by the insulating body. As a result, the mechanical strength of the latter need not be considered, and the bolts may be tightenel considerably.

If in the conventional four-point support of transformers the supporting base is not quite level, or if the supporting surfaces, e. g. washers 30, of the transformer are not exactly in one plane, any tightening of the bolts would create mechanical stresses between the points of support, which, in the case of a brittle material such

as porcelain, will crack the base. In order to prevent this, a three-point support is used, as shown in Fig. 2, so that the transformer may be suitably mounted without the usual danger of breakage of the insulator body.

Having described my invention in what I now consider to represent a preferred embodiment, I desire to have it understood that the specific structure described is merely illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A transformer comprising a primary winding, a rigid tubular insulating body around said winding, a magnetic core surrounding a part of said body, said part of said body having an inner surface relatively closely fitting said primary winding and the remainder of the inner surface of said body being spaced from said primary winding so as to substantially prevent contact between said winding and said remainder of the inner surface of said body, means including integral portions of said body supporting said core around said body, means including certain of said integral portions forming a supporting base for said transformer, and means including said magnetic core structure relatively closely fitting said body part for bracing said part and for absorbing forces due to said primary winding upon short circuit.

2. A transformer comprising a primary winding of a plurality of turns, a body of solid and relatively brittle insulating material surrounding at least a portion of said winding, a core structure arranged around said body, a terminal for said winding, a member surrounding said winding and closely fitting the inner walls of said body for supporting said terminal.

3. A transformer comprising a hollow body of solid and relatively brittle insulating material, a primary winding of a plurality of turns arranged in said body, a core structure arranged around said body, an opening in said body, a terminal for said winding, a tubular member secured to said terminal and extending into said body through said opening, said member fitting closely with the internal walls of said body.

4. A current transformer comprising a substantially U-shaped tubular insulating body, a primary winding arranged in the passage of said tubular body, means including terminals for said primary winding mounted on the upper ends of the U legs of said tubular body, said terminals having integral portions extending around said winding and downwardly into the U legs of said insulating body.

5. A transformer comprising a hollow body of solid and relatively brittle insulating material, a primary winding of a plurality of turns arranged in said body, an opening in said body, a terminal for said winding, a tubular member secured to said terminal extending into said body through said opening, and elastic means closely fitting between said tubular member and the internal walls of said body.

KARL WETHMÜLLER.