This invention relates to transformers.

According to one aspect of the invention there is provided for a transformer, a bobbin onto which a winding is to be wound, wherein the bobbin includes at least two supports carrying respectively at least two terminals (e.g. screw clamp terminals) to which the releasable external connections to the winding can be made.

According to another aspect of the invention there is provided for a transformer unit, a coil comprising a bobbin as set forth in the preceding paragraph and a winding wound thereon, at least the ends of which winding being non-releasably connected e.g. by soldering respectively to the terminals.

According to yet another aspect of the invention there is provided a transformer unit comprising a core and a pair of coils as set out in the preceding paragraph mounted on the core. Preferably the core comprises a stack of U-shaped laminations, the bobbin of the primary coil being carried on one limb of the stack and the bobbin of the secondary coil or coils being carried on the other limb of the stack. Conveniently, the laminations are inserted into the stack from opposite ends so that the bobbin cores formed by the side limbs of the stack are interconnected at one end by the bases of half the laminations and at the other end by the bases of the other half of the laminations.

Preferably each bobbin comprises a tubular former carried between two end plates, each end plate providing a seating for a screw clamp terminal.

According to yet a further aspect of the invention there is provided a bell transformer comprising a casing formed in two or more parts and forming a cavity within which is received a transformer unit as set out in the preceding paragraph wherein the casing is formed with sets of apertures through which the terminals project to be accessible externally of the casing. Preferably the bell transformer further comprises one or more detachable cover plates which define with the casing a cavity into which the terminals project. The terminals of each bobbin may be arranged in side-by-side relationship. The apertures through which the terminals project may be flanked by side plates to limit access to the terminals.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:

FIGURE 1 is a perspective view of a transformer unit of the invention;

FIGURE 2 is a plan view of the transformer unit;

FIGURE 3 is a view in the direction of the arrow 3 in FIGURE 2;

FIGURE 4 is a section of a bobbin forming part of the transformer unit of FIGURES 1 to 3;

FIGURE 5 is a perspective view of a bell transformer of the invention with one cover plate removed;

FIGURE 6 is a plan of the base plate of the transformer casing; and

FIGURE 7 is a section on line 7--7 of FIGURE 5.

Referring now to the drawings, the transformer unit

3,243,746
ENCASED BOBBIN SUPPORTED TRANSFORMER UNIT
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1 Claim. (Cl. 356--92)
provided with an intermediate tapping so that three secondary voltages can be tapped.

The bobbin of the primary coil 14 comprises a rectangular sectioned core tube 17 carried between two end plates 18 moulded from plastic material. Conveniently the core tube 17 and end plates 18 are a single moulding. Extension pieces 21 are integrally formed with the end plates 18 to provide seatings for brass terminal blocks 22. Each terminal block 22 includes a tubular ended part 23 which is passed through a passage in the appropriate extension piece, and through an eye in a connection tag 24 and is then riveted or spun over to secure the terminal block 22 and the tag 24 to the end plate 18. The end leads 25 (see FIGURES 2 and 3) from the primary winding 14 are passed through grooves 26 in the two end plates 18 and are soldered to the tags 24. The primary coil 14 is thus a self contained assembly in which there are no loose leads between the ends of the winding and terminal blocks and can therefore be readily and simply handled. Further during assembly of the transformer no additional connections need to be made.

The secondary coil 15 is similar to the primary coil 14 but includes a tapping plate 31 moulded on the core tube intermediate its length. The tapping plate 31 is similarly provided with an extension piece 32 which provides seating for a terminal block 33. The terminal block 33 is provided with a tubular ended part which is passed through the extension piece 32 and the eye of a connection tag 34 and which is riveted or spun over to secure the terminal block 33 and the connection tag 34 to the extension piece 32. A small loop 35 (see FIGURE 2) formed intermediate the length of the secondary winding is led to the tag 34 through a groove in the tapping plate 31. The secondary coil 15 is again a self-contained assembly and can be readily and simply handled.

The core of the assembly 11 comprises a stack of U-shaped soft iron laminations 37, alternate laminations being fed into the assembly from one end and the intermediate laminations being fed into the assembly from the other end. The iron cross-section in the side limbs of the stack within the core tubes 17 is double the iron cross-section in the end limbs of the stack. This affords the advantage that the end limbs become magnetically saturated before the side limbs. Consequently when the transformer is tested under appropriate short circuit conditions, the end limbs of the stack become magnetically saturated and the current induced in the secondary coil is limited to a value insufficient to break down its insulation.

The adjacent edges of the end plates 18 of the primary and secondary coils are formed with notches which, when the bobbins are side by side, form a groove 38. A stiff but resiliently flexible polypropylene insulator plate 39 is inserted between the two coils 14, 15 before the core is inserted. This plate 39 has flanges 40 at its ends and strengtheners 41 and gussets 42 for the flanges 40. When the plate 39 is inserted between the coils and the latter moved together to receive the core, the flanges 40 will lie in the grooves 38. The provision of plate 39 with its flanges 40 results in a long "creep" distance between the windings 14 and 15 and between the windings and the laminations.

To enable the laminations better to be located within the bobbin former, the sides 43 of passages 44 through the latter are inwardly bowed to a few thousandths of an inch as shown (grossly exaggerated) in FIGURE 4. This bowing is sufficient to cause the limbs of laminations to jam against the sides 43 of the passage of the bobbin former. Thus when laminations are inserted from opposite ends of the former, this jamming effect will tend to hold laminations inserted from one end of
the former from being forced out of that end on insertion of a laminations from the other end. Again it is to be noted that the transformer unit is a self-contained unit which can be easily handled.

The transformer unit 11 is contained within a cavity in a casing which comprises a cover part 45 (see FIGURES 5 and 7) and a base plate 46 (see FIGURES 6 and 7). The base plate 46 has a peripheral wall 47 which defines a recess 48 into which the transformer unit 11 snugly and firmly seats. The outer sides and top of the wall 47 are recessed at 49. The recesses being spaced from the sides of the cover provide an air passage.

The cover part 45 of the transformer comprises two sides which form side plates 54 and two end assemblies (see FIGURE 5) which are covered by removable terminal cover plates 55. Each end assembly comprises an upright back wall 56, a slanting lead wall 57, and a second or front upright wall 58. A clamping block 59 is moulded to each corner of each back wall 56 of each end assembly 54, and has a through bore, the upper portion of which is of hexagonal cross-section to accommodate an elongated nut and the lower portion of which is of circular cross-section. Three apertures 61 (see FIGURE 7) are formed through one end assembly for the reception of the terminal block 22 and 33 of the secondary and two similar apertures are formed through the other end assembly for the reception of the terminals of the primary coil 14. The apertures are flanked by outstanding probes 62 (see FIGURE 5) so that each terminal block 33 is accommodated between two probes 62 or between a probe 62 and a clamping block 59. The probes 62 and the clamping block 59 are of such a size that it is virtually impossible to touch the terminal block 33 accidentally. The slanting lead wall 57 facilitates guiding external leads to the terminals.

A small bite 63 is formed in the wall 58 of each assembly leading to a small cavity 64 formed in the slanting wall 57. The bite 63 and cavity 64 enable feed wire to be led into the end assemblies.

The terminal cover plates 55 are held in position by screws 60 passing through guide blocks (not shown) within the terminal cover plates 55 and engaging respectively in the upper ends of the nuts in the bores of the clamping blocks 59. These guide blocks are formed with keyways which engage keys 65 formed on the back walls 56. The keys 65 of one end assembly 54 are closer spaced than the keys of the other end assembly so that the terminal cover plates 55 cannot be interchanged. These terminal cover plates 55 bear markings indicating primary or secondary connections to be made at that end.

The top of the cover is formed with two series of parallel square fins 66. These fins 66 are moulded on to two walls 67 (see FIGURE 7) within the cover and extend from that wall to the top of the cover. The fins 66 define between them rectangular cavities 68, one edge of which communicates with the interior of the casing and an adjacent edge of which communicates with the exterior of the casing. These fins provide an air passage through the cover. However, the cover is not weakened by these air flow apertures through it. In fact, the walls 67 and the fins 66 strengthen the cover and increase its resistance to impact damage. The walls 67 and the fins 66 provide surfaces from which heat radiation can occur.

When the cover 45 is fitted over the coil and core assembly, the upper face of the stack of laminations abuts against the lower face of the walls 67. The cover 45 is clamped to the base plate 46 by four screws, the heads of which are accommodated in counterbores in the underside of the base plate 46 and which engage in the lower ends of the hexagonal nuts accommodated in the hexagonal portions of the bores in the blocks 59. As these screws are tightened, the stack of laminations 37 is clamped between the wall 67 and the abutments 50.

The transformer described above is designed to facilitate manufacture and so to minimize assembly operations. The first stage in the assembly of the transformer is to fit the terminal blocks 22 and 33 together with their screws into the extensions 21 and 32 and to rivet the parts 23 to the tags 24 and 34. The two windings are then wound (preferably on a winding machine having a plurality of winding heads) and the various connections cleaned. This marks the end of the first stage of assembly. The connections 25 and 35 are then soldered to the tags 24 and 34. The primary and secondary coils are brought into juxtaposition gripping the insulator plate 39 between the end plates 18. These parts are then placed into the recess 48 in the base 46 and placed in an automatic laminating machine which inserts laminates from opposite ends of the former building up the windings. When the apertures (not shown) in the base are formed, the one unit is now tested. The cover part 45 is then placed over the base, allowing the terminals to pass through the openings. The terminal covers 55 are correctly positioned, the screws which engage the hexagonal nuts are inserted and the whole assembly screwed up. It will be seen that the assembly is done in two stages only.

The cover 45 and the base plate 46 are formed by compression moulding from suitable plastic material e.g. a phenol formaldehyde resin. Similarly, the bobbin assemblies respectively comprising core tube 17 and end plates 18, and core tube 17, end plates 18 and tapping plate 31, may be formed as integral units by compression moulding.

The invention is not limited to the precise constructional details hereinbefore described and illustrated in the accompanying drawings. For example the various plastics parts may be injection moulded. The bobbins may be moulded with the terminal blocks in position during the moulding operation.

We claim:

A transformer, comprising: a transformer unit including a pair of bobbins disposed in side by side relationship, at least two terminals secured to each of said bobbins and extending outwardly therefrom on the side thereof opposite the other of said bobbins, an electrical coil wound on each of said bobbins with said terminals connected to the terminals of the respective bobbins, an insulator plate disposed between said electrical coils and extending from one end to the other end thereof, and a core that forms a base and a cover, said said housing and enclosing said transformer unit, said cover having apertures therein on opposite sides thereof through which said terminals of said transformer unit freely project to a position outside said casing, abutment means on said base and on said cover engaging therebetween said transformer unit, readily removable fastening means holding said base and said cover together, said base and said cover having openings formed therein for cooling air to flow through said casing and around said transformer unit, and probe partition portions projecting from the outer surface of said cover and flanking each of said terminal apertures on each side thereof, said cover having an inclined surface extending from immediately adjacent each of said terminals in a direction away from the apertures through which said terminals project for guiding external electrical conductors to said terminals.

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