

1

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PULSE TRANSFORMER CONSTRUCTION

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This invention relates to electrical transformers, and more particularly to precision transformers of the type used to generate transient pulses in electronic computing equipment and similar devices.

Miniature transformers of the type to which this invention relates ordinarily employ a toroidal ferrite core on which the primary and secondary coils are wound. These parts are enclosed in a housing or casing and the connections to the primary and secondary coils attached to lead wires carried to the outside of the casing. The casing is filled with a potting compound. These elements are used in large numbers in electronic assemblies which are put together by automatic machinery. One of the problems encountered is to ensure alignment of the lead wires so that they will be in proper position for automatic assembly operations. Hitherto it has been necessary to straighten and align the lead wires after assembly of the transformer in many cases. Furthermore, it is very important to ensure accurate operation and long life of each transformer element because many thousands of transformers are used in a computer, and failure of any one will cause faulty performance of the entire system. Detection of the particular part which has failed is time consuming and expensive. In conventional transformers of this type, the core is held in place in the casing merely by the potting compound with which the casing is filled. The coils are of fine wire wound to very close tolerances to generate a pulse of specific shape. Consequently, minute mechanical strains are likely to cause a short circuit in the coils.

One of the objects of this invention is to facilitate proper alignment of the lead wires of a miniature pulse transformer so that the transformer can be readily assembled with other circuit components by automatic machinery. Another object is to ensure long life of the delicate coil windings by permanently securing the core in the proper position and relieving the windings of mechanical strains arising from shock, or expansion and contraction of the casing.

According to this invention, the annular or toroidal core, with the primary and secondary windings, is first mounted in a hollow rectangular block of molded plastic. Embedded in this block are tinned copper wires which are accurately bent to form studs for connection to the coil winding wires and to form spaced parallel leads intended to extend from either end of the outer casing. The core is placed transversely through the block and a small piece of flexible plastic tubing is forced between the core and the block on either side to anchor the two together. The block fits closely enough inside a tubular casing to hold the core in a predetermined position, but has enough clearance to permit the lead wires to be aligned with bushings in glass plates which are used to close the ends of the casing.

In the drawings illustrating the invention:

Fig. 1 is a plan view of a transformer constructed according to the invention, the casing being shown in crosssection;

2

Fig. 2 is a side view of the core and shell assembly; and

Fig. 3 is an end view of the shell prior to assembly with the core.

5 The standard electrical elements of the transformer here shown are the toroidal or ring-shaped core 10, and the primary and secondary coils 11 and 12. The block 13, shown before assembly in Fig. 3, is a hollow rigid rectangular piece preferably molded of thermosetting plastic, having a central rectangular opening 13a, and pairs of arcuate notches 14 and 15 in its top and bottom walls 13b and 13c. Embedded in the right-hand end wall 13d of the block are two lead wires 16 and 17 made of tinned copper. These wires are formed with 10 long straight portions 16a, 17a, oblique offsets 16b, 17b, and stud portions 16c, 17c which project upward and downward, respectively, through the block, the oblique portions being embedded in the latter. The stud portions are initially long enough to permit the coil wires to be 15 wound around several times and soldered.

The lead wires are molded into the shell when the latter is molded, so that the extensions 16a and 17a may be made accurately parallel, by means of a die, and spaced to line up with the bushings in the end plates. 25 The core 10, with the coils 11 and 12 already wound on each side in the desired arrangement, is slid into the opening 13 and a piece of round, somewhat compressible plastic tubing 18 is inserted between one side of the core and the block at notches 14. The core is then forced 30 over to the opposite side by compressing tube 18, and a second piece of compressible tubing 19 is inserted between the opposite side of the core and block 13 at notches 15. When the core is released both tubes are somewhat flattened between the core and the top and 35 bottom walls of the block, and the core is centered in the block. The space 20 in the interior of the core is then filled with resin, so that the core and block become firmly united. The coil wires are wrapped a number 40 of times around studs 16c and 17c and soldered. The studs, along with any excess coil wire, are clipped off short after the coil wires have been attached.

The core and block assembly fits into a tubular metal can 21 which has a lining 21a of woven glass. The can has end grooves 21b in which glass end plates 22 and 23, 45 having metal rims 24 and 25, are seated. These plates have pairs of metal bushings 26 and 27 (only one being seen in each case in Fig. 1) through which the leads 66 and 67 are passed and soldered.

50 The preferred method of assembling the transformer in the casing is to set one end plate in place and solder its rim to the can. The block and core assembly is then slid into the can, one pair of leads passing through the bushings of the attached end plate. The second end plate is then slid along the other pair of leads into position, its rim is soldered to the can, and its bushings 55 soldered to the respective leads. The assembled can is heated to drive out any moisture. Potting compound is then flowed into the can through the bushings of the first end plate. It is important to leave some space for thermal expansion of the compound, as these transformers may be operated under temperature conditions ranging from about -65° F. to 165° F. After the can has been filled to about the right degree, it is tilted and heated, causing any excess compound to leak out through 60 the open pair of bushings. These bushings are then soldered to the respective leads.

It is understood that the coil windings may be varied in number and position according to the electrical characteristics desired.

70 Pulse transformers of this type are made in very small sizes. For example, the casing may be about half an inch in diameter. In automatic assembly of various

3

circuits, these parts are frequently rolled into a feeding mechanism. For this reason it is important that the projecting lead wires, which may be two or three inches long, be aligned within the diameter of the casing. The embedding of these wires into the plastic shell ensures their proper placement and alignment for this purpose, as well as lining up the wires with the bushings. The wire leads can be subsequently bent, cut, or otherwise manipulated without danger of damage to the coils, because any stress applied to the leads is carried by the block. The firm anchoring of the core is important in prolonging the life of the device, as the core ordinarily has square edges, and any relative movement between the core and the wire is likely to cause these edges to wear through the extremely thin insulation of the wires.

This transformer is relatively inexpensive to manufacture as the block itself costs very little and results in considerable saving in labor because the placement of the core and leads in the casing is made much easier. Also, the percentage of rejects due to damaged coils is lower than in production of the conventional type of transformer.

What is claimed is:

1. A transformer comprising: a toroid-shaped core; primary and secondary coils wound on said core; a hollow, generally rectangular insulating block having a transverse opening, top and bottom walls and end walls, said core being disposed in said opening and having portions projecting transversely outward therefrom to either side of said block; and two pairs of rigid lead wires, each pair having portions embedded in one of said end walls and portions extending endwardly outward from the block, one wire of each pair having a stud portion projecting upward from said top wall and the other wire of each pair having a stud portion projecting downward from said bottom wall, said coils having electrical connections to said stud portions.

2. A transformer as described in claim 1, having a pair of compressible members, one disposed between said block and each of the transversely projecting portions of said core.

4

3. A transformer as described in claim 2, said top and bottom walls having notches in which said compressible members are engaged.

4. A transformer comprising: a casing having end walls, each end wall having a pair of spaced bushings, a hollow block disposed in said casing; a first pair of rigid lead wires having portions embedded in said block, stud portions extending from said block but contained within said casing, and parallel lead portions aligned with and extending outward through the bushings of one of said end walls; a second pair of rigid lead wires having portions embedded in said block, stud portions extending from said block but contained within said casing, and parallel lead portions aligned with and extending outward through the bushings of the other of said end walls; a transformer core mounted in said block; and primary and secondary coils wound on said core, each coil having electrical connections to two of said stud portions.

5. A transformer comprising: a substantially toroid-shaped core; primary and secondary coils wound on said core; a hollow, generally rectangular insulating block having a transverse opening and top and bottom walls, said core being disposed in said opening and having portions projecting transversely outward therefrom to either side of said block; a pair of compressible members, one inserted between each of said projecting portions and said block, said top and bottom walls having aligned pairs of notches in which the respective compressible members are engaged; and rigid lead wires embedded in said block, said wires having lead and stud portions projecting from the block and said coils having electrical connections to said stud portions.

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