

The invention relates to a transformer, in particular a miniature or safety transformer according to the preamble of claim 1, and to a process for manufacturing a transformer according to the preamble of claim 5.

5

It is known from DE-A-22 08 457 to wind a first winding of a transformer on a coil former made from plastics material by injection moulding, which coil former encloses a cavity for one limb of a transformer and is provided at its ends with retaining flanges for the winding. In order to insulate a second winding, to be applied over the first winding, from the first winding a second coil former is provided, to be interposed between the windings, which is likewise made from plastics material by injection moulding. This second former is in two parts. Each of its two parts is C-shaped when viewed along the axis of the coil. The two C-shaped parts are pushed over the first winding so that their ends overlap. The two C-shaped parts of the second former also have retaining flanges at their ends for the second winding to be wound on them.

European Standard DIN VDE 0551 Part 1/09.89 for isolating and safety transformers prescribes for a particular transformer rating that formers of the kind described above, i.e. those made by injection moulding from plastics material, must for reasons of safety have a wall thickness of at least 1 mm. In the case of miniature transformers and coils such as those used for electrical appliances such as lights (particularly halogen lamps), toys, shavers etc. such a thickness is undesirable, since it stands in the way of the requirement for reducing the size of such appliances to a minimum.

The above-mentioned Standard also permits the wall thickness to be made less than 1 mm for the same rating if the former comprises at least three layers or thicknesses and meets the insulating property requirements. As an

example, the Standard recommends making a former by winding a strip of foil that is feathered or perforated on its two longitudinal edges in at least four layers on a core so that the feathered or perforated edge regions bend upwards, thus giving the former, in cross-section, a U-profile with lateral edge flanges. However, because of the edge cuts (feathering) or perforations in the edge region air gaps, i.e. positions of reduced insulation, occur in each position. This is the reason why - as tests have shown - formers made in this way have hitherto not met the insulation property requirements.

DE-A-31 07 059 discloses a former that is made from a multilayer winding of insulating tape and likewise has a U-profile cross-section. The insulating tape winding, wound of three or more layers, can be changed in shape through elastic deformation and then applied to the primary winding.

It is the object of the invention to provide a transformer having a coil former that meets the Standard, has a wall thickness substantially less than 1 mm, and above all ensures unimpeachable insulation properties in the region of the U-limb.

This object is achieved, according to the invention, by means of the features of claim 1 or 5.

The Standard is satisfied by the fact that the outer former of the transformer according to the invention consists of a plurality of shells. The wall thickness of the shells can be selected so that the total thickness of the superimposed shells is considerably less than 1 mm.

The dimensional stability on the one hand and elastic deformability, on the other hand ensure that the shells can be joined together to make up the ring-shaped former. Each

of the shells has solely one interruption in its circumference.

It is preferable to use shells of the same kind for a former, but this is not absolutely necessary.

Another possible useful development consists in interposing a metal foil, preferably a copper foil, between at least two of the shells. In this way electrical shielding of the superimposed windings can be ensured. To avoid the formation of air gaps, the shells are formed so that the ends resulting from the interruption overlap in the assembled former.

The shells or part-shells may consist of thermoplastic material, which enables them to be made by plastic forming.

The process for manufacturing a transformer in accordance with the invention is described by means of the features of claim 5.

Thus one possible way of making a coil former of the transformer is to make straight U-sections from a flat strip of foil by plastic forming, to form ring-shaped shells or C-shaped part-shells from the U-sections by plastic forming, and then to assemble the coil former from the ring-shaped shells or C-shaped part-shells, if desired with the interposition of a metal foil, in particular a copper foil.

It is also possible to simultaneously produce a plurality of U-sections, and therefrom a plurality of ring-shaped shells or C-shaped part-shells, from a plurality of superimposed flat strips of foil in a single process step by plastic forming.

As an alternative to the last-mentioned possibility, when ring-shaped shells are used they can be elastically bent open in succession at the interruptions and pushed over one another. This can be done so that the interruptions either
5 all come at the same position on the coil former or alternately on opposite sides.

In the process of the invention a foil material with a thickness of less than 100 μm , e.g. 80 μm , can be used,
10 resulting in coil formers with very thin walls and hence more room for the winding. For example, in the case of a three-layer coil former the total wall thickness may be less than 300 μm . Compared with the recommended former of the Standard, made by winding from foil strip, this former
15 has the advantage that gaps in the insulation are excluded.

Exemplary embodiments of the invention will now be described with reference to the drawings, in which:

- 20 Fig. 1 shows a transformer with two superimposed windings wound on coil formers;
Fig. 2 is a perspective view of the inner former of Fig. 1 and its winding, and an exploded view of the outer former without its winding;
25 Fig. 3 shows a side view of a first embodiment of the coil former of the transformer in accordance with the invention; and
Fig. 4 shows a side view of a second embodiment of the coil former of the transformer in accordance with
30 the invention.

Figure 1 shows a transformer 1 with an iron core 2, a first winding 3 and a second winding 4. The first winding 3 is wound on an inner former 5A that surrounds an opening 10
35 through which one limb 6 of the transformer core extends. The second winding 4 is on an outer former 5B placed on the first winding 3. The winding axis of both windings 3, 4 is

indicated by 7.

Figure 2 shows the inner former 5A with the winding 3 in perspective. The construction of this inner former 5A is the same as will now be described in connection with the outer former 5B.

The outer former 5B consists, as shown in Figure 2, of two parts 5Ba and 5Bb. Each of these two parts, in its turn, is made up of a plurality of part-shells, only two of which are shown in Figure 2 in each case. The part-shells 5Ba1 and 5Ba2 make up the part-former 5Ba. The part-shells 5Bb1 and 5Bb2 make up the part-former 5Bb.

Each of the part-shells consists of thermoplastically formable foil having a U-section, the web of the U-section being indicated by 9 and the edge flanges by 11. As the arrows indicate, the part-shells 5Ba1 and 5Ba2 on the one side are pushed over one another to make up the part-former 5Ba. In the same way the part-shells 5Bb1 and 5Bb2 are pushed over one another to form the part-former 5Bb. To form the outer coil former 5B the two part-formers 5Ba and 5Bb are then pushed on to the inner coil former 5A in such a way that the edges that come together overlap.

25

In Figure 3 a coil former 5 is shown that is built up in the same way as the formers 5A and 5B in Figures 1 and 2. Here the former 5 consists of two C-shaped parts 5a and 5b that are placed with their ends 15 together so as to overlap in an overlap region $\bar{U}$. The part-former 5a consists of three part-shells 5a1, 5a2 and 5a3 arranged nested inside one another. The part-former 5b consists of three part-shells 5b1, 5b2 and 5b3 arranged nested inside one another. Each of the part-shells again has a U-section and consists of a thermoplastically formable foil. As a result of the C-shaped part-formers 5a, 5b being placed up against one another, the coil former 5 has two

35

interruptions 18.

Figure 4 shows a coil-former 5C with only one interruption 18. It consists of three ring-shaped shells 5c1, 5c2 and 5c3 arranged as layers over one another or nested inside one another. Each of the shells has a U-shaped cross-section and consists of a thermoplastically formable plastic foil. The shells are in themselves dimensionally stable but elastically deformable. In particular they can be bent open by moving their ends 15 apart. In this opened form they can be fitted over the other shells and packed inside another. As can be seen from Figure 4, the ends 15 of the shells are alternately pushed together and form an overlap region Ü.

Between the shells or part-shells of all the embodiments an additional metal foil, in particular a copper foil, can be inserted to provide shielding for the windings from other windings or from the iron core.



CLAIMS

1. Transformer, in particular miniature or safety transformer,
5 having an inner and an outer coil former (5A, 5B), configured to be ring-shaped, of electrically insulating material, which at a sectional plane containing the ring axis (7) have an approximately U-shaped cross-section, the U-limbs (11) of the coil formers (5A, 5B) pointing away
10 from the ring axis (7) and forming edge flanges for a transformer winding, the inner coil former (5A) surrounding a cavity (10) for receiving a core limb (6), and the outer coil former (5B) being dimensionally stable and elastically deformable under stress and having an interruption (18) at
15 at least one position on its circumference, the ends (15) formed by the interruption (18) overlapping, and having a first transformer winding (3) wound on the inner coil former (5A) and a second transformer winding (4) wound on the outer coil former (5B), the first transformer
20 winding (3) being electrically insulated from the second transformer winding (4) by the outer coil former (5B), characterised in that, the outer coil former consists of at least two ring-like shells (5Ba1, 5Ba2, 5Bb1, 5Bb2, 5a1, 5a2, 5a3, 5b1, 5b2,
25 5b3, 5c1, 5c2, 5c3) superimposed over one another in a layered fashion, of which each is in itself dimensionally stable and elastically deformable under stress, e.g. by bending apart, and has only one interruption (18) at its circumference.

30

2. Transformer according to claim 1, characterised in that the shells (5Ba1, 5Ba2, 5Bb1, 5Bb2, 5a1, 5a2, 5a3, 5b1, 5b2, 5b3, 5c1, 5c2, 5c3) are similar.

35

3. Transformer according to claim 1 or 2, characterised in that a metal foil, preferably a copper foil, is inserted between at least two shells.



4. Transformer according to any preceding claim, characterised in that the shells are of thermoplastic material.

5 5. Process for manufacturing a transformer, in particular a miniature or safety transformer, a first transformer winding (3) being wound on an inner coil former (5A) of electrically insulating material and surrounding a cavity for receiving a core limb (6), an
10 outer coil former (5B) being placed on the first transformer winding (3) and a second transformer winding (4) being wound on the outer coil former (5B), the first transformer winding (3) being electrically insulated from the second transformer winding (4) by means of the outer
15 coil former (5B), and the outer coil former (5B) having at a sectional plane containing the ring axis (7) an approximately U-shaped cross-section, the U-limbs (11) pointing away from the ring axis (7) and forming edge flanges for the winding,
20 characterised in that, U-sections are made from a flat strip of foil by plastic forming, in that ring-shaped shells (5c, 5c1, 5c2, 5c3) or C-shaped part-shells (5Aa, 5Ab, 5Ba1, 5Ba2, 5Bb1, 5Bb2) are made
25 from the U-sections by plastic forming, each being in itself dimensionally stable in the absence of stress and elastically deformable under stress, in that the outer coil former is assembled from the ring-shaped shells (5c, 5c1, 5c2, 5c3) or C-shaped part-shells
30 (5Aa, 5Ab, 5Ba1, 5Ba2, 5Bb1, 5Bb2), at least two ring-shaped shells (5c1, 5c2, 5c3) being pushed over one another or at least two C-shaped part-shells (5Aa, 5Ab, 5a1, 5b1) being pushed together so that their ends (15) overlap, and then at least two further C-shaped part-shells (5Ba1, 5Bb1, 5Ba2, 5Bb2, 5a2, 5b2, 5a3, 5b3) being pushed over the first
35 C-shaped part-shells (5Aa, 5Ab, 5a1, 5b1) so that their ends also overlap, and



in that the shells or part-shells of the outer coil former (5B) are pushed over the first transformer winding (3).

5 6. A process according to claim 5, characterised in that a plurality of U-sections, and therefrom a plurality of ring-shaped shells or C-shaped part-shells are simultaneously made from a plurality of superimposed flat strips of foil by plastic forming in a single process step.

10 7. A process according to claim 6; characterised in that when ring-shaped shells are used these are successively opened by elastic bending apart at the interruptions and pushed over one another.

15 8. A process according to claim 7, characterised in that the ring-shaped shells are successively pushed over one another in such a way that the interruptions come to lie alternately at opposite positions of the outer coil former.