Sept. 2, 1958 S. J. ANTALIS 2,850,708

TRANSFORMER CORE CONSTRUCTION

Filed Oct. 29, 1954

Fig.1.

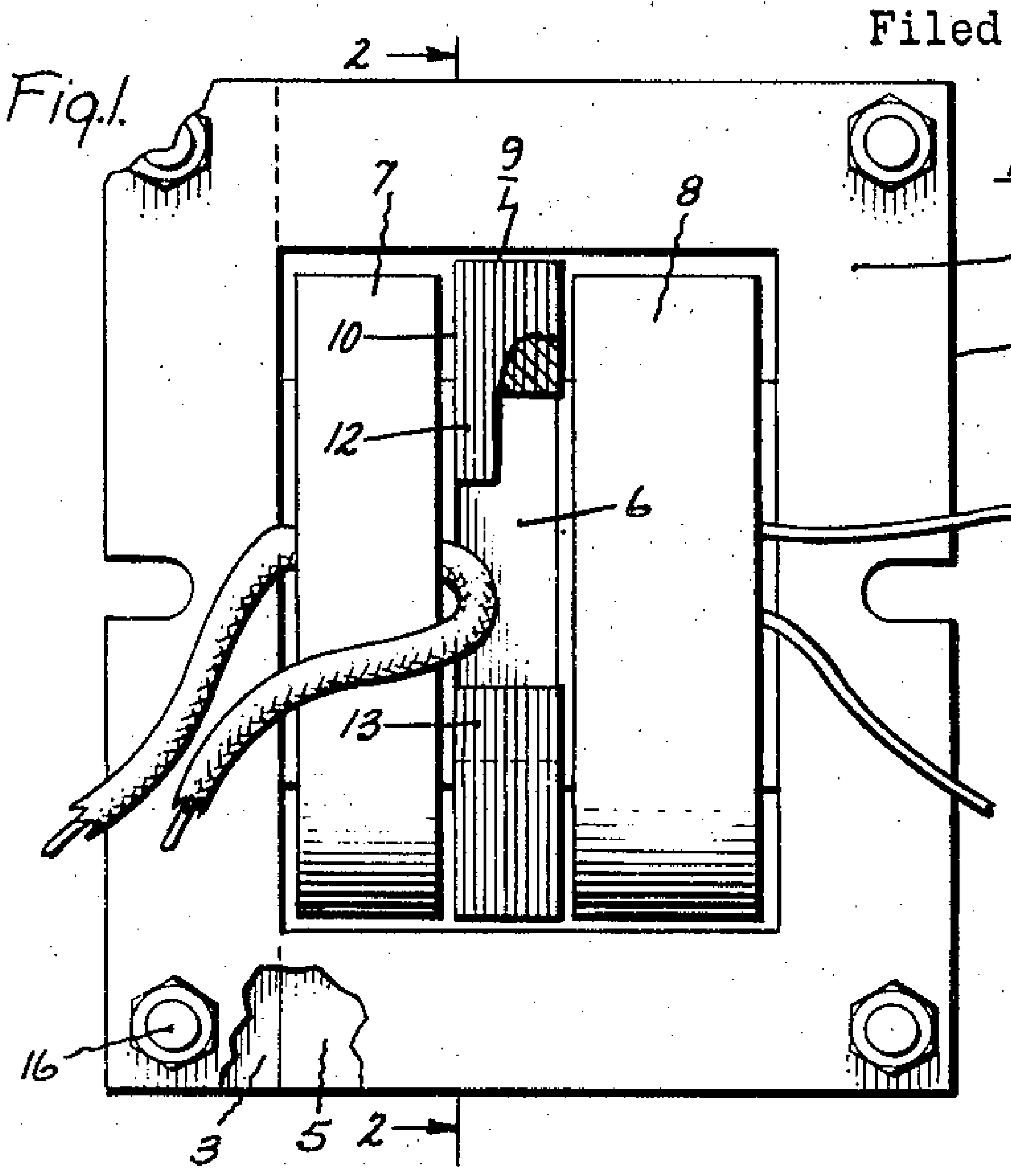

Fig.2.

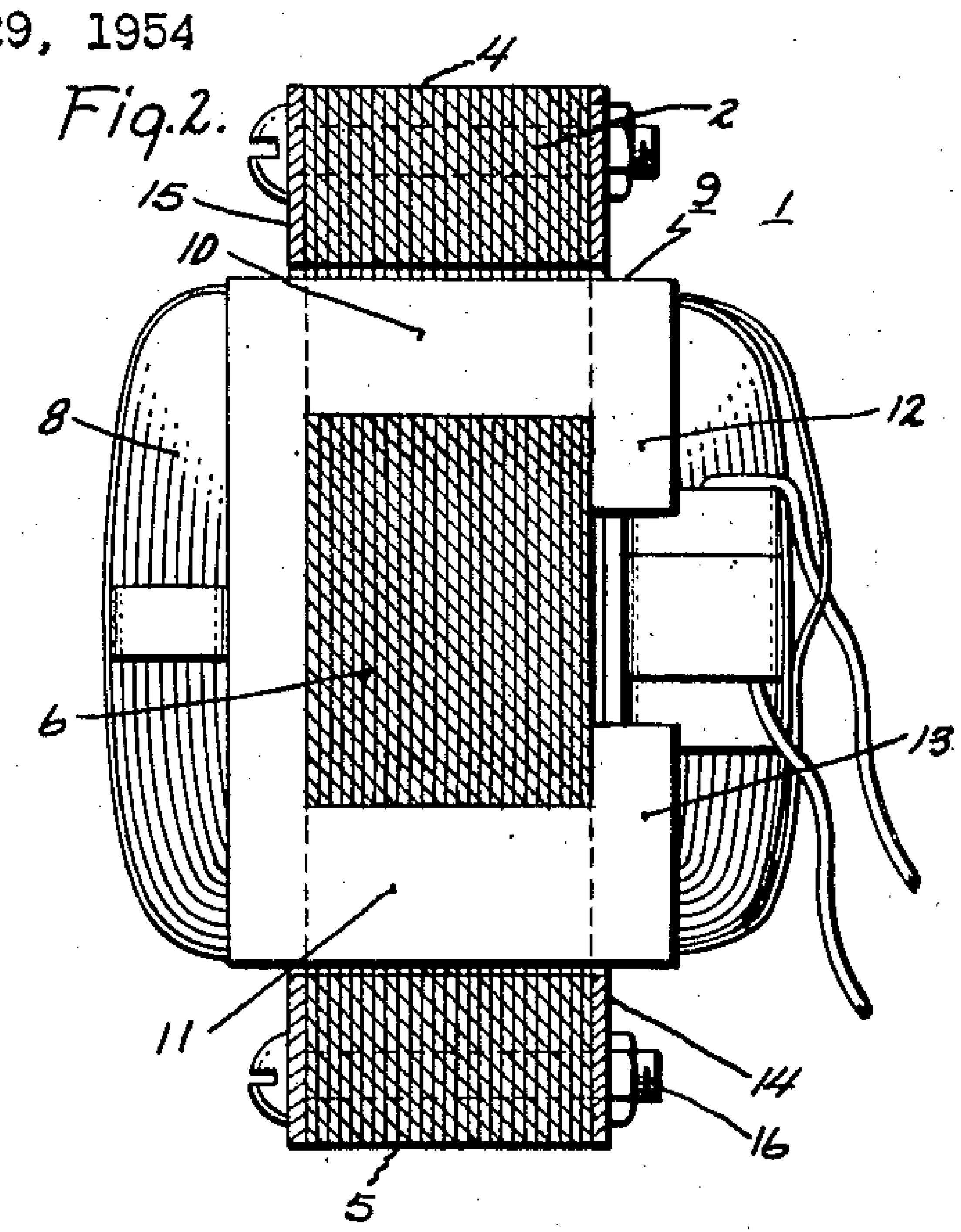

Fig.6.

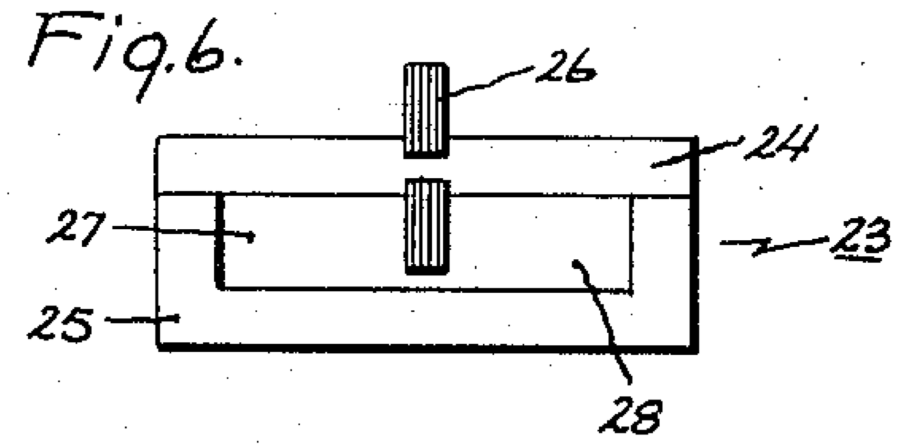

Fig.3.

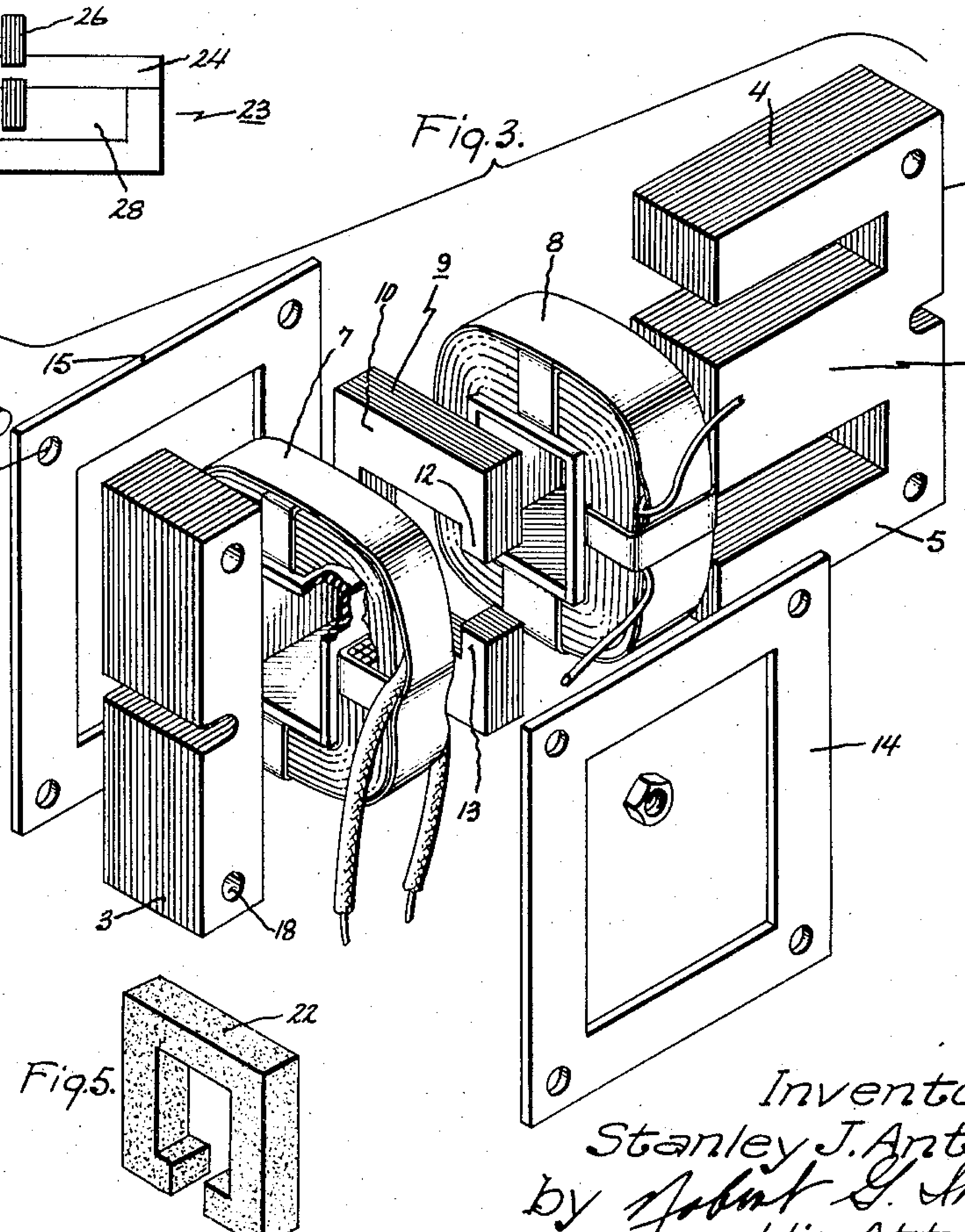

Fig.4.

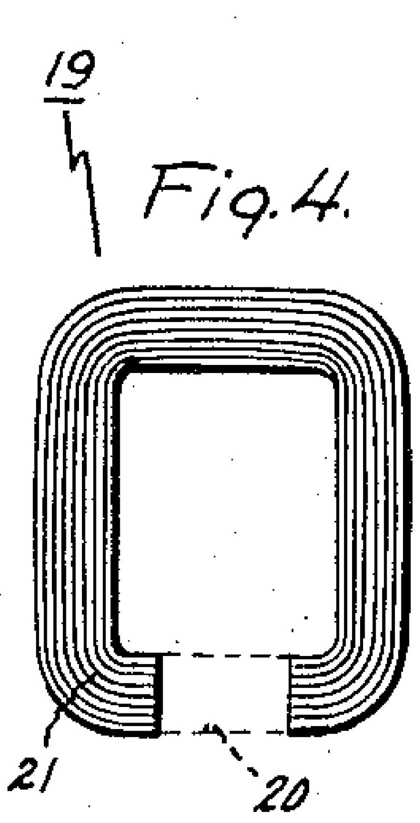

Fig.5.

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TRANSFORMER CORE CONSTRUCTION

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11 Claims. (Cl. 336—165)

This invention relates to transformer cores and more particularly to cores for high reactance type transformers.

High reactance transformers are used for energy limiting purposes since they have inherent winding impedance which limits output current to a particular maximum value. Because of this characteristic, they are frequently used for starting and operating arc discharge devices, such as fluorescent and mercury vapor lamps. These devices are characterized by their negative resistance characteristic, i. e., their internal resistance decreases as the current flow therethrough increases. A relatively high voltage is initially required in order to break down or ionize the gas in the lamp however, once an arc has been struck and current is beginning to flow, by virtue of the negative resistance characteristic of the device, it is necessary that the applied voltage be reduced in order to limit the current flow to a value which will not destroy the lamp. The high reactance or "leaky" transformer is thus ideally suited for starting and operating arc discharge devices since it can be designed to provide a relatively high open circuit voltage for initially striking the arc however, because of its "leaky" construction, its output voltage drops substantially when load current rises.

High reactance transformers are commonly constructed with a laminated core on which the primary and secondary windings are positioned and with a magnetic shunt disposed between the windings in order to provide a path for the leakage flux produced by the load current and thus providing the decoupling effect. In the past, the magnetic shunts have frequently been formed as a projection on the laminations comprising the winding leg of the transformer core, however this has necessitated a so-called forced-core construction with the winding leg a separate core element in order to permit assembly of the cores on the winding leg. In the alternative, the shunts have been formed as separate members positioned between the winding leg of the transformer and the yoke portion of the core. Such an arrangement however has necessitated the provision of means for providing the requisite air gap in the shunt circuit and means for holding the shunt in position. It is thus seen that both the forced core and separate shunt types of high reactance transformer core constructions have necessitated additional expense in order to provide the shunts. Therefore, it is desirable to provide a transformer core construction wherein the shunts need not be formed integral with the winding leg of the core, but which nevertheless does not require separate means for spacing the shunts to provide the requisite air gap and for holding the shunts in the desired position. It is of course further desirable that such a core construction be simple, inexpensive, and easy to assemble.

It is therefore an object of this invention to provide an improved core construction for a high reactance transformer incorporating the desired features set forth above.

Further objects and advantages will become apparent by reference to the following description and the accompanying drawing, and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

This invention in its broadest aspects provides a core for a high reactance transformer having a winding leg portion and a yoke portion joining the ends of the winding leg portion. A C-shaped shunt member is provided disposed on the winding leg portion and having a side defining an air gap with the yoke portion. It is thus seen that the advantages of a separate shunt are obtained without the disadvantage of having to provide spacing means and mounting means for the shunt since the shunt member of this invention by virtue of its C-shaped configuration, fits snugly over the winding leg of the transformer core thus automatically defining the requisite air gaps.

In the drawing,

Fig. 1 is a top view partially in section, illustrating the improved core construction of this invention;

Fig. 2 is a cross sectional view of the transformer of Fig. 1 taken along the line 2—2 of Fig. 1;

Fig. 3 is an exploded view in perspective partially broken away, further showing the improved core construction of Fig. 1;

Fig. 4 shows a modified form of the shunt member of this invention;

Fig. 5 shows another modified form of the shunt member of this invention; and

Fig. 6 shows the improved shunt member of this invention assembled on a different type core.

Referring now to Figs. 1, 2, and 3, there is shown a high reactance transformer, generally identified as 1. The core of the transformer 1 is formed of an E-shaped portion 2 formed from a stacked plurality of relatively thin laminations of magnetic material, and an I-shaped portion 3 also formed from a stacked plurality of relatively thin laminations of magnetic material. When the transformer 1 is completely assembled, I-shaped core portion 3 is arranged abutting the ends of side legs 4 and 5 and center leg 6 of E-shaped core portion 2.

A pair of suitable coils 7 and 8 are positioned on the center or winding leg 6 of E-shaped core portion 2, coil 7 being for example the primary winding and coil 8 the secondary winding. In order to provide a high reactance construction, a shunt member 9 is disposed between primary coil 7 and secondary coil 8. Shunt member 9 is C-shaped in configuration and is disposed on the center or winding leg 6 of E-shaped core portion 2, as best seen in Fig. 2. The shunt member 9, as shown, partially encircles the center winding leg 6 and embracingly engages the same. In the embodiment of Figs. 1, 2, and 3, C-shaped shunt member 9 is formed of a stacked plurality of relatively thin laminations of magnetic material which may be held together in any desired manner, as, for example, by riveting or by bonding with known bonding materials. It will be seen that side legs 10 and 11 define shunt air gaps respectively with side legs 4 and 5 of E-shaped core portion 2 and that the fact that ends 12 and 13 of C-shaped shunt member 9 are spaced apart prevents the center leg 6 of E-shaped core portion 2 from being entirely shunted. The spacing of the ends 12 and 13 of the shunt member, as shown, is less than the distance between its opposite inner sides whereby the shunt member is self-supporting retained on the center leg 6. The E-shaped core portion 2, I-shaped core portion 3, coils 7 and 8, and C-shaped shunt member 9 are held in assembled relation by means of suitable plates 14 and 15 and suitable screw bolts 16 which extend through suitable openings 17 and 18 in the plates and core portions respectively as shown.

Referring now to Fig. 4 there is shown C-shaped shunt member 19 formed from a wound strip of relatively thin magnetic material. Here, the strip is preferably wound upon a rectangular arbor to the desired size and a portion is cut out, as at 20 to define the C-shaped configuration. It is thus seen that the resultant shunt member is formed of a plurality of superimposed layers of strip material 21.

Referring now to Fig. 5, there is shown a C-shaped shunt member 22 formed of sintered magnetic material, molded in the desired configuration.

Referring now to Fig. 6 there is shown a transformer core 23 having a laminated winding leg portion 24 and a yoke portion 25 joining the ends of the winding leg portion 24. It will be seen that this is magnetically the equivalent of center leg 6. I-shaped portion 3, and side leg 5 of E-shaped portion 2 of Figs. 1 to 3 inclusive. Here, C-shaped shunt member 26, which may be either laminated at shown in Figs. 1 to 3 inclusive, wound as shown in Fig. 4, or sintered as shown in Fig. 5, is positioned on winding leg 24 thus defining coil windows 27 and 28 on either side thereof.

While an E and I core construction has been shown in Figs. 1 to 3 inclusive and a "core type" of core construction has been shown in Fig. 6, it will be readily understood that these two types of core constructions are by way of illustration only and that the C-shaped shunt member of this invention is equally applicable to other core configurations.

It will now be readily seen that the C-shaped shunt member of this invention is simply and inexpensively formed either by punching, winding, or sintering, and further can be readily formed to the precise dimensions necessary to give the proper shunt air gap. It is further seen that it is simply assembled on the winding leg of the core and that it eliminates the need for mechanically securing a separate shunt member in place. While I have shown and described particular embodiments of this invention, further modifications and improvements will occur to those skilled in the art. I desire that it be understood therefore that this invention is not limited to the forms shown and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of this invention.

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

1. A core for a high reactance transformer comprising a winding leg portion and a yoke portion joining the ends of said winding leg portion, and a C-shaped shunt member partially encircling said winding leg portion and embracingly engaging the same, said shunt member having its ends spaced apart a distance less than the distance between its opposite inner sides whereby said shunt member is self-supportingly retained on said winding leg portion, said shunt member having at least one outer side spaced from a corresponding inner side of said yoke portion and defining a fixed shunt air-gap therewith.

2. A core for high reactance transformer comprising a laminated winding leg portion and a laminated yoke portion, and a C-shaped shunt member partially encircling said winding leg portion and embracingly engaging the same, said shunt member having its ends spaced apart a distance less than the distance between its opposite inner sides whereby said shunt member is self-supportingly retained on said winding leg portion, said shunt member having at least one outer side spaced from a corresponding inner side of said yoke portion and defining a fixed shunt air-gap therewith.

3. A core for a high reactance transformer comprising a laminated winding leg portion and a laminated yoke portion joining the ends of said winding leg portion, and a laminated C-shaped shunt member partially encircling said winding leg portion and embracingly engaging the same, said shunt member having its ends spaced apart a distance less than the distance between its opposite inner sides whereby said shunt member is self-supportingly retained on said winding leg portion, said shunt member having at least one outer side spaced from a corresponding inner side of said yoke portion and defining a fixed shunt air-gap therewith.

4. A core for a high reactance transformer comprising a laminated winding leg portion and a laminated yoke portion joining the ends of said winding leg portion, and a C-shaped shunt member formed of a stacked plurality of laminations partially encircling said winding leg portion and embracingly engaging the same, said shunt member having its ends spaced apart a distance less than the distance between its opposite inner sides whereby said shunt member is self-supportingly retained on said winding leg portion, said shunt member having at least one outer side spaced from a corresponding inner side of said yoke portion and defining a fixed shunt air-gap therewith.

5. A core for a high reactance transformer comprising a laminated winding leg portion and a laminated yoke portion joining the ends of said winding leg portion, and a C-shaped shunt member formed of a plurality of layers of strip material partially encircling said winding leg portion and embracingly engaging the same, said shunt member having its ends spaced apart a distance less than the distance between its opposite inner sides whereby said shunt member is self-supportingly retained on said winding leg portion, said shunt member having at least one outer side spaced from a corresponding inner side of said yoke portion and defining a fixed shunt air-gap therewith.

6. A core for a high reactance transformer comprising a laminated winding leg portion and a laminated yoke portion joining the ends of said winding leg portion, and a C-shaped shunt member formed of sintered material partially encircling said winding leg portion and embracingly engaging the same, said shunt member having its ends spaced apart a distance less than the distance between its opposite inner sides whereby said shunt member is self-supportingly retained on said winding leg portion, said shunt member having at least one outer side spaced from a corresponding inner side of said yoke portion and defining a fixed shunt air-gap therewith.

7. A core for a high reactance transformer comprising a laminated E-shaped portion and another laminated portion joining the ends of the legs of said E-shaped portion, and a C-shaped shunt member partially encircling the center leg of said E-shaped portion and embracingly engaging the same, said shunt member having its ends spaced apart a distance less than the distance between its opposite inner sides whereby said shunt member is self-supportingly retained on said center leg, said shunt member having its opposite outer sides respectively spaced from the inner sides of the side legs of said E-shaped portion and respectively defining fixed shunt air-gaps therewith.

8. A core for a high reactance transformer comprising a laminated E-shaped portion and another laminated portion joining the ends of said E-shaped portion, and a laminated C-shaped shunt member partially encircling the center leg of said E-shaped portion and embracingly engaging the same, said shunt member having its ends spaced apart a distance less than the distance between its opposite inner sides whereby said shunt member is self-supportingly retained on said center leg, said shunt member having its opposite outer sides respectively spaced from the inner sides of the side legs of said E-shaped portion and respectively defining fixed shunt air-gaps therewith.

9. A core for a high reactance transformer comprising a laminated E-shaped portion and a laminated I-shaped portion joining the ends of the legs of said E-shaped portion, and a C-shaped shunt member partially encircling the center leg of said E-shaped portion and embracingly engaging the same, said shunt member having its ends spaced apart a distance less than the distance between its opposite inner sides whereby said shunt member is self-supportingly retained on said center leg, said shunt member having its opposite outer sides respectively spaced from the inner sides of the side legs of said E-shaped portion and respectively defining fixed shunt air-gaps therewith.

10. A core for a high reactance transformer comprising a laminated E-shaped portion and a laminated I-shaped portion, and a laminated C-shaped shunt member partially encircling the center leg of said E-shaped portion and embracingly engaging the same, said shunt member having its ends spaced apart a distance less than the distance between its opposite inner sides whereby said shunt member is self-supportingly retained on said center leg, said shunt member having its opposite outer sides respectively spaced from the inner sides of the side legs of said E-shaped portion and respectively defining fixed shunt air-gaps therewith.

11. A core for a high reactance transformer comprising a winding leg portion and a yoke portion joining the ends of said winding leg portion, and a C-shaped shunt member partially encircling one of said portions and embracingly engaging the same, said shunt member having

its inner ends spaced apart a distance less than the distance between its opposite inner sides whereby said shunt member is self-supportingly retained on said one portion, said shunt member having at least one outer side spaced from a corresponding inner side of the other of said portions and defining a fixed shunt air-gap therewith.

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