Nov. 20, 1956 W. L. R. HENDERSON 2,771,587

INDUCTIVE DEVICE

Filed Nov. 12, 1953

Fig. 1.

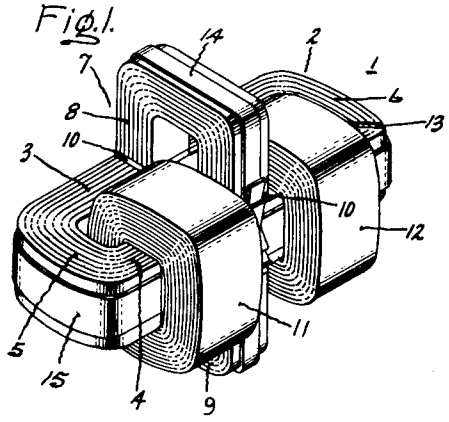


Fig. 2.

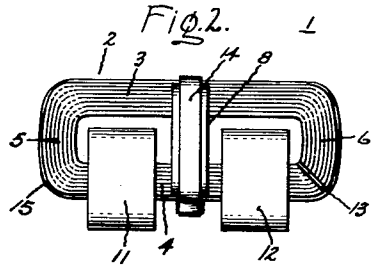


Fig. 3.

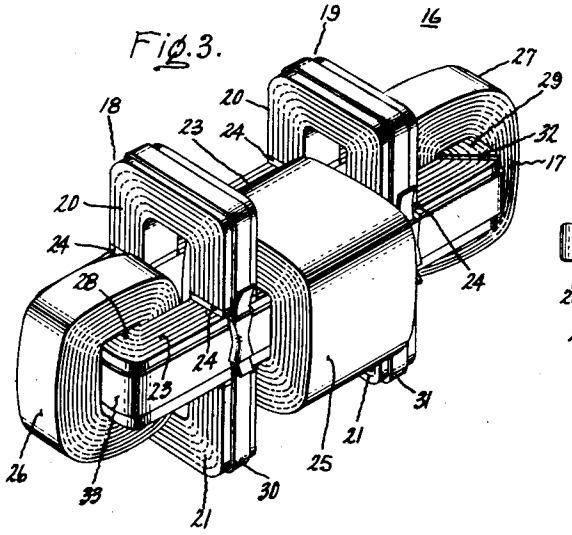


Fig. 4.

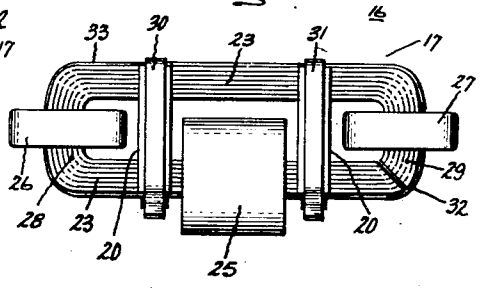


Fig. 5.

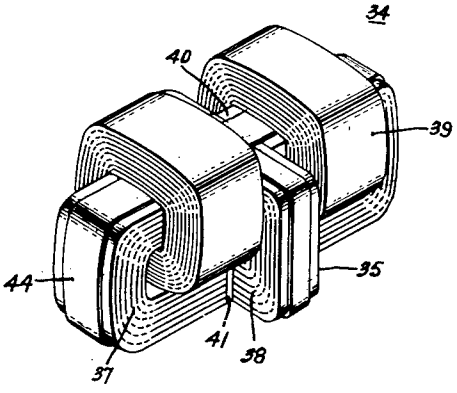
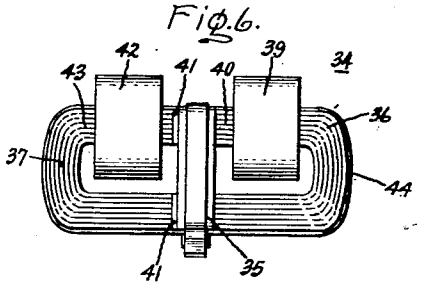


Fig. 6.



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2,771,587

INDUCTIVE DEVICE

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14 Claims. (Cl. 336—160)

This invention relates to inductive devices such as ballast transformers for arc discharge devices and more particularly to inductive devices of the wound core type.

Small transformers are conventionally used to energize arc discharge devices, for example, mercury vapor lamps. These transformers serve a dual function in initially providing a sufficiently high voltage to produce ionization in the lamp and subsequently limiting current after the lamp is fired. In order to provide the current limiting action, these transformers are conventionally of the high leakage reactance type, i. e. with shunts providing a low reluctance path for leakage reactance flux.

In the past, such transformers have generally been provided with a magnetic core formed of a stack of relatively thin flat laminations of magnetic material. It is well known that the use of grain oriented magnetic material provides greater flux density with less core loss and lower exciting current. However, sheet magnetic material used in forming transformer core laminations can only be grain oriented in one direction and therefore even though the core may be grain oriented in its principal direction, the portions of the core which are transversely arranged with respect to the principal dimension are not grain oriented in the proper direction.

It is also well known that instead of fabricating a core by stacking up a plurality of thin laminations of flat magnetic material, the core may be produced by winding up a continuous relatively thin strip of magnetic material. If this strip of magnetic material is likewise grain oriented the resultant core is completely grain oriented, i. e. both in its principal dimension and transversely thereto thus producing more efficient operation. While low reactance leakage wound core transformers have been provided in the past, it is desirable to provide a wound core high leakage reactance transformer in which all elements including the high leakage reactance shunts are formed of wound core elements.

It is therefore the object of this invention to provide an improved inductive device of the wound core type incorporating the desirable features set forth above.

Further objects and advantages of this invention will become apparent and the invention will be better understood 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 an inductive device having a first generally O-shaped wound core member and a second wound core member formed of two generally U-shaped portions respectively arranged on either side of the first core member and in a plane at right angles thereto. At least two coils are respectively arranged on one of the core members on either side of the other core member. It will thus be seen that one of the core members forms the basic core element while the other core member forms the magnetic shunt element.

In the drawing,

Fig. 1 is a perspective view showing a high leakage reactance transformer constructed in accordance with this invention;

Fig. 2 is a side elevational view of the transformer of Fig. 1;

Fig. 3 is a perspective view of another high leakage reactance transformer incorporating the improved wound core construction of this invention;

Fig. 4 is a side elevational view of the transformer of Fig. 3;

Fig. 5 is a perspective view of an autotransformer-reactor having the improved wound core construction of this invention; and

Fig. 6 is a side elevational view of the transformer of Fig. 5.

Referring now to Figs. 1 and 2, there is shown a high leakage reactance transformer, generally identified as **1**, having a first generally O-shaped core member **2** wound from a relatively thin strip of magnetic material. The strip from which core member **2** is wound is preferably grain oriented in a longitudinal direction so that side legs **3** and **4** and end legs **5** and **6** are all grain oriented in the same direction. In order to provide shunt members for the leakage reactance flux, another wound core member **7** is provided having two generally U-shaped portions **8** and **9**. Portions **8** and **9** are originally formed as a single generally O-shaped member wound from a single strip of relatively thin preferably longitudinally grain oriented magnetic material. After winding, the member **7** is transversely cut in two forming portions **8** and **9** which are then respectively arranged on either side of core member **1** and at a plane at right angles thereto. U-shaped portions **8** and **9** are spaced from sides **3** and **4** of core member **2** by suitable spacers **10** of insulating material thus forming shunt air gaps. A suitable coil **11**, which may be the primary coil, is arranged on side leg **4** of core **2** on one side of core member **7** and another suitable coil **12**, which may be the secondary coil is arranged on side leg **4** on the other side of core member **7**. Coils **11** and **12** may be wound directly on side leg **4** of core member **2**, however they are preferably prewound in which case core member **2** may have a transverse cut **13** formed therein thereby permitting end leg **6** and side leg **4** to be sprung apart so that coils **11** and **12** may be positioned thereon. In order to secure U-shaped portions **8** and **9** to core member **2**, a suitable band or strap **14** is wrapped around U-shaped portions **8** and **9** and core member **2**, as shown, and its ends fastened together in any suitable manner (not shown). Similarly, in order to hold core member **2** in assembled relation so that the ends on either side of cut **13** do not separate, band **15** is arranged around core member **2** with its ends being secured together in any suitable manner (not shown).

It will now be seen that Figs. 1 and 2 show an improved high leakage reactance transformer-ballast wherein both the main core element and the magnetic shunts are of the wound-core type thereby permitting complete grain orientation of the entire core.

Referring now to Figs. 3 and 4, there is shown a transformer-ballast for use with two arc discharge devices, such as two mercury vapor lamps. Here the two-lamp transformer ballast **16** is provided with a main core **17** wound from a relatively thin strip of magnetic material, preferably grain oriented in the longitudinal direction. Two spaced apart shunt members **18** and **19** are provided each formed of two generally U-shaped portions **20** and **21**. As in the case of Figs. 1 and 2, shunt members **18** and **19** have been originally formed as generally O-shaped members wound from a relatively thin strip of magnetic material, preferably longitudinally grain

oriented, and subsequently transversely cut into two parts. Portions 20 and 21 of shunt members 18 and 19 are respectively arranged on either side of core member 17 and their ends are spaced from side legs 22 and 23 of core member 17 by suitable non-magnetic spacers 24 thereby providing shunt air gaps. A primary winding 25 is mounted on side leg 23 of core 17 intermediate shunt core members 18 and 19 and secondary windings 26 and 27 are respectively mounted on end legs 28 and 29 of core member 17. Portions 20 and 21 of shunt core members 18 and 19 are secured to core member 17 by bands 30 and 31. Core member 17 is transversely cut as at 32 to permit assembly of coils 25, 26 and 27 thereon. Core member 17 is held in assembled relation by band 33.

Referring now to Figs. 5 and 6, there is shown a low leakage reactance auto-transformer with an associated reactor. Here, the auto-transformer-reactor device 34 includes a generally O-shaped wound core member 35 again wound up from a relatively thin strip of magnetic material, preferably longitudinally grain oriented. A transformer core number 36 and a reactor core number 37 are provided, these members having been initially formed as a single generally O-shaped wound core member wound up from a single relatively thin strip of magnetic material, again preferably longitudinally grain oriented and subsequently transversely cut in two to form the two generally U-shaped members 36 and 37. Transformer core member 36 is arranged with its ends butting the sides 38 of core member 35 and has a suitable auto-transformer coil 39 mounted on side leg 40. Reactor core member 37 is arranged with its ends spaced from the side of core member 35 remote from transformer core member 36 by suitable non-magnetic spacers 41 thus forming air gaps. Reactor coil 42 is mounted on side leg 43 of reactor coil 37. The device is held in assembled relation by a suitable band 44 surrounding transformer core member 36, reactor core 37 and crossing legs 38 of core member 35.

It will now be seen that this invention provides an improved transformer construction wherein all core elements are of the wound core type thereby permitting complete grain orientation with a resultant increase in operating efficiency.

While I have shown 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 impart from the spirit and scope of this invention.

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

1. An inductive device comprising a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member and in a plane at right angles thereto with the ends of the legs of said U-shaped portions being respectively magnetically adjacent opposite sides of said first core member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member, and at least two coils respectively arranged on only one of said core members on either side of the other of said core members.

2. An inductive device comprising a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member and in a plane at right angles thereto with the ends of the legs of said U-shaped portions being respectively magnetically adjacent opposite sides of said first core member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member, a band surrounding said second core member thereby securing the same to said first core member, and at least two coils respectively arranged on only one of said core members on either side of the other of said core members.

3. An inductive device comprising a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member and in a plane at right angles thereto with the ends of the legs of said U-shaped portions being respectively magnetically adjacent opposite sides of said first core member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member, and two coils respectively arranged on only said first core member and on either side of said second core member.

4. An inductive device comprising a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member and in a plane at right angles thereto with the ends of the legs of said U-shaped portions being respectively magnetically adjacent opposite sides of said first core member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member, a band surrounding said second core member thereby securing the same to first core member, and two coils respectively arranged on said first core member only and on either side of said second core member.

5. A high leakage reactance transformer comprising a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member with the ends of their legs respectively spaced from opposite sides of said first core member thereby forming shunt air gaps, said second core member being in a plane at right angles to said first core member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member and two coils respectively arranged on said first core member only on either side of said second core member.

6. An inductive device comprising a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member and in a plane at right angles thereto with the ends of the legs of said U-shaped portions being respectively magnetically adjacent opposite sides of said first core member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member, said first core member being transversely split at one point thereby to permit the assembly of coils thereon, and two coils respectively arranged on said first core member only on either side of said second core member.

7. An inductive device comprising a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member and in a plane at right angles thereto with the ends of the legs of said U-shaped portions being respectively magnetically adjacent opposite sides of said first core member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member, said first core member being transversely split at one point thereby to permit the assembly of coils thereon, a band surrounding said first core member thereby holding the same in an assembled relation, and two coils respectively arranged on said first core member only and on either side of said second core member.

8. A high leakage reactance transformer comprising a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member with the ends of their legs respectively spaced from opposite sides of said first core member thereby forming shunt air gaps, said second core member being in a plane at right angles to said first core member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member a band surrounding said second core member thereby securing the same as to said first core member, said first core member being transversely split at one point thereby to permit the assembly of coils thereon, a band surrounding said first core member thereby holding the same in assembled relation, and two coils respectively arranged on said first core member only and on either side of second core member.

9. An inductive device comprising a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member and in a plane at right angles thereto with the ends of the legs of said U-shaped portions being respectively magnetically adjacent opposite sides of said first core member, a third wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member, said third core member being spaced from said second core member and being in a plane at right angles to the plane of said first core member with the ends of the legs of said last-named U-shaped portions being respectively magnetically adjacent said opposite sides of said first core member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member a primary coil arranged on said first core member intermediate said second and third core members, and a pair of secondary coils respectively arranged on said first core member on the sides of said second and third core members remote from said primary coil.

10. A high leakage reactance transformer comprising of a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member with the ends of their legs respectively spaced from opposite sides of said first core member thereby forming shunt air gaps, said second core member being in a plane at right angles to said first core member, a third wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member with the ends of their legs respectively spaced from said opposite sides of said first core member thereby forming shunt air gaps, said third core member being in a plane at right angles to said first core member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member a primary coil arranged on said first core member intermediate on said second and third core members, and pair of secondary coils respectively arranged on said first core member from the sides of said second and third core members remote from said primary coil.

11. An inductive device comprising a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member in a plane at right angles thereto with the ends of the legs of said U-shaped portions being respectively magnetically adjacent opposite sides of said first core member, a third wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member, said third core member being spaced from said second core member and being in a plane at right

angles to the plane of said first core member with the ends of the legs of said last-named U-shaped portions being respectively magentically adjacent said opposite sides of first core member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member a primary coil arranged on said first core member intermediate of said second and third core members, a pair of secondary coils respectively arranged on said first core member on the sides of said second and third core members remote from said primary coil, and bands surrounding said second and third core members securing the same to said first core member.

12. An inductive device comprising a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member and in a plane at right angles thereto with the ends of the legs of said U-shaped portions being respectively magnetically adjacent opposite sides of the first core member, a third wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member, said third core member being spaced from said second core member and being in a plane at right angles to the plane of said first core member with the ends of the legs of said last-named U-shaped portions being respectively magnetically adjacent opposite sides of first core member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member a primary coil arranged on said first core member intermediate said second and third core members, a pair of secondary coils respectively arranged on said first coil member and the sides of said second and third core members remote from said primary coil, said first core member being transversely split at one point thereon to permit the assembly of said coils thereon, and a band surrounding said first core member thereby holding the same in assembled relation.

13. A high leakage reactance transformer comprising of a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member with the ends of their legs respectively spaced from opposite sides of said first core member only thereby forming shunt air gaps, said second core member being in a plane at right angles to the plane of said first core member, a third wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member with the ends of their legs respectively spaced from said opposite sides of said first core member thereby forming shunt air gaps, said third core member being spaced from said second core member and being in a plane at right angles to the plane of said first core member, the laminations of the ends of said legs being respectively in the same plane as the laminations of said opposite sides of said first core member a primary coil arranged on said first core member intermediate said second and third core members, a pair of secondary coils respectively arranged on said first core member on the sides of said second and third core members remote from primary coil, bands respectively surrounding said second and third core members thereby securing the same as to said first core member, said first core member being transversely split at one point thereby to permit the assembly of said coils thereon, and a band surrounding said first core member thereby holding the same in assembled relation.

14. An inductive device comprising a first generally O-shaped wound core member, a second wound core member formed of two generally U-shaped portions respectively arranged on either side of said first core member and in a plane at right angles thereto with the ends of the legs of said U-shaped portions being respectively magnetically adjacent opposite sides of said first core

member, the laminations of the ends of said legs being respectively in the same planes as the laminations of said opposite sides of said first core member, and two coils respectively arranged on said second core member on either side of said first core member.

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