Nov. 28, 1961 R. H. DIERSTEIN 3,011,139

INDUCTIVE DEVICE AND FRAME THEREFOR

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Fig. 1.

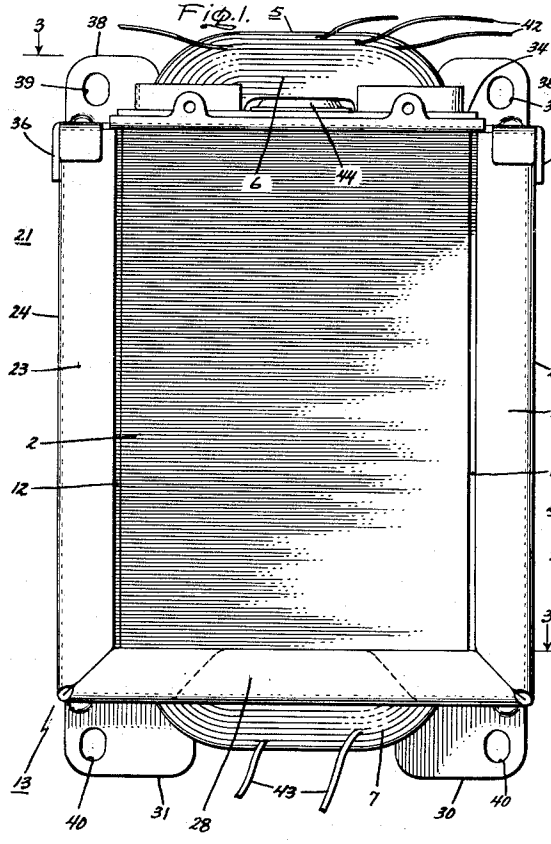


Fig. 2.

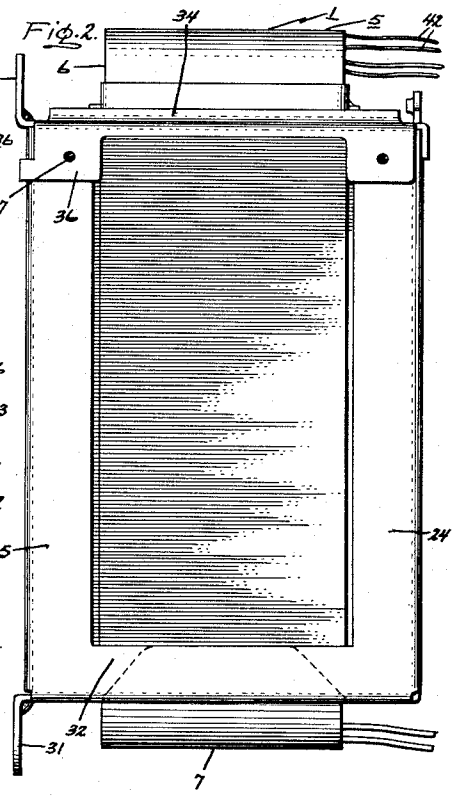


Fig. 3.

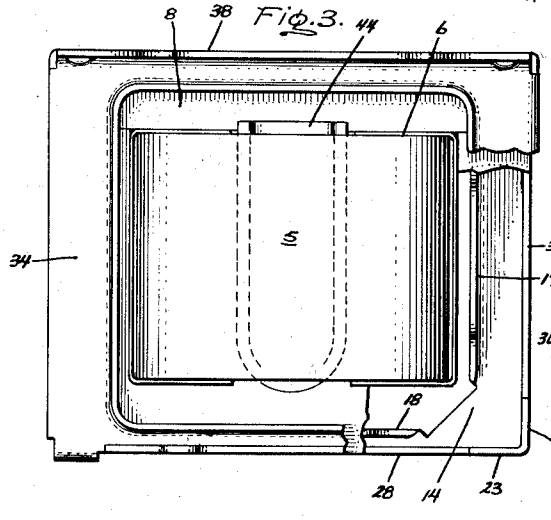
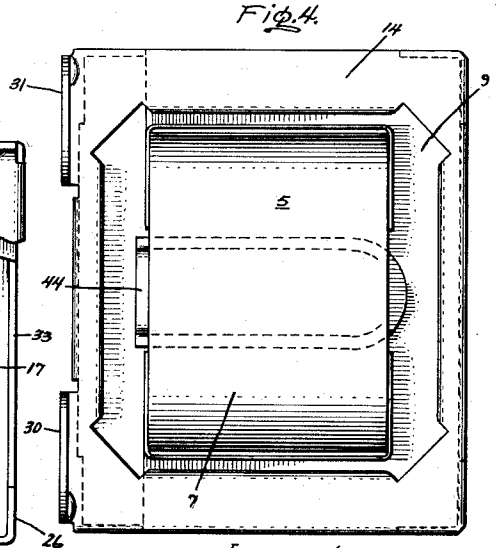


Fig. 4.



Inventor:
Roy H. Dierstein,
by H. F. Manbeck, Jr.
Attorney.

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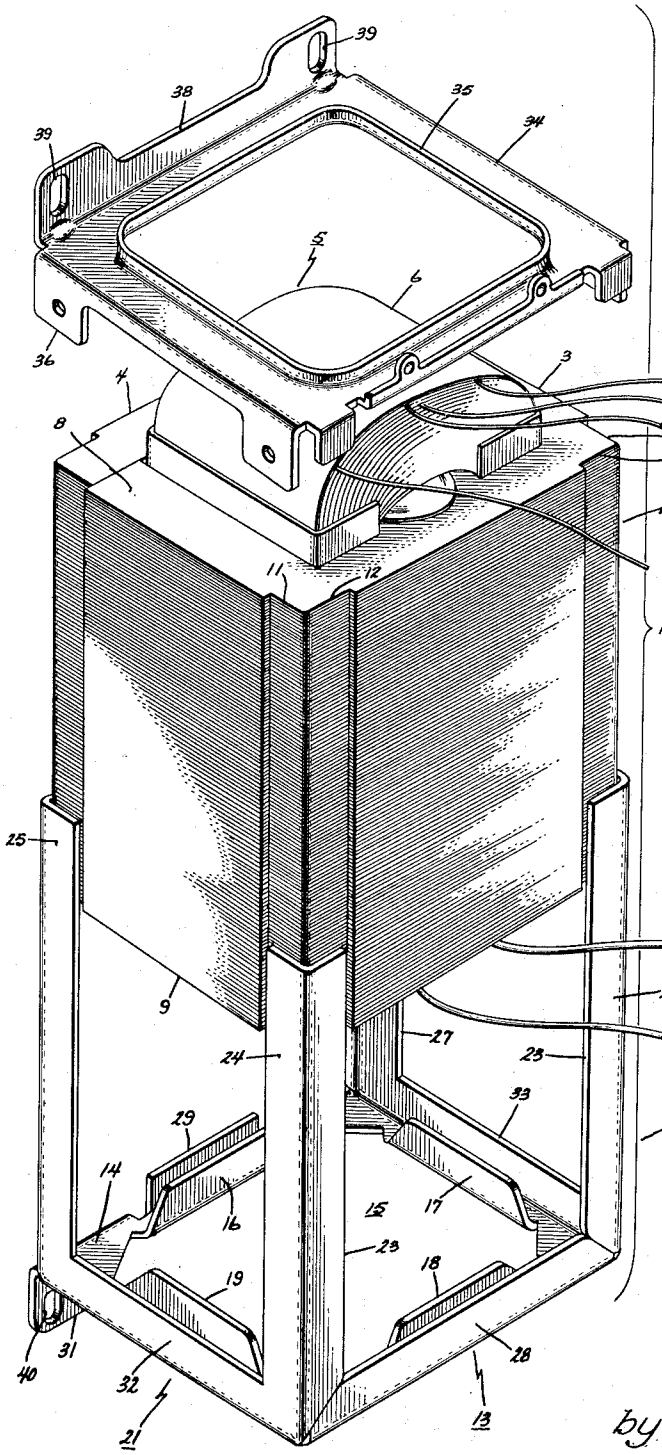
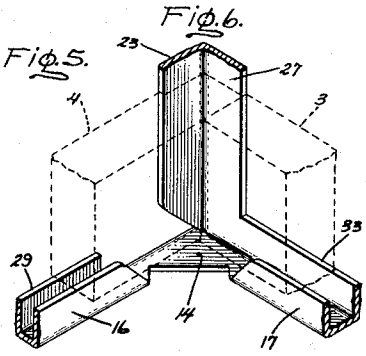


Fig. 5.

Fig. 6.



Inventor:
Roy H. Dierstein,
by H. F. Manbeck, Jr
Attorney.

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INDUCTIVE DEVICE AND FRAME THEREFOR

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Fig. 7.

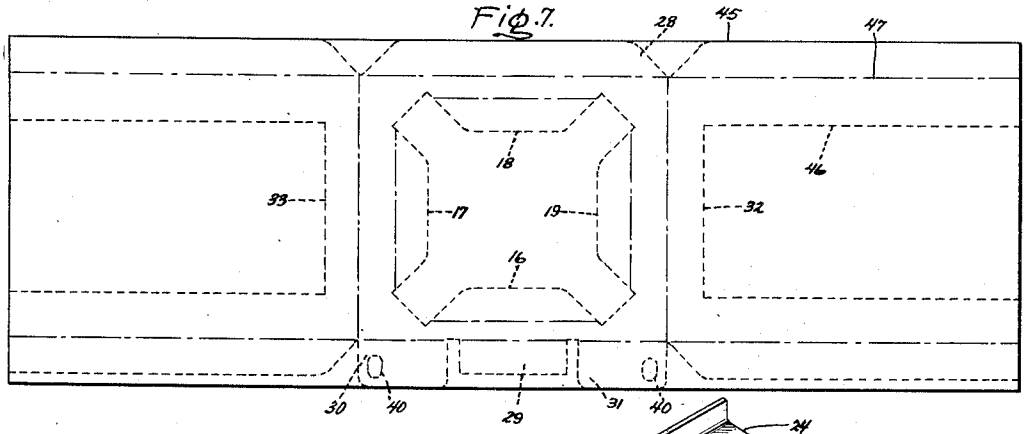


Fig. 8.

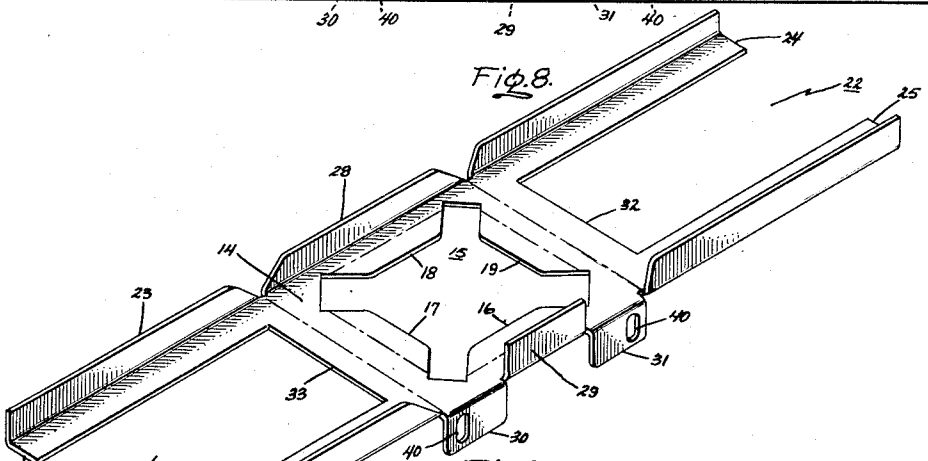
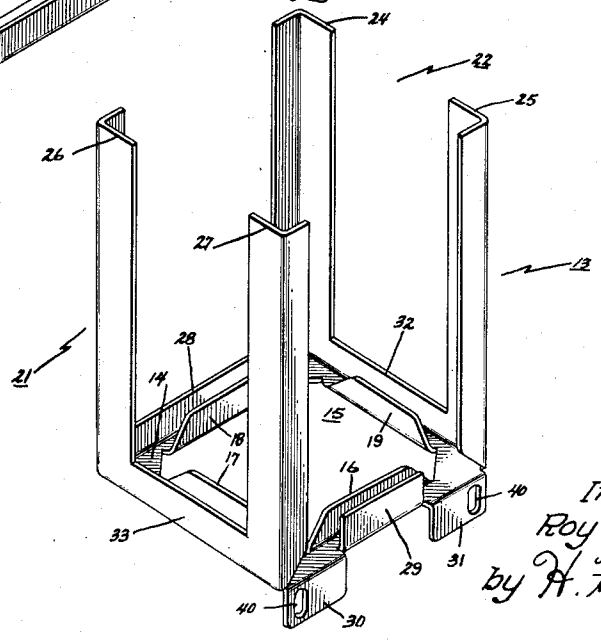


Fig. 9.



Inventor:
Roy H. Dierstein,
by H. F. Maulbeck, Jr.
Attorney.

United States Patent Office 3,011,139 Patented Nov. 28, 1961

3,011,139

INDUCTIVE DEVICE AND FRAME THEREFOR

Roy H. Dierstein, Fort Wayne, Ind., assignor to General Electric Company, a corporation of New York

Filed July 7, 1958, Ser. No. 746,765
7 Claims. (Cl. 336—98)

This invention relates to inductive devices comprising a laminated core with a coil thereon, such as transformers, and more particularly to a frame construction for supporting the core of such devices.

Power transformers, conventionally comprise a magnetic core member formed of a stacked plurality of relatively thin laminations of magnetic material with a coil arranged thereon. While other configurations are sometimes employed, the core members for such transformers are generally formed of E and I shaped laminations with the coil being arranged on the center leg of the core formed by the bar portions of the E-shaped laminations: the coil thus has its sides surrounded by the core with its ends extending respectively beyond the ends or faces of the core.

Dry type transformers, i.e., as opposed to transformers in which the core and coil assembly is arranged within a tank of cooling fluid, particularly in the smaller ratings, are frequently mounted upon a panel board in conjunction with other control apparatus, the entire panel board and the equipment assembled thereon being in turn arranged within an enclosing case or housing. In such installations, it is not necessary that the transformer be individually enclosed and it is therefore merely necessary to provide for mounting the core and coil assembly; transformers and reactors of this type are commonly referred to as core and coil units. In the past, the core members of such core and coil units having commonly been clamped together and thus held in assembled relation by a plurality of through-bolts extending through openings in the core, four such bolts generally being provided adjacent each corner of the core, and appropriate mounting feet have been secured to the ends of the core by means of the through-bolts. The provision of through-bolt holes in the core, however, wastes considerable magnetic material with the through-bolts themselves having a tendency to short circuit the individual laminations. Furthermore, when the core is clamped adjacent the corners only, the magnetostrictive forces exerted on the laminations intermediate the through-bolts tend to cause undesirable humming of the transformer. It is therefore desirable to provide a core and coil type inductive device in which the laminations comprising the core member are clamped together without the use of through-bolts. It is further desirable that the clamping force exerted on the laminations of the core be applied over a greater area of the core thereby to eliminate undesirable noise in the assembled device, and it is of course additionally desirable that the construction be simply and inexpensively constructed and assembled with convenient means for mounting the resulting assembly being provided.

Patent Number 2,815,491 of Stanley J. Antalis, Myrle O. Marsh and Elmer J. Zelt, issued December 3, 1957 and assigned to the assignee of the present application disclosed a transformer assembly and which the laminations of the core member were clamped in assembled relation without the use of through-bolts. In that construction, a sleeve member was provided having four angle-shaped projections or extensions formed on the corners thereof. The core member was disposed within the four angle portions with one and seated on inwardly extending flanges formed on the sleeve member between the angle portions and with the angle portions respectively embracing the corners of the core. The core was held in assembled relation with its laminations clamped by means of a cover

member abutting the other end of the core and secured to the ends of the angle portions respectively. While the construction of the aforementioned Antalis, Marsh and Zelt patent has been eminently satisfactory for its intended purpose, i.e., transformers of the type which are required to be totally enclosed, a welding operation was required in order to assemble the sleeve member and furthermore, particularly in the case of larger transformers having a long laminated stack, it has been found that adequate support for the core was not provided with the result that excessive noise was still present. It is therefore desirable to provide a frame construction for inductive devices, such as transformers, of the general type shown in the aforementioned Antalis, Marsh and Zelt patent, but which eliminates the welding operation required in the construction of the aforementioned patent, and more particularly which provides support for the core both adjacent its outer periphery and also adjacent the coil so that a level plane is provided for the bottom lamination thus eliminating sagging of the core and resulting undesirable noise.

It is further desirable that such a frame construction be unitarily formed from a single piece of sheet metal with a minimum of manufacturing operations required.

It is accordingly an object of my invention to provide an improved frame construction for inductive devices.

Another object of my invention is to provide an improved frame construction for inductive devices which eliminates the use of through-bolts for clamping the core.

A further object of my invention is to provide an improved frame construction for inductive devices in which the core is supported in a level plane.

Yet another object of my invention is to provide an improved frame construction for inductive devices unitarily formed from a single piece of sheet metal with no welding operations being required.

A still further object of my invention is to provide an improved inductive device having a frame construction which eliminates the requirement for through-bolts for clamping the core and which is unitarily formed from a single piece of sheet metal with support being provided for the core both adjacent its outer periphery and also adjacent the coil.

Further objects and advantages of my invention will become apparent by reference to the following description and the accompanying drawings, 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.

My invention, in its broader aspects provides a unitary frame member for an inductive device having a core formed of a stack of rectangular laminations with a coil disposed thereon, the frame member being formed from a single piece of sheet metal and having a generally rectangular base portion adapted to support one end of the core and further having an opening formed therein for accommodating the corresponding end of the coil. Four angle portions extend upwardly respectively from the corners of the base portion and are respectively adapted to embrace the corners of the core. In the preferred embodiment of my invention, the base portion of the frame member has a generally rectangular central opening formed therein with each side of the opening having an upwardly extending right angle flange formed thereon. A pair of U-shaped portions extend upwardly at right angles from one pair of opposite sides of the base portion, the outer edge of each leg of the U-shaped portions having a right angle flange formed thereon with the flanges of one of the U-shaped portions extending respectively toward the flanges of the other U-shaped portions thereby defining four angle portions. The other pair of opposite sides of the base portion have upwardly extending

right angle flanges formed thereon, these flanges respectively forming a pair of channel portions with the flanges on a corresponding pair of opposite sides of the opening, the bight sections of the U-shaped portions likewise respectively forming a pair of channel portions with the flanges on the other pair of opposite sides of the opening. These channel portions are adapted to support one end of the core adjacent its outer periphery and also adjacent the coil with the corresponding end of the coil extending through the opening. The angle portions are respectively adapted to be seated in and to embrace notches formed at the corners of the core and the device may be held in clamped assembled relation by means of a clamping member having an opening formed therein, the clamping member being positioned on the other end of the core with the corresponding end of the coil extending therethrough and having flanges integrally joined to the ends of the angle portions of the unitary frame member.

In the drawings,

FIG. 1 is a front-elevational view of an inductive device, such as a transformer, incorporating my improved unitary frame member;

FIG.2 is a side-elevational view of the device of FIG. 1;

FIG. 3 is a top view, partly broken away, taken along the line 3—3 of FIG. 1;

FIG. 4 is a bottom view of the device of FIG. 1;

FIG. 5 is an exploded view in perspective further illustrating the assembly of the core and coil of the device of FIG. 1 with my improved unitary frame member;

FIG. 6 is a fragmentary view in perspective further illustrating the details of construction of my improved unitary frame member and particularly the channel-shaped portions supporting the laminated core;

FIG. 7 is a plan view of the blank of sheet metal from which my improved unitary frame member is formed;

FIG. 8 is a view in perspective showing an intermediate step in the manufacture of my improved unitary frame member; and

FIG. 9 is a view in perspective of the improved unitary frame member of my invention prior to assembly of the core and coil thereon.

Referring now to the figures of the drawings, my improved unitary frame member is shown embodied in an inductive device, such as a transformer, generally identified as 1, comprising a core 2 formed of a stacked plurality of relatively thin laminations of suitable magnetic material. Here, the magnetic core 2 is shown as being formed of a stack of E-shaped laminations 3 with a stack of I-shaped laminations 4 abutting the ends of the legs thereof and with coil 5 being positioned on the center leg of the core formed by the bar portions of the E-shaped laminations 3. It will be readily understood that coil 5 conventionally comprises several windings which may form the primary and secondary windings of the transformer. It will be seen that the sides of the coil 5 are completely enclosed by the core 2 with ends 6 and 7 extending respectively beyond the ends or faces 8 and 9 of the core 2. Each laminated side of the core 2 has a pair of transverse notches 11 and 12 formed therein extending to the corner, as shown.

The improved unitary frame member 13 of my invention comprises a base portion 14 having a generally rectangular central opening 15 formed therein with upwardly extending right angle flanges 16, 17, 18 and 19 formed from the side edges thereof, as shown. A pair of U-shaped portions 21 and 22 extend upwardly at right angles from a pair of opposite exterior sides of the base portion 15, the U-shaped portions 21 and 22 respectively having right angle flanges 23 formed on their leg portions 24, 25, 26 and 27. It will be seen that the flanges 23 of legs 24 and 25 of U-shaped portion 21 respectively extend toward the flanges 23 of legs 26 and 27 of the U-shaped portion 22 so that the legs 24 through 27, with their respective right angle flanges 23 define four upwardly extending angle portions. An upwardly extending right angle flange 28 is formed on an exterior side of the base portion 14 intermediate the flanges 23 on legs 24 and 26 and another upwardly extending right angle flange 29 is formed on the opposite exterior side of the base portion 14 intermediate a pair of downwardly extending flanges 30 and 31.

It will now be seen that the upper edges of the bight sections 32 and 33 of the U-shaped portions 21 and 22, the upper edges of the upwardly extending flanges 28 and 29 on the exterior sides of the base portion 14, and the upper edges of the upwardly extending flanges 16, 17, 18 and 19 formed on the sides of the central opening 15 are co-planar. Particular reference to FIG. 6 will reveal that the bight sections 32 and 33 form channels with flanges 17 and 19 while flanges 28 and 29 likewise respectively form channels with flanges 18 and 16.

It will now be seen that the core 2 is positioned within the angle portions 24, 25, 26 and 27, the angle portions being seated in and respectively embracing the notches 11 and 12 formed at the corners of the core 2. It will further be seen that the bottom end 9 of core 2 is supported by the aforementioned channels formed by the bight sections 32 and 33 and the flanges 16, 17, 18, 19, 28 and 29, this support being provided adjacent the outer periphery of the core 2 and likewise adjacent the coil 6. It will further be seen that the end 7 of coil 6 extending beyond the end 9 of core 2 extends through the opening 15 in the bottom portion 14 of the frame member 13. It will now be seen that entirely adequate support is provided for the core 2, the weight of which may be substantial, by the channels defined by the bight sections 32 and 33 and the upwardly extending right angle flanges 16 through 19, 28 and 29, and it will be further seen that the coplanar relationship of the upper edges of the bight sections and the upwardly extending flanges establishes a level plane for the bottom end or face 9 of the core 2 thereby preventing sagging of the laminations not only adjacent the outer periphery of core 2 but also adjacent the coil 6. This support of the bottom end or face of the core 2 in a level plane reduces vibration of the laminations and thus excessive noise encountered in previous constructions of this type known to the present applicant.

In order to complete the assembly, a clamping member 34 is provided having a central opening 35 formed therein. Clamping member 34 is arranged abutting the upper surface 8 of core member 2 with end 6 of coil 5 extending through opening 35 as shown. Clamping member 34 has downwardly extending right angle flanges 36 formed on its edges which are integrally joined to legs 24 through 27 of the U-shaped portions 21 and 22 of frame mmber 13, as by spot welding, as shown at 37. An upwardly extending right angle flange 38 formed on the side of clamping member 34 is disposed in the same plane as the downwardly extending right angle flanges 30 and 31 on the base portion 14 of frame member 13 these flanges being adapted for vertical mounting of the assembly by means of suitable mounting holes 39 and 40 respectively formed therein. It will be seen that appropriate external leads 42 and 43 respectively extend from the ends 6 and 7 of coil 5, it being understood that the particular arrangement of the windings of coil 5 and the particular external leads provided do not form a part of my invention. Coil 5 is held tightly with respect to core 2 thereby to prevent noise by means of a suitable wedge 44 inserted between end 6 and the center leg of the core 2, as is well known in the art.

In the assembly of the core 2 with coil 5 thereon with the unitary frame member 13 and clamping member 34, core 2 is initially positioned in frame 13, the laminations 3 and 4 comprising the core stack are then placed under compression and the clamping member 34 is then welded

to the angle portions **24** through **27** while the laminations are maintained under compression.

Referring now particularly to FIGS. 7, 8 and 9, it will be seen that my improved unitary frame member **13** is readily blanked in one operation from a single relatively thin sheet **45** of metal, as shown in FIG. 7 in which the portions which are punched out are delineated by dashed lines **46** and the portions which are ultimately folded are delineated by broken lines **47**. Following the initial blanking operation as shown in FIG. 7, the right angle flanges **23, 28, 29, 30** and **31** may be formed, as shown in FIG. 8 as a second step, or, it will be readily understood, the blanking and flange forming operations of FIGS. 7 and 8 may be performed with a progressive die as is well known in the art. The third step in the formation of my improved unitary frame member **13** is the upward folding of the U-shaped portions **21** and **22** and the central flanges **16, 17, 18** and **19**, as shown in FIG. 9; it will be readily understood that if the quantity required justifies the tooling expense, the entire frame assembly **13** may be formed in a single deep-draw press in progressive operations.

It will now be seen that my improved unitary frame member is integrally formed from a single piece of sheet metal, for example twenty gauge sheet steel, with the seam weld required in the aforementioned Antalis, Marsh and Zelt patent being eliminated. It will further be seen that the core stack is supported in a level plane by the channels formed from the base portion of my improved unitary frame member, this support being provided both adjacent the outer periphery of the core and adjacent the coil thereby preventing sagging of the core laminations with the resultant undesirable noise.

While I have illustrated and described a particular embodiment of this invention, further modifications and improvements will occur to those skilled in the art and I desire that it be understood therefore that this invention is not limited to the specific form 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 new and desire to secure by Letters Patent of the United States is:

1. For use with an inductive device having a core formed of a stack of rectangular laminations with a coil disposed thereon, a unitary frame member for holding said laminations in assembled relation, said frame member being formed from a single piece of sheet metal and comprising: a generally rectangular base portion adapted to support one end of said core and having an opening formed therein for accommodating the corresponding end of said coil, each side of said opening having an upwardly extending right angle flange formed thereon to define four channel-shaped portions; and four angle portions extending vertically respectively from the corners of said base portion and respectively adapted to embrace the corners of said core.

2. For use with an inductive device having a core formed of a stack of rectangular laminations with a coil disposed thereon, a unitary frame member for holding said laminations in assembled relation, said frame member being formed from a single piece of sheet metal and comprising: a generally rectangular base portion having an opening formed therein, each side of said opening having an upwardly extending right angle flange formed thereon to define four channel-shaped portions; a pair of U-shaped portions extending upwardly at right angles from opposite sides of said base portion, the outer edge of each leg of said pair of U-shaped portions having a right angle flange formed thereon, the flanges of one of said U-shaped portions extending respectively toward the flanges of the other of said U-shaped portions so that said legs of said U-shaped portions and their respective flanges define four angle portions, said angle portions being adapted respectively to embrace notches formed in the corners of said core, the edges of the bight portions of said U-shaped portions being adapted to support an end of said core with a corresponding end of said coil extending downwardly through said base portion opening.

3. For use with an inductive device having a core formed of a stack of rectangular laminations with a coil disposed thereon, a unitary frame member for holding said laminations in assembled relation, said frame member being formed from a single piece of sheet metal and comprising: a generally rectangular base portion having a generally rectangular central opening formed therein, each side of said opening having an upwardly extending right angle flange formed thereon to define four channel-shaped portions, said flanges being adapted to support an end of said core with a corresponding end of said coil extending downwardly through said opening; and four angle portions extending vertically respectively from the corners of said base portion and respectively adapted to embrace the corners of said core, said four angle portions being integrally formed with said flanges and said base portion from said single piece.

4. For use with an inductive device having a core formed of a stack of rectangular laminations with a coil disposed thereon, a unitary frame member for holding said laminations in assembled relation, said frame member being formed from a single piece of sheet metal and comprising: a generally rectangular base portion having a generally rectangular central opening formed therein, each side of said opening having an upwardly extending right angle flange formed thereon; a pair of U-shaped portions extending upwardly at right angles from one pair of opposite sides of said base portion, the outer edge of each leg of said pair of U-shaped portions having a right angle flange formed thereon, the flanges of one of said U-shaped portions extending respectively toward the flanges of the other of said U-shaped portions so that said legs of said U-shaped portions and their respective flanges define four angle portions, said angle portions being adapted respectively to embrace notches formed in the corners of said core; the other pair of opposite sides of said base portion having upwardly extending right angle flanges formed thereon, said last-named flanges respectively forming a pair of channel portions with the flanges on a corresponding pair of opposite sides of said opening; the bight sections of said U-shaped portions respectively forming another pair of channel portions with the flanges on the other pair of opposite sides of said opening, said U-shaped portions and said base portion being integrally formed with said channel portions from said single piece; said channel portions being adapted to support one end of said core adjacent its outer periphery and adjacent said coil with the corresponding end of said coil extending through said opening.

5. For use with an inductive device having a core formed of a stack of rectangular laminations with a coil disposed thereon, a unitary frame member for holding said laminations in assembled relation, said frame member being formed from a single piece of sheet metal and comprising: a generally rectangular base portion having a generally rectangular central opening formed therein, each side of said opening having an upwardly extending right angle flange formed thereon; a pair of U-shaped portions extending upwardly at right angles from one pair of opposite sides of said base portion, the outer edge of each leg of said pair of U-shaped portions having a right angle flange formed thereon, the flanges of said U-shaped portions extending respectively toward the flanges of the other of said U-shaped portions so that said legs of said U-shaped portions and their respective flanges define four angle portions, said angle portions being adapted respectively to embrace notches formed in the corners of said core; one of the other pair of opposite sides of said base portion having a right angle flange extending upwardly therefrom and extending between respective flanges on

said U-shaped portions, said flanges being integrally formed with said U-shaped portions and said base portion from said single piece; the other of said other pair of opposite sides of said base portion having formed thereon a pair of spaced apart downwardly extending right angle flanges and an upwardly extending right angle flange intermediate said downwardly extending flanges; said upwardly extending flanges on said base portion and the bight sections of said U-shaped portions having their upper edges co-planar and adapted to support an end of said core with the corresponding end of said coil extending downwardly through said base portion opening; said downwardly extending flanges being adapted for mounting said device.

6. In combination with an inductive device having a core formed of a stack of rectangular laminations with a coil disposed thereon having ends extending respectively beyond the ends of said core, each side of said core having a pair of transverse notches extending thereacross respectively at the corners thereof: a unitary frame member for holding said laminations in assembled relation, said frame member being formed from a single piece of sheet metal and comprising a generally rectangular base portion having a generally rectangular central opening formed therein, each side of said opening having an upwardly extending right angle flange formed thereon; a pair of U-shaped portions extending upwardly at right angles from one pair of opposite sides of said base portion, the outer edge of each leg of said pair of U-shaped portions having a right angle flange formed thereon, the flanges of one of said U-shaped portions extending respectively toward the flanges of the other of said U-shaped portions so that said legs and their respective flanges define four angle portions; the other pair of opposite sides of said base portion having upwardly extending right angle flanges formed thereon, said last-named flanges respectively forming channel portions with the flanges on a corresponding pair of opposite sides of said opening; the bight sections of said U-shaped portions respectively forming another pair of channel portions with the flanges on the other pair of opposite sides of said opening; said frame member being arranged on said core with said angle portions respectively seated in said core member notches, and with one end of said core seated on said channel portions with the corresponding end of said coil extending through said opening.

7. The combination of claim 6 further comprising a clamping member formed of sheet metal and having a central opening formed therein, said clamping member being arranged on the other end of said core with the corresponding end of said coil extending through said opening therein, said clamping member having flange portions respectively integrally joined to the ends of said angle portions thereby tightly clamping said core member laminations.

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