March 5, 1957 P. A. VANCE 2,784,384

INDUCTIVE DEVICE

Filed June 7, 1954

Fig. 1.

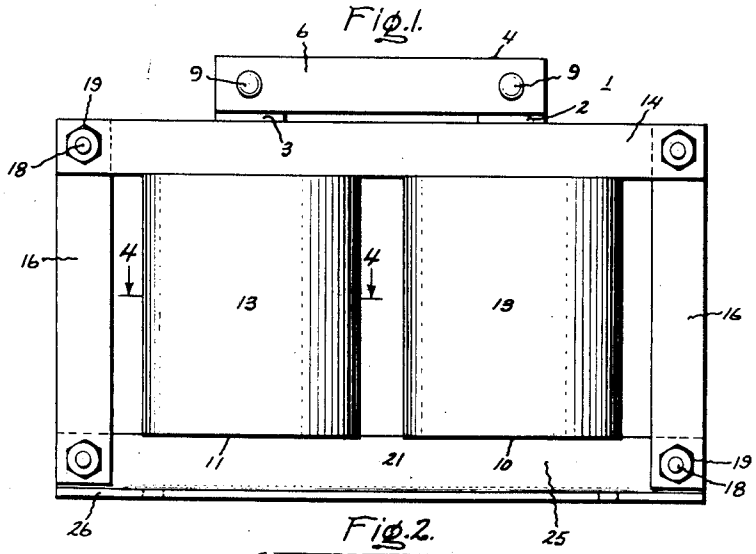


Fig. 2.

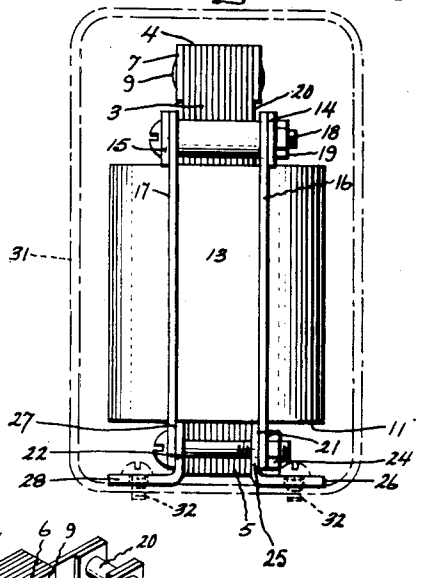


Fig. 3.

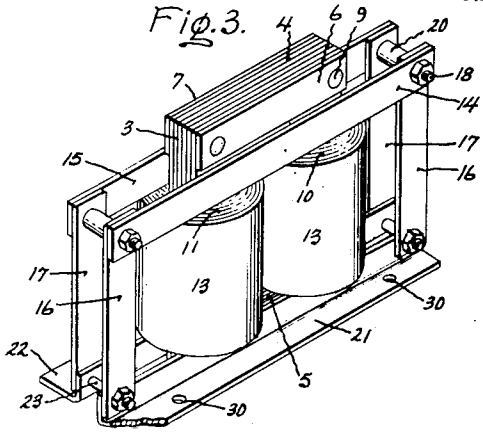
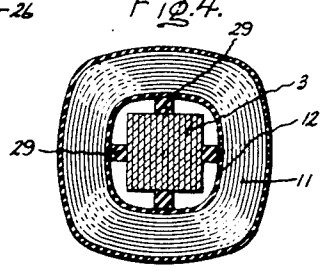


Fig. 4.



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INDUCTIVE DEVICE

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7 Claims. (Cl. 336—100)

This invention relates to inductive devices such as transformers, and more particularly to means for reducing the noise thereof when they are in operation.

A particularly undesirable feature in most transformers and reactors is the noise emanating therefrom when they are in operation. When a body, such as the core of a transformer or reactor is magnetized there occurs a phenomenon known as magnetostriction, which is the change in dimensions that occurs when a body is magnetized. This results in a slight increase in the length of the body (where it is arranged lengthwise to the lines of flux), and an even slighter decrease in the width thereof.

Transformers and reactors are most commonly used in connection with 60 cycle alternating current. Because of the phenomenon of magnetostriction, the use of such current for a transformer or reactor means that the core elements will change their lengths 120 times per second. This causes an undesirable vibratory hum, which, in the past, has been amplified considerably by magnetic or mechanical excitation of other parts of the device, such as coils, casings, covers, and the like, in response to the vibrations of the magnetic structure. In addition to this, it will be apparent that the individual elements of the core will rarely, if ever, be perfectly parallel, with the result that small gaps will be created between them at some points while they are in close contact with each other at other points. The stresses caused by magnetization will cause each core element to tend to move as it is magnetized thereby changing the spacing between the elements where they had occurred and making the elements move with the result that additional noise is created. It will be apparent that there is no way to prevent the phenomenon itself, that is, the core cannot be prevented from changing in dimensions in response to the cycling change in magnetic flux. Nor would it be practical to avoid the second cause of noise by making the individual elements perfectly parallel, since this would result in an extremely expensive device. One solution to the problem therefore lies in sufficiently isolating the core from the coil or coils so that the vibrations will not be transmitted thereto, and in sufficiently isolating that part of the core which expands and contracts from the casing means so that the casing will not amplify the sound but will, as it should, dampen it.

It is, therefore, an object of this invention to provide an improved inductive device which will provide 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 invention.

This invention, in its broadest aspect, provides an inductive device having a magnetic core with a coil positioned on a leg thereof. Means are provided, preferably

at the ends of the coil, so that it is securely clamped into position independently of the core. It is of course, preferable that the means at the top of the coil be spaced from the core so that the vibrations therefrom will not be transmitted to the coil. Additional means may be provided to secure the clamping means to a casing. The core may be secured between the bottom of the clamping means and the casing member so that the change in volume and the resulting vibration will occur at the top of the core, which is spaced from the other elements, so that the vibrations will not be transmitted to the casing member. It is of course, possible to anchor the transformer by other means; this may be effected by providing resilient means at all points of connection with either the clamping means, the coil, or the cover, so that rather than depending upon the clamping of the core to prevent vibrations at any point, the vibrations are permitted but effectively dampened before they reach the rest of the elements.

In the drawing:

Figure 1 is a front view of a transformer provided with the improved noise reducing means of this invention;

Figure 2 is a side view of the apparatus of Figure 1;

Figure 3 is a view in perspective of the apparatus of Figures 1 and 2; and

Figure 4 is a cross section through line 4—4 in Figure 1.

Referring now to the figures of the drawing, there is shown a core type transformer, generally identified as **1**. It will be understood that this type of transformer is used for purposes of illustration and that any other type of inductive device may be used in connection with the invention with equal effectiveness. The core of transformer **1** has a pair of legs **2** and **3** which are mechanically and magnetically connected together by a top yoke **4** and a bottom yoke **5**. These parts of the transformer core are generally made up of groups of relatively thin laminations of magnetic material. It will, however, be understood that the problem of magnetostrictive noise is not limited to cores of this type, and that this invention is applicable to any magnetic core structure (such as wound cores, for instance) in addition to that set forth above for illustrative purposes. Strengthening clamps **6** and **7** may be provided along the top yoke **4** of the transformer. Clamps **6** and **7** will generally be provided on each side respectively of yoke **4** and secured together by means of bolts or rivets **9**. A pair of coils **10** and **11** are positioned on legs **2** and **3** respectively. These coils are generally made up of suitable copper or aluminum conductors. It will be understood that suitable electrical connections to the coils **10** and **11** are provided; however, these form no part of the present invention and therefore have been omitted for greater clarity. Each of the coils **10** and **11** will generally be provided with an inside insulating sleeve **12** and, frequently, with an outside insulating cover **13**.

In order to mount the core and coils, there are provided a pair of clamping members **14** and **15** positioned respectively on opposite sides of the core legs **2** and **3**, preferably parallel to each other, and to the sides of the core legs, and extending entirely across and beyond the coils **10** and **11**. Members **14** and **15** are secured to two pairs of members **16** and **17** respectively, and to each other as by bolts **18** and nuts **19**. Spacers **20** are provided respectively for bolts **18** and are positioned around the bolts so as to maintain a definite clearance between the sides of the core legs **2** and **3** on the one hand and members **14** and **15** on the other hand. Members **16** and **17** extend down on each side of the transformer assembly, and each pair of these members is secured to one end of a pair of members **21** and **22**, as by means of a pair of bolts **23** and nuts **24** respectively. No spacer is pro-

vided in this instance, and bolts 23 are used to clamp securely members 21 and 22 to the sides of the bottom core yoke 5. It will be observed that members 21 and 22 are preferably formed as L-shaped members, member 21 comprising legs 25 and 26 and member 22 comprising legs 27 and 28, and that members 21 and 22 are preferably substantially parallel to members 14 and 15, and coextensive therewith. Members 16 and 17 secure top members 14 and 15 to bottom members 21 and 22 respectively, so that coils 10 and 11 are securely clamped between the top and bottom members. Also, by arranging members 14 and 15 outside members 16 and 17 respectively, all contact of the top members with the transformer core is avoided. The arrangement of members 14, 15, 21, and 22 is such that coils 10 and 11 are clamped independently of the core and out of contact therewith.

While the clamping means just described will generally be sufficient to maintain coils 10 and 11 entirely separate and isolated from the core legs 2 and 3 respectively, it may be desirable to insert flexible spacers which may, for instance, be made of a relatively soft grade of rubber and arranged between each core leg and the coil positioned thereon substantially parallel to members 16 and 17. Spacers of this type, such as 29, will not transfer the vibration of the core leg to the coil, but will insure that the coil is kept at a minimum distance on all sides from the core.

It will be seen that the transformer core is tightly clamped at the bottom and that this is effected by placing members 21 and 22 within members 16 and 17 respectively, whereas the spacing from the core at the top was achieved by placing members 14 and 15 outside members 16 and 17 respectively. By this arrangement, unnecessary strain from bending is avoided as to the various members. In order to secure properly the assembly to some secure base, such as an outer cover 31, a pair of bolt openings 30 may be provided in legs 26 and 28 of members 21 and 22 respectively. Legs 26 and 28 are preferably arranged to lie in the same plane when assembled. Thus, the assembly may be secured, as is best seen in Figure 2, to rigid outer cover 31 by means of bolts 32 extending through openings 30. It will be understood that any other appropriate means of holding the assembly to the outer cover may be used with equal effectiveness, either by rigid or flexible connections.

It will be observed that there has been provided means by which the bottom of the transformer core may be securely clamped so that the major part of the vibrations, which must inevitably occur, will come about at the top part of the core. It will further be seen that the assembly of this invention permits the top part of the core to be completely separated from the coil so that the vibrations will not be transmitted thereto. In addition, the apparatus is so designed that it may be secured to an outer covering at any location where the vibrations are minimized so that the outer covering will dampen the noise from the vibrations because of its relative isolation from the vibrating part of the device.

While this invention has been explained by describing a particular embodiment thereof, it will be apparent that improvements and modifications may be made without departing from the scope of the invention as defined in the appended claims.

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

1. Noise-reducing means for inductive device having a substantially closed laminated core with a coil positioned on a leg thereof, said means comprising a member engaging the one end of said coil on a side of said core, said member being spaced from said core, a second member engaging the other end of said coil on a side of said core, means connecting said members thereby to clamp said coil therebetween, said coil being maintained on said leg out of contact therewith and independently thereof by said clamping means, said second member being clamped to said core, said connecting means and said coil both being spaced from said core at said one end of said coil whereby said noise reducing means and said coil are both entirely out of contact with said core at said one end of said coil.

2. Noise-reducing means for an inductive device having a substantially closed laminated core with a coil positioned on a leg thereof, said means comprising a pair of members engaging one end of said coil on each side of said core respectively, said pair of members being spaced from said core, a second pair of members engaging the other end of said coil on each side of said core, and means connecting said pair of members thereby to clamp said coil therebetween, said coil being maintained on said leg out of contact therewith and independently thereof by said clamping means, said second pair of members being further arranged to clamp tightly against each side respectively of said core, said connecting means and said coil both being spaced from said core at said one end of said coil whereby said noise reducing means and said coil are both entirely out of contact with said core at said one end of said coil.

3. Noise-reducing means for an inductive device having a substantially closed laminated core with a coil positioned on a leg thereof, said means comprising a pair of relatively long and thin members engaging one end of said coil on each side of said core respectively and being spaced therefrom, said members extending substantially parallel to each other and to the sides of said core, a second pair of relatively long L-shaped members engaging the other end of said coil on each side of said core respectively and each having one leg tightly engaging a side of said core, said second pair of members extending substantially parallel to said first pair of members, all of said members having their ends extending beyond said core and said coil, third and fourth pairs of elongated members, each of said third pair having its ends securely fastened to an end of one of said first pair and an end of one of said second pair respectively, each of said fourth pair having its ends securely fastened to the other end of one of said first pair and the other end of one of said second pair respectively thereby to clamp said coil on said leg out of contact therewith and independently thereof between said first and second pairs, the other legs of said second pair lying in a plane and being adapted to be secured to a base, said third and fourth pairs and said coil all being spaced from said core at said one end of said coil whereby said noise reducing means and said coil are both entirely out of contact with said core at said one end of said coil.

4. Noise reducing means for an inductive device having a substantially closed laminated core with a coil positioned on a leg thereof, said means comprising a pair of relatively long and thin members engaging one end of said coil on each side of said core respectively and being spaced therefrom, said members extending substantially parallel to each other and to the sides of said core, a second pair of relatively long L-shaped members engaging the other end of said coil on each side of said core respectively and each having one leg tightly engaging a side of said core, said second pair of members extending substantially parallel to said first pair of members, all of said members having their ends extending beyond said core and said coil, third and fourth pairs of elongated members, each of said third pair connecting respectively an end of said first pair and an end of said second pair, each of said fourth pair connecting respectively another end of said first pair and another end of said second pair thereby to clamp said coil between said first and second pairs of members, the other legs of said second pair lying in a plane and being adapted to be secured to a base, and a plurality of resilient spacer members extending between said coil and said core thereby correctly to position said coil on said core for clamp-

ing, said third and fourth pairs and said coil all being spaced from said core at said one end of said coil whereby said noise reducing means and said coil are both entirely out of contact with said core at said one end of said coil.

5. In combination, an inductive device comprising a substantially closed laminated core having a leg with a coil positioned on said core leg; and noise-reducing means comprising a pair of members engaging one end of said coil on each side of said core respectively, said pair of members being spaced from said core, a second pair of members engaging the other end of said coil on each side of said core, said second pair of members being secured to said core, means connecting said pairs of members thereby to clamp said coil therebetween, and resilient spacers positioned between said core and said coil to ensure separation thereof when said coil is so clamped, said connecting means and said coil both being spaced from said core at said one end of said coil whereby said noise reducing means and said coil are both entirely out of contact with said core at said one end of said coil.

6. In combination, an inductive device comprising a substantially closed laminated core having a leg with a coil positioned on said core leg; and noise-reducing means comprising a pair of relatively long and thin members engaging one end of said coil on each side of said core respectively and being spaced therefrom, said members extending substantially parallel to each other and to the sides of said core, a second pair of relatively long L-shaped members engaging the other end of said coil on each side of said core respectively and each having one leg tightly engaging a side of said core, said second pair of members extending substantially parallel to said first pair of members, all of said members having their ends extending beyond said core and said coil, third and fourth pairs of elongated members, each of said third pair having its ends securely fastened to an end of one of said first pair and an end of one of said second pair respectively, each of said fourth pair having its ends securely fastened to the other end of one of said first pair and the other end of one of said second pair respectively thereby to clamp said coil between said first and second pairs, the other legs of said second pair lying in a plane and adapted to be secured to a base, and a plurality of elongated resilient spacers arranged about said leg within said coil substantially parallel to said leg, said third and fourth pairs and said coil all being spaced from said core at said one end of said coil whereby said noise reducing means and said coil are both entirely out of contact with said core at said one end of said coil.

7. In combination, an inductive device comprising a substantially closed laminated core having a pair of parallel legs and a pair of yokes joining said legs at their ends with a pair of coils mounted respectively on said legs; and noise-reducing means comprising a pair of relatively long and thin members engaging one end of said coils on each side of said core respectively, said pair of members being spaced from said core, said members extending substantially parallel to each other and to the sides of said core, a second pair of relatively long L-shaped members engaging the other end of said coils on each side of said core respectively and each having one leg tightly engaging a side of said core, said second pair of members extending substantially parallel to said first pair, all of said members having their ends extending beyond said core and said coils, third and fourth pairs of elongated members, each of said third pair connecting respectively an end of said first pair and an end of said second pair, each of said fourth pair connecting respectively another end of said first pair and another end of said second pair whereby said coil is clamped between said first and second pairs of members, the other legs of said second pair lying in a plane and adapted to be secured to a base, and a plurality of resilient spacer members extending between said coil and said core substantially parallel to said third and fourth pairs thereby correctly to position said coil on said core for clamping, said third and fourth pairs and said coil all being spaced from said core at said one end of said coil whereby said noise reducing means and said coil are both entirely out of contact with said core at said one end of said coil.

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