March 9, 1965 E. B. FRANKLIN 3,173,117

NOISE REDUCING ARRANGEMENT FOR TRANSFORMERS

Filed May 31, 1961

Fig. 1.

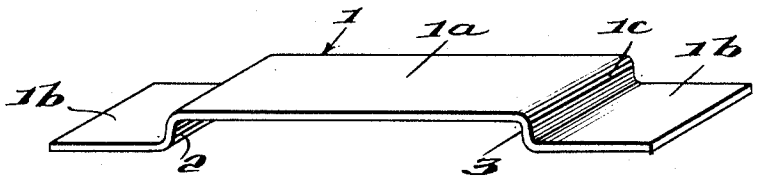


Fig. 2.

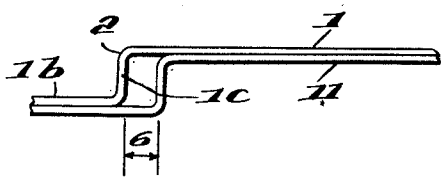
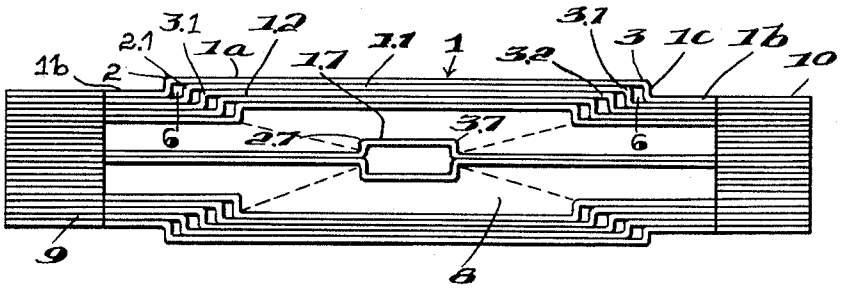


Fig. 3.



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NOISE REDUCING ARRANGEMENT FOR TRANSFORMERS

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This invention provides a means of reducing noise produced in transformer cores.

It is generally conceded that magnetostriction is responsible for most of the noise generated in transformers, and, of course, this originates in the core.

Consider first the noise produced by the legs of a core type transformer. Magnetostriction produces cyclic length variations in the yokes. This movement is then transmitted to the leg members by virtue of a relatively tight mechanical coupling between the ends of the yokes and ends of legs. If the legs were considered to be completely rigid, the whole of the leg would vibrate at the frequencies and magnitudes of the yoke ends. In fact, however, due to their being flexible, the legs vibrate about their axis in a complex manner depending on the magnetostriction characteristics of the particular steel and on the natural frequency of the core structure.

The yokes may be considered as sound producing members from similar considerations. It may be further seen that for example in pushing against the leg masses, the yokes would tend to flex in both planes. The same applies to the legs in pushing against the yoke members.

Now, the amount of push transmitted to the legs by the yokes, and by the yokes to the legs, depends on the stiffness of these members, and it is reasonable to assume that if stiffness in the longitudinal direction could be reduced, a reduction in noise could be achieved.

This is the way in which the present invention reduces noise. In addition, the reduction of the axial stiffness of the core component members reduces the natural box frequency of the core to a value below that of the fundamental magnetostriction frequency, so that resonance at this frequency is avoided.

The stiffness mentioned above is reduced by introducing one or more kinks or offsets into each, or into a limited number of laminations or plates in the core structure. The kinked laminations might also be described as stepped or U-shaped..

There is, of course, an almost infinite variety of ways in which such kinked laminations may be assembled.

The system will be best understood by reference to the drawings in which:

FIGURE 1 shows a single lamination with two kinks. The depth of the kink being any convenient value.

FIGURE 2 shows two adjacent laminations and how they position in relation to each other.

FIGURE 3 shows a portion of a transformer core wherein one leg of the core between two yokes is constituted from an assembly of the laminations of FIGURE 1.

With reference now to FIG. 1, the improved transformer core structure is characterized by laminations **1** which are not planar but rather are kinked at **2** and **3** to establish a central part **1***a* and two end parts **1***b* all of which are parallel to each other, the central part **1***a* being offset from the common plane of the two end parts **1***b* by relatively short offsetting perpendicular parts **1***c* developed by the kinks **2** and **3**. FIG. 2 illustrates an assembly of two of the laminations shown in FIG. 1, it being noted that these are staggered longitudinally to leave a gap **6** between the respective offsetting perpendicular parts **1***c* of the two laminations. The longitudinal spaces **6** between adjacent laminations may be of any desired length and prevents the vibrations arising from magnetostriction of the single laminations being transmitted to other laminations and consequently also to the core legs through the yokes, or to the yokes through the core legs. In this way it is possible to diminish considerably the noise that will arise.

With reference now to FIG. 3, it will be seen that the inventive concept has been applied to the leg **8** of a transformer core, the ends of the leg **8** being joined to yoke parts **9** and **10**. Leg **8** is constituted by an assembly of the laminations as represented in FIG. 1. The outermost lamination **1** of core leg **8** is provided with kinks at **2** and **3** to establish the central part **1***a* and the two end parts **1***b*, all parallel to each other, and the offsetting perpendicularly extending parts **1***c*. The next inner lamination **1.1** is similarly kinked at **2.1** and **3.1**, the spaces **6** being established between the kinks **2** and **2.1** and between kinks **3** and **3.1**. The next inner lamination is indicated at **1.2** and it is kinked at **2.2** and **3.2**. The other laminations of the nested lamination assembly except the innermost one have not been indicated by reference numerals, and have been shown only generally by the broken lines. The innermost lamination is designated **1.7** and the kinks therein are designated **2.7** and **3.7**. It will thus be seen that the laminations **1**, **1.1**, **1.2** . . . **1.7** are symmetrically arranged in staggered relationship from the outside of the core leg to the center, that each lamination lies in actual contact over the major length of the portions which extend parallel to each other with the laminations which precede and follow it, and that the perpendicularly extending portions of each lamination established at the kinks are spaced from the similarly extending portions of an adjacent lamination. Longitudinal vibrations established in the core leg **8** due to the magnetostriction effect will thus not be transmitted to the end yokes **9** and **10** but rather are compensated out in the spaces **6** between adjacent laminations. In FIG. 3 only the end faces of the yokes **9** and **10** have been included.

The advantage of these systems lies in the fact that, without additional noise-reducing devices, it is possible to reduce the noises simply through shaping the sheets in an appropriate manner.

I claim:

In a transformer core structure, the combination comprising a plurality of kinked laminations nested together, each said lamination being comprised of three portions extending parallel with each other and two portions extending in a direction perpendicular to and between two of said parallel extending portions, said laminations being arranged symmetrically in staggered relationship from the outside of the core to the center, each said lamination being in actual contact over the major length of the portions extending parallel to each other with the laminations that precede and follow it, and said perpendicularly extending portions of each lamination being spaced from the similarly extending portions of an adjacent lamination.

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