L. M. KILLGORE.

MAGNETIC SHUNT.

APPLICATION FILED JAN. 29, 1917.

1,257,246. Patented Feb. 19, 1918.

Fig. 1.

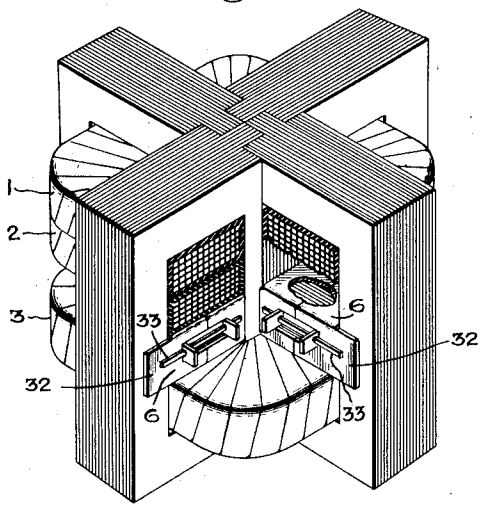


Fig. 3.

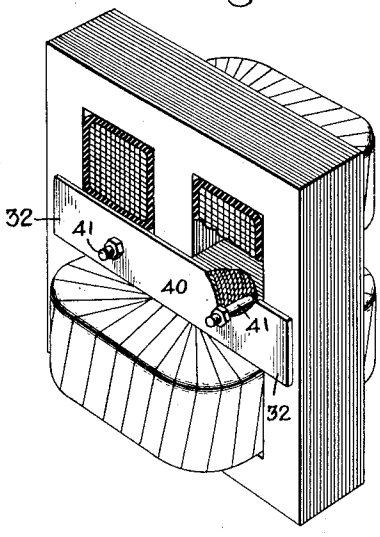


Fig. 2.

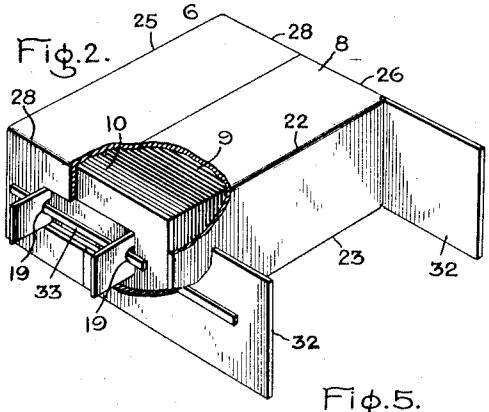


Fig. 4.

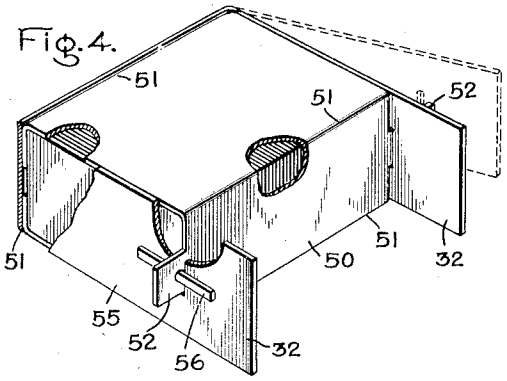
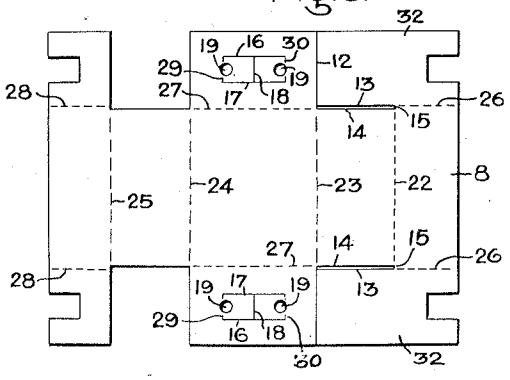


Fig. 5.



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UNITED STATES PATENT OFFICE.

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MAGNETIC SHUNT.

1,257,246. Specification of Letters Patent. Patented Feb. 19, 1918.

Application filed January 29, 1917. Serial No. 145,134.

To all whom it may concern:

Be it known that I, LLOYD M. KILLGORE, a citizen of the United States, residing at Pittsfield, county of Berkshire, State of Massachusetts, have invented certain new and useful Improvements in Magnetic Shunts, of which the following is a specification.

My invention relates to magnetic shunts for induction electrical apparatus, such as transformers, auto-transformers, some reactances, etc. An object of my invention is to provide devices of this type having magnetic shunts which in each piece of apparatus may be readily increased or decreased in effectiveness during or after manufacture.

Magnetic shunts are perhaps most commonly applied to transformers. I shall therefore hereinafter for the sake of simplicity describe my invention mostly as it is embodied in transformers; from this embodiment its application to other devices will be readily understood.

Magnetic shunts are commonly used for increasing the leakage flux. The exact effect of a magnetic shunt is very difficult to determine during the design of the apparatus, and commonly in order to secure different effects in different transformers which are otherwise quite similar, it is necessary that the magnetic shunts in the otherwise similar transformers be materially different from each other. These considerations have rendered difficult the use of proper magnetic shunts.

In carrying out my invention I compose each magnetic shunt of a number of pieces of magnetic material, the number of which may be readily varied after the complete assembly of the transformer. It is possible therefore to more or less complete the transformer and thereafter, as during the usual or a special testing of the same, vary the amount of iron in the magnetic shunt until the magnetic shunt is sufficiently effective. To this end I prefer to provide a holder or carrier for the loose pieces of the shunt, the holder or carrier more or less completely inclosing the loose pieces and being readily opened and closed after the assembly of the transformer. The carrier may be large enough to accommodate a very large shunt and then may be only partially filled with magnetic material when a smaller effect is desired. When the magnetic material fails to fill the carrier I preferably add a sufficient number of pieces of non-magnetic material, as pressboard, to completely fill the carrier. The carrier may assume any one of numerous forms. three of which are described in detail hereinafter. Preferably the pieces of the magnetic and the non-magnetic materials are in the form of fairly thin laminations arranged in planes substantially parallel to the planes of the laminations of the adjacent core legs.

In the accompanying drawing and the following description I have illustrated and described in detail some preferred embodiments of my invention. Figure 1 is an elevation partially in section of a distributed core transformer embodying my invention; Fig. 2 is an elevation partially in section of one of the magnetic shunts of Fig. 1; Fig. 3 is an elevation also partially in section of a transformer of the shell type embodying my invention; Fig. 4 is an elevation partly in section of another form of magnetic shunt, and Fig. 5 is a pattern of the carrier or holder of the magnetic shunt of Figs. 1 and 2.

The core of the transformer of Fig. 1 comprises four sections disposed at right angles to each other. The winding of this transformer comprises three coils 1, 2 and 3, the winding being divided into two parts separated from each other between coils 2 and 3. Since the exact construction and functions of the different parts of the winding are immaterial to my invention, they need be no further described. The magnetic shunts of this transformer are inserted between these two parts of the winding, that is between the coils 2 and 3, to increase the leakage magnetic flux between the coils 1 and 2 on the one hand and the coil 3 on the other. In this particular transformer four magnetic shunts are provided, one in the window of each core section. Two of these magnetic shunts are shown at 6.

The construction of these magnetic shunts will be better understood from Figs. 2 and 5. From Fig. 2 it appears that the shunt comprises a carrier 8 forming a box-like structure substantially completely filled with laminated pieces. The carrier may be of pressboard or other suitable material. These laminated pieces are partially of magnetic material as steel of the same sort as that used in the core of the transformer of Fig.

1. The steel laminations are shown at 9 in somewhat heavier lines. The laminations at 10 are of non-magnetic material, as for example pressboard, and complete the filling of the carrier 8. As appears from Figs. 1 and 2, the laminations, both of the steel and the non-magnetic material, are disposed in planes substantially parallel to the planes of the laminations of the legs of the core adjacent the window containing the respective shunt. The carrier 8 of the shunt of Fig. 2 is formed from the pattern illustrated in Fig. 5. This pattern or blank is cut on the outlines shown in Fig. 5 and is also cut on the lines 12, 13, 14, 15, 16, 17, 18 and similar lines in the lower portion of the figure. Holes 19 are cut through the material. The blank is then bent at right angles along each of the dashed lines, that is, the lines 22, 23, 24, 25, and the lines 26, 27, 28, 29, 30 and similar dashed lines at the bottom of the figure. When the blank is bent at right angles along each of these dashed lines the carrier 8 is formed and assumes the appearance indicated in Fig. 2. Some of the lines of Fig. 5 along which the blank has been bent are indicated by similar reference characters in Fig. 2. After the blank is folded into shape it is held in this shape by means of two rods 33 one at each end of the carrier, passed through the two adjacent holes 19 as shown in Fig. 2. As the transformer is assembled the necessary number of carriers 8, with or without their inclosed contents, are assembled therewith, the ends of the carriers being adjacent the sides of the core sections as illustrated and the extensions 32 of the carrier embracing an adjacent core leg to hold the shunt in place. The transformer when thus substantially completed may have the effect of its magnetic shunts added or varied by opening the carriers 8 at one end of each and inserting its contents changing the relative number of pieces of magnetic material to the number of pieces of non-magnetic material; that is, some of the magnetic laminations may be replaced by non-magnetic laminations or vice versa. As appears from Fig. 1 this may be readily done since by removing one of the pins 33 of each of the carriers 8 and folding back the adjacent parts of the carrier away from the body thereof, access to its interior is obtained. When the proper number of magnetic laminations have been determined, as by testing of the transformer, the remaining space in the carrier, if any, is filled with the laminations of non-magnetic material, the carrier again closed and the rod 33 replaced. The transformer is then restored to its completed condition but with the effect of the magnetic shunt very closely adjusted.

In Fig. 3 is illustrated another form of carrier which is particularly applicable to transformers of the shell type illustrated in this figure. As appears from this figure a single carrier is sufficient for two shunts. Each carrier comprises two strips 40 of suitable material each substantially as wide as the magnetic shunt and extending from one outer leg to the other leg. The strips carry two rods 41 penetrating the laminations of the shunts. Each rod is screw threaded at at least one end, and the strips 40 and the laminations of the shunts are more or less tightly gripped between the ends of the rods by means of the nuts on the screw-threaded ends thereof. The ends or extensions 32 and the centers of the strips embrace the core legs. The carrier may be opened by removing the nuts on the rods.

In Fig. 4 is illustrated still another form of carrier, this carrier also being in effect something like a box. This carrier comprises two strips 50 and 55 of suitable material as pressboard. The strip 50 is bent at four right angles as illustrated at 51, this strip being provided with tongues 52 near the center of its long edges; each tongue is provided with an opening therein as indicated. The box is completed by the second strip 55 bent into a U-shape and providing three of the external surfaces of the shunt as indicated. Openings in the strip 55 receive the tongues 52 and pins or rods 56 in the openings in the tongues maintain the closure of the carrier. The carrier may be opened at either side by removing the corresponding pin. The ends or extensions 32 of the strip 55 embrace a core leg.

It will be understood that the shunts of Figs. 3 and 4 are applied and adjusted in substantially the same manner as the shunt of Figs. 1 and 2.

While I have described the principle of my invention and the best mode contemplated for applying this principle, other modifications will occur to those skilled in this art, and I aim in the appended claims to cover all modifications which do not involve a departure from the spirit and scope of my invention.

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

1. An induction apparatus comprising a core, a winding thereon, said winding comprising a plurality of parts separated from each other, and a magnetic shunt between said parts of the winding and comprising a plurality of pieces of magnetic material and a carrier for said pieces of magnetic material, said carrier being readily opened and closed for addition to or removal of some of the pieces of magnetic material.

2. An induction apparatus comprising a core, a winding thereon, said winding comprising a plurality of parts separated from each other, and a magnetic shunt between said parts of the winding and comprising a carrier, a plurality of pieces of magnetic

material carried thereby and a plurality of pieces of non-magnetic material also carried by said carrier, said pieces of magnetic and non-magnetic material substantially filling said carrier and said carrier being readily opened and closed after inclusion in said induction apparatus for a change in the relative number of pieces of magnetic material to the number of pieces of non-magnetic material.

3. An induction apparatus comprising a core, a winding thereon, said winding comprising a plurality of parts separated from each other, and a magnetic shunt within a window of said core and between said parts of the winding, said shunt comprising a carrier and a plurality of laminations of magnetic material carried thereby in planes substantially parallel to the planes of the laminations of the core legs adjacent said window, said carrier being readily opened and closed adjacent one side of said core legs for addition to or removal of some of the pieces of magnetic material.

4. An induction apparatus comprising a core, a winding thereon, said winding comprising a plurality of parts separated from each other, and a magnetic shunt within a window of said core and between said parts of the winding, said shunt comprising a carrier, a plurality of laminations of magnetic material carried thereby in planes substantially parallel to the planes of the laminations of the core legs adjacent said window, and a plurality of laminations of non-magnetic material also carried by said carrier in planes substantially parallel to the planes of the laminations of magnetic material, said laminations of magnetic and non-magnetic material substantially filling said carrier, and said carrier being readily opened and closed adjacent one side of said core legs after inclusion in said induction apparatus for a change in the relative number of laminations of magnetic material to the number of laminations of non-magnetic material.

5. An induction apparatus comprising a core, a winding thereon, said winding comprising a plurality of parts separated from each other, and a magnetic shunt within a window of said core and between said parts of the winding, said shunt comprising a carrier and a plurality of pieces of magnetic material carried thereby, said carrier extending at each side of an adjacent core leg to maintain the shunt in position.

In witness whereof, I have hereunto set my hand this 23rd day of January, 1917.

LLOYD M. KILLGORE.