

April 17, 1945.

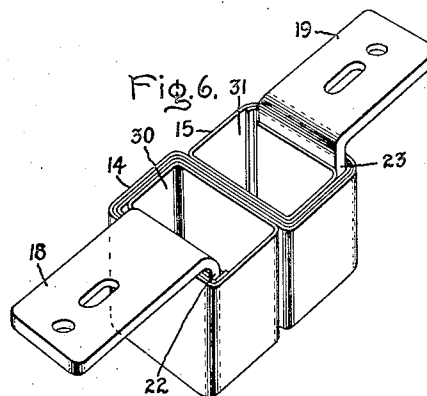
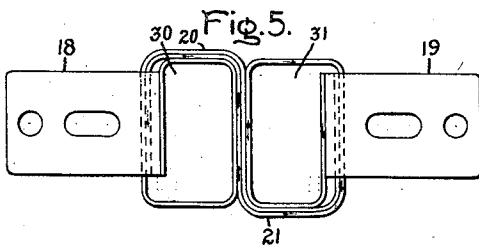
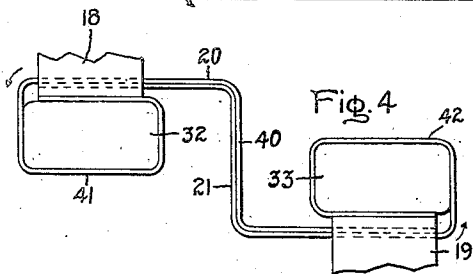
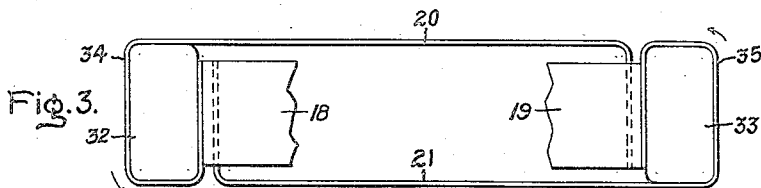
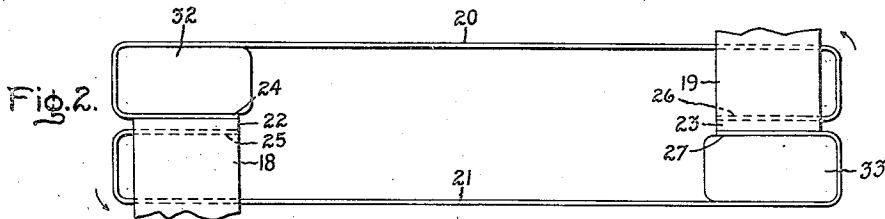
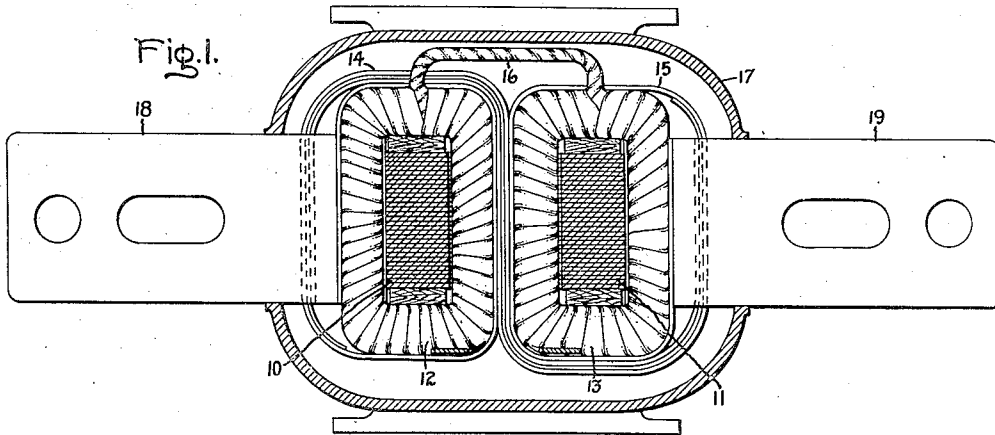
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2,374,018

COIL WINDING

Filed Nov. 5, 1943

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 7.

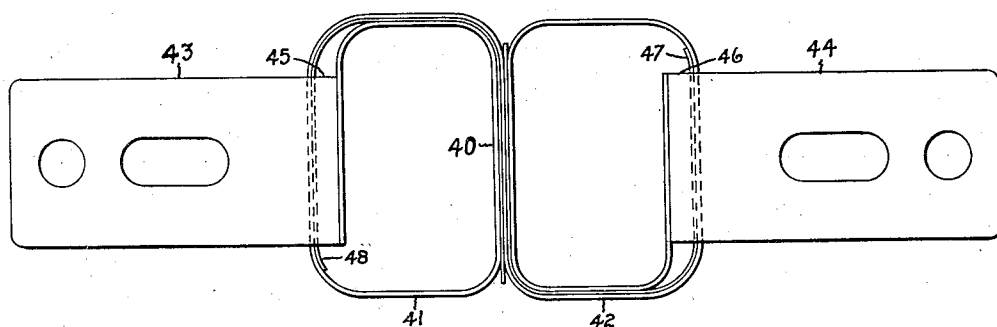
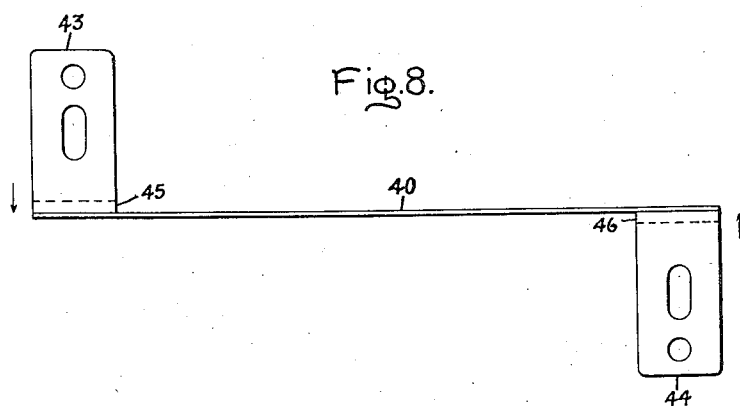


Fig. 8.



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UNITED STATES PATENT OFFICE

2,374,018

COIL WINDING

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Application November 5, 1943, Serial No. 509,143

3 Claims. (Cl. 175—358)

My invention relates to a coil winding for an electrical induction apparatus and to a method of making the winding.

Coil windings for electrical induction apparatus and particularly transformers of the instrument current type usually include a primary winding which has a small number of turns provided by a conductor of a relatively large cross section since the primary winding is connected in series with an electrical line. Since the primary winding carries a relatively large amount of current it must be rugged in construction. A pair of relatively rugged terminals are also usually connected to opposite ends of the primary winding for connection to the electrical line. The instrument transformer usually also includes a core passing through a winding window of the primary winding with a secondary winding having a relatively large number of turns provided by a conductor of relatively small cross section since the secondary winding does not carry a very large amount of current.

It is therefore an object of my invention to provide an improved winding construction for an electrical induction apparatus which is particularly adapted for a primary winding for an instrument transformer.

A further object of my invention is to provide an improved electrical induction apparatus having a primary winding which is simple in construction so as to facilitate its manufacture.

A further object of my invention is to provide an improved method of forming a coil winding for an electrical induction apparatus.

Further objects and advantages of my invention will become apparent from the following description referring to the accompanying drawings, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In the drawings Fig. 1 is a top view in partial section of an instrument transformer which is provided with an embodiment of my invention; Figs. 2 to 5, inclusive, illustrate the various steps of my method of producing the primary winding employed in the apparatus of Fig. 1; Fig. 6 illustrates the primary winding employed in the transformer of Fig. 1; Fig. 7 illustrates a modification of the coil of Fig. 6, and Fig. 8 illustrates the conductor employed to form the winding of Fig. 7.

Referring more particularly to Fig. 1 of the drawings, I have illustrated an electrical induction apparatus which has particular application

as an instrument transformer and includes a core having a pair of winding legs 10 and 11 which are surrounded by a pair of secondary or low voltage coils 12 and 13 and a pair of primary winding portions 14 and 15. The secondary winding portions 12 and 13 may be of any suitable construction such as having a plurality of distributed turns around the winding legs 10 and 11. The secondary windings are connected in series by the conductor 16 and suitable terminals are provided, which are not shown, for connecting the secondary windings to any suitable burden, which in the construction shown in Fig. 1, includes a suitable instrument such as an ammeter, wattmeter or a relay coil. A casing 17 surrounds the core and coils and is provided with a pair of apertures through which extend the primary terminals 18 and 19.

As will be seen in the drawings the terminals 18 and 19 are symmetrically arranged or extend from opposite sides of the transformer construction and in order to provide a simple arrangement of obtaining an even number of electrical turns for the coil winding portions 14 and 15 I provide an improved primary winding construction which will now be described in relation to Figs. 2 through 5.

As will be seen in Fig. 2, the coil winding portions 14 and 15 are provided by a pair of conductor straps 20 and 21, the opposite ends of which are connected to the terminals 18 and 19. Thus the terminals 18 and 19 have depending or right angularly extending lug portions 22 and 23, respectively, as will be seen particularly in Fig. 6. To one face of the lug 22, an end 24 of the conducting strap 20 is attached in any suitable manner, such as by welding, and to the opposite face of the lug 22, an end 25 to the strap 21 is similarly attached. Also, to the lug 23 of the terminal 19 there is attached an end 26 of the strap 20 and to the opposite surface of the lug there is attached an end 27 of the strap 21. It will also be noted that the terminals 18 and 19 are disposed with their terminal portions extending in opposite directions, and the straps 20 and 21 are so positioned that they form a pair of C-shaped members or U-shaped members with inwardly turned flanges during the step of the method as is shown in Fig. 2.

In order to form coil portions with the conducting straps 20 and 21, each of the terminals 18 and 19 is rotated in the same direction, as is illustrated by the steps shown in Figs. 3, 4, and 5. Also so as to insure that the coil portions 14 and 15 will have window portions 30 and 31, respec-

tively, through which extend the winding legs 10 and 11, I provide winding mandrels 32 and 33 which have the same shape as the resulting window. These winding mandrels it will be seen in Fig. 2 are placed adjacent the lug surfaces 22 and 23. Thus when the terminals 18 and 19 are each rotated in the same direction, for instance, in a counterclockwise direction through an angle of 90 degrees, substantially full turns 34 and 35 will be wound around the mandrels 32 and 33, as will be seen in Fig. 3, the turn 34 being provided by the end of the strap 20 and the turn 35 being provided by the end of the strap 21. When the terminals 18 and 19 are rotated another 90 degrees in the same direction the ends of the conducting straps 20 and 21 are then forced into relatively tight engagement around the lugs 22 and 23 as will be seen in Fig. 4. Also the straps may be placed in tight engagement all along the central surface as is illustrated in Fig. 4 so as to facilitate the completion of the winding of the straps 20 and 21. Thus when the terminals 18 and 19 are wound another 90 degrees, as is illustrated in Fig. 5, the central leg portion 40 of both straps 20 and 21 and the outer surface 41 and 42 which surrounds the mandrels 32 and 33 respectively are brought into relatively tight engagement, as is shown in Fig. 5.

In order to facilitate the discernment between the straps 20 and 21, arrows have been placed on the strap 21 so that it may be seen from an inspection of Fig. 5 how many turns are included in each of the coil portions 14 and 15. Thus with the construction illustrated in the drawings each of the conductors provides two electrical turns, and since the straps are connected in parallel this means a total of two electrical turns linking the core legs. Also, from a mechanical viewpoint a half turn is provided for one of the coil portions and one and one-half turns for the other coil portions with each strap. It is to be understood, however, that by properly proportioning the sizes and number of straps in relation to the size of the mandrel and the terminal lugs, any suitable number of turns may be provided in the coil portions, and these even numbers of mechanical turns are provided by odd numbers or fractions of odd number of turns for each of the straps 20 and 21. Thus it will be seen, from a mechanical viewpoint, that if X is the number of turns provided for one of the coil portions by one of the straps, X+1 turns are provided by the same strap for the other coil portion. This may be seen from an inspection of Fig. 3 where at this step, in the method one end of each conductor has formed one turn for each coil before the opposite ends are brought adjacent the mandrel. Thus in the construction illustrated, X is equal to one-half so that each strap provides one-half mechanical turn for one coil and one and one-half turns for the other coil, making a total of two turns each for each coil.

After the coils have been wound in the manner illustrated in Figs. 2 through 5, the mandrels 32 and 33 may be forced out of the coils thus providing a pair of coil portions with windows, as is illustrated in the perspective view of Fig. 6. In order to form the complete electromagnetic induction apparatus as is illustrated in Fig. 1, the core leg portions 10 and 11 with the secondary windings 12 and 13 may be inserted in the windows 30 and 31 of the primary winding.

A further important advantage of the construction described above is that by attaching

the terminals and then winding the conductors in the manner described the terminals are relatively tightly and snugly supported inside the coil windings and thus a very rugged construction is provided which will withstand relatively large short circuit forces.

It is to be understood that any suitable number of conductors may be employed to form any suitable number of coil portions according to my invention, and in the construction illustrated in Figs. 7 and 8 only one conductor 40 is employed to provide a pair of side-by-side coil portions 41 and 42 which coil portions have parallel but spaced axes. The coil is formed by providing the strap 40 with terminals 43 and 44 which are attached to spaced points of the conductor. Thus in the construction as shown in Figs. 7 and 8 the terminals 43 and 44 have similar depending or lug portions 45 and 46, respectively, which are attached in any suitable manner such as by soldering or welding to the ends of the strap 40. The coil portions 41 and 42 are then formed by winding the strap around a pair of mandrels in the same manner as described above in relation to Figs. 2 to 5. Thus the terminals 43 and 44 may each be turned in a counterclockwise direction for a suitable number of degrees to produce the coil portions 41 and 42. It is to be understood that any suitable insulation may be provided between the turns in forming the various coil portions, as is shown in the drawings, and in Fig. 7 it will be seen that this insulation is provided by employing sheets 47 and 48 of suitable insulating material, such as paper.

Any suitable number of turns may be provided with the coil construction, and in Fig. 7 three electrical turns are provided which link the winding legs or approximately one and one-half mechanical turns are provided for each of the coil portions 41 and 42. It will also be noted that in the construction as illustrated in Fig. 7, an odd number of electrical turns is provided while in the construction as illustrated in Figs. 1 through 6 an even number of electrical turns is provided. Also the construction in Fig. 7 has the similar important advantage that the terminals are each wound with the continuous conductor so that the terminals are inside the convolutions so as to provide a very rugged construction which will stand relatively large short circuit forces.

Although I have shown and described particular embodiments of my invention, I do not desire to be limited to the particular embodiments described, and I intend in the appended claims to cover all modifications which do not depart 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. A winding for an electrical induction apparatus including a pair of strap conductors, a pair of terminals having right angularly extending lug portions, means for attaching opposite ends of each of said strap conductors to said lug portions, said conductors being wound snugly forming a pair of coil portions of a coil winding, each of said straps providing one-half a mechanical turn for one coil and one and one-half mechanical turns for the second coil so that each coil includes a total of two mechanical turns.

2. A winding for an electrical induction apparatus including a pair of snugly wound strap conductors providing a first and a second coil, one of said conductors providing X mechanical turns

for one coil and X plus one turns for said second coil, said other conductor providing X mechanical turns for said second coil and X plus one turns for said first coil.

3. An electromagnetic apparatus including a core having a pair of winding legs, and a pair of coil portions surrounding said legs, said pair of coil portions formed of a pair of snugly wound

conductors, one of said conductors providing X mechanical turns for one coil and X plus one turns for said second coil, said other conductor providing X mechanical turns for said second coil portion and X plus one turns for said first coil portion.

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