April 5, 1932. J. J. FRANK 1,852,805

TRANSFORMER WINDING

Filed Oct. 2, 1931

Fig. 1.

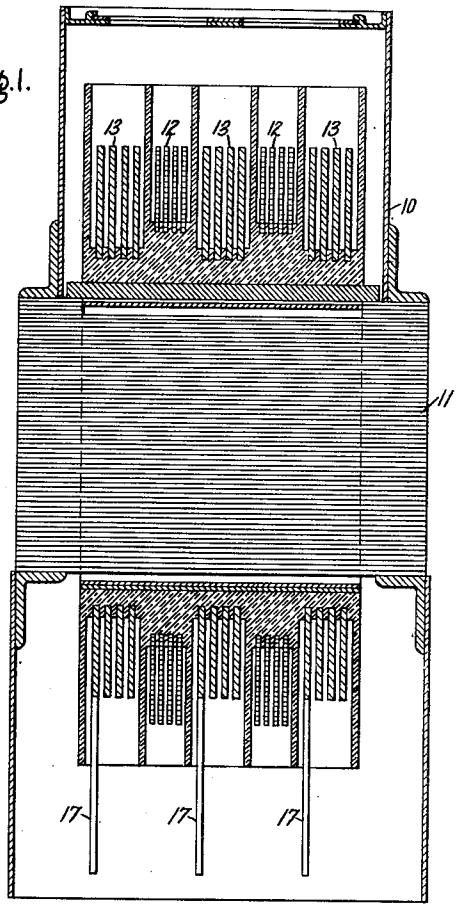


Fig. 2.

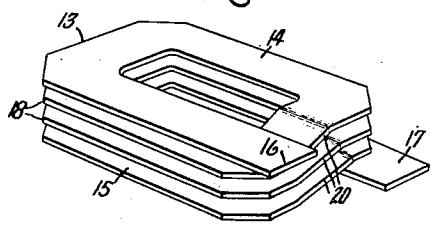
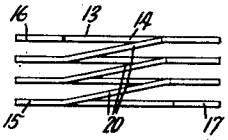


Fig. 3.



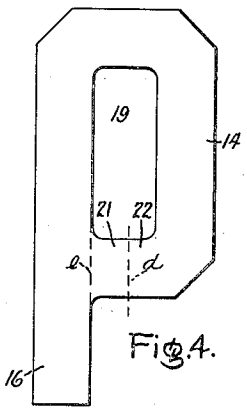


Fig. 4.

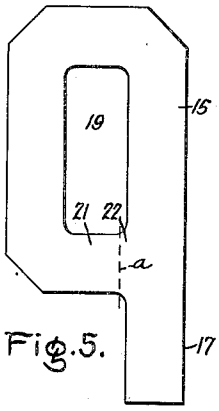


Fig. 5.

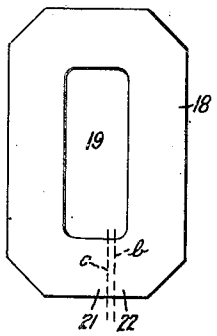


Fig. 6.

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Patented Apr. 5, 1932 1,852,805

UNITED STATES PATENT OFFICE

JOHN J. FRANK, OF PITTSFIELD, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

TRANSFORMER WINDING

Application filed October 2, 1931. Serial No. 566,560.

My invention relates to windings for electrical apparatus, such as transformers, and more particularly to windings of large cross section conductor for carrying heavy currents. Some transformers such as are used to furnish current for welding and electric furnace operation have windings which operate at very low voltage but which carry very large currents. Such large currents make it necessary that the conductor forming the turns of these windings have such large cross section that it cannot be bent into the required shape and the turns have sometimes been made up of short heavy metal plates welded or brazed end to end as disclosed, for example, in United States Patent No. 1,723,840, issued August 6, 1929, on an application filed by Locke H. Burnham. This method of forming a winding avoids any bending of the conductor but results in a winding having a considerable number of joints which are expensive to make and which may have some objectionable resistance. The general object of the present invention is to provide an improved transformer winding and a method of forming it, the winding conductor being of large cross section and having few joints.

The invention will be better understood from the following description taken in connection with the accompanying drawings in which Fig. 1 is a vertical sectional view of a transformer of the air blast type having a winding formed in accordance with the invention; Fig. 2 is a perspective view of a section of the winding; Fig. 3 is an edge view of the winding; and Figs. 4, 5 and 6 are views of metal blanks from which the winding may be formed.

Like reference characters indicate similar parts in the different figures of the drawings.

The transformer 10 shown in Fig. 1 is of the air blast type and includes a magnetic core 11 with a high voltage winding 12 formed in two sections and a low voltage winding 13 formed in three sections. These three winding sections are alike, one of them being shown in detail in Figs. 2 and 3. The two end turns 14 and 15 of each section of the low voltage winding are provided with terminals 16 and 17 respectively so that the sections may be connected in series or multiple as desired. The other or inner turns 18 are similar to the end turns 14 and 15 but without the terminals.

As shown in Figs. 2 to 6 inclusive, which are about half size as compared with Fig. 1, each turn of the winding sections 13 is made from a blank in the form of a heavy flat metal plate, preferably copper, with an opening 19 for the winding leg of the core 11. Each blank is thus a continuous turn surrounding its opening 19. These blanks may be formed in any desired way as by casting them or by shearing, cutting or punching them from solid flat metal plates or sheets.

The turns in the finished winding, as indicated in Figs. 2 and 3, are preferably spaced to permit heat to be readily dissipated. Each turn includes a flat portion extending nearly around the space 19 occupied by the winding leg of the core and these flat portions are connected together in series by crossovers 20. Each of the blanks 14, 15 and 18 is cut or severed at one side to change it from a closed turn to an open turn with two ends 21 and 22. Each of the ends 21 at one side of the series of cuts is bent at an angle to the plane of its turn to meet the end 22 at the opposite side of the cut in the adjacent turn, the bent ends of the turns thus forming the crossovers 20 between turns. Each of the crossovers 20 and the end 22 of the adjacent turn are fused together as by welding or brazing as indicated in Figs. 2 and 3.

After an end 21 of a turn has been bent out of the plane of the rest of the turn, it does not, of course, reach quite as far around the axis of the turn as it did before being bent. For this reason, the cuts in the two turns must be displaced slightly as indicated in Fig. 3 in order that the bent end 21 of the first turn may reach the end 22 of the next turn. The cuts are therefore progressively displaced in successive turns about their common axis. Thus, the first turn 15 may be cut as indicated by the line *a* in Fig. 5, successive intermediate turns 18 as indicated by the lines *b* and *c* in Fig. 6 and the last turn 14 by the line *d* as indicated in Fig. 4. Inasmuch as

no crossover is required beyond the last turn 14, another cut *e* is made in this turn and the section or end 21 of this turn between the cuts *d* and *e* is removed.

The invention has been explained by describing and illustrating a particular form of winding and method of forming it, but it will be apparent that changes may be made without departing from the spirit of the invention and the scope of the appended claims.

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

1. The method of forming a winding for electrical apparatus from flat metal blanks in the form of closed turns, said method including the steps of cutting each of said turns at one side to form open turns, said cuts being progressively displaced in successive turns about their common axis, bending at least one end of each turn except the last to meet an end of the next turn, and fusing the meeting ends together.

2. A winding for electrical apparatus, said winding including turns having spaced flat portions, each turn except the last having one end bent and connected to an adjacent turn by a fused joint, said fused joints being progressively displaced in successive turns about the common axis of the turns.

In witness whereof, I have hereunto set my hand.

JOHN J. FRANK.