Oct. 12, 1937. J. G. SOLA 2,095,294

TRANSFORMER AND THE LIKE

Filed April 17, 1935

Fig. 1

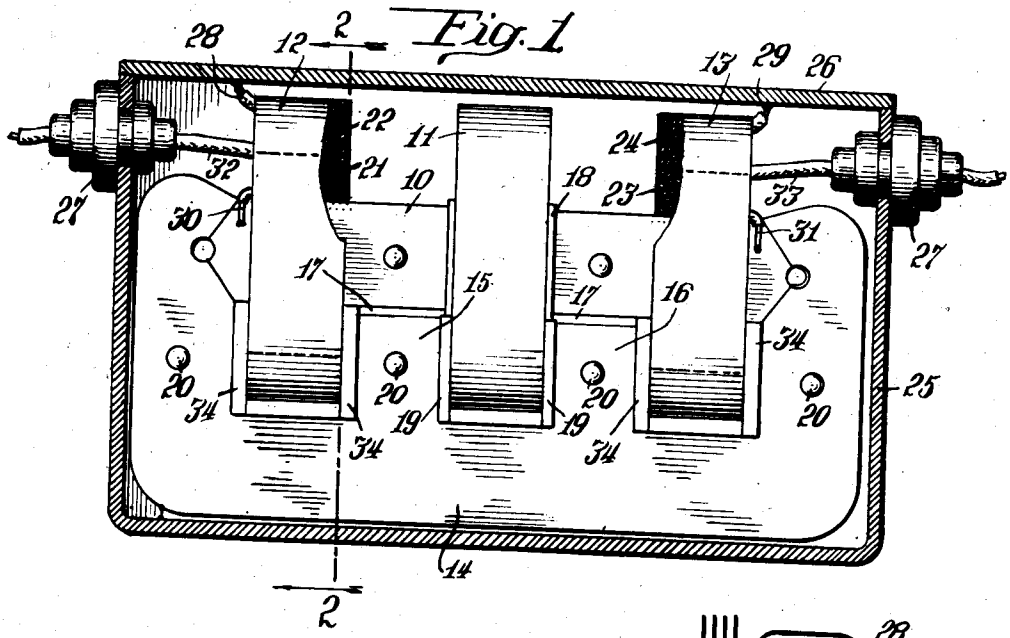


Fig. 3.

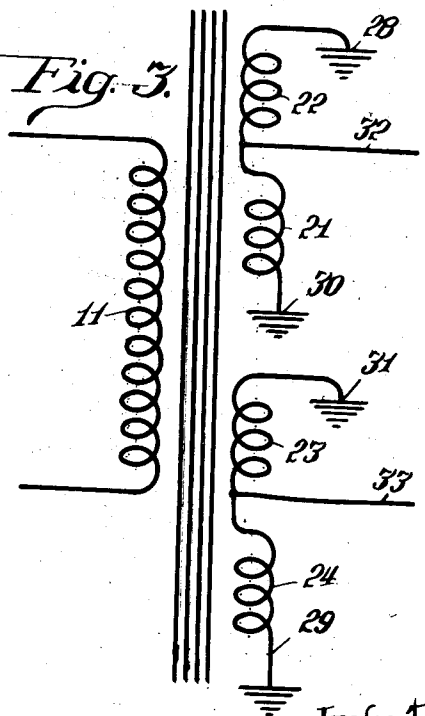
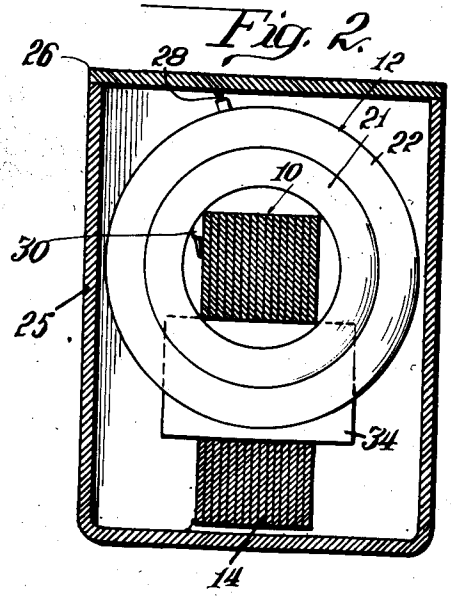


Fig. 2.



Inventor,
Joseph G. Sola,
By Fricke & DeBusk,
Attorneys

Patented Oct. 12, 1937

2,095,294

UNITED STATES PATENT OFFICE

2,095,294

TRANSFORMER AND THE LIKE

Joseph G. Sola, Oak Park, Ill., assignor to Sola Electric Co., Chicago, Ill., a corporation of Delaware

Application April 17, 1935, Serial No. 16,832

2 Claims. (Cl. 171—119)

My invention relates to transformers and the like, and it has for its object the provision of a new and improved form and arrangement of parts in a device of this character by reason of which the trouble and expense in connection with the insulation of the parts may be substantially reduced as compared with prior constructions. In transformers of the type comprising coils mounted on iron cores and enclosed within metal casings or located adjacent to frames or other parts formed of metal, it has been found necessary heretofore to provide insulation in connection with all such coils carrying high tension currents between the core bars and the inner portions of the coils and between the outer portions of the coils and the adjacent parts of the core or casing, and the provision of such insulation so as to be effective at the required points and the maintainment of such insulation in condition to be effective have been highly important factors in the use and operation of transformers representing a substantial portion of the total cost of providing the instruments and keeping them in condition.

It is one of the objects of my invention to provide an improved arrangement by reason of which the insulation carried by the wire shall provide the required protection at the inner and outer faces of the coils without the necessity for the use of any coil insulation whatever at these points in addition to the insulation carried by the wire, and by which the amount of coil insulation necessary to be used at other points is kept to a minimum. To this end, it is one of the objects of my invention to provide an improved arrangement of windings by which the structure of the coil itself is utilized for providing effective insulation, utilizing the turns carrying the lower voltage current as insulation means for the turns carrying the highest voltage current. It is another object of my invention to provide an improved arrangement in which one coil section serves as insulation between the core or other metal parts and another coil section.

It is another object of my invention to provide an improved double coil comprising two coil sections, one located inside of the other with each section wound reversely with respect to the other, with two such double coils mounted on the same core bar so as to be influenced by a single magnetic field, and with the outer turns of the outer coil sections connected directly with the inner turns of the inner coil sections either by grounding to the core or casing parts or otherwise, whereby the four coil sections are connected in parallel series arrangement. By this construction, the high tension turns of each coil section are located directly adjacent to the high tension turns of the adjacent coil sections, with the potential of substantially the same value in said adjoining turns of the two coil sections, so that there is no necessity for the provision of any insulation between the sections of the double coil arrangement. In this arrangement, no insulation is required for the double coils except at the ends where the high tension turns are located close to the core parts.

It is another object of my invention to improve devices of this type in sundry details hereinafter pointed out. The preferred means by which I have accomplished my several objects are illustrated in the drawing and are hereinafter specifically described. That which I believe to be new and desire to cover by Letters Patent is set forth in the claims.

In the drawing,—

Fig. 1 is a side face view of a transformer, enclosed within a casing which is shown in cross section, and with portions of the coils broken away for better showing my construction;

Fig. 2 is a vertical cross sectional view taken at line 2—2 of Fig. 1; and

Fig. 3 is a diagrammatic view showing the connections of the coil sections.

Referring now to the several figures of the drawing, in which corresponding parts are indicated by the same reference characters, 10 indicates a laminated core bar having a primary coil 11 and secondary coil members 12 and 13 mounted thereon, a core member 14 in the form of a yoke serving as a return path for the flux established in the core bar 10, the parts 10 and 14 together constituting a core in the form of a loop. The yoke 14 is provided with arms 15 and 16 thereon extending between the primary coil 11 and the secondary coil members 12 and 13 respectively, such arms 15 and 16 extending into close proximity to the core bar 10 but stopping short of said bar so as to provide air gaps 17 between the arms and the bar 10. In the arrangement shown, an insulating sleeve 18 of any suitable type is provided between the primary coil 11 and the core bar 10, and insulation parts 19 in the form of plates are positioned between the end faces of the primary coil 11 and the adjacent shunt arms 15 and 16. Rivets 20 are provided in the arrangement shown for holding the core laminations rigidly together.

As is clearly shown in the drawing, the coil member 12 comprises two coil sections located

one inside of the other, the inner coil section being indicated by the reference character 21 and the outer coil section by the reference numeral 22. In like manner, the coil member 13 is formed of two sections 23 and 24, one located inside of the other. The inner and outer coil sections of each of the double coil members 12 and 13 are provided with the same number of turns, being reversely wound, as is clearly shown in Fig. 3.

In the arrangement shown in Figs. 1 and 2, my improved transformer is enclosed within a casing member 25 comprising a lid or cover portion 26, the walls of the casing being located in close proximity to the core means and to the outside face portions of the coil sections 22 and 24. The casing member 25 is provided in its ends with outlet bushings 27 of any suitable type for carrying the high tension wires out of the casing.

In the arrangement shown, the outside turns of the outer coil sections 22 and 24 are grounded to the cover plate 26 at the points 28 and 29 respectively. The inside turns of the inner coil sections 21 and 23 are grounded upon the core bar 10 at the points 30 and 31 respectively. A circuit lead 32 is connected with the inside turns of the outer coil section 22 and with the outside turns of the inner coil section 21, and a circuit lead 33 is connected with the inside turns of the outer coil section 24 and with the outside turns of the inner coil section 23. By this means, the coil sections of the two double coils are connected in series between the leads 32 and 33, with the coil sections of each double coil connected in parallel arrangement with respect to each other.

As will be readily understood, the coil sections 21 and 23 are adapted to cooperate with respect to the magnetic flux in the core bar 10 and the coil sections 22 and 24 are likewise connected and wound so as to cooperate with each other. The coil sections 21 and 24 are connected and wound so as to cooperate, and the coil sections 22 and 23 are likewise connected and wound for cooperative results. The resistance of the coil sections 24 and 21 is equal to the resistance of the coil sections 23 and 22, with the result that the four coil sections operate in complete equilibrium.

By reason of my improved arrangement of the coils, the outside turns of the outer coil sections and the inside turns of the inner coil sections all have substantially zero potential so as to make it unnecessary to provide any insulation between such turns and the adjacent metal parts. The inner and outer coil sections of each of the double coils are wound and connected so as to cooperate with each other for the production of induced current, the outside turns of the inner coil section of each double coil being of the same potential as that of the inside turns of the outer coil section. It is thus unnecessary to provide any insulation between the coil sections of either double coil. At the ends of the double coils, I have provided plates 34 of insulating material for insulating the high tension turns of said coil sections from the core parts, such limited amount of insulation having been found adequate for complete protection of the secondary coils.

By my improved construction, in which the induced current is carried by two coil structures connected in parallel, wire of just half the size necessary for a single coil arrangement is of course used for such coils, this being effected without any change in the resistance feature of the transformer. Inasmuch as the windings are arranged in four sections in lieu of the usual two sections or coils, it will be appreciated that the repair of a transformer in which there has been a short circuit may sometimes be effected much more readily by reason of my improved construction.

By the use of my construction, a transformer properly insulated can be produced at a very great saving as compared with prior constructions, the plates 34 being provided and applied in operative position at a very slight expense as compared with the cost of insulation as carried out heretofore in connection with the secondary coils. Such plates 34 may moreover be of such a character as to be effective for many years without deterioration even when the transformer is substantially overloaded so as to cause heating such as would very quickly break down many types of insulation as heretofore employed.

While I prefer to employ the form of device as shown in my drawing and as above described, it is to be understood that my invention is not limited to such features except so far as the claims may be so limited by the prior art.

I claim:—

1. In a device of the type described, the combination of a core in the form of a loop, primary coil means on said core for magnetizing it, two secondary coil sections on said core loop in spaced relation to said primary coil means and each comprising a plurality of layers of turns, with the inside turns of said secondary coil sections connected together, and arranged so that said secondary coil sections cooperate with each other with respect to the production of an induced current, two other secondary coil sections mounted on said first named secondary coil sections respectively and each comprising a plurality of layers of turns, with the outside turns of said second named secondary coil sections connected together and the inside terminals of said second named secondary coil sections joined with the outside terminals of said respective first named secondary coil sections, and with said second named secondary coil sections arranged so that they cooperate with each other and cooperate with said first named secondary coil sections with respect to the production of an induced current, output leads extending from said joined terminals respectively, shunt core means providing a magnetic return path including an air gap effective between said primary coil means and two of said secondary coil sections, and other shunt core means providing a magnetic return path including an air gap effective between said primary coil means and the other two secondary coil sections.

2. In a device of the type described, the combination of a core bar, primary coil means mounted on said core bar for magnetizing it, two secondary coil sections mounted on said core bar on opposite sides of said primary coil and in spaced relation thereto and each comprising a plurality of layers of turns, with the inside turns of said two coil sections connected together, and arranged so that said coil sections cooperate with each other with respect to the production of an induced current, two other secondary coil sections mounted on said first named secondary coil sections respectively and each comprising a plurality of layers of turns, with the outside turns of said second named secondary coil sections connected together and the inside terminals of said second named secondary coil sections joined with the outside terminals of said respective first

named secondary coil sections, and with said second named secondary coil sections arranged so that they cooperate with each other and cooperate with said first named secondary coil sections with respect to the production of an induced current, output leads extending from said joined terminals respectively, each of said four secondary coil sections having approximately the same number of turns therein, auxiliary core means connecting the ends of said core bar about all of said coils providing a return path for the magnetic flux set up in said core bar, shunt core means providing a magnetic return path including an air gap effective between said primary coil means and two of said secondary coil sections, and other shunt core means providing a magnetic return path including an air gap effective between said primary coil means and the other two secondary coil sections.

JOSEPH G. SOLA.