Aug. 12, 1924. 1,504,625

C. G. JONES

TRANSFORMER

Filed Aug. 15, 1919

Fig. 1.

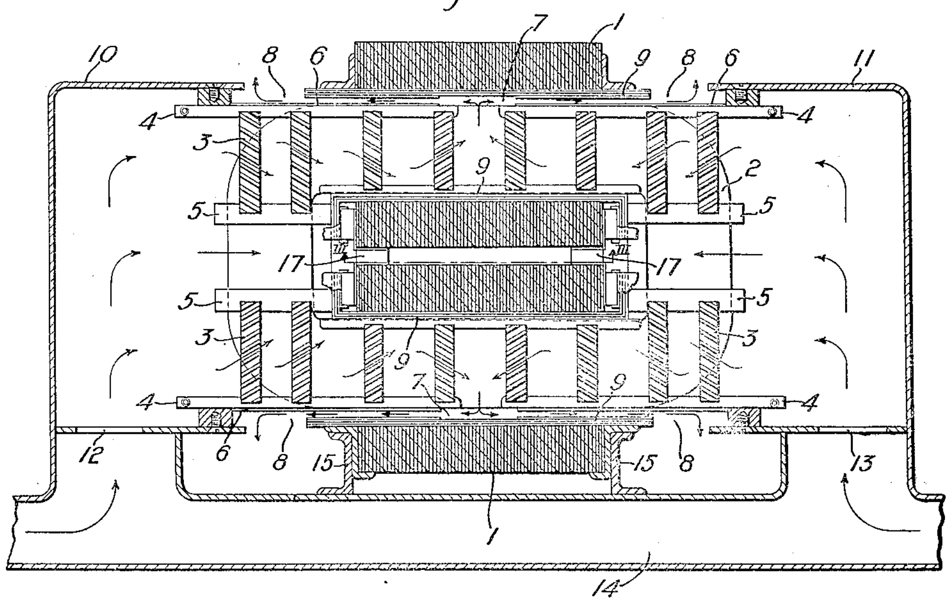


Fig. 2.

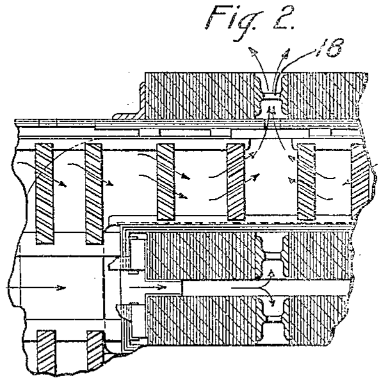


Fig. 3.

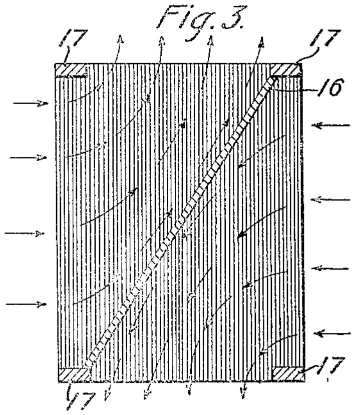
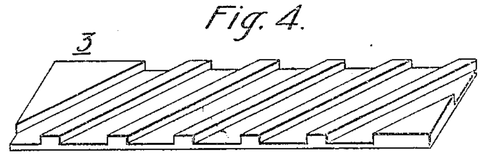


Fig. 4.



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UNITED STATES PATENT OFFICE.

CARL G. JONES, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

TRANSFORMER.

Application filed August 15, 1919. Serial No. 317,641.

To all whom it may concern:

Be it known that I, Carl G. Jones, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Transformers, of which the following is a specification.

My invention relates to transformers and it has especial relation to apparatus of the character designated in which a cooling medium is directed over the heated portions thereof.

For a better understanding of my invention, reference may be had to the accompanying drawing, in which Figure 1 is a sectional view of a transformer embodying my invention; Fig. 2 is a fragmentary sectional view illustrating a modification of the transformer shown in Fig. 1; Fig. 3 is a fragmentary sectional view taken on the line III—III of Fig. 1 and illustrates the supporting barrier which is interposed between two portions of the transformer core member, and Fig. 4 is a view of the spacing member which is utilized between the coil members.

I find that in certain types of transformers, especially those types which are commonly utilized for electrical railway purposes and which are cooled by an air-blast, there are many difficulties attendant upon forcing the air from one end of the coil members to the other end thereof, and this is particularly true when the entire transformer structure is positioned with the long dimension of the coils extending in a horizontal direction. The latter method of disposing a transformer is that which is commonly utilized when the apparatus is placed in an electrical railway locomotive. I find that when an attempt is made to force the cooling air through the transformer from one end thereof to the other, the ends of the coil members at which the air is withdrawn become somewhat more heated than desirable, on account of the fact that the fluid which is utilized to cool these coil ends has become quite highly heated during its passage through the opposite end of the transformer. Moreover, because of construction limitations, it is more or less difficult to direct the cooling air over to the center faces of the coils when the air is blown through the apparatus from one end thereof to the other.

I propose, therefore, to so construct a transformer that the cooling medium will be forced thereinto from both ends of the coil members and constrained to pass over the coil faces in such manner that but one-half substantially of the coil faces need be cooled by the air entering from adjacent that end and that thereafter the cooling medium will be withdrawn from substantially the middle point of the coil faces, thus insuring that each half of the heated coils will be supplied with fresh air.

In connection with my novel cooling system, I employ a particular form of coil spacing member the advantages and novelty of which I will hereinafter more fully point out.

Referring now more particularly to Fig. 1, a core member 1 is built up of laminations and is comprised of two portions. A plurality of flat pan cake coils, of which that one shown at 2 is the only one visible in the drawing, is inductively related to the core member 1 and the coil members separated from each other by slotted spacing members 3 which extend transversely across the faces thereof. Notched holding strips 4—4 and 5—5 are disposed between the coils and are adapted to hold the spacing members 3—3 securely in place after the coil members have been stacked. A fuller-board insulating member 6 is wrapped around the stack of pan cake coils in such manner that they are entirely enclosed except at their ends. Since the insulating member 6, just described, so surrounds, and is contiguous to, the edges of the coils, it will be understood that air which is forced between the coils from their ends is constrained to flow over the faces thereof before leaving the interior of the transformer. The member 6, however, is provided with openings 7—7 through which the cooling medium which is forced through the coils, may be withdrawn at substantially their middle points.

In the apparatus shown in Fig. 1, I have provided a channel between the insulating member 6 and the outer core legs, through which the air may escape, by passing therethrough and outwardly at the points 8—8. In addition to the channel, formed as shown, fuller-board insulating layers 9—9 are disposed between the core iron and the coils, both at the outer and inner edges of the latter, those used between the inner core portions and the coils being bent at their ends to form a substantially box-like structure which almost entirely surrounds the inner portion of the core member.

Hoods 10 and 11 are secured to the extreme ends of the fuller-board insulating layers which surround the coils, and are provided with openings 12 and 13, respectively, which connect to a pressure chamber 14 in which a constant air pressure is maintained for the purpose of forcing the air into the hoods 10 and 11 and thereafter between the coils. While a transformer used in railway work may be disposed in the locomotive cab in any well-known fashion, I have illustrated the one just described as provided with feet 15.

From the foregoing description, the manner in which I supply a cooling medium to a transformer of the type described will be more or less apparent. It should be observed, however, that, inasmuch as the holding strips 4 and 5, when disposed between the stacked coil members, comprise barriers which direct the movement of the air, three main channels for the cooling medium will be provided, and I have indicated the approximate direction of the cooling medium streams through these channels by arrows. That portion of the air which flows through the slots in the spacing members and over the coil faces towards the centers of the latter is withdrawn from the coil edges through the openings 7 and is thereafter constrained to pass over the inner edges of the outer portions of the laminated core.

I find that by so directing the cooling air that the portions of the coil which are hottest are first cooled while the final use of the cooling medium is made in alleviating high temperature conditions in a portion of the coil which is comparatively cool as compared with the inner portions of the transformer. The air, however, which seeks a path through the center of the coil ultimately enters the space between the two portions of the core member, and is there directed as shown in Fig. 3, that is to say, one-half of the portions just described is cooled by the air entering from each direction, on account of the provision of a spacing and directive member 16. It will be observed that by the use of the directive member 16 disposed in the manner shown, I am able to direct the air freely over the edges of the inner laminations and, at the same time, to so support them by the member 16, as well as by auxiliary corner supports 17, that no tendency for them to become displaced is evidenced. Moreover, the difficulty of supplying air to the center portion of the coil faces is overcome by the provision of passages leading to the space between the core portions.

While I have described that portion of the cooling medium which is withdrawn from the middle point of the coils as escaping outwardly between the outer core portions and the coil edges, I find that, in some instances, as shown in Fig. 2, certain advantages are obtained by dividing the laminations of the core at substantially the midpoint of the coils by a member 18 of substantial I-beam form having openings in the web thereof through which the air may escape. I find this latter provision especially desirable when it is desired to force large quantities of cooling medium through the transformer; that is, such quantities as would be more or less restricted by being forced to pass through the channel formed between the member 6 and the insulating layers 8.

In Fig. 4 I have shown one of the insulating spacing strips which are disposed between the coil members. I find that by using strips of this character I am able to much more efficiently support all the conductors of the coils and, at the same time, allow substantially unimpeded movement of a cooling medium between the coils by reason of the deep, wide slots which are cut in the strips. At the same time, the employment of such a spacing member gives many advantages, in that, the aggregate area which is covered thereby is substantially small as compared with the entire area of the coil face. Again, by referring to Fig. 1, it will be seen that spacing members of the character described may be disposed in such manner that substantially transverse support is offered to every conductor at the corner of the coils, a feature which has always been more or less difficult of attainment in the past. Moreover, I find that the spacing members may be very simply and expeditiously manufactured of a molded insulating material and that, therefore, in addition to the many operative advantages heretofore ascribed to them, their cost is comparatively low.

While I have described but one form of my invention, I believe that there are many other structures in which the same principle may be embodied without departing from the spirit of the appended claims, and I desire, therefore, that my invention be limited only by the prior art or by the scope of the appended claims.

I claim as my invention:

1. In a transformer, a core member, coils inductively related thereto, means for directing a cooling medium over the faces of the coils from each end thereof, said means being so arranged that the cooling medium is supplied first to the hottest portion of

said core and across the faces of said coils, and then to the less heated portions of the core, and means for alternately deflecting the flow of said cooling medium over the faces of said coils in different directions.

2. In a transformer, a core member, coils inductively related thereto, separating members between said coils comprising diagonally slotted strips extending transversely across the faces of said coils, and directive means causing a cooling medium to flow from both ends of said transformer between said coils and through the slotted portions of said separating strips.

3. In a transformer, a core member, coils inductively related thereto, separating members between said coils comprising diagonally slotted strips extending transversely across the faces of said coils, and directive means causing a cooling medium to flow from both ends of said transformer between said coils and through the slotted portions of said separating strips, and enclosing means partially surrounding said coils but having openings at substantially the midpoint thereof whereby the cooling medium escapes from substantially the middle of the coils.

4. In a transformer, a core member, coils inductively related thereto, separating members between said coils comprising diagonally slotted strips extending transversely across the faces of said coils, the diagonal supporting portions of said separating members being arranged transversely to the coil conductors throughout the length thereof although the slotted portions thereof afford passages for a cooling medium through said transformer from end to end.

5. In a transformer, a two-part laminated core member, coils inductively related thereto, separating and supporting members between the two portions of said core member comprising a barrier diagonally disposed with respect thereto, and means whereby a cooling medium may be directed into the space between the core portions from each end thereof, the medium entering from one end cooling substantially one-half of the exposed faces of said portions and that entering from the other end cooling the other halves thereof.

6. In a transformer, a core member, coils inductively related thereto, slotted spacing members disposed transversely between said coils and providing ventilating passageways therebetween, and insulating means partially surrounding said coils and positioned between said coils and the core member, an opening being provided in said surrounding insulating means at substantially the mid-point of the coils whereby a cooling medium may flow between said coils, through said opening, and then outwardly between the coils and the core.

7. In a transformer, a core member, coils inductively related thereto, slotted spacing members disposed transversely between the coils, holding strips for said spacing members extending at right angles thereto and forming barriers dividing the space between the coils into a plurality of passages, means for supplying a cooling medium to the ends of said passages, and for withdrawing the same from substantially the middle thereof.

In testimony whereof, I have hereunto subscribed my name this 6th day of August, 1919.

CARL G. JONES.