Jan. 29, 1957 W. N. KILNER 2,779,884

DYNAMO-ELECTRIC MACHINES

Filed Oct. 25, 1955 4 Sheets-Sheet 1

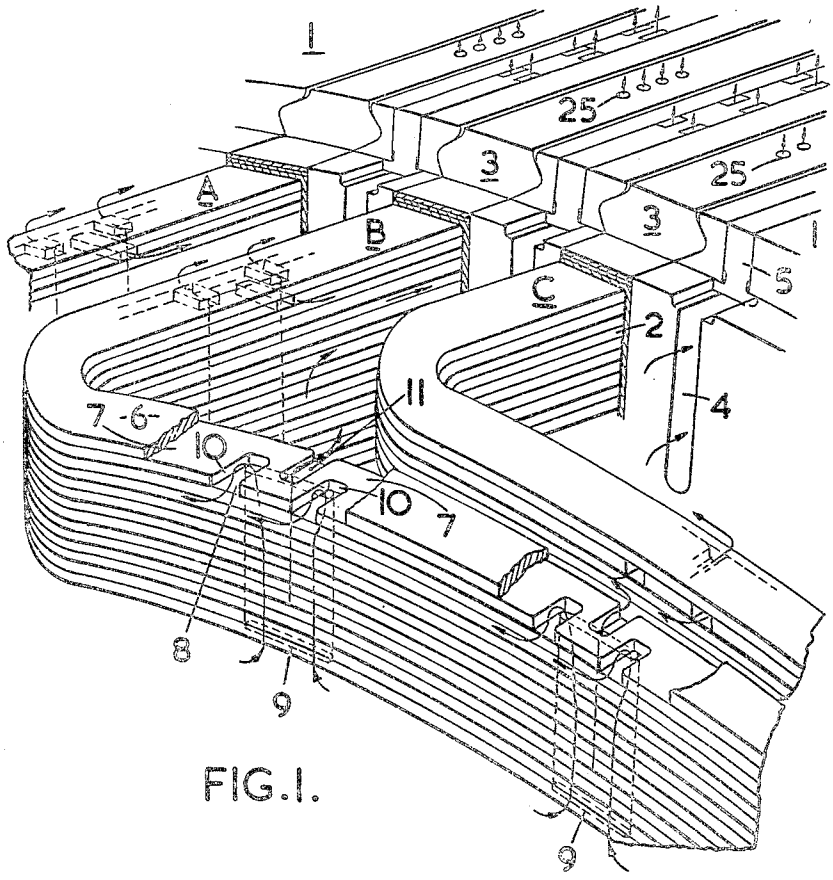


FIG. 1.

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4 Sheets-Sheet 2

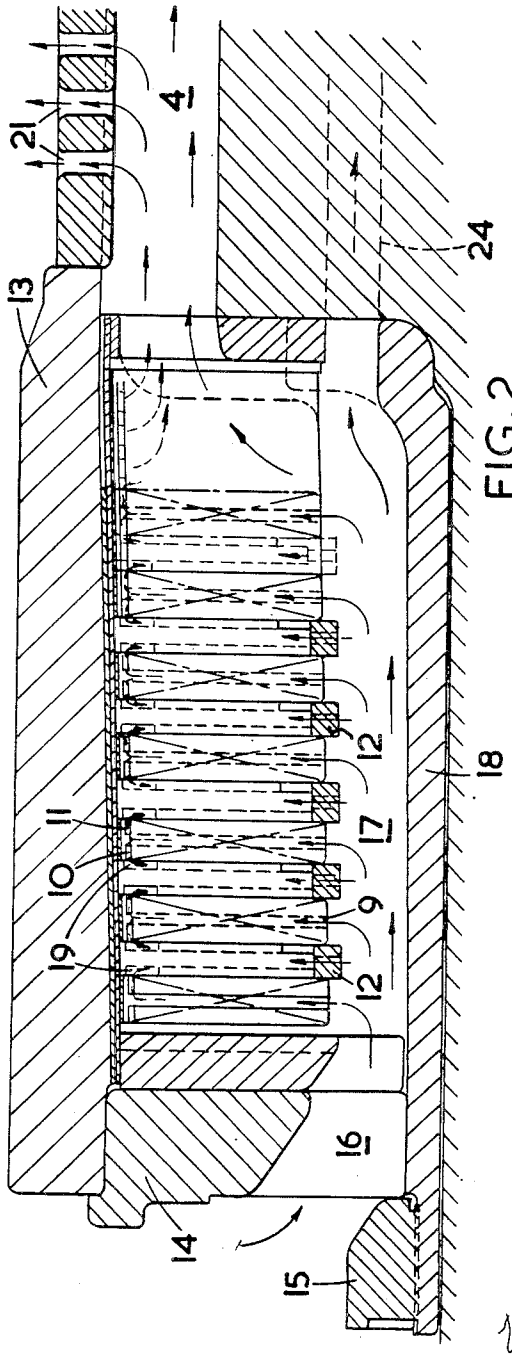


FIG. 2.

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Jan. 29, 1957 W. N. KILNER 2,779,884

DYNAMO-ELECTRIC MACHINES

Filed Oct. 25, 1955 4 Sheets-Sheet 3

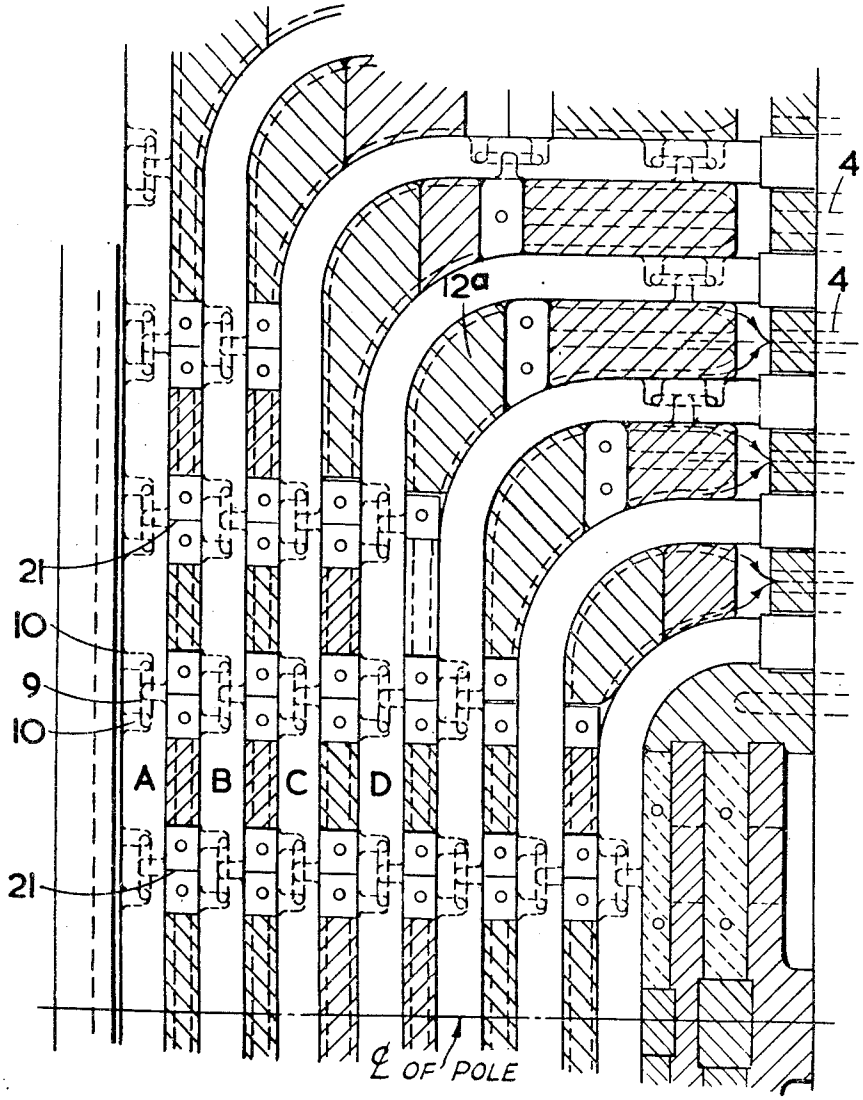


FIG.3.

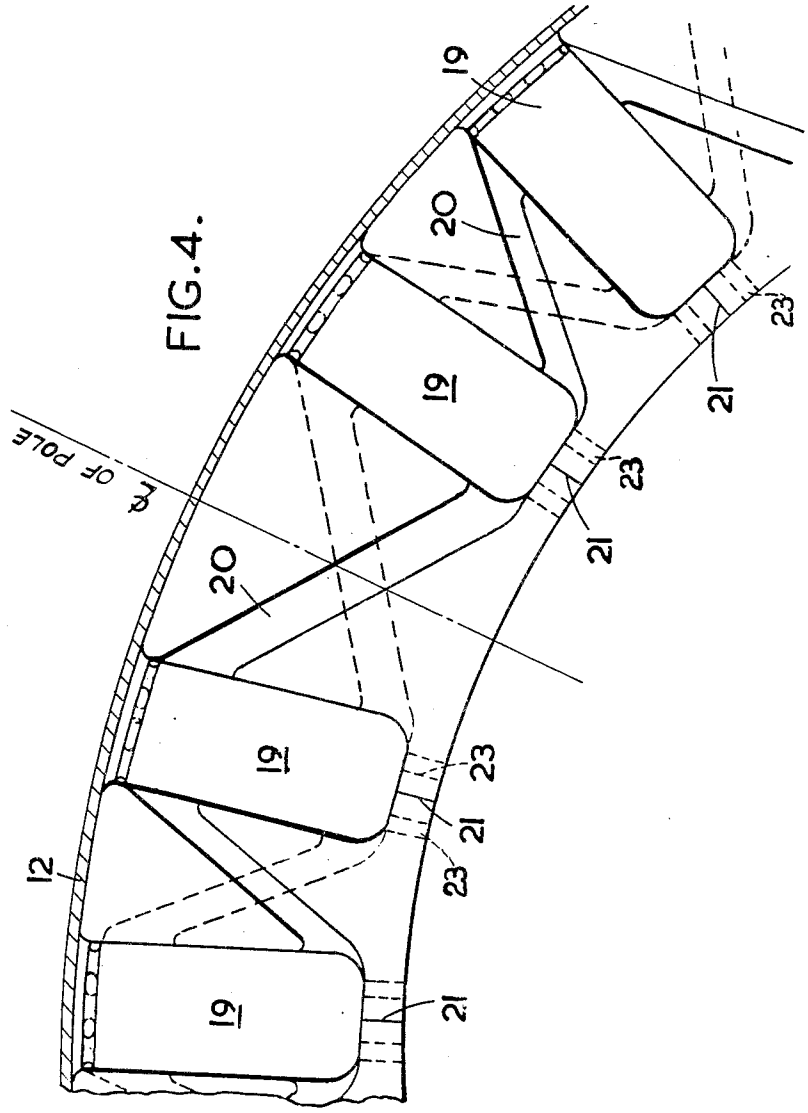
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DYNAMO-ELECTRIC MACHINES

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FIG. 4.



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2,779,884

DYNAMO-ELECTRIC MACHINES

William Norman Kilner, Hale, England, assignor to Metropolitan-Vickers Electrical Company Limited

Application October 25, 1955, Serial No. 542,602

Claims priority, application Great Britain November 2, 1954

5 Claims. (Cl. 310—64)

This invention relates to dynamoelectric machines and more particularly to the rotors of high speed turbo-alternators.

Whilst the need for increasing the power output of such machines continues, considerable difficulties arise if the physical dimensions of these machines are increased. Such difficulties largely arise in connection with handling the machines and particularly in transporting the machines from the place of manufacture to their permanent site which may, in many cases, be overseas.

It follows, therefore, that increased output can only be achieved by increased loading of the machine which in turn necessitates improved heat dissipation. Clearly the actual conductors constitute the main source of heat and the present invention is concerned with improving the heat dissipation in the exposed parts of the end turns.

It is customary to form the conductors of rectangular copper straps which are superimposed one on each other to form a coil, there usually being a pair of such straps constituting each conductor. With such constructions it has been proposed to ventilate the conductors by radial passages through a coil combined with discharge ports in the side faces of the coil, also to provide longitudinal passages through the conductors. In forming the radial passages it has been necessary to slot the individual straps prior to assembly as it is impracticable to bore through the assembly conductor. However, it has been found that in such cases difficulties arise in ensuring that the apertures in the various straps register. It has also been proposed to form the longitudinal passages and the side ports by machining grooves in the abutting faces of a pair of straps forming a conductor so that when the straps are placed together the grooves register and form a passage. However, difficulties have again arisen both in ensuring during assembly, that the gooves in an abutting pair of faces register and also to avoid unduly weakening the section of the conductors mechanically, it being remembered that such machines operate at high speed and hence under conditions of severe mechanical stress.

The main object of the invention is to provide an improved arrangement which avoids the above difficulties.

The present invention comprises a turboalternator rotor having a winding of superimposed conductor straps, each conductor comprising a pair of such straps and having radial passages through the exposed end portions of the winding, which passages are elongated longitudinally of the conductors to assist in registration of the apertures in the individual straps during assembly together with ports between each of said passages and the side faces of the coils, said ports being formed by cutting away one of the straps of a pair forming a conductor.

Preferably ports extend from each radial passage to both side faces of a coil to the radial passages, the ports on opposite sides being staggered along the conductors to provide continuity of the conductor metal.

It will be appreciated that with such an arrangement the abutting faces of the conductors are not interfered

with unduly so that they bed together solidly and form a mechanically strong construction.

It will be understood that in such constructions the end turns of the winding are normally encircled by a coil binding ring which is a usually solid steel ring encircling the end turns of the winding to retain the winding from splaying out radially under centrifugal force, and according to a further feature of the invention spacing blocks are interposed between the individual coils of the winding so as to block these spaces and assist in promoting a flow of cooling gas through the radial passages in the conductors. Such blocks may conveniently have side ports registered with the discharge ports of the conductors and longitudinal passages whereby cooling gas discharging from the conductors passes along passages in the spacing blocks until it reaches the rotor core where it can discharge into longitudinal slots in the core teeth between the winding slots. In such a case the spacing blocks would be formed in sections placed end to end, and in such a case the whole arrangement may be made to form a rigid construction.

In order that the invention may be more clearly understood reference will now be made to the accompanying drawings, in which:

Fig. 1 is a perspective view of part of an end winding of a rotor, omitting the distance pieces;

Fig. 2 is a longitudinal section through the end turns with distance blocks placed between the coils;

Fig. 3 is a plan view of the peripheral face of the end turns and distance blocks, whilst

Fig. 4 is a transverse section through a distance block.

In Fig. 1, the reference **1** indicates the rotor core of a machine, having winding slots **2**, closed by wedges **3** in the normal manner, whilst the intervening teeth are formed with longitudinal tooth ducts **4**, the peripheral faces of which are closed by wedges **5**. Each conductor is formed of a pair of straps, i. e. an upper strap **6** and a lower strap **7**. In the construction shown there are seven conductors, each formed of a pair of straps. The individual conductors are separated by layers of insulation **8**. Ventilation is provided by radial ducts through the winding as indicated by the dotted lines **9**, which ducts extend from the inner face outwards through all the conductors excepting the top conductor as shown in Fig. 1, i. e. the conductor which is radially outermost. The slots **9**, it will be observed, are elongated longitudinally of the conductors and the purpose of this is to assist in registration of the slots in the different straps when assembling a coil. It will be appreciated in forming such windings apertures must be stamped in the individual straps before assembly of the coils, and by elongating the slots it is possible to ensure that the apertures will register when assembled.

In the arrangement shown, discharge ports are formed in the lower strap **7** of the top conductor and these discharge ports are formed by cutting away portions **10** and **11**, of which the portions **10** provide communication between the ends of the passages **9** and the front face, as viewed in the figure, of the conductors, whilst the slot **11** provides a discharge port between the passage **9** and the rear face of the coil, as viewed in the figure. The top strap **6** is made continuous and not slotted so as to overlie and close the tops of the slots **10** and **11**. It will be understood that whilst in the actual arrangement shown the discharge ports provided by the slots **10** and **11** have only been provided in the top conductor, they may also be provided in other conductors; they may, for instance, be staggered along the coils so that different passages **9** discharge out through different conductors. It will also be appreciated that whilst in the arrangement shown each passage **9** discharges through two slots **10** and a single slot **11** this need not necessarily be the case, as clearly

any suitable combination of slots on the two faces may be employed.

As above mentioned a further feature of the invention consists in blocking the spaces between the coils, i. e. between the coils A and B and between the coils B and C, and so forth.

Figs. 2 and 3 show how spacing blocks **12** may be interposed between the various coils whilst an end ring **13** encircles the assembly of coils and is held in position by locking members **14** and **15**. The spacing blocks **12** are arranged in sections and are arranged completely to fill the spaces between the coils A, B, C. . . . It will be appreciated that in this manner cooling gas projected axially by the rotor fan (not shown) will pass through apertures **16** in the locking member **14** and then along to the space **17** between the inner faces of the winding and the shaft **18**. From here it will be caused to pass up the radial passages **9** through the conductors and then discharge through the ports **10** and **11** on each side of the conductors into recesses **19** formed in the side faces of the distance blocks **12** and constituting gas spaces. These recesses **19** are distributed along both faces of the blocks so that those on one side communicate with the discharge ports **10** of the coil and those on the other side with the discharge ports **11** of the next coil. The recesses **19** are interconnected by passages **20** so that gas discharging from the conductors into the spacing blocks will pass along the passages in the spacing blocks until eventually it reaches the end face of the rotor core; from here it will discharge into the tooth slots **4** from which it discharges to the periphery of the rotor through radial discharge ports **21**.

As above mentioned, the spacing blocks are formed in section separated along the lines **21** (Fig. 4), and it will be appreciated that the blocks separating the curved parts of the coils, such as the blocks **12A**, are suitably shaped to follow the curvature of the coils. In some cases it may be desired to promote an increased flow of cooling gas through the passages in the spacing blocks and to this end additional ports **23** may be provided between the space **17** (Fig. 2) and the recesses **19** in the spacing blocks.

Whilst the arrangement above described ventilates the exposed end turns of the winding it will be appreciated that additional means must be provided for ventilating the embedded parts of the winding, and, as shown, this is effected by causing gas from the space **17** to pass along sub-slots **24**, indicated in Fig. 2 in dotted lines, through which gas will pass out through radial passages through the embedded conductors and discharge through ports **25** (Fig. 1) in the slot wedges **3**.

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

1. A turboalternator rotor, a winding to said rotor comprising a plurality of coils, said coils each comprising a plurality of conductors each conductor comprising a pair of straps and the straps being stacked to form the coil, internal edges to said straps defining apertures elongated longitudinally of the conductors said apertures being aligned radially to define a radial passage, and edges to at least one strap of a conductor defining discharge ports between a radial passage and the side face of the coil in question.

2. A turboalternator rotor, a winding to said rotor comprising a plurality of coils, said coils each comprising a plurality of conductors each conductor comprising a pair of straps and the straps being stacked to form a coil, internal edges to said straps defining apertures elongated longitudinally of the conductors said apertures being aligned radially to define a radial passage and edges to at least one strap of a conductor defining discharge ports between a radial passage and the side face of the coil in question, and insulating blocks interposed between the coils of the winding, said blocks being formed with ducting providing communication between said discharge ports and passages in the rotor teeth.

3. A turboalternator rotor, a winding to said rotor comprising a plurality of coils, said coils each comprising a plurality of conductors each conductor comprising a pair of straps and the straps being stacked to form the coils, internal edges to a plurality of said straps in said coils defining apertures elongated longitudinally of the conductors, said apertures being aligned radially to define a radial passage and edges to at least one other conductor defining a lateral slot which is aligned with the radial passage to form a discharge port therefor.

4. A turboalternator rotor, a winding to said rotor comprising a plurality of coils, said coils each comprising a plurality of conductors each conductor comprising a pair of straps and the straps being stacked to form the coils, internal edges to a plurality of said straps defining apertures elongated longitudinally of the conductors, said apertures being aligned radially to define a radial passage and edges to at least one other conductor defining lateral slots extending respectively to opposite edges of the strap and forming discharge passages between the radial passage and the radial faces of the coil.

5. A turboalternator rotor, a winding to said rotor comprising a plurality of coils, said coils each comprising a plurality of conductors each conductor comprising a pair of straps and the straps being stacked to form the coils, internal edges to a plurality of said straps defining apertures elongated longitudinally of the conductors said apertures being aligned radially to define a radial passage and edges to at least one other conductor defining lateral slots extending respectively to opposite edges of the strap and forming discharge passages between the radial passage and the radial faces of the coil, insulating blocks interposed between the coils of the winding and recessed surfaces in opposite faces of said blocks defining gas spaces registering with the discharge ports of the conductor.

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