Jan. 6, 1925.

1,522,333

G. SCHROEDER

COOLING OF DYNAMO ELECTRIC MACHINES

Filed Oct. 30, 1920

2 Sheets-Sheet 1

Fig. 1.

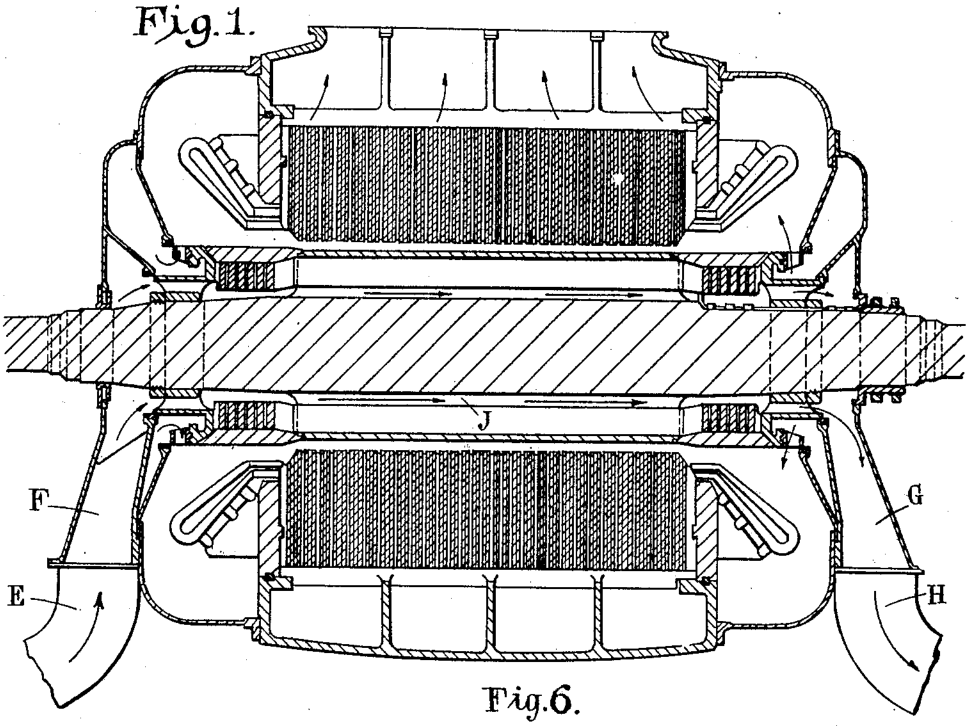

Fig. 6.

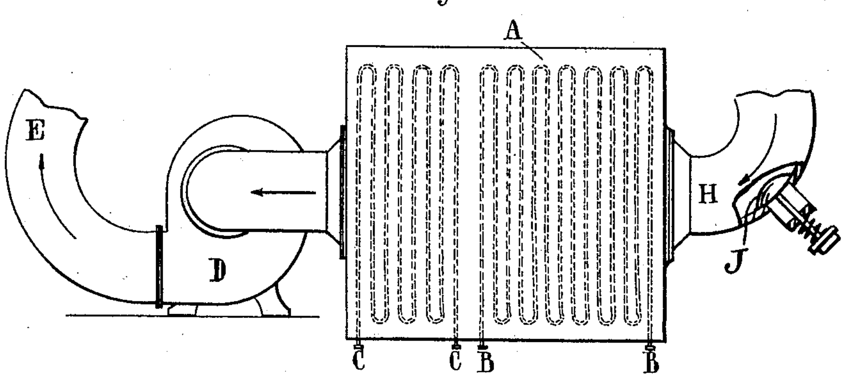

Fig. 2.

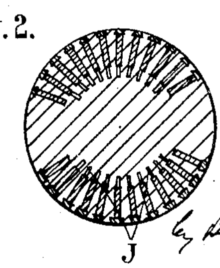

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Fig.3.

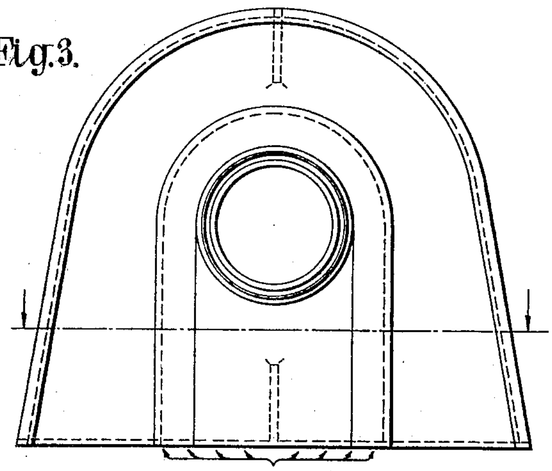


Fig.4.

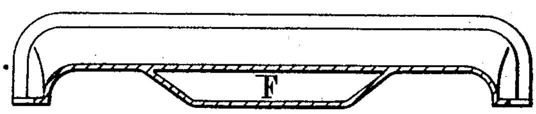
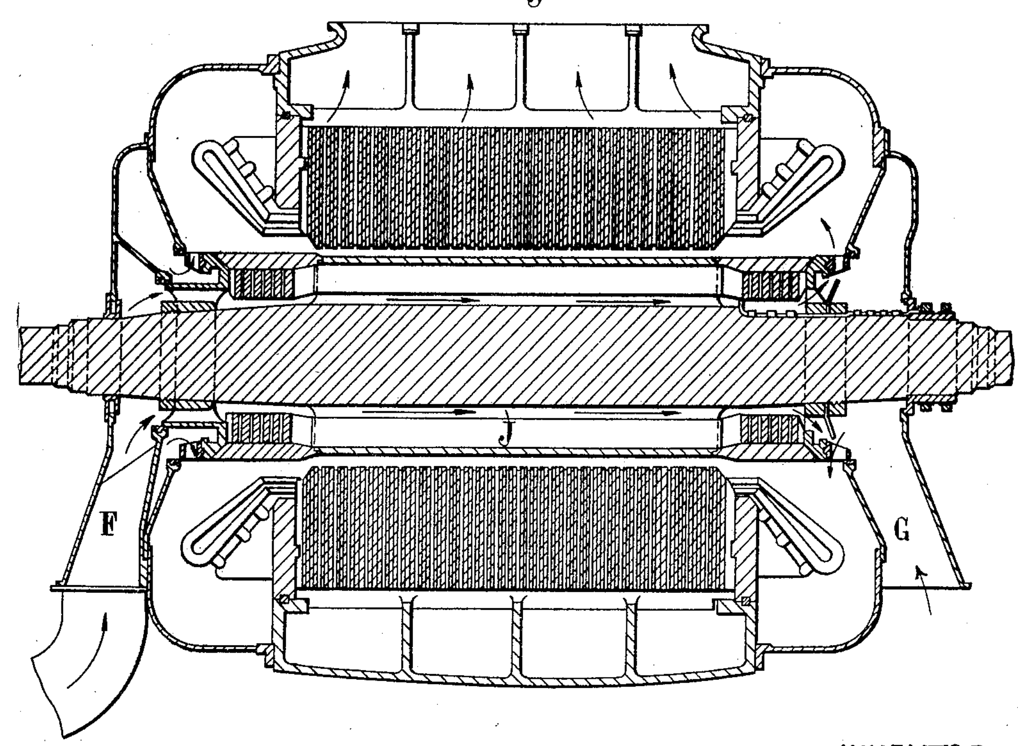


Fig.5.



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Patented Jan. 6, 1925. **1,522,333**

UNITED STATES PATENT OFFICE.

GIULIO SCHROEDER, OF HALE, ENGLAND.

COOLING OF DYNAMO-ELECTRIC MACHINES.

Application filed October 30, 1920. Serial No. 420,667.

To all whom it may concern:

Be it known that I, GIULIO SCHROEDER, a subject of the King of Italy, residing in Hale, Cheshire, England, have invented certain new and useful Improvements in the Cooling of Dynamo-Electric Machines, of which the following is a specification.

This invention relates to the cooling arrangements of turbo alternators and other high speed electric machinery.

In machines of the kind to which this invention relates the limitations to the possibility of the cooling of the rotor greatly influence the output that can be obtained from a given size of machine. This is due to the greater difficulty of supplying cooling fluid in sufficient quantities to the rotor than to the stator, and to the difficulty in applying the cooling fluid near those parts of the rotor where the heat is generated, principally owing to the mechanical requirements of the structure.

In accordance with this invention the cooling arrangements are divided into two concentric systems and the gaseous cooling fluids supplied to the two systems are different in that the fluid for the inner system has a materially greater heat absorbing capacity per unit volume within the temperature limits permissible in the machine than the fluid supplied to the outer system. In general air will be the fluid employed and the heat absorbing capacity of the supply to the inner system will be increased by passing that air through a refrigerating plant so that its temperature at admission to the machine is reduced below the temperature of the surrounding atmosphere. After leaving the inner system the air or other gaseous fluid may be either discharged outside or circulated or passed into the outer cooling system.

The inner system will deal with the interior of the rotor and the intensified cooling which it provides will give the result that the rotor temperature need no longer be a limitation to the output of large high speed machines.

The invention will be further described by the aid of the accompanying drawings in which Figure 1 shows in vertical section a machine to which the invention is applied; Figure 2 shows a transverse section through the rotor shown in Figure 1; Figure 3 shows an inside elevation of the member in which the air inlet and outlet passages for the machine are formed; Figure 4 shows a section on the line IV—IV of Figure 3; Figure 5 shows in vertical section a machine similar to that shown in Figure 1 but embodying a modification at the outlet end of the rotor; Figure 6 shows in elevation an arrangement of apparatus for producing the cooling and compressing of the cooling fluid for the rotor.

In the form shown in Figures 1–4 the cooling gaseous fluid for the rotor flows in a closed circuit through the rotor and through a refrigerator as indicated by the arrows so as to avoid the continual drawing in of large quantities of fresh fluid which may bring with them a considerable amount of dust which may accumulate in the rotor passages. In this circulation the air passes through a refrigerating chamber A in which it flows over cooling coils which may be arranged in two sets, to the first of which water at approximately atmospheric temperature from any convenient cold supply is delivered while in the second brine or other suitable liquid from a refrigerator flows. The connections for the water supply are indicated at B and those for the refrigerating liquid are shown at C. A centrifugal blower or compressor D takes the air as it comes from the chamber A and drives it forward through the duct E to the inlet end of the rotor, making connection with the admission chamber F. This chamber leads the air to the inlet end of axial passages through the rotor and from the other end of these passages the air passes into the outlet chamber G similar in form to the chamber F. To this chamber is attached a duct H which completes the circuit back to the chamber A.

In arranging the circulation of the fluid through the rotor the axial passages will preferably be so located as to produce an approximation to uniformity of temperature of the teeth and of the metal adjacent to the roots of the teeth. In the arrangement illustrated the axial passages are shown at J as formed by continuations of the slots so that the air flows directly in contact with the coils and with the metal at the roots of the teeth.

As shown in Figures 3, 4 and 6, the member in which the admission chamber F for the rotor air is formed also provides in the usual way a passage for conducting air to the stator cooling system. This passage is kept quite distinct from the chamber F but surrounds it on both sides so that the two streams of cooling fluid for rotor and stator respectively pass upward into the machine side by side but are kept apart. In the arrangement shown in Figure 1 the construction of this member is the same at each end of the machine, the only difference being that at the outlet end the rotor air is flowing down and the stator air is flowing upward, the stator cooling system being of a type in which the air enters at both ends and flows axially and then radially, leaving by an outlet at the top of the machine as indicated by the arrows.

It is to be noted that where the air passes from a stationary to a rotating part and vice versa, a joint is made having small clearance or rubbing contact so as to minimize leakage from the rotor cooling system either to the stator cooling system or to the external air. To take care of small unavoidable leakage an inlet may be provided on the suction side of the system controlled by a non-return valve J which permits the inflow of make-up air when the pressure falls below a determined value.

In many cases it will be preferable to provide that the cooling fluid be sent through the rotor under a pressure considerably above atmospheric so as to obtain an increased heat transmitting capacity for a given area of rotor duct surface.

Figure 5 illustrates an alternative arrangement in which a closed circulation system for the rotor air is not used. In it the air coming from the outlet end of the rotor flows as indicated by the arrows to join the incoming air at that end of the stator and passes with it into the stator cooling system leaving that system by the outlet shown at the top of the figure. With such a construction it is unnecessary to provide an outlet chamber such as indicated at G in Figure 1, and accordingly the stator air inlet is of an ordinary construction at this end, that is to say, it has the form shown in Figures 3 and 4, except for the omission of the wall separating the part F from the rest of the space enclosed by the cover. As the duct H of Figure 1 is omitted in Figure 5, it will be obvious that the refrigerator inlet (H of Figure 6) will receive air from the atmosphere.

By the term "refrigeration" used herein, it is intended to indicate the lowering of the temperature of the gaseous fluid to a point materially below the temperature of the surrounding atmosphere.

It will be understood that the illustrations given are only by way of example and that the relative arrangement and proportions of the plant shown in the figures are only diagrammatic.

What I claim as my invention and desire to secure by Letters Patent is:—

1. The combination of a dynamo electric machine having ventilating passages arranged in the machine structure to form two concentric systems, the outer system serving for the exterior of the rotor and for the stator and the inner system for the interior of the rotor and comprising ducts in the rotor body and an inlet chamber forming part of the stationary structure of the machine adjacent one end of the rotor, the said chamber enclosing the inlet ends of the ducts and separating them from the outer system, and means for supplying the two systems with gaseous fluid at different temperatures, the colder fluid being fed to the inner system.

2. The combination of a dynamo electric machine having ventilating passages arranged in its structure to form inner and outer concentric systems, the inner system serving for the interior of the rotor and the outer system for the exterior of the rotor and for the stator and each system comprising an inlet chamber formed in one and the same stationary end part of the machine structure, the inlet chamber for the inner system lying inside that for the outer system, and means for supplying the two systems with gaseous fluids differing in temperature, the colder fluid being fed into the inner inlet chamber.

3. The combination of a dynamo-electric machine having ventilating passages arranged in the machine structure to form two concentric systems, the outer system serving for the exterior of the rotor and for the stator and the inner system for the interior of the rotor and comprising ducts in the rotor body and an inlet chamber forming part of the stationary structure of the machine adjacent one end of the rotor, the said chamber enclosing the inlet ends of the ducts and separating them from the outer system, means for supplying the two systems with separate bodies of gaseous fluid, and means for refrigerating one of such bodies so that the fluid fed to the inner system is colder than that fed to the outer system or than the adjacent atmosphere.

4. The combination of a dynamo-electric machine having ventilating passages arranged in its structure to form inner and outer concentric systems, the outer system having an inlet chamber at each end of the

machine, and the inner system having an inlet chamber at one end of the machine, means for leading the discharge from the inner system into an inlet chamber for the outer system, means for supplying to the two systems from two external sources separate bodies of gaseous cooling fluid, and means for refrigerating one of said bodies so that the fluid fed to the inner system is colder than that fed to the outer system or than the adjacent atmosphere.

In testimony whereof I affix my signature.

GIULIO SCHROEDER.