G. O. HOLMGREN.

ELECTRIC MACHINE.

APPLICATION FILED JAN. 3, 1910.

Patented Apr. 19, 1910.

955,268.

Fig: 1.

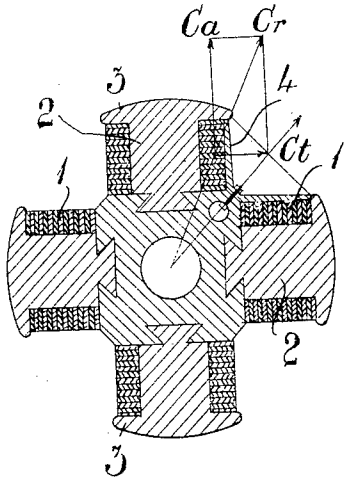


Fig: 2.

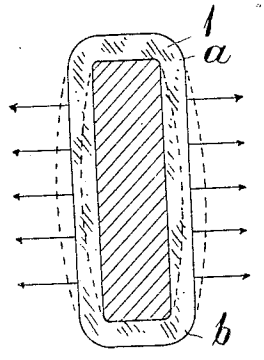
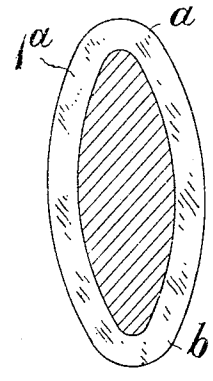


Fig: 3.



Witnesses
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UNITED STATES PATENT OFFICE.

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ELECTRIC MACHINE.

955,268. Specification of Letters Patent. Patented Apr. 19, 1910.

Application filed January 3, 1910. Serial No. 536,017.

To all whom it may concern:

Be it known that I, GUSTAF OTTO HOLMGREN, a citizen of the Kingdom of Sweden, residing at Vesterås, Sweden, have invented new and useful Improvements in Electric Machines, of which the following is a specification.

In high speed electric generators with a small number of poles and projecting pole pieces on the rotor, such as turbo-generators, a sufficient ventilation of the rotor windings and the central parts of the stator winding is prevented by the mechanical devices that are necessarily used between the pole pieces to prevent the axial parts of the rotor windings from being bent outward by the horizontal components of the centrifugal force acting on the said winding parts.

The object of the present invention is to remove the said inconvenience, and is reached by giving the axial parts of the rotor windings a curved shape, substantially that of a chain line, as will be more particularly set forth herebelow.

In the accompanying drawing, Figure 1 shows a cross section of a rotor of well known construction, Fig. 2 shows a plan view of a coil thereof, the pole piece being shown in section, and Fig. 3 shows a plan view of a coil embodying the present invention, the pole piece being shown in section.

Referring to Figs. 1 and 2, the centrifugal force Cr acting on every element of the axial portion a—b of a coil 1 can be divided in two components Ca and Ct of which the former acts parallelly to the center line of the pole piece 2, while the latter component acts at right angles thereto. The component Ca is taken up by the pole plate 3, while the component Ct tends to bend the straight portion a—b of the coil 1 outward as is indicated by dotted lines in Fig. 2. In high speed engines of the kind in question the last mentioned component Ct reaches a high value, viz. about one half of the total centrifugal force. In constructing such machines it is therefore necessary to provide abutments 4 for the axial parts of the windings. The said abutments increase in a high degree the costs of manufacturing the machines inasmuch as they must be made of non-magnetic material of great tenacity and solidity. As the said abutments are placed in the air paths between the pole pieces in such a manner as to constitute a bar to the ventilation air reaching the motor windings, it has, moreover, been necessary, in order to obtain a sufficient ventilation, to make the whole machine larger with less magnetic density and less density of current in the windings than would otherwise be necessary. These circumstances have reduced in an essential degree the advantages that may be reached by providing the rotor of high speed electric machines with projecting pole pieces, and in many cases it has been necessary, for instance in 4-pole turbo-generators, to use cylindric magnetic field cores without projecting pole pieces.

In order to render it possible to use also in high speed alternating electric current machines having a small number of poles projecting pole pieces on the rotor, the windings 1^a (Fig. 3) of the latter in accordance with the present invention are so shaped that the axial parts thereof a—b are curved as a chain line or substantially as such a line. The chain line is as well known the form of equilibrium of a flexible wire or chain suspended at both ends and loaded uniformly along its whole length, such a wire being subjected only to stretching strains. By the use of such a form of the rotor windings the abutments heretofore used will be dispensable, inasmuch as the said windings will be subjected only to stretching strains instead of bending strains. Further, an advantageous shape of the ventilation passages between the pole pieces is obtained, inasmuch as the cross-sectional area of the said passages decreases inward. The air flowing in sidewise between the pole pieces thus is offered comparatively wide inlet passages which decrease inward according as the quantity of air flowing in axially is reduced by the quantity of air flowing radially toward the stator and through the ventilation passages thereof, sudden changes of speed of the air currents being thereby obviated.

Having now described my invention, what

2

I claim as new and desire to secure by Letters Patent is:

An electric machine having a rotor with projecting pole pieces and windings on the latter the axial parts of which are curved substantially as a chain line, substantially as and for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

GUSTAF OTTO HOLMGREN.

Witnesses:

LUND DELMAR,

HILDUR HÅKANSON.