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(54) DYNAMOELECTRIC MACHINE ROTORS

(71) We, SUNDSTRAND CORPORATION, a corporation organised and existing under the laws of Delaware, United States of America, of 4751 Harrison Avenue, Rockford, Illinois 61101, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to dynamoelectric machine rotors.

In brushless synchronous motors and generators the main field windings are usually wound around each pole of the rotor and lie within the recesses created by adjacent poles. A retaining wedge or cover spans the recess over the main field windings, pole to pole, and retains the windings therein during rotation. Hence the retaining wedge must be made with sufficient strength to assure that it does not become separated from the poles and interfere with the rotation and cause a failure of the system.

Since weight considerations are important, especially in high speed aircraft generators, it is desirable to decrease the thickness of the retaining wedge, thereby reducing its weight while at the same time ensuring that the wedge will not separate from the rotor and impact the stator.

We have developed a rotor assembly for a dynamoelectric machine which employs a wedge retention structure which permits thinner covers over the field windings, thereby decreasing the weight of the rotor assembly.

The invention provides a rotor for a dynamoelectric machine, comprising a core, a plurality of poles extending radially outwardly from the core, windings around each pole having portions between the poles, and covers for retaining the windings between the poles during rotation, each cover having a pair of longitudinal edge mounting portions each provided with an outstanding lip which is received between radially inner and radially outer surfaces of a slot in a respective pole and behind a radially inwardly directed ridge of the pole. In the preferred construction the slots are of a size to prevent radially inward

movement of the mounting portions of the covers on flexure of the covers during rotation of the rotor.

According to a typical embodiment of the invention, integrally formed shoulders extend laterally from the walls of the poles of a rotor assembly. The shoulders form the undersurfaces of the slots in the poles. The slots receive the lips of the retaining wedges or covers that span the field windings to retain the wedges or covers over the recesses between adjacent poles during rotation. The slots prevent the separation of the wedges or covers from the rotor and also serve to minimize deformation of the wedges or covers due to the bending moment caused by centrifugal force during rotation of the rotor. The thickness of the wedges or covers can be reduced, thus lessening the weight of the entire rotor assembly. It is possible to construct a rotor assembly of the present invention, with a weight increase due to the addition of the shoulders on the poles forming the slots and a weight decrease due to the use of thinner covers, that is lighter than a comparable prior art rotor without the shoulders.

The invention is hereinafter particularly described by way of example only, with reference to the drawings of which:

Fig. 1 shows a rotor known to the prior art:

Fig. 2 shows the bending moment developed in the cover due to rotation of the rotor of Fig. 1;

Fig. 3 shows the improved rotor having shoulders which preclude the bending moment shown in Fig. 2; and

Fig. 4 is a detailed view of the improved rotor construction.

Referring to Figs. 1 and 2, a prior art rotor for a brushless synchronous electric machine is shown. Rotor 10 has a bore 12 which receives a shaft (not shown). Rotor 10 is constructed from similar stacked laminated sections 14 to obtain a desired thickness. Stack laminations 14 form a core 16 having four outwardly extending poles 18, 20, 22 and 24. Although a four-pole rotor is shown, the selection of any particular number of poles depends upon the RPM at which the rotor is

10

to rotate and the frequency of the system voltage.

The description of pole 18 will now be provided, it being understood that the remaining poles 20, 22 and 24 have a similar construction. Pole 18 is defined by spaced parallel walls 26 and 28 which extend outwardly from core 16. Pole 18 terminates in an outer portion 30 which extends peripherally from pole 18 on each side thereof. The outer portion 30 has a width greater than the width of pole 18. Outer portion 30 has an arcuate outer surface 32 and undersurfaces 34 and 36 which are generally perpendicular to walls 26 and 28. Each undersurface 34 and 36 is provided with ridges 38 and 40, respectively.

DC main field windings 42 are wound around the poles and lie within the winding recesses, such as recess 44 formed by adjacent poles 22 and 24. An arcuately formed non-magnetic metal retaining wedge or cover 46 is placed over field windings 42, and lips 48 and 50 are retained by the ridges, such as ridge 40, of adjacent poles. During rotation of rotor 10, field windings 42 are subjected to centrifugal force. In an aircraft generator, the rate of rotation can be up to 12,000 RPM, which produces a fairly substantial centrifugal force on the main field windings and the wedge. As a result, a bending moment is developed around point 49 where lips 48 and 50 engage the ridges, such as ridge 40. The force causing this bending moment is best shown in Fig. 2 as F acting outwardly upon cover 46 during rotation with the complementary reaction force R acting inwardly. If the bending moment developed is sufficiently great, lips 48 and 50 disengage from ridges 40 and 50. In such case, wedge 46 will impact the stator (not shown) of the machine, causing a major failure of the electric machine. In order to minimize this deflection or deformation of the wedge due to centrifugal force, the prior art wedges 46 are of relatively thick material so that the possibility of the wedge disengaging from ridges 38 and 40 is substantially reduced.

Referring to Figs. 3 and 4, the improved rotor construction is shown. Improved rotor 52 is of a construction similar to rotor 10 in that rotor 52 has a bore 54, is constructed from similar stacked laminated sections 56 and has similar poles 58 extending radially from core 60. Moreover, pole 58 is defined by parallel-spaced walls 62 and 64 which extend outwardly from core 60. Pole 58 terminates in an outer portion 66 which has an arcuately formed outer surface 68 and undersurfaces 70 and 72. Ridges 74 and 76 are provided on undersurfaces 70 and 72, respectively.

Rotor 52 differs from rotor 10 in that rotor 52 is provided with shoulders 78 and 80 which extend outwardly from walls 62 and 64, respectively. Shoulders 78 and 80 each have an upper side 82 and 84. A slot 86 is formed by upper side 82 and undersurface 70. Slot 86

opens outwardly from wall 62. A slot 88 is formed by upper side 84 and undersurface 72. Slot 88 opens outwardly from wall 64. Ridges 74 and 76 extend across the opening of slots 86 and 88, respectively. A wedge or cover 90 retains main field windings 96 within the recesses between adjacent poles during rotation. The wedge has a lip 92 and a lip 94 which are retained in slots 86 and 88 on adjacent poles. Upper surface 82 of shoulder 78 and upper surface 84 of shoulder 80 support the lower portion of the lips 92 and 94 during rotation of the rotor. Ridges 74 and 76 engage lips 92 and 94 of the wedge 90 and preclude wedge 90 from extending outwardly from walls 62 and 64. This construction also tends to minimize the deflection of the wedges due to the bending moment caused during rotation. The thickness and the width of the lips 92 and 94 and the size of channels 86 and 88 are selected so that the wedge may be easily inserted into the slots 86 and 88 of rotor 52. As shown in Figs. 3 and 4, the thickness of the lips 92 and 94 is greater than the thickness of the wedge 90.

Weight reduction in the electric machine is important, especially in aircraft generators, for obvious reasons. The addition of shoulders 78 and 80 to the slots 86 and 88 tends to add weight to rotor 52. However, the relative size of the shoulders 78 and 80, as shown in Figs. 3 and 4, is somewhat exaggerated for purposes of illustration, and as a practical matter they are relatively small since the reaction force R (Fig. 2) does not require a massive structure to oppose it. Since the thickness of the wedge 90 can be reduced to the minimum required to retain the main field windings 96 between the poles, the overall weight of the rotor can be significantly reduced, while at the same time the possibility of the wedge separating from the rotor is substantially reduced.

WHAT WE CLAIM IS:—

1. A rotor for a dynamoelectric machine, comprising a core, a plurality of poles extending radially outwardly from the core, windings around each pole having portions between the poles and covers for retaining the windings between the poles during rotation, each cover having a pair of longitudinal edge mounting portions each provided with an outstanding lip which is received between radially inner and radially outer surfaces of a slot in a respective pole and behind a radially inwardly directed ridge of the pole.

2. A rotor according to claim 1, wherein the slots are of a size to prevent radially inward movement of the mounting portions of the covers on flexure of the covers during rotation of the rotor.

3. A rotor according to claim 2, wherein the radially inner surface of each slot is provided by a shoulder extending laterally from the side of the respective pole.

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2. A rotor according to claim 1, wherein the slots are of a size to prevent radially inward movement of the mounting portions of the covers on flexure of the covers during rotation of the rotor.

3. A rotor according to claim 2, wherein the radially inner surface of each slot is provided by a shoulder extending laterally from the side of the respective pole.



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4. A rotor for a dynamoelectric machine, substantially as particularly described herein with reference to Figures 3 and 4 of the drawings.

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