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(54) RECTIFIER SUPPORTS FOR DYNAMOELECTRIC MACHINES

(71) We, SUNDSTRAND CORPORATION, a corporation organised and existing under the laws of the State 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 rectifier supports for dynamoelectric machines in which rectifiers mounted in rotary shafts are cooled by the direct action of coolant sprays.

In dynamoelectric machines, particularly synchronous generators having exciter assemblies which include rotating exciter windings along with rectifier diodes for converting the AC current generated in the exciter windings into a DC field current, effective cooling of the exciter assembly is of great importance. This is especially true for certain classes of synchronous generators such as high speed aircraft generators, where the operation environment is restricted and weight requirements are critical.

One particularly effective approach to cooling the exciter assembly and rectifier diodes is to have a coolant, such as oil, sprayed directly on the rectifier diodes. In one type of synchronous generator the diodes are supported by plates which are secured to a hub which rotates with the generator shaft. The hub also serves to support the rotating exciter windings. However, since the cooling oil generally contains minute particles of metal and other substances, the centrifugal force resulting from the rotation of the hub will tend to cause accumulations of the metals and the other substances to build up on the inner surface of the hub. Practical experience has shown that the sludge build-ups can become so large that they can electrically connect the plates to the hub, causing a short circuit and thus, the failure of the generator. As a result, it has become extremely important, from a practical standpoint, to provide means for eliminating this type of sludge build-up while maintaining efficient cooling.

The invention provides a rectifier support for a dynamoelectric machine in which rectifiers are mounted on a rotary shaft and are cooled by the direct action of a coolant spray, the support comprising a hub structure including at least one support member adapted to be secured to and rotatable with the shaft, supporting an annular rim concentric with the shaft, at least one rectifier mounting plate secured to the hub structure and electrically insulated therefrom, and coolant passageways in the or each plate. Preferably the coolant passageways extend to radial positions on the or each plate outwardly of the annular rim. In use, cooling oil impinges directly upon the rectifier diodes and rectifier mounting plates, — and then flows through the coolant passageways away from the inner surface of the hub structure, thereby reducing sludge and particle build-ups.

The invention also provides a dynamoelectric machine, such as synchronous generator, having a rectifier support according to the invention, and means for cooling rectifiers supported on the rectifier mounting plate or plates by directing an oil spray directly onto the rectifiers.

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

Figure 1 is a longitudinal sectional view of a dynamoelectric machine according to the invention; and

Figure 2 is a cross-sectional view of the dynamoelectric machine taken along section lines 2—2 of Figure 1.

In Figure 1 of the drawings a sectional view of a synchronous generator is provided with 10 indicating the generator housing. As is conventional for synchronous dynamoelectric machines, armature coils, indicated generally by the reference numerals 12, are attached to the housing 10, and rotating main field windings and core 14 are attached to a rotating shaft 16. The shaft 16 is supported at the end of the housing 10 by the bearing 17.

In addition, a plurality of exciter field windings, indicated by the reference numerals 18, and their associated cores 20 are spaced about the circumference of the generator

housing 10 and secured thereto. Rotating past the exciter field cores 20 are a plurality of exciter cores 22 and windings 24. The exciter cores 22 and windings 24 are attached to the shaft 16 by means of a hub structure indicated generally in the upper portion of Figure 1 by reference numeral 26. The hub 26, as illustrated in Figure 2, includes three angularly spaced support members 28 which extend outwardly from a collar 30, which is secured to the shaft 16. Typically, the collar 30 is a force-fit on the shaft 16 so that the hub 26 will rotate with the shaft 16. The hub 26 also includes an annular rim 32 supported by the support members 28 and concentric with the shaft 16. Also, as shown in Figure 1, the rotating field cores 22 are secured to the outer portion of the annular rim 32. For simplicity, the rotating exciter cores 22 and windings 24 are not shown in Figure 2, nor are the exciter field core 20 and windings 18.

Also attached to the hub support members 28 is a plurality of angularly spaced conductive rectifier mounting plates 34. As shown in Figure 2, there are three mounting plates 34, each of which is configured with two apertures for holding rectifier diodes 36. Each diode 36 includes a terminal portion 38 and a stud 40 which extends through the mounting plate 34 for attaching the rectifier diode 36 to the mounting plate 34 by means of a nut 42 as shown in Figure 1. Each mounting plate 34 is electrically insulated from the hub 26 by means of the insulating material shown at 44 and 45 of Figure 1.

In addition, the exciter cores 22 are secured, typically by a press fit, to the outer surface of the annular rim 32. Rivets 46 serve to attach the mounting plate 34 to the core 22. It should also be noted that in this particular embodiment, each of the support members 28 contains an aperture 48 through which electrical connectors 50 extend, serving to electrically connect the rectifier diodes 36 to the generator's main field 14. For simplicity only one such electrical connection is shown in Figure 2.

In order adequately to cool the generator, a supply of cooling oil is received from an outside source through a conduit 52. A portion of the coolant that is being delivered to the generator through conduit 52 is directed through a branch conduit 54 which extends through the generator housing 10 in a position approximately the same radial distance from the generator shaft 16 as the rotating rectifier diodes 36. As the diodes 36 and the rectifier mounting plates 34 rotate past the conduit 54, a spray of coolant is forced under pressure through an orifice 56 axially directly upon the rectifier diodes 36 and mounting plates 34. Since the rectifier diodes 36 generate significant amounts of heat and are of a semi-conductor material, it is very important to keep them as cool as possible, to maintain long life and optimum performance. By spraying the coolant directly on the diodes 36 and the mounting plates 34, that also serve as heat sinks for the diodes, the maintenance of specified temperature limits for the diodes within the generator is greatly facilitated.

In order to prevent sludge, including metal particles, from building up on the inner surface of the annular rim 32 due to the centrifugal force resulting from the spinning hub angularly spaced coolant passageways 58 are included in the mounting plates 34. As shown in Figures 1 and 2, these coolant passageways are located on centres aligned with the annular rim 32 so that outer portions are at a slightly greater radial distance from the centre line of the shaft 16 than the annular rim 32 and in close proximity to the diodes 36. Locating the coolant passageways 58 in this manner permits the coolant to traverse the inner portion of the annular rim 32, due to the axially directed spray, thereby preventing the build-up of sludge and other undesired particles and enhancing the cooling effects of the oil. Coolant in the generator housing 10 ultimately falls by gravity to the bottom of the housing where it may be withdrawn by appropriate means.

WHAT WE CLAIM IS:—

1. A rectifier support for a dynamoelectric machine in which rectifiers are mounted on a rotary shaft and are cooled by the direct action of a coolant spray, the support comprising a hub structure including at least one support member adapted to be secured to and rotatable with the shaft, supporting an annular rim concentric with the shaft, at least one rectifier mounting plate secured to the hub structure and electrically insulated therefrom, and coolant passageways in the or each plate.

2. A support according to claim 1, wherein the coolant passageways extend to radial positions on the or each plate outwardly of the annular rim.

3. A support according to claim 1 or claim 2, wherein each coolant passageway comprises a a circular aperture in a rectifier mounting plate.

4. A support according to claim 3, wherein the coolant passageways are provided in close proximity to rectifier mounting positions on the or each plate.

5. A support according to any preceding claim, wherein a number of rectifier mounting plates are secured in circular array to the hub structure.

6. A support according to any preceding claim, wherein the annular rim mounts a

housing 10 and secured thereto. Rotating past the exciter field cores 20 are a plurality of exciter cores 22 and windings 24. The exciter cores 22 and windings 24 are attached to the shaft 16 by means of a hub structure indicated generally in the upper portion of Figure 1 by reference numeral 26. The hub 26, as illustrated in Figure 2, includes three angularly spaced support members 28 which extend outwardly from a collar 30, which is secured to the shaft 16. Typically, the collar 30 is a force-fit on the shaft 16 so that the hub 26 will rotate with the shaft 16. The hub 26 also includes an annular rim 32 supported by the support members 28 and concentric with the shaft 16. Also, as shown in Figure 1, the rotating field cores 22 are secured to the outer portion of the annular rim 32. For simplicity, the rotating exciter cores 22 and windings 24 are not shown in Figure 2, nor are the exciter field core 20 and windings 18.

Also attached to the hub support members 28 is a plurality of angularly spaced conductive rectifier mounting plates 34. As shown in Figure 2, there are three mounting plates 34, each of which is configured with two apertures for holding rectifier diodes 36. Each diode 36 includes a terminal portion 38 and a stud 40 which extends through the mounting plate 34 for attaching the rectifier diode 36 to the mounting plate 34 by means of a nut 42 as shown in Figure 1. Each mounting plate 34 is electrically insulated from the hub 26 by means of the insulating material shown at 44 and 45 of Figure 1.

In addition, the exciter cores 22 are secured, typically by a press fit, to the outer surface of the annular rim 32. Rivets 46 serve to attach the mounting plate 34 to the core 22. It should also be noted that in this particular embodiment, each of the support members 28 contains an aperture 48 through which electrical connectors 50 extend, serving to electrically connect the rectifier diodes 36 to the generator's main field 14. For simplicity only one such electrical connection is shown in Figure 2.

In order adequately to cool the generator, a supply of cooling oil is received from an outside source through a conduit 52. A portion of the coolant that is being delivered to the generator through conduit 52 is directed through a branch conduit 54 which extends through the generator housing 10 in a position approximately the same radial distance from the generator shaft 16 as the rotating rectifier diodes 36. As the diodes 36 and the rectifier mounting plates 34 rotate past the conduit 54, a spray of coolant is forced under pressure through an orifice 56 axially directly upon the rectifier diodes 36 and mounting plates 34. Since the rectifier diodes 36 generate significant amounts of heat and are of a semi-conductor material, it is very important to keep them as cool as possible, to maintain long life and optimum performance. By spraying the coolant directly on the diodes 36 and the mounting plates 34, that also serve as heat sinks for the diodes, the maintenance of specified temperature limits for the diodes within the generator is greatly facilitated.

In order to prevent sludge, including metal particles, from building up on the inner surface of the annular rim 32 due to the centrifugal force resulting from the spinning hub angularly spaced coolant passageways 58 are included in the mounting plates 34. As shown in Figures 1 and 2, these coolant passageways are located on centres aligned with the annular rim 32 so that outer portions are at a slightly greater radial distance from the centre line of the shaft 16 than the annular rim 32 and in close proximity to the diodes 36. Locating the coolant passageways 58 in this manner permits the coolant to traverse the inner portion of the annular rim 32, due to the axially directed spray, thereby preventing the build-up of sludge and other undesired particles and enhancing the cooling effects of the oil. Coolant in the generator housing 10 ultimately falls by gravity to the bottom of the housing where it may be withdrawn by appropriate means.

WHAT WE CLAIM IS:—

1. A rectifier support for a dynamoelectric machine in which rectifiers are mounted on a rotary shaft and are cooled by the direct action of a coolant spray, the support comprising a hub structure including at least one support member adapted to be secured to and rotatable with the shaft, supporting an annular rim concentric with the shaft, at least one rectifier mounting plate secured to the hub structure and electrically insulated therefrom, and coolant passageways in the or each plate.

2. A support according to claim 1, wherein the coolant passageways extend to radial positions on the or each plate outwardly of the annular rim.

3. A support according to claim 1 or claim 2, wherein each coolant passageway comprises a a circular aperture in a rectifier mounting plate.

4. A support according to claim 3, wherein the coolant passageways are provided in close proximity to rectifier mounting positions on the or each plate.

5. A support according to any preceding claim, wherein a number of rectifier mounting plates are secured in circular array to the hub structure.

6. A support according to any preceding claim, wherein the annular rim mounts a

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number of exciter coils for the dynamoelectric machine.

7. A support according to any preceding claim, wherein the hub structure comprises a collar adapted to be secured to the shaft as a force-fit, and a number of support members between the collar and the annular rim.

8. A rectifier support for a dynamoelectric machine, substantially as particularly described herein with reference to the drawings.

9. A dynamoelectric machine having a rectifier support according to any preceding claim, and means for cooling rectifiers supported on the rectifier mounting plate or plates by directing an oil spray directly onto the rectifiers.

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