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(54) MOUNTING A CURRENT TRANSFORMER ON A DYNAMOELECTRIC MACHINE

(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 current transformer assemblies in dynamoelectric machine housings and provides a means for securing the current transformer assembly to the housing.

Current transformers are typically used in three-phase machines to measure the current in each of the three-phase neutral leads of the main stator coils. In prior art dynamoelectric machines such as AC synchronous generators utilized in aircraft, the methods used to attach current transformers to the interior of the generator housing often give rise to a number of problems. For example, the current transformers are normally attached to the interior of the generator housing by means of a screw or a bolt which penetrates the housing of the generator, resulting quite often in leakage of cooling oil from the interior of the housing in those generators that utilize oil spray cooling. In addition, securing the current transformer by means of a screw or bolt that penetrates the housing can potentially result in a safety hazard since the mounting screw is frequently in contact with substantial electrical potentials from within the machine.

The invention provides a dynamoelectric machine having a current transformer assembly mounted within a housing of the machine, comprising a fastening member extending through an aperture in the housing to retain the current transformer assembly on an internal wall of the housing, an electrically insulating element between the fastening member and the housing and a cap member covering an outer end of the fastening member. The invention enables a current transformer assembly to be secured to a dynamoelectric machine housing with a fluid-tight seal. Furthermore the attachment can be electrically insulated from electrical potentials. The fluid-tight seal is preferably provided by sealing means for example an O-ring cooperating with the cap member and the housing. The electrical insulation is provided by the electrical insulating element between the fastening member and the housing, in conjunction if desired with an electrical insulating member between the transformer assembly and the housing. The cap member itself is advantageously electrically insulating.

In a preferred embodiment of the invention the fastening member is inserted through the aperure in the housing effective to secure the current transformer assembly to the inner surface of the housing, the current transformer assembly is electrically insulated from the housing by the insulating member, the fastening member is electrically insulated from the housing by the insulating element, the cap is electrically insulating and the current transformer assembly comprises a magnetic flux shield secured to thte lower part thereof. Preferably the fastening member retains the current transformer assembly by engagement with a self-locking insert in the magnetic flux shield.

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

Figure 1 is a partial longitudinal cross-section of a dynamoelectric machine including a longitudial cross-section of a current transformer attachment structure;

Figure 2 is a schematic diagram of

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a dynamoelectric machine stator circuit; and

Figure 3 is a perspective view of a magnetic flux shield including a helical coil used as a self-locking insert.

Figure 1 of the drawings is a longitudinal cross-section of a portion of a three-phase AC generator. Enclosed within a housing 10 (typically metallic) is a shaft 12 which supports a rotor 14 and secured to the housing 10 is a stator coil 16 that is electrically connected to a neutral lead 18. As is typical in three-phase alternating current machinery, there are three such neutral leads connecting the stator coils to a neutral terminal. A schematic illustration of this type of circuit is provided in Figure 2 wherein the neutral terminal is represented by terminal 20. In the schematic three-phase generator stator circuit in Figure 2 there are three stator coils 16, 16′, and 16″, and three current transformers 22. 22′, and 22″. The current transformer coils 22, 22′ and 22″ are used to measure the amount of current flowing in the neutral leads 18, 18′ and 18″. In Figure 2 the stator coil 16, current transformer 22, and leads 18 and 24 correspond to the stator coil 16, current transformer coil 22. and leads 18 anl 24, respectively, of Figure 1. In order to protect the generator from electrical malfunctions, it is often required to have a measure of the current in each of the neutral leads. One widely used approach is to measure the current in the neutral lead by means of a current transformer coil 22 which typically in aircraft generators, for example, is a coil having from 250 to 1000 turns.

In a preferred embodiment of the invention, the neutral lead 18 is connected to a spool-shaped transformer support member. shown in cross-sectional form at 26, which serves to conduct the neutral lead current through the centre of the coil 22 as well as serving as a support for the coil 22. Preferably the coil support member 26 is made of copper for maximum conductivity. Connected to an upper flange 27 of the support member 26 is the lead 24 which conducts the neutral current to the neutral terminal 20.

As shown in Figure 1, a metallic screw 28 is inserterd through an aperture 30 in the machine housing 10. The housing 10 is configured with an enlarged annular recessed area 32, coaxial with the aperture 30, for receiving the head 34 of the screw 28. Engaging a lower flange 33 of the coil support member 26 is a circular member 36 composed preferably of soft iron which includes a sleeve 38 configured with an internal screw thread 40 for retaining the member 36 on the screw thread 43 of the screw 28. A perspective view of the circular member 36 is shown in Figure 3. In addition to providing a mechanical connection for the screw 28, the member 36 acts as a magnetic flux shield to reduce the electrical effects on the coil 22 of magnetic fields that are often generated by the stator 16.

In order to lock the screw 28 to the current transformer assembly, a self-locking helical coil insert 44 is inserted or screwed into the screw thread 40 in the sleeve 38 and is screw threaded to the screw 28 to prevent the screw from rotating due to the effects of vibration. In Figure 3 the helical coil 44 is shown partially removed from the transformer shield 36 for clarity, although normally the coil 44 would be completely contained in the sleeve 38. Helical coils such as 44 are well-known in the art and may be similar to those defined by U.S. Military Part Number 21209, comprising a wound wire having a diamond-shaped cross-section. as shown at 46 of Figure 3, which is very effective in preventing undesired rotaton of a threaded member. The helical coil 44 is screwed into the screw threads 40 of the sleeve 38 and the screw 28 is in turn screwed into the helical coil 44.

An annular disc member 48 of electrically insulating material is inserted between the housing 10 and the upper flange 27 of the support member 26 in order to insulate the support member 26 from the housing 10. In addition, the coil 22 is electrically insulated from the copper support member 26 by means of annular discs 50 of insulating material and an inner sleeve 51, so that the turns of the coil 22 are not in electrical contact with the support member 26.

The upper portion of the screw 28 is spaced and insulated from the housing 10 by means of a collar-shaped insulator element 52 which also provides for the support of the head 34 of screw 28. The insulator element 52 includes a sleeve portion 54 that is inserted in the lower portion of the aperture 30 and serves electrically to insulate the shaft of the screw 28 from the housing 10. A cap 56 is inserted over the head of the screw 34 within the annular portion 32 of the housing. Preferably the cap 56 is made of an electrically insulating material such as a moulded plastics material, or it may be made of a metal such as aluminium with an electrically insulating varnish disposed on the outer surface. An O-ring 58. inserted in a groove 60 of the cap 56, provides a fluid-tight seal, thus preventing cooling oil from leaking past the screw 28 and out of the housing 10. This is a particularly useful feature in aircraft generators which utilize spray oil cooling. In addition, a snap ring 62 is engaged with a groove 64 in the annular portion 32 of the housing 10 to

retain the cap 56 within the annular space 32. Thus the cap 56, in combination with the O-ring 58, serves both to seal the housing from coolant leakage and to prevent the screw 28 from coming into electrical contact with anything outside of the housing thereby eliminating any danger from electrical potentials on the screw 28.

WHAT WE CLAIM IS:

1. A dynamoelectric machine having a current transformer assembly mounted within a housing of the machine. comprising a fastening member extending through an aperture in the housing to retain the current transformer assembly on an internal wall of the housing, an electrically insulating element between the fastening member and the housing and a cap member covering an outer end of the fastening member.

2. A machine according to claim 1, further comprising sealing means cooperating with the cap member and the housing to provide a substantially fluid-tight seal for the aperture of the housing.

3. A machine according to claim 2, wherein the sealing means comprises an O-ring retained in an annular groove in the cap member and abutting a surface of the housing.

4. A machine according to any preceding claim, wherein the cap member is secured to the housing by retaining means.

5. A machine according to claim 4, wherein the retaining means is a retaining ring in an annular groove in the housing, coaxial with the aperture.

6. A machine according to any preceding claim, further comprising an electrically insulating member between the transformer assembly and the housing.

7. A machine according to any preceding claim, wherein the cap member is electrically insulating.

8. A machine according to any preceding claim. wherein the fastening member is a screw having a head engaging the electrically insulating element and a screw-threaded shaft retaining the current transformer assembly on the internal wall of the housing.

9. A machine according to claim 8, wherein the head of the screw is recessed within the housing.

10. A machine according to claim 8 or claim 9, wherein the screw-threaded shaft of the screw engages a self-locking insert that is screw-threaded into a central aperture of the current transformer assembly.

11. A machine according to claim 10, wherein the self-locking insert is a helical coil.

12. A machine according to claim 10 or claim 11, wherein the current transformer assembly comprises a magnetic flux shield for the current transformer.

13. A machine according to claim 12. wherein the magnetic flux shield is made of soft iron.

14. A machine according to claim 12 or claim 13, wherein the self-locking insert is screw-threaded into an internally screw-threaded portion of the magnetic flux shield.

15. A dynamoelectric machine according to any preceding claim, having a polarity of current transformer assemblies similarly mounted within the housing.

16. A dynamoelectric machine having a current transformer assembly mounted within a housing of the machine, substantially as particularly described herein with reference to the drawings.

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2. A machine according to claim 1, further comprising sealing means cooperating with the cap member and the housing to provide a substantially fluid-tight seal for the aperture of the housing.

3. A machine according to claim 2, wherein the sealing means comprises an O-ring retained in an annular groove in the cap member and abutting a surface of the housing.

4. A machine according to any preceding claim, wherein the cap member is secured to the housing by retaining means.

5. A machine according to claim 4, wherein the retaining means is a retaining ring in an annular groove in the housing, coaxial with the aperture.

6. A machine according to any preceding claim, further comprising an electrically insulating member between the transformer assembly and the housing.

7. A machine according to any preceding claim, wherein the cap member is electrically insulating.

8. A machine according to any preceding claim. wherein the fastening member is a screw having a head engaging the electrically insulating element and a screw-threaded shaft retaining the current transformer assembly on the internal wall of the housing.

9. A machine according to claim 8, wherein the head of the screw is recessed within the housing.

10. A machine according to claim 8 or claim 9, wherein the screw-threaded shaft of the screw engages a self-locking insert that is screw-threaded into a central aperture of the current transformer assembly.

11. A machine according to claim 10, wherein the self-locking insert is a helical coil.

12. A machine according to claim 10 or claim 11, wherein the current transformer assembly comprises a magnetic flux shield for the current transformer.

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15. A dynamoelectric machine according to any preceding claim, having a polarity of current transformer assemblies similarly mounted within the housing.

16. A dynamoelectric machine having a current transformer assembly mounted within a housing of the machine, substantially as particularly described herein with reference to the drawings.

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