May 31, 1932. C. H. THORDARSON 1,861,036

ELECTRICAL MOTOR AND GENERATOR

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Fig. 4.

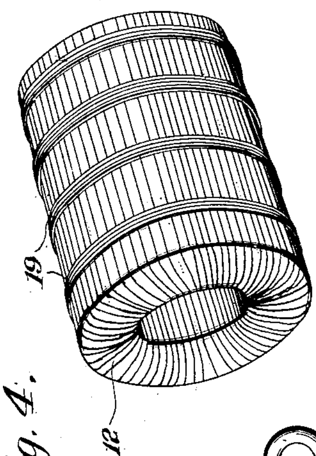


Fig. 1.

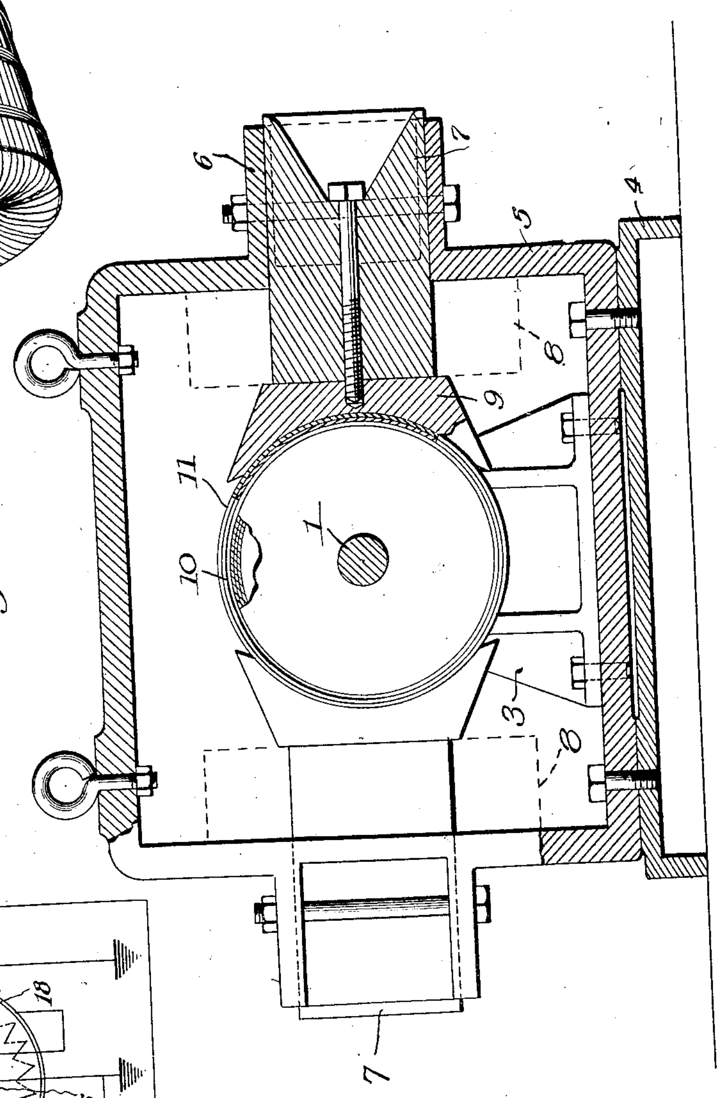
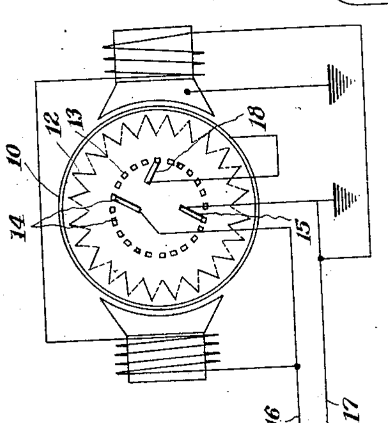


Fig. 3.



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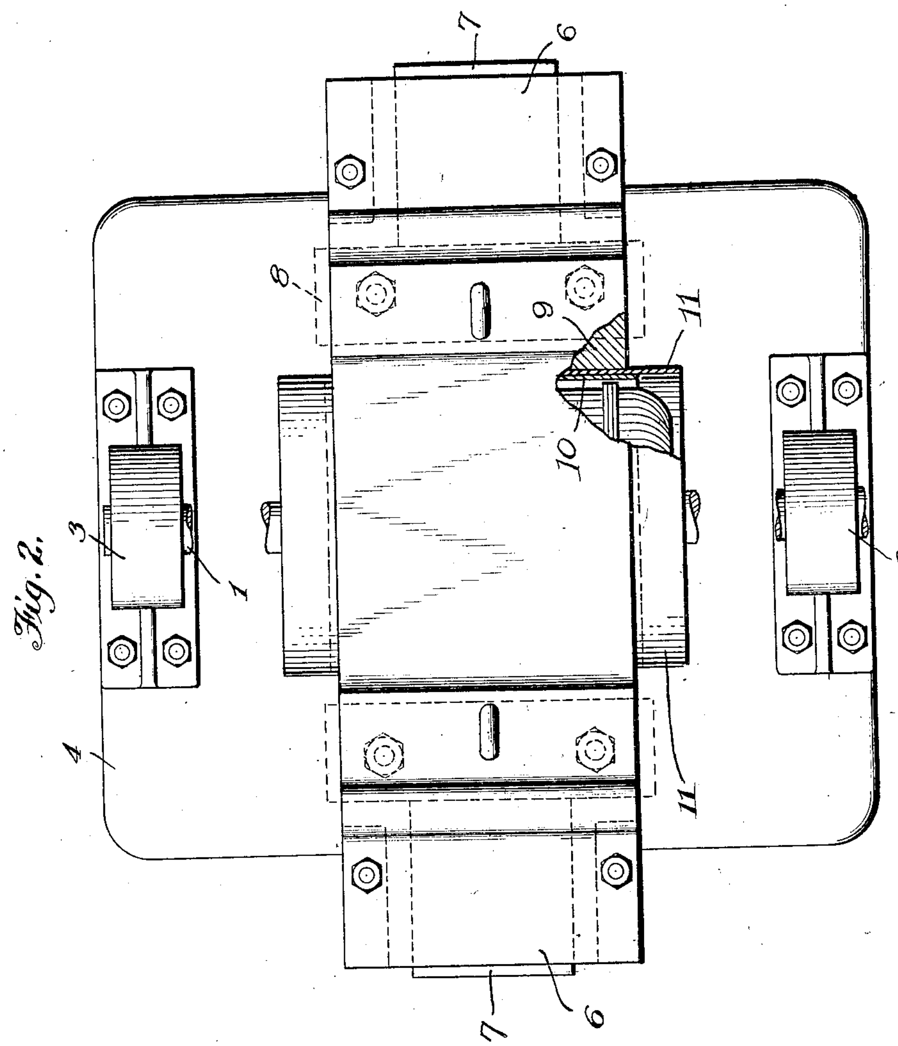

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UNITED STATES PATENT OFFICE

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ELECTRICAL MOTOR AND GENERATOR

Application filed May 4, 1926. Serial No. 106,696.

This invention relates to improvements in electrical motors or generators, and is more particularly adapted for high voltage direct current machines.

The invention is chiefly characterized by providing a metallic shield between the periphery of the armature and the pole faces and maintaining the shield at a potential difference intermediate that of the terminals of the machine.

Although broadly considered the invention may be practiced by sub-dividing the electrostatic field between the armature and the pole pieces and maintaining at least half of the sub-divided field substantially uniform, this latter sub-division is preferably effected by interposing an electrostatic shield between the armature and pole pieces, which shield is preferably maintained at a potential difference having a value intermediate that of the terminals of the machine. The main objects are to decrease the insulation losses of the armature; to reduce the leakage current losses at high voltages and to reduce the surface creepage losses; to maintain a low resistance to the magnetic flux and to reduce hysteresis and eddy current losses; to provide a machine adapted for higher voltages than heretofore attained; and to reduce the length of the total air gap.

An illustrative embodiment of this invention is shown in the accompanying drawings, in which:—

Figure 1 is a view in partial cross section of a bi-polar machine.

Fig. 2 is a plan view of Figure 1.

Fig. 3 is a diagram of one form of electrical connections.

Fig. 4 represents a barrel type ring-wound armature.

In electric machines in general it is highly desirable that the air gap between the armature and pole-pieces be reduced to a minimum. However, the dimensions of the gap are usually confined to certain minimum dimensions determined by the working voltage of the machine and the desired clearance. In the case of high voltage machines the clearance is ordinarily greater than in low voltage machines because of the greater tendency to disruptive discharges between the armature conductors and the pole-pieces proper which are usually connected to the frame and grounded. In accordance with the present invention it is proposed to achieve greater safety against such disruptive discharges in high volage machines by sub-dividing the gap between the armature proper and the pole-pieces into two parts which are separated by an electrical conductive member or shield capable of being maintained at a fixed potential difference, which is preferably of a value less than the maximum operating potential of the machine. As a result of this sub-division and as a result of the constant potential difference which is maintained between the armature proper and the pole-pieces or frame the insulation of the armature conductors is subjected to a substantially constant or at least a uniform electro-static field throughout the entire periphery of the armature. Furthermore the electro-static strains which are set up in the insulation between successive armature portions are provided with a parallel path to the shield. Consequently at any point in the periphery of the armature the maximum strain to which the armature insulation is subjected is that determined by the potential difference of the shield.

Illustrating one particular manner of carrying out the features of the invention there is shown in the drawings an armature 1 rotatably mounted in the pedestal bearings 2 and 3 which are supported by the base 4. The field frame 5 is mounted on the base 4, intermediate the bearings and is provided with squared hubs 6, in which the pole pieces 7 are mounted. The field coils 8 are mounted on the outwardly extending ends of the pole pieces, and the inner ends or faces 9 of the poles are made concave to conform to the surface of the armature 1 in the usual manner.

The metallic shield 10 comprises a cylindrical tube preferably of a material having preferably electrical and magnetic characteristics of a metal such as silica iron. The shield 10 is mounted on the inner surfaces of the pole faces 9 and insulated therefrom by means of a layer 11 of such material as mica. The mica tube 11 extends laterally beyond the poles to lengthen the creepage path from the armature to the frame of the machine.

The shield 10 is held at a potential intermediate the potential difference of the machine, and the air gap between the shield and the periphery of the armature may thereby be considerably shortened over the air gap which would be required for the full voltage between the pole and the armature.

As is well known the strains set up in a dielectric as well as the displacement currents and heating effects therein increase as the voltage differences applied to the dielectric increase. In the usual type of machine where the frame and pole-pieces are connected to ground or zero potential the potential difference between the pole-pieces and the peripheral insulation of the armature corresponds to the maximum potential encountered in the machine proper. However, when the above described shield is interposed between the pole-pieces and the periphery of the armature and maintained at a constant voltage which is lower than the maximum voltage of the machine there is a tendency to disruptive break-down between the armature insulation and the pole-piece. For example, if the machine is a generator, designed to generate 5000 volts and the shield 10 is maintained at a potential difference of 2500 volts the maximum strain on the armature insulation corresponds to a potential gradient of 2500 volts, whereas without the shield the armature insulation may be subjected to potentials as high as 5000 volts.

The machine shown is bi-polar and has a barrel type ring-wound armature, and may be used either as a generator or a motor. An illustrative form of electrical connections is diagrammatically shown, in which the ends of the armature coils 12 are connected to adjacent ones of the commutator bars 13. The bars are connected by means of the brushes 14 and 15 to the main lines 16 and 17 respectively. The brushes contact with segments half way between poles and the current divides and flows through the series of coils on either side to the opposite brush. Preferably, the low potential brush 15 is grounded to the frame of the machine. The shield 10 is held at an intermediate potential by a connection to a third brush 18 which contacts with a commutator bar half way beween the main brushes 14 and 15.

The commutator bands 19, which are provided to hold the coils 12 against the centrifugal force, are in close relation with the coils carrying the maximum potential and may be considered as being at the highest potential with regard to possible leakages. By reducing the voltage drop to the bands or the armature surface, as described, higher voltages may be impressed before the air gap resistance is broken down.

Although but one specific embodiment of this invention has been herein shown and described, it will be understood that numerous details of the construction shown may be altered or omitted without departing from the spirit of this invention as defined by the following claims. Thus any well known means may be employed for controlling the potential gradient between the periphery of the armature and the pole-pieces.

I claim:

1. In an electrical machine of the class described, a rotating armature, fixed field poles about the periphery of the armature, a cylindrical metallic shield surrounding the armature and insulated from the field poles, and means for maintaining the shield at a predetermined potential.

2. In an electrical machine of the class described, a rotating armature, fixed field poles about the periphery of the armature, and a metallic shield mounted on and insulated from the inner faces of the poles, said shield surrounding the armature and spaced therefrom, and means for maintaining the shield at a predetermined potential.

3. In an electrical machine of the class described, a rotating armature having terminals at a potential difference, field poles fixed about the periphery of the armature, a cylindrical metallic shield mounted on the inner faces of the poles to surround the armature, said shield being insulated from said poles and spaced from the periphery of the armature, one of said terminals being grounded to the machine frame, and means for maintaining the shield at a potential intermediate the potentials of said terminals.

4. In an electrical machine of the character described, an armature, a field pole for said armature, and means interposed between said armature and said pole for controlling the maximum electro-static strain on the armature insulation, said last mentioned means adapted to be maintained at a potential lower than the maximum working potential difference of the machine.

5. In an electrical machine of the character described, an armature, coils mounted on said armature and insulated therefrom, field magnets and separate means for controlling the potential difference between the periphery of the armature and the field poles.

6. In an electrical machine of the character described, means for reducing insulation losses comprising a conductive shield surrounding the armature, and means for maintaining said shield at a fixed potential difference, said potential difference being less than the maximum working potential of the machine.

7. In an electrical machine of the character described, an armature, a plurality of field poles for said armature, and a conductive shield extending before all said field poles but insulated therefrom, said shield be-

ing spaced from said armature, and means for maintaining the shield at a potential difference intermediate the minimum and maximum working potentials of the machine.

8. In an electrical machine of the character described, a rotating armature, a plurality of field poles surrounding the armature, a conductive shield, said shield being mounted in spaced relation both with respect to the armature and with respect to the field poles, and means for maintaining said shield at a potential difference less than the maximum working potential of the machine.

9. An electrical machine according to claim 8 in which the shield is in the form of a cylinder, and is freely spaced from the armature, but is separated from the field poles by a layer of solid insulation.

10. A machine according to claim 8 in which the shield is insulatingly mounted on the pole-pieces.

11. In a machine of the character described, a rotating armature, a commutator for said armature, a conductive shield surrounding said armature, a pair of brushes connected to said commutator, another brush for said commutator intermediate the said pair of brushes, and a connection from said other brush to said shield.

12. An electrical machine according to claim 11 in which one of the brushes of said pair is grounded.

13. A machine according to claim 11 in which the said other brush is midway between the pair of brushes.

14. A machine according to claim 11 in which the shield is in the form of a metallic cylinder freely spaced from the armature and insulated from the pole-pieces.

15. In an electrical machine of the character described the method of reducing armature insulation losses, which comprises subjecting the armature insulation to the action of an equipotential surface in spaced relation to the armature, the potential for said surface being intermediate the zero and maximum working potentials of the machine.

16. The method according to claim 15 wherein the potential difference of the shield is one-half the maximum potential of the machine.

17. In an electrical machine of the character described, means for reducing armature insulation losses including a member in close proximity to the armature and insulated therefrom, and means for applying to said member a constant potential intermediate that of the machine terminals.

18. In an electrical machine of the character described, means for reducing insulation losses, comprising a conductive shield surrounding the armature, and means for maintaining said shield at a fixed potential but less than the maximum working potential of the machine.

19. In an electrical machine of the character described, means for reducing insulation losses including a conducting member mounted in proximity to the armature but freely spaced therefrom, and means for applying to said member a constant potential intermediate the potential of the machine terminals.

20. In an electrical machine of the character described the combination of an armature, an equipotential surface in spaced relation to said armature and surrounding the same, and means for maintaining said surface at a potential difference lower than the maximum potential of the machine.

Signed at Chicago this 30th day of April, 1926.

CHESTER H. THORDARSON.