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DYNAMO ELECTRIC MACHINE.

APPLICATION FILED JAN. 22, 1915.

1,243,966.

Patented Oct. 23, 1917.

Fig. 1

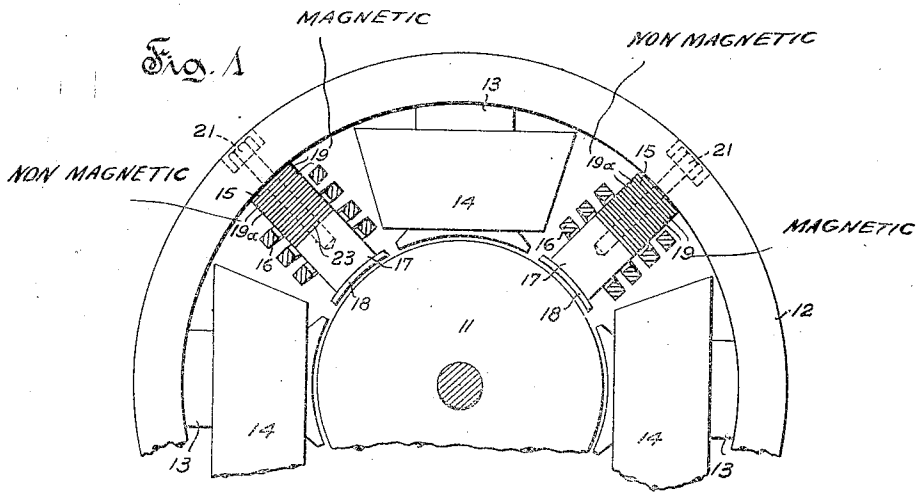


Fig. 2

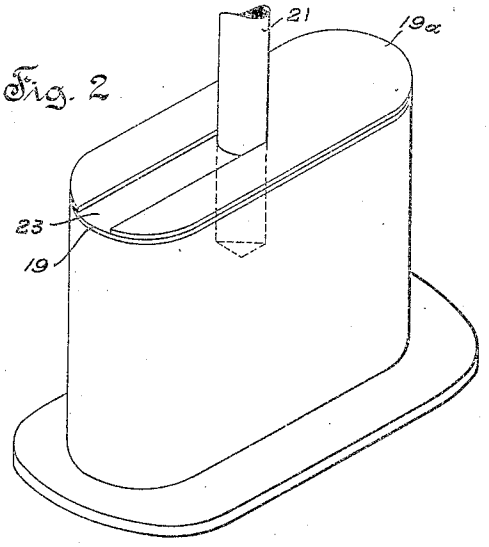
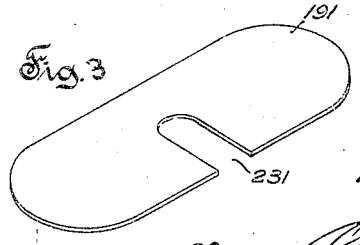


Fig. 3



Witnesses

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DYNAMO-ELECTRIC MACHINE.

1,243,966. Specification of Letters Patent. Patented Oct. 23, 1917.

Application filed January 22, 1915. Serial No. 4,069.

To all whom it may concern:

Be it known that I, LOUIS C. NICHOLS, a citizen of the United States, residing at Norwood, in the county of Hamilton and State of Ohio, have invented a certain new and useful Improvement in Dynamo-Electric Machines, of which the following is a specification.

This invention relates in general to dynamo-electric machines, and has particular reference to such machines, as are of the projecting-pole type and wherein it is desirable that the reluctance of the magnetic circuit of a field pole be adjustable.

In designing the electrical and magnetic features of a dynamo-electric machine so that a certain flux density be produced in the field poles, it is often difficult to obtain exactly the desired magnetic conditions. While it might be possible, where the exciting winding is of the shunt type, to change the number of turns or insert a resistance in series with the winding, nevertheless, where the winding is of the series type, a winding of which type very often consists of but a comparatively small number of turns or fractional turns, it is inexpedient and undesirable to vary the number of turns or to insert a variable resistance in series with the winding. In some cases, fairly good operation might be secured by arranging a reactance in shunt to the series winding, provided such shunt has a time constant equal to that of the winding itself, so that a constant ratio would exist between the currents in the winding and in the shunt reactance, without which condition the operation of the machine would be unsatisfactory, for the flux produced would not always be proportional to the current in the winding or, consequently, the load upon the machine. Again, under certain conditions, even though the time constant of the shunt reactance were designed to be equal to that of the winding, it is probable that, due to the shunt reactance being ordinarily removed from the immediate vicinity of the machine, the temperatures of the winding and the reactance would vary at different rates, and, hence, the current in the winding would not always be proportional to the current supplied by the machine.

The best operating results along with the most economical construction exists when the winding is of just such dimensions as to produce the proper flux at all times, as the load on the machine varies, without resort to resistance or reactance in series with or in shunt to the winding, and when the pole and windings are of as small dimensions as possible to secure the desired results, since economy in construction is best attained by maintaining the field structure of as small size as possible, while securing the desired results. Further, the air gap adjacent the armature should be maintained at a minimum to reduce leakage between adjacent pole tips to a minimum.

The more desirable advantages of this invention are attained in connection with dynamo-electric machines provided with commutating poles effective to produce a magnetic flux in line with the armature coil undergoing commutation and of such intensity as to compensate for armature reaction and, ordinarily, to produce a field of the required amount to induce current in such short-circuited coil that is of approximately the same value as is present in the effective armature coils when the short-circuit is removed from the coil undergoing commutation. Unless this winding is of the proper dimensions to produce the required commutating flux, which will vary as the load varies, the commutating winding being in series with the mains, sparking will occur at the brushes.

It is an object of this invention to provide an improved construction of dynamo-electric machine wherein the field poles are provided with flux producing windings of a fixed number of turns, and wherein, with constant current in such windings, the flux produced thereby may be varied by means other than a resistance or reactance associated with said winding.

It is a further object of this invention to provide a construction of dynamo-electric machine embodying improved means for varying the reluctance of the magnetic path of a field pole.

It is a further object of this invention to provide an improved construction of dynamo-electric machine wherein the air gap between a field pole and the armature may be maintained constant and the reluctance of the magnetic path of the pole may be varied.

It is a further object of this invention to provide an improved construction of dyna-

mo-electric machine wherein the field poles are of substantially solid construction and are of variable reluctance.

These and other objects are attained by this invention, the various novel features of which will appear from the description and drawings forming a part of this specification, and will be particularly pointed out in the claims.

In the accompanying drawings:

Figure 1 is an end elevation, with parts in section, of a portion of a dynamo-electric machine embodying features of this invention.

Fig. 2 is a perspective view of a portion of a field pole of the machine shown in Fig. 1.

Fig. 3 is a perspective view of a modified form of a detail of the construction shown in Figs. 1 and 2.

In the drawings, there is disclosed a dynamo-electric machine having a rotating armature 11 and a field frame or yoke 12 provided with projecting main poles 13 having windings 14. Also secured to the frame 12, intermediate the main poles 13, are commutating poles 15 provided with windings 16. Each commutating pole comprises a body portion 17, to the radially inner end of which may be secured a pole shoe 18, and a plurality of separate disks or laminations 19, 19_a, secured in position intermediate the body portion 17 and the frame 12 by a bolt or screw 21, which passes through the frame 12 and the laminations 19, 19_a, and is threaded into body portion 17, this bolt serving to hold the parts of the commutating pole in operative position.

The laminations or disks 19, 19_a are, ordinarily, of both magnetic material and non-magnetic material. It may be considered that 19 indicates those of magnetic material and 19_a those of non-magnetic material. While, in order to maintain the air gap between the pole shoe 18 and the armature 11 constant, it is necessary that the space occupied by the laminations 19, 19_a, at all times, be of the same radial extent, nevertheless, it will be obvious that by varying the proportion of magnetic laminations to non-magnetic laminations, the reluctance of the commutating pole may be varied. As will be apparent, this may be accomplished by substituting for a certain number of laminations of magnetic material an equal number of laminations of non-magnetic material, or vice versa.

These laminæ 19, 19_a, are of substantially the same cross-sectional area as that of the body portion 17, and, while they may be provided with closed slots for the reception of the screw or bolt 21, which construction requires insertion and removal of the laminations by a movement parallel to the axis of the screw or the insertion of the screw through the previously assembled body portion 17 and laminations, they are, preferably, provided with an open slot, as indicated at 23, this slot extending parallel to the axis of the machine when the laminations are in operative position on the body portion 17. Such an arrangement provides for the utmost facility in removing laminations from and inserting the same to operative position from the end of the machine, which operation may be accomplished on loosening the bolt or screw 21 to a slight extent. However, as indicated in Fig. 3, these laminations 191 may be slotted along the longer side, so as to permit insertion and removal of the same in a circumferential direction, if desired, the slot being designated as 231.

It will be obvious that, at all times, independently of the number and magnetic qualities of the laminæ, the cross-sectional area of the pole is the same throughout its length from the pole shoe to the frame 12, and that this pole is substantially solid throughout its length. This latter feature is of advantage in that there is a solid and substantial bearing for the comparatively heavy body portion 17, and such a bearing that, while capable of being varied, will offer no difficulty in maintaining the air gap between the pole shoe and the armature substantially constant. There is a decided advantage in having the pole piece of substantially the same cross-sectional area throughout its entire length, in that the smallest and most economical type of series coil can be utilized, the coil fitting readily over either the body portion 17 or the laminations 19, 19_a.

In ordinary design, the cross-section of the series winding is fixed to a great extent by the maximum current which the machine is intended to furnish. This winding should be of such cross-section that it can safely carry this maximum current without any considerable heating. Considering the cross-section of the series winding as fixed, and that the preliminary design indicates that say 3¾ turns of winding are necessary to secure the required commutating flux, the commutating poles being considered as being of magnetic material throughout the full length, it will be apparent that since it is not at all feasible to provide a fractional turn about the commutating pole, the required flux must be produced with four full turns of the winding. Were the full line current to pass through these four full turns, the excitation produced would be greater than that required, and hence, it is necessary to reduce this excitation. This might be done by placing a resistance, inductive or non-inductive, in shunt to the winding, but, as stated above, both of these expedients have undesirable features. In

accordance with this invention, the required flux may be secured by using four full turns of winding and by increasing the reluctance of the pole to the extent that the magnetic effects due to the four turns are the same as that which might be obtained with 3⅞ turns, using a pole wholly of magnetic material. This required effect is produced by replacing a portion of the laminations of magnetic material 19 by laminations of non-magnetic material 19_a, without varying the total radial space occupied by these laminations.

In most cases, the proportion between these laminations 19 and 19_a is calculated in advance, and the pole, made up of the body portion 17, the pole shoe 18, and the laminations 19 and 19_a, and the winding 16, is secured in position. The machine is then tested, and, if the commutating flux produced is not exactly that required, adjustment is made by exchanging one or more laminations of magnetic material for a number of laminations of non-magnetic material whose total thickness is equal to that of the laminations of magnetic material which have been removed, or vice versa. Again, adjustment may be made by substituting for one lamination, a lamination of equal thickness and of magnetic properties that differ to the required extent to produce the desired result. It will also be obvious that further adjustment may be made by substituting for two laminations, two other laminations, one of magnetic material and the other of non-magnetic material, or two laminations of different material and of such relative thickness as to produce the required result.

It will be obvious that those laminations that have been described as being of non-magnetic material need be only of material having different magnetic properties from the material of the other laminations.

Where the machine is of a type requiring comparatively few series turns, it may be desirable that the so called "non-magnetic" laminations be actually of a comparatively non-magnetic material, such as brass, and hence be capable, on substitution of one non-magnetic lamination for a magnetic lamination, of causing considerable change in the total reluctance of the magnetic circuit of the pole; and, where a greater number of series turns are required, it may be desirable that the "non-magnetic" laminations, while of considerably less permeability than the magnetic laminations, be of a material, possibly an alloy, of greater permeability than air.

It will be obvious that, in accordance with this invention, the required amount of series field flux may be produced, and that the flux produced by a winding of given dimensions may be varied other than through the use of resistance, either in series or in shunt to the winding, and that the air gap between the field pole and the armature is maintained constant and the pole is substantially solid and of the same cross-sectional area throughout its full length.

It should be understood that it is not desired to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In a dynamo-electric machine, a frame, and a field pole secured in position relatively to said frame, said pole being of substantially uniform cross-section throughout its entire length and one portion of said pole being made up of a plurality of laminæ having different magnetic properties and extending substantially perpendicular to the axis of said pole throughout substantially the full cross-sectional area of the pole.

2. In a dynamo-electric machine, a frame, a field pole secured in position relatively to said frame, said pole being of substantially uniform cross-section throughout its entire length, one portion of said pole being made up of a plurality of laminæ disposed in planes substantially perpendicular to the axis of said pole and extending throughout the full cross-sectional area of the pole, said laminæ being removable from and insertible to position without removing another portion of said pole from said frame, and common means for holding the latter portion and said laminæ in operative position.

3. In a dynamo-electric machine, a frame, a field pole comprising a plurality of portions of different magnetic properties, and means for securing said portions together to form a pole of substantially solid construction and for securing said pole in operative position relatively to said frame, one of said portions being removable and replaceable without necessitating shifting of another portion.

4. In a dynamo-electric machine, a yoke, a pole piece, means for supporting said pole piece from said yoke, said pole piece comprising a body portion of magnetic material spaced from said yoke, and means occupying substantially the entire space between said body portion and said yoke for spacing said body portion from said yoke, said latter means comprising a plurality of laminations held in position by the supporting means for said body portion.

5. In a dynamo-electric machine, a yoke, a pole piece, means for supporting said pole piece from said yoke, said pole piece comprising a body portion of magnetic material spaced from said yoke, and means occupying substantially the entire space between said body portion and said yoke for spacing

said body portion from said yoke, said latter means comprising a plurality of laminations of material having different magnetic properties.

6. In a dynamo-electric machine, a yoke, a pole piece, means for supporting said pole piece from said yoke, said pole piece comprising a body portion of magnetic material spaced from said yoke, and means occupying substantially the entire space between said body portion and said yoke for spacing said body portion from said yoke, said latter means comprising a plurality of laminations of the same cross-sectional area and shape as said body portion and of different magnetic properties.

7. In a dynamo-electric machine, a yoke, a pole piece, means for supporting said pole piece from said yoke, said pole piece comprising a body portion of magnetic material spaced from said yoke, and means occupying substantially the entire space between said body portion and said yoke for spacing said body portion from said yoke, said latter means comprising a plurality of laminations of substantially the same cross-sectional area as said body portion and of different magnetic properties, and said laminations being held in operative position by the supporting means for said body portion.

8. In a commutating dynamo-electric machine, the combination with the yoke of the machine and its main polar projections, of commutating polar portions interposed between said main polar portions and secured to said yoke, and windings surrounding said commutating polar portions, each of said commutating polar portions comprising a body portion of magnetic material adjacent the armature of said machine and a plurality of laminations of different magnetic properties and the same cross-sectional area and shape as said body portion and disposed similarly to said body portion, said laminations being secured in position between said body portion and said yoke.

9. In a commutating dynamo-electric machine, the combination with the yoke of the machine, of a commutating pole piece attached to said yoke and comprising a body portion of magnetic material adjacent the armature of said machine and a plurality of laminations of different magnetic properties and of the same cross-sectional area as said body portion and disposed between said body portion and said yoke, and common means for holding said body portion in operative position and for securing said laminations between said body portion and said yoke.

10. In a commutating dynamo-electric machine, the combination with an armature and a yoke, of a commutating pole piece, a winding therefor through which substantially all of the current generated by the machine passes, said pole piece comprising portions of different magnetic properties and being of substantially solid construction when in assembled condition and of uniform cross-section throughout its entire length, and means for securing said portions together and said pole piece to said yoke.

11. In a dynamo-electric machine, a yoke, a pole piece, means for supporting said pole piece from said yoke, said pole piece comprising a body portion of magnetic material disposed adjacent the armature of the machine, and means occupying substantially the entire space between said body portion and a portion associated with said yoke and spacing said portions apart, said latter means comprising a plurality of laminations held in position between said body portion and the portion associated with said yoke.

12. In a dynamo - electric machine, a frame, a field pole of substantially solid construction and comprising a body portion disposed adjacent the armature of the machine, and a portion disposed between said body portion and said frame and comprising a plurality of laminations of substantially the same cross-sectional area as said body portion, and means disposed within the periphery of said pole for securing said body portion in position adjacent the armature and said laminations in position between said body portion and said frame.

In testimony whereof, the signature of the inventor is affixed hereto in the presence of two witnesses.

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Witnesses:

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