M. E. THOMPSON.

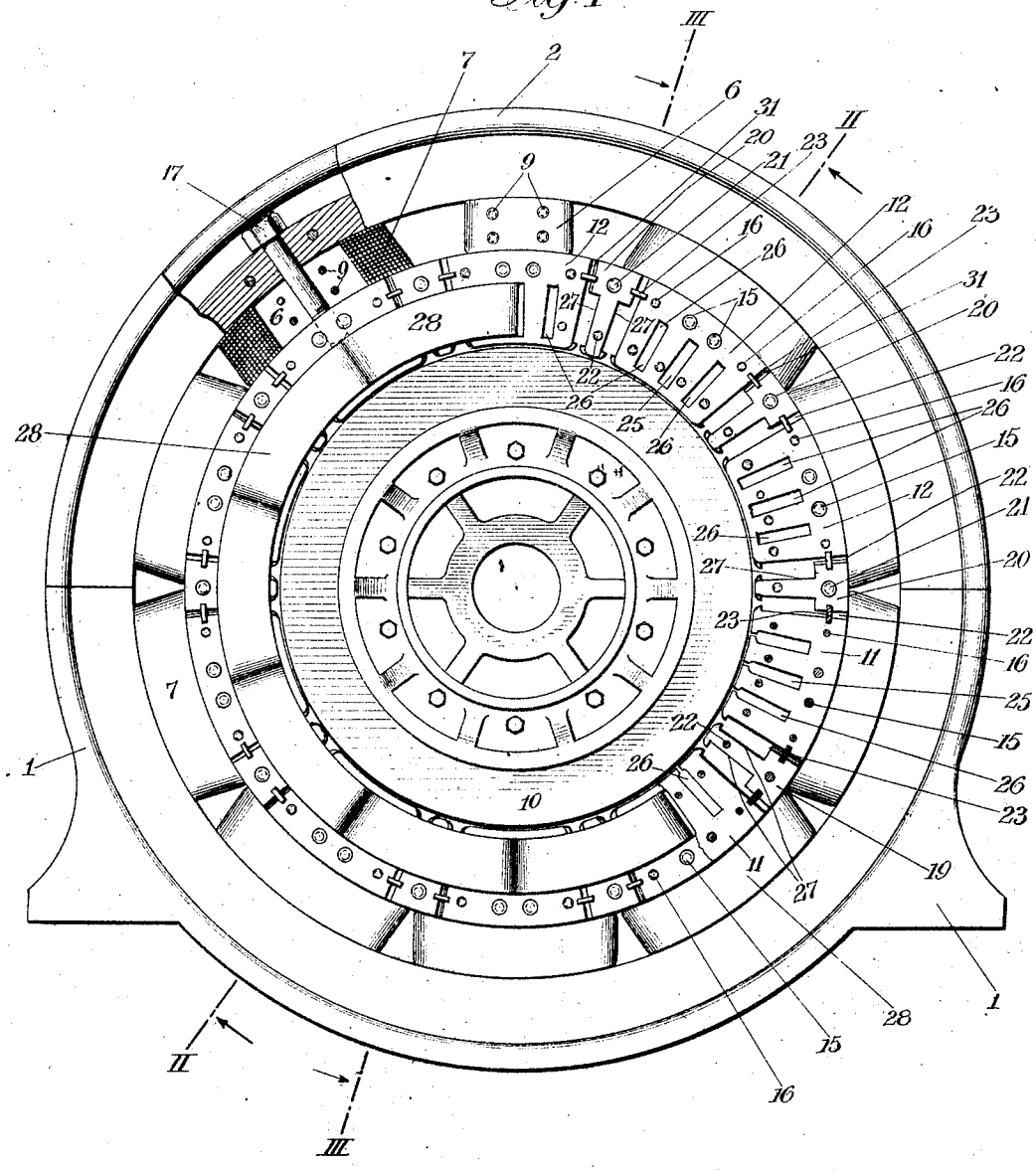
DYNAMO ELECTRIC MACHINE.

APPLICATION FILED JUNE 23, 1910.

1,048,006. Patented Dec. 24, 1912.

4 SHEETS—SHEET 1.

Fig. 1



Witnesses:
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4 SHEETS—SHEET 2.

Fig. 2

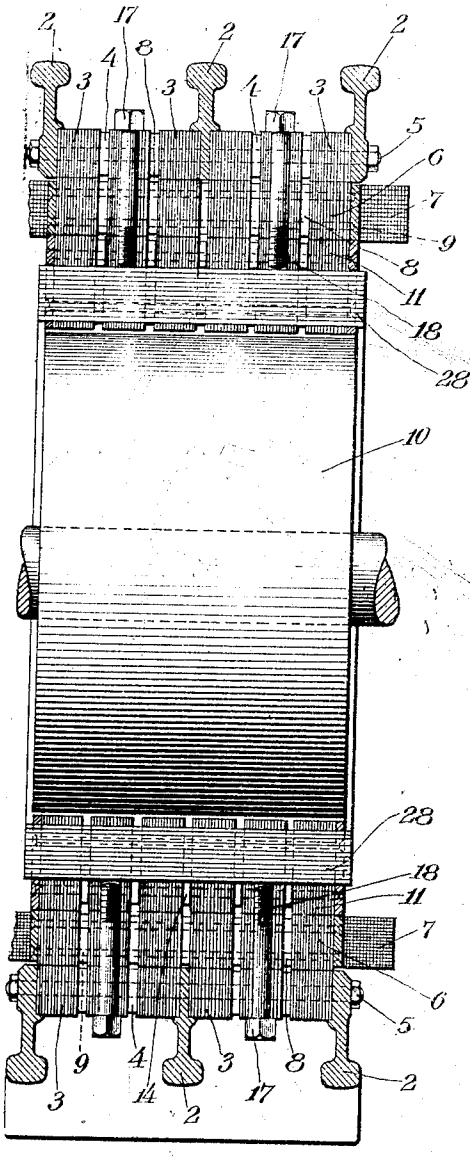
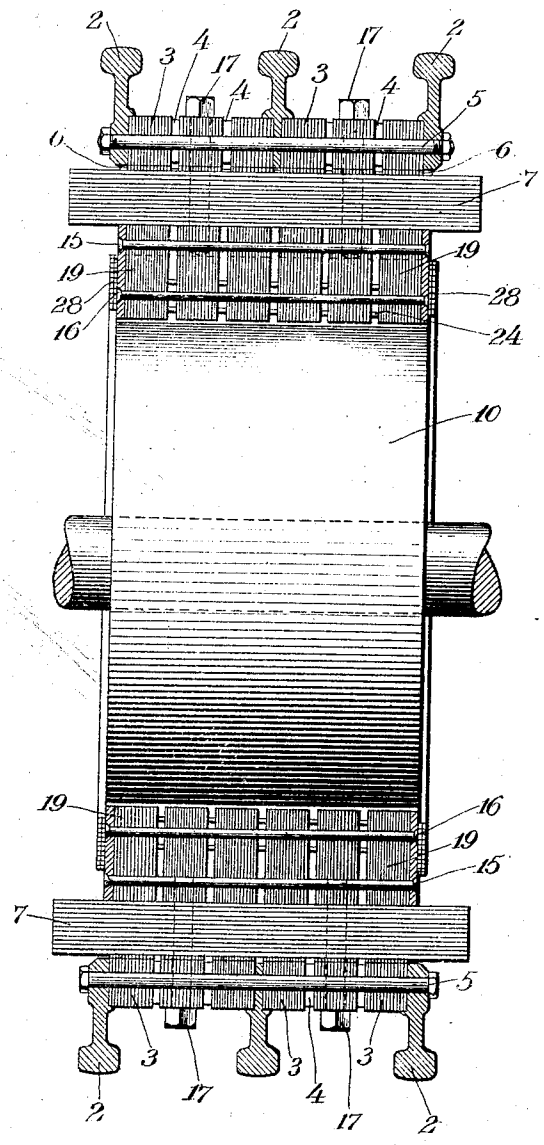


Fig. 3



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4 SHEETS—SHEET 3.

Fig. 4

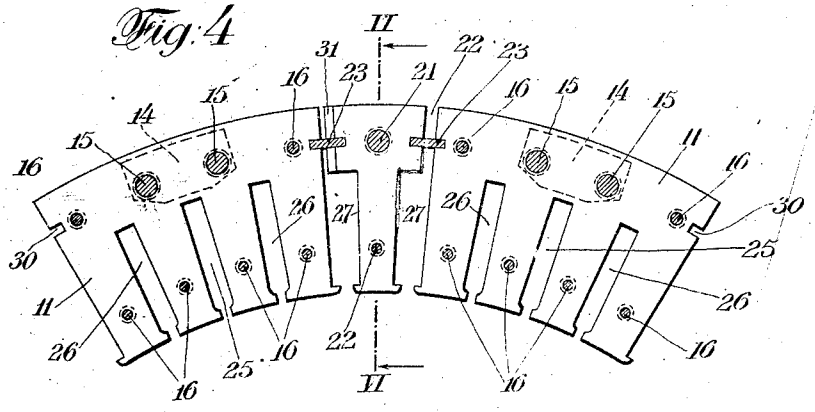
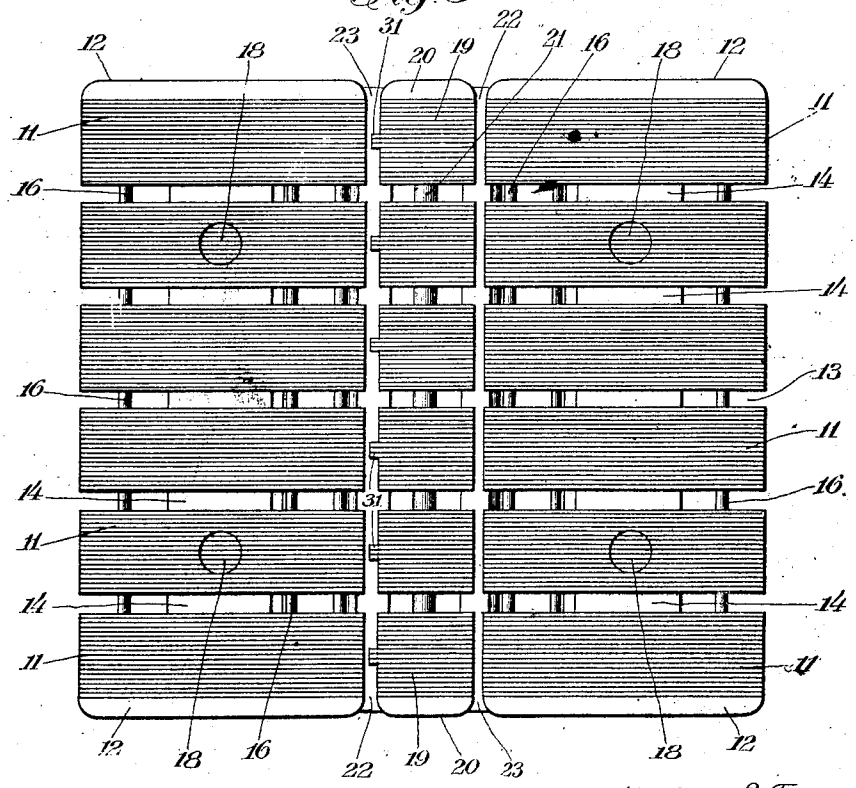


Fig. 5



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4 SHEETS—SHEET 4.

Fig. 6

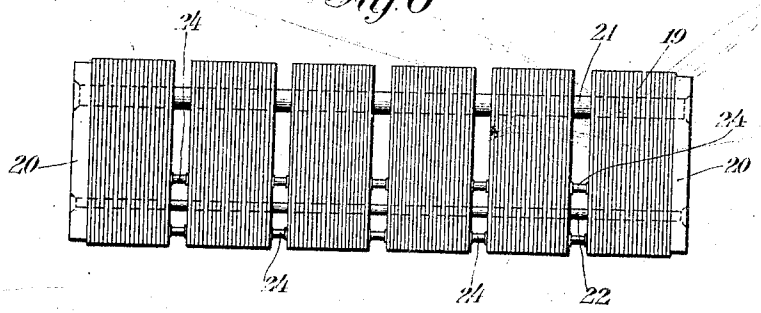
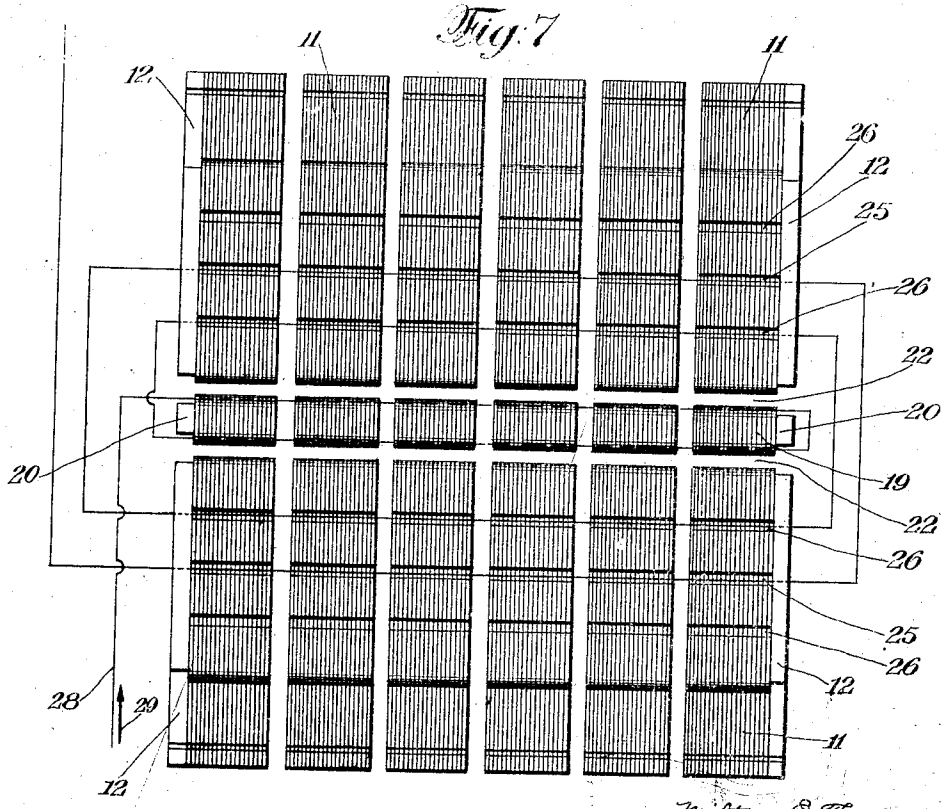


Fig. 7



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UNITED STATES PATENT OFFICE.

MILTON E. THOMPSON, OF RIDGWAY, PENNSYLVANIA.

DYNAMO-ELECTRIC MACHINE.

1,048,006. Specification of Letters Patent. Patented Dec. 24, 1912.

Application filed June 23, 1910. Serial No. 568,454.

To all whom it may concern:

Be it known that I, MILTON E. THOMPSON, a citizen of the United States, and a resident of Ridgway, Elk county, State of Pennsylvania, have invented certain new and useful Improvements in Dynamo-Electric Machines, of which the following is a specification.

My invention relates to improvements in dynamo-electric machines or electric generators and motors and is more especially directed to improvements in that type of machine shown and described in Letters Patent No. 591,024, granted to me October 5th, 1897.

The dynamo of that patent is provided with a cast iron ring interposed between the main field cores and armature. This forms an especially efficient and simple means upon which balancing coils may be located and at the same time provides suitable interpoles and commutation lugs with a minimum amount of windings and expenditure of energy. I have found, however, that in the construction of the machine as set forth in said Letters Patent that there is a certain leakage flux between the main poles of the machine through the outside part of the cast iron ring. This leakage flux could not be utilized in any way and made the machine less efficient than it otherwise would be and necessitated a more liberal amount of material in all parts of the field structure therefore making the machine heavier, more expensive and less efficient than it would otherwise be.

It is the principal object of my present invention to obtain all the advantages of my said former machine while avoiding this leakage flux and the resultant harm therefrom. To this end in my improved dynamo I have constructed the main pole pieces and interpoles as independent members securing them together alternately in such a way that when assembled they constitute in substance the ring of my former patent but with the interpoles separated from the main pole pieces by a sufficient magnetic gap at all points to enable the desirable results obtained from my former structure to be obtained while preventing the leakage that existed in that former structure. The interpoles are supported from the main pole pieces by brass keys while the main pole pieces are supported in place by being separately bolted to the main frame and the cores projecting therefrom. The interpoles are thus although magnetically separated by small gaps from the pole pieces and from the armature, yet so much more magnetically separated from the main frame that the flux flowing through the interpole is derived from the main pole pieces without interfering or substantially affecting the flux in the frame itself.

While I prefer the precise construction I have briefly described and which I will describe more at length hereinafter with reference to the drawings, yet my invention in its broader phase is not limited to all the precise features which I have thus far mentioned.

Further objects, features and advantages will more clearly appear from the detailed description given below taken in connection with the accompanying drawings which form a part of this specification.

In the drawings, Figure 1 is a side view of a dynamo-electric machine embodying one form of my improvements, certain parts being omitted in order to more clearly show the structure thereof. Fig. 2 is a transverse section of the machine taken on the line II—II of Fig. 1. Fig. 3 is a transverse section of the machine taken on the line III—III of Fig. 1. Fig. 4 is a side view showing the shape and arrangement of the laminations forming the auxiliary cores or magnetic structures. Fig. 5 is a detailed top plan view of laminations forming the auxiliary cores or magnetic structures and showing the arrangement of the same. Fig. 6 is a transverse section taken on the line VI—VI of Fig. 4. Fig. 7 is a bottom plan view of the laminations of Fig. 4, showing in detail their arrangement and also diagrammatically showing the method of winding the same.

Referring to the drawings, 1 represents a main frame composed of circular ribs 2 and circularly arranged laminations 3. As shown there are three of the ribs 2 and therebetween the laminations 3 are arranged in six sets. Certain of these laminations are omitted as shown at 4 by the inclusion of suitable spacing blocks in order to form

air spaces in the field frame that the same may be properly cooled. The various spacing blocks, laminations 3 and ribs 2 are securely bound together by means of bolts 5, forming a rigid circular field frame structure. Arranged within this structure and adjacent thereto are suitably spaced field cores 6 for carrying the main field windings 7. These main field cores are also formed of laminations and have certain of the laminations omitted and spacing blocks 8 interposed, as already described with respect to the laminations 3. The laminations forming the main field cores 6 are rigidly bound together by means of bolts 9.

Within the circular structure formed by the field frame and the field cores 6 is the armature 10 which may be of any well known form and construction. The armature 10 has a diameter considerably less than that of the bore of the series of field cores. Interposed between each field core 6 and the armature 10 is an auxiliary magnetic structure preferably formed of laminations 11 and provided with cast iron plates 12 forming the end pieces of these structures. In Fig. 1 the windings have been removed from part of these auxiliary structures so as to clearly show the shape of the cast iron plates 12 and on a portion of that figure the cast iron plates have been removed in order to clearly show the shape of the laminations 11. The shape of the laminations 11 is also clearly shown in detail in Fig. 4. These auxiliary field structures are built up of these laminations as clearly shown in Figs. 4, 5 and 7 and suitable air spaces 13 are provided therein by the omission of certain of the laminations and the inclusion of spacing blocks 14, (see Figs. 2, 4 and 5). The laminations 11 and blocks 14 are rigidly secured together to form a firm magnetic structure by means of bolts 15 and 16. The bolts 15 and 16 and the spacing blocks 14 are omitted from Fig. 7 for the sake of clearness. The various magnetic structures formed by the laminations 11 and cast pieces 12 are secured to the main cores 6 and field frame 2, 3, by means of bolts 17 which pass from the outside of the field frame down through the cores 6 and into threaded openings 18 within the laminations 11, (see Figs. 1, 2, 3 and 5). It will, therefore, be seen that the magnetic structures formed of the laminations 11 are interposed between the main field cores 6 and the armature 10 and are individually and separately secured or fastened to said cores and thereby to the field frame and lie in planes radially the same as that of field cores 6. Also interposed between the field cores 6 and the armature 10 and lying between the various auxiliary magnetic structures preferably formed of laminations 11, is a second set of auxiliary magnetic structures formed of laminations 19. These magnetic structures are arranged to form interpoles or commutation lugs and on each end thereof are provided cast iron plates 20. The shape of these plates is clearly shown in Fig. 1 and the shape of the laminations is clearly shown in Figs. 1 and 4. The structure formed of these laminations 19 and plates 20 is made rigid by means of bolts 21 and 22 passing therethrough. These auxiliary magnetic structures formed of laminations 19, etc., are magnetically separated from the structures formed of the laminations 11 by short spaces 22 but are secured to the structures formed of the laminations 11, etc., by means of brass keys 23, inserted in slots 30 in the various laminations. By the term "spaced magnetically" or "magnetically separated" I mean that the gaps between the magnetic structures 11 and 27 are not substantially bridged by any material having any considerable magnetic conductivity, but I do not mean that flux crossing such gap is not intended to be utilized in the operation of the machine for as I will show I make use of this flux for the commutation.

The parts so far described are assembled by first forming the pole cores 6 and the auxiliary structures formed of laminations 11 and making them rigid structures by means of the bolts already described. These structures are then rigidly secured to the field frame of the machine by means of the bolts 17. The interpole structures formed of laminations 19 are then assembled and made rigid by means of bolts 21 and 22 and these are slipped in between the structures formed of laminations 12 and properly secured thereto and to the frame of the machine by means of the brass keys 23. The various auxiliary magnetic structures formed of laminations 11 and 19, etc., are thus arranged in the form of a ring interposed between the main field cores and the armature 10. Each interpole structure formed of laminations 19 is provided with suitable air spaces therein by the omission of certain of the laminations and the inclusion of suitable spacing members 24, (see Fig. 6).

After assembling the parts as thus described it will appear that the auxiliary structures formed of the laminations 11 and plates 12 are provided with one slot 25 in the center thereof and two slots 26 at the sides thereof. In the laminations these slots extend clear through to the edge thereof but in the plates 12 they do not. The magnetic structures formed of laminations 19 are cut away, as at 27, so as to provide suitable spaces for the windings to be included thereupon.

After the various magnetic structures have been assembled in place as described

and the main field coils 7 slipped on the field cores 6 the balancing windings 28 are put in place. The method of winding these is well known but will be clearly understood from a consideration of Fig. 7. The wire 28 indicated on that figure shows the direction in which the windings go. Starting at the arrow 29 the windings pass in about the laminations 19 of the interpole structure through the space 22, then back through the space 22 on the opposite side of said structures, then the windings pass through the slot 26 of one of the structures formed of laminations 11 and back through the slot 26 of the adjacent structure formed of laminations 11. Thence the winding passes through the slot 25 of the first mentioned structure formed of laminations 11 and then back through the slot 25 of the second mentioned structure formed of laminations 11. Then the winding passes to the next series of auxiliary structures and is wound thereupon in a similar manner but in the opposite direction. This winding is connected to be responsive to the armature current in the well known manner and is clearly described in my prior patent above mentioned, so that the windings will act to provide a proper interpole flux through the auxiliary structures formed of laminations 19 and will also provide a proper balancing magnetomotive force in the various auxiliary magnetic structures, the axis of which will lie in a radial plane between the axes of the main field cores.

Some of the laminations 19 are made wider than others at the top portion thereof, as shown at 31, in order to properly reduce the air gap between these laminations and the adjacent laminations 11. By varying the number of laminations 19, which are provided with the extensions 31, the reluctance of the magnetic path from the interpole to the adjacent auxiliary magnetic structure may be varied as desired.

In operation the windings 28 act as balancing coils or compensating windings to properly compensate for the armature reaction in the well known manner. At the same time, however, these windings act to provide the proper interpole flux for the commutation lugs formed of laminations 19.

After the parts are assembled the shortest distance between the interpole and the frame is much greater than the gap between the interpole and adjacent pole piece so that substantially none of the flux utilized in the interpole passes through the gap between the interpole and the frame. As a result the flux utilized in the interpole does not interfere with or substantially vary the flux in the main frame passing from one main core to the next. Previous to this invention those who had endeavored to provide interpoles separated from the main pole pieces in any practicable machine so constructed the field structure that the interpole flux passed through the frame of the machine causing in the first place a constant leakage flux from each main pole through the interpole and in the second place causing such an inequality in the flux at different parts of the frame as to seriously interfere with the proper compounding of the machine. I have at the same time utilized the main field frame and pole pieces to carry the flux utilized in the interpole and avoided the passing of the flux directly from the interpole to the frame with the disadvantages I have indicated. While obtaining these results I have avoided any substantial leakage of the main flux.

My present invention also enables a certain compounding of the machine by the eccentric placing of the compensating windings which could not be practically done heretofore except with the machine of my former patent.

In referring to the relatively short gap between each interpole and its adjacent pole piece I do not, of course, refer to the distance between the pole tips of interpole and main pole as that does not form any part of the magnetic circuit of the interpole. Such flux as might pass between the tips of these portions of the magnetic circuit would be harmful because opposing the effective flux and there is no functional relation between this gap and the gap between the interpole and the main frame. The relatively short gap between interpole and main pole that is important is that which exists between the back of the interpole and the back of the main pole piece, this being at a point between the compensating winding and the main field winding, and enabling the interpole, although separated by a gap from the main pole, to nevertheless derive its effective flux therefrom.

Aside from the above advantages the arrangement is especially advantageous for its accessibility and easy removal of parts. If it is desired to remove any one of the main field poles 6 with its windings 7 the same may be done without removing substantially any of the other parts of the machine. It is only necessary to remove the bolts 17 corresponding to that field pole when the field pole structure may be readily slipped outward laterally. In a similar manner the various auxiliary magnetic structures may be removed laterally by simply removing the windings therefrom and then removing the adjacent brass keys 23 and bolts 17 when they may be slipped out laterally without removing any remaining structure. The great advantage of thus having the various auxiliary magnetic structures in the form of a ring, the parts of which are separable from one another, and independently se-

cured in the machine is clearly apparent. A ring made up by thus connecting the various auxiliary magnetic structures to the main pole cores and the interpole structures to the other auxiliary structures, is found to be most satisfactory and to form a very rigid structure. The spaces between the pole faces of these structures and the armature may be made only just sufficient for mechanical clearance.

Although I have described my improvements with reference to one particular embodiment of my invention and in great detail, nevertheless I do not desire to be limited to such details except as clearly specified hereinafter in the claims since many changes and modifications within the spirit and scope of my invention will readily suggest themselves to those skilled in the art.

Having thus fully and clearly described my improvements what I claim as new and desire to secure by Letters Patent is:

1. In a dynamo, a field frame with radial cores and windings thereon, a ring having an outer periphery substantially that of the bore of said cores and composed of alternate main pole-pieces and interpoles magnetically separated by relatively low reluctance gaps as compared to the distance from ring to frame, mechanical connections securing said main pole pieces to the cores and frame, non-magnetic members supporting each interpole solely from the adjacent pole-pieces, and compensating windings carried by said pole-pieces.

2. In a dynamo, a field frame with radial cores and windings thereon, a ring having an outer periphery substantially that of the bore of said cores and composed of alternate main pole-pieces and interpoles magnetically separated by relatively low reluctance gaps as compared to the distance from ring to frame, said gaps being greater at the inner periphery of the ring than at the outer, mechanical connections securing said main pole pieces to the cores and frame, non-magnetic members supporting each interpole solely from the adjacent pole-pieces, and compensating windings carried by said pole-pieces.

3. In a dynamo, a field frame with radial cores and windings thereon, a ring having an outer periphery substantially that of the bore of said cores and composed of alternate main pole-pieces and interpoles magnetically separated by relatively low reluctance gaps as compared to the distance from ring to frame, mechanical connections securing said main pole pieces to the cores and frame, and non-magnetic members supporting each interpole solely from the adjacent pole-pieces.

4. In a dynamo, a field frame with cores and windings thereon, main pole pieces and interpoles alternately arranged and mechanically connected but magnetically separated throughout, and independent means for securing each main pole piece against one of the cores, the gap between the interpoles and the frame being great as compared to that between interpoles and main pole pieces to permit the effective flux for the interpoles to be received from the main poles.

5. In a dynamo, a field frame with cores and windings thereon, main pole pieces and interpoles alternately arranged and mechanically connected but magnetically separated throughout, independent means for securing each main pole piece against one of the cores, the gap between the interpoles and the frame being great as compared to that between interpoles and main pole pieces and compensating windings around said interpoles carried by said main pole pieces to permit the effective flux for the interpoles to be received from the main poles.

6. In a dynamo, a field frame, main pole pieces separably secured to the frame, interpoles magnetically separated from each other and from all other parts of the structure and within said compensating windings, said interpoles outside of said windings being separated from the main pole pieces by a short gap and from the said frame by a long gap, the relative size of gaps being such as to enable said interpoles to receive their effective flux from the main pole pieces.

7. In a dynamo-electric machine, the combination of an armature, a field frame having inwardly projecting field cores, a magnetic structure interposed between each field core of the armature, and magnetic structures between said first mentioned magnetic structures separated magnetically from all other parts of the structure, and spaced to permit them to receive their effective flux from the adjacent magnetic structures between which they are placed, brass keys for supporting said second mentioned magnetic structures from the first mentioned magnetic structures, and bolts for independently securing each of said first mentioned magnetic structures to its corresponding field core.

8. In a dynamo, a field frame with pole cores and windings thereon, separate pole pieces fastened to said pole cores, interpoles placed between said pole pieces, the outer ends of the said interpoles being separated from said pole pieces by a short gap and from the frame by a long gap, the relative gaps being such as to permit the effective flux for the interpoles to be received from said pole pieces.

9. In a dynamo, a field frame with pole cores and windings thereon, separate pole pieces fastened to said pole cores, interpoles placed between said pole pieces and spaced with reference thereto and to the said frame to permit the effective flux for the interpoles to be received from the said pole pieces, non-

magnetic members supporting each interpole, and compensating windings carried by said pole pieces and interpoles.

10. In a dynamo, a field frame with pole cores and windings thereon, separate pole pieces fastened to said pole cores, interpoles placed between said pole pieces, the outer ends of the said interpoles being separated from said pole pieces by a short gap and from the frame by a long gap, the relative gaps being such as to permit the effective flux for the interpoles to be received from said pole pieces, and non-magnetic members supporting the interpoles in position.

11. In a dynamo, a ring structure including the main pole pieces and interpoles alternately arranged and having slots for compensating windings, the interpoles and the main pole pieces being keyed directly together with magnetic gaps between them, and a field frame magnetically connecting the main pole pieces, the interpoles being spaced with reference to the main pole pieces and frame to permit their effective flux to be received from the main poles.

12. In a dynamo, a field structure having cores and pole pieces separably secured thereto, windings on said cores, interpoles magnetically separated but mechanically supported from the pole-pieces, the outer ends of the interpoles not extending substantially beyond the inner ends of said windings, and auxiliary windings surrounding said interpoles said interpoles receiving their flux from the main pole pieces at points between said two sets of windings.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

MILTON E. THOMPSON.

Witnesses:
A. R. MEEK,
J. M. SCHRAM.