No. 742,600. PATENTED OCT. 27, 1903.

E. R. COX, Jr.

DYNAMO ELECTRIC MACHINE OR MOTOR.

APPLICATION FILED AUG. 21, 1903.

NO MODEL.

Fig. 1.

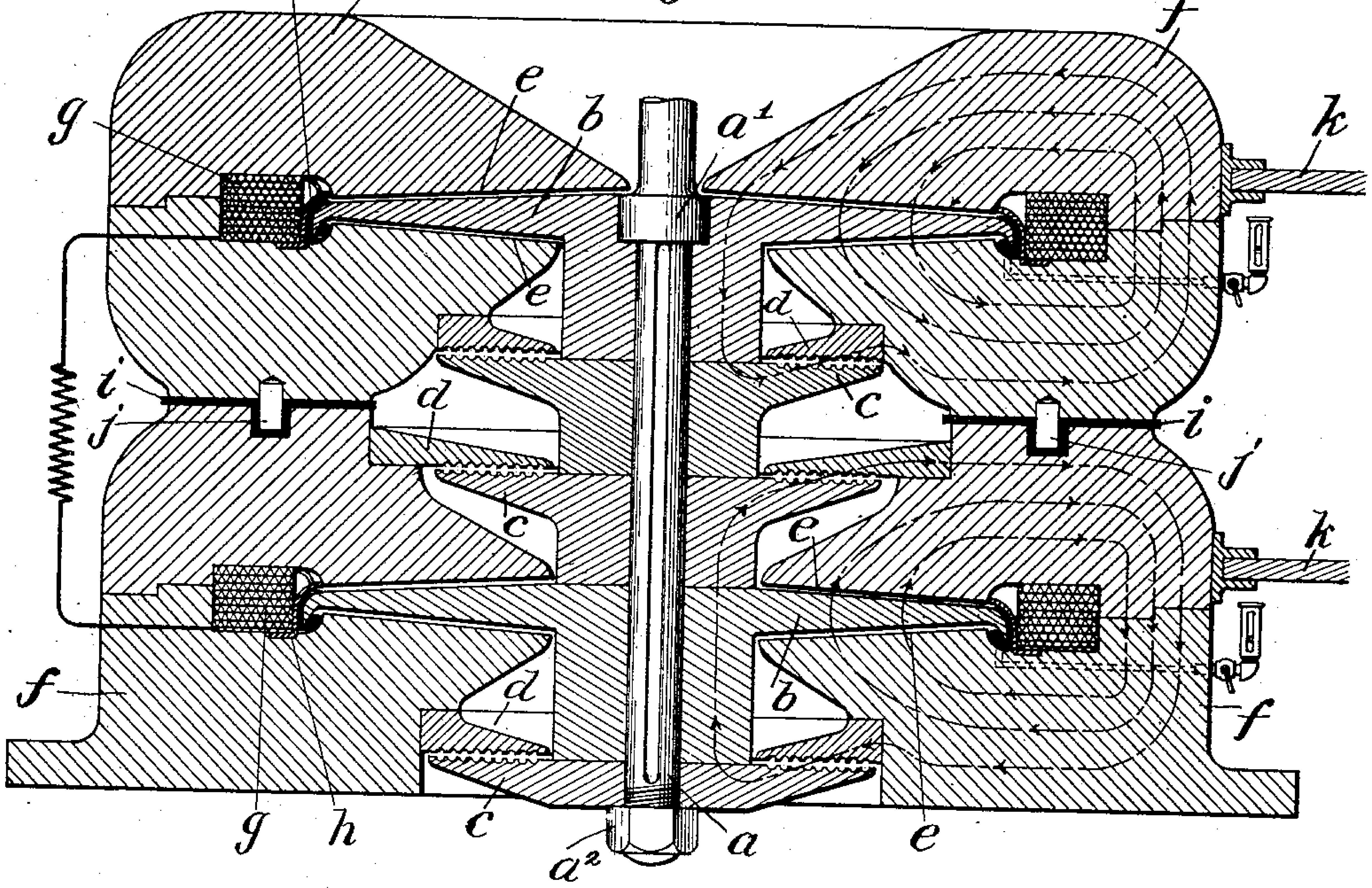


Fig. 2.

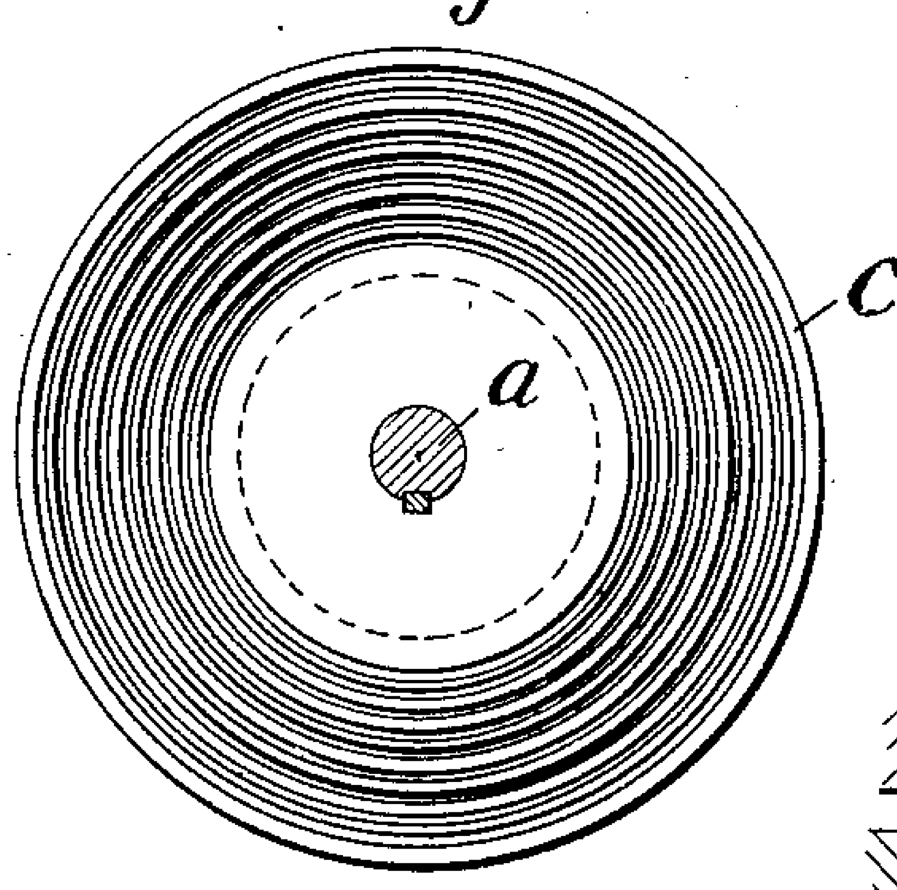


Fig. 3.

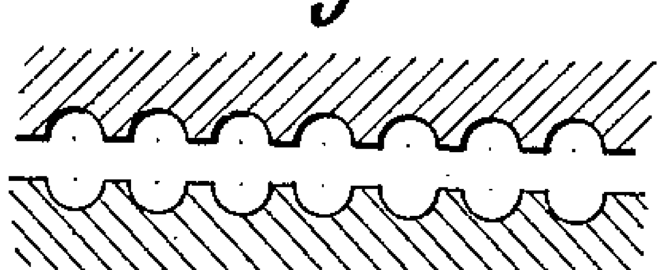


Fig. 7.

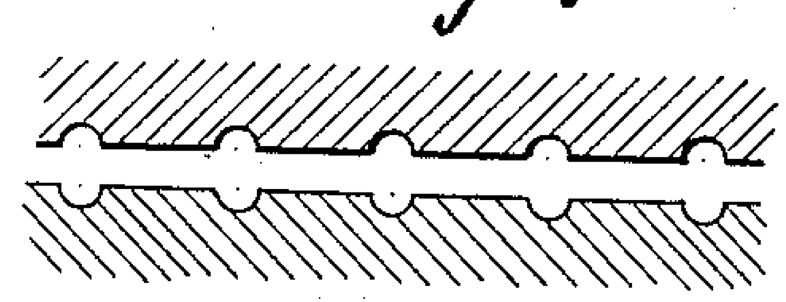


Fig. 4.

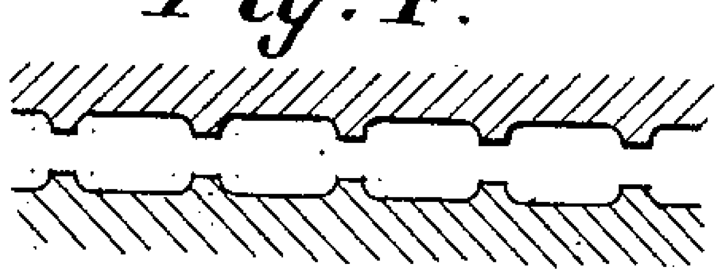


Fig. 5.

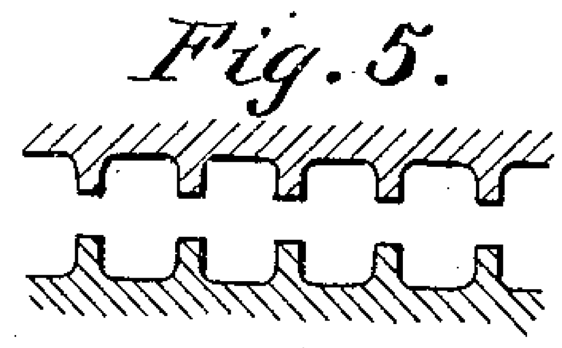


Fig. 8.

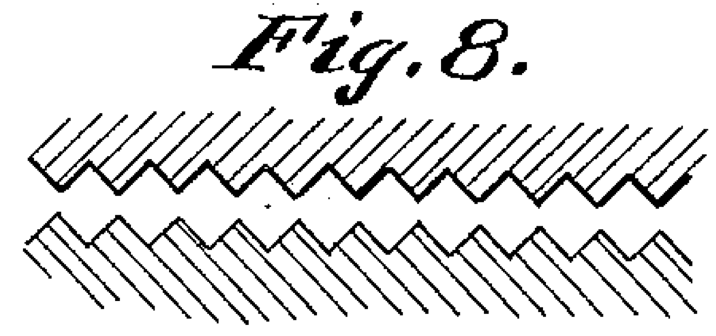
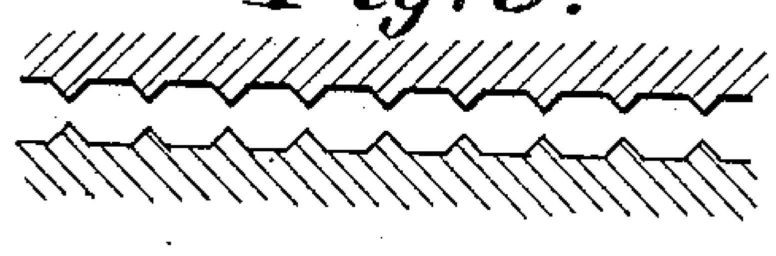


Fig. 6.



WITNESSES:-

Ernest Pulsford.

[illegible]

INVENTOR:-

E. R. Cox Jr.

BY HIS ATTORNEYS,

Baldwin, Davidson & Wight

No. 742,600. Patented October 27, 1903.

UNITED STATES PATENT OFFICE.

EDWIN R. COX, JR., OF BIRMINGHAM, ALABAMA.

DYNAMO-ELECTRIC MACHINE OR MOTOR.

SPECIFICATION forming part of Letters Patent No. 742,600, dated October 27, 1903.

Application filed August 21, 1903. Serial No. 170,341. (No model.)

To all whom it may concern:

Be it known that I, EDWIN R. COX, Jr., a citizen of the United States, residing at Birmingham, county of Jefferson, and State of Alabama, have invented certain new and useful Improvements in Dynamo-Electric Machines or Motors, of which the following is a specification.

My invention relates to uniform-field dynamo-electric machines or motors, and has for its object to provide a so-called "unipolar" machine of improved and simplified form and increased mechanical and electrical efficiency.

To these ends the invention contemplates a machine of the class described comprising multiple magnetic circuits, each having its energizing-coil and field-yoke, which yokes are preferably electrically insulated from each other and serve as the electrical terminals of the machine, disk armatures, of iron or steel, supported upon a vertical shaft in operative relation with the field-yokes and having electrical connection with each other and with the field-yokes to constitute a series circuit for the armature-current, said yokes and disks being provided upon their coöperating faces with a series of concentric ridges to localize the magnetic flux from the field-yokes through the disks, and thereby center and support the armature-shaft and its disks in proper relation to the said field-yokes.

The invention is illustrated in the accompanying drawings, in which—

Figure 1 is a vertical section through a uniform-field machine embodying my invention. Fig. 2 is a plan view of one of the supporting-disks. Figs. 3, 4, 5, 6, 7, and 8 illustrate various modifications of the ridges upon the coöperating faces of the armature-disks and field-yokes.

Referring to the drawings, *a* indicates a vertical shaft, to which is secured a series of iron or steel disks *b* and *c*, each of which is provided with an enlarged hub portion which bears upon the face of the disk next below. The lowest disk, however, is without a hub and serves to maintain the series of disks upon the shaft between an upper collar a' and a securing-nut a^2 on the end of said shaft.

In the particular modification of my invention shown the disks *b b* constitute the main or generating disks, while the other disks, *c*, hereinafter termed the "auxiliary" disks, are intended to operate, in conjunction with the contiguous faces of the field-yokes, to magnetically support and center the shaft and disks.

The generator-field in which the disks are supported consists of two annular yokes *f f*, of iron or steel, provided with tapering recesses on their inner peripheries, forming lips which almost completely envelop the disk armatures *b b*. Each of said annular yokes *f* constitutes a pole-piece, and said pole-pieces are electrically insulated from each other, as indicated at *i* in Fig. 1. Said pole-pieces are provided with a central annular recess to receive the magnetizing-coils *g g*, respectively, and also to provide two annular troughs to contain mercury or other suitable liquid conductor, by means of which connection is made between the periphery of the armature-disks and the field-yokes which constitute the terminals of the machine. One side of each of said troughs is formed by an annular rim *h*, which serves to properly confine the liquid conductor, and is preferably made of non-magnetic material to prevent magnetic leakage, and in this case, if necessary, the part in contact with the mercury should be coated, plated, or amalgamated in order to prevent it acting injuriously upon the mercury.

The magnetizing or energizing coils *g* are wound so as to produce fields of force of opposite polarity in the respective yokes and generate magnetic currents flowing in opposite directions, so that the lines of force traverse the generator-disk in opposite directions also, as indicated in Fig. 1, and the electromotive force generated is accordingly the sum of the electromotive forces developed in the separate disks, and the current-flow is progressive from the periphery of one disk *b* to the hub thereof, thence to the hub of the other disk *b* and out to its periphery, where it passes through the mercury-bath to the corresponding field-yoke, thence to the external circuit-conductor *k*, back to the other field-yoke and to the mercury-bath in contact with the periphery of the corresponding disk *b*, thus completing the circuit.

The auxiliary disks *c* are provided with concentric ridges matching similar ridges in pole-faces *d*, which lie opposite the disks *b* and are formed, preferably, of separable ring-sections of magnetic material secured to the field-yokes *f*. The ridges on the pole-faces and disks are so constructed and disposed that any axial displacement of the armature-shaft causes a magnetic pull, resisting said displacement. Hence the armature-shaft is magnetically self-centering. The auxiliary disks *c* are also so arranged with respect to the pole-faces *d* that they constitute a part of the magnetic circuit from the field-yokes *f* to the pole-faces *d* and are therefore subject to a magnetic pull exerted upon them by the pole-faces *d* in an upward direction, so that with proper proportioning any part or all of the weight of the armature and of such driving mechanism as may be secured to the armature-shaft will be supported by the magnetic pull. This arrangement of centering and supporting the disks, while a preferable one, is not the only effective arrangement for that purpose, as the desired effect—viz., a magnetically-centered and magnetically-supported armature—may be attained, for example, by omitting the auxiliary disks *c* entirely and providing the armature-disks *b* on their upper faces and the contiguous lips of the field-yokes with corresponding concentric ridges. Since the magnetic pull varies with the square of the induction per unit area, it will be evident that the pull or lifting force exerted between the upper or grooved surfaces of the armature and the field pole-faces *e* is greater than that exerted between the lower or smooth surfaces of the disks and the pole-faces *e*. Thus by sufficiently intensifying or localizing the induction along certain lines—viz., the ridges on the disks *b* and pole-faces *e*—the same self-centering and support effect is attained, but at the expense of a greater magnetizing-current, since with the same mechanical clearance the grooved surfaces present a greater length of air-space to the magnetic circuit. By the use of the auxiliary disks *c*, moreover, provided with relatively large hub-sections, it is possible to utilize the several hubs of the disks *b* and *c* to conduct the heavier armature-current, as well as to carry part of the magnetic flux. The particular embodiment of the invention shown in the drawings is preferable also in that it dispenses with all interior wiring and the electrical circuit is formed by the metallic parts of the machine itself.

Since a perfect balance between weight of armature and magnetic supporting force is hardly practicable and if attained would only result in unstable or, at best, neutral equilibrium, it is necessary to provide set-screws or other suitable stops to retain the armature at its proper distance between pole-faces. Also positive bearings may be provided to prevent lateral displacement of the armature (accidental or otherwise) beyond a certain amount, in which case there should be sufficient play between journal and bearing to allow clearance under working conditions, and so preserve the advantage of magnetic centering and support, whereby friction of the rotating armature is almost wholly avoided.

The ridges on the disks and pole-faces may be given any desired form, so long as they preserve the general relation of concentricity with the shaft. Several such forms of ridges are illustrated in Figs. 3 to 8, inclusive.

It is to be understood, of course, that the construction of the machine as illustrated and described is capable of wide variation without departing from the spirit of the invention. The peripheral lips on the main armature-disks *b* may be formed as separate rings attached thereto and may be of non-magnetic material to reduce magnetic leakage and eliminate Foucault currents. The mercury-troughs may be entirely of non-magnetic material, but electrically connected to the field-yokes *f*. It is also feasible to arrange two or more of the machines, as above described, in battery, either on the same axis by means of an insulated shaft-coupling or upon separate shafts and either in series or in multiple.

What I claim as my invention is—

1. A uniform-field dynamo-electric machine or motor, comprising oppositely-excited field-magnet pole-pieces electrically insulated from each other, and rotary armature-disks coöperating with said pole-pieces, said disks being in electrical connection with each other and with the respective pole-pieces, whereby the armature-currents are conducted to and from the machine through the metal in the body thereof.

2. A uniform-field dynamo-electric machine or motor, comprising oppositely-excited field-magnet pole-pieces, rotary armature-disks coöperating with said pole-pieces, said disks being in electrical connection with each other, liquid-conductor connectors between the respective disks and pole-pieces, and circuit-terminals electrically connected to said pole-pieces, whereby the armature-currents are directly conducted through the armatures and pole-pieces in series.

3. A uniform-field dynamo-electric machine or motor, comprising a field-magnet yoke, a rotary armature-disk of magnetic material coöperating with said field-magnet yoke, and means for magnetically supporting and centering said disk with respect to the field-magnet.

4. A uniform-field dynamo-electric machine or motor, comprising an annular field-magnet yoke, an exciting-circuit for the same, and a rotary disk of magnetic material coöperating with said field-magnet yoke, said yoke and disk having concentric matching ridges, to localize the magnetic flux between the corresponding ridges and thereby magnetically support and center the armature.

5. A uniform-field dynamo-electric machine or motor, comprising an annular field-magnet yoke, an exciting-circuit for the same, a disk of magnetic material rotating in juxtaposition to said annular yoke and constituting a

part of the magnetic circuit of said yoke, and concentric series of ridges on the contiguous faces of the yoke and the disk respectively, to localize the magnetic flux between corresponding ridges and thereby magnetically support and center the armature.

6. A uniform-field dynamo-electric machine or motor, comprising an annular field-magnet yoke, an exciting-circuit for the same, a shaft within said yoke, an armature-disk on said shaft coöperating with said field-magnet, an auxiliary disk on said shaft constituting part of the magnetic circuit of said yoke, and concentric series of ridges on the contiguous faces of the yoke and the auxiliary disk respectively, serving to localize the magnetic flux between corresponding ridges and thereby magnetically support and center the shaft and the disks carried thereby.

7. A uniform-field dynamo-electric machine or motor, comprising annular field-magnet pole-pieces, a vertical shaft concentric with said pole-pieces, an armature-disk and an auxiliary supporting-disk for each pole-piece on said shaft, and means for centering and supporting said shaft and disks, comprising a series of concentric ridges on each of said auxiliary disks and the corresponding pole-pieces, whereby the magnetic flux is localized between corresponding ridges on the disks and pole-pieces.

8. A magnetic support and centering device for rotary shafts and the like, comprising a pole-piece surrounding the shaft, a disk on said shaft, and concentric mating ridges on the pole-piece and disk respectively, to localize the magnetic flux.

In testimony whereof I have hereunto subscribed my name.

EDWIN R. COX, Jr.

Witnesses:
J. B. Crawford,
S. A. Smith.