No. 733,549. PATENTED JULY 14, 1903.

D. L. LINDQUIST.

ELECTROMAGNET.

APPLICATION FILED MAR. 25, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

FIG. 1.

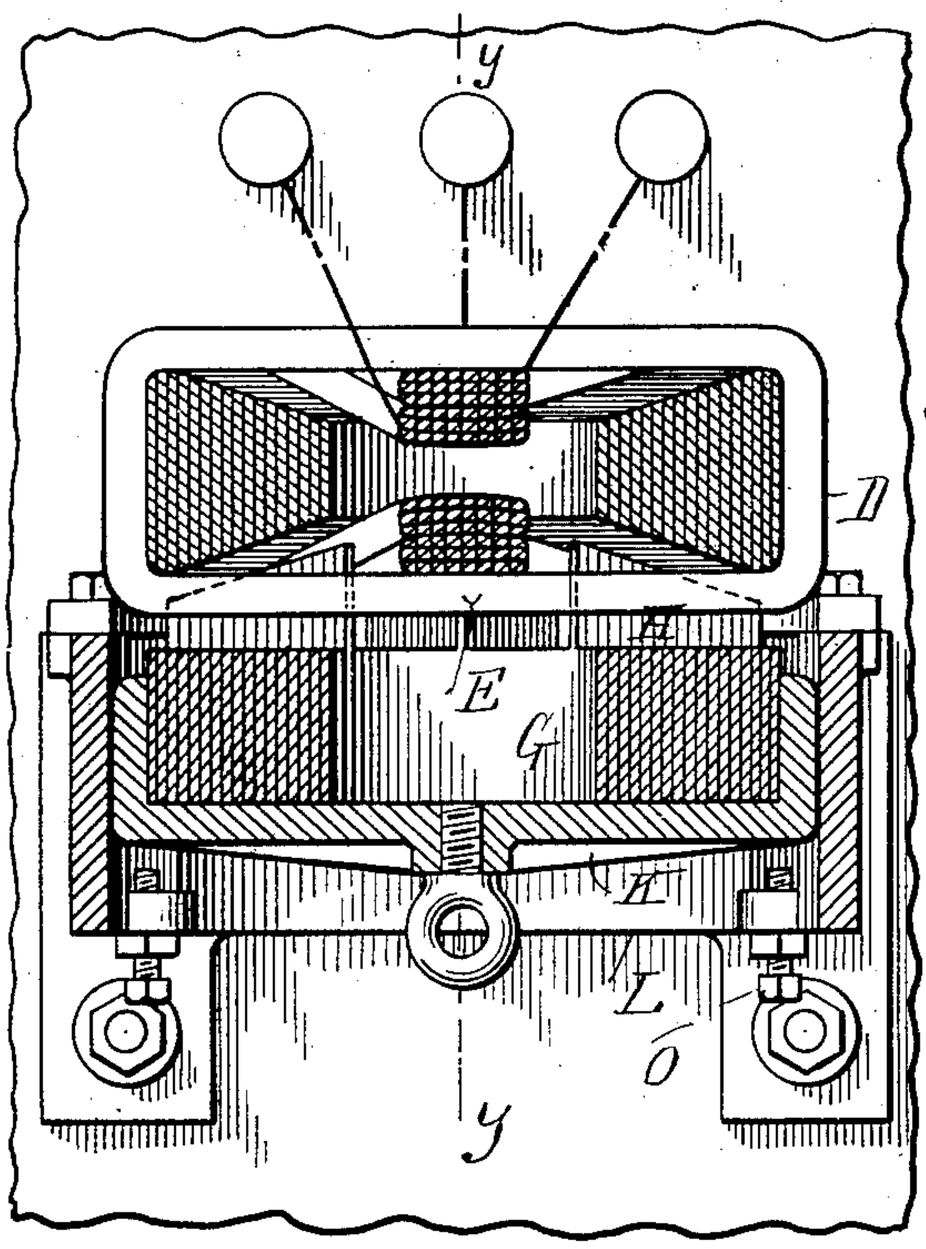


FIG. 2.

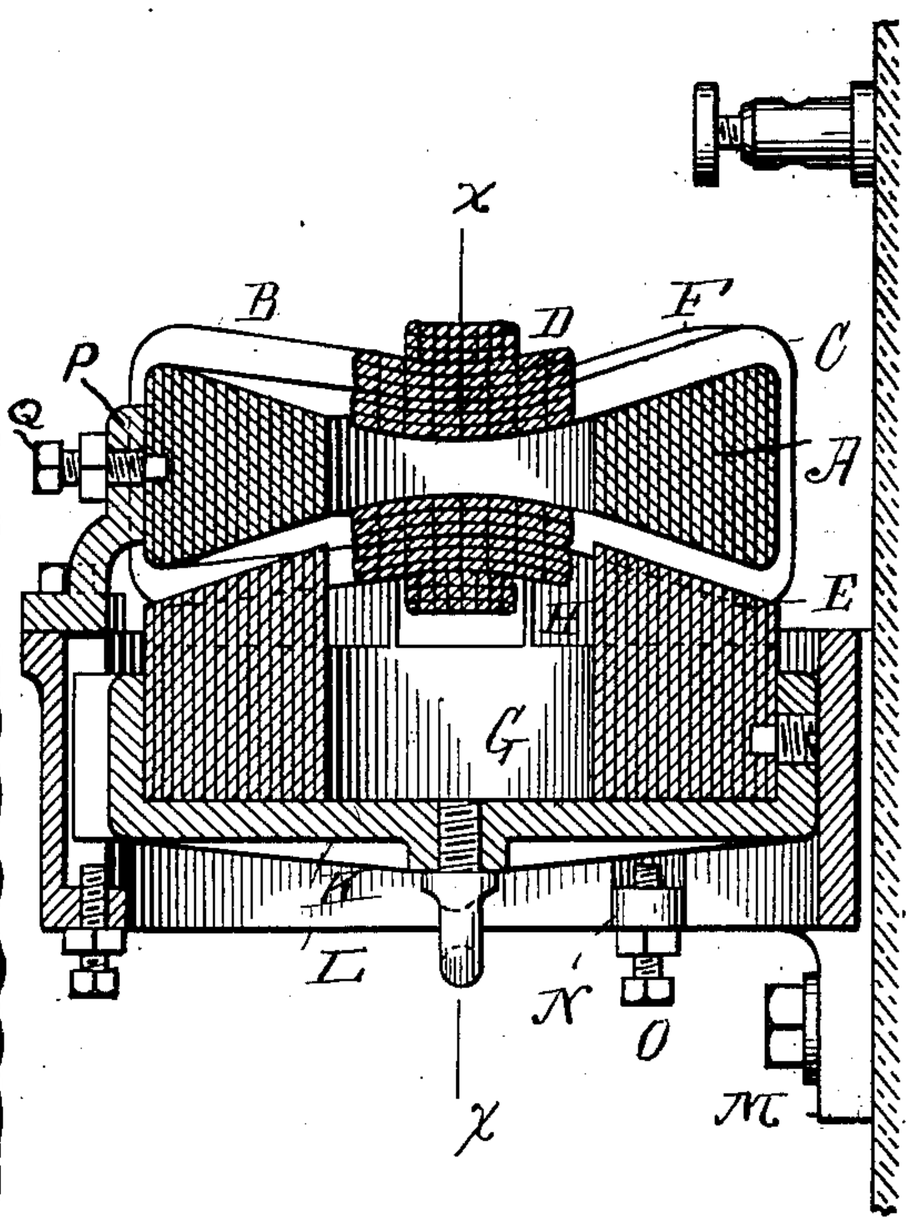
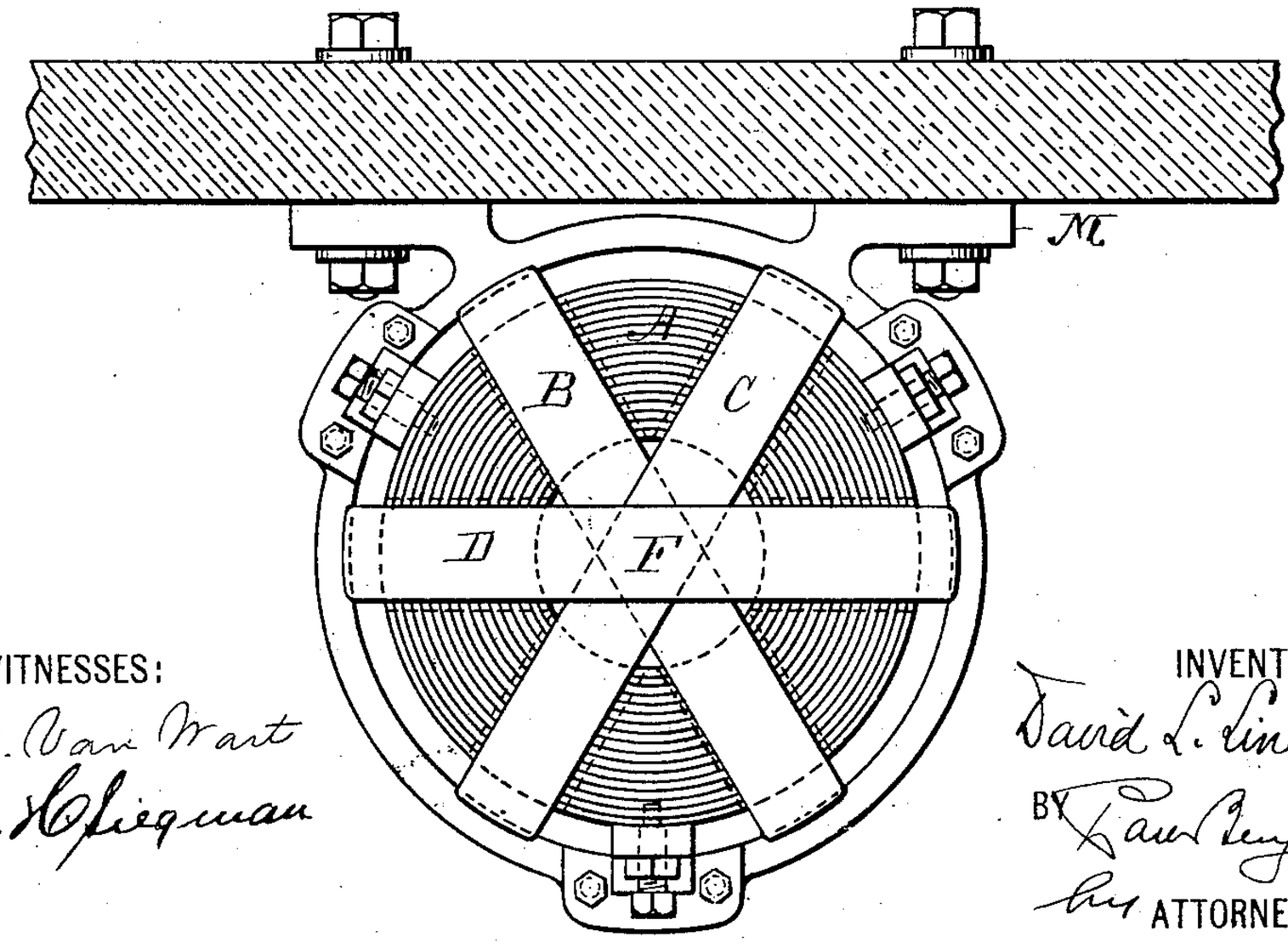


FIG. 3.



WITNESSES:

J. A. Van Wart

Wm. Hoffman

INVENTOR

David L. Lindquist.

BY Lauer Benjamin

his ATTORNEY

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NO MODEL. 3 SHEETS—SHEET 2.

FIG. 4.

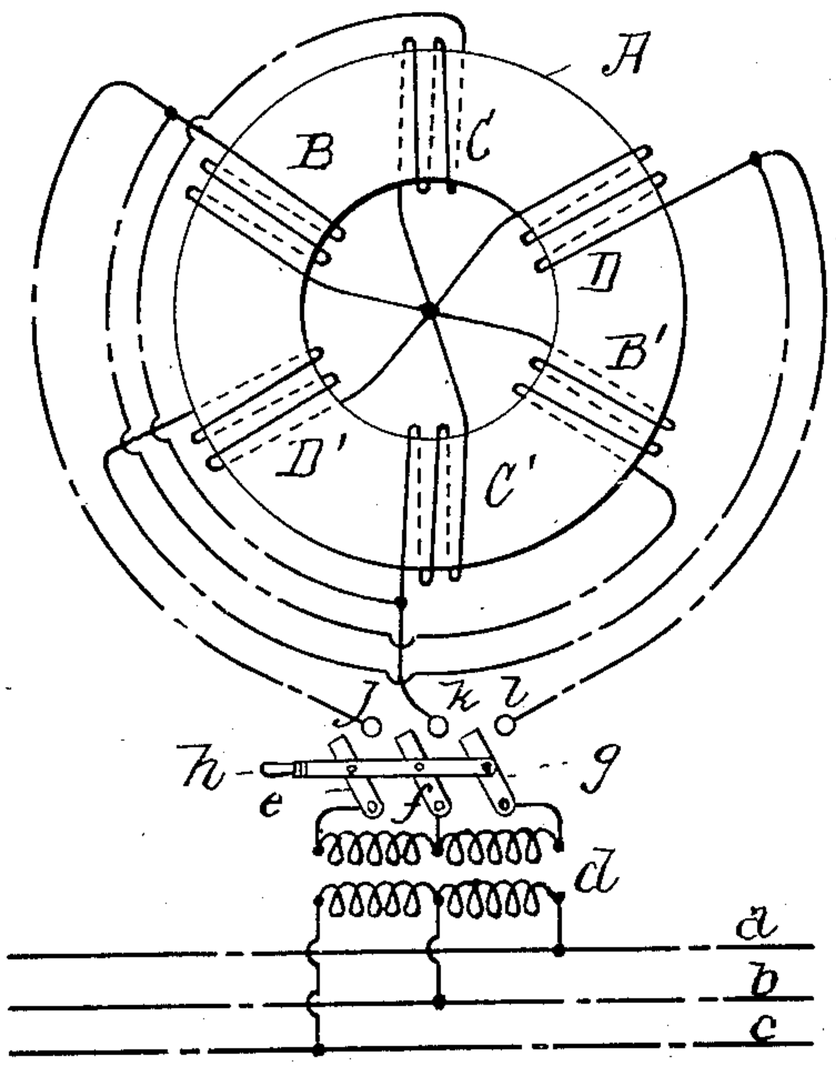


FIG. 5.

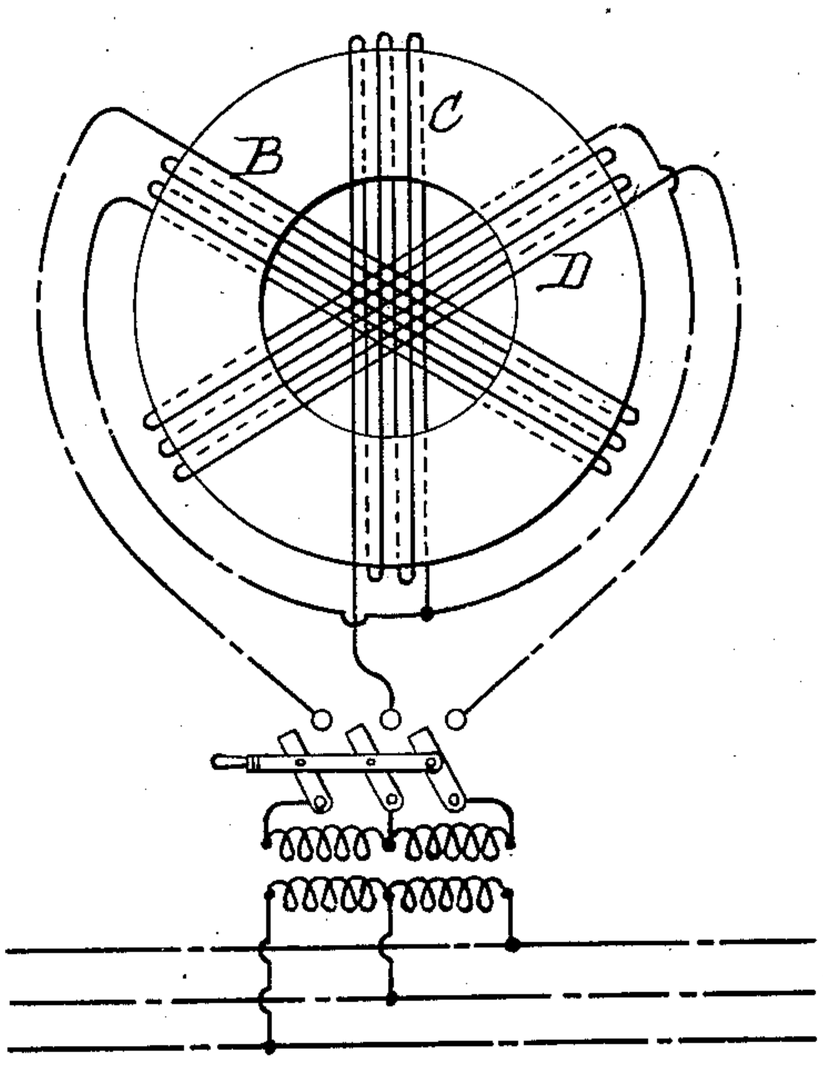


FIG. 6.

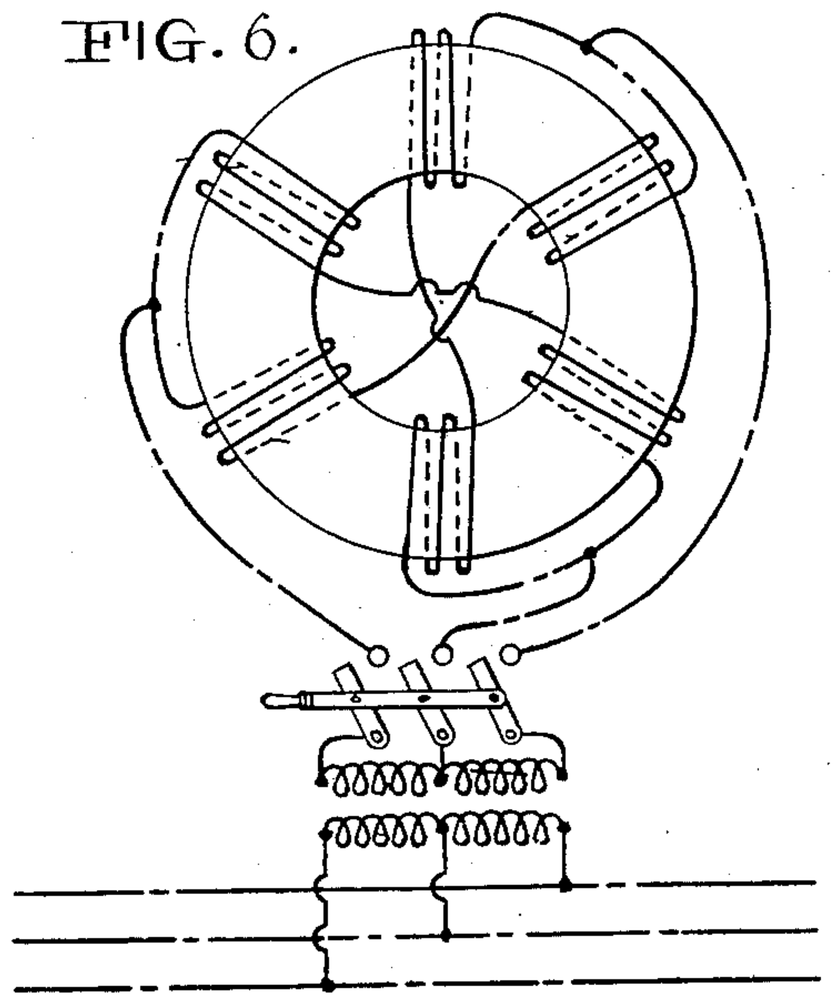
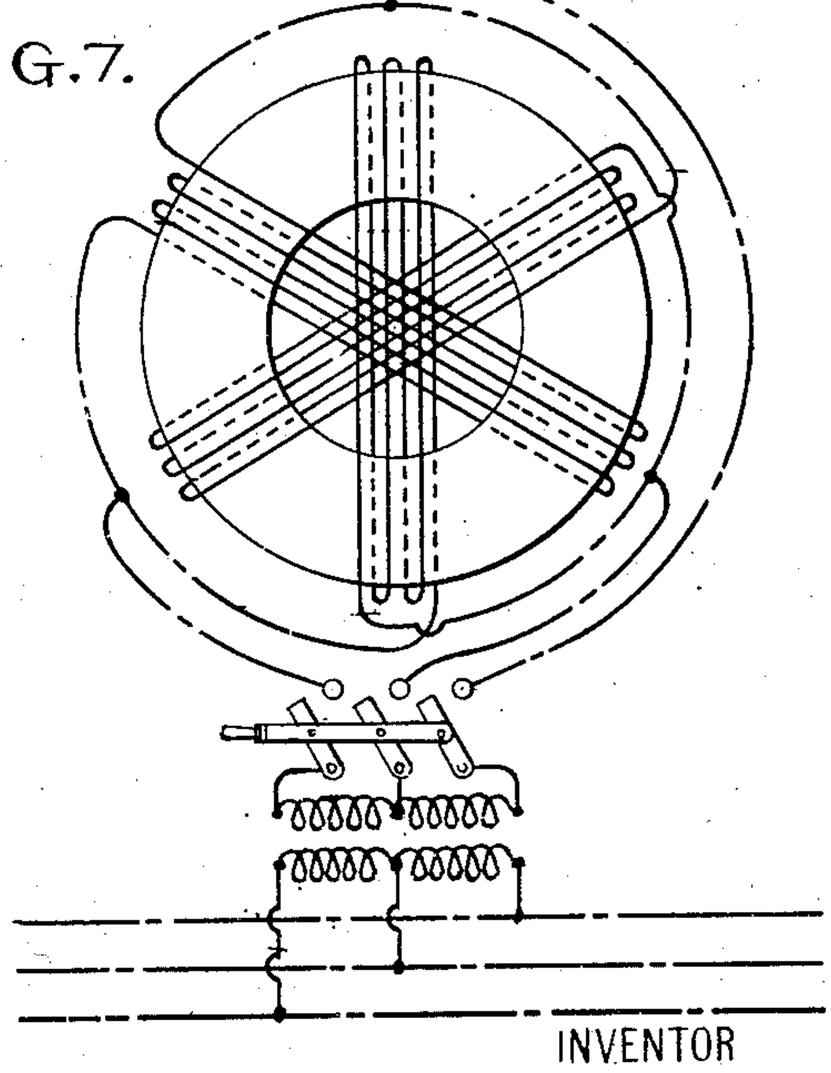


FIG. 7.



WITNESSES:

J. A. Van Wart

Wm. Hofieman

INVENTOR

David L. Lindquist

BY Carl Benjamin

his ATTORNEY

No. 733,549. PATENTED JULY 14, 1903.

D. L. LINDQUIST.

ELECTROMAGNET.

APPLICATION FILED MAR. 25, 1903.

NO MODEL. 3 SHEETS—SHEET 3.

FIG. 8.

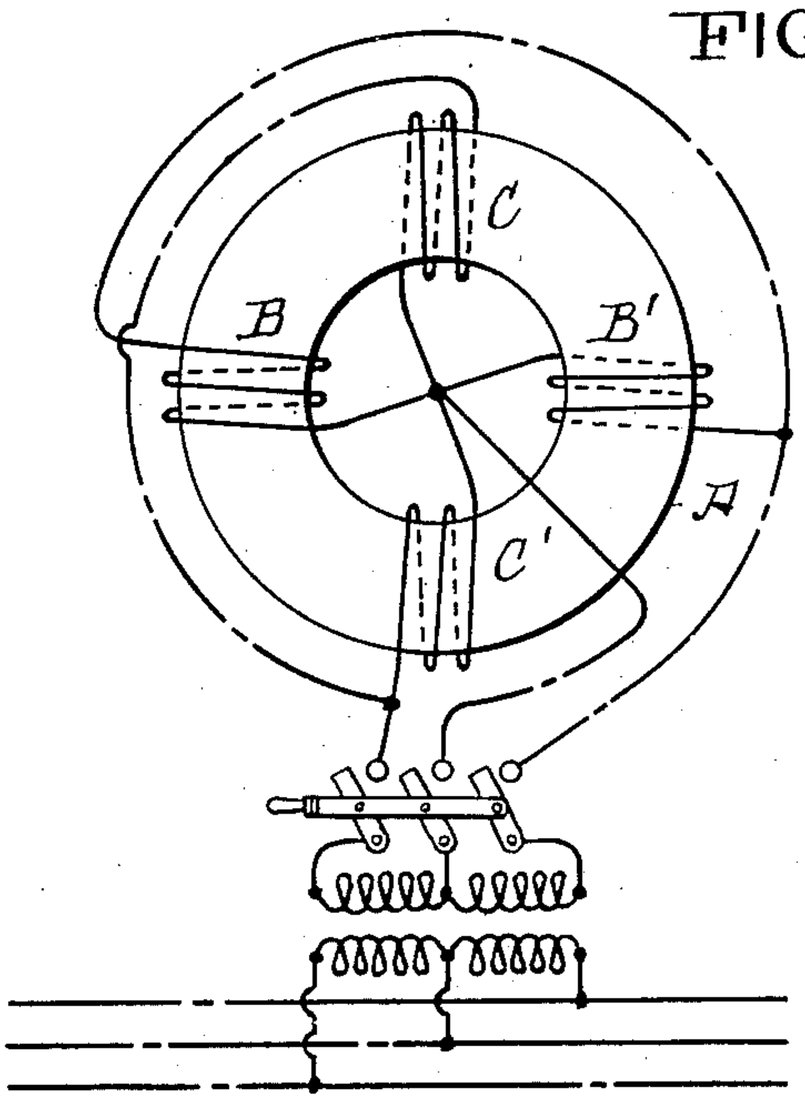


FIG. 9.

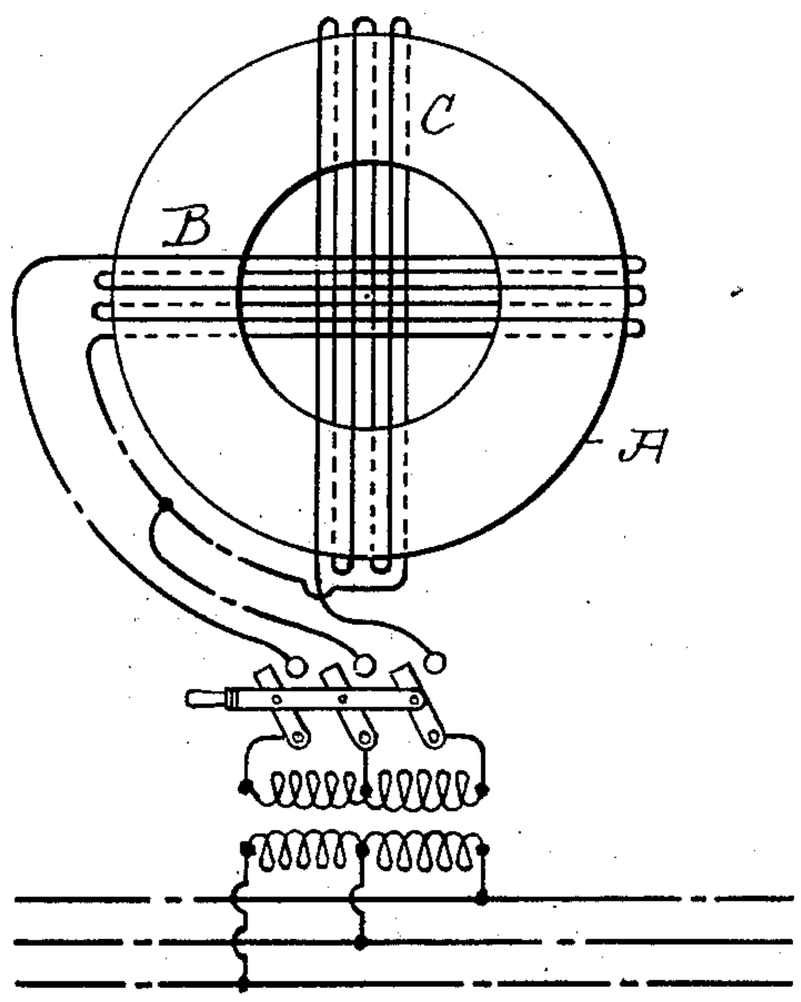


FIG. 10.

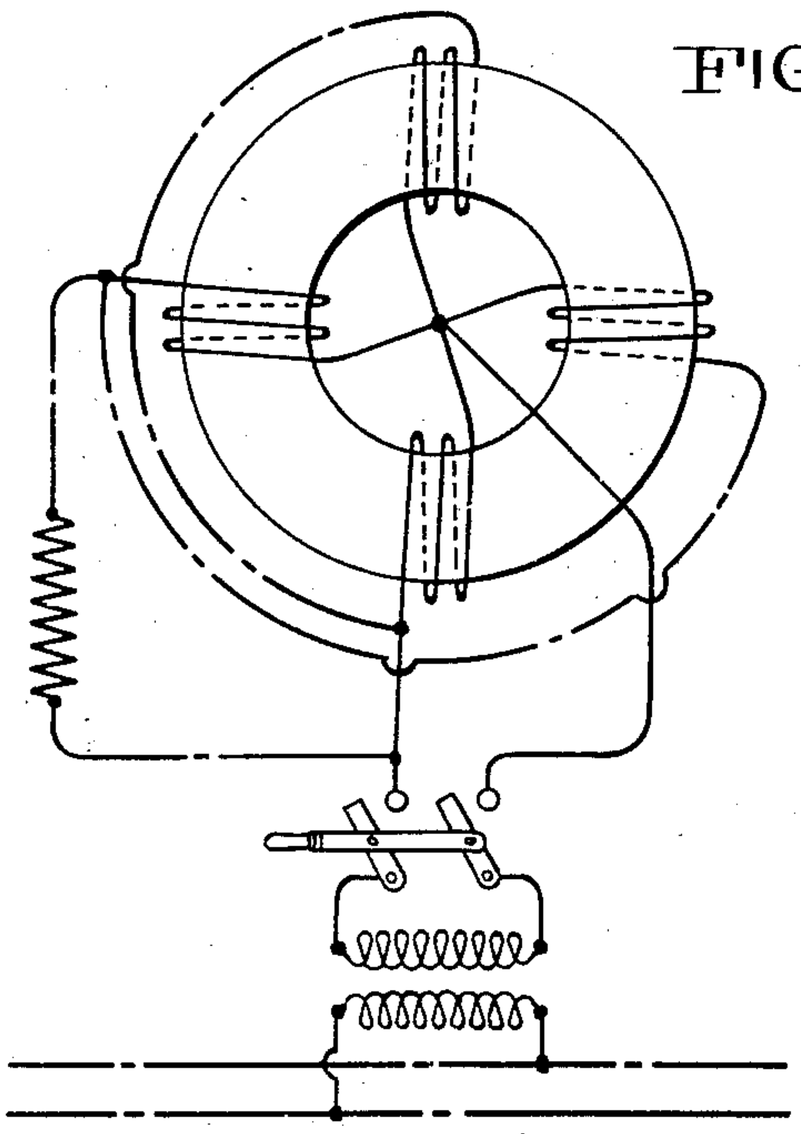
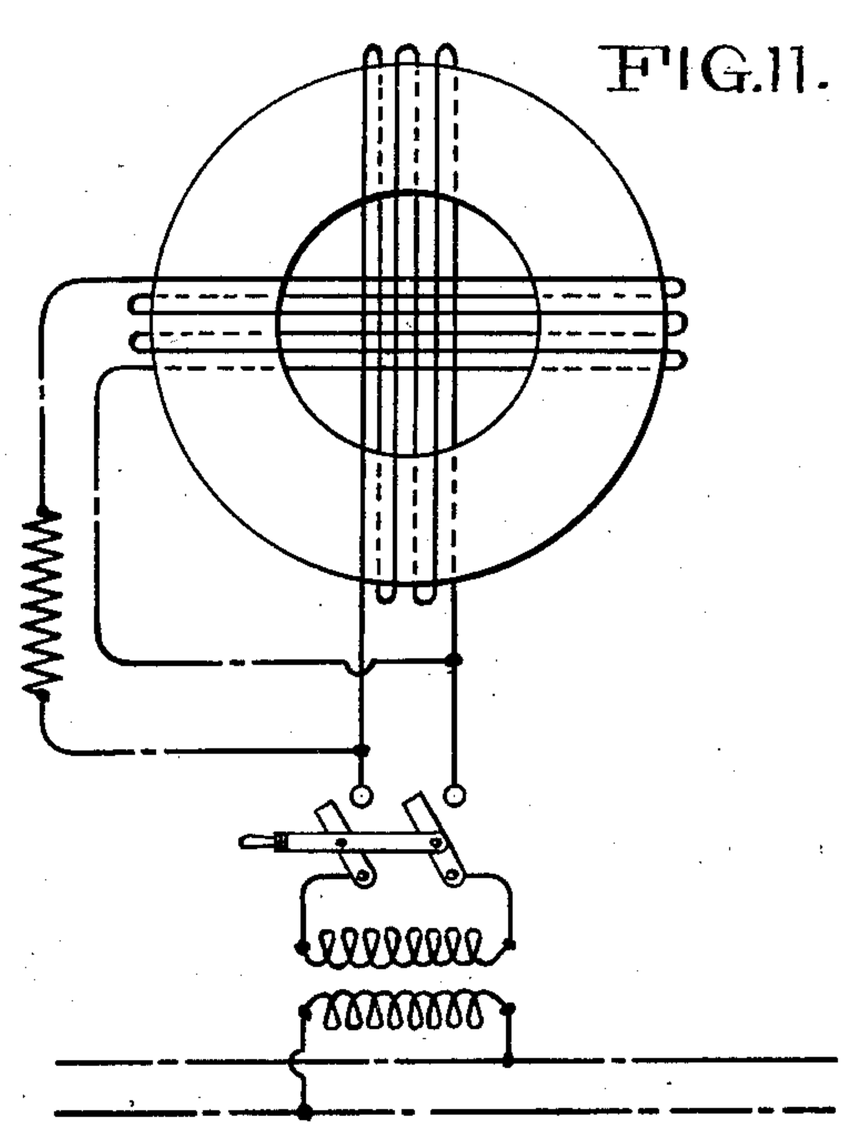


FIG. 11.



WITNESSES.

D. L. Van Wart

Wm. H. Siegman

INVENTOR

David L. Lindquist

BY Dale Benjamin

his ATTORNEY

No. 733,549. Patented July 14, 1903.

UNITED STATES PATENT OFFICE.

DAVID L. LINDQUIST, OF YONKERS, NEW YORK.

ELECTROMAGNET.

SPECIFICATION forming part of Letters Patent No. 733,549, dated July 14, 1903.

Application filed March 25, 1903. Serial No. 149,500. (No model.)

To all whom it may concern:

Be it known that I, DAVID L. LINDQUIST, of Yonkers, Westchester county, New York, have invented a new and useful Improvement in Electromagnets, of which the following is a specification.

The invention relates to an electromagnet intended for operation with an alternating current.

The object is to prevent the noisy vibration of the magnet-armature due to the change from maximum to zero of the current in the coils.

The invention consists, broadly, in an electromagnet-core, a plurality of coils wound on said core extending transversely a polar face thereof and symmetrically disposed with reference to an axis perpendicular to and passing through the center of said polar face, and an armature in front of and movable toward said face. When said magnet is energized by an alternating current, it exerts a substantially constant pull upon its armature, holding the same quiet and without chattering.

In the accompanying drawings, Figure 1 is a section of my electromagnet and armature on the line *x x* of Fig. 2. Fig. 2 is a section on the line *y y* of Fig. 1. Fig. 3 is a top view. Figs. 4 to 11, inclusive, are diagrams illustrating various modifications in the arrangement of magnet-coils and connections. Figs. 4 and 5 show the magnet adapted to a three-phase current with the coils in star connection, and Figs. 6 and 7 the same with the coils in delta connection. Figs. 8 and 9 show the magnet-field wound for two-phase current, and Figs. 10 and 11 for a single-phase current.

Similar letters of reference indicate like parts.

The core A is preferably laminated and of symmetrical closed figure. It is here shown in the form of a hollow cylinder or ring; but this shape is not essential. Upon the core are wound the coils B C D. The coils are symmetrically disposed upon the core with reference to the axis thereof, which is of course perpendicular to the polar faces E F. The coils extend transversely said polar faces.

The armature G is preferably of closed and symmetrical figure and may be provided on the face which is in juxtaposition to the polar face of the magnet with recesses to receive the magnet-coils when said armature is attracted to said polar face. The advantage of this recessed construction is that it tends to prevent magnetic leakage.

The coils may extend entirely across the polar faces diametrically, as shown in Fig. 3, or partially across, as when they are wound around the body of a ring-core, as illustrated in Fig. 4. In the latter case they are symmetrically disposed around said ring.

The armature G is preferably placed in a metal cup K, which is received within the cylindrical casing L, held by the brackets M on any suitable back plate or other support. Within the casing L are lugs N, having adjusting-screws O, upon which the armature rests when not attracted to the magnet and by means of which the extent of its path of movement to and from the magnet-face can be regulated. On the upper side of casing L are bracket-arms P, in which the magnet is detachably secured by the set-screws Q.

Referring now to the winding diagrams and the connections there shown, in Figs. 4 to 9 the main three-phase conductors are represented at *a b c* and connect to the usual converter *d*, which in turn connects with the three contact-levers *e f g*, which are actuated by the handle *h* to make and break circuit with the terminals *j k l*. Said terminals respectively connect with the coil-sections. In Fig. 4 the coils are each wound in two sections B B′ C C′ D D′ directly upon the ring-body, and these sections are connected in star, as shown. In Fig. 5 the coils are disposed diametrically the polar faces, as in Fig. 3, and are similarly connected. In Fig. 6 the winding is the same as in Fig. 4, and in Fig. 7 it is the same as in Fig. 5, the difference being in the connection of the coils or pairs of coil-sections in delta instead of in star. In Figs 8 to 11, inclusive, there are but two coils B C or pairs of coils B B′ C C′, whereby Figs. 8 and 9 become adapted for two-phase current. In Figs. 10 and 11 but two main conductors and two contact-levers and terminals are used to suit a single-phase current, which, however, goes to the split circuit of the magnet. One branch of this circuit contains an ohmic resistance, so as to get a phase difference, which should be as near

ninety degrees as possible to obtain the constant pull. Of course instead of a resistance a single-phase motor may be introduced into one branch of the magnet-circuit, the direct current on the magnet then lagging about ninety degrees behind the voltage, while the current in the branch through the motor is almost in phase with the voltage. In all cases there will be produced in the magnet-core a rotary field which will be endless in the direction of rotation in both armature and core. Because of the symmetrical winding of the coils on the magnet-core the resultant action upon the armature will be a uniform and constant pull, which will bring the armature to its final attracted position and hold it there without producing in said armature the usual noisy vibrations due to changes in the magnetic flux, which have hitherto been regarded as unavoidable in electromagnets energized by an alternating current.

I claim—

1. An electromagnet-core, a plurality of coils wound on said core extending transversely a polar face thereof and symmetrically disposed with reference to an axis perpendicular to and passing through the center of said polar face and an armature in front of and movable toward and from said face.

2. An electromagnet-core, a plurality of coils wound on said core and extending transversely a polar face thereof and symmetrically disposed with reference to and intersected by an axis perpendicular to and passing through the center of said polar face and an armature in front of and movable toward and from said face.

3. An electromagnet-core, a plurality of coils wound on said core and symmetrically disposed with reference to an axis perpendicular to and passing through the center of a polar face, a movable armature in front of said face and means for guiding said armature in its path of movement toward and from said face.

4. An electromagnet-core, a plurality of coils wound on said core and symmetrically disposed with reference to an axis perpendicular to and passing through the center of a polar face, a movable armature in front of said face and means for guiding said armature in its path of movement toward and from said face and means for adjusting the extent of said path.

5. A cylindrical electromagnet-core, a plurality of coils symmetrically disposed thereon each coil being intersected by the axis of said cylinder and an armature facing one end of said core and movable to and from said end.

6. A cylindrical electromagnet-core, a plurality of coils symmetrically disposed with reference to the axis of said cylinder each coil being intersected by said axis and a cylindrical armature in front of a polar face of said core; the said armature being movable to and from said face and provided with recesses to receive the coils projecting therefrom.

7. A cylindrical electromagnet-core, a plurality of coils thereon, each coil being intersected by the axis of said cylinder and the angles subtended by adjacent coils being equal, and a cylindrical armature disposed in front of and movable to and from a polar face of said core.

8. The combination of the cylindrical casing L, the cylindrical electromagnet-core A having symmetrically-disposed coils B C D, supported above said casing and the cylindrical armature G within said casing.

9. The combination of the cylindrical casing L, the cylindrical electromagnet-core A having symmetrically-disposed coils B C D, means for detachably supporting said core above and on said casing, the cylindrical armature G within said casing and adjustable supports O for said armature.

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

DAVID L. LINDQUIST.

Witnesses:
I. A. VAN WART,
WM. H. SIEGMAN.