No. 744,773. PATENTED NOV. 24, 1903.

D. L. LINDQUIST.

ELECTROMAGNET.

APPLICATION FILED JULY 14, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

FIG. 1.

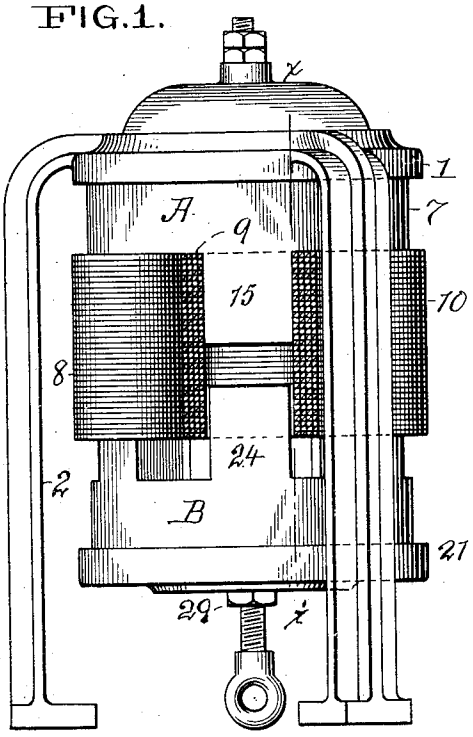


FIG. 2.

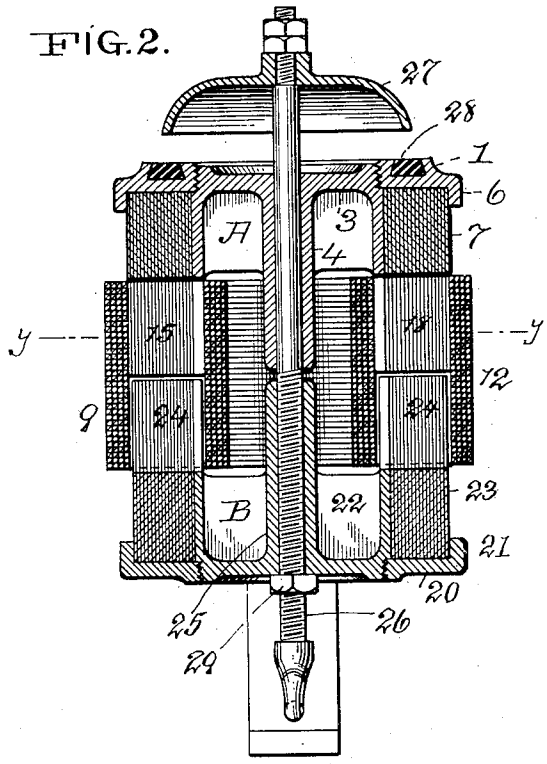


FIG. 3

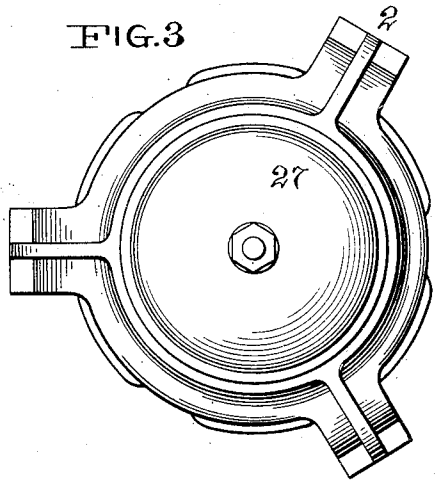
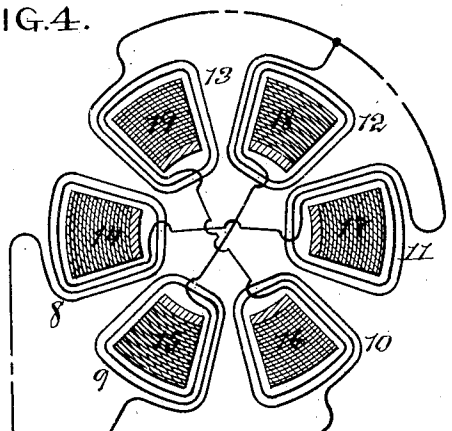
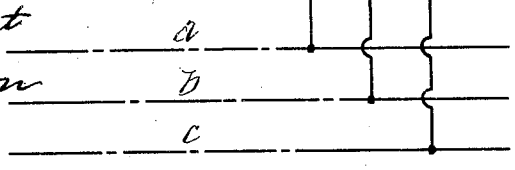


FIG. 4.





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APPLICATION FILED JULY 14, 1903.

NO MODEL. 2 SHEETS—SHEET 2.

FIG. 5.

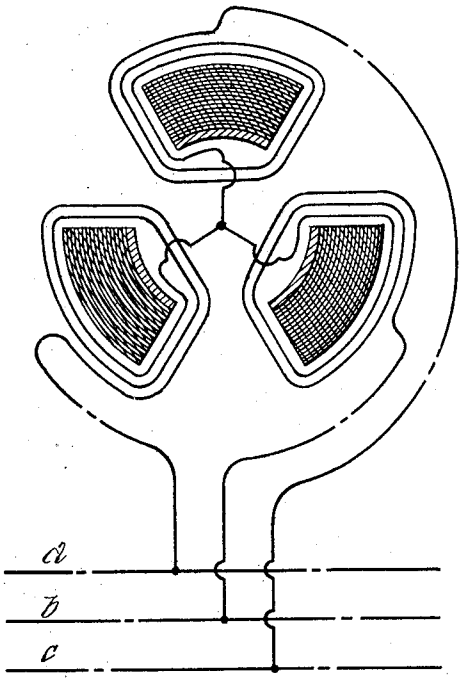


FIG. 6.

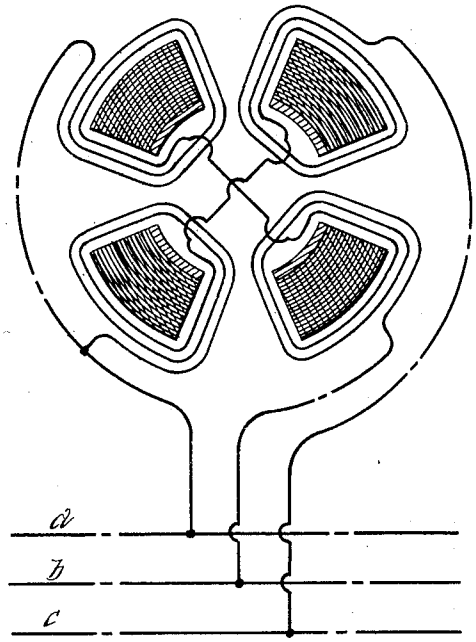
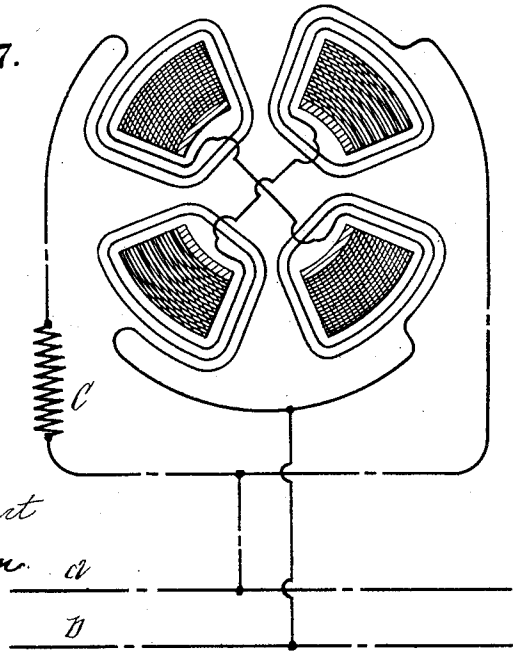


FIG. 7.



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No. 744,773. Patented November 24, 1903.

UNITED STATES PATENT OFFICE.

DAVID LEONARD LINDQUIST, OF YONKERS, NEW YORK.

ELECTROMAGNET.

SPECIFICATION forming part of Letters Patent No. 744,773, dated November 24, 1903.

Application filed July 14, 1903. Serial No. 165,428. (No model.)

To all whom it may concern:

Be it known that I, DAVID LEONARD 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 constructed to be energized by an alternating current and when so energized to attract its armature and hold the same in position by a substantially constant pull and without chattering.

The invention consists in an electromagnet having a plurality of coils symmetrically disposed around a central axis, the individual axis of each of said coils being parallel to said central axis; also, in the construction more particularly hereinafter set forth.

In the accompanying drawings, Figure 1 is a side elevation of my magnet and its armature, showing three of the six coils present, the middle coil being in vertical section. Fig. 2 is a vertical section on the line *x x* of Fig. 1. Fig. 3 is a top view. Fig. 4 is a diagram in cross-section on the line *y y* of Fig. 2, showing the connections of the magnet represented in Figs. 1, 2, and 3 for three-phase currents. Figs. 5, 6, and 7 illustrate modified forms and and different windings.

Similar letters and numbers of reference indicate like parts.

The magnet A is constructed as follows: 1 is a supporting-ring carried by standards 2. The inner periphery of said ring is threaded to receive the inverted-cup-shaped support 3, integral with which is a central sleeve 4. The outer periphery of ring 1 has a downwardly-turned flange 6. On the exterior of support 3 and held between said piece and flange 6 is the laminated magnet-core 7, the laminations being concentric with said support 3. The laminated core 7 and support 3 are cut away at their lower portion to form six equidistantly-spaced pole-pieces 14 15 16 17 18 19, and upon each of said pole-pieces is wound a coil 8 9 10 11 12 13. Said coils fit securely upon said pole-pieces and extend below the same, so that each pole-piece fills about one-half the cylindrical space within its associated coil. The several coils are alike, and their axes are all parallel to and symmetrically disposed around the axis of the cylindrical laminated core 7.

The armature B consists of a ring 20, similar to ring 1 and provided with a flange 21. The inner periphery of ring 20 is threaded to receive the cylindrical cup-shaped support 22, on the exterior of which is the laminated cylinder 23, held between flange 21 and the said support 22. The laminated cylinder 23 is of the same thickness as the magnet-core and, with its support 23, is cut away at its upper portion to form six pole-pieces 24, each of which is so located and of such size as that all of said pole-pieces may loosely enter the magnet-coils 8 to 13 and fill the spaces therein not already filled by the pole-pieces 14 to 19. The support 23 has a central sleeve 25 internally threaded to receive the threaded rod 26. Said rod extends loosely through the sleeve 4 of magnet-support 3, and at its upper end carries the bell-shaped stop 27. In the upper side of ring 1 is a dovetail groove containing a cushion 28, of rubber or leather, which forms an elastic seat for the edge of stop 27. On rod 26, below support 23, is a nut 29.

When the magnet A is not energized, armature B drops into the position shown in Fig. 1, the stop 27 then resting on the elastic cushion 28. When, however, magnet A is excited, the coils draw into themselves the pole-pieces 24 of the armature, thus raising said armature to the position shown in Fig. 2. The extent of movement of the armature may be limited as desired by means of the nut 29.

The winding of the magnet having six pole-pieces, as above described, is indicated in Fig. 6, in which *a*, *b*, and *c* represent conductors of currents of different phase. Instead of constructing magnet and armature with six pole-pieces I may use a different number. Thus in Fig. 5 three and in Figs. 6 and 7 four pole-pieces are illustrated. The conductors *a b c* in Fig. 5 are wound for three-phase current and in Fig. 6 for two-phase current. Fig. 7 shows a magnet similar to that of Fig. 6 adapted to a single-phase-current system, an ohmic resistance C being placed in branch to get phase difference in the two branches of the winding and so to obtain the desired approximately con-

stant pull. In all cases it will be noted that the axes of the coils are always parallel to and symmetrically disposed around the axis of the cylindrical magnet-core.

I claim—

1. An electromagnet having a plurality of coils symmetrically disposed around a central axis, the individual axis of each of said coils being parallel to said central axis, and means for producing currents of different phase in said coils.

2. An electromagnet having a cylindrical core and a plurality of symmetrically-disposed coils thereon, the said coils having their individual axes parallel to the axis of said core, and means for producing currents of different phase in said coils.

3. An electromagnet having a cylindrical core, with symmetrically-disposed pole-pieces at one end thereof, coils on said pole-pieces and means for producing currents of different phase in said coils.

4. An electromagnet having a cylindrical laminated core with integral symmetrically-disposed pole-pieces at one end thereof, coils on said pole-pieces and means for producing currents of different phase in said coils.

5. An electromagnet having a cylindrical core with symmetrically-disposed pole-pieces at one end thereof and coils on said pole-pieces and extending beyond the same.

6. In combination with an electromagnet having a plurality of coils symmetrically disposed around a central axis, the individual axis of each of said coils being parallel to said central axis, a movable armature having pole-pieces corresponding in number and position to said coils.

7. In combination with an electromagnet having a plurality of coils symmetrically disposed around a central axis, the individual axis of each of said coils being parallel to said central axis, a movable armature having pole-pieces corresponding in number and position to said coils and means for regulating the extent of movement of said armature.

8. In combination with an electromagnet having a cylindrical core with symmetrically-disposed pole-pieces at one end thereof and coils on said pole-pieces extending beyond the same, a movable armature having pole-pieces corresponding in number and position to said coils and constructed to enter the same.

9. The combination with the cup-shaped cylindrical support of the laminated core on said support provided with integral symmetrically-disposed pole-pieces and coils on said pole-pieces.

10. The combination with magnet A having a cup-shaped cylindrical support and laminated core thereon provided with integral symmetrically-disposed pole-pieces, and coils on said pole-pieces, of the movable armature B having a cup-shaped cylindrical support and laminated core thereon provided with integral symmetrically-disposed pole-pieces constructed to enter said coils.

11. A cylindrical electromagnet having a plurality of symmetrically-disposed pole-pieces and coils thereon, a cylindrical armature having a plurality of symmetrically-disposed pole-pieces constructed to enter said coils, a central supporting-rod for said armature extending axially through said magnet and a stop on said rod constructed to bear on the outer end of said magnet and limit the stroke of said armature.

12. A cylindrical electromagnet having a plurality of symmetrically-disposed pole-pieces and coils thereon, a cylindrical armature having a plurality of symmetrically-disposed pole-pieces constructed to enter said coils, a central supporting-rod for said armature extending axially through said magnet and a stop on said rod constructed to bear on the outer end of said magnet and limit the stroke of said armature, and means for adjusting the distance of said stop from said magnet end.

13. A cylindrical electromagnet having a plurality of symmetrically-disposed pole-pieces and coils thereon, a cylindrical armature having a plurality of symmetrically-disposed pole-pieces constructed to enter said coils, a central supporting-rod for said armature extending axially through said magnet and a stop on said rod constructed to bear on the outer end of said magnet and limit the stroke of said armature and on said magnet end, an elastic seat for said stop.

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

DAVID LEONARD LINDQUIST.

Witnesses:

WM. H. SIEGMAN,

I. A. VAN WART.