D. L. LINDQUIST.
ALTERNATING CURRENT ELECTROMAGNET.
APPLICATION FILED JUNE 16, 1909.

1,005,855.

Patented Oct. 17, 1911.

Fig.1.

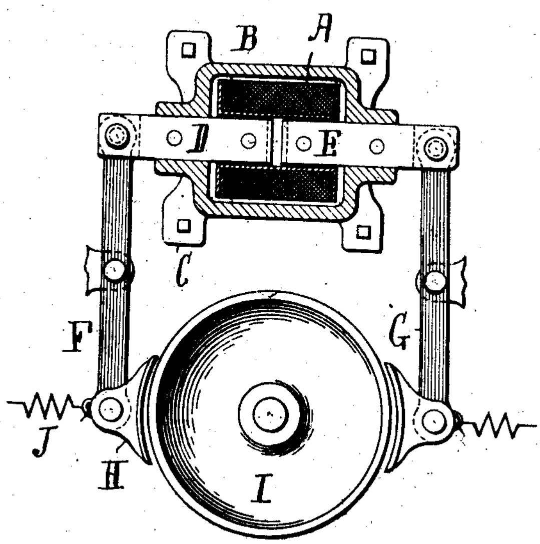


Fig.4.

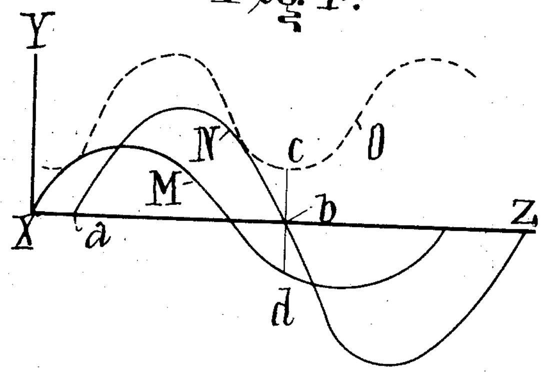


Fig.5.

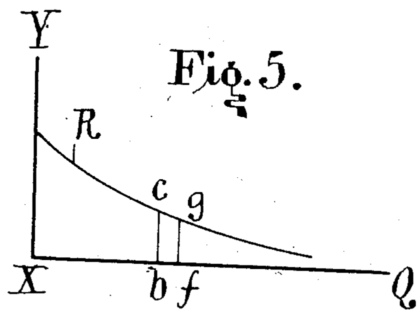


Fig.2.

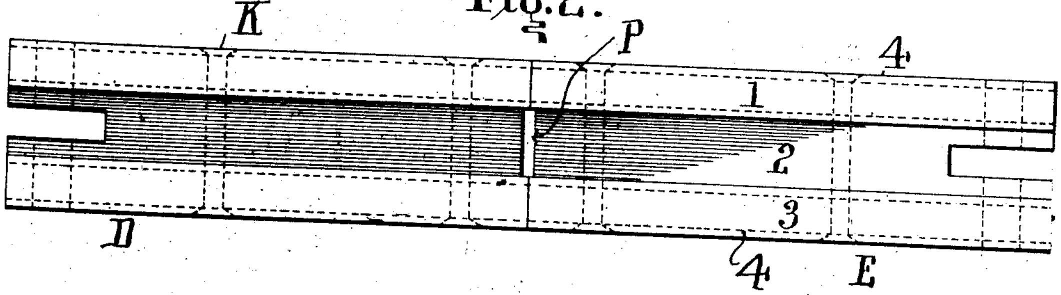
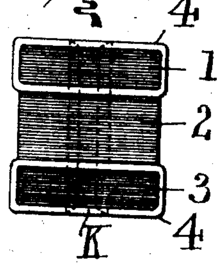


Fig.3.



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By his Attorney
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UNITED STATES PATENT OFFICE.

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ALTERNATING-CURRENT ELECTROMAGNET.

1,005,855. Specification of Letters Patent. **Patented Oct. 17, 1911.**

Application filed June 16, 1909. Serial No. 502,431.

To all whom it may concern:

Be it known that I, David L. Lindquist, a subject of the King of Sweden, residing at Yonkers, in the county of Westchester and State of New York, have invented a certain new and useful Improvement in Alternating-Current Electromagnets, of which the following is a specification.

The invention is a single phase alternating current electromagnet with its core carrying magnetic fluxes of different phase relation. By reason of this construction, the magnet is caused to exercise a certain predetermined minimum traction so long as energized, whereby an armature may be held without chattering due to the current alternations.

In the accompanying drawings—Figure 1 shows my alternating current electromagnet in longitudinal section and applied to the levers of an ordinary brake. Fig. 2 is a side elevation of the two magnet cores disposed end to end with their secondary sleeves in contact. Fig. 3 is an end view of one of said cores. Figs. 4 and 5 are diagrams illustrating the traction of said cores under the action of the alternating current, and the phase relation in the sections of said cores.

Similar numbers and letters of reference indicate like parts.

A is the magnet coil, supported in any suitable way in an inclosing case B. Said case may be supported by the lugs C secured to a wall or bracket, not shown.

D and E are the magnet cores here rectangular in cross section and entering the coil from opposite ends through openings in the case B. For purpose of illustrating a use of my invention, I here show the outer ends of cores D, E connected to the pivoted levers F, G, which carry brake shoes H in proximity to the periphery of a rotary pulley or wheel I. Said shoes are provided with springs J which normally operate to press the shoes against the wheel rim. When the magnet coil is energized, the cores D, E mutually attract and so come together, and the brake shoes then are withdrawn—and when the coil is deënergized, the springs, as already stated, force the brake shoes against the rim. The sections of each core are connected together by transverse bolts K.

My invention lies in the construction of the cores D, E and their combination with the coil A which is energized by an alternating current. Each core is formed of three sections 1, 2, 3, divided in planes parallel to the lines of force, each section being composed of juxtaposed plates or laminations of magnetic material. The outer sections 1, 3 are incased in sleeves or tubes 4 of non-magnetic material, such as brass or aluminum. By reason of this construction, when the coil is energized, the secondary currents set up in the sleeves 4 produce a counter-electro-motive force which throws the magnetization of sections 1 and 3 out of phase with that of section 2. Hence minimum and maximum traction of section 2 does not synchronize with the minimum and maximum traction of sections 1 and 3. Hence there is always mutual traction between the cores if the minimum resultant traction be properly established and, hence, no chattering by reason of the current alternations. In order to make this more plain, let the ordinate X Y in Fig. 4 represent magnetic traction and the abscissa X Z represent time. Then the traction of core sections 1, 3 may be represented by the sinusoidal curve M starting from the origin X, and the traction of section 2 may be represented by the sinusoidal curve N, of different phase, starting later from the point *a* on abscissa X Z. It is obvious that the resultant traction may be represented by the dotted sinusoidal curve O, and that the minimum traction there indicated is at the point *b* and corresponds to the ordinate distance $b, c = b, d$. If this traction is made sufficient to hold the two cores in contact, then plainly, any other traction is greater in magnitude and hence chattering is impossible. This minimum traction may be governed in various ways. Thus I may change the cross sectional area of the secondary sleeves 4 or change their material, in order to vary their resistance. The change of material will depend upon the frequency of the alternations—increased resistance being chosen for high, and decreased resistance for low frequency. I have found the best efficiency to be obtained by establishing an air gap P between the abutting ends of the sections 2 of cores D, E, the ends of the secondary sleeves 4 being allowed to come into contact. Preferably, this air gap should be rather large, and the traction exercised by the sections 1, 3 kept as small as possible so to avoid overheating in the secondary sleeves. A convenient way of establishing the width of the air gap is illustrated in Fig. 5, in which the ordinate X Y, as in Fig. 4, represents magnetic traction, and the abscissa X Q the width of gap in any convenient units. The curve R then represents the drop in traction proportionate to increase in distance between the cores. If then the ordinate distance b, c, Fig. 4, be transferred to Fig. 5 so that its ends meet the curve R and the abscissa X Q, then the distance X b, will represent the width in selected units of air gap corresponding to this minimum traction, and the air gap may be thus proportioned. In order to avoid chance disturbances due to variations in construction, etc., it is better to adjust the air gap to a width something over that corresponding to the minimum traction, as for example, to the traction represented by f, g in Fig. 5. The corresponding increased air gap distance will then be represented by X f. When the two cores, as here shown, come together, the air gap forms a permanent reluctance in that portion of the magnetic circuit which includes the two middle sections of the cores.

The following are the actual dimensions of an alternating current magnet of the specific form shown in the drawing, which has been manufactured under my direction for actual commercial use. Length of the sleeves—4 inches. Material—German silver, 18% nickel, for 60 cycles; soft brass for 25 cycles. External dimensions of cross section of sleeves; length $1\frac{1}{2}$ inches—width $\frac{7}{16}$ inch. Thickness of sleeves $\frac{1}{16}$ inch. Laminations—sheet steel, No. 28 gage; fractional number inclosed in each sleeve about 20; laminations between the sleeves about 40. For 220 volts, 60 cycles, the magnet coil was wound with 500 turns of No. 14 B. & S. D. C. C. wire with taps at 450, 400 and 350 turns. For exactly the above voltage the 450 turn tap was used. With 192 volts, 60 cycles, the total pull of the magnet was 82 pounds.

I claim:

1. An alternating current electro-magnet comprising a primary circuit conductor, a core formed of sections divided in planes parallel to the lines of force, and a secondary conductor inclosing a fractional number of said sections.

2. An alternating current electro-magnet comprising a primary circuit conductor, a core formed of sections divided in planes parallel to the lines of force, and a secondary conductor of non-magnetic metal inclosing a fractional number of said sections.

3. An alternating current electro-magnet comprising a primary circuit conductor, a core, and a plurality of secondary conductors, each inclosing a portion of the same polar extremity of said core.

4. An alternating current electro-magnet comprising a coil, a core formed of sections divided in planes parallel to the lines of force, means for establishing magnetic flux of different phase relation respectively in said sections: the magnetic field having permanent reluctance in a portion thereof.

5. An alternating current electro-magnet comprising a coil, two cores therein disposed end to end and formed of sections divided in planes parallel to the lines of force, and means for establishing magnetic flux of different phase relation respectively in the sections of each core: the magnetic fields of both cores having permanent reluctance in a portion of each.

6. An alternating current electro-magnet comprising a coil, a core formed of sections divided in planes parallel to the lines of force, one section overlapping the other at a polar extremity, and a secondary conductor inclosing the overlapping section.

7. An alternating current electro-magnet comprising a coil, an elongated core formed of longitudinal laminations, and a secondary conductor extending from end to end of said core and inclosing a portion of said laminations.

8. An alternating current electro-magnet comprising a coil, a core formed of longitudinal laminations, and a plurality of secondary conductors, each inclosing a fractional number of said laminations.

In testimony whereof I have affixed my signature in presence of two witnesses.

DAVID L. LINDQUIST.

Witnesses:

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MAY T. MCGARRY.