(No Model.)

2 Sheets—Sheet 1.

# C. E. DRESSLER.

## ELECTRIC MOTOR.

No. 440,699.

Patented Nov. 18, 1890.

Fig. 1

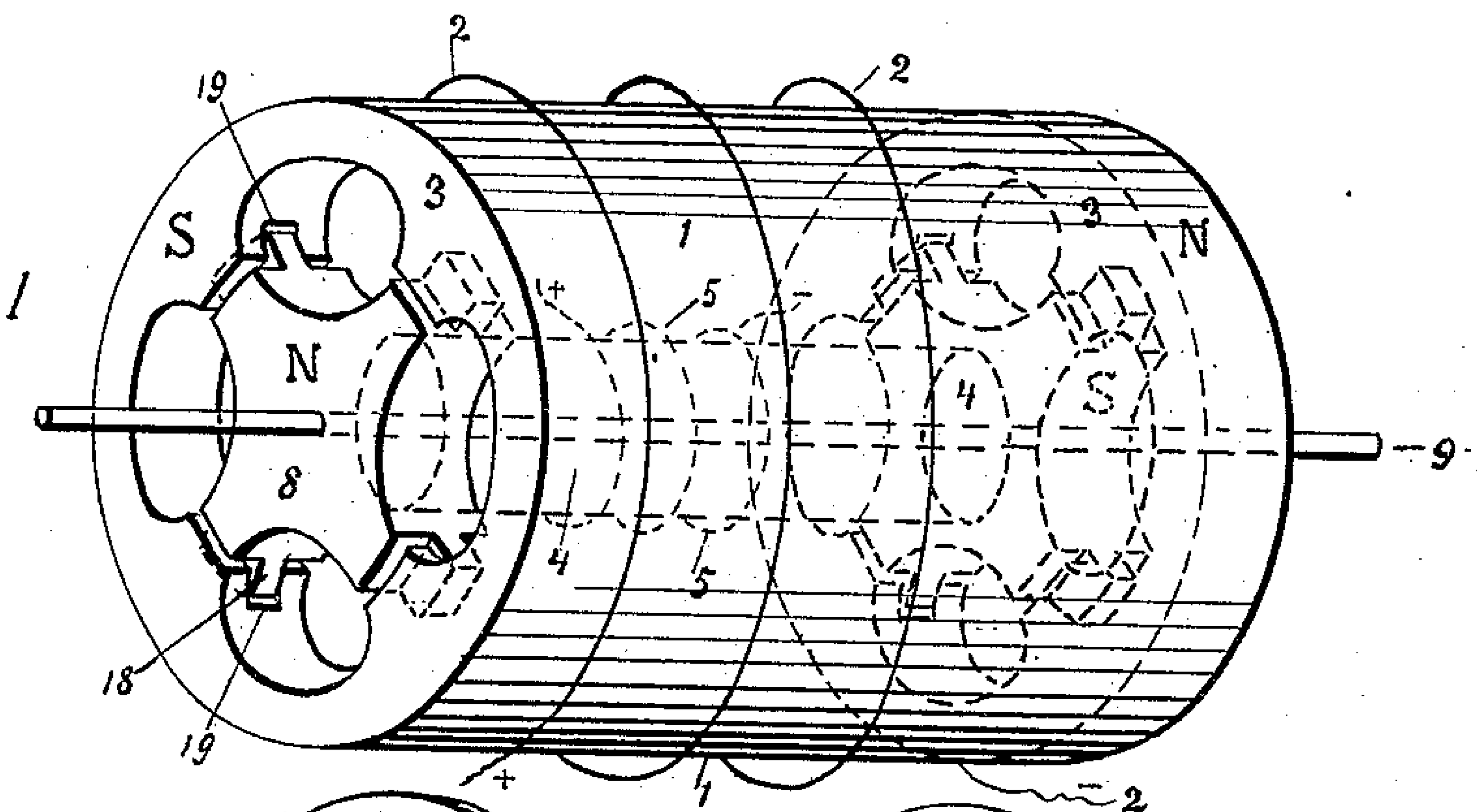
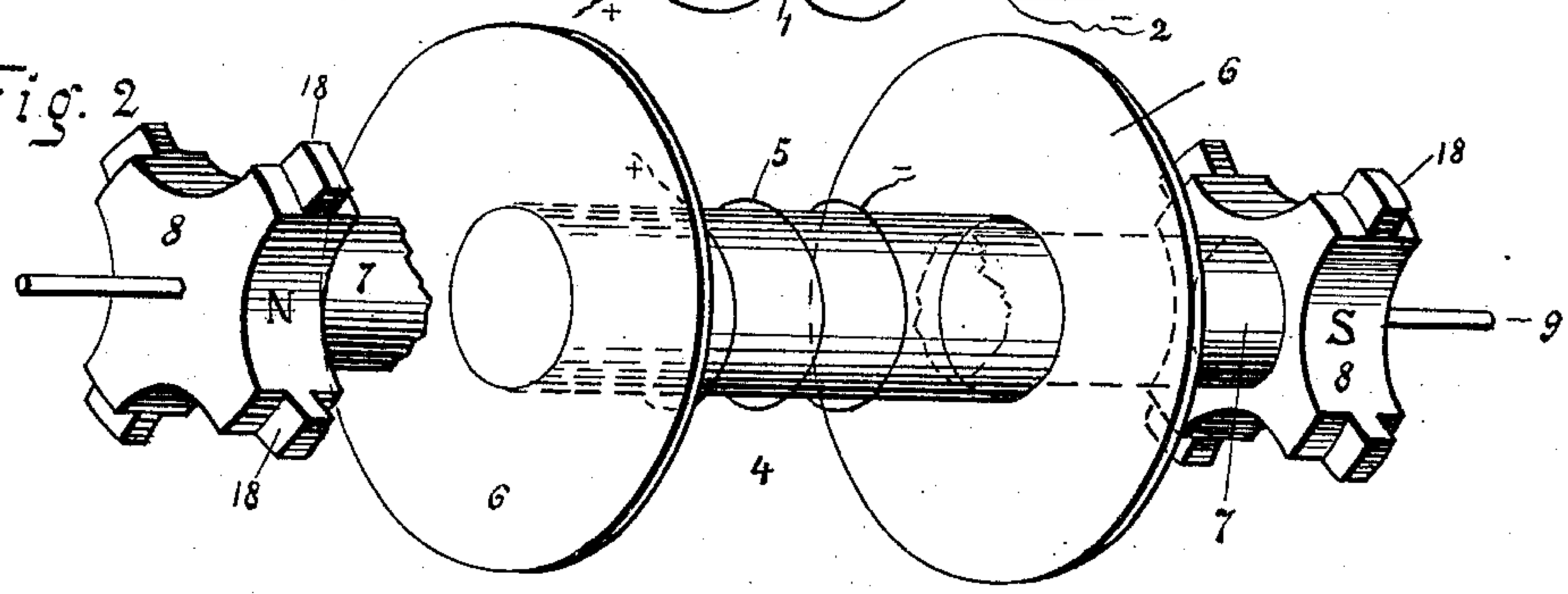


Fig. 2



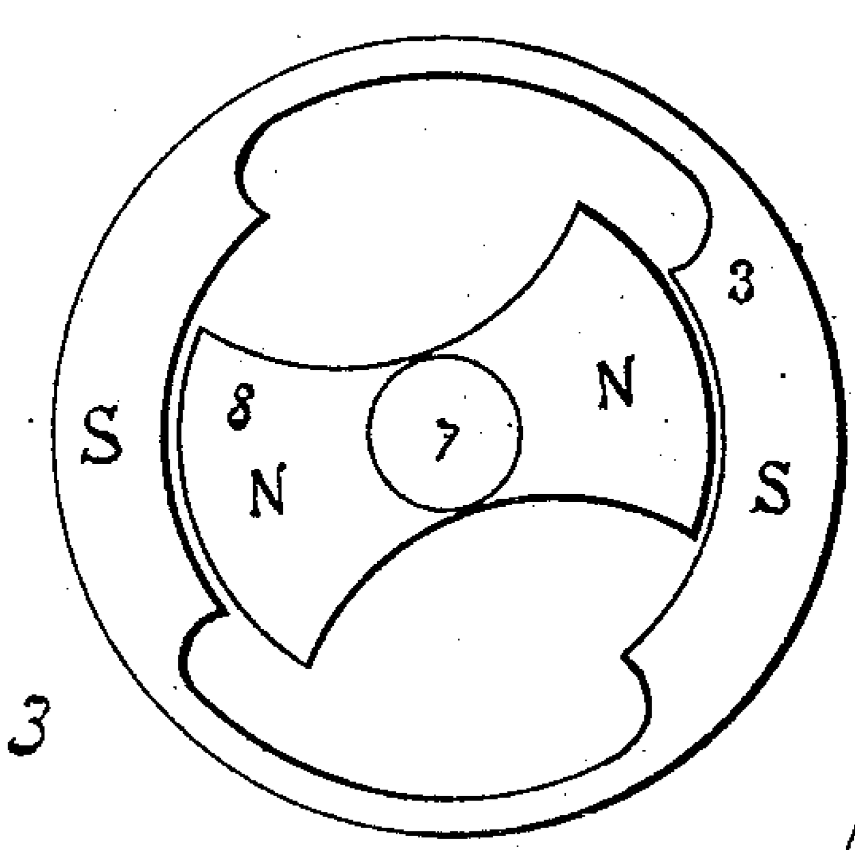


Fig. 3

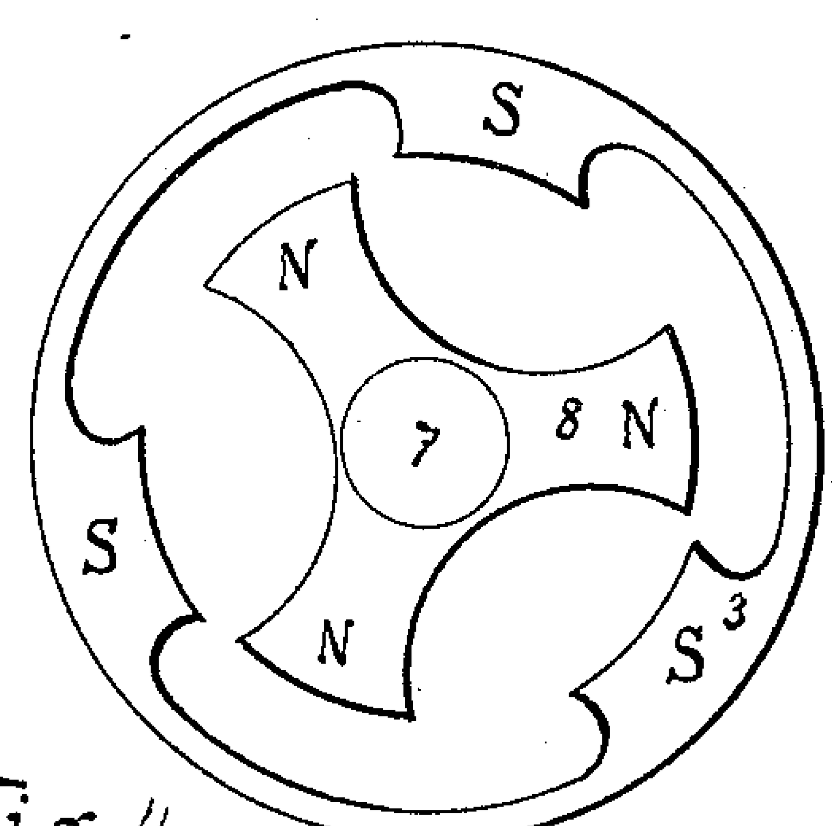


Fig. 4

Witnesses

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(No Model.)

2 Sheets—Sheet 2.

# C. E. DRESSLER.

## ELECTRIC MOTOR.

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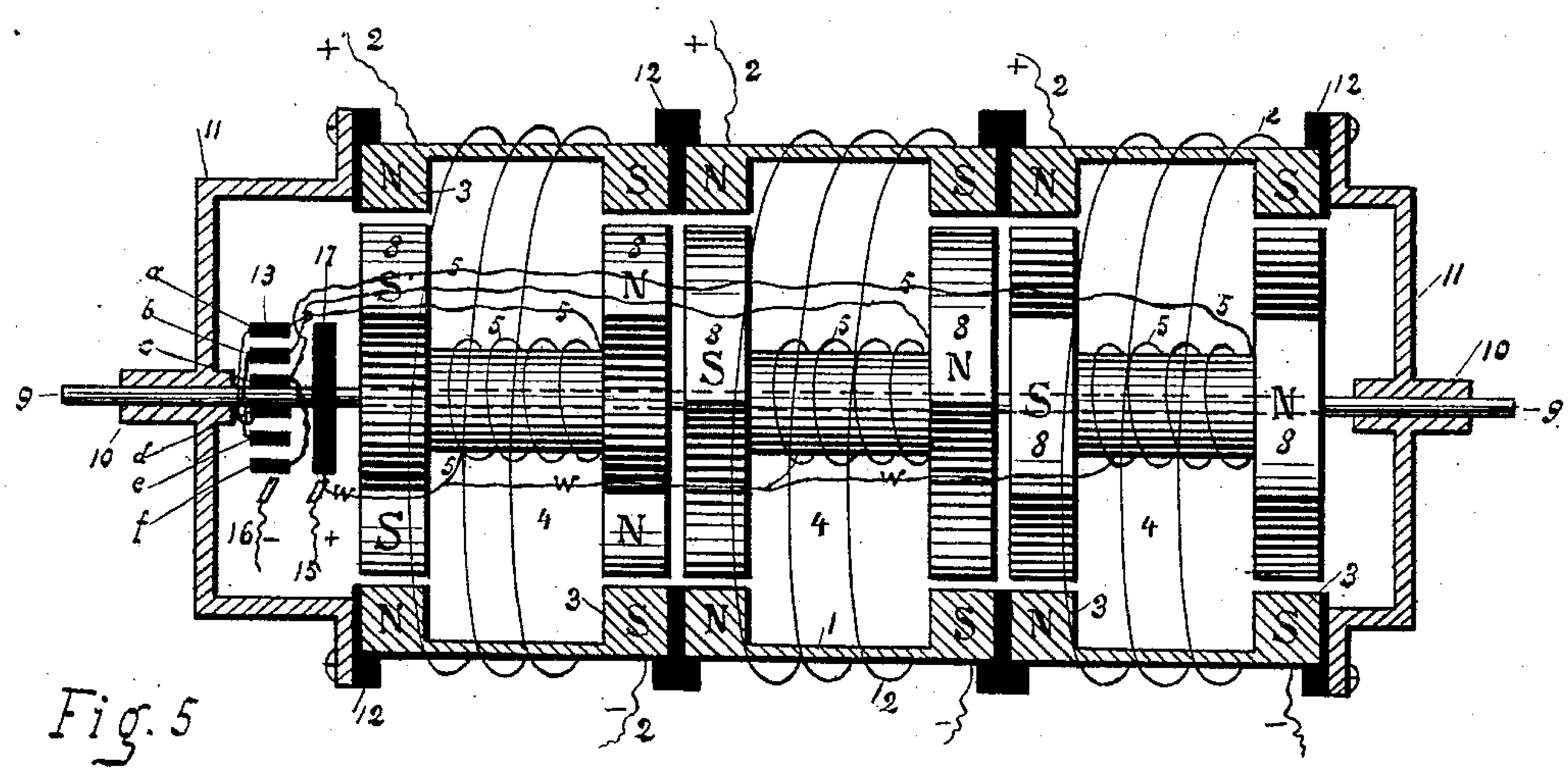

Fig. 5

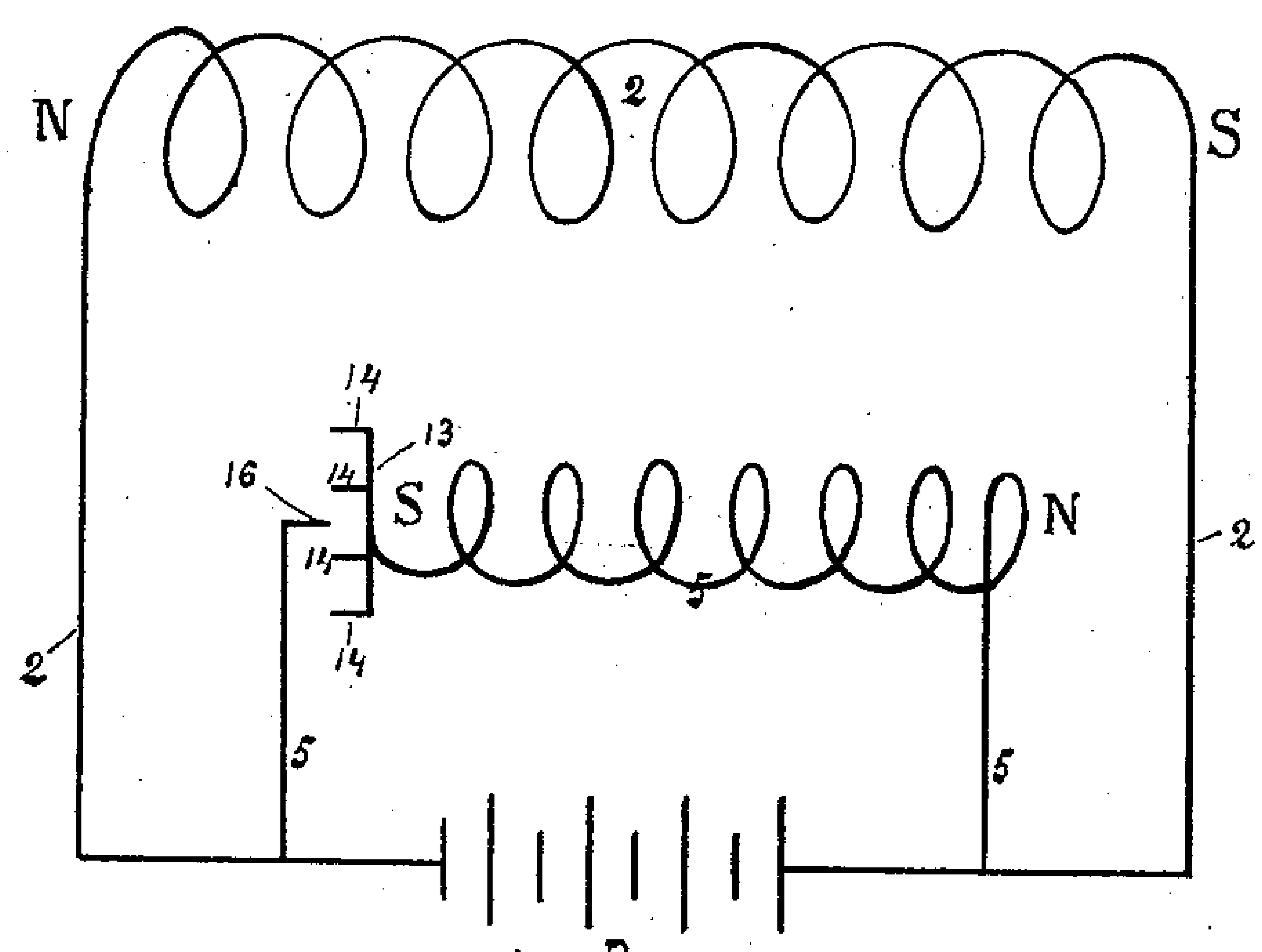

Fig. 6

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# UNITED STATES PATENT OFFICE.

CHARLES E. DRESSLER, OF NEW YORK, N. Y.

## ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 440,699, dated November 18, 1890.

Application filed April 10, 1890. Serial No. 347,413. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES E. DRESSLER, of the city of New York, in the county and State of New York, have invented a new and useful Electric Motor, which invention is fully set forth and illustrated in the following specification and accompanying drawings.

The object of this invention is to simplify the construction, cheapen the cost, and increase the efficiency of such machines as are commonly known as "electric motors."

The invention will first be described in detail, and then particularly set forth in the claims.

In the accompanying drawings, Figure 1 shows in perspective an annularly-arranged field-magnet and armature. Fig. 2 shows in perspective the interior construction so modified that, instead of, as in Fig. 1, the whole armature consisting of coil and core and pole-pieces revolving together, the armature-coil is a simple non-rotative spool, while the armature-core revolves within its bore, the end pole-pieces rotating with the core. Fig. 3 shows in end view the core or shaft having two pole-pieces at each end and the corresponding field pole-pieces. Fig. 4 shows three pole-pieces at each end for both field and armature, while Figs. 1 and 2, it will be observed, show four respective pole-pieces at each end of the armature. Fig. 5 shows a series (three in number) of corresponding field-magnets and armatures, all operating upon one central shaft, a single commutator so closing and opening the armature-circuits that at least one armature shall always be exerting rotary effort upon the driving-shaft of the machine. Fig. 6 is a diagram illustrative of the principle upon which the motor operates, as will be hereinafter particularly described.

In the figures the several parts are indicated by reference numbers and letters, as below described.

An outer cylinder or hollow spool 1, preferably of soft iron, is circumferentially wound with preferably insulated copper wire 2, the whole forming a field-magnet of annular shape provided with interior pole-pieces 3 at each end. Within said annular field-magnet is set the armature proper 4, preferably of soft iron and having, as seen in Fig. 1, insulated wire 5 circumferentially wound directly upon it; but, as shown in Fig. 2, the armature is divided, so that it is composed of a fixed or non-rotative spool 6 and an interior rotative shaft or core 7, on which are the end pole-pieces 8. Where the armature is thus divided the frame of the spool 6 is made of some non-magnetic material. The machine when put together to do any but light work is preferably connected and arranged as shown in Fig. 5, mounted upon a shaft 9, journaled in end bearings 10, formed in or secured to heads 11, secured by screws or bolts through non-magnetic material 12 to the ends or pole-pieces 3 of the field-magnets 1. The commutator 13 is shown in position in Fig. 5.

The operation of the motor will now be described. The letters N S wherever they appear in the several figures indicate, respectively, the north and south poles of the magnets, or the polarity, respectively, of the parts so marked. The letter B, Fig. 6, indicates a battery, dynamo, or other primary source of electricity, from which the motor is energized to perform its work. When the motor is in operation, the circuit through the field-magnets is closed and remains unbroken or unopened, while by means of the commutator the armature-circuit is opportunely closed and opened, so that the proper pole-piece or pole-pieces of the armature shall be energized and de-energized, respectively, as the same approach and leave the magnetized pole-piece or pole-pieces of the field-magnets.

In the diagram Fig. 6 let the numbers 2 indicate the insulated wire coil of one annular field-magnet whose ends form a closed circuit with the poles of the battery B, and the numbers 5 the insulated wire coil of the interior-armature, one of the ends of which coil—the north end, as shown—is connected to one pole of the battery, and its south end connected to strips or plates 14 of the commutator 13, from which commutator, by means of a brush or contact-wire at 16, the circuit is closed or opened between the south end of the armature and the other pole of the battery. The connections having been thus made, the principle underlying the operation of the invention becomes at once apparent to those skilled in the art to which the invention pertains.

The operation of the motor and its construction, as shown in Fig. 5, will now be described more in detail. The field-magnets 1 are shown in longitudinal section, three in number, being hollow cylinders bolted or otherwise suitably secured together in line of axis, disks or washers 12 of non-magnetic material being interposed between the pole-pieces 3 and the outer ends or heads 11. Said pole-pieces are in line in all of the cylinders—that is, they are not "staggered." In bearings 10 in the center of said heads the driving-shaft 9 is journaled, secured fast to which shaft are three armatures 4, each provided with four pole-pieces 8. The armatures may have non-magnetic washers or spacing-pieces interposed between them, if desired; but such spacing-pieces are not necessary to the invention if the several armatures are suitably insulated from each other. A suitable provision for efficient insulation is shown in the construction illustrated in Fig. 5; but the middle armature of the series between its pole-pieces may have its exciting-coil wound in the direction opposite to the winding of the coils of the other two members if it be desired to dispense with magnetic insulation between the several members of the series. The pole-pieces 8 on each end of each armature are in line; but each armature is so set on the shaft 9 that their respective pole-pieces shall be angularly set or staggered in series at such angles as may be desired. The number of pole-pieces to be used is governed more particularly by the size or power required in the motor, which may be varied in either diameter or length, or both, almost indefinitely, as the circumstances of practice may present themselves to the designer or constructer of the plant.

All parts of the armature 4 in Fig. 5, like that shown in Fig. 2, move together, coils and core, like a series of spools. In Fig. 2, however, four pole-pieces 8 are shown at each end of one armature, instead of only two at each end, as in Fig. 5.

In the diagram Fig. 6 the coil or spool 5 of the armature is supposed to be fixed and not to rotate with its core, as is shown in Fig. 1. Hence in the diagram one end of the coil 5 (the north end) is connected to the battery by its wire without any interposed brush or similar contrivance; but in Fig. 5, as the whole armature is shown rotative, two brushes are indicated to be located, respectively, at 15 and 16, to effect a circuit-connection with the battery or other source of electricity, as will now be described.

The wires or brushes 15 16 are held in contact, respectively, with a disk 17, insulatedly secured on the shaft 9, and with the commutator 13. Connections are then made with the several parts of the motor as follows: The wires 5 being wound around the first, second, and third armatures, any desired number of turns, as already described, lead, respectively, to the strips *a b c* of the commutator 13, a short connecting-wire *w* uniting all of the coils 5 with the disk 17 on the shaft 9. The strip *a* of the commutator is then connected by a wire to strip *d*, strip *b* by a wire to strip *e*, and strip *c* by a wire to strip *f*. These connections insure one complete or entire revolution and prevent any "dead-point" at any part of one complete revolution. These connections having been made, the brush 15, regarded as plus, is connected to the wires +2 of the first, second, and third field-magnet coils, and the brush 16, regarded as minus, is connected to the wires −2 of said first, second, and third field-magnet coils. The circuit being now complete, the driving-shaft is rotated under the attractive force developed between the pole-pieces of the field-magnets and the pole-pieces of the armatures. This rotative force is thus obtained and utilized. The field-magnets remain magnetized all the time the machine is in operation—that is, their circuits are not broken; but by the setting of the commutator the armature-circuits are broken at the proper times to prevent any back-pull of any field pole-piece upon any armature pole-piece. Hence the armature must rotate the driving or power-transmitting shaft. Not only is there in this invention no back-pull of field-magnet upon armature, but all tendency to such resistance or loss of power is neutralized by reason of the fact that the annular location of armature and magnet so regulates the lines of magnetic force that the residual magnetism in the armature remaining after its circuit is opened is neutralized by its surrounding magnetic field when the respective pole-pieces are in closest proximity, at which time, of course, the armature-circuit is open or broken. In addition to this elimination of loss by residual magnetism, it can readily be seen that by this invention a motor can be constructed having a maximum potential of power transmission in a minimum of space, no space being wasted, the magnets all traveling in the closest proximity short of frictional contact, regardless of the size of the motor or of the size of the coils or length or weight of wire used. The motor may be made of small diameter and of any length desired within any permissible limits of shaft length, or it may be made very short and of large diameter, the coils being of very great depth of winding.

The principle underlying this invention is such that in any given size of motor coarser wire can be used in the coils than that commonly used in motors, so that a large margin of safety may always exist against burning the coils by the passage, accidentally or otherwise, of a more powerful current than that intended to be normally used in the machine. In other words, a smaller machine can be safely used with a current suited to ordinary machines of more largely rated powers without danger of burning its coils.

The pole-pieces 3 and 8, as shown in Figs. 1 and 2, are interlet, so that the tongue 18 makes an easy fit in the groove 19. While this interfitting is deemed preferable, the pole-pieces 3 may, if desired, be made to project into the pole-pieces 8, greater attractive surface being the object sought and accomplished by any suitable interletting of pole-piece with pole-piece.

The field-magnets shown in Fig. 5, instead of being made of three separate cylinders, may be made of but one longer cylinder, the non-magnetic disks 12 being entirely omitted. In such construction the winding of the field-coils will be in sections and in opposite directions, instead of all in one direction, as in the case of the separate magnet-cylinders in Fig. 5.

It is obvious that this machine if run by power may be used as an electric generator or "dynamo," instead of as a motor, when desired, such interchange of function or mutual conversion being well recognized in the practical construction of machines typical of their class as inherent in the principle underlying their mode of operation.

Having thus fully described my said invention, I claim—

1. In an electromotor, the combination of the following-named elements, arranged, connected, and operating as described: a cylindrical field-magnet provided with pole-pieces at each end and exteriorly wound with coiled insulated wire and a rotary armature-core in the axis of the field-magnet within an interposed coil of insulated wire and provided with pole-pieces at each end, said insulated coils being wound so that field-magnet and armature when respectively energized thereby from an electric circuit have opposite polarity each at their respective ends, whereby the combined energy of the whole of both field-magnet and armature is exerted attractively at both ends to rotate the armature, substantially as and for the purposes set forth.

2. In an electromotor, the combination of the following-named elements, all arranged, connected, and operating as described: a cylindrical field-magnet and a rotary armature annularly within the same, respectively provided with pole-pieces at each end and respectively wound with coiled insulated wire, so as to produce opposite polarity therein at each of their respective pole-pieces when the field-magnet and armature are respectively energized by said coils from an electric circuit, whereby the combined energy of the whole of the field-magnet and armature is exerted attractively at both ends to rotate the armature, substantially as and for the purposes set forth.

3. In an electromotor, the combination of the following-named elements, arranged, connected, and operating as described: a cylindrical field-magnet provided with pole-pieces at each end and wound with coiled insulated wire, a rotary armature-core in the axis of the field-magnet within an interposed coil of insulated wire and provided with pole-pieces at each end, said insulated coils being wound so that field-magnet and armature when respectively energized thereby from an electric circuit have opposite polarity each at their respective ends, and a commutator for closing and opening the armature-circuit, whereby at least one pole-piece at each end of the armature simultaneously has the combined energy of the whole of both field-magnet and armature attractively exerted thereupon, substantially as and for the purposes set forth.

4. In an electromotor, the combination of a series of cylindrical field-magnets in line of axis, provided each with pole-pieces at both of their respective ends and wound with coiled insulated wire, and a series of rotary armature-cores in the axis of said field-magnets within interposed coils of insulated wire and provided each with pole-pieces at both of their respective ends, each series of armature-cores being fixed to but magnetically insulated from its adjacent series, and said insulated coils being wound so that each opposite series of field-magnets and armatures is of opposite polarity when respectively energized thereby, whereby the whole energy of each field-magnet and armature of the series is attractively exerted at both ends of each of said members to rotate the series of armatures, substantially as and for the purposes set forth.

5. In an electromotor, the combination of a series of cylindrical field-magnets in line of axis, provided each with pole-pieces at both of their respective ends and wound with coiled insulated wire, a series of rotary armature-cores in the axis of said field-magnets within interposed coils of insulated wire and provided each with pole-pieces at both of their respective ends, said insulated coils being wound so as to oppositely polarize opposite field-magnets and armatures, and each series of armature-cores being fixed to but magnetically insulated from its adjacent series, and a commutator for closing and opening the several armature-circuits, whereby all the armatures of the series are rotated by the whole attractive energy of each field-magnet and armature successively applied to each armature, substantially as and for the purposes set forth.

6. In an electric motor or dynamo, the combination of a series of cylindrical field-magnets in line, provided each with pole-pieces at both ends and wound with coiled insulated wire, and a series of rotary armature-cores in the axis of said field-magnets within interposed coils of insulated wire, each of said cores being provided with pole-pieces located at their opposite ends in line with each other but out of line with the pole-pieces of an adjacent core, substantially as and for the purposes set forth.

7. In an electric motor or dynamo, the combination of a series of cylindrical field-magnets in line, provided each with pole-pieces at both ends, and a series of armatures annularly within the same, provided each with

end-pole pieces staggered in series and interlet with the field pole-pieces, substantially as and for the purposes set forth.

8. An electro field-magnet of hollow cylindrical form for an electric motor or dynamo, provided at each end with one or more interior pole-pieces and circumferentially wound with coiled insulated wire, substantially as and for the purposes set forth.

9. A series of electro-magnets of hollow cylindrical form set in line axially and having each pole-pieces at both ends and wound with coiled insulated wire, the whole forming field-magnets for an electric motor or dynamo, substantially as set forth.

10. A series of electro-magnets of hollow cylindrical form set axially in line but insulated from each other and wound each with coiled insulated wire, the whole forming field-magnets for an electric motor or dynamo, substantially as set forth.

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Witnesses:

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