(No Model.) 2 Sheets—Sheet 1.

C. S. BRADLEY.

ELECTRIC MOTOR.

No. 438,603. Patented Oct. 21, 1890.

Fig. 1.

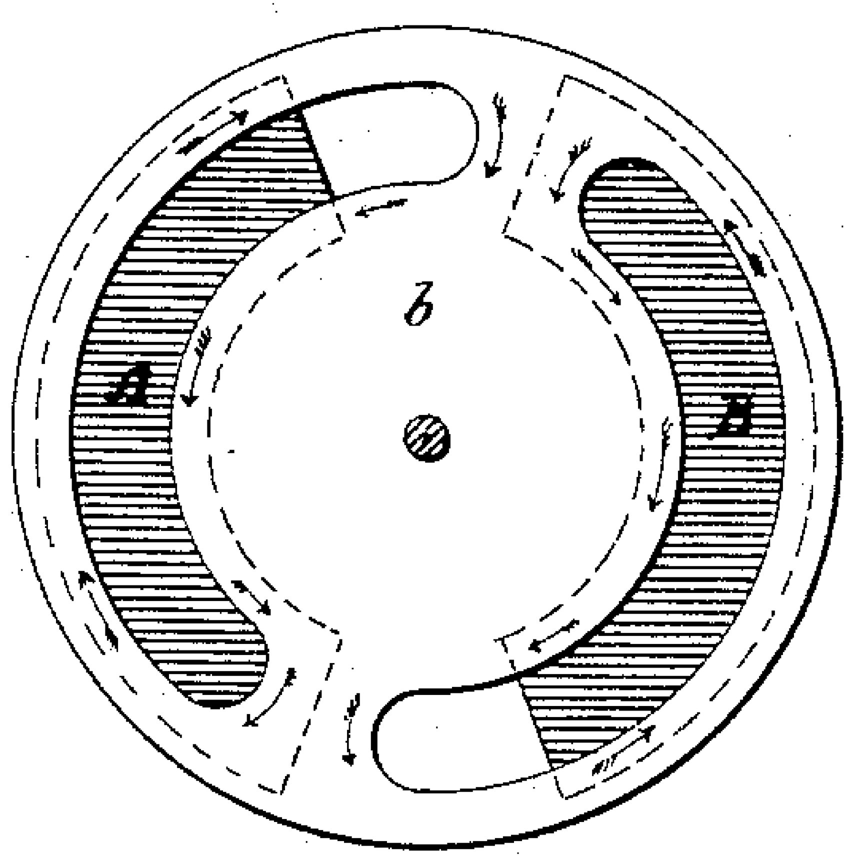


Fig. 2.

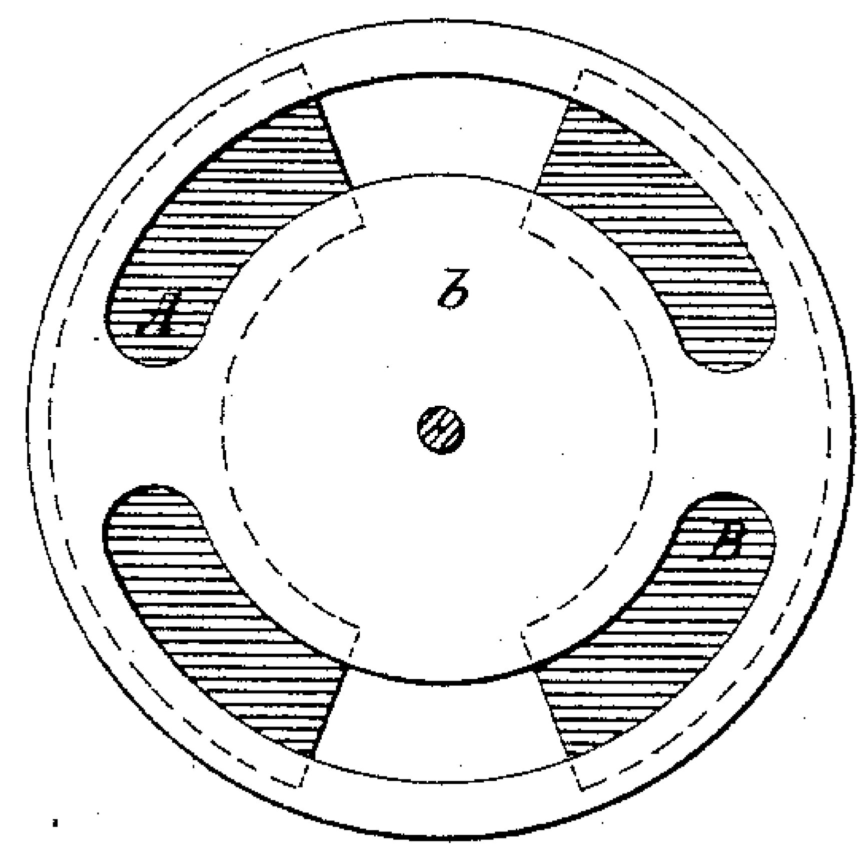


Fig. 3.

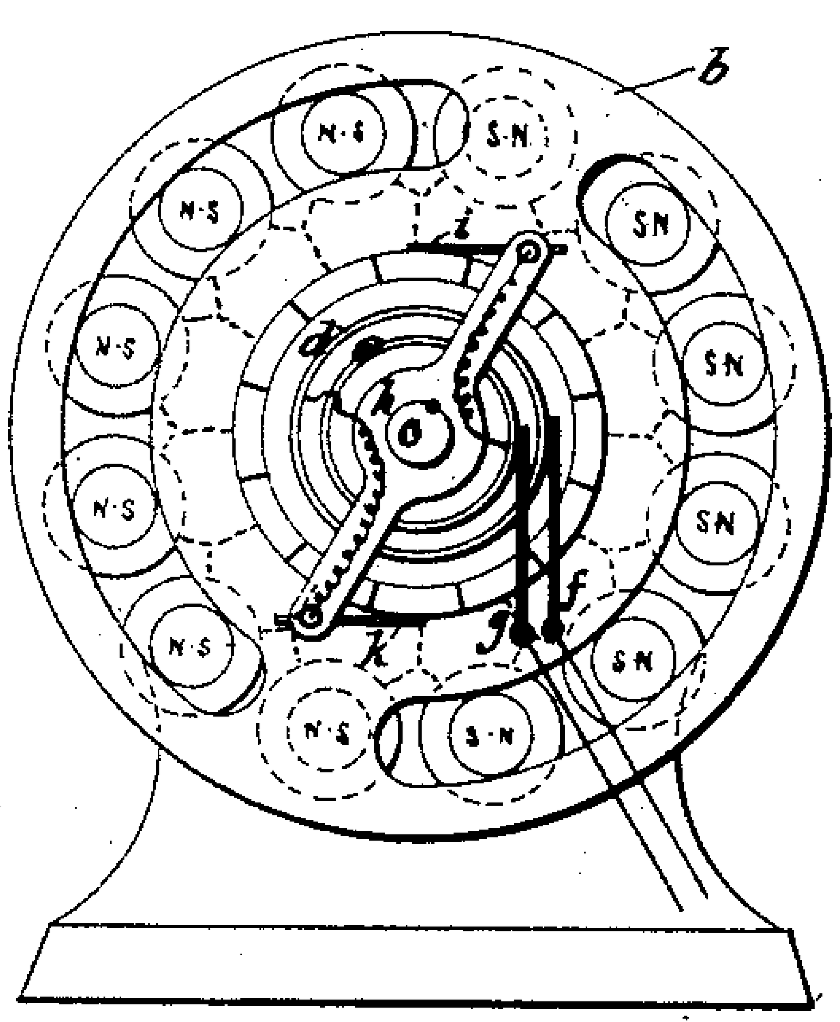
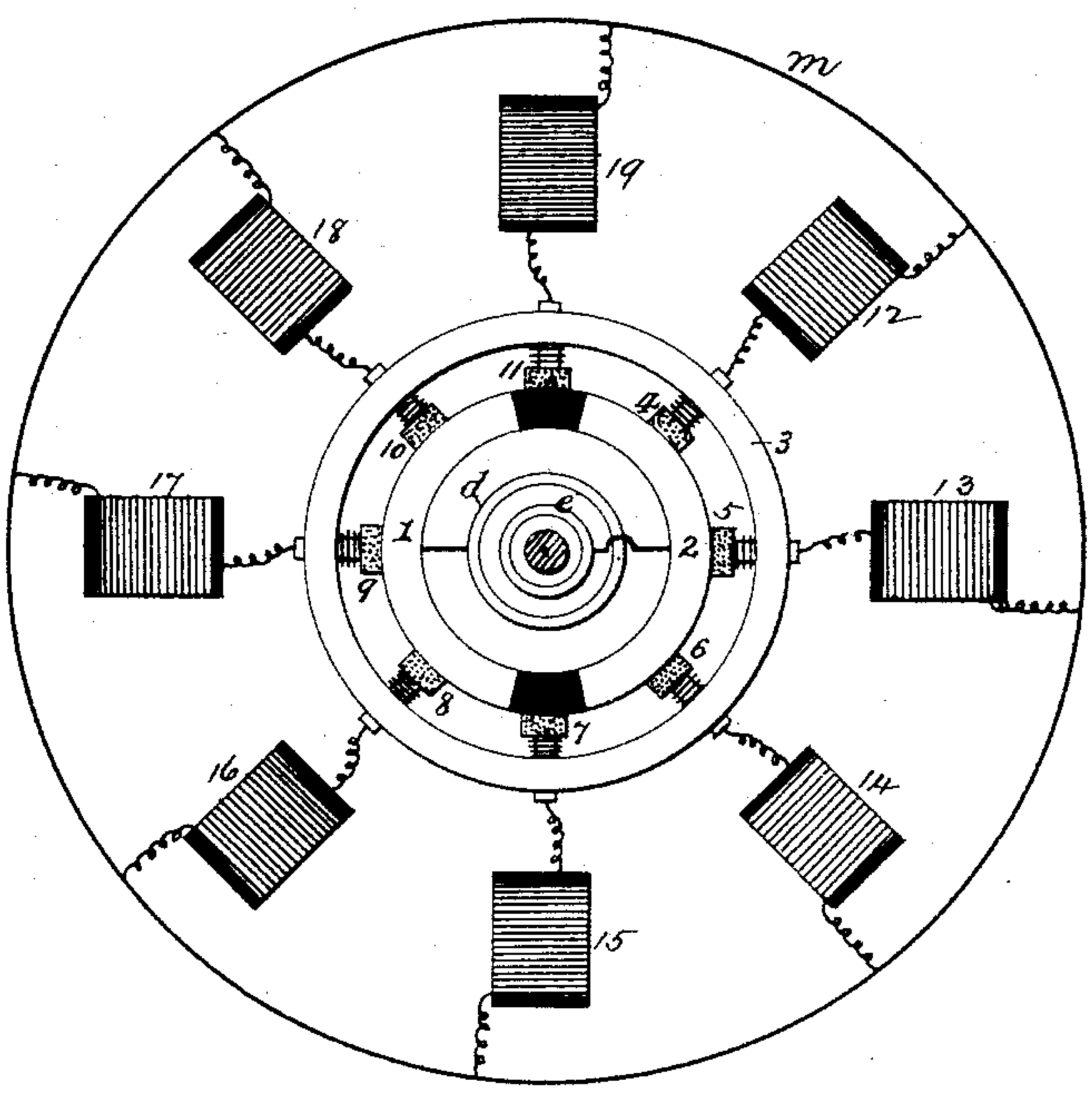


Fig. 5.



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(No Model.) 2 Sheets—Sheet 2.

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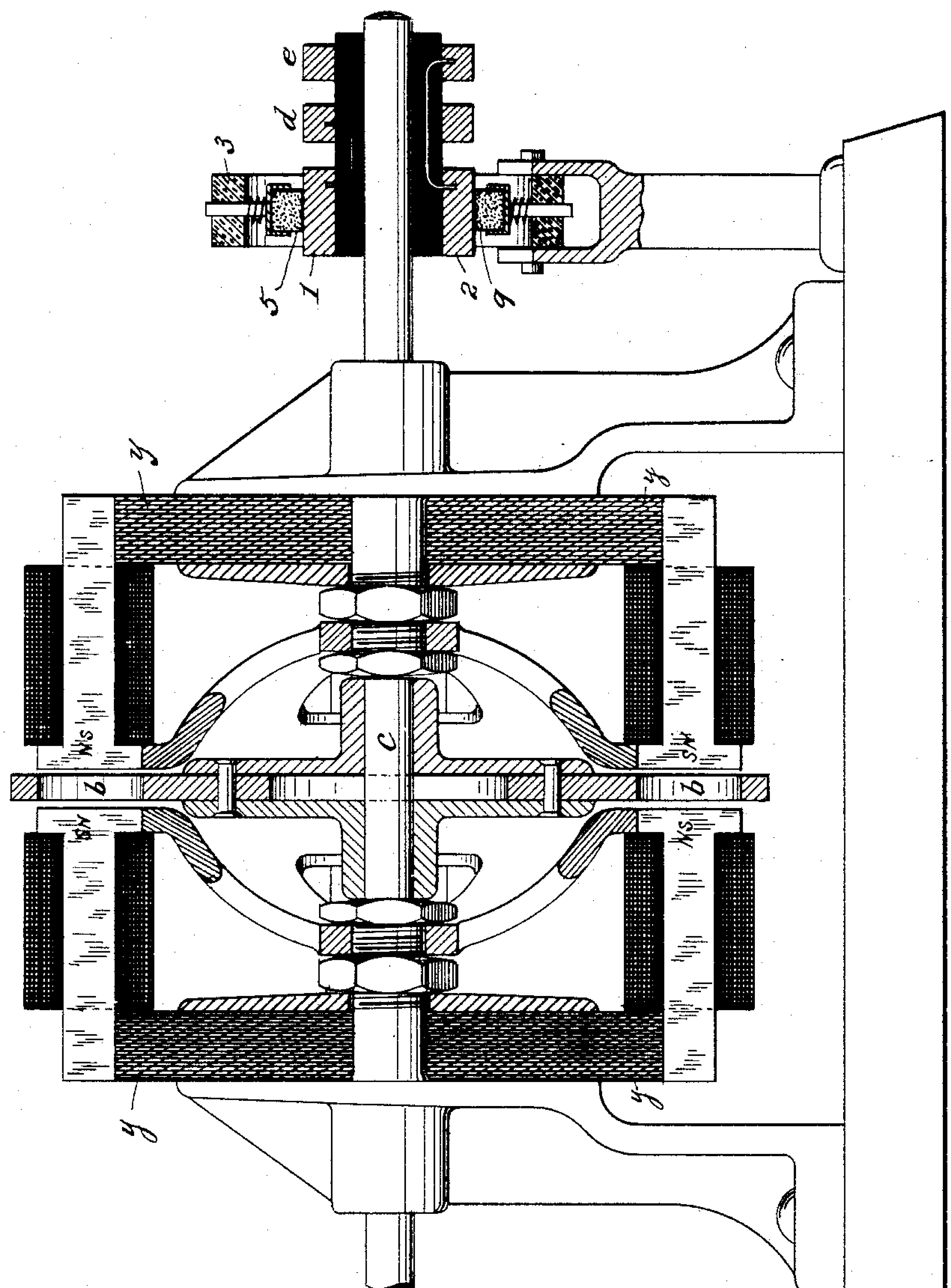
Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES S. BRADLEY, OF YONKERS, NEW YORK.

ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 438,603, dated October 21, 1890.

Application filed August 13, 1890. Serial No. 361,905. (No model.)

To all whom it may concern:

Be it known that I, CHARLES S. BRADLEY, a citizen of the United States, residing at Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Electric Motors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the organization and construction of alternating-current motors, being particularly designed for application and use on single-current circuits.

If we take a disk *b* having two circumferential slots, as in Figures 1 and 2, and set it so that each slot surrounds or threads the lines of force from alternate fields of force (represented in Figs. 1 and 2) by the pole-pieces A and B, the disk becomes the seat of induced or secondary currents when the field-magnets are energized by an alternating current, the paths of such currents being approximately indicated by small arrows on the disk, which constitutes two closed circuits. If the disk be placed in the relation shown in Fig. 1, as soon as the alternating current is admitted to the field A B the rise and fall of potential therein sets up induced currents, and motion of the disk results from the following principles: All the lines of force momentarily produced during one phase of alternation of magnetism in the field-poles cause momentary induced currents, as indicated by the arrows. These currents pass from the center to rim and rim to center of the disk at the two unslotted portions shown, being from center to rim at one and from rim to center at the other at the same instant, and therefore the currents generated by A and by B have common directions through such unslotted portions, and are therefore attracted one by the nearest part of field A and the other by the nearest part of field B, and as these attractions take place at opposite sides of the shaft or center motion of the disk necessarily results. This motion continues in one direction till the disk is about in the position shown at Fig. 2. Motion then ceases, because the closed circuits of the disk are equally attracted by the oppositely-induced field-magnets, which neutralize each other. The principle of my invention is thus established, and continuous rotation of an element can be effected by subdividing and angularly displacing or commutating the field magnets.

My invention comprises a single-current field-magnet, an armature having two or more closed induced circuits, and a commutating device for shifting the neutral point in the field-magnet and producing progressive torque.

My invention further comprises the arrangement and combination of devices substantially as hereinafter more fully described and claimed.

In the accompanying drawings, which form part of this specification, Figs. 1 and 2 are explanatory diagrams illustrating the fundamental principle of my invention. Fig. 3 is an end elevation of a simple form of continuous rotary motor containing the elements of my invention. Fig. 4 is a longitudinal section of a motor, illustrating a modified form of motor having a subdivided field wherein the polar lines of the field are commutated; and Fig. 5 is a diagram of the circuits of Fig. 4.

In its simplest form the motive device consists of the field-magnet A B and the slotted disk *b*, as in Figs. 1 and 2.

In Fig. 3 I use the disk *b*, fixed on a shaft *c*, provided with suitable bearings. On this shaft are the two insulated rings *d e*, on which bear the respective brushes *f g* continuously. The shaft has fixed to it the brush-arm *h*, which in turn carries at diametrically-opposite points the insulated brushes *i k*. These brushes bear on a stationary segmental collector or commutator C, having its blocks looped in successively to the subdivided field-circuit, so as to shift the polar line of the latter accordingly. The field-magnet is composed of a group of cores arranged in a circular series, each provided with its own coil, and the pole-pieces facing the path of the semicircular slot in the disk *b*. I have shown in Fig. 3 such a series of field-magnets facing one side of the disk only; but I prefer to have two series of such field-magnets facing each other and so wound that at any instant at which a given pole has north polarity the pole-piece opposite it on the other side of the disk has south polarity, and so on, so that the lines of force pass directly from the pole-piece of one series to the pole-piece of the opposite series of field-magnets. The entire annular series of field-magnets have their coils connected in series similarly to the connections of a Gramme ring, so as to form a closed circuit, and between each coil and the next adjoining one a loop is taken and connected to the corresponding plate of the commutator C, which is supported in a stationary position by any suitable means so as to always preserve the same angular relations with the field-magnets. Obviously the line-current passing in at the brush *f* to ring *d* would go through brush *k* into the commutator, and then dividing, one half would pass around the magnet-coils on the right of the vertical line and the other half around the magnet-coils on the left of the vertical line, and at the top both currents join together at the commutator and pass out at the brush *i* through ring *e* into brush *g* and thence to line. Consequently at any given moment all the field-poles on one side of the vertical line will have one polarity and all those on the other side of the vertical line the opposite polarity. Thus in the position shown in Fig. 3 the neutral line will be a vertical line drawn through the figure, and this line will be the line of commutation and correspond with the operating position of the brushes *i k*. The disk *b* being already advanced a little toward the right, so as to correspond with Fig. 1, immediately takes up motion due to the preponderating attraction, as already explained, and this motion continues with a powerful torque until the brushes have reached the next segment of the commutator, whereupon the neutral line is immediately shifted to the right and the position of maximum torque is again obtained, causing a further attraction of the disk *b* in the same direction, and the corresponding movement of the brushes *i k* repeats this indefinitely as the disk rotates, owing to the described commutation of the field-magnets, so as to keep the position of maximum torque continuously ahead of the actual position of the disk.

In Fig. 4 is illustrated a form of motor wherein the disk *b* is fixed to a suitable shaft and rotates between the adjacent ends of two circular series of field-magnet poles, as already alluded to with reference to Fig. 3. In this form of machine the field-magnets are commutated, as before, and the opposite pole-pieces will at any one instant be always of opposite polarity, so that the lines of force between the two will pass through the rotating disk *b*. I use laminated cores for the field-magnets and join their back ends by means of the laminated yokes *y*, as shown in Fig. 4. Instead, however, of connecting the members of the field-magnet and commutating them, as shown in Fig. 3, I adopt the arrangement more fully shown in the diagram, Fig. 5. On the shaft and rotating therewith I place the insulated rings *d* and *e*, as before, and on these suitable brushes bear and convey the line-currents to the commutator. I also fix on the shaft the two semicircular commutator-plates 1 and 2, plate 1 being connected to ring *d* and plate 2 being connected to ring *e*. Surrounding the commutator is a ring 3 of suitable material and carrying at points corresponding to the angular displacement of the several field-magnets the brushes 4, 5, 6, 7, 8, 9, 10, and 11. The plates 1 and 2 at their adjoining ends are separated from each other by a gap at least equal in width to that of one of the brushes, as shown in Fig. 5. These respective brushes are connected to the corresponding ends of the field-magnet coils, which are designated in Fig. 5 by the numerals 12, 13, 14, 15, 16, 17, 18, and 19. The other or outer terminals of all the field-magnet coils have a common connection, as illustrated by the circle *m*, which is obviously the same as if all the outer terminals of the coils were connected together at one point. Suppose, now, an impulse of current arrives from the line to the ring *d*. It passes thence to the plate 1, from it through the three brushes 8 9 10, and divides in parallel circuit through the three field-magnets 16 17 18, joining together at the common connection and passing into the field-magnets 12 13 14, thence through the brushes 4 5 6, thence to the plate 2, ring *e*, and back to line. It will thus be observed that field-magnet coils 19 and 15 are open-circuited. As the commutator 1 and 2 rotates, field-magnets 12 and 16 become open-circuited, and in the further rotation of the armature and commutator each diametrically-opposite set of coils becomes open-circuited, while the set of coils on each side of such line respectively contribute opposite polarities to the circular range of field-magnet poles and the commutation proceeds with the same effect as in Fig. 3, but with the additional advantage that the short-circuiting effect which would take place in the form shown at Fig. 3 when the brushes connected to adjoining plates of the commutator is totally absent, and consequently the damaging sparking is entirely eliminated.

I claim as my invention—

1. An alternating-current electric motor comprising a single-current field-magnet, an armature having two or more closed induction-circuits, and means for shifting the neutral line of the field.

2. An alternating-current electric motor comprising a stationary single-current field-magnet, a rotating armature having two or more closed induction-circuits, and a commutating device for shifting the neutral line of the field.

3. An alternating-current electric motor comprising a rotating armature having two or more closed induction-circuits, a stationary multipolar field-magnet in inductive relation thereto and having its poles divided in sign

on the respective sides of a diameter or neutral line, and means for continuously displacing such dividing-line in one direction.

4. An alternating-current electric motor comprising a rotating armature having two or more closed induction-circuits, a stationary multipolar field-magnet composed of an even number of electro-magnets arranged in two or more parallel circuits so as to have all poles on one side of a neutral line of one polarity of opposite sign to that of those on the other side, and means for shifting the neutral line between the groups.

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

CHARLES S. BRADLEY.

Witnesses:
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ROBT. H. READ.