H. A. RHODES.

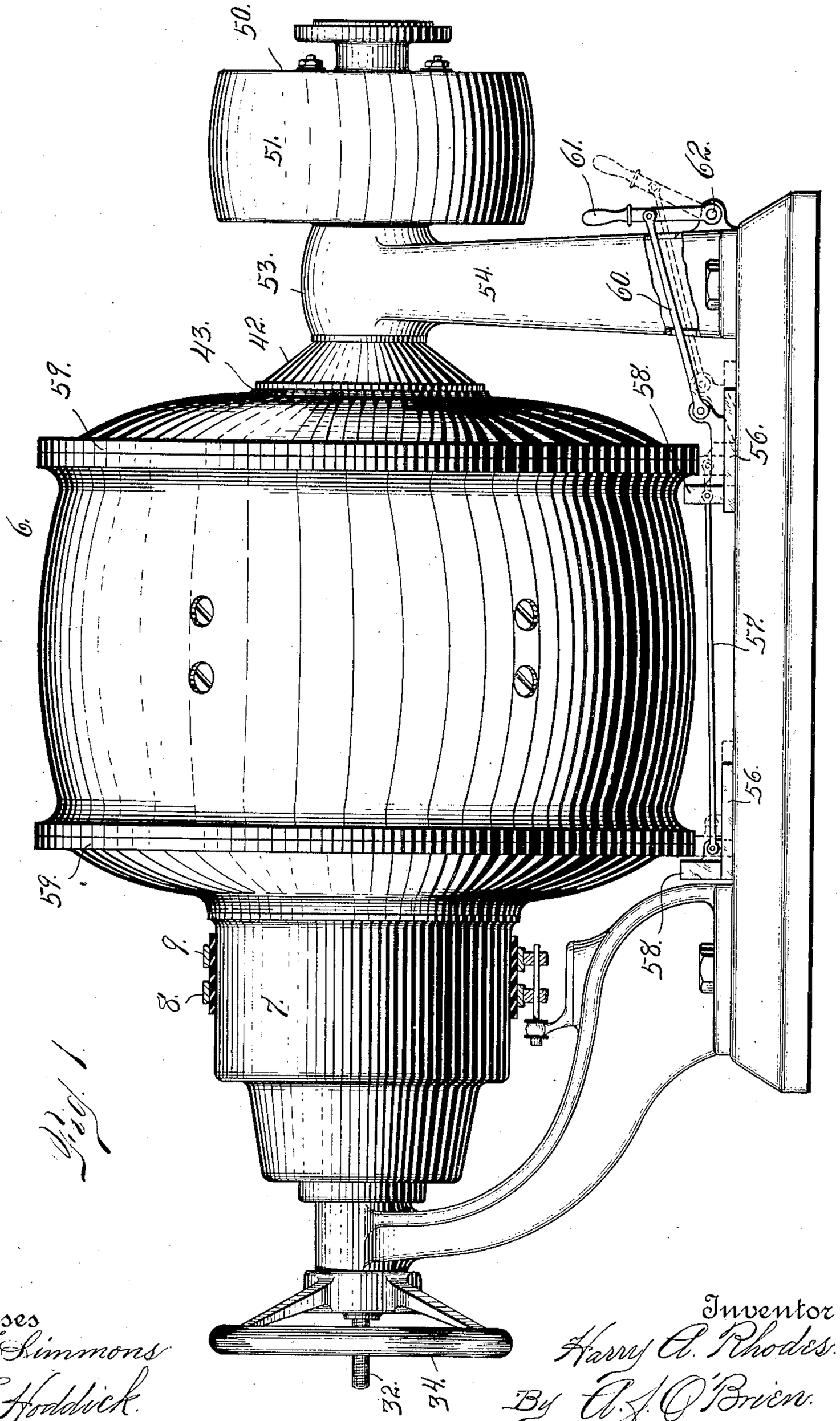
ELECTRIC MOTOR.

APPLICATION FILED JULY 20, 1909.

993,459.

Patented May 30, 1911.

4 SHEETS—SHEET 1.



Witnesses
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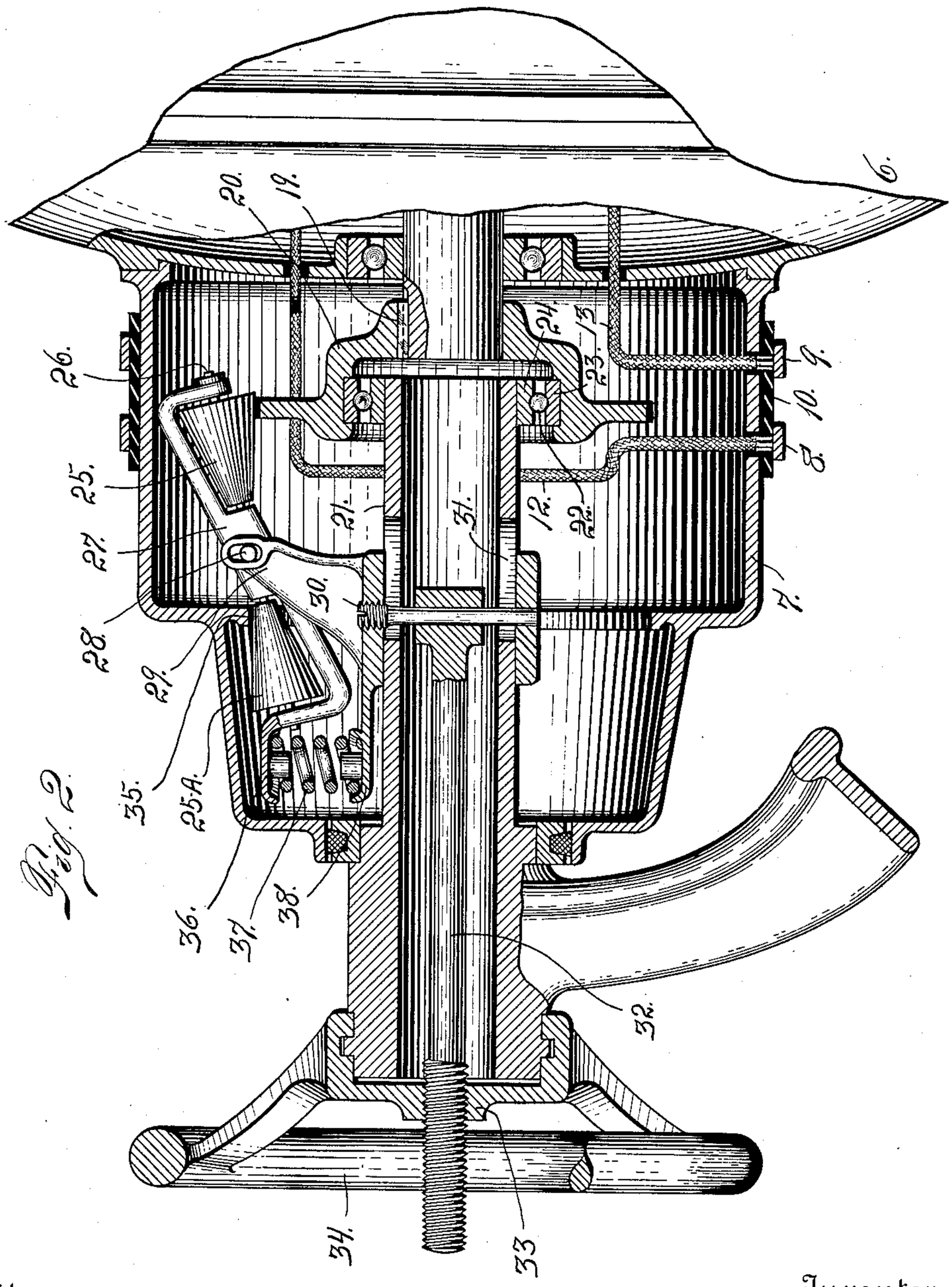

Fig. 2.

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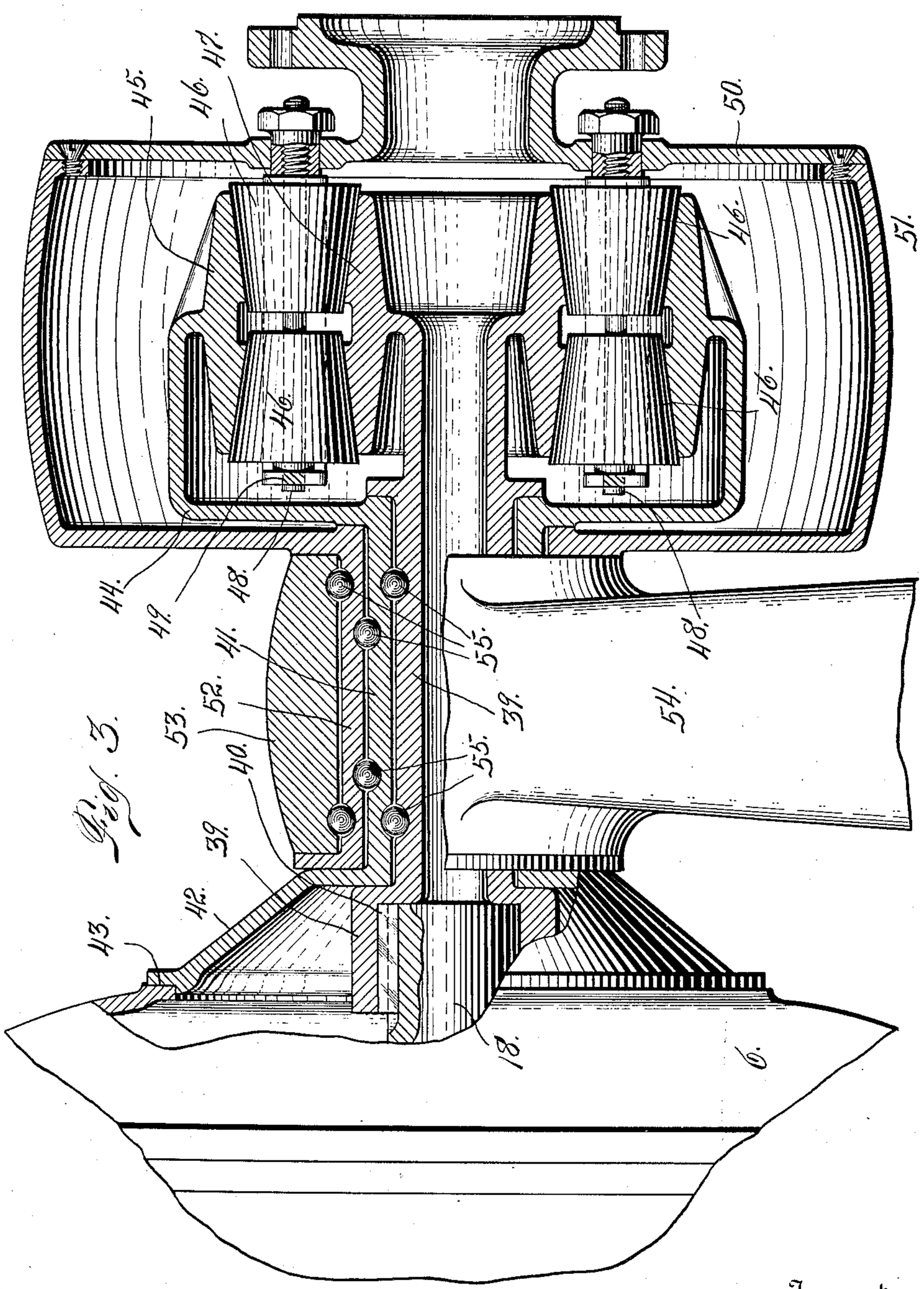

Fig. 3.

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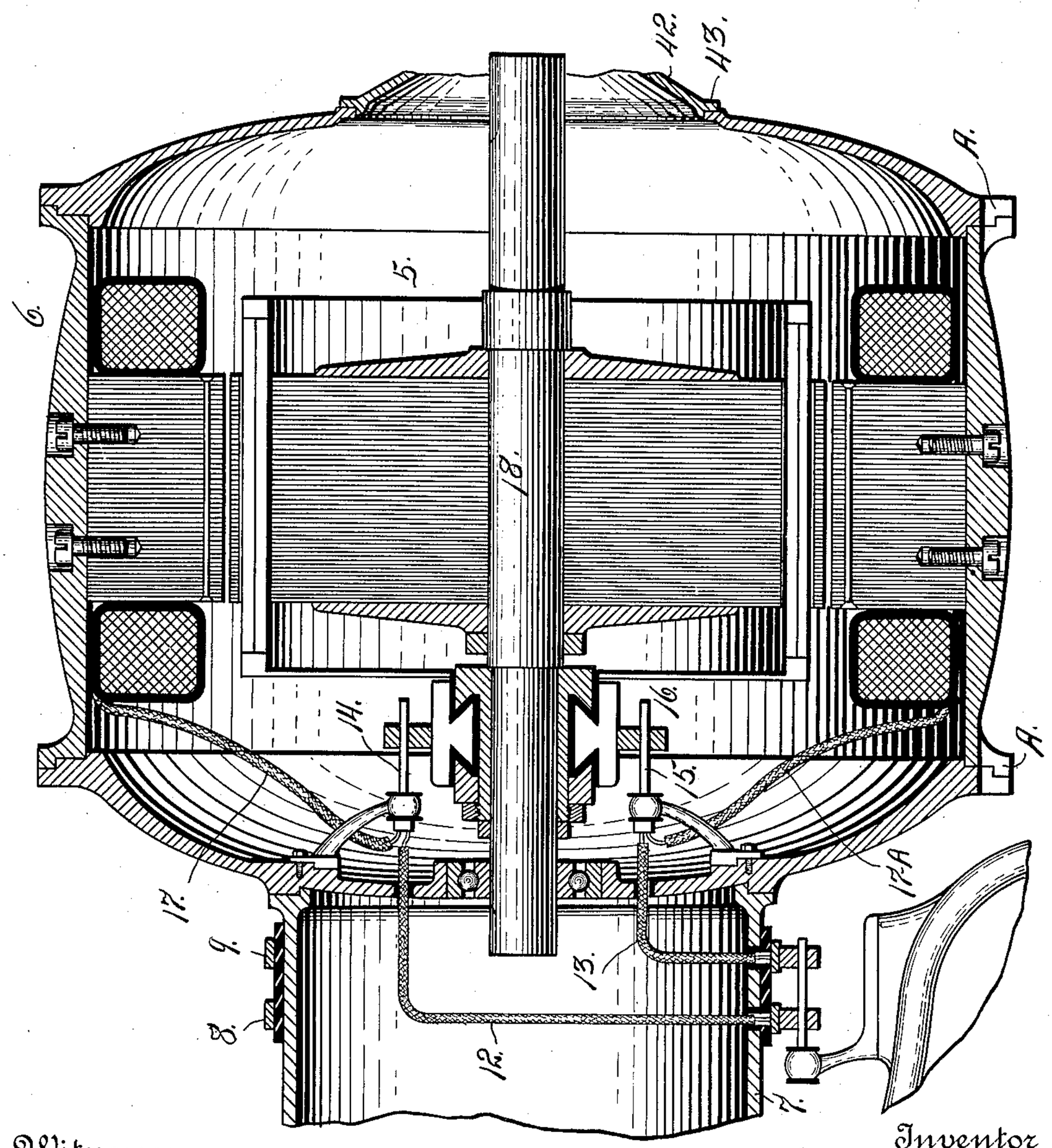

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UNITED STATES PATENT OFFICE.

HARRY A. RHODES, OF DENVER, COLORADO, ASSIGNOR TO THE UNIVERSAL MOTOR COMPANY, OF DENVER, COLORADO, A CORPORATION OF ARIZONA TERRITORY.

ELECTRIC MOTOR.

993,459. Specification of Letters Patent. Patented May 30, 1911.

Application filed July 20, 1909. Serial No. 508,654.

To all whom it may concern:

Be it known that I, HARRY A. RHODES, citizen of the United States, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Electric Motors; and I do 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, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to improvements in electric motors. Most motors of this class run at a high speed, thus reducing the construction weight and allowing a high efficiency. For practical use however, the motor speed must be geared down to a considerable extent. The means employed to accomplish this speed reduction heretofore, so far as I am aware, have been very complicated, in order to reduce the loss of power to a minimum. In other cases the speed reduction has been attained by disregarding the loss of efficiency in the motor. The construction employed in the first case, however, has proved unsatisfactory for practical use, on account of the many complications connected therewith, which endanger the working of the power producer, and the second form of construction is at present generally used wherever speed regulation is necessary. It is well known that by using such means as to decrease the efficiency of the motor, the resulting loss of power is very high. It is obvious therefore, that the price per H. P. in such cases is quite out of proportion to the work accomplished.

The object of my present invention is to provide means for regulating and reversing the movement of any motor without losing much power in gearing, and still retain the same efficiency of the motor all the time. This is accomplished by causing both members of the motor to rotate in opposite directions and introducing a third member, to which the reduced speed or differential is communicated, the third member being connected to do work of any desired character. The regulation of speed is accomplished by varying the difference of the two individual speeds of the two motor members; as each rotating member has a certain kinetic energy, I provide means to transfer this energy from the member I desire to slow down in speed to the other member. It is obvious that the last named member, if given an opportunity to increase its speed will take on that part of the kinetic energy which is available from the member whose speed is reduced. Hence wherever the term "equal speed" is employed in this specification, peripheral speed will be understood as distinguished from speed measured in revolutions.

Having briefly outlined my improved construction of motor, as well as the principle upon which it operates, I will proceed to describe the same in detail, reference being made to the accompanying drawing, in which is illustrated an embodiment thereof.

In this drawing: Figure 1 is an elevation of a motor equipped with my improvements. Fig. 2 is an enlarged fragmentary section of the left-hand side of the same. Fig. 3 is a similar section of the right-hand side of the construction shown in Fig. 1. Fig. 4 is a central vertical section of the central part of said construction, the parts being shown on a larger scale.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate the armature member of the motor, and 6 the field member thereof. It must be understood however, that these terms are applied to these members for convenience only, and in order to distinguish the one member from the other. It may also be stated that in order to carry out the principle of my improved construction, it is not necessary that the two motor members moving in opposite directions shall necessarily maintain such a relation to each other that one may always be properly termed the "field" and the other the "armature."

It may be stated that so far as the general construction of the motor which I employ is concerned, it may be of any ordinary manufacture except that the two members, for convenience designated the armature member and the field member, must both be permitted to revolve, and the polarity of the current supplied to them must be so regulated that the two members will rotate in opposite directions. The speed of the two members will, of course, be determined by their relative mass. One extremity, 7, of the

casing or field member of the motor, is supplied with rings 8 and 9 which are separated from the part 7 by insulating material 10. The current from the generator (not shown) is supplied to these rings and conductors 12 and 13, mounted in the motor, lead from the rings 8 and 9 respectively, to the brushes 14 and 15, which engage the commutator 16, through which the armature member 5 is supplied with current. The coils of the field member are also supplied with current through the conductors 17 and 17A, which are electrically connected with the conductors 12 and 13, see Fig. 4.

One extremity of the armature shaft 18, is keyed as shown at 19 to the hub of a wheel 20, journaled upon a stationary sleeve 21, by means of ball bearings 22, interposed between steel rings 23 and 24 mounted upon the wheel and sleeve respectively. The periphery of the wheel 20, engages a cone-shaped member 25, fast upon a spindle 26, journaled in a holder 27, the latter being trunnioned upon a bracket 29, connected with the stationary sleeve 21 of the motor, by means of a screw pin 30, passing through a slot 31, formed in the said sleeve. This pin 30 is connected with a rod 32, threaded in a cap 33, journaled on the outer extremity of the sleeve 21, and formed integral with an operating wheel 34. As the rod 32 is prevented from rotating the rod may be caused to travel longitudinally within the sleeve 21, by rotating the wheel 24 and the cap 33, thus changing the relative position of the bracket 29, upon which the holder 27 is mounted. This holder 27 carries a second cone-shaped member 25A, mounted and made fast upon the spindle 26, the latter being journaled in the frame or holder 27, as just explained. As shown in the drawing, the two cones 25 and 25A, have their smaller extremities toward the center. As just explained, the periphery of the wheel 20, engages cone 25 while the field-casing member 7 has an inwardly extending flange 35, engaging the cone member 25A. In order that the two cone members may be held in proper operative contact with the parts 20 and 35, the holder 27 is provided at one end with an extension 36, which engages one extremity of a coil spring 37, whose opposite extremity engages an extension 38 of the bracket 29. It will now be understood that the wheel 20, engaging one of the cones, is connected to rotate with the armature member of the motor, while the flange 35, engaging the other cone, is mounted upon and rotates with the field member of the motor. I will also state that the trunnioned device carrying the two cones 25 and 25A, is a speed regulating device, whereby any desired differential speed between the two members of the motor, that is to say the field and armature members, may be maintained. As illustrated in the drawing, the circumferences of the wheel 20 and that of the flange 35, where it engages the cone 25A, are equal. Now if we assume that the two members of the motor are traveling at equal speed in opposite directions, it will be understood that the speed of either member may be reduced, and that of the other member accelerated by the adjustment of the speed regulating device. For instance if this device is so adjusted that the periphery of the wheel 20 and the engaging part of the flange 35, both engage the cones 25 and 25A, at the center or where the said cones are of equal circumference, the speed of the two members will remain the same in relation to each other, and the speed regulating device will have no effect. If, however, the speed regulating device be shifted toward the left, see Fig. 2, by turning the wheel 34 and the cap 33, so that the flange 35 shall engage the smaller extremity of its cone and the periphery of the wheel 20 shall engage the larger extremity of its cone, the speed of the field member of the motor will be retarded and that of the armature member of the motor correspondingly accelerated. Furthermore if we assume that the circumference of the cone 25, where it engages the wheel 20, is three times that of the circumference of the cone 25A, where the latter engages the flange 35, the result will be that the armature member of the motor is traveling three times as fast as the field member of the motor. The extremity of the armature shaft remote from its connection with the wheel 20, is keyed to a sleeve 39, as shown at 40, thus connecting the armature member of the motor with this sleeve. A sleeve 41 is also connected at one extremity with the field member of the motor, by means of a cone shaped casing member 42, which is made fast to one end of the casing or field of the motor, as shown at 43. The opposite extremity of the sleeve 41, is connected by means of a bracket 44, with a bearing ring 45, which engages a series of rollers 46, interposed between the ring 45 and an opposing ring 47, formed upon the outer extremity of the sleeve 39, connected with the armature member as heretofore explained. All of the rollers 46 of the series are mounted on spindles 48. The inner extremities of the spindles 48 engage a ring 49, while their outer extremities are connected with the detachable head 50, of a wheel or pulley 51, from which the differential speed may be transmitted to the device or machine to be operated.

In the foregoing description it has been assumed that the speed regulating device has been so adjusted that the two motor members are traveling at different speeds in the proportion of one to three, that is to say we have assumed that the armature member is traveling three times as fast as the

field member, and in this case the speeds may be considered either in terms of revolutions or in terms of peripheral travel, since the parts engaging the speed regulating cones are of the same circumference. Attention is now called to the fact that the bearing ring 47, engaging the rollers 46, is of less circumference than the bearing ring 45, engaging the same rollers. Now if the armature member with which the ring 47 is connected, travels three times as fast in revolutions, as the field member with which the ring 45 travels, the peripheral speed of the two rings 45 and 47 will have a still smaller differential, and it is evident that in order for the speed of the ring 45 traveling in one direction to neutralize the speed of the ring 47 traveling in the opposite direction, so that there would be no orbital travel of the rollers 46, it would be necessary for the ring 47 to make less than one revolution, while the ring 45 was making a single complete revolution. In any event however, the relative rapid travel of the ring 47 in one direction, is neutralized to the extent of the travel of the ring 45 in the opposite direction, and if we should assume that the peripheral travel of the two rings is in the proportion of two to one, the differential speed imparted to the pulley 51, would be one half of the speed of the ring 47. From this it is evident that by adjusting the regulating device, any desired differential may be delivered to the pulley or wheel 51 and transmitted to any device to be operated.

It is evident that the pulley or wheel 51, might be a vehicle wheel if desired, or a pulley with which a belt may be connected for transmitting motion to any machine or device to be operated.

The wheel 51 is provided with a hollow journal or sleeve 52 interposed between the sleeve 41 and a stationary bearing 53, mounted upon a pedestal 54, of the frame work.

In order to reduce the friction between the bearing 53, the pulley sleeve 52, and the sleeves 39 and 41, ball bearings 55, are employed.

It will be understood from what has already been stated, that in order to reverse the travel of the member 51, to which is transmitted the differential speed between the two motor members, it will only be necessary to reverse the position of the speed regulator, that is to say referring to Fig. 2, by shifting the latter toward the right, which may be accomplished by turning the hand wheel 34, whereby the periphery of the wheel 20 will act upon the smaller extremity of its cone 25, while the flange 35 will act upon the larger extremity of its cone member 25A. In this case the field member of the motor will have the greater speed, and the bearing ring 45, with which the last named member is connected will determine the direction of orbital travel of the rollers 46, and the pulley or wheel member 51. It is evident that in this case the direction of travel of the member 51 will be the reverse of its travel, when the speed regulating device is in the position shown in Fig. 2. It will thus be seen that the speed of the member 51, which is determined by the speed differential between the two motor members may be determined with perfect accuracy since by the proper adjustment of the regulating device the differential speed between the two motor members may be regulated as desired, and in favor of either member, the member having the greater travel determining the direction of the rotation of the third member 51. In Fig. 1 of the drawing, I have illustrated a suitable construction to accomplish this purpose, the same consisting of two blocks 56, connected by a rod 57, each block having an upward projection 58, adapted to engage a recess A employed in the rims 59 forming the exterior rims 59 of the field member. One of these plugs is connected by means of a rod 60, with a hand lever 61, fulcrumed at 62. When this lever is thrown to the dotted line position in Fig. 1, the locking device is thrown to a corresponding position, whereby the projections 58 engage the recesses of the rims of the field of the motor and lock the latter and its attachments against rotation.

The mechanism, whereby the speed differential of two electric motor members, rotating in opposite directions, may be transmitted to a third member, to give the latter any desired slow speed, regardless of the velocity of the rotating members of the motor, may be advantageously utilized by reversing the operation of the same, when it is desired to change the electric motor into a dynamo or generator. In this case, it will only be necessary to connect a slow speed engine with the third member, of the said differential speed mechanism; in which event the operation of the motor parts will, of course, be given the same velocity in opposite directions that could be initially imparted when the device is used as a motor, in order to produce a corresponding differential slow speed in the third member. This construction will, therefore, overcome a difficulty heretofore experienced, viz: that it has been found impossible to employ certain slow speed engines for generating electricity, since the maximum speed at which it is practicable to run these engines, is not sufficient for electrical generating purposes on a commercial scale.

Having thus described my invention, what I claim is:

1. A motor having its two members

mounted to rotate in opposite directions and at varying speeds, the two motor members having extensions at opposite ends of the motor, a regulating device acting upon the extensions of the motor members at one end thereof, and a third member acted on by the motor members at the opposite end thereof, to utilize the differential speed of the two members substantially as described.

2. A motor whose field and armature members are mounted and connected to rotate in opposite directions, the two members of the motor having circular bearing extensions at one end thereof, a speed regulating device, acting upon the said extensions to produce any desired differential speed in favor of either member, extensions at the opposite end of the motor forming bearing rings annularly arranged, and a device equipped with rollers interposed between the two bearing rings, the rollers of the said device being mounted to rotate on their individual axes and to travel in an orbit, whereby the said device is adapted to utilize the differential speed between the two motor members.

3. A motor whose field and armature members are mounted and connected to rotate in opposite directions, the two members having circular bearing extensions, the extension of the field member surrounding and inclosing the extension of the armature member, a speed regulating device also inclosed by the extension of the field member and acting upon the circular bearing parts of the said extensions, means for adjusting the speed regulating device to produce any desired differential speed, and means connected with the motor members for utilizing the differential speed between the two members, substantially as described.

4. A motor having its field and armature members mounted to rotate in opposite directions, the said motor members having extensions at one end of the motor, a speed regulating device acting on the said extensions to produce any desired differential speed, the motor members having extensions at the opposite end forming bearing rings annularly arranged, and a third member interposed between the said bearing rings to utilize the differential speed of the motor members, substantially as described.

5. A motor whose field and armature members are mounted to rotate in opposite directions, the said members having extensions at one end of the motor, including circular bearing parts, a speed regulating device adapted to engage said bearing parts, and means arranged coaxially with the motor members for adjusting the speed regulating device to produce any desired differential speed in favor of either motor member.

6. A motor having its field and armature members mounted to rotate in opposite directions, the said members having bearing extensions at one end of the motor, and a speed regulating device inclosed by one of the bearing extensions of one of the motor members, the said speed regulating device engaging both bearing extensions of the motor members and adjustable to produce any desired differential speed in favor of either member, substantially as described.

7. A motor whose field and armature members are mounted to rotate in opposite directions, the said members having extensions at one end of the motor, a speed regulating device inclosed by the extension of one motor member and arranged to engage both extensions of the motor members and adjustable to produce any desired differential speed in favor of either member, the motor members having annularly arranged bearing rings, and a third member engaged by the bearing rings of the two members to utilize the differential speed, the third member including a housing inclosing the bearing rings of the motor members, substantially as described.

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

HARRY A. RHODES.

Witnesses:
A. J. O'Brien,
Jessie F. Hobart.