L. J. ARON & C. E. HARRISON.

ELECTRIC MOTOR.

APPLICATION FILED SEPT. 7, 1912.

1,199,652. Patented Sept. 26, 1916.

Fig. 1.

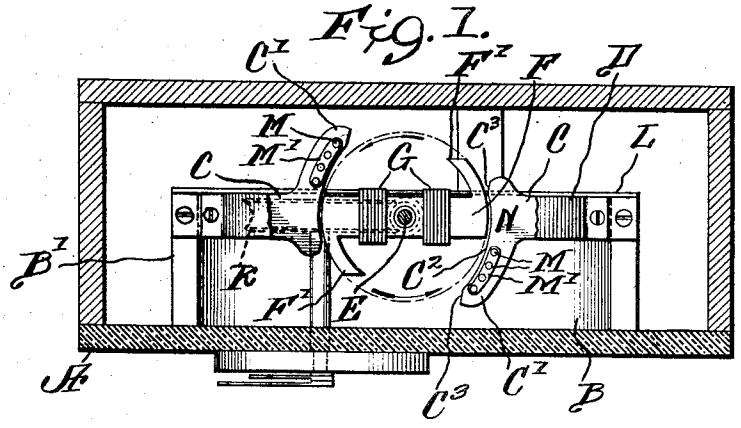
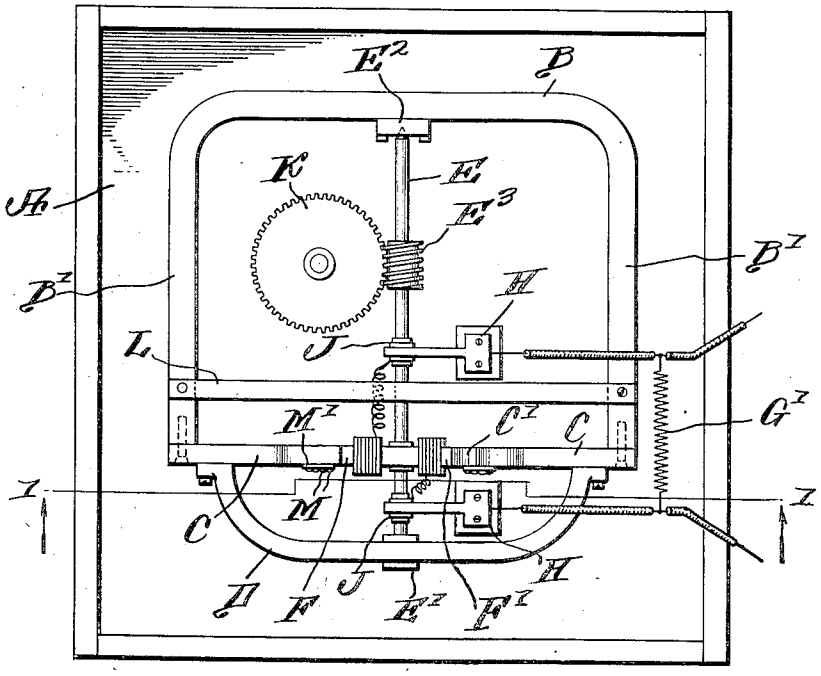


Fig. 2.



Witnesses
Edwin J. Beller.
P. J. Mawhinney.

Inventors:
Leonard James Aron and
Charles Edward Harrison,
by Wilkinson, Gusta & MacKaye.
Attorneys.

UNITED STATES PATENT OFFICE.

LEONARD JAMES ARON AND CHARLES EDWARD HARRISON, OF LONDON, ENGLAND, ASSIGNORS TO X. L. ELECTRIC COMPANY LIMITED, OF LONDON, ENGLAND.

ELECTRIC MOTOR.

1,199,652. Specification of Letters Patent. Patented Sept. 26, 1916.

Application filed September 7, 1912. Serial No. 719,223.

To all whom it may concern:

Be it known that we, LEONARD JAMES ARON and CHARLES EDWARD HARRISON, both subjects of the King of England, and residing at London, England, have invented certain new and useful Improvements in Electric Motors, of which the following is a specification.

This invention relates to improvements in electric motors, and broadly stated consists in a rotor journaled to revolve between the poles of a magnetic stator, both said rotor and stator having extensions or horns which serve to determine the direction of movement of the rotor at each current impulse. The said extensions or horns are of magnetic material so as to form true polar extensions or polar horns, and in the horns of the stator are preferably disposed rods of less electrical resistance than the iron of the pole pieces in order to exert a damping effect. When the parts are at rest the rotor is in the magnetic embrace of the stator.

The invention has for its object to provide an improved mechanism for operating a dial indicator in a system of the above character, which shall be relatively simple and cheap to manufacture and efficient and reliable in operation.

It has heretofore been proposed to construct time indicating devices of this kind in which the step-by-step magnetic mechanism comprised members whose polar extensions were directed in the same direction on both members and were of such length as very nearly to bridge across, each from its own pole to one of opposite polarity, but we have found that we do not obtain satisfactory operation with extensions so arranged. According to this invention, therefore, we employ in an electrically operated time-indicating device of the kind described, a magnetic driving mechanism having one or more poles of the stator member provided with a horn extending in a direction opposite to that of the required movement of the rotor and one or more poles of the rotor provided with a horn extending in the same direction as that of its required movement. According to another feature of the invention the parts are so arranged that when at rest the joint magnetic bridging effect of a horn on a fixed pole and the next thereto approaching horn on a movable pole is such as to leave between the two said horns an air gap whose circumferential extent is one quarter or more than one quarter of the value it would have if both the said horns were removed. In order that the rotor may be magnetically locked within the embrace of the polar extensions on the stator we may employ for such an extension one having that face which is toward the rotor so shaped at one or both ends that the radial distance of such part or parts from the pivotal center of the rotor is greater than that of the remainder of the said face from the said center. In order that the movable member, or armature, may be magnetically locked within the embrace of the polar extensions on the other member or field magnet, we may employ for such an extension one having that face which is toward the movable member so shaped at one or both ends that the radial distance of such part or parts from the pivotal center of the movable member is greater than that of the remainder of the said face from the said center. When it is desired to bring the movable member to a definite position of rest within the embrace of the polar extensions of the other member each of the said extensions may have that face which is toward the other member so shaped that the air gap between it and an extremity of the movable member as it rotates, is least at a point intermediate of the ends of the extension, from which point, in both directions toward the two ends, it gradually increases. The speed of rotation of the rotor may conveniently be checked by arranging conductors of less resistance than iron on the polar extensions either of the stationary magnetic element or of the rotating magnetic element or of both. Eddy currents generated in the said conductors will tend to retard the movement in a greater degree than those formed in the iron faces either of the stationary or movable member.

In order that the invention may be fully described and ascertained a construction of electric motor embodying the invention will be described by way of example.

In the accompanying drawings—

Figure 1 is an end elevational view, partly in section, of an improved electric motor as

constructed in accordance with the present invention; and Fig. 2 is a plan view of the same.

Like letters indicate like parts throughout the drawings.

Upon a base plate A is supported a permanent magnet B whose polar ends B^1 are provided with soft iron pole-pieces C. A brass or other non-magnetic bridge-piece D spans the gap between the pole-pieces C and serves to support a spindle E. This spindle carries the second magnetic member, or armature, F and is journaled at one end in the bridge-piece at E^1 and at the other end at E^2 in a projection secured to the magnet.

The pole-pieces C are provided with horn-like extensions C^1 extending in opposite directions to one another in the direction of the circular path of the ends of the bar F, each extension being directed away from the pole-piece in a direction opposite to that of the desired rotation of the member F. The inner faces of the extensions C^1 however are not struck from the center E about which the member F rotates but at a larger radius from points correspondingly more remote from each face than the said center. By this means the inner faces of the extensions, that is to say those which are toward the member F, provide for that member, as it rotates, an air gap which varies from a minimum value at the position shown in Fig. 1 to gradually increasing values on either side of that position. A chain line in Fig. 1 indicates the path of the ends of the pivoted member.

The member F is in the form of a bar having polar extensions F^1 such that the general shape of the the bar with its extensions is that of the letter Z, the extensions F^1 being carried in the direction in which rotation of the bar F is desired. Coils G are carried upon the bar-like portion of the member F, the coils being connected in series with one another and supplied by current brought from brushes H to two slip rings J mounted on insulation on the spindle E. The brushes H are insulated from the base A if the latter is of conducting material, and the line wires are brought to the brushes.

Upon the spindle E is a worm E^3 which gears with a worm-wheel K, the worm-wheel K serving to drive the hands of a dial or other mechanism through suitable gearing.

A magnetic shunt L is provided across the magnet B between two points which lie within the polar ends B^1.

The operation of the device is as follows: When no current flows the armature F takes up the position shown in Fig. 1, since in that position the air gap is at its least so that the magnetic forces tend to bring it into that position. If now current be sent through the coils from the controlling wires of the system in such a direction that, assuming the right-hand pole-piece to be north as marked in Fig. 1, the right-hand end of the bar F is also made north, the armature will be rotated in the direction indicated by the arrow in Fig. 1. The direction of rotation is determined by the arrangement of the polar extensions C^1 and F^1 for it will be obvious that the right-hand polar extension F^1 will be subject to greater attraction from the left-hand pole-piece C in the direction of the arrow than in the reverse direction, while the left-hand extension F^1 will be similarly more powerfully attracted to the right-hand polar extension C^1 in the same sense of rotation than in the opposite. If the current be kept on sufficiently long to carry the armature around until the gap between the right-hand extension F^1 and the left-hand extension C^1 is less than that between the right-hand end of the bar F and the right-hand pole C, the movement will be completed even though the current be stopped, by the action of the permanent magnetism derived from the magnet B. If, however, the current be not stopped, then the action will be completed under the joint effect of the said permanent magnetism and that produced by the current in the coils C. Whether the current be left on or whether it be cut off at the point above indicated, the movement will cease when the armature has turned through 180°, since in this position the condition of minimum air gap is again attained and it is this condition which determines the position of rest of the armature. In other words, the armature is magnetically locked in this position. If by inertia it tends to over-shoot the mark, it will be drawn back ultimately to the said position of rest. If current be again sent through the coils in the same direction any number of times, no further movement occurs, but if now a current be sent in the reverse direction the above described movement will be repeated as will be readily understood. Thus the operation is dependent upon current impulses that are alternately in opposite directions, and when once movement has been produced by current in one direction successive impulses in the same direction produce no effect of movement.

The inner face C^2 of the pole-piece is, for the greater part of its length, struck from the center about which the armature rotates but is tapered off toward each end as at C^3. The object of this is to serve to pull the armature magnetically well within the embrace or the pole-piece and its extension without, however, giving it a very definite position of rest; it will readily be appreciated that at any point intermediate of the parts C^3 the air-gap is of uniform length

and the armature F will remain at rest at any point within a considerable range of movement. There are also preferably conductors M formed of copper wires passing through holes in the extension C^1, the ends of the wires being riveted into plates of copper M^1 to form amortisseurs in the well known manner.

Preferably the coils G are shunted by a non-inductive shunt G^1 connected across the brushes H as shown in Fig. 2: the effect of such a shunt is to minimize or reduce sparking at the contact through which current is sent to the line wires of the clock circuits, and it also tends in some degree to brake the movement of the armature F if the current be cut off from the line before the movement is at an end.

The arrangement shown in Fig. 1 causes the rotation of the pivoted member to occur with certainty and always in the same direction. It will be observed that the extensions F^1 have a direction which is forward as referred to the direction of rotation and may thus be called "leading" extensions, while those on the stationary poles, namely C^1, have a backward direction as referred to the direction of rotation, and may therefore be called "trailing" extensions, coupled with the fact that the position of rest is as shown in Fig. 1, that produces the said certainty of operation in this construction.

An advantage arising from the construction illustrated together with the employment of the magnetic shunt L is that the parts may be so designed as to operate with certainty throughout a considerable change in the strength of the current delivered to the coils G. Hitherto failure has frequently occurred in clock systems through the falling off of battery power, and in order to meet this the movement according to this invention may be constructed to respond to very feeble currents, such as would be received from a weak battery; on the other hand, when the battery is fresh there would be danger of the strong currents through coils G demagnetizing the permatnent magnet to a greater or less degree, but the shunt L eliminates this danger almost entirely and at the same time the construction is such that small polarization of the movable member F is sufficinet to secure definite action.

We desire it to be understood that slight changes in the construction, arrangement and combination of parts may be resorted to without departing from the spirit of our invention, provided such changes fall within the scope of the appended claims.

What we claim as our invention and desire to secure by Letters Patent is:—

1. In an electrically-operated mechanism of the character described, the combination of a rotatably supported magnetic rotor provided with pole pieces having each a single polar extension lying in the plane of rotation of the rotor and projecting forwardly in the direction of rotation thereof, a magnetic stator supported so as to embarce said rotor and provided with pole pieces having each a single polar extension lying in the plane of rotation of the rotor and rearwardly directed against the direction of rotation thereof, rods of less electrical resistance than said pole pieces mounted in spaced relation therein, and plates for connecting said rods, substantially as described.

2. In an electrically-operated mechanism of the character described, the combination of a magnetic yoke, a pair of pole pieces secured to the outer ends of said yoke providing therewith a permanent magnet, a non-magnetic bridge supported between said pole pieces, a spindle journaled in said yoke and bridge, an armature mounted on said spindle in the gap between said pole pieces, a magnetic shunt arranged between the ends of said yoke in proximity to said pole pieces, an extension on each of the pole pieces of said permanent magnet lying in the plane of rotation of said armature and rearwardly directed against the direction of rotation thereof, a plurality of rods of less electrical resistance than said pole pieces mounted in the extensions thereof, plates connecting said rods, and extensions on said armature projecting forwardly in the direction of rotation thereof and coöperating with the extensions on said pole pieces, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

LEONARD JAMES ARON.
CHARLES EDWARD HARRISON.

Witnesses:
HARRY B. BRIDGE,
PERCY HEWITT.