No. 834,098. PATENTED OCT. 23, 1906.

C. A. ABLETT.

ALTERNATING CURRENT MOTOR.

APPLICATION FILED JULY 30, 1903.

2 SHEETS—SHEET 1.

Fig. 1

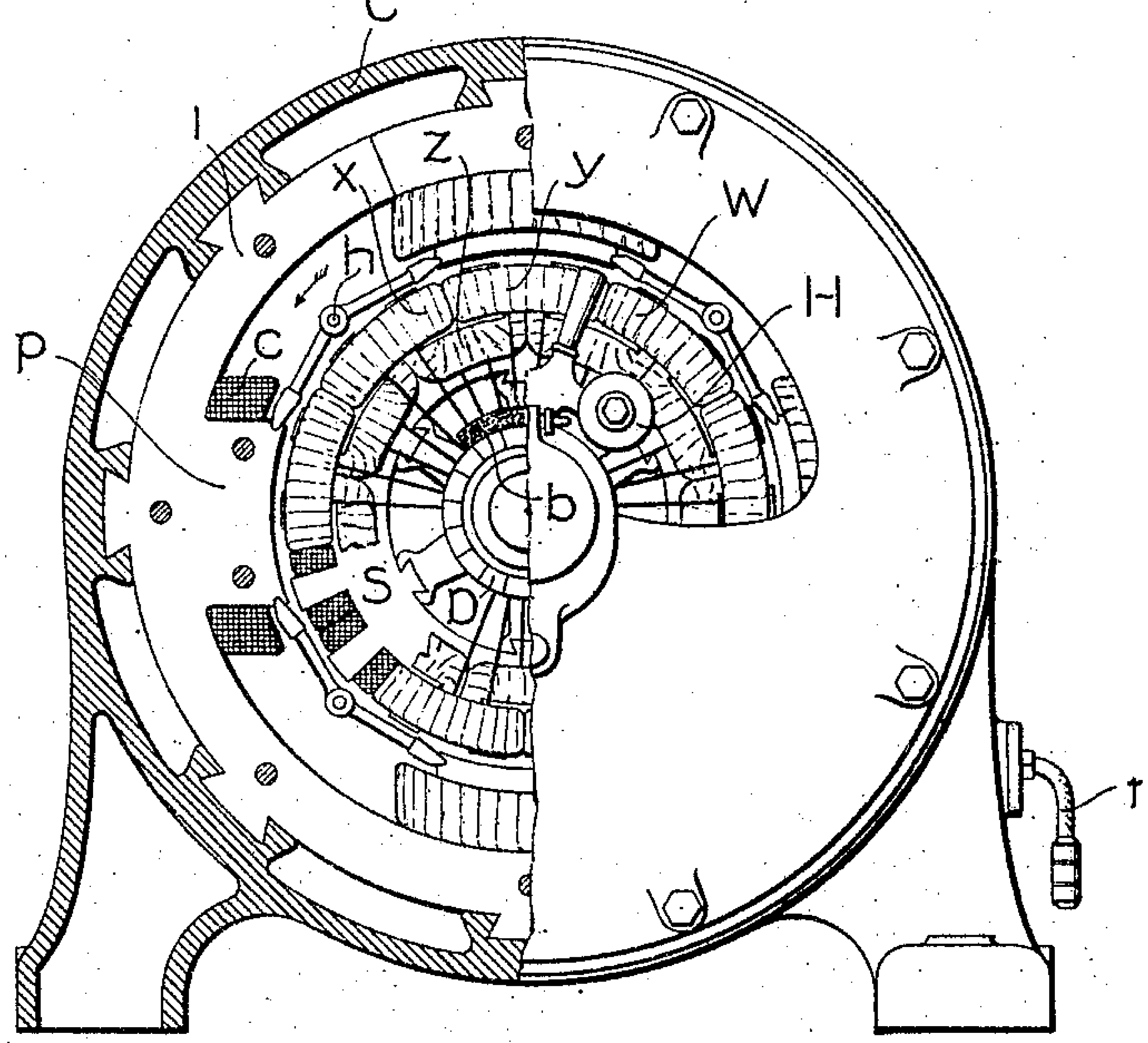
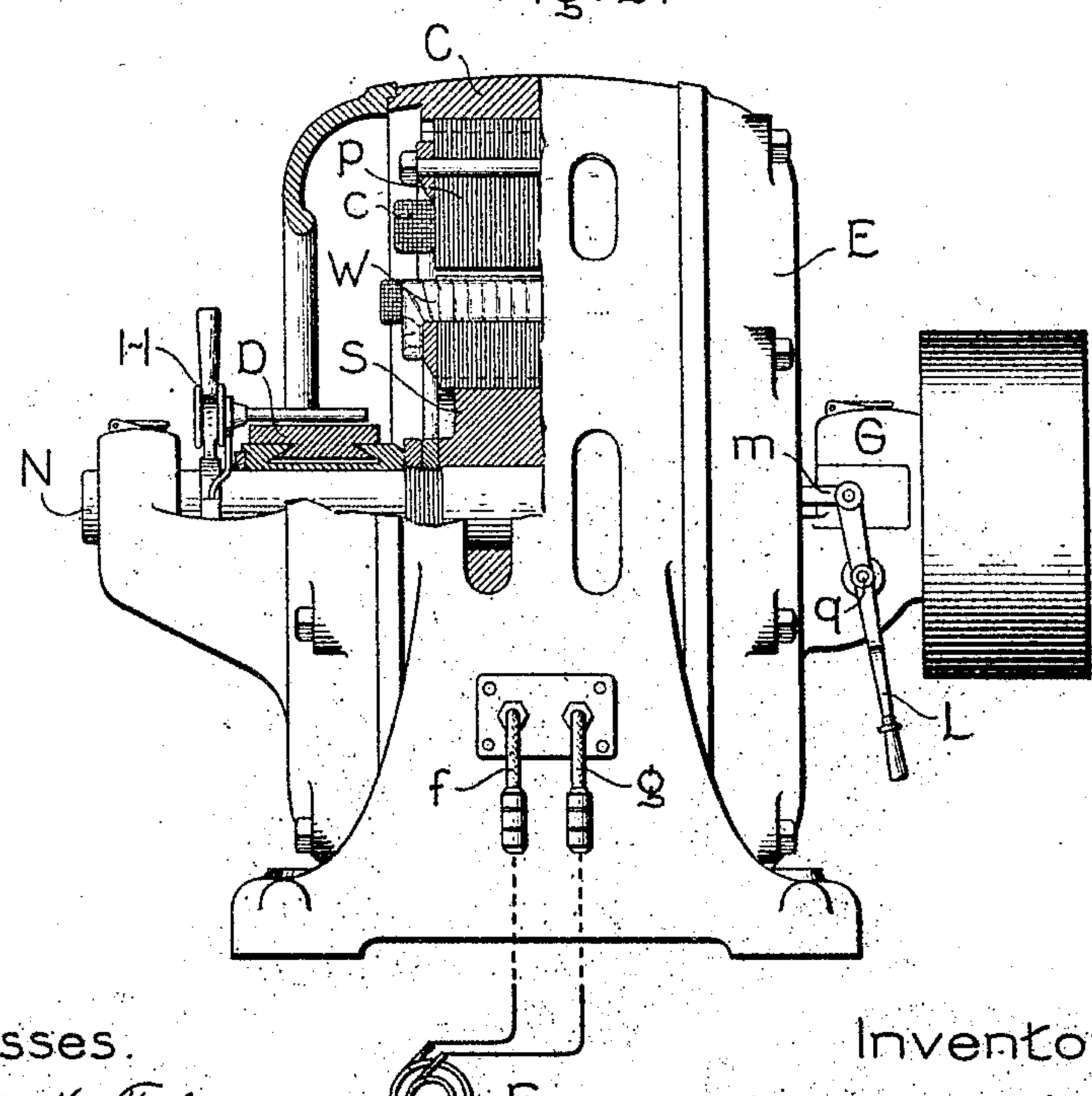


Fig. 2.



Witnesses.

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2 SHEETS—SHEET 2.

Fig. 3

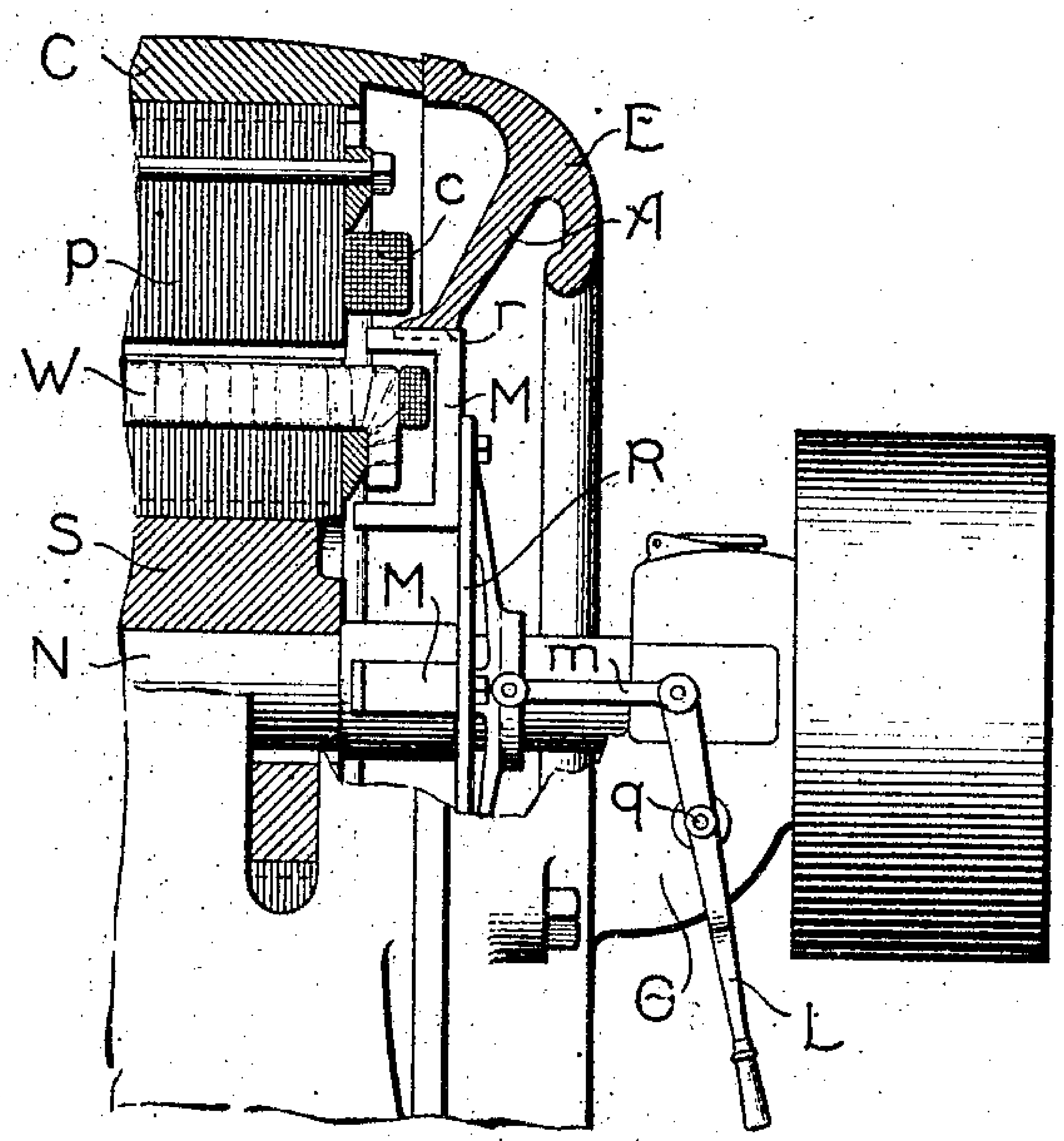
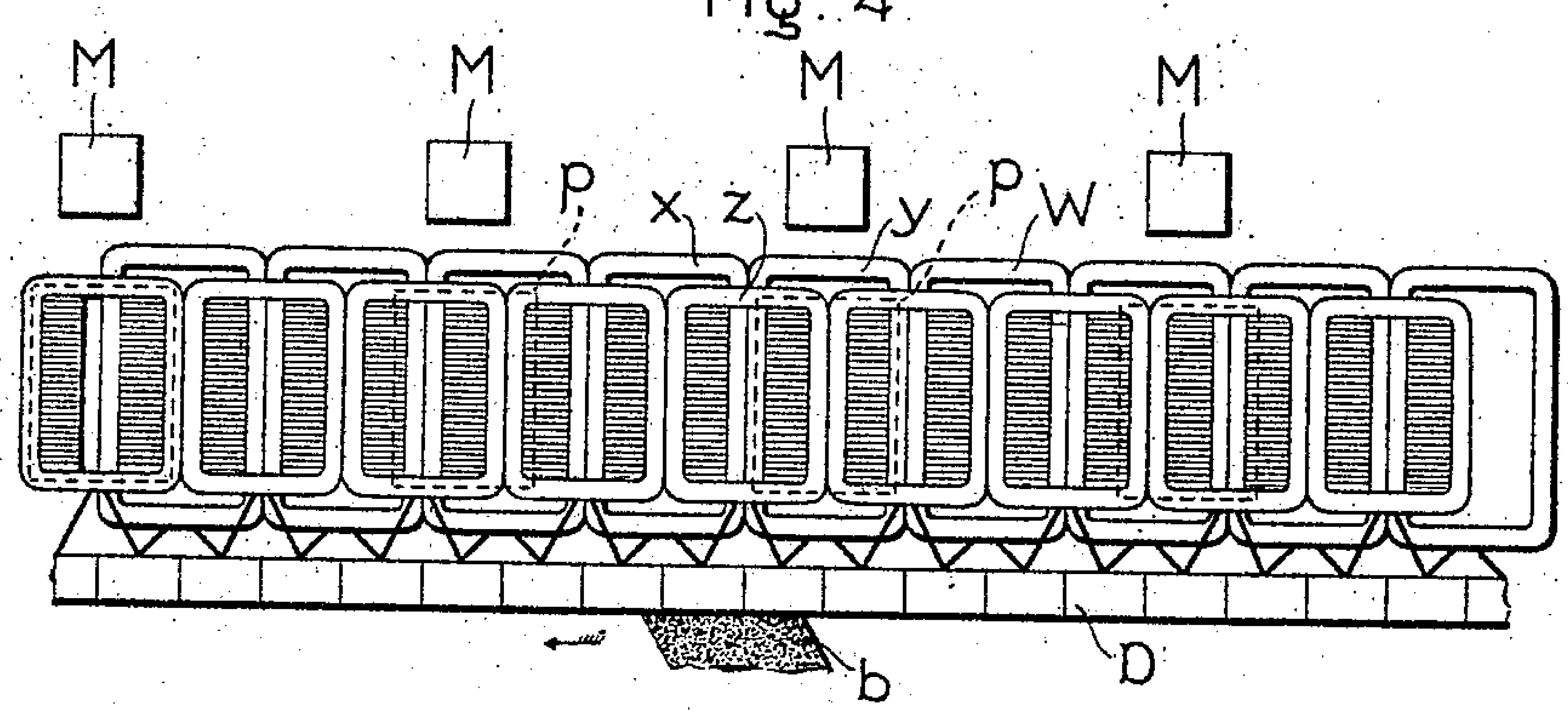


Fig. 4



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UNITED STATES PATENT OFFICE.

CHARLES A. ABLETT, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ALTERNATING-CURRENT MOTOR.

No. 834,098. Specification of Letters Patent. Patented Oct. 23, 1906.

Application filed July 30, 1903. Serial No. 167,529.

To all whom it may concern:

Be it known that I, Charles A. Ablett, a subject of the King of Great Britain, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Alternating-Current Motors, of which the following is a specification.

This invention relates to alternating-current electric motors. Motors of this class in which commutators are employed have not come into practical use, largely on account of the destructive sparking which occurs at the commutator.

The object of my invention is to so reduce such sparking that it will be practically inconsiderable. I accomplish this result by reducing the self-induction of each coil of the secondary winding and the resultant magnetic flux through it to a minimum at the time at which its circuit is broken at the commutator. This may be accomplished by constructing the core of the primary circuit with polar projections and so proportioning the width and pitch of said polar projections and the width of the coils of the secondary winding that a position may be found in which the self-induction of the coil of the secondary occupying that position, and the magnetic flux through it, will be so reduced that its circuit may be broken without causing any serious sparking at the break. This condition may be produced in the case of a repulsion-motor by constructing a primary with polar projections and making the coils of the secondary of a width not greater than the distance between said projections, the circuit of each coil being broken in the position in which it incloses the fewest magnetic lines. The action may be assisted by placing between the polar projections a ring or plate of conducting material to screen the secondary coils when between the projections from the magnetic influence of the primary.

I have found it advantageous to have self-induction of the secondary circuits of a repulsion-motor less in certain positions with relation to the primary when the motor is starting than it is when the motor is running.

It is therefore a further object of my invention to provide a motor in which these conditions will be realized. This I do by constructing a motor the secondary circuits of which have the proper self-induction for one condition and providing means for suitably changing such self-induction to meet the other condition. This change in self-induction of the secondary circuits may be brought about by changing the reluctance of the magnetic circuit of the secondary winding.

Referring to the accompanying drawings, Figure 1 is a side elevation, partly in section, of a repulsion-motor embodying my invention. Fig. 2 is an end elevation of said motor with parts broken away and shown partly in section and with an alternating-current source of supply (shown in diagram) connected thereto. Fig. 3 is a side view, partly in section, of the pulley end of the motor, showing a means for changing the self-induction of the secondary circuits, while Fig. 4 is a development of the secondary member of the motor, the location of the polar projections being indicated by dotted lines and the position with relation to said projections of certain portions of my induction-changing device being also shown.

Referring to the figures, C is the frame of the machine, usually of cast-iron, having dovetailed slots for receiving appropriate projections from the laminations *l*, which constitute the primary core. The laminations constituting the polar projections *p* are in this case stamped in the same piece with those constituting the remainder of the primary core and are held in place by the usual clamping bolts and rings. The primary coils *c* may be slid onto the projections after the machine has been assembled, and they are held in position by the flux-screens *h*, which may be of a construction similar to the ordinary antihunting devices—such, for instance, as shown in Patent No. 650,677, issued to Geisenhoner and Knight, May 29, 1900. These screens extend between the polar projections, and are secured in place by engagement with the notches in said projections, as shown.

The construction of the primary thus far described is not new and may be varied as circumstances require. The coils *c* are connected in any suitable relation to produce north and south poles alternately about the frame and are connected to the alternating source of supply F, as indicated in Fig. 2, the leads *f* and *g* being connected to the terminals of coils *c*. Upon the secondary member S, which may be constructed in any well-known and suitable manner, is placed the secondary winding W, which comprises individual coils, as x, y, and z—that is, each coil is adapted to be short-circuited upon itself without other coils in series with it. Each of said coils is of approximately the same width as a polar projection p, and it will be noted that the width of the polar projection is less than one-half of the polar pitch. At certain times, therefore, the coils will lie between the polar projections and will be entirely removed from beneath them. In this position these coils are removed from inductive relation to the primary, and their magnetic circuits are practically broken, thereby reducing the magnetic flux through them and also their self-induction to a minimum. The flux-screens h assist the action by choking back any leakage flux which might tend to flow between the poles.

The width of each secondary coil should be not greater than the distance between the polar projections, and if its width is somewhat less than that distance the action will be improved, because the current in the secondary coil will have an opportunity to die down after the coil has passed out of inductive relation to the primary circuit. The coils are wound in two-phase relation—that is to say, in two sets—one of which is displaced ninety degrees from the other, the sides of adjacent coils of one set being placed in the same slot. Any other suitable arrangement of coils might be used however. From the terminals of each of the secondary coils leads are brought out and connected to segments of the commutator D. Bearing upon the commutator D are brushes b, which are so proportioned and placed as to short-circuit each of the secondary coils when it is in operative relation to the primary and to open the circuit of said coil when it lies between the polar projections. In this case the brushes are of sufficient width to cover two commutator-segments. When the width of each coil is less than the distance between projections, the operation is improved if the brushes are so set that the circuits of the coils will be broken after the coils have remained between the projections for a short interval, thus giving the current a chance to die down before the circuit is broken, and I have so shown them in the drawings. Although not shown in the drawings, it will be understood that there will be a brush for each polar projection. H is a rocker-arm of any suitable type, the supporting means for the brush shown being omitted, as it would merely complicate the drawings without aiding in the illustration of my invention.

The relative positions of the parts as the various secondary coils move into and out of action and their circuits are made and broken may be understood by reference to the coils x, y, and z in Figs. 1 and 4, the direction of rotation being as indicated by the arrows. The coil y lies directly under a polar projection and has not yet been short-circuited, for, as is well known, the axis of the coil should be at an angle to the polar line when its circuit is completed. The axis of the coil z lies at an angle with the polar line. The coil is short-circuited and is in inductive relation to the primary, being still under the polar projection. It is therefore in operative condition. The coil x has just passed out of inductive relation to the primary, but its circuit is still closed and remains so for a short interval after the coil has come between the projections in order to allow the current to die down before the circuit is broken. A small further movement of the secondary member S opens the circuit of coil x and closes the circuit of coil y, the axis of the latter then being at an angle to the polar line, and the circuit of the coil z remains closed. Continued movement of the secondary member causes succeeding secondary coils to be brought into and out of action in a similar manner. Similar operations take place at each of the polar projections.

I will now describe my device for varying the self-induction of the secondary circuits. It is best shown in Fig. 3. The secondary coils are wound so as to extend beyond the primary, as shown. The end plate E of the machine-frame has at each polar projection an arm A, having a slot r, in which is adapted to slide a guide-piece secured to the U-shaped mass M of magnetic material, the masses M being adapted to embrace the extended portions of the secondary coils. Sleeved upon the shaft N is a ring R, (which for best results should be of non-magnetic material,) to which are rigidly secured the various masses M. Ring R is slidable upon shaft N through such distance as is necessary to cause the masses M to approach and recede from the secondary coils sufficiently to produce the desired change in self-induction of said coils, such movement of the ring being brought about by means of links, as m, located on each side of the shaft N, said links being pivoted to ring R and also to the arms of an actuating-lever L, which is pivoted at q in the pulley-bearing G. Movement of the handle of the lever L toward and away from the frame of the machine will cause the desired movements of the masses M, as described. Care should be taken to so mount the masses M that no considerable amount of the primary flux will pass through them. This may be done by making the air-gaps between said masses and the primary and secondary cores considerably greater at all times than the air-gap between the primary and secondary members, as will be well understood. The proportions of the masses M should be such as to produce the desired induction in the given case.

By referring to Fig. 4 the winding of the secondary member will be more plainly seen and also the relative positions of the brushes and the polar projections. The relative location of the masses M is also shown in this figure. It will be noted that these masses are located in line with the polar projections, for while it is desired that the coils of the secondary winding shall be under the influence of these masses when the motor is running, yet this is only true when the coils lie under the polar projections—that is, when they are in inductive relation to the primary. It is not desirable at any time that coils lying between the poles should have self-induction, and in the construction shown coils in this position are not affected. The direction of rotation of the secondary member is indicated in this figure by the arrow.

The motor shown may be considered as constructed to give the appropriate conditions for either the starting or running operation, since it is a matter of proportioning the parts to produce the proper self-induction in the secondary coils for the given case, as will be readily done by one skilled in the art. In the preceding description the motor was assumed to be constructed to meet starting conditions and a device was described for increasing the self-induction of the secondary coils to that value required to meet the running condition. The motor might, however, have been considered as constructed to meet the requirements of running, in which case a device would be employed to decrease the self-induction of the secondary coils to that value required to meet the starting condition. The device as already illustrated and described is suitable for the latter purpose without any structural change other than forming the masses M of solid conducting material instead of laminated magnetic material.

In accordance with the patent statutes I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown in the drawings is only illustrative and that the invention may be carried out by other means than the specific embodiment which I have shown.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination of a primary core, a primary winding thereon, an alternating source of supply connected thereto, a secondary core, coils constituting a secondary winding in which currents are induced by said primary winding, a commutator connected to said secondary winding, and brushes bearing on said commutator arranged to open and close the circuits of said coils, the whole being so proportioned and constructed that the circuit of each of said coils will be broken when its self-induction and the magnetic flux through it is a minimum.

2. The combination of a primary core having polar projections, a primary winding upon said core, an alternating source of supply connected thereto, a secondary core, coils constituting a secondary winding in which currents are induced by said primary winding, each of said coils being less in width than the distance between polar projections, a commutator connected to said secondary winding, and brushes bearing upon said commutator arranged to open and close the circuits of said coils, the said brushes being so positioned that the circuit of each of said coils will be broken when it lies between said polar projections.

3. The combination of a primary core having polar projections, flux-screens between said polar projections, a primary winding upon said core, an alternating source of supply connected thereto, a secondary core, coils constituting a secondary winding in which currents are induced by said primary winding, each of said coils being less in width than the distance between polar projections, a commutator connected to said secondary winding, and brushes bearing upon said commutator arranged to open and close the circuits of said coils, the said brushes being so positioned that the circuit of each of said coils will be broken while it lies between said polar projections.

4. The combination of a primary core having polar projections, a primary winding upon said core, an alternating source of supply connected thereto, a secondary core, coils thereon constituting a secondary winding in which currents are induced by said primary winding, each of said coils being less in width than the distance between polar projections, a commutator connected to said secondary winding, and brushes bearing upon said commutator arranged to open and close the circuits of said coils, the whole being so constructed and arranged that the circuit of each of said coils is broken an interval of time after it has passed between said projections.

5. The combination of a primary core having polar projections which in width are less than one-half of the polar pitch, a primary winding upon said core, a secondary core, a secondary winding thereon comprising coils each of which is of approximately the same width as one of said polar projections, a commutator connected to said secondary winding, and brushes bearing upon said commutator arranged to open and close the circuits of said coils, the said brushes being so positioned that the circuit of each of said coils will be broken when it incloses the least magnetic flux.

6. The combination of a primary core having polar projections which in width are less

than one-half of the polar pitch, a primary winding upon said core, a secondary core and a secondary winding thereon comprising coils each of which is of approximately the same width as one of said polar projections, a commutator connected to said secondary winding, and brushes bearing upon said commutator arranged to open and close the circuits of said coils, the whole being so constructed and arranged that the circuit of each of said coils will be broken when it lies between said projections.

7. The combination of a primary core having polar projections which in width are less than one-half of the polar pitch, a primary winding upon said core, a secondary core, a secondary winding thereon comprising coils each of which is of approximately the same width as one of said polar projections, a commutator connected to said secondary winding, and brushes bearing upon said commutator arranged to open and close the circuits of said coils, the said brushes being so positioned that the circuit of each of said coils will be broken an interval of time after it has passed between said projections.

8. The combination of a primary core having polar projections which in width are less than one-half of the polar pitch, a primary winding upon said core, a secondary core, a secondary winding thereon comprising individual coils each of which is of approximately the same width as one of said polar projecjections, a commutator connected to said coils, and brushes bearing on said commutator and arranged to close the circuits of said coils when they are in operative relation to said polar projections and to open said circuits when the coils lie between said polar projections.

9. The combination with a motor, requiring different self-induction in its secondary circuits for starting from that required for running, of a member in inductive relation to said secondary circuits and movable relatively thereto and adapted to vary by its movement the self-induction of said circuits.

10. The combination of a motor constructed to have suitable self-induction in its secondary circuits for the condition of starting, and a member in inductive relation to to said secondary and movable relatively thereto and adapted to increase by its movement the self-induction of said secondary circuits to a point at which the best running condition is obtained.

11. In an alternating-current motor, a stationary primary core, a primary winding thereon, a rotary secondary core, a secondary winding carried thereby, and means for changing the reluctance of the magnetic circuit of the secondary winding, whereby the self-induction of the secondary winding is varied.

12. The combination of a primary core, a primary winding thereon, a secondary core, a secondary winding thereon, masses of magnetic material, and means for causing said masses to approach and recede from said secondary winding.

13. The combination of a primary core, a primary winding upon said core, a secondary core, coils thereon comprising a secondary winding, and means for changing the self-induction of said coils at that time only when they are in inductive relation to said primary winding.

14. The combination of a primary core having polar projections, a primary winding on said core, a secondary core, coils thereon, masses of magnetic material, and means for causing said masses to approach and recede from the coils which lie under said polar projections.

15. The combination of a primary core having polar projections, a primary winding on said core, a secondary core, coils thereon extending beyond the primary core, masses of magnetic material, and means for causing said masses to approach and recede from the extended portions of those coils which lie under said polar projections.

16. The combination of a primary core having polar projections, a primary winding on said core, a secondary core, coils thereon extending beyond the primary core, masses of magnetic material adapted to embrace the extended portions of said coils, and means for causing said masses to approach and recede from said extended portions of those coils which lie under said polar projections.

In witness whereof I have hereunto set my hand this 28th day of July, 1903.

CHARLES A. ABLETT.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.