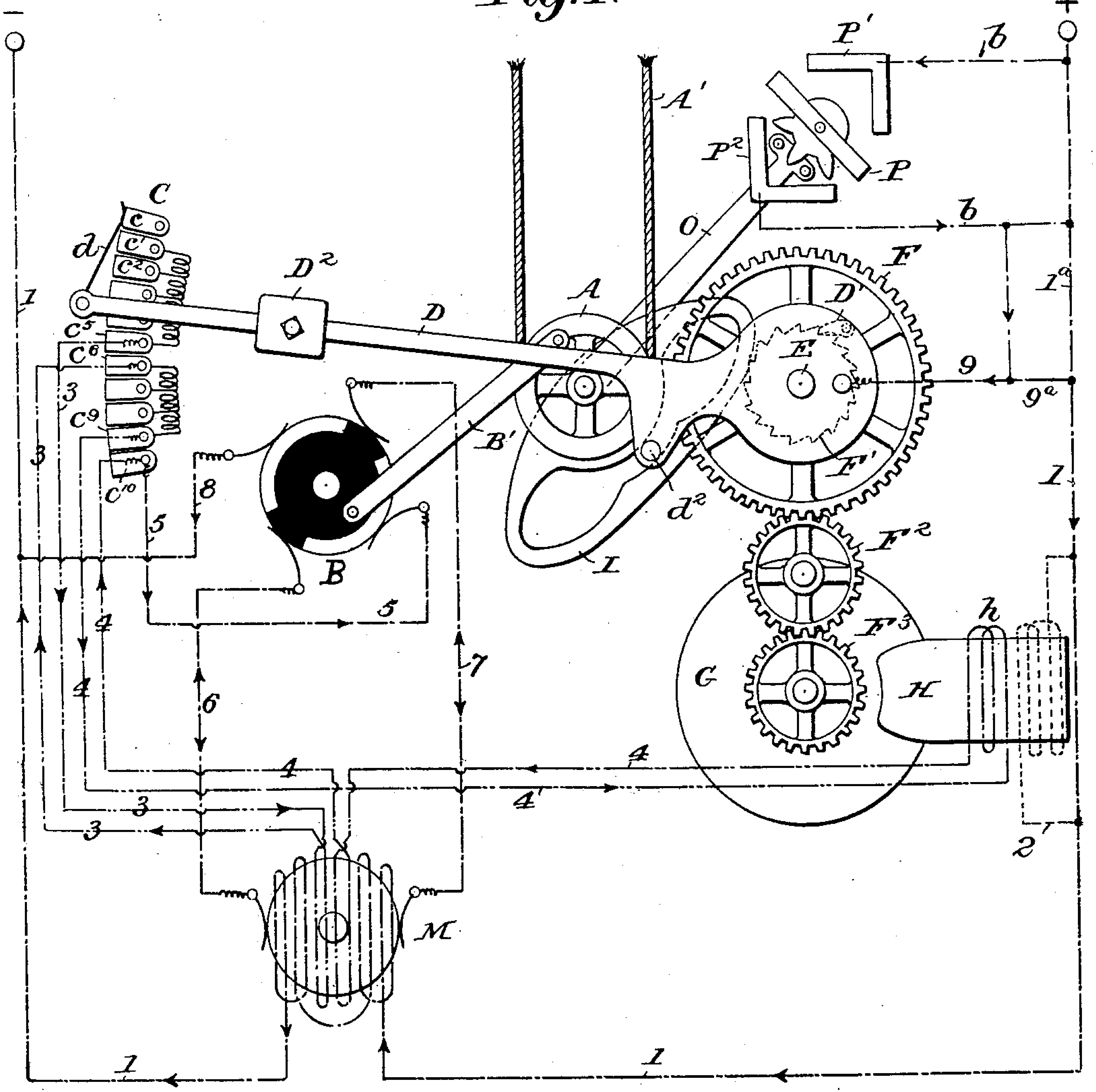
(No Model.) 2 Sheets—Sheet 1.

J. D. IHLDER.

ELECTROMAGNETIC DASH POT.

No. 560,216. Patented May 19, 1896.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2

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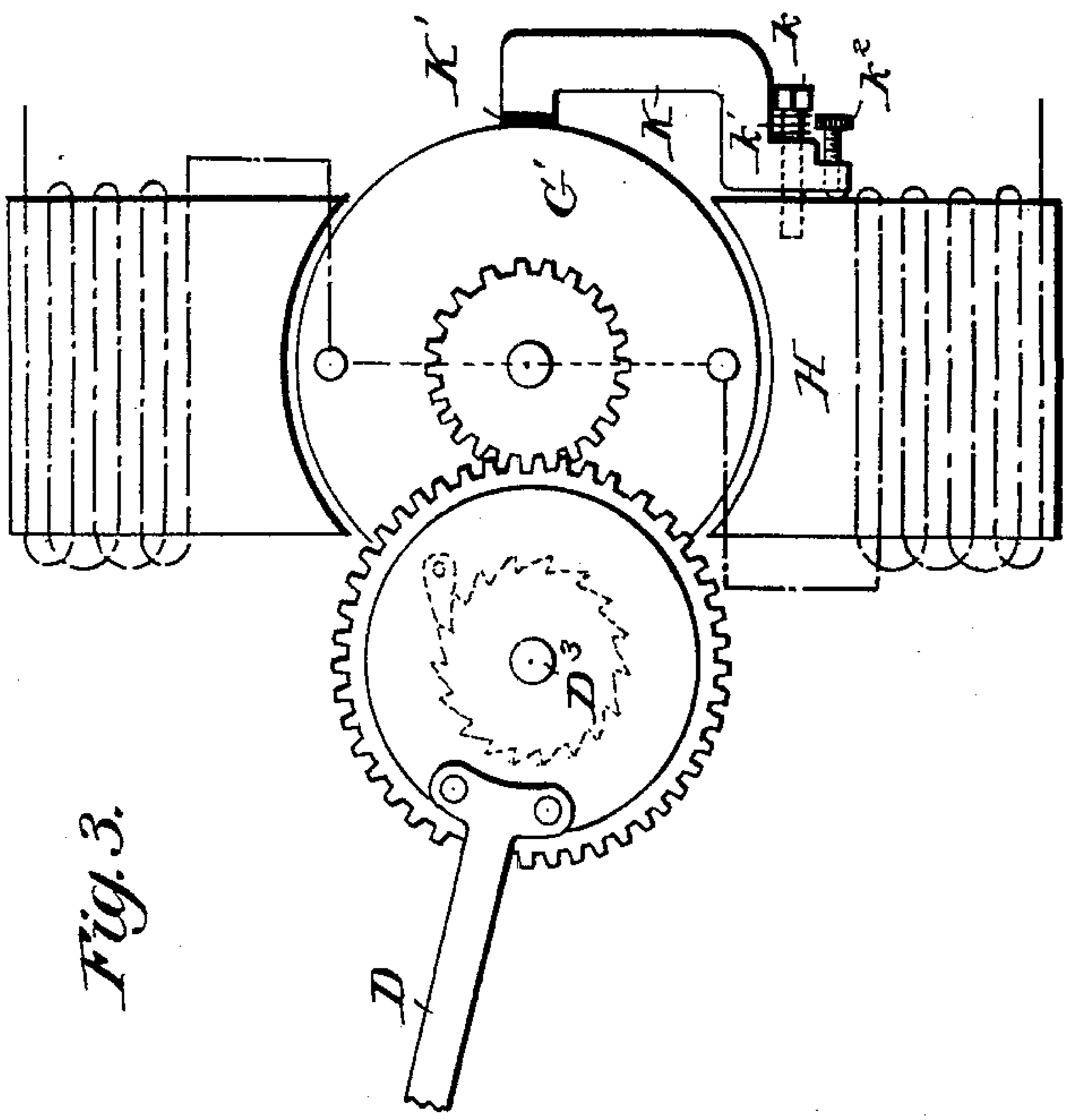

Fig. 3.

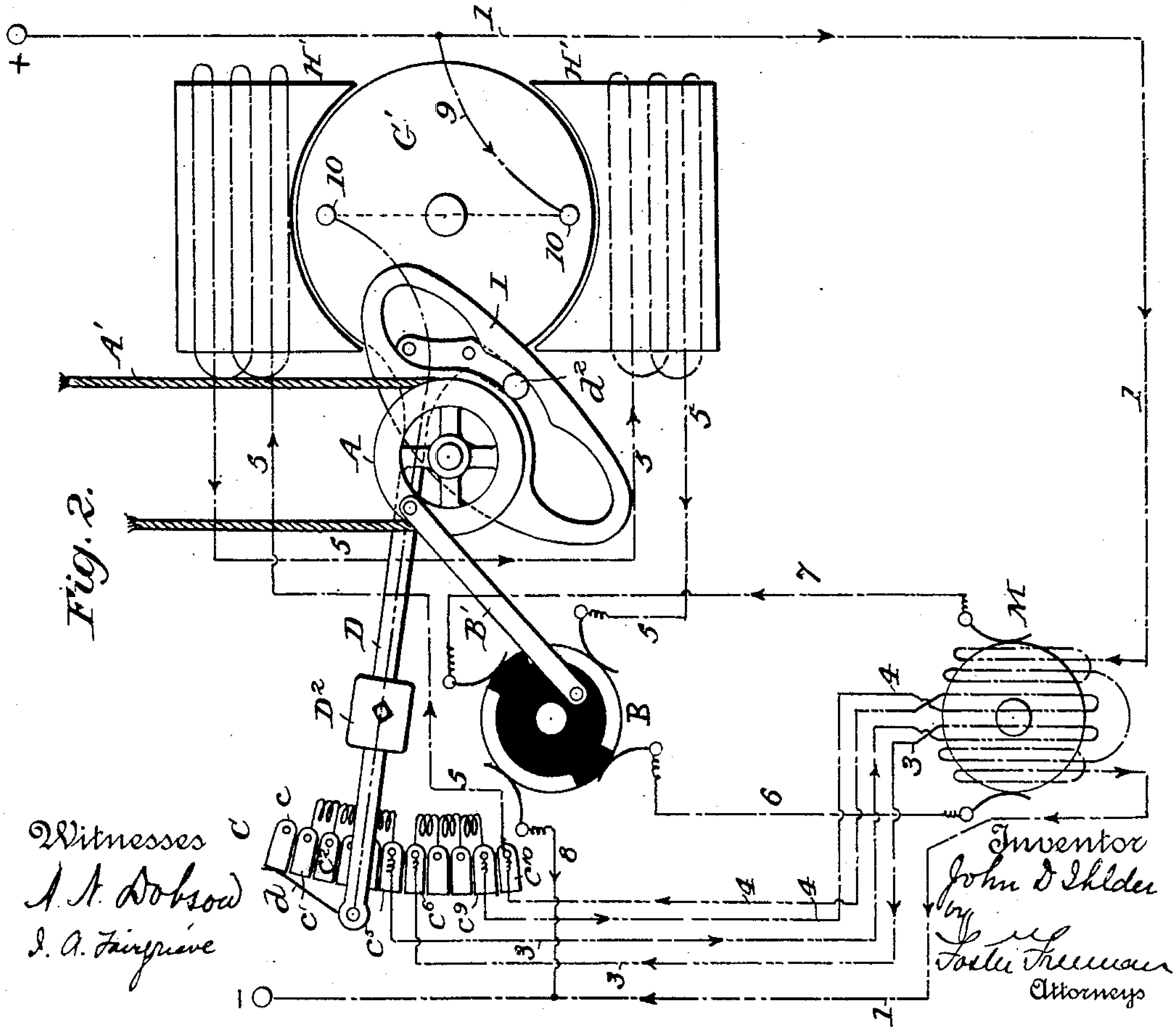

Fig. 2.

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UNITED STATES PATENT OFFICE.

JOHN D. IHLDER, OF YONKERS, NEW YORK, ASSIGNOR TO THE OTIS BROTHERS & COMPANY, OF NEW YORK, N. Y.

ELECTROMAGNETIC DASH-POT.

SPECIFICATION forming part of Letters Patent No. 560,216, dated May 19, 1896.

Application filed February 8, 1895. Serial No. 537,716. (No model.)

To all whom it may concern:

Be it known that I, JOHN D. IHLDER, a citizen of the United States, residing at Yonkers, Westchester county, State of New York, have invented certain new and useful Improvements in Electromagnetic Dash-Pots, of which the following is a specification.

My invention relates to electric motors, and more particularly to means for regulating the starting of said motors; and it has for its object to provide improved means for this purpose which shall operate automatically and magnetically to control the electric current passing to the motor in starting; and the invention consists in the various features of construction and arrangement of parts, having the mode of operation substantially as hereinafter more particularly set forth.

Referring to the accompanying drawings, Figure 1 is a diagrammatic representation of one embodiment of my invention. Fig. 2 is a similar diagrammatic representation of a modified arrangement of the invention, and Fig. 3 is a detail view showing a modified arrangement of part of the apparatus for carrying out my invention.

It is well known that in starting an electric motor, especially when used in connection with a constant-potential circuit, it is desirable to admit the current to the armature of the motor gradually, and to do this it has been common to include a certain amount of resistance in the armature-circuit of the motor, which resistance is gradually reduced or cut out as the speed of the motor increases and the counter electromotive force of the motor accumulates. A number of devices have been suggested to accomplish this general purpose of automatically reducing the auxiliary resistance of the armature-circuit of a motor, and it has been suggested to use in connection with such devices a mechanical dash-pot to control their operation, and it is one of the objects of my invention to do away with this mechanical dash-pot and accomplish the same purposes and objects by electromagnetic devices, and a portion of my invention may be said to consist in an electromagnetic dash-pot, which is arranged and connected with the other parts of the apparatus in such a way as to control or regulate the motor. While such an apparatus is capable of many and various uses wherever electric motors, and especially shunt or compound wound electric motors, are used, I have shown my invention in the present instance as adapted to be used in connection with electric elevators, for which purpose it is specially adapted, and I will explain the principles thereof in that connection, without, of course, intending to limit my invention to such uses.

It is not deemed necessary to show the entire electric-elevator apparatus, as such is well known and understood by those skilled in the art, and only the parts necessary to a clear understanding of the present invention are displayed in the drawings.

Referring more particularly to Fig. 1, (although corresponding parts are similarly lettered in other figures,) A represents the usual wheel or pulley around which the hand-rope A′ passes, which hand-rope, as is usual, is under the control of the operator in the car of the elevator, and this wheel is mechanically or manually operated by the hand-rope or some equivalent device in order to start and stop the electric motor, which may be connected in any of the usual ways with the elevator-car or with other machinery which it may drive.

M represents diagrammatically an electric motor, which may be of any desired type or construction, but is shown in the present instance as being a shunt or compound wound motor, in which a portion of the coils of the field-magnet are included in a constantly-closed branch circuit between the main-line terminals plus and minus. Thus it will be seen that the conductor 1 is shown diagrammatically as forming a portion of the field-magnet coils in a constantly-closed shunt, although of course, if desired, the usual make-and-break switch may be applied to break the shunt whenever the motor is stopped and to close the shunt whenever it is started.

The armature-circuit of the motor includes a pole-changer or current-reverser B, which may be of any usual and well-known type, and which in the present instance is illustrated as comprising a plate or cylinder having on its periphery certain portions of conducting material and non-conducting material arranged in the well-known manner, and this current-reverser is also shown as being operated mechanically by a connecting bar or rod B', which in this instance is connected positively to the wheel or pulley A and directs the current through the armature in one direction or the other, according as the wheel or pulley A is rotated in one direction or the other. Also included in the armature-circuit of the motor is an auxiliary resistance device C, composed in the present instance of a number of plates c c' c^2 c^5 c^6 c^9 c^{10}, with intermediate resistance-coils between the contact-plates, except at the extremities, and between plates c^5 c^6. Connected to operate with this resistance is a lever-arm D, carrying on its extremity a spring-arm or contact-piece d, adapted to sweep over the various contact-plates c as it is moved in the manner hereinafter set forth. In Fig. 1 this lever-arm is shown as being mounted on an axle E, so that it can rotate freely thereon, and mounted on the same axle or shaft E is a gear-wheel F, having a ratchet-wheel F', with which a pawl D' on the lever-arm engages, so that when the lever-arm D is moved in one direction the wheel F and ratchet-wheel F' will not rotate, but when they are moved in the opposite direction the pawl D' will engage the ratchet-wheel F' and rotate the wheel F. This wheel F is connected in the present instance through a train of wheels F^2 F^3 with a metal disk G, which is mounted in such a relation to the magnet or pole-piece H as to be within the magnetic field thereof, so that the movements of the disk will be influenced or controlled by such magnetic field, thus acting as a magnetic brake or dash-pot. This magnetic field may be produced in many and various ways, which will readily suggest themselves to those skilled in the art, and may be used in accordance with the requirements or wishes of any particular case. Thus, if it is desired to make a uniform magnetic field in which the disk shall operate, such field may be readily produced by a shunt-winding from the field-magnet circuit, as is indicated in dotted lines 2, while a variable magnetic field may be produced by winding the magnet or pole-piece H in series with the armature-circuit, and consequently the speed of rotation of the disk G will vary in proportion to the current passing through the armature-circuit, and this is generally a more desirable arrangement, as the less work the motor has to do the quicker will the lever-arm be allowed to cut out the auxiliary resistance in the armature-circuit. This winding (indicated in Fig. 1) will be explained more fully hereinafter. So far we have assumed that the weight of the lever-arm itself is sufficient to operate it to cut out the resistance gradually; but if this is insufficient a counterweight D^2 may be applied to the lever-arm, and this is preferable, and preferably is made adjustable, so that by properly adjusting the switch in relation to the other parts of the apparatus the resistance may be cut out of the armature-circuit in the most satisfactory manner. This lever-arm D is preferably arranged so that in cutting out the resistance it can move under the control of the magnetic brake or dash-pot device; but when the motor is stopped it is generally desirable to cut in the resistance to the armature-circuit quickly and positively, so that accidents may be avoided, and especially if the motor is again started immediately after being stopped the resistance should all be included in the armature-circuit without fail, and for this purpose there is provided a cam I, which in this instance is attached to the shaft of the wheel or pulley A and is operated mechanically therewith, and is so arranged that the lever-arm is positively moved upward or in such a direction as to cut in the resistance whenever the pulley A is moved in a position to stop the motor. Various forms and shapes of cams or other equivalent devices may be used, but that shown in the drawings is simple and effective, and it will be observed that the lever-arm D is provided with a stop or stud d^2, which fits in the cam-recess, and when the parts are in their normal position, as shown in the drawings, the lever-arm is raised to its upper position, but when the pulley or wheel A is moved in either direction the cam-slot permits the lever-arm to move downward without being positively controlled by the cam, but when the cam is restored to its normal position the lever-arm is positively lifted by the stud d^2, bearing on the cam-face, so that the resistance in the armature-circuit is positively included.

While, as above indicated, the motor may be variously wound and various arrangements of the contact-pieces of the resistance may be made, I have indicated in the drawings an arrangement in which the contact-piece c is insulated from the others, so that when the brush d of the lever-arm D is on the contact-plate c the circuit of the armature is broken, but as soon as it moves onto contact-plate c' all the resistances between the adjacent plates are included in the armature-circuit. I have also shown an arrangement whereby the series field-magnet coils are arranged in sections and are included between some two of the various contact-plates. As, for instance, connected to contact-plate c^5 is a conductor 3, which extends to the field-magnet coils of motor M and returns to contact-plate c^6. Again, contact-plate c^9 is connected by a conductor 4, which in this instance leads to the coils h of the electromagnet or pole-piece H, and thence includes a portion of the coils of the field-magnet of the motor M, and, returning, is connected to the contact-plate c^{10}, and it will be observed that when the brush d is on the contact-plate c^{10} all the series field-magnet coils are short-circuited or cut out, as well as the coils of the electromagnet H. From the contact-plate c^{10} leads a conductor 5, bearing on the pole-changer B, and from the pole-changer lead the conductors 6 7, connected to the brushes of the armature of the motor M, and a conductor 8 leads from the pole-changer to the main conductor 1, while a conductor 9 connects with the conductor 1 and with the lever-arm D which in this instance is shown as being of conducting material, although, of course, it may be otherwise made and the conductor 9 be connected directly to the brush d, or otherwise, as most convenient.

In the position in which the parts are shown in Fig. 1 it will be apparent that while the main field-magnet coils of the motor M are energized the armature-circuit is broken between the brush d and contact-plate c, and is shown as also being broken at the pole-changer B, which is the preferred arrangement. Assuming now that the pulley A is turned to the right to start the motor, the pole-changer will be rotated so as to connect conductors 5 and 6 and conductors 7 and 8 and direct the current through the armature of the motor in a certain direction, and at the same time the cam I has moved so that the stud d^2 is free to move in the cam-space, and the lever-arm (weighted or not, as the case may be) tends to fall to gradually cut out the resistance C on the armature-circuit. As soon as this moves, however, so that the brush d bears on the contact-plate c', the current passes through the various resistances and conductors connected thereto, energizing the magnet H, and as the pawl D′ engages the ratchet-wheel F′ and rotates the wheel F and its train of gears connecting it to the disk G this disk will be rotated in the magnetic field of the magnet H, which field will tend to retard or control the speed of rotation of said disk, thus regulating the movements of the lever-arm D, the magnet H and disk G acting as a brake or dash-pot to the movements of the lever-arm.

As before intimated, as the lever-arm moves, cutting out the resistance, the series field-magnet coils 3, when connected in the manner indicated, are cut out, and subsequently the series field-magnet coils 4 are cut out, and at the same time the coils h of the magnet H are cut out, when the full current is passing through the armature-circuit and the motor is working at its normal speed as a pure shunt-motor, the series field-magnet coils being used, preferably, in starting the motor, so as to more readily overcome the inertia of the motor and its load and to produce a relatively great torque at the moment of starting the motor. When it is desired to stop the motor, the cam is restored to its normal position, and the cam-face is such that it engages the stud d^2 and positively moves the lever-arm to the position indicated, and in doing so the pawl D′ passes over the ratchet-wheel F′ without moving the wheel F or the disk G, connected thereto. This arrangement embodies in one form the general principles of my invention in a practically-operating apparatus for many purposes; but it will be observed that by this construction there is nothing to prevent the lever-arm from cutting out all the auxiliary resistance whenever the cam is moved to release said arm, and this results in increasing the current in the armature to the maximum amount, and, while this is generally desirable, it may happen for some reason that the motor does not start properly and the internal resistance or counter electromotive force of the motor does not increase in the proper ratio, so that an undesirable excess of current may pass through the armature-circuit of the motor; and I therefore provide means whereby this excessive current may be avoided and the maximum current passing through the armature-coils may be limited to that which the motor can properly take without danger. One means of accomplishing this result is shown more particularly in Fig. 2, where most of the parts are the same and are similarly lettered as in Fig. 1, and need not be again described. In this instance, however, the lever-arm D is shown as formed or connected with a disk or armature of magnetic metal G′, which is arranged to move in the magnetic field produced by the magnets H′ H′, as before, but which magnets are energized somewhat differently, as will now be explained. In this case the magnets H′ are continuously energized and their coils are not cut out of circuit when the lever-arm reaches its lowermost position and the brush d is on the contact-plate c^{10}; but leading from said contact is a conductor 5, which includes the coils of the magnets H′, in series with the armature-circuit at all times, as is clearly indicated in the diagram, and this is true whether the series field-magnet coils 3 4, when used, are in or out of the series circuit and whether the motor is operating as a compound or simple shunt motor. This magnet and the circuits thereof are so arranged and the magnetization produced is such that the disk or armature G′ tends to turn in a direction to cut in the resistance C, while the weight D^2 tends to move the lever-arm D, and consequently the disk or armature connected thereto, in an opposite direction. It will readily be seen that by properly proportioning the strength of the magnetic field and the disk or armature thereof with relation to the weight such a torque may be produced on the disk or armature G′ as to just balance the weight of the lever-arm for a predetermined current passing through the armature and the magnets thereof, so that if an excessive amount of current passes through the motor M and the magnets H′ and disk or armature thereof the lever-arm will be moved upward to include more of the resistance until the resistance of the motor is increased to such an extent as to properly admit the entire current to pass through it, and it will thus be seen that I am enabled to so adjust the parts that under normal conditions the resistance will be gradually and regularly cut out of circuit, but under abnormal conditions the resistance will be cut in or out, according to the requirements of the case, so that all danger of injuring the motor or other parts is avoided, the apparatus being self-regulating and positive in its operation.

It will be obvious that the lever-arm may be attached directly to the disk or armature G', as shown in Fig. 2, or indirectly, as shown in Fig. 3, wherein the lever-arm D is connected to or mounted on a separate shaft D^3 and connected by gears to the armature G', or it may be arranged in any other equivalent manner, it being only necessary that it can be moved backward to cut in the resistance C by the armature or disk G'. Furthermore, the revolving disk or armature G' may be of any suitable construction—as, for instance, a thin copper disk when used in the manner shown in Fig. 1, in connection with the magnet or pole-piece H, or an iron disk or drum, as shown in Fig. 2, which may be constructed in various shapes and proportions and wound with more or less armature-coils 10, or it may be of non-magnetic material, or it may be simply a series of coils or any other well-known equivalent structure. Furthermore, it is not absolutely necessary to have the pole-pieces H', as surrounding the disk or armature with magnetized coils of wire may be made to answer the purpose; but I have not deemed it necessary to show all these modifications, as they are well-known equivalents of the structure shown, which is illustrated as typical and not as limiting my invention to the precise construction set forth.

It will further be understood that although the motor is shown as having a compound winding and the compound series field is divided into several parts and connected thereto between different resistance contact-plates other well-known arrangements may be provided; but by arranging the circuits in the manner illustrated the strength of the motor-field is gradually reduced, the speed thereof increasing steadily and without fluctuations of the armature-circuit.

Instead of the adjustable weight on the lever-arm heretofore described I may use a friction-brake, such as is illustrated in Fig. 3, in which there is a brake-piece K secured to the side of the pole-piece or magnet H and having one end bearing on the disk or armature G'. This brake-piece is shown as mounted on a stud k, having a spring k', which tends to hold it against the face of the pole-piece, and an adjusting-screw k^2 for regulating the air-gap between the brake-piece and the pole-piece. With this arrangement it will be seen that the brake-piece K is pressed against the disk with a pressure that varies as the magnetism in the pole-piece and disk varies, and this varies with the curent, in the manner heretofore pointed out, and the motion of the lever-arm is thereby regulated through the medium of the brake-piece in accordance with the current flowing through the motor. I have found it advantageous sometimes to tip the brake-piece K with non-magnetic material K' where it bears upon the disk or armature to prevent the parts sticking together. It will be seen that by regulating the air-gap between the magnet and brake-piece the force or power of the brake can be accurately and delicately adjusted.

A circuit-breaking switch may be operated to open and close the armature-circuit or both the armature and field, and in Fig. 1 I have shown an arm O, arranged to be moved with the hand-rope wheel A and to operate a switch-arm P, controlling the terminals P' P^2 in a manner well understood. It is evident that the portion 1^a of conductor 1 may be omitted and the whole current pass by the conductor 1^b through the break-switch, thus opening and closing both the armature and field circuits, or the portion 9^a of conductor 9 may be omitted and the break-switch P used to control the armature-circuit only. All these details of circuit connections, however, do not materially affect my invention.

Having thus described the general principles of my invention and illustrated the preferred manner of applying the same, so as to enable those skilled in the art to make use thereof, what I claim is—

1. The combination with a motor and resistance device in the armature-circuit thereof, of a lever-arm controlling said resistance device, and an armature connected to said lever-arm and controlling its movements in one direction, said armature moving in a magnetic field controlled by the resistance device, substantially as described.

2. The combination with a motor and resistance device in the armature-circuit thereof, of a lever-arm mechanically operated to cut out said resistance from the armature-circuit, and an electromagnetic device connected to the arm to control its movement in cutting out the resistance, the said electromagnetic device comprising an armature moving in a magnetic field controlled by the resistance device, substantially as described.

3. The combination with a motor and resistance device included in the armature-circuit of the motor, of a lever-arm mechanically operated to cut out said resistance device and mechanically and positively operated to cut in said resistance device, and an armature connected with said lever-arm to control its movement in cutting out the resistance, the armature moving in a magnetic field controlled by the resistance device, substantially as described.

4. The combination with a motor and resistance device therefor, of a lever-arm mechanically operated to cut out said resistance, and a disk connected to said lever-arm, said disk rotating in a magnetic field to control the movements of said lever-arm in one direction, the magnetic field being controlled by the resistance device, substantially as described.

5. The combination with a motor and resistance device included in the armature-circuit of the motor, of a lever-arm mechanically operated in one direction and controlled by an electromagnetic device and positively and mechanically operated in the other direction to cut in the resistance device, substantially as described.

6. The combination with a motor and resistance device included in the armature-circuit of the motor, of a shaft, means for moving the shaft, a lever-arm controlling the resistance device, connections on the shaft for positively moving the lever-arm in one direction, a pole-changer in the armature-circuit connected to be moved from the shaft, and a current-breaking switch controlled from said shaft, substantially as described.

7. The combination with a shunt-motor and resistance device included in the armature-circuit, of series field-magnet coils connected to said resistance device at different points thereof, means for controlling said resistance device and arranged on starting the motor to include the series field-magnet coils in the armature-circuit and to cut them out as the resistance is cut out of the armature-circuit, and electromagnetic devices for controlling said means, substantially as described.

8. The combination with a shunt-motor and resistance device included in the armature-circuit, of series field-magnet coils connected to the resistance device at different points, a lever-arm for cutting in and out said resistance device and controlling the series field-magnet coils, an electromagnetic device controlling said lever-arm in cutting out the resistance and included in the armature-circuit, and mechanical means for positively moving said lever-arm to cut in the resistance, substantially as described.

9. The combination with a motor and resistance device in circuit therewith, of a lever-arm controlling said resistance, a disk rotating in a magnetic field, and a pawl-and-ratchet connection between said disk and lever-arm, substantially as described.

10. The combination with an electric motor and resistance device therefor, of series field-magnet coils for the motor connected with said resistance device, a lever-arm controlling said resistance device, a disk connected with said arm, and a magnet controlling said disk and included in the resistance-circuit, substantially as described.

11. The combination with a motor and resistance device in the circuit thereof, of a lever-arm controlling said resistance device, a cam for moving said lever-arm in one direction, a disk controlling the movements of the lever-arm in the other direction, and a magnet controlling the said disk, substantially as described.

12. The combination with a field-magnet and a disk or armature, of a brake-piece connected to said field-magnet and bearing on the disk or armature and having a piece of non-magnetic material on its armature-bearing face, substantially as described.

13. The combination with a field-magnet and a disk or armature, of a brake-piece connected to said field-magnet, and means for adjusting the air-space between the brake-piece and field-magnet, said brake-piece bearing on the armature and acting as a brake therefor, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN D. IHLDER.

Witnesses:
JAMES S. FITCH,
O. B. WARING.