No. 894,237.

PATENTED JULY 28, 1908.

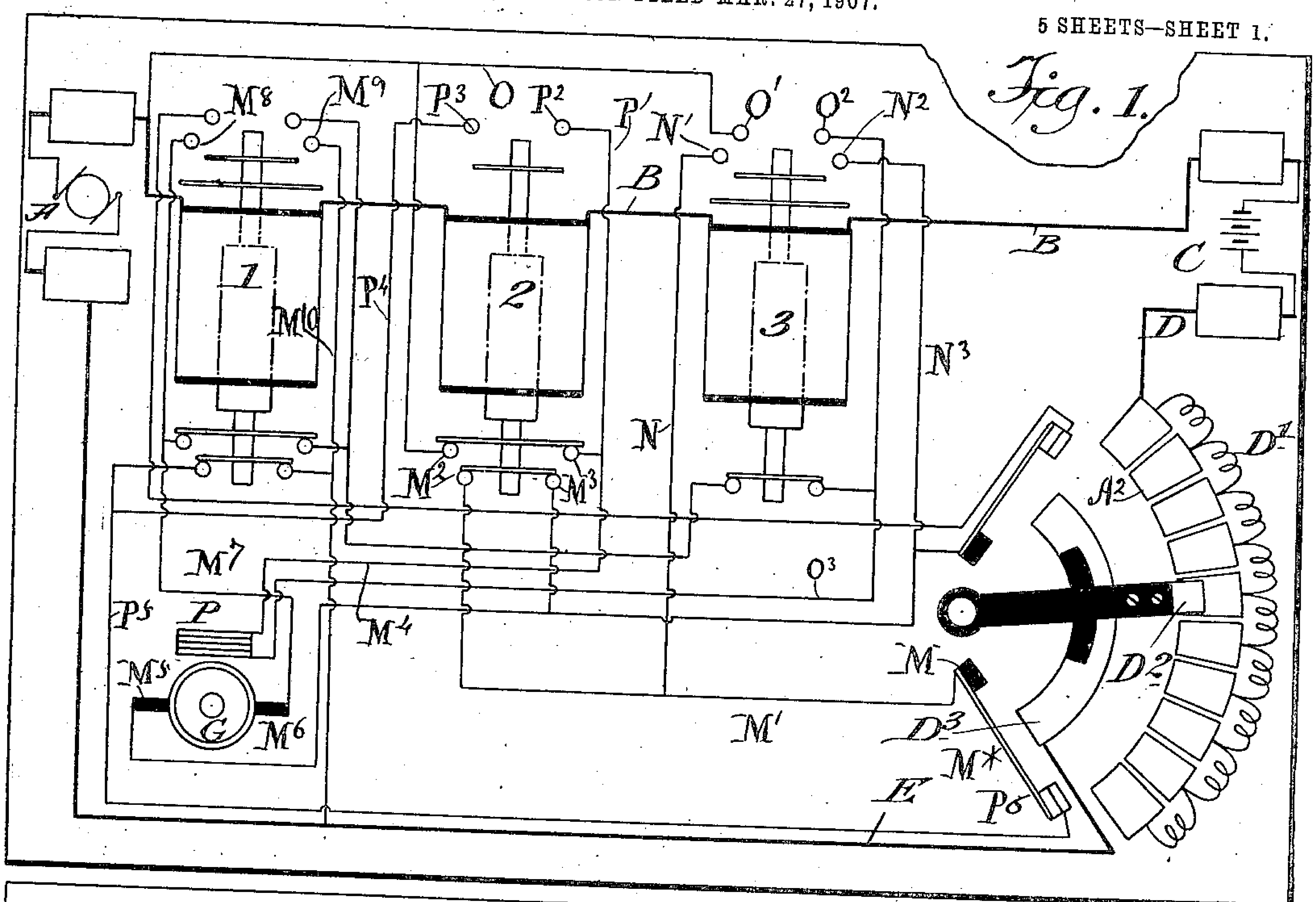
W. D. STIVERS, DEC'D.

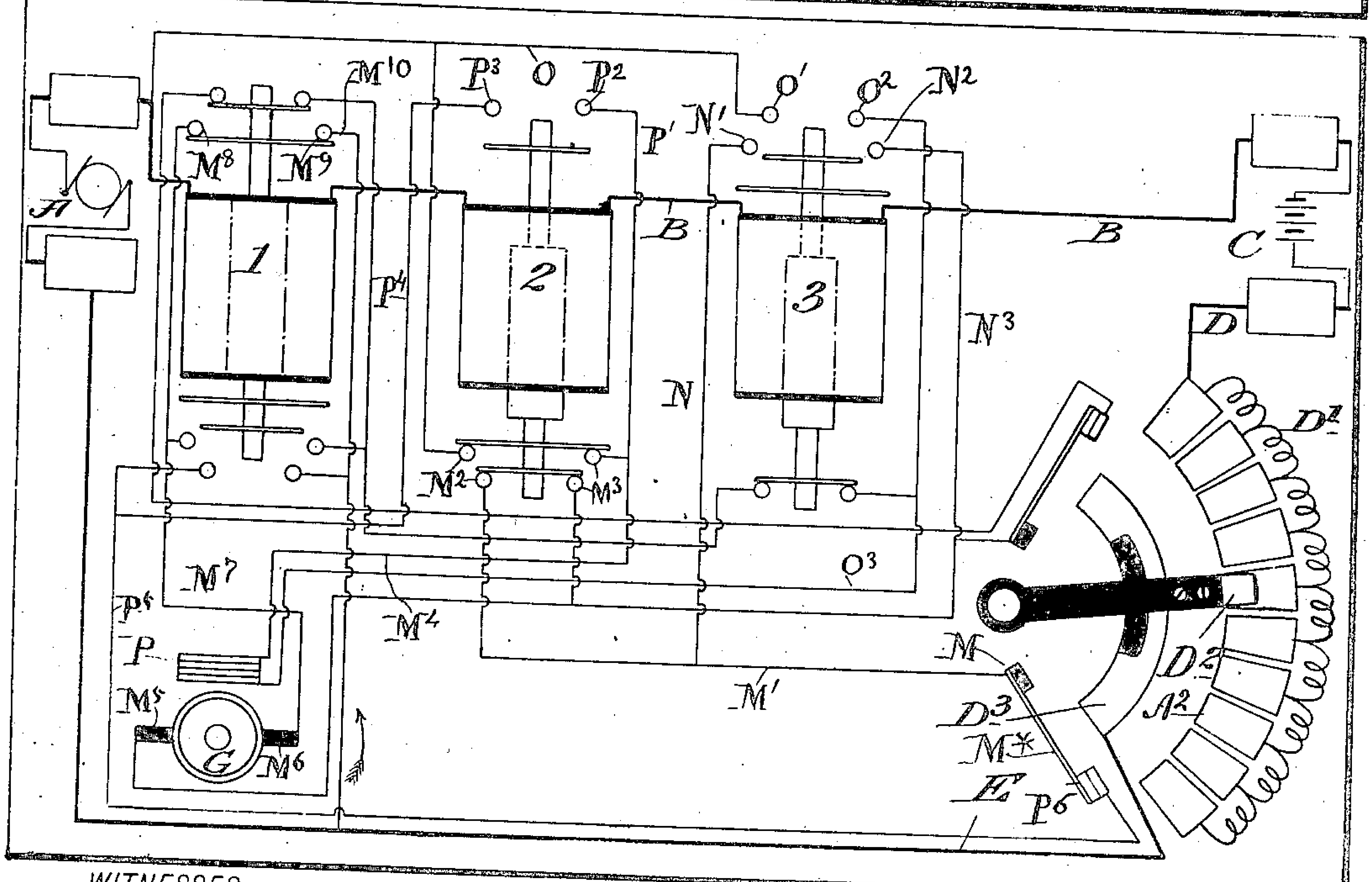
M. N. STIVERS, ADMINISTRATRIX.

MEANS FOR CHARGING STORAGE BATTERIES.

APPLICATION FILED MAR. 27, 1907.

5 SHEETS—SHEET 1.





WITNESSES

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Fig. 2.

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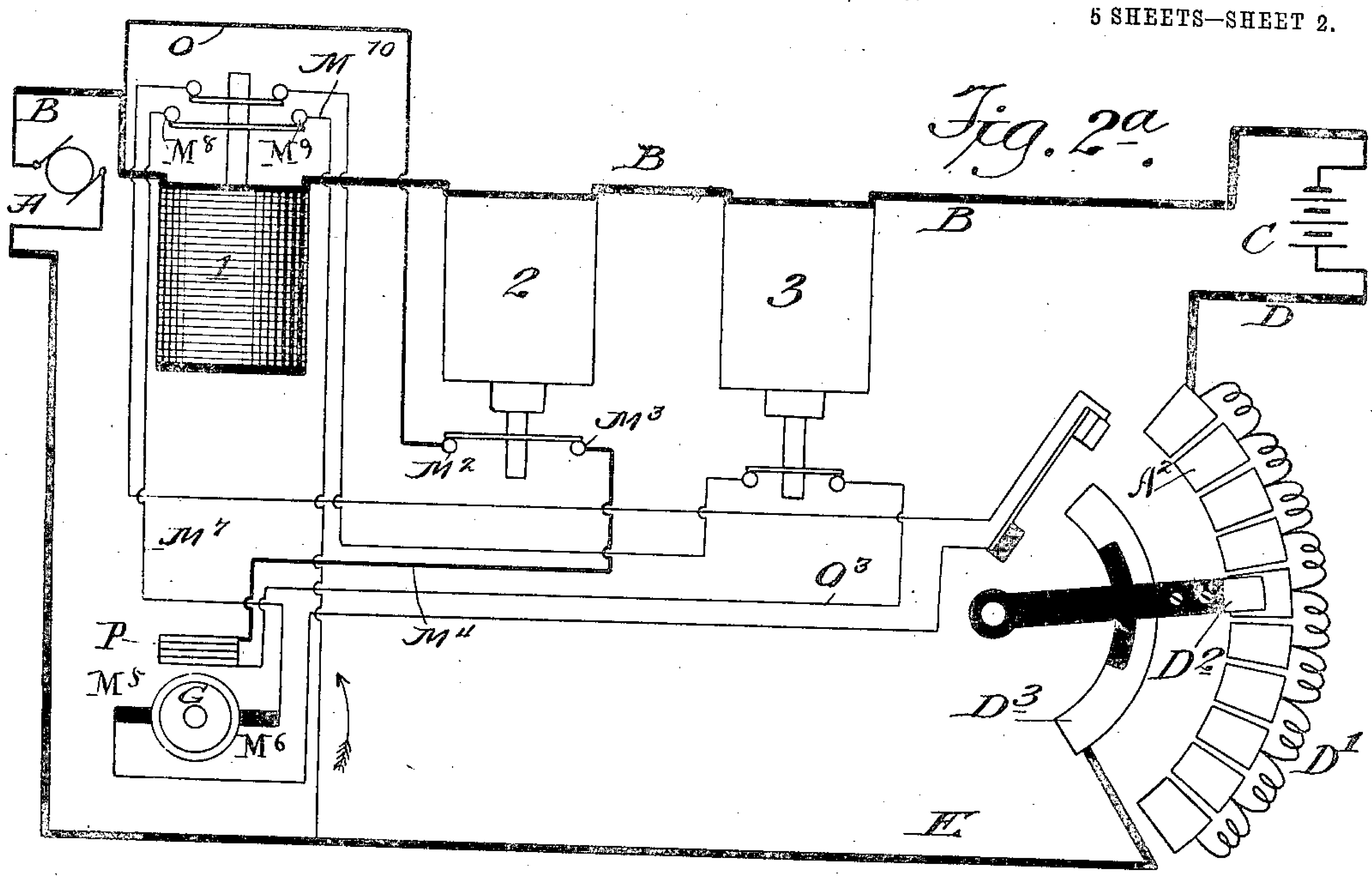

Fig. 2a.

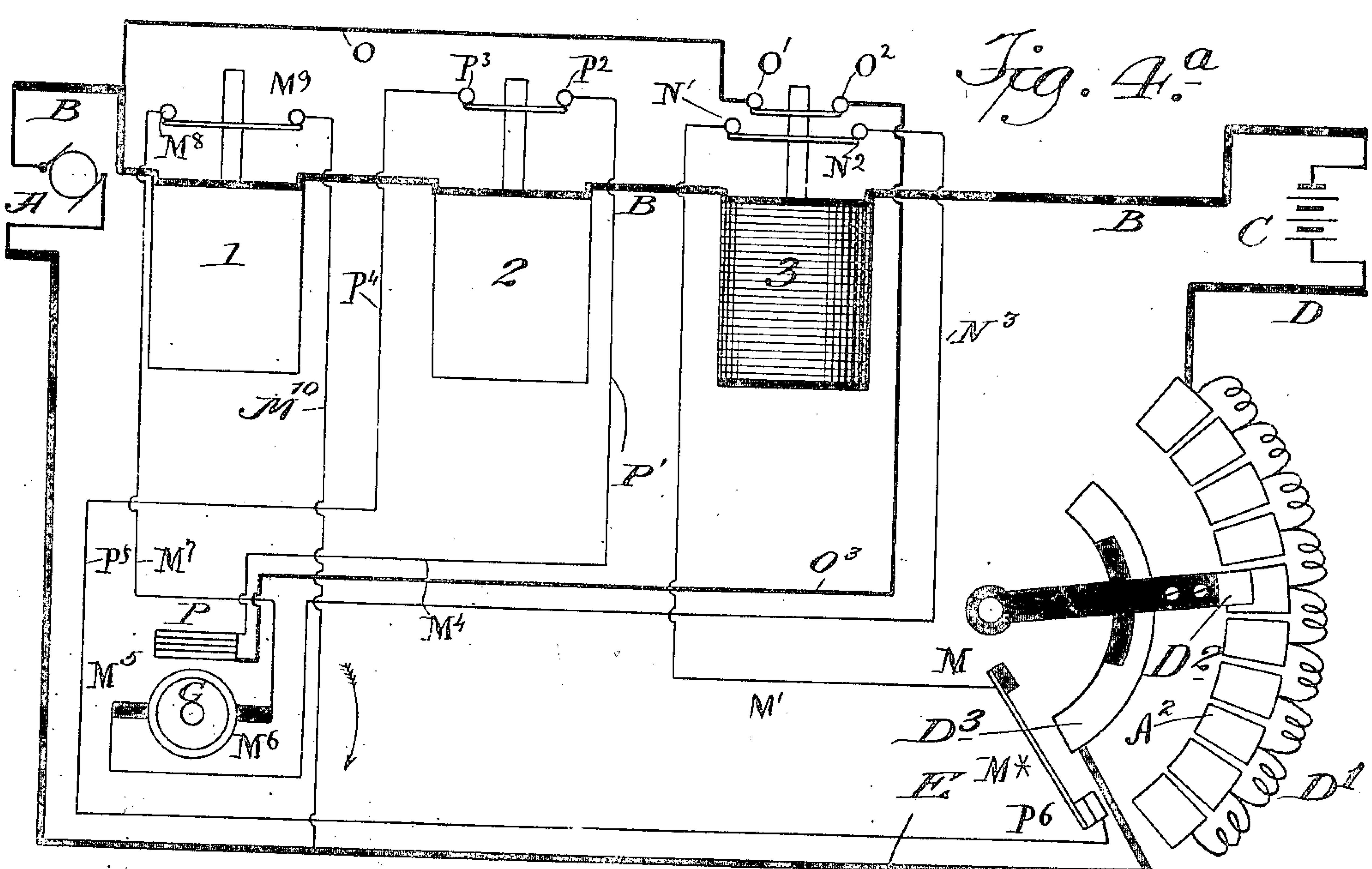

Fig. 4a.

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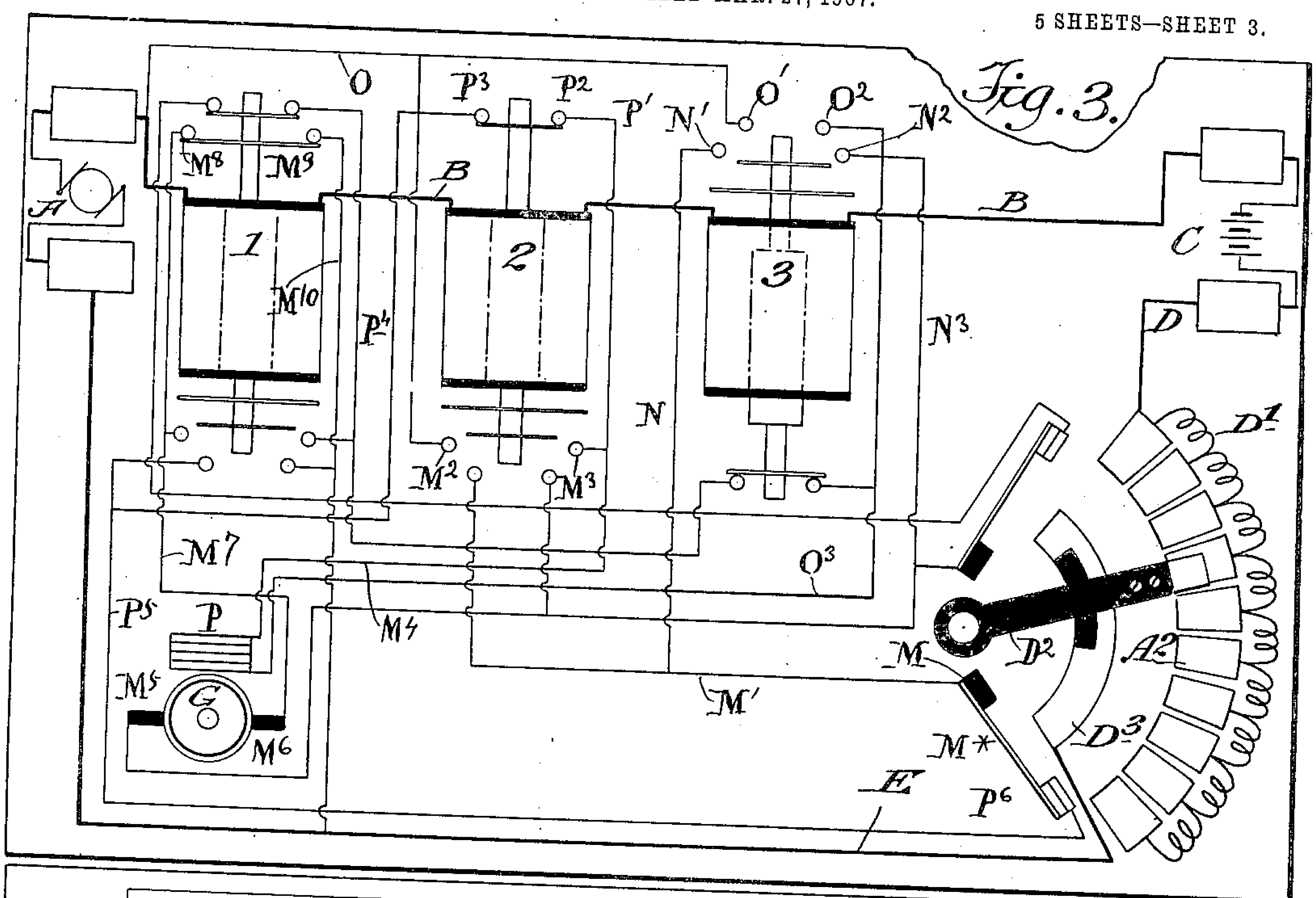

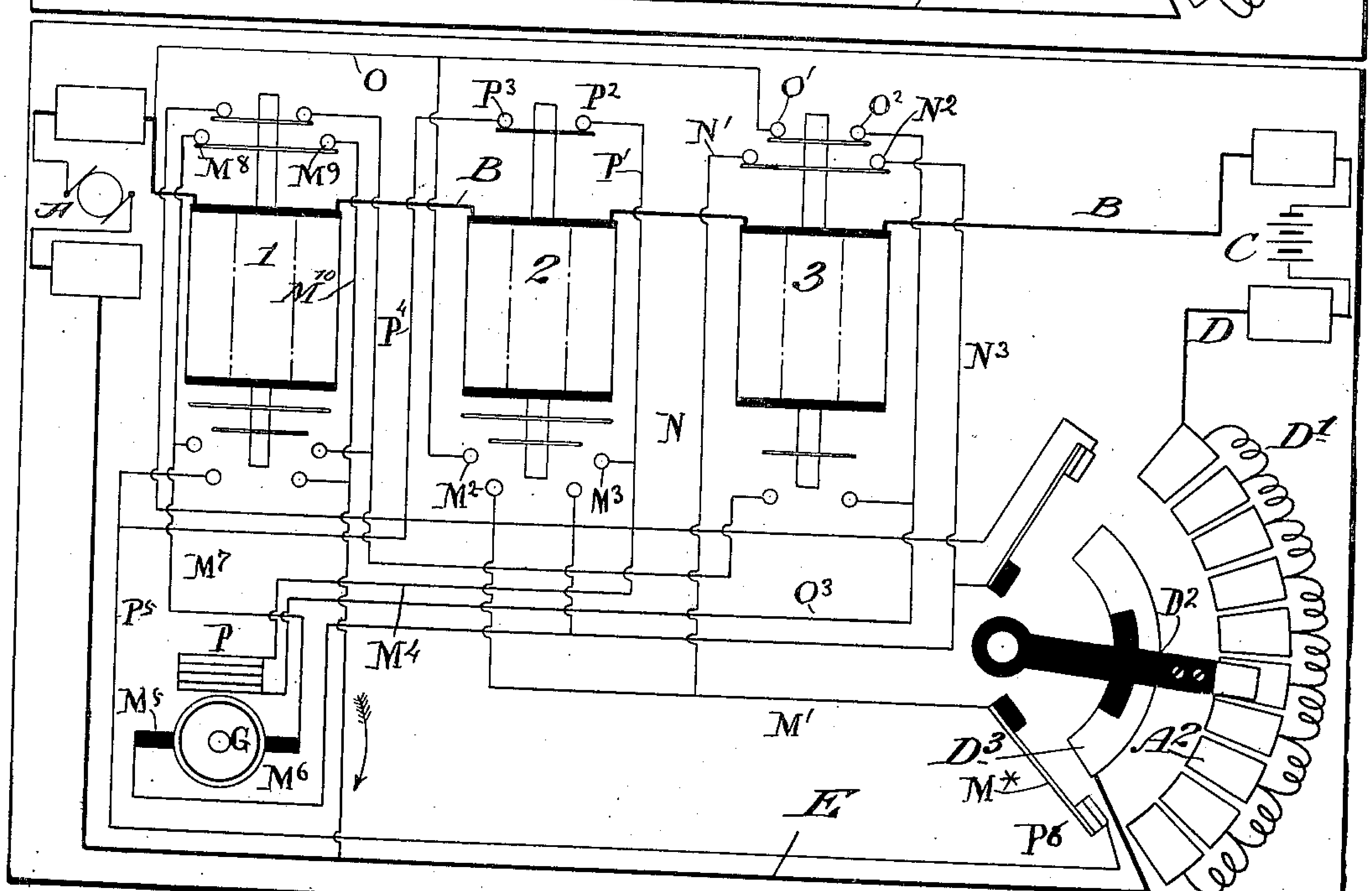

Fig. 4.

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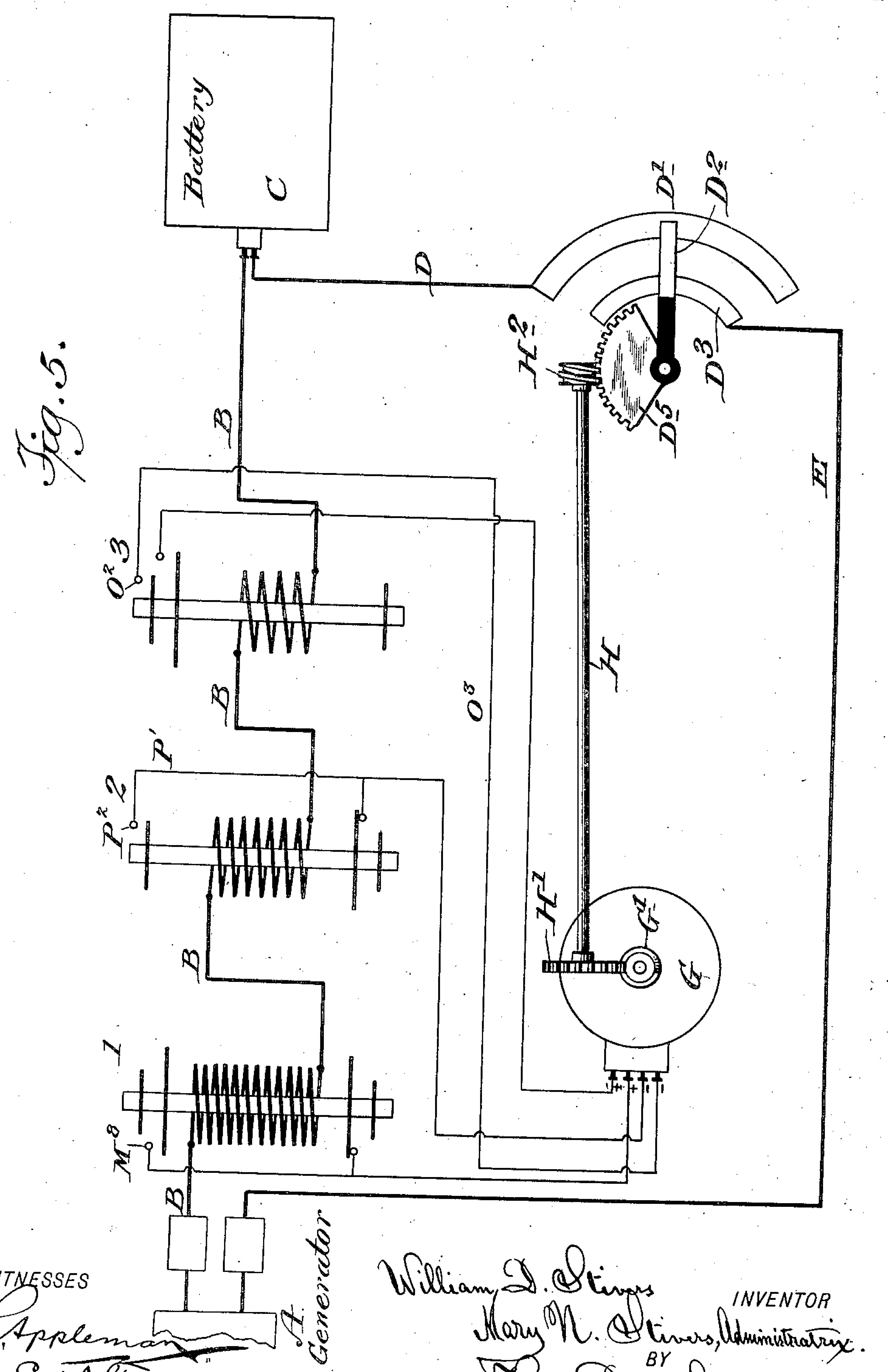

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Fig. 7.

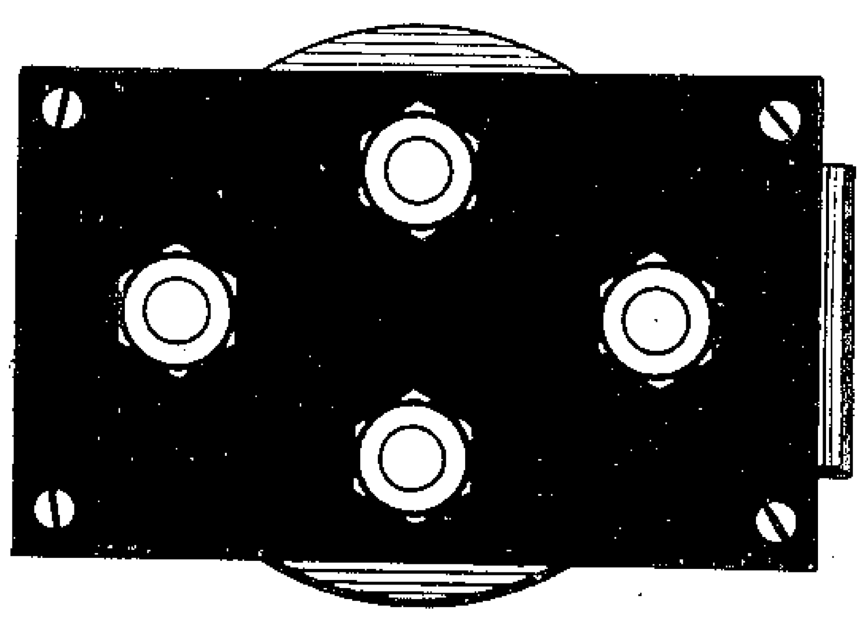


Fig. 6.

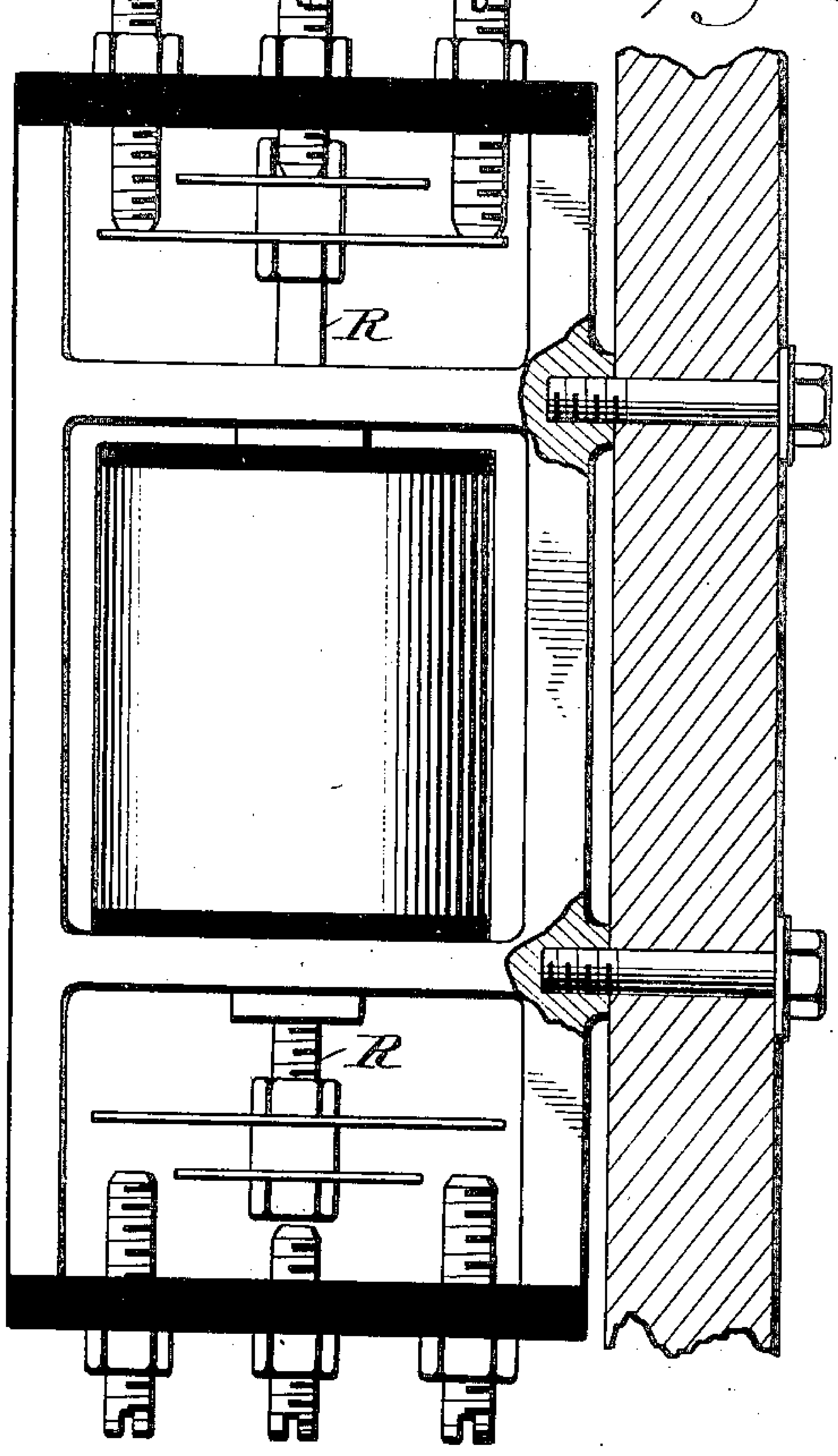
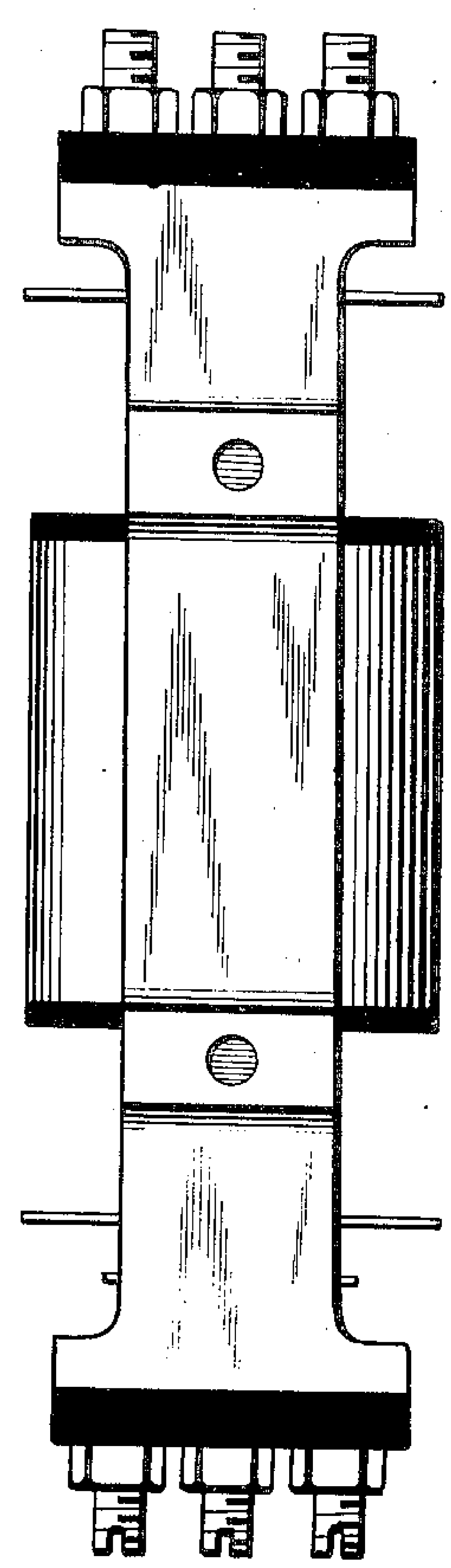


Fig. 8.



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UNITED STATES PATENT OFFICE

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MEANS FOR CHARGING STORAGE BATTERIES.

No. 894,237. Specification of Letters Patent. Patented July 28, 1908.

Application filed March 27, 1907. Serial No. 364,952.

To all whom it may concern:

Be it known that WILLIAM D. STIVERS, deceased, late a citizen of the United States, and a resident of Jersey City, in the county of Hudson and State of New Jersey, represented by me, the undersigned, MARY N. STIVERS, of Jersey City, New Jersey, his widow and the administratrix of his estate, invented a certain new and useful Improvement in Means for Charging the Well-Known Electrical Apparatus known as Storage Batteries or Accumulators; and I do hereby declare that the following is a full and exact description thereof.

As in the ordinary method of charging batteries a current is allowed to flow from a dynamo or other efficient source through each successive accumulator which is temporarily connected, and induces the chemical changes therein which are requisite to establish its charged condition. The current returns through a corresponding liberal conductor in the ordinary long known and well-approved manner.

It is known that it is important to have the charging current nearly or quite uniform. This has been attained by the use of ordinary controlling means, as the well-known resistance-box with an easily movable lever which will increase the resistance or diminish it according as the lever is moved in one direction or the other. The same may be used with this apparatus. This inventor discovered that it was practicable to attain these ends automatically. He devised means for conveniently effecting this by the use of a small motor mechanically connected to the resistance arm so as to turn the latter slowly according as the motor is impelled in one direction or the other. He provided for actuating it by a separate auxiliary circuit supplied by a small conductor from the same or any other source of electricity. The details of one mode of carrying this out will be set forth at length below. The result is that the motor is controlled by the varying force of the charging current. When the current is just right the controlling motor does not interfere, it remains still; but at any stage, when the current requires to be increased, the motor revolves actively for a sufficient period and turns the arm slowly until the resistance is reduced to the required extent, and when by reason of an increase in the supply or of changed conditions of any kind, the potential is too great, the motor will automatically change the arm in the opposite direction to make the resistance greater and consequently reduce the current.

The following is a description of what I consider the best means of carrying out the invention.

The accompanying drawings form a part of this specification.

Figures 1, 2, 2^a, 3, 4 and 4^a are diagrammatic representations. All are elevations. Fig. 1 shows the condition when the apparatus is out of use. The resistance-arm should preferably be lower. Fig. 2 shows the condition when the current in the main circuit which is to charge the battery is too weak and a current in the auxiliary circuit is revolving the motor in the direction to diminish the resistance in the rheostat or resistance-box and thus increase the main current. Fig. 2^a is a key to Fig. 2. In this all the parts not now in use are omitted. Fig. 3 shows the desired condition attained and the work of charging the battery by the main current is proceeding at just the proper amperage. The auxiliary circuit is open and the motor is at rest. Fig. 4 shows the condition when from any cause the tension of the main current is too great. Now the auxiliary current is moving the motor in the opposite direction to that in Fig. 2 with the effect to increase the resistance in the main circuit. Fig. 4^a is a key to Fig. 4. In this all the parts not now in use are omitted. Fig. 5 shows the motor and the worm-gearing by which its active revolutions slowly adjust the resistance-arm, with so much of the other parts as is necessary to show the relation thereto. Fig. 6 shows a solenoid in the form actually used. It is a side elevation. Fig. 7 is a corresponding plan view, and Fig. 8 is an elevation at right angles to that in Fig. 6.

Similar letters of reference indicate like parts in all the figures where they appear.

The apparatus in the preferable form as shown includes the following. A motor of standard make, series-wound, and made to operate in clock-wise or counter-clock-wise motion at the initial voltage of line wires or feeders. Two poles and two brushes, both armature leads to have terminals outside of case. Fields placed in series, the starting and finishing of fields ends to have outside terminals. A standard resistance of the grid type and of such ohmic resistance and capacity as is necessary for the type and size of accumulator with which this apparatus is to be used and having a detachable face plate which can be readily mounted and incorporated into and with this apparatus. The speed-reducer designed to be used with this apparatus is of the worm-and-gear type and so proportioned as to reduce the motor speed of whatever it may be to a quadrant speed of about two revolutions per minute. Small spring switch and block contacts, the switches normally in contact. Two of these are provided. Each has the power of automatically returning to contact whenever liberated.

Referring to the figures, B is a wire of sufficient thickness and properly insulated, which conducts the positive current freely from an efficient source assumed to be a dynamo A shown on the left side in the figures, and leads with coils to be described further on, to the charging contact for the storage battery C which is being charged. The latter is shown on the right in Fig. 5 and slightly indicated conventionally in the other figures. D is a corresponding wire arranged to constitute the first part of the liberal conductor to convey the return current. It attains this by passing it through an ordinary resistance-box D^1 which may be in all respects of the ordinary construction except for the provisions for moving the resistance-arm D^2 automatically and affording a free communication for the return current,—the negative current,—through the conducting wire E from the resistance-plate D^3 back to the negative terminal of the dynamo A.

The coils consist of three movable-core solenoids each provided with a surrounding casing of gray cast-iron, of the shape indicated in Figs. 6, 7, and 8, and adapted to carry fiber bars, contacts, etc. The conditions under which these solenoids act are different. If we consider a standard type of lead cell, the normal charging rate of which is twenty (20) amperes solenoid 1 is wound with a sufficient number of turns to enable it to draw up into its field its movable-core and retain it there so long as the current flowing through this coil is 6 amperes or more.

Solenoid 2 contains all the characteristics common to the three coils and also the following condition which exists in this coil only; sufficient turns to enable it to draw up into its field and retain its movable core there only so long as the current flowing through the coil is the desired charging current for the accumulator.

Solenoid 3 contains all the characteristics which are common to the three coils and in addition the following; only sufficient turns to enable it to draw into its field and retain there its movable core so long as the current flowing through the coil is a certain amount, say 10 per cent., above the desired charging rate of the accumulator.

To the shaft which carries the arm D^2 is attached a worm-segment D^5 (see Fig. 5) which is engaged by a worm H^2 carried on a shaft H, the other end of which shaft has a worm-wheel H^1 which is engaged by a worm G^1 carried by the motor G. As this motor is revolved in one direction or the other the arm D^2 will be traversed over the several plates in the rheostat or resistance-box D^1 and caused to interpose more or less resistance with the effect to increase the current by being changed in one direction, and to diminish it by being changed in the other. The action in this respect may be similar to that which has long been used in regulating by hand.

I will proceed to describe how a small auxiliary current is caused to turn the motor G in the direction to diminish the resistance in the main,—the charging current, when the tension is too small; to stand idle when the tension is just right and to revolve in the opposite direction when the current is in excess. The core of each solenoid is extended by a brass rod R (see Fig. 6) and carries near each end one or more plates of conducting material each insulated and arranged in a transverse position and sufficiently elastic to yield to accommodate slight inequalities in the height of the contacts. The core of solenoid 1 carries two such insulated elastic plates near its upper end the upper one being smaller than the next below and two such plates near its lower end the lowest being smallest. The core of solenoid 2 carries one such on its upper end and two on its lower end and the core of solenoid 3 carries two on its upper end and one on its lower. The contacts are correspondingly arranged as will presently appear.

When all of the unit sections which go to make up this "method of automatic control" have been prepared and each has been placed in its specific position and wired according to wiring diagram, the solenoid coils are in series with one side of the line which carries a current between the source of generation and the accumulator that it is desired to charge. The normal rate of charge being known, in this case assumed to be 20 amperes, the weight and size of plungers, which I shall sometimes refer to as cores, the size of housings and cores and the size and length of wire are determined and constructed to accomplish the following results.

First, that the core of coil 1 shall rise and remain up so long as the current flowing through the coils is greater than the moderate flow which is technically known as a "fully charged current flow" of the accumulator being charged in this case 6 amperes.

Second, that the coil of core 2 shall lift and remain up when the current reaches the normal charging rate of the accumulator, in this case 20 amperes, the tension desired to work efficiently without injury. This is the condition which will obtain the greater portion of the time when at work, and

Third, that the core of coil 3 will lift and remain up so long as the current flowing remains 10% above the normal charging rate of the accumulator.

A fourth condition is obtained when by opening the circuit on either side of this apparatus by an ordinary switch, not shown, the cores of all the coils drop and remain down until the circuit is closed again. This condition obtains during each period while out of use.

The results obtained by the movements of the solenoid cores are as follows: The cores of all the solenoids are down, the pivoted arm D^2 which travels back and forth on the contact strips of the resistance,—the rheostat,—is in such position as to insert the greatest resistance into the charging circuit. When the circuit is closed and a current is allowed to flow into the accumulator C that has been inserted in a charging position, the core of coil 1 promptly rises, closing the two circuits between the contact screws in the fiber bar at the top of coil 1, (see Fig. 2. See also Fig. 2[a]). The result is that the motor receives current that will make it run in a counter-clock-wise motion in turn actuating a speed-reducing device which in its turn actuates the movable arm of the resistance causing it to move upward so that it will continually cut out the resistance until,—when the current flowing reaches the normal charging rate of the accumulator, the core of solenoid 2 rises, opening the circuit between two contacts in the fiber bar at the bottom of this coil; (Fig. 3) causing the motor to stop and remain at rest until the current drops down to or below the normal charging rate. When this occurs the core of solenoid 2 drops again, closing the two circuits between contacts placed in a fiber bar at bottom of this coil, thereby causing the motor to rotate in the counter-clock-wise motion once more.

If for any reason the current flow should become 10% above the normal charging rate of the accumulator, the core of coil 3 rises. (Fig. 4, also Fig. 4[a]). This closes two circuits between contact blocks in the fiber bar at the top of this coil and gives current to the motor in such a way as to cause it to rotate in a clock-wise motion, and through the speed-reducer the arm is forced to travel downward in such a way as to insert resistance into the charging line until such time as the current flow is brought once more to the normal rate. In constructing this coil it must be borne in mind that its core must rise when the current is a small amount, say 10 per cent., above normal rate and drop and remain down at normal rate. When the charging circuit is opened on either side of this apparatus the cores of all three solenoids drop, causing the motor to run in a clock-wise motion forcing the movable arm D^2 to travel in a direction to insert a greater resistance into the charging circuit until it is stopped by the limit switch, (Fig. 1,) and thereby leaving the apparatus ready for safe use at any time.

It is desired to draw special attention to the following conditions. First, that when core of coil 1 is up and the charging rate is below normal, cores of 2 and 3 are down. Second, that when at any time the core of coil 2 is up the core of coil 1 will also be up, but if the current flow is less than 10% above normal the core of coil 3 is down. Third, that at any time when the core of coil 3 is up, the cores of coils 1 and 2 will also be up, and, fourth, that when the circuit is opened on either side of this apparatus the cores of all the coils are down.

Fig. 3. This shows the charging current working steadily at the proper tension and the controlling apparatus idle. This results from there being no continuous circuit in the auxiliary.

Fig. 2 shows the motor operating in the direction to decrease the resistance in the main circuit,— the charging current. This is due to the fact that the solenoid 1 is up and that solenoids 2 and 3 are down. Positive current is received through wire O led through a descending branch to the contact M^2. It flows across through the next-to-the-bottom plate of the solenoid 2, and through the contact M^3 and the short descending connection to the wire M^4 and thus through the latter supplies current to the field P and performs the important function of causing the motor to turn rapidly in one direction, which we have assumed to be counter-clock-wise, and through the mechanical connections turns the controlling arm D^2 slowly in the required direction to diminish the resistance and thus increase the tension of the main current. The return of the auxiliary current is more simple. It flows away from the motor through the brush M^6 and wire M^7 to the contact M^8 which by reason of the continued holding up of core 1 and thus of the horizontal cross-plate next to the top thereof, flows across to the contact-point M^9 from whence it flows down through wire M^{10} shown as discharging into the return wire E, the negative wire of the main current. The motor will continue to work in that direction, slowly turning the regulating arm D^2 until the tension in the charging circuit is increased so much that the core of the solenoid 2 rises. When this occurs it instantly induces the idle condition of the auxiliary current as shown in Fig. 3 already canvassed.

The reverse condition obtains when the main current becomes of too high tension, so that the core of solenoid 3 rises as shown in Fig. 4. The action here is reversed. We will follow it with the same minuteness of detail. The cores of the solenoids 1, 2 and 3 are all up. Positive current is received from the dynamo A through the small wire O, to the contact O^1, flows across through the top plate of core 3 to the contact O^2 and thence through wire O^3 to the lower terminal of the field P thus inducing a current upward through the field,—the reverse of that which before obtained there. This insures that the direction of the turning of the motor shall now be reverse to the previous direction. The current flows away from the upper terminal of the field P through the wire P^1 to the contact P^2 and across through the top plate of core of solenoid 2 and through the contact P^3 and wires P^4 and P^5 to the contact P^6 and lower limit switch M*, and thence through a portion of the length of wire M^1 to its junction with wire N which latter conducts it up to contact N^1. From this it flows through the next-to-the top-plate of core of solenoid 3, contact N^2 and wire N^3 to the motor G in which it induces rapid revolutions as before, but in the reverse direction, because of the reverse action in the field P. It thence flows as a negative current from the motor as before through the brush M^6 and wire M^7 to the contact M^8 and thence across through the next-to-the-top plate of core 1, contact M^9 and wire M^{10} to some convenient provision for its escape, shown as the negative wire E of the charging circuit. The reverse revolutions of the motor operates through the worm G^1, (see Fig. 5) worm-wheel H^1 shaft H, worm H^2 and worm-segment D^5 to turn the arm D^2 in the direction to subject the charging current to increased resistance. This action continues until such current is sufficiently reduced, so soon as this stage is reached the reduced current will be insufficient to sustain the core of solenoid 3 and it will drop, on which step the inert condition of all the provisions for auxiliary current will be again resumed. Thus the charging current remains practically uniform;—when its force rises a little above 21 amperes, core 3 will rise and induce a reduction, and when it falls below 19 or 20 amperes core 2 will sink and induce an increase.

Modifications may be made without departing from the principle or sacrificing the advantages of the invention. Instead of producing the required difference in the action of the solenoids by varying the number of turns in the coils, the coils may be alike and the required difference in the action may be induced by making the cores of different weights.

I use the term solenoid with its broad significance as comprehending both electro-magnets, having a fixed core and a movable armature, and "solenoids" strictly so-called having a movable core.

I claim as his invention:

1. Apparatus for regulating electric currents comprising a main circuit an auxiliary circuit and a motor actuated thereby, capable of being reversed, a variable resistance in the main circuit and mechanical connections from the motor to such resistance arranged to vary the latter by the action of the motor in combination with two solenoids in the main circuit adapted to act with different amperage, and electrical connections made and broken by such solenoids, arranged to close the auxiliary circuit by the raising of the core of the first solenoid and to revolve the motor in the direction to reduce the resistance and thus to increase the amperage when the current is weak and to open such circuit by the raising of the core of the second solenoid and thus to arrest the action of the motor and allow the main circuit to continue its action without change when the desired amperage is attained, all substantially as herein specified.

2. Apparatus for regulating electric currents comprising a main circuit, an auxiliary circuit and a motor actuated thereby capable of being reversed, a variable resistance in the main circuit and mechanical connections from the motor to such resistance, arranged to vary the latter by the action of the motor, in combination with three solenoids in the main circuit adapted to act with different amperage and electrical connections made and broken by such solenoids, arranged to close the auxiliary circuit by the elevation of the first solenoid and revolve the motor in the direction to reduce the resistance and increase the amperage when the current is weak and to open such circuit by moving of the core of the second solenoid and arrest the action of the motor and allow the main circuit to continue its action without change when the desired amperage is attained, and to reverse the auxiliary circuit by the action of the third solenoid and thus to revolve the motor in the reverse direction and thereby to increase the resistance when the potential is too great, all substantially as herein specified.

3. As a means for regulating the charging of accumulators, the combination with a charging circuit having a variable resistance therein, of an auxiliary circuit, a motor which is capable of being reversed, provisions for actuating such motor by such auxiliary circuit, mechanical connection of such motor with the resistance, a movable arm D^2 and its connections, means controlled by variations of the charging current for revolving the motor in the direction to reduce the resistance when the amperage is too low, hold it arrested when the amperage is right and operate the motor in the reverse direction and thereby increase the resistance when the amperage is too great, and the switches M, and their connections arranged to limit the extent of the changing motions, all arranged for joint operation, substantially as herein specified.

4. As a means for regulating the charging of accumulators, the combination with a charging circuit having a variable resistance therein, of an auxiliary circuit, a motor which is capable of being reversed, provisions for actuating such motor by such auxiliary circuit, provisions for electrically changing the action of such motor, mechanical connection of such motor with the resistance, provisions actuated by variations of the charging current for reducing the resistance when the amperage is too low, holding it unchanged when the amperage is right and operating the motor in the reverse direction and thereby increasing the resistance when the amperage is too great, and provisions for limiting the extent of the changing motions, all arranged for joint operation, substantially as herein specified.

MARY N. STIVERS,
Admrx.

Witnesses:
GEORGE E. DE GROAT,
THOMAS DREW STETSON.