No. 607,551. Patented July 19, 1898.

J. A. POWERS.

ELECTRIC REGULATOR.

(Application filed Oct. 28, 1897. Renewed June 17, 1898.)

(No Model.)

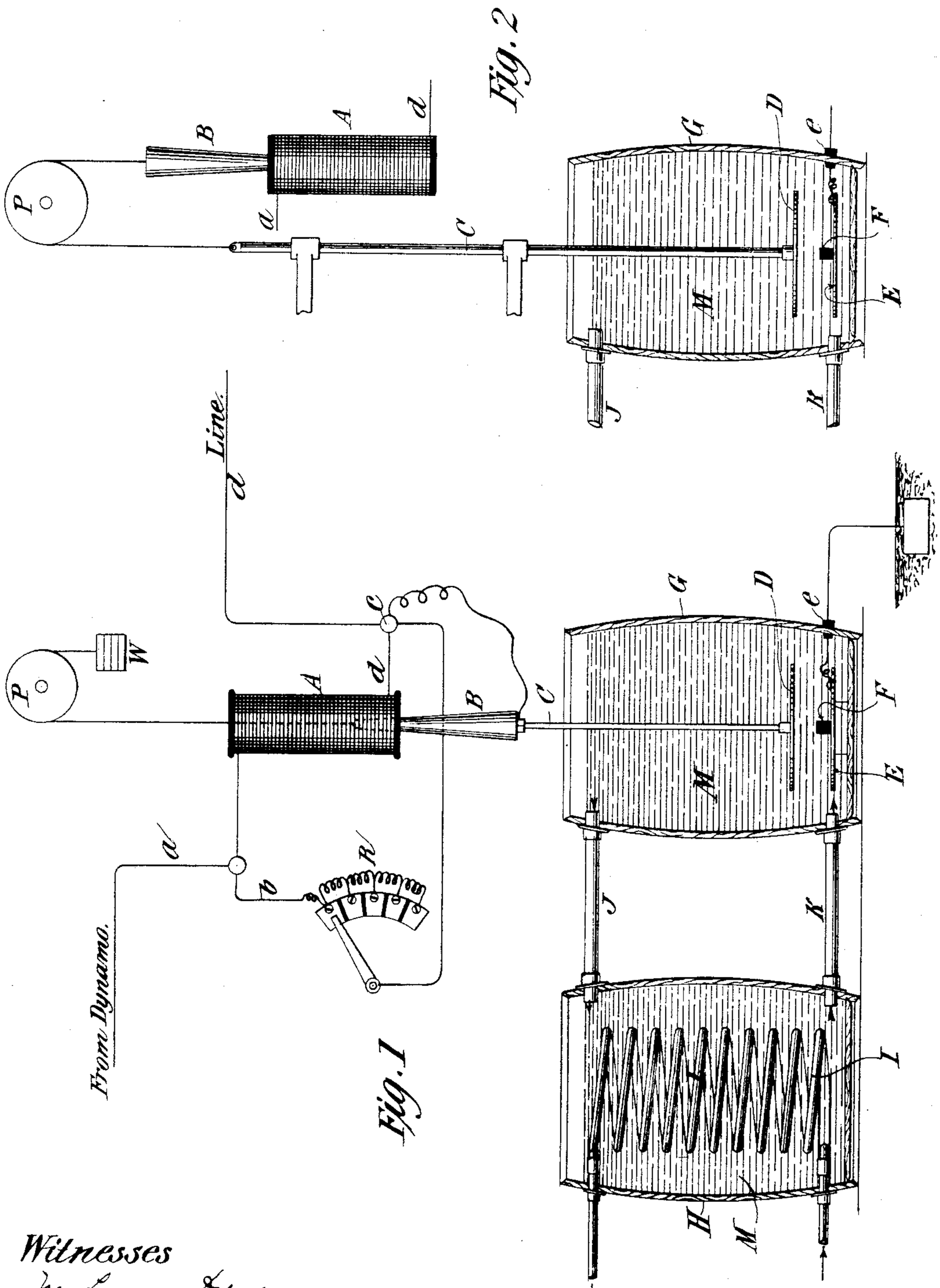

Fig. 1

Fig. 2

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UNITED STATES PATENT OFFICE.

JOSEPH A. POWERS, OF LANSINGBURG, NEW YORK.

ELECTRIC REGULATOR.

SPECIFICATION forming part of Letters Patent No. 607,551, dated July 19, 1898.

Application filed October 28, 1897. Renewed June 17, 1898. Serial No. 683,763. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH A. POWERS, a citizen of the United States, residing at Lansingburg, in the county of Rensselaer and State of New York, have invented certain new and useful Improvements in Electric Regulators, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

In a number of installations for the conversion and distribution of electrical energy the source of power available is a water-wheel or similar device which when once adjusted for a given power is not readily varied for the regulation of the voltage on the line to compensate for variations of load. Water-wheel regulators which operate to vary the power in accordance with variations of load are not uncommon, but they are necessarily, from the nature of the work which they are likely to be called on to perform, complicated and expensive; but when such an apparatus is not employed recourse is usually had to electrical regulators, which, owing to the heavy currents that frequently have to be handled, are generally more expensive and cumbersome than the others. These considerations apply particularly to electrical railroad systems, for which the regulator, subject of my present application, was especially designed.

The object which I sought in making this invention was to provide a simple, inexpensive, and effective means of regulating the voltage on the line in an electric railroad or trolley system the power for which is furnished by a water-wheel, and while in carrying out the invention I have utilized in the main only well-known principles and expedients I have devised a novel form of apparatus and employ it under certain novel conditions which very greatly contribute to the attainment of the results which I had in view.

In the drawings hereto annexed, Figure 1 is a diagrammatic illustration of my invention. Fig. 2 is a modification of a part of the apparatus employed.

Assuming that the improvement be applied to an electric railroad operated by a water-wheel which is adjusted to give a certain power the apparatus illustrated is designed to keep a constant load on the dynamo whatever may be the variations of load on the outside circuit and is constructed and arranged in the following manner:

A is a solenoid the wire of which is or may be of sufficient capacity to carry the maximum current used on the line and with a power when the full current is passed through it to nearly or fully support the armature or core B and the parts connected with it. The core B is tapered in form, so that the solenoid will exert a nearly equal lifting power upon it in any position when the current passing through the solenoid is constant.

To the core B is attached a rod C, carrying at its end a conducting-disk D and which extends down into an insulating-receptacle G, containing a fluid resistance M, such as a weak solution of sodium carbonate or of an acid.

At or near the bottom of the receptacle G is a stationary conducting-plate E, carrying a non-conducting stop F, which limits the movement of the plate or disk D toward the stationary plate, and the size of the plates and conductivity of the fluid are so determined that when the two plates are as close together as the stop F will permit a current equal to the full capacity of the dynamo may pass between them at the standard voltage and through an insulated connection *e* to an earth-plate.

As the current in the solenoid A is increased and the core B raised the plates D and E will be separated and the resistance through the intermediate fluid increased nearly in proportion to the distance between them.

Although various well-understood plans may be followed for energizing the solenoid, a convenient means is to lead the current from the dynamo by a conductor *a* through the solenoid to line by the conductor *d* and to lead off at a point *c*, between the solenoid and line, a branch to the rod C. I also employ a variable resistance or rheostat R in a shunt *b* to the solenoid, which may be used to vary the pull of the solenoid and to prevent when necessary overheating of the solenoid when adjusted to work on a current too heavy for the size of wire used for its coil.

In lieu of or in addition to the variable shunt I may employ a weight W, connected with a cord attached to the core B and running over a pulley P, so that by varying the

weight I may effect the same adjustment of the pull of the solenoid, as by means of the rheostat.

When the apparatus is to be used, the adjustment, by the means above described, is so made that the desired quantity of current will cause sufficient pull on the core to keep the plates D and E at such distance apart as to maintain the voltage at the desired point. The gates of the water-wheel are then opened until the dynamo attains the proper speed to produce the working voltage. The current passes through the solenoid to the point *c*, where it divides and passes through the two paths, one through the rod C, disk D, the solution M, disk E, and ground-wire *e*, and the other through the line-wire *d*. The current rises to a point slightly above that for which the adjustment is made, causing the disks to draw apart until, according to Ohm's law, the resistance between them is equal to the voltage divided by the amperes.

When current is drawn from the line-wire, the pull on the core due to the increased current raises the upper plate D until the increase of the resistance between the disks diminishes the flow of current between them by an amount equal to the amount drawn from the line, and when this condition is attained the total current passing through the solenoid will be the amount the apparatus has been adjusted to and the core will remain stationary until more or less current is drawn from the line.

Should the demand for current on the line decrease, the weakening of the magnetism in the solenoid will allow the core to descend, decreasing the resistance between the disks until the current flowing between them is sufficient, together with that which is flowing out onto the line, to make the total amount equal to that for which the adjustment is made, when the pull of the solenoid again balances the weight of the cord and disk.

The passage of current through the solution heats the latter, and in order to avoid the consequences of any material variation of temperature I provide a second receptacle H, connected with the first at top and bottom by the insulated pipes J K, and introduce into the receptacle H a coil I, through which a current of cold water is kept flowing. By this means as the solution is heated in the receptacle G a circulation is set up, the warmer solution flowing through the pipe J into H and the cooler through the pipe K back into G.

Instead of arranging the solenoid, as shown, to lift the core and its attached parts the latter may be suspended by a cord which runs over the pulley P and is connected with the core B, which latter is drawn downward into the solenoid or permitted to rise by the counterbalancing-weight of the rod C and disk D, as shown in Fig. 2.

The apparatus constructed as above described works rapidly and accurately as a regulator, the action of the disk D in the solution having the steadying effect of a dash-pot.

All parts of the device are free from complication and may be cheaply constructed.

What I claim is—

1. A regulator for electric-railway systems, consisting in the combination with a fluid resistance and separable plates therein, one of said plates being connected to earth and the other to the line, of a solenoid and core for varying the distance between said plates, the solenoid being included in the circuit from the generator and adapted to exert a pull or attractive force upon the core equal, with a given current, in all positions of said core, as set forth.

2. A fluid rheostat or variable resistance, comprising in combination two receptacles containing a conducting solution and communicating at different levels, means for cooling the solution in one receptacle, separable plates in the other, and a solenoid and core for varying the distance between said plates, as set forth.

3. The combination with a receptacle containing a conducting solution and fixed and movable plates therein, of a solenoid and a core connected with the movable plate, and a circuit to be regulated including the solenoid, and then divided between the line and the earth through the separable plates and solution, as set forth.

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Witnesses:
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