(No Model.)

4 Sheets—Sheet 1.

W. HOCHHAUSEN.

ELECTRIC REGULATOR.

No. 413,279. Patented Oct. 22, 1889.

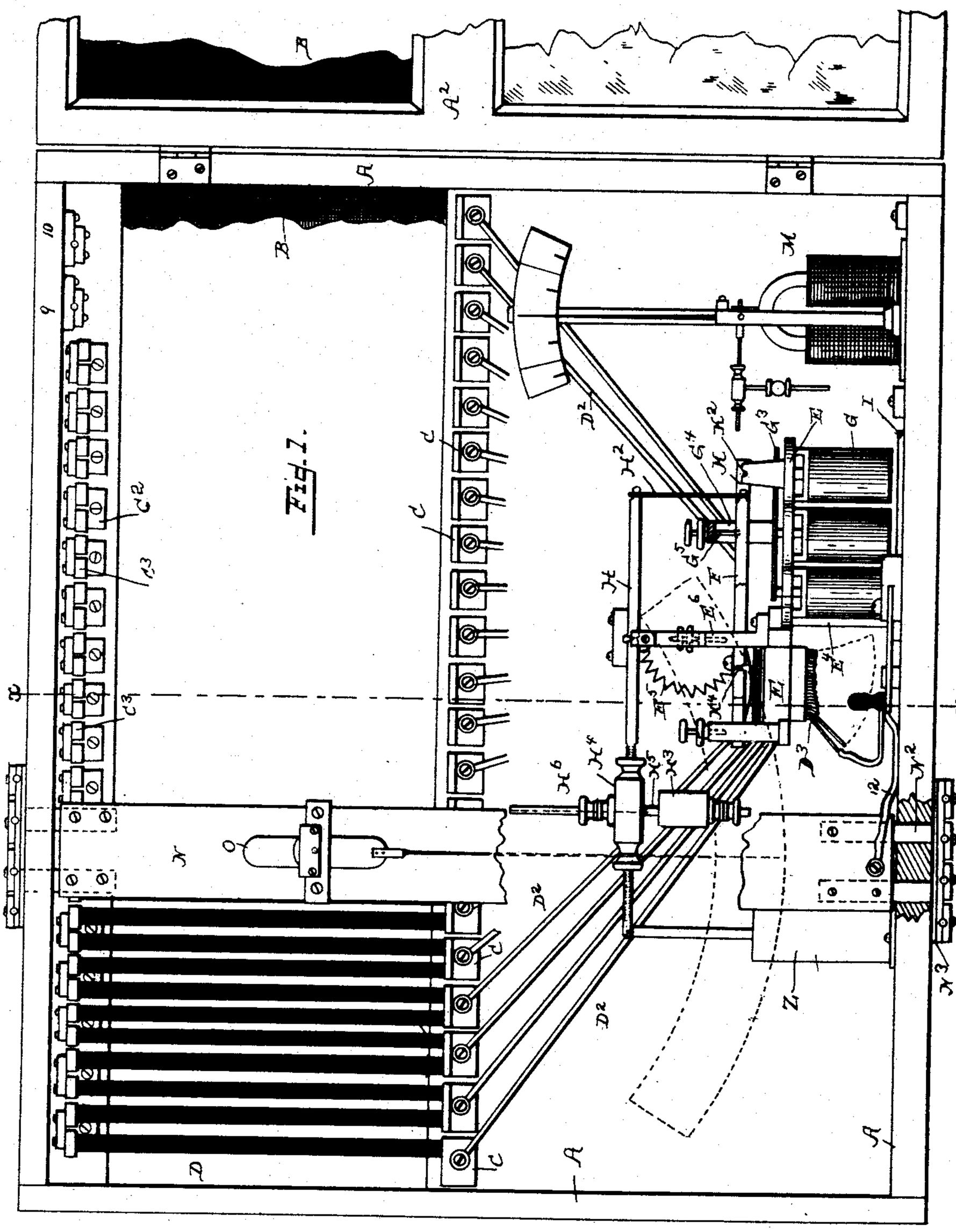

Fig. 1.

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(No Model.)

4 Sheets—Sheet 2.

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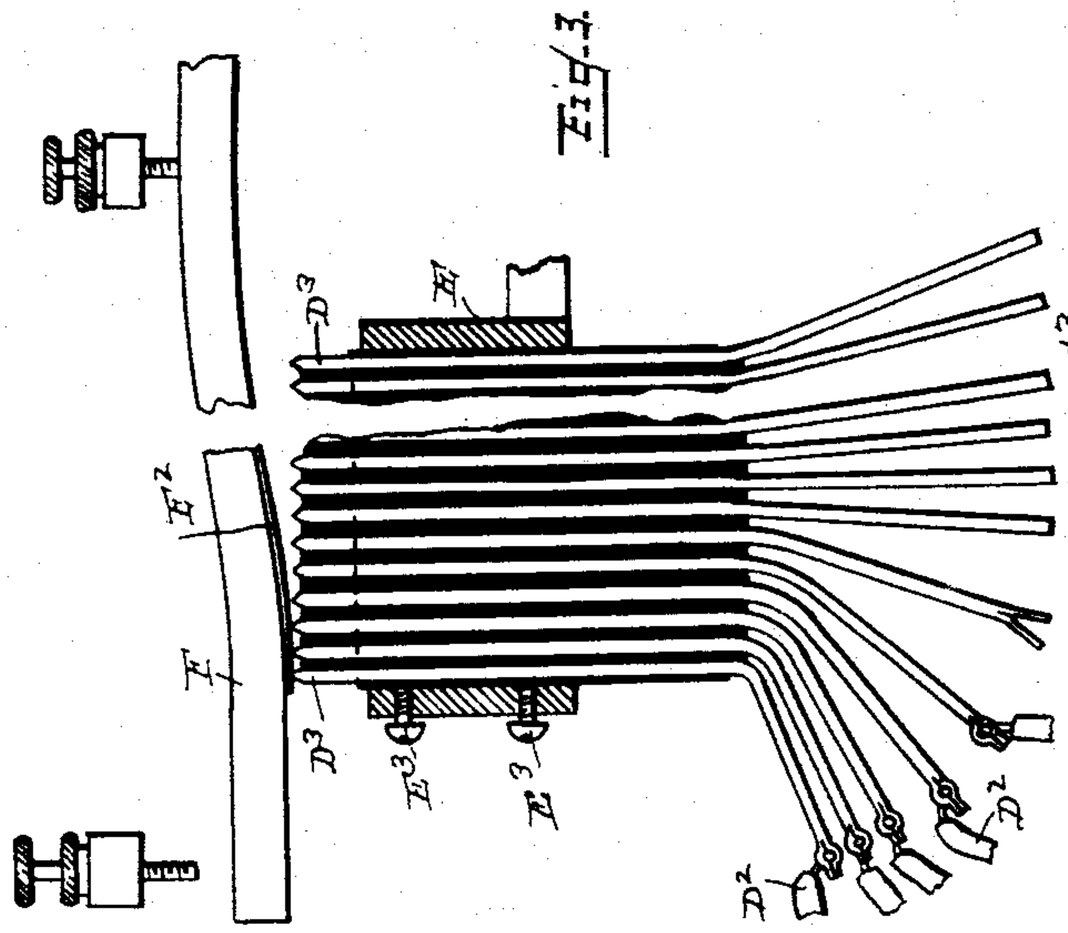

Fig. 3.

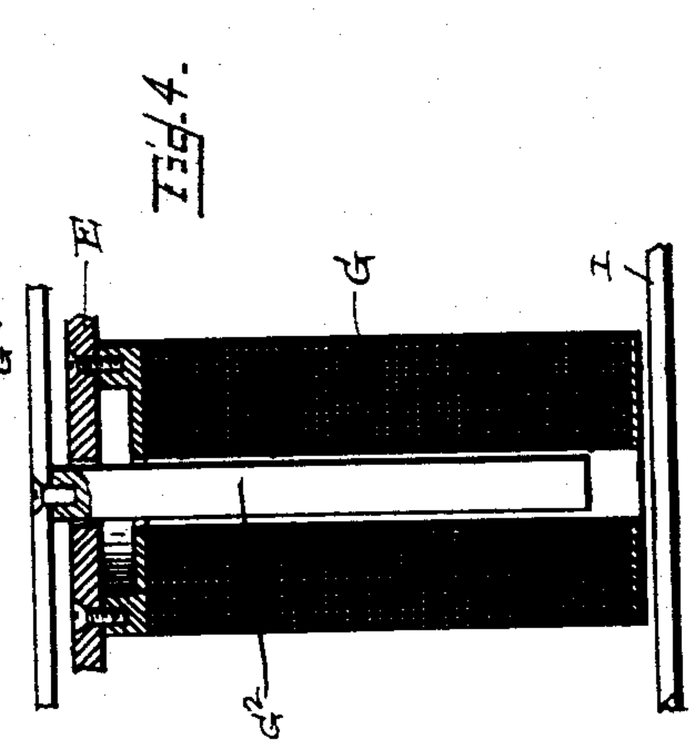

Fig. 4.

Fig. 2.

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4 Sheets—Sheet 3.

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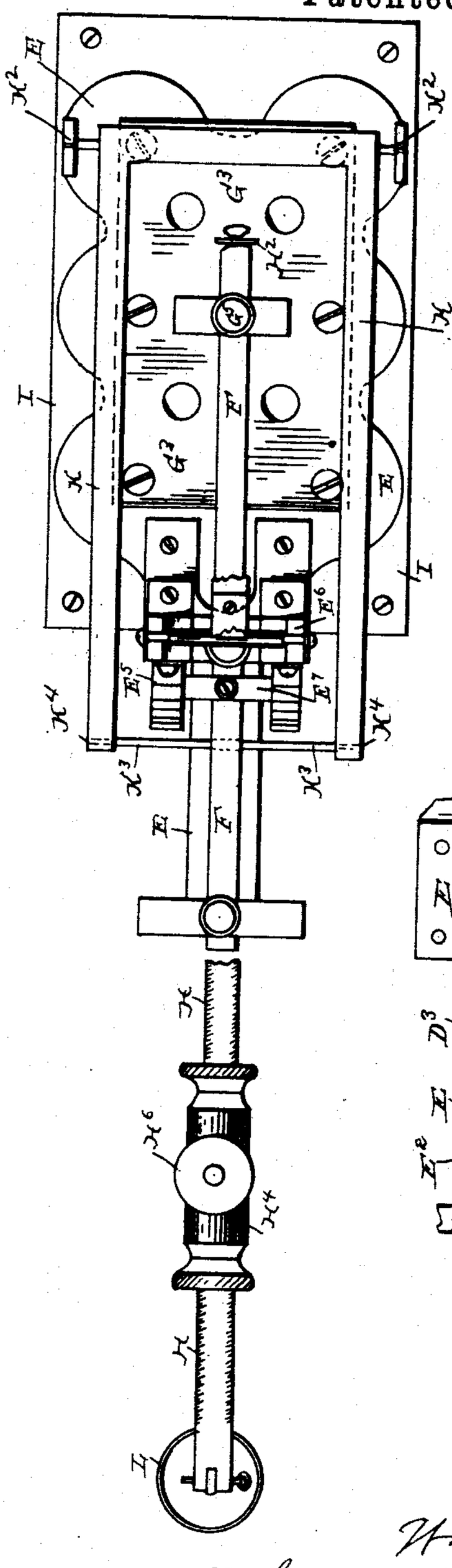

Fig. 5.

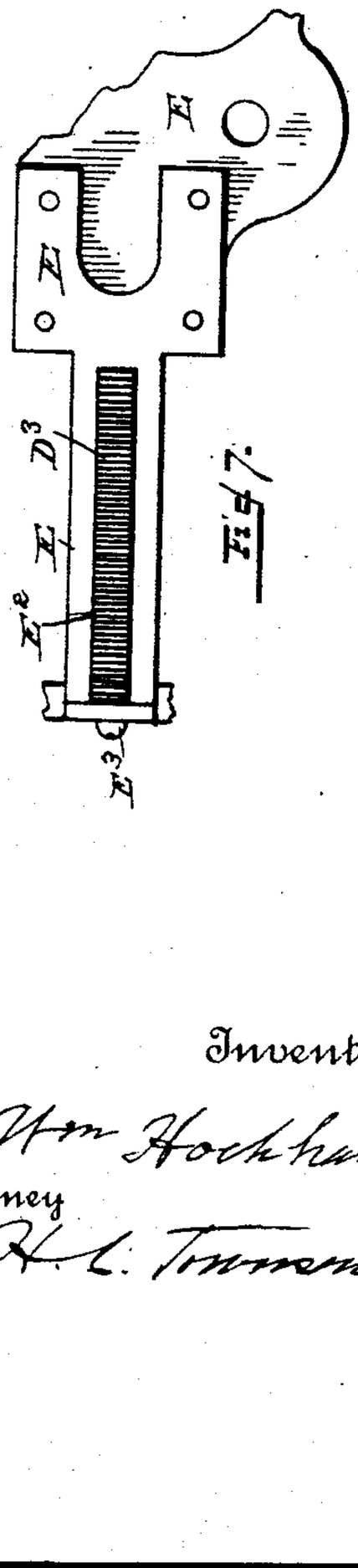

Fig. 7.

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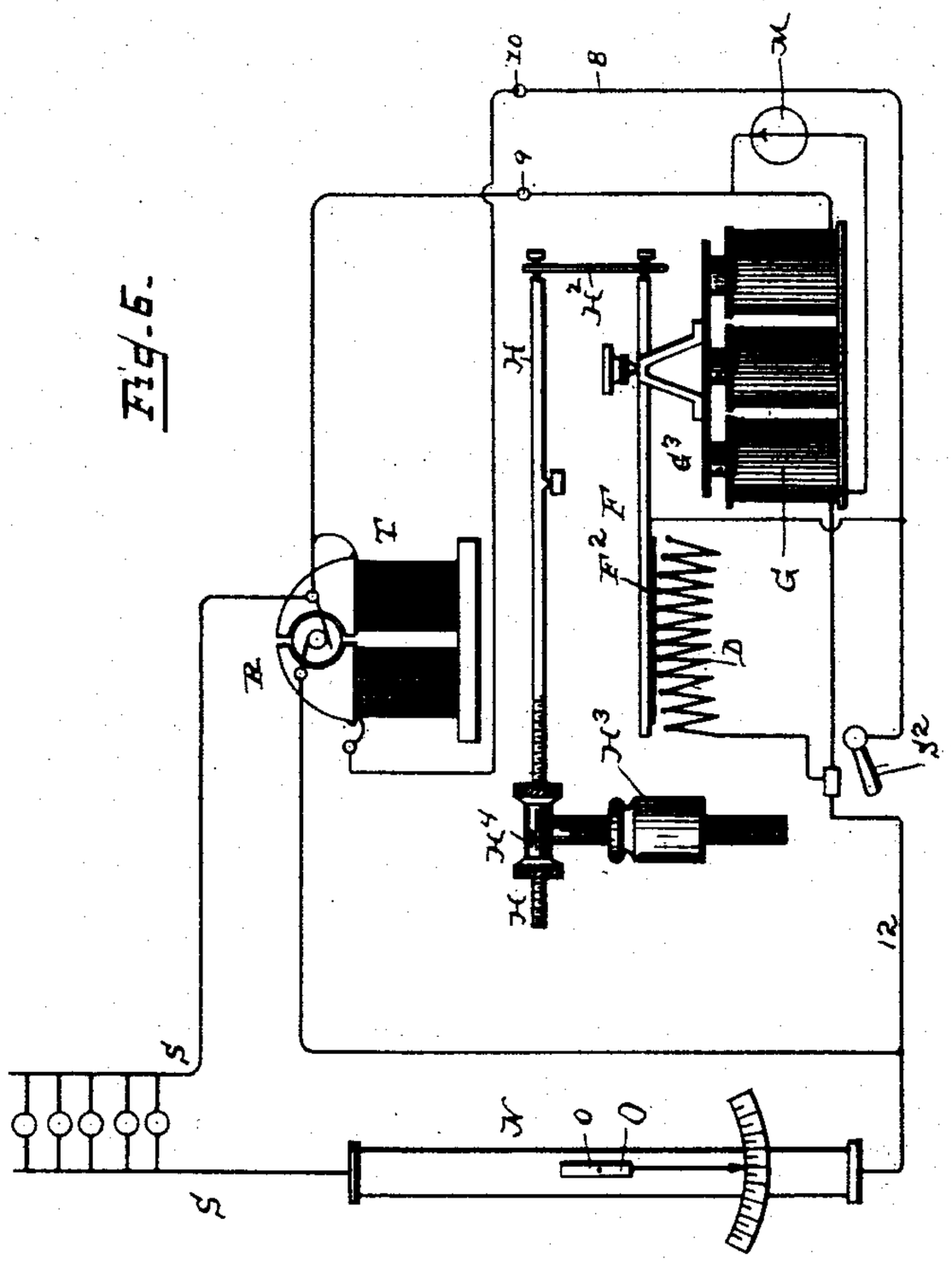
ELECTRIC REGULATOR.

No. 413,279. Patented Oct. 22, 1889.

Fig. 6.



Witnesses
Ira R. Steward
Wm H. Capel

Inventor
Wm Hochhausen
By his Attorney
H. C. Townsend

UNITED STATES PATENT OFFICE.

WILLIAM HOCHHAUSEN, OF BROOKLYN, NEW YORK.

ELECTRIC REGULATOR.

SPECIFICATION forming part of Letters Patent No. 413,279, dated October 22, 1889.

Application filed March 12, 1889. Serial No. 303,011. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM HOCHHAUSEN, a citizen of the United States, and a resident of Brooklyn, in the county of Kings and State of New York, have invented a certain new and useful Improved Electric Regulator, of which the following is a specification.

My invention relates generally to the construction of electric regulators, and more particularly to that kind of regulator in which a variable resistance is employed in connection with a controlling magnet or magnets, which operate upon the controlling-lever of the variable resistance.

The object of my invention is to provide an efficient and reliable regulator, adapted, among other things, to use in connection with dynamo-machines feeding lines or circuits of constant potential to which translating devices of any kind are connected in multiple.

My invention consists in various details of construction and combinations of parts involving various portions of the regulator, such as the variable resistance, the regulating-magnet, the contact-lever of the variable resistance, the retracting devices working in opposition to the magnet or magnets, and other features, all of which will be first described in connection with the accompanying drawings, and then specified in the claims.

My invention consists, also, in a particular combination of apparatus (to be hereinafter specified) involving a dynamo-electric machine and regulating appliances for constant potential, the object of which is to obtain reliability and certainty of action, together with simplicity.

In the accompanying drawings, Figure 1 is a side elevation of a regulating apparatus involving my invention. Fig. 2 is a vertical cross-section on the line X X, Fig. 1. Fig. 3 shows in side elevation a portion of the contact-plates of the variable resistance, the part of the frame holding the same being shown in section. Fig. 4 is a vertical section of one of the spools of the controlling-magnet and a part of its sustaining plate or frame. Fig. 5 is a plan of a part of the apparatus, the supplemental retractor-lever being broken away. Fig. 6 is a diagram of circuits and apparatus, showing the manner of applying the regulator to the regulation of potential of a dynamo-machine. Fig. 7 is a part of the frame holding the contact-plates, over which the rocking contact-lever moves.

A indicates the case of the apparatus, and A^2 a door of the case. The rear of the case and the door, at their upper portions B, are provided with wire-gauze instead of being solid, thus affording a circulation of air to keep down the temperature of the variable resistance mounted in the upper portion of the case at its rear. The resistance is made up of a series of plates or rods D, preferably consisting of ordinary sticks or pencils of carbon—such as are used for electric-arc lights—although rods or strips of other material—such as German silver—might be employed. The rods D are mounted between two sets of electrodes C C^2. The lower set C consists of plates or blocks of conducting material, preferably in the form of angle-pieces, one side of which is fastened in vertical position to the rear of the case, while the projecting horizontal portion has two seats or sockets to receive a pair of rods D. The upper set of electrodes, also fastened to the back of the case, is provided with pairs of spring-sockets for the upper ends of the rods, for which purpose bent plate-springs C^3 are fastened at one end to the projecting portions of the blocks C^2, leaving their opposite ends free to hold the rods in holes in such ends. The pairs of springs fastened to the same block are electrically connected through such block. The ends of the rods D, which rest in the same pair of spring-sockets, are at their opposite ends placed in sockets in adjoining blocks C; or, in other words, each pair which at their lower ends rest in the same block C at their upper ends are received in the sockets of adjoining blocks or plates C^2, so that the rods are connected in series through their supports. The spring-sockets not only permit ready removal and replacement of rods, but also prevent breaking during transportation. Other forms of holding devices for the resistance and other kinds of resistance might be used in connection with the apparatus to be presently described; but I prefer to use those shown.

D^3 D^3, &c., indicate a series of plates of copper, brass, or other good conducting material separated from one another by thin layers of

insulating material and clamped together in an opening E^2 in a frame E by means of screws E^3 E^3. The bundle of plates D^3 D^3 is preferably wrapped in mica or other insulator before being placed in the frame. The upper ends of the plates are tipped with platinum and form the contacts of a rocking contact-lever F, the rocking contact portion of which, at F^2, is also faced with platinum. The opposite ends of the plates D^3 are spread out and form means of connection for wires D^2, fastened or connected to the blocks or electrodes C, supporting the resistance D. The left-hand terminal block C is connected with the left-hand terminal plate D^3, and the same plate is also connected to one pole of the circuit in which the variations of resistance are to be produced. The other pole of the circuit connects with the rocking contact-lever through flexible copper strips E^5, fastened at one end to a cross-piece E^7 on the lever and at the other to brass posts E^6, rising from the frame E. Connection with the frame and posts E^6 is made through the supporting-post E^4 for said frame. The obvious effect of rocking the lever F is to vary the number of rods D in circuit, the number, and hence the resistance, increasing as the point of connection changes from left to right.

The contact-lever is operated by a series or gang of electro-magnets, used in preference to a single magnet of the same power as the series combined, in order that there may be a greater aggregate radiating-surface, and hence less tendency to abnormal heating of the coils by the passing current. Thereby less tendency to variations of resistance exists, and derangement of the action of the regulator from this cause is, so far as may be, prevented.

The spools of the electro-magnets are indicated at G. They are hollow, are suspended separate from one another from the right-hand end of frame or plate E, with a space between the head of the spools and said plate, and have their lower ends separated by an air-space from the surface beneath. These features all conduce to securing ventilating or cooling air-currents.

The cores G^2 of the magnets are movable cores, and are attached to a common plate G^3—preferably of iron—which plate carries a yoke G^4, in turn sustained by the lever F, through a pin or screw G^5, resting on said lever. The pin is vertically adjustable to permit vertical adjustment of the cores G^2 in the coils, thereby permitting their depth of immersion in the coils, or the distance of their lower ends from an iron plate, armature, or attracting mass of iron to be varied. By this adjustable suspension of the cores the initial or normal magnetic pull may be varied without disturbing the adjustment of the retractor or of other parts. The suspension of the cores from the lever is also by means of a conical bearing afforded by the conical end of the pin or screw G^5. This suspension of the cores permits them to accommodate themselves to the bore of the spools in the various positions of the lever F.

It will be observed that owing to the rocking contact of lever F its fulcrum is continually changing in position—a fact which would introduce an element of complication in adjusting the action of retractor and magnet with relation to one another if the retractor were connected to the working-lever itself, because the position of the fulcrum between the power and weight would constantly change. To get rid of this difficulty, I employ a supplemental retractor-lever H, mounted on the posts E^6 and coupled to the lever F, or a part moving therewith, near the point of application of the pulling force, by means of a link H^2.

It is obviously necessary, in order to obtain a uniform and regular operation of the apparatus, that there should be an increase of retracting-power as near as possible in proportion to the increase in magnetic pull or magnetic advantage brought about by a change in position of the magnet-cores as they are drawn into the coils. I have ascertained that this result is accomplished very well by employing a retractor for the movable core operating after the manner of the pendulum or bent lever-balance often used as a weighing device. A pendulum-weight operating in this manner is indicated at H^3, and is suspended on a rod H^5, depending from a slide or sleeve H^4, adjustable horizontally by means of nuts on the lever H. The weight H^3 exerts an increasing retracting force as it moves from vertical position and outward in a direction away from the vertical line, passing through the fulcrum of lever H, and this increase is in a measure of the same degree as the increase in the pull on the cores in any new or changed position required by the conditions of regulation; hence there is a balance in all positions ready to be disturbed in all cases by any increase in the current flowing in the coils of the magnet over normal. The vertical adjustment of the weight permits an adjustment of the rate of increase of the retracting force to correspond with the rate of increase of the magnet's power in changed positions of its core, or determines the sensitiveness of the device to an increase of current in the coils.

The horizontal adjustment of the weight H^3 by sliding its support H^4 permits the pulling and retracting power to be exactly counterbalanced for normal conditions. Under ordinary circumstances it would be easier to adjust the retractile force to the pulling force if the cores entered the coils but a short distance; but this condition weakens the power of the magnet. To overcome this objection, I make the core extend into the coils a considerable distance, and in order that the increase in pull or magnetic advantage may be more nearly in accordance with the increase of retractile power of the weight, I place op-

posite the lower ends of the core an iron plate-keeper or attracting mass of iron I, which causes the cores to pull harder with the same currents as their ends approach said plate.

A further capacity for fine adjustment is afforded by a supplemental weight H^6, vertically adjustable above the horizontal line of the retractor-lever.

K is a guide-lever for the rocking contact-lever F. Lever K is pivoted in two posts K^2, rising from plate E at a considerable distance from the rocking portion of the lever. Pivots K^3 extend from the rocker into the sockets at K^4 in the guide-lever, which latter thereby holds the rocking contact-lever against horizontal and lateral displacement, while at the same time permitting it to move freely in rocking or changing its point of contact with the series of plates D^3. To best secure this result, the guide-lever should be horizontal when the rocking contact bears on the contact-plates at the extreme left of the series, and should be connected to the contact-lever near the extreme right of the rocking surface. When the contact rocks to the right, the points where the guide-lever and the contact-lever are connected will then move together to the right, the point of connection on the guide-lever swinging downward from the horizontal and inward toward its fulcrum on the arc of a circle, and the point of connection on the contact-lever also moving to the right as it swings with the rocking surface toward connection with the right-hand portion of the series of plates D^3. A dash-pot Z, connected to the lever H, prevents violent sudden overmovement of the apparatus.

M indicates a potential indicator mounted on the base of the case, as shown, and consisting of two movable cores yoked together and moving in two fixed coils. The cores are suspended from a lever having a pendulum or bent lever retractor like that already described. A suitable indicator or pointer moving over a scale and connected to the lever shows the volts potential.

N indicates a massive bar or rod of copper or other good conducting material fastened at opposite ends to one or more studs or rods N^2, projecting through the case at opposite walls—as, for instance, top and bottom. The studs N^2 project from plates or blocks N^3 on the outside of the case, and the blocks N^3 carry suitable clamping devices, as indicated, whereby one or more heavy conductors may be secured. By these means the principal current of the circuit to which the apparatus is connected may be caused to pass through the bar N, and a piece of steel O, magnetized and pivoted over one face of the bar, as shown, will by such current be influenced so as to have a tendency to set itself at right angles to the bar. This influence is opposed by the superior weight of the lower end of the bar O and the attached pointer. By providing a suitable scale for the pointer to move over, the devices become an ammeter or current-indicator, which may carry the whole current of a machine supplying a current of very large volume for operating a great number of devices in parallel. The device may be readily introduced into the circuit of any machine to which the regulator is applied, by simply attaching the proper conductors to the outside plates, between which the bar N is supported.

The manner of connecting up the apparatus to regulate the potential of a dynamo is shown in Fig. 6.

R indicates the dynamo having its armature connected to and supplying current to the main conductors S S, between which are incandescent lamps or other devices in multiple. The main circuit is made to include the bar N by suitable connections, as already explained.

In a derived circuit to the main conductors are placed the field-magnet coils T, the rocking contact-lever F, and the resistance D, while in a separate derived circuit are placed the coils G of the magnets which act on the lever F. The coils G are of high resistance, as also are the coils T. The connections are made by attachment of wires running from one pole of the dynamo to posts or blocks 9 10, which connect within the case with the regulating apparatus in the manner indicated. The connections to the other pole may be made through a wire 12, Figs. 1 and 6, attached to one end of the bar N.

The connections within the case may be made in any desired way, the special manner or devices for the purpose being immaterial.

The apparatus having been connected as shown, and the normal number of lamps which the machine is intended to supply having been placed in circuit, the machine is started and the regulator adjusted by moving the weight H^3 longitudinally until the regulator assumes position where the lamps run with the proper or desired brilliancy. If after cutting out lamps or other translating devices between the mains the potential remains too high, the weight H^3 is to be adjusted upward, the indication being that the action of the regulator is not sensitive enough. An opposite adjustment would obviously be made for an opposite condition. When the apparatus is left to itself, a cutting out of electric lamps or other translating device will increase the flow of current in the branch containing magnets G, which will thereupon increase in power and pull down the regulator-lever F, causing the working contact to rock and increase the resistance in the branch with the field-magnet coils, thereby causing a decrease of current-flow in such coils and lowering the potential. When the potential becomes normal, the magnet-cores cease to move and maintain their position, the equilibrium being maintained between the magnet's pull and the retractor so long as the normal potential is maintained with the contact-lever in its new position.

What I claim as my invention is—

1. The combination, with a regulating or controlling magnet having a movable core, of a pendulum-retractor, as and for the purpose described.

2. The combination, with a regulating or controlling magnet having a movable core, of a keeper or mass of iron near its free end, and a pendulum or bent lever retractor.

3. The combination, with the regulating or controlling magnet or magnets having movable cores, of a vertically and horizontally adjustable pendulum or bent lever retracting-weight.

4. The combination, with the regulating-magnets having movable cores, of a rocking contact-lever, a supplemental retracting-lever, and a vertically-adjustable weight suspended from the latter.

5. The combination, in an electric regulator, of the magnet or magnets having hollow spools, movable cores entering such coils from above, an armature-plate beneath the coils, and a frame or support above the coils, by which said coils are suspended in position to leave a ventilating air-space beneath them.

6. The combination, with the rocking contact-lever and its operating-magnet, of a supplemental retractor-lever having a fixed fulcrum, as and for the purpose described.

7. The combination, with the rocking contact-lever, of the supplemental guide-lever, as and for the purpose described.

8. In an electric regulator, a high-resistance regulator-magnet consisting of a gang of coils separated from one another by free air-spaces and having movable cores, all connected to a common regulating-lever, as and for the purpose described.

9. The combination, with the movable cores for the regulating or controlling magnets, of a sustaining-yoke and a vertically-adjustable pin mounted on said yoke having a conical bearing on the regulator-lever.

10. The combination, with the series of contact-plates connected to a series of resistances, of a rocking contact-lever, derived-circuit magnet-cores adjustably suspended from said lever, and a supplemental retractor-lever, as and for the purpose described.

11. The combination, with the series of movable magnet-cores secured to a common support, of a conical suspension-bearing, as and for the purpose described.

12. The combination, with the movable magnet-cores, of the suspension-yoke and the vertically-adjustable supporting-pin passing through said yoke, as and for the purpose described.

13. The combination, with the series of contact-points, of the rocking contact-lever, a yoke carrying an adjustable pin or screw resting on said lever, and a series of magnet-cores sustained from said yoke.

14. The combination, with the series of regulating-magnet coils suspended above a common iron plate, of movable cores for said coils having their lower ends in proximity to said plate, and a support for said cores connected to a lever having a vertically-adjustable retracting-weight suspended from an arm of said lever opposite the cores, as and for the purpose described.

15. The combination, with the regulator-case, of the conducting bar or rod extending across the same and fastened to studs or rods projecting through the case from the under side of plates on the outside of the case, clamping devices secured to said plates, and a magnetized bar or plate pivoted over the face of the bar, as and for the purpose described.

16. In an electric regulator, two sets of conducting blocks or electrodes secured to the interior of the casing parallel to one another, each having two contact-seats on the same side for variable-resistance rods or strips, in combination with the opposite spring-contact electrodes insulated from one another.

17. In an electric regulator, the combination, with a series of conducting angle-pieces secured to the inside of the case, of a second series of plate-springs, each perforated as described, and an intermediate set of carbon rods secured between the springs and angle-pieces.

18. In an electric regulator, the combination, with a series of carbon sticks or pencils, forming an electric resistance, of a series of blocks, each having two contact seats or sockets receiving pairs of the pencils at one end, and a second series of spring-plate sockets secured in pairs to a common conducting-support, each spring-socket of a pair receiving the ends of rods or pencils resting at their opposite ends in adjoining blocks.

Signed at New York, in the county of New York and State of New York, this 21st day of January, A. D. 1889.

WILLIAM HOCHHAUSEN.

Witnesses:

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G. W. HOPKINS.