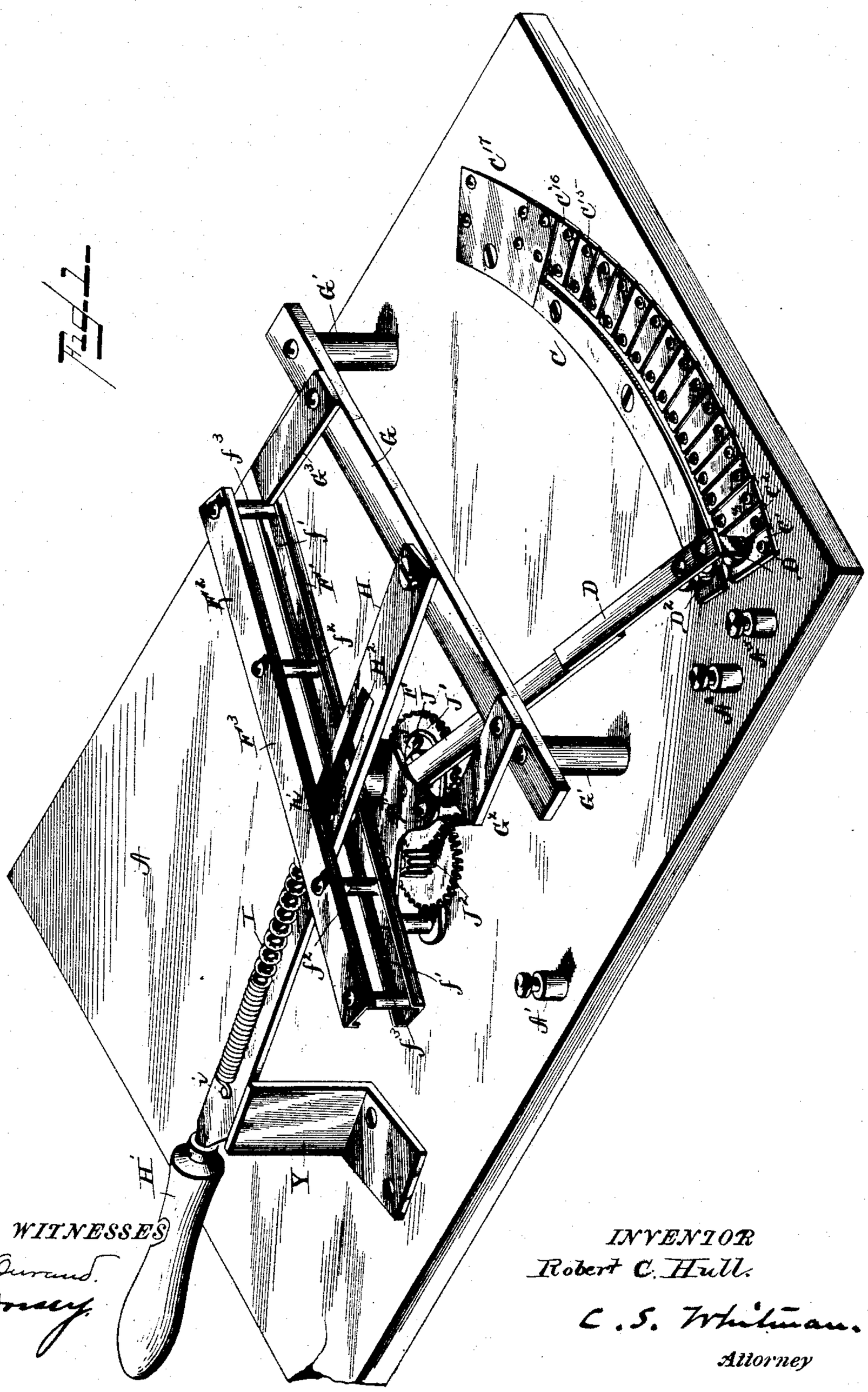
(No Model.) 3 Sheets—Sheet 1.

R. C. HULL.

ELECTRIC SWITCH.

No. 413,512. Patented Oct. 22, 1889.

Fig. 1.



WITNESSES

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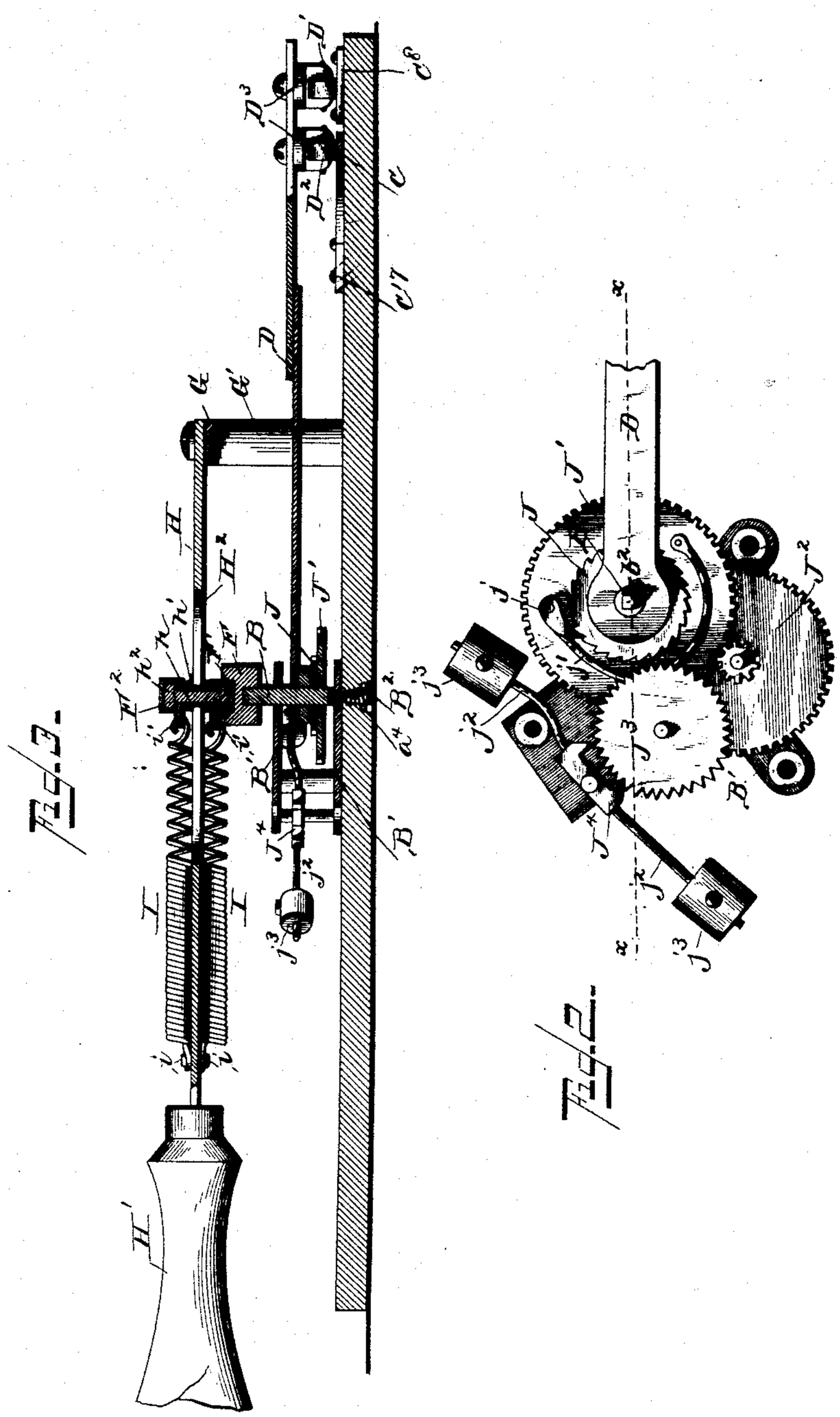

FIG. 1.

FIG. 2.

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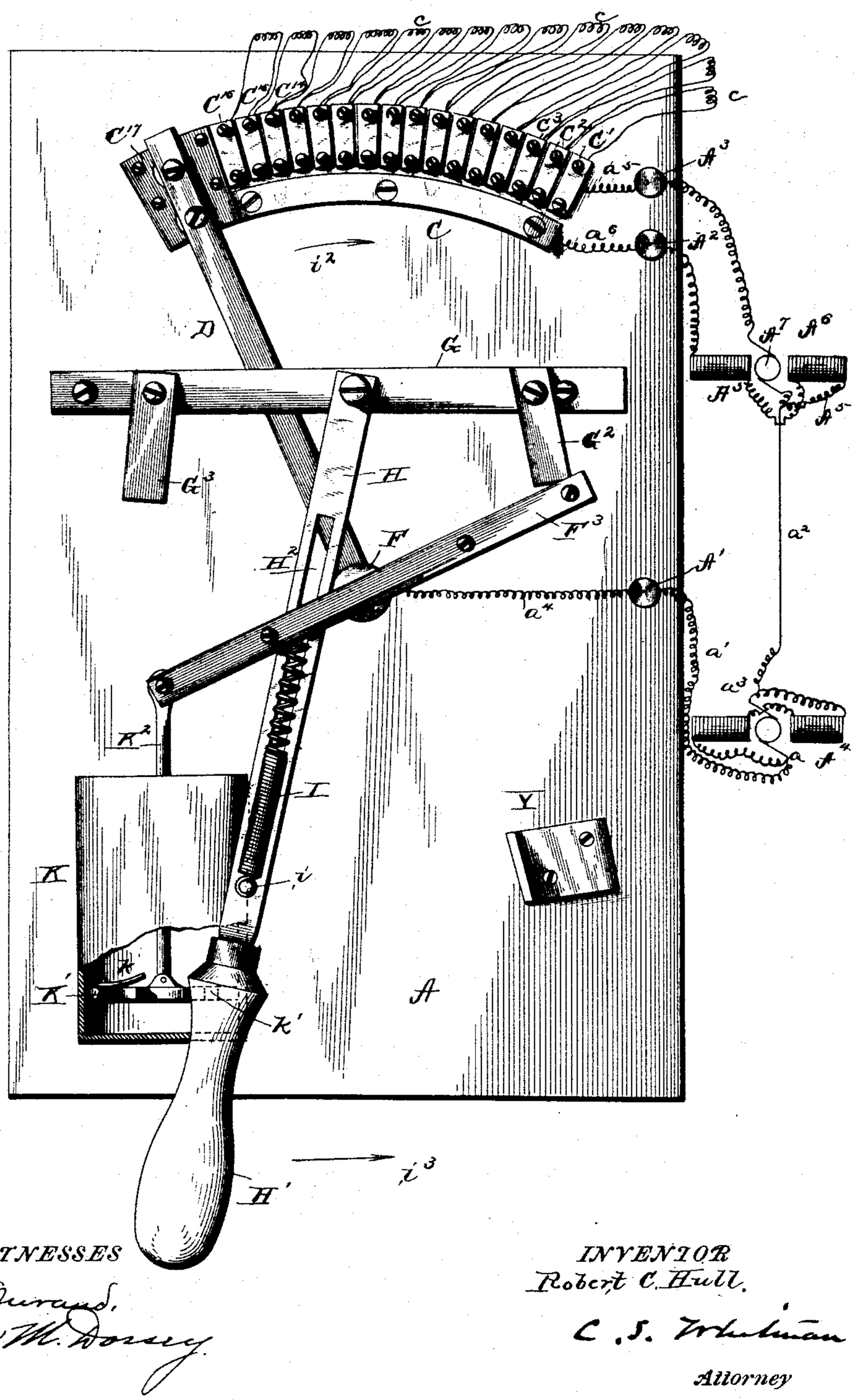
Fig. 4.



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UNITED STATES PATENT OFFICE.

ROBERT CARTER HULL, OF BALTIMORE, MARYLAND.

ELECTRIC SWITCH.

SPECIFICATION forming part of Letters Patent No. 413,512, dated October 22, 1889.

Application filed July 9, 1889. Serial No. 316,936. (No model.)

To all whom it may concern:

Be it known that I, ROBERT CARTER HULL, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Electrical Switches; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention consists in certain new and useful improvements in electrical switches; and it relates more particularly to means whereby an electrical circuit may be quickly broken and gradually made, so that only a portion of the current shall pass at first, which portion will gradually become larger until its full strength is attained.

My invention is adapted for use where the above-mentioned results are desirable, and more particularly in connection with electrical motors, as if the full current be suddenly passed through the armature-coils thereof they will be burned out, injuring the machine. With ordinary switches this danger is especially great, as persons not skilled in the management of electrical apparatus will often throw the handle of the switch around to its full extent suddenly, passing a corresponding current and damaging the armature-coils, the field-magnet coils, on account of their different conditions, not being susceptible to such injury. To prevent this damage to the armature-coils and still permit inexperienced and unskilled persons to have charge of the motor, I construct my switch in such a way that the power developed in throwing the handle around to make the circuit is stored up and used to cause a contact-lever to make a contact through gradually-increasing resistance with the armature, the expenditure of such power being regulated by a governing device, while the power developed in throwing the handle around to break the circuit is stored up, and upon the handle passing a certain point is quickly released, effecting an almost instantaneous breaking of the circuit.

My invention, therefore, consists in the construction of the apparatus used to effect such result in its several parts and in combinations thereof, as will be hereinafter described and claimed.

Referring to the accompanying drawings, in which corresponding parts are designated by similar letters, Figure 1 is a perspective view of a switch-board constructed according to my invention and adapted to be used with an electric motor, the switch being in a position to pass the full current. Fig. 2 is a top view of the governing mechanism thereof. Fig. 3 is a central longitudinal vertical section of the device in a position to pass one-half of the current, being taken on the line $x\ x$ of Fig. 1. Fig. 4 is a top plan view of another form of the device, in which the regulating is effected by a dash-pot, and shows in a diagrammatic manner the electrical circuits, the said circuits being common to all forms of the invention herein shown.

The base A of the switch has three binding-posts A′, A^2, and A^3, the former of which A′ is connected to one pole a of a suitable generator of electricity A^4 by means of the lead a' and to the shaft B, as will be hereinafter described. The second post A^2 is connected to a metallic arc C and to one end of the field-coils A^5 of a motor A^6, the opposite end thereof being connected to the return a^2, which is connected to the pole a^3 of the source of electricity. The third post A^3 is connected to the first contact-plate C′ and to one end of the armature-coils A^7 of the motor A^6, the opposite end thereof being connected to the return a^2, all of which is shown in Fig. 4.

In a frame B′ on the base A is carried a shaft B, in the base of which is a conical recess working on the corresponding point of the screw B^2, inserted in the base A. Under the head of this screw is held one end of the wire a^4, the other end being held by the binding-post A′, and thus being in electrical connection to the pole a of the generator A^4. Upon the shaft B is rigidly fastened the contact-arm D, the outer end of which has a contact-making device in the form of rollers D′ and D^2, carried in stirrups D^3, fastened to the lever, being thus in connection with the pole a of the generator. Concentric to the shaft B and at the same distance therefrom as is the roller D′, but separated slightly from

each other, are placed contact-plates C′, C², to C¹⁶. The first of these plates C′ is connected directly to binding-post A³ by the wire a^5, and thus to the armature of the motor, while the second plate C² is connected to the first plate C′ by resistances *c*, and each plate is connected with those on each side thereof in a similar manner, except the last plate C¹⁶, which is only connected to the plate C¹⁵ on the inner side thereof. Concentric to the shaft B and to the contact-plates C′, &c., and at a distance from the former equal to the distance of the roller D² therefrom, is the contact-arc C, the said arc equaling the arc measured from the outer side of the contact-plate C′ to the outer side of contact-plate C¹⁶. The arc C is connected to the binding-post A² by the wire a^6, and thus to the field-magnet coils of the motor. An insulating-plate C¹⁷ is placed on the base A and covers the outer side of the contact-plate C¹⁶ and one end of the arc C.

The upper end of the shaft B is squared, as at b^2, to receive a cap F, having a corresponding squared recess in its lower face. Upon the upper part of this cap is fastened at its middle the grooved plate F′, with its groove *f′* on its upper surface. Above the plate F′ and separated therefrom by two braces f^2 and f^3 at each end is a corresponding grooved plate f^2, having its grooves *f′* on its lower surface, the grooves *f′* together forming a channeled slot, the plates F′ and F² forming in effect a beam F³. Between the shaft B and the contact-arc C is erected on posts G′ a cross-piece G, extending across the base A, and having projecting arms G² and G³, which, by striking the outer braces f^3 of the plates F′ and F², limit their movement, and consequently that of shaft B and contact-lever D. A bar H is pivoted at one end to the middle of the cross-piece G, and has upon its other end a handle H′ of insulating material—such as wood—and has along its central portion a longitudinal slot H², the said bar passing between the plates F′ and F². In the slot H² is an axle *h*, having a grooved friction-wheel *h′* thereon, the groove thereof resting within the slot. Upon both ends of the axle *h* are wheels h^2, which rest within the grooves *f′* of the plates F′ and F². Springs I, fastened at one end to projections *i* on the bar H, near the handle H′, are connected at their other ends to hangers *i′*, through which the axle *h* passes.

A stop Y is placed on the base A and limits the movement of the handle-bar H in turning on the current, while the inner braces f^2, by striking the handle-bar, also limit the movement of the beam F³, formed by the plates F′ and F².

In Fig. 4 the rollers D′ and D² are shown as resting on the insulating-plate C¹⁷, and it is seen that there is a break in the circuit between the rollers D′ and D² and the contact-plates C¹⁶, &c., and the contact-arc C, respectively. It is also seen that the circuit would be completed if the lever D were moved in the direction of the arrow I², as the roller D′ would make a contact with the contact-plate C¹⁶, sending a current through the armature; but this current would be a weak one on account of the number of resistance-coils *c* it would have to pass through. At the same time the roller D² would make a contact with the arc C and send a current through the field-magnet coils of the motor. If the lever D be still further turned, the roller D′ will successively make contact with other plates C¹⁵ C¹⁴, &c., and thus successively removed resistances from the circuit until finally on touching plate C′ the full current will pass through the armature. If now the handle-bar H be moved from the position shown in Fig. 4 in the direction indicated by the arrow i^3 until it has assumed the position as represented in Fig. 3, it will gradually cause the axle *h* to move farther down the slot H² toward its pivoted end, and also along the grooves *f′* of beam F³, until the axle is over the cap-piece F, which is the pivoting-point of the beam. In this movement the springs I are stretched, as the pivoting-point of the beam is nearer the pivoted end of the bar H than is the brace f^2, against which the bar H rested at the beginning of the movement, and is therefore farther from the projections *i*, to which the springs are attached. The beam is held by the projecting arm G², bearing upon the brace f^3, from yielding to the spring and assuming a more oblique position to the cross-piece G. Until the axle *h* crosses the center of the cap-piece F there is a constant pressure exerted by the brace f^3 against the projecting arm G²; but after the axle in the continuing movement of the handle-bar has crossed the pivoting-point of the beam F³ the tension of the springs I is exerted to draw the brace f^3 away from the arm G², and to force the brace f^3 on the other end of the beam against the opposite arm G³. If means were not used to prevent the tension of the springs from having an immediate action upon the beam, they would, after the passage of the axle over the cap-piece F, suddenly throw the roller D′ from off the insulating-plate C¹⁷ onto the contact-plate C′, sending a current of full strength through the armature-coils, and producing the damage which it is one of the objects of this invention to obviate. It will be thus seen that it is desirable to provide a mechanism to regulate the action of the springs in closing the circuit, which will not prevent them from exerting their power instantaneously when breaking the circuit, as the latter is often desirable. In order to accomplish this I may rigidly secure to the shaft B a ratchet-wheel J, while immediately thereunder is loosely mounted on the same shaft a gear-wheel J′. Upon the upper surface of the last wheel is pivoted a click *j*, the nose of which is forced against the ratchets of wheel J by a spring *j′*, and which permits the wheel J, and con-

sequently the shaft B and connections, to move freely backward—*i. e.*, to move in a direction to break the circuit, but which necessitates that the wheel J′ be moved forward when the circuit is to be completed. The wheel J′ has thus a rotary motion given to it from the oscillatory motion of the contact-lever in making and breaking the circuit. This rotary motion is transmitted by suitable gearing J^2 to the escape-wheel J^3, the motion of which is governed by the escapement J^4, which has prolonged arms j^2, upon which weights j^3 are mounted, the position of the latter being variable in order to cause the escape to increase or decrease its speed. It will now be seen that the tension of the spring acting on one end of the beam F^8 will, when that tension is exerted to close the circuit, cause the gearing J^2 to move, the rapidity of which movement will be governed by the escapement, and thus the lever D will be slowly moved over the plates C^{16} C^{15}, &c., to C′, at each successive plate reducing the resistance to the passage of the current through the armature-coils, while the field-magnet coils will be thrown into circuit the moment the roller D^2 is upon the contact-arc C. It is also evident that the tension of the springs I, if exerted to break the circuit, will meet with no opposition when the axle *h* is once over the pivoting-point of the beam F^3, and that the lever D will be instantly thrown by the full tension of the springs upon the insulating-plate C^{17}, the ratchet and click permitting the free backward rotation of the shaft B.

Instead of using the clock-work escapement, as hereinbefore described, and illustrated in Figs. 1, 2, and 3, I may use the device shown in Fig. 4. In this case I use an air-cylinder K, in which works a piston-head K′, having an outwardly-opening valve *k* and a small perforation *k′*. The piston K^2 has its ends pivoted to the beam F^3 and to the piston-head K′, respectively. If now the handle-bar H be thrown in such a way as to complete the circuit, the piston-head will be slowly drawn out of the cylinder, forming a vacuum, which will be filled by the entrance of air through the perforation *k′*, the rapidity of the entrance of which will limit the movement of the lever D. When the handle is now moved to break the circuit, the piston will be driven in and the valve *k* will operate and permit its rapid movement.

Having now described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination of a contact-lever, resistances traversed thereby, a beam connected with the lever, a handle-bar, and a sliding connection between the said beam and handle-bar, as and for the purpose described.

2. The combination, with a contact-lever, of resistances traversed thereby, a beam connected to the said lever, a handle-bar crossing the said beam, an axle common to the said beam and handle-bar at their point of intersection, and devices tending to change the position of the said axle in relation to the said beam and handle, and thus to move the point of intersection, as and for the purposes described.

3. The combination, with a contact-lever, of resistances traversed thereby, a beam connected to the said lever, a handle-bar crossing the said beam, an axle common to the beam and handle-bar at their point of intersection, devices tending to change the position of the said axle in relation to the said beam and handle-bar, and thus to move the point of intersection, and a retarding device whereby such a change is governed, as and for the purposes described.

4. The combination of a pivoted contact-lever, a source of electricity, the said contact-lever being in circuit through the said source with the armature and field-magnet coils of an electrical motor, an electrical motor, resistances traversed by the contact-lever, and which are in circuit with the armature-coils of the motor, a contact-arc, also traversed by the contact-lever, in circuit with the field-magnet coils of the motor, a beam connected with the contact-lever, a handle-bar crossing the said beam, an axle common to the beam and handle-bar at their point of intersection, springs mounted on the handle-bar tending to change the position of the said axle in relation to the said beam and handle-bar, and thus to move the point of their intersection, and a retarding device, whereby such a change is governed, as and for the purposes described.

5. The combination of a pivoted contact-lever, resistances traversed thereby, a beam having a longitudinal slot mounted on the pivot of said lever, a pivoted handle-bar having a longitudinal slot, an axle received by the slots of the beam and handle-bar, springs whereby the axle is changed in its relation to the handle-bar and beam and the contact-lever moved, a ratchet transmitting motion to an escape-wheel, and an escape, whereby the movement of the contact-lever is retarded, as and for the purposes described.

6. The combination of a pivoted contact-lever, resistances traversed thereby, a beam having a longitudinal slot mounted on the pivot of the said lever, a pivoted handle-bar having a longitudinal slot, an axle received by the slots of the beam and handle-bar, springs whereby the axle is changed in its relation to the handle-bar and beam and the contact-lever moved, and a retarding device, whereby the movement of the contact-lever in one direction is governed, as and for the purposes described.

In testimony whereof I have affixed my signature in presence of two witnesses.

ROBERT CARTER HULL.

Witnesses:
MURRAY HANSON,
WILLIAM H. BERRY.

Correction in Letters Patent No. 413,512.

It is hereby certified that in Letters Patent No. 413,512, granted October 22, 1889, upon the application of Robert Carter Hull, of Baltimore, Maryland, for an improvement in "Electric Switches," an error appears in the printed specification requiring correction, as follows: In line 40, page 1, the compound word "gradually-increasing" should read *gradually-decreasing;* and that the Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 3d day of December, A. D. 1889.

[SEAL.]

CYRUS BUSSEY,
Assistant Secretary of the Interior.

Countersigned:

C. E. MITCHELL,
Commissioner of Patents.