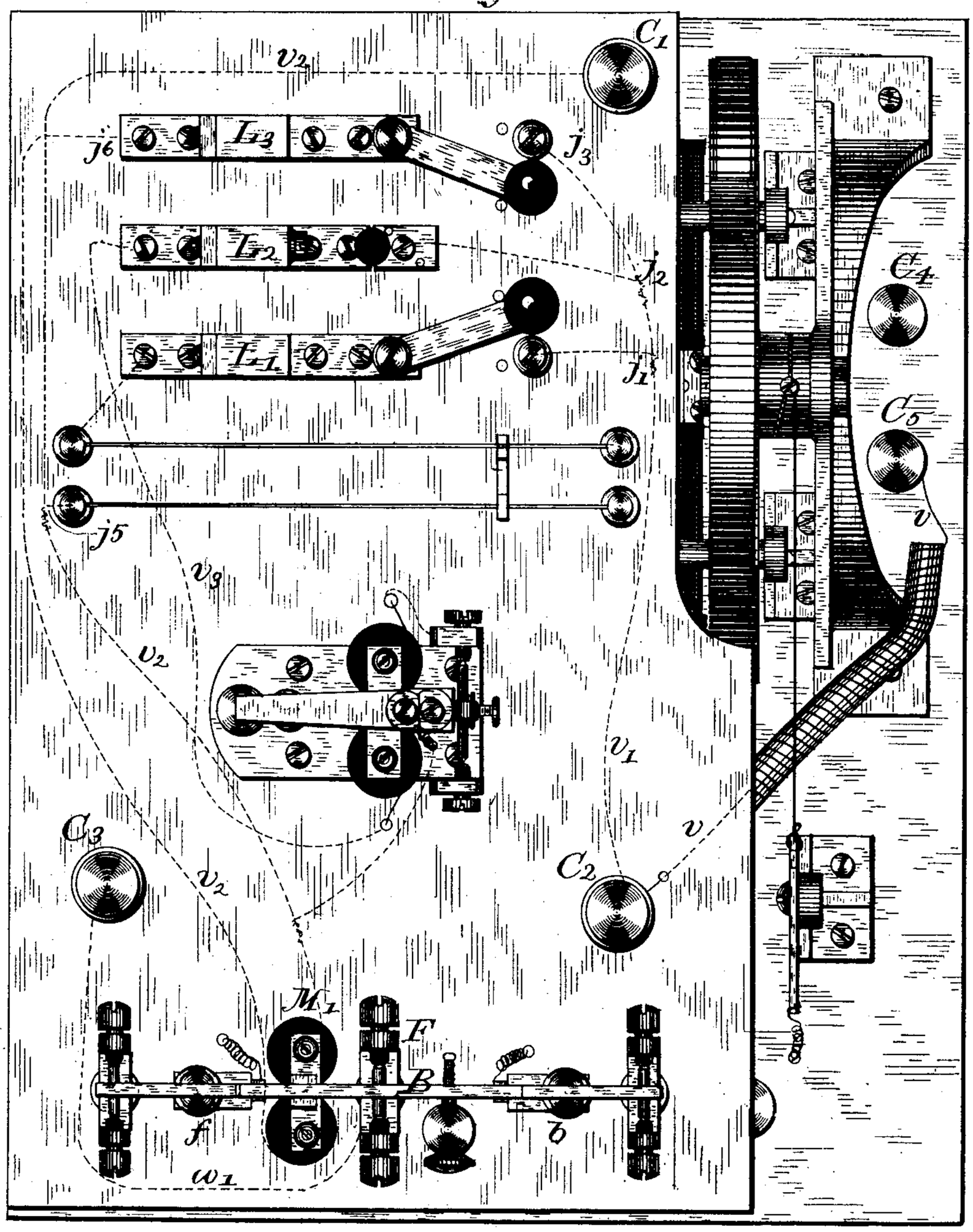
(No Model.) 2 Sheets—Sheet 1.

M. G. FARMER.

ELECTRIC LIGHTING APPARATUS.

No. 253,817. Patented Feb. 14, 1882.

Fig: 1.



Witnesses;

Miller & Early

Myer K. Lockwood French,

Inventor,

Moses G. Farmer,

By his Attorney,

Frank L. Pope

(No Model.) 2 Sheets—Sheet 2.

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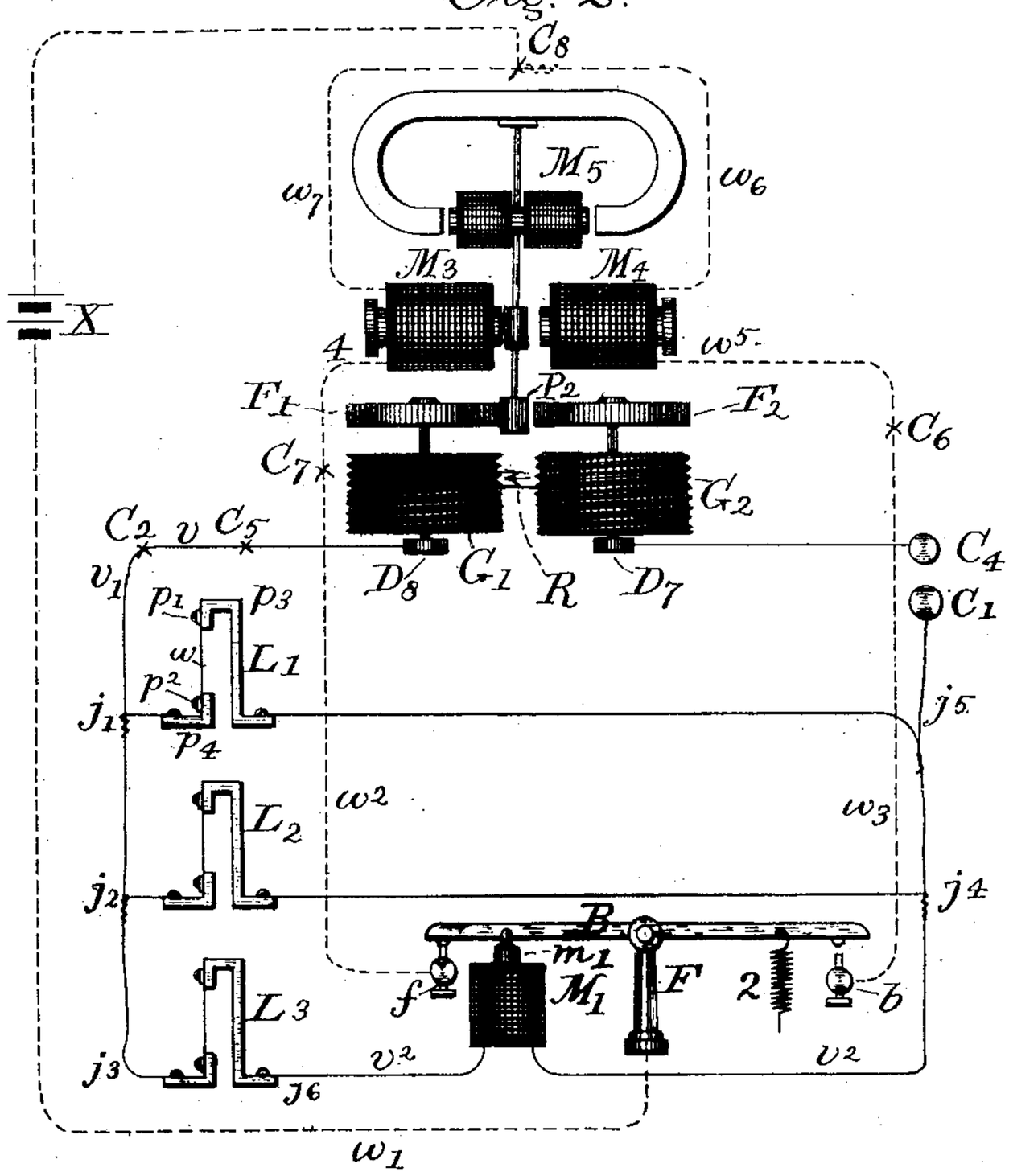
Fig. 2.



Witnesses;

Willis G. Early

Mrs K. Lockwood French,

Inventor,

Moses G. Farmer,

by his Attorneys,

Frank L. Pope

UNITED STATES PATENT OFFICE.

MOSES G. FARMER, OF NEWPORT, RHODE ISLAND, ASSIGNOR TO THE UNITED STATES ELECTRIC LIGHTING COMPANY, OF NEW YORK, N. Y.

ELECTRIC LIGHTING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 253,817, dated February 14, 1882.

Application filed March 7, 1881. (No model.)

To all whom it may concern:

Be it known that I, MOSES G. FARMER, a citizen of the United States, residing at Newport, in the county of Newport and State of Rhode Island, have invented certain new and useful Improvements in Electric Lighting Apparatus, of which the following is a specification.

My invention relates more particularly to the organization of the incandescent system of lighting by electricity, or that in which a current of electricity is caused to traverse one or more sections of a conductor, which sections are composed of some suitable conducting material refractory to heat having a considerably higher resistance per unit of length than the remainder of the circuit, and by means of which resistance a portion of the electricity which traverses the circuit is converted into heat, which, when of sufficient intensity, produces light.

The object of my invention is automatically to secure uniformity in the strength of current which traverses one or more circuits in which one or more electric lights are included, so that the strength of current shall not be materially affected by any variations that may occur in the resistances of the illuminating portions of the lights. This end I attain by certain novel combinations of instrumentalities hereinafter specified.

In the accompanying drawings, Figure 1 is a plan view of so much of an apparatus embodying the subject-matter herein claimed as is necessary to illustrate the invention. Fig. 2 is a theoretical diagram, illustrating the electric circuits and the relation of the different parts of the mechanism to each other.

When heat is developed by the passage of an electric current through a resisting conductor, such as is used in the construction of the incandescent light, its temperature increases in a much more rapid ratio than the increase in the strength of the current. Thus it requires only about twice the absolute strength of current to fuse a strip of platinum that it does to render it faintly luminous, and the amount of light emitted just below the temperature of fusion is about five times that which would be obtained with a current of seven-eighths of the strength. While therefore a high temperature must be maintained in the incandescent lamp for the sake of economy, it is obvious that a slight variation in the strength of the current at such a temperature will make a very great difference in the amount of light emitted. The object of my regulating apparatus therefore is so to regulate the strength of current as to secure economy as well as uniformity in the light.

Referring to the accompanying figures, one of the main conductors proceeding from the electric generator X (which may be a dynamo-electric machine, a galvanic battery, or other suitable source of electricity) is attached to the binding-screw C^4. The current passes thence to the binding-screw C^5, through a regulator consisting of an automatically-adjustable rheostat, hereinafter described; thence by the wire *v*, Figs. 1 and 2, to the binding-screw C^2, Fig. 1; and thence by the wire *v'*, dividing at j', j^2, and j^3 into three branches, leading respectively to the three lamps L', L^2, and L^3, these branches again uniting upon a single wire, v^2, at the points j^4, j^5, and j^6, which wire terminates at the binding-screw C', to which is attached the return main conductor leading to the other pole of the electric generator.

The automatic regulator, which is interposed in the circuit leading from the source of electricity and in the main conductor, (or portion thereof which is common to all the lamps in the system,) may be constructed in various ways, the general principle being that any increase in the normal strength of the current acting upon the regulator shall set in action mechanism acting to diminish said current, while the reverse effect will take place when the strength of the current acting upon the regulator is diminished. One very effective arrangement which I have devised for this purpose is illustrated theoretically in Fig. 2. The principle of this apparatus will be sufficiently well understood by reference to the diagram Fig. 2 in connection with the following description.

A cylinder or roller, G', constructed of non-conducting material, is mounted upon a me-

tallic support, D^8. G^2 is another cylinder or roller, of metal, of similar size and form, and mounted upon a metallic support, D^7. A flexible conductor, R, of some metal offering considerable specific resistance to the passage of an electric current, has one of its ends connected with the axis and metallic support D^8 of the non-conducting roller G′, and is wound several times around the periphery of the said roller, (the convolutions being of course insulated from each other,) and thence passes across to the metallic roller G^2 and a number of times around its periphery in the opposite direction. It being premised that one end of the flexible conductor R is electrically connected with the binding-screw C^4 and the other with the binding-screw C^5, it will be readily understood that the rotation of both rollers G′ and G^2 in such a direction as to wind the conductor from one to the other, as indicated by the arrow, would have the effect of increasing the resistance of the circuit between the points C^4 and C^5, because the current is obliged to pass through such portion of the whole length of the conductor R as is not in contact with the metallic roller G^2. Therefore the greater the portion of its length that is wound upon the insulating-roller G′ and off from the metallic roller G^2 the greater will be the resistance in circuit, and, conversely, the less will it become when the conductor is wound in the opposite direction. The required movement of the rollers G′ and G^2 in one direction or the other is preferably effected by means of an independent motor, M^5, the particular construction and arrangement of which is immaterial. Any known form of electro-motor (of which the one shown in diagram in Fig. 2 is a type) will serve the purpose well. The electric current for actuating such a motor may be derived from an independent source of electricity, or it may be taken from the main current which supplies the lamps by means of a branch or derived circuit, the former plan being usually preferable. The pinion P^2 receives its motion from said motor, and is capable of being shifted in one direction or the other, so as to engage with one or the other of the toothed wheels F′ F^2, which are mounted upon the respective axles of the rollers G′ and G^2. As the electro-motor M^5, when in action, always revolves in the same direction, carrying with it the pinion P^2, it is obvious that the rollers G′ and G^2 will be caused to rotate in one direction or the other, according as the pinion P^2 is engaged with one or the other of the toothed wheels F′ F^2.

I will now explain the mechanism whereby the pinion P^2 is shifted and the manner in which this shifting is automatically effected by the increase or decrease of the strength of the current in the main conductor.

Referring to Figs. 1 and 2, M′ represents a pair of electro-magnetic or magnetizing helices, which are placed in one of the branch circuits uniting the poles of the generator.

m represents a pair of movable soft-iron cores, which tend to be drawn into the helices when rendered magnetic by the action of the electric current, the distance which they are thus drawn depending upon the strength of the current. The movable cores *m* are attached to one end of a horizontal beam or lever, B, pivoted at or near its center upon a standard, F, the attractive force of the helices being opposed by the constant force of an adjustable antagonistic spring, 2. The lever B is capable of a slight oscillatory motion upon its axis, which is limited in each direction by adjustable screw-stops *f* and *b*. One pole of a battery or other generator of electricity, X, is connected with the standard F by means of wire *w*′, which terminates in a binding-post, C^3. The adjustable contact-screw *f* is connected by the wire w^2 with binding-post C^7, and thence by wire 4 with an electro-magnet, M^3. Similarly, the contact-screw *b* is connected by the wire w^3, binding-post C^6, and wire w^5 with the electro-magnet M^4. The electro-magnets M^3 and M^4 are connected by wires w^7 and w^6, respectively, with a common binding-post, C^8, to which the remaining pole of the generator is connected. This circuit may, if preferred, be supplied with electricity from the main circuit, which supplies the lamps, instead of making use of a separate generator.

It will be understood from the explanation which has been given that as the lever B is deflected from its normal position of equilibrium, under the greater or less attraction exerted by the regulating-helices M′ in opposition to the constant force of the spring 2, an electric current will be directed through one or the other of the electro-magnets M^3 M^4, as the case may be.

By reference to Fig. 2 it will readily be understood that the electro-magnet M^3, when in action, will by the force of its attraction throw the pinion P^2 into gear with the wheel F′, and in like manner the electro-magnet M^4 will throw the pinion into gear with the wheel F^2. Thus if the current in the main conductor, and consequently that in the several branch conductors, tends to become too strong, the core *m*′ of the regulating-magnet M′ will be attracted, causing the lever B to make contact with the point *f*, thus throwing the electro-magnet M^3 into action, which shifts the pinion P^2 in such a manner as to cause the motor M^5 to interpose a gradually-increasing resistance in the circuit, in the manner hereinbefore explained, and thus reduce the strength of the current traversing the regulating-helices M′, as well as the several branch circuits and lamps, until the attraction in the magnet M′ becomes sufficiently diminished, when the antagonistic spring 2 will come into action and interrupt the contact at *f*, thus preventing further increase of the resistance. A decrease in the normal strength of the current will produce the reverse effect upon the balanced lever B, and will also reverse the above-described mechanical operation, bringing the electro-magnet M^4 into action, and thus with-

drawing the necessary amount of resistance from the main circuit. By this means the current traversing the entire system of main and branch circuits, which includes the lamp or lamps, will be automatically maintained at a practically uniform strength, and this normal strength may be made greater or less at pleasure by varying the tension of the spring 2 or the position of the contact-stops *f* and *b*.

This application constitutes a division of one filed by me January 19, 1880, serial No. 965, which exhibits a convenient organization of apparatus for carrying out the objects of my invention.

I do not herein claim gradually varying the resistance of an electric-light circuit, nor the location in a branch circuit of the regulating apparatus by which the same is effected, as these constitute the subject-matter of other pending divisions of the above-mentioned application. I do not, however, herein limit myself to the specific construction and organization of apparatus shown, as the details of such apparatus may be greatly varied without departing from the principle of my invention.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, of a rheostat, mechanism for increasing or decreasing the resistance of said rheostat, an electro-magnet included in the same electric circuit with the rheostat, or in a branch thereof, and a lever for controlling the action of said mechanism, which is normally balanced between the attractive force of said electro-magnet and a constant antagonistic force, and contact-stops for limiting the motion of and determining the action of said lever.

2. The combination, substantially as hereinbefore set forth, of a generator of electricity, an electric circuit uniting the poles of said generator, one or more electric lamps included in said circuit, an electro-magnet included in said circuit, a lever acted upon in opposite directions by said electro-magnet and by an antagonistic force, electrical contact-stops limiting the motions of said lever, reversible mechanism actuated by electricity and controlled by said lever, and having its motion in one direction or the other determined by the respective preponderance of the opposing forces acting upon said lever, and mechanism for increasing and decreasing the current traversing said circuit, which mechanism is controlled by the reversible mechanism.

In testimony whereof I have hereunto subscribed my name this 3d day of March, A. D. 1881.

MOSES G. FARMER.

Witnesses:

SARAH J. FARMER,

DARIUS BAKER.