(No Model.)

M. J. WIGHTMAN.

ELECTRIC CURRENT REGULATOR.

No. 348,876. Patented Sept. 7, 1886.

Fig. 1.

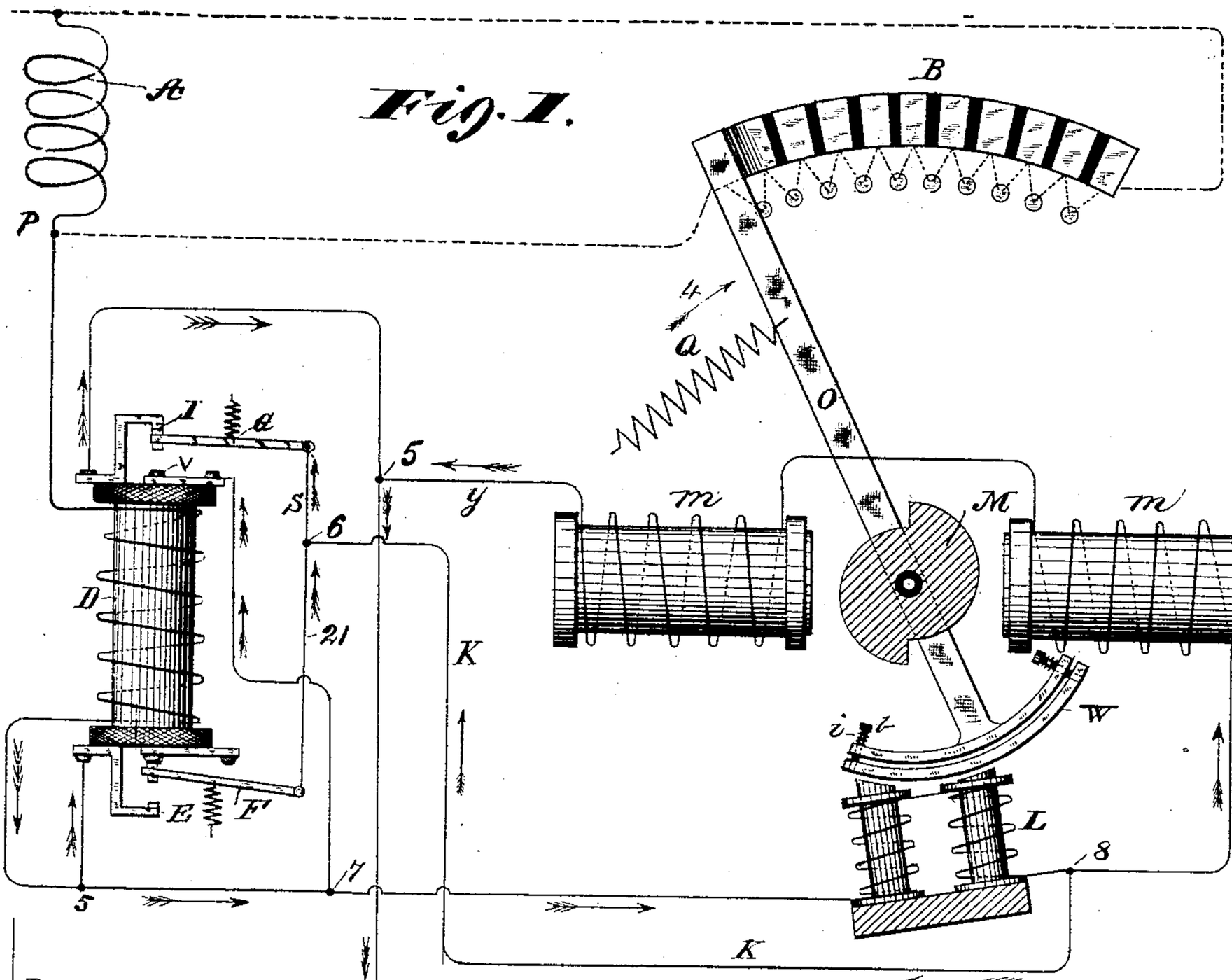


Fig. 2.

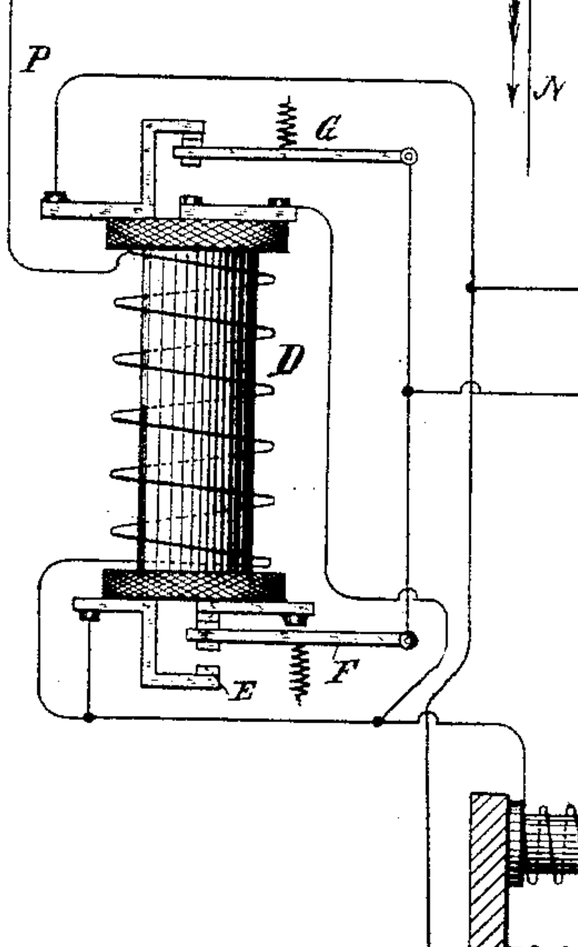
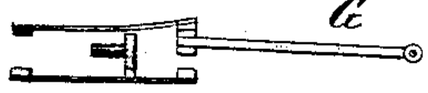
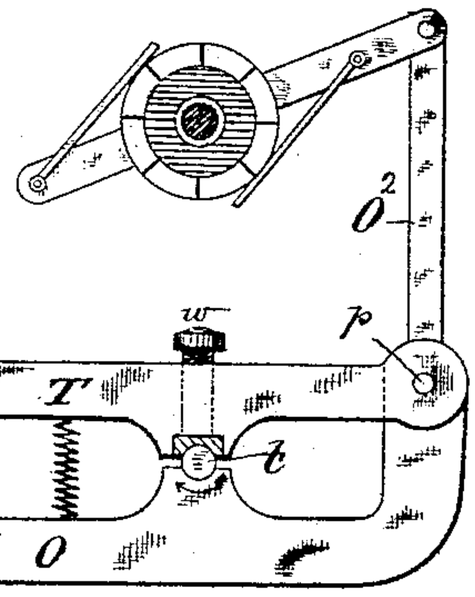


Fig. 3.





WITNESSES:

Gabriel J. W. Galster.

Wm. H. Capel.

INVENTOR

a M. J. Wightman.

BY

Hb. Townsend

ATTORNEY

UNITED STATES PATENT OFFICE.

MERLE J. WIGHTMAN, OF HARTFORD, CONNECTICUT, ASSIGNOR TO THE SCHUYLER ELECTRIC LIGHT COMPANY.

ELECTRIC-CURRENT REGULATOR.

SPECIFICATION forming part of Letters Patent No. 348,876, dated September 7, 1886.

Application filed June 3, 1886. Serial No. 203,981. (No model.)

To all whom it may concern:

Be it known that I, MERLE J. WIGHTMAN, a citizen of the United States, and a resident of Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Electric-Current Regulators, of which the following is a specification.

My invention relates to means for imparting movement to and adjusting the position of a lever or other device by the operation of which movement may be imparted directly or indirectly to the devices for adjusting the strength of an electric current. The devices operated or controlled by said lever for adjusting the current may be any of those known in the art—such, for instance, as a variable resistance, an adjustable commutator, or any other device for accomplishing the same purpose.

The invention consists in the combination, with the operating-lever for the adjusting devices, of certain combinations of motor-magnet and clamping or brake magnet thrown into and out of action in the manner to be presently described.

By the term "motor-magnet" I mean not only one in which the magnetism is employed as the direct motive agent for moving the lever, but also a magnet which indirectly effects the same result by throwing into and out of action another mechanism, which shall impart movement to the lever.

The novel combinations of motor-magnet, clamp-magnet, and circuit-controlling devices by which said magnets are thrown into and out of action at the proper time will be described in connection with the accompanying drawings and then specifically stated in the claims.

Figure 1 is a diagram of an apparatus constructed in accordance with my invention, and showing the operating-lever of the current-regulator applied to working the contacts of an adjustable rheostat. Fig. 2 illustrates a modification of the invention in which the motor-magnet throws into action a mechanical power instead of working directly upon an armature, and the operating-lever imparts movement to a set of adjustable commutator-brushes. Fig. 3 represents a modification in the circuit-controlling contacts.

Referring to Fig. 1, O indicates the lever by means of which, either directly or indirectly, the proper adjustments of the current-regulating devices proper are effected. Said lever is furnished with an armature, M, which is placed within the attractive influence of motor-magnets *m m*, so that when said magnets are energized the lever is turned in the direction of the arrow 4, and to greater or less extent depending upon the exigencies of the case. The retractor Q, consisting of a spring or other device, moves the lever in the opposite direction when the magnets *m m* cease to operate upon the armature. Any form of magnet and armature might be used in place of those shown without changing the essential character of the invention. Acting also upon the operating-lever O is an electro-magnet, L, which is the clamp-magnet of my invention, and which serves to hold the lever O positively in any one of its adjusted positions. The clamp-magnet L is thrown into and out of action by suitable circuit-controlling devices, which come into play when the lever O is to be moved in one or the other position, and which hold said magnet out of action until the proper position of said lever is attained. At this time the magnet L comes into action to clamp the lever, and the motor-magnets *m m*, if the movement has been effected by their agency, are at such time preferably thrown out of action. The clamping is effected by means of an armature, W, carried on the lever O, and having a slight movement which will permit it to be drawn toward the pole of the magnet L, and held firmly against the same when it is desired to clamp the lever.

The magnet W is mounted on pins *b b*, as shown, and is provided with springs *i i*, which tend to draw the armature away from the poles of the magnet. When the magnet acts, the armature is held against the poles, and the lever O is prevented from turning. When the magnet ceases to act, the springs *i i* withdraw the armature, and the operating-lever O can then be turned, either by the agency of the spring Q or by the motor-magnets *m m*.

The operation of the magnets is controlled

by electro-magnetism excited, preferably, by the current or a portion of the current whose power it is desired to regulate. It is obvious that one or more magnets may be used for the purpose, though for the sake of simplicity I prefer to employ a single magnet, D, which acts upon two circuit-controlling armatures, the main office of one of which is to throw the magnet L into and out of action, while the principle function of the other is to throw the magnets *m m* into and out of action. The latter armature-lever has the function also of of throwing the magnet L out of action when the first-named armature is held in such position that otherwise the magnet would remain in action.

The magnet D is here shown as placed in the main circuit P N. The two armature-levers are simply indicated at G and F.

The circuit-controlling contacts governing the circuits of the magnets are indicated at E, I, and V. These contacts form stops for the levers G and F, and the levers themselves carry contacts, through which circuits are completed when said contacts bear, respectively, against the stops I, V, and E.

When no current is passing through the coils of magnet D, or when the current-strength is below the normal, the levers G and E are held against the back stops, I E, by the action of suitable retracting-springs. Under these conditions both magnets L and *m* are out of action, being short circuited through the circuit-controlling contacts closed in this position of the lever. By following the lines it will be seen that the current entering at P will under this condition of the parts pass to the stop E, thence through lever F to lever G, stop I, and out by way of wire N. This path evidently constitutes a short circuit, diverting current from a path which, as indicated, includes the coils of the magnets L and *m*, and which path joins the path just described at the points 5 5. If armature F be raised, the short circuit around L only is broken, the current in this condition of the parts then passing through L, then by wire K, and joining the former short circuit at point 6, so that magnets *m m* still remain out of action though magnet L is excited. If in this position of the parts armature G be attracted so as to break the short circuit at I, the current which before passed through K will be obliged to pass through the magnet *m*, so as to find circuit through N, and both magnets would then be in action were it not that at the same time that lever G breaks contact at I it makes contact at V and completes a circuit in the reverse direction through K, making of K now a short-circuit path around L. This path starts from point 7 on the main circuit and passes through contact V, lever G, and wire K to point 8. As will be obvious the wire K, while under one condition it serves to convey the current-exciting magnets L, under the other condition becomes a short-circuit path for L.

From this description of the circuit-controlling devices it will be seen that when the levers G F are both retracted the circuit-controllers complete circuits by which current is shunted from both sets of magnets and both are out of action, so that the spring Q can move the lever O. If lever F alone be attracted, the clamp-magnet L comes into action to hold the lever O. If lever G be attracted, the motor-magnets *m m* are thrown into action; but at the same time and by the same operation the clamp-magnet L is thrown out of action, so that the motor-magnets can move the lever against the action of the retracting-spring Q and in the direction of the arrow 4. If the lever G returns to its normal position, the magnets *m m*, being thrown out of action, will cease to move the lever, but at the same instant the clamp-magnet L will come into action and hold the lever in the new adjusted position.

The circuit-controlling contacts operated by lever G are shown as rigid contacts. It is preferable, however, to make them as spring-contacts, after the manner indicated in Fig. 3, so that they may follow the movements of the lever, and so that there shall be no sensible period of time between the throwing out of the motor-magnets and the throwing in of the clamp-magnet in the operation just described.

The retractor of the armature F is so adjusted that when the current reaches a normal amount the armature may be attracted, so as to break the circuit at E and throw the circuits into condition where the clamp-magnet L may be thrown into and out of operation by the action of the lever G.

The retractor of lever G is so adjusted that said lever will only be moved when the current surpasses the normal strength, the amount of excess being determined by the adjustment of the spring. This adjustment may be such that there shall be a margin between the action of levers G and F sufficient to prevent any operation from taking place excepting on abnormal fluctuations of any determinate or desired amount. Within this margin of difference no action will take place, and all the parts concerned in operating or controlling the movements of the operating-lever O will remain quiescent.

In Fig. 1 the operating-lever O acts upon an adjustable or variable resistance, B, which is in a shunt around the coils A, supposed to be the coils of the field-magnet for the machine supplying current to the circuit P N. In the positions of the levers shown the resistance B is at its highest, and the amount of current flowing through A is therefore the maximum. When the machine is started, current rises in the coils of magnet D until the retractor of the armature F is overcome, whereupon the shunt around magnet L is opened, as before described, and the circuits of magnet L are now in such condition that current will flow through said magnet, or will cease to flow through the same, according to the position of

the lever G. If the amount of current required to draw up the lever F be the normal, the lever G will retain the position shown in the drawings, and the clamp-magnet L will continue to be excited, the parts still retaining the position shown. If the current increase beyond normal sufficiently to overcome the retractor for armature-lever G, the motor-magnets *m m* will come into action, as before described, and at the same time the magnet L will be thrown out of action. The lever O will then be moved in the direction of the arrow 4 by the magnets *m m* and against the action of the retractor Q, gradually weakening the resistance in B and decreasing, therefore, the current-flow, in the coils of A, so as to diminish the output of current from the generator. This regulating action will continue until the current is restored approximately to normal, when the lever G will be drawn back by its retractor, thus throwing the motor-magnets *m m* out of action, and at the same time bringing into action the clamping-magnet L, which will thereupon attract the armature W and hold the lever in the adjusted position—that is to say, the one required for maintaining the current on the circuit at normal under the conditions producing or tending to produce the abnormal flow. If, while the lever O is in such new adjusted position the current now decreases below normal, the retractor of lever F will cause the contact to be closed at E, thus bringing the apparatus into the position supposed before the current begins to flow, and shunting the current from the clamp-magnet L. The retractor Q will therefore be at liberty to draw the lever O back, so as to gradually increase the flow in the field-magnet coils A, and causing the current to rise on the circuit until the armature-lever F is drawn up again, whereupon the clamp magnet L will be again excited and will bring the lever O to rest and hold it until the occurrence of conditions resulting in an abnormal increase or decrease of the current controlling the operation of the circuit-controllers.

In Fig. 2 I have shown the operating-lever O connected to a link, O^2, through which it may impart movement to a current-regulating device consisting of a set of adjustable commutator-brushes for a dynamo-machine. In the apparatus shown in this figure the motor-magnet *m m* has the function of bringing into operation a mechanical power to move the lever O in the direction opposite to that in which it is moved by the action of the retracting-spring Q. The motive power for this purpose is derived from a revolving-shaft, *t*, which may be the shaft of the dynamo-machine, or any other revolving shaft. The lever O is clamped to said shaft with a varying degree of pressure by means of a supplemental lever, T, between which and lever O the shaft is grasped, so as to make a frictional connection. The lever T carries the armature of motor-magnet *m m*, and the motor-magnet itself is mounted on the lever O. A suitable spring tends to hold the two parts together and to support them upon the revolving-shaft, though other means might be employed for normally supporting the parts when they are not required to act. The friction between the shaft *t* and the two arms T O, embracing it, is not sufficient to overcome the clamp-magnet L. When, however, the clamping-magnet is thrown out of action and the motor-magnet *m* comes into action so as to increase the friction, the lever O is turned against the action of its retractor Q, effecting the same result by adjusting the commutator-brushes that is effected in Fig. 1 by the cutting out of the resistance B—that is to say, cutting down of current on the circuit.

The other devices shown in Fig. 2 are substantially the same as those of Fig. 1 and operate in substantially the same way.

It may, in some cases, be desirable to use a dash-pot connected to the moving parts of the regulator, in order to prevent sudden and violent movements. As this is a device well known in the art, and is commonly employed with current-regulators, I have not deemed it necessary to illustrate the same.

What I claim as my invention is—

1. The combination, with a lever, O, of a clamping-magnet, a motor-magnet, a circuit-controlling lever and contact therefor, controlling-circuits, by means of which one of said magnets is thrown out of action, and front contacts for the same controlling-circuits, by which the other magnet is thrown out of action.

2. The combination, with an operating-lever, O, or its equivalent, as described, of a motor-magnet and a clamping-magnet, a circuit-controlling lever for throwing the clamping-magnet into action and having its retractor adjusted so that the lever may operate when the current reaches normal, and a second circuit-controlling lever having contacts by which the motor-magnet may be thrown into action, and provided with a retractor, adjusted, as described, to permit the lever to act when the current passes beyond the strength at which the first-named lever will act.

3. The combination, with a movable lever, O, of a clamping-magnet, L, and an armature for said magnet mounted on the lever and movable on the same, so that it may be withdrawn from the magnet when the lever is at rest.

4. The combination, with the lever O, of a clamping-magnet, L, a curved armature adapted to be drawn into contact with the magnet-poles and mounted on the lever O, and suitable springs for withdrawing the armature when the magnet ceases to act.

5. The combination, with the movable lever O, of a motor-magnet, and a clamping-magnet, and armature for said magnet carried by the lever.

6. The combination, in an electric-current regulator, of a motor-magnet, a clamping-magnet, circuit-controllers governing the circuits of said magnets, and a relay provided with two

armatures for operating said circuit-controllers, one of said magnets being adjusted to respond to a strength of current less than that required for operating the other.

7. The combination, in an electric-current regulator, of a regulating arm or lever, O, a movable segmental armature carried thereby, an electro-magnet, L, for operating on the same, and a circuit-controller governed by a relay responsive to changes in the current.

8. The combination, with an operating-arm, O, of a clamping-magnet, L, and two sets of circuit-controlling contacts governing the operation of the same, one set being adjusted to throw the magnet into action when the current is at or below normal and the other to throw the magnet out of action when the current rises to a predetermined degree above normal.

9. The combination, in a current-regulating device, of a motor-magnet, a clamping-magnet, and two sets of circuit-controlling contacts, one for throwing the clamping-magnet out of action and the other controlling the circuits of the motor-magnet and serving to throw the same into action at the same time that the clamping-magnet is thrown out.

MERLE J. WIGHTMAN.

Witnesses:
H. LEMP,
C. C. STIRLING.