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E. A. EDWARDS.

REGULATION OF ELECTRIC CIRCUITS.

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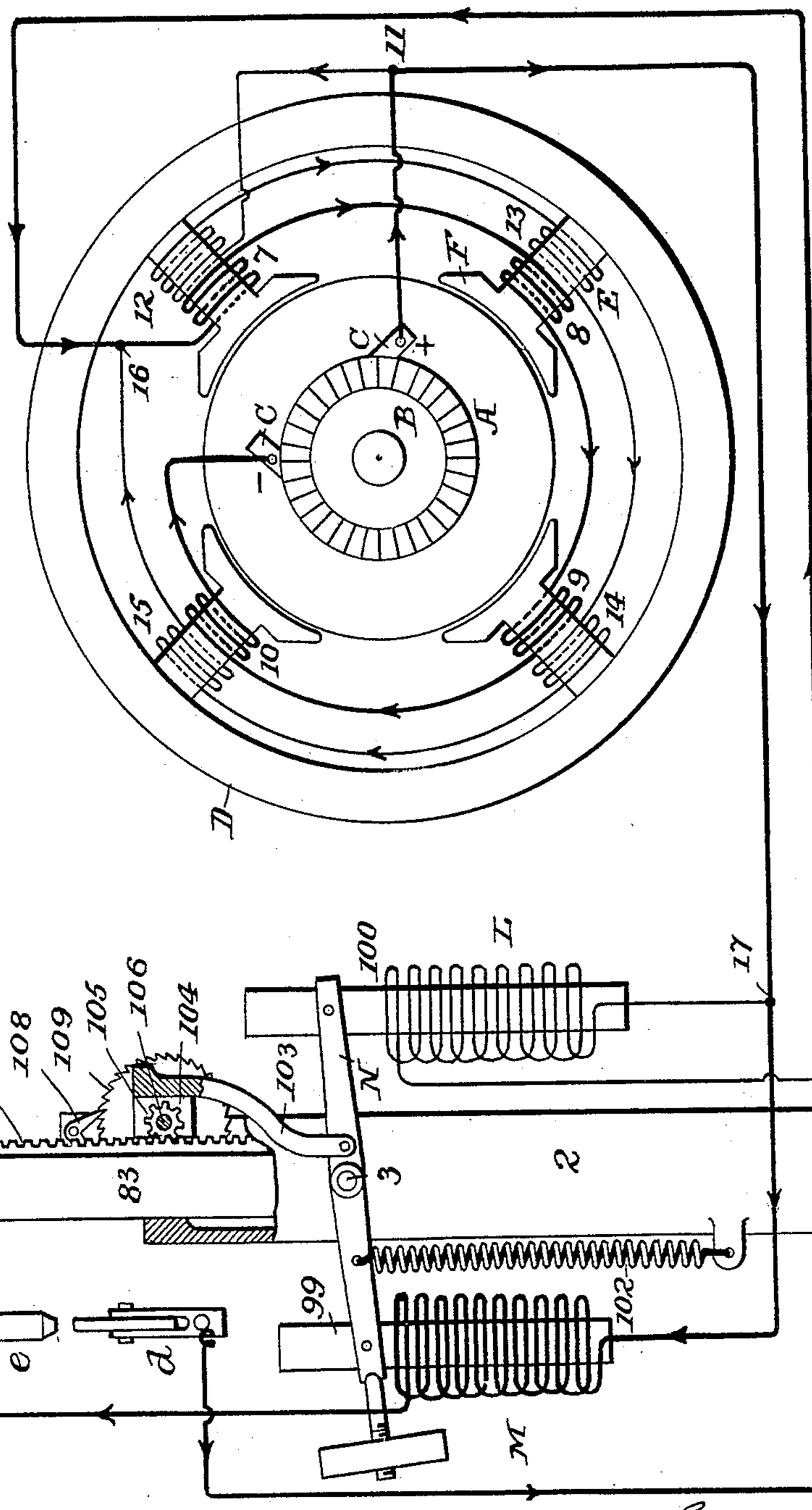

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REGULATION OF ELECTRIC CIRCUITS.

No. 817,232. Specification of Letters Patent. Patented April 10, 1906.

Application filed March 7, 1902. Renewed February 12, 1906. Serial No. 300,625.

To all whom it may concern:

Be it known that I, EDGAR A. EDWARDS, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in the Regulation of Electric Circuits, of which the following is a specification.

My invention relates to the regulation of electric circuits by means of a differentially-wound dynamo; and the object of my invention is to secure a constant current from a differentially-wound dynamo to supply an electric circuit, more particularly a series arc-light circuit containing a lamp of the class having normally open electrodes adapted to be automatically brought into contact after the current is switched on and then separated to strike an arc.

There are many advantages attendant upon the use of a differential dynamo for arc-lighting purposes, not the least of which are its comparative simplicity and ready adaptability to the end in view—viz., automatic regulation for constant current—for the opposing shunt and series field-windings have only to be properly adjusted to produce automatic regulation for constant current, any decrease in the line resistance, for instance, tending to increase the current therein being counteracted by the increased differential action of the series and shunt field-windings, while an increase of resistance in the line tending to reduce the current therein is correspondingly counteracted by the reduced differential action of the field-coils.

I have found that it is unnecessary to operate the dynamo on a normally closed circuit, for this form of dynamo if properly designed is particularly applicable to a normally open circuit, such as is found with an arc-lamp in series wherein the carbons are normally separated, but which lamp is provided with regulating-coils for bringing the carbons initially into contact.

My invention consists in the various combinations and arrangements of parts having the mode of operation substantially as hereinafter more particularly pointed out.

I am not to be understood as limiting myself to the precise combinations of apparatus hereinbefore referred to as a series arc-lamp circuit combined with a differential dynamo, as my invention is applicable to other normally open circuits adapted to be automatically closed after the dynamo has been started; but I have preferred to illustrate my invention in connection with an arc-light circuit, as this is perhaps the connection in which the invention will be most frequently used.

Referring to the drawing, A represents the armature, B the commutator, C the brushes, and D the yoke, of a suitable dynamo, shown in this instance as a differentially-wound dynamo having salient pole-pieces E, preferably provided with pole-shoes F of substantially the same shape and arrangement as those disclosed in the application hereinbefore referred to. I have chosen to show a dynamo with four poles only, as this conveniently illustrates my invention; but I am not to be understood as limiting myself to a dynamo of this precise character, as any suitable number of poles and any desired winding for the armature may be used.

I illustrate an arc-lamp of substantially the character fully disclosed in my Patent No. 708,032, dated September 2, 1902, and, referring to the diagrammatic representation of the lamp, 1 represents a suitable base provided with a frame 2, adapted to move vertically, within which is a plunger 83, carrying the upper electrode *e*, while the other electrode *d* is suitably supported upon the base 1. Pivoted at 3 on each side of the frame 2 is a beam N, carrying cores 100 and 99 at each end, the cores being surrounded by regulating-magnets L and M, respectively. A suitable tension-spring 102, adjusted to assist the magnet M, is connected to one arm of the beam N and to the base 1, while a bracket 103 is pivoted on the other arm a short distance from the pivot 3. On the same side of beam N as the spring 102, is an adjustable counterweight 101, which is set to exactly counterbalance the weight at the opposite side of the fulcrum. By this the beam N is maintained in absolute mechanical equilibrum so far as the weight of the parts acting upon opposite sides of the fulcrum is concerned, and it will therefore be evident that mechanically there is no tendency of the beam to vibrate in either direction to change the position of

the movable electrode, while the beam N is free to move instantly upon the application of any power tending to change the preponderance of the pull to either side—as, for instance, any change in the electrical conditions of magnet L or M, acting upon one or the other of cores 99 and 100. The bracket 103 carries a block 104, within which is journaled the shaft 106 of a pinion 105 and a ratchet-wheel 109, so that the pinion and ratchet-wheel turn together with the shaft. Suitably supported from the frame 2 is a pawl 108, adapted to engage the ratchet-wheel 109 and prevent movement of the pinion 105 relative to a rack 107 on the plunger 83, the rack and pinion being in constant engagement.

When the parts are in the positions shown in the drawing, with the spring 102 tilting one end of the beam N downward, the ratchet-wheel 109 will be raised into engagement with the pawl 108 and motion of the pinion 105 relative to the rack 107 on the plunger 83 cannot take place. With the parts in this position the electrodes will be slightly separated, as shown.

In the operation of the device, which, as stated before, is only shown diagramatically for the sake of simplicity, when the beam N is tilted to a sufficient degree against the force of the counterweight the ratchet-wheel 109 will be moved out of engagement with pawl 108, and the plunger 83 may then move downward, carrying electrode *e* with it into engagement with electrode *d*, and this downward movement of the plunger 83 may be step by step, one tooth of the ratchet-wheel 109 at a time, according to the adjustment of the device and the requirements of the lamp. The spring 102 is so adjusted as not to be brought under tension until the side of beam N, carrying core 100, is tilted down below the horizontal. Magnet L is arranged in shunt to the circuit of the dynamo, and magnet M is arranged directly in series with the armature thereof and in series with the electrodes *e* and *d*, these magnets being adjusted to regulate the operation of the lamp, as will hereinafter be described.

Referring to the diagram, it may be stated that the heavy lines represent the armature-circuit and differential series field-winding, while the light lines represent the shunt field-winding. The armature-circuit and series field-winding may be traced as follows: from the positive brush (marked a plus-sign) to and through the magnet M, from thence to electrode *e*, and from electrode *d* through the series field-windings 7 8 9 10 and back to the negative brush, (marked with a minus-sign.) The shunt field-winding of the dynamo wound to oppose the series field-winding is led from any suitable point, as 11, on the armature-circuit and passes from thence through the shunt field-windings 12 13 14 15 back to a point 16 on the armature-circuit. The shunt-regulating magnet L of the arc-lamp is shown connected between any suitable points 17 and 18 on the armature-circuit.

The lamp being connected in circuit as described and the parts being in the positions shown in the diagram, upon starting the dynamo it will be seen that the armature-circuit is not completed through the electrodes, because they are normally separated; but current may flow through the regulating-magnet L of the lamp in shunt relation with the shunt field-winding of the generator. The magnetic stress produced by the shunt-magnet L is in practice about double that of the series magnet M, so that with spring 102 there is a combined mechanical and magnetic action wholly separate from the mechanical balance of the parts before referred to. The shunt-regulating magnet L will first become energized and pull core 100 downward, tilting the beam N against the force of the counterweight 101. The block 104 will be lowered, carrying with it ratchet-wheel 109, thus releasing pawl 108 and allowing the plunger 83 to descend until the electrodes are in contact. The weight of the plunger 83 and attached parts will cause it to descend if the pinion 105 is no longer held from rotation by the engagement of pawl 108 with ratchet-wheel 109. The main circuit is thus completed and the series magnet M of the lamp will become energized, while at the same time the current in the shunt-magnet L is weakened, so that the series magnet will pull the core 99 downward and tilt the beam N in such manner as to separate the electrodes and strike the arc. When this occurs, the resistance of the main circuit will be increased, and the series and shunt magnets, as stated, are so adjusted that an electrical equilibrium between them will be established in the well-known manner, which is only disturbed to affect the electrodes upon an increase of the resistance of the armature-circuit as the carbon of the electrodes becomes disintegrated. When this occurs, more current flows through the shunt-magnet L, causing it to attract the core 100 and allow the plunger 83 to descend and decrease the distance which the electrodes *d* and *e* are apart, as desired. When the circuit is broken and magnets L and M are deënergized, the spring 102 acts to carry the ratchet-wheel 109 into engagement with the pawl 108, thereby preventing the plunger 83, with its attached parts, and electrode *e* from moving downward, thus maintaining an open circuit between the electrodes *d* and *e*.

Without limiting myself to the precise construction and arrangement of parts shown and described, I claim as my invention—

1. The combination with a normally open constant-current circuit and a regulating-magnet in shunt thereto, of a differentially-wound dynamo for supplying current there-

to, and means for automatically closing said circuit by current from the dynamo, substantially as described.

2. The combination with a dynamo having differential shunt and series field-windings, of an arc-lamp provided with regulating-magnets, one in series with the series field-winding and another in shunt to the shunt field-winding of the dynamo, substantially as described.

3. The combination with a dynamo having differential shunt and series field-windings, of an arc-lamp provided with regulating-magnets, one in a normally open circuit with the series field-winding, and another in a normally closed shunt to the shunt field-winding of the dynamo, substantially as described.

4. The combination with a dynamo having differential shunt and series field-windings, of an arc-lamp provided with normally open electrodes, and regulating-magnets for the lamp, one in series with the normally open electrodes and the series field-winding, and another in a normally closed shunt about the armature of the dynamo, substantially as described.

5. The combination with a constant-current circuit, of a differentially-wound dynamo for supplying current thereto, an arc-lamp in said constant-current circuit, said lamp having normally open electrodes, a regulating-magnet in series with said electrodes and one of the windings, and another regulating-magnet in shunt about the armature of the dynamo, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDGAR A. EDWARDS.

Witnesses:
W. E. COLE,
H. F. HUFF.