No. 748,145. PATENTED DEC. 29, 1903.

M. H. BAKER.

METHOD OF REGULATING ELECTRIC CIRCUITS

APPLICATION FILED JUNE 26, 1902.

NO MODEL.

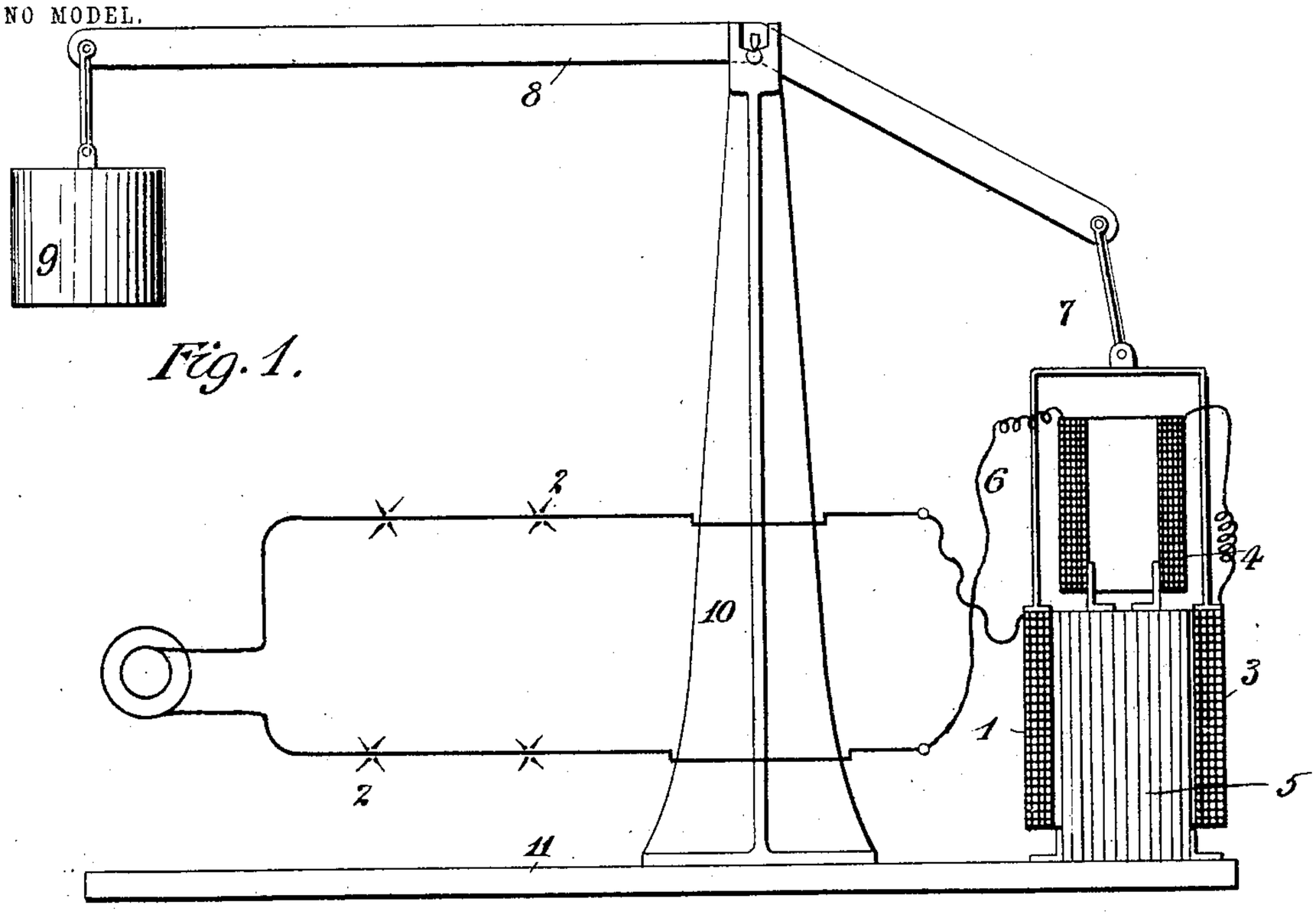

Fig. 1.

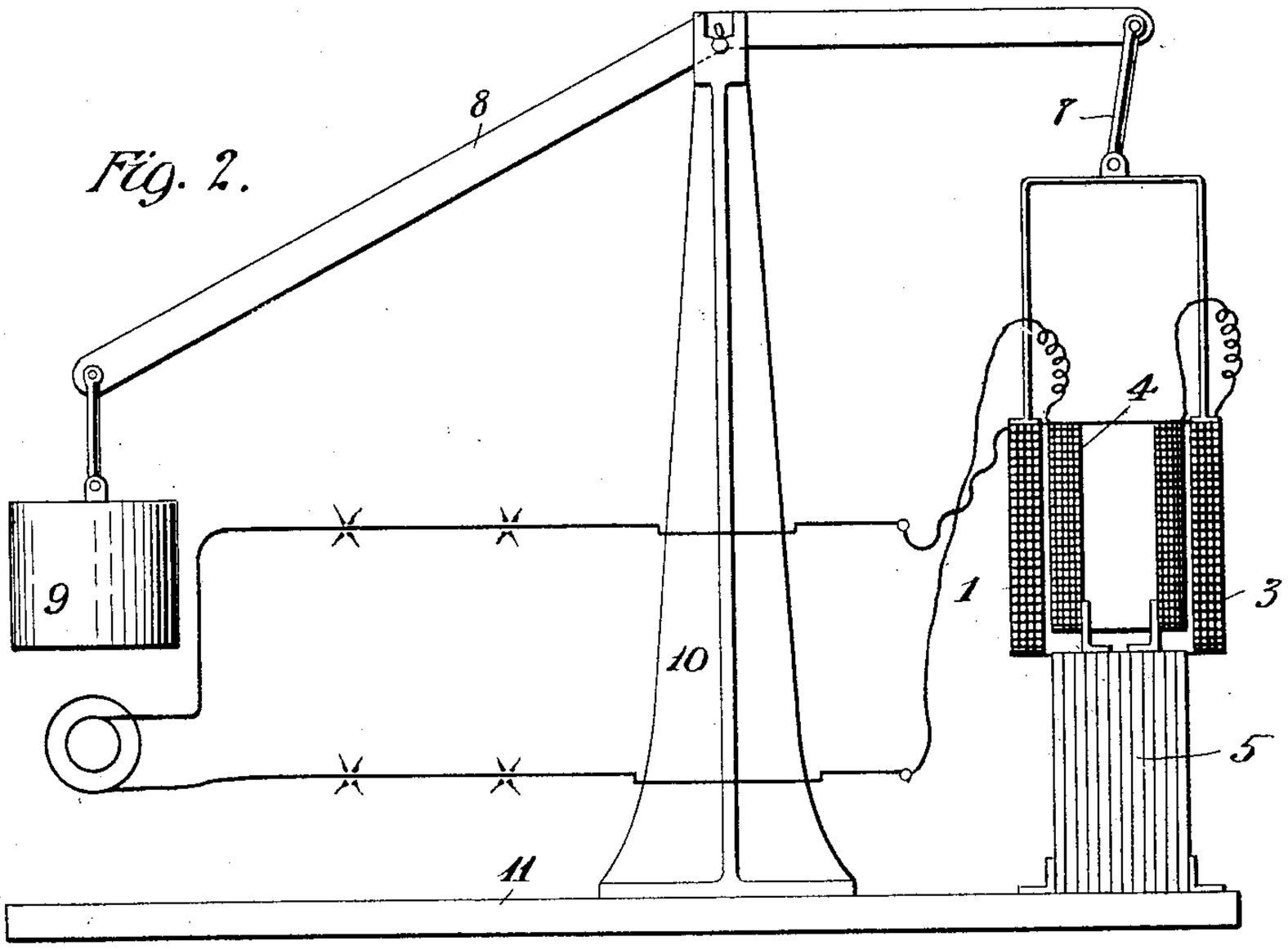

Fig. 2.

Witnesses
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Inventor:-
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By his Attorney
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No. 748,145. Patented December 29, 1903.

UNITED STATES PATENT OFFICE.

MALCOLM H. BAKER, OF EAST LIBERTY, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

METHOD OF REGULATING ELECTRIC CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 748,145, dated December 29, 1903.

Application filed June 26, 1902. Serial No. 113,313. (No model.)

To all whom it may concern:

Be it known that I, MALCOLM H. BAKER, a citizen of the United States, and a resident of East Liberty, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Methods of Regulating Electric Circuits, of which the following is a specification.

In certain patents issued in my name on October 8, 1901, I have shown and described a variety of devices whereby a mechanical force is opposed to the pull of a reactance-coil, the force and the magnetic pull being so correlated that the choking effect of the coil varies automatically to compensate for changes in the resistance of the circuit. Particularly in the United States Patents Nos. 684,165 and 684,340, dated October 8, 1901, I disclose a method and apparatus whereby the above-described results are accomplished through the medium of a counterweight acting against the moving part of a reactance device, the said moving part and the said counterweight being attached to opposite ends of a pivoted lever having a critical angle whereby the varying effects of the weight and the magnetic pull of the coil cause varying choking effects which are adapted to maintain the current in the circuit constant. The last-described form of apparatus may be regarded as a type of my various regulating devices. It is arranged in series with the translating devices in the circuit which it is intended to control and operates through a certain range of action to maintain the current constant. In passing from the position of no load, however, to the position of full load the apparatus operates with substantial perfection only to the point where the coil and the core are completely separated or about to be separated. In other words, when the movement of one part of the reactance device, whether the coil or the core, brings the two elements named to a point where they are about to separate or are actually separated the weakening of the field through any further movement is so rapid that any force opposing the magnetic pull with approximately constant variations per unit of travel will cease to compensate for the largely-increased magnetic variations.

I have devised several methods of automatically securing the necessary increase in compensating value, such methods being mainly mechanical in their nature. The present invention aims to accomplish the same result by means that are mainly electrical, while at the same time the action of my apparatus is such as to gradually remove the resistance of the compensating coil from the circuit in passing from no load to full load. In other words, when the circuit is fully loaded the line is supplied with the full potential. The means by which I accomplish the described results comprise an auxiliary coil electrically opposing the original regulator-coil, the auxiliary coil being fixed and the regulator-coil being adapted to surround the auxiliary coil on a fully-loaded circuit. The auxiliary coil, itself stationary, is arranged in line with the stationary core of the reactance device or in line with a portion of said core, so that as the moving coil begins to separate itself from the core when the resistance of the circuit is increased by the switching in of a translating device or devices it also begins to encircle more and more the auxiliary coil which is electrically opposed to it. The two coils are arranged in series with each other and with the translating devices in the electric circuit. When the two coils are apart from each other under a condition of no load in the circuit, the resistance of the two coils is included in the circuit as an element of the total resistance thereof. When, however, the coils begin to approach and the moving coil begins to encircle the stationary coil, the differential relations of the coils are varied until at the position of full load the opposing inductions of the coils substantially cancel each other. During this movement the counteraction exercised upon the moving coil is not simply the counteraction of the weight opposed to the said coil, but it includes also the repulsive effect of one coil upon the other.

My invention will be clearly understood by reference to the accompanying drawings, in which—

Figure 1 illustrates my reactance device connected up in circuit with a series of arc-lamps, the device being shown partly in elevation and partly in vertical section and the parts being shown in the position which they occupy at no load. Fig. 2 is a similar view showing the parts in the position which they occupy at full load.

In the drawings, 1 represents an electric circuit, including translating devices 2 2, which are here represented as arc-lamps in series with each other. In the same circuit is a regulator-coil 3 and an auxiliary coil 4, the former being suspended, so as to surround the latter and also to surround a magnetic core 5, which will generally be constructed of laminated iron. The coils 3 and 4 are in series with each other and are so wound as to be electrically opposed to each other.

The coil 3 is suspended upon a frame 6, which is itself swiveled or pivoted at 7 to one end of a lever 8, having a weight 9 attached to its remote end. The lever 8 is pivoted at the top of a standard 10, which is supported like the core 5 upon a suitable base 11. It will be observed that the lever 8 extends in different directions on opposite sides of its pivot—that is to say, it is bent out of a straight line. As a matter of fact, the said lever is provided with a "critical angle," whereby the effect of the counterbalance between the weight 9 and the moving coil 3 will be such as to maintain the current in the circuit 1 practically constant.

The mode of determining the critical angle of the lever 8 or one such mode can be learned by reference to either of the patents, Nos. 684,165 or 684,340, above referred to. The pertinency of the method therein described is not affected by the fact that the element of mutual repulsion between the coils 3 and 4 forms part of the counteraction in the present form of device.

The coil 4 may be supported in a fixed position by any suitable means.

The present application relates more particularly to a method of regulating electric circuits, and the claims herein are confined to the method, the apparatus described in this application forming the subject of another application executed on the same day herewith.

I claim as my invention—

1. In a circuit containing translating devices in series and also containing in series two opposed coils one of which has a relative movement as respects the other and as respects a suitable magnetic core, the method of maintaining constant current between the limits of no load and full load on the circuit, which consists in automatically varying the self-induction of the apparatus by shifting the relative positions of the movable coil and the core, and simultaneously varying the differential relations of the coils, whereby the resulting inductive effect of their interaction is varied between a maximum at no load and a minimum at full load.

2. In a circuit containing translating devices in series and also containing in series two opposed coils one of which has a relative movement as respects the other and as respects a suitable magnetic core, the method of maintaining constant current between the limits of no load and full load on the circuit, which consists in automatically varying the self-induction of the apparatus by shifting the relative positions of the movable coil and the core, and simultaneously varying the differential relations of the coils until, at the position of full load, the opposing inductions thereof substantially cancel each other.

3. In a circuit containing translating devices in series and also containing in series two opposed coils one of which has a relative movement as respects the other and as respects a suitable magnetic core, the method of utilizing the inductive effects of a reactance device for maintaining constant current when translating devices are successively thrown into the circuit, and of withdrawing substantially all of the inductive resistance of the reactance device at full load, which consists in varying the choking effects of the reactance device by the differential action of a suitable mechanical force and the magnetic pull of the coil, and progressively neutralizing the inductive effects in the coils as the movable coil is removed from the core.

4. In a circuit containing translating devices in series and also containing in series two opposed coils one of which has a relative movement as respects the other and as respects a suitable magnetic core, the method of maintaining constant current in passing from lower load to greater load by the successive introduction of translating devices, which consists in automatically controlling the varying self-induction of the apparatus by the action of a mechanical force opposing the magnetic pull of the coil, and at the same time progressively reducing the number of inducing-coils directly exposed to inductive action.

5. In a circuit containing translating devices in series and also containing in series two opposed coils one of which has a relative movement as respects the other and as respects a suitable magnetic core, the method of maintaining constant current in the circuit, which consists in causing the changes in the resistance of the circuit due to the switching in or out of one or more translating devices to vary the number of coils in the apparatus directly exposed to inductive action, thereby determining the magnetic pull of the movable coil, opposing to the magnetic pull a mechanical force, and so correlating the said force to the magnetic pull that the self-induc-

tion of the apparatus will vary automatically to compensate for the changes in resistance in the circuit.

6. The method of utilizing the inductive effects of a reactance device including two opposed coils and a suitable magnetic core one coil having a movement relative to the said core and to the other coil, for maintaining constant current in a circuit containing translating devices in series and for withdrawing substantially all of the inductive resistance of the reactance device when the circuit is fully loaded, which consists in opposing to the varying magnetic pull of the movable coil as affected by the varying force resulting from the differential action of the reactance device, the automatic counter variations of a mechanical force.

Signed at New York, in the county of New York and State of New York, this 13th day of June, A. D. 1902.

MALCOLM H. BAKER.

Witnesses:
WM. H. CAPEL,
GEORGE H. STOCKBRIDGE.