No. 684,341. Patented Oct. 8, 1901.

# M. H. BAKER.

## REGULATING DEVICE FOR ARC LAMP CIRCUITS.

(Application filed May 11, 1900.)

(No Model.) 2 Sheets—Sheet 1.

*Fig. 1*

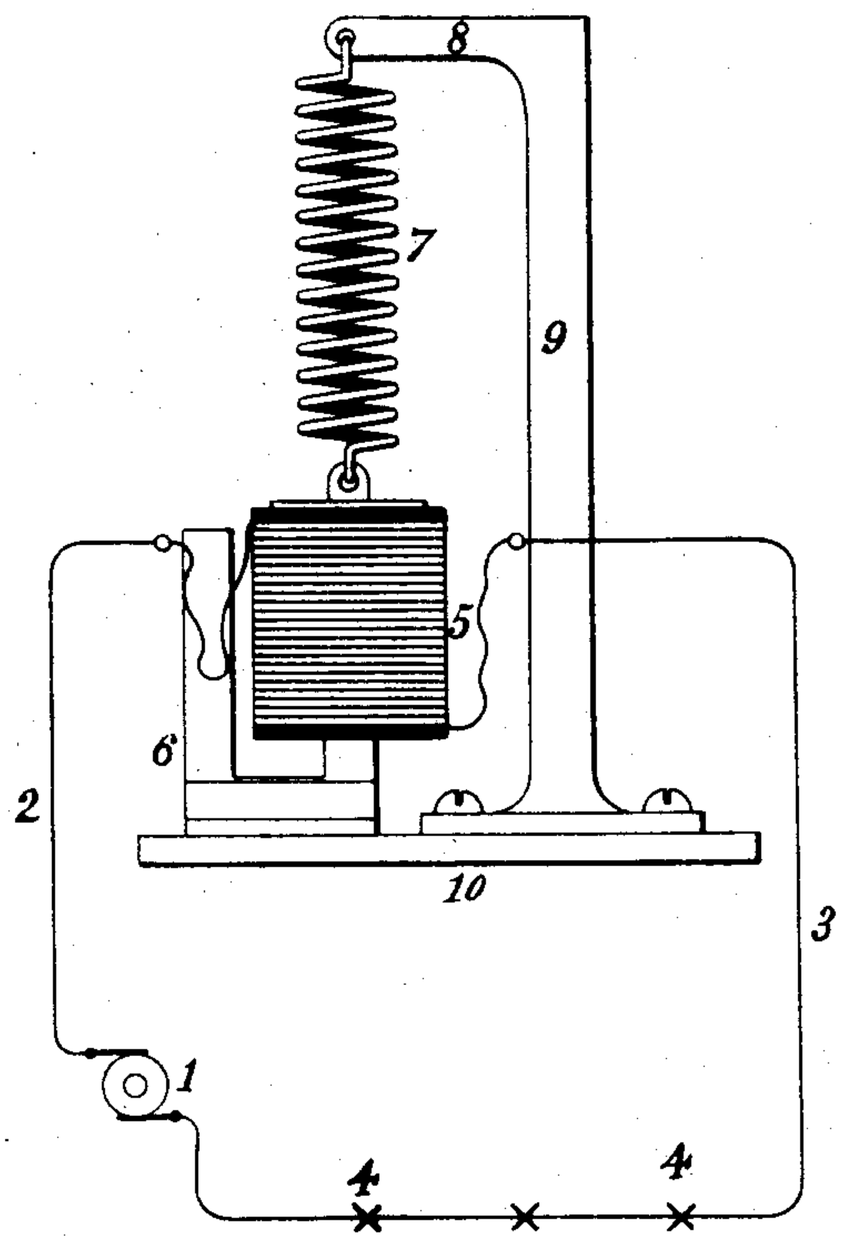



*Fig. 2*

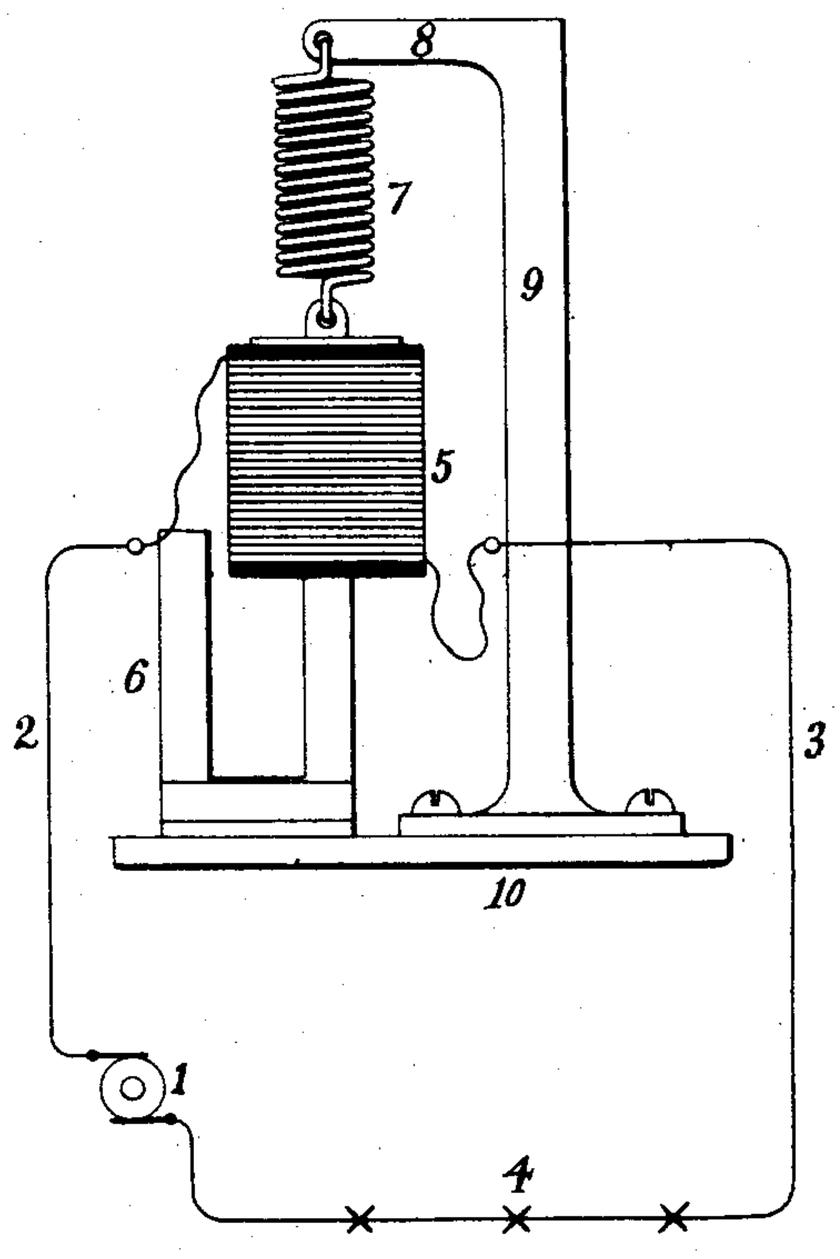
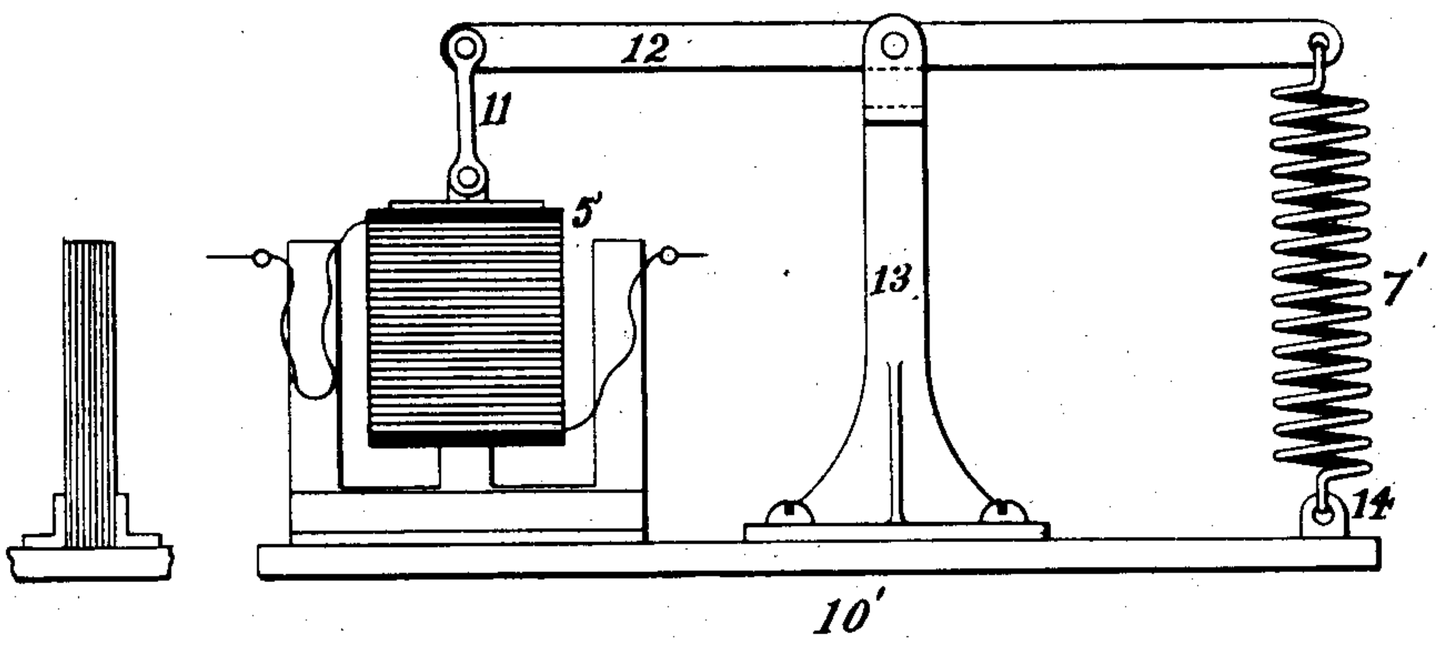



*Fig. 3*

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## REGULATING DEVICE FOR ARC LAMP CIRCUITS.

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(No Model.) 2 Sheets—Sheet 2.

Fig. 5

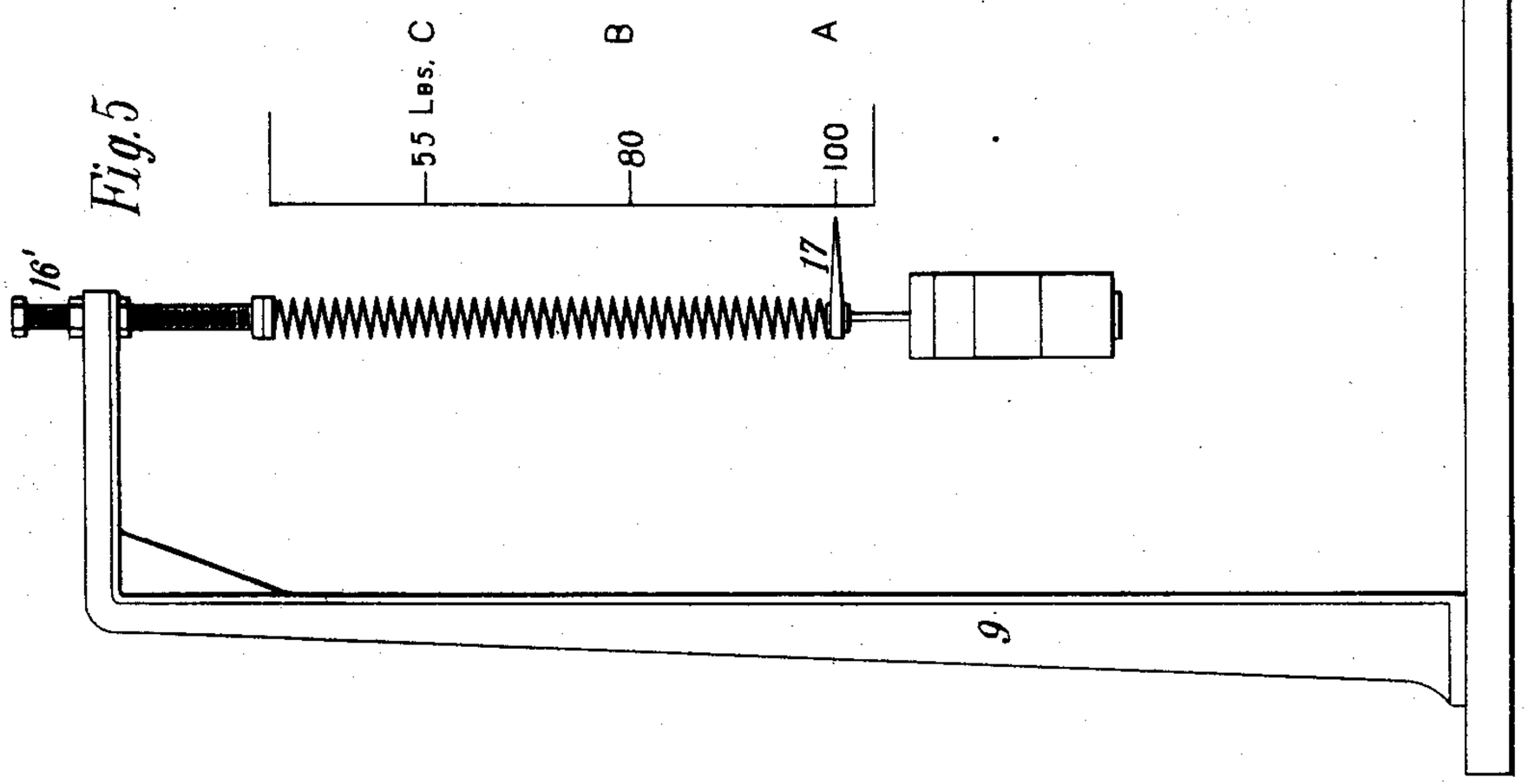
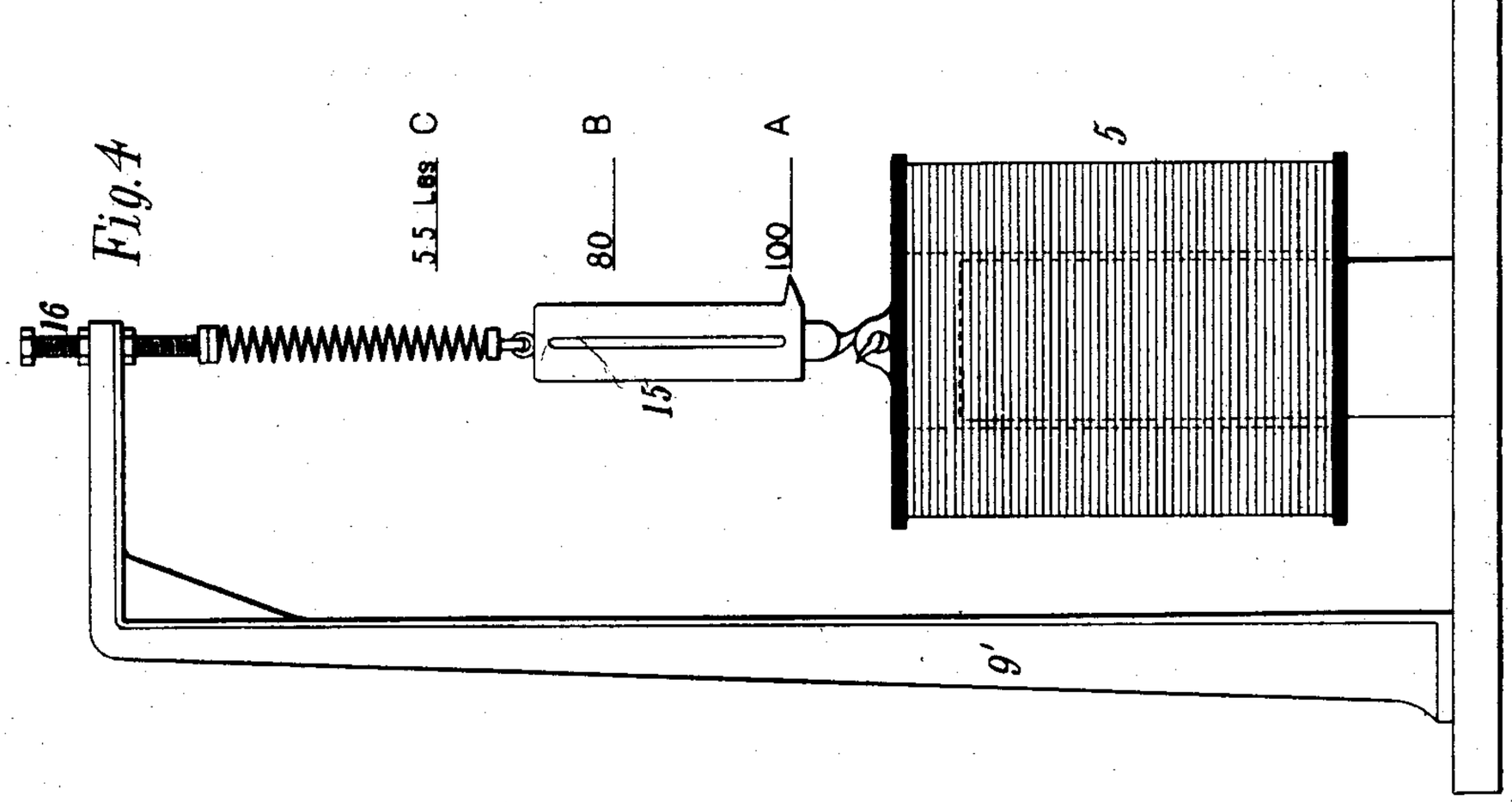



Fig. 4

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# UNITED STATES PATENT OFFICE.

MALCOLM H. BAKER, OF NEW YORK, N. Y., ASSIGNOR TO THE MANHATTAN GENERAL CONSTRUCTION COMPANY, OF SAME PLACE.

## REGULATING DEVICE FOR ARC-LAMP CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 684,341, dated October 8, 1901.

Application filed May 11, 1900. Serial No. 16,260. (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 New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Regulating Devices for Arc-Lamp Circuits, of which the following is a specification.

My invention relates to improvements in regulators for circuits containing alternating-current arc-lamps arranged in series. Heretofore the regulation of this class of devices has been accomplished through the medium of very complicated and expensive apparatus. By means of my present invention all complication is avoided and the regulation of a current in an alternating-current arc-lamp series circuit is made certain and effective by the use of very simple mechanism having few parts and very little liable to get out of order.

My invention relates, broadly, to automatically varying the reactance in a circuit such as described to compensate for changes in the resistance of the circuit due to the cutting in or out of lamps or to any other cause.

Otherwise expressed, my invention relates to automatically varying the value of a variable reactance in the circuit in accordance with changes of resistance in the said circuit in such a manner as to maintain the current practically constant.

In carrying out my invention I include in the circuit in series with the lamps a reactance device consisting of a coil of wire so placed as to have a free relative movement with respect to a laminated core inside the coil. It is well understood that the current passing through a coil having such a relation to a magnetic core is more or less choked or impeded, according to the relative position which the coil and the core occupy, the choking or impeding effect increasing with the farther and farther insertion of the core within the coil and decreasing with the gradual withdrawal of the core from the coil. The relative movements of the coil and the core may be brought about by variations of the magnetic pull due to variations of the current passing through the coil. If now a force could be discovered which would automatically vary the choking effect produced in the coil in correspondence with variations in the resistance of the circuit, which force should oppose and vary with the magnetic pull of the said coil, the value of the current traversing the coil might be made practically independent of the resistance of the circuit, so that a constant current could be maintained irrespective of the number of lamps in operation in the circuit. I have discovered that such a force can be supplied mechanically in several ways. In the present instance I make use of a spring connected either directly or indirectly to the moving part of my regulating reactance device and also connected at its opposite end to a fixed or stationary part of my apparatus. The arrangement is such that as the pull of the magnet increases, owing to the switching out of lamps in the main circuit, as the moving part of the reactance device is gradually drawn down by the increase of the magnetic pull the effect of the spring shall be correspondingly increased, the spring being so constructed in the first instance as to have a gradually-increasing resistance under the influence of retraction, according to a determinate law. It is to be understood that the parts are so connected as to cause the spring to be retracted or extended while the coil and its core are approaching each other and to be relieved while the coil and the core are being relatively separated.

I have illustrated my invention in the accompanying drawings, in which—

Figure 1 shows my apparatus connected up with a group of lamps, the position of the parts being that which they occupy at minimum load and the spring being connected directly to the moving part of the reactance device. Fig. 2 is a similar view showing the position of the parts when the circuit is fully loaded. Fig. 3 shows my reactance device connected indirectly with the counterbalancing-spring, and Figs. 4 and 5 are diagrammatic views illustrating the method by which a spring is calibrated, so as to serve the purposes of my invention.

In the drawings, 1 is a suitable source of alternating current, and 2 and 3 are electric mains leading therefrom. The lamps are shown at 4, and the regulating or reactance coil appears at 5. The coil 5 is represented

as surrounding one leg of a laminated iron core 6, of horseshoe shape, and its top is connected, in the form illustrated in Figs. 1 and 2, to a spring 7, the other end of which is attached to an arm 8 on a standard or upright 9. The whole is mounted on a suitable base 10.

The action of the apparatus will be readily understood. When the parts are in the position illustrated in Fig. 2, the movable portion of the reactance device is in its most elevated position. This represents the position of the parts at maximum load. Should one or more lamps now be cut out of the circuit and the resistance of the main circuit be thereby decreased, the coil of the reactance device will exercise a stronger pull upon its core and these two parts will approach each other, at the same time stretching or extending the spring 7. Meanwhile the pull of the magnet has been constantly increasing, and it will also be noted that the effectiveness of the spring has also been increasing by reason of the qualities inherent in its construction, as above described. Accordingly the effect of the spring increases in the same ratio as the pull of the core increases, and if the spring is originally constructed so that its increase of resistance, on being stretched, shall correspond to the increasing pull of the magnet under the conditions of actual service a substantial counterbalance can be maintained throughout the entire excursion of the reactance coil or core, as the case may be. As intimated, the spring 7 may be attached to the core 6 instead of to the coil 5. The action would be the same in either case.

The particular shape of the core of the reactance device may be varied. In the present instance I make use of a laminated horseshoe-core, with the coil arranged around one leg thereof. Moreover, my apparatus may be applied to a single series of arc-lamps, as shown in the drawings, or a number of them may be combined with several series of lamps.

In Fig. 3 I show a regulating reactance device in which the coil 5′ is connected by a link 11 with a lever 12, centrally pivoted at the top of a standard 13. To the opposite end of the said lever is joined a spring 7′, the farther end of which is attached through an eye 14 to the base 10′. In this instance the core of the reactance device is of double-horseshoe shape, the coil 5′ being mounted on the central leg of the core. Whether the counterbalancing-spring is connected directly to the moving part of the reactance device, as shown in Fig. 1, or indirectly, as shown in Fig. 3, makes no difference with the operation of my device.

Figs. 4 and 5 illustrate a method which may be employed for calibrating a spring to serve the purposes of my invention. Referring to Fig. 4, the movable part 5 of my reactance device is here shown as being suspended from a frame or standard 9′ by means of a spring-balance 15, connected with an adjusting-screw 16. It will be understood that the size of the coil 5 is determined the same as any standard regulator—that is, a sufficient number of turns of wire are wound upon the coil to choke the desired number of volts when the coil is all the way down on the iron. The coil being in this position, as shown in Fig. 4, the screw 16 is adjusted until the coil is in equilibrium at the desired current, this being the position of no load. The number of pounds pull is read from the spring-balance and the position is noted. Half the load of lamps, for instance, may now be turned on and the spring-balance raised by means of the screw 16 until a new position of equilibrium for the desired current—say seven amperes—is found, the pounds and the position being again noted. The same operation is repeated for a full load of lamps, and in this way three points, A, B, and C, are determined, thus giving a calibration-scale. Instead of choosing conditions of no load, half-load, and full load only a scale may be formed, depending on a much larger selection of circuit conditions, thus obtaining, if desired, a reading for every change of condition due to the switching in of a single new translating device. The scale having been obtained, as indicated, the problem now is to wind a spring that will meet the conditions of the scale. Let it be assumed that the number of pounds pull when the coil is in its lowermost position is one hundred and that the pull under conditions of half-load is eighty pounds, and that the pull under conditions of full load is fifty-five pounds. The first thing to do in order to secure a spring which will fulfil the conditions demanded of it is to select a spring of approximately the same length as the total travel on the calibration-scale. The spring must also be of such size and strength that when nearly closed it will support fifty-five pounds, if that be the number of pounds indicated by the spring-balance for the position C. Let this spring be suspended from the standard 9 and capable of adjustment therein by means of an adjusting-screw 16′. The screw should then be adjusted so that the pointer 17 is opposite the line indicating the position C, when a weight of fifty-five pounds is hung at the lower end of the spring. The weight may then be removed and a weight of eighty pounds substituted for it. Under these conditions the pointer should be opposite the line indicating the position B. Should the pointer be too low, the spring should be shortened a little by cutting off a portion of it and then reset, this operation being repeated until the pointer rests in the proper position. Should the pointer be too high, the outside of the spring may be ground off a little for the same purpose. The same operation should be repeated for adjusting the spring to the point A, in which case a weight of one hundred pounds will of course be substituted for the weight previously used. By pursuing these methods and retempering the spring it is possible to obtain a spring that is suited to all the vary-

ing conditions of a circuit containing translating devices, so that perfect regulation can be secured within the limits of no load and full load.

The point to be noted is that the regulator is first calibrated to find the calibration-scale, and then a properly-selected spring is adjusted to meet the conditions of the scale.

The invention claimed is—

1. In a system of electrical distribution, an electric circuit containing a number of translating devices in series, a regulating-reactance device in series with the said translating devices and consisting of a relatively-movable coil and core whose position with respect to each other determines the choking effect of the coil, a spring connected with the movable part of the reactance device and acting in opposition to the magnetic pull thereof, the force of the spring being adjusted throughout its effective range of operation so that, on a change of resistance in the circuit, it shall bring the moving part of the reactance device to equilibrium at such a point as to produce the proper choking effect for maintaining the current constant.

2. A regulating reactance device consisting of a relatively-movable coil and core whose position with respect to each other determines the choking effect of the coil when the latter is included in an electric circuit, a spring connected with the movable part of the reactance device and acting in opposition to the magnetic pull thereof, the force of the spring being adjusted throughout its effective range of operation so as to bring the moving part of the reactance device to equilibrium at definite predetermined points representing definite choking effects corresponding to anticipated changes of resistance in a circuit.

Signed at New York, in the county of New York and State of New York, this 7th day of May, A. D. 1900.

MALCOLM H. BAKER.

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