P. H. THOMAS.

SYSTEM OF LIGHTING AND DISTRIBUTION BY VAPOR LAMPS.

APPLICATION FILED AUG. 20, 1907.

969,004. **Patented Aug. 30, 1910.**

3 SHEETS—SHEET 1.

Fig. 1.

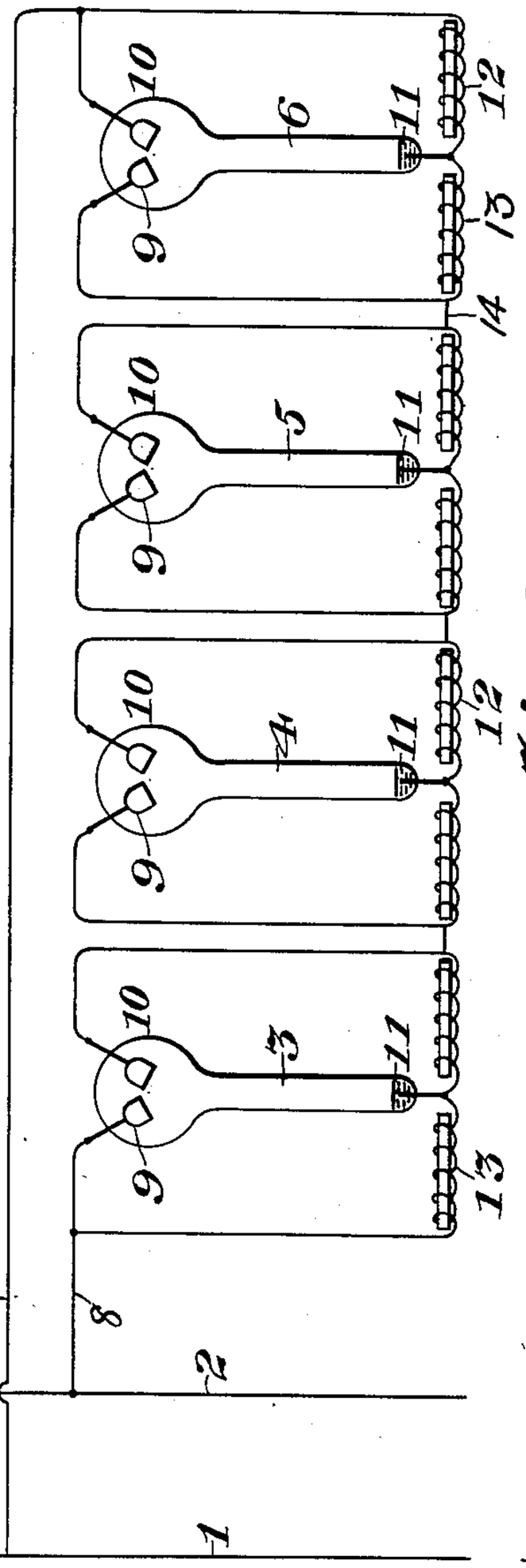
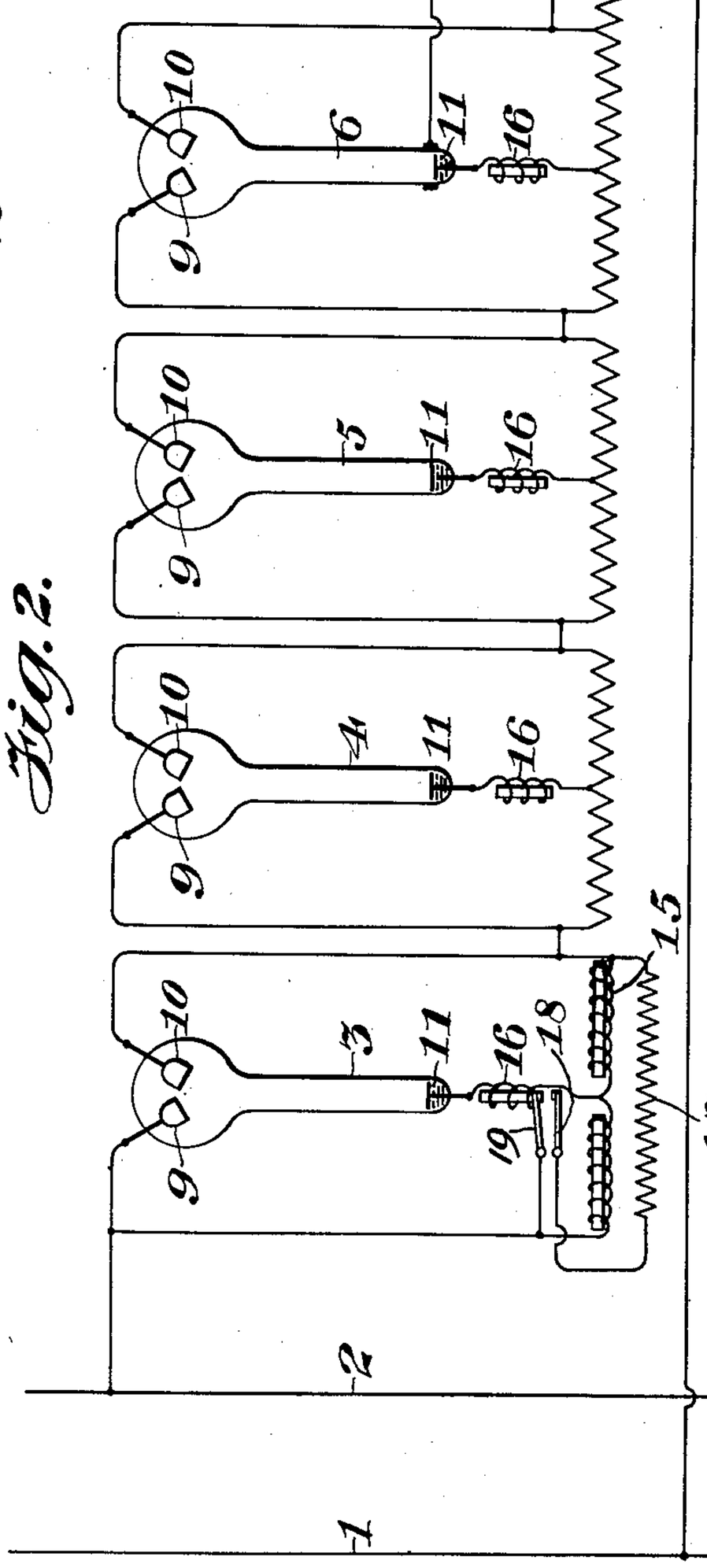


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 3.

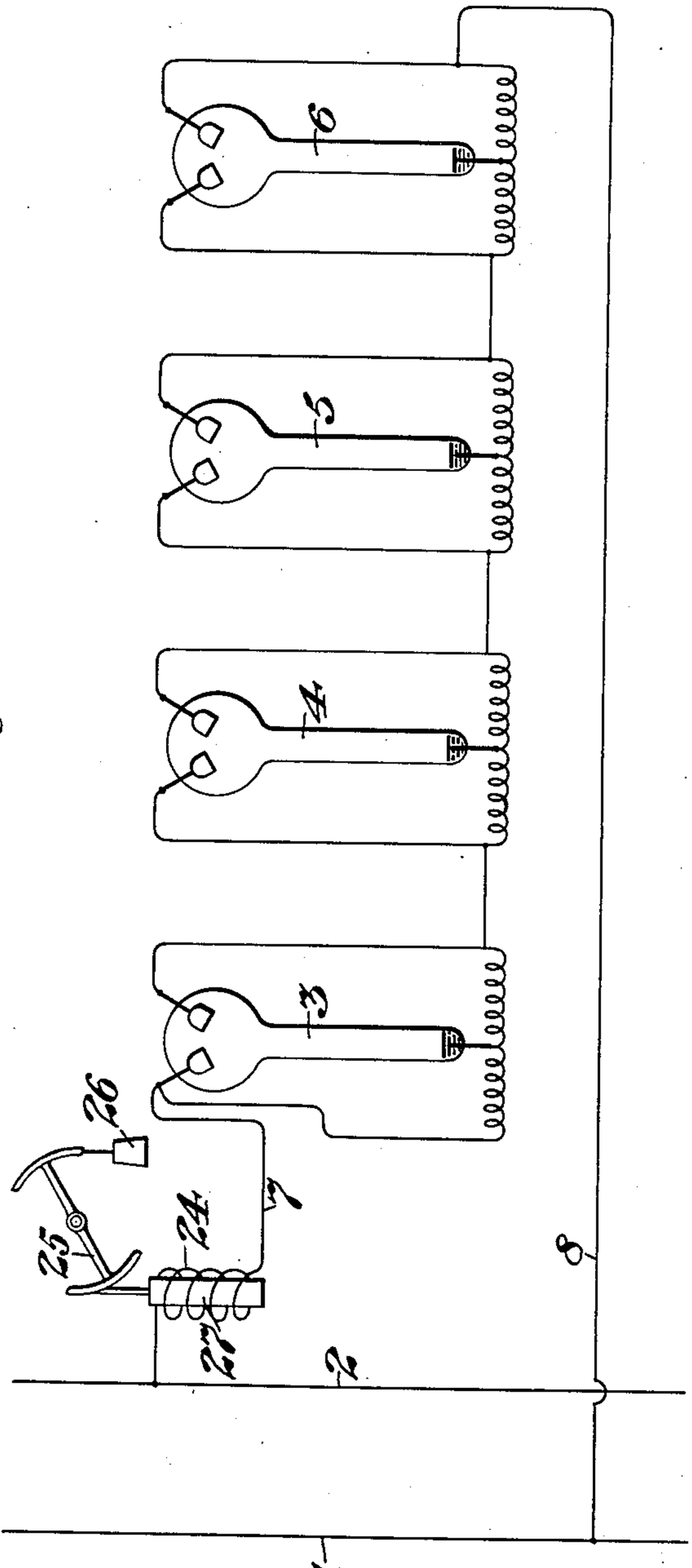
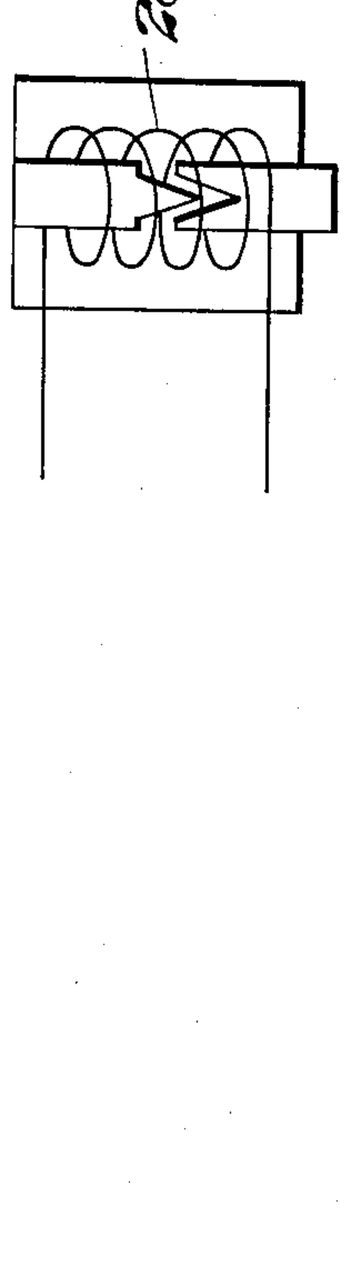


Fig. 4.



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3 SHEETS—SHEET 3.

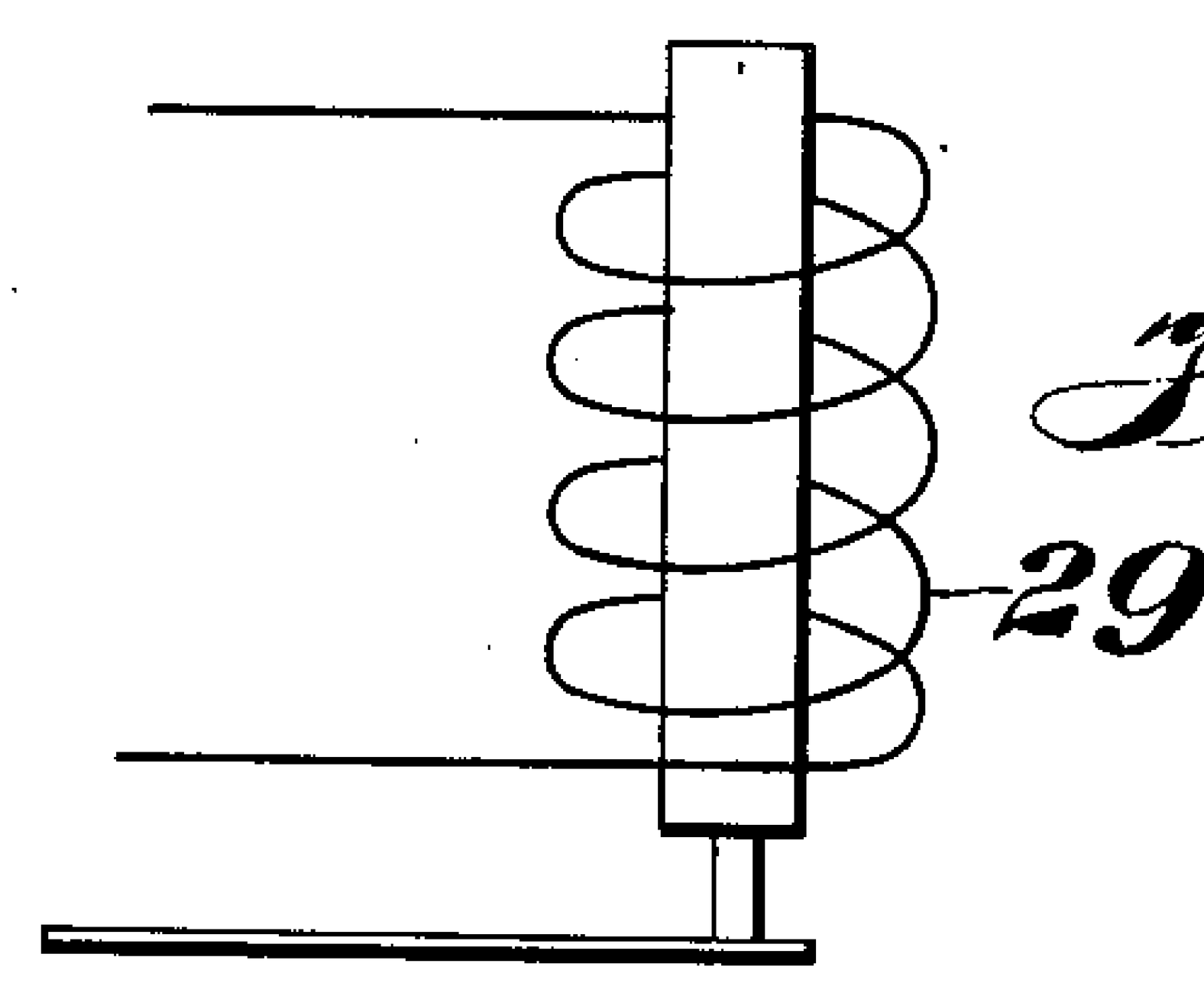
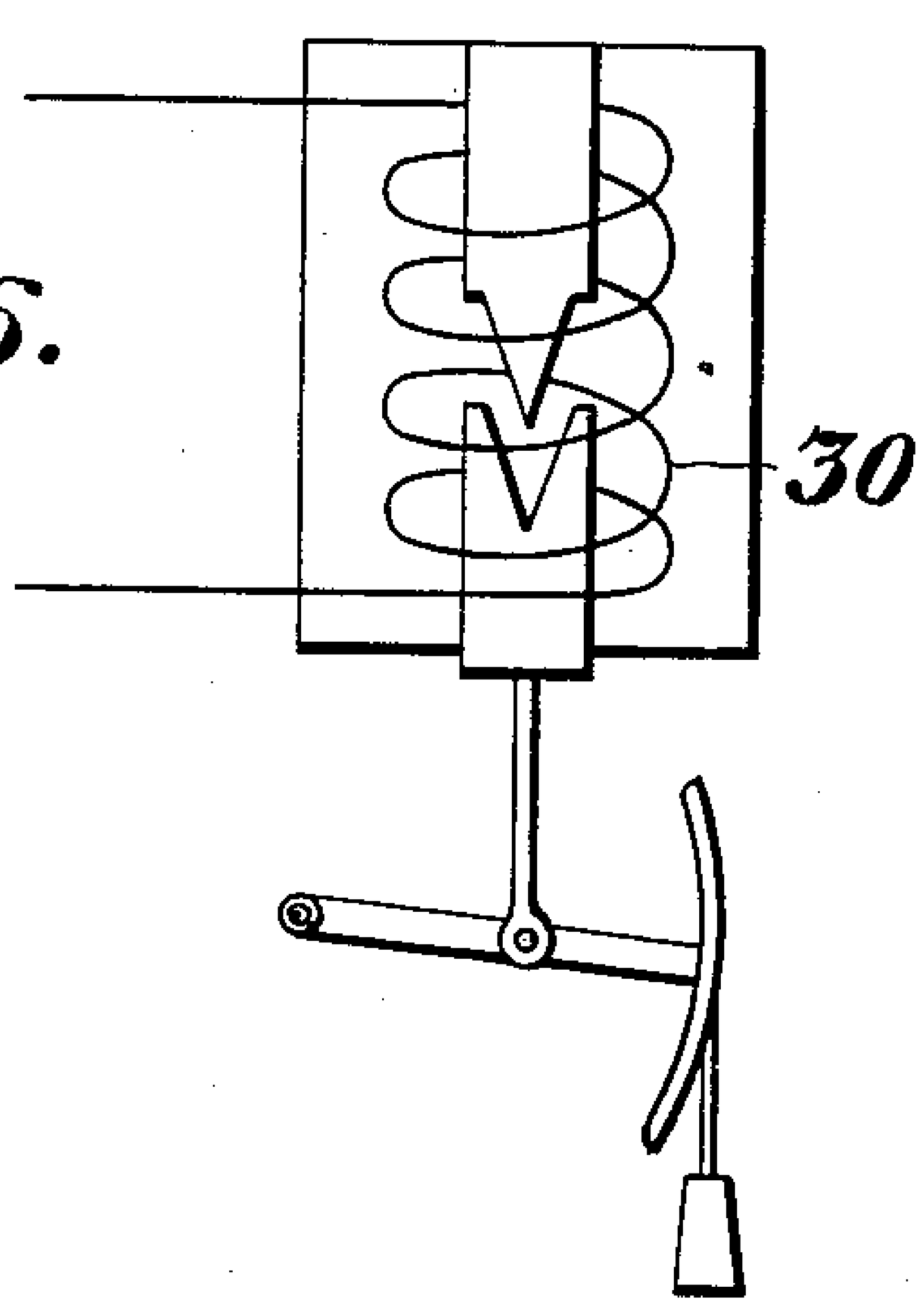


Fig. 5.

Fig. 6.



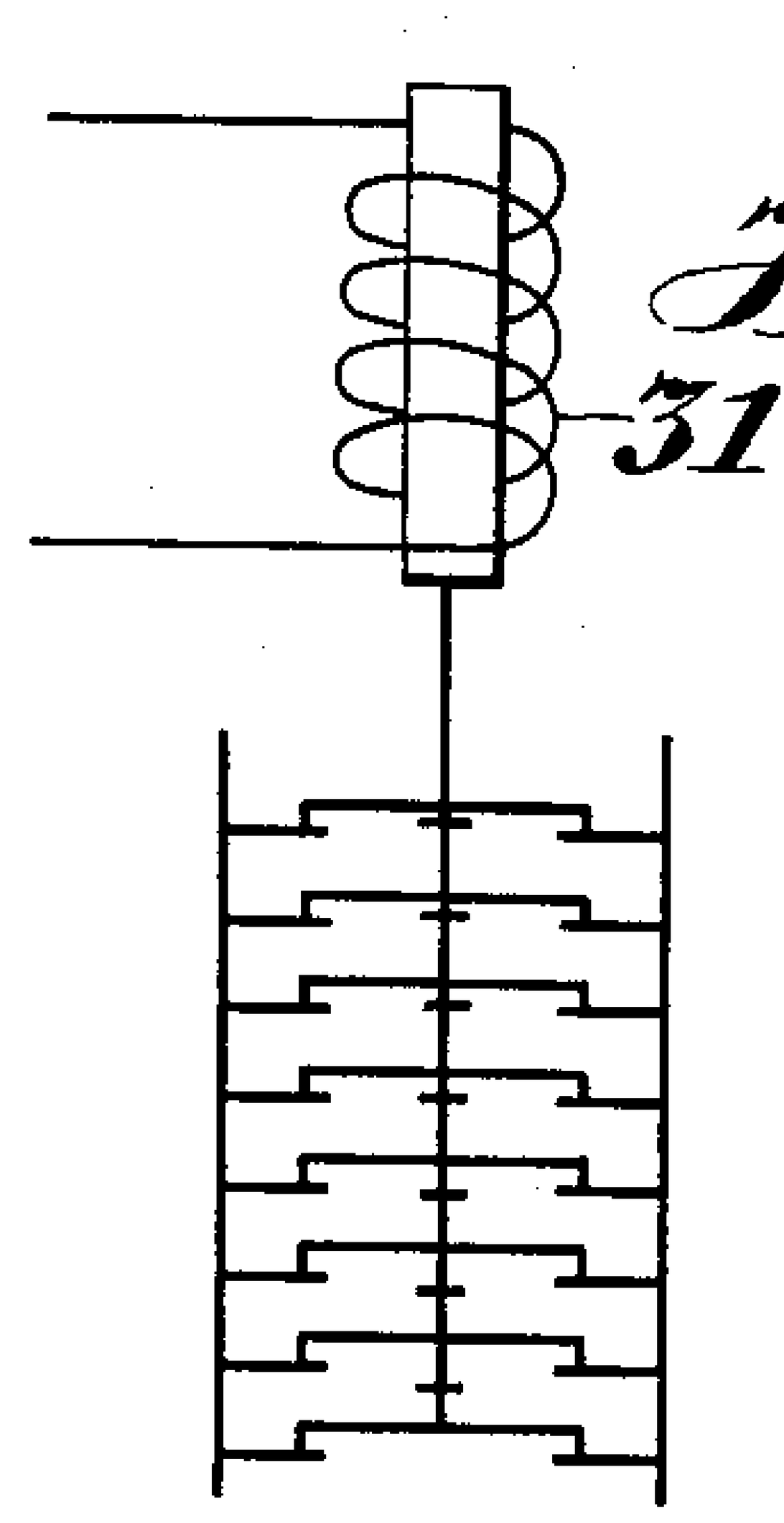


Fig. 7.

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UNITED STATES PATENT OFFICE.

PERCY H. THOMAS, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO COOPER HEWITT ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

SYSTEM OF LIGHTING AND DISTRIBUTION BY VAPOR-LAMPS.

969,004. Specification of Letters Patent. Patented Aug. 30, 1910.

Original application filed May 5, 1906, Serial No. 315,276. Divided and this application filed August 20, 1907. Serial No. 389,363.

To all whom it may concern:

Be it known that I, PERCY H. THOMAS, a citizen of the United States, and resident of Montclair, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Systems of Lighting and Distribution by Vapor-Lamps, of which the following is a specification.

Systems of electrical distribution whereby mercury vapor lamps or other vapor apparatus can be utilized in connection with the lighting of buildings or other work have already been disclosed, in which systems the lamps or other devices are situated in more or less close proximity to each other, so that the energy losses in distribution are comparatively small. It happens, however, that in other cases requiring the distribution of current by vapor electric devices, these devices may be widely separated, in such a manner that there would normally be very considerable energy losses in transmission, or inconveniences of control might be developed, if the transmission should be installed according to the usual methods of lighting streets or buidings. To avoid these difficulties I have invented a novel system of circuits adapted to be utilized with alternating or other kinds of current, as may be found suitable; and the system is applicable to vapor lamps and to other forms of vapor apparatus. In this system of circuits economy of distribution is obtained by the utilization of a comparatively high transmission voltage, and by dividing this voltage among a number of lamps or other vapor devices. I may, or may not, supply several such circuits from a common source.

The present invention contemplates the providing of starting means for the vapor apparatus and means for providing that disturbances in one of the said vapor devices shall not seriously influence the other devices. In connection with the starting apparatus, it is now well-known that automatic devices for this purpose may either actuate the container itself so as to cause a local rupture of the circuit or may operate magnetically an iron element of the apparatus for the same purpose. This is said without regard to any other means for starting, it being only understood that the types of starting apparatus are now sufficiently well known so that the illustration of one such type is sufficient to constitute it an equivalent of other types now common in the art.

In the circuits illustrated, it is not intended that each individual lamp shall be operated only upon the circuit in connection with which it is shown; but it may be combined with other circuits shown or described, as may be found suitable or convenient.

In the accompanying drawings, forming part of this application, Figures 1 and 2 are diagrams of systems of distribution embodying the subject matter of the present invention; Fig. 3 is a diagram of a system of circuits and apparatus adapted to secure close regulation upon vapor devices supplied from a main circuit having considerable variation in the supply, or in which the number of translating devices in actual operation is liable to vary; and Figs. 4, 5, 6 and 7 are detail views.

Referring to the first figure of the drawing, 1 and 2 are constant potential mains supplied from an alternating current source (not shown). In this figure of the drawing I have shown four vapor devices, 3, 4, 5 and 6, which are here represented as mercury vapor lamps. The mains 1 and 2 are connected by branch circuits, 7 and 8, to the said lamp in series, as will presently be explained, and as is clearly shown in the drawing. Each of the several vapor devices 3, 4 5 and 6 is supplied with two positive electrodes, 9 and 10, and with a common negative electrode, 11, the former being of iron or some other suitable material, and the latter being preferably of mercury. Now, the branch 7 is connected to the positive electrode 10 of the vapor device 6, as shown, and is also connected to the negative electrode thereof through a choke coil or inductance, 12. A second choke coil or inductance, 13, is interposed between the said negative electrode and the positive electrode 9 of the vapor device 6, while the last named connection is cross-connected by a conductor, 14, to the positive electrode 10 of the vapor device 5. This arrangement is continued through the several vapor devices until the return branch circuit 8 is reached whereby a complete circuit is made through the various vapor devices described between the mains 1 and 2. An analysis of the circuit thus set forth shows that every one of the four lamps is connected in shunt, as to its

positive electrodes, to two choke coils, or inductances, whose common point is joined to the negative electrode of the vapor device. In this figure of the drawing, no starting means are illustrated, but it will be understood that the vapor devices 3, 4, 5 and 6 may be started by any of the well known means, either manual or automatic, and that when the potential of the alternating current mains has been applied to the circuit and the starting operation has been effected, the current will first flow through the choke coils (before the starting takes place) and afterward the lamps or other vapor devices will take current from the choke coils, thereby providing a continuous current in the lighting or useful portion of the circuit, in a manner already well-known in the art. For convenience, the vapor devices shown in this and other figures of the drawing will be referred to as vapor electric lamps, although it will be understood that such devices may represent other vapor electric apparatus. Should one lamp of the series fail to operate, current will be fed to the others through the two choke coils appropriate to the non-operating lamp. If the number of such non-operating lamps is not excessive, the remainder of the lamp circuits will not be disturbed, and in any case, if the choke coils be properly designed as to the saturation of their cores, current may be passed through them without interrupting the action of the rest of the circuit.

In Fig. 2 is shown another set of lamps or vapor devices, each operated from a transformer winding instead of from two choke coils, although a choke coil, 16, is provided in the negative lead of each lamp. The lamps in this figure are also arranged in series, as before, and the transformer windings are shown at 15, 15. In connection with one or more of the lamps (in this instance in connection with the lamp 3) I show a shunt resistance, 16, so arranged that during the normal operation of the lamp 3, its circuit is interrupted, but should the lamp fail to work properly, this resistance will transmit sufficient current to the transformer windings of the other lamps for securing their proper operation. Such resistances may, of course, be utilized with as many of the lamps of the series as may be desired or found necessary. In the present instance I have shown the resistance 17 as being connected with a stationary contact, 18, in operative relation to a movable contact, 19, so placed as to be operated by the choke coil or inductance 16 included in the circuit of the lamp 3. Thus, while the lamp is in operation, and the inductance 16 connected therewith is energized, the resistance 17 will be cut out, but when the said lamp ceases to operate, the said resistance will be cut into the circuit and will carry sufficient current to properly energize the transformer windings of the remaining lamps in the series.

Referring next to Fig. 3, I show therein a system for securing close regulation upon lamps operated substantially as in Fig. 1 from mains carrying currents of considerable fluctuation or variation, or in a system in which the number of translating devices in actual operation is liable to vary. I accomplish this by introducing, say, into the branch or supply leads, 7, of one or more series of lamps, as 3, 4, 5 and 6, a current regulator, 24. This current regulator may be of the type known as the Baker regulator and may be provided with a pivoted segment, 25, provided with a counter-weight, 26, the arrangement being such that the cutting in or out of lamps or other vapor devices will be compensated for by the changed position of the core, 27, of the regulator coil 24. Other forms of regulator adapted to perform substantially the same function are illustrated at 28, 29, 30 and 31, in Figs. 4, 5, 6 and 7, respectively. The compensating principle appears in all these regulators and the action will, it is thought, be understood without further detailed description. The types of regulator shown in Figs. 3, 4, 5 and 6 may further be replaced by any suitable means for providing for current control, such as will occur to those skilled in the art.

In Fig. 2 I may add a supplementary winding upon one or more of the auto-transformers, or may otherwise obtain an accellerated electro-motive force which may be applied to a starting band, 100, appropriately located at the negative electrode upon one or more of the devices. The operation of starting bands is now well understood. Similar means for starting may be employed in other illustrated systems.

Fig. 4 illustrates a device for accomplishing the function of the so-called Baker regulator through the proper shaping of the magnetic parts so that in all positions the weight of the movable part and attached parts is approximately equal to the pull due to the chosen current in all positions.

Fig. 5 is a device to accomplish the purposes of the Baker regulator by providing a coil, magnetic moving parts, and an attached spring so proportioned as to balance the normal pull of the main current in all positions.

This application is a division of my application Serial Number 315,276, filed May 5, 1906, in which parent application claims are made upon the apparatus described herein.

I claim as my invention:

1. In a system of electrical distribution, a number of vapor electric devices arranged in series, means for impressing upon an anode of each lamp an electromotive force obtained from the supply during one alternation, and means for impressing upon an-

other anode of each lamp electromotive force obtained from the supply during the alternate alternations.

2. In a system of electrical distribution, a number of vapor electric devices arranged in series, each vapor device containing a negative electrode and a plurality of positive electrodes, means for impressing upon one of the positive electrodes of each lamp and the negative electrode thereof an electromotive force obtained from the supply during one alternation, and means for impressing upon the other positive electrode of each lamp and a negative electrode an electromotive force obtained from the supply during the alternate alternations.

3. In a system of electrical distribution, a number of vapor electric devices arranged in series, each vapor device being provided with a negative electrode and a plurality of positive electrodes and all the vapor devices being connected with constant potential mains, the several lamps being connected in shunt as to their positive electrodes to two choke-coils whose common point is connected to the negative electrode of each device.

4. In a system of electrical distribution, a number of vapor electric devices arranged in series, a source of supply for the said lamps, connections from the said source to the terminal positive electrodes at each end of the series, and connections through the series from the said terminal positive electrodes by way of choke-coils, as set forth.

5. In a system of electrical distribution, a pair of alternating current mains having practically constant potential, a plurality of vapor devices, connections from one of the said mains to a positive terminal of one of the vapor devices, a connection from the other main to a positive terminal of another of the said vapor devices, intermediate vapor devices connected to the two last named devices, and a shunt circuit to each vapor device, said shunt containing two choke-coils connecting the negative electrode of each device to anodes on opposite sides.

6. In a system of electrical distribution, a series of vapor devices, each having a common negative electrode and a plurality of positive electrodes, cross-connections between the said vapor devices, and shunt connections including at each vapor device a pair of choke-coils connected to the negative electrode thereof.

7. In a system of electrical distribution, the combination of distributing mains and a local consumption circuit comprising a plurality of electric vapor devices fed from serially connected transformer windings, said devices each comprising an hermetically sealed and completely exhausted container, with a plurality of anodes and a common vaporizable reconstructing cathode therein, together with connections for passing supply currents flowing in one direction alternately through the said devices and alternating sections of the transformer windings and for passing oppositely directed impulses alternately in the same direction through the vapor devices and in the opposite direction through the remaining sections of the transformer windings.

8. In a system of electrical distribution, the combination of distributing mains and local consumption circuit comprising a plurality of operating electric vapor devices fed from serially connected transformer windings, said devices each comprising an hermetically sealed and completely exhausted container, with a plurality of anodes and a common vaporizable reconstructing cathode therein, together with connections for passing supply currents flowing in one direction alternately through the said devices and alternating sections of the transformer windings and for passing oppositely directed impulses alternately in the same direction through the vapor devices and in the opposite direction through the remaining sections of the transformer windings, and shunt paths for transmitting said currents from the source around any disabled device.

9. In a system of electrical distribution, the combination with distributing mains, of a plurality of transformer windings provided with terminals and a middle point lead, an equal number of alternating current mercury vapor devices and suitable means for passing currents from the supply through the several devices and portions of the several transformer windings in series, together with means for locally maintaining the flow of current in the several devices individually at the times of insufficient supply.

Signed at New York, in the county of New York, and State of New York, this 17th day of August A. D. 1907.

PERCY H. THOMAS.

Witnesses:

WM. H. CAPEL,

THOS. H. BROWN.