

A. R. EVEREST.
ELECTRIC REGULATOR.
(Application filed Oct. 9, 1900.)

(No Model.)

2 Sheets—Sheet 1.

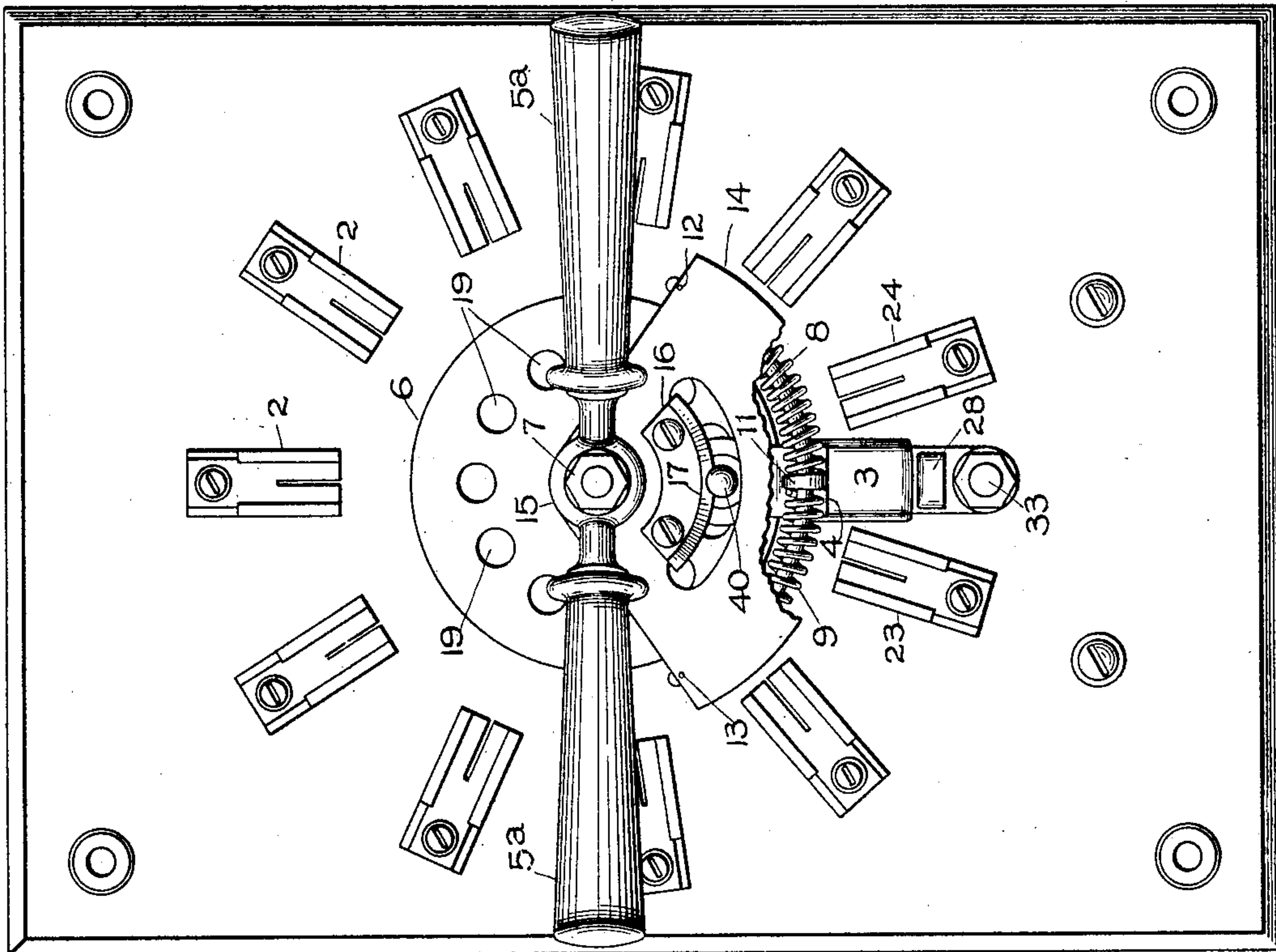


Fig. 2.

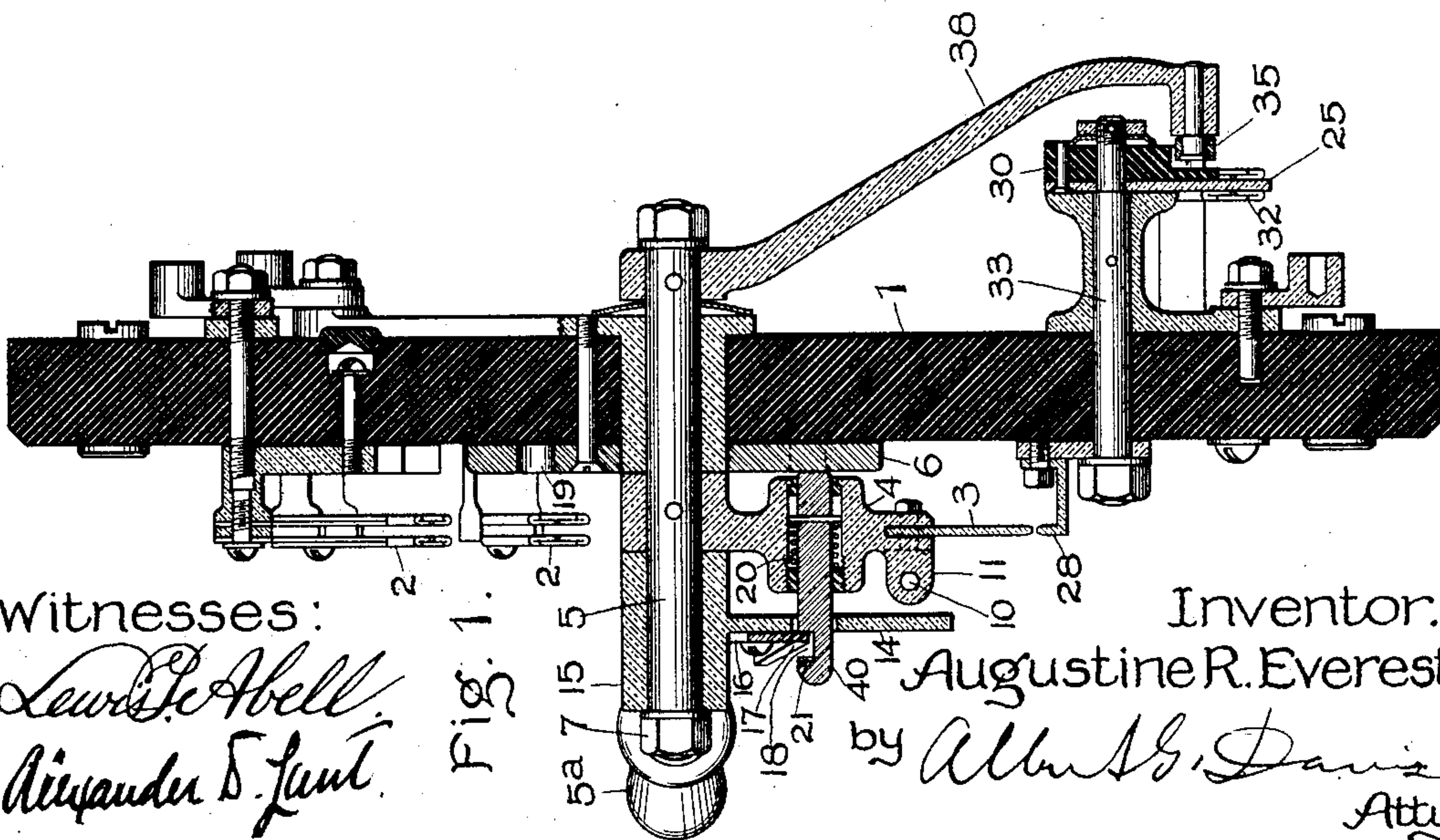


Fig. 1.

Witnesses:
Lewis P. Bell
Alexander S. Lunt

Inventor.
Augustine R. Everest,
by *Albert G. Davis*
Atty

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2 Sheets—Sheet 2.

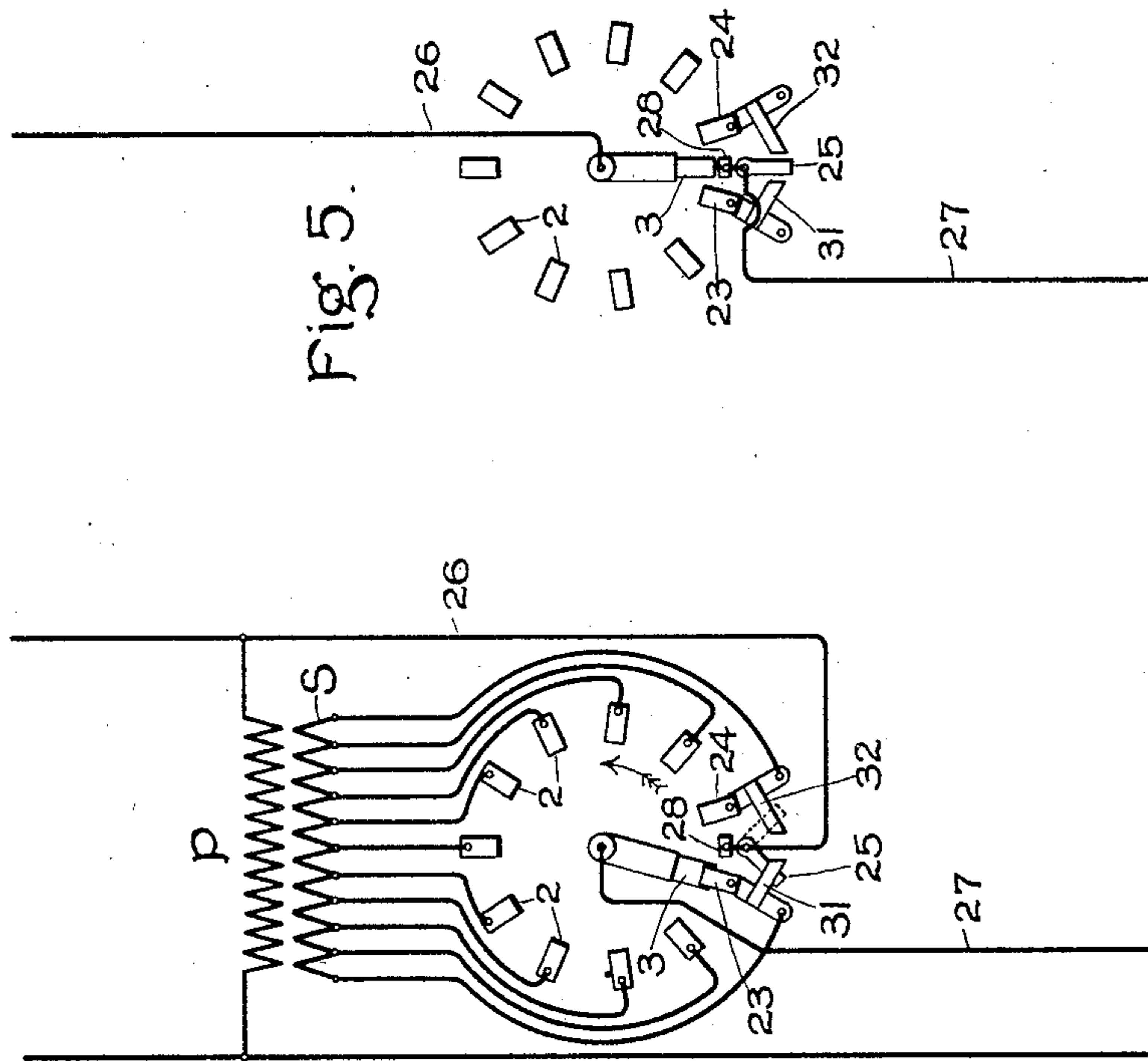
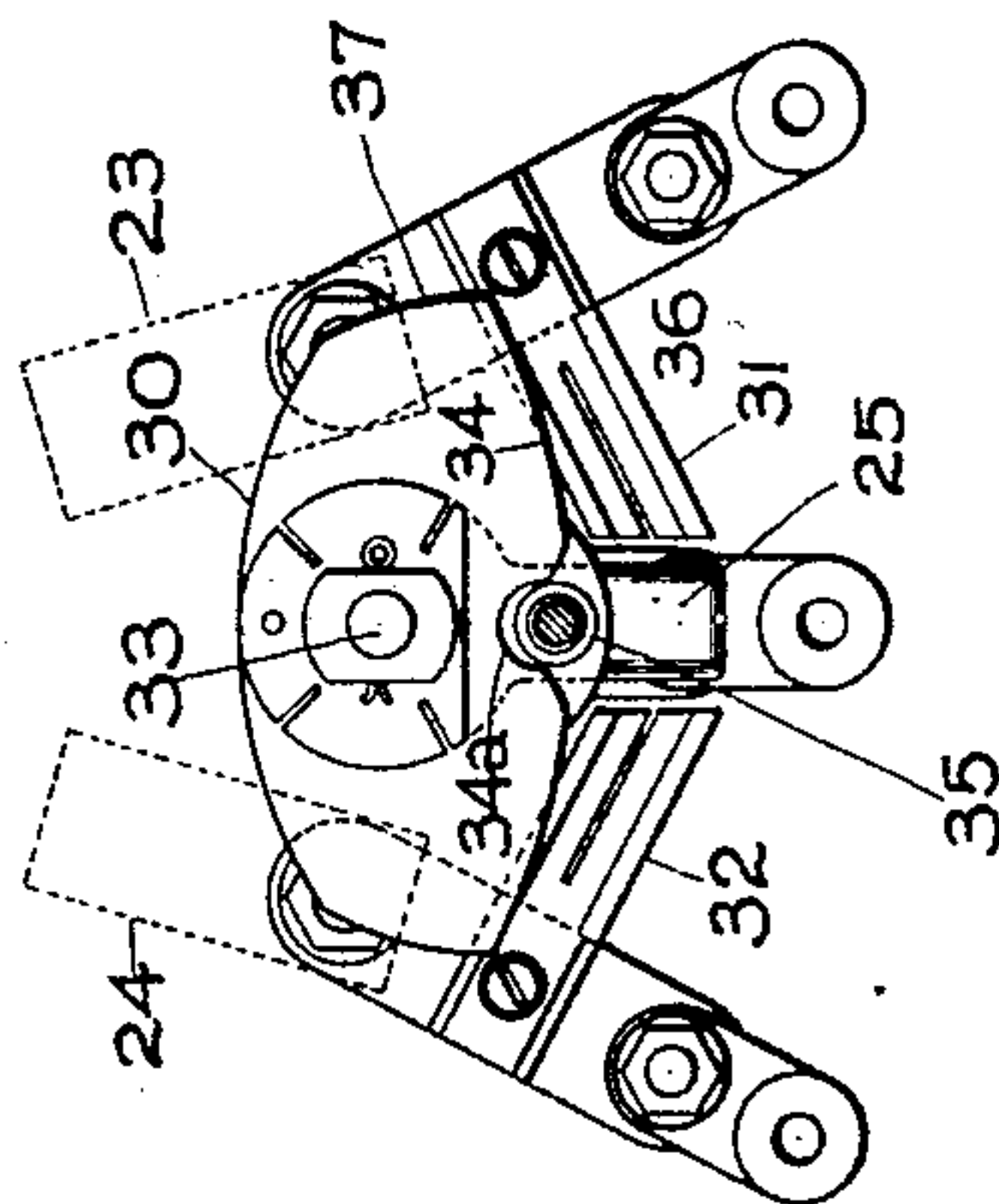


Fig. 4

Fig. 3.



Witnesses:

Lawrence H. Bell
Alexander S. Lunt

Inventor:

Augustine R. Everest
by *Albert B. Davis*
Atty

UNITED STATES PATENT OFFICE.

AUGUSTINE R. EVEREST, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC REGULATOR.

SPECIFICATION forming part of Letters Patent No. 706,039, dated August 5, 1902.

Application filed October 9, 1900. Serial No. 32,481. (No model.)

To all whom it may concern:

Be it known that I, AUGUSTINE R. EVEREST, a subject of the Queen of Great Britain, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Electric Regulators, (Case No. 1,206,) of which the following is a specification.

My present invention comprises certain improvements in regulators of the type used for controlling the current or voltage of an electric circuit, and is particularly applicable in connection with the regulation of alternating-current circuits, although not, however, limited to use in this particular relation.

The features of novelty which constitute my invention comprise certain arrangements of the electric circuits, together with certain details in the specific construction of the regulator itself, all of which will be more particularly pointed out in the appended claims and set forth at length in the following description, reference being had to the accompanying drawings, in which—

Figures 1 and 2 represent, respectively, a sectional and a plan view of a regulator embodying my invention, Fig. 3 being a detail view of a portion of the same and Figs. 4 and 5 diagrams of the circuits of the regulator.

The regulator which I have shown in the drawings as representing one form which my invention may assume is intended for use in regulating the potential of an alternating electric current. I will preface my description of the details of the device itself by stating that the regulator operates upon the principle of inserting in the circuit to be regulated a desired number of turns of the secondary winding of a transformer the primary of which is connected in shunt across the regulated circuit. Various degrees of regulation are secured by cutting in and out a greater or less portion of this secondary winding and also by reversing its connections with respect to the regulated circuit, this reversal being for the purpose of extending the range of regulation. Thus the secondary winding may be connected so as to give a boosting effect variable within the limits of capacity of the regulating-winding, or it may be connected in to give the opposite or depressing

effect, the reversal of connections thus enabling a regulation to be obtained varying from a maximum boosting effect in one direction to a maximum depressing effect in the other. With this brief reference to the operation of my invention I will turn to a description of the details of the mechanism as set forth more particularly in Figs. 1, 2, and 3.

The regulating device as I have embodied it consists of mechanism mounted upon a base-plate 1. This mechanism, among other features, consists of a circularly-arranged series of fixed contacts 2, with which a single movable contact or switch-arm 3 is adapted to cooperate. This contact is arranged so as to snap intermittently from one fixed contact to the next, the purpose of this snapping action being to prevent undue burning and destruction of the contacts without at the same time rupturing the circuit, which in this case is maintained through the arc which is formed as the movable contact snaps away from a fixed contact and which lasts until the movable contact engages the next fixed contact.

The movable contact 3 is bolted to a projecting casting 4, fixedly secured to a central shaft 5, this contact being removable from the casting for purposes of renewal. The casting 4 is recessed and carries therein a spring-actuated locking-plug 40, the inner end of which is adapted to engage in any one of a series of circularly-arranged holes drilled in a disk or ring 6, concentric with the shaft 5 and bolted to the base-plate 1.

In order to turn the shaft 5, and thereby the movable contact 3, I provide two operating-handles 5^a, carried by a casting sleeved upon the shaft 5, about which it is capable of a limited rotation, but prevented from longitudinal disengagement by a locking-nut 7. In order to turn the shaft 5 and its connected parts by manipulation of the operating-handles 5^a, I make use of some suitable spring connection between the handles and the shaft. In the drawings this connection is effected by means of two centering-springs 8 9, mounted upon a rod bent in the arc of a circle and passing through a hole 10 in a lip or fin 11, projecting from the casting 4, the ends of the rod being pinned at 12 and 13 to inwardly-projecting lips (not shown) formed on a sec-

tor-shaped plate 14, cast integral with the sleeve 15, to which the operating-handles are rigidly connected. This sector-shaped plate 14 has an arc-shaped opening therein concentric with the main shaft of the regulator, and through this opening the outer end of the pin 40 projects. On the sector-shaped plate 14 and on the side of the arc-shaped opening therein next to the main shaft of the regulator is attached a cam 16, the central portion 17 of which is lowest, while on both sides of the central portion the cam-surface extends up or outwardly from the plane of the plate 14. A notch 18 on the pin 40 is adapted to engage this cam-surface, as will readily be seen.

The drawings indicate a position of the parts other than that which is normally the case, the parts being shown in this position in order more clearly to illustrate the operation of a change-over switch shown on the rear side of the base board or panel, Fig. 1, and in detail in Fig. 3. In the normal position of the switch the pin 40 engages some one of the holes 19 in the disk 6. In this position the operating-handles 5^a and the contact or switch-arm 3 will have the relative positions shown in Fig. 2, while the pin 40 by reason of its connecting-spring 20 will be forced into one of the holes in the disk 6 until the side 21 of the notch 18 comes into engagement with the surface of the cam 17. With the parts in this locked position the effect of rotating the operating-handles about the shaft 5 is to cause one of the springs 8 or 9 to be compressed against the fin 11, the pin 40 at the same time riding up on the inclined surface of the cam 17. A sufficient rotation of the operating-handles about their axis will through the instrumentality of the cam 17 draw the pin 40 out of that hole in the disk 6 with which it happens to be in engagement. The tension of the centering-spring acting on the fin 11 then quickly snaps the casting 4, with its attached parts, back to its central position, thereby causing the movable contact 3 to snap from one fixed contact to the next and allowing the pin 40 to drop into the next succeeding hole 19 in the disk 6. By adjusting the cam-surface and its coacting parts the movement of the pin 40 may be made such that when brought into a centralized position by means of the springs 8 and 9 it will be in proper position to move into locking engagement with the disk 6, as described.

By means of the construction so far described a movable contact may be caused to traverse the entire series of fixed contacts, thereby cutting in or out of circuit the sections of regulating-winding to which the fixed contacts may be connected. For the purpose of increasing the range of regulation of the apparatus I make use of a change-over switch brought into action when the movable contact passes between the two fixed contacts, which represent connections with the extremities of the regulating-winding. This

switch is shown in diagram in Fig. 4, in which P represents the primary of the regulating-transformer, and S its divided secondary connected to a series of fixed contacts 22, traversed by the movable contact 3. The extremities of the regulating or secondary winding are connected to the fixed contact 23 24.

The change-over switch consists of a single contact-arm 25, adapted to make electrical connection with either the fixed contact 24 or the fixed contact 23. When the movable contact 3 is snapped across between the two fixed contacts 23 and 24, the simultaneous operation of the change-over switch 25, as will presently be described in detail, obviously causes a double break in the circuit, which if no special means were provided to prevent it would interrupt the flow of current or at least cause a violent fluctuation therein. To obviate this undesirable result, I make use of a supplementary contact electrically connected with the change-over switch and across or in front of which the movable switch-arm or contact 3 moves in passing between the fixed contacts 23 and 24, which constitute the ends of the circular series of contacts. The circuit to be regulated (indicated by the main 26 and its continuation 27) is connected with the regulating device by terminals joined, respectively, to the switch-arm or movable contact 3 and the change-over switch 25. The supplementary contact above referred to is indicated in Fig. 4 by the reference-numerals 28. Its relative position with respect to the movable contact 3 at the instant the latter is moving between the two fixed contacts 23 24 is indicated in Fig. 2 and also in Fig. 5, from which it will be seen that at this instant the current in the circuit or main 26 27 has a free path without passing through the regulator proper, this path being provided by reason of the proximity of the movable contact 3 and the supplementary fixed contact 28, the space between which is so small as to allow the current to jump. It is quite within my invention, however, that these two coöperating contacts should actually engage each other as they pass.

The actual construction of the change-over switch is indicated in detail in Figs. 1 and 3. This switch consists of a contact-arm 25, riveted or otherwise secured to a pivotally-mounted cam 30, formed, preferably, of insulating material. This contact-arm by moving in one direction or the other is adapted to make contact with coöperating switch members 31 32, connected with the fixed contacts 23 24. (Indicated in dotted lines in Fig. 3 and in diagram in Fig. 4.)

The cam 30 is pivotally mounted upon a bolt 33, which serves as a medium of electrical connection between the change-over switch 25 and the supplemental contact 28. (Indicated in sectional view in Fig. 1 and in diagram in Figs. 4 and 5.)

Motion is communicated to the change-over switch by means of an arm 38, fixedly secured

to the shaft 5 of the regulator and carrying at its outer end an antifriction-roller 35, adapted to engage the operating-surface of the cam. This cam is provided with an arc-shaped cam-surface 34, having a centrally-located indentation 34^a. As the motion of the arm 38 causes the antifriction-roller 35 to move from the central position shown in Fig. 3 the cam 30 is moved about its pivot, thereby causing the switch-arm 25 to be shifted to one side or the other and finally allowing disengagement of the antifriction-roller and the cam. Supposing, for example, the antifriction-roller, as shown in Fig. 3, to be moved toward the left, then the cam 30 will be given a clockwise rotation about its axis until finally the roller is free to move out of engagement with the cam. The right-hand end of the cam will then have been moved downward toward a position indicated by the position of the reference-numerals 36. A continued movement of the regulator-shaft and therefore of the roller 35 through a complete or nearly complete revolution will consequently bring the roller around into a position where it engages the surface 37 of the cam 30, which by the movement described has been brought into the path of the roller. The cam therefore serves as a stop for any further rotation of the regulator. Starting from this point and supposing the connections to be such that the entire regulating-winding S is connected into the circuit 26 27 in a direction to depress the voltage therein, a reverse movement of the regulator would cause this winding to be gradually cut out of circuit until the switch-arm has made practically one revolution, at which time the position of the parts is as shown in Fig. 4. A further revolution in the direction indicated by the arrow in Fig. 4 will cause a movement of the change-over switch across the intermediate position shown in Fig. 5 and then into connection with the fixed contact 24 at the opposite end of the series. Further movement of the regulator causes a gradual cutting in of the regulating-winding, but in a direction opposite from that which existed before the change-over switch was thrown. In a certain sense the movable contact or switch-arm 3 of the regulator may be said to form one element of a reversing-switch. This function being joined with that of the shifting contact of the ordinary regulator results in a much simpler construction than the reversing arrangement or arrangements heretofore employed.

Although I have shown my invention in connection with a particular form of potential-regulator adapted for use in connection with alternating-current circuits, I do not wish it to be understood that my invention is therefore useful in this relation alone, since, on the contrary, it is capable of wide and varied applications in other relations, for which reasons I wish a construction given to my

claims such as will take cognizance of this fact.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination of a regulating-winding connected to a row of contacts, and a circuit having one terminal connected to a movable contact cooperating with said row of contacts and the other terminal to a switch-arm adapted to make electrical connection with either of two of the contacts of said row of contacts.

2. In a potential-regulator, the combination of a row of fixed contacts, a movable contact for cooperating with said fixed contacts, and a change-over switch brought into operation as the movable contact passes from one fixed contact to another and cooperating with said movable contact to reverse the connections of said row of fixed contacts or a portion thereof with respect to the circuit to be regulated.

3. The combination of a row of fixed contacts, a movable contact arranged to snap from fixed contact to fixed contact, a cooperating change-over switch, a circuit to be regulated, and connections between one terminal of said circuit and said movable contact and also between the other terminal of said circuit and said change-over switch.

4. In a regulator, the combination of a regulating-winding, a row of contacts connected to said winding, a movable contact for traversing said fixed contacts, and a cam-actuated change-over switch for connecting one terminal of the circuit to be regulated to either one of two of said fixed contacts.

5. The combination of a row of fixed contacts, a movable contact cooperating therewith, and a circuit connected with one terminal to the movable contact and the other to a supplemental fixed contact.

6. The combination of a row of fixed contacts, a movable contact cooperating therewith, and a circuit connected with one terminal to the movable contact and the other to a supplemental contact located between two of the fixed contacts.

7. The combination of a plurality of fixed contacts, a movable contact cooperating therewith, and a supplemental contact between which and the movable contact current temporarily passes across an intervening space.

8. The combination of a plurality of fixed contacts, a movable contact arranged to snap from fixed contact to fixed contact and a supplemental contact between which and the movable contact current may pass as the movable contact passes from one fixed contact to another.

In witness whereof I have hereunto set my hand this 6th day of October, 1900.

AUGUSTINE R. EVEREST.

Witnesses:

DUGALD MCKILLOP,
JOHN J. WALKER.