No. 689,452. Patented Dec. 24, 1901.

W. K. BASSFORD, JR.

ELECTRIC CIRCUIT CONTROLLER.

(Application filed June 8, 1901.)

(No Model.) 8 Sheets—Sheet 1.

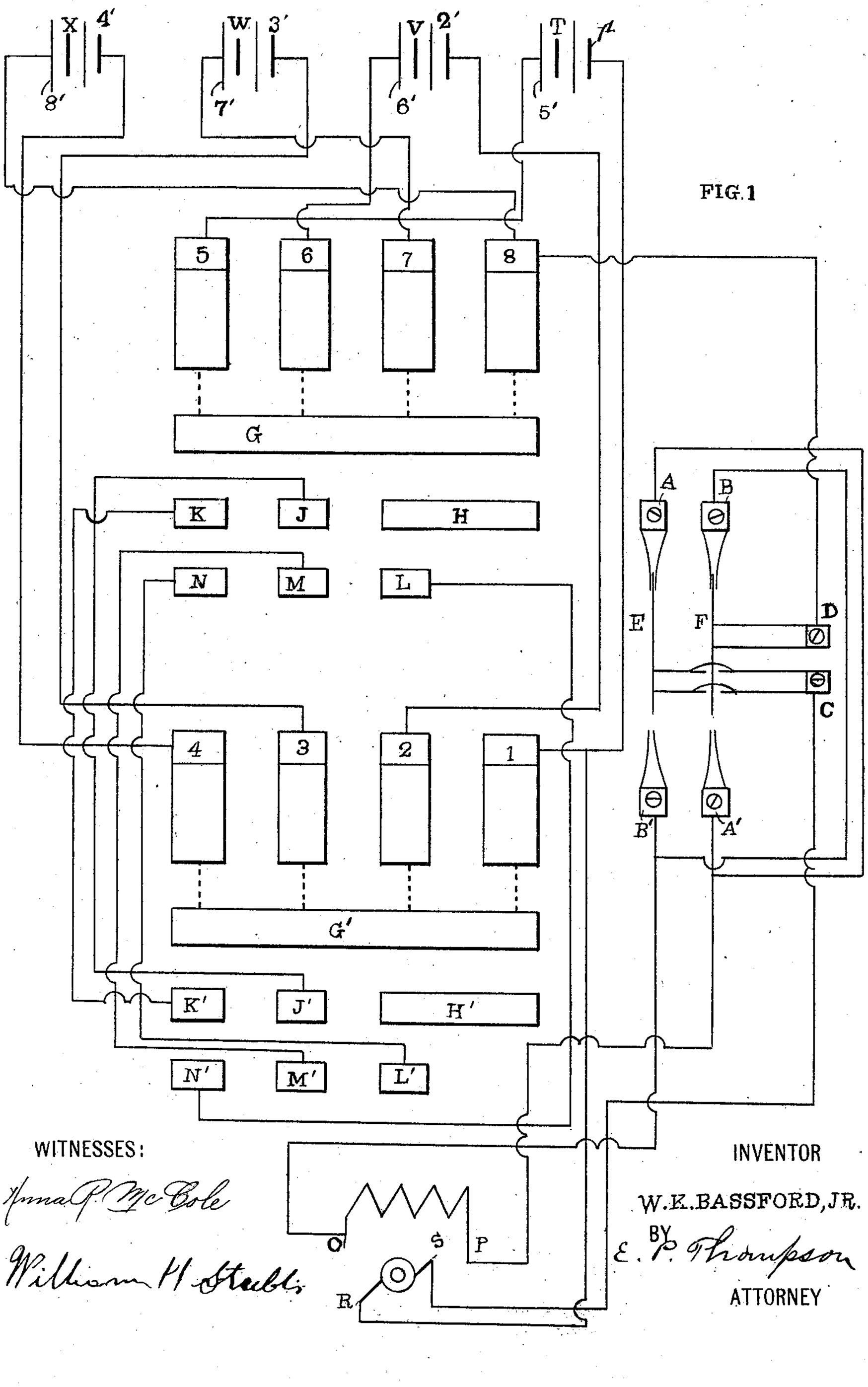

FIG. 1

WITNESSES:

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No. 689,452. Patented Dec. 24, 1901.

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(No Model.) 8 Sheets—Sheet 2.

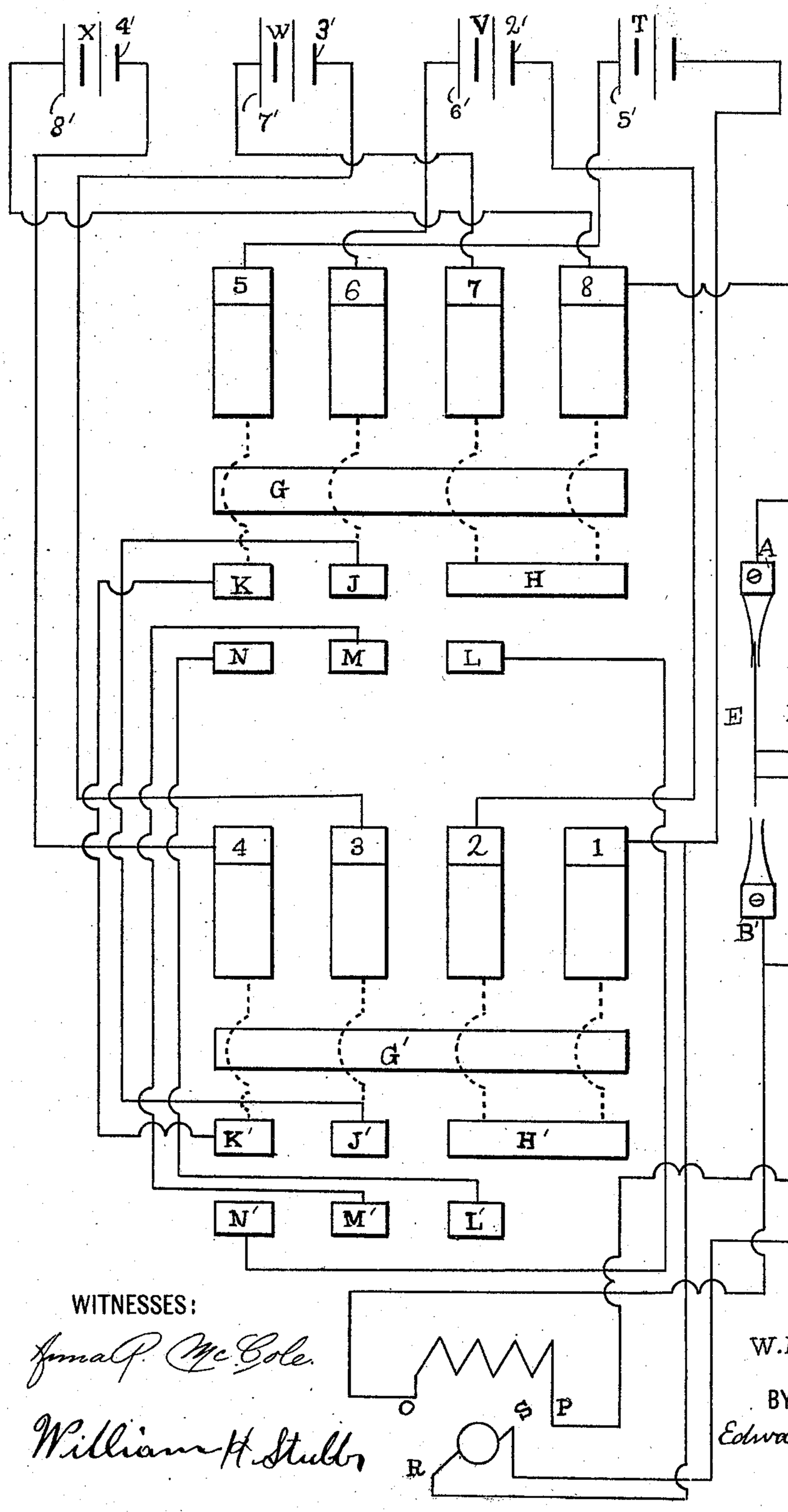
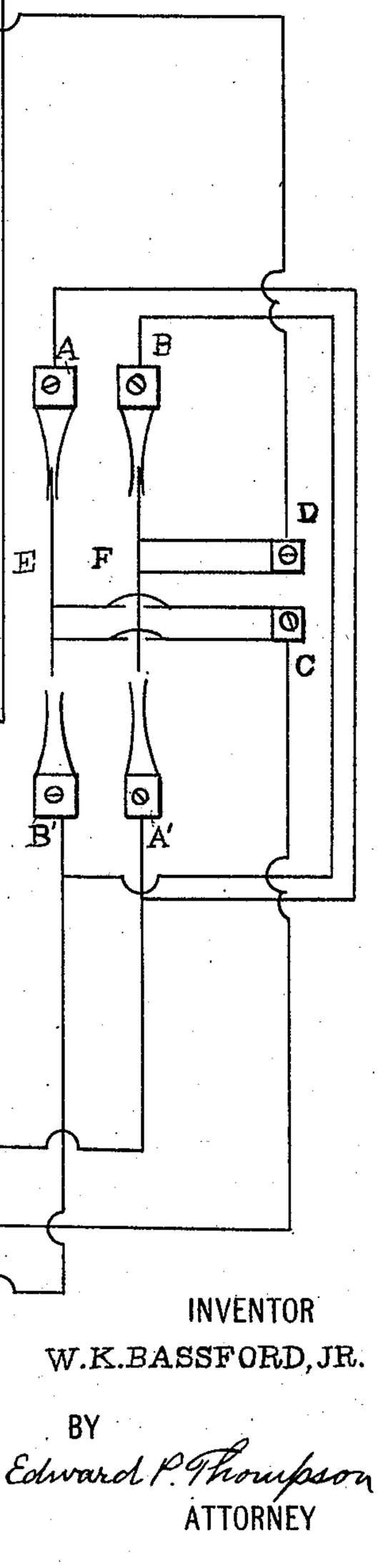


FIG. 2



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(Application filed June 8, 1901.)

(No Model.) 8 Sheets—Sheet 3.

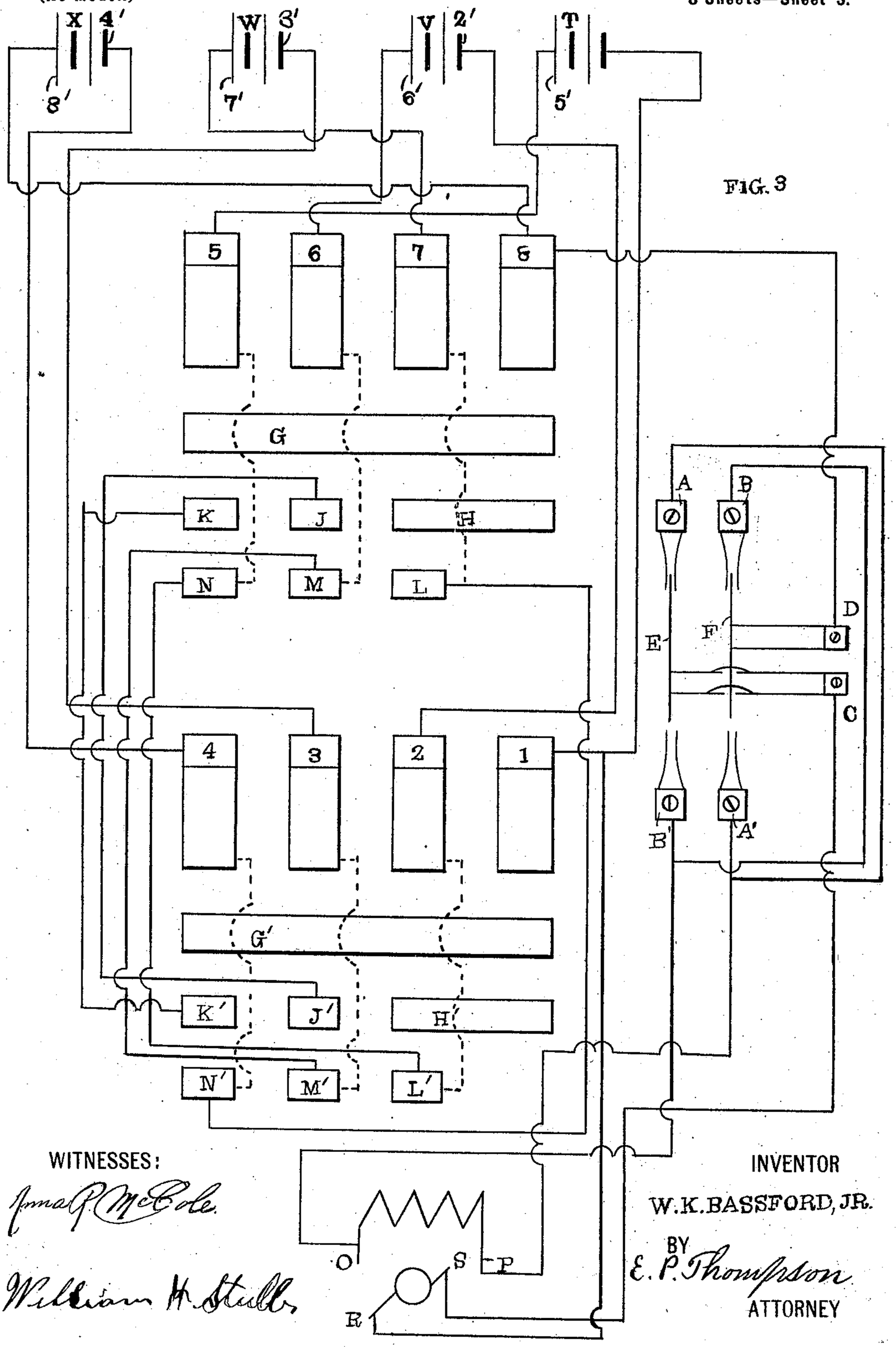

FIG. 3

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ELECTRIC CIRCUIT CONTROLLER.

(Application filed June 8, 1901.)

(No Model.) 8 Sheets—Sheet 4.

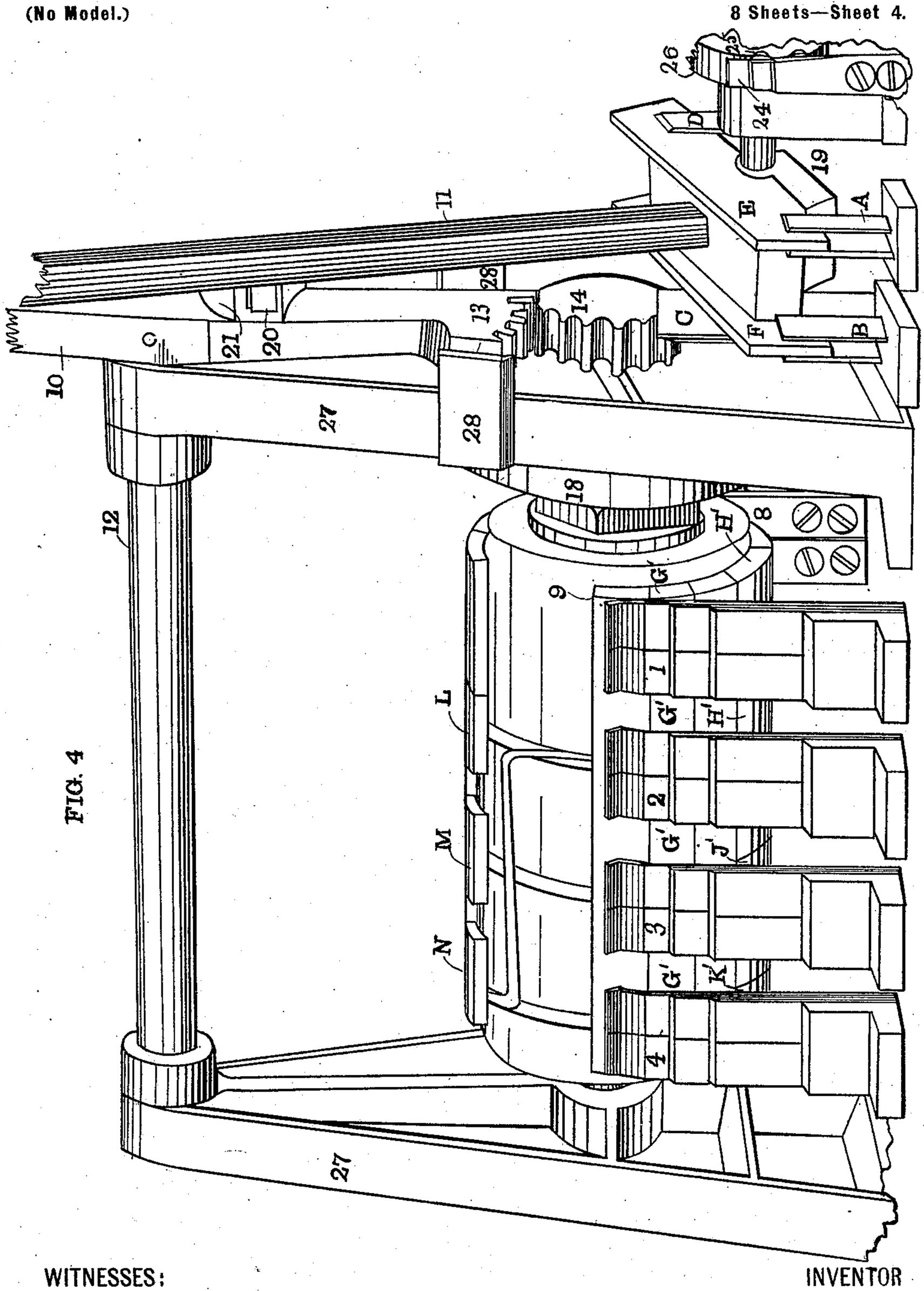

FIG. 4

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ELECTRIC CIRCUIT CONTROLLER.

(Application filed June 8, 1901.)

(No Model.) 8 Sheets—Sheet 5.

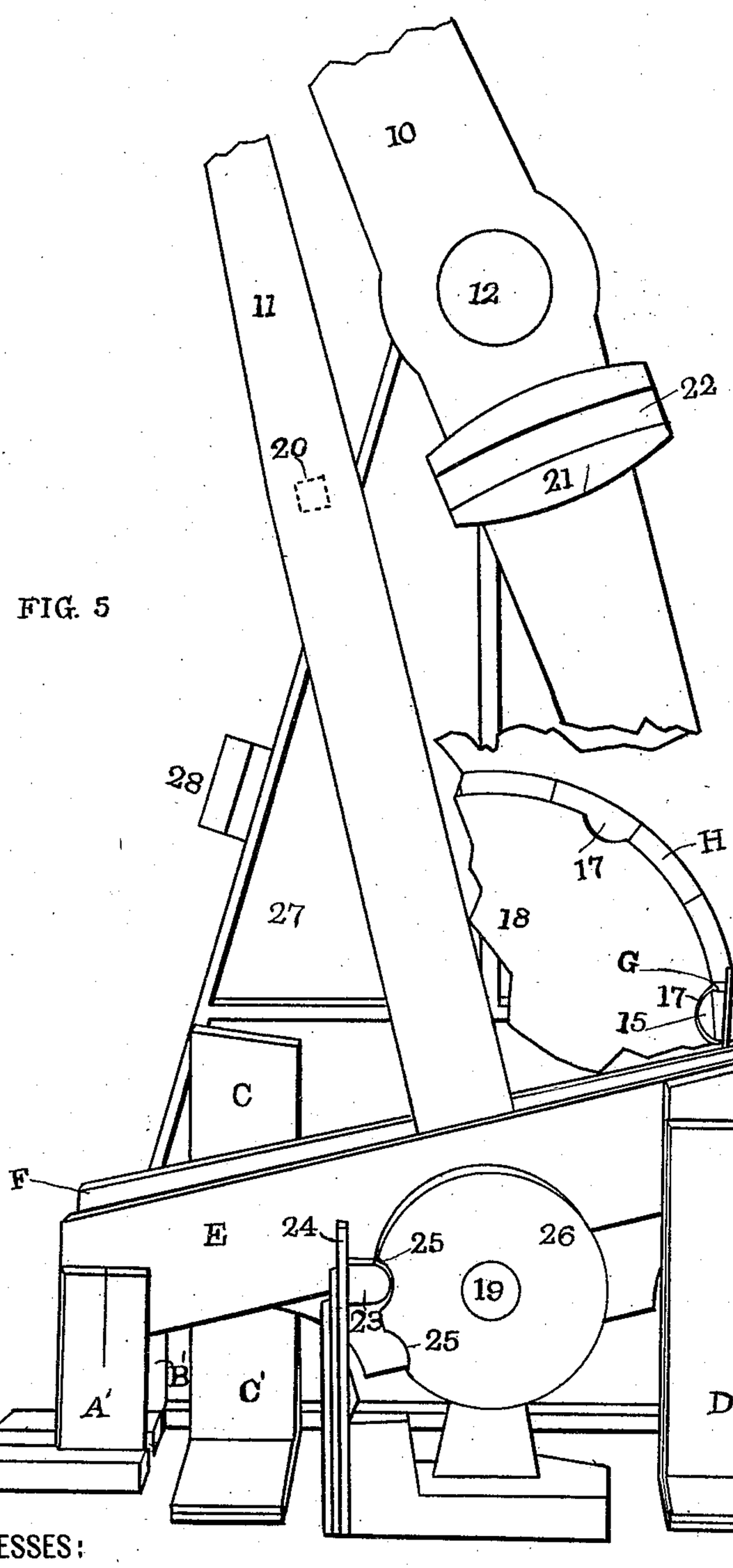

FIG. 5

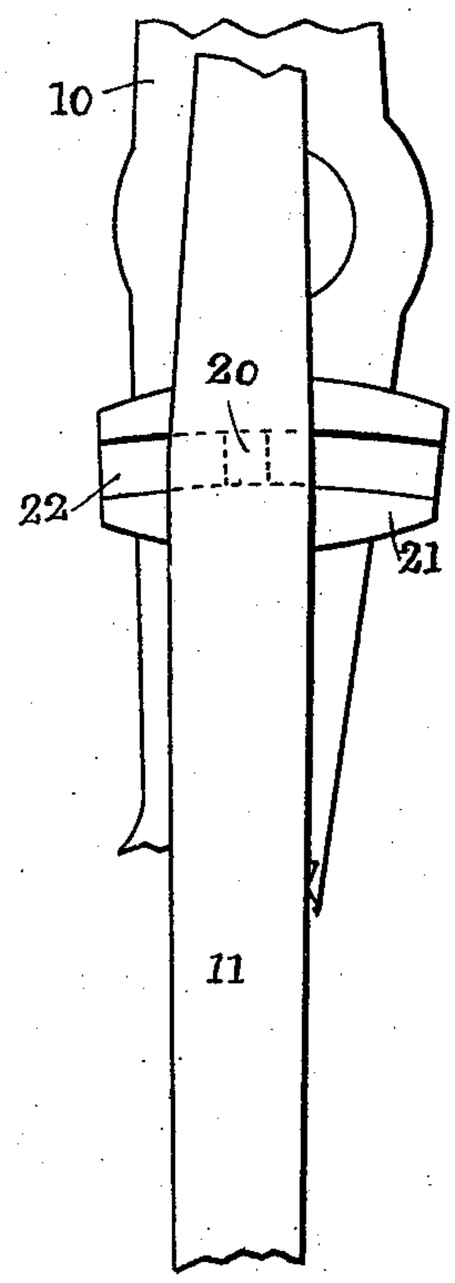

FIG. 6

WITNESSES:

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ELECTRIC CIRCUIT CONTROLLER.

(Application filed June 8, 1901.)

(No Model.) 8 Sheets—Sheet 6.

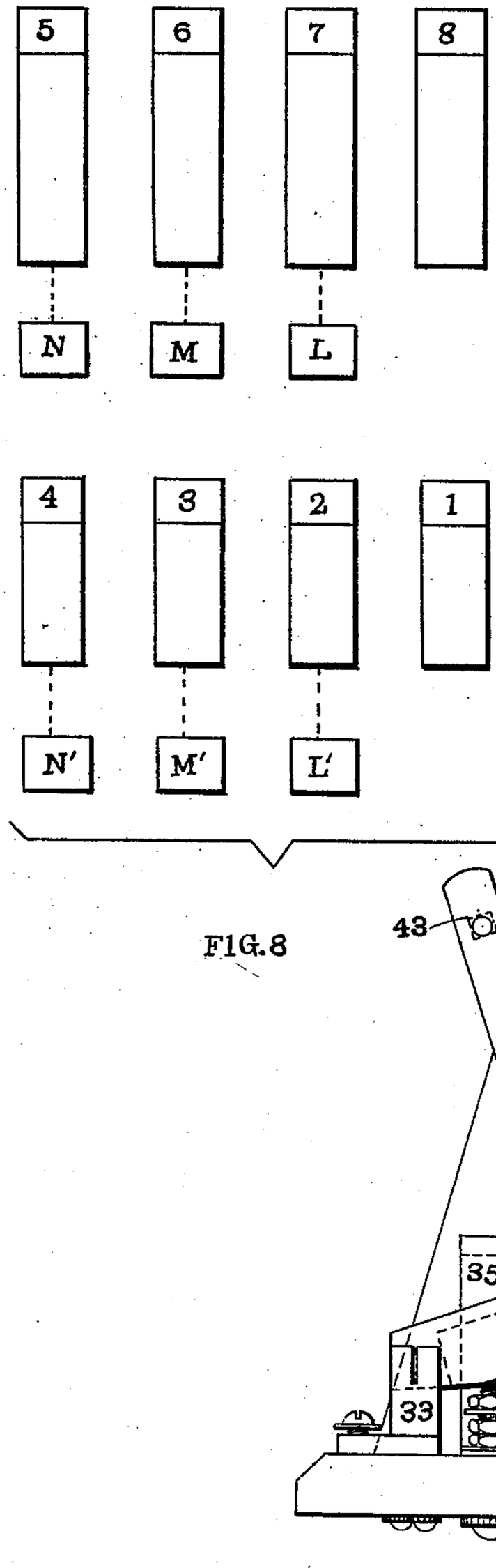

FIG. 8

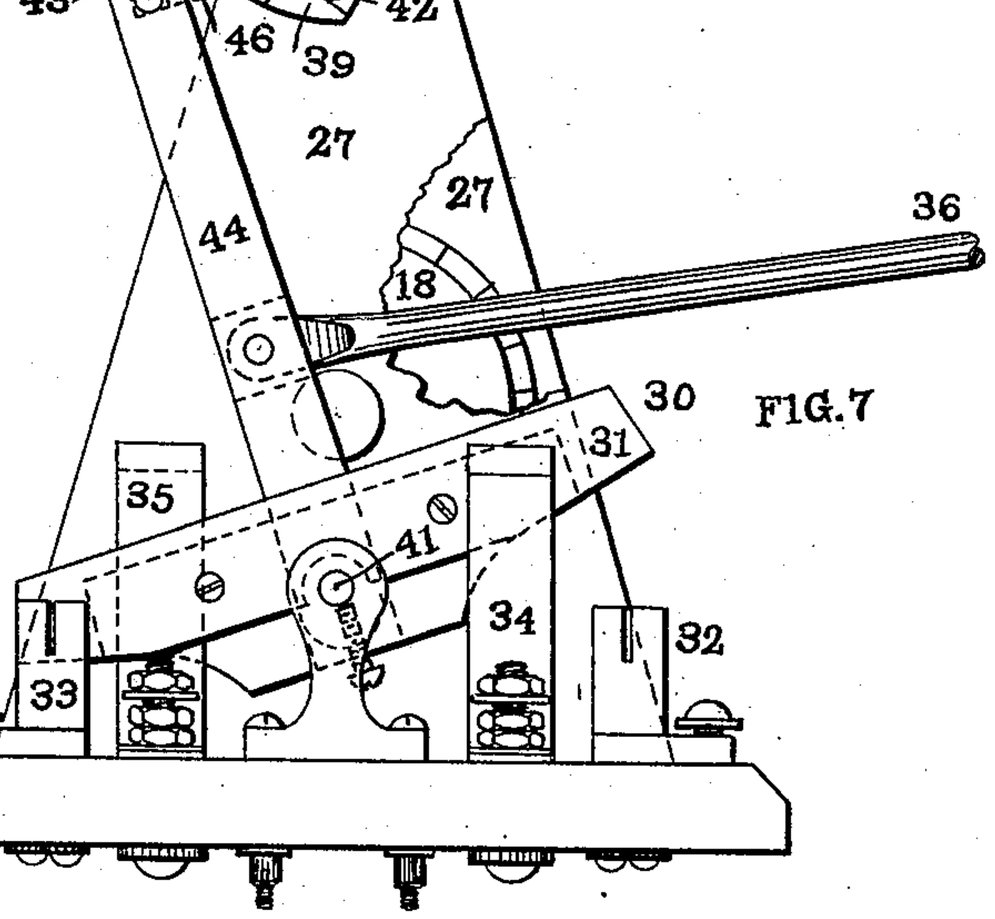

FIG. 7

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ELECTRIC CIRCUIT CONTROLLER.

(Application filed June 8, 1901.)

(No Model.) 8 Sheets—Sheet 7.

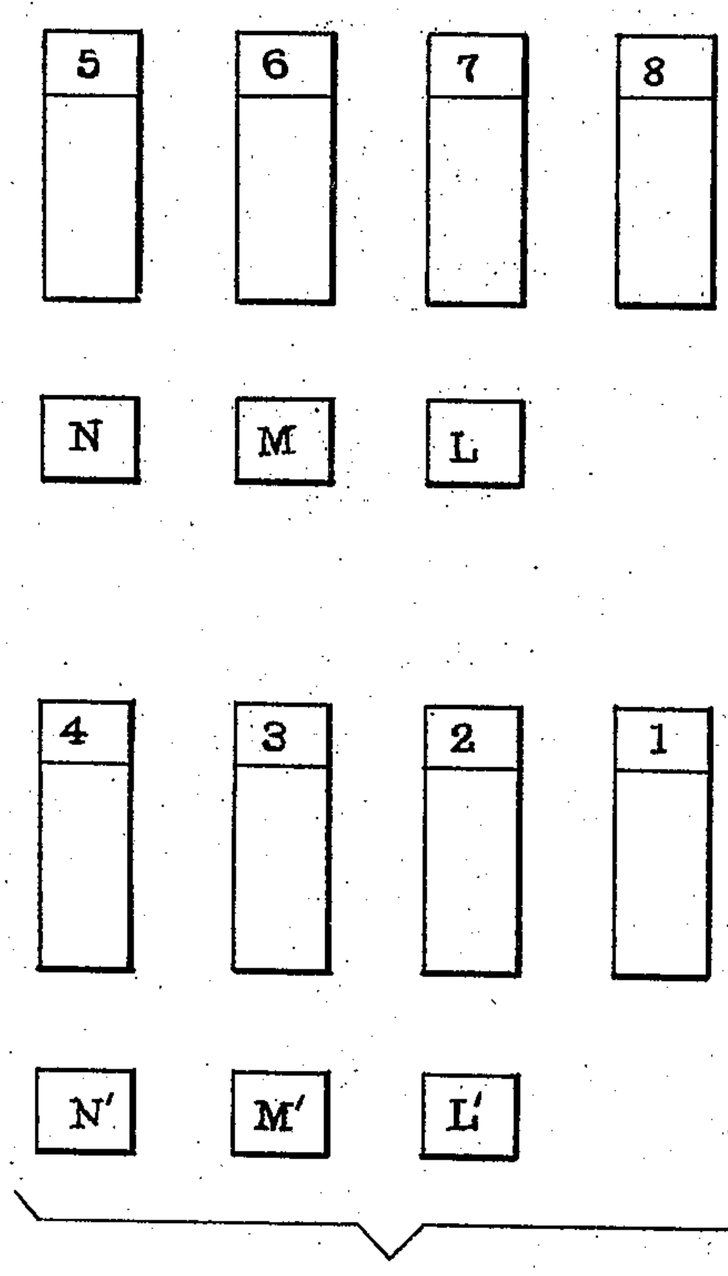

FIG. 10

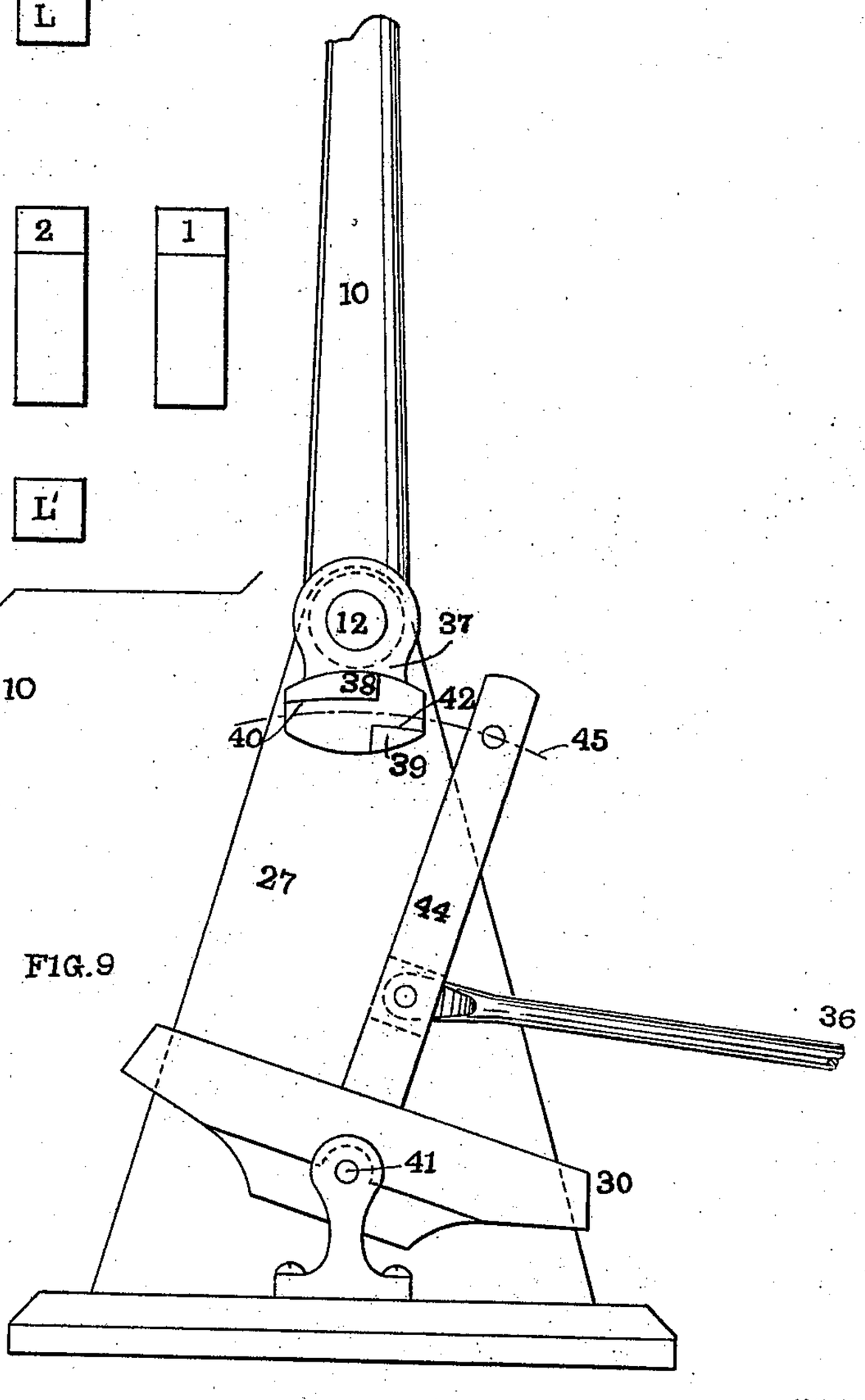

FIG. 9

WITNESSES:

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No. 689,452. Patented Dec. 24, 1901.

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ELECTRIC CIRCUIT CONTROLLER.

(Application filed June 8, 1901.)

(No Model.) 8 Sheets—Sheet 8.

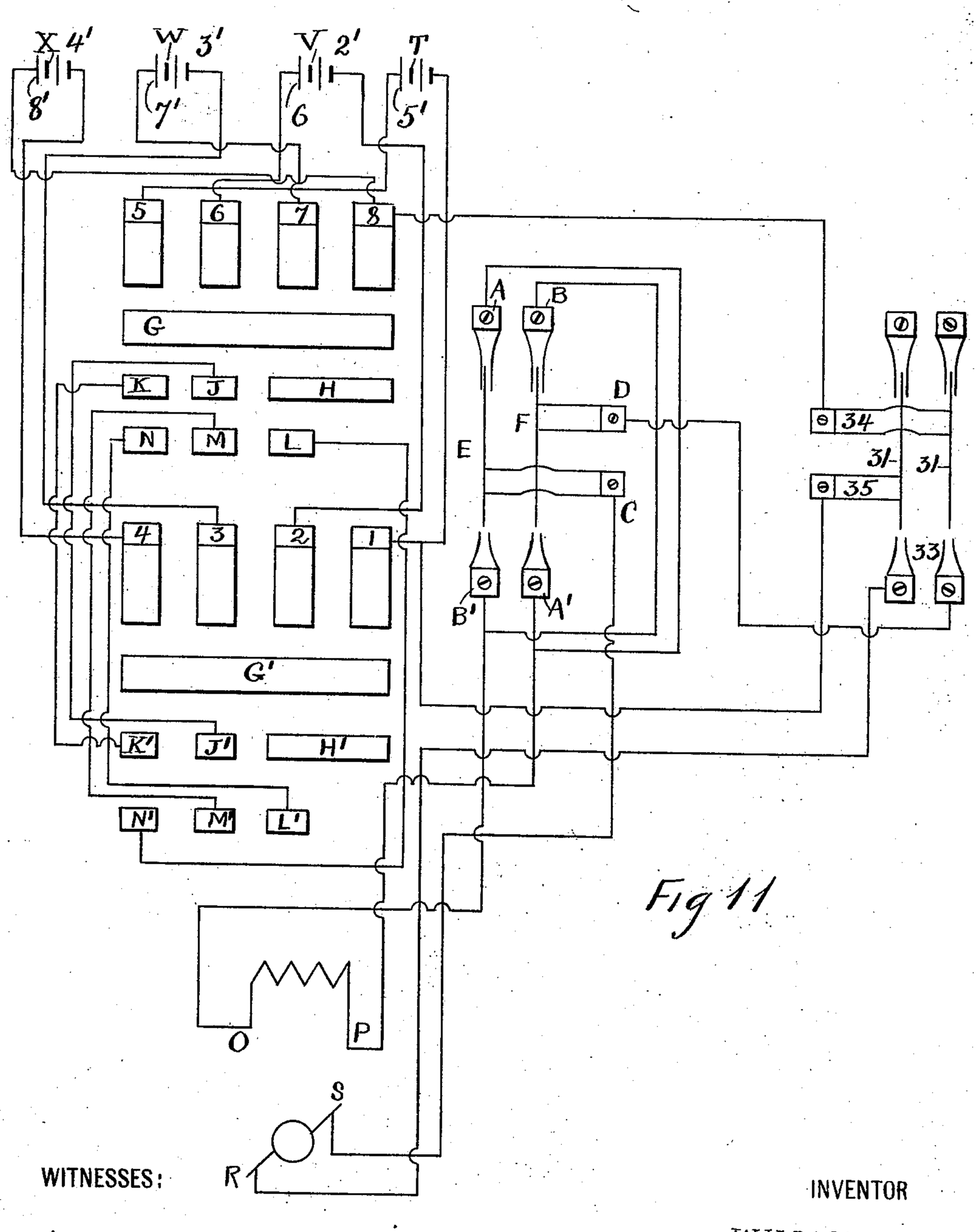

Fig 11

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UNITED STATES PATENT OFFICE.

WILLIAM K. BASSFORD, JR., OF BOUNDBROOK, NEW JERSEY.

ELECTRIC-CIRCUIT CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 689,452, dated December 24, 1901.

Application filed June 8, 1901. Serial No. 63,702. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM K. BASSFORD, Jr., a citizen of the United States of America, and a resident of Boundbrook, in the county of Somerset and State of New Jersey, (post-office address care of The Pierce Electric Vehicle, Boundbrook, New Jersey,) have invented certain new and useful Improvements in Electric-Circuit Controllers, of which the following is a specification.

My invention relates to a device for controlling the electric circuits for running a vehicle, such as an automobile or electric car, provided with secondary batteries. It has also a general application for cases where batteries or resistances are to be cut in and out successively or in a predetermined sequence.

The leading feature of the present device is means for preventing the motorman from reversing the current for the motor while the batteries are in circuit. As this feature involves several mechanical details, any general description is not given here; but an accurate explanation may be found hereinafter by reference to the drawings.

Another feature involves the mechanical construction of means for gradually including and excluding the batteries in a certain order.

Figure 1 is a diagram of the circuits connecting the batteries through the controller to the motor. Only the contacts and brushes of the controller are shown. By means of a few dotted lines the circuits may be traced for a first phase of the controller. Fig. 2 is the same diagram, except that the dotted lines serve to indicate the change in the circuits taking place in a second phase of the controller. Fig. 3 is the same, in which the third phase of the controller has been reached. In all the three figures the reversing-switch is indicated and also the diagram of the motor. Fig. 4 is intended to represent as much as possible of the controller in one figure, which is an elevation in perspective, the observer being supposed to look downward at the side and top and end of the device. Parts are broken away, as shown by ragged edges. The base-plate is omitted and also such details as binding-screws. The mechanical construction is indicated as far as it has anything to do with my invention. The electric circuits are not indicated, nor are insulators distinguished from conductors by being in heavy black, because the circuits and electrical features are completely shown in Figs. 1, 2, and 3. The perspective may not be absolutely precise from an artist's point of view, but it is sufficiently so to enable one to distinguish the different parts, especially when taken in connection with the other figures. Fig. 5 is an end elevation of the same device, about which remarks may be made similar to those of Fig. 4, except that the view is in a general way a perspective directly in front of one end and somewhat above the central line, so that some parts are partly looked down upon. The phase of the controller is the opposite of that shown in Fig. 4. Fig. 6 is a view of a part of the controller in which the phase is different from either of those shown in Figs. 4 and 5. Fig. 7 is a view of the end opposite from that shown in Fig. 5. Unimportant details, such as the upright supports, are merely outlined, and, as seen, the figure is drawn to a similar scale. Fig. 8 illustrates how the brushes are connected up with the contacts of the controller. Fig. 9 is a similar view to Fig. 7, with some parts omitted and intended to show a different phase of the parts. Fig. 10 is a similar view to Fig. 8 and for a similar purpose, showing the relation of the brushes to the contacts of the controller corresponding to the phase shown in Fig. 9. Fig. 11 is a diagram of the complete circuits when the invention is equipped with the construction shown in Figs. 7 and 9.

Referring particularly to Figs. 1, 2, and 3 and generally to the other figures, there are eight brushes 1 2 3 4 5 6 7 8, four of which bear upon one side of a rotary cylinder 9 and the rest upon the other side of the same cylinder. These brushes are stationary. Now suppose that the cylinder is evolved upon a plane. Then the contacts of the cylinder will have substantially the arrangement shown in Figs. 1, 2, and 3. The first and smallest movement of the cylinder arranged for brings the contact G in touch with the brushes 5 6 7 8 and the contact G′ in contact with the brushes 1 2 3 4, the connections between said brushes and said contact being shown in Fig. 1 by

dotted lines. The next movement brings the brushes against the contacts K J H, as indicated by dotted lines in Fig. 2, and the brushes 1 2 3 4 against the contacts K′ J′ H′. The next movement brings the brushes 5 6 7 in contact, respectively, with N M L and the brushes 2 3 4 against the contacts N′ M′ L′, the dotted lines in Fig. 3 indicating such connections.

The permanent connections will now be described, it being noticed that X W V T are different batteries, O and P the terminals of the field-magnets of the motor, and R and S the brushes of the armature of said motor. E F are the reversing-switch blades. The reversing-switch contacts are A B and A′ B′. In Figs. 1, 2, and 3 the reversing-switch blades E F are in contact with the reversing-switch contacts A B. The circuits starting from the positive poles of the batteries are from poles 1′ 2′ 3′ 4′ through contact-fingers 1 2 3 4, through barrel-contact G′ to contact-finger 1, to armature-terminal R, through armature of motor to armature-terminal S, to reversing-switch-blade contact C, through reversing-switch blade E to reversing-switch contact A, to reversing-switch contact A′, to motor-field terminal P, through motor-field to terminal O, to reversing-switch contact B′, to reversing-switch contact B, through reversing-switch blade F, to reversing-switch-blade contact D, to contact-finger 8, to contact-fingers 7 6 5, through barrel-contact G, and to battery-negatives 5′ 6′ 7′ 8′, thus putting batteries T V W X all in parallel with the motor.

Method of reversing the direction and rotation of the motor, whereby the relation of field and armature is to be done, is accomplished by throwing the reversing-switch blades E and F in contact with reversing-switch contacts B′ and A′, respectively. Now referring to Fig. 2, the circuits starting from the positive pole of the batteries go from battery-positive 1′ through contact-finger 1 to controller-barrel contact H′, to armature-terminal R, through armature to S, from S to reversing-switch-blade contact C, through reversing-switch blade E to reversing-switch contact A to A′, from A′ to motor-field terminal P, through motor-field to terminal O, through reversing-switch contact B′ to B, through reversing-switch contact B, through reversing-switch blade F to reversing-switch-blade contact D, to contact-finger 8, and to battery-negative contact 8′, through the battery to positive contact 4′, to contact-finger 4, to controller-barrel contact K′, to controller-barrel contact K to contact-finger 5, through contact-finger 5 to battery-negative 5′, completing the circuit putting batteries T and X in series, from battery-positive 2′ to contact-finger 2, to barrel-contact H′, to contact-finger 1, from contact-finger 1 to armature-terminal R, through armature to S, from armature-terminal S to reversing-switch-blade contact C, through reversing-switch blade E to reversing-switch contact A to A′, from A′ to motor-field terminal P, through motor-field to O, to reversing-switch contact B′, to reversing-switch contact B, through reversing-switch blade F to reversing-switch-blade contact D, to contact-finger 8, to controller-barrel contact H, to contact-finger 7, from contact-finger 7 to battery-contact 7′, through battery to battery-contact 3′, to contact-finger 3, to controller-barrel contact J′, to controller-barrel contact J, to contact-finger 6, from contact-finger 6 to battery-terminal 6′, thus putting batteries V and W in series, and by means of contact-fingers 7 and 8 being in contact with controller-barrel contact H and contact-fingers 1 and 2 in contact with controller-barrel contact H′ the two series T X and V W are put in parallel with the motor.

Now refer to Fig. 3. The circuits start from the positive poles and extend in the following manner: The circuit from the positive 1′ to contact-finger 1, from contact-finger 1 to armature-terminal R, through armature to S, from armature-terminal S to reversing-switch-blade contact C, from reversing-switch-blade contact C through reversing-switch blade E to reversing-switch contact A to A′, from A′ to motor-field terminal P, through motor-field to terminal O, from terminal O to reversing-switch contact B′, to reversing-switch contact B, through reversing-switch blade F, to reversing-switch-blade contact D, to contact-finger 8, through battery X to positive terminal 4′, to contact-finger 4, to controller-barrel contact N′, to controller-barrel contact L, from controller-barrel contact L to contact-finger 7, from contact-finger 7 to battery-terminal 7′, through battery W to 3′, from battery-terminal 3′ to contact-finger 3, to controller-barrel contact M′, to controller-barrel contact M, to contact-finger 6, to battery-terminal 6′, through battery V to battery-terminal 2′, from battery-terminal 2′ to contact-finger 2, to barrel-contact L′, from L′ to N, from N to contact-finger 5, from 5 to negative-battery terminal 5′, thus putting the batteries T V W X all in series with the motor and giving maximum voltage. The result is as follows: Assume that each battery had an electromotive force of twenty volts. In the first phase there will be twenty volts, with all batteries parallel with each other and in series with the motor. In the second position there will be forty volts, because two batteries are in parallel and two in series. In the third position there will be eighty volts, as all the batteries will be in series.

I will now describe the leading feature: When the main lever 10 is moved from the position of rest, the reversing-lever 11 cannot be moved till the main lever is brought back to the normal position, thereby preventing a reversal of the motor when the current is on. The lever 10 may be rocked to and fro upon the shaft 12 for the purpose of turning the cylinder 9 back and forth for the purpose of

bringing the contacts thereon against the brushes 1 2 3, &c. The lever 10 is terminated by a segment 13 of a toothed wheel gearing with another segment 14 upon an extension of the shaft of the barrel 9. The turning of the lever 10 therefore back and forth turns the barrel 9 to different positions, in which said barrel is held by the button 15 on the spring 16, bearing in one of the notches 17 on a disk 18, which is on the shaft of the barrel 9. This disk 18 may be larger than the barrel 9, as shown in Fig. 4, or about the same size, as shown in Fig. 5. The reversing-lever 11 extends from a shaft 19 and carries a projection 20. Corresponding to this projection is a grooved piece 21, carried on the main lever 10, the groove in which is curved in such a manner that in the off position of the lever the projection 20 may pass freely across the piece 20 through its groove when the lever 11 is operated for reversing the current. Such a phase is shown in Fig. 4, where the lever 11 is in a reversed position or, say, a given position. In Fig. 6 the lever 11 is shown vertical in the process of reversing the current. The projection 20 is shown passing through the groove 22 in the piece 21. When, however, the lever 10 is turned even a very small amount, the center from which the curve 22 is drawn leaves the center of rotation of the lever 11, and therefore the current cannot be reversed, because the projection 20 would not be able to pass through the groove 22. Consequently the motorman must always turn off the current before he can reverse it. The button 23 is on a spring 24 and is adapted to press in one of the notches 25 on a wheel 26, which is on the shaft 19, all for the purpose of holding the reversing-switch in either one of its two phases.

27 represents the two uprights for supporting the various parts. A portion of one of these uprights and of the lever 10 is broken away and all behind are omitted—for example, the other upright—except the portions which are numbered and lettered.

28 represents stops for the main lever 10.

The barrel 9 should be so constructed as not to conduct currents from one contact to another except where intended. Electricians will understand how to accomplish this by reference to Figs. 1, 2, and 3, where every electric connection is shown.

Referring particularly to Figs. 7 to 11, inclusive, there may be seen represented a switch 30, formed of the two parts 31 and 32, for throwing into circuit the motor-circuits 32 or the charging-dynamo terminals 33, or the switch 30 may be open with respect to both of these terminals when standing in a horizontal position. In Fig. 7 the switch 30 is closed for charging the batteries, (shown at the upper parts of Figs. 1, 2, 3, and 11,) while in Fig. 9 the switch 30 is shown in a position for including the motor in circuit. In Figs. 1, 2, and 3 there is no switch shown, as the motor whose brushes are R and S is permanently connected up with the controller. In practice, however, I use the device shown in Figs. 7 and 9 for a purpose which will hereinafter appear.

34 and 35 are the terminals for the switch 30, that connect with the controller, as shown in diagram Fig. 11.

36 is a handle for swinging the switch 30 back and forth. By experience it is found that the operation of the switch 30 without a certain improvement to be described soon cannot safely be manipulated, because the following dangers will arise: When the controller is off of the circuit, as indicated in Fig. 9 in conjunction with Fig. 4, the handle 10 being vertical, the switch 30 can be moved to all three of its positions freely, and of course no mishap can take place, because the controller is in the electrical condition represented in Fig. 4, where the brushes 1 2 3 4 5 6 7 8 are excluded from circuit. To permit this action, the shaft 12 on the uprights 27 carries an arm 37, which is rotary with said shaft, and has two stops 38 and 39, the upper one, 38, having its surface 40 curved around the pivot 41 of the switch 30 as a center. The surface 42 of the stop 39 is curved around the same center; but 41 is the center of these circular curves only when the handle 10 stands up straight—that is, when the controller is off. In this position the square pin 43, carried on the extension 44 from the switch 30, when swung back and forth by the handle 36 passes close to but free from the surfaces 40 and 42, because the pin 43 is at the right distance from the pivot 41. Therefore the pin 43 is only just able to escape the projections 38 and 39, its path being indicated by the line 45, made of dots and dashes.

Fig. 10 shows the electrical condition of the controller, there being no dotted lines, as in Figs. 1, 2, 3, and 8, to show that the brushes 1, 2, 3, 4, 5, 6, 7, and 8 are connected to any of the contacts of the rotating cylinder 18. When, however, the handle 10 is turned to any new position, so as to connect up the brushes 1 2 3, &c., with any of the contacts—for example, N M L and N′ M′ L′, as in Fig. 8—the surfaces 40 and 42 are no longer circumscribed about the center 41, and therefore the pin 43 cannot glide between the projections 38 and 39, but will strike the projection 39, as indicated by the line 46, made of dots and dashes. There is a purpose in this stoppage, for when the handle 36 is pulled to the right for disconnecting the charging-dynamo from the storage batteries there will be no danger of throwing all the current from the batteries directly upon the motor of the automobile. The switch 30 will open from the terminals 33; but the stop 39 will prevent said switch 30 from closing upon the terminals 32 for the reason stated. Consequently by my device there will be no danger of burning out or too suddenly overloading the motor, for the only manner in which the motor can be thrown into circuit is to throw the

controller out of circuit first, and always out of circuit first, and then of course no harm can follow from turning the switch 30 directly from the terminals 33 to the terminals 32. The same simple construction prevents the switch 30 from being thrown to connect the dynamo with the batteries except when the controller is freely opened. This can be imagined from the two views, Figs. 7 and 9, by supposing merely that to begin with the extension 44 is at the right hand of the projection 39 instead of at the left hand. This is shown in Fig. 9, in which imagine that the handle 10 is tipped to the right, as in Fig. 7. Then the stop 39 will prevent the switch 30 from being turned any farther than necessary for the opening of the motor-terminals 32.

It will be noticed that the stops 38 and 39 are like the stops forming the sides of the groove 22 on the handle 10 except that they are cut off for the purpose of permitting the extension 44, and therefore the switch 30, to reach a central position, where both the terminals 32 and 33 are free of said switch.

To understand the connections between the terminals 32 and the motor and terminals 33 and the batteries is not essential to the understanding of the invention except very indirectly; but nevertheless the connections are shown and may be traced in Fig. 11, where the parts are identified by reference-numerals.

I claim as my invention—

1. In an electric controller, the combination of a main handle for governing the distribution of the currents, a projection rigidly fixed to said handle, a second handle for reversing the currents, and a projection rigidly fixed to said second handle, the shapes of said projections being such that the former is a stop to the latter in all the on positions of the said main handle, and not a stop in the off position thereof.

2. In an electric-circuit controller, the combination of a main handle for switching currents, and having a projection fixed thereto and a reversing-switch handle having a projection, fixed thereto, the former projection acting as a stop to the latter projection only in the on positions of the former.

3. In an electric-circuit controller, the combination of a main handle for switching the currents, a reversing-switch handle, each movable to and fro, a grooved piece on the main handle with a groove struck from the center of rotation of the reversing-switch handle, and mounted upon the main handle in such a position that a projection of the reversing-switch handle may pass through said groove only in the off position of said main handle.

4. In an electric-circuit controller the combination of a main handle for switching the currents and provided with a groove, a reversing-switch handle having a projection, said groove being in the path of said projection in the normal position of the first-named handle.

5. In an electric-circuit controller the combination of a main handle for switching the currents and provided with a groove, a reversing-switch handle having a projection, said groove being in the path of said projection in the normal position of the first-named handle, a barrel upon which electric contacts are located, brushes adapted to bear upon the contacts in a predetermined order, said contacts being in two sets, one of which is for half of the brushes and the other set for the other half, and said contacts and said brushes being so relatively located at the first position of the main handle as to put all the batteries in parallel, the next position partly in parallel and partly in series, and the next position all in series with one another.

6. In an electric-circuit controller, the combination of a main handle for governing the distribution of the current, a reversing-switch, a second handle for operating the reversing-switch, and movable only during the off position of the main handle, a single switch governing both motor-currents and the dynamo-charging currents, and movable from the motor-circuit to the storage-circuit only during the off position of the main handle.

7. In an electric-circuit controller, the combination of a handle for governing the distribution of the current, a switch for changing the currents from the motor to the charging current, and means for preventing said switch from changing from one phase to the other except in the off position of said handle.

8. In an electric-circuit controller, the combination of a main handle for regulating currents, and movable to and fro, a single switch adapted both to open and close the motor-circuit and to open and close the charging-circuit, and to be in a position where both of said circuits are open, and means governed by the main handle for preventing said switch from turning from the motor-circuit to the storage-circuit, during a predetermined position of said handle.

9. In an electric-circuit controller, the combination of a main handle for switching currents, a reversing-switch, means governed by the main handle for preventing the operation of the reversing-switch handle except in the off position of the main handle, a switch for opening and closing the motor-circuit and for opening and closing the charging-circuit, and a device governed by said main handle for preventing the last-named switch, under predetermined conditions, from being moved from one of its said phases to the other.

10. In an electric-circuit controller, the combination of a main handle for regulating currents, a switch for reversing the currents, a switch for opening and closing the motor-circuits, and when in a different phase, for opening and closing the charging-circuits, and devices controlled by the movements of the first-named switch for limiting the motions of the other switches under predetermined phases of all the switches.

11. In an electric-circuit controller, the combination of a main handle for regulating the currents, and provided with a groove, a reversing-switch handle having a projection, said groove being in the path of said projection only in the normal position of the first-named handle, a switch for opening and closing the motor-circuit and for opening and closing the charging-circuit, stops controlled by the main handle, both of said stops only being out of the path of a projection, which belongs to the last-named switch, when the main handle is in its normal position.

12. In an electric-circuit controller, the combination of a main handle for regulating the current, stops controlled by the handle, a switch for opening and closing the motor-circuit and for opening and closing the charging-circuit, an extension from said switch, a projection on said extension freely movable between said stops at the off position of said handle, and movable to said stops only, and to an open position with respect to both of said circuits, when said handle is in an abnormal position.

13. An electric-circuit controller consisting of the combination of a handle for regulating the current, a handle for reversing the current, a handle for opening and closing the motor-circuit and for opening and closing the charging-circuit the movements of the last two named handles being dependent upon the phase of the first-named handle.

In testimony whereof I have hereunto subscribed my name this 5th day of June, 1901.

WILLIAM K. BASSFORD, JR. [L. S.]

Witnesses:
ROBT. T. BRAMPTON,
JOHN G. FLEMING.