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SWITCH.

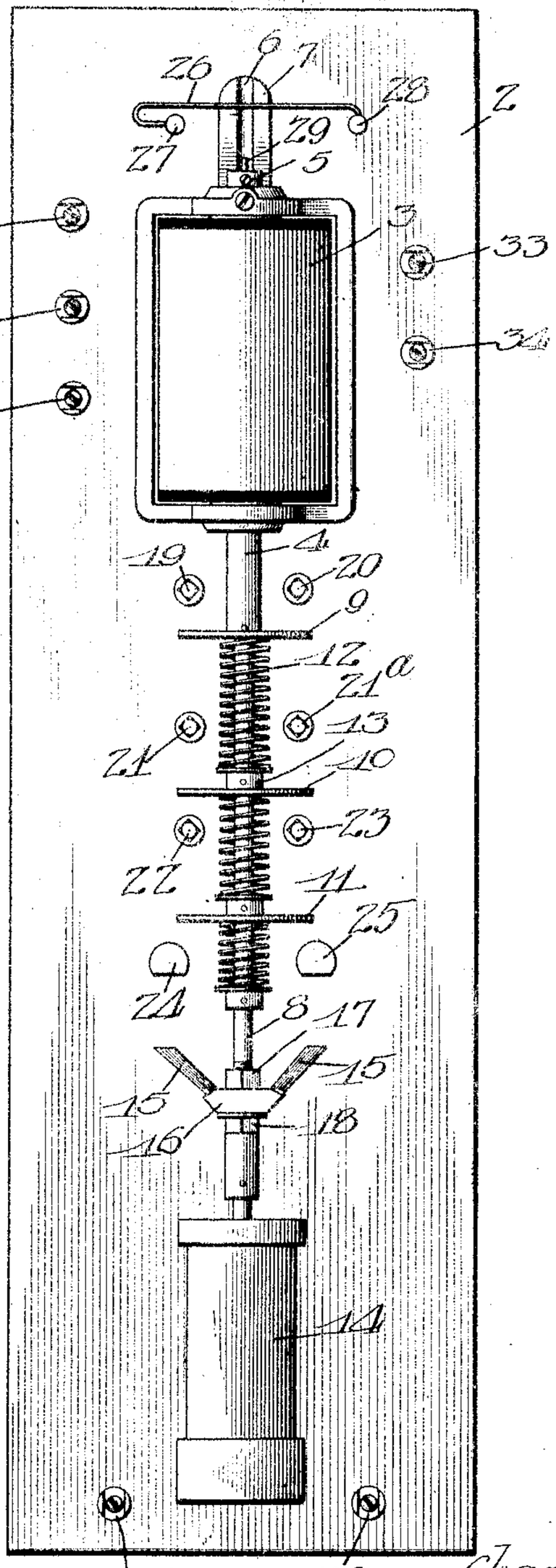
APPLICATION FILED MAY 9, 1907.

985,509.

Patented Feb. 28, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



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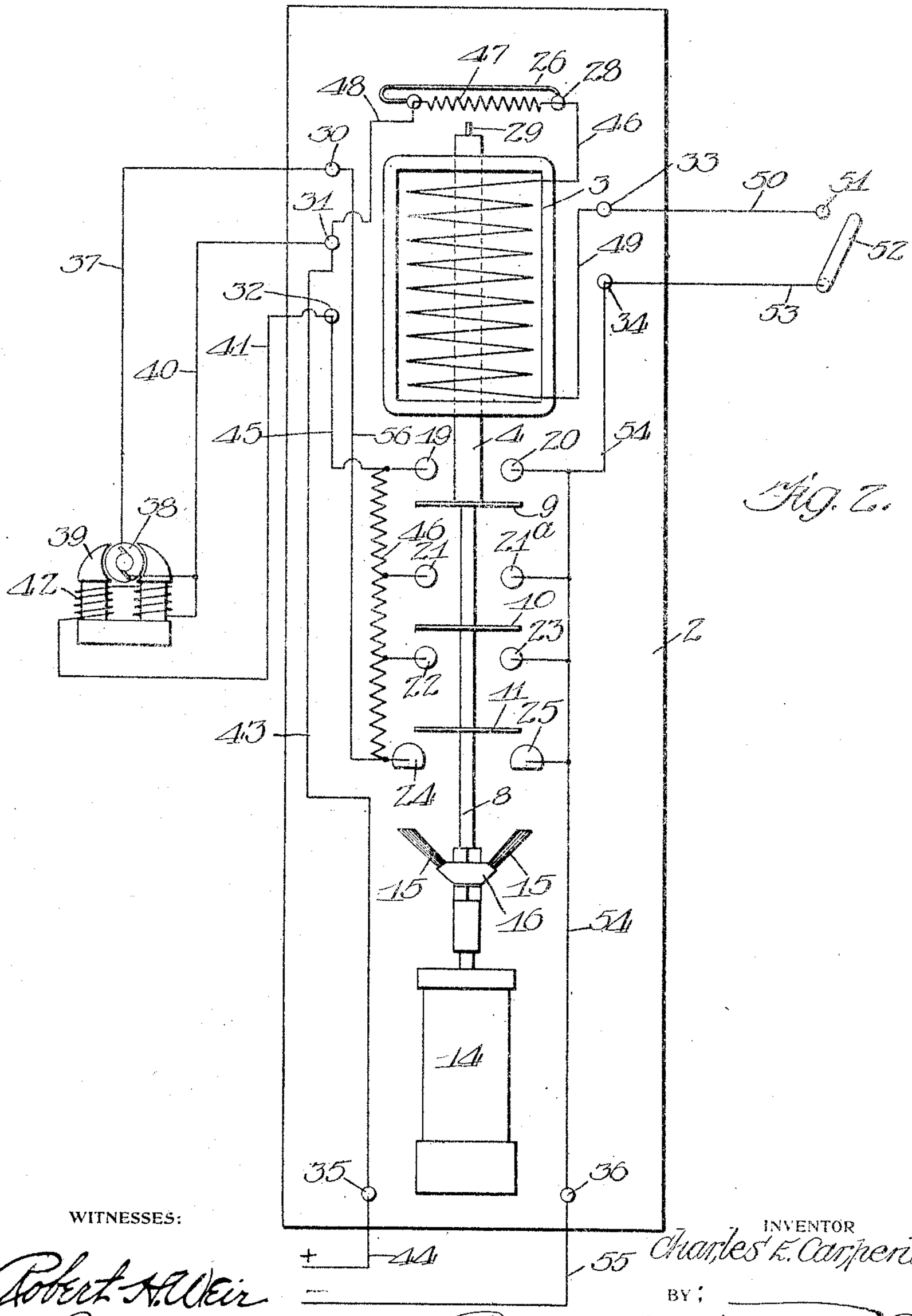

Fig. 2.

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3 SHEETS—SHEET 3.

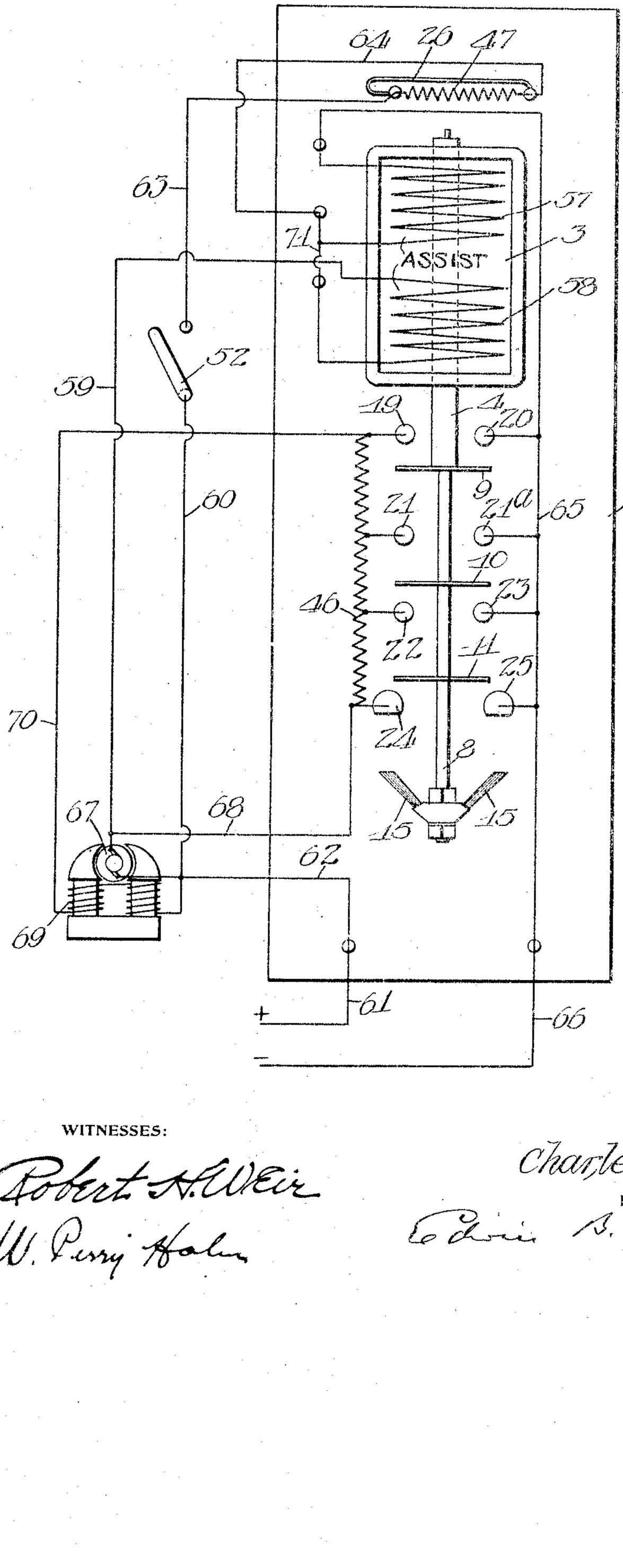

Fig. 3.

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SWITCH.

985,509. Specification of Letters Patent. Patented Feb. 28, 1911.

Application filed May 9, 1907. Serial No. 372,736.

To all whom it may concern:

Be it known that I, CHARLES E. CARPENTER, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented new and useful Improvements in Switches, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in switches, one of the objects thereof being the provision of a single electro-responsive device for operating a plurality of switches successively.

My invention is particularly adapted to switches for controlling the resistance of a motor, and contemplates in its preferred form, the provision of a plurality of switches arranged to be successively closed by means operated by a single solenoid, for cutting a resistance out of a motor circuit.

I have illustrated in the accompanying drawings for the purpose of disclosing my invention, one embodiment thereof, and in said drawings: Figure 1 is an elevation of one form of my device, Fig. 2 is a diagrammatic view of the circuit arrangement of the form illustrated in Fig. 1, and Fig. 3 is a diagrammatic view of a modification of my device.

In the embodiment of my invention illustrated in Fig. 1, upon a suitable panel or base 2, preferably formed of slate or other insulating material, is mounted a solenoid 3 having a core 4. The upper end of the core is provided with a small collar 5 having a projection arranged to operate in a slot 6, formed in a guide plate 7.

The lower end of the core has secured thereto a tail rod 8, carrying a plurality of disk contacts 9, 10, and 11. Each contact is supported in position upon the tail rod upon a coiled spring 12 interposed between the bottom of the disk and a collar 13 secured upon the tail rod. The end of the tail rod is connected with a piston rod, the piston of which operates in a suction or dash-pot 14, to retard the upward movement of the tail rod when the core 4 is attracted. At a point intermediate of the disk 11 and the end of the tail rod 8, is supported a contact 15, which may take the form of leaves or laminations of copper suitably supported in a cup 16, secured upon the tail rod between a pair of nuts 17 and 18. The disk 9 is arranged to engage a pair of contacts 19 and 20. The disk 10 is arranged to engage a pair of contacts 21 and 21^a, and the disk 11 is arranged to engage a pair of contacts 22 and 23. All of these contacts preferably take the form of rollers supported on suitable studs, secured to the base, and the engagement thereof, by the various disks, changes the position of the rollers whereby a new surface is presented. The contact brush 15 is arranged to engage a pair of contacts 24 and 25, also mounted upon the base 2.

It will be noted that when the tail rod is in its normal or down position that the distance between the contacts 19 and 20 and the switch member 9 is less than the distance between the contact 21 and 21^a and the switch member 10, and that the distance between the contacts 22 and 23 and the switch member is greater than the distance between the switch member 10 and its contacts, and that the distance between the brushes 15 and their respective contacts is greater than the distance between the switch member 11 and its respective contacts. By this arrangement when the tail rod is raised by the core 4, the switch member 9 will engage its contacts first, the spring supporting the same, however, permitting the tail rod to continue to rise until the switch member 10 engages its contacts and so on until the brushes 15 bridge the contacts 24 and 25.

Above the top of the solenoid 3 is mounted a switch 26 supported at 27 and arranged to engage contact 28. This switch is arranged to be opened by a projection 29 on the upper end of the core 4 when the core reaches the upward limit of its travel. Suitable binding posts 30, 31, 32, 33, 34, 35 and 36 are provided upon the face of the base 2 by which the various circuit connections of the switch may be made.

In the circuit arrangement illustrated in Fig. 2, the binding post 30 is connected by a conductor 37 with one terminal of the armature 38 of the motor 39. The opposite terminal of the armature 38 is connected with the binding post 31. The binding post 32 is connected by a conductor 41 with one terminal of the field 42 of the motor, the opposite terminal of the field being connected with conductor 40. The binding post 31 is also connected by conductor 43 with the

binding post 35, which is also connected with the positive side 44 of the line. The binding post 32 is connected by conductor 45 with the contact 19, and extending between the contacts 19 and 24 is an armature resistance 46 divided into sections and connected with the contacts 21, 22 and 24. One terminal of the winding of the solenoid 3 is connected by conductor 46 with the contact 28 of the switch 26. Between the switch and the contact 28 is connected a resistance 47. The switch 26 is connected by conductor 48 with the binding post 31. The opposite terminal of the winding of the solenoid 3 is connected by conductor 49 with the binding post 33, which is connected by a conductor 50 with the contact 51 of a switch 52, the switch 52 being connected by conductor 53 with the binding post 34. The binding post 34 is also connected by conductor 54 with the binding post 36, which in turn is connected with the negative side 55 of the line. The contacts 20, 21[a], 23 and 25 are all connected with the conductor 54.

In operation, assuming that the switch 52 which may be located at any distant point, is closed, then circuit will immediately be closed from the positive side 44 of the line, through conductors 43 and 48, across switch 26, by conductor 46, through the winding of the solenoid 3, thence by conductors 49 and 50, across switch 52, and by conductors 53 and 54 to the opposite conductor 55 of the line. This energizes the winding of the solenoid 3 and the solenoid immediately attracts its core, raising the tail rod 8, and as the tail rod rises, the disk 9 bridges the contacts 19 and 20, thereby establishing the motor circuit from the positive side 44 of the line, by conductors 43 and 40, through the armature 38 of the motor 39, thence by conductors 37 and 56, to the contact 24, through all the resistance 46, across the contact disk 9, and by conductor 54 to the opposite side 55 of the line. The field circuit of the motor is established from conductor 40 through the field 42, and by conductor 41, to conductor 45, thence by way of contacts 19 and 20 and conductor 54, to the opposite side 55 of the line. The motor thus starts with all the resistance in circuit and as the core of the solenoid continues to raise the tail rod 8, the disk 10 will bridge contacts 20 and 21 to cut out one section of resistance. A continued upward movement of the tail rod causes the disk 11 to bridge contacts 22 and 23 to cut out another section of resistance. and finally contact brush 15 will bridge the contacts 24 and 25, thereby cutting out the last section of the resistance 46, and the motor will be operating at full speed. When the core 4 of the solenoid 3 reaches the extreme upward limit of its travel, the projection 29 thereof engages the switch 26, opening the same and inserting resistance 47 in series with the winding of the solenoid 3, thereby cutting down the current to prevent over heating the magnet, as it is well understood that the magnet requires more current to start and raise the tail rod 8, than it does to maintain the same in its raised position.

In a lifting solenoid of the construction shown, having a fixed number of ampere turns in the winding thereof, the pull on the plunger would increase as the plunger rises and the magnetic gap is closed, and this would tend to increase the speed of the rise of the plunger rod against the action of the dash-pot. This difference in pull, however, in the present device is compensated for by the springs on which the various contacts of the tail rod rest, and which as the contacts are successively closed increase the resistance to pull on the plunger.

In Fig. 3 I have shown a modification of my device wherein I have dispensed with the dash-pot for regulating the upward movement of the core of the solenoid, and in place thereof, I have provided a means for regulating the movement of the core of the solenoid, through the action of the winding of the solenoid. This means is illustrated as a second winding connected across the armature terminals. In this structure the upper winding 57 of the solenoid 3 serves to raise the tail rod to a starting position, and the lower winding 58 which is connected across the armature terminals, by conductors 59 and 60, serves, as the counter electro-motive force of the armature increases, to raise the tail rod to successively close the switches. In operation when the switch 52 is closed, circuit will be established from the positive side 61 of the line, by conductors 62 and 60, across the switch 52, by conductor 63, across the switch 26, by conductor 64, through the winding 57 of the solenoid, and thence by conductor 65, to the opposite side 66 of the line. The winding 57 thus being energized, raises the core 4 of the solenoid to its initial position, and the disk 9 bridges the contacts 19 and 20, thereby establishing the armature circuit from conductor 62, through the armature 67, by conductor 68, through resistance 46, across the disk 9, and by conductor 65, to the opposite side 66 of the line. The field circuit is established at the same time from the conductor 62, through the field 69, and thence by conductor 70, across the contact 19, and by conductor 65 to the opposite side 66 of the line. The armature thus starts with all resistance in circuit and the winding 58 is energized by the circuit across the armature terminals extending from one terminal of the armature, by conductor 60, across the switch 52, by conductor 71, through the winding 58 of the solenoid 3, and thence by conductor 59, to the opposite

terminal of the armature 67. As the counter electro-motive force of the armature increases the strength of the solenoid 3 is increased by the winding 58, and the switches 10, 11 and 15 will successively be closed to cut out the resistance, section by section.

With the form of device shown in Fig. 3 where the dash-pot is omitted, the accumulative effect of the winding connected across the terminals of the motor tends further to increase the pull of the plunger as it rises, due to the increasing counter voltage of the motor as the armature of the motor accelerates. In this case also, however, the springs of the contacts on the tail rod offer an increasing resistance, thereby making the speed at which the plunger of the solenoid rises the same under all conditions.

While in Fig. 3 I have shown two independent windings, one placed upon the other, it is obvious that one winding may be superimposed upon the other or one solenoid spool may be telescoped upon the other, and in a certain class of work this construction is preferred. It will be further understood that I do not wish to be limited to the precise construction illustrated and described, but may make various changes therein. For instance, instead of arranging the coils to assist one another, I may arrange the same to coöperate in other ways.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a controller for electric motors, the combination with an electro-responsive device, a member movable thereby, a plurality of switch members resiliently mounted on said member, a plurality of contacts so positioned as to be successively bridged by the switch members upon the movement of the member by the electro-responsive device, and resistances connected to certain of said contacts to be short-circuited by said switch members.

2. In a motor controller, the combination with a movable member, of an operating winding therefor, a plurality of switches resiliently mounted on said movable member, a plurality of contacts arranged to be successively engaged by said switches, a resistance connected to certain of said contacts whereby said resistance will be short-circuited as the contacts are engaged by said switches, and means for controlling the movement of the movable member.

3. The combination with a solenoid, a longitudinally movable core therefor, a plurality of switch members resiliently mounted thereon, a plurality of stationary contacts arranged in pairs, resistances connected to said stationary contacts, the distance between each pair of stationary contacts and their respective switch member being increased toward the bottom of said core, the springs between the switch members being successively compressed by the switch members moving down on said rod and allowing the rod to continue to move until the last contacts are bridged.

4. The combination with a solenoid, a movable core therefor, an extension on said core, collars on said extension, a plurality of disk contacts loosely mounted on said extension, springs interposed between each disk and the collar next below it, a laminated contact secured to the lower end of said extension, and a plurality of stationary contacts arranged in pairs and having resistances connected thereto, said contacts being arranged to be bridged successively.

5. A motor controller comprising a solenoid, a movable core therefor, an extension on said core, collars on said extension, a plurality of switch members loosely mounted on said extension, springs interposed between each switch member and the collar next below it, a plurality of stationary contacts arranged in pairs, resistances connected to said contacts, the distance between the contacts and their switch members increasing toward the bottom of the extension, whereby when the core is raised the pairs of contacts will be successively engaged and the resistances removed from the motor circuit step by step.

6. The combination with a solenoid, of a movable core therefor, a plurality of collars on said core, a plurality of switch members loosely mounted on said core, springs, interposed between each switch member and the collar next below it, a plurality of stationary contacts arranged in pairs and having resistances connected thereto, said contacts being adapted to be successively engaged by the switch members, the springs being adapted to yield as the switch members engage their respective contacts to allow the core to move to final position to bring the last switch member in engagement with its pair of stationary contacts.

7. In a motor controller, the combination with a solenoid winding adapted to be connected across the circuit, and a winding adapted to be connected across the armature terminals, of a longitudinally movable core for said windings, a plurality of switch members loosely mounted on said core, springs interposed between said switch members, and a plurality of stationary contacts arranged in pairs, the distance between each pair of contacts and its respective switch member increasing toward the bottom of the core, whereby the contacts will be successively engaged, said springs allowing the core to move through the switch members until the last contacts are bridged.

8. In a motor controller, the combination with a resistance, of an electro-responsive

winding, a longitudinally movable plunger therein, a plurality of contact disks loosely mounted on the plunger, springs surrounding the plunger between said disks, a laminated brush contact at the bottom of said punger, a plurality of contacts arranged in pairs and connected to said resistance, the distance between each pair of contacts and their respective bridging contact increasing toward the bottom of the plunger, whereby the contacts will be engaged successively, and means to control the movement of said plunger.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

CHARLES E. CARPENTER.

Witnesses:

A. J. HORTON,

ROBERT LEWIS AMES.