E. M. HEWLETT.

SOLENOID OPERATING MECHANISM.

APPLICATION FILED NOV. 17, 1906.

962,958.

Patented June 28, 1910.

4 SHEETS—SHEET 1.

FIG. 1.

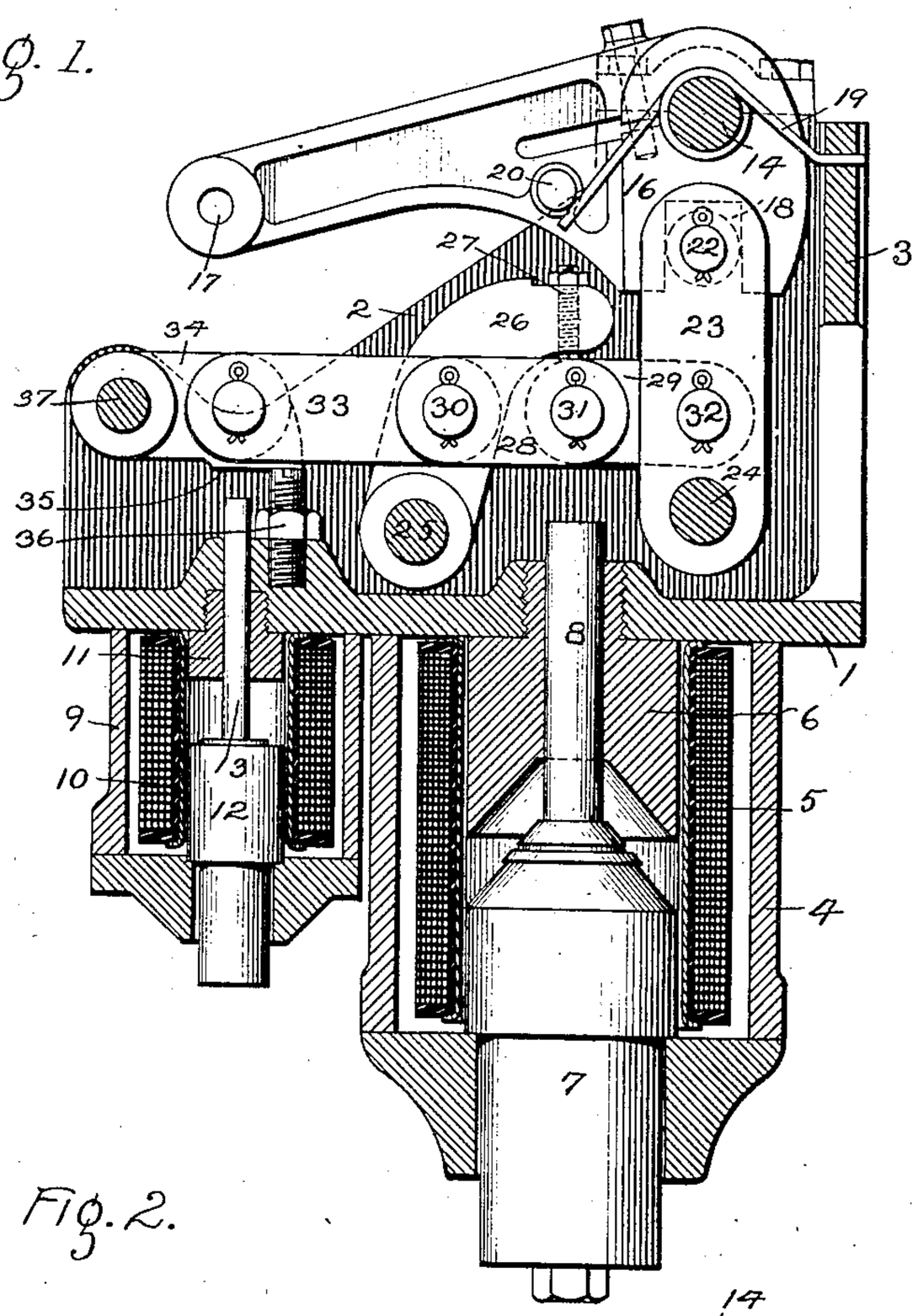
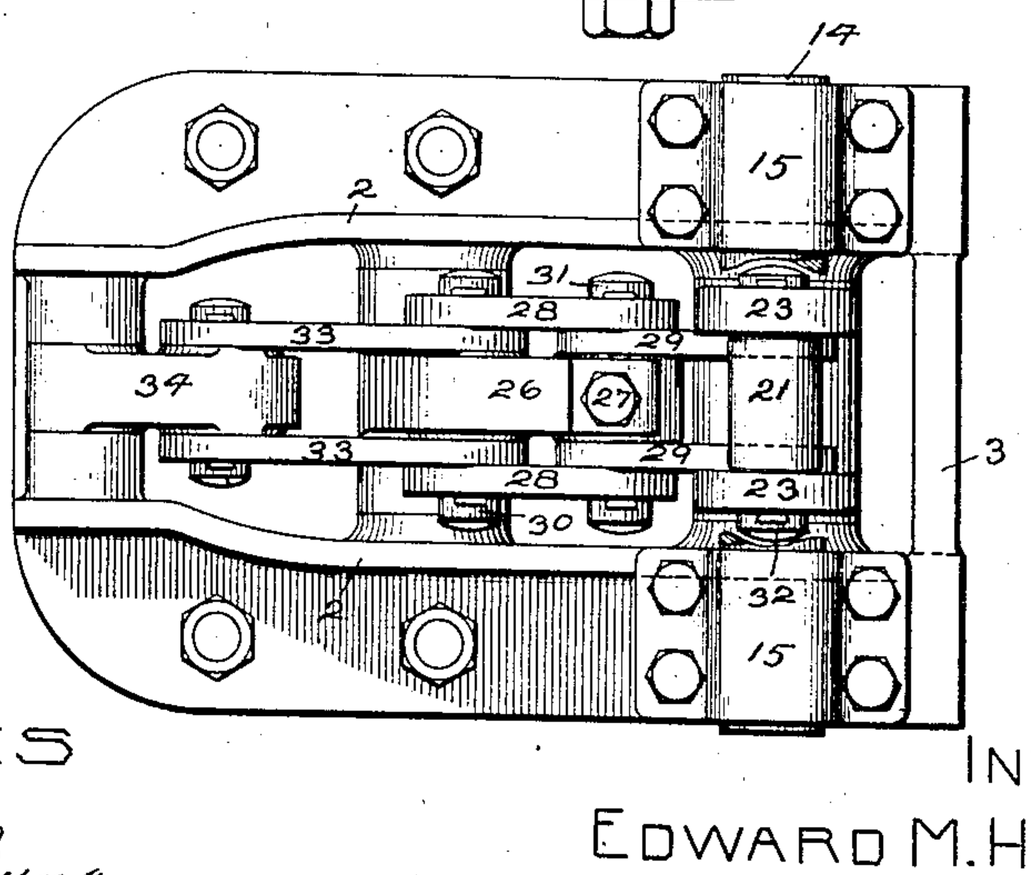


FIG. 2.



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4 SHEETS—SHEET 2.

Fig. 4.

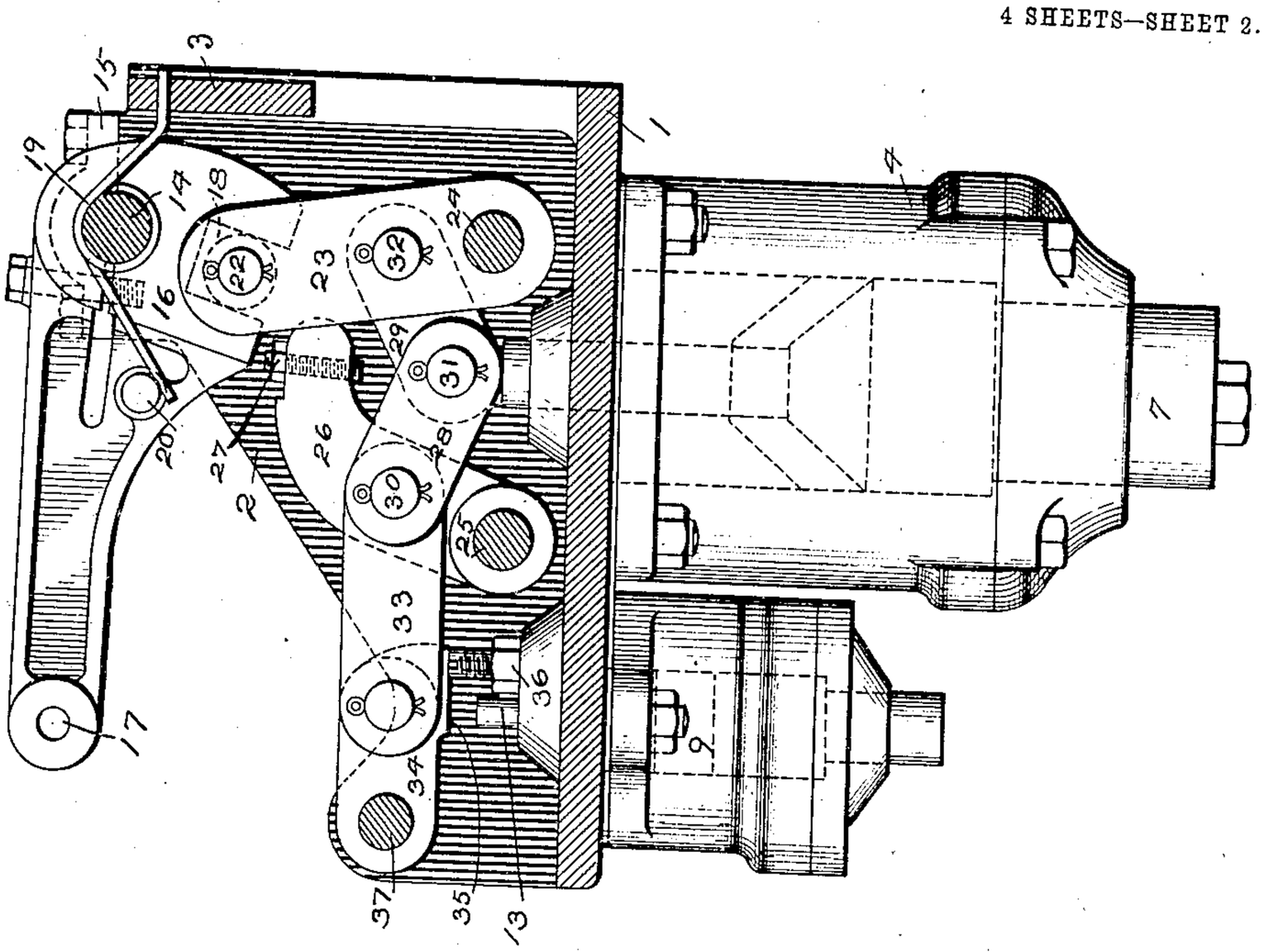
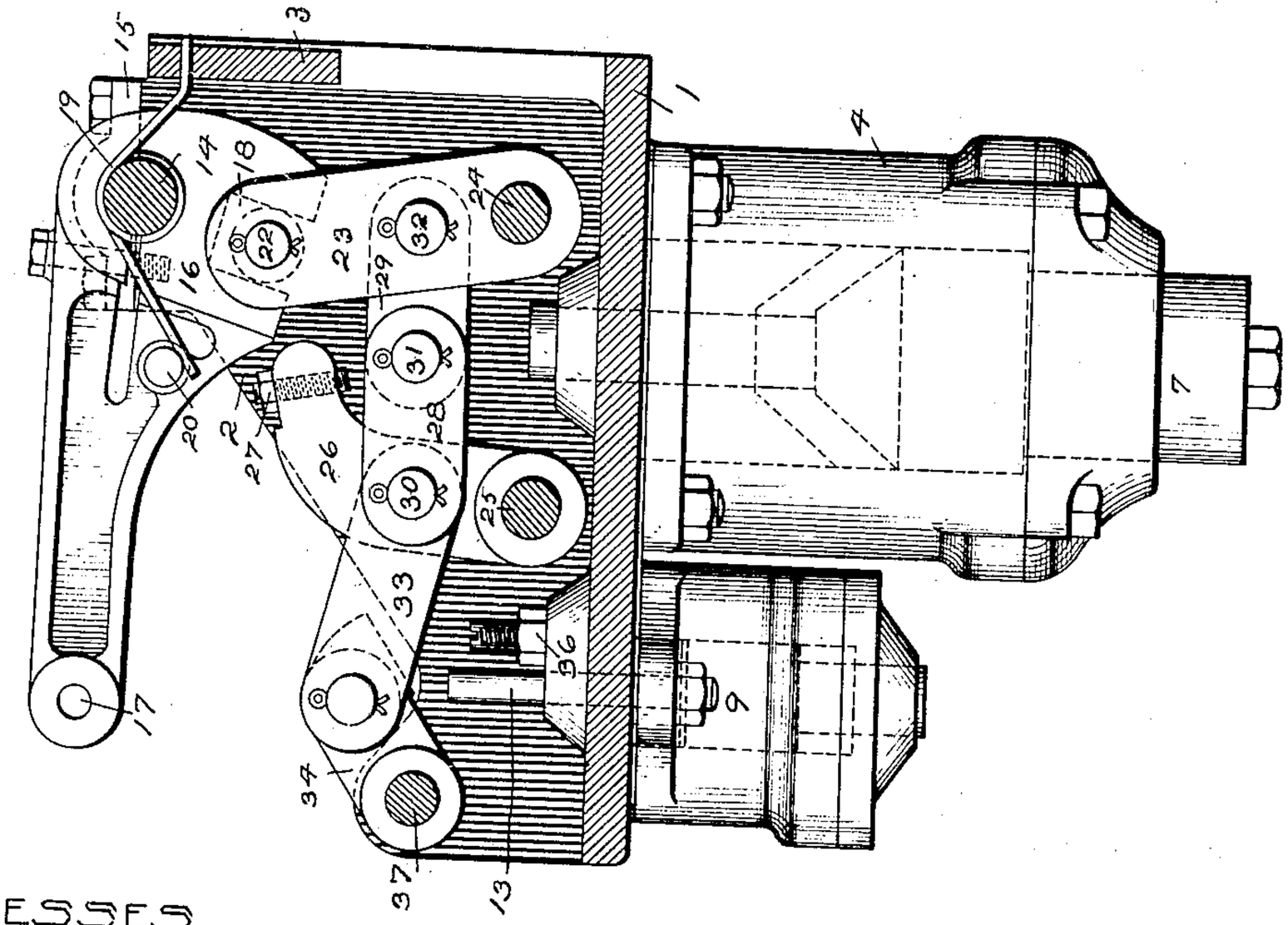


Fig. 3.



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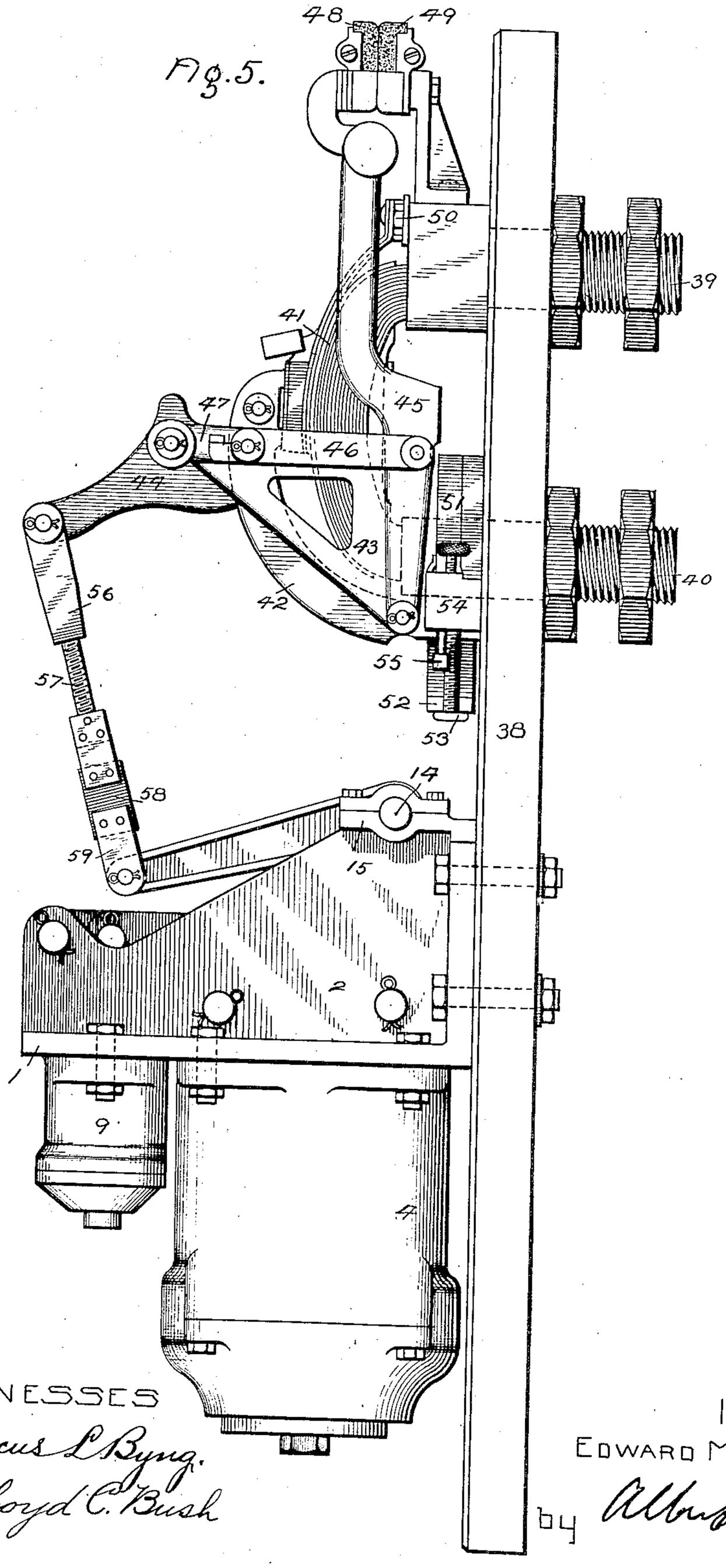
4 SHEETS—SHEET 3.

Fig. 5.



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4 SHEETS—SHEET 4.

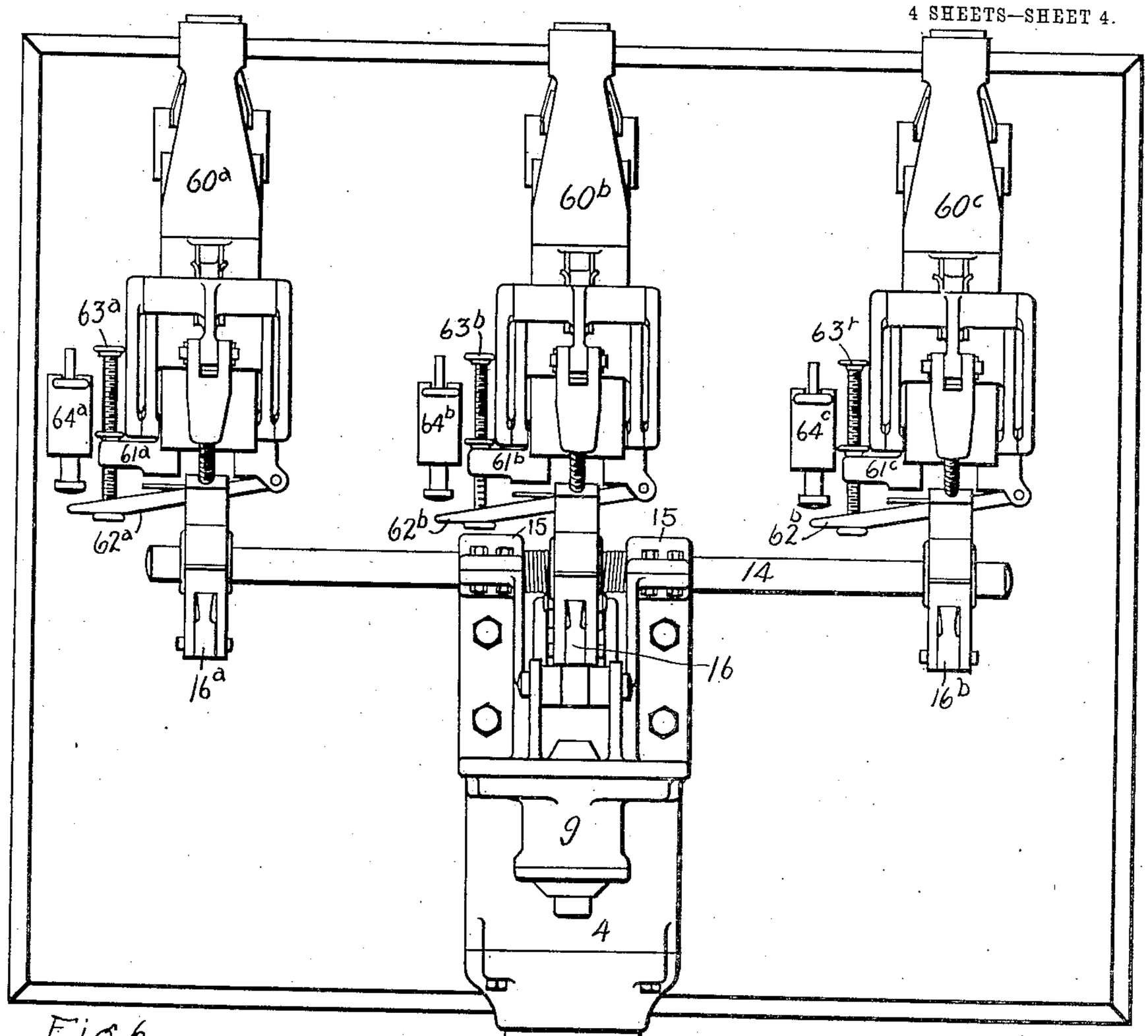

Fig. 6

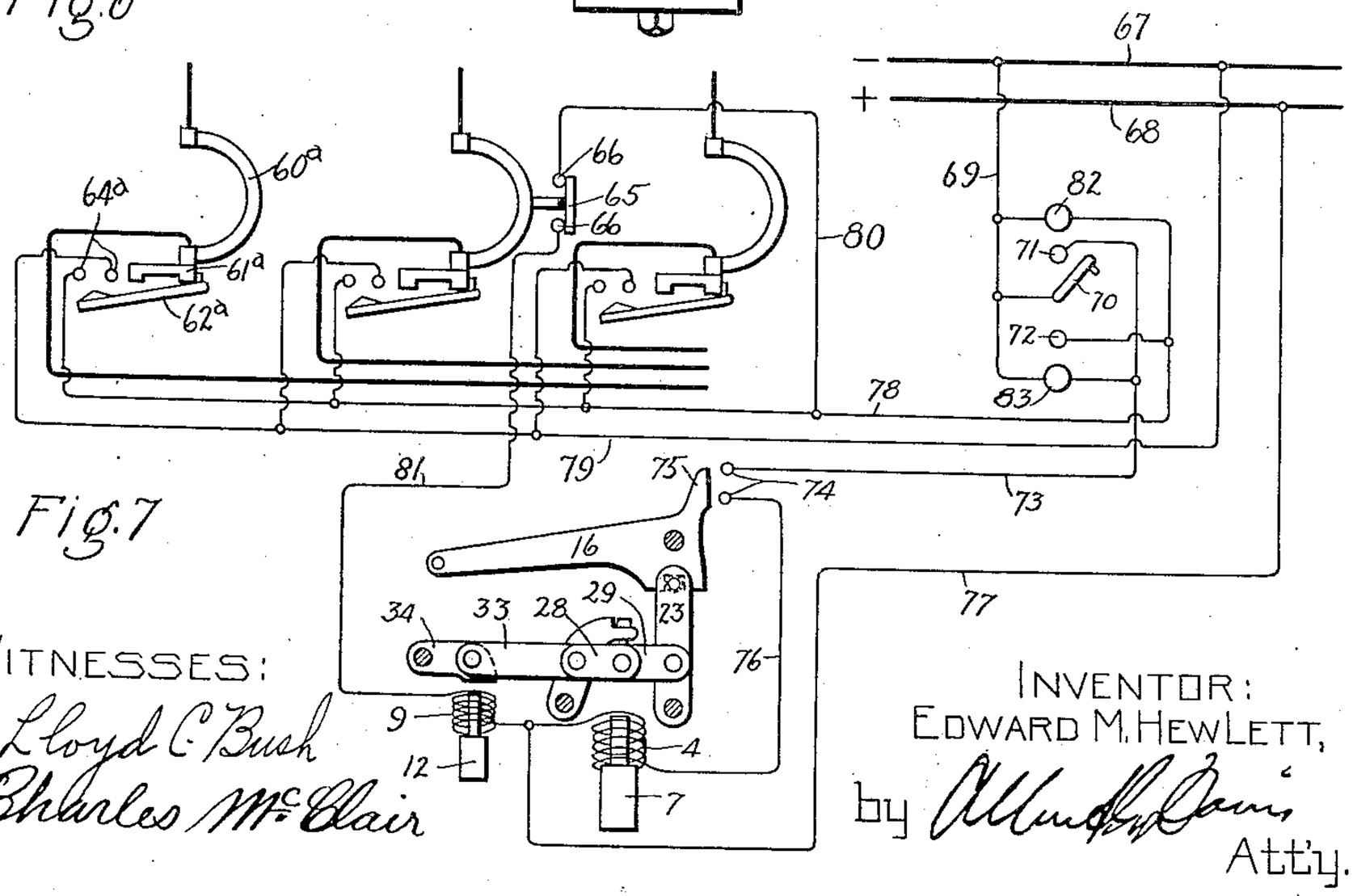

Fig. 7

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UNITED STATES PATENT OFFICE.

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SOLENOID OPERATING MECHANISM.

962,958. Specification of Letters Patent. Patented June 28, 1910.

Application filed November 17, 1906. Serial No. 343,790.

To all whom it may concern:

Be it known that I, EDWARD M. HEWLETT, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Solenoid Operating Mechanism, of which the following is a specification.

This invention relates to mechanism for operating electric switches or similar devices by means of motors, and more particularly to mechanism in which the power is furnished by solenoids, and the object of the invention is to provide a device of this character which will permit the switch to be opened while the motor for closing the switch is energized and the closing mechanism is in position to close the switch, so that if an automatic trip is used and an abnormal current flows when the switch is closed the switch may open immediately regardless of the position of the closing mechanism and without waiting for the closing means to be deënergized.

The invention consists of a mechanism comprising a movable member connected to the switch or other device to be operated; a toggle or other suitable actuating device for the movable member, a movable abutment connected to the toggle or other actuating device and receiving the reaction thereof and means for holding the movable abutment against the reaction of the toggle and in such position that the actuating device can close the switch, the holding means also permitting the movable abutment and the actuating means to move bodily when desired so as to permit the switch to open.

The invention also consists of other features and details more fully brought out in the accompanying specification and claims.

The invention will best be understood by reference to the accompanying drawings, in which—

Figure 1 is a sectional view showing the position assumed by the parts when the switch actuated thereby is closed; Fig. 2 is a plan view of the mechanism shown in Fig. 1 with a part of said mechanism removed; Fig. 3 is a view showing the position the parts assume when the switch is opened by energizing the tripping solenoid; Fig. 4 is a view showing the position of the operating mechanism after the switch has been opened and the parts are in position to close the switch when the main solenoid is energized; Fig. 5 shows the mechanism holding a switch in the closed position; Fig. 6 shows the mechanism operating a switch for three phase circuits; and Fig. 7 is a diagram of the connections for the switch shown in Fig. 6.

My invention may be embodied in many different forms, but the form which I have shown comprises a frame on which the various parts of the actuating mechanism are mounted, and consisting of base 1, sides 2, and an end-plate 3. An actuating motor of any suitable kind, but preferably an iron-clad solenoid 4, is mounted on the base 1. This solenoid consists of a coil 5, a fixed core 6 secured to the frame and projecting inside the coil, and a core 7 movably mounted within the coil, the upper end of the core being cone-shaped and fitting into a correspondingly-shaped depression in the fixed core 6. The core 7 carries an actuating rod 8 preferably of non-magnetic material which passes through the fixed core 6 and projects above the base 1 of the frame. A suitable motor for tripping the switch, preferably an iron-clad solenoid 9, is also mounted on the base 1 and consists of a coil 10 within which is a fixed core 11 secured to the base 1. A movable core 12 is slidably mounted within the coil and carries an actuating rod 13, preferably of non-magnetic material projecting above the base.

A shaft 14 is suitably mounted in journals 15 upon the sides 2 of the frame, and an operating lever 16 in the form of a bell-crank is securely mounted upon the shaft 14. At the end of one of the arms of the bell-crank operating lever 16, is an eye 17, by means of which the rod leading to the switch or other device to be operated may be connected to the actuating mechanism. In the other arm of the bell-crank operating lever is a rectangular slot 18. A coiled spring 19 surrounds the shaft 14 and one end of said spring engages a stud 20 on the operating lever 16, while the other end of the spring is securely attached to the end-plate 3 of the frame. The tendency of this spring is to throw the operating lever to the position assumed by it when the switch is open, shown in Fig. 4. In the slot 18 works a roller 21 mounted upon a pivot 22 in the end of an actuating link 23 mounted upon a pivot 24 carried by the walls of the

frame. The actuating link 23 forms a movable member of the mechanism moved to cause the switch to open or to close.

A pin 25 carried by the walls 2 of the frame forms the pivot of a supporting link 26 which is bent as shown in Fig. 1, and carries in the end thereof an adjusting screw 27. An operating toggle comprising links 28 and 29 connects the supporting link 26 with the actuating link 23. The links 28 of the actuating toggle are pivoted to the supporting link 26 by means of a pin 30, and to the links 29 by means of a pin 31, while the links 29 are secured to the actuating link 23 by means of a pin 32. When the toggle is in the position shown in Fig. 1, it is slightly over set, and the links are in engagement with the adjusting screw 27, which regulates the upward movement of the toggle links. The supporting link 26 forms a movable abutment against which toggle 28, 29 reacts when straightened to move the actuating link 23, and it is apparent that the supporting link 26 must be held in the position shown in Figs. 1 and 4, in order that the toggle 28, 29 may be held in effective position and may move the actuating link 23. When the supporting link 26 and the actuating link 23 move to the left, carrying the actuating toggle bodily to the left, the adjusting screw 27 is also carried with the link 26, hence there is no friction between the actuating toggle and the adjusting screw to retard the movement of the parts and delay the opening of the switch. This movement of the parts of the mechanism may take place when the core of the actuating solenoid is in position to close the switch, and in opening the switch it is unnecessary to wait until the core of the actuating solenoid has dropped to inoperative position.

A locking toggle composed of links 33, 34 is connected to the supporting link 26 by means of the pin 30. The link 34 of the locking toggle is provided with a shoulder 35, which, when the locking toggle is in the slightly over-set position shown in Fig. 1, engages the end of an adjustable stop 36 consisting of a stud inserted in the base 1 of the frame. One end of the link 34 is mounted upon a pin 37 which is rigidly secured to the walls 2 of the frame and forms a fixed point which receives any strain upon the locking toggle.

The actuating mechanism above described is capable of many uses, but for the purpose of illustration I have shown it applied to an electric switch. As shown in Fig. 5, the actuating mechanism is securely attached to a panel or support 38 on which the switch is also mounted. The switch is of a well known type forming no part of the present invention, and comprises studs 39 and 40, passing through the panel 38 and having contact blocks engaged by a laminated bridging contact 41. The studs 39 and 40 are connected to the leads of the circuit to be controlled, and when the switch is closed, the current flows from one stud to the other through the laminated brush 41 which is mounted upon a swinging arm 42, pivoted to the frame work 43, which is securely mounted upon the panel 38. An operating arm 44 is pivotedly mounted on the outermost end of the frame 43, and is suitably connected to the swinging arm 42, so that when the parts are in the position shown in Fig. 5, the switch is closed. A shunt contact arm 45 is also pivoted to the frame 43, and is actuated by the operating arm 44 by means of a toggle composed of links 46 and 47. On the upper end of the shunt contact 45 is pivotedly mounted a carbon contact block 48, engaging a corresponding carbon block 49 rigidly secured to the stud 39. A metallic shunt contact 50 is flexibly mounted upon the bridging contact 41.

An automatic device for opening the circuit in case an abnormal current is flowing therein, is provided; this device comprising an iron yoke 51 partly surrounding the stud 40 in such a way as to be magnetized when current is flowing through the circuit, and a pivoted armature 52 coöperating with the yoke, the position of the armature being controlled by a calibrating screw 53, mounted in a fixed lug or projection 54. When abnormal current flows through the circuit, the yoke 51 is sufficiently energized to draw the armature 52 into engagement with a pin 55 connected to a switch by means of which the circuit through the tripping solenoid 9 is closed.

The switch is connected to the actuating mechanism by means of a clamp 56, pivoted to the operating arm 44, and having a threaded stem 57. A block 58 of insulation connects the stem 57 with a clamp 59, pivoted to the actuating mechanism at 17. By means of the threaded stem 57, the relation of the actuating mechanism to the switch may be adjusted.

My invention is shown in Fig. 6 applied to mechanism for controlling a 3-phase circuit. The operating mechanism shown in this figure is the same as that shown in Figs. 1 and 2, except that the shaft 14 is extended and carries at each end thereof cranks 16^a and 16^b, the crank 16 being at the middle of the shaft. A suitable panel or switchboard is provided, upon which are mounted switches 60^a, 60^b and 60^c, connected to the cranks 16^a, 16 and 16^b. These switches may be of any suitable construction, and form no part of my invention. The switches are provided with yokes 61^a, 61^b and 61^c surrounding the studs through which current flows to the switches, and when an excessive current flows on any phase of the circuit, the yoke

of the switch controlling that phase acts as an electromagnet. The yokes are provided with pivoted armatures 62^a, 62^b and 62^c, attracted by the yokes when an excessive current flows, and which are adjusted in relation by calibrating screws 63^a, 63^b and 63^c. The armatures when attracted engage switches 64^a, 64^b and 64^c, by means of which a controlling circuit through the tripping solenoid 9 is closed, thereby tripping the mechanism and simultaneously opening all phases of the circuit. One of the switches carries a bridging piece 65 which engages contacts 66 when the switch is in a closed position.

The controlling circuits for the mechanism shown in Fig. 6 are shown diagrammatically in Fig. 7. Leads 67 and 68 of a control circuit supplied from any suitable source of continuous current are provided, and one lead 67 is connected by means of a lead 69 to a switch-blade 70 of a controlling switch coöperating with fixed contacts 71 and 72. The fixed contact 71 is connected by a lead 73 to one of two contacts 74, which are engaged by a bridging piece 75 when the main switches are open, the other one of the contacts 74 being connected by means of the lead 76 through the solenoid 4 and the lead 77 with the lead 68 of the control circuit. The contact 72 is connected through a lead 78 to one of the contacts of each of the switches 64^a, 64^b and 64^c, the other contacts of these switches being connected through a lead 79 with the control lead 67. A lead 80 connects the lead 78 and one of the contacts 66, the other one being connected through the lead 81 to the tripping solenoid 9, and thence through the lead 77 to the control lead 68. An indicating lamp 82 is connected to the leads 69 and 78 in parallel to the switch-blade 70, and another indicating lamp 83 is similarly connected between the lead 69 and the lead 73.

The operation of the actuating mechanism is as follows: When the parts are in the position shown in Fig. 1, the switch operated by the mechanism is in the closed position. If it is desired to open the switch, the tripping solenoid 9 is energized, causing the core 12 to move upward and bringing the actuating rod 13 against the shoulder 35 of the link 34 of the locking toggle. The force of the blow is sufficient to move the link 34 upward, thereby collapsing the locking toggle and causing the links to assume the position shown in Fig. 3. The circuit of the tripping solenoid is then broken and the core drops back to inoperative position, moving the actuating rod 13 out of the way of the toggle. When the locking toggle breaks, the supporting link 26 forming a movable abutment receiving the reaction of the actuating toggle 28, 29, is no longer held in the position shown in Figs. 1 and 3, but is free to move, and the weight of the switch and the force of the spiral spring 19 causes the supporting link 26, the straightened actuating toggle, and the actuating link 23 to move to the left, the links swinging about the pivots 24 and 25, and carrying the actuating toggle bodily to the left, thereby permitting the switch to open. As soon, however, as the switch is opened, the toggles are free from strain, and when this occurs the weight of the toggle links 28, 29, causes them to drop to the position shown in Fig. 4, causing the supporting link 26 to move to the right, thereby straightening out the locking toggle and bringing the shoulder 35 into engagement with the adjustable stop 36, in which position the locking toggle is overset and holds the supporting link 26 firmly in the position shown in Figs. 1 and 4. The weight of the toggle links assist in these movements, and if desired, a light spring might be used to insure the straightening of the locking toggle. At the end of this series of operations, the toggles are in the position shown in Fig. 4 and the switch is opened. If it be desired to close the switch, the operating solenoid 4 is energized, thereby bringing actuating rod 8 into engagement with the actuating toggle, causing it to straighten, and bringing the parts of the device into the position shown in Fig. 1, since the supporting link 26 is held immovable against the thrust of the actuating toggle by the locking toggle. In this position the actuating toggle is overset to an extent determined by the adjusting screw 27. Both the operating toggle and the locking toggle are now overset and the parts are locked in position to hold the main switch closed.

The operation of the mechanism shown in Figs. 6 and 7 is as follows: The switches are shown in Fig. 7 in a closed position, and if it be desired to open the main switches, the blade 70 of the control switch is thrown into engagement with the contact 72. Current then flows from the lead 67 through the blade 70, contact 72, leads 78 and 80, bridging piece 65, contacts 66, lead 81, tripping solenoid 9, and lead 77, to the other lead 68. This current is sufficiently great to energize the tripping solenoid 9, and as a result, the locking toggle 33, 34, is broken, causing the operating mechanism to open the switches 60^a, 60^b and 60^c. If, while the switches are closed as shown in Figs. 6 and 7, an over-load occurs upon any phase of the circuit, one of the armatures 62^a, 62^b and 62^c is attracted, thereby closing the circuit between the leads 78 and 79, through one of the switches 64^a, 64^b and 64^c, and permitting current to flow from the lead 67 through the lead 79, lead 78, lead 80, bridging piece 65, contact 66, lead 81 and tripping solenoid 9, thereby energizing the trip-

ping solenoid and opening the switches. When the switches are closed, current flows from lead 69 through the lamp 82 to lead 78 and thence through solenoid 9, the amount of current being great enough to light the lamp, but not enough to energize the solenoid. When the blade 70 is moved to open the main switches, the lamp 82 is short-circuited and extinguished, and when the main switches open the lamp 83 is rendered luminous; the lamps therefore indicate the position of the main switches. When the main switches are open, bridging piece 65 is no longer in engagement with the contact 66, while bridging piece 75 is in engagement with the contact 74, thereby connecting the leads 73 and 76. If it be desired to close the switches the blade 70 is thrown into engagement with the contact 71, thereby short-circuiting and extinguishing the lamp 83, and permitting current to flow through the lead 73, contacts 74, bridging piece 75, lead 76, tripping solenoid 4, and lead 77, thereby energizing the tripping solenoid and causing the operating mechanism to close the main switches.

It is evident that many other types of locking device may be used instead of the locking toggle; that the movable abutment for the actuating means may assume many other forms than that of the pivoted link shown; and many other forms of actuating means may be substituted for the toggle without departing from the spirit of my invention, and I, therefore, do not restrict the claims to the structure shown and described, but intend to cover all changes and modifications within the spirit and scope of my invention.

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

1. In an actuating mechanism for electric switches, the combination with a base having a lug and a movable switch actuating member connected to the switch and pivoted to said base, of an actuating toggle having one end connected to said member, and locking means for forming a rigid connection between said lug and the other end of said actuating toggle, said locking means being set in locking position by the collapse of said toggle.

2. In an actuating mechanism for electric switches, the combination with a movable switch actuating member, of an actuating toggle having one end of one link movable to inoperative position to render said actuating toggle unable to move said switch actuating member, and disengageable locking means for holding said end of said link against movement to inoperative position, said locking means being set in locking position by the collapse of said actuating toggle.

3. In an actuating mechanism for electric switches, the combination with a movable switch actuating member, of an actuating toggle having one end of one link movable to inoperative position to render the straightening of said toggle ineffective to move said member, locking means for holding said end of said link against movement to inoperative position, said locking means being set in locking position by the collapse of said toggle, and electro-responsive means for disabling said locking means upon the occurrence of abnormal current in the circuit.

4. In an actuating mechanism for electric switches, the combination with a movable switch actuating member, of an actuating toggle for moving said member having one end of one link movable to a position rendering said toggle incapable of moving said member, and disengageable locking means for holding said end of said link in position to cause said actuating toggle to move said member when straightened, said locking means being set in locking position by the collapse of the actuating toggle.

5. In an electric switch, the combination with a switch member, of an actuating toggle for moving said member to close the switch, a movable abutment for said toggle, and locking means for holding said abutment immovable in position to enable the toggle when straightened to close the switch, said locking means being set in locking position by the collapse of the actuating toggle.

6. In an electric switch mechanism, the combination with a base, a movable member pivoted to the base, a movable abutment pivoted to the base, an actuating toggle for moving said member to close the switch connected to said abutment and to said member, and locking means mounted on said base for holding said abutment immovable to enable the toggle to close the switch, and means for disengaging said locking means to permit the abutment to move.

7. In an actuating mechanism for electric switches, the combination with a base, of a switch actuating member movably mounted on said base, an actuating link connected to said member and pivoted to said base, a supporting link pivoted to said base, an actuating toggle connected to said links, a locking toggle connected to said supporting link and to the base, means for straightening the actuating toggle, and means for breaking the locking toggle.

8. In an actuating mechanism for electric switches, the combination with a movable member connected to the switch, of a movable abutment, an actuating toggle having one link connected to the movable abutment and the other link to the movable member, an adjusting stop carried by said abutment to engage said actuating toggle when said toggle is overset, and locking means for holding said abutment immovable in such

relation to said member that straightening the actuating toggle closes the switch.

9. In an actuating mechanism for electric switches, the combination with a movable member connected to the switch, of a movable abutment, an actuating toggle having one link connected to the movable abutment and the other link to said movable member, an overset locking toggle for holding said abutment immovable to resist the end thrust of the actuating toggle when straightened to close the switch, an adjustable stop for controlling the extent to which the locking toggle is over-set, and means for breaking said locking toggle.

In witness whereof, I have hereunto set my hand this 15th day of November, 1906.

EDWARD M. HEWLETT.

Witnesses:

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HELEN ORFORD.