No. 829,785. PATENTED AUG. 28, 1906.

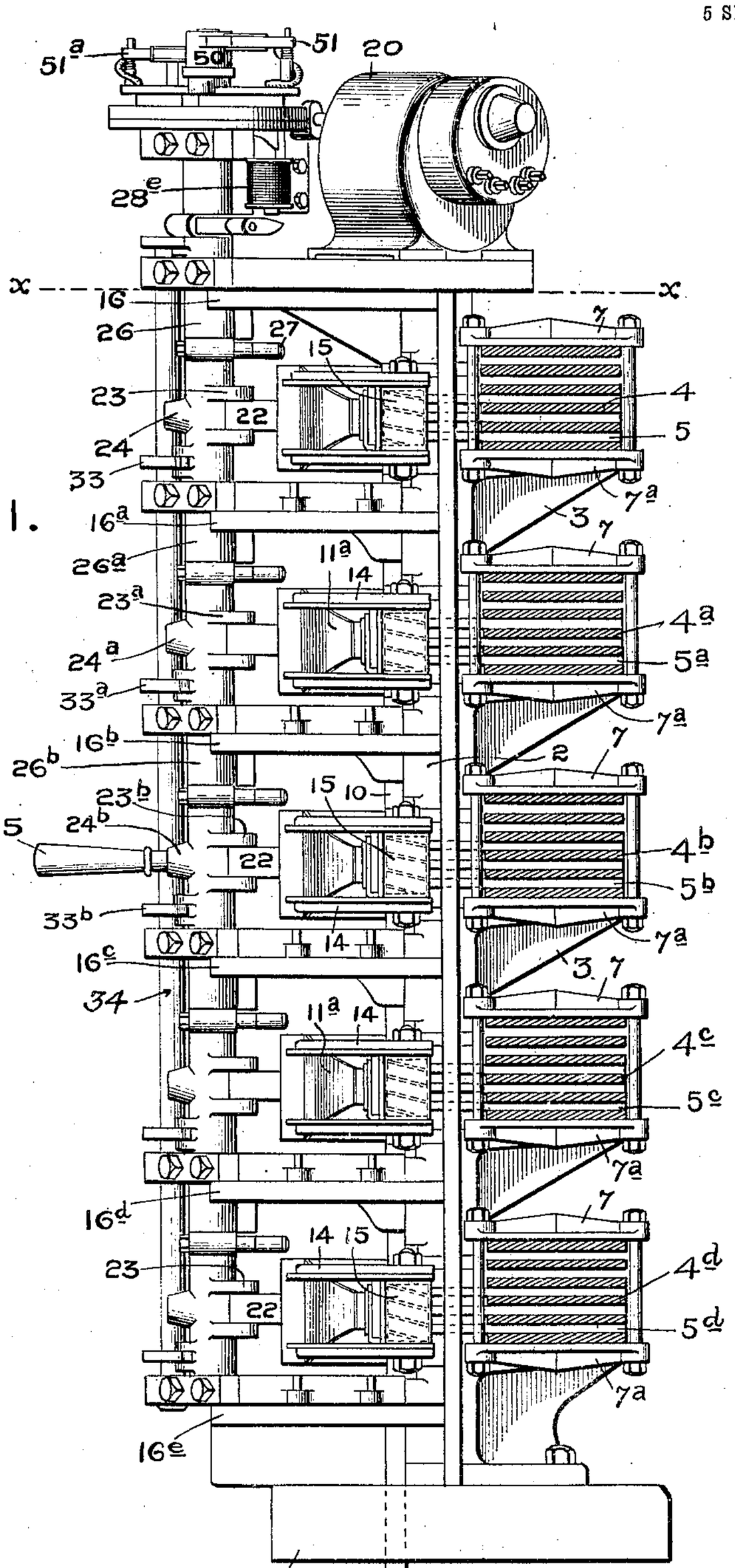
E. M. HEWLETT & T. E. BUTTON.

ELECTRIC SWITCH.

APPLICATION FILED FEB. 7, 1902.

5 SHEETS—SHEET 1.

Fig. 1.



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5 SHEETS—SHEET 2.

Fig. 3.

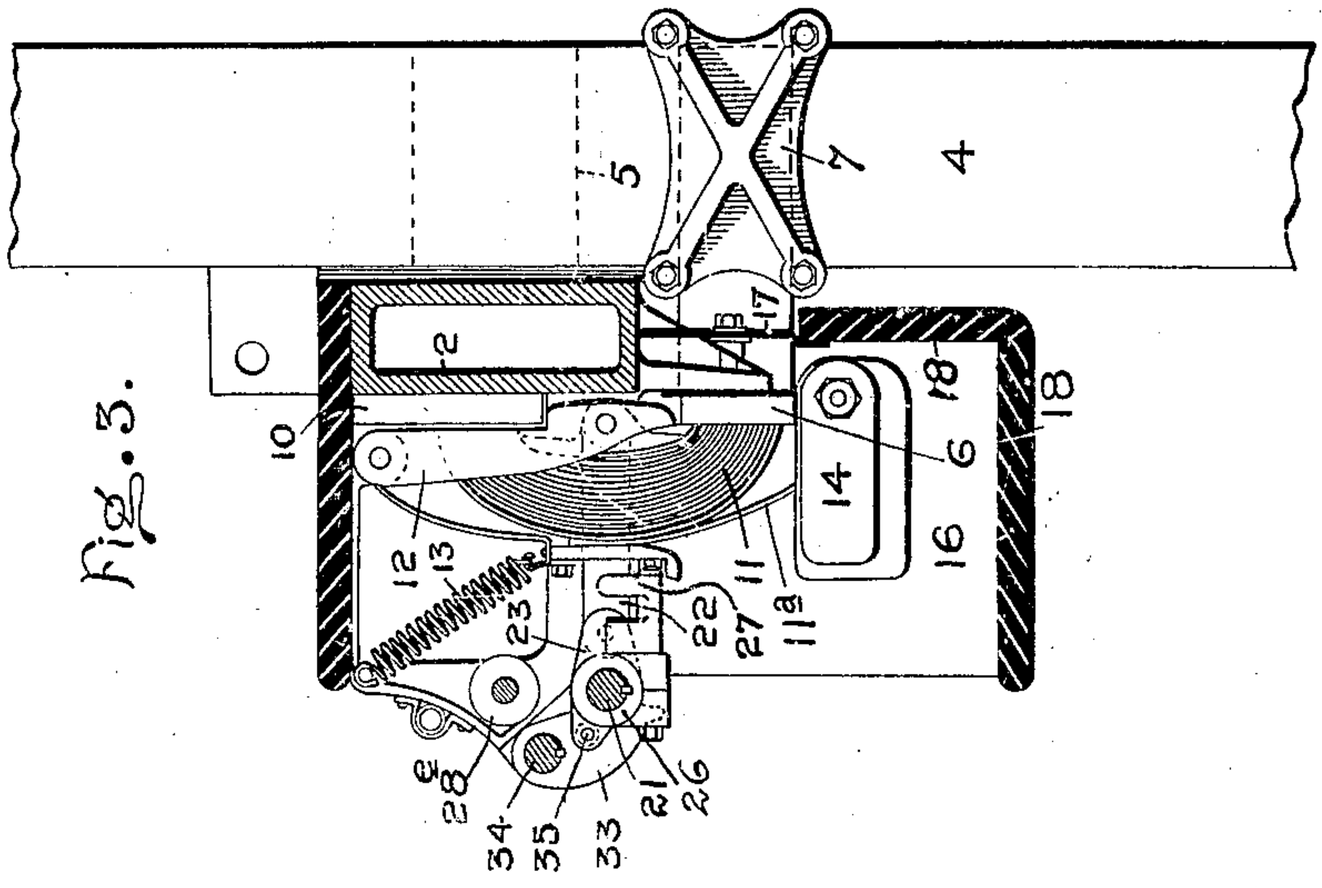
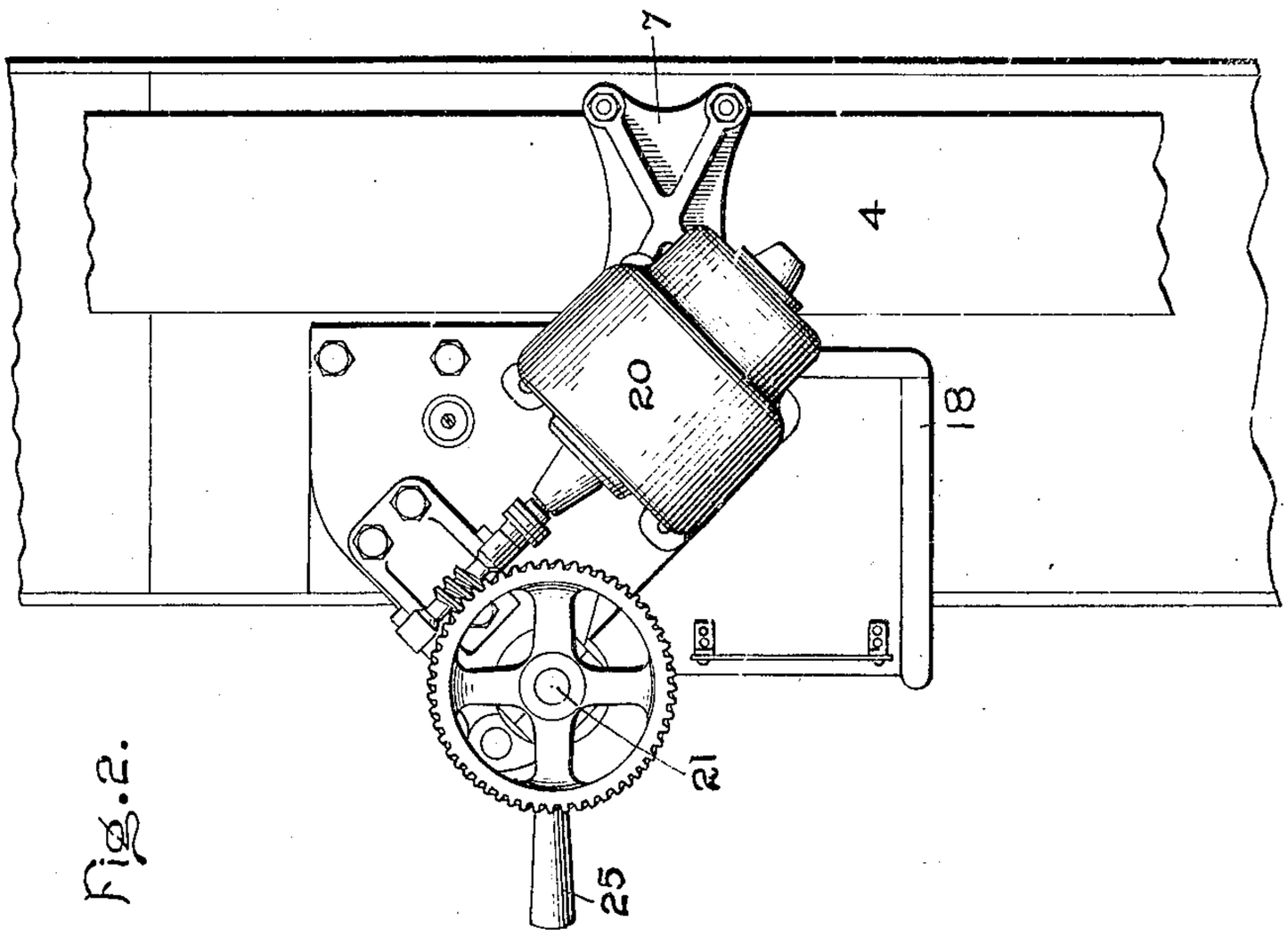


Fig. 2.



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5 SHEETS—SHEET 3.

Fig. 4.

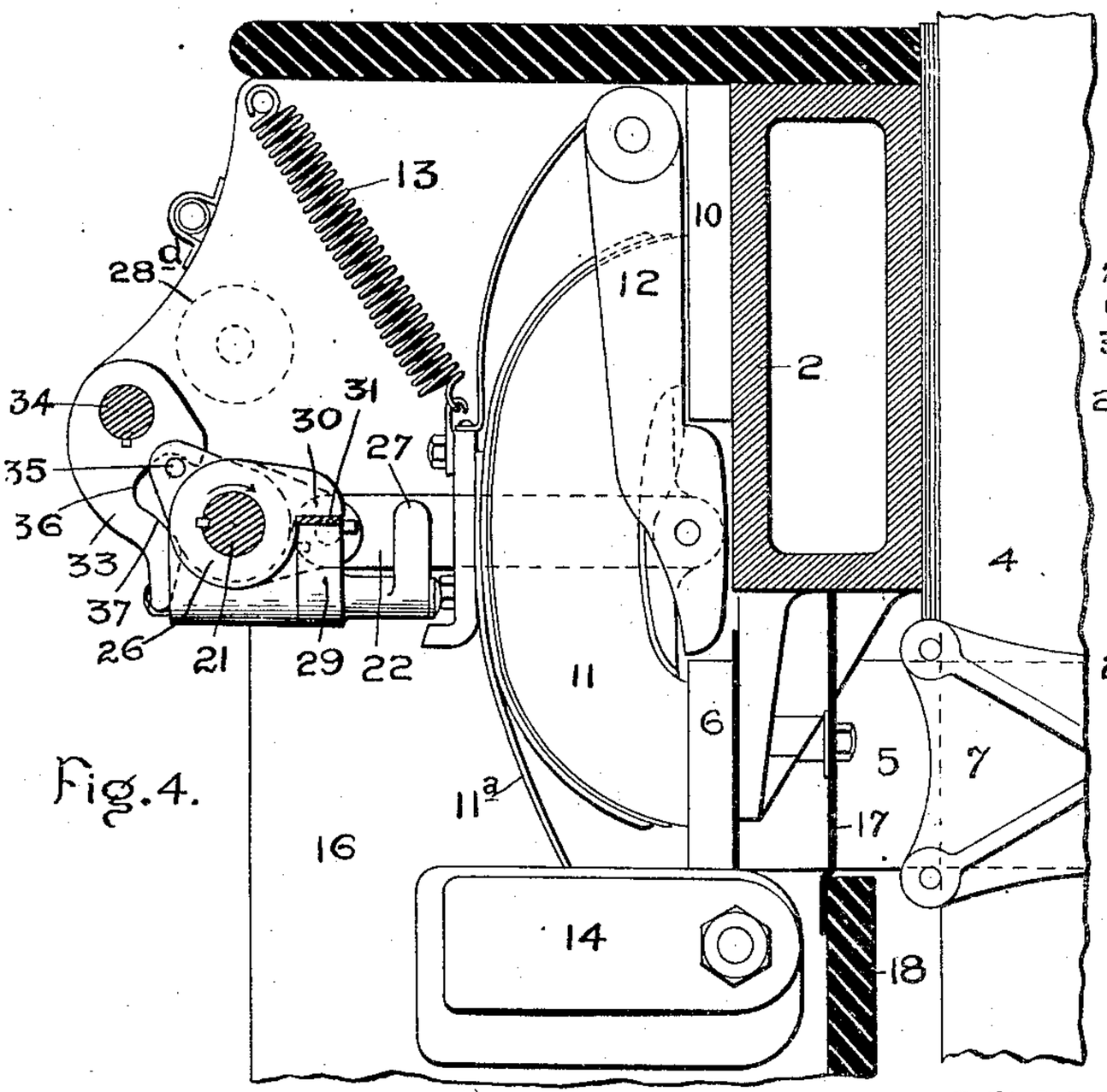


Fig. 6.

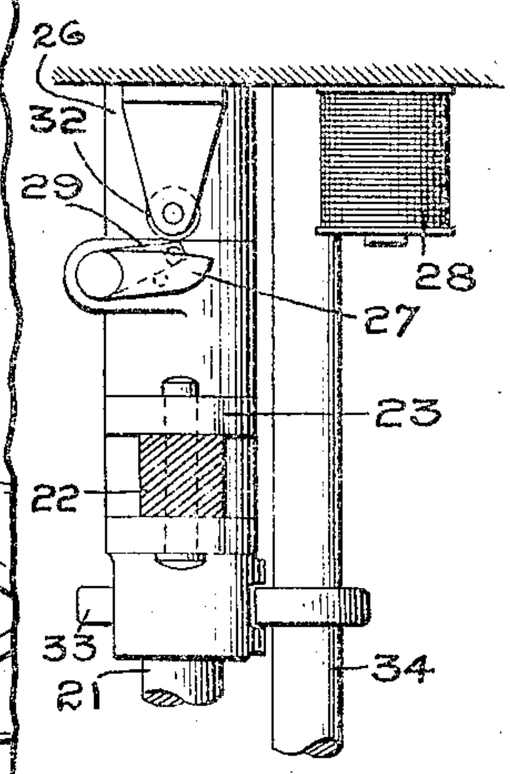


Fig. 5.

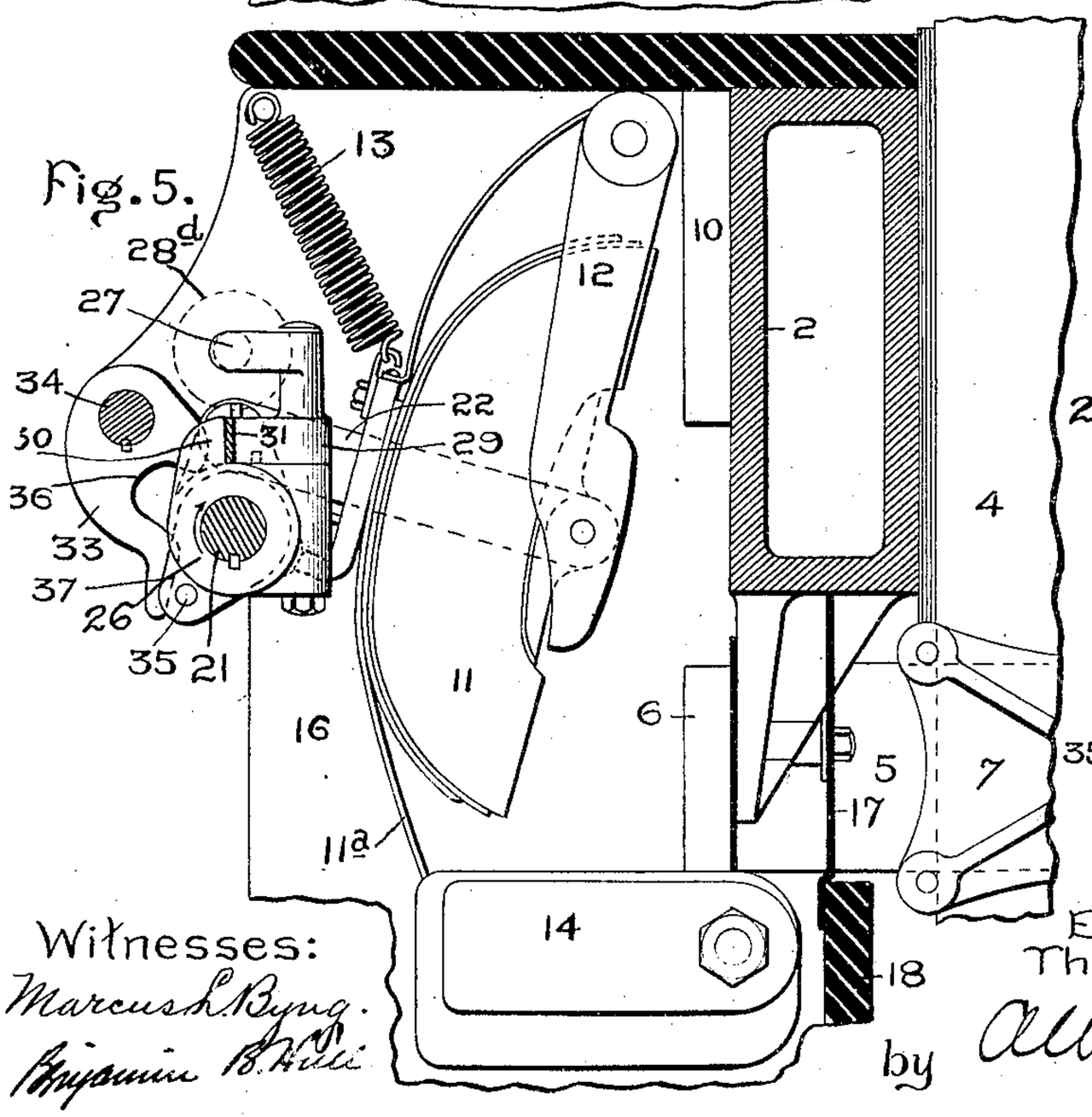
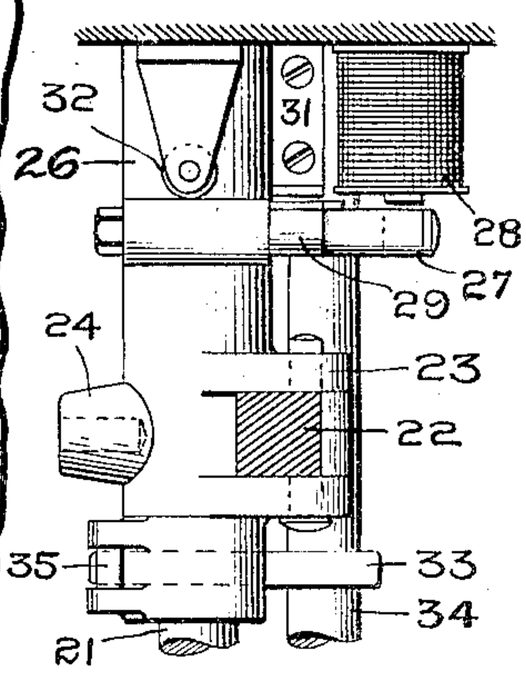


Fig. 7.



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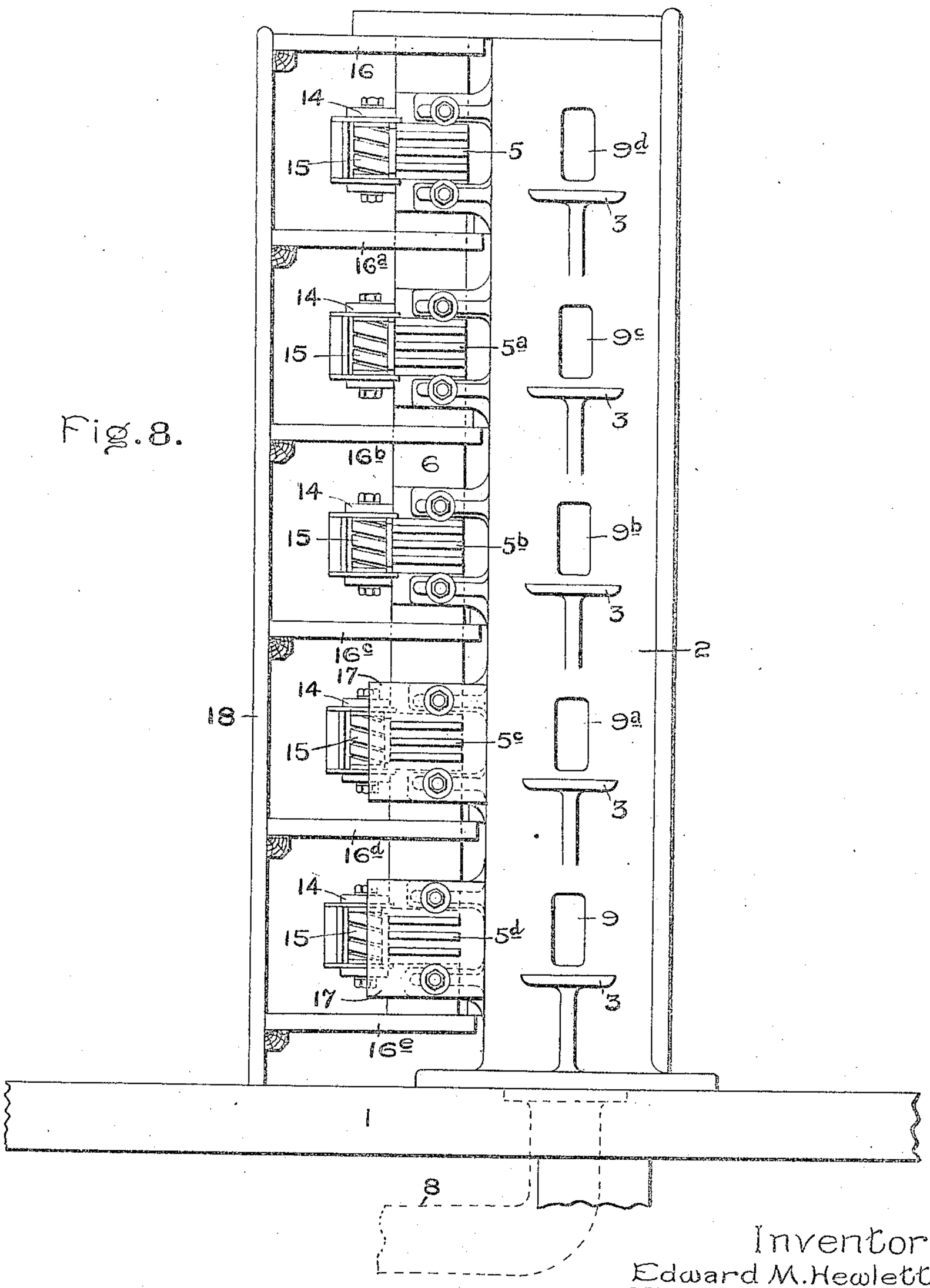
5 SHEETS—SHEET 4.

Fig. 8.



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No. 829,785. PATENTED AUG. 28, 1906.

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ELECTRIC SWITCH.

APPLICATION FILED FEB. 7, 1902.

5 SHEETS—SHEET 5.

Fig. 9.

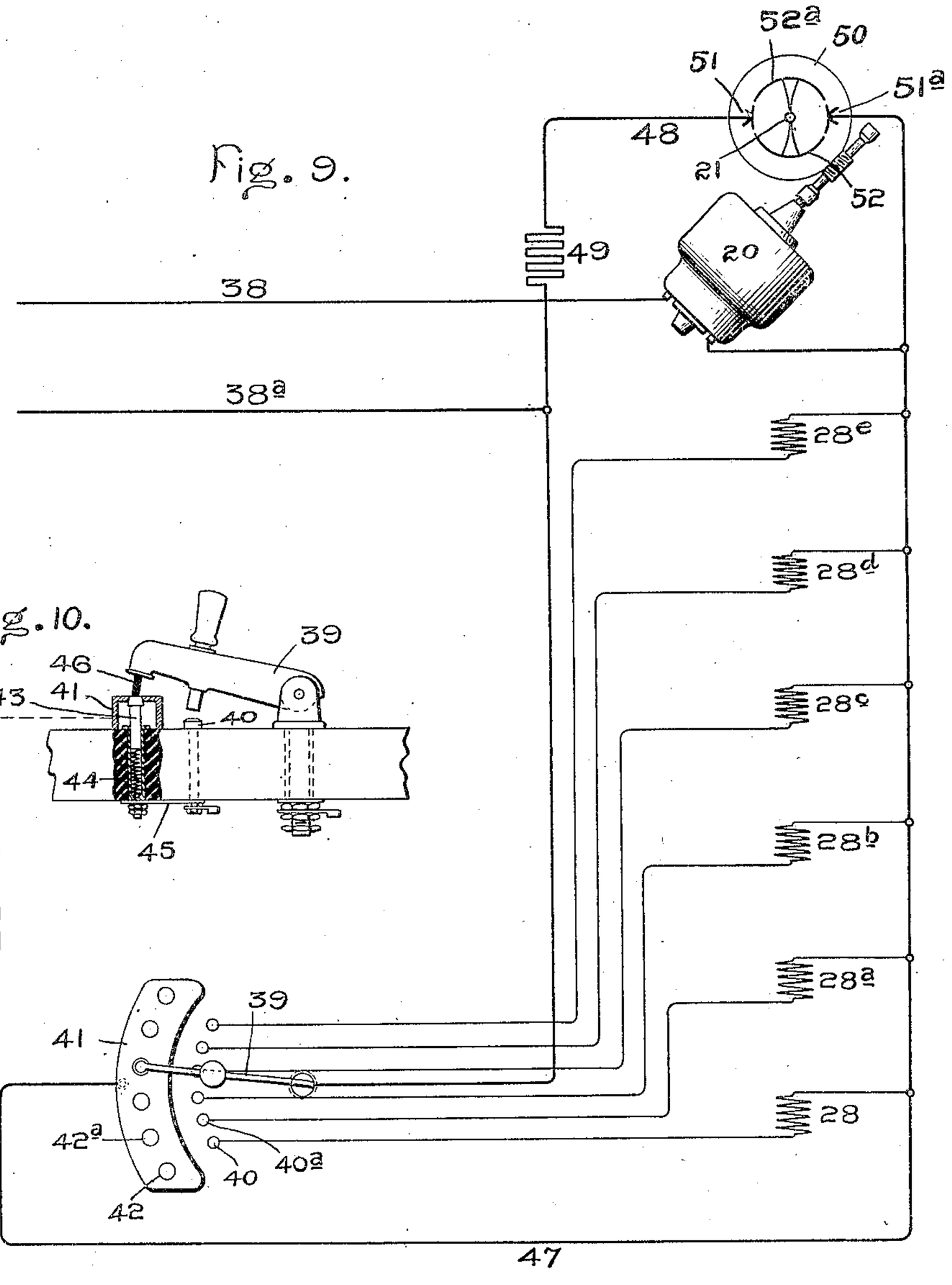

Fig. 10.

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UNITED STATES PATENT OFFICE.

EDWARD M. HEWLETT AND THEODORE E. BUTTON, OF SCHENECTADY, NEW YORK, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC SWITCH.

No. 829,785. Specification of Letters Patent. Patented Aug. 28, 1906.

Application filed February 7, 1902. Serial No. 93,014.

To all whom it may concern:

Be it known that we, EDWARD M. HEWLETT and THEODORE E. BUTTON, citizens of the United States, and residents of Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric Switches, of which the following is a specification.

In distributing currents from centers of distribution—such, for example, as a central station—it is frequently necessary to transfer the bus-bar connected with different feeders to different station-generators, so as to provide for a considerable increase of load, and it is desirable to provide switching mechanism which will permit this transfer to be effected quickly. In many stations, moreover, it is the practice to utilize storage batteries to increase the efficiency of the plant by connecting them with certain bus-bars or distribution feeders at particular hours when there is a peak in the station-load.

It is the object of this invention to provide for such service, and we effect the result by rendering possible the interchange of bus-bar feeders and generators, so that any generator may be connected with any feeder, or vice versa. In order to effect this connection quickly, we provide an electric control-circuit and motor-operated switches controlled thereby. The switches are arranged in groups corresponding to the number of feeders served, one switch being provided for each feeder and several groups of switches being arranged in operative relation to the feeders in the station, so that each may, if necessary, be connected to an independent generator. With such a system it is important to render it absolutely certain that no two feeders shall be connected to the same generator, since if such connection were made between feeders of different voltage great damage to the station apparatus would result. We guard against such a possibility by an interlocking arrangement between the several bus-bar switches in each switch group by means of which more than a single connection between the generator and the bus-bar cannot be maintained, means being provided for insuring the opening of any switch before another can be closed.

We mount the several switch groups on posts one above another, preferably in vertical arrangement, and provide a control-shaft for setting them operated by the electrically-controlled motor. This shaft we preferably drive by means of worm-gearing driven by the motor, an electrically-controlled clutch being provided for each switch governed by a magnet operated from the control-circuit, said clutch being so arranged that when set it will maintain the connection between the motor-driven shaft and the switch-setting devices until the switch is closed, after which the latter will be disconnected and the shaft or its driving-motor have no further control over it until the control-circuit is again brought into action. Each switch is set by a toggle cramped by the motor-driven shaft and has a mechanical connection with an auxiliary rock-shaft operated when any switch is set, the arrangement being such that after one switch has been set the rock-shaft is moved if another is operated, thereby releasing the one already set. Means are provided also for setting any switch by hand. An auxiliary mechanism is provided for tripping any switch which may be closed by means independent of the closure of another switch.

The invention embodies various features of novelty in addition to those noted above, which will be hereinafter more fully described and will be definitely indicated in the claims appended to this specification.

In the accompanying drawings, which illustrate our invention, Figure 1 is a side elevation showing the bus-bars in section of a switch embodying our improvements. Fig. 2 is a top plan view with parts removed. Fig. 3 is a horizontal section on a plane indicated by the line X X of Fig. 1. Fig. 4 is an enlarged view on the same plane, showing one of the switches closed. Fig. 5 is a similar view showing a switch open. Fig. 6 is a detail view, partly in section, showing the clutch-operating mechanism. Fig. 7 is a similar view of the clutch parts after having been shifted through an operating range of movement. Fig. 8 is a side elevation of the switch-post with parts removed to show the arrangements for ventilating the bus-bars. Fig. 9 is a diagram of the control-circuit, and Fig. 10 is a detail of a safety mechanism to guard against accidents from short-circuits.

1 represents a base of slate or other insu-

lating refractory material on which is mounted a hollow post 2, of cast-iron, provided with brackets 3, on which are supported a plurality of bus-bars 4 4^a 4^b 4^c 4^d. The switch shown in the drawings is adapted to serve five bus-bars, each of which is composed of a plurality of heavy copper bars, as indicated in section in Fig. 1, resting upon the brackets 3.. These bars extend along the wall or other part of the distributing-station and are tapped into the several switches by means of interleaved bars 5 5^a 5^b 5^c 5^d, which are solidly connected with vertical bus-bar 6, set against and insulated from a bracket extending laterally from the hollow iron post 2. (See Figs. 4 and 5.) For each bus-bar multiple bars or conductors are employed to promote cooling, as shown in Fig. 1, and in each multiple-bar as many interleaved bars as required by the capacity of the switch may be employed (as shown three only are used.) For a heavier current as many interleaved bars as there are sections in the bus-bar might be employed. The bus-bars where the leads 5^d are interleaved with them are clamped firmly together by means of cast-iron plates 7 7^a held firmly together by four bolts, as indicated in Fig. 1. A low air-pressure may be maintained in the interior of the hollow post by means of a pipe 8, extending beneath the floor of the station, which may be connected with a blower by which a stream of cool air is forced through openings 9 9^a, &c., over the bus-bars and keeps them cool at their joints with the switch-leads. The vertical bus-bar 6 extends from end to end of the switch-post, so as to be in operative relation to any one of the group of switches it contains. A companion bus-bar 10 is mounted against the post 2 in alinement with the bus-bar 6, and the two are adapted to be bridged by a laminated contact 11, pivoted on a lever 12, and adapted to be closed against the tension of a retracting-spring 13. Each switch carries a shunt-contact mounted on a phosphor-bronze spring 11^a and adapted to take any arc formed on opening the circuit within an arc-extinguishing chute 14, provided with a blow-out magnet 15. Each switch is mounted between slate barriers 16 16^a 16^b 16^c, &c., so as to avoid possibility of cross connection and to guard against arc-gases being blown back toward the feeder bus-bar. Fiber screens 17 are mounted between the slate casing 18 and the hollow post 2 at points in the rear of the switches. Thus it will be evident that the generator bus-bar 10 may be connected with any of the five feeder bus-bars by closure of the switch corresponding to that bus-bar. It is desirable to effect such connections quickly to accommodate change of load on a particular feeder—as, for example, to connect another machine to that feeder. A group of these switch-posts, as already stated, is provided in the station, and connected with each post is a control-circuit by which the several switches may be independently manipulated. This control-circuit operates an electric motor 20, mounted on top of the switch-post, connected by worm-gearing with a shaft 21, extending from top to bottom of the post. Each switch is connected by a link 22 with a crank 23, loosely sleeved on this shaft, the crank and link forming a toggle which when its centers are in alinement cramps the bridging contacts 11 upon the bus-bars 6 and 10. The loose sleeves which carry the cranks 23 23^a, &c., also carry each a socket 24 for an operating-handle 25, one of which is provided for each switch-post and which may be transferred to any switch it is desired to operate by hand. The crank 23 being loosely sleeved on the shaft may be turned freely by means of the handle 25 until the toggle is cramped and the switch set. Adjacent to each crank-sleeve is a collar 26 26^a, &c., keyed fast to the shaft 21, as indicated in Figs. 4 and 5, which collar may be clutched to the crank-sleeve by means of an armature 27, controlled by an electromagnet 28. The armature is rigidly connected with a clutch-piece 29 normally dropping by gravity away from a projection 30 on the crank-sleeve 23, but adapted to be swung into alinement with said projection and bear against a shoe 31 when the electromagnet is energized.

In the open position of the switch the armature 27 lies under the hole of the magnet 28, Figs. 5 and 7, and when this magnet is energized the armature is drawn up, the same impulse which energizes the magnet starting the electric motor 20 and driving the shaft 21. The armature being carried on the sleeve keyed to the shaft is thus driven against the projection 30 and held in clutch therewith by friction, and the toggle gradually straightens until its centers come in line, when the switch is set. In this position the armature has been shifted out of the field of its magnet to position ninety degrees displaced therefrom, as indicated in Fig. 6, in which position the clutch-piece 29 rides under a roller 32, mounted in a bracket secured to the frame, the upper face of the clutch having a slope, so that as it rides under the roller it is forced down and disconnected from the projection 30, thereby freeing the crank-sleeve from the influence of the motor-driven shaft and permitting the shaft and attached motor to run free, arrangements being provided for cutting the motor out of circuit after the shaft 21 has made a complete revolution, as will be hereinafter more fully explained. With this arrangement it will be evident that when any of the controlling-magnets corresponding to a particular switch in the post is energized, the motor will be simultaneously started and the correspond-

ing switch will be closed. If, however, another switch has already been closed, this action will automatically open that switch by means of a cam 33 33ª 33ᵇ, &c., keyed to a rock-shaft 34, extending from the top to the bottom of the post. One such cam is provided for each switch and lies in the path of a pin 35, set in the loose sleeve which carries the crank 23. This cam is provided with a notch 36, against the rear wall of which the pin 35 impinges when a switch is set and a face 37 normally lying, when a switch is in the open position, in a plane to be struck by the pin 35. Thus it will occur if any switch is closed when another is operated that the pin 35, connected to the crank-sleeve of that being closed moving over the cam-surface 37, will shift the shaft 34 through a determinate angle, thereby shifting all of the cams fastened to the shaft, and consequently tripping any switch already set, since when any switch is set its tripping-pin 35 will have been shifted against the wall of the recess 36 of its cam. From this it will be seen that it is impossible to set one switch while another is closed, and it is also impossible to close more than one switch at a time, except by special effort. If for a remote contingency it is deemed necessary to close more than one switch at the same time, the operator by inserting handles in the sockets 24 24ª &c., and moving them simultaneously may do so. It is impossible to do this electrically, since the control-switch is so designed that but a single magnet may be energized at once.

The operating-motor 20 is controlled by a circuit extending to a convenient board in the station, and the circuit connections are indicated in Fig. 9. The motor is fed by a separate circuit 38 38ª, across which in series relation to the motor may be connected any one of the control-magnets 28 28ª 28ᵇ 28ᶜ 28ᵈ 28ᵉ, six of which are provided, one for each switch, and one—say 28ᵉ—at the top of the switch-post not belonging to a switch, but intended solely for the purpose of releasing any switch which may be set without entailing the setting of another switch. These control-magnets are connected in parallel relation to the control-circuit and may be operated by means of a pivoted hand-switch 39, the pivot of which is connected with main 38ª; but such connection can only be established with one magnet at a time by shifting the switch-lever 39 into alinement with an insulated contact 40 40ª, &c., corresponding to the several magnets.

In order to render it impossible to effect the closure of more than one switch at a time in case a short-circuit exists in the connecting-wires of the control-magnets, we provide means for normally interconnecting all of the control-wires, so that a short-circuit always exists, and a control-magnet is cut in by opening the short-circuit only in so far as its particular control-wire is concerned. Thus it will be seen that any wire or cross connection between the control-wires can by no possibility cause the setting of two switches. Further, the control-magnets are so wound that the motor-operating current is insufficient to pick up the magnet-armature if the current is divided between two or more magnets. These provisions are indicated in Fig. 10, where the controlling-board is provided with a metal shell 41, perforated on top with a number of holes 42 42ª, &c., into which normally a metal plug 43 is pressed by a spring nesting in the metal socket 44, one of which is provided for each control-wire. The several sockets are cross-connected by means of a metal strap 45 with the contact-studs 40 40ª, &c. The control-switch 39 carries in its front end an insulating-pin 46, adapted when shifted to a position to close any control branch to aline with the spring-pressed plug-contact 43, and when the switch is closed the plug is pushed down, thereby rupturing the connection between the plug and shell 41 and opening a short-circuit through 47, normally completed by each of the several plugs. Thus if two control-wires are cross connected and one of those control-wires is operated the two magnets will be in parallel and neither switch will be operated, and if an accidental short-circuit occurs by which one of the control-magnets would be cut in under normal conditions all would necessarily be cut in and none of the switches would be operated.

We provide the control-circuit wi a shunt around the control-magnets, completed after any control-magnet is actuated, thereby rendering a simple instantaneous push all that is required to effect the closure of the switch. This is indicated in the diagram at 48 and includes a resistance 49 and a rotary switch 50, coöperating with brushes 51 51ª, forming the terminals of the shunt-circuit. The shunt is normally open. The rotary element 50 is mounted on the motor-driven shaft 21 and when turned brings two cross-connected arcs 52 52ª under the brushes and completes the shunt. Thus when the control-magnet is energized and the control-circuit completed the motor is started and immediately thereafter the branch shunting the magnet closed by means of the contacts 52 52ª, after which the motor runs, beyond the power of the operator to stop it, until the switch-operating shaft makes a complete revolution. The operator therefore need not hold down the control-switch, but a simple instantaneous closure is all that is required.

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

1. A system of controlling electric switches, comprising a distributing system, a series of switches in said system, a motor device for all of said switches, means for actuating the

motor device, and means for controlling the action of the motor device upon the individual switches.

2. The combination with a switch-actuating mechanism, of a motor, a shaft driven by the motor, a ratchet-wheel on the shaft, means for transmitting the motion of the shaft to the ratchet-wheel, a latch adapted to engage with the ratchet-wheel, electrical means for controlling the engagement of the latch with the ratchet-wheel, and means driven by the ratchet-wheel for actuating the switch mechanism.

3. In a system of controlling electric switches, a motor, a shaft driven by the motor, a series of independent switches, means interposed between the shaft and the switches for actuating the switches, and separate electrical means for controlling the independent switch-actuating mechanisms.

4. In a system of controlling electric switches, the combination of a motor, a shaft operated by the motor, a series of switch-actuating mechanisms normally out of engagement with the shaft, a series of switches to be operated thereby, and means for throwing said switch-actuating mechanisms into and out of engagement with the shaft as desired.

5. In an electric switch, the combination with a plurality of distributing-terminals, of a plurality of generator-terminals, switches for closing the circuit through any pair of said terminals, common operating means for said switches, means for causing any one of said switches to be actuated by said operating means, and means for automatically opening any circuit during movement to effect the closure of another.

6. The combination of a circuit-lead, a plurality of independent leads adapted to be connected therewith, a switch for each branch, an operating-motor shared in common by the several switches, and means for selectively operating any switch.

7. The combination with a circuit-lead, of a plurality of independent leads adapted to be connected therewith, switches for effecting such connections, an operating device shared in common by the several switches, means for effecting individual operation, and means for releasing any switch when another is being operated.

8. A station-switch comprising a plurality of bus-bars, a supporting-post, a generator-lead, switches for connecting the lead with any bus-bar, a setting device for each switch, and means for tripping any switch when another is being set.

9. A station-switch comprising a plurality of bus-bars, a circuit-terminal adapted to be connected with any of said bars, switches controlling said connections, an operating-motor shared in common by the several switches, and electrically controlled clutches for coupling the motor with any switch.

10. An electric switch for currents of heavy amperage provided with a hollow metal support, and means for circulating a cooling medium through such support.

11. A multiple switch provided with a hollow support, a plurality of switches mounted thereon, and means for circulating a cooling medium in heat-conductive relation to the terminal.

12. A multiple switch comprising a common support, a plurality of switches inclosed in separate insulated compartments mounted thereon, a common operating device for the several switches, and means for selectively effecting the connection of any switch with said common operating device.

13. A multiple switch comprising a supporting-standard, a plurality of bus-bars mounted thereon, a common lead adapted to be connected to any bus-bar, a switch for each bus-bar, a common operating-shaft, means for driving said shaft, and clutching mechanism for connecting and disconnecting any switch with the shaft.

14. The combination with a plurality of bus-bars, of a plurality of supply-conductors extending therefrom to outlying districts, a generator, switches for effecting a connection between the generator and any desired bus-bar, and means for preventing closure of more than one switch at a time.

15. A multiple switch comprising a plurality of bus-bars, a common lead adapted to be connected with any switch, switch-operating mechanism shared in common by the several switches, a clutch for connecting and disconnecting any switch therewith, and means for opening any switch when another is operated.

16. A multiple switch comprising a plurality of bus-bars, a switch for each bus-bar, operating connections with a shaft shared in common by all of the switches, electrically-operated clutches for connecting any switch therewith, and tripping devices adapted to open any switch when another is driven by the operating-shaft.

17. A multiple switch comprising a plurality of bus-bars, a switch for each bus-bar, a drive-shaft common to all switches, clutches between the shaft and the several switches, means for setting any clutch, and means for disconnecting any clutch after its switch is set.

18. A multiple switch comprising a plurality of bus-bars, a switch for each bus-bar, a drive-shaft common to all switches, clutches between the shaft and the several switches, means for operating any clutch, a release device for opening any clutch after its switch is set, and tripping mechanism for any switch dependent on the closure of a second switch.

19. A multiple switch comprising a plurality of bus-bars, a common lead adapted to be connected therewith, independent switches for establishing such connection, a motor-

driven shaft and means for operating the same, operating devices for the several switches, a loose sleeve on the shaft connected therewith, independently-operated clutches for locking any sleeve with the shaft, means for opening the lock after the switch is set, and a tripping device for each switch carried by another shaft, whereby any closed switch is automatically opened before another can be closed.

20. A multiple switch comprising a plurality of terminals and corresponding switches for connecting the same, a motor-driven shaft and means for operating the same, mechanical connections with the shaft for each switch, electrically-controlled clutches for rendering said connections effective, release devices for opening any clutch after its switch has been set, and independent hand-operated devices for setting any switch.

21. A multiple switch comprising a plurality of terminals and corresponding switches for connecting the same, an operating-shaft shared in common by all switches, a loose sleeve on the shaft for each switch, a socket for a handle connected thereto, independent clutches for locking the several sleeves with the shaft, an auxiliary shaft carrying tripping devices for the several switches, and connections for operating said shaft when a second switch is closed.

22. A multiple switch comprising a plurality of terminals and corresponding switches for connecting the same, an operating-shaft shared in common by all switches, magnetically-controlled armatures carried by the shaft for clutching it with the setting devices of any switch, a fixed electromagnet for each armature, and mechanical means for disconnecting the clutch after a determinate range of shaft movement.

23. The combination with a plurality of electric switches, of setting devices therefor, a motor-driven shaft in operative relation to all switches, and an electrically-controlled clutch between the shaft and the setting devices of each switch.

24. The combination with a plurality of electric switches, of setting devices therefor, a motor-driven shaft, an electrically-controlled clutch between the shaft and setting device of each switch, and means for opening each clutch after a determinate range of shaft movement.

25. A multiple electric switch comprising a plurality of circuits, a switch for each, a common operating-motor, selective devices determining the closure of any switch, and a common release device to effect the opening of any switch.

26. A multiple switch comprising a plurality of circuits, a switch for each, a common operating motor, selective devices determining the closure of any switch, a tripping device for each switch mounted on a common trip-shaft, and means for clutching said shaft to the motor to release any switch.

27. A multiple switch provided with a plurality of circuits and independent switches controlling the same, a common operating-motor, selective magnets determining the operation of any switch, a control-circuit including the magnets and motor, the several magnets being normally connected in parallel, and a circuit-controller for opening the parallel relation and putting any magnet in circuit with the motor.

28. A multiple switch provided with a plurality of circuits and independent switches controlling the same, a common operating-motor, selective magnets determining the operation of any switch, a control-circuit including the magnets and motor, the several magnet branches being normally connected in parallel and so wound as to be operative only by the full motor-current, and a circuit-controller for disconnecting any magnet from the parallel relation and putting it in circuit with the motor.

In witness whereof we have hereunto set our hands this 5th day of February, 1902.

EDWARD M. HEWLETT.
THEODORE E. BUTTON.

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