No. 865,588. PATENTED SEPT. 10, 1907.

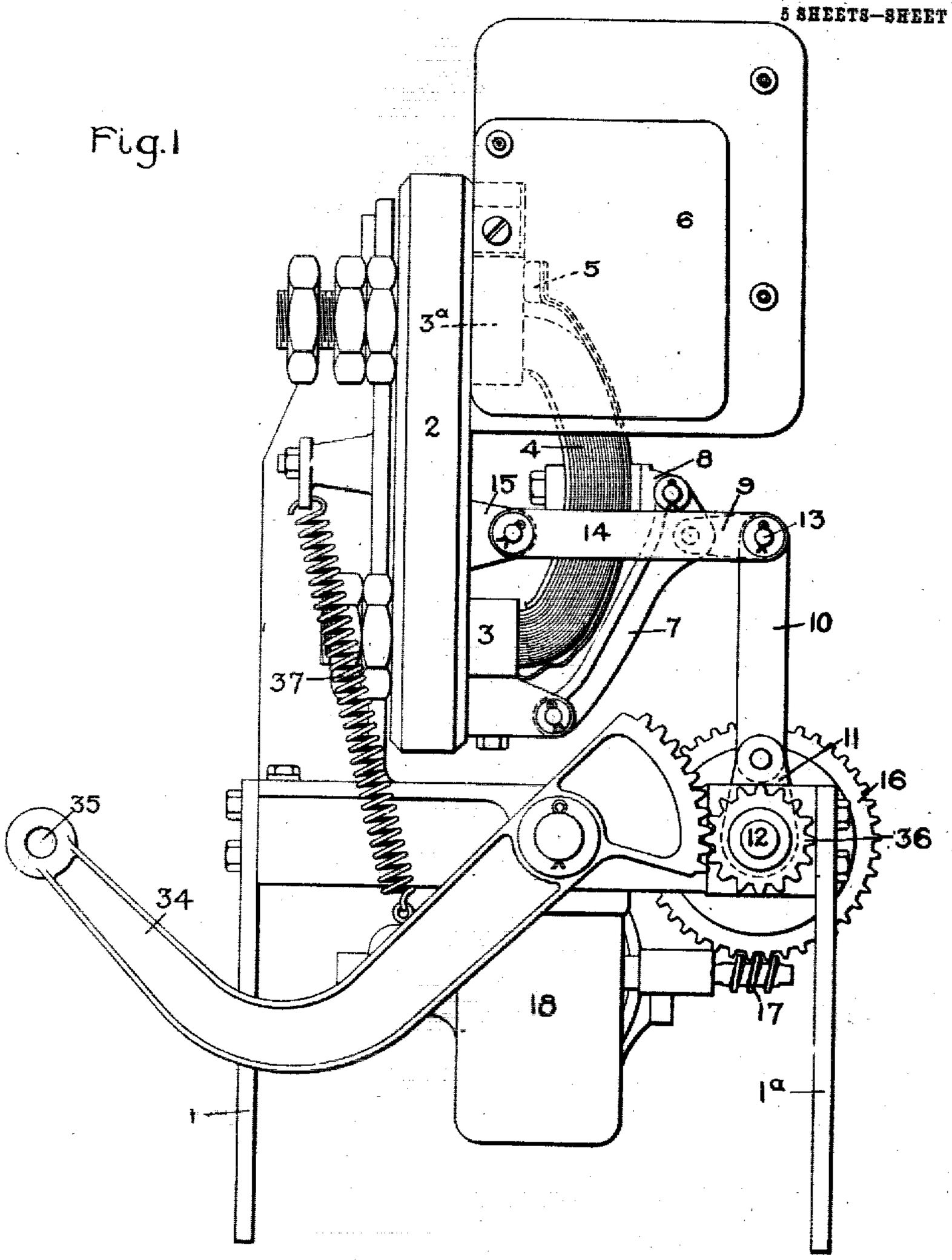
E. M. HEWLETT & T. E. BUTTON.

ELECTRIC SWITCH.

APPLICATION FILED NOV. 19, 1902.

5 SHEETS—SHEET 1.

Fig. 1



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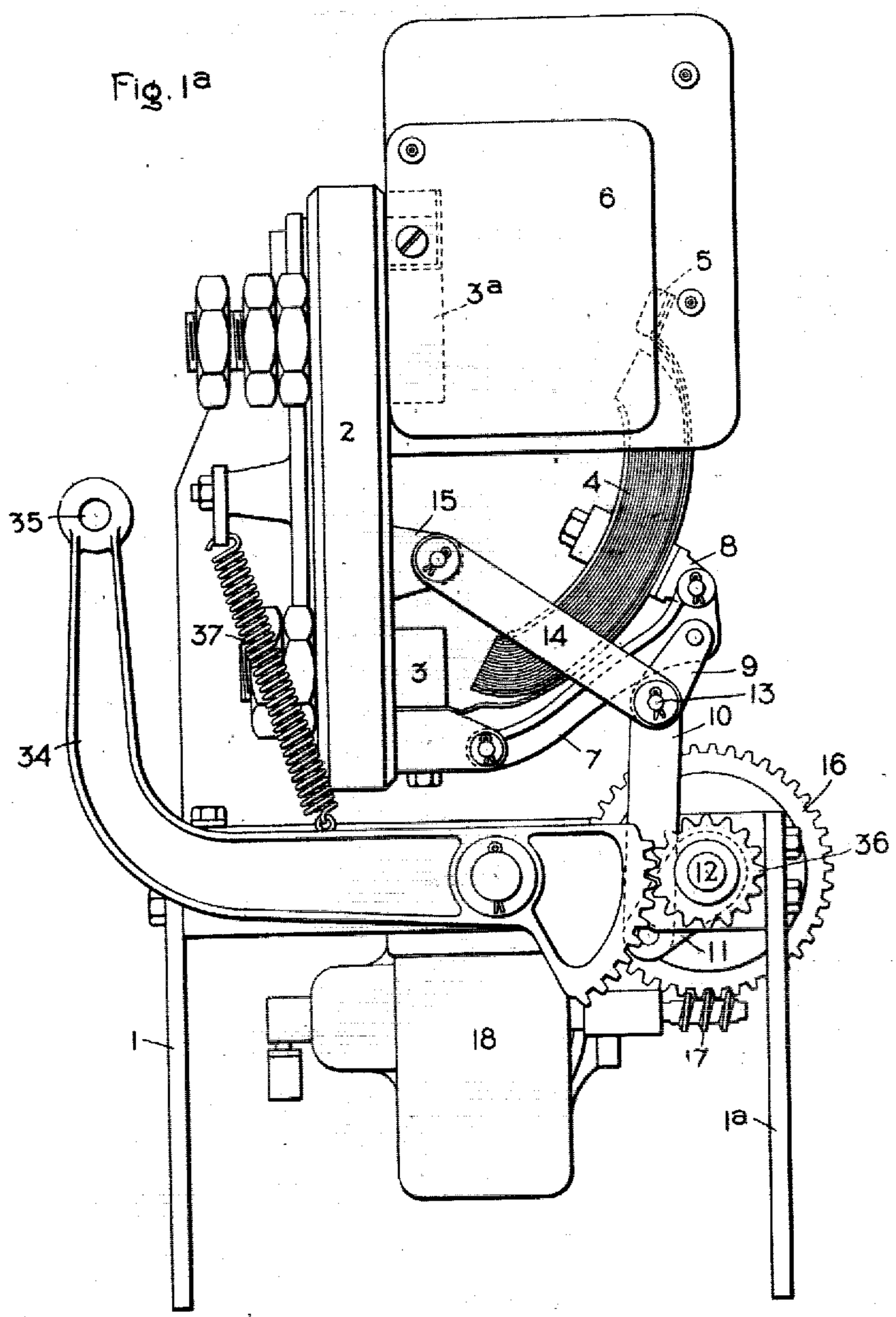
5 SHEETS—SHEET 2.

Fig. 1a



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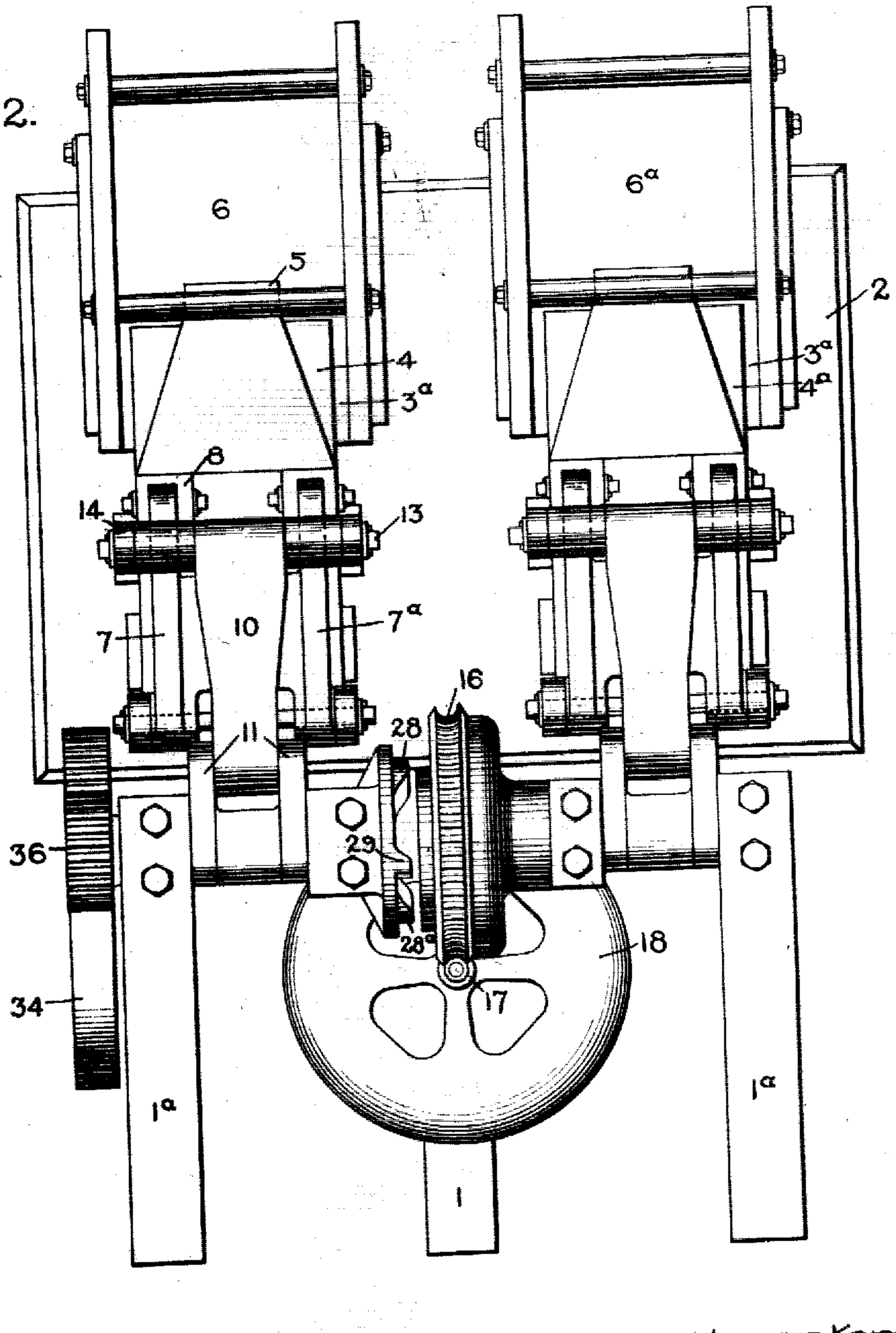
5 SHEETS—SHEET 3

Fig. 2.



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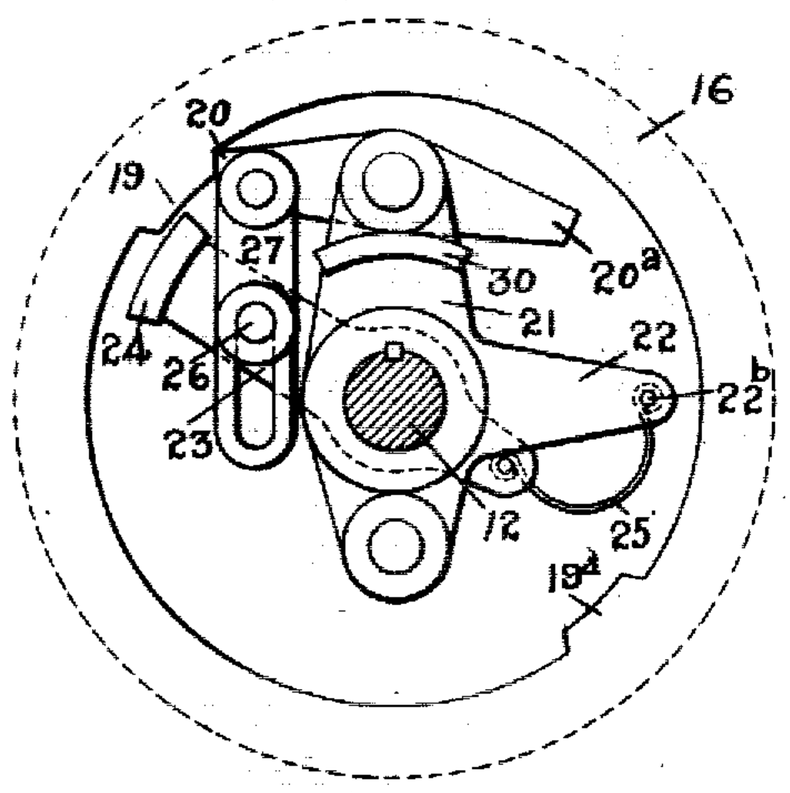
5 SHEETS—SHEET 4.

Fig. 3.



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No. 865,588. PATENTED SEPT. 10, 1907.

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ELECTRIC SWITCH.

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5 SHEETS—SHEET 5.

Fig. 3.a

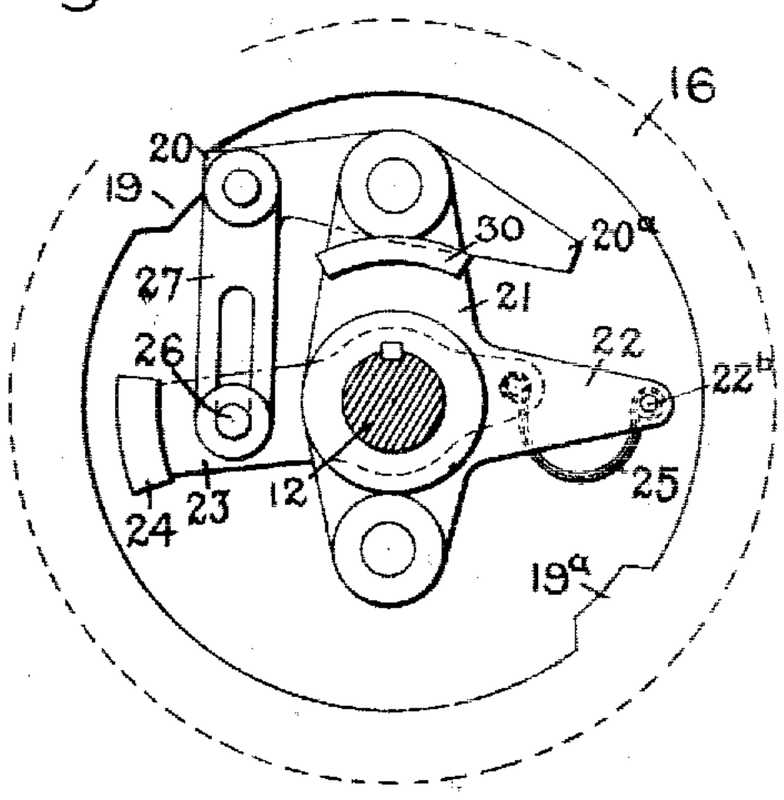


Fig. 4.

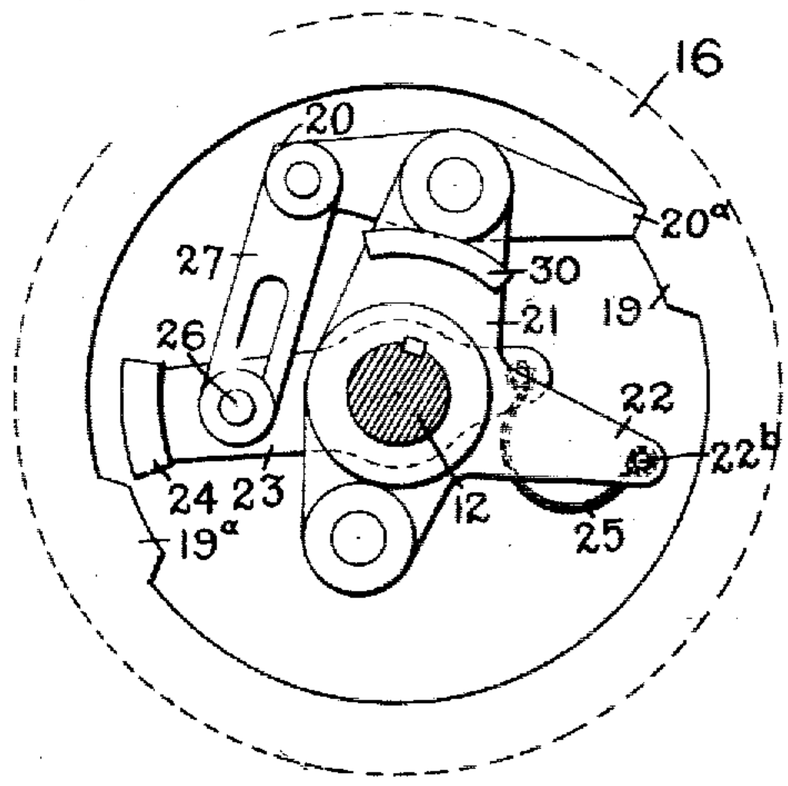


Fig. 5.

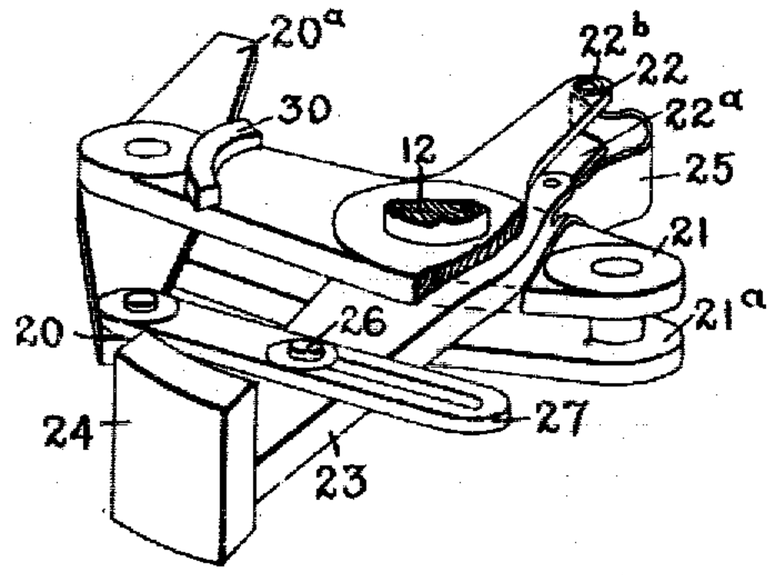
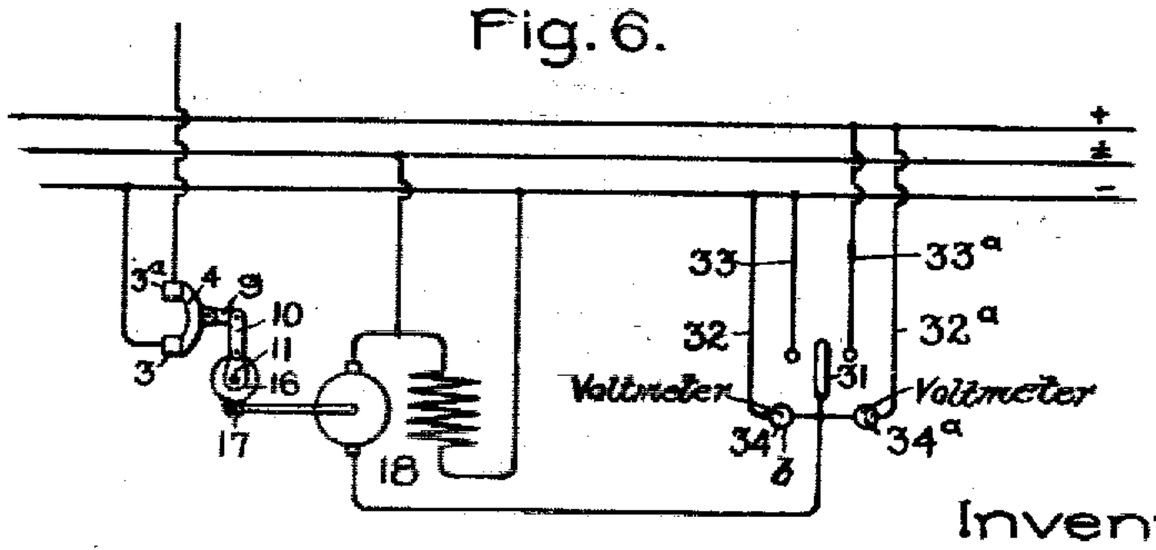


Fig. 6.



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UNITED STATES PATENT OFFICE.

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ELECTRIC SWITCH.

No. 865,588. Specification of Letters Patent. Patented Sept. 10, 1907.

Application filed November 19, 1902. Serial No. 131,964.

To all whom it may concern:

Be it known that we, EDWARD M. HEWLETT and THEODORE E. BUTTON, citizens of the United States, residing at 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.

This invention relates to switches for handling large electric currents, the main object of the improvements being to provide an organization which will respond effectively to a control device located at a point distant from the point of installation of the switching member.

Other features of the invention are improved toggle-operating mechanism for giving an increased leverage to set the switch, and an improvement in the clutch between the motor or power device which governs the switch and the latter by which reliable operation may be assured.

The control system comprises essentially a three-wire circuit and a switch at the control point by which potential may be thrown on the armature of the motor from either the positive or negative main, the field being continuously excited.

The switch-setting apparatus consists, broadly stated, in a compound toggle comprising two toggles between the bridging contact and the power-driven member acting together so as to multiply the power. These toggles are operated by a shaft between which and the worm wheel driven by the motor is a pawl governed by a snap action by which the two parts may be connected and disconnected at any desired points of angular traverse of the shaft, acting instantly, when the determined traverse has been made, to throw off the motor and permit it to run free.

The invention also comprises in addition to the distant control a hand-operated device by which the switch may also be operated in cases of emergency.

The various features of novelty will be hereinafter more fully described and definitely indicated in the claims.

In the accompanying drawings, which illustrate the invention, Figure 1 is a side elevation of an electrically-operated switch embodying our improvements showing the switch closed; Fig. 1ª is a like view showing the switch open; Fig. 2 is an end elevation; Figs. 3, 3ª 4 and 5 are details of the clutching device; and Fig. 6 is a diagram of the control circuits.

The particular type of switch shown in the drawings is designed for underground use, as in a man-hole, although many features of the invention are applicable to all types of switches.

Referring first to Figs. 1 and 2, 1—1ª represent a supporting frame, and 2 a switchboard upon which are mounted the contact studs 3—3ª for the switch contacts. 4 is a bridging contact, and 5 a shunt contact which may be tipped with carbon at its engaging end. The switch is shown double-pole, the several parts just recited being therefore employed in duplicate, as seen at 4—4ª in Fig. 2, such a design being particularly applicable for a double-pole switch. 6—6ª represent arc chutes through which one end of the contacts moves when the circuit is opened, and in which a suitable arc-extinguishing arrangement may be provided as desired. On the lower end of the support 2 on the front of the board, are pivoted arms 7—7ª, in the upper ends of which is journaled the carrier 8 for the bridging contact. Between the extremities is journaled a link 9 the other end of which is pivoted to a link 10 pivotally connected with a crank 11 keyed to the shaft 12. The pivot 13 is common to the links 9 and 10 and to a cramping frame 14 the fixed end of which is journaled on a rigid block or support 15 mounted on the board 2.

The organization thus far described comprises a compound toggle consisting of two systems at right angles to each other, one formed by the crank 11 and the link 10 and the other by the link 9, arm 7 and cramping frame 14; and the two act together to compound the power and give a particularly powerful leverage on the bridging contact. This is especially advantageous in the case of heavy switches, where great power is necessary to set the bridging contact into firm engagement with its blocks, and is also particularly advantageous in connection with motor-set switches, since it permits of the use of a small operating motor. The toggles are shown in Fig. 1 in set position, the switch being closed. On opening, the crank 11 moves angularly with the shaft 12, thus lowering the outer end of the cramping frame 14 and collapsing the toggle immediately adjacent to the bridging contact, the latter rocking outwardly in a plane perpendicular to the switchboard and producing a wide break. In resetting the switch the crank 11 is raised to a vertical position and when in that position is instantly released from the motor the moment the center of its wrist-pin alines with the center of the shaft 12 and the pivot 13 at the outer end of the cramping frame 14.

It is particularly desirable in the case of a motor-set switch that this release shall be instantaneous, so that the acquired momentum of the motor armature shall not require sudden checking and shall not tend to throw the parts beyond the required range of movement. This result is provided for by our improved form of clutch. This clutch is mounted within a hollow worm wheel 16 meshing with a worm 17 driven by

the operating motor 18. The inner periphery of the worm wheel is provided with two interiorly projecting lugs or teeth 19—19ª against which is adapted to bear either of the two ends of a pivoted pawl 20—20ª journaled in arms 21—21ª forming a part of a frame including arms 22—22ª, which is keyed to the shaft 12. Pivoted on the shaft within this frame is an arm 23, one end of which carries a lug 24 and the other end is pivotally connected with one end of a spring 25, the other end of which is pivoted between the fixed arms 22 and 22ª. This spring is shifted off center with respect to the center of the shaft and the pivot pin 22ᵇ. In Fig. 3 it is shown in one position of rest, in Fig. 3ª in a transitional position and in Fig. 4 in the opposite position. The arm 23 carries a stud 26 projecting through a slot in a link 27 journaled on one end of the pawl 20—20ª. Thus if the arm 23 be shifted back and forth on the shaft 12, the spring 25 will gradually approach a position where its strain is on the line of the centers 22ᵇ, 12, after passing which the arm 23 will be snapped quickly to its extreme position. When in the position shown in Fig. 3 this shifts the pawl outwardly and causes the end to which the link 27 is connected to intercept one of the lugs 19—19ª on the worm wheel, and when shifted to the other position the end 20ª is shifted outwardly to intercept these lugs, as indicated in Fig. 4. This is done at a definite position of the parts by means of lugs or stops 28—28ª, 29 (see Fig. 2) fastened securely to a fixed part of the framework, one pair of these stops approximately 180° apart, being at the same radial distance from the center of the shaft 12 as the lug 24, and the other set, also approximately 180° apart, being at a shorter radial distance to coöperate with a lug 30 on the pawl-carrying frame which is secured to the shaft. Thus when the motor is started the worm wheel runs free until one of the lugs 19 or 19ª, according to the direction in which the motor rotates, engages the pawl.

Assuming that the wheel is driven clockwise in Fig. 3, in the position of the pawl therein shown, when the lug 19 engages the pawl, the motor will be clutched to the shaft and will shift the latter through an approximate angle of 180°, at the end of which range of motion the lug 24 will abut against one of the lugs 29 there being two of these diametrically opposite, the rear one not being visible in the drawings, which latter will detain it, drawing downwardly on the end of the pawl and pulling it out of engagement with the lug 19, thereby disconnecting the motor. At the same time the lug 30 on the crank shaft is brought just over center and in close relation to a stop 28ª limiting the motion of the operating parts of the switch. The disconnection of the pawl from the worm wheel is instantaneous; the motor then runs free and may expend its momentum without disturbing the switch parts. Even if the operator should by carelessness permit the switch at the control station to remain set longer than necessary, it could have no damaging influence on the operation of the switch. When the lug 24 engaged the fixed stop the arm 23 was shifted far enough to throw the spring 25 over the line of the centers, after which it snapped quickly back and set the end 20ª of the pawl in position to engage one of the lugs 19 or 19ª upon a reverse movement of the worm wheel, so that when it became necessary to open the switch, a reversal of the motor would act in a similar manner to that already described in clutching the motor to the switch parts.

Three views of the clutch are shown, Figs. 3, 3ª and 4; Fig. 3 showing it in position maintaining engagement between the crank shaft and the worm wheel for a clockwise motion, Fig. 4 for an anti-clockwise motion, while Fig. 3ª shows a position where the lug 24 has just engaged the fixed stop, and the pin 26 has been thrown to the bottom of the slot in link 27, and is just in the act of pulling away the pawl 20 from the stop 19; a moment later the stop 19 will have been cleared when the spring 25 will flip the pawl to the position of Fig. 4. The shaft driven by the worm wheel is then free from clockwise rotation and the switch parts are arrested by the fixed stop 28, the motor running free until the operator at the distant control switch opens the switch, after which the motor will continue to run until its inertia is expended in overcoming the friction of the parts. While it is thus running free the right-hand end of the clutch pawl drags over the inner wall of the worm wheel and slips by the lugs 19 19ª. Thus the parts are, when they come to rest, in a position where the right-hand end of pawl 20ª bears against the inner periphery of the worm wheel. Consequently when the operator throws the control switch to release the controlled switch the worm-wheel catches on the right-hand end of pawl 20ª and drives the crank-shaft in an anti-clockwise direction, thereby shifting the toggle away from the stop and permitting the switch to open.

The control circuits are indicated in Fig. 6. As will be seen from the diagram, the motor 18 has its field winding connected permanently across two of the mains of a three-wire lighting circuit. The armature has one brush connected with the neutral wire, and the other with the pivot of a two-way switch 31, the two contacts of which connect respectively with the outside wires, plus and minus, as indicated in the diagram. Return wires 32—32ª are connected in circuit between the pivot of the control switch and the outside mains of the system, in series with which are voltmeters 34ª—34ᵇ which indicate the potential of the mains. The wires 33—33ª connecting respectively with the negative and positive mains of the three-wire system are provided with contact studs for the hand-control switch 31, and suitable indications provided to show that when the switch is in one position the distant-control switch is off, and when in the other it is on.

Let us assume that the operator at the control point, which may be in the central station, desires to set the man-hole switch. The operating control lever 31 is shifted to the position marked "On", thereby closing the circuit to the motor from the positive main through the armature to the neutral main, as will be evident from the diagram. The field of the motor being continuously in circuit, the motor starts up in a direction to set the switch. The worm wheel 16 is driven, say in a clockwise direction, causing an engagement of one of the lugs on the interior of its periphery with the pawl 20, as seen in Fig. 3. It makes no difference at what point the motor has stopped in the prior control operation. One of the lugs will be brought into engagement with the pawl and will be put into clutch with the shaft 12 and will shift it through an angle of approxi-

mately 180°; during this traverse the projection 24 is brought against the fixed stop already described; the projection is thereby instantly arrested, and the worm wheel moving on, the link 27 is drawn down, thereby freeing the engaging nose of the pawl from the lug on the inner periphery of the gear wheel. Immediately on the spring 25 being shifted over center, it snaps the pawl over a considerable range of movement and shifts its free end against the inner periphery of the worm wheel. The motor can now continue running without driving the shaft, since the lugs 19—19ª simply slip by the edge of the pawl. During this range of motion, the crank 11 on the shaft 12 has been raised to a vertical position or just a little beyond a vertical position, to overset the toggle 10—11, and after the clutch with the motor is released the parts are brought to rest by engagement of the lug 30 on the arm 21 of the clutch with the fixed stop 28 for holding the switch set. In shifting the crank 11 the link 10 is raised, thereby lifting the cramping frame 14 and simultaneously shifting in toward the switch terminals the bridging contact 4. The outer end of the link 9 is also raised, thereby bringing into action the toggle 7—9—14, of which it forms a part. Thus we have the two toggles acting to compound or multiply the power of the motor, the leverage due to the toggle 10—11 being multiplied into that due to the toggle 7—9—14. After the clutch has opened, the motor runs until the switch at the control station is opened, after which it may expend its momentum and will come to a position of rest, the particular point at which it comes to rest being of no significance. Thus there is no necessity for care on the part of the operator as to the time during which he shall hold the control switch closed, simply throwing it for a short interval and then opening it, the parts at the operated switch taking care of the rest.

In opening the switch the operator throws the control switch 31 to the position marked "Off", thereby putting the motor into connection with the negative main and reversing its direction of rotation. This will shift the worm gear in a direction anti-clockwise (see Fig. 4), bringing one of the lugs 19—19ª into engagement with the opposite end 20ª of the clutching pawl, as indicated, the pawl having been left, as previously described, in a position to insure this result. The crank shaft 12 is then carried back over its previous path a distance of approximately 180° during which the lug 24 encounters the stop, when the pawl is again disconnected with a snap action by the spring 25 being shifted off-center.

It is sometimes desirable to control the switch at the point where it is installed. To admit of this we have provided a hand-operating lever 34 provided with a hole 35 on the handle end by which a pole may be hooked to the handle when inserted into the man-hole. The opposite end of the lever is provided with a gear sector, as indicated in Fig. 1, in mesh with a pinion 36 on the crank shaft 12. A spring 37 connects the hand-operating lever with a fixed part of the switch. Thus in operating by hand it is unnecessary to disturb the motor, the lever 34 being lifted and directly acting on the crank shaft. As a call for hand operation of the switch will be one that requires opening of the switch to permit examination of the parts, the parts are positioned as shown in Fig. 1, so that the gear sector is raised with relation to the pinion.

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

1. An electric switch comprising a movable contact, a swinging arm carrying the same, a main toggle, one link of which is pivoted to said arm and the other to a fixed point of the switch frame, and an auxiliary toggle for cramping the main toggle with its two links parallel and side by side.

2. An electric switch provided with a movable contact mounted on a lever swinging to and from a fixed contact, a cramping frame, a link having one end pivoted to the lever and the other end pivoted to the outer end of the cramping frame, said link forming a toggle with said frame, and an auxiliary toggle for raising and lowering the cramping frame.

3. The combination of an electric switch, an operating motor, a gear wheel, and a reversible pawl for clutching the gear wheel for a determinate range of movement in either direction.

4. In a motor-operated switch, the combination with a reversible motor, of a gear wheel, a clutch-pawl, and a means for setting the pawl for reverse clutching after a determinate range of operation.

5. The combination of a reversible motor, a shaft, a clutch-pawl adapted to connect the two, means for releasing the clutch-pawl after a determinate angular movement of the shaft, and means for setting the pawl when released to clutch the shaft on a reversal of the motor.

6. The combination of a reversible motor, a shaft, a pivoted clutch-pawl having an engaging toe at either end, and means for disconnecting one toe of the pawl after a determinate range of shaft movement, thereby shifting the other toe into position for engagement for a reverse movement of the motor.

7. The combination of a reversible motor, a shaft, a snap clutch, a pawl operated thereby to connect the motor and shaft, and means for snapping the clutch to release the motor and reverse the pawl after a determinate range of shaft movement.

8. The combination of a reversible motor, a shaft, a snap-clutch pivoted concentrically with one of them, a pivoted pawl having two engaging toes, a stop to pull the pawl out of clutching position after a determinate angle of shaft movement, and means for reversing its position during such operation to set the clutch for a reverse motor movement.

9. The combination of a reversible motor, a shaft, a clutch provided with a reversible pawl for connecting them for either direction of driving, a pivoted clutch part, connections between the pivoted clutch part and the pawl for operating it, and a stop to shift the pivoted part and reverse the pawl.

10. The combination of a reversible motor, wheel 16, pivoted reversible pawl 20, pivoted operating lever 23, and a fixed stop for shifting the lever after a determinate range of motor movement.

11. The combination of a reversible motor, wheel 16, pivoted reversible pawl 20, slotted link 27, pivoted lever 23, spring, as 25, for snapping it out of action, and a fixed stop for shifting the lever after a determinate range of motor movement.

12. The combination with a motor-operated switch, of a clutch between the motor and switch mechanism locking them for a definite direction of drive, distant control devices for the motor, and a hand-operating lever for operating the switch independently of the motor.

13. The combination with an electric switch, of an electric motor for operating the same, said motor having a permanently excited field, a control circuit, and a control switch for connecting the armature between the neutral and either outside wire of a three-wire system, for the purpose set forth said armature having one brush permanently connected to said neutral.

14. In an electric switch operated by an electric motor, the combination, with leads for supplying current to the motor, of a control switch for controlling the direction of

the rotation of the motor, and a plurality of indicating devices each connected to a different lead in parallel with the control switch and in series with the motor.

15. In a motor operated electric switch comprising a motor having a permanently excited field and an armature supplied with current from a three wire system, one brush of said armature being permanently connected to the neutral wire, the combination with a control switch for connecting the other brush of the armature to either outside wire, of two indicating devices each connected to one of the outside wires and to said other brush in parallel with said control switch, whereby when said control switch closes the circuit from either outside wire through the motor the corresponding indicating device is short circuited.

In witness whereof we have hereunto set our hands this 18th day of November, 1902.

EDWARD M. HEWLETT.
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