No. 755,771. PATENTED MAR. 29, 1904.

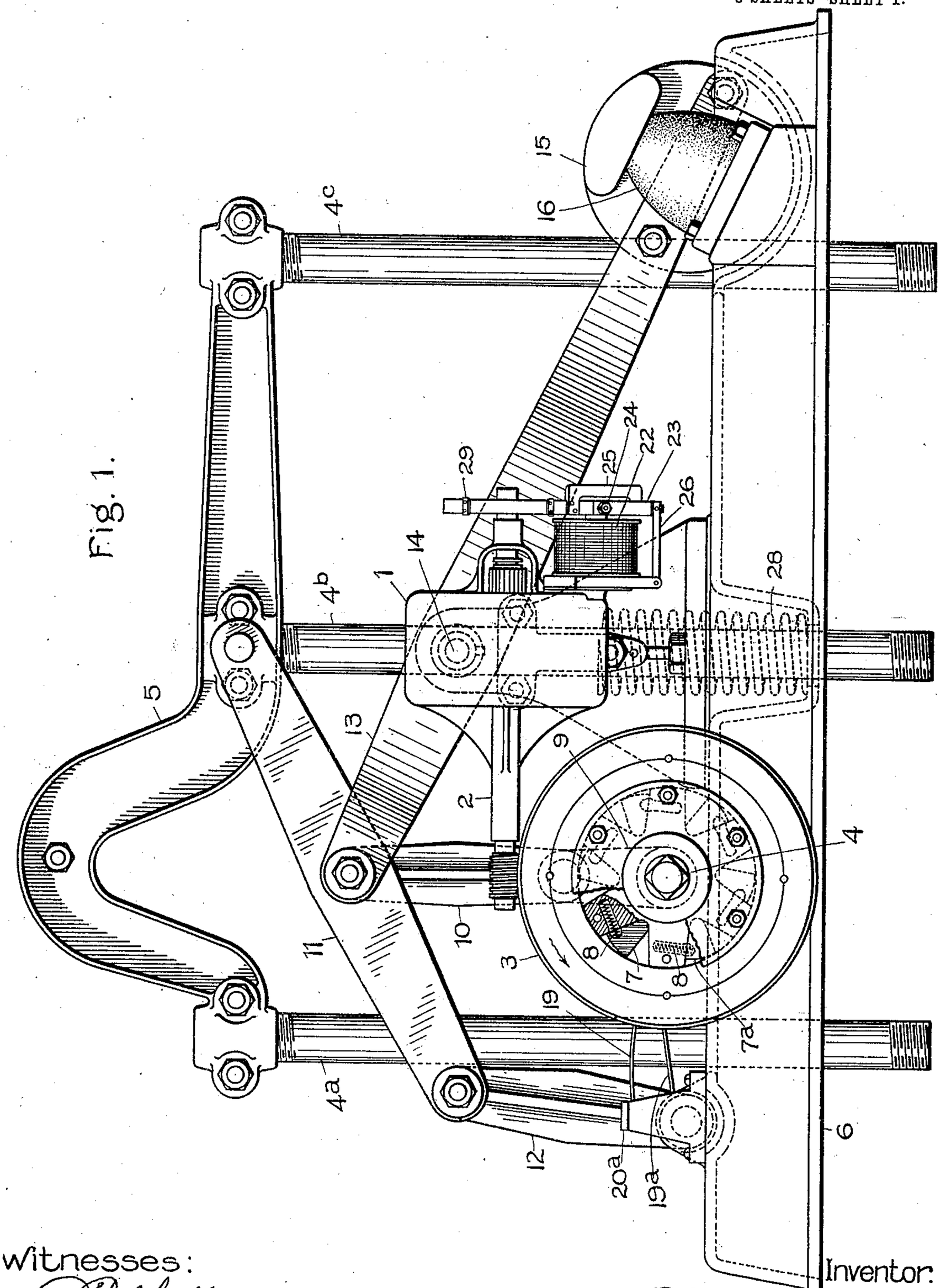
E. M. HEWLETT.

ELECTRIC SWITCH OR CIRCUIT BREAKER.

APPLICATION FILED JAN. 29, 1900. RENEWED MAY 7, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
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Inventor:
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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.

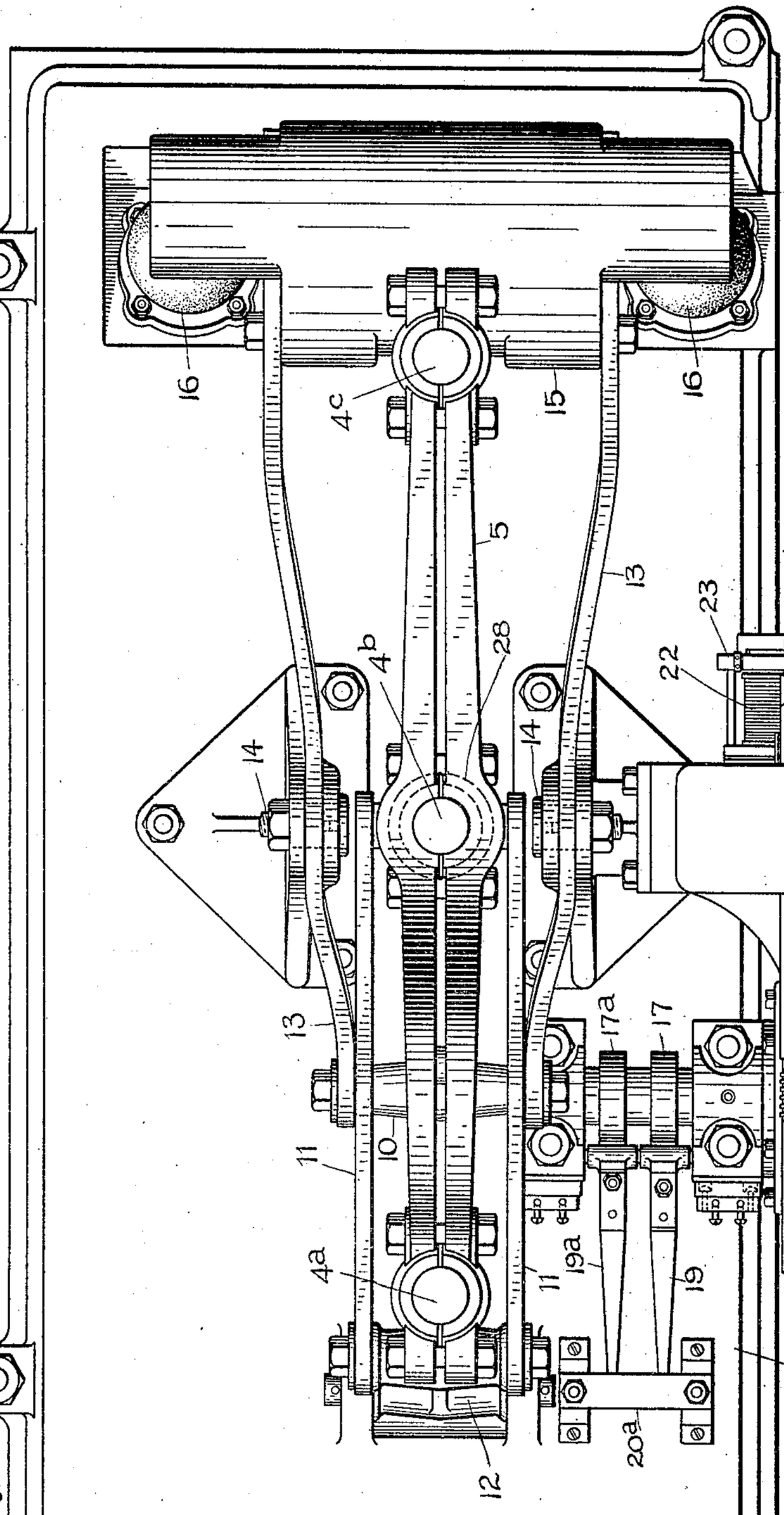
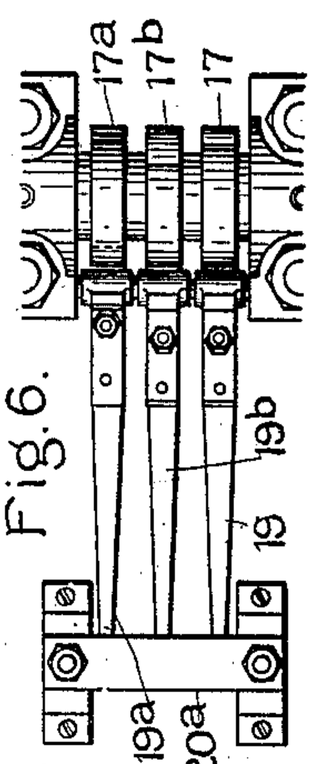


Fig. 6.



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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 3.

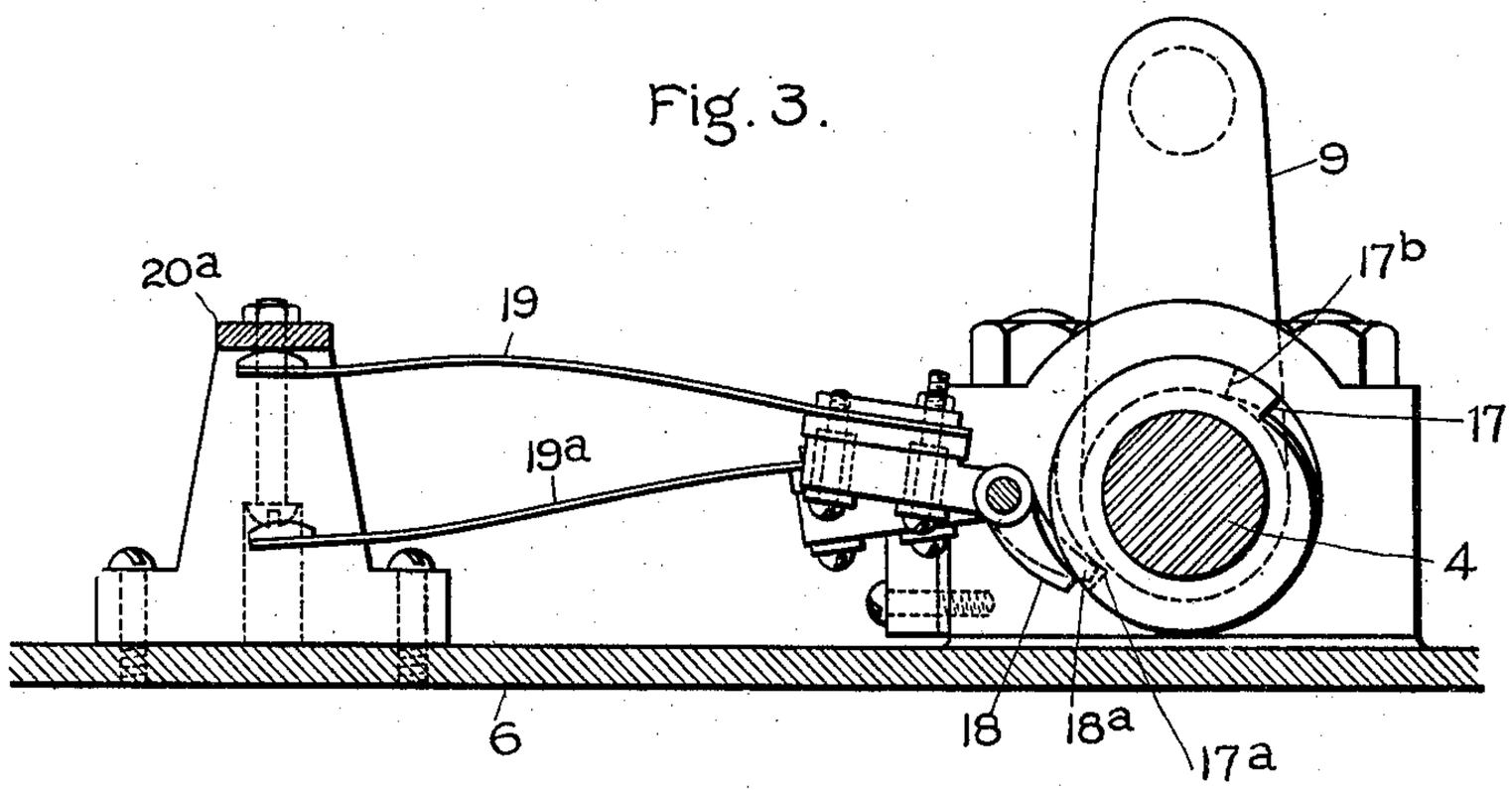
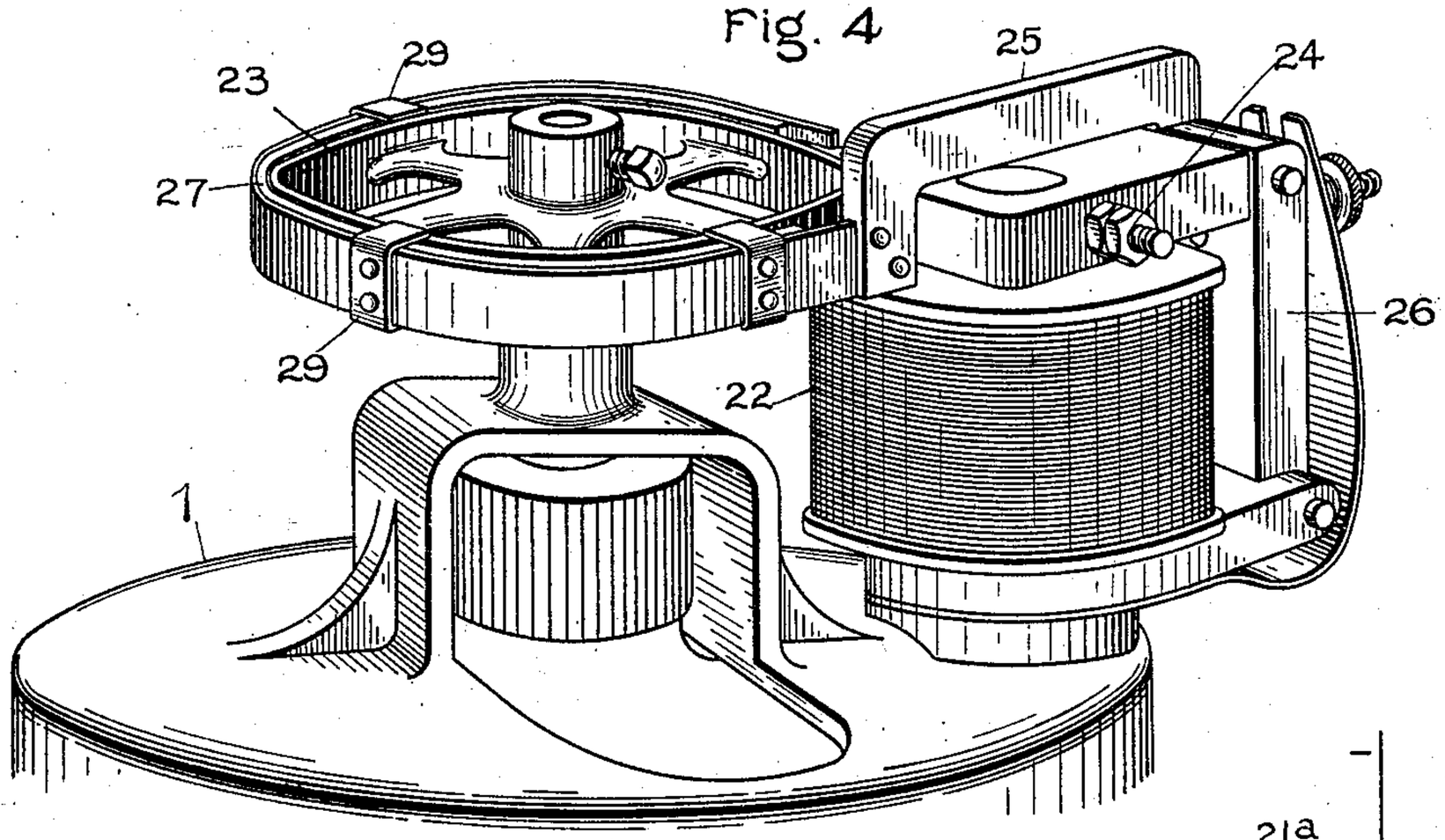


Fig. 4



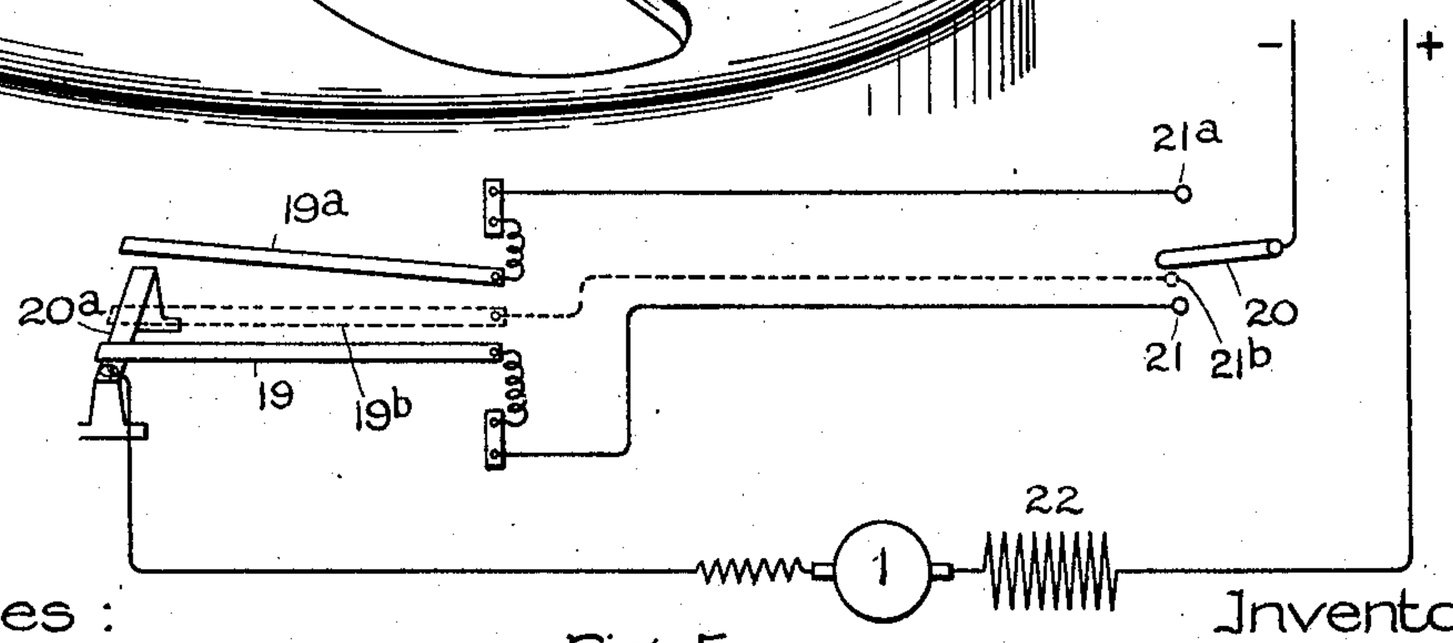


Fig. 5.

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UNITED STATES PATENT OFFICE.

EDWARD M. HEWLETT, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC SWITCH OR CIRCUIT-BREAKER.

SPECIFICATION forming part of Letters Patent No. 755,771, dated March 29, 1904.

Application filed January 29, 1900. Renewed May 7, 1902. Serial No. 106,340. (No model.)

To all whom it may concern:

Be it known that I, EDWARD M. HEWLETT, a citizen of the United States, residing in Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric Switches or Circuit-Breakers, of which the following is a specification.

This invention relates to controlling mechanism for circuit-breakers, one object being to simplify the construction and reduce the danger in the management of high-potential switches or circuit-breakers. The points of contact rupture in circuit-breakers of this character are commonly provided with means for producing a quick and wide separation at the instant of circuit rupture and in order to reduce the arc are very often submerged in oil or the movable contact is at least carried through oil over part of its path of movement.

It is one object of my invention to control the switch or circuit breaker from a point of safety to the operator.

In carrying out my invention I provide means for gradually approximating and bringing into engagement the circuit-terminals by controlling devices operated at a distance and auxiliary devices for rapidly separating the coöperating terminals. To this end I provide a controllable motor operatively related to the movable terminal or terminals and by which they may be brought into engagement with the fixed terminal or terminals, energy being stored by such movement in a separating mechanism by which a rapid disruption of the circuit may be produced. I provide also means for disconnecting or unclutching the motor to permit the circuit-rupturing device in which the energy was stored by a prior movement of the switch parts to act instantaneously. In controlling currents of extremely high potential and large amperage—as, for example, of ten thousand to twenty thousand volts and from one hundred to five hundred amperes—it is imperatively necessary to manipulate the circuit-breakers from a distance to insure safety to the operator.

The novel features of my invention will be more particularly hereinafter described and will be definitely indicated in the claims appended to this specification.

In the accompanying drawings, which illustrate one form of my invention, Figure 1 is a side elevation of the operating mechanism for controlling a high-potential circuit-breaker and embodying my improvements. Fig. 2 is a top plan view of the same. Fig. 3 is a detail view of the circuit-completing mechanism for the control-circuit. Fig. 4 is a detail view in perspective of the motor-brake. Fig. 5 is a diagrammatic view of the control-circuit, and Fig. 6 is a detail view showing the cams governing the motor.

Referring first to Fig. 1, 1 represents an electric motor which may be supplied with energy from any suitable source, and 2 the armature-shaft on which is a worm engaging a worm-wheel 3, operatively related to a crank-shaft 4, to which is connected by a link system one or more rods 4^a 4^b 4^c, carrying the movable terminals of a circuit-breaker.

The organization which I have shown in the present drawings is adapted for rupturing the current on a triphase alternating circuit. My improvements, however, although of especial advantage in connection with high-potential currents, are applicable to a circuit of any character, direct current or single phase or polyphase alternating current. In the present organization the three terminals are rigidly connected at their upper ends by a yoke or bar 5, provided with a bend to permit proper play of the link system connecting the shaft 4 with the terminal-carrying rods. The rods 4^a 4^b 4^c pass loosely, as indicated in dotted lines, Fig. 1, through guides in the supporting-cap 6, which is adapted to rest upon apparatus containing the oil and circuit-breaker terminals or other switch-contacts. As this feature of the organization may be of any suitable construction I have deemed it necessary only to illustrate that part which carries the movable terminals. Between the worm-wheel and the shaft 4 is a clutch gripping in one direction of rotation and that by a very slight angular movement

when the shaft drags relatively to the motor, but permitting a free movement of the shaft 4 in a definite direction. Many types of clutches suitable for the purpose are well known in the art. I have shown for the sake of illustration one form which gives satisfactory results. This comprises one or more clutch-shoes 7 7ª, &c., journaled or otherwise mounted to work on an axis eccentric to the axis of the shaft 4 and connected to the arms of a spider rigid with the shaft by light springs, as indicated at 8. With this organization the shaft 4 and its connected parts have a perfect freedom of movement in the direction of the arrow under torque applied to the shaft, but will be firmly clutched to the worm-wheel if the latter be moved in the same direction. In the former case the spring holds the clutch-shoe firmly against the arm of the spider. In the latter it is distended, and the dogs 7 clutch the worm-wheel and shaft 4 together. The crank 9 is fixed to the shaft 4 and is connected by a link or rod 10 with a beam 11, pivoted to the yoke or cross-head 5, one end of the beam being journaled to a link 12, pivoted in a bearing on the base 6. On the same center on beam 11 as link 10 is pivoted a lever 13, adapted to rock upon a fulcrum 14 in a standard mounted on the base 6, the free end of the lever carrying a counterbalance 15, sufficient to shift the parts to the position shown in Fig. 1, and engaging when the circuit-breaker is open cushions 16.

The link system just described constitutes a parallel-motion organization in which the point from which the movable contacts 4ª 4ᵇ 4ᶜ are suspended reciprocates in a right-line motion up and down. To this end the two arms of beam 11 are of equal length and of the same length as the distance between the center of the fixed support-pivot 14 and the point on the beam 11, to which lever 13 is pivoted. The center of the suspending-pivot for rods 4ª 4ᵇ 4ᶜ by reason of this construction does not describe in its motions an arc of a circle, but a right line, and this arrangement permits a free suspension and free motion of the movable contacts, which are carried by the rods 4ª 4ᵇ 4ᶜ.

With the orgaization thus described it will be understood that when the motor is cut into circuit and turns the worm-wheel 3 in the direction of the arrow in Fig. 1 the crank 9 is carried around to the left and the circuit-terminals lowered into engagement with coöperating fixed terminals. (Not shown.) I provide an arrangement for arresting this movement when the circuit is closed, which will be understood from an examination of Fig. 3. On the crank-shaft 4 are two cams 17 17ª, with which coöperate corresponding pivoted dogs, as 18 18ª, carrying on their free ends springs 19 19ª, connected in the control-circuit for the electric motor. Each cam-wheel is provided with a notch, and the two are set relatively so as to come into operation with the respective dogs at angular positions of the crank-shaft one hundred and eighty degrees apart. Thus in the position shown in Fig. 3 one of the cams has been shifted to a position where it permits its dog to drop into the notch, thereby allowing the contact on the spring 19ª to separate from a corresponding contact 20ª by a quick movement over a long arc, so as to safely interrupt the control-circuit. The contact-spring 19, however, will not be shifted until the crank-shaft has made a further half-turn, during which the spring 19ª will have again been brought into contact. The object of this organization is to cut out the motor after a definite range of movement and after it has traveled through a sufficient movement to close the circuit and then to start it again and cut it out after the circuit has been properly broken and at the same time to permit the operator at a distant point of control to effect this result by a simple manipulation of a controlling-switch.

Fig. 1 shows the switch mechanism and the parts it controls in the open position of the switch. In closing the switch the worm-wheel when the motor is started is instantly clutched to the crank-shaft and shifts the parts so as to raise the counterweight and compress the spring 28. I preferably in the present case cut out the motor by means of one of the switches 19 19ª at a position where the contacts are close together; but the circuit is not yet completed. This will be more particularly hereinafter described. Assuming the circuit to have been closed, the crank-shaft will have been shifted so as to put the centers of the shaft 4 and wrist-pin of the crank almost or quite in line with the pull of the spring 28 under compression and the counterweight raised. Almost instantaneously, therefore, when the motor is again started the crank-shaft is shifted off center with relation to the connecting-rod 10 and the parts by reason of the slip-clutch permitted to yield immediate and free obedience to the potential energy stored by a prior movement.

The control-circuit will be understood from an inspection of Fig. 5 of the drawings, wherein 20 represents the control-switch connected with one terminal of a source of electric energy and 21 and 21ª the two switch-contacts for operating the motor. The control-switch is placed at a point of safety away from the circuit-breaker. The contact-springs 19 19ª connect, respectively, by circuit-wires with the contacts 21 and 21ª, 22 representing the brake-controlling magnet by which the motor is suddenly checked after being cut out. With this organization the contacts 21 and 21ª represent, respectively, the closed and open positions for the circuit-breaker in any position in which the motor may stand, the springs 19 19ª being

automatically shifted by the operation of the motor into such a position as to cut it out or into circuit relation with the contacts 21 21[a], respectively, at definite positions of the crank-shaft 4.

The brake will be understood from an examination of Fig. 4, wherein there is mounted on the motor-shaft a pulley or brake disk 23, adapted to be engaged by a strap-brake one end of which is connected to the pole-piece of the controlling-magnet 22, as indicated at 24, and the other end being connected through a yoke 25 to the armature 26, provided with a strong retracting-spring, as shown. The brake-band, which may be made of sheet metal, if desired, is preferably shod with some soft gripping material, such as leather, (indicated at 27.) Strap-retainers 29, overlapping the pulley, hold the strap in place. Thus when the armature 26 is attracted by the closure of the switch 20, controlling the circuit, including magnet 22, and the operating motor-armature 26 is drawn up tension is taken off the brake-strap, thereby permitting the motor to start, and similarly when the control-circuit is opened by the angular movement of the crank-shaft through one hundred and eighty degrees and the rupture of the circuit at the point 19 or 19[a] the motor-current is cut off and the brake simultaneously applied by the demagnetization of magnet 22 and the retraction of its armature. When the circuit-breaker contacts are moved by the motor in a position to close, a short stiff coil-spring 28 in operative relation to some part of the movable frame is put under compression and serves when the circuit is broken to rapidly overcome the inertia of the parts and separate the circuit-terminals with great rapidity. Their further range of movement is completed by means of the counterweight 15, which is arrested and the movement of all parts stopped by engagement with the elastic buffer 16, which may be of soft rubber or other yielding material.

The operation of the device may be briefly set forth as follows: When the control-circuit is closed, the brake is released and the motor started, bringing the worm-wheel into clutch with the shaft 4 and shifting the latter through an angle of one hundred and eighty degrees, thereby closing the main terminals of the circuit-breaker. When it is desired to break the circuit, the control-circuit is closed at the opposite point, thereby again operating the motor and shifting the shaft 4 until it shifts the crank 9 to the right of a vertical line below its center, thus shifting the point of application of the spring off center with relation to the crank, when the energy stored in the spring 28 and the counterweight 15 acts upon the shaft, which is free to move forward, as we have seen, and rapidly opens the circuit, the worm-wheel following more slowly, until it has completed its angular movement of one hundred and eighty degrees, when the motor is cut out. As a matter of fact, in practice before the switch has fully opened the motor has speeded up sufficiently to overtake the moving parts, thereby again setting the clutch and completing the opening movement. By means of this organization the switch can open much more quickly than if directly operated by the motor, since it is not necessary with my present organization to submit to the delay in raising the motor to a high speed. The energy is stored by a prior operation of the motor and all parts are in a condition for instantaneous action for an opening movement of the circuit.

In some cases it is desirable to arrest the movable element of the switch before it makes contact with the fixed terminals. For example, when the switch is employed in a station to cut in and out a generator it is desirable to have the closure occur at the instant when the generator to be cut in is in synchronism with the generators already feeding the circuits. In such a case I provide an additional cam-disk and contact in the control-circuits, the parts being so related that the motor is arrested by one of the cams (shown in Fig. 3) before the switch is closed, but leaves the movable switch-contact in close relation to the fixed terminal. Then when the generator being cut in is synchronized, as evidenced by a phase-indicator, the switch 20 is moved quickly to a third contact 21[b], which takes off the brake, starts the motor, and immediately closes the switch. A third cam 17[b] may be used to open the contact 19[b] corresponding to this branch of the control-circuit, being set so that its notch is a short distance ahead of the switch-closing cam which governs contact 19, as indicated in dotted lines in Fig. 3 and in full lines in Fig. 6.

While I have described herein as the motive mechanism an electric motor and prefer to use the same, it is not in all respects essential, since certain features of my invention may be carried out by the use of other operating devices than electric motors.

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

1. An electric switch or circuit-breaker comprising an electric motor, a movable switch member operated thereby, a clutch to connect or disconnect the motor, a circuit-breaker for the motor-circuit operated after determinate ranges of motor movement, and a circuit-controller for closing the motor-circuit at any position of rest.

2. An electric switch or circuit-breaker comprising an electric motor, a movable switch member operated thereby to close the switch, a cut-out for the motor-circuit operated when the switch is closed, a switch-opening spring strained when the switch is in closed position, connections for releasing the same by a further movement of the motor, and means for

closing the motor-circuit independently of the cut-out.

3. An electric switch or circuit-breaker comprising an electric motor, a movable terminal, a crank-shaft connected to the movable terminal, a clutch between the motor and crank-shaft set by drag of the crank-shaft relatively to the motor, and a spring strained by the motor and acting on the crank-shaft whereby the spring is released and the switch quickly opened when the point of application of the spring is shifted off center with relation to the crank-shaft.

4. An electric switch or circuit-breaker comprising a motor governable from a point distant from the switch, a movable switch member controlled thereby, automatic devices operated by the motor for arresting it at a determinate position before full closure of the switch and during full closure, and means for quickly opening it.

5. An electric switch comprising a control-circuit, a motor thrown into operation thereby, fixed circuit-terminals, reciprocating movable terminals operated by the motor to close the circuit, a clutch to connect and disconnect the motor, and a quick-acting agency to open the terminals operating independently of the motor but governed thereby.

6. An electric switch or circuit-breaker comprising an electric motor, a movable terminal, a clutch between the motor and the movable switch-terminal to connect or disconnect them, a spring strained coördinately with a closing movement of the terminal, and connections for giving the clutch a forward movement relative to the motor on opening the switch, thereby permitting the spring to quickly open the circuit.

7. A high-potential switch or circuit-breaker, comprising an electric motor, a crank driven thereby, a movable switch-contact, a clutch between the crank and the movable switch contact or contacts, a counterbalance acting on the crank in the opening movement of the switch, and means for releasing the clutch to open the switch.

8. A high-potential switch or circuit-breaker, comprising fixed circuit-terminals, reciprocating movable contacts to close or open the circuit, means for storing energy on closing the switch to effect its opening movement, an electric motor geared to a crank-shaft to close the switch, and a slip connection permitting the stored energy to open the switch when the crank passes a definite position.

9. The combination with an alternating-current circuit, of an electric switch, a control-circuit therefor, connections for operating the switch-contacts to shift them into close relation, and means for quickly shifting them into contact at a definite instant.

10. The combination with an alternating-current circuit, of a switch, means for approximating the switch-contacts and arresting them when in close relation, and means for quickly effecting their engagement at a definite instant.

11. The combination with an alternating-current circuit, of a switch, means for approximating and arresting its contacts, and apparatus for establishing contact at the desired instant by shifting them from such position of approximation.

12. The combination with an alternating-current circuit, of a switch, operating devices therefor, a control-circuit including such devices, a contact in said circuit for energizing the control-circuit and approximating the switch-contacts, and a synchronizing contact for effecting their engagement after such a position of approximation, thereby permitting a rapid closure when necessary.

13. An electric switch or circuit-breaker comprising an electric motor, a movable terminal, a crank-shaft connected with the movable switch-terminal, a clutch between the motor and crank-shaft locked relatively thereto by a small angular drag of the crank-shaft, and a spring strained by the motor and acting on the crank-shaft whereby the spring is released and the switch quickly opened when the point of application of the spring is shifted off center with relation to the crank-shaft.

14. An electric switch or circuit-breaker having a movable member, a motor to operate the same, a clutch between the motor and the movable member adapted to engage or release at any angular position throughout its revolution, a spring strained when the switch is closed, and control devices for releasing the clutch and freeing the movable member from the motor.

15. An electric switch or circuit-breaker comprising a motor, a movable switch member operated thereby, a clutch to connect or disconnect it instantly at any point, a spring strained by the motor, means for automatically checking the motor after the spring has been set, and means for releasing the clutch when the motor starts again.

16. An electric switch or circuit-breaker comprising separable contacts to make and break the circuit, a spring, a motor for straining the spring coincidently with the closing movement of the switch, and means for releasing the spring and cutting in the motor to open the circuit.

17. An electric switch or circuit-breaker comprising separable contacts to make and break the circuit, a spring, a motor, means for straining the spring to store up motor energy, said spring controlling the switch movement, and means for freeing the spring and opening the circuit immediately upon the restarting of the motor.

18. An electric switch or circuit-breaker having a movable member, a motor to operate

the same, a ratchet-clutch between the motor and the movable member, a spring strained by the motor in affecting one switch operation, and means for opening the clutch and permitting the spring to operate the switch.

19. An electric switch or circuit-breaker having a movable member, a motor to operate the same, a ratchet-clutch between the movable member and the motor, a crank and link between one of the clutch parts and the movable element of the switch, a spring strained by the motor, and means for shifting the crank off center and releasing the spring.

20. An electric switch provided with a movable contact, a pivoted support therefor, motive mechanism for shifting the contact, and connections between said motive mechanism and the support for giving the latter a right-line motion.

21. An electric switch provided with a movable contact, a pivoted support therefor, motive mechanism for shifting the contact, a rock-arm actuated by the motor and connected to the support, and link connections between the motor, the frame, and the rock-arm to effect a right-line motion of the support.

22. An electric switch provided with a movable contact, a rod carrying the same, a rotary motor for operating the rod, and parallel-motion connections between the motor and rod for reciprocating the latter in a right line.

23. An electric switch provided with a movable contact, a rock-arm from one end of which the contact is supported, a motor-crank connected to the center of the rock-arm, a pivoted connection between the center of the rock-arm and a stationary point on the frame, said connection being of the same length as the two branches of the rock-arm, and means for permitting a lateral motion of the free end of the rock-arm, whereby the movable contact is reciprocated in a right line.

24. The combination with an electric switch, of a motor-driven shaft for operating the same, an electrically-controlled clutch between the shaft and switch, and means for opening the clutch after a determined range of shaft movement.

In witness whereof I have hereunto set my hand this 27th day of January, 1900.

EDWARD M. HEWLETT.

Witnesses:

BENJAMIN B. HULL,

MABEL E. JACOBSON.