No. 636,029. Patented Oct. 31, 1899.

A. H. ENGSTROM.

AUTOMATIC CIRCUIT BREAKING DEVICE FOR POLYPHASE CURRENTS.

(Application filed Jan. 31, 1899.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.

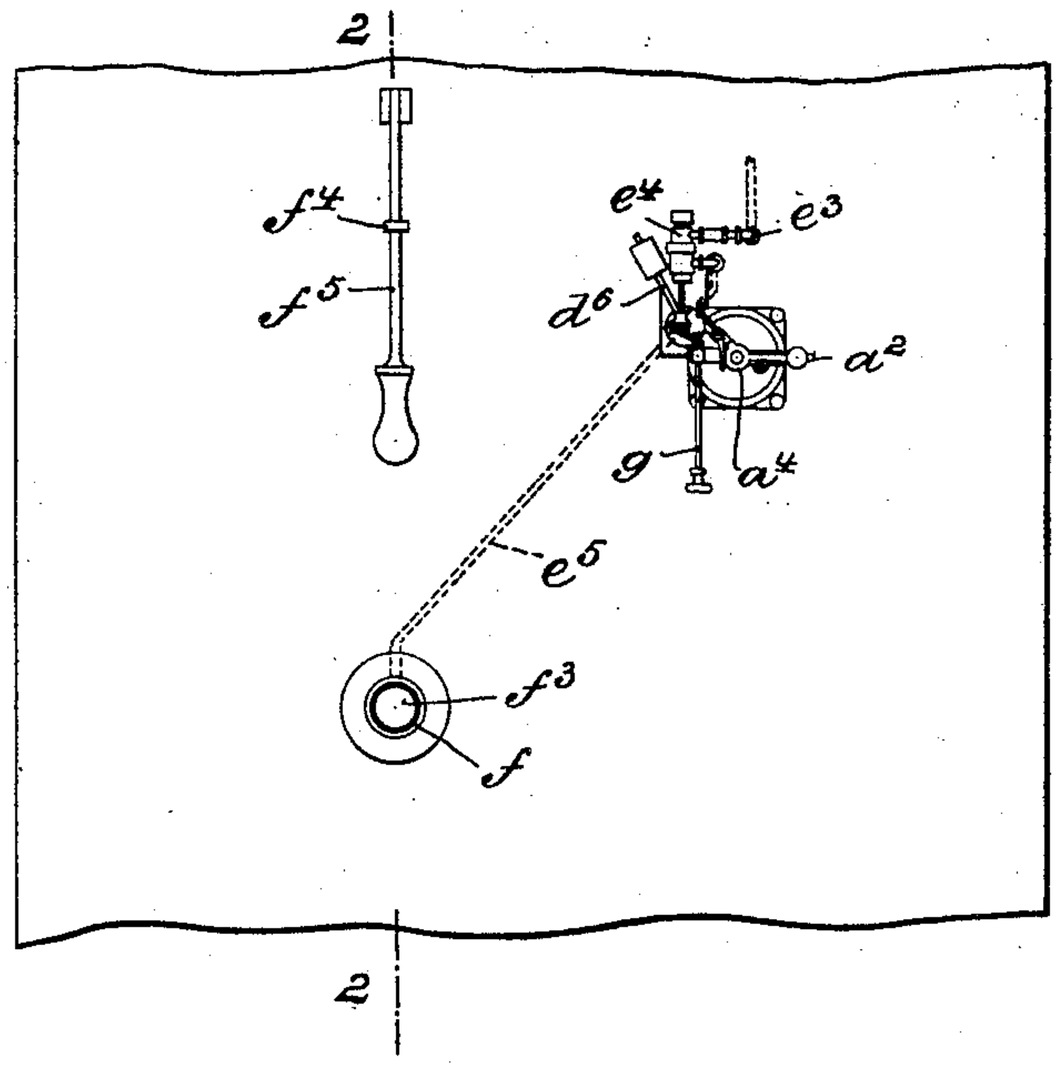
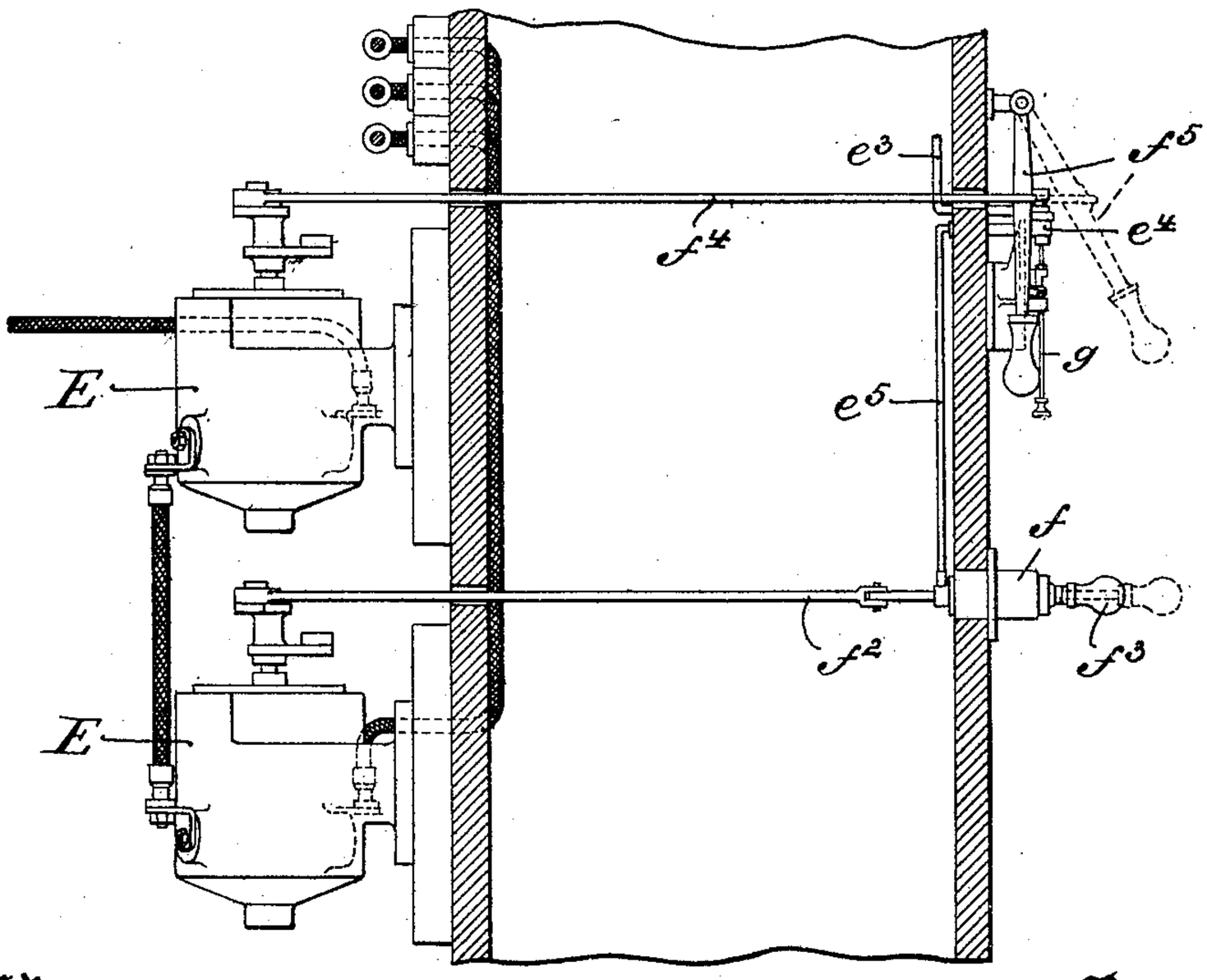


Fig. 2.



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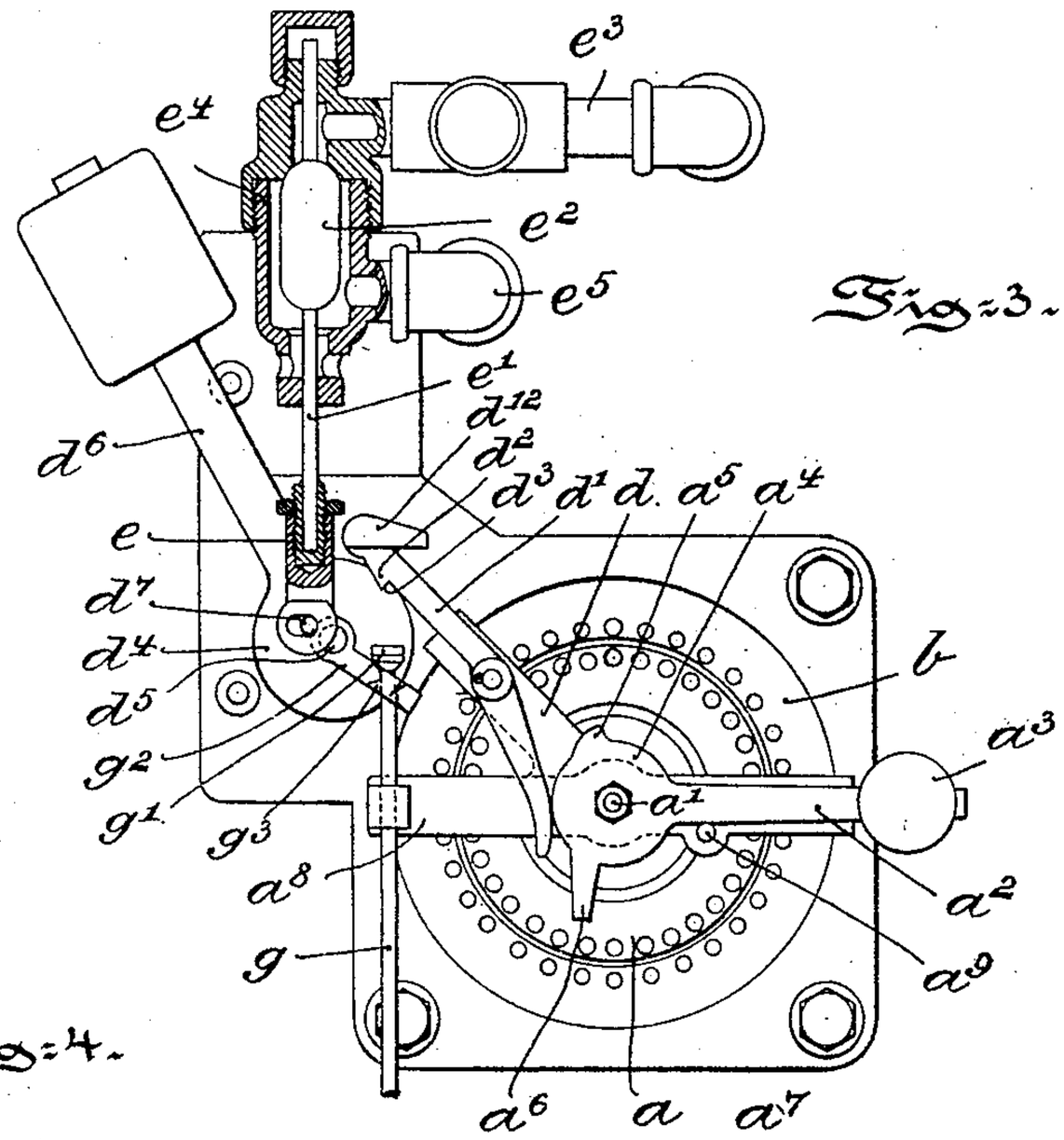


Fig. 3.

Fig. 4.

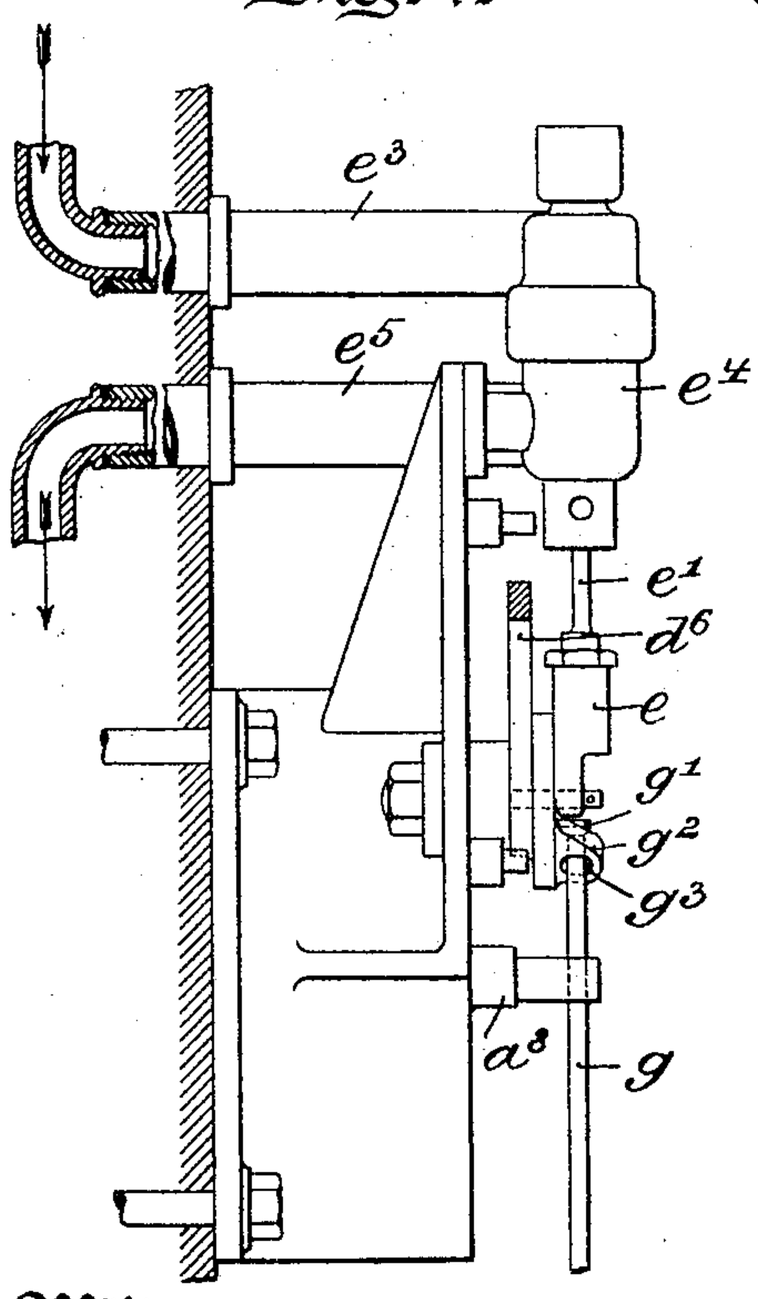
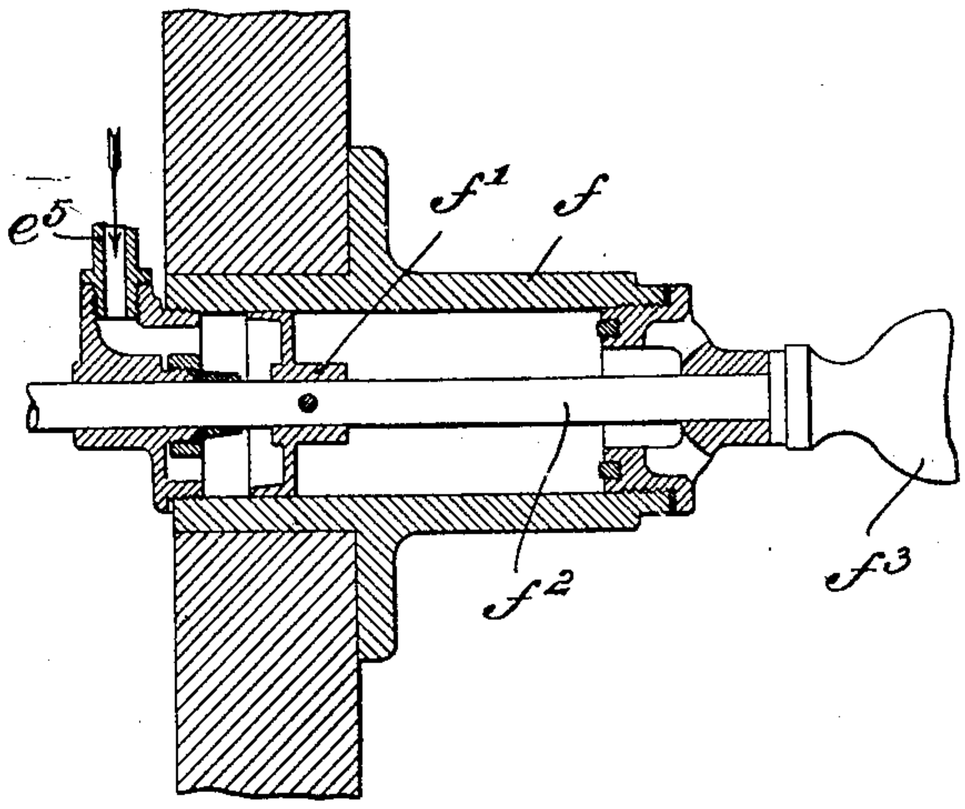


Fig. 5.



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(No Model.) 4 Sheets—Sheet 3.

Fig. 6.

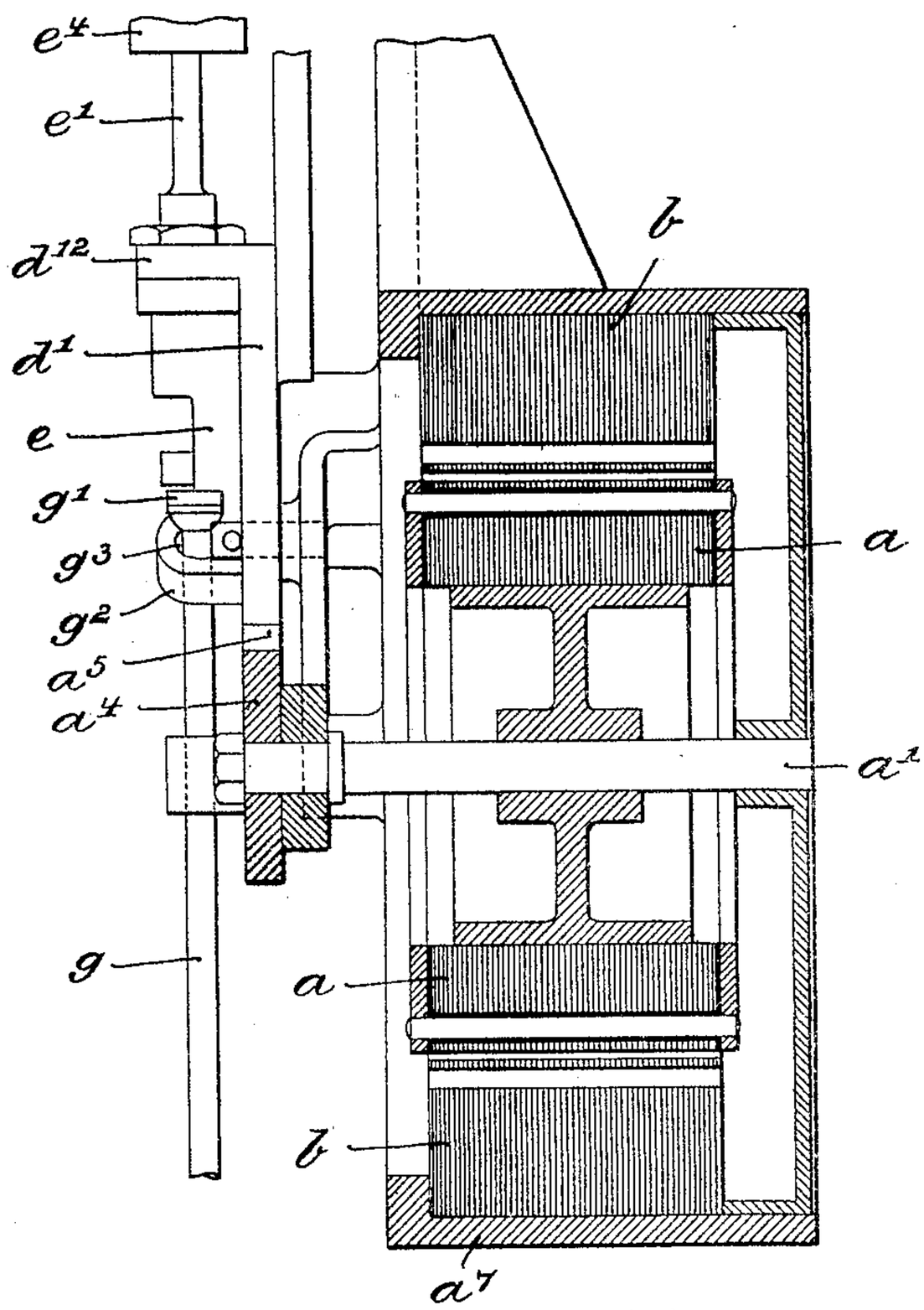

Fig. 7.

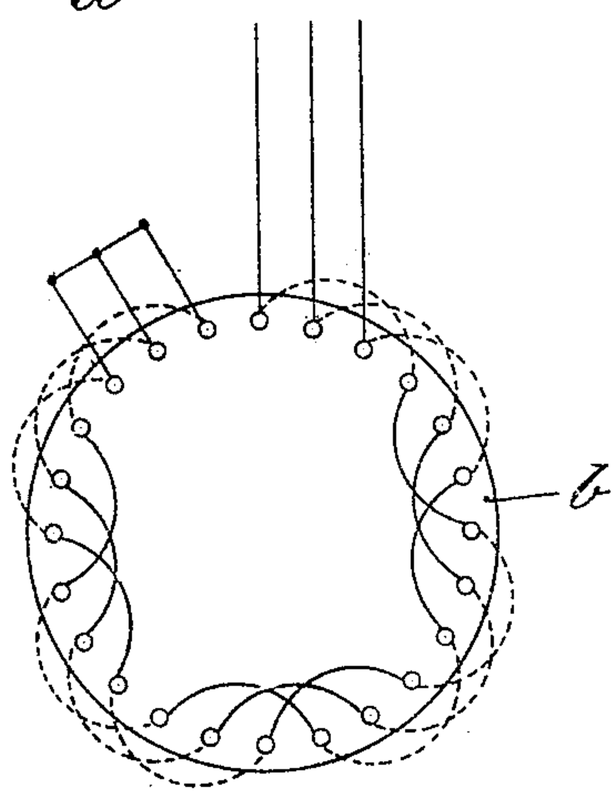

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Fig. 8.

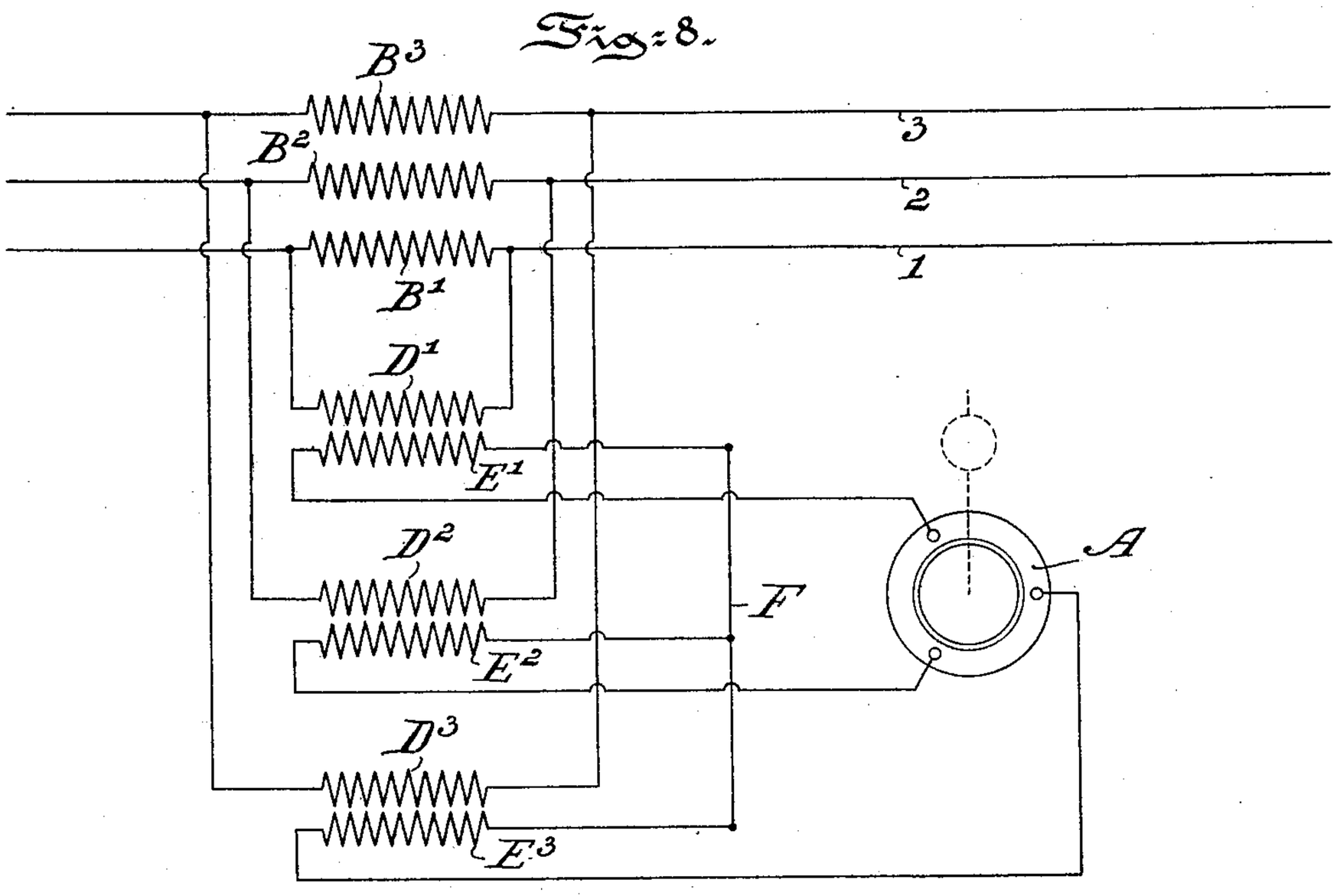
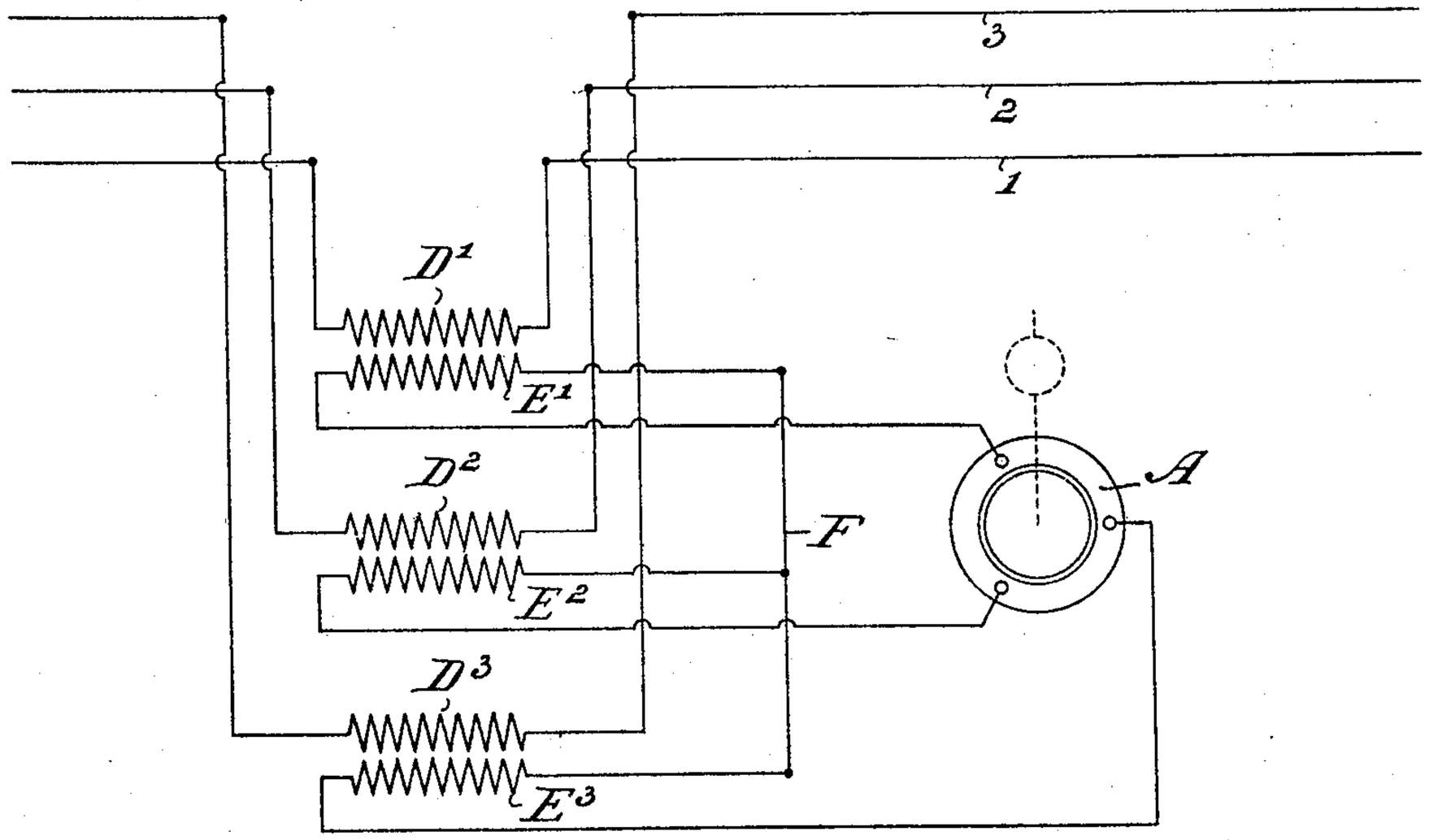


Fig. 9.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC CIRCUIT-BREAKING DEVICE FOR POLYPHASE CURRENTS.

SPECIFICATION forming part of Letters Patent No. 636,029, dated October 31, 1899.

Application filed January 31, 1899. Serial No. 703,981. (No model.)

To all whom it may concern:

Be it known that I, AXEL H. ENGSTROM, a citizen of the United States, residing at the city of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Automatic Circuit-Breaking Devices for Polyphase Currents, of which the following is a specification.

My present invention has relation to an automatic circuit-breaking device for polyphase currents, and in such connection it relates more particularly to the arrangement and construction of such a device.

The principal object of my present invention is to provide an automatic circuit-breaking device for polyphase currents in which a motor or its equivalent having a rotary magnetic field and a counterweighted armature is adapted to control the circuit-breaker and to operate it automatically when necessity requires.

My invention, stated in general terms, consists of an automatic circuit-breaking device for polyphase currents when constructed and arranged in substantially the manner hereinafter described and claimed.

My invention will be more fully understood from the following description, taken in connection with the accompanying drawings, forming part hereof, in which—

Figure 1 is a front elevational view of a portion of a switchboard, illustrating the motor and connections for automatically operating the circuit-breaker and the switch-lever for manually operating the same. Fig. 2 is a transverse sectional view on the line 2 2 of Fig. 1. Fig. 3 is an enlarged front elevational view of the motor and its accessories. Fig. 4 is a side elevational view thereof. Fig. 5 is an enlarged transverse sectional view of the air-cylinder for controlling the circuit-breaker. Fig. 6 is a transverse sectional view, enlarged, of Fig. 3. Fig. 7 is a diagrammatic view illustrating the winding of the rotary magnetic field of the motor, and Figs. 8 and 9 are diagrammatic views illustrating the arrangement of the circuits and series transformers for the motor.

In an application for a patent filed the 28th day of January, A. D. 1899, under Serial No. 703,693, I have shown and described a system for automatically governing polyphase-circuit breakers in which is contemplated the use of a polyphase motor or its equivalent having a rotary magnetic field exerting a continuous but varying torque upon an armature which is counterweighted or otherwise subjected to an opposing torque. In the present application I have illustrated a preferred form of motor and its accessories for controlling the circuit-breaker, and these, with their equivalents, form the subject-matter of the present application.

Referring now to the diagrammatic views, Figs. 8 and 9, a brief description of my system is as follows: The main circuit 1, 2, and 3 may include the resistances B', B^2, and B^3, as illustrated in Fig. 8, or these resistances may be omitted, as illustrated in Fig. 9. In either case in shunts from the main circuit are arranged in series the primary coils D', D^2, and D^3 of series transformers, the secondary coils E', E^2, and E^3 of which have one terminal of each terminating in a common junction F and the other terminal connected with the field-windings of a polyphase motor A.

The preferred form or type of motor A is illustrated in Figs. 3, 4, and 6, and consists of what is generally known as a "non-synchronous" motor, with an armature of the "squirrel-cage" type. The armature *a* tends to rotate under the continuous but varying influence or torque of a rotary magnetic field set up in the plates *b* of Fig. 6. The diagram Fig. 7 illustrates one method of winding the field-ring *b* for a three-phase current. Inasmuch as this general type of motor is well known, no further description of the same is deemed necessary. The armature *a* is provided with a shaft a', to which is secured an arm a^2, having a counterweight a^3, normally tending, as illustrated in Fig. 3, to turn the shaft from left to right. On the arm a^2 concentric with the shaft a' is formed a plate a^4, having extending from its periphery a cam a^5 and a stop-finger a^6. Outside the casing a^7 of the motor is located a cross-piece a^8, forming one of the bearings for the shaft *a*, and from this piece a^8 projects a bracket *d*, to which is pivoted an angle-arm d', one end of which normally rests adjacent to the periphery of the plate a^4, whereas the other end carries a pawl or detent d^2. The pawl d^2 is adapt-

ed normally to rest in a notch d^3 of a plate d^4, carried by a shaft d^5, suitably supported in the casing of the motor, and said plate d^4 has a counterweighted arm d^6, normally tending to turn the plate d^4 and shaft d^5 in one direction, which, as shown in Fig. 3, is from right to left. When the detent or pawl d^2 is in the notch d^3, the plate d^4, shaft d^5, and arm d^6 are locked and cannot turn. When, however, the detent d^2 is elevated, the counterweighted arm d^6 turns the plate d^4 and shaft d^5. Eccentrically located on the plate d^4 is a pin d^7, engaging one end of a slotted tubular bracket e, in which is suitably secured the stem e' of the air-valve e^2, which when lowered is adapted to permit the entrance of air from the pipe e^3, which is connected to a source of compressed air, (not shown,) into the air cylinder or bulb e^4 and its passage into an outlet-pipe e^5, which outlet-pipe e^5 extends to an air-cylinder f, in which works a piston f', as illustrated in Fig. 5. The piston f' is secured in any suitable manner to a rod f^2, adapted to operate the circuit-breaker E. The rod f^2 is provided with a handle f^3, whereby when required the rod may be manually manipulated.

So far as explained the operation of the motor A and its accessories is as follows: The rotary magnetic field of the motor exerts a continuous but varying torque upon the armature a, which tendency is normally overcome by the torque exerted upon the shaft a' by the counterweighted arm a^2. When the torque of the rotary magnetic field is abnormally increased to an extent sufficient to overcome the opposing torque upon the armature a, the shaft a' and plate a^4 will be turned until the cam a^5 impinges upon the free end of the detent-arm d' and shifts the same to elevate the detent d^2 from the notch d^3 of the plate d^4. The counterweighted arm d^6 now turns the plate d^4, and the eccentric-pin d^7 lowers the stem e' of the valve e^2 to thereby permit air to pass into the air-cylinder f to operate the piston f' and shift the rod f^2 in one direction, the rod f^2 when so shifted operating the circuit-breaker E and cutting out or breaking the current. To prevent the weighted arm a^2 of the armature-shaft a' from rotating too far in either direction, a stop-pin a^9 is located on the cross-piece a^8, and against this pin either the stop-finger a^6 of the plate a^4 or the arm a^2 itself impinges. The detent d^2 may be manually operated when desired by means of the slide-bar g, having a headed end g', adapted to impinge when the bar is elevated upon a flange d^{12} on the pawl or detent d^2 and to elevate the same. The slide-bar g is also adapted when depressed to set the weighted plate d^4 in operative position. To accomplish this result, upon the shaft d^5 of the plate d^4 is provided a rock-arm g^2, having a slot g^3, through which the bar g slides. The head g' of the bar g when depressed will depress the arm g^2, and thereby turn the plate d^4 and shaft d^5 into their normal positions, wherein the detent d^2 again engages the notch of said plate d^4.

In the drawings the invention above explained is shown as adapted for use with three-phase currents, although it is obvious that with suitable modification in the winding of the field-magnet it may be used in conjunction with any polyphase current, whether two or more, which may be deemed desirable and practicable.

The circuit-breakers E may be of any desired form or type and will range in number according to the phase of the current. It is desirable to have two sets of circuit-breakers, as illustrated in Fig. 2, one set being operated automatically and the other manually by means of the rod f^4 and switch-handle f^5. The preferred type of circuit-breaker which is partly shown in Fig. 2 forms the subject-matter of a separate application for a patent filed by me on the 3d day of February, 1899, under the Serial No. 704,439, and hence I do not desire in the present application to show, describe, or claim the same, as it is obvious that any other form of circuit-breaker may be used with the motor A and its accessories.

Having thus described the nature and object of my present invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an automatic circuit-breaking device for polyphase currents, a circuit-breaker interposed in the polyphase current, a motor having a field-ring wherein a rotary magnetic field is adapted to be set up from the polyphase current, an armature under the continuous but varying torque of said field, means for holding said armature under a constant opposing torque, and mechanism controlled by said armature for operating the circuit-breaker when the torque of the field overcomes the constant opposing torque on the armature, substantially as and for the purposes described.

2. In an automatic circuit-breaker for polyphase currents, a motor having a rotary magnetic field, an armature under the varying torque of said field and under a constant opposing torque, a pneumatic device controlling the circuit-breaker, and mechanism controlled by said armature whereby when the armature yields to the torque of its field, the pneumatic device is actuated to operate the circuit-breaker, substantially as and for the purposes described.

3. In an automatic circuit-breaking device for polyphase currents, a circuit-breaker interposed in the polyphase current, a motor having a field-ring, wherein a rotary magnetic field is adapted to be set up from the polyphase current, an armature under the continuous but varying torque of said field, a shaft carried by said armature, a counterweighted arm carried by and exerting a constant torque upon the shaft and armature in opposition to the torque of said field, and mechanism controlled by the shaft for operating the circuit-breaker, when the torque of the field overcomes the constant opposing torque upon the

shaft, substantially as and for the purposes described.

4. In an automatic circuit-breaking device for polyphase currents, a circuit-breaker, an air-cylinder and its piston directly controlling the circuit-breaker, a valve controlling the inlet to said cylinder, a counterweighted arm adapted when released to operate said valve, a detent adapted to lock said counterweighted arm, a motor having a rotary magnetic field, an armature under the varying torque of said field and under a constant opposing torque, and mechanism controlled by said armature whereby when said armature yields to the torque of its field, the detent will be actuated to release the counterweighted arm, substantially as and for the purposes described.

In testimony whereof I have hereunto set my signature in the presence of two subscribing witnesses.

AXEL H. ENGSTROM.

Witnesses:
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THOMAS M. SMITH.