

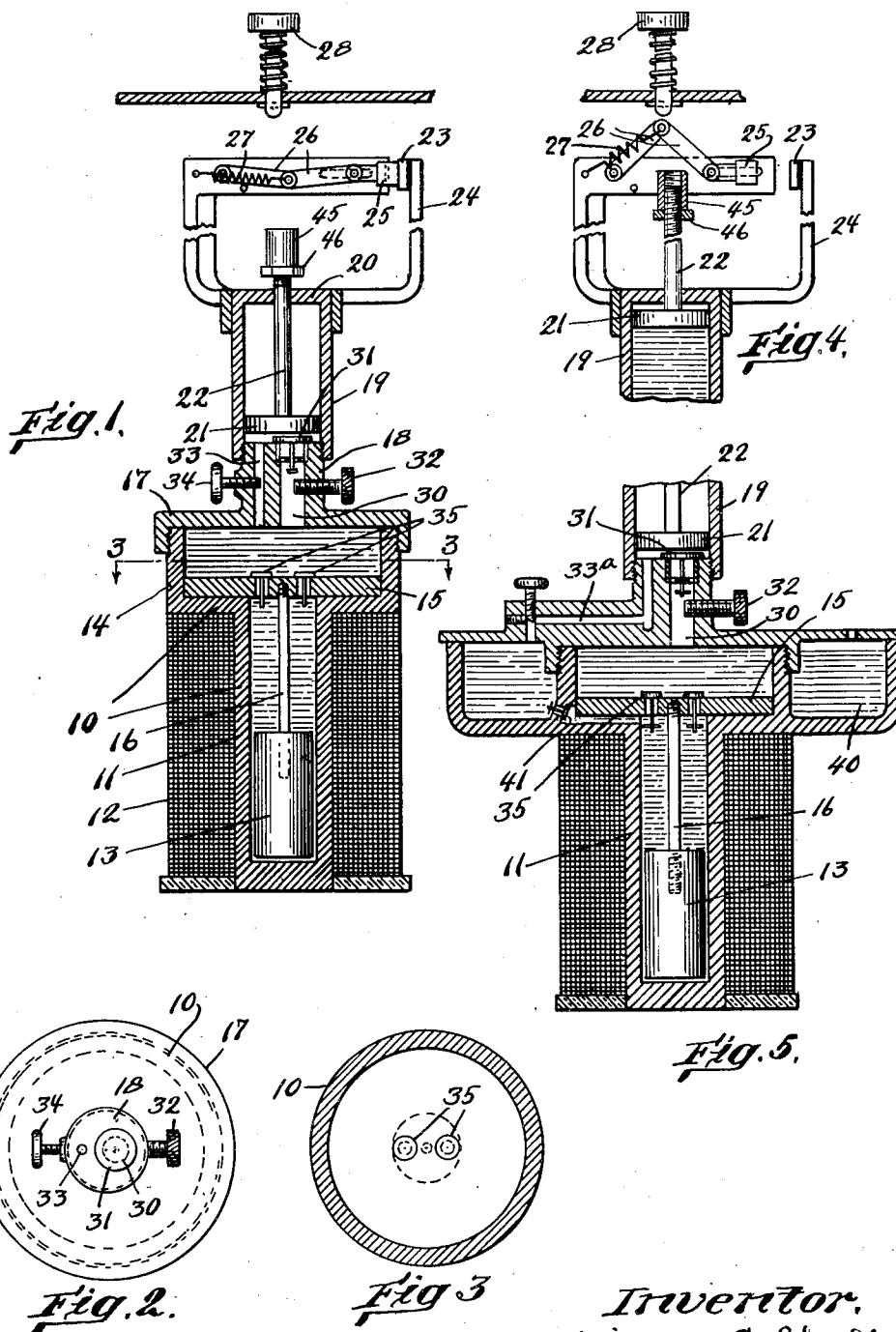
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ELECTRIC CIRCUIT CONTROLLER

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UNITED STATES PATENT OFFICE

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ELECTRIC CIRCUIT CONTROLLER

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This invention relates to electric circuit-controllers and particularly to a relay adapted to be energized a successive number of times before it is finally actuated to control its circuit.

In electric distribution systems, when a short circuit or other abnormal condition occurs on the system, and the electric switch controlling the particular part of the system in which the abnormal condition occurs is caused to open upon over-load, it is or may be desirable to reclose the switch automatically and within a short time after it has opened in order to maintain continuity of service. If the abnormal condition still exists in the system, the switch may be again opened. It is desirable to reclose the switch a number of times as, for instance, three or four times and if the abnormal condition is only temporary, it may disappear prior to one of the switch-reclosing operations, and the switch, when reclosed will remain closed. If, however, after the switch has been automatically reclosed a certain number of times and still trips open, it is evident that the abnormal condition is more or less permanent and it is thereupon desired to maintain the switch open.

This invention has for its object the provision of a relay, termed a "notching" or "counting" relay, which is arranged to control the number of times that the switch may be reclosed, and to finally disconnect the switch from the automatic reclosing devices until an operative manually reconditions the system for further automatic reclosing.

Briefly the invention comprises a hydraulic relay having a notching piston and cylinder which are in fluid communication with a second or actuating piston and cylinder, and said latter piston is arranged to be electrically operated each time the switch is opened. The actuating piston is adapted to force a suitable fluid into the notching cylinder and thereby move the notching piston outwardly. The arrangement is or may be such that, when the actuating piston has been operated a predetermined number of times, sufficient fluid will have been forced into the notching cylinder to move the notching piston into a

circuit-controlling position. The notching cylinder is preferably provided with a leak passage extending therefrom and the fluid in said cylinder is adapted to flow continually therefrom through said passage so that, while the notching piston may be moved into circuit-controlling position, if the actuating piston has operated with sufficient rapidity a sufficient number of times, yet if said actuating piston has operated repeatedly but with relative long intervals between successive operations, the fluid will leak out of the notching cylinder between the operations and consequently, the notching piston will not be moved a sufficient distance to effectively control the controlling circuit.

Fig. 1 is a sectional elevation of a notching relay embodying the invention.

Fig. 2 is a plan view of Fig. 1 with the notching cylinder removed.

Fig. 3 is a section along line 3—3 of Fig. 1.

Fig. 4 is a detail illustrating the relative position of the relay contacts and the notching piston in an operated position thereof.

Fig. 5 is a sectional detail illustrating a modified construction of relay.

As here shown, the notching relay embodying the invention includes a casing 10 which may be formed of bakelite or other suitable material. Said casing may have a lower cylinder portion 11 about which a solenoid winding 12 may be disposed and in which a core or plunger 13 may be movably received. Said casing may have an enlarged upper portion 14 which is adapted to form the pump or actuating cylinder of the relay. An actuating piston 15 is movably disposed within said cylinder and is or may be connected with said plunger 13 by means of the rod 16 whereby, when said plunger 13 is moved upwardly, said piston 15 will also be moved upwardly. The upper portion of said cylinder 14 may be externally screw-threaded and a cover 17, which may comprise a cylinder head, is or may be screw-threaded on said cylinder. Said cover 17 is or may be formed with a neck 18 which extends above said cover; and a notching cylinder 19 may be screw-threaded thereon. Said notching cylinder may be closed at its upper end by the integrally-

formed end wall 20 or other suitable means. A notching piston 21 is or may be received within said cylinder and the piston rod 22 thereof may extend upward and slidably through an aperture in the end wall 20 of said cylinder. A stationary contact member 23 of the circuit-controller of the relay may be carried by a suitable supporting frame 24 in a position above the notching cylinder, and a movable contact member 25 may cooperate with said fixed contact member. Said movable contact member may be actuated by any suitable means such as links 26 which are connected to form toggle members. A spring 27 may be connected with said frame 24 and the toggle and may be arranged to hold the contact members closed when in the position illustrated in Fig. 1. Said spring is also arranged to forcibly separate said contact members when the toggle is tripped or moved beyond off-center position, whereby to move said contact members and the toggle members into some such circuit-open position as illustrated in Fig. 4. Suitable means may be provided to effect the resetting of the switch after it has been effectively operated. For convenience, manual resetting means is herein illustrated and said means may comprise a manual resetting button 28 which may be disposed above said toggle members and may serve, when depressed, to reset the toggle members and close the switch.

The neck 18 of said cylinder cover 17 is or may be formed with a passage 30 therein by which communication between the upper end of the actuating cylinder 14 and the notching cylinder 19 is or may be established. A valve 31 may be disposed within said notching cylinder above said passage 30 and serve to admit a suitable fluid as oil into the notching cylinder through said passage but prevent its return to the actuating cylinder through said passage. A valve member, which may comprise the screw 32, may be adjustably disposed in said passage whereby to vary the cross-sectional area thereof and thereby regulate the rate of flow of oil from the actuating into the notching cylinder. Said neck 18 is or may be also provided with a second or leak passage 33 which is or may be disposed in direct communication with the pump and notching cylinders. A regulating screw 34 may be disposed in said passage to govern the rate of escape of oil from the notching cylinder into the pump cylinder.

The piston 15 is or may be provided with valves 35 therein which may serve to admit oil from the space beneath said piston, if oil leaks past the piston, although if the piston is maintained in oil tight engagement with the cylinder said valves may not be necessary. The actuating cylinder 14, in the arrangement illustrated in Fig. 1, is adapted to be of substantially greater diameter than the diameter

of the notching cylinder and is adapted to contain a substantial amount of oil. The solenoid 12 is or may be energized for a comparatively short interval each time the line switch is opened. Consequently, at each energization of the solenoid, the pump piston 15 is moved upwardly in its cylinder and oil is forced from the pump cylinder into the notching cylinder whereby to raise the notching piston 21. Due to the restricted passage 30 connecting said cylinders, the contents of the pump cylinder are not transferred completely into the notching cylinder at the first momentary operating impulse thereof. If there are a number of operating impulses in close sequence, the pump piston 15 will be correspondingly actuated and at each operation force a certain amount of oil or other suitable fluid into the notching cylinder. When the pump piston has been actuated rapidly a successive and predetermined number of times, determined by the relative volumes of the pump and notching cylinders, a sufficient quantity of oil will have been introduced into the notching cylinder to raise the notching piston upwardly a sufficient distance to engage and trip the circuit-controller. If, however, the time period between impulses is relatively long, oil which has been moved into the notching cylinder during one impulse will have had an opportunity to escape from the notching cylinder through the leak passage 33 and the notching piston will descend so that upon the next operating impulse, the notching piston must be again raised over substantially the distance it was raised on the previous impulse. Therefore, if the time period between the operating impulses of the pump piston 15 is relatively long, the notching piston will not be raised a sufficient amount to trip the circuit-controller and for the reason that the fluid will leak back into the pump piston between each successive impulse. If, however, the time period between impulses is sufficiently short, then oil will be forced into the notching cylinder at a greater rate than it can escape therefrom and, after a predetermined number of impulses, the notching piston will be moved upwardly a sufficient distance to trip the circuit-controller. The number of impulses necessary to effectively actuate the notching piston may be governed by the adjusting screws 32 and 34.

Fig. 5 illustrates a modified form of the structure illustrated in Fig. 1, the principal modification being a fluid reservoir 40 disposed about the pump cylinder and having communication with the lower end thereof through the check valve 41. The notching cylinder in this modification is or may be arranged to leak through the leak passage 33 into the reservoir rather than directly into the pump cylinder as illustrated in Fig. 1. With this arrangement, the actuating cylinder

der is or may be arranged to displace substantially its entire contents into the notching cylinder at each operation thereof and receive a further supply of liquid from the reservoir

3 40. The dimensions of the actuating and notching pistons in this instance are or may be so proportioned that a desirable number of successive operations may take place without effectively actuating the notching cylinder.

10 The upper end of the piston rod 22 of the notching piston may be screw-threaded and an adjustable extension member 45 may be screw-threaded thereon and locked in adjusted position by suitable means as the check-nut 46. Said member is adapted, by suitable adjustment thereof along the length of the piston rod 22, to control the number of successive impulses necessary to actuate the

20 circuit controller.
The structure herein shown may be otherwise modified without departing from the spirit of the invention.

I claim:

25 1. An electric circuit-controller having a circuit-controlling member arranged normally to remain in one position until operated, an operating member for said circuit-controlling member having provision for successive

30 step by step movements in the same direction to gain control of and operate said circuit controlling member, an actuating member for said operating member, and fluid-means connecting said operating and actuating members arranged to require the rapidly repeated operation of said actuating member for one effective operation of said operating member to control said circuit-controlling member.

40 2. An electric circuit-controller comprising a circuit-controlling member, two intercommunicating cylinders adapted to contain a fluid, an operating piston for said circuit-controlling member disposed in one of said cylinders, an actuating piston disposed in said

70 40. The dimensions of the actuating and notching pistons in this instance are or may be so proportioned that a desirable number of successive operations may take place without effectively actuating the notching cylinder.

75 4. An electric circuit-controller having a circuit-controlling member adapted normally to remain in closed-circuit position, means to hold it in open-circuit position when operated, and operating means for said circuit-controlling member comprising an actuating cylinder and piston, an operating cylinder and piston for said circuit-controlling member governed by said actuating cylinder and piston, means providing fluid communication in both directions between said cylinders, and means governing such fluid communication

85 arranged to provide for a plurality of repeated operations of said actuating piston within a predetermined time period for effective actuation of said operating piston to operate said circuit-controlling member.

90 5. An electric circuit-controller having a circuit-controlling member, and operating means for said member comprising an operating cylinder and piston, an actuating cylinder and piston arranged for fluid control of said operating piston, said actuating piston being free from said circuit-controlling member, means to govern the amount of fluid delivered into said circuit-controlling cylinder at each stroke of said actuating piston, and means to withdraw fluid from said circuit-controlling cylinder.

105 6. A counting relay having a normally closed circuit-controller, and tripping means therefor including a circuit-controlling cylinder and piston, an actuating cylinder and piston arranged to control said circuit-controlling piston, said cylinders and pistons so constructed and arranged to require a plurality of operations of said actuating piston to fill said circuit-controlling cylinder, and a leak passage leading from said circuit-controlling cylinder.

110 7. A counting relay having a normally closed circuit-controller, and tripping means therefor including a circuit-controlling cylinder and piston, an actuating cylinder and piston, a valve-governed passage to admit fluid from said actuating into said circuit-controlling cylinder, means to regulate the amount of fluid delivered into said circuit-controlling cylinder at each operation of said actuating piston, means to provide a continual fluid leak from said circuit-controlling cylinder, and means to govern such fluid leak.

125 8. A counting relay having a normally closed circuit-controller, and tripping means therefor including a circuit-controlling cylinder and piston, an electric circuit-controller arranged to be operated by said piston,

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an actuating cylinder and piston arranged to force fluid into said circuit-controlling cylinder to move the piston thereof to operate said controller, means to establish fluid communication between said cylinders, means to regulate the flow of fluid from said actuating to said circuit-controlling cylinder, means to provide for a flow of fluid from said circuit-controlling cylinder, and means to govern such fluid flow.

9. A counting relay having a normally closed circuit-controller, and tripping means therefor including a circuit-controlling cylinder and piston, an electric switch having a movable member arranged to be operated by said piston, said piston having an adjustable member thereon arranged to be adjusted toward and away from the movable switch member, an actuating cylinder and piston arranged to force fluid into said circuit-controlling cylinder to move the piston thereof and operate the switch, means to establish fluid communication between said cylinders, means to regulate the flow of fluid from said actuating to said circuit-controlling cylinders, means to provide for a flow of fluid from said circuit-controlling cylinder, and means to govern such fluid flow.

10. A counting relay including a circuit controller arranged normally to remain in one condition until operated, an actuating member therefor adapted repeatedly to operate in an attempt to operate said circuit-controller, and fluid-governed means interposed between said circuit-controller and said actuating member having provision for effecting the operation of said circuit-controller only after a predetermined number of attempts by said actuating member within a predetermined period of time.

In testimony whereof, I have signed my name to this specification.

WILLIAM S. EDSALL.

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