May 12, 1931. W. S. EDSALL 1,805,082

COUNTING RELAY

Filed Nov. 19, 1927

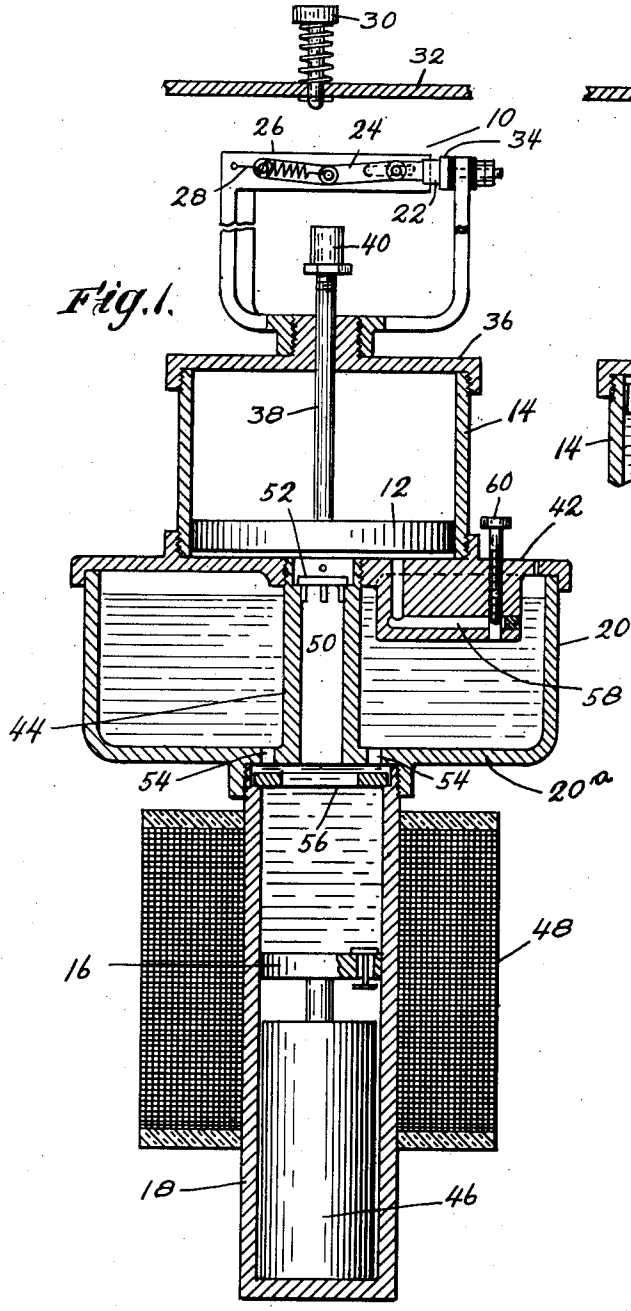


Fig. 1.

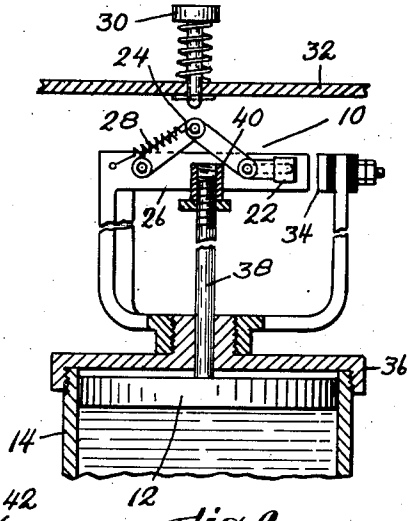


Fig. 2.

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UNITED STATES PATENT OFFICE

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COUNTING RELAY

Application filed November 19, 1927. Serial No. 234,384.

This application is a continuation in part of my copending application Serial No. 634,890, filed April 26, 1923, which eventuated into Patent No. 1,737,649, dated December 3, 1929.

This invention relates to electric circuit controllers and particularly to notching or counting relays which are characterized by necessitating energization a predetermined number of times within a predetermined time interval in order to effectuate control of the associated circuit controller.

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 overload, 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. The notching or counting relay is used for this purpose and is arranged, after its effective operation, to prevent further automatic reclosing of the switch.

An object of this invention is the provision of a notching or counting relay which is cheap, simple and rugged and free from pawls and ratchets and other mechanical parts that may wear with continued use and eventually cause trouble.

A further object is the provision of a counting relay having a circuit controller which is operated hydraulically by means of a large piston when it moves to the end of its stroke in its cylinder, combined with a small pump piston and cylinder actuated electrically, the large cylinder having several times the capacity of the small cylinder so that the small cylinder must be operated several times before filling the large cylinder and moving the piston therein to the end of its stroke. The large cylinder is provided with a leak passage through which the fluid in the cylinder can gradually escape so that the cylinder must be filled within a predetermined time governed by the size of the leak passage in order for the piston therein to be effectively operated.

A further object is generally to improve the construction and operation of counting relays.

Fig. 1 is a sectional elevation through a counting relay embodying the invention.

Fig. 2 is a sectional detail of the upper portion of the relay of Fig. 1 and particularly illustrating the open circuit position of the movable circuit controlling member.

The counting relay embodying this invention includes a circuit controller 10, the operating piston 12 and cylinder 14 therefor, the actuating or pump piston 16 and its cylinder 18 and a reservoir 20 for fluid, as oil for instance, interposed between the operating and pump cylinders. The circuit controller includes a movable member 22 which is adapted to remain in one position, herein shown as circuit closed position, until moved therefrom and is operated by means of a toggle 24 carried by a supporting frame 26. The toggle is adapted to be maintained in slightly overshot and circuit closed position by an operating spring 28, which spring also snaps the movable member to open position and holds it in such position as illustrated in Fig. 2. The toggle can be reset and the circuit controller closed by means of a yieldingly supported push button 30 carried on a support 32 which may be the wall of a casing enclosing the counting relay. The movable contact member 22 cooperates with an insulated stationary contact member 34 also carried by the frame 26, which frame is carried by the upper cover plate 36 of the operating cylinder 14. A piston rod 38 of said piston 12 is slidably extended upwardly through said cover plate and has a

sleeve 40 adjustably screw threaded thereon which is disposed beneath and normally out of engagement with the toggle 24, and is adapted to be moved upwardly and to engage said toggle and thereby open the circuit controller when the piston 12 is moved upwardly about to the end of its stroke in the cylinder 14.

The lower end of the cylinder 14 is closed by a cover plate 42 which also forms a cover plate for the fluid reservoir 20. Said cover plate 42 is screw threaded on the upper end of a neck 44 upstanding from the bottom wall 20*a* of the fluid reservoir. The bottom wall 20*a* of the reservoir 20 is screw threaded to the upper end of the pump cylinder 18, which cylinder is closed at its lower end. The pump piston 16 is connected with the upper end of an iron core or plunger 46 which normally occupies the lower end of the pump cylinder 18. A solenoid 48 surrounds said pump cylinder and is adapted when energized to attract the core 46 and move it upwardly and thus move the pump piston to the top of its cylinder. Fluid can flow from the pump cylinder into the operating cylinder 14 through a passage 50 in the neck 44 but a valve 52 in said passage prevents the return flow of oil through said passage. Fluid can flow into the cylinder 18 on the down stroke of the piston therein from the fluid reservoir 20 through holes or passages 54 in the wall thereof and a valve plate 56 operating in a recess in the upper end of the wall of the cylinder 18 prevents flow of fluid in the opposite direction. Fluid can escape from the operating cylinder 14 and return to the reservoir 20 through a leak passage 58. A screw 60 in said passage serves to govern the effective cross-sectional area thereof and thus governs the rate at which fluid flows out of said cylinder.

As thus arranged, each time the solenoid 48 is energized the pump piston 16 will make a complete stroke and force the fluid in its cylinder into the operating cylinder 14 and thus raise the piston 12 a certain amount, which is less than the full stroke of said piston. The capacity of the cylinder 14 is adapted to be considerably greater than that of the pump cylinder so that it will require, say, three strokes of the pump piston to fill the operating cylinder and move the operating piston 12 to the end of its stroke and cause it to operate the circuit controller. If, however, the time intervening between successive pumping operations is too long, the fluid in the cylinder 14 will have had time to run out of the cylinder so that the effect of previous pumping operations will have been nullified so that a new cycle of pumping operations must be started and the successive pumping operations must be performed with a predetermined rapidity, depending upon the setting of the adjusting screw 60, for the piston 12 to operate the circuit controller.

The number of strokes of the pump piston necessary to raise the operating piston sufficiently to actuate the circuit controller can be varied by moving the sleeve 40 up and down the piston rod 38, it being apparent that, if said sleeve is close to the circuit controller, it will take fewer pumping operations than if the sleeve is farther away.

I claim:

1. A counting relay including a circuit controller adapted to remain in one position until moved therefrom to control its circuit, an operating cylinder, a piston therein normally disposed in the bottom of the cylinder and adapted to return to such position when moved therefrom and being normally free from operative connection with said circuit controller and adapted to actuate said circuit controller when moved to the end of its stroke in said cylinder, a pump piston and cylinder for supplying fluid to said operating piston and cylinder, and a passage between said cylinders providing for free transfer of fluid from said pump cylinder to said operating cylinder, said operating cylinder having a larger volume than the pump cylinder so that it requires a number of strokes of the pump piston to fill the operating cylinder and effect operation of the circuit controller.

2. A counting relay including a circuit controller adapted to remain in one position until moved therefrom to control its circuit, an operating cylinder, a piston therein normally disposed in the bottom of the cylinder and adapted to return to such position when moved therefrom and being normally free from operative connection with said circuit controller and adapted to actuate said circuit controller when moved to the end of its stroke in said cylinder, a pump piston and cylinder for supplying fluid to said operating piston and cylinder, and a passage between said cylinders providing for free transfer of fluid from said pump cylinder to said operating cylinder, said operating cylinder having a larger volume than the pump cylinder so that it requires a number of strokes of the pump piston to fill the operating cylinder and effect operation of the circuit controller, said operating cylinder having a leak passage through which fluid therein can slowly escape.

3. A counting relay including a circuit controller, a hydraulic cylinder, a piston therein for operating said controller only when the piston is moved to the end of its stroke in the cylinder, a pump cylinder and piston for supplying fluid to the operating cylinder and piston, and a passage between said cylinders providing for free transfer of fluid from said pump cylinder to said operating cylinder, said operating cylinder having a greater fluid capacity than said pump cylinder so that it requires several operations of the pump piston to move said operating piston to the end

of its stroke and actuate said circuit controller.

4. A counting relay including a circuit controller, a hydraulic cylinder, a piston therein for operating said controller when the piston is moved to the end of its stroke in the cylinder, a pump cylinder and piston for supplying fluid to the operating cylinder and piston, and a passage between said cylinders providing for free transfer of fluid from said pump cylinder to said operating cylinder, said operating cylinder having a greater fluid capacity than said pump cylinder so that it requires several operations of the pump piston to move said operating piston to the end of its stroke, said operating cylinder having a leak passage through which fluid can slowly escape from said cylinder.

5. A counting relay including a circuit controller, a hydraulic cylinder, a piston therein for operating said controller when the piston is moved to the end of its stroke in the cylinder, a pump cylinder and piston for supplying fluid to the operating cylinder and piston, a passage between said cylinders providing for free transfer of fluid from said pump cylinder to said operating cylinder, said operating cylinder having a greater fluid capacity than said pump cylinder so that it requires several operations of the pump piston to move said operating piston to the end of its stroke, and a fluid reservoir supplying fluid to said pump cylinder and piston, said operating cylinder having a leak passage opening into said reservoir through which fluid can slowly leak out of said operating cylinder.

6. A counting relay comprising an operating cylinder, and piston, a pump cylinder and piston disposed therebeneath and supplying said operating cylinder and piston with fluid, a fluid reservoir disposed between said operating and pump cylinders and having provision for supplying said pump cylinder with fluid, a circuit controller disposed above said operating cylinder in position to be engaged and operated by said operating piston when it arrives at the upper end of its stroke, said piston normally tending to descend in said cylinder and occupy the bottom part thereof, and a passage between said cylinders providing for free transfer of fluid from said pump cylinder to said operating cylinder, said operating cylinder having a larger capacity than said pump cylinder so that said pump piston must operate several times to fill said operating cylinder and move said operating piston to the upper end of its stroke, and said operating cylinder having a fluid leak passage extending from said cylinder to said fluid reservoir by which fluid can slowly leak out of said operating cylinder.

7. A counting relay including a circuit controller, a hydraulic cylinder, a piston therein for operating said controller, and a pump piston and cylinder for supplying a measured volume of fluid to said operating cylinder and piston, said operating cylinder having a greater fluid capacity than said pump cylinder.

8. A counting relay including a circuit controller, a hydraulic cylinder, a piston therein for operating said controller, and a pump piston and cylinder for supplying a measured volume of fluid to said operating cylinder and piston, said operating cylinder having a greater fluid capacity than said pump cylinder, and means by which the number of pumping operations of said pump piston necessary to effectively actuate said operating piston can be varied.

9. A counting relay including a circuit controller, an operating cylinder, a pump cylinder adapted to contain fluid and having a fluid capacity which is a fraction of the fluid capacity of said operating cylinder, a passage connecting said operating and pump cylinders by which all of the fluid contained in said pump cylinder is delivered into said operating cylinder, an operating piston in said operating cylinder for operating said controller, a pump piston in said pump cylinder, and means to operate said pump piston to transfer the entire fluid content of said pump cylinder to said operating cylinder at each operation of said pump piston.

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

WILLIAM S. EDSALL.