Oct. 17, 1933. W. KEMP ET AL 1,930,561

ELECTRICALLY OPERATED REGULATOR

Filed Jan. 13, 1932

Fig.1.

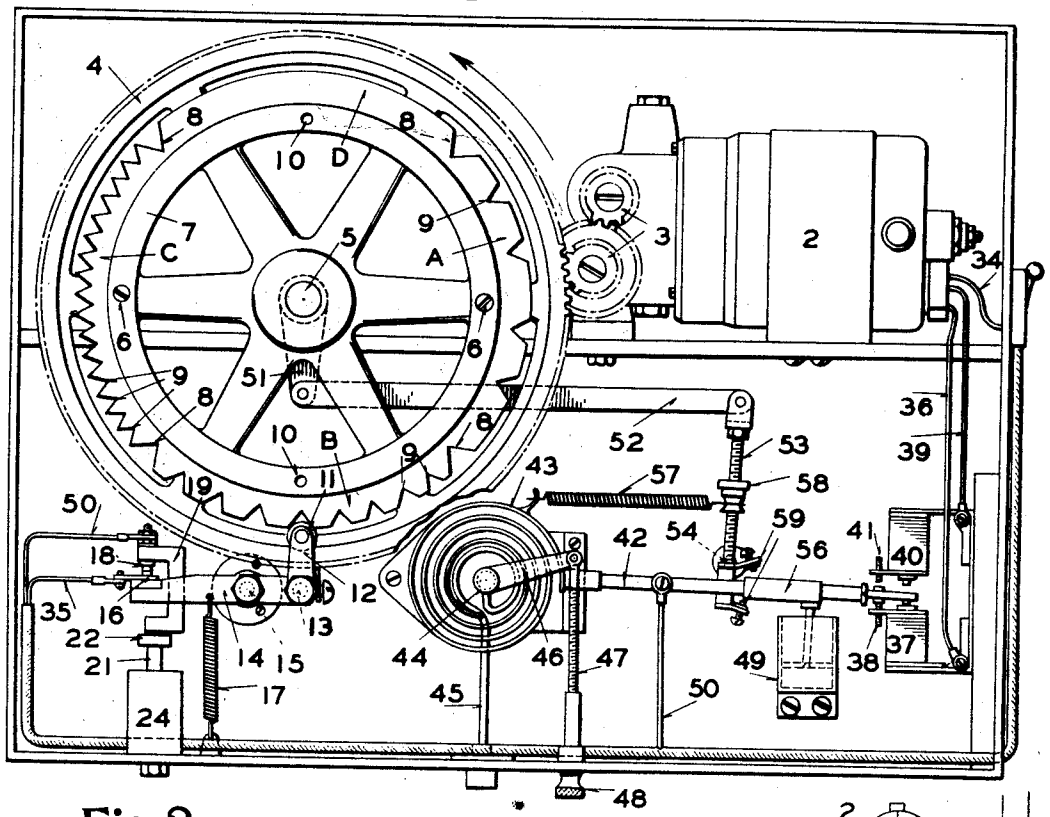


Fig.2.

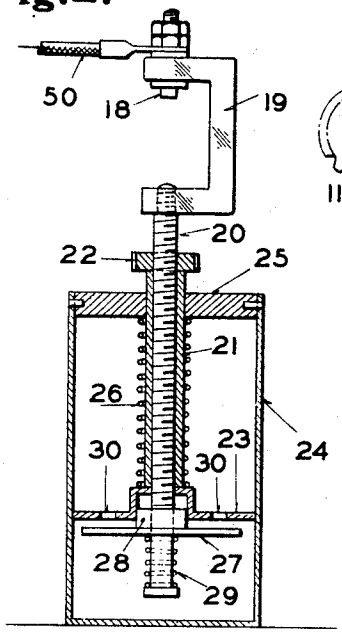
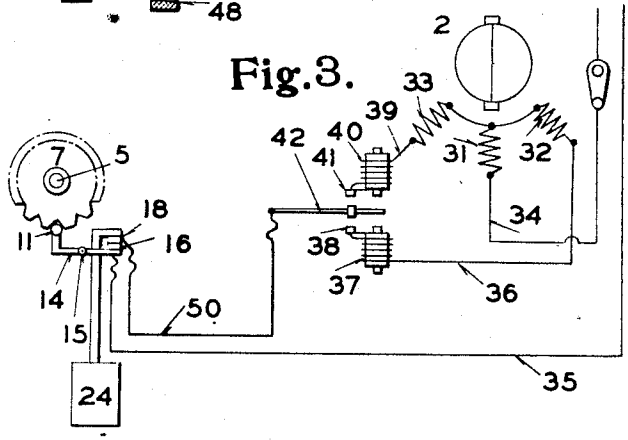


Fig.3.



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ELECTRICALLY OPERATED REGULATOR

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8 Claims. (Cl. 172—239)

Our invention relates to an electrically operated regulator such as is adapted to open and close a damper, valve, or other control device to regulate pressure, temperature or the like.

One object of our invention is to so construct a regulator, of the class referred to, that the operation of the control device will take place in a series of distinct steps, and further, to provide means for the lapse of a predetermined minimum of time between steps, which minimum may, however, be varied by suitable adjusting means to comply with the requirements of the particular apparatus to be regulated.

Another object of our invention is to provide an auxiliary circuit breaker, whereby injury to the contact points of the reversing switch by sparking or arcing, is avoided, and to further protect the reversing switch points by providing holding magnets to prevent vibration of the moving parts of the switch.

In the accompanying drawing, which illustrates one form of regulator made in accordance with our invention, Figure 1 is a side elevation; Figure 2 is an enlarged section of the time control device; and Figure 3 is a wiring diagram.

The parts of the device are carried on a supporting plate 1 adapted to be mounted in vertical position on a wall or the like. A motor 2 drives, through the medium of reducing gearing 3, a large gear wheel 4 mounted on a rock shaft 5. One end of this shaft is connected with the damper, valve, or other control means (not shown) of the apparatus to be regulated. The shaft and wheel have a maximum movement of 90 degrees. Mounted on the gear wheel 4 by a pair of oppositely disposed screws 6 is a control member 7 in the form of an annulus or ring. The periphery of this ring is divided by deep or safety notches 8 into quadrants "A", "B", "C", and "D". The quadrants have formed in them shallow notches 9, the number of which in a quadrant determines the number of steps required to move the control mechanism from one extreme position to the other when that segment is in operative position. To allow any of the four quadrants to be brought into operative position we form, midway between the opening in which the screws 6 are positioned, a second pair of screw holes 10. In Figure 1 the ring is shown in the position to bring the quadrant "B" into operative position. In the drawing we have shown quadrant "A" provided with four notches 9, quadrant "B" with eight, and quadrant "C" with sixteen, quadrant "D" being left unnotched or blank. It will be understood, however, that the number of notches used is purely arbitrary and may be varied as desired.

Engaging with the notches in the control ring is a roller 11 carried on an arm 12 pivoted at 13 to a lever 14 fulcrumed at 15 and carrying a contact 16. The arm 12 has a limited movement on its pivot in order to impart a quick or snap movement to the contact as the roller enters and leaves the notches of the control ring. A spring 17 tends to move the arm toward the ring. The contact 16 cooperates with a contact 18 carried by a U-shaped frame 19. This frame is mounted on a threaded rod 20 engaging with the threaded interior of a tube 21 having on its upper end a knurled head 22 and on its lower end a piston 23 fitting in a dash pot cylinder 24. The tube 21 slides in a central opening in the cover 25 of the dash pot and is biased to move downwardly by a coil spring 26 interposed between the cover and the piston. Situated below the piston is a disk 27 slidingly mounted on the lower end of the rod 20. The upper movement of this plate on the rod is limited by a collar 28 fixed upon the rod but it may move downwardly on the rod against the pressure of a coil spring 29. The object of the disk 27 is to retard the downward movement of the piston in the cylinder by limiting the flow of the liquid such for example, as oil with which the cylinder is filled, through ports 30 in the piston. The amount of retardation will depend upon the distance which the lower face of the collar 28 projects below the lower face of the piston 23. This may be varied by rotating the knurled head 22 so that the speed at which the piston descends may be adjusted to any desired rate. During the upward movement of the piston the disk is free to move away from it against the pressure of spring 29 so that the upward movement is unretarded.

The motor 2 is reversible to drive the gear wheel 4 in either direction. In the form of device shown, we accomplish this result by using the type of motor having a main field winding 31 and two side windings 32 and 33. The current is lead through the main winding and one of the side windings to drive the motor in one direction and through the main winding and the other side wnding to drive it in the opposite directon. The main winding is connected to one side 34 of the supply line, the other side 35 being connected to the contact 16. The side winding 32 is connected by a line 36, including a holding magnet 37, with a fixed contact 38. The side

winding 33 is connected by a line 39, including a holding magnet 40, to a fixed contact 41. Positioned between the contacts 38 and 41 is an arm 42 which functions both as a movable contact and as an armature for the holding magnets. This arm is moved toward one or the other of the contacts 38 and 41 by changes in temperature, pressure, or other condition to be regulated, and is connected by line 50 with the contact 18. In the form of device shown, which is adapted for pressure regulation, the arm is carried on one end of a Bourdon gauge 43, the other end of which is attached to a hollow post 44. The fluid, the pressure of which is to be regulated, is delivered to the post and thence to the gauge through a tube 45. The post is capable of rocking movement and carries an arm 46, the end of which is attached to a threaded rod 47 engaged by a nut 48, by the rotation of which the post may be moved to adjust the gauge. A dash pot 49 of any usual construction may be attached to the arm 42 to dampen its movement.

Carried by the shaft 5 is an arm 51 connected by a link 52 to a lever 53 pivoted at 54 and provided with a pair of adjustable stops 59 adapted to contact with a block of insulating material 56 on the arm 42. The lever 53 is connected by a coil spring 57 with the gauge 43, the point of attachment of the spring to the lever being adjustable by means of a nut 58 threaded on the lever.

The operation of our regulator is as follows: Assuming the pressure to be normal, the parts will be in the position shown in Figure 1, the roller 11 engaging with one of the intermediate notches 9 of the operative quadrant "B". The arm 42, however, will be in the position shown in the diagram (Figure 3) so that no current will be supplied to the motor. In the event of rise in pressure, the gauge 43 will move the arm 42 upwardly until it engages the contact 41 which will supply the motor with current through the main winding 31 and side winding 33. This will actuate the motor in the direction to drive gear wheel 4 in the direction indcated by the arrow in Figure 1. As the current passes through the holding magnet 40, the arm 42, acting as an armature for the magnet, will be held in position against the contact 41 to prevent vibration of the arm with consequent interruption of current and sparking, or arcing, at the contacts. As soon as the wheel 4 moves, it will force the arm 12 downwardly, swinging the lever 14 on its fulcrum and raising the contact 16 and with it, the contact 18 and attached parts. These parts are capable of rapid movement in an upward direction, as has been heretofore set forth. When the next notch 9 reaches the roller 11, the roller will be forced into it by the action of spring 17 lowering the contact 16 by a rapid or snap movement. As the movement of the contact 18 is retarded by the time control device, the circuit will be broken between contacts 16 and 18 and the motor stopped. A certain interval of time, depending upon the adjustment of the disk 27 with respect to the piston, will intervene before the contact 18 is brought against the contact 16 by the action of the spring 26. This interval is to allow time for the action of the valve, damper, or the like to reduce the pressure. If the pressure is sufficiently reduced when the contacts 16 and 18 are brought together, the arm 42 will be returned to the position shown in Figure 3 by the gauge so that the parts will remain in this position until further change in the pressure. In the event the pressure has not been sufficiently reduced, the arm will remain against the contact 41 and the apparatus will be moved another step to further close the valve or damper. These steps will be continued until the pressure is reduced to the desired amount, or until the end of the movement of the control device is reached. When the limit of the control movement in the direction indicated is reached, the upper end of the lever 53 will be moved so far toward the right hand side that the upper stop 59 prevents the arm 42 from engaging the contact 41 so that the motor cannot be further operated in this direction. When the limit of movement in the other direction is reached, the lower stop 59 performs the same function, preventing the arm 42 from engaging the contact 38. If, for any reason, such as wear or improper adjustment, the stops 59 fail to perform their proper function, the safety notches 8 provide a further means for preventing overrunning of the device. These notches are deeper than the notches 9 and when the roller enters one of them, the contact 16 is allowed to drop so far that it will not be engaged by the contact 18 when the latter is in the lowest position. Consequently, the motor circuit will remain interrupted and the device will not resume automatic operation until the wheel 4 is positioned manually so that the roller 11 will engage with an intermediate portion of the quadrant. It will be noted that the gauge 43 moves the same distance to close the circuit at each step. In order, therefore, that it may properly function, tension must be added to the gauge as the device moves in one direction, and subtracted from it as it moves in the other direction. This is accomplished by the spring 57, the tension of which varies with the movement of the lever 53. The rate at which this variation takes place may be adjusted to the proper amount to meet the requirement of the case by adjusting the nut 58 toward or away from the pivot point 54 of the lever. In case the pressure falls below normal, the same step or series of steps takes place, except that the arm 42 engages the contact 38 leading the current through the main field winding 31 and side winding 32 to drive the motor in the opposite direction.

It will be seen that with our regulator, the opening and closing of the damper or other control device, is accomplished in a series of timed steps, both the duration and number of which may be varied to suit the requirements of the case. Further, the breaking of the motor circuit takes place between the auxiliary contacts 16 and 18 and not between the points of the main or control switch and, consequently, these points are not subjected to the surge of current occurring when the current is interrupted. The holding magnets 37 and 40 prevent vibration of the arm 42 while the motor is running. The arrangement of the circuits is, however, such that the magnets do not influence either the opening or closing of the circuit through the reversing switch and hence do not interfere with the functions of the gauge.

Having fully described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. In a device of the class described, an electric motor, a control actuating member driven thereby, a reversing switch for said motor including a magnet for holding the movable member of the reversing switch while the motor is

running, said reversing switch being actuated by an element responsive to the condition of the apparatus to be controlled, an auxiliary switch operated from said control actuating member for opening the motor circuit, and means operated from said control actuating member when it has reached the limit of its travel for preventing the operation of said reversing switch in one direction.

2. In a device of the class described, an electric motor, a rotary member driven by said motor and provided with a plurality of cam faces, a reversing switch for said motor, a magnet included in the motor circuit for holding the movable member of the reversing switch, a pressure actuated element for operating said reversing switch, a spring connected to said pressure responsive element, means for varying the tension of said spring with the movement of said rotary member, an auxiliary switch in the motor circuit operated from the cam faces of said rotary member and timing mechanism for closing said auxiliary switch.

3. In a device of the class described, an electric motor, a rotary member driven by said motor and provided with a plurality of cam faces, a reversing switch for said motor, a magnet included in the motor circuit for holding the movable member of the reversing switch, a pressure actuated element for operating said reversing switch, a spring connected to said presure responsive element, means for varying the tension of said spring with the movement of said rotary member, an auxiliary switch in the motor circuit operated from the cam faces of said rotary member, and variable retarding means for closing said auxiliary switch after a predetermined period of time.

4. In a device of the class described, an electric motor, a rotary member driven from said motor and provided with a series of spaced notches, a reversing switch for the motor, a pressure gauge for controlling said reversing switch, an auxiliary switch in the motor circuit, a dog cooperating with successive notches in said rotary member to open said auxiliary switch, and retarding means for closing said auxiliary switch.

5. In a device of the class described, an electric motor, a rotary member driven from said motor and provided with a series of operating notches and with safety notches, a reversing switch for the motor, a pressure gauge for controlling said reversing switch, an auxiliary switch in the motor circuit, a dog cooperating with successive notches in said rotary member to open said auxiliary switch, and retarding means for closing said auxiliary switch, said means being inoperative to close the switch when the dog engages with a safety notch.

6. In a device of the class described, an electric motor, an annular member driven from said motor and adapted to oscillate through a limited arc, a plurality of series of notches in said annular member, means for shifting said annular member to bring a predetermined series of notches into operative position, a reversing switch for the motor, a pressure gauge for controlling said reversing switch, an auxiliary switch in the motor circuit, a dog cooperating with successive notches in said rotary member to open said auxiliary switch, and retarding means for closing said auxiliary switch.

7. In a device of the class described, an electric motor, a member driven from said motor and provided with a plurality of cam faces, a reversing switch for the motor, a Bourdon gauge controlling said reversing switch, an auxiliary switch in the motor circuit intermittently actuated by said cam faces, and connections between said member and gauge for varying the pressure at which the latter operates the reversing switch.

8. In a device of the class described, an electric motor, a member driven from said motor and provided with a plurality of cam faces, a reversing switch for the motor, a Bourdon gauge controlling said reversing switch, an auxiliary switch in the motor circuit intermittently actuated by said cam faces, a pivoted arm moved by said member, a spring connection between said arm and the gauge, and stops carried by said arm for preventing the closing of the reversing switch when the arm is in either extreme position.

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