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MOTOR OPERATED VALVE

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Fig. 1.

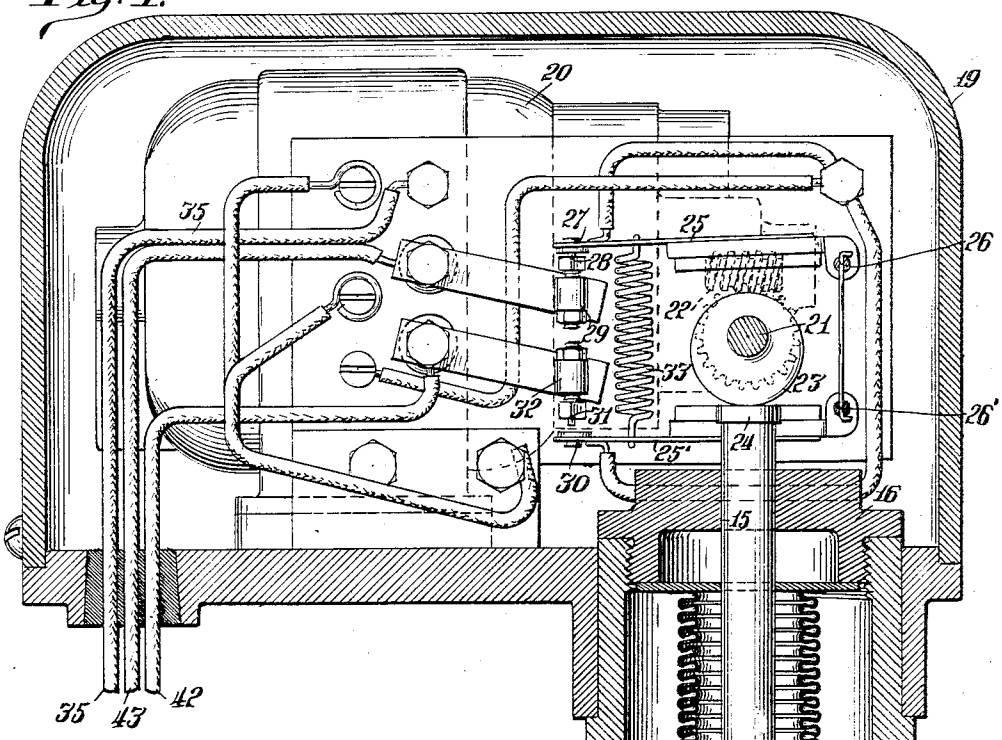
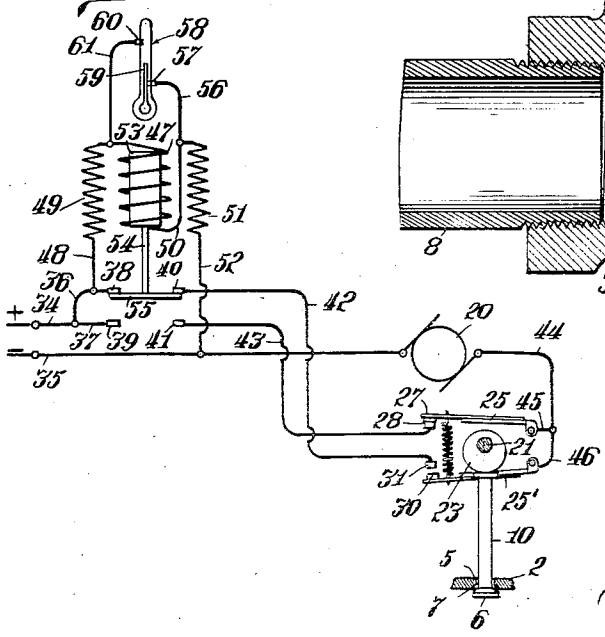


Fig. 2.



Inventors

Paul B. Parks

William M. Smith

and John VanVulpen

By Barnett & Truman

Attorneys.

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MOTOR OPERATED VALVE

Paul B. Parks, Oak Park, and William M. Smith and John Van Vulpen, Chicago, Ill., assignors to Vapor Car Heating Company, Inc., Chicago, Ill., a corporation of New York

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1 Claim. (Cl. 137—139)

This invention relates to certain new and useful improvements in a motor operated valve, and more particularly to motor-operated mechanism for opening and closing a valve and for breaking the motor-operating circuit when each valve movement has been completed.

Briefly described, this improved apparatus comprises a small electric motor which is connected through reduction gearing with a means for successively moving the valve to open and closed positions. This operating means comprises a rotary cam which is swung through successive arcs of 180° each in the same direction as the valve is successively moved to open and closed positions, respectively. A pair of alternative operating circuits is provided for the motor, each adapted to rotate the motor in the same direction, and a thermostatically controlled mechanism is provided for alternately closing and opening these two circuits. A pair of similar normally closed circuit-breakers is provided, one in each of these operating circuits, and a movable member of each circuit breaker is so positioned as to be moved by the cam and open the circuit which has been actuating the motor when the valve has been moved to either its open or closed position.

The general object of this invention is to provide an improved motor-operated valve of the type briefly described hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide a motor-operated valve comprising a rotary cam adapted to successively open the motor-operating circuits as the valve reaches its desired positions.

Another object is to provide an improved thermostatically - controlled motor - operated valve.

Another object is to provide improved means for controlling the actuating motor for a motor-operated valve.

Other objects and advantages of this invention will be more apparent from the following detailed description of certain approved forms of apparatus constructed and operating according to the principles of this invention.

In the accompanying drawing:

Fig. 1 is a vertical section through one form of the valve-operating mechanism.

Fig. 2 is a wiring diagram illustrating the electrical connections for operating the valve.

Referring to the drawing, the valve casing 1 is formed with an internal web 2 which separates the inlet chamber 3 from the outlet chamber 4. The valve passage 5 formed in web 2 connects the inlet and outlet chambers, a movable valve member 6 being adapted to be moved up into engagement with valve seat 7 at the lower end of passage 5 so as to close the valve and cut off communication between the chambers 3 and 4. When valve member 6 is moved down to the position shown in the drawing, the passage 5 is open. A supply pipe 8 is connected into the inlet chamber 3, and a discharge pipe 9 leads from the outlet chamber 4. In the example shown, this valve is adapted to control the flow of a heating medium such as steam, but it could obviously be used for controlling the flow of other fluids.

The movable valve member 6 is mounted on a valve stem 10, the lower end of which is guided in a passage 11 formed in the plug 12 which closes the lower end of valve casing 1. An upper portion of stem 10 is guided through a slide-way 13 formed in a web 14 in the valve casing. The upper portion of the valve stem 10 projects outwardly through a guide passage 15 formed in a plug 16 which closes the upper end of the valve casing. A flexible metallic diaphragm 17 of bellows form is sealed at its upper end to plug 16 and at its lower end to the valve stem so as to prevent the escape of steam (or other fluid) through the passage 15 in which the valve stem is slidably mounted. A compression spring 18 is confined between the lower face of movable valve member 6 and the upper face of plug 12, and is adapted to move the valve member 6 to closed position, that is, into engagement with valve seat 7. The valve is opened by depressing the valve stem 10 in opposition to the spring 18 by means hereinafter described.

The motor-actuated mechanism for opening the valve is mounted in a casing 19 which may be supported from or attached to the upper end of valve casing 1. In casing 19 is mounted a small electric motor 20 which is adapted to rotate the shaft 21 through suitable reduction gearing, such as the worm gearing indicated in dotted lines at 22. A cam or eccentric 23 is mounted on shaft 21 and is adapted to be rotated by motor 20 through successive arcs of 180° each, always in the same direction. When the cam 23 is swung to the lowered position shown in Figs. 1 and 2, the high portion of the cam will engage the head 24 at the upper end of valve stem 10 and depress this valve stem so as to compress the spring 18 and move valve member 6 to the open position shown in Figs. 1 and 2. When the cam member 23 is swung through an arc of 180° so that the high portion of the cam projects upwardly, the spring 18 will be permitted to expand and raise

the valve stem and move valve member 6 to its closed position in engagement with valve seat 7.

It will be understood that sufficient reduction is obtained through gearing 22 so that the motor 20 will rotate continuously through a multiplicity of revolutions in order to swing the cam 23 through an arc of 180°. Means is provided for automatically stopping the motor when the cam 23 has reached each of these opposite positions. This means comprises a pair of similar switches or circuit-breakers, these circuit-breakers comprising similar movable arms 25 and 25', respectively, pivotally mounted at 26 and 26', respectively, within the casing 19 so that one of the arms will be positioned above the cam 23 and the other in a diametrically opposite position below the cam 23. The upper movable arm 25 carries a movable contact member 27 adapted to engage with a fixed contact 28 adjustably mounted at 29 within the casing 19. The lower arm 25' carries a movable contact member 30 adapted to engage a fixed contact 31 adjustably mounted at 32 within the casing. A tension spring 33 is connected between the two movable arms 25 and 25' so as to tend to draw these arms toward one another and hold the movable contacts 27 and 30 in engagement with the fixed contacts 28 and 31, respectively. When the rotary cam 23 is swung to the lowered position shown in Figs. 1 and 2, so as to depress the valve stem 10 and open the valve, it will also engage a portion of the movable arm 25' and swing this arm down so as to open the circuit between contacts 30 and 31. At this time the circuit through contacts 27 and 28 will be held closed by spring 33. When cam 23 is rotated through an arc of 180° so as to permit the valve to close, it will engage the upper arm 25 and swing this arm upwardly so as to break the circuit between contacts 27 and 28, the spring 33 now operating to move the lower arm upwardly and close the circuit between contacts 30 and 31.

The electrical connections and means for thermostatically controlling the valve-operating motor, are shown in Fig. 2. The positive and negative power lines are indicated at 34 and 35. Branches 36 and 37 of the positive line 34 connect with fixed contacts 38 and 39 of a relay-controlled switch mechanism. Other fixed contacts 40 and 41 of this switch mechanism are connected through wires 42 and 43, respectively, with the fixed contacts 31 and 28 of the circuit-breakers. The negative main 35 connects with one side of motor 20, the other terminal of the motor being connected through wire 44 and branches 45 and 46 with the respective movable circuit breaker arms 25 and 25', and through these arms with the movable contacts 27 and 30, respectively.

The relay mechanism comprises a solenoid coil 47 which is normally energized through a circuit extending from positive main 34 through wire 36, wire 48, resistance 49, solenoid coil 47, wire 50, resistance 51, and wire 52 to the negative main 35. When this solenoid 47 is energized, it will hold up the core 53 which, through stem 54, supports the movable contact plate 55 and holds this plate in engagement with the pair of fixed contacts 38 and 40. When the solenoid is de-energized, the core 53 will drop so as to permit the contact plate to bridge the other pair of fixed contacts 39 and 41. One terminal of solenoid coil 47 is connected through wire 56 with a fixed contact 57 mounted in mercury tube thermostat 58 so as to always be in engagement with the mercury column 59. When a certain predetermined temperature is reached, the mercury column 59 will also engage with a second fixed contact 60 which is connected through wire 61 with the other terminal of solenoid coil 47. It will be apparent that when this shunt circuit is thus completed through the thermostat, the solenoid coil 47 will be de-energized so as to permit the contact plate 55 to drop and complete a circuit through contacts 39 and 41.

With the parts in the position shown in Figs. 1 and 2, the temperature is below the predetermined temperature which will close the circuit through the thermostat, and the valve is in open position so as to permit the flow of heating medium through the valve. It will be noted that one of the motor-operating circuits is broken between the switch contacts 39 and 41, and the other circuit is broken between the circuit breaker contacts 30 and 31. It is desirable that when a certain predetermined temperature is reached, the valve 6 shall be closed so as to cut off the further flow of heating medium through the valve. When this temperature is reached, the mercury column 59 will engage the fixed contact 60 and complete the shunt circuit which de-energizes solenoid 47, thus permitting contact plate 55 to fall and bridge the fixed switch contacts 39 and 41. A motor-operating circuit will now be completed as follows: from positive main 34 through wire 37, fixed contact 39, movable contact plate 55, fixed contact 41, wire 43, circuit breaker contacts 27 and 28, circuit-breaker arm 25, wires 45 and 44, motor 20, and negative main 35. The motor 20 will now be operated to swing the cam 23 through an arc of 180° and thus permit the valve 6 to close. As this 180° swinging movement of the cam is completed, it will engage the circuit-breaker arm 25 and lift this arm so as to break the operating circuit between contacts 27 and 28, thus stopping the motor 20.

When the temperature has fallen so that mercury column 59 moves down out of engagement with fixed contact 60, the shunt circuit will be broken and the solenoid 47 will again be energized, so as to lift the core 53 and bring contact plate 55 again into engagement with fixed contacts 38 and 40. The second motor-operating circuit will now be completed as follows: From positive main 34 through wire 36, fixed contact 38, movable contact plate 55, fixed contact 40, wire 42, circuit breaker contacts 31 and 30, circuit breaker arm 25', wires 46 and 44 to motor 20, and negative main 35. The motor 20 will now be operated so as to swing the cam 23 to the position shown in Figs. 1 and 2, thus again opening the valve 6. As this movement is completed, the cam 23 will engage the circuit breaker arm 25' to move this arm downwardly and break the operating circuit between contacts 30 and 31, thus stopping the motor 20. This cycle of events will be automatically repeated as the temperature rises or falls.

It will be apparent that this improved mechanism is entirely automatic, and is quite simple, since the same rotary mechanism which actuates the valve also operates the circuit-breakers to stop the motor whenever a desired valve movement has been completed.

We claim:

In combination with a valve, a reciprocable valve-stem for moving the valve to open or closed positions, a spring for moving the valve in one direction, a rotary cam positioned to engage the stem and move the valve in the other direction

in opposition to the spring, a motor for rotating the cam, reduction gearing between the motor and cam, a pair of operating circuits for the motor, means for alternately closing these circuits, a pair of circuit-breakers one in each circuit, each circuit-breaker comprising a fixed contact and a movable contact arm, the contact arms being pivotally mounted at opposite sides of the cam, and a spring connecting the arms and normally tending to move them toward one another and into engagement with the fixed contacts, the cam successively engaging the arms and alternately moving them out of engagement with the respective fixed contacts as the cam is rotated through successive arcs of 180°.

PAUL B. PARKS.
JOHN VAN VULPEN.
WILLIAM M. SMITH.