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AUTOMATIC ELECTRIC SWITCH

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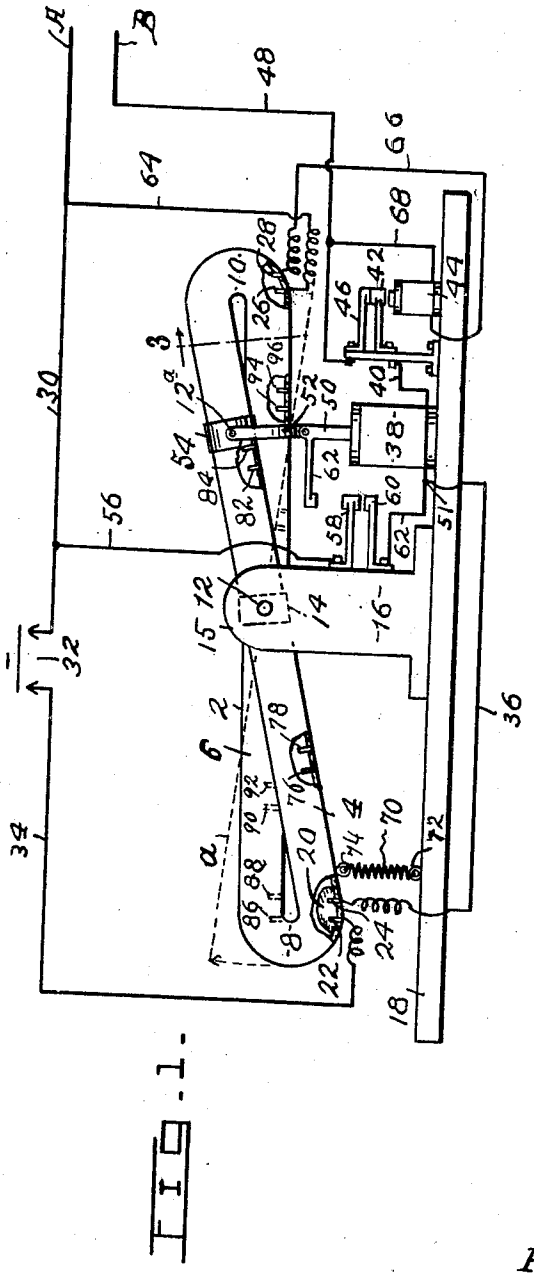


FIG. 1.

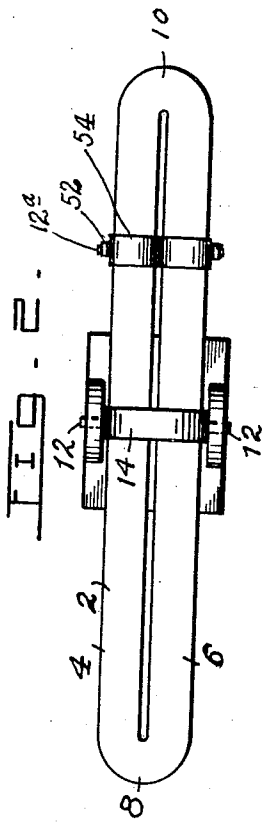


FIG. 2.

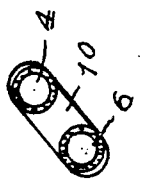


FIG. 3.

Inventor

Robert E. Swisher
and George W. Gates.

By F. G. Fischer.

Attorney

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AUTOMATIC ELECTRIC SWITCH

Robert E. Swisher and George W. Gates,
Kansas City, Mo.

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Our invention relates to mercury switches and means for controlling the same. One object of the invention is to provide a new and useful mercury switch whereby one or more electrical circuits may be opened or closed with a minimum of sparking at the terminals thereof.

A further object is to provide a mercury switch including a pair of oscillatory tubes arranged side by side and having their longitudinal axes extending at intersecting angles to approximately resemble the numeral 8 disposed in approximately a horizontal plane instead of, as normally, in a vertical plane. The tubes have communicating ends so that a circuit-closing mass or globule of mercury may run in cycles through the tubes by force of gravity during oscillation of the tubes and close one or more circuits, as will hereinafter more fully appear.

Another object is to provide each tube near one end with a pair of spaced terminals which are sealed in the tube and have their inner ends disposed in the path of the globule. The outer ends of one pair of terminals are connected to a normally open circuit including means adapted to cooperate with spring-means in controlling the oscillatory movements of the tubes. The other pair of terminals are connected to a shunt circuit which is connected across the normally open circuit. A second shunt circuit is also connected across the normally open circuit and like the first shunt circuit, cooperates with the normally open circuit in controlling the operation of the oscillatory switch. The tubes are also provided intermediate their ends with one or more pairs of spaced terminals arranged in the path of the globule for the purpose of closing other circuits having electrical instrumentalities for performing various duties, such, for instance, as operating clock-chimes and the like.

Other objects will hereinafter appear and in order that the invention may be fully understood, reference will now be had to the accompanying drawing in which:

Fig. 1 is a side elevation of the mercury switch in normal position, and electrical circuits associated therewith for cooperating with the switch in the operation thereof.

Fig. 2 is a top plan view of the switch with the circuits removed.

Fig. 3 is a cross section of the switch tubes on line 3 of Fig. 1.

Referring in detail to the different parts, 2 designates the mercury switch which includes a pair of tubes 4 and 6, from which the atmosphere has been exhausted and which communicate with

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each other through semi-circular left and right ends 8 and 10, respectively. The tubes 4 and 6 are slightly inclined in opposite directions to each other as disclosed by Fig. 1, and may consist of glass, plastic or other suitable nonconductive material. The switch 2 is operably mounted for oscillation across a horizontal plane, on a transverse axis so that when in operation it is alternately inclined in opposite directions. The transverse axis may comprise trunnions 12, the adjacent ends of which are connected to the switch in any appropriate manner, such for example, as by a band 14 embracing the tubes 4 and 6. The distal ends of the trunnions 12 are operably mounted in the bifurcated upper end 15 of a supporting member 16 fixed at its lower portion to a base plate 18. A globule of mercury 20 is disposed within the switch 2 and forms a component part thereof. In the present instance it is adapted to first run by gravity through the tube 4 and back to the starting point through the tube 6, as will hereinafter more fully appear. The left hand end of the tube 4 has two spaced terminals 22 and 24 sealed therein, and the tube 6 has a like pair of spaced terminals 26 and 28, respectively, sealed in its right hand end. The foregoing terminals are also arranged in the path of the globule 20 to be contacted thereby as it runs through the tubes to close circuits which assist in oscillating the tubes.

The terminals 22 and 24 are connected to a normally open local circuit which is connected to positive and negative mains A and B, respectively. The local circuit proceeds as follows: A wire 30 leading from the main A to a switch 32, wire 34, terminal 22, globule 20, terminal 24, wire 36, solenoid 38, wire 40, armature 42 of a relay 44, contact 46 normally engaged by the armature 42, and a wire 48 leading from the contact 46 to the main B, thus completing the local circuit.

When the switch 32, which may be of any appropriate type, shown in the present instance as a push-button, is closed the normally open circuit above described becomes energized by current from the main A and in turn energizes the solenoid 38, causing it to pull down the raised end of the tubes 2 and 3 by means of the armature 50 and a connecting rod 52 connected at its upper forked end by pivots 12a to opposite sides of a reinforcing band 54 embracing the switch 2 near the right end thereof. As the armature 50 moves downward it swings the switch 2 clockwise until inclined downwardly towards its right end as indicated by the dotted line *a*, Fig. 1. The globule 20 which has been in simultaneous engagement with the terminals 22 and 24, now runs by gravity to

the lowered right end of the switch 2, thus opening the above described local circuit from the push-button 32 to a junction 51, adjacent to the inlet side of the solenoid 38. However, when said local circuit is thus partially opened the solenoid 38 remains energized by current flowing through a shunt circuit until the globule 20 simultaneously contacts the terminals 26 and 28, respectively. The shunt circuit is connected across the first-mentioned circuit and comprises a wire 56, connected to the wire 30, a contact 58, which is forced into engagement with a companion contact 60 by an arm 62 forming part of the armature 50, and a wire 62 leading from the contact 60 to the junction 51.

When the globule 20 contacts the terminals 26 and 28, as above stated, deenergization of the solenoid 38 is effected through the action of a second shunt circuit connected across the normally open circuit and including the manual switch 32. The second shunt circuit proceeds as follows: A wire 64 connected to the wire 30 in advance of the wire 56, terminal 26, the globule 20, the terminal 28, wire 66, the relay 44, and wire 68 leading from the relay to the wire 48. Current flowing through the relay 44 energizes the latter, causing it to draw its armature 42 away from the contact 46, and thus interrupt the current flowing through the solenoid 38. The switch 2 is then swung counter-clockwise by a coil spring 70 until the left ends of the tubes 4 and 6 are again inclined downwardly to normal position. As the switch 2 is swung counter-clockwise, the globule 20, which has run down into the right end of tube 6, returns by gravity through the latter to normal position and again simultaneously engages the terminals 22 and 24, respectively. When the globule 20 runs from the terminals 26 and 28, the shunt circuit including the relay 44 becomes deenergized and the relay armature 42 moves into engagement with the contact 46. The coil spring 70, which is under tension is connected at its ends to eyes 72 and 74 fixed to the base plate 18 and the left end of the tube 4, respectively.

In addition to the terminals above described the tubes 4 and 6 are provided intermediate their ends with pairs of terminals 76 and 78, 82 and 84, 86 and 88, 90 and 92, and 94 and 96, respectively, each pair of which is simultaneously but momentarily engaged by the globule 20 as it runs by gravity through the tubes 4 and 6. Each pair of the intermediate terminals may be connected to a circuit, not shown, which may include various instrumentalities for performing useful work.

From the foregoing description it is apparent that we have provided an electric switch and circuits for controlling the same which are economical in use of electrical current. Also that we have provided a switch which may be utilized for controlling a large number of circuits and that the operation of the switch is attended with but little friction.

It is also to be understood that insulation is used wherever needed on the switch and in the circuits.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. In a mercury switch, two tubes communicating at their respective ends and having their longitudinal axes arranged at opposite inclinations to each other, a suitably supported transverse axis on which the tubes are mounted for simultaneous oscillation, means for effecting oscillation of the tubes involving a normally open electrical circuit, a first pair of terminals sealed in one end of one tube and connected in series with said circuit, a second pair of terminals sealed in the opposite end of the companion tube, a circuit-completing globule of mercury adapted to describe an orbit through the tubes during the oscillation thereof and contact each pair of terminals, electrical means energized by the normally open circuit, adapted to swing the tubes downward in one direction, means for deenergizing said electrical means and arranged in series with the second pair of terminals, and means for swinging the tubes downward in the opposite direction.

2. In a mercury switch, two tubes communicating at each end and mounted for simultaneous oscillation, a pair of spaced terminals sealed in one end of one tube, a circuit-closing globule of mercury normally in contact with the terminals and adapted to run in a cycle through the tubes when the latter are oscillated, a normally open electrical circuit in series with the terminals, a manual switch for cooperating with the globule and the terminals in closing the circuit, a solenoid in series with the circuit, a plunger controlled by the solenoid and adapted to swing the tubes downward at one end and thereby cause the globule to run by gravity from the terminals into the opposite end of the companion tube, a normally open shunt circuit connected across the first-mentioned circuit and adapted to be closed by the plunger as the latter swings the tubes downward as stated, said shunt circuit, when closed, being adapted to energize the solenoid when the globule runs from the terminals, means for deenergizing the shunt circuit when the globule enters the opposite end of the companion tube, and means for swinging the tubes back to first position.

3. In a mercury switch, two tubes communicating at each end and mounted for simultaneous oscillation, a pair of spaced terminals sealed in one end of one tube, a circuit-closing globule of mercury normally in contact with the terminals and adapted to run in a cycle through the tubes when the latter are oscillated, a normally open electrical circuit in series with the terminals, a manual switch for cooperating with the globule and the terminals in closing the circuit, a solenoid in series with the circuit, a plunger controlled by the solenoid and adapted to swing the tubes downward at one end and thereby cause the globule to run by gravity from the terminals into the opposite end of the companion tube, a shunt circuit connected across the first-mentioned circuit, normally open contacts in the shunt circuit adapted to be closed by the plunger when swinging the tubes downward at one end, said shunt circuit, when closed, being adapted to energize the solenoid when the globule runs by gravity from the terminals, means for deenergizing the shunt circuit when the globule enters the opposite end of the companion tube, and means for swinging the tubes back to first position.

4. In a mercury switch, two tubes communicating at each end and mounted for simultaneous oscillation, a pair of spaced terminals sealed in one end of one tube, a circuit-closing globule of mercury normally in contact with the terminals and adapted to run in a cycle through the tubes when the latter are oscillated, a normally open electrical circuit in series with the terminals, a manual switch for cooperating with the globule and the terminals in closing the circuit, a solenoid in series with the circuit, a plunger controlled by the solenoid and adapted to swing the tubes

downward at one end and thereby cause the globule to run by gravity from the terminals into the opposite end of the companion tube, a shunt circuit connected across the first-mentioned circuit, a relay in series with the last-mentioned circuit, normally closed contacts in series with the first-mentioned circuit and adapted to be opened by the relay and thereby effect deenergization of the solenoid, means for deenergizing the shunt circuit when the globule enters the opposite end of the companion tube, and resilient means for swinging the tubes back to first position.

5. In a mercury switch, two tubes communicating at their ends with each other and having their longitudinal axes arranged at opposite inclinations to each other, supporting means on which the tubes are adapted to oscillate, a first pair of spaced terminals sealed in one end of one tube, a second pair of terminals sealed in the distal end of the other tube, a globule adapted to described an orbit through the tubes during oscillation thereof and successively contact the first and second pairs of terminals, means for normally holding the first-mentioned end of the tubes lower than the distal end, thereby normally retaining the globule in engagement with the first pair of terminals, a normally open circuit in series with the first pair of terminals, a solenoid in series with said circuit, adapted to be energized and draw down the raised end of the tubes when the circuit is closed, thereby causing the globule to run down into contact with the second pair of terminals and thus open the circuit, and electrical means controlled by the solenoid and adapted to continue to energize the latter on interruption of the circuit.

6. In a mercury switch, two tubes communicating at their ends with each other and having their longitudinal axes arranged at opposite inclinations to each other, supporting means on which the tubes are adapted to oscillate, a first pair of spaced terminals sealed in one end of one tube, a second pair of terminals sealed in the distal end of the other tube, a globule adapted to describe an orbit through the tubes during oscillation thereof and successively contact the first and second pairs of terminals, means for normally holding the first-mentioned end of the tubes lower than the distal end, thereby normally retaining the globule in engagement with the first pair of terminals, a normally open circuit in series with the first pair of terminals, a solenoid in series with said circuit, adapted to be energized and draw down the raised end of the tubes when the circuit is closed, thereby causing the globule to run down into contact with the second pair of terminals and thus open the circuit, electrical means controlled by the solenoid and adapted to continue to energize the latter on interruption of the circuit, and means for deenergizing the solenoid.

7. In a mercury switch, two tubes communicating at their ends with each other and having their longitudinal axes arranged at opposite inclinations to each other, supporting means on which the tubes are adapted to oscillate, a first pair of spaced terminals sealed in one end of one tube, a second pair of contacts sealed in the distal end of the other tube, a globule adapted to describe an orbit through the tubes during oscillation thereof and successively contact the first and second pairs of terminals, means for normally holding the first-mentioned end of the tubes lower than the distal end, thereby normally retaining the globule in engagement with the first pair of terminals, a normally open circuit in series with the first pair of terminals, a solenoid in series with said circuit, adapted to be energized and draw down the raised end of the tubes when the circuit is closed, thereby causing the globule to run down into contact with the second pair of terminals and thus open the circuit, a normally open shunt circuit connected across the first-mentioned circuit, which is closed by the solenoid and continues to energize the latter after the first-mentioned circuit has opened, and a second shunt circuit connected across the first-mentioned circuit, including a relay for opening the first-mentioned shunt circuit and in circuit with the second set of terminals, said second shunt circuit being interrupted when the globule flows from the second set of terminals.

ROBERT E. SWISHER.
GEORGE W. GATES.

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