May 9, 1933. A. E. YOUNG 1,907,639

MERCURY SWITCH

Filed Oct. 20, 1931

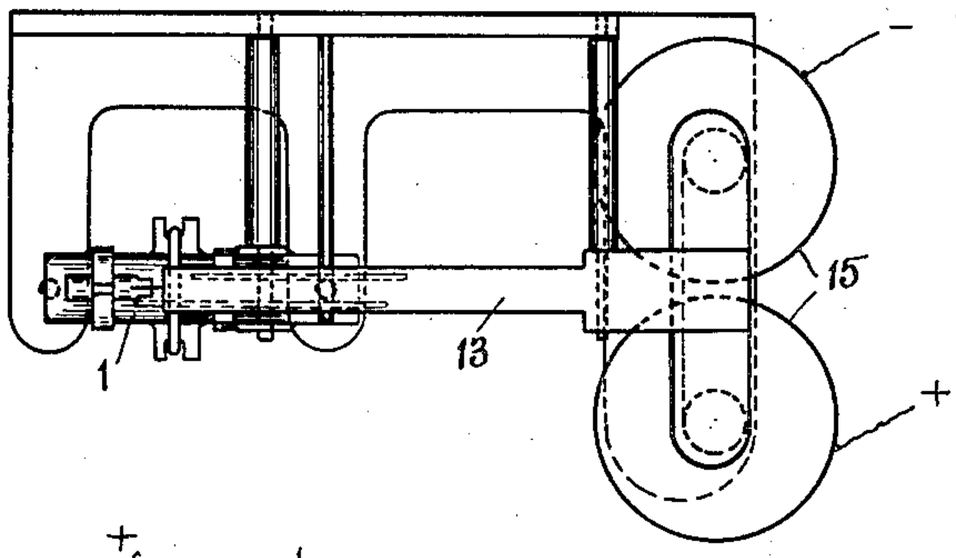


Fig. I

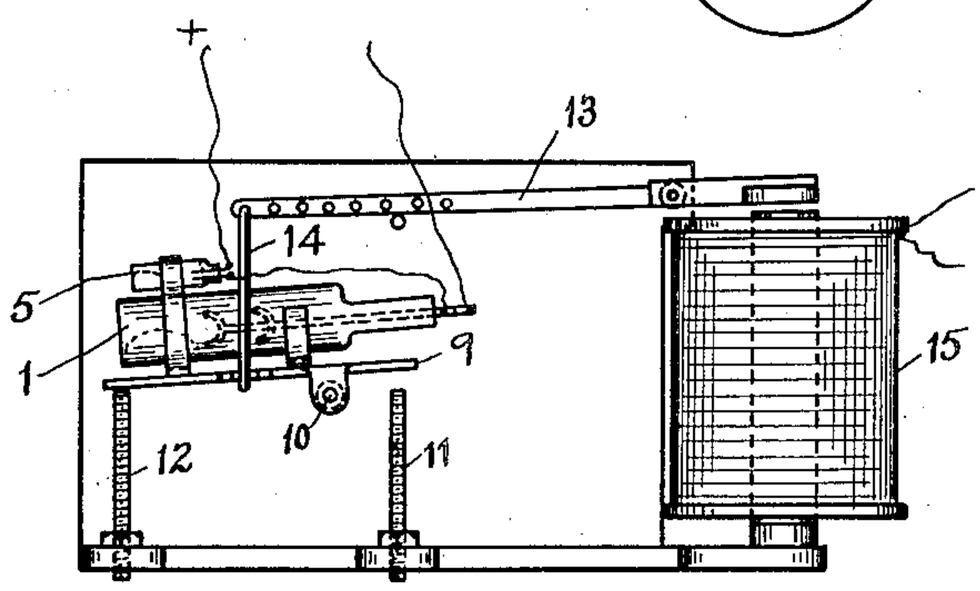


Fig. II

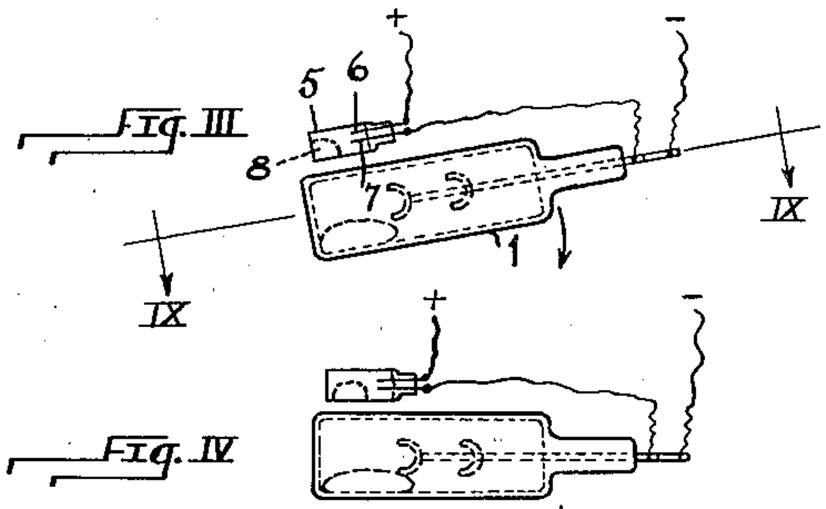


Fig. III

Fig. IV

Fig. V

Fig. VI

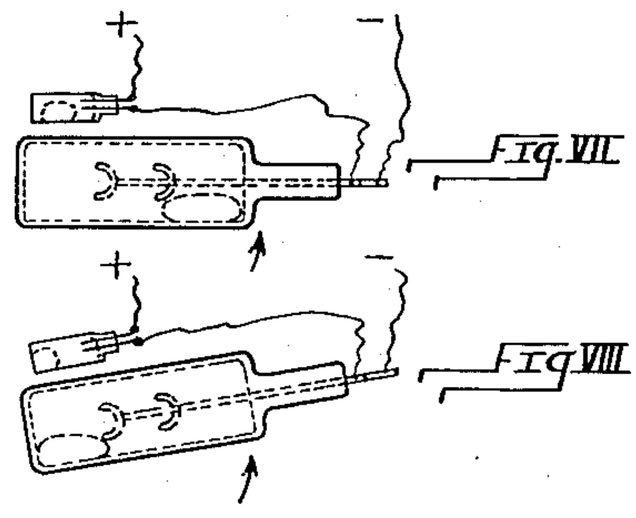


Fig. VII

Fig. VIII

Fig. IX

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# UNITED STATES PATENT OFFICE

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## MERCURY SWITCH

Application filed October 20, 1931. Serial No. 570,025.

My invention relates to mercury switches for electrical circuits, and consists in a provision whereby the switch, effective on the swinging of the mercury-containing tube in one direction, is ineffective to complete the circuit on the swinging in opposite direction. In consequence, there is, in any case, a saving of current, and the switch is thereby more minutely adapted to particular uses.

In the accompanying drawing Figs. I and II are views in plan and in side elevation of the essential parts of a relay in which the switch of my invention is employed. Figs. III–VIII are fragmentary views, showing in side elevation the mercury-containing tube of the switch in successive operative positions. Fig. IX is a view in longitudinal section of the mercury-containing tube, the plane of section being that indicated by the line IX—IX, Fig. III.

The mercury switch here shown possesses the following well-known and essential features: It includes a tube 1, ordinarily of glass, within which two spaced-apart terminals 2 and 3 of the circuit are sealed; the tube is mounted for oscillation across a horizontal plane, on an axis transverse to its length, so that in the range of oscillation it is alternately inclined in opposite directions; and within the tube a globule 4 of mercury is contained, of such size that, as the tube oscillates and as the globule runs by gravity first to one and then to the other end of the tube, it will make simultaneous contact with the two said spaced-apart terminals and in so doing will momentarily complete the circuit. These essential features and this essential characteristic of operation will be understood on considering Figs. III–VIII. In Fig. III the tube is shown to be inclined upwardly from left to right; in Fig. IV it is in horizontal position; in Figs. V and VI it is inclined downwardly from left to right; in Fig. VII it is horizontal again; and in Fig. VIII it is shown in the initial position first mentioned. As the tube 1 swings from the position of Fig. III to that of Fig. VI the globule 4 of mercury runs from its initial position at the left-hand end to its opposite position at the right-hand end of the tube, and in its passage it momentarily makes simultaneous contact with the two terminals 2 and 3, as indicated in Fig. IV. This movement of the globule of mercury is reversed as the tube swings back, from the position of Fig. VI to that of Fig. VIII (and Fig. I).

The invention consists in providing a second tube 5, mounted for oscillation across the horizontal simultaneously with the described oscillation of tube 1. Conveniently, the two tubes are mounted in parallelism and oscillate as a unit. Within the tube 5 also two terminals 6 and 7 of the same electrical circuit are sealed, and within the tube 5 also a globule of mercury 8 is contained. The tube 5 is so arranged and its parts are so proportioned and disposed that as the tube oscillates the globule 8 alternately completes and breaks the circuit between terminals 6 and 7. On the clockwise swing, as seen in the drawing, the contact in tube 5 is closed, and continues closed until the counter-clockwise swing is effected; whereupon the contact in tube 5 is broken. The structure is so arranged and proportioned. relatively to tube 1, that the contact completed in tube 5 by the clockwise swing is completed not later than the instant of completion of the contact in tube 1; while, on the return counter-clockwise swing, the contact in tube 5 is broken before the globule in tube 1 comes to the position of simultaneous contact with terminals 2 and 3. These features of structure and arrangement, as here illustrated, are as follows: The positions of the two terminals 2 and 3 are intermediate the length of tube 1, and successive, longitudinally of the tube, but the positions of the terminals 6 and 7 are at one end of the tube 5 and side by side; the tube 5 is shorter than the tube 1. The important feature in this respect, however, is that the globule 8 in tube 5 shall be as delicately responsive (substantially) to the swinging of the tube, and as rapid (substantially) in movement, as the globule 4 in tube 1. It is further characteristic of the contact making and breaking in tube 5, as distinguished from that in tube 1, that the globule makes contact with the two terminals 6 and 7 with substantial simultaneity. And, as has

been said, while the contact effected in tube 1 is momentary and occurs while the globule of mercury is in passage from one end of the tube to the other, the contact effected in tube 5 occurs when the globule reaches one end of the tube, and continues so long as the tube is inclined downward toward that end.

Such being the characteristics of my improved mercury switch, its operation is as follows. The two pairs of terminals are connected in series in the circuit to be controlled. The initial and inactive position of the switch is that of Fig. III (VIII). Operation consists of a complete reciprocal oscillation: a clockwise turning from the position of Fig. III to that of Fig. VI and a counter-clockwise, reverse turning from the position of Fig. VI to that of Fig. VIII. As the switch turns clockwise from the position of Fig. III to that of Fig. VI, the globule 4 runs from left to right in tube 1 and as it so runs it momentarily makes simultaneous contact with terminals 2 and 3; and by the time the globule running in tube 1 reaches such position of contact, the globule 8 in tube 5 has run to the right-hand end of tube 5 and has closed the circuit between terminals 6 and 7. Accordingly, in the clockwise swing of the switch the circuit is closed momentarily and broken again. In the ensuing counter-clockwise swing of the switch, the globule 8 leaves the right-hand end of tube 5 before the globule 4 in tube 1 reaches its intermediate position of simultaneous contact with the successively spaced terminals 2 and 3. Accordingly, in the counter-clockwise swing of the switch the circuit is not closed.

As a practical matter, to insure delicacy of operation, it is desirable not only to form the terminals 2 and 3 as stems with heads which spread transversely within the tube, but to coat with glass or other insulation the stem of the longer, and conveniently the stems of both, of the terminals. These features are indicated in the drawing.

Figs. I and II show the switch of the invention in practical application to a relay. The switch, connected as described, is rigidly mounted upon a carrier 9 which is pivoted at 10 in a suitable stationary casing. Pivotal movement of carrier 9, limited by adjustable stops 11 and 12, is through such range as to permit the oscillation described above. The carrier 9 at a point remote from its pivot-point 10 is engaged by a swinging lever 13. Conveniently, the lever is a vertically swinging beam, and the engagement is by means of a stirrup 14 which hangs from the beam. The beam is subject to the action of a solenoid 15. The arrangement is such that the weight of the switch tends to swing both the pivoted support 9 and the beam 13 in counter-clockwise direction, and to maintain the instrument normally in the inactive position shown in Fig. II, with the support 9 resting upon stop 12. The switch is then in the position shown in Fig. III. The energizing of solenoid 15 effects the swinging of support 9 in clockwise direction, and when the solenoid is deenergized the movable parts return under gravity to the positions shown in Fig. II. The clockwise swinging of support 9 in response to the energizing of solenoid 15 brings the switch to the position illustrated in Fig. VI. Accordingly, when a relay circuit is completed through solenoid 15 and the solenoid is energized, the switch operates, and the main circuit is momentarily closed; the deenergizing of the solenoid and the consequent return swing of the switch is, however, ineffective, in that a second closure of the main circuit does not occur. This characteristic is advantageous in particular applications, if only in a saving of current and a saving of a drain upon batteries, because of an otherwise occurring useless duplication of circuit closure.

I claim as my invention:

1. In a mercury switch two tubes arranged for simultaneous oscillation between positions of opposite longitudinal inclination, an electrical circuit, and two pairs of terminals included in series in the said circuit and projecting, one pair into each of the two said tubes, the terminals of one pair being arranged in successive and intermediate positions within the tube, and the terminals of the other pair being arranged in side-by-side positions adjacent one end of the tube, and a circuit-completing globule of mercury contained in each tube, the globule in the second of the tubes as characterized above completing and breaking contact in response to tube oscillation with a celerity exceeding that of the globule in the first tube in its contact-making movement therein.

2. In a mercury switch two tubes unequal in length arranged for simultaneous oscillation between positions of opposite longitudinal inclination, an electrical circuit, and two pairs of terminals included in series in the said circuit and projecting, one pair into each of the two said tubes, the terminals of the pair within the longer tube being arranged in successive and intermediate positions within the tube, and the terminals of the pair within the shorter tube being arranged in side-by-side positions adjacent one end of the tube, and a circuit-completing globule of mercury contained in each tube.

In testimony whereof I have hereunto set my hand.

ARCHER E. YOUNG.