Nov. 15, 1938. W. BÄRTSCH 2,136,874

MULTIPLE MERCURY CONTACT DEVICE

Filed July 24, 1937

Fig. 1.

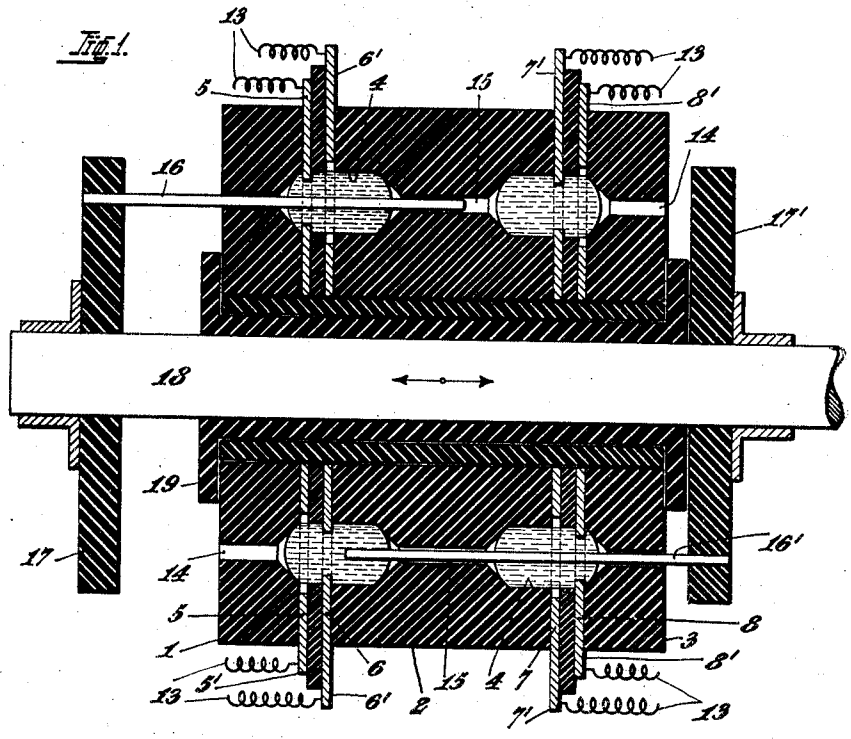


Fig. 2.

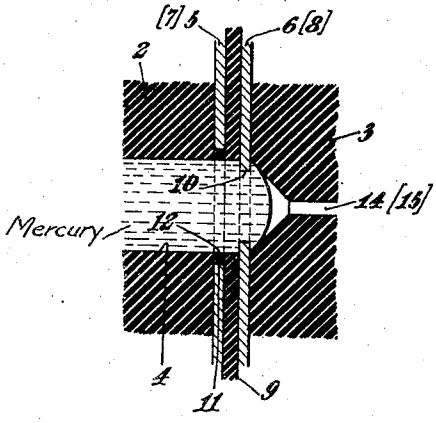
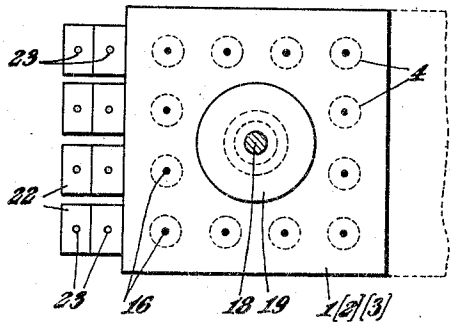


Fig. 3.



INVENTOR
Walter Bärtsch
BY
Otto Munk
ATTORNEY

Patented Nov. 15, 1938 2,136,874

UNITED STATES PATENT OFFICE

2,136,874

MULTIPLE MERCURY CONTACT DEVICE

Walter Bärtsch, Kreuzberg Kerzers, Switzerland

Application July 24, 1937, Serial No. 155,488
In Switzerland July 8, 1937

8 Claims. (Cl. 200—16)

My invention relates to improvements in multiple mercury contact devices of the immersion type used in the low tension electrical field; and the objects of my improvement are, first, to provide a positive and simple operative combination of a relatively great number of contacts at the expense of only little material, small initial cost and small volume; second, to afford facilities which make the provision of a vacuum in the contact cell unnecessary; and, third, to provide means assuring the positive operation of the contacts in either a horizontal or vertical position.

More particularly, the present invention relates to a mercury contact device which is suitable, for example, for operating contacts in telephone work and in other instances where electrical circuits are used.

The present invention makes it possible to control a relatively large number of circuits simultaneously, in a simple manner, with decreased consumption of material, production costs, and with great economy of space.

The mercury contactor devices of the prior art, and which operate with exclusion of air are operated by tilting an airtight, sealed, mercury container made of glass or other insulating material. Such arrangements are not suited for the simultaneous control of a large number of circuits. It has also been proposed to provide mercury chambers, which are connected at one side with an electric conductor, with a longitudinally movable contact plug carried by a resilient link and to have this dip into the mass of mercury. It is not possible, however, to operate such contact arrangements constantly under air-tight conditions. When electric sparks occur, the mercury becomes oxidized, thus deleteriously affecting the circuit-making capacity and, finally, if this condition prevails for a prolonged time, operation of the device becomes impossible. A permanently satisfactory circuit closing can be effected with mercury only if the air is excluded from the contacting region. This is effected in accordance with the invention by using two spaced chambers, placed one behind the other and each containing a mass of mercury, and which are connected by a channel through which the mercury does not pass. A longitudinally displaceable contact plug member passes entirely through one of the masses of mercury and through the channel and is adapted to connect both mercury masses electrically when extended into contact with the other mass of mercury, and when moved in the opposite direction the contact member moves out of the second mass of mercury and breaks the connection. The opening and closing of the circuit, therefore, takes place in a chamber which is sealed off in airtight relation by two spaced mercury masses, wherein, due to absence of oxygen the oxidation of the mercury by the formation of sparks is prevented. Hence, a permanently satisfactory closing and opening of the circuit is insured.

I attain these objects by the device and combination of elements shown in two forms of design in the accompanying drawing, in which—

Fig. 1 is a vertical section of one form of invention possessing two contact cells arranged in line; Fig. 2, a part section in a larger scale; and Fig. 3, a control board in elevation in combination with a plurality of contact plunger pins.

The three plates 1, 2 and 3 (Fig. 1) are made of insulating material and are combined in one block. On the inside faces of the plates 1 and 3 and on both sides of the intermediate plate 2 there is a plurality of co-axially arranged recesses 4. Appurtenant recesses on the plates 1 and 2, and, respectively, on the plates 2 and 3, together form two cylindrical cells for the reception of mercury which latter in each instance constitutes a mercury contact. Between the plates 1 and 2, or, respectively, 2 and 3 there are at least as many metallic current-conducting layers 5 and 6 or, respectively, 7 and 8 as there are cell-pairs arranged in line within the contact block 1—3. The said layers are insulated from each other by means of the insulating layers 9. All these layers are provided with a hole at their junction with the appurtenant contact cell. That conducting layer which is to be in contact with the mercury in a cell—e. g., the layer 6 in Fig. 3—is provided with a circular hole of a diameter smaller than that of the mercury cell 4. The said latter layer, therefore, with the edge of its aperture is immersed into the mercury. The contact-surface between the conducting layer and mercury, therefore, is relatively large so that a positive contact is assured. The aperture 11 of those conducting layers which must not come in contact with the mercury—e. g., the conducting layer 5 in Fig. 3—has a greater diameter than the cell 4. Such a latter layer is not in a current-conducting connection with the mercury therefore. The conducting layers are of such a small gauge—e. g., 0.004 in.—that the mercury, by virtue of its inherent cohesion, is not capable of penetrating into the groove 12 lying on the periphery of the cell 4. In order, however, to be absolutely sure that no mercury

can touch the conducting layer 5, the groove 12 is filled with an insulating plastic mass such as, e. g., insulating lacquer. Extension strips 5' or, respectively, 6' are projected from the corresponding conducting layers beyond the periphery of the plate-aggregate 1—3 and each is provided with one or more connecting wires 13. The said strips are of unequal length so as to enable one to easily distinguish between the various wires 13. In order to produce a conducting connection between the mercury contents of two co-axial cells lying in line—and thus also between the conducting layers submerging with the edge of their apertures into the mercury—a capillary bore 14 or, respectively, 15 is carried from the outside into each cell and also from the one cell to the adjacent co-axial cell. Thin metal wires 16 or, respectively, 16' which are fastened to a plate-like carrier 17 or, respectively, 17' project through the said bores and serve as contact plunger pins. Both the said pin-carriers 17 and 17' are fastened to a common rod 18 at either side of the block 1—3. The said rod 18 is axially displaceable within a boss sleeve 19 made of an insulating material and which is holding the plate elements 1—3 of the block together. The said rod, furthermore, may be moved forward and backward by any mechanically or electromagnetically operated mechanism (not shown). The length of the contact plunger pins 16 and 16' is so dimensioned that its inner end in the drawn-back or inoperative position is lying in the capillary bore 15, and thus does not touch the mercury in the forward cell; in its projected position, however, its tip penetrates into the mercury. In the first position the electrical connection between the mercury contents of adjacent and appurtenant cells 4 (see top part of Fig. 1) is interrupted, and in the second position (see bottom of Fig. 1) this connection is established. With each movement of the rod 18 a connection is interrupted and another one established in the form of invention illustrated in Fig. 1. In order that no mercury may pass up to the orifices of the capillary bores 14 and 15 when moving the contact plunger to and fro, i. e., in order to attain a secure sealing between two adjacent appurtenant cells, the ends of the cells are sharply tapered down so that the meniscus of the mercury may project into this conically tapering space but normally cannot reach up to the orifices of the capillary bores, due to the cohesion of the mercury (Fig. 2 at right).

Instead of establishing a contact, when moving the rod 18 in one direction, in one and the same block and interrupting another contact, the contacts for a plurality of connections may be all established or interrupted simultaneously and, respectively, may be interrupted or established in another block at the same time. A plurality of cell-pairs 4 is grouped around the said sleeve (Fig. 4). The plunger-carriers 17 and 17' for each cell-pair are provided with very fine contact pins 16 or, respectively, 16'. In the direction of a left-to-right motion all plunger-pins 16 establish as many electrical connections between the appurtenant mercury bodies of two cells lying in line, and the pins 16' at the same time interrupt the connections between their appurtenant mercury-bodies. In the case of a greater number of conducting layers and contact plunger pins the extension strips 22, together with the connecting wires 23, are of different length and staggered in groups with relation to each other (Fig. 3), in order to distinguish the different connections and to make the latter easily accessible.

The insulating plate 2 suitably is made of one piece of insulating material so that the opening spark of a circuit is occupying a very small airspace. The latter, on the one hand, is isolated from the outside by the said insulating material and, on the other hand, by the mercury. The oxygen in this airspace very quickly thus is changed to mercury-oxide and a further oxidation afterwards is made impossible. This construction then is avoiding an oxidation of the mercury without the contact-system having to be operated under a vacuum.

Any number of such switching devices, of course, may be combined in any suitable group-formation into an aggregate, and the plunger-carriers may be operated either over a common drive or, for the purpose of switching in stages or groups, by a plurality of independent driving devices. The contact plunger pins also may be of different, instead of equal, length.

The mercury contact device described may be used in the whole field of low tension and, with particular advantage, in telephony and electric sign illumination.

I am aware that prior to my invention mercury contact devices of the immersion-type have been made in which a metal element is submerged in a vertical sense into the mercury. Again, there are such devices which are operated by tipping, in which the contacts are fused into a glass tube and flooded with mercury when tipping the tube. I therefore do not claim such a first combination broadly; but what I claim and desire to secure by Letters Patent is:

1. A mercury contact device comprising a block, having at least two spaced, axially aligned, mercury-filled cells therein, and a conductor for each cell, a movable contact member slidable in said block and permanently in contact with one of said cells, and selectively in contact with the other cell, the contact member being reciprocable in said block to make or break a circuit between said cells.

2. A device according to claim 1, in which the block is formed of a plurality of insulating plates and the cells are formed by a series of co-axial recesses in the abutting faces of said plates.

3. A mercury contact device comprising a sleeve, a plurality of insulating plates seated on said sleeve and forming a block, and a shaft reciprocable within the sleeve, said plates having aligned recesses formed in the abutting faces thereof to form spaced cells, mercury in each cell, and a conductor for each cell, a contact supporting member seated on one end of said shaft, a contact carried by the supporting member extending into said block and permanently in contact with one cell and selectively in contact with the next cell, said contact member being reciprocable in said body to make or break a circuit between said cells.

4. A mercury contact device comprising a sleeve, a plurality of insulating plates seated on said sleeve and forming a block, and a shaft reciprocable within the sleeve, said block having a series of horizontally and axially spaced, mercury-filled cells and a conductor for each cell, a contact supporting member seated on each end of the shaft and contacts projecting from said member into the block, and arranged to be in permanent contact with at least one mercury-filled cell, and selectively in contact with an adjacent axially aligned cell, the arrangement being

such that when a contact member on one end of the shaft breaks the circuit between two aligned cells of the series, a contact member on the other end of the shaft will close a circuit between two other aligned cells of the series.

5. A mercury contact device comprising a sleeve having a plurality of insulating plates seated thereon and forming a block, a shaft reciprocable within said sleeve, said block having at least two spaced, axially aligned, mercury-filled cells therein, insulated conducting layers in the block for each cell, one conducting layer for each cell having an aperture coincident with and of smaller diameter than that of the mercury-filled cell and in contact with the mercury, at least one contact carrier plate carried by the shaft, at least one contact pin projecting from said plate and extending into said block, said pin being permanently in contact with the mercury of one cell and selectively operable along the axis of said cells to contact the mercury in the adjacent cell to make or break the circuit between said cells.

6. A device according to claim 5, in which the conducting layer not in contact with the mercury has an aperture coincident with and of a diameter larger than that of the cell, and insulating means between the edge of said aperture and the mercury in the cell.

7. A device according to claim 5, in which the conducting layer not in contact with the mercury is spaced therefrom by a groove of the thickness of the said layer, the thickness of which is such that the mercury will not enter the groove because of the surface tension of the mercury, and insulating material in the groove.

8. A mercury contact device according to claim 1, in which the block is formed of a plurality of insulating plates combined into at least one unit and having a bore, a sleeve within the bore to secure said plates together, a shaft reciprocable in said sleeve and a contact carrier on said shaft, the cells being of cylindrical shape with conically tapering ends and horizontally arranged in the block, capillary bores in said block extending between the cells and from the cells to the atmosphere, said contact member being carried by said carrier and axially reciprocable in said bores, the arrangement of the bores and cells being such that the mercury will not flow from the cells because of its surface tension and cohesion.

WALTER BÄRTSCH.