Nov. 23, 1937. F. T. JENKINS 2,100,033

MERCURIAL ELECTRIC CUT-OUT

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Fig.1.

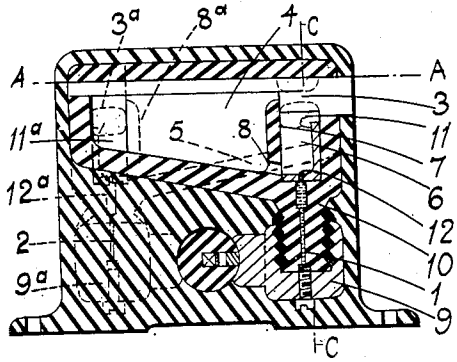

Fig.3.

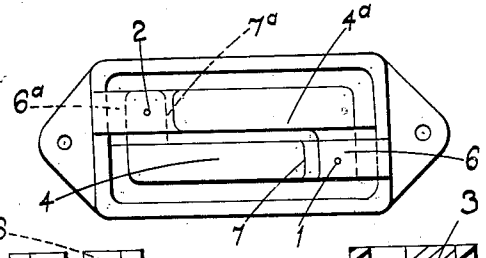

Fig.4.

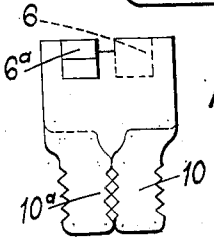

Fig.2.

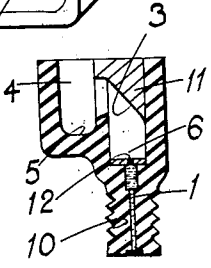

Fig.5.

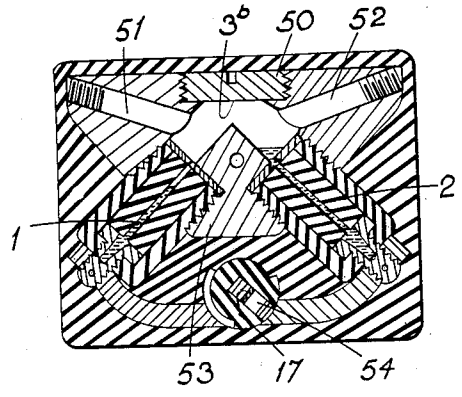

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Fig.6.

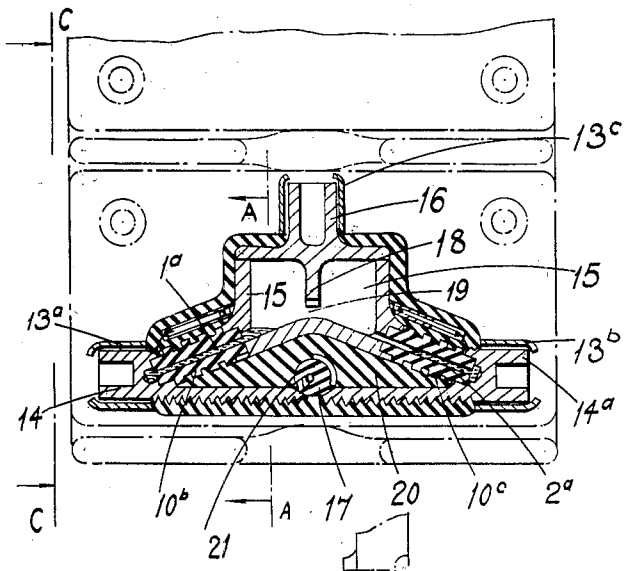

Fig.7.

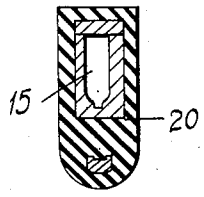

Fig.8.

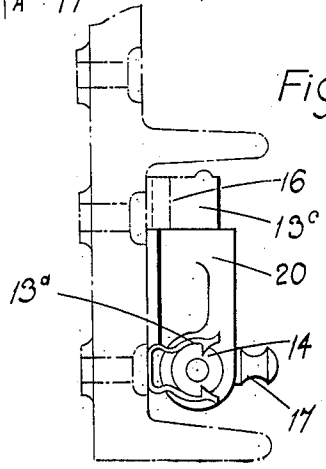

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Fig.9.

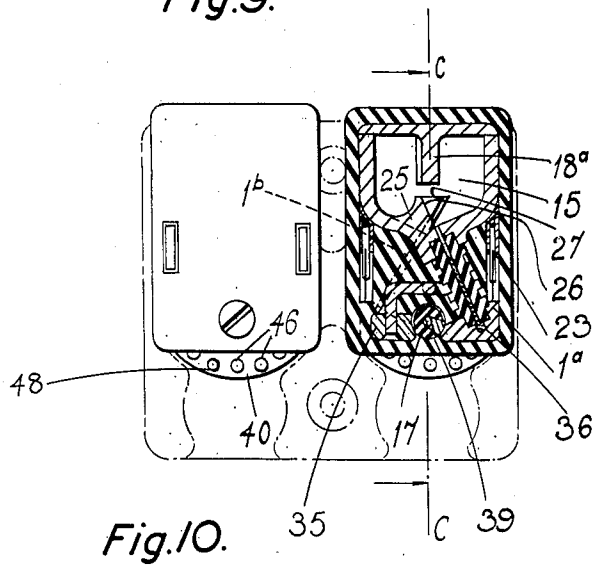


Fig.10.

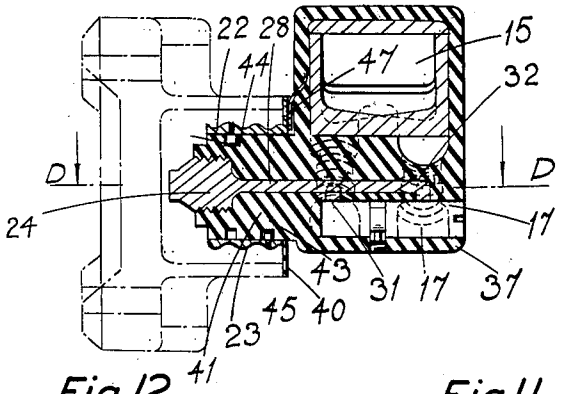


Fig.12.

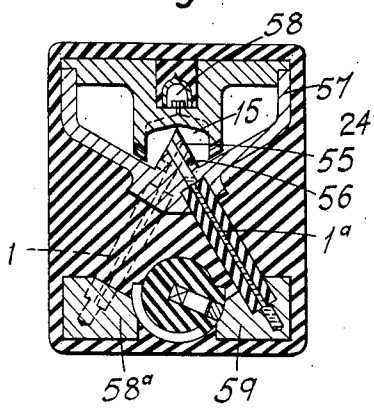
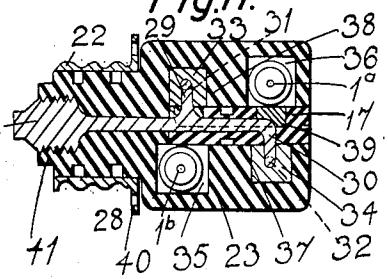


Fig.11.



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2,100,033

UNITED STATES PATENT OFFICE

2,100,033

MERCURIAL ELECTRIC CUT-OUT

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Application December 29, 1936, Serial No. 118,141
In Great Britain October 16, 1935

16 Claims. (Cl. 200—113)

The present invention relates to mercurial electrical cut-outs, that is to say, to cut-outs of the type wherein the current to be controlled is passed through a column of mercury, a portion of which, on the current exceeding a predetermined value is vaporized by the heat generated therein due to its electrical resistance, mercury being thereby expelled from the column, the continuity of the circuit being accordingly broken.

The invention particularly relates to the construction of such cut-outs in which two or more paths are provided through mercurial columns, the apparatus being such that when one of these columns is ruptured, expelled mercury automatically renders an alternative path available through the other or another column, the alternative paths for the current being adapted for connection with external circuits so that when the path through one column is broken the path through the alternative column is not completed until appropriate external means have been actuated.

Among the objects of this invention is to construct the cut-out in such a way as to minimize the quantity of mercury that is necessary to enable the cut-out to function and to reduce the risk of the mercury expelled returning to the last ruptured column and again completing the circuit independent of external actuation. To this end in accordance with the invention a column is provided in each path, and above each column an inclined deflecting surface is provided whereby mercury expelled by rupture of a column in any one of the paths for the time being in circuit is deflected towards another column and flows or is forced into such column in order to render available an alternative path. Instead of providing such deflecting surfaces, the columns may be inclined towards each other so that the expelled mercury is discharged directly into a collecting space above or communicating with the other column wherefrom it may flow into the latter column in order to render an alternative path available. These constructions permit of the mercury expelled flowing in at the top of the other column and little or no mercury in excess of that necessary to complete the columns is required.

If desired, inclined columns and a deflecting surface may be used in combination.

Cut-outs according to the present invention may be provided with mercury trapping chambers for each column and these chambers and the columns so arranged that when rupture of a column in circuit occurs mercury is discharged clear of the chamber associated with that column and into the trap chamber of the other column, from which the mercury can pass only into the latter column.

In the alternative form, columns are preferably disposed in an inclined position in alignment with an opening into the opposed chamber, this opening conveniently providing a communication between the chambers.

In the ordinary form of the cut-out only two columns will be provided, although if desired three or more columns adapted to be rendered available in rotation may be employed.

The chambers may be of any convenient shape and their floors are preferably sloped downwardly towards the upper end of the columns. The tubes containing the mercury may be of ceramic or other suitable nonconducting material.

In order that the invention may be the more readily understood reference will be made to the accompanying drawings in which several forms are illustrated by way of example.

Fig. 1 is a longitudinal sectional view of one form, Fig. 2 being an end sectional view on the line C—C and Fig. 3 a plan view on the line A—A and Fig. 4 an end elevation of this view.

Fig. 5 is a longitudinal section of a modified form.

Fig. 6 is a longitudinal sectional elevation of another form, Fig. 7 being an end sectional view and Fig. 8 an outside end elevation thereof.

Fig. 9 is a front elevation partly in section of a further form, Fig. 10 being a side sectional elevation and Fig. 11 a sectional plan of this view.

Fig. 12 is a sectional elevation of another variant form.

Figs. 1 to 4 show a form of cut-out comprising deflecting surfaces. The mercury columns 1, 2 may be vertically disposed, an inclined deflecting surface 3 or 3a being located above each mercury column and so disposed as to deflect the mercury into an opposing chamber 4 or 4a, i. e., a chamber which supplies the other column, which is provided with a floor 5 sloping downwards towards the top of the other column. The deflecting surface may take the form of a roof of a box-like or cylindrical compartment 6, 6a one wall 7, 7a separating off the compartment from the trap chamber which supplies that column, communication being had between the compartment and the lowest end of such chamber by way of a bottom slot or opening 8, 8a in the separating wall.

A compact form of such a cut-out is attained

by disposing the trap chambers as shown in laterally abreast order, i. e., so that they are separated by a longitudinally extending dividing wall, but the chambers may be of any convenient shape and disposition.

At the lower end of each mercury column a terminal block 9, 9a is arranged and a suitable switch, e. g., a rotary switch, as for example is employed in the forms hereinafter described, may be provided.

The tubes 10, 10a which contain the mercury may be formed integrally with the chamber walls of ceramic or other suitable material, the deflecting surfaces being formed on metal inserts 11, 11a which have apertured contact pieces situated at the top of the mercury columns and which carry or serve as a common terminal for each column. The deflecting surfaces may be machined and if desired polished. A small volume of mercury filling the apertures 12, 12a in the contact pieces when the column is complete suffices to maintain the circuit closed, and conversely the expulsion of a very small quantity of mercury from the column in circuit is sufficient to break that circuit.

If desired the action of passing the mercury over a raised wall into the opposed trap chamber may be effected by employing a curved guide surface and arranging the discharging end of the mercury column so that the expelled mercury is given a rolling action over such surface into the opposed trap chamber, and the curving may be so arranged as to tend to guide scattered particles of mercury to a predetermined station where they may mingle or coalesce and pass into the appropriate trap chamber.

Fig. 5 shows a modified form in which the two columns 1, 2 are inclined upwardly towards each other and a common deflecting surface 3b is provided for example by a machined end surface of a metal plug 50. Expansion chambers 51, 52 are provided for the mercury vapour. The current enters and leaves by way of the switch 17, one of the columns, and a common terminal on the metal body 53.

Figs. 6 to 11 show cut-outs in which the columns are inclined and arranged so that the expelled mercury is discharged directly into a space above the other mercury column.

According to the form shown in Figs. 6 to 8 which is designed to be sprung into engagement with spring clips, the ceramic tubes 10b, 10c are located in an inclined position, each column at one end being in electrical connection with a conducting cylindrical end piece 14, 14a adapted to fit into a spring clip 13a, 13b and at the other end being in electrical connection with the conducting wall of a divided chamber 15, such wall having a cylindrical extension 16 adapted to spring into a third clip 13c. The two end cylindrical pieces are adapted to be connected alternatively to the external circuit by means of a manually-operated switch 17 which can be incorporated as part of the cut-out as shown or be placed in a remote position, i. e., externally of the cut-out.

The floor of the divided chamber slopes upwards from and substantially in alignment with each column 1a, 2a to a crest position which lies a little below the lower edge of a baffle 18 which serves to divide off the chamber, so as to form an aperture 19 through which mercury can be shot from one column into that part of the chamber which lies on the other side of the baffle. The chamber is shaped to trap the mercury despatched into it and cause such mercury to pass into and complete only the other column.

The various parts of the cut-out, excepting the cylindrical terminal pieces, may be embedded in a body 20 of a synthetic resin such as the material known by the registered trade-mark "Bakelite" or other suitable non-conducting material, the switch 17 conveniently being located therein. For example a rotary switch may be employed arranged in a transverse bore 21 in the insulated body 20 and provided with an external actuating means, the column being re-made only put into circuit when such switch is actuated.

Instead of constructing the device for forcing into engagement with terminal clips, pins may project rearwardly from the upper portion of the conducting wall and from the switch for engagement with suitable sockets, or any other suitable means of connecting the common switch terminal and the common conducting portion of the wall to the circuit may be adopted.

According to the form depicted in Figs. 9 to 11, the cut-out is adapted to be connected with the external circuit by means of an Edison type thread coupling. The conducting wall of the divided chamber 15 is electrically connected to the conducting thread 22 which is carried by a body 23 of insulating material, and the central terminal 24 is adapted to be alternatively connected to the mercurial columns 1a, 2a by means of a manual switch 17.

It is preferred in this form to incline the columns upwardly as before but to locate them in different planes, a central ridge 25, spaced below the lower edges of the baffle 18a which divides the chamber, having inclined faces 26, 27 lying in intersecting planes, and so disposed that each face is substantially in alignment with the adjacent column. The baffle 18a may be slightly inclined with respect to the transverse axis of the chamber so as to assist in the correct discharge of the mercury.

As in the previous form the baffle produces two trap chambers, one to each column, and mercury expelled by the rupture of any one column is, as it were, shot into the trap chamber of the other column, wherein the mercury collects and runs down the walls and/or a sloping floor to the column to be remade.

A convenient internal switch arrangement is realized by providing the central external contact with a rod-like extension 28 provided with intermediate and end lateral branches 29, 30 respectively extending on opposite sides of the rod and provided with right-angled ends 31, 32 which are each connected to a contact block 33, 34. These blocks are secured in a position opposite to conducting terminal blocks 35, 36 at the foot of each column. The switch 17 housed in the insulated body, e. g., a rotary switch in a longitudinal bore 37, is provided with contacts 38, 39 adapted to bridge one contact block 33 or 34 and one terminal block 35 or 36 and to insulate from each other the other contact block and terminal block and vice versa. The contacts 38, 39 are in electrical connection, and in the position of the switch shown in Fig. 11 they are bridging contact block 33 and terminal block 36, column 1a being then in circuit.

The conducting Edison type threaded sleeve 22 may be formed with an external flange 40, the sleeve being rotatably mounted on a cylindrical part 41 of the insulated body 23, and is provided with inward projections 42, 43 (see Fig. 10) which intrude into annular recesses 44, 45 in the in-

sulated body so that the body travels axially with the sleeve when the latter is rotated. This construction permits of the thread being engaged with the corresponding threaded socket without rotating the cut-out as a whole, and in order to facilitate the rotation of the threaded sleeve in places difficult of access, or when a number of cut-outs are to be placed adjacently, it is advantageous to provide the flange **40** with a peripheral series of holes **46** and to extend the flange or a local part thereof so far beyond or below the cut-out body as to permit the holes to be engaged by a tommy bar for screwing home the sleeve.

The peripheral edge of the flange may be knurled to facilitate grip thereof.

The contact between the threaded sleeve and the conducting wall of the divided chamber may be effected through the medium of a blade type spring **47** which also serves to take up tolerance between the engaging threaded parts and prevent slackness of the cut-out with respect to the socket.

Fig. 12 shows another variant in which inclined columns **1**, *1a* are used, discharging through a passage **56** into opposite compartments of a chamber **15** divided by the ridge **55**. The mercury expelled from one column say the left-hand column passes into the compartment above the right-hand column and flows into the top of such column by way of a lateral passage 56. The circuit is from the common terminal of the switch through which ever column is in circuit to the conducting wall **57** which is common to both columns. 58 shows where the interior has been sealed off after evacuation of the air therefrom.

The tubes containing the mercury columns may be externally serrated or holed and the bores in the lower terminal blocks correspondingly serrated or holed and a cement or other suitable filling used to unite the parts firmly.

Each of the forms above described permits the interior of the cut-out to be exhausted of air or charged with a nonoxidizing gas and hermetically sealed.

Indicator means, e. g., neon tubes, may be provided for giving a visual indication which column is ruptured.

It is also to be understood that where I speak of mercury I include any other liquids, e. g., mercury amalgams, suitable for use in cut-outs since my invention is not concerned with the particular liquid used.

In some cases in which it may be desirable to employ a cut-out in accordance with this invention, it may be required for a short period of time to pass a current of an amount sufficient to rupture the mercury column; such conditions may, for example, arise in respect of the heavy starting current taken by a motor. In such a circuit two cut-outs of appropriate carrying capacities, one temporarily acting, may be provided as branch lines, and suitable means provided for connecting the columns alternatively in circuit; such alternative connecting means may be of such a character as automatically to switch out the temporary cut-out after a predetermined interval. Where it is essential to minimize the interruption of a circuit due to rupture, this can be effected by bridging the pins, terminals, or connections that are normally connected to the two-way switch **13** thus dispensing with the latter.

I claim:—

1. A mercurial electric cut-out containing a plurality of mercurial columns, said columns being contained in alternative paths for the passage of the current through the cut-out and being such that when the current passing through a column exceeds a predetermined value, mercury is expelled therefrom, a separate collector associated with each column, said columns being inclined to one another and at least one impact surface being provided, arranged so that mercury expelled from one column is caused to strike an impact surface above the collector associated with another column in such manner that the expelled mercury is positively directed into such collector and into such other column in order to render another of such alternative paths available for the passage of the current.

2. A mercurial electrical cut-out containing a plurality of mercury columns said columns being contained in alternative paths for the passage of the current through the cut-out and being such that when the current passing through a column in any one path exceeds a predetermined value mercury is expelled therefrom, said columns being inclined to one another, and deflecting means being provided arranged so that mercury expelled from any one column is caused thereby positively to pass to another column so that another of such alternative paths is rendered available for the passage of the current.

3. Mercurial electric cut-out containing alternative paths for the passage of the current, a mercurial column in each of said paths, a compartment associated with each column for draining mercury thereinto, a barrier, said compartments being at least partially divided off from each other by said barrier, a deflecting surface obliquely to each column and arranged so that mercury expelled from any one column passes directly beyond said barrier to the compartment associated with another column before it strikes said deflecting surface and is deflected into such other column and renders another of such paths available for the passage of the current.

4. A mercurial electric cut-out containing a plurality of mercurial columns said columns being contained in alternative paths for the passage of the current through the cut-out, a compartment associated with each column, said compartments being at least partially divided off from each other, said columns being inclined to each other so that mercury expelled from one column is discharged directly into a compartment associated with another column so as to drain into such other column in order to render another of such paths available for the passage of the current.

5. A mercurial electric cut-out containing a plurality of mercurial columns, said columns being contained in alternative paths for the passage of the current through the cut-out, a compartment associated with each column, said compartments being at least partially divided off from each other, said columns each being situated in alignment with the compartment associated with another column so that when rupture of the column in circuit occurs mercury is discharged clear of the compartment associated with that column and into the compartment of another column where after impacting with a wall of such compartment the mercury can pass into the latter column but cannot return to the first column.

6. A mercurial electrical cut-out according to claim 4, in which the mercury trap compartments are placed in communication by means of an

aperture aligned with inclined mercury columns, so that mercury can be expelled directly from one column into a compartment leading to the other column, the compartments having oppositely sloping floors leading down to the top of the respective columns.

7. A mercurial electrical cut-out according to claim 2, in which the inclined columns are in alignment with the floors of the respective chambers.

8. A mercurial electric cut-out containing a plurality of mercurial columns, said columns being inclined to one another, said columns being contained in alternative paths for the passage of the current through the cut-out, a trap compartment associated with each column, said compartments being formed by a divided common chamber, said division being effected by a partition, said partition having oppositely inclined passages co-linear with said inclined mercury columns, a passage co-linear with one column communicating with the trap compartment associated with the other column.

9. A mercurial electrical cut-out as in claim 1, in which the columns are inclined towards each other and a common deflecting surface is provided for deflecting expelled mercury to the other column, said compartments being formed by dividing a common chamber by means of a barrier, and said columns and said deflecting surface being arranged so that the expelled mercury is discharged over said barrier before striking said deflecting surface.

10. A mercurial electric cut-out containing a plurality of mercurial columns, said columns being contained in alternative paths for the passage of the current through the cut-out, a compartment associated with each column for draining mercury thereinto, a box-like structure partitioned to form such compartments, a deflecting surface obliquely to each column and arranged so as to deflect mercury expelled from any one column directly to the compartment associated with another column so that the expelled mercury drains into such other column and renders another of such paths available for the passage of the current, the deflecting surfaces being formed by inserts of conducting material, said inserts being connected together to form a common terminal.

11. A mercurial electric cut-out as claimed in claim 10, having metal inserts, said inserts being each provided with a base piece, and a small hole in each base piece registering with the mercury column.

12. A mercurial electric cut-out according to claim 1, comprising a body portion housing said columns, and a switch carried by the body of the cut-out and arranged so that the column into which mercury is drained after expulsion from another column can only be placed in circuit when such switch is actuated.

13. A mercurial electric cut-out according to claim 1, comprising a body portion housing said columns, and a rotary switch carried by the body of the cut-out and arranged so that the column into which mercury is drained after expulsion from another column can only be placed in circuit when such switch is actuated.

14. A mercurial electric cut-out according to claim 2, comprising a body portion housing said columns, and a rotary switch carried by the body of the cut-out and arranged so that the column into which mercury is drained after expulsion from another column can only be placed in circuit when such switch is actuated, said switch being located between the lower parts of the columns.

15. A mercurial electrical cut-out according to claim 1, comprising a body housing said mercury columns, a central terminal carried by the body and an externally threaded sleeve terminal rotatably mounted on the body, said sleeve terminal being coupled for axial movement with the body so that the sleeve terminal can be screwed into its socket without rotating the said body.

16. A mercurial electric cut-out containing alternative paths for the passage of the current, a mercurial column in each of said paths, a space in communication with each column, said columns being inclined towards each other so that mercury expelled from one column is discharged directly into the space communicating with another column in order to render another of such paths available for the passage of the current.

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