

Nov. 3, 1953

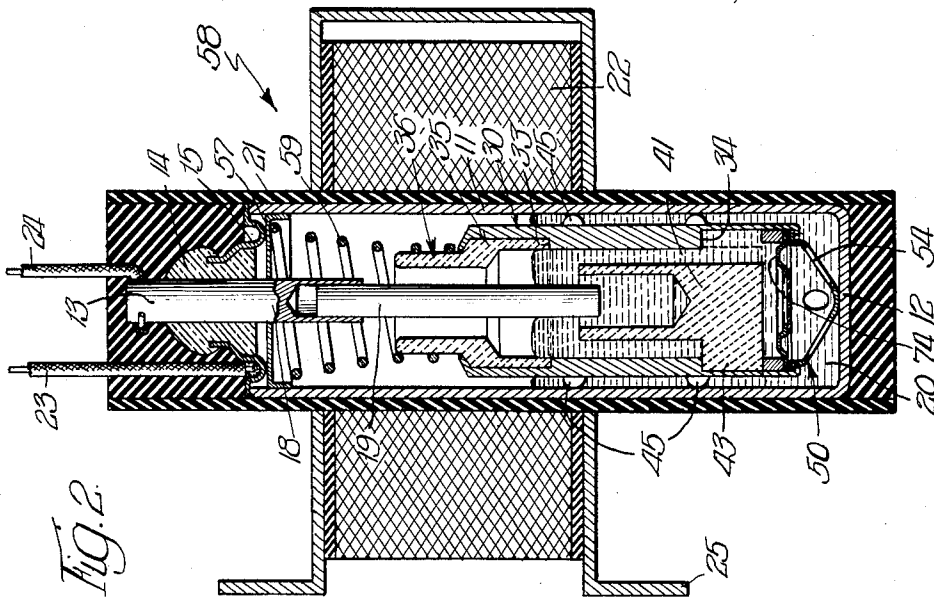
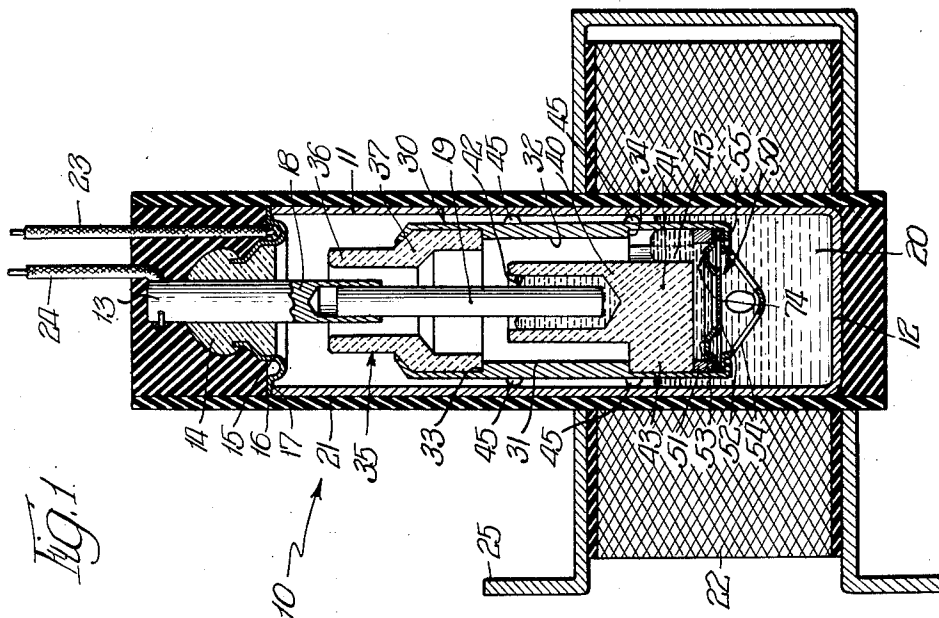
G. L. WEIMER

2,658,124

MERCURY RELAY

Filed Nov. 15, 1951

2 Sheets-Sheet 1



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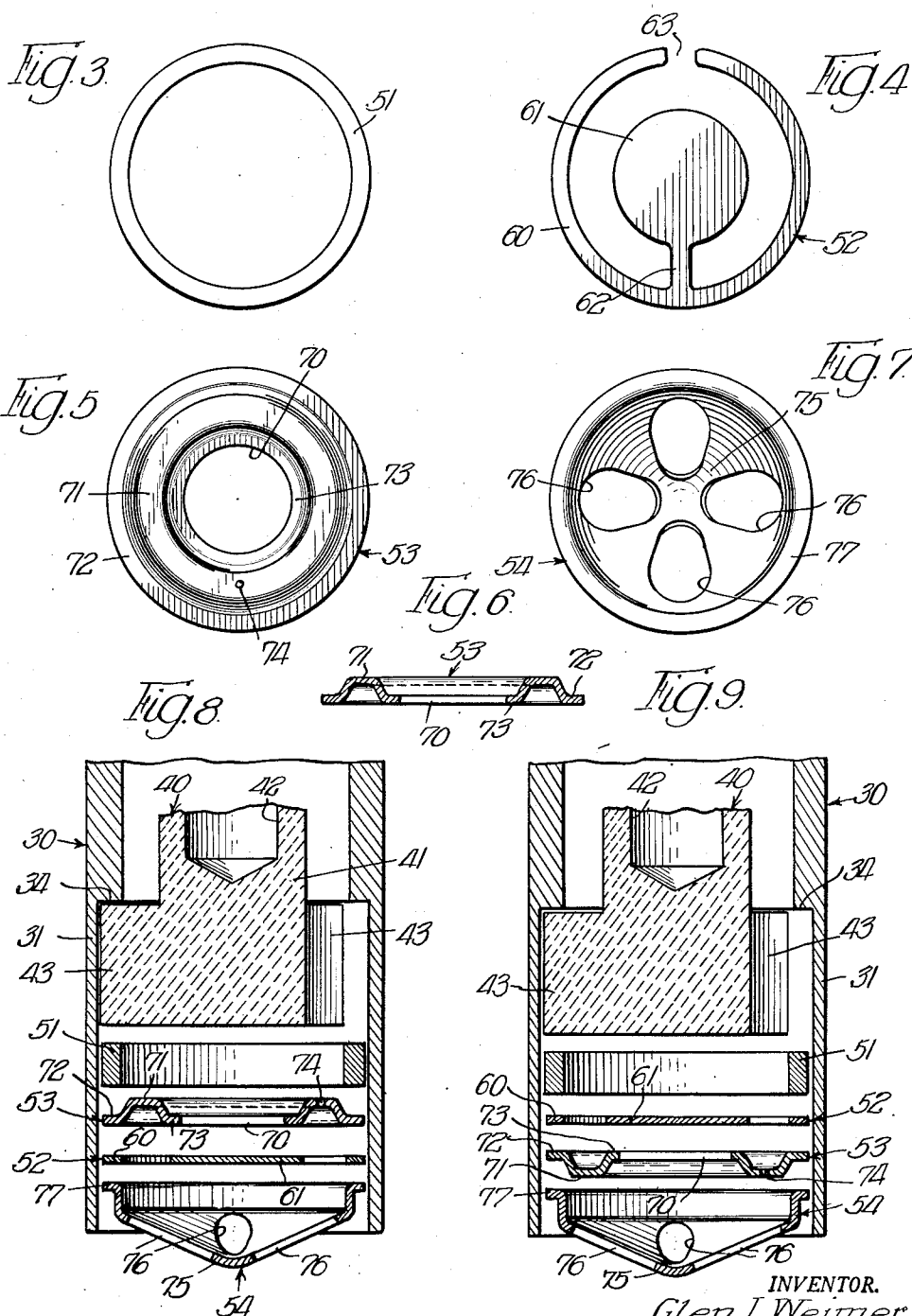
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MERCURY RELAY

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,658,124

MERCURY RELAY

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My present invention is directed generally to improvements in mercury relays and more specifically to a new and improved check and metering valve means for use with a displacer type of mercury relay whereby "slow-make" and "quick-break" or "quick-make" and "slow-break" energization and interruption of an electrical circuit through the relay may be accomplished.

In the particular embodiments of my invention herein disclosed I have shown and described two forms of a displacer type relay, namely, a "normally open" type and a "normally closed" type, with which my new and improved check and metering valve means is readily adapted to effect a desired quick or slow make and break control of an electrical circuit through the relay, as desired. Each of the relays illustrated comprises an outer casing or shell which provides for the support of the main body of mercury for the relay and in which a plunger or displacer is contained for displacement of the mercury in response to energization of an electro-magnetic coil surrounding the relay shell in a conventional manner; the plunger or displacer acting as a movable core therefor. The plunger in each embodiment may be arranged with my valve means to provide for the desired "quick-make" and "slow-break" or "slow-make" and "quick-break" control of the electrical circuit as desired.

Further, it will be recognized that the desired slow or quick making of the circuit through the relay and its accompanying quick or slow breaking is accomplished through the arrangement of the valve means utilized with the plunger, with the length of the time delay, utilized for a desired operating characteristic of the relay, being effected by the metering feature of my valve means, as will be described in specific detail later herein.

It is the primary object of my invention to disclose and describe, in its relation to several preferred embodiments of a mercury relay, a new and improved check and metering style of valve means readily adapted to effect the desired time delay and circuit controlling characteristics required of the relay.

It is a further object of my invention to disclose a new and improved check and metering valve means for use with a displacer type of mercury relay in which the time operational characteristics of the relay may be controlled by the selection of the metering orifice utilized in my valve construction.

The above and further objects and features

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of my invention will appear to one skilled in the art from the accompanying specification and description thereof and with relation to the illustrative drawings of several embodying relays and arrangements of the valve elements by which the desired flexibility in operational characteristics of my valving means may be accomplished.

In the drawings:

Figure 1 is a front elevational view, in full cross section, of a normally open displacer style of mercury relay with which my new and improved valve means readily is utilized;

Figure 2 is a front elevational view in full cross section, similar to Figure 1, illustrating a normally closed displacer type of mercury relay with which my new and improved valve means is embodied;

Figure 3 is a top plan view of an annular spacing ring utilized in my valve means;

Figure 4 is a top plan view of my new and improved check valve;

Figure 5 is a top plan view of the check valve seat utilized with the valve means illustrated in Figure 4;

Figure 6 is a front elevational view, in full cross section of the check valve seat illustrated in Figure 5;

Figure 7 is a top plan view of the bumper washer utilized in the assembly of my valve means;

Figure 8 is an exploded partial front elevational view, in full cross section, of the lower end of the displacer plunger shown in Figures 1 and 2 and demonstrating in exploded relation the elements of my new and improved valve means arranged for "slow-make" and "quick-break" operation of the circuit through the relay;

Figure 9 is a partial front elevational view in full cross section, similar to Figure 8, of the lower end of the relay plunger and illustrating in exploded relation the elements of my new and improved valve means arranged for "quick-make" and "slow-break" operation of the circuit through the relay.

Referring now to Figure 1 of the drawings, it will be recognized that I have therein illustrated a "normally open" type of displacer style mercury relay indicated generally at 10 which is conventional in most respects with the exception of the addition thereto of my new and improved valve means. Specifically, the relay 10 illustrated in this figure embodies an outer shell or body 11 formed as a cylindrical tubular member closed over at its lower end 12 and preferably made of stainless steel or other suitable metal which is

preferably non-magnetic and non-amalgamating with mercury. One preferred metal for the body is that of an 18-8 group steel, having not less than 24% of chromium and nickel combined, but no less than 8% of each element. It is conventional in the art to term the body or casing 11 as an "open envelope" type of casing which, in the embodiments of my invention illustrated herein, serves as one electrode or terminal for the relay. An additional electrode means 13, 10 serving as a second electrode or terminal for the relay, extends inwardly of the open upper end of the casing or envelope 11 and is suitably mounted and insulated therefrom in preferably gas tight relation. The electrode 13 may be of any suitable form, such as a cylindrical rod illustrated herein, and may comprise a two part construction as illustrated. Means for holding the electrode 13 in a desired vertical relation within envelope 11 comprises a glass bead 14 which serves to anchor the electrode centrally of a closing cap member 15 with which it is embedded in fused relationship, as illustrated. The cap member 15 is further securely sealed with the envelope 11 by means of a welded junction between the peripheral skirt 16 thereof and the upper end of the envelope, as at 17. In connection with the electrode assembly described immediately above, it will be recognized that it is desirable that the glass bead 14 and the portion 18 of the two part electrode 13 means be of like thermal expansion coefficients, to prevent breaking away of these parts from each other due to heat generated in operation of the relay. Glasses and metals having such characteristics are now well known in the art, with one such metal for the electrode consisting of approximately 25% nickel, 17% cobalt, 0.003% manganese and the balance of iron. Likewise suitable borosilicate glasses, otherwise known as hard glasses, are suitable for use with the metal parts made of the aforesaid alloy used in the electrode portion 18. A lower portion 19 of the electrode, or that portion which is illustrated as fitting coaxially within the upper electrode portion 18, suitably may be made of molybdenum or other suitable arc resisting metal or alloys as desired. With the sealing of the electrode assembly and the envelope 11, the interior of the latter is usually evacuated and a body of mercury 20 introduced thereto.

The envelope 11 is normally carried by a surrounding cylindrical insulating shield 21 and mounted axially of an energizing electromagnetic coil 22 of a familiar design in the art. A first electrical lead 23 is suitably connected to the upper end of the envelope 11 as illustrated, for circuit connection therewith, and a second electrical lead 24 is connectively associated with the upper end of the electrode means 13 to complete circuit connection with the relay. Normally the relay is mounted within the core of the coil member 22 so that the coil surrounds the tubular assembly comprising the metal envelope 11 and the insulating shield 21. The coil 22 is normally carried by a suitable bracket means, such as 25.

As previously related the envelope casing 11 is preferably of a cylindrical shape and of a dimension suitable for receiving a substantially cylindrical plunger or displacer means 30 utilized for displacing the body of mercury 20 within the envelope in a conventional manner in operating displacer type relays of the class described herein. The displacer means or plunger 30 comprises a substantially cylindrical, magnetic, metal sleeve 31, having a centrally disposed and in-

wardly offset cylindrical shoulder 32 formed internally thereof and of a diameter reduced from the upper and lower end extensions of the sleeve to provide an upper annular internal shoulder 33 and a lower annular internal shoulder 34. A first insulating member 35, formed as a substantially cylindrical ceramic tube having a reduced upper arc shielding neck portion 36 is then mounted coaxially within the sleeve member 31 so that the lower end thereof rests atop and against the upper internal shoulder 33 of the sleeve 31, with the lower electrode portion 19 extending coaxially through the hollowed interior of insulating member 35. The upper end of the sleeve member 31 is then suitably rolled inwardly to grip a frustro-conical portion 37 of the ceramic member 35, for sealing the same with the sleeve member 31.

A second ceramic member 40, having a substantially cylindrical core portion 41, distinguished by a hollow mercury retaining bore or cup 42 at its upper end and a plurality of integrally formed and radially projecting wing members 43 at its lower end, is then insertively received in the lower hollow interior of sleeve member 31 so that the upper edges of the wing members 43 rest against the lower shoulder 34 of the sleeve member 31. In this latter connection it is preferable that at least three wing members 43 project radially outward from the core portion 41 of the ceramic member 40 to give stability and coaxial centering and positioning of the core member 40 radially inward of the sleeve member 31 to provide a substantially annular passageway for the flow of the mercury 20. The sleeve 31 of the plunger or displacer means 30 is further provided with a plurality of steel balls 45—45 which are suitably inserted in sockets drilled therefor in the walls of the plunger sleeve 31 at suitable intervals about its surface to permit the free rolling movement of the balls 45 which are provided for guiding the plunger means 30 vertically within the interior of the relay envelope 11. It will be understood, of course, that other forms of guiding means may be employed for the guiding of the plunger's movement within the relay envelope 11, but the expedient illustrated herein has been found to be completely satisfactory in operation and is preferred.

Located immediately below the lower ceramic member 40 is my new and improved check and metering valve means indicated generally at 50 and comprising an annular spacer ring 51, a disc or flap check valve 52, a check valve seat 53 and a bumper washer 54 suitably assembled to provide the required operating characteristics with which the relay is to perform, as will be amplified later herein. The elements 51 through 54 of the valve assembly 50 are all of a circular plan configuration and designed to fit snugly within the lower cylindrical interior of the plunger sleeve 31. The lower edge of sleeve 31 is suitably rolled over, as at 55, to hold the valve assembly tightly against the lower end of the ceramic member 40 as illustrated.

Referring now to Figure 2 of the drawings, it will be recognized that I have therein illustrated a "normally closed" style of mercury relay 53 of the plunger or displacer variety. The relay 53 shown therein, is identical in construction to the relay 10 heretofore described in all respects with the exception that a compression coil spring member 59 is provided intermediate the upper end of the upper ceramic member 35 and the lower end of the electrode assembly cap 15 which

seals over the upper end of the relay envelope member 11. It will be appreciated that with the provision of the spring member 59, which concentrically receives the reduced upper neck portion 36 of the ceramic member 35 in its lower end, the plunger assembly 30 of this style relay is normally partially submerged in the mercury 20 so that the bumper washer 54 thereof lies adjacent the lower wall 12 of envelope 11 with the mercury closing contact between the electrode portion 19 and the envelope 11 and is thus termed a "normally closed" style relay in the art. It will be understood that the operational characteristics of relay 58 are the reverse of relay 19 previously described, in that the circuit through relay 58 is normally closed with a mercury to mercury contact between the two electrodes 13 and the outer shell 11 while in the relay 19 the plunger assembly normally floats atop the body of mercury 20 so that the circuit through the relay is normally open. In the relay 58, the compression spring 59 received the neck 36 of the upper ceramic member 35 at one end and at its opposite end is preferably received within and confined by a cup-shaped retainer 57 which bears against the underside of cap 15.

Turning now to Figures 3 through 7 of the drawings, which illustrated in specific detail the makeup of the several elements of my valve construction or assembly 50, it will be recognized from Figure 3 that the spacer ring 51 is formed as an annular ring of a material such as cold rolled steel or the like, and having a rectangular cross section as exemplified by the cross sectional views thereof in Figures 1, 2, 8 and 9. It should be particularly noted in connection with the spacer ring that the upper and lower surfaces thereof must lie in true parallel relation with one another and transversely of its central longitudinal axis.

In Figure 4 I have illustrated the plan configuration for my new and improved check valve 52 which is made of a very flat and thin spring material, such as tempered steel, having a vertical thickness of approximately 0.015 inch or the like. In particular, it will be recognized that the valve 52 includes an outer annular ring 60 interconnected with a central circular flap member 61 by means of a reduced neck portion 62, so that the flap member and bordering ring 61 and 60, respectively, are integrally associated, such being normally formed as by a stamping operation or the like. Further it will be noted that the outer ring 60 is open at 63, at a point diametrically opposite from neck portion 62 which interjoins the flap member 61 and ring 60, providing radial resilience to ring 60. However, the ring portion 60 also can be constructed without the opening 63 without hampering the working efficiency of my valve assembly.

In Figures 5 and 6 I have illustrated the preferred embodiment of the check valve seat member 53 upon which the check valve member 52 is mounted. It will be recognized from Figure 5 in particular, that the valve seat 53 is formed as an annular metal ring having a central circular port or aperture 70 formed therethrough. Member 53 is further provided with a reentrantly formed bead portion 71 of an annular configuration, located radially outward and in spaced relation from the central aperture 70, and projecting to one side of the main plane of the valve seat member. A small metering orifice 74 is also provided through the bead portion 71 to act as a means for regulating the flow of mercury in one direc-

tion past my valve means as will appear later herein. The size of the orifice 74 may be varied to regulate the mercury flow for adjusting a time delay operating feature of the relays herein as will appear later. The metering orifice 74 may also be located centrally of the valve flap 61 if desired. The valve seat member is further provided with an outer annular planar skirt portion 72 which borders the reentrantly turned bead portion 71, radially outward thereof to define the radial limits of the seat member 53. A second planar skirt portion 73 borders the bead portion 71, radially inward thereof and defines the radial limits of the central aperture 70. My check valve 52 is to be positioned adjacent the two skirt portions 72 and 73 so that the outer annular ring 60 of the valve lies flush against the face of the skirt portion 72 and on the opposite side of the plane of valve seat member from the projecting bead member 71, while the flap member 61 of the check valve lies coaxially of the central opening 70 of the valve seat member and contacts the face of the skirt portion 73 about its periphery; skirt 73 thus constituting a valve seat for flap 61. In this connection it is requisite that the faces of the two skirt portions 72 and 73 of the seat member 53, against which the valve member 52 is mounted, be in flush coplanar relationship to avoid warpage of the very thin check valve.

In Figure 7 I have illustrated the bumper washer 54 of my valve assembly which constitutes and defines a lower projection of the plunger assembly 30. The bumper washer 54, as shown in Figure 7 and in the enlarged cross sections of Figures 8 and 9, is circular in plan and extended downwardly with a lower conical portion 75. As noted particularly in Figure 7, of the drawings, the conical portion 75 is provided with a plurality of pear shaped openings 76, 76, herein illustrated as four in number, which are provided for the purpose of free flooding entry and exit of the mercury past the valve washer and through the valve 52 upon vertical actuation of the plunger assembly of the relay. The bumper washer is further provided with an upper planar peripheral flanged portion 77 defining the radial limits thereof and configured flatly on one face to provide close fitting assembly with the valve seat member or valve as will appear later herein.

It should be noted particularly that the several elements of the valve assembly 50, comprising the spacer ring 51, check valve 52, check valve seat member 53, and bumper washer 54 are all designed with equal external diameters to fit snugly within the cylindrical interior of the plunger sleeve 31, with the apex of the conical portion 75 of washer 54 defining the lower reaches of the plunger assembly 30. Further, as mentioned heretofore, the various elements of the valve assembly are maintained in a close fitting relationship within the plunger sleeve 31 by means of the rolled over lower end portion 55 of the plunger sleeve which presses the valve assembly tightly against the lower end of the plunger's lower ceramic member 40.

Referring now particularly to Figure 8 of the drawings, it will therefrom be recognized that the lower end of the plunger assembly 30, illustrated in Figures 1 and 2 of the drawings, is demonstrated in enlarged cross section and in a demonstrative exploded form to illustrate the positioning of the various elements of the valve assembly 50 to accomplish a "slow-make" and "quick-break" circuit activating and interrupting plunger characteristic. In this connection,

it will be observed that in the mounting of the valve elements 51 through 54 in the lower end of the plunger to provide a "slow-make" and "quick-break" style of plunger, the spacer ring 51 is placed adjacent and immediately below the lower end of the inserted ceramic member 40 of the plunger assembly. The check valve seat member 53 is then assembled immediately below the spacer ring so that its beaded portion 71 projects coaxially inward and upwardly into the interior of the spacer ring, with the central opening 70 thereof lying coaxially of the plunger itself. My check valve member 52 is then placed below and immediately adjacent the valve seat member 53 so that the flap portion 61 thereof underlaps the central aperture 70 of the valve seat member 53. The bumper washer 54 is then assembled below the valve member 52 with the flat face of its peripheral flange 77 contacting the lower face of the annular ring portion 60 of the valve member 52 so that, when the lower end 55 of the plunger sleeve 31 is rolled over, the flange of the bumper washer and the outer peripheral flange of the valve seat will tightly grip my check valve 52 at its annular portion 59 to hold the same in concentric operating position relative to the other elements of the valve assembly. With the elements of the valve assembly 59 thus assembled in the lower end of the plunger assembly 30, downward movement of the plunger will force the flap portion 61 of the check valve 53 tightly against the inner peripheral flange on the valve seat 73 to force the body of mercury 20 to be metered through orifice 74. Conversely, upward movement of the plunger will cause the flap 61 of the valve member to hinge downwardly away from the valve seat member, uncovering the central aperture or port 70 thereof to permit free passage of mercury there-through. It will thus be appreciated that the flow of mercury through the valve means is delayed in response to movement of the plunger 30 in one direction and is permitted free flow through the valve means in response to movement of the plunger assembly in an opposite direction, thus the "slow-make" and "quick-break" characteristic for the plunger.

As related to the normally open variety of relay 10, illustrated in Figure 1, it will thus be seen that with the elements of the valve assembly mounted as illustrated in Figure 8 of the drawings, downward movement of the plunger assembly 30 in response to electrical energization of coil member 22 will cause a slow metering of the body of mercury 20 through orifice 74, resulting in a time delay in the closing of the circuit through the relay. Conversely upward movement of the plunger assembly 30 of the normally open variety of relay 10 will cause the flap 61 of the check valve 53 to hinge downwardly, permitting a quick dumping of the mercury held within the body of the plunger and resulting in a quick disruption of the circuit through the relay. In connection with the operation of the free floating plunger of a normally open relay 10 it will be appreciated that the depression of the plunger assembly 30 in response to energization of coil 20 causes mercury to be displaced from the lower end of the relay body or envelope upwardly through the free flooding port 76 of the bumper washer, through the metering orifice 74 and into the interior of the sleeve member 31 to overflow the top of the lower ceramic member 40 and cup 42 therein to contact the lower electrode portion 19 and complete electrical circuit through the

relay. Reverse or upward actuation of the plunger assembly 30 of course causes the flap 61 of my valve means 52 to open downwardly to dump the mercury quickly out of the interior of the plunger sleeve 31 and break the circuit through the relay.

With reference to the normally closed type of relay 58, illustrated in Figure 2 of the drawings, with the elements of the valve assembly mounted, as illustrated in Figure 8, for a "slow-make" and "quick-break" operation, it will be appreciated that the metering effect permitted by the orifice 74 when flap 61 is closed against seat 73 again causes a time delay in the closing of the circuit through the relay, or that is, the depression of the plunger assembly 30 in response to the force exerted by compression spring 59 is delayed. In this style of relay of course, energization of coil 22 causes upward movement of the plunger assembly against the force of spring member 59 to open the circuit through the relay and to this end the dumping action of the flap of my valve means 52 again permits a quick breaking of the circuit through the relay.

Referring now specifically to Figure 9 of the drawings, it will be recognized that the particular assembly of the elements 51 through 54 of my valve assembly therein illustrated, results in a valve having the reverse operational characteristics for the plunger as that shown in Figure 8 of the drawings. That is to say, the assembly of the valve member 52 above the valve seat member 53 as illustrated in Figure 9, or in reverse relation to the position of these parts as shown in Figure 8, results in "quick-make," "slow-break" operating characteristics for a plunger to which such is attached.

In particular it will be noted that since the valve 52 in the Figure 9 assembly, is positioned above the valve seat member 53 downward movement of the plunger permits upward movement of the flap portion 61 of the valve to allow free flow of the mercury through aperture 70 of the valve seat member. Conversely upward movement of the plunger would cause a metering of the mercury through the metering orifice 74 of my valve means.

Thus it will be recognized that if the free floating plunger of the normally open relay 10 of Figure 1 were provided with the valve assembly as illustrated in Figure 9, downward actuation of the plunger assembly 30 thereof in response to energization of coil 22 would cause a quick closing of the circuit through the relay, while the reverse or upward movement of the plunger assembly of relay 10 (after release of the energizing effects of the coil member 22) would result in a "slow-break" of the circuit due to the time delay caused by the necessity of the mercury flowing away from the inner-electrode portion 19, and slowly through the metering orifice 74 of my valve means. Likewise, if the normally closed relay of Figure 2 were provided with the "quick-make," "slow-break" assembly of my valve elements, as illustrated in Figure 9, downward actuation of the plunger assembly 30 thereof, in response to the compressive force of spring member 59, would cause a "quick-make" or closing of the circuit through the relay while the reverse actuation of the plunger, in response to energization of coil member 22, would result in a "slow-break" or opening of the circuit through the relay.

Thus it will be recognized that I have herein illustrated and described a new and improved

relay embodying a novel and simple combined metering and check valve means whereby either "quick-make" and "slow-break" or "slow-make" and "quick-break" operating characteristics for the relay may be accomplished by the mere reversal of the flap type check valve and valve seat in the plunger's valve assembly. Further it will be appreciated that the exact time delay caused by the metering of the body of mercury through the metering orifice 74, may be regulated at desired intervals by variations in the size of the metering orifice as desired. Therefore, while I have herein illustrated two embodiments and two alternate arrangements in which the features of my invention may appear, it will be appreciated that numerous changes, modifications and substitutions of equivalents may be made therein without departing from the spirit and scope of my invention and consequently I do not wish to be limited to the specific embodiments herein described and illustrated except as may appear in the following claims.

I claim:

1. A plunger for use in a tubular relay body of a displacer type mercury relay to displace a body of mercury contained therein, comprising, a hollow, substantially tubular, open-ended, metal sleeve of magnetic material, a hollow, first insulating member mounted coaxially within the upper end of said sleeve, a second insulating member mounted coaxially within the lower interior of said sleeve and positioned radially inward thereof and having means defining a passageway for the mercury, and a combined metering and check valve means positioned transversely across the lower end of said sleeve and beneath said second insulating member, said valve means having an arcuately removable resilient flapper arranged to permit the free flow of mercury therepast upon movement of said plunger in one direction and to meter the mercury therepast upon movement of said plunger in an opposite direction.

2. A plunger for use in a tubular body of a displacer type mercury relay for displacing mercury contained therein, comprising, a hollow, substantially cylindrical, open-ended, metal sleeve of magnetic material, a hollow, first insulating member mounted coaxially within the upper interior of said sleeve, a second insulating member mounted coaxially within the lower interior of said sleeve and having means defining an annular passageway for said mercury, and a combined metering and check valve means mounted transversely across the lower end of said sleeve, beneath said second insulating member, and comprising an annular spacing ring adjacent said second insulating member, an annular valve seat member, having a central circular aperture and a small metering orifice formed therethrough, mounted transversely across said sleeve and beneath said spacer member, a resilient planar flapper type valve positioned adjacent said seat with a central flapper portion thereof overlying said seat's central aperture, and a conical buffer washer mounted at the lower extremity of said plunger and having a plurality of free flooding ports formed there-through, said buffer spacing the plunger from the lower end of said relay body when such is in its lowermost position therein, said valve and valve seat member being so arranged that vertical movement of said plunger in the relay body in one direction causes said flapper to hinge outwardly from said seat to cause a free flow of mercury through said seat's aperture while movement

of said plunger in an opposite direction in the relay body causes said flap to close over said seat's central aperture accompanied by a metering of mercury through said metering orifice.

3. A plunger assembly for displacing a body of mercury contained in a displacer type mercury relay, comprising, an outer, magnetically materialized, cylindrical shell open at both ends, a first ceramic insulating member fitted within the upper interior of said shell and providing a coaxial passageway therethrough, a second, substantially cylindrical, ceramic, insulating member fitted within the lower interior of said shell, spaced concentrically and radially inward therefrom, and having means defining a passageway for mercury, an annular, spacer ring mounted coaxially within said shell and adjacent the lower end of said second ceramic member, a disc type valve seat member, having a circular central aperture and a small metering orifice formed therethrough, mounted coaxially with said shell and beneath said spacer ring, said valve seat member having an annular valve seat formed about the periphery of said aperture therein, a resilient, planar, flapper type check and metering valve mounted coaxially of said shell and adjacent said valve seat member and having an arcuately movable valve flap formed centrally thereof and engageable with said valve seat to enclose said central aperture, and a substantially conical, bumper washer mounted beneath said valve and valve seat member with its apex end downward for preventing collision of said shell with the lower end of said relay body, whereby said valve serves to meter mercury through said orifice in said valve seat when closed over said central aperture therein and to permit free passage of mercury through said aperture when opened arcuately outward from said valve seat member.

4. A plunger for a displacer type mercury relay, comprising, a hollow, open-ended, magnetic sleeve; a hollow, open-ended, first insulating member mounted within the upper interior of said sleeve, a substantially cylindrical second insulating member mounted concentrically within the lower interior of said sleeve and having means defining a passageway for mercury, an annular spacer ring mounted adjacent the lower end of said second insulator, concentrically within said shell, an annular valve seat disc, having a central aperture and a small metering orifice formed therethrough, mounted beneath said spacer ring; a planar flapper valve mounted coaxially of said shell, adjacent said valve seat and having a central arcuately movable flap portion adapted to close over said valve seat's central aperture and the lower end of said shell, and a substantially conical bumper washer mounted coaxially within the lower end of said shell beneath said valve and valve seat and defining the lower reaches of said plunger, said washer serving to prevent collision of said plunger with the adjacent end of the relay body in which the same is mounted and having a plurality of flood ports formed therethrough for the free flow of mercury therepast whereby mercury in the relay closes said flap over said aperture and is metered through said orifice when flowing in one direction through said plunger and opens said valve flap when flowing in an opposite direction.

5. The plunger assembly as set forth in claim 4 wherein said valve seat is positioned below said valve flap thereby to form a time delay means when mercury is metered through said orifice in

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response to upward vertical movement of said plunger in said relay.

6. A plunger assembly as set forth in claim 4 wherein said valve seat is positioned above said valve flap thereby to provide a time delay means when mercury is metered through said orifice in response to downward vertical movement of said plunger in said relay.

GLEN L. WEIMER.

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