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MEANS FOR GAS FILLING AND SEALING OF TUBES

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Fig. 1.

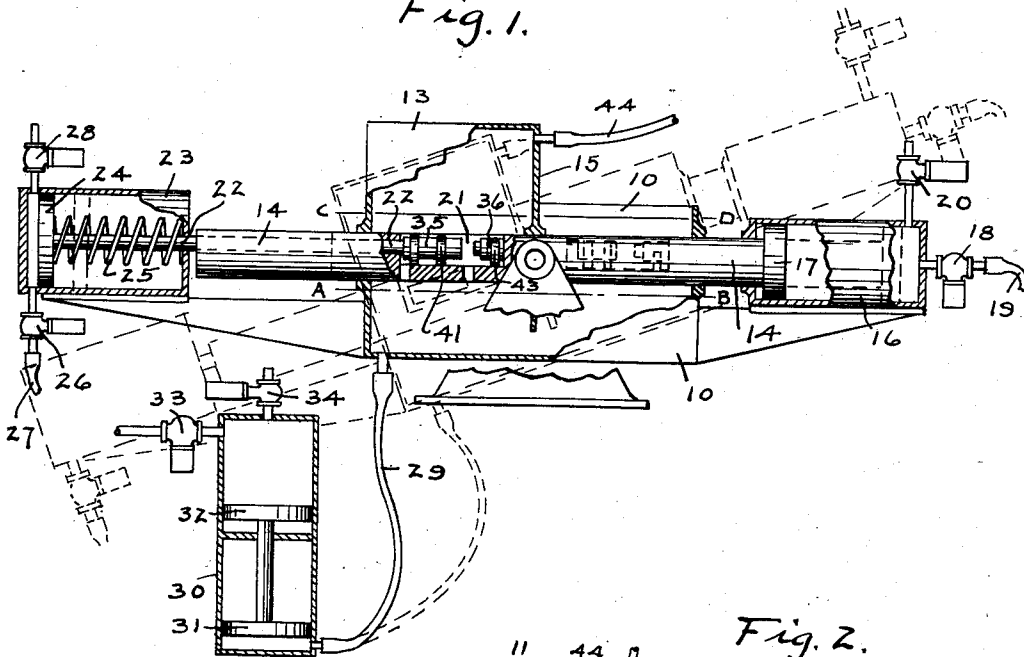


Fig. 2.

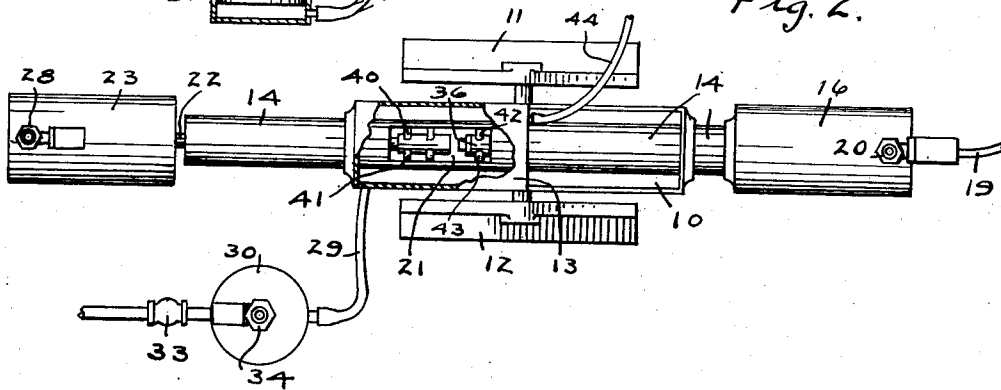
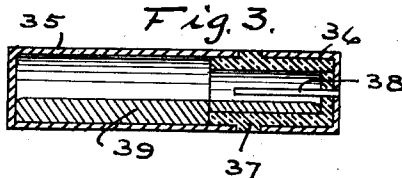


Fig. 3.



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UNITED STATES PATENT OFFICE

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MEANS FOR GAS FILLING AND SEALING OF TUBES

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This invention relates to the art of making mercury containing units as are employed in making and breaking electrical circuits by rocking of the units and it is a primary object of the invention to provide means in a simple easily operated form to exhaust the air from such units, place a definite quantity of mercury therein, fill the unit with a gas, and then seal the unit to retain that gas. Other objects and advantages such, for example, as the elimination of a vacuum pump and of weighing means, will become apparent in the following description of the invention as illustrated more or less diagrammatically in the accompanying drawing in which

Fig. 1 is a diagram in fragmentary side elevation of an apparatus embodying my invention;

Fig. 2, a fragmentary top plan view, and Fig. 3, a central longitudinal section through one form of unit adapted to be handled by the apparatus.

Like characters of reference indicate like parts in the several views in the drawing.

I provide a tank 10 somewhat elongated in respect to its width and rockably mounted by some supporting means such as the brackets 11 and 12. One end of this tank 10 is left open across its top and the other end is closed over by a housing 13 which has a wall 15 serving as a partition passing down to within the tank 10 substantially centrally thereacross and terminating at a slight distance above the floor of the tank. A shaft 14 is slidably entered to pass longitudinally through the tank in such a manner that it may be reciprocated through the end walls of the tank and the central partition 15 which extends down from the box 13. The end of the shaft 14 which extends from the open part of the tank 10 is entered to within a cylinder 16 and is there fitted to a piston 17. The cylinder 16 is provided with an inlet valve 18 to which a line 19 leads from any suitable source of a compressed oil supply. This valve 18 is located at the outer end of the cylinder so that oil under pressure may be admitted therethrough to force the piston 17 to the inner end of the cylinder as shown in

Fig. 1. An exhaust valve 20 is also fitted to the cylinder 16 so that when the piston 17 is carried toward the outer end of the cylinder the oil may escape. The shaft 14 has a pocket 21 formed therein opening from the upper side and provided with a number of drain holes. This pocket is so located in the shaft 14 that upon longitudinal shifting of the shaft the pocket may be selectively shifted from within the open part of the tank to within the closed over part and the reverse, the pocket being shifted to either side of the central partition 15.

The other end of the shaft 14 has an eccentric longitudinal bore entering from the outer end and opening into the pocket 21, within which bore a small shaft 22 is slidably fitted whereby the shaft may be shifted to have an end enter to within the pocket 21. The shaft 22 is carried outwardly to within a cylinder 23 and is connected to a piston 24 therein, which piston is normally carried to an outer position by means of a compression spring 25 which encircles the shaft 22 within the cylinder. An inlet valve 26 is provided to admit some fluid under pressure such as oil from a line 27 to within the outer end of the cylinder and an exhaust valve 28 is also located at the outer end of the cylinder through which oil may escape from the cylinder.

From the under side of the tank 10 a pipe line 29 flexible in nature leads to the lower end of a cylinder 30 within which is a piston 31. A rod leads from the piston 31 up to a second piston 32 which may be acted upon by oil under pressure admitted through the valve 33. An exhaust valve 34 is provided to permit the escape of oil. The oil lines 19 and 27 are made of some flexible material so that the tank 10 may be rocked. Both the cylinders 16 and 23 are supported from the tank 10 so that they form a unitary part therewith and are rocked with the tank.

The structure above described is adapted for use in assembling mercury switch cartridges or units of the type as shown in Fig. 3 wherein there is a metal body 35 open at one end and a cover 36 also open at one end and an insulating bushing 37 over which both the

body and the cover are pressed one toward the other to form a connection therebetween substantially air tight. In the form shown, an electrode 38 is fixed to the cover to extend through the bushing to within a central bore and a quantity of mercury 39 is carried within the cavity defined within the body and the bushing whereby suitable rocking of the unit will cause the mercury to flow from one end to the other making and breaking an electrical circuit between the wall of the body and the electrode 38.

The normal initial position of the shaft 14 is that indicated by the dash lines wherein the pocket 21 is shifted to the right to be in the open end of the tank 10 so that access to the pocket may be had. The various valves above referred to may be hand operated but are here shown as being of the solenoid type whereby they may be electrically operated.

In operating the filling structure above described, the body 35 of a cartridge or unit is placed within the pocket 21 between spring clips 40 and 41 which detachably retain the body in a horizontally disposed position with its axis parallel to that of the shaft 14.

The body 35 is positioned within the pocket 21 to have the closed end directed to the left to be over the end of the bore through the shaft 14 through which the rod 22 slides. The cover 36 is placed within the pocket 21 between clips 42 and 43 at the right end of the pocket to have its closed end against the end of the wall of the pocket. The length of the pocket is such that the body and cover are spaced apart one from the other when in the positions as above indicated. The bushing 37 has previously been pressed into the cover 36 so that it projects from the open end of the cover with an end which is adapted to fit within the body 35. The pocket 21 has a number of drain holes in its bottom side. The tank 10 has a quantity of mercury placed in it some of which will flow down the pipe 29 to the cylinder 30 and force the piston 31 up and fill the space thereunder, this space being determined by the opening and closing of the exhaust valve 34. To permit the insertion of the switch unit parts within the pocket 21, the valve 34 is opened to allow the mercury in the tank to flow down through the pipe 29 into the cylinder 30 in a sufficient quantity to bring the level of the mercury in the tank to some such line as A—B Fig. 1. The tank 10 is held in a horizontally disposed position and after the switch unit parts are placed in the pocket, the valve 34 is closed and the valve 33 opened to admit oil under pressure into the cylinder 30 to force the piston 32 down and consequently push the mercury under the piston 31 back up through the pipe 29 into the tank 10 to raise the level of the mercury to some such line as C—D whereby the pocket 21 will be flooded and completely covered over with mercury. The body 35 and

cover 36 are held within the pocket 21 to have their open ends directed slightly above a horizontal line so that as the mercury floods the pocket and covers over the parts therein, the air within the body and cover is displaced by the mercury flowing therein and completely filling them. When the air is thus displaced the valve 18 in the cylinder 16 is opened to allow oil under pressure to enter the cylinder and force the piston 17 from the dash line position to the solid line position and thereby carry the pocket 21 still submerged in the mercury through the partition 15 to within the closed end of the tank 10. The space within the housing or cover 13 over the closed end of the tank above the mercury has previously been cleared of air and filled with some gas other than oxygen, such as hydrogen, nitrogen or other gas inexpensively obtained. The tank 10 is then rocked from the horizontal position to a position such as indicated by the dash lines and the level of the mercury is lowered by allowing it to flow down the pipe 29 to within the cylinder 30 under the control of the valve 34. The angle to which the tank is rocked and the level to which the mercury is reduced are correlated so that all the mercury will have been drained out of the cover 36 and just the desired amount of mercury will be permitted to remain in the body 35, the angle of inclination of the body determining the amount of mercury left within. Gas under slight pressure is admitted to within the housing 13 through the pipe 44 so that as the mercury level drops to uncover the body and cover in the pocket 21 the gas within the housing will replace the mercury flowing out of the body and cover. Thus the required amount of mercury is placed within the body and the air originally in both the body and cover has been replaced by the desired gas.

While the tank 10 is maintained in the rocked position, oil is admitted to within the cylinder 23 through the valve 26 to force the piston 24 against the spring 25 and carry the rod 22 through the shaft 14 to cause the rod 22 to strike the body 35 and push it along between the fingers 40, 41 and force its open end over the bushing 37 to seal the mercury and gas therewithin. The tank 10 is rocked around to the horizontal position and the piston 24 is allowed to continue in its travel to carry the shaft 14 back to the right as the rod 22 pushes the assembled unit against the end wall of the pocket 21, the valve 20 having been opened to permit the piston 17 to shift within the cylinder 16. When the shaft 14 has been shifted to carry the pocket 21 through the partition 15 and into the open end of the tank 10, the valve 26 is closed and the valve 28 opened to allow the piston 24 to return to the outer end of the cylinder under the influence of the spring 25 thereby carrying the rod 22 along through the shaft 14.

The level of the mercury in the tank 10 may be raised to flood the pocket 21 while it is being shifted through the partition 15 to prevent the escape of any gas through the partition as the pocket is being shifted there-
 5 through, following which shifting the level of the mercury may then be lowered to the line A—B as before indicated. The assembled unit may be lifted from the pocket and
 10 disassembled parts placed therein for the next operation. It is to be understood that the particular structure of the switch unit does no enter into my present invention and that
 15 this structure may vary considerably as to its details.

Mercury may be added to that in the tank from time to time as the extreme upper level may drop due to removal of mercury in the filled unit.

20 While I have herein shown and described my invention in the form as now best known to me, it is obvious that structural changes may be made without departing from the spirit of the invention and I, therefore, do not
 25 desire to be limited to that precise form beyond the limitations as may be imposed by the following claims.

I claim:

1. In a filling device for a multiple part
 30 mercury switch tube, a closed tank, a member having a pocket therein adapted to hold said tube parts, said member being disposed to be shifted to carry the pocket within said
 35 tank, means for shifting the member, a quantity of mercury, means for relatively submerging and uncovering the tube parts in said pocket, and means for assembling said
 tube parts while in said tank.

2. In a filling device for a mercury switch
 40 tube, a tank adapted to hold a quantity of mercury, means for holding the tube within the tank, said tank being rockable, and means for varying the level of the mercury in the
 45 tank whereby the level may be varied in the tank to fill the tube, and the tank rocked to partially empty the tube.

3. The method of filling a mercury switch
 50 tube having a body, and a body closing member adapted to be telescoped to form a closed tube, which comprises submerging the body and closing member in a bath of mercury to displace the air therein, carrying the sub-
 55 merged body and member to within a gas filled chamber, rocking the body and member in the presence of the gas to partially drain the mercury therefrom to leave a predeter-
 60 mined amount of mercury in the body and to allow the gas to replace the drained mercury, and pushing the body and member together to enclose the residual mercury and
 65 the gas therewithin.

4. In a mercury and gas filling device for
 a multiple part mercury switch tube, a tank
 70 having a closed end and an open end, a quantity of mercury in the tank, a partition be-

tween the tank ends having its lower end
 submerged in said mercury and under which
 end the mercury may flow to either tank end,
 a shaft slidably mounted to shift through
 70 said partition, means carried by the shaft to removably retain said tube parts one sepa-
 rated initially from the other, means for
 75 shifting said shaft to carry said parts through said partition from the open to the
 closed tank end, means for varying the level
 of the mercury in the tank, a rod adapted
 to move one of said tube parts toward the
 other when in the closed tank end, and means
 for shifting said rod.

5. In a mercury and gas filling device for
 80 a multiple part mercury switch tube, a tank having a closed end and an open end, a quantity of mercury in the tank, a partition between the tank ends having its lower end
 85 submerged in said mercury and under which end the mercury may flow to either tank end, a shaft slidably mounted to shift through
 said partition, means carried by the shaft to
 removably retain said tube parts one sepa-
 90 rated initially from the other, means for shifting said shaft to carry said parts through said partition from the open to the
 closed tank end, means for varying the level
 of the mercury in the tank, a rod adapted to
 move one of said tube parts toward the other
 when in the closed tank end, and means for
 shifting said rod, said tank being rockably
 supported whereby the angle of inclination
 of said tube parts may be varied.

6. In a device for placing a quantity of
 liquid in a tube, a tank containing the liquid,
 means for holding a tube in the tank at a
 relatively fixed position, means for rocking
 the tank, and means initially lowering the
 level of the liquid to permit positioning of
 the tube, then raising the liquid level while
 the tank is rocked, and finally lowering the
 level while the tank is in the rocked position.

7. In a device for exhausting air from a
 tube and gas filling it, a tank, a liquid in the
 tank, a tube holder in the tank, means for
 lowering and raising the liquid to uncover
 and cover said holder whereby the holder
 may be uncovered to receive a tube and then
 covered to displace the air therein by the
 liquid, means for bringing a volume of fill-
 ing gas over the surface of said liquid in
 the absence of air, and means for rocking
 said tank to spill out liquid from the tube
 upon lowering of the liquid level in the tank
 to permit gas to replace the spilled out liquid
 in the tube.

8. The method of placing a predetermined
 quantity of mercury in a tube which com-
 95 prises submerging the tube in a bath of mer-
 cury to completely fill the tube, relatively
 rocking the tube while submerged in the bath
 to a predetermined angle, and relatively
 raising the tube in that rocked position from
 the bath, whereby excess mercury will spill

out from the tube down to that level as determined by the rocked position of the tube.

9. The method of placing a predetermined quantity of mercury in a tube and gas filling the tube, which comprises submerging the tube in a bath of the mercury to displace all of the air in the tube by the mercury, subjecting a volume of gas under pressure against the surface of said bath, rocking the tube in the bath to a predetermined angle, and lowering the level of the bath in the presence of the gas to permit excess mercury to spill out of the tube down to the level determined by the rocked position and to permit said gas to flow into the tube to replace the spilled out mercury.

10. The method of placing a predetermined quantity of mercury in a tube and gas filling the tube, which comprises submerging the tube in a bath of the mercury to displace all of the air in the tube by the mercury, subjecting a volume of gas under pressure against the surface of said bath, rocking the tube in the bath to a predetermined angle, and lowering the level of the bath in the presence of the gas to permit excess mercury to spill out of the tube down to the level determined by the rocked position and to permit said gas to flow into the tube to replace the spilled out mercury, and sealing the tube while subjected to said gas.

11. In combination, a double compartment tank, one of said compartments being closed over to retain a gas, and the other subjected to atmospheric pressure, a tube-holder, means for shifting the holder from one compartment to the other, means for relatively rocking the holder in said closed compartment, said tank being adapted to hold a liquid, and means for varying the level of the liquid in the tank.

12. In combination, a double compartment tank, one of said compartments being closed over to retain a gas, and the other subjected to atmospheric pressure, a tube-holder, means for shifting the holder from one compartment to the other, means for relatively rocking the holder in said closed compartment, said tank being adapted to hold a liquid, and means for varying the level of the liquid in the tank, said shifting means including means for compressing a tube in said holder longitudinally while in said closed compartment.

13. In combination, a double compartment tank, one of said compartments being closed over to retain a gas, and the other subjected to atmospheric pressure, a tube-holder, means for shifting the holder from one compartment to the other, means for relatively rocking the holder in said closed compartment, said tank being adapted to hold a liquid, and means for varying the level of the liquid in the tank, said compartments being intercon-

nected whereby the liquid level in each is normally the same.

14. In a tube mercury and gas filling device, a tank adapted to hold a quantity of mercury, a tube holder in the tank, means for varying the angularity of the tube holder, and a gas tank bell relatively submerged by its edges in the mercury under which bell said holder may be brought.

15. In a tube mercury and gas filling device, a tank adapted to hold a quantity of mercury, a tube holder in the tank, means for varying the angularity of the tube holder, and a gas tank bell relatively submerged by its edges in the mercury under which bell said holder may be brought, and means for sealing the tube while under the bell.

16. In a tube mercury and gas filling device, a tank adapted to hold a quantity of mercury, a tube holder in the tank, means for varying the angularity of the tube holder, and a gas tank bell relatively submerged by its edges in the mercury under which bell said holder may be brought, means for relatively raising the holder above the mercury, and means for closing the tube while under said bell.

In testimony whereof I affix my signature.
JOSEPH H. STALEY.

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