Dec. 10, 1968 E. R. COUTANT 3,415,965

MERCURY BUTTON SWITCH

Filed April 17, 1967

FIG. 1

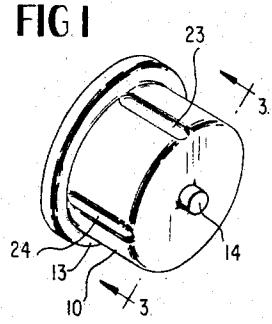


FIG. 2

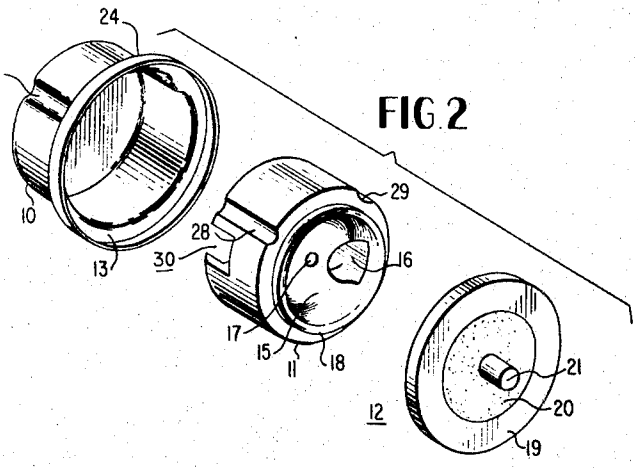
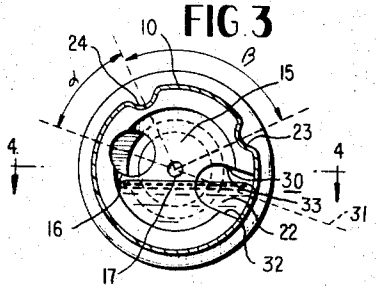


FIG. 3



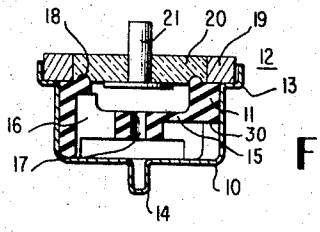
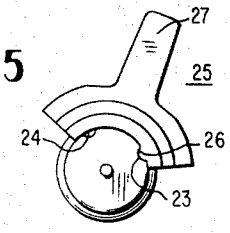


FIG. 4

FIG. 5



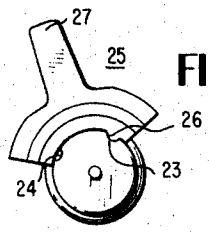


FIG. 5A

FIG. 6

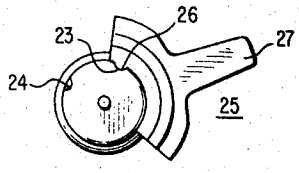


FIG. 7

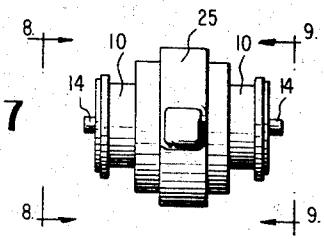


FIG. 6A

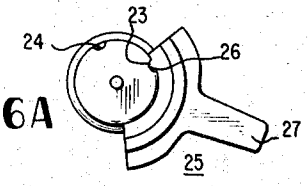


FIG. 8

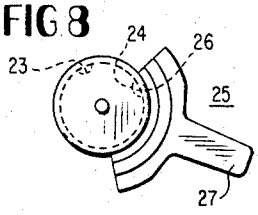
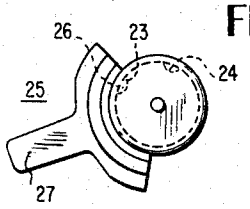


FIG. 9



INVENTOR.
EDWARD COUTANT
BY Paul E. Rockford
ATTORNEY

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3,415,965

MERCURY BUTTON SWITCH

Edward R. Coutant, Warwick, R.I., assignor to General Electric Company, a corporation of New York

Continuation-in-part of application Ser. No. 537,345, Mar. 25, 1966, which is a continuation-in-part of application Ser. No. 303,787, Aug. 22, 1963. This application Apr. 17, 1967, Ser. No. 657,431
2 Claims. (Cl. 200—152)

ABSTRACT OF THE DISCLOSURE

A mercury switch is provided having a small amount of mercury in a steel shell container which also serves as one switch contact,

a glass closure for the shell supports a second metal switch contact in insulated relation to the steel shell,

a ceramic liner for the container is shaped to permit electrical connection of the two contacts through the contained mercury, and also permits separation of the mercury into electrically separate pools responsive to the special orientation of the container.

The liner configuration permits inverted use of the switch. Power rating of the switch is higher although contained mercury is lower.

This invention relates to an electrical switch and, more particularly, to a mercury button electric switch.

This application is a continuation-in-part of my application Ser. No. 537,345, filed Mar. 25, 1966, now abandoned, which is in turn a continuation-in-part of my application Ser. No. 303,787 filed Aug. 22, 1963, now abandoned.

Many mercury switches and mercury buttons for use in such switches are known in the prior art. Most mercury switches have rated capacities for switching of electric power and the upper limits of voltage and amperages as well as of the combination of these two for which any switch is rated are most frequently shown on the switch. It is evident from examination of most mercury switches of a particular type such as gravity switches or plunger operated relay switches that the actual physical size of the switch structure as well as the amount of mercury contained in the switch increases with increases in the power switching capacity of the switch.

Typically, for a mercury tilt switch of recent manufacture product literature shows that switches are formed with an open ended generally cylindrical outer shell of steel and an insulating closure for the open end having an electrode extending through the insulating end closure. From such product literature, it is also evident that as the rating of the switch increases its size also increases. When rated on capability to handle tungsten lamp loads, such a generally cylindrical switch which is capable of handling a 100 watt lamp load will be 1.010 inches in length and 0.366 inch in diameter. The same style of switch when built to handle a 400 watt lamp load is $1\frac{33}{64}$ inches long and 0.425 inch in diameter. A similar mercury switch of the same style capable of handling an 800 watt lamp load is $1\frac{55}{64}$ inches long and 0.500 inch in diameter. Still another similar switch of the same style capable of handling a 1600 watt lamp load is $2\frac{9}{64}$ inches in length and 0.600 inch in diameter.

The amount of mercury contained within such switches of the art increases with increasing size of the switch housing as recited above.

It may be stated to be generally the pattern of mercury switch construction in the industry to increase the size of both the switch housing and the quantity of mercury contained within the housing as the power rating of the switch increases.

Certain mercury buttons of the art comprises a cylindrical metal shell having a terminal end and an open end, a ceramic liner, and a cover plate which may be sealed over the open end of the shell. A partition, having a hole therethrough, divides the interior of the shell into two chambers which contain pools of mercury. When the button is rotated to an "on" position, the hole through the partition is lowered below the surface of the mercury pools, so that the mercury pools are joined through the hole and complete an electrical circuit. When the button is rotated to an "off" position the hole through the partition is raised above the surface level of the mercury pools and the circuit is broken.

Certain problems have been recognized to exist in such buttons, arising from the vaporization of some of the mercury caused by arcing when a circuit is completed or broken. Such vaporization may create high pressures within the button, disturbing the preferred proportions of mercury in the two pools. The combination of vaporization and higher internal pressures resulting from arcing can cause leakage to develop.

As the power rating of mercury button switch increases the pressures resulting from mercury vaporization must of course also tend to increase. Accordingly, it may be seen that a mercury button construction which operates satisfactorily at a lower power rating will be unsuited for operation at some higher rating which may be reached and determined by simple trial and error testing over a range of continually increasing power values.

Additional problems have been recognized to exist in using such buttons in switch assemblies, arising from the sensitivity of the button to the particular orientation of the mercury pools relative to the hole through the partition. Examples of such problems in button use may be seen in the switch assemblies of the single pole and double acting type illustrated in the prior art.

In the single pole switches, a single button is used. The double acting switches find their application in three-way operation, and employ two buttons. The three-way circuit configuration is such that one of the mercury buttons must open a circuit on the rotation which closes a circuit through the other button. For example, if one button opens a circuit on a clockwise rotation of the switch assembly operating means, the other button must close a circuit on clockwise rotation.

In use of the prior art single pole switch assemblies for use in vertical orientation, such as a wall mounting, care must be exercised to assure that the switch assembly is placed in the use location in the proper orientation. This has been found to be true in previous switch assemblies including those employing buttons providing more than one hole through the partition, such as a vent ing hole to permit balancing the mercury pressures in the two chambers. For this reason, the switches are marked as to which end must be placed uppermost. Should the switch be mounted upside down, the pools of mercury within the chambers are not properly located relative to the holes through the partition, and the switch will not function properly.

For a similar reason, and in order to achieve a desired circuit action, it has been necessary to use two types of mercury buttons in the double acting switches of the prior art which are designed for use in a three-way circuit configuration. This requirement results from the circuit requirement that one button opens a circuit on a clockwise rotation and the other closes a circuit on a clockwise rotation. To achieve this action, two buttons which are mirror images of each other have been used. As only one of these two buttons may be directly substituted into the conventional single pole assembly and be carried at the proper orientation for the desired use location, increased

manufacturing costs are incurred in producing a small number of the second or mirror image buttons.

The mercury button of the present invention provides solutions for these problems of high pressures within the button and limitations on use orientation, while providing a further advantage of a long reliable period of life.

It is an object of this invention to provide an improved mercury button resistant to high internal pressures and having a long reliable operating life.

Still a further object is to provide a gravity operated button for a switch to be wall mounted where the button is so constructed so that either end of the switch may be directed upward.

An additional object is to provide a button operable in a standard wall box for a switch and capable of switching lamp loads of 15 amps at voltages of 270 watts.

An additional object is to provide a single button capable of performing dual functions in a single switch such as a three-way switch.

A still further object of the present invention is to provide a closure for a mercury button of high durability and pressure resistance.

Another object is to provide an improved mercury button for making switch assemblies for operation in a multiplicity of positions.

Another object is to provide a single button usable interchangeably in a number of switch assemblies designed for application in various use locations.

A further object is to provide a mercury button which utilizes a smaller quantity of mercury in the switching of higher power loads such as lamp loads than previously known mercury switches.

Additional objects and advantages of the invention will be in part apparent and in part pointed out in the description which follows.

Briefly, in one of its broader aspects the objects of the present invention are achieved by providing a single mercury button switch operable to both make and break electrical contact in two use orientations which are inverted relative to one another.

In another of its broader aspects, objects of the present invention are achieved by providing a mercury button switch having a specific mercury switching capacity in excess of 1000 watts per gram of mercury.

In another of its broader aspects the objects of the present invention are achieved by providing a mercury button switch having at least two external indexing means angularly displaced by an angle greater than the operating angle of the button for a complete switching operation. As indicated above a preferred angular separation is about 90°.

More specifically, and in one of its narrower aspects, the mercury button of the present invention comprises a cylindrical metallic shell having an open end, a liner having a partition which divides the interior of the shell into two chambers, and a cover plate sealing the end of the shell. The cover plate is assembled from three concentrically arranged elements, namely, a metallic rim, an annular insulator and a central terminal. The insulator is pierced by the terminal, and is surrounded by the metallic rim. A seal, preferably a compression type, capable of resisting high internal pressures is produced between the elements of the cover plate. The cylindrical metallic shell has a plurality of indexing slots angularly disposed from each other about its circumference. These indexing slots may be selectively engaged by the operating means of a switch assembly to cause the button to complete a circuit on a desired rotation.

The present invention may be better understood when described in conjunction with the accompanying drawings in which:

FIGURE 1 is a perspective view of a mercury button embodying the present invention;

FIGURE 2 is an exploded perspective view of the elements which are assembled into the button;

FIGURE 3 is a sectional view of the button taken along the line **3—3** of FIGURE 1;

FIGURE 4 is a cross-sectional view of the button taken along the line **4—4** of FIGURE 3;

FIGURE 5 illustrates the relationship of the button and a switch operating means in a single pole switch assembly for use in a horizontal orientation, with the button in an "off" condition;

FIGURE *5a* is similar to FIGURE 5 with the button in an "on" condition;

FIGURE 6 illustrates the relationship of the button and a switch operating means in a single pole switch assembly for use in a vertical orientation, with the button in an "on" condition;

FIGURE *6a* is similar to FIGURE 6 with the button in an "off" condition;

FIGURE 7 illustrates the relationship of two mercury buttons and a switch operating means as they would be used in a double acting, or three-way, switch assembly for use in a vertical orientation;

FIGURE 8 is a left-hand end view of the double acting switch assembly illustrated in FIGURE 7;

FIGURE 9 is a right-hand end view of the double acting switch assembly illustrated in FIGURE 7.

The elements from which the button of the present invention is assembled are best shown in FIGURE 2 where a cylindrical metal shell **10**, a liner **11** of a suitable insulating material, and a cover plate **12** are shown. The metal shell **10** is provided at its open end with a flange surface **13** to which the cover plate **12** may be hermetically sealed in the assembled button as shown in FIGURE 4.

Additionally, the metal shell has an axially extending embossment **14**, as shown in FIGURE 1, which serves as a terminal and as a bearing surface for rotation of the button.

The insulating liner **11** may be composed of a porous or vitreous ceramic and has a central transverse partition **15** which serves to divide the space within the metal shell **10** into two chambers for retaining the mercury. The central transverse partition **15** is pierced by a passageway or opening **16** for the passage of mercury and a smaller ventilating hole **17**. Also formed on one side of the central transverse partition **15** is a well **30**. An annular projection **18**, on the liner **11**, cooperates with the cover plate **12** to seal the liner in the assembled button.

In order to assure that the cover plate **12** is able to resist the high internal pressures which may be generated within the mercury button, the present invention provides a compression seal between the elements of the cover plate. These elements are an outer metallic rim **19**, an annular insulating body **20** and a terminal **21** which axially pierces the insulating body. The seal is accomplished by using materials having differing coefficients of thermal expansion. For instance, the annular insulating body **20** is a glass preform having a lower coefficient of thermal expansion than the metallic rim **19**. Suitable glass compositions might be those disclosed in Stanworth Patent 2,719,932, assigned to the same assignee as the present invention, while a suitable material for the metallic rim could be cold rolled steel. As a result, when the cover plate is assembled at the temperature levels necessary for bonding between the elements and cooled to ambient temperatures, the metallic rim **19** will contract to a greater degree than the insulating body **20**.

This variation in contraction causes a radially inwardly directed compressive force to arise. This force assures a superior seal between the metallic rim and the insulating body, which is more resistant to the possibly occurring high internal pressures within the button than the seals of the prior art.

In assembly of the mercury button shown in FIGURES 1–4, a preform of the insulating body **20**, which may be a suitable compacted powdered glass material, is assembled with a terminal **21** and metallic rim **19**. The insulating body preform, if of the compacted powdered glass

type, may be quite porous and contain a quantity of gas. As the three elements of the cover plate **12** are heated, the gases in the preform expand and begin to escape. However, when the glass reaches its softening point, a glaze is formed and the gases can no longer escape. As a result, the preform expands as the temperature is raised above its softening point. Upon expansion, the glass insulating body bonds to the metallic rim **19**. On cooling, the metallic rim **19** contracts to a greater degree than the insulating body **20**, giving rise to the radially inwardly directed compressive sealing forces.

The liner **11** is then placed on the assembled cover plate **12**, and these elements reheated. On this reheating, the insulating body **20** becomes bonded to the annular projection **18** of the liner, sealing the liner to the cover plate assembly. This particular sealing bond between the liner **11** and the cover plate **12** and the method of attaining the bond are not part of the present invention, but are described and claimed in application Serial No. 104,939, filed April 24, 1961, now U.S. Patent No. 3,229,354, assigned to the assignee of the present invention. The assembled cover plate **12** and the liner **11** are then inserted into the shell **10**, with the inclusion of a measured quantity of mercury **22**. Hermetic sealing is accomplished by welding the flange surface **13** of the shell to the metallic rim **19** of the cover plate.

In order to assure that the correct quantities of mercury are always retained in the two chambers formed within the button of the present invention, in spite of the vaporization effects of arcing when a circuit is completed or broken, the present invention provides a ventilating hole **17**, as illustrated in FIGURES 2, 3, and 4. This ventilating hole serves to balance the pressures within the two chambers at all times. This pressure balancing avoids the blowing of mercury from one chamber into the other due to the creation, by vaporization of the mercury, of a pressure within one chamber higher than that in the other chamber.

In order to serve this function without materially interfering with the desired electrical operation of the button, it is necessary that the ventilating hole **17** be located on the partition **15** so as to be always above the level of the mercury within the chambers. As the button of the present invention is designed to operate in various orientations, the ventilating hole **17** is placed at or near the axial center line of the assembled button. With this placement for the ventilating hole **17**, the quantity of mercury **22** placed within the assembled button must be measured so as to always fill less than half the volume of each chamber, when the axial center line of the button is oriented horizontally. This is most clearly shown in FIGURE 3.

In order to permit use of the button of the present invention in switch assemblies designed for operation in various orientations, first and second indexing slots **23, 24** are provided on the metal shell **10**. These indexing slots may be engaged by a suitable switch operating means or trigger **25**, as illustrated in FIGURES 5–9. The engagement is accomplished by providing a protuberance **26** on the curved portion of the trigger which is placed in contact with one or the other of the indexing slots in the metal shell **10** in assembling the switch structure.

The relationships of the trigger to a single button illustrated in FIGURES 5 and 6 and to two buttons illustrated in FIGURES 7–9 show the various positions in which the trigger or buttons may be assembled for use in single-pole or double acting switch assemblies designated to operate in various orientations. As the electrical operation of the mercury button of the present invention is dependent upon moving the mercury passageway **16** above or below the surface of the mercury pools within the chambers to complete or break an electrical circuit, the discussion of these various switch assemblies always assumes that the axis of the assembled button, as defined by the shell terminal **14** and the cover plate terminal **21**, is disposed in a horizontal plane. The buttons in the various assemblies are generally placed so that, considering the vertically upward direction to be indicated by the general direction of the handle **27** of the trigger **25**, in FIGURE 5, the indexing slots are on the generally upper part of the horizontally oriented button.

The operative condition of the mercury button switch element and various partial switch assemblies illustrated in FIGURES 5–9 is best understood by considering FIGURE 3. In that figure, a button is illustrated in the same general orientation shown in FIGURES 5 and 6. This view illustrates the position of the mercury passageway **16** relative to the first and second indexing clots **23, 24** and the level of the quantity of mercury **22** contained within the chambers. As there positioned, the mercury passageway **16** is located above the surface of the pools of mercury **22**, thus placing the button in an "off" condition. Rotation of the button through an angle of approximately 40° in a counterclockwise direction would move the mercury passageway **16** below the surface of the mercury pools, permitting electrical contact between the pools and placing the button in an "on" condition.

Reliable operation of the button in various orientations is further enhanced by making the well **30** symmetrical with respect to a line **31** passing through the center of the ventilating hole **17** and mercury passageway **16**. This well is established to provide more reliable operation of the button. As the button shown in FIGURE 3 is rotated counterclockwise, the mercury will begin to flow into the mercury passageway **16** from both chambers. As these flows of mercury come into contact, a high inrush current will immediately vaporize the frontal surfaces of the flows. Final circuit closure might occur only after two or more such vaporizations or explosions. The purpose of the well is to dump the last traces of mercury out of the well and into one of the mercury flows at the opportune moment when the two flows begin to merge in the mercury passageway **16**. This occurs as wall **32** of well **30** is raised to the level of the surface of the mercury pool. This dumping action will increase the kinetic energy of the mercury flow and deter the local explosive effects of the contacting surfaces of mercury.

When the switch is turned in the opposite direction, i.e. clockwise, the well **30** again serves to increase the kinetic energy of one of the mercury flow as the flows begin to separate. The well performs this function by absorbing a quantity of mercury at the opportune time when the flows separate from each other.

By making the well symmetrical with respect to line **31**, the well is also effective in providing equally reliable operation of the button if it should be operated in an inverted position, that is, with the mercury passageway **16** located on the right instead of the left as shown in FIGURE 3, and with the well **30** on the left instead of the right as shown in FIGURE 3. In the inverted position, the indexing slots **23** and **24** are located in the generally lower part of the horizontally oriented button, rather than in the generally upper part as shown in FIGURE 3.

In the inverted position, the wall **33** of well **30** would be located below the surface of the mercury pool when the button is in the "off" position. Rotation of the button in the clockwise direction causes the mercury to begin to flow into the mercury passageway **16** from both chambers. As previously described with respect to normal operation, in the inverted position, wall **33** of well **30** is raised to the level of the surface of the mercury pools at the opportune moment to increase the kinetic energy of the mercury and deter the local explosive effects of the contacting surfaces of mercury.

As may be noted from FIGURES 2 and 3 of the drawings, the insulating liner **11** carries first and second slots **28** and **29**. The provision of these two indexing slots on the liner, which must be aligned with and engage corresponding first and second indexing slots **23** and **24** on the

metal shell **10**, assures accurate positioning of the indexing slots **23** and **24** on the metal shell with relation to the passageway **16** through the partition **15** of the insulating liner. As only the two slots are provided on both the shell **10** and the liner **11**, it is apparent that there is only one corresponding engaging relationship in which the bonded liner and cover plate assembly may be placed in the metal shell to assemble the button.

Certain relationships between the mercury passage **16** and the indexing slots **23** and **24** are clearly shown in FIGURE 3, where it may be seen that mercury passageway **16** is cylindrical in form, as are the liner **11** and the metal shell **10**. Radial lines from the ventilating hole **17** drawn through the mercury passageway **16**, the corresponding first indexing slots **23** and **28**, and the corresponding second indexing slots **24** and **29**, are there indicated and are useful in analyzing the relationships. The angle α included between the radial lines drawn through the mercury passageway **16** and the adjacent second indexing slots **24** and **29** is about 45°. The first indexing slots **23** and **28** on the metal shell **10** and the insulating liner **11** are displaced about 90° from the corresponding second indexing slots **24** and **29**, but in any event less than 180°. This displacement is indicated as the angle β, included between the radial lines drawn through the indexing slots. As may be noted, the angle β, does not include the angle α.

The button of the present invention may be employed in single pole switch assemblies for use in horiontal orientations as illustrated in FIGURES 5 and 5*a*, or in single pole switch assemblies for use in vertical orientations, as illustrated in FIGURES 6 and 6*a*. More specifically, a trigger **25** may be assembled with a button of the present invention so that a protuberance **26** on the trigger engages the first indexing slot **23** of the button and a portion of the trigger extends toward the second indexing slot **24**, as shown in FIGURES 5 and 5*a*. When assembled in this manner, the handle **27** of the trigger **25** extends in a generally vertical direction, directed oppositely to the protuberance **26**, and lies within the angle β included between the indexing slots. Thus, movement of the trigger handle in a generally horizontal direction will rotate the button between an "off" condition as shown in FIGURE 5, and an "on" condition as shown in FIGURE 5*a*.

Alternatively, for use of a button of the present invention in single pole switch assemblies for use in vertical orientations as illustrated in FIGURES 6 and 6*a*, the trigger **25** is reversed so that the protuberance **26** of the trigger engages the first indexing slot **23** of the button and a portion of the trigger extends away from the second indexing slot **24**. In this arrangement, the operating handle **27** of the trigger **25** extends in a generally horizontal direction and lies outside the angle β included between the indexing slots. Thus, movement of the switch handle **27** in a generally vertical direction will rotate a button between an "on" condition as in FIGURE 6, and an "off" condition as in FIGURE 6*a*.

When assembled for use in vertical orientations, the button of the present invention has a further advantage arising from the centrally placed vent hole **17**. The quantity of mercury being such that the vent hole is always above the mercury level, the operation of the switch is not affected regardless of which end of the switch assembly is placed uppermost when the switch is installed in a use location. Thus, the requirement of special care in installing the prior art single pole switches is avoided. Further, by providing symmetrical well **30**, reliable operation is provided regardless of which end of the switch assembly is placed uppermost when the switch is installed in a use location. The enhanced operation provided by the use of symmetrical well **30** has been previously set forth herein.

Further, two buttons of the single type of the present invention may be employed in a double acting switch assembly as illustrated in FIGURES 7–9, eliminating the prior art requirement of providing mirror image buttons. This double acting switch assembly is of the type particularly useful in a three-way lighting circuit. In this switch assembly, two buttons of the type taught by the present invention may be mounted so that their center lines are aligned, and with the closed ends of the metal shells **10** placed adjacent each other. A single trigger **25** is mounted so as to engage both buttons, moving them together. The particular assembly illustrated in FIGURES 7–9 is designed for use in a vertical use orientation, similar to the single pole switch assembly of FIGURES 6 and 6*a*. As illustrated in FIGURE 8, the protuberance **26** on the trigger **25** engages the second indexing slot **24** of the left hand button shown in FIGURE 7. This button is thus in an "on" condition when the handle **27** of the trigger is at the lower extremity of its travel in the switch assembly. As shown in FIGURE 9, the right hand button of the vertical orientation double acting switch assembly of FIGURE 7 has the first indexing slot **23** engaged by the protuberance **26** of the trigger. Thus, when the handle **27** is at the lower extremity of its travel in the switch assembly, this right hand button is held in an "off" condition. As may be seen from these relationships, moving the handle **27** of the trigger **25** vertically upward to the upper extremity of its travel within the switch assembly, through an angle of approximately 40°, would move the left hand button from an "on" condition to an "off" condition while the right hand button would be moved from an "off" condition to an "on" condition. In this manner the single button type of the present invention is employed in both button positions of a double acting switch assembly, avoiding the necessity of providing mirror image buttons as was the prior art practice.

The double acting switch assembly using the button of the present invention is also insensitive to which end of the switch assembly is placed uppermost when the switch is installed in a use location. This results from the use of a centrally placed vent hole **17** and symmetrical design as discussed previously with regard to a single pole assembly for use in vertical orientations. Again, enhanced operation is provided by use of the symmetrical well **30**, irrespective of which end of the switch assembly is placed uppermost when the switch is installed in a use location.

The two indexing slots **23** and **24** thus perform, in the button of the present invention, several functions. First, these two slots, in conjunction with two indexing slots **28** and **29** placed on the insulating liner **11**, assure correct orientation of the passageway **16** relative to the indexing slots on the metal shell **10**, and retention of this correct orientation. Secondly, these slots permit assembly of a trigger means **25** with a single button into a single pole switch assembly for use in either a horizontal or a vertical use orientation. Thirdly, the provision of the two indexing slots **23** and **24** permits assembly of two identical buttons with a single trigger means into a double acting switch assembly useful in three-way lighting circuits.

Another operating criteria which mercury switches must pass for wall switch use is the capability of operating with fluorescent loads which, being inductive in nature, cause high transient voltages in the circuit when the electric circuit is opened as well as the capacity for operating with the transient current surge (8 to 12 times normal current) when the electrical circuit supplying current to an incandescent lamp load is closed.

Significantly it has been found that while the mercury buttons of the present invention meets all criteria for operation at 15 amperes and 277 volt alternating current it does not meet all the criteria for operation at 20 amperes and 277 volt alternating current and that operation at 20 amperes and 277 volts is not attained even though the volume of the button and of the contained mercury is scaled up by a factor of sevenfold. From this it is believed evident that certain parameters, such as internal button configuration, which change the switching capability of mercury buttons are highly critical and that the

increase in the rating of a mercury button (i.e its rating with reference to its capability to switch electric power at higher and higher voltages and currents) is not necessarily achievable through increasing the overall size of the button or through increasing the quantity of mercury contained in the button. Further it is apparent that the mercury button of the present invention represents a singular achievement in this art inasmuch as a button of a higher power rating is provided although the contained mercury is reduced by 20% below buttons which had a rating for switching alternating current of 10 amperes at 277 volts or 15 amperes at 120 volts.

Where the mercury button is to be used as the switching component of a wall mounted switch as most mercury buttons are, it is evident that only a limited amount of enlargement of the button is feasible and that it is of course preferable that no enlargement of the button occur at all as this provides the economically most useful form of the button.

It has been found that a mercury button with suitable ceramic liner such as one composed of Steatite and having the smaller amount of mercury needed to less than half fill the chambers within the button will permit the button to operate reliably over extended periods of time totalling in excess of one million power switching cycles of ON-OFF-ON operation. Moreover it has been demonstrated that extended cycling of mercury button switches as described herein can be accomplished at uniquely high specific power ratings, that is power ratings which are based on the total number of watts of electrical energy which are switched by a mercury button divided by the number of grams of mercury contained within the mercury button. As noted above the button of this invention is unique in being able to accomplish switching of alternating current at ampere and voltage levels of 15 amperes and 277 volts with little more than 3 grams of mercury. Accordingly, unique specific mercury switching capacities in excess of 1300 watts per gram are achieved over extended periods of time. This contrasts with mercury buttons which contain slightly less than 4 grams of mercury and which are rated for switching alternating current power at ratings of 10 amperes at 277 volts. The specific mercury switching capacity of such switches is accordingly limited to less than 700 watts per gram of mercury. Extended life novel mercury button switches having specific mercury switching capacities in excess of 1000 watts per gram of mercury are provided pursuant to this invention.

While particular embodiments of this invention have been shown and described, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from this invention on its broader aspects and, therefore, it is intended that the appended claims cover all such changes and modifications as fall within the true spirit and scope of this invention.

What is claimed is as follows:

1. A mercury button switch operable to make and break electrical contact in two use orientations which are inverted relative to one another which comprises

a cylindrical metal shell having a closed end and an open end,

a cover plate hermetically sealed to close said open end,

said cover plate comprising an annular insulator, a metallic rim surrounding said insulator, said insulator being held in a compression seal of radial inwardly directed compressive forces by said rim,

an insulating liner in said shell having a transverse partition dividing said shell into two chambers,

said chambers containing a quantity of mercury occupying less than half the volume thereof,

said partition having an opening therethrough for the passage of mercury between said chambers and a centrally disposed ventilating hole joining said chambers to balance the pressures within the two chambers,

said partition having a well for mercury diametrically opposite said opening,

said opening, said ventilating hole, and said well being of symmetrical configuration and being symmetrically disposed about a midline extending through the cylindrical axis of said shell.

2. A double acting mercury switch

said switch having two essentially identical axially aligned mercury buttons therein engaged by a switch operating means,

said mercury buttons having a cylindrical metal shell having a closed end and an open end,

a cover plate hermetically sealed to close said open end,

said cover plate comprising an annular insulator, a metallic rim surrounding said insulator, and a terminal extending axially through said insulator, said insulator being held in a compression seal of radially inwardly directed forces by said rim,

an insulating liner in said shell having a transverse partition dividing said shell into two chambers,

said chambers containing a quantity of mercury less than half the volume thereof,

said partition having an opening therethrough for the passage of mercury between said chambers and a centrally disposed ventilating hole joining said chambers to balance the pressures within the two chambers,

said partition having a well for mercury diametrically opposite said opening,

said opening, said ventilating hole and said well being of symmetrical configuration and being symmetrically disposed about a midline extending through the cylindrical axis of said shell,

two indexing slots on said shell exterior each angularly displaced from said line of symmetry by an equal amount,

and the two indexing slots on one button being aligned with the two indexing slots on the other button.

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ROBERT K. SCHAEFER, *Primary Examiner.*

H. HOHAUSER, *Assistant Examiner.*