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MULTIPLE POSITION VACUUM SWITCH
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3,679,481<br>MULTRPLE POSTHON VACUUM SWTTCR

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6 Claims. (C. 200-144)
My invention relates to vacuum switches and particularly to single pole multiple position switches.

One of the objects of my invention is the provision of a multiple position switch particularly suitable for radio frequency applications.

Another object is the provision of such a switch which is insulated internally and so may be grounded at its mounting flange to permit safe manual operation.

Another object is the provision of a vacuum switch mechanism employing a bellows seal and operating with so little wear that many millions of operations may be expected during its normal life.

Still further objects include the provision of a small vacuumized single pole multiple position switch having extremely high resistance to voltage break down, thermal stress, and mechanical shock.

Other objects will appear in the following description of my invention, in which I do not limit myself to the showing made by said description and drawings, since I may use variant forms of the invention within the scope of the appended claims.
Referring to the drawings:
FIG. 1 is an elevation of my vacuum switch partly in vertical half section.
FIG. 2 is a horizontal sectional view taken in the plane indicated by the line 2-2 of FIG. 1.
FIG. 3 is an end view taken in the direction indicated by the arrow 3 of FIG. 1.
Broadly my multiple position switch comprises a dielectric bulb or shell having an open end closed hermetically by a metallic mounting end plate and internally arranged bellows to form a vacuumized envelope. An operating lever extending through an aperture in the end plate and secured to the closed end of the bellows permits the bellows to be swayed from side to side in operating of the switch, the lever sliding and pivoting in the aperture.

A non-conducting extension of the operating lever is rigidly fixed on the closed end of the bellows; and engages the end of a metal contact rod, the other end of which engages a central lead hermetically mounted in the end of the bulb. The contact rod is in effect a flexible extension of the central lead, and the parts are so arranged that the contact rod is resiliently held between the central lead and the non-conductor extension of the lever by atmospheric pressure in the bellows. A plurality of poles is evenly arranged in the shell around the contact rod, each pole being sealed in the shell and providing a lead for connection on the outside of the shell. These poles mark the different positions to which the contact rod may be swung to energize the different circuits controlled by the switch, six in the switch illustrated, but which may vary from one to eight or even more.
By manipulation of the operator lever, the contact rod may be swung sideways out of its normal axial alignment and into contact with a selected pole, so that an electrical circuit is completed through the central lead, the contact rod and the chosen pole, a firm engagement of contact surfaces being maintained by the resilient pressure of the bellows.

In greater detail my switch as it is illustrated in the drawings, comprises a glass bulb or shell 2 , closed at the hottom by a copper sealing ring 3 , and an end mount-
ing plate 4. Secured to the mounting plate and extending downwardly therefrom is a cup-like housing 6 in the botiom of which is an aperture of a shape designed to provide retention seats 7 for the manual operating lever 8 , when it is swung laterally from its central position during operation of the switch.
The operator 8 extends upwardly through an aperture 9 in the end plate 4. The aperture is bordered by a rounded edge bead or flange 11, closely confining the operator, but with sufficient clearance to permit a limited pivotal and axial motion within the flange as a fulcrum and bearing.
The upper end of the operator is rigidly secured to a head 12 which hermetically closes the upper end of a bellows 13, the lower open end 14 of which is brazed and hermetically sealed to the end plate 4 while surrounding the operator 8 and the flanged bearing 11.
Extending upwardly from the bellows head is a sapphire or other non-conductor shaft 16 held in rigid alignment with the operator $\mathbb{g}$ and in effect constituting an extension thereof. An effective means for insuring. a rugged connection comprises a stiff post 17 fixed rigidly in the head 12. A yoke 18 having apertured spring arms 19 is rigidly brazed to the post with the arms slightly deflected from parallelism, so that when the arms are held parallel and the sapphire shaft is threaded through the apertures and seated against the head 12, release of the yoke arms clamps the shaft $\mathbf{1 6}$ as a rigid extension of the operator 8 . Keeper rings 21 are optional.
Sealed in the top of the bulb and in axial alignment with the operator lever and its extension 16, is a central lead 22, continuous on the outside of the bulb in the terminal stud 23. Both the end of lead 22 and of sapphire shaft 15 are semi-spherical in shape so as to make smoothly operating universal joints with the cupped ends of a cylindrical preferably molybdenum distributor or contact rod 24. The rod is of such length between the lead and the shaft as to force a partial collapse of the bellows, so that atmospheric pressure within the bellows acts with a steady resilient pressure against the distributor rod.
Spaced downwardiy from the top on the side of the envelope and in a plane perpendicular to the axis thereef, are a plurality of rods hermetically sealed in the wall and providing on the outside of the envelope a plurality of terminal leads 26 and on the inside a plurality of evenly spaced poles 27 extending radially toward the axis of the bulb in which the distributor lies when the switch is open, and with ends evenly spaced therefrom. Each of the poles is slightly concaved at its free end to make surface contact with the distributor rod when it is swung to one side or the other to engage a chosen pole and close the circuit of which the pole is a part.
Resilient upward pressure exerted by the bellows is suffiient to hold the operating lever 8-16 and the distributor rod 24 in axial alignment with the center lead 22 as shown in the drawing. When the lever 3 is swung laterally to a selected seat 7 on one side of the axis the distributor rod 24 resiliently engages a pole 27 on the opposite side, the bellows adjusting vertically and laterally automatically to the slight change, and the operator lever sliding and tipping slightly in its pivotal bearing flange 11 in the end plate. Because all of the relative movements of engaged parts are so small, and the flexing of all portions of the bellows are so minute in extent, my structure may confidently be expected to last without failure tbrough many millions of operative cycles.
I claim:

1. A vacuum switch comprising a vacuumized dielectric bulb closed at one end with a mounting plate having an aperture therein, a bellows having a closed end and an open end hermetically fixed on the mounting plate around the aperture, an operating lever pivotally and slid-
ably arranged in the mounting plate aperture and rigidly connected on the inside of the bellows to the closed end thereof, a dielectric shaft extension of the operating lever rigidly connected to the opposite side of the closed end of the bellows and in alignment with the operating lever, a metal rod hermetically sealed in the bulb wall in alignment with the longitudinal axis of the bulb to form a terminal stud outside and a central lead inside the bulb, a plurality of metal rods hermetically sealed in the bulb side wall to form terminal leads on the outside and evenly spaced poles on the inside of the bulb extending toward the longitudinal axis of the bulb, and a metal distributor rod constituting an extension of the central lead interposed between and movably engaging the free ends of the central lead and the dielectric shaft and selectively en- 15 gageable with the poles.
2. A vacuum switch in accordance with claim 1 in which means are provided for positioning the operating lever to seat the distributor rod against a selected pole.
3. A vacuum switch according to claim 1 in which the dielectric shaft is clamped in the free ends of a $U$-shape spring yoke rigidly connected to and spaced from the closed end of the bellows.
4. A vacuum switch according to claim 1 in which the dielectric shaft is clamped in the free ends of a $U$-shape spring yoke, the yoke being spaced from the closed end of the bellows and rigidly mounted on a post rigidly extending therefrom.
5. A vacuum switch according to claim 1 in which the distributor rod forms a ball-socket engagement with the central lead and with the dielectric shaft.
6. A vacuum switch according to claim 1 in which at10 mospheric pressure in the bellows provides resiliently applied force to the distributor rod from the dielectric shaft to retain the distributor rod in its position.

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## Disclaimer

3,079,481.-Jo Emmett Jennings, San Jose, Calif. Muutiple Postition Vacuum Switch. Patent dated Feb. 26, 1963. Disclaimer filed Apr. 15, 1963, by the assignee, Jennings Radio Manufacturing Corporation, the inventor approving.
Hereby enters this disclaimer to all the claims of said patent. [Official Gazette June 4, 1963.]

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