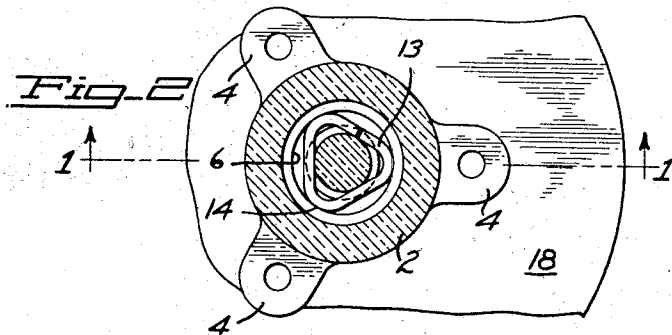
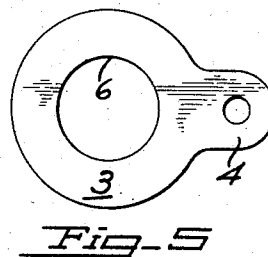
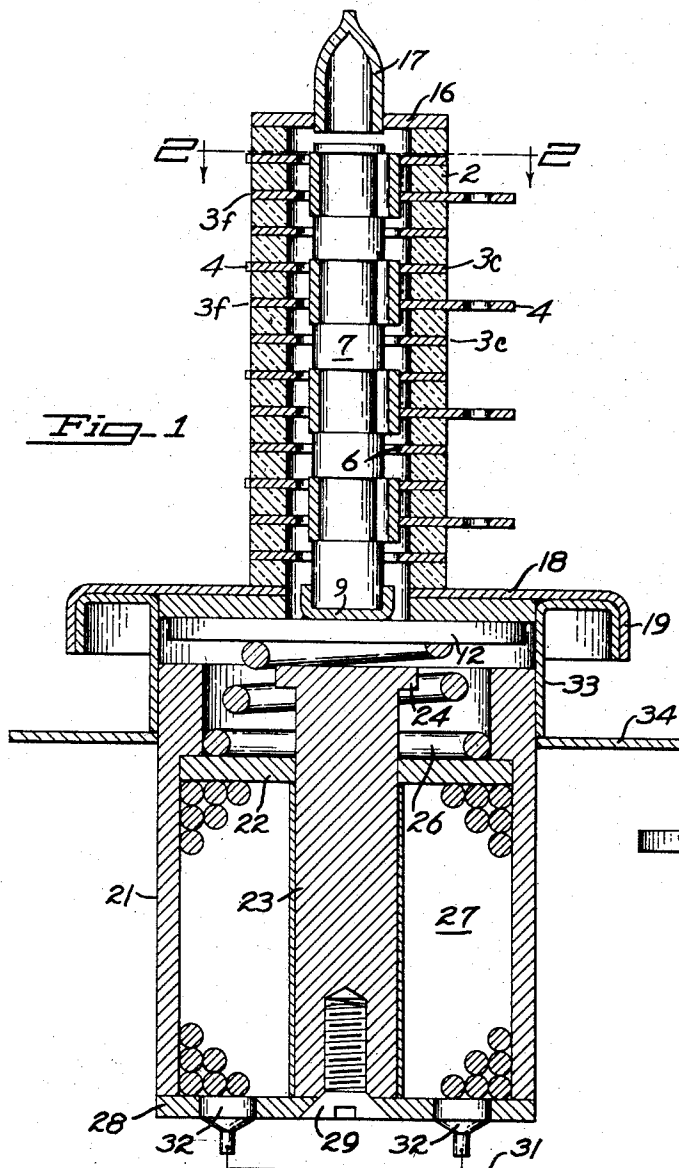
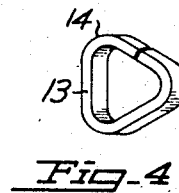
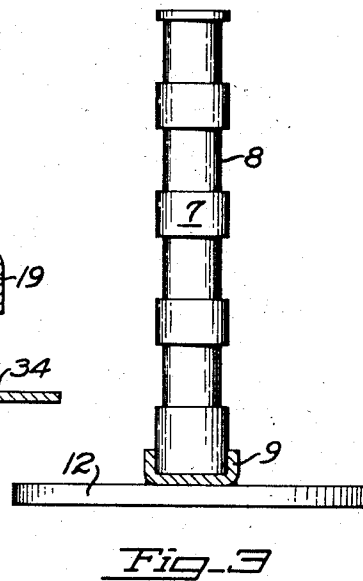


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MULTIPLE POLE VACUUM SWITCH

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MULTIPLE POLE VACUUM SWITCH

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Our invention relates to vacuum switches, particularly of the multiple pole type.

One of the principal objects of our invention is the provision of a multiple pole vacuum switch having a substantially perfect reliability within the range of capacity, power and operative life for which it is designed.

Other objects of our invention include the provision of a multiple pole vacuum switch capable of withstanding without impairment in operation, the most violent acceleration and shock and high temperature; having minimum contact resistance; having a self-contained actuator with power requirements in the low ranges; and characterized by extremely low inductance; miniature size; extremely rugged construction, and adaptability for mass production at low cost.

There are many other objects of our invention which will be brought out in the following description. We do not limit ourselves to the showing made by said description and the drawings, since we may use variant forms of the invention within the scope of the appended claims.

The development of guided missiles has required a switch having the characteristics above referred to. Most of these newly designed pieces of equipment require a vacuum switch of multiple pole type to handle a multiplicity of operations. Generally, the voltages are low, and the currents also are in low range. However, to insure absolutely reliable as well as efficient operation, we have designed our switch for high current carrying capacity as compared to voltage breakdown. In the switch illustrated, we assume these voltages never to exceed 1000 and the test voltages on the pumps never to exceed 1500.

Structurally, the vacuumized envelope of our switch is formed by brazing together an assembly of annular pieces or rings of metallized ceramic material, alternating with thin, flat, conductive feed and contact rings, a common feed ring lying between two contact rings; and thus controlling two circuits. In the drawings, Fig. 1 shows four common feed rings and eight separate controlled circuits.

The lateral cylindrical wall thus formed by the rings is closed at its opposite ends with metallic plate structures; one of which provides a mounting for a metallic tubulation, and the other of which provides a mounting for the operator mechanism, part of which is within the envelope and part outside of it.

An important feature of our invention lies in our assembly and sealing of components, the easily accessible interior surfaces of which have previously been cleaned, so that the closed assembly does not require the difficult washing to remove oxides and contamination which has heretofore been necessary in the manufacture of vacuumized envelopes housing electrical devices.

By our method of construction, the extremely simple component parts lend themselves to rapid clean assembly and brazing together to form an hermetically tight envelope, ready for evacuation and final bake-out heating.

Referring now to the drawings which are three times actual size:

Fig. 1 is a vertical half sectional view of our multiple switch, the plane of section being indicated by the line 1—1 of Fig. 2.

Fig. 2 is a horizontal sectional view of our switch, the plane of section being indicated by the line 2—2 of Fig. 1.

Fig. 3 is an elevation of the stem and attached armature, the interposed cap being in vertical section.

Fig. 4 is a perspective view of one of the movable contact shoes.

Fig. 5 is a plan view of one of the feed or contact rings.

In the main body of our switch we use ceramic rings 2 which have been metallized on both flat faces, alternated with molybdenum rings 3 until the required length of the cylindrical assembly is attained. This is determined by the number of circuits the switch is to control.

The rings 3 as shown in Fig. 5, are all the same shape, and while disposed alternately with the ceramic rings 2, are in themselves arranged in groups of three, a feed ring 3f, Fig. 1, with a contact ring 3c on each side of it. Each of the rings 3 is provided with an outwardly extending lug or tab 4, serving as an outside terminal or lead for connecting the ring into a circuit. In the assembly shown in Figs. 1 and 2, these lugs are spaced around the envelope 120° apart to provide ample space for connections.

The rings are assembled in a jig with the holes in axial alignment; and after brazing, a reamer is run through the holes in the metal rings to insure as near perfect alignment of the edges 6 as possible.

Means within the ring assembly are provided for selectively closing the circuit between each feed ring and one or the other of the associated contact rings. Arranged within the entire extent of the ring assembly is a ceramic shaft or stem 7, having wide grooves 8 spaced along its length. The lower end is metallized and crowned with a nickel cap 9 to which is brazed a circular steel armature plate 12.

Fitting in each of the grooves 8 is a molybdenum three-sided split ring or resilient triadic shoe 13, shown alone in Fig. 4. The proportion of parts is such as to seat each shoe in its groove so that there is no appreciable axial or transverse movement therein, and the rounded faces 14 of the shoe lie in lightly resilient engagement with the inner edge 6 of the associated feed ring 3f and the corresponding edge of the upper (or lower) contact ring 3c.

To prevent friction and wear so far as practicable, the edges of the engaging parts are lightly chamfered and the surfaces polished.

It will be noted that for each feed ring and its associated contact rings, there are three separate points of resilient engagement with the triadic shoe, so that while there is very little likelihood of an imperfect electrical contact between one of the triadic shoe faces 14 and its place of engagement with the inner edge 6 of a feed or contact ring, there is substantially no chance whatever of such failure with three such engagements in parallel with each feed and contact ring.

Each triadic shoe is continuously in resilient engagement at three places with its associated feed ring; and with upward movement of the stem 7, three additional separate resilient sliding engagements are made with the contact ring above, thus closing a circuit therethrough simultaneously at three separate places. Downward movement of the stem opens the circuit previously made, and closes another one through three separate places of engagement with the lower contact ring of the group.

Thus with four groups of feed and contact rings, as shown in Fig. 1, four circuits are closed by upward move-

ment of the stem; and these are broken and four others closed by downward movement.

The upper end of the switch is hermetically closed by a metal top plate 16 integrally united as by brazing to the top-most ceramic ring; and a metal tube 17 provides rugged means for sealing off the envelope after the vacuumizing procedure has been completed.

Brazed to the lower face of the bottom ceramic ring is a copper ring or annulus 18, having an external flange 19. This entire ring assembly of top plate, tubulation and alternated ceramic and metal rings, and flanged annulus is put together and then brazed in the furnace in one operation. The edges 6 of the central holes in the molybdenum rings are brought into substantially perfect alignment by reaming, the entire cavity thoroughly cleaned, and the stem with attached armature and shoes pushed into place.

Brazed to and axially aligned with the ring assembly is a steel housing 21 containing the actuating elements of our switch. The housing has a transverse partition 22 brazed to and hermetically closing the housing near its inner end, but leaving its free end outside the vacuumized part of the envelope. Mounted rigidly in the partition and integrally united thereto is the electro-magnetic core 23, its inner end widened into the head 24, just below and spaced from the armature 12. Between the partition and the armature is the spiral spring 26, which normally presses the armature and stem upwardly to close the upper series of contacts. The upper contacts are broken and the lower contacts closed, when the armature and stem are drawn down against the resistance of the spring; and this occurs when the coil 27 surrounding the core is energized.

The coil is mounted on a base plate 28, held on the lower end of the housing 21 by a single screw 29 threaded into the end of the core. Leads 31 for the windings on the coil pass through the plate in sealed bushings 32. Coils are thus quickly removed and replaced, or exchanged for others of different electrical values.

Before joining the housing 21 to the ring assembly we first braze an annular channel 33 to the rim of the housing along with a mounting flange 34; and then assemble the spring 26 around the head end of the core. This unit is then placed within the seat formed by the flanged ring 18—19, and brazed by heliarc, so that the heat of brazing is localized, and excessive heat is not transmitted to other parts within the envelope.

This heliarc brazing is done with a mixture of nitrogen and hydrogen inside the envelope at slightly above atmospheric pressure, so that formation of oxides therein during the brazing is prevented, and the cleanliness of the parts is fully preserved. For this forming gas mixture, we use about 85% nitrogen and 15% hydrogen. Immediately after the heliarc brazing, the switch envelope is ready for exhaustion and final bake-out heating.

The particular design shown is intended for direct current low voltage usage. Due to small size and high efficiency, the actuating wattage is kept low and is predicated on the amount of dampening and internal friction desired to make the switch withstand the required vibration and shock tests. It is obvious however that by expanding the size of the rings we can make a high voltage, heavy duty product using the same basic technique to eliminate much of the costly hand work formerly required in producing vacuumized switches.

Our switch is particularly suitable for radio frequency service since inductance has been kept at a minimum, and no external mechanism is required for operation. No matter to what type of service our switch is to be applied, the coil assembly can be operated at ground potential without danger of flashing over internally due to insufficient resistance to ground.

It will be obvious without specific illustration or description that our invention may be embodied in a switch having any desired number of poles, either single or

double throw, by a suitable number of ceramic rings alternated with feed and contact rings, arranged as necessary to give the desired single or double throw operation.

We claim:

1. In a vacuumized switch, a vacuumized envelope, a group of first and second and third conductive rings spaced axially inside the envelope and insulated from each other by the wall of the envelope, a unitary conductive shoe having a plurality of integrally connected slide faces slidably engaging the inner edge of the second conductive ring, and means for moving the shoe to slidably engage selectively the first or third conductive ring while maintaining its engagement with the second ring.

2. The combination of claim 1 in which the means for moving the shoe in one direction is a spring within the vacuumized ring assembly and for moving the shoe in the opposite direction is a magnetic coil outside the ring assembly.

3. A vacuumized switch comprising a plurality of metallized ceramic rings, conductive feed and contact rings interposed between the ceramic rings and brazed thereto to unite all the rings in an hermetically tight assembly, each feed ring spaced between two contact rings, an end plate structure hermetically closing each opposite end of the ring assembly, a non-conducting stem within the ring assembly, a conductive shoe having a plurality of slide faces resiliently engaging the inner edge of each feed ring and arranged on the stem, and means for moving the stem selectively to engage each shoe with the inner edge of the contact ring on either side of the associated feed ring while maintaining its engagement with the feed ring.

4. A vacuumized switch in accordance with claim 3 in which each of the conductive feed and contact rings has an integral tab extending through the wall of the ring assembly to constitute a terminal outside the ring assembly.

5. The combination of claim 4 in which an armature plate is fixed on one end of the stem and within the hermetically tight ring assembly and a spring is arranged to move the armature plate and stem in one direction, and outside the ring assembly a magnetic coil is arranged to move the armature plate and stem in the opposite direction.

6. A multiple pole vacuum switch comprising an assembly of alternate rings of metallized ceramic and metal brazed together, each of the metal rings having an externally extending terminal lug and a central aperture in axial alignment with the apertures of the other metal rings, a metal plate brazed to and closing one end of the ring assembly, a housing having an integrally united partition extending thereacross and brazed to and closing the opposite end of the ring assembly, a non-conducting stem axially arranged within the ring assembly, a conductive shoe mounted on the stem and in continuous sliding engagement with one of said metal rings, and means arranged on both sides of the partition in said housing for moving the stem selectively to engage and disengage the shoe with the metal ring on either side of the ring continuously engaged by the shoe.

7. In a multi-polar switch a plurality of parallel conductive rings insulated from each other and having apertures axially aligned therein, a dielectric stem extending axially through the aligned apertures, and a plurality of conductive shoes comprising axially spaced resilient triadic rings fixed on the stem for axial movement therewith and each shoe in continuous engagement with one associated ring and in discontinuous and selective sliding engagement with other associated rings.

8. In a multi-polar switch, a cylindrical dielectric stem having a plurality of annular grooves spaced therealong, and a split triadic ring disposed in each groove and constituting a contact shoe.

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