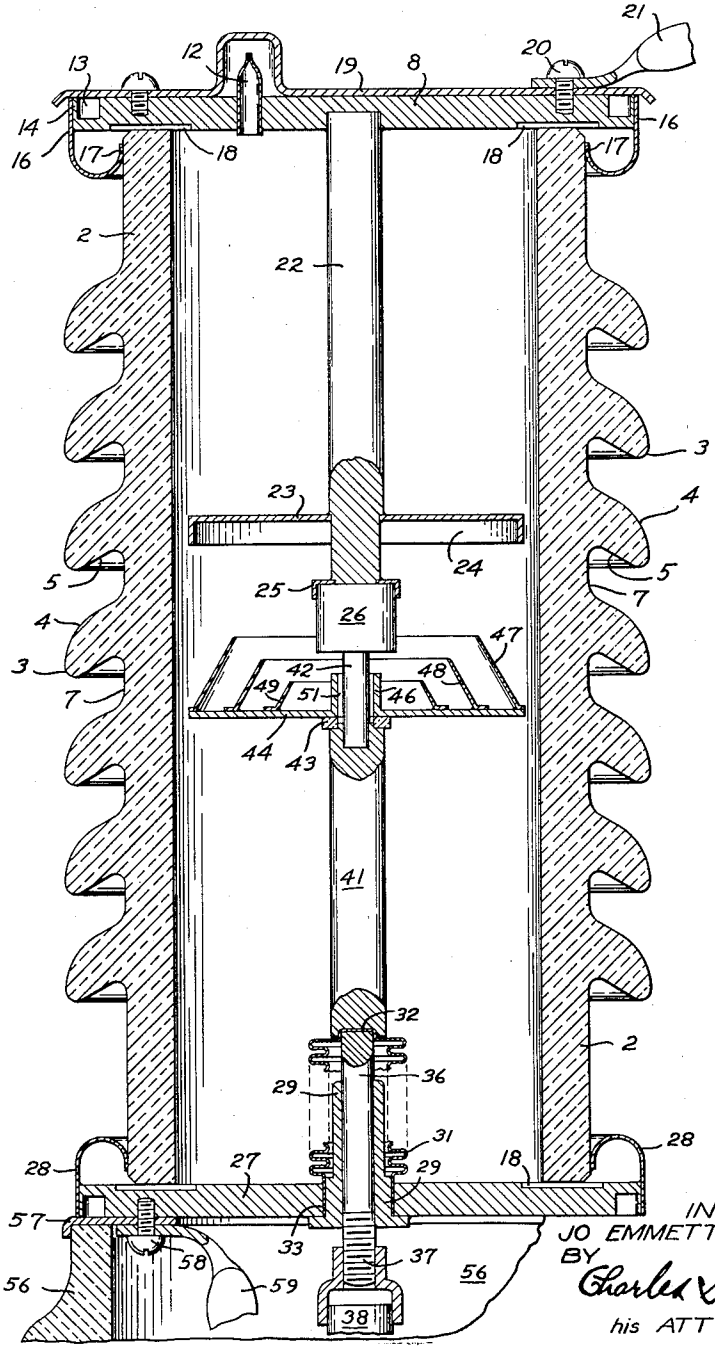
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VACUUM SWITCH

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VACUUM SWITCH

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My invention relates to vacuumized switches; and one of the objects of the invention is the provision in such a switch of efficient means for directing and trapping the metallic particles and vaporized metal that are thrown off when the switch points are separated.

Another object of the invention is the provision of a vacuum power switch in which means are provided for preventing and delaying indefinitely the formation of a continuous conductive film or layer between the terminals upon the inner and outer surfaces of the vacuumized envelope.

Another object is the provision of a new type of envelope particularly adapted for outdoor all-weather service.

Another object of my invention is the provision of a switch having contact elements or points so conditioned as to concentrate into a relatively narrow zone the spatter of metallic particles and gases thrown off with almost explosive force when the circuit is broken between the points, and to permit the deposit of such particles and the condensation of the gases in harmless areas.

Another object of the invention is the provision of an improved method of and means for hermetically sealing the ends of a ceramic tube.

Still another object of my invention is the provision in a vacuum power switch of improved baffle and shield means adjacent the contact points.

Other objects will be brought out in the following description of the invention. I do not limit myself to the showing made by said description and the drawings, since I may use variant forms of the invention within the scope of the appended claims.

Referring to the drawings:

The figure is a vertical half-sectional view of my switch mounted in the preferred position of use with the actuator end down.

In vacuum switches there is a spatter of metallic particles and vaporized metal when the points are separated. In load current breaks, the line voltage may be expected to say reasonably constant and the current should rapidly decay to zero with very little superimposed voltages or transients, until the open circuit is achieved, but in fault current breaks where the potential momentarily may rise to four or five times the normal line voltage, the arcing between points reaches a near-explosive violence; and in outdoor switches used in high power lines, the disposal of the metallic particles and vapor which follow opening of the switch poses an extremely severe problem. The service life of this expensive but essential piece of equipment is directly related to the degree of success with which the problem is met.

If no restraint is imposed, the missile-like particles are capable of such penetration of sensitive parts, as to cause destruction of the vacuum. The vaporized metal, while slower to act, can be just as deadly by building up by condensation on the interior surface of the switch, a conducting film or short around the contact points. On the exterior surface of the switch, a somewhat similar problem is presented, when the exterior surface is subjected to rain and snow in such a way as to dangerously shorten the normally non-conductive distance between the exterior terminal electrodes.

Broadly expressed, I have met this problem by controlling the direction in which the spatter and gases are projected during the arcing, and providing a basket baffle within and upon which the spatter and gases are slowed down, caught and deposited to an extent approaching totality. Only after many openings of my switch in actual service may a light isolated deposit of metal be detected within a narrow zone on the inside surface of the switch envelope opposite the contacts.

In the use of baffles to attempt a needed protection to the implement, an unexpected and destructive reaction is encountered, which must be appraised and provided for. When a fault current break takes place, a very large pressure is built up, directly dependent upon the kva. of the break. This has been indicated by ionization gauges, where the actual vacuum has been measured prior to the break and immediately afterward, dropping from a pressure of 10^{-7} to 10^{-5} or even lower.

High internal pressure during current breaks tends to sustain the arc, preventing its prompt cutting off as would occur with maintenance of the normally high vacuum. If the pressure is high enough it is possible for the current to be conducted across the break during more than the one-half cycle, and this is the danger point, since it can destroy the switch if the contacts are allowed to continue to arc.

It is therefore necessary to position the baffles so as to allow sufficient space about the contacts for the high pressures to equalize rapidly with no damage. Shape, position and spacing of baffle surfaces therefore become of utmost importance if their values in the structure are to be realized while preventing a detrimental or destructive concentration of pressures at the moment of a fault break. A factor of considerable importance in breaking high currents and still maintaining a vacuum after the break is the rapid condensation of tungsten from its vapor back to solid form. For this reason I use this metal for the contact points.

In detail, the envelope of my vacuum switch comprises a ceramic shell 2, conveniently of cylindrical shape and having downwardly extending annular flanges 3 spaced along its outer surface. Since my switch is intended for outdoor use where it is exposed to all kinds of weather, the upper surfaces 4 of the flanges are downwardly curved as shown to facilitate the rapid draining of moisture and a minimal retention of snow and dust.

The lower surfaces 5 are deeply undercut as shown, to prevent accumulation of air-borne surface adhering materials. The undercut surface curves smoothly into the vertical surface 7 between adjacent flanges, so that while the flanges provide an efficient shedding of water and snow because of their upper surfaces, the undercut surfaces tend to remain dry and free of accumulations of conductive material. The flanges are also a potent aid in the rapid dissipation of heat.

Closing the upper end of the cylindrical shell is the copper end plate 8 of larger diameter than the shell and in which the tubulation 12 for exhausting the envelope is brazed. The plate has an annular groove 13 close to its circular edge, leaving a relatively thin and somewhat flexible L-section peripheral flange 14 to which the long stem 16 of the J-section sealing ring is brazed. The short stem 17 of the sealing ring turns inwardly toward the shell wall and is brazed thereto, the end zone of the shell having previously been metalized in accordance with well-known procedures. There is thus formed an hermetically tight joint between the ceramic shell and the end plate closure, which provides the flexibility imposed by the dif-

fering coefficients of expansion of the adjoining parts. Four small drain passages 18 are evenly spaced around the plate between the plate and the end edge of the shell, so that any chemical solution which may have gotten into the sealing ring chamber during the cleaning process can be removed. An overlying cover plate 19 protects the tubulation; and one of the fastening screws 20 also secures a connector lug 21 for this end of the implement.

Brazed rigidly into a socket on the inner face of the end plate 8, in the long axis of my switch is the copper stem 22, carrying near its inner end and brazed integrally thereto, the metal plate shield 23 having the peripheral flange 24. On the end of the stem, a copper cup 25 is brazed, and in this is brazed the cylindrical tungsten contact point 26, having a broad contact face as shown. These parts together with the end plate 8 constitute the fixed end of my vacuum switch. The broad face of the contact point preferably lies about in the center of the implement.

The opposite and lower end of the ceramic shell is similarly closed by the copper end plate 27, and hermetically sealed by the sealing ring 28 in the manner already described.

Brazed centrally into the end plate 27 is a flanged bearing tube 29 extending well into the shell. A metal bellows 31, having a closed and cupped inner end 32, and the sleeve 33 at its opposite end, surrounds the inwardly extending bearing tube; and its sleeve is interposed between the bearing tube and the end plate, being integrally united to both by brazing so that the bellows hermetically closes this end of the envelope.

Centered and brazed in the cupped end of the bellows, and slidably disposed in the bearing tube is the actuator rod 36, threaded at its free end 37 for convenient attachment to a non-conductive actuator link 38 for mechanical connection to a solenoid or other actuator by which the switch is opened.

Brazed over the cupped end of the bellows within the envelope and extending to within a short distance of the contact 26 is a copper stem 41, in the inner end of which is brazed the relatively small diameter tungsten contact 42, which normally seats firmly against the larger contact 26 in the closed position of the switch. Bellows, actuator rod, stem and contact comprise the movable or mobile end of my switch; and like the fixed end parts, are concentrically aligned about the long central axis of the implement.

Means are provided around the contact points for directing and trapping the spatter of incandescent tungsten particles and the vaporized tungsten metal which accompany the opening of the switch in operation. Such means functions in addition to and in cooperation with the flanged shield plate 23, and the broad face of the contact 26.

Brazed into an annular shoulder at the inner end of the stem 41 is a metalized ceramic ring or body 43, to the exposed face of which the flat metallic baffle plate 44 is brazed, so that the ceramic ring insulates the baffle plate from the stem. The plate is formed with the integral cylindrical flange 46 spaced concentrically about the contact 42 and extending therealong about half the distance to its end.

Brazed to the side of the plate 44 which faces the contact point 26 are a concentric succession of spaced conically shaped flanges. The outer flange 47 on the edge of the supporting plate overhangs the face of the contact 26. The succeeding smaller conical flanges 48 and 49 are successively shorter, so that around the contact points and opening toward the broad face of the contact 26 are concentric annular chambers, the smallest of which 51 is a narrow annular space immediately surrounding the contact point 42.

When the contact 42 is pulled downwardly from the contact 26 by the actuator to break the circuit through them, the flat face of the larger contact tends to direct the spatter of metallic particles and vaporized metal downwardly below the plane of the large face and into the annular chambers. Metal particles are entrapped in the chambers and the vapor milling around in violent turbulence tends to condense on the surfaces of the plate and flanges where it is harmless. Relatively little of spatter or vapor is thrown straight back and substantially none reaches the bottom of the narrow annular space 51, so that the plate and flanges remain insulated from the stem and contact point.

The difference in diameters of the engaging faces of the contacts is not too critical, but should be a material one in order to be effective as the contacts fully open. A ratio of at least 1 to 2 in diameter is good, but up to 1 to 3 as shown, is preferred for contacts opening 1/8" or more.

Some vaporized tungsten will pass both baffle plates 23 and 44, but the deposit of condensed metal on the inside surface of the shell is negligible, and the deposit zone is largely confined to the mid portion opposite the contact points. If spattered particles do get below the plate 44, they fall to the surface of the end plate and can do no harm to the thin walls of the bellows, piercing of which would of course destroy the vacuum.

The spacing between the baffles 23 and 44, and their distances from the shell wall, are such as to avoid a harmful build-up of pressure around the contacts after a fault break, and allow rapid equalization of pressures throughout the vacuumized chamber of the envelope.

Any suitable means may be used to support my switch, but I have shown a somewhat larger ceramic shell 56, large enough to hold the actuator, and having a ring 57 brazed on its upper metalized end. Screws threaded into the end plate, secure the switch envelope to the supporting shell, and one of them 58 also secures a connector lug 59.

I claim:

1. An hermetic seal between the metalized edge zone of a hollow ceramic cylinder and a circular metal end plate, comprising an annular sealing ring having a radial section substantially the shape of a capital J, the long stem of the J integrally united to the periphery of the end plate and the short stem integrally united to the edge zone of the ceramic cylinder.

2. An hermetic seal as recited in claim 1 in which the metal end plate is provided with an annular groove adjacent its peripheral edge to form an L-shaped flange to which the long stem of the J is united.

3. An electric switch comprising a hollow vacuumized cylindrical envelope, a plate closing each end of the envelope, an axially disposed conductive stem fixed in one end plate and extending into the envelope, an axially disposed conductive stem movably arranged in the other end plate and extending into the envelope, aligned contact points mounted in the adjacent ends of the stems, a transversely extending baffle plate fixedly supported on one of the stems, and a plurality of spaced concentric flanges fixed on the baffle plate and extending toward the contact points.

4. An electric switch in accordance with claim 3 in which said baffle plate is metallic and a non-conductive body is interposed between the baffle plate and its supporting stem.

5. An electric switch in accordance with claim 3 in which the contact point on one of the stems has a contact face perpendicular to the axis of the cylindrical envelope and has a diameter at least twice the diameter of the other contact point.

6. An electric switch in accordance with claim 5 in which said baffle plate is metallic and a non-conductive body is interposed between the baffle plate and its supporting stem.

7. In a switch having a movable contact point and a fixed contact point, a stem for fixedly supporting each contact point, a transversely extending metallic baffle

plate fixedly supported on the stem with the movable contact point, and a plurality of concentric flanges fixed on the baffle plate and extending toward the contact points.

8. An electric switch in accordance with claim 7 in which a non-conductive body is interposed between the baffle plate and its supporting stem.

9. An all-weather envelope for housing an electrical device comprising a hollow vacuumized cylindrical non-conductive body having its cylindrical axis vertical when in operative position, conductive end plates closing the ends of the hollow body, a succession of outwardly and downwardly extending annular flanges spaced along the exterior surface of the cylindrical body, the upper surface of each flange sloping outwardly and downwardly to facilitate shedding of moisture and the lower surface of each flange being undercut to prevent access of moisture, an axially disposed conductive stem fixed in one end plate and extending into the envelope, an axially disposed conductive stem movably arranged in the other end plate and extending into the envelope, aligned contact points mounted in the adjacent ends of the stems, a transversely extending baffle plate fixedly supported on one of the stems, and a plurality of spaced concentric conical flanges fixed on the baffle plate and extending toward the contact points, the conical flange of largest diameter overhanging the free end of the associated contact point.

10. An electric switch comprising a hollow vacuumized cylindrical envelope, a plate closing each end of the envelope, an axially disposed conductive stem fixed in one end plate and extending into the envelope, an axially disposed conductive stem movably arranged in the other end plate and extending into the envelope, aligned contact points mounted in the adjacent ends of the stems, a

transversely extending baffle plate fixedly supported on one of the stems, and a plurality of spaced concentric flanges fixed on the baffle plate and extending toward the contact points, said flanges being conical and each of the inner conical flanges is shorter than the next larger diameter conical flange and the largest conical flange overhangs the free end of the associated contact point.

11. An electric switch comprising a hollow vacuumized cylindrical envelope, a plate closing each end of the envelope, an axially disposed conductive stem fixed in one end plate and extending into the envelope, an axially disposed conductive stem movably arranged in the other end plate and extending into the envelope, aligned contact points mounted in the adjacent ends of the stems, a transversely extending baffle plate fixedly supported on one of the stems, and a plurality of spaced concentric flanges fixed on the baffle plate and extending toward the contact points, the outer flanges being conical and the inner flange cylindrical.

12. In a switch having a movable contact point and a fixed contact point, a stem for fixedly supporting each contact point, a transversely extending baffle plate fixedly supported on one of the stems, and a plurality of concentric flanges fixed on the baffle plate and extending toward the contact points, said flanges being conical and the outer flange overhanging the free end of the associated contact point.

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