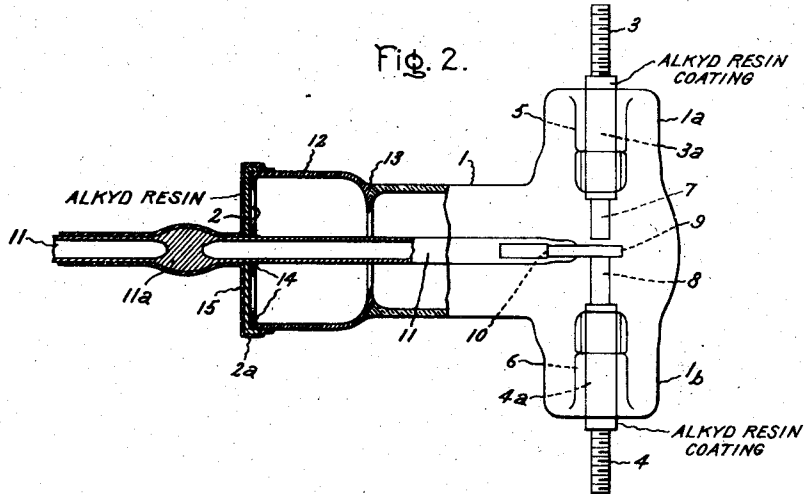
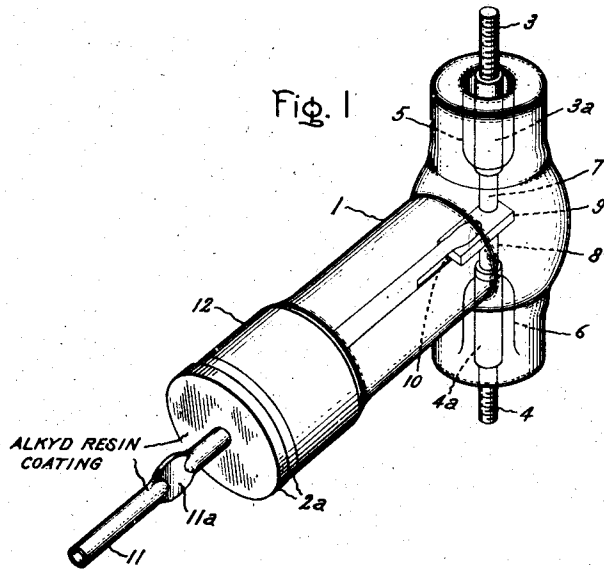


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ELECTRIC VACUUM SWITCH

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ELECTRIC VACUUM SWITCH

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2 Claims. (Cl. 200—144)

My invention relates to electric vacuum switches, and more particularly to vacuum switches of the flexible diaphragm type for controlling high voltage, high frequency circuits, such as control circuits associated with radio apparatus.

The use of vacuum switches of the flexible diaphragm type for high voltage, high frequency circuits of low amperage, such as for example the receiving and transmitting radio circuits of aircraft has been proposed. However, in the practical application of switches to such circuits, a number of serious difficulties are encountered that may prevent proper and reliable operation of the switch. For example, in aircraft operating at high altitudes the problem of voltage flash-over at the switch becomes very serious since a switch rated at a certain voltage at sea level will flash over at a much reduced voltage at 40,000 feet altitude. Also, when operating at sea level in surface craft the switch must be capable of withstanding long exposure to the corrosive effects of salt water spray.

In addition to the above considerations, it is necessary that the switch be capable of thousands of operations without impairment of the vacuum seal at the flexible diaphragm associated with the movable contact. This is often a serious problem since a thin metal diaphragm sensitive to a small operating force may be liable to leakage which would destroy the vacuum within the switch and cause failure thereof. On the other hand, a thick metal diaphragm may be too stiff and insensitive to the operating force, and also might crack under repeated use.

The principal object of my invention therefore is the provision of an improved vacuum switch of the aforesaid type that is particularly adapted for high voltage, high frequency circuits at all flying altitudes and under practically all sea level conditions, that is capable of operating efficiently a large number of times without failure both under normal conditions and when subjected to corrosive agents such as sea water spray, that is responsive to a small operating force and that is electrically efficient, simple and rugged in construction.

My invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawing Fig. 1 is a perspective view of a single pole, double throw vacuum switch

embodying the present invention and Fig. 2 is an elevational view, partly in section of the vacuum switch in a circuit closing position thereof.

The single pole, double throw vacuum switch illustrated by way of example comprises an insulating glass envelope 1 having a flexible metal wall portion 2 comprising a diaphragm by which motion is transmitted from the exterior to the interior of the switch casing. As illustrated, the switch envelope or casing is T-shaped so that two laterally extending portions 1a and 1b of the glass envelope provide insulating mountings for the fixed lead-in terminals 3 and 4 which are preferably composed of an iron, nickel and cobalt alloy. These terminals are provided with reentrant seals 5 and 6, respectively, extending into the switch casing in order more effectively to insulate the terminals at high voltage. With this construction there is not only less metal within the envelope to be degassed during the switch conditioning process, but the aforesaid alloy leads, which have high resistance at high frequencies, can be plated for the most part with a lower resistance metal, such as cadmium, thereby reducing heating and permitting the switch to be operated at higher frequencies. The terminals 3 and 4 extend to within a short distance of each other within the switch casing and terminate in the fixed contacts 7 and 8, which are composed of a suitable contact material such as molybdenum.

The movable contact for grounding or connecting electrical apparatus to alternate circuits such as receiving and transmitting radio circuits, associated with the terminals 3 and 4 comprises a spade-like member 9 composed of molybdenum for example, suitably attached at 10 to the slotted free end of a tubular switch arm 11. This arm is composed of copper-plated steel tubing and extends through and is copper brazed and sealed to the diaphragm 2. The contact arm 11 and diaphragm are electrically connected through suitable connections exteriorly of the switch to any apparatus or ground that is to be connected alternatively with circuits connected to the contacts 7 and 8. A suitable operating mechanism (not shown) is adapted to tilt the movable contact arm 11 so that the movable contact 9 engages either the upper contact 7 or the lower contact 8 or is in an intermediate position.

The metal wall or diaphragm 2 is united to the glass envelope 1 through a metal thimble 12 composed of a suitable metal, such as an iron, nickel and cobalt alloy whose coefficient of expansion is similar to that of glass. The union of

the thimble 12 to the glass envelope 1 is indicated at 13 and the metal seal between the diaphragm 2 and the thimble is indicated at 14. The diaphragm 2 is suitably united to the thimble 12 by means of an overlapping circumferential flange 2a. This thimble, which is electrically connected through the diaphragm to the movable contact, may conveniently form one terminal of the switch.

When the switch has been properly assembled and treated, it is evacuated to a high degree through the tubular switch arm 11, after which the tubular arm is flattened and sealed exteriorly of the casing at 11a. The technique of sealing and joining metal parts of the switch to glass parts, as well as the technique of degassing all interior parts of the switch and evacuation of the switch casing are known to the art and are not my invention. Therefore a description thereof is believed to be unnecessary for a complete understanding of the present invention.

The thickness of the diaphragm 2, which is composed of an iron, nickel and cobalt alloy above referred to, is exaggerated in the drawing, the actual thickness being approximately .003 inch. It will therefore be seen that adequate protection of the sensitive diaphragm presents a difficult problem from the standpoint of leakage due to mechanical wear, and to the effects of corrosion. It was found that additional metal plating not only added undesirable stiffness to the diaphragm but involved danger of "gassing" the tube interior during the plating process.

In accordance with my invention the diaphragm is coated exteriorly with an alkyd resin, specifically a rosin-modified, oil-modified, glyceryl phthalate resin that is suitably thinned by a solvent, such as a coal-tar hydrocarbon, e. g. benzene or toluene. This alkyd resin coating is indicated at 15 and covers the entire exterior side of the diaphragm and extends into contact with the thimble 12 to overlap the diaphragm flange at 2a and also extends continuously from the diaphragm along the outer section of the switch arm 11. Since the alkyd resin is a good insulator the switch arm 11 and its associated terminal can thereby be efficiently insulated with respect to the switch actuating mechanism.

I have found that this alkyd resin coating for the diaphragm is not only a perfect seal for the thin diaphragm but also because of its flexibility does not add appreciably to the stiffness of the diaphragm. Furthermore, the resin coating does not limit the normal long life of the diaphragm since it is capable of being flexed practically indefinitely without cracking. I have also found that this alkyd resin coating prevents the formation of corona at the diaphragm terminal when the switch is operating at high voltages. This prevention of corona is most important at high altitudes where excessive corona discharge may cause flashover and failure of the switch. I have further found that this alkyd resin coating is highly resistant to the corrosive influence of sea water, and in fact my improved vacuum switch

has withstood without damage a 200-hour, 20% salt spray test according to Government specifications.

It will therefore be seen that I have solved in a most simple manner a number of serious problems involved in the successful operation under severe conditions of a high voltage vacuum switch of the flexible diaphragm type.

The lead-in terminals 3 and 4 comprise conductor studs that are threaded at the outer ends as indicated for suitable connection with the circuit conductors. For the purpose of protecting the terminals from corrosion, the threaded portion of each stud is cadmium plated and the remaining portion, at 3a for example, between the threaded portion and the glass seal is also plated as previously described and in addition is coated with the alkyd resin above referred to. Therefore, the terminal as far as the threaded portion is both efficiently insulated and protected from corrosion. I have found that this additional insulation between the glass seal and the threaded portion is of material value in preventing corona discharge. In addition to the aforesaid advantages of my invention, the alkyd resin coating is also resistant to the corrosive effects of oil.

It should be understood that my invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A vacuum switch for high voltage, high frequency circuits comprising an evacuated glass casing, a thin metal diaphragm composed of an iron, nickel and cobalt alloy forming a flexible wall portion of said casing, circuit controlling contacts separable within said casing, means connecting one of said contacts to said diaphragm whereby said contact can be operated by means exterior to said casing, structure composed of the aforesaid alloy for joining said diaphragm to said glass casing, and a protective and insulating coating comprising an alkyd resin extending continuously over the exterior of said diaphragm and to said joining structure.

2. A vacuum switch for high voltage, high frequency circuits comprising an evacuated glass casing, a thin metal diaphragm of approximately .003 inch thickness forming a flexible wall portion of said casing, circuit controlling contacts separable within said casing, means including a tubular exhaust member connected to one of said contacts and extending in sealed relation through said diaphragm whereby said contact can be operated by means exterior to said casing, and a protective and insulating coating completely covering the exterior wall of said diaphragm and extending continuously from said diaphragm over the exterior of said tubular exhaust member, said coating comprising an alkyd resin.

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