March 14, 1939. H. KERSCHBAUM 2,150,379

MERCURY SWITCH

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Fig. 1

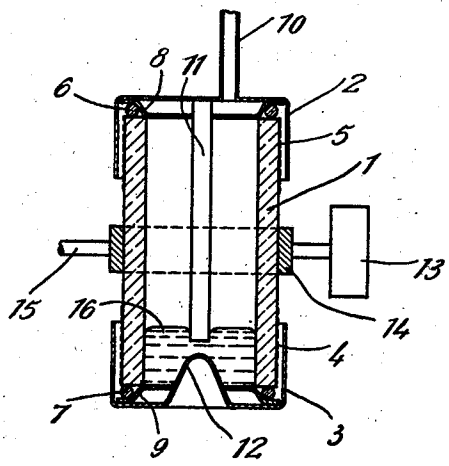
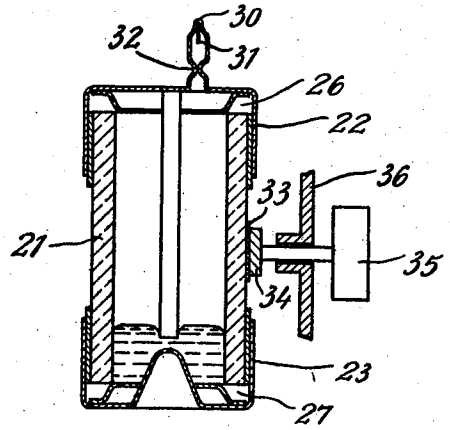


Fig. 2



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MERCURY SWITCH

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3 Claims. (Cl. 200—152)

My invention relates to improvements in vacuum circuit breakers.

The walls of vacuum circuit breakers which, for instance, employ mercury have, as a rule, been hitherto made of glass. Apart from the relatively small mechanical strength of such circuit breakers, the latter may also be damaged by arcs occurring during the switching operation. For this reason other materials, for instance ceramic materials, have been employed for the walls of such circuit breakers, whereby the application of glass was confined to such points where the supply leads pass through the walls of the vacuum circuit breakers. However, such glass-containing elements will constitute a constructional part whose small mechanical and thermal strength impairs the properties of the whole unit.

My invention has for its object to avoid the above-mentioned drawbacks hitherto experienced in vacuum circuit breakers.

According to the invention the insulating enclosure of a vacuum circuit breaker employing particularly mercury or gallium as a liquid metallic element, consists exclusively of a ceramic tube which without the use of glass is vacuum-tightly joined with the metallic contact parts of the breaker by means of a hard solder. The ceramic tube may consist of steatite containing magnesium silicates or aluminum silicates, and is provided at the places where it is to be bonded with the metallic contact parts with a base metallic coating and with means for preventing the mercury or gallium to contact the soldered bond. As coatings, highly refractory base metals such as iron, chromium, tungsten, nickel or the alloys thereof are particularly suitable. These metals are applied in a finely divided state with the aid of an organic adhesive substance to the points to be metallized and then sintered in a vacuum furnace so as to form a vacuum-tight bond between the parts to be united. The temperature of the furnace must be so chosen that the metal applied to the places to be coated is properly united therewith by the sintering process without causing a volatile component of the ceramic support to penetrate to any appreciable extent the metallic layer. When using iron powder for the metallization, which powder may be produced, for instance, according to the carbonyl method, temperatures of about 1,265 degrees centigrade are most favorable. The metallic coatings thus produced are of a very compact structure and may be readily soldered by means of a hard solder.

As a hard solder a material of great ductility is preferably chosen, for instance silver, which may be applied to the point to be soldered in a solid state. The silver upon the subsequent heating penetrates the metallic coating in a completely uniform maner, thus producing a gas-tight bond between the parts to be united.

The metallization and the soldering process may also be effected in one operation, for instance, in a furnace with reducing atmosphere. In this manner the further advantage is obtained in that the contacts of the circuit breaker are not attacked by noxious vapors or gases. Consequently, the formation of a conductive smear is with certainty avoided. Such smear formation otherwise always occurs if the contacts of a mercury circuit breaker are oxidized because the oxide evaporates during the operation of the breaker and gradually forms a conductive, smeary compound with the mercury.

As hard solders besides silver also copper, phosphorus bronze or gold are suitable which may be likewise employed in the above-described manner. In order to keep the solder at its proper place when effecting the soldering process and to prevent the mercury from contacting the soldered bond, the switch may be designed in such a manner that the interior of the switch is parted from the bond.

In the accompanying drawing is shown a mercury switch as an embodiment of the invention which may, for instance, be operated in the same manner as rotary switches for house lighting.

Fig. 1 shows a circuit breaker whose parts are assembled and ready for being soldered. The cylinder wall 1 is made of a ceramic material, for instance, of magnesium silicate. The metallic caps 2 and 3 are placed on the ceramic part after having metallized the points of the ceramic part as indicated at 4 and 5. The metallic layer may be applied by spreading or spraying a paste consisting of a powder of a highly-refractory metal which is mixed with a glutinous organic binding agent. The solder is indicated by the numerals 6 and 7. It is applied to the joint to be soldered in the form of a ring and penetrates when heated the interstitial space between the wall and the caps. The iron disks 8 and 9 prevent the solder from passing into the interior of the circuit breaker. The cap 2 is provided with a conduit 10 leading to a vacuum pump not shown and with the contact 11. The cap 3 is provided with a central enlargement 12 in order to keep the quantity of mercury 16 necessary for the switching operations as small as possible. The knob 13 serves to actuate the circuit breaker. It is secured to a clip 14 which surrounds the ceramic cylinder 1.

15 is a pin also secured to the clip 14 and serves to support the circuit breaker.

In Fig. 2 is shown a completely soldered vacuum circuit breaker. As will be seen from the figure the solder has flowed away from the points 26 and 27 and has soldered the caps 22 and 23 with the ceramic part 21 to a vacuum-tight bond. The conduit is sealed at the point 30 with the aid of a silver solder 31. Further, the conduit is provided with a constriction 32 in order to prevent the mercury or mercury vapors from amalgamating the conduit and pump system. The ceramic part 21 is also metallized at the point 33 according to the method already proposed and a metal piece 34 to which the knob 35 is secured is soldered to the ceramic part 21. 36 indicates a part of the switch casing broken away which serves to guide the switch shaft.

Owing to the fact that the assembled vacuum circuit breaker according to the invention may be manufactured in one operation, for instance in a hydrogen furnace or a vacuum furnace, a relatively simple manufacture results which is an essential condition to the production on a large scale. The circuit breakers manufactured according to the invention are very resistant to high temperatures, since the materials which they are made of have a high melting point. Therefore, the circuit breakers may be manufactured for high interrupting capacities and for high switching frequencies. Furthermore, they may be employed in chambers in which high temperatures prevail; for instance, in furnaces. For the same reason the circuit breakers may also have smaller dimensions than has hitherto been possible.

The above-described advantages are not only inherent in circuit breakers according to the embodiment shown, but they may be obtained with any other form of the invention. Thus, for instance, also vacuum circuit breakers may be manufactured according to the invention in which the contact is made by raising the mercury level, that is to say, by the immersion of iron parts which are, for instance, actuated with the aid of an electromagnet.

I claim as my invention:—

1. As an article of manufacture, an evacuated mercury switch comprising a ceramic tube partly filled with mercury, a metal cap at each end of said tube, said cap being designed to form an interstice between its end face and the ring-shaped front face of said tube and having a centrally arranged part protruding against the opening of said tube so as to close said opening, a coating of a refractory base metal disposed on and integrated with the bare ceramic surface portions at the ends of said tube which are covered by said caps, and hard solder bonds vacuum-tightly connecting said coatings and said caps.

2. As an article of manufacture, a vacuum switch having a one-piece ceramic tube, a mercury contact body within said tube, and a contact arrangement including two metal caps covering the ends of said tube, in combination with coatings of a refractory base metal disposed on and integrated with the bare ceramic surface portion at each end of said tube which is covered by one of said caps, a hard solder bond tightly connecting said coating and said cap, a circular member arranged within each of said caps between said cap and said tube so as to close the opening of said tube and to prevent contact of the mercury with the bond, and an annular chamber formed between said cap and said member and bordered by said bond.

3. As an article of manufacture, a vacuum switch having a ceramic tube, a liquid metallic contact element within said contact arrangement including two metal caps covering the ends of said tube, in combination with a coating of a refractory base metal disposed on and integrated with the bare ceramic surface portion at each end of said tube which is covered by one of said caps, a bond consisting of a ductile hard solder and tightly connecting said coating and said cap, and means disposed within said cap between said bond and the interior of said tube, said means forming an annular chamber with said cap.

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