

Prevention of Contact Contamination in Sealed Relays

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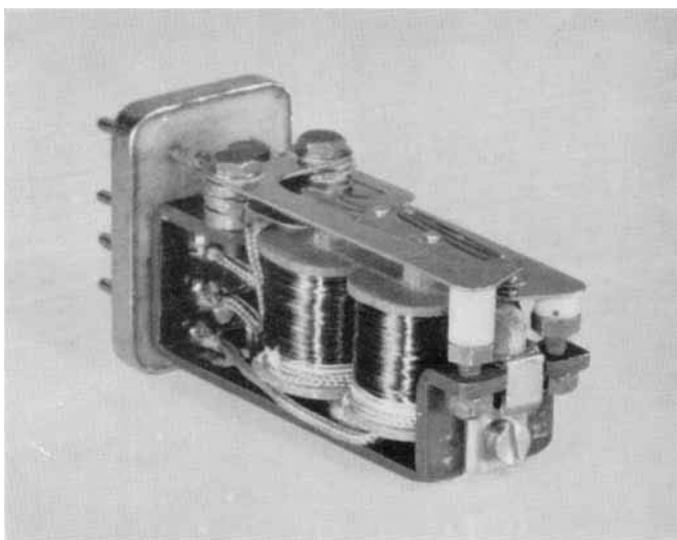
In the October 1957 issue of *Platinum Metals Review* there appeared a review-abstract of some work done by Germer and Smith at the Bell Telephone Laboratories on the effect of organic vapours on platinum metal contacts. In the article on the preceding pages of this issue a comprehensive study of the formation of organic deposits carried out by Hermance and Egan, also of the Bell Telephone Laboratories, is fully reviewed.

This problem has also been the subject of considerable investigation and research by Siemens Edison Swan in connection with their hermetically sealed miniature high speed relay when used as a "chopper" for converting low power D.C. signals into alternating voltages usually for the purpose of amplification in computers and similar apparatus. In one particular application the contacts are required to switch a few micro-

amps at 20 millivolts or less with complete reliability for many millions of operations at a speed of 100 operations per second.

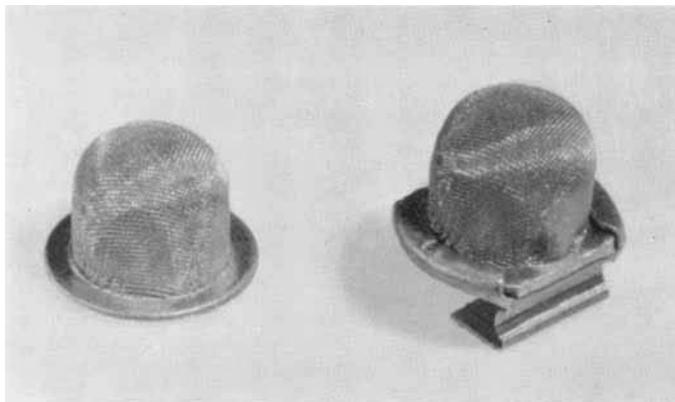
When operating under these so-called "dry" circuit conditions the original hermetically sealed relay, Type 96, was found to fail relatively quickly due to the formation upon the platinum contact surfaces of carbonaceous deposits resulting from the catalytic cracking by the working contacts of absorbed volatiles given off by the organic materials used in the construction of the relay. This effect was aggravated when the relay was hermetically sealed.

In the improved version, known as the Siemens Edison Swan Relay Type 130, shown here with cover removed, all the non-metallic parts, as far as practicable, are manufactured from inorganic materials. However, no suitable inorganic winding wire insulant is



The Siemens Edison Swan Relay, Type 130, fitted with platinum contacts and with an activated carbon "getter" to adsorb organic vapours and so prevent contamination of the contacts

An enlarged view of the activated carbon "getter", contained in a capsule of phosphor-bronze gauze



yet available, and therefore although all but one of the organic materials had been eliminated, thereby improving the performance to some extent, relatively early contact failure can still be caused by microgram quantities of volatile material produced as a result of chemical breakdown of the winding wire insulant. In order to neutralise the effect of such breakdown a "getter" has been embodied into the relay, its function being to adsorb the organic vapours and thus prevent contamination of the contacts.

The "getter" material, which is in pellet form, consists of activated carbon mixed with cellulose fibres as a binding agent and is contained within a small protective gauze capsule shown in the enlarged view above. The vapours given off are adsorbed on the relatively large internal surfaces of the getter material provided by the capillary construction of the activated carbon.

Although the use of inorganic materials, as far as practicable, together with the inclusion of the "getter", prevents the formation of carbon on the contacts, it is also necessary to manufacture the relay in dust filtered locations and to maintain a very high standard of cleanliness at all stages of the assembly, with particular emphasis on the contact surfaces. Therefore, after the relay has been assembled and adjusted it is finally cleaned by total immersion in freshly distilled hot carbon tetrachloride, using the Soxhlet extraction method, to remove all traces of

grease, resin, or any other organic contaminants.

Subsequent to this process, the relay is handled only by tongs and is not allowed to come into contact with the fingers. The relay is then thoroughly baked in a well-ventilated oven to remove all traces of the solvent. After testing to ensure that the contact resistance is of a low and stable value, the "getter" is assembled and the relay encapsulated by soldering the glass-to-metal seal to the cover and finally sealing off the vent hole in the bottom end of the cover.

Before the introduction of the "getter" a great amount of research was carried out to determine whether a change in contact material would effect any improvement in performance. Materials such as copper-palladium, platinum-gold-silver alloy, special gold alloys, silver, and gold and rhodium plating were investigated but none of these materials was found to show any improvement over platinum, the contact material used at present for this type of relay.

There is no doubt that the introduction of the "getter" into the improved version of this relay has considerably increased its working life; when functioning under the conditions mentioned above the results of life tests indicate that runs of more than 3,000 hours are now quite common. Some relays have in fact exceeded 10,000 hours continuous running, equivalent to at least $3,600 \times 10^6$ operations.