F. R. McBERTY.
ELECTRICAL SWITCH CONTACT.
APPLICATION FILED FEB. 27, 1908.

1,046,823. Patented Dec. 10, 1912.

Fig. 1.

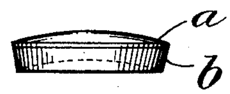


Fig. 2.

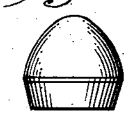


Fig. 3.

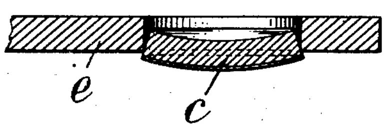


Fig. 4.

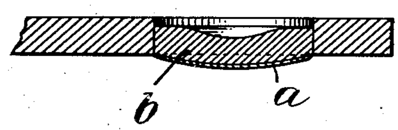


Fig. 5.

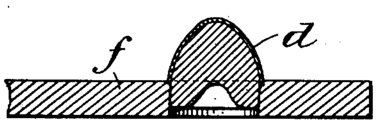


Fig. 6.

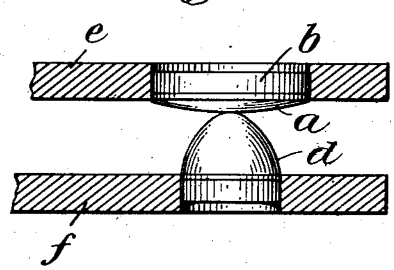


Fig. 7.

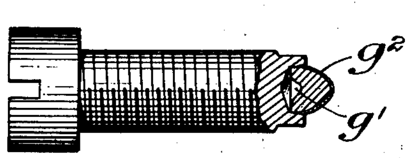
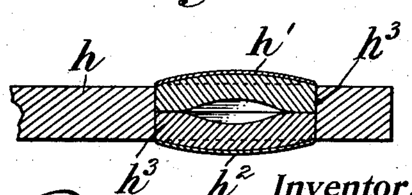


Fig. 8.



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ELECTRICAL SWITCH-CONTACT.

1,046,823. Specification of Letters Patent. Patented Dec. 10, 1912.

Application filed February 27, 1908. Serial No. 418,129.

To all whom it may concern:

Be it known that I, FRANK R. McBERTY, a citizen of the United States, residing in the town of New Rochelle, county of Westchester, and State of New York, have invented a new and useful Improvement in Electrical Switch-Contacts, of which the following is a full, clear, concise, and exact description.

My invention relates to the construction of electrical switch contacts, particularly for telephone apparatus, in which the contact surfaces are composed of a material different from that of the switch levers. In other applications of even date herewith, I have described a material for the contact faces of such electrical switches, said material consisting of a thin platinum foil backed by a heavy plate of pure copper electrolytically deposited on the foil. I have also described therein a process for making and mounting the contacts or contact faces.

My invention herein described relates to the construction of contact points, disks or plates from said material and their combination with the switch-parts, such as switch springs, of telephonic apparatus.

In the manufacture of telephonic appliances, it is necessary to provide a single form of contact capable of meeting a variety of conditions arising at the switch contacts with respect to current, inductance, mechanical wear and pressure. This invention is the result of a study of such electrical and mechanical conditions, from which study, the following facts were developed: During the cycle of closing and breaking the circuit, six different stages of electrical action are distinguished. During the first stage, a spark breaks across between the approaching contacts. In the second stage, the discharge becomes a glow. In the third stage the metals are brought into contact and heat is developed due to the resistance of the metal. The fourth stage covers the period during which the metals are pressed together to produce a circuit of low resistance. During the separation of the contacts the fifth stage is established, in which an arc of increasing resistance is formed, which when ruptured gives place to the sixth stage, the open circuit. In non-inductive circuits having considerable voltage, the initial spark (first stage) may be strong and destructive of the contacts, carrying off particles of the metal. In inductive circuits, the spark is relatively feeble or may be absent. In the second stage, the glow is produced in non-inductive circuits or in inductive circuits of high voltage and produces the well known result of evaporating the metal of one of the electrodes and dissipating it or transferring it to the other electrode. When the metals touch, the first contact is between minute particles, filaments or globules left by preceding discharges; these globules heat, by reason of the resistance of the metal, and tend to weld together. The dimensions of the welded area depend upon the heat developed and the fusibility of the metal. Under continued pressure, the stage of solid contact is reached. When the contact area is considerable, the current through each particle is relatively small and the heat is conveyed away by the metal. During the third and fourth stages, the amount of heat depends largely upon the volume of current flow. When the contact is broken, the welded parts must be torn apart. The effect of the arc during the fifth stage is to heat the anode, evaporating the metal and transferring it to the cathode in the well known manner. In circuits having fairly high electro-motive forces, the conditions produced in the first, second and fifth stages are particularly destructive. In circuits carrying large current, whatever the voltage may be, the conditions produced during the third, fourth and fifth stages are destructive of the contacts. In non-inductive circuits, the effects during the first, second and third stages are strongly marked, while those in the fifth stage are relatively feeble; but on the other hand, in inductive circuits, the destructive effects during the first and second stages are relatively slight, while that taking place during the fifth stage is highly destructive.

The actions of the currents on the metal under the different conditions of practice may be enumerated as follows: tearing out of particles; evaporating the metal from either cathode or anode; heating the surface filaments of the metal, with dissipation or oxidation; welding the contact surfaces; breaking the welded joint with transfer of metal from one to the other; great heating of the anode crater, with transfer of the metal to the cathode.

The evaporated metal, if oxidizable, will be oxidized and deposited in the neighborhood of the hot parts, the position depending upon the distribution of temperature in the parts and the temperature of condensation of the metal or oxid. In the case of those metals which condense at high temperatures and oxidize, the oxid may be deposited so near the contact surfaces as to interfere with subsequent operation. In the case of metals which evaporate and condense at relatively low temperatures, the loss of metal by evaporation and the welding will prevent the satisfactory operation of the contacts.

Of telephonic appliances, such as line relays, for example, the great majority will be used a limited number of times during their lives, but a small number will be subjected to very much greater usage and wear; so that the pitting or destruction of contacts may be slight in a great number of cases of any kind of appliances, but may be great in relatively a few cases. For this reason, it is desirable in practice that the great majority of cases shall be met in a wholly satisfactory manner while the few cases shall be met in some way which shall avoid failure. The electrical contacts of this invention fulfil all of the conditions above stated.

In the drawing accompanying this application, Figure 1 represents a disk or plate of the material suitable for forming a plate contact. Fig. 2 shows a conical plate, disk or piece intended to form a point contact. Fig. 3 shows in section a switch spring with the disk in place. Fig. 4 illustrates the combined spring and disk in final form. Fig. 5 illustrates the final form of contact point. Fig. 6 shows a section of a pair of typical springs provided with contact disks of Figs. 1 and 2. Fig. 7 is a view, partly in section, of a contact screw carrying a tip of my improved material. Fig. 8 is a longitudinal section of a contact spring having a platinum face on each side.

The disks or plates of the material are struck out in a press in a concavo-convex shape. The disk for the plate (Fig. 1) may be one tenth inch in diameter; that for the point (Fig. 2) may be eight hundredths inch in diameter. Each disk is composed of a face, a, of platinum foil, which may be one thousandth inch thick, and a backing or base, b, of pure copper, electrolytically deposited on the foil, which may be one fiftieth inch thick. These disks are formed by a suitable tool into cups, as shown in Figs. 1, 2, and 3. As illustrated, the forming of the disks has been simultaneous with the punching operation. Forcing these disks into the concavo convex form makes the edges of the disks conical. These disks, c and d, are dropped into holes very slightly larger than the disks in the switch springs or supporting parts, e and f, respectively, and then are struck by a tool which reduces the convexity of the cups and thereby spreads the metal in the holes as shown in Fig. 4. The peripheral edge of each disk is forced into binding engagement with the edge wall of its perforation, thereby securing the disk in place. It is preferable that the plate contact should be raised a little above the flush surface of the switch spring. The point contact should protrude considerably from the spring.

The contact screw shown in Fig. 7 has an opening in the form of a cup-shaped recess, g', in its end, in which the conical contact point g^2, like that shown in Fig. 2 is placed. Then, as before, the piece g^2 is crushed down and spread in the recess, by means of a riveting tool.

In the spring, h, shown in Fig. 8 two disk-contacts, h' and h^2, have been placed back to back in the hole h^3 in the spring, and flattened into place.

The platinum faced contacts thus produced are held strongly in place with respect to mechanical forces, and also have an intimate and permanent electrical contact with the metal of the supporting parts.

The process of forming the contacts requires great malleability of the metal as well as strong adhesion between the platinum and the copper. To meet this requirement the rotary process should be employed in electrolytically depositing the copper on the platinum foil, the latter being wrapped around a cylindrical mandrel rotating in the plating solution at a fairly high rate—say one thousand revolutions per minute; and the platinum having been chemically cleaned in advance, the plating current is raised carefully from an extremely low value to a maximum. By this process, a very tough and strongly adherent plating a of copper is produced upon the foil.

Switch contacts of the present invention have in the great majority of cases, all the advantages of solid platinum contacts, and in addition, are of low cost. There would be no great saving of cost if the platinum were made of such thickness as to meet the extreme wear of all appliances. The peculiar advantages of the use of the pure copper plating arise in the minority of cases in which the electrical actions wear through the thin platinum facing. As an example, a platinum facing one thousandth inch thick will withstand the action of the ordinary current in the subscriber's line for more than 100,000 operations, which number exceeds the average number occurring in a life of say twenty years; but the platinum of the contact would be perforated in cases of lines calling as frequently as 100 times per day for a period of years. But the percentage of lines calling with such frequency is small.

When the platinum is perforated the evaporation of the copper is extremely slight; copper being one of those metals which evaporates slowly under electrical action. When contact with the first particles occurs (third stage) the low resistance of copper permits the minimum of heat; and, because of this fact and the relatively high melting point of copper, the melted globules fused together are small. When solid contact occurs, the copper does not weld strongly. For these reasons a slight force, such as is available in relays, is sufficient to separate the contacts. During the arc (fifth stage) the copper is not volatilized in large volume, for the reasons before noted, and it condenses mainly as clean metal upon nearby parts. As a result of these characteristics of the copper, and the method of attaching it, I find that the contacts can be successfully operated several hundred thousand times after perforation of the platinum in circuits carrying currents capable of producing such perforation. In circuits carrying currents of such feebleness as not to wear through the platinum, such as telephonic currents, the platinum alone serves.

If brass, tin, lead or zinc be used as backing, these metals give off large volume of oxidized vapor as soon as perforation of the platinum occurs and prevent subsequent closing of the circuit. Iron used as a backing rusts and keeps the circuit open after perforation occurs. Nickel gives off vapor which condensing near the contacts, oxidizes with a thin but hard non-conducting film, which after a few operations, prevents closing of the circuit.

Attempts have been made to provide contact surfaces of platinum plated upon base metals; but so far as I am aware, only excessively thin films of platinum can be produced which fail to withstand either the mechanical or electrical wear of comparatively few operations. Also thin contacts of platinum foil have been soldered to contact springs of base metal; but it has been found that the solder flows through and alloys the platinum so that the contact partakes of the properties of the solder more than of the platinum and is readily destroyed.

I claim—

An electrical contact composed of platinum foil having a backing of other metal electrolytically deposited thereon.

FRANK R. McBERTY.

Witnesses:
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WILLIAM G. McKNIGHT.