Nov. 14, 1933. A. T. MUSGRAVE 1,935,516

SWITCH CONTACT AND METHOD OF MAKING THE SAME

Filed April 15, 1930

Fig. 1.

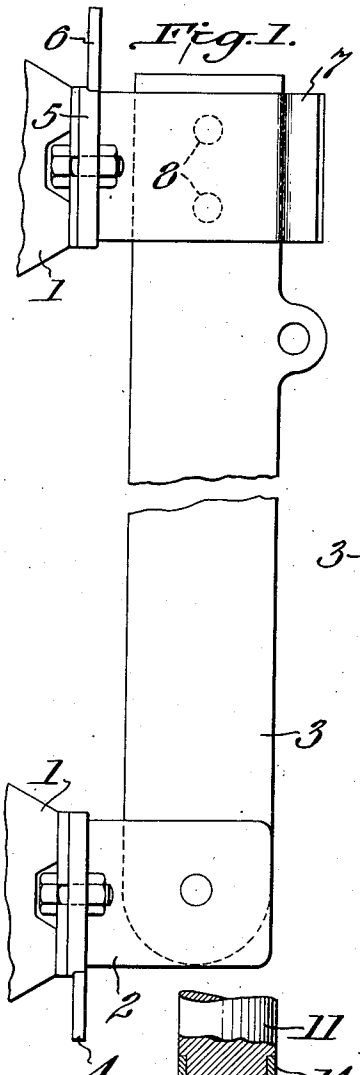


Fig. 2.

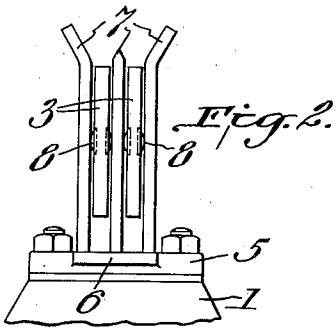


Fig. 3.

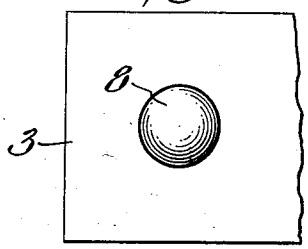


Fig. 4.

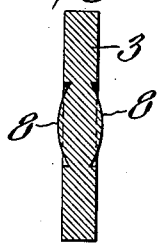


Fig. 5.

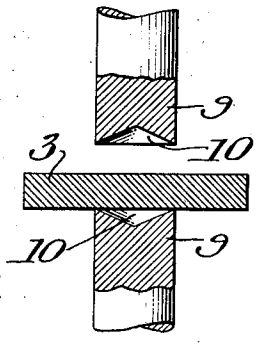


Fig. 6.

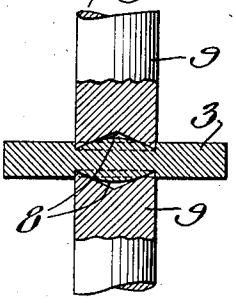
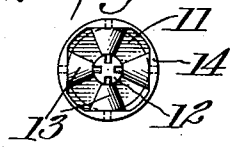


Fig. 7.

Fig. 8.



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1,935,516

SWITCH CONTACT AND METHOD OF MAKING THE SAME

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Application April 15, 1930. Serial No. 444,579

9 Claims. (Cl. 29—155.55)

This invention relates to electrical switches for carrying heavy currents and particularly to contact elements for such switches and to methods of forming the contact elements.

It had been the practice to provide a large contact area between the switch blade and the switch jaws when the switch was to carry relatively heavy currents, the practice having been to provide such contact areas that the current density was of the order of 50 to 80 amperes per square inch when the unit pressure between the contact surfaces was a few pounds per square inch. The copending application of Carl G. Koppitz, Ser. No. 367,013, filed May 29, 1929, describes an electrical switch in which the contact surface is of very limited extent and the unit pressure is of the order of upward of many thousand pounds per square inch. As described in the said application, switches of this type may be made by drilling the switch blade or switch jaw and inserting therein a section of a harder metal which extends beyond the original surface of the blade or jaw.

An object of the present invention is to provide switch elements in which contact surfaces of limited area are integral with the main body of the element but have electrical and metallurgical characteristics differing from those of the element. Another object is to provide switch elements having limited contact areas that are integral with but harder than the metal forming the remainder of the elements. A further object is to provide a switch element in which a small portion of the metal of the element is forced outwardly from the original surface of the element by the pressure applied upon and at an angle to the said surface.

Other objects of the invention are to provide methods of forming contact elements having the characteristics noted above. Other specific objects are to provide methods of forming switch contact elements having limited areas forced outwardly beyond the original surface of the element.

These and other objects of the invention will be apparent from the following specification when taken with the accompanying drawing in which:

Fig. 1 is a fragmentary side elevation of a disconnect switch,

Fig. 2 is an end elevation of the same,

Fig. 3 is an enlarged side elevation of the end of a switch blade having a limited contact area formed thereon,

Fig. 4 is a transverse section through the said contact area,

Figs. 5 and 6 are fragmentary sectional views illustrating the method of stamping a switch element to provide limited contact areas thereon,

Fig. 7 is a fragmentary sectional view of a spinning tool for forming a limited contact area, and,

Fig. 8 is an end elevation of the spinning tool.

In the drawing, the reference numerals 1 indicate the ends of the insulator columns or other supports upon which the disconnect switch is mounted. The lower support 1 carries a suitable fitting 2 upon which the switch blade or blades 3 are povitally mounted, the fitting being provided with an integral terminal lug 4. The upper insulator column carries a fitting 5 which has an integral terminal lug 6 and a plurality of substantially parallel blades 7 to provide the switch jaw within which the switch blade 3 may be engaged.

As best shown in Fig. 2, the switch blades 3 do not have full surface contact with the transversely alined portions of the adjacent blades 7 of the switch jaw, but the engagement is limited to the domes or spherical bosses 8 that are formed on the switch blades. As shown in Fig. 4, the bosses 8 at opposite sides of the switch blade may be, and preferably are, in axial alignment with each other.

Although it would be possible to form an element having the identical shape as the described blade element 3 by casting an oversized element and grinding to final form, or by machining away the excess metal from a larger blank, such operations would be comparatively expensive, and would not impart to the elements the mechanical properties which are essential when small contact areas are to slide along plain contact surfaces under heavy pressure. As shown graphically in Figs. 5 and 6, the contact bosses may be formed on the surface of the contact element or blade 3 by stamping the blade between dies 9 that have conical recesses 10 in the adjacent ends thereof. When the dies are pressed toward each other and into the metal forming the blade 3, pressure is exerted over an annular area and, due to the inclined end faces 10 of the dies, the lines of application of the pressure define the surface of a pair of cones that have their bases located beneath the surface of the switch blade. This application of pressure along converging lines effects a cold flow of the metal toward the center of the annular area, and the central portion of this area is forced outwardly beyond the planes defining the parallel surfaces of the contact element 3.

Similar spherical bosses may be formed by spinning tools of the general type shown in Fig. 8. The tool may take the form of a cylindrical rod 11 having a central extension 12 which provides seats for the inner ends of the pivots of the conical rollers 13. The pivotal supports for the outer ends of the series of rollers are mounted in a sleeve 14 that telescopes over the end of the rod 11.

The blade 3 will preferably be formed of soft copper of high electrical and thermal conductivity and the jaw members 7 are preferably of a harder metal such as spring copper. The normal spacing of the jaw members 7 is slightly less than the maximum thickness of the switch blades 3 in order that there may be a relatively low pressure between the engaging surfaces. Although the total pressure may be comparatively low, for example, of the order of from 25 to 70 or 80 pounds, the unit pressure of contact is extremely high since switch elements engage the areas which are of the order of point contacts, i. e., the area in engagement at each contact is of the order of one one-hundredth of one square inch.

The switch shown in Figs. 1 and 2 provides eight contact areas and I have found that a switch of this type will carry loads of the order of 2000 amperes and upward. Assuming an equal distribution of the current, each contact area carries approximately 250 amperes, and therefore the current density is of the order of 25,000 amperes per square inch. The operation of a switch of this limited contact area type is materially improved when the contact points or zones are provided by an integral part of the metal of the blade.

The separate contact inserts give rise to electrical and thermal losses at the junction of the metals and such losses are reduced or substantially eliminated when the contact area is formed by pressing or deforming the metal of the blade to force a part of the metal out from the original surface of the blade. It is to be noted that the contact elements embodying the invention possess the same advantages as those formed by separate inserts so far as concerns the relative hardness, and the electrical and thermal conductivity of the body of the contact element and the contact bosses. The cold working of a soft copper switch blade results in a hardening of the worked section, thus providing a hardened contact area of limited extent, but the remainder of the blade or switch element has a high electrical and thermal conductivity.

The opposed contact bosses are preferably alined in a single plane passing through the axis of the movable element. This construction provides the full contact area and contact pressure as soon as engagement of the line of bosses with the other contact element is complete and therefore, aside from any arcing conduction upon the opening of the switch, the effective opening or closing of the switch corresponds to a very small relative movement of the cooperating contact members.

It will be apparent that the invention is not limited to the formation of the contact-restricting area or areas upon the movable element of a high pressure contact switch since the same economy in manufacture and the same advantages in operation are observed when the projecting bosses are located on the switch jaw.

While I have described two methods of swaging or upsetting a part of the metal, it will be apparent that other methods may be employed to effect the desired outward flow of the metal at opposed zones on opposite faces of the contact element.

The spherical boss may be replaced by bosses or projecting areas of other contour and, when extremely heavy currents are to be carried, it may be convenient to provide a line contact in place of a plurality of point contacts. The deformation of the metal to provide a line contact may be effected by applying pressure along two converging planes.

It will be apparent that the invention is not limited to disconnect switches of the high pressure contact type, since it may be usefully employed for all switches that carry heavy currents. The particular data given above is illustrative of the invention, but it is to be understood that the invention is not limited to switches employing unit pressures or current densities of the exact or approximate values herein specified.

I claim:

1. The method of forming contact area of limited extent on the surface of a switch contact element, which comprises applying pressure to the periphery of a limited area of said elemnt to effect a cold flow of the metal of said limited area towards the center thereof, whereby the metal at the center of said limited area is forced outwardly from the original surface of said element.

2. The invention as set forth in claim 1, wherein the pressure is symmetrically applied at opposite surfaces of said element, whereby raised contact surfaces are formed at transversely alined points on said element.

3. The method of forming a contact area of limited extent upon a switch contact element, which comprises applying pressure upon the surface of said element along spaced converging lines, whereby the metal between said lines of application is forced outwardly from the surface of said element.

4. The method as set forth in claim 4, wherein the converging lines along which pressure is applied define the surface of a cone whose apex lies outside said element.

5. In the manufacture of a switch element for a high pressure contact switch of high current-carrying capacity, the process which comprises shaping a restricted section of a one-piece element to form a contact area projecting beyond the surface of the adjacent portion of said element, and hardening the surface of said contact area to impart a characteristic thereto which differs from a corresponding characteristic of the adjacent portion of said element.

6. In the manufacture of a switch element for a high pressure contact switch of high current-carrying capacity, the process which comprises cold working a restricted portion of a one-piece element to impart thereto a rounded and smooth contact surface and simultaneously hardening said rounded contact surface to impart thereto electrical and mechanical characteristics different from those of the remainder of the said one-piece element.

7. In the manufacture of a switch element consisting of a metallic plate of one density and a contact boss integral with and projecting beyond said plate, the method which comprises simultaneously hardening a section of said plate and forcing the said hardened section outwardly to form a contact boss by applying pressure to the periphery of said section to force the same below the surface of said plate and towards the center of said section.

8. An electrical contact element for a high pressure contact switch of high current-carrying capacity, said element comprising a body of relatively soft metal of high electrical and thermal conductivity, and a contact portion integral with and projecting beyond the adjacent portion of said body, the metal of said contact portion being harder than the rest of said element and having a lower thermal and electrical conductivity.

9. An electrical contact element for use in the construction of a switch, said element comprising a flat plate formed of relatively soft metal of high electrical and thermal conductivity, and a contact boss integral with and projecting beyond one face of said plate, the metal of said boss being harder than that of said plate and possessing a lower thermal and electrical conductivity.

ARTHUR T. MUSGRAVE.