

Aug. 10, 1965

J. R. COOLEY
ELECTRICAL CONTACT MEMBER HAVING A RAISED
CUP SHAPED WORK-HARDENED AREA
Filed Jan. 2, 1963

3,200,226

Fig. 1.

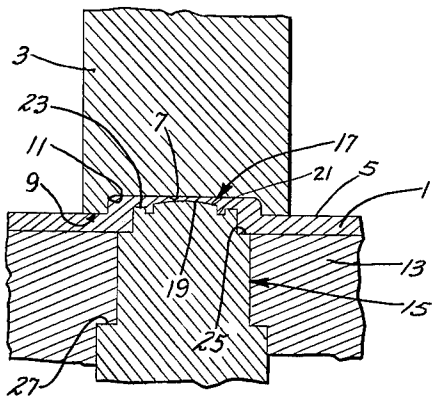


Fig. 2.

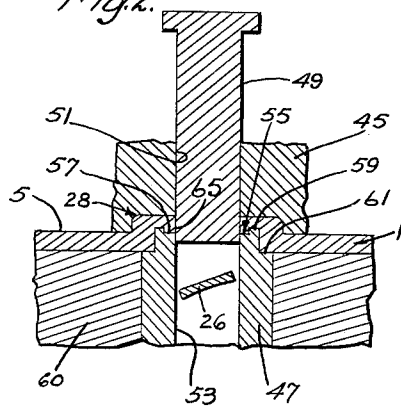


Fig. 4.

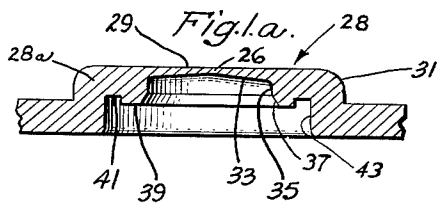
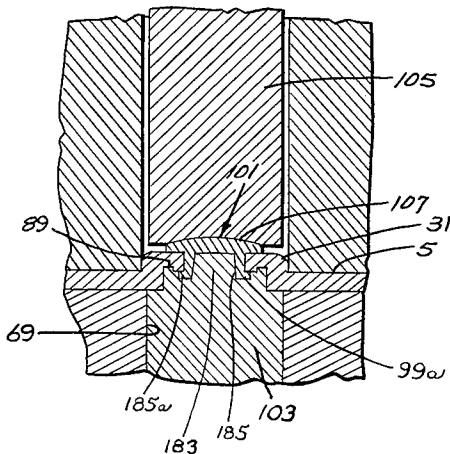


Fig. 3.

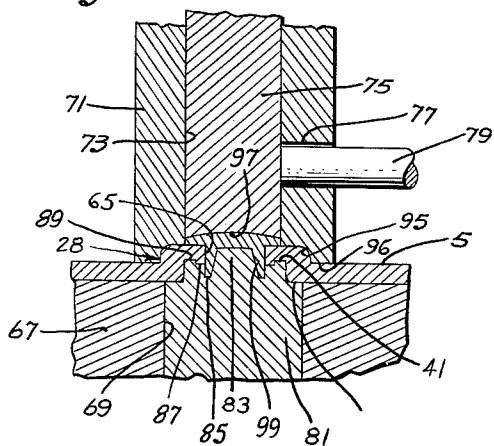


Fig. 7.

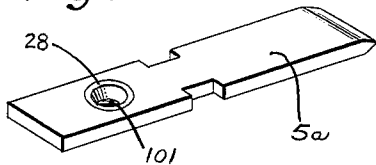


Fig. 5.

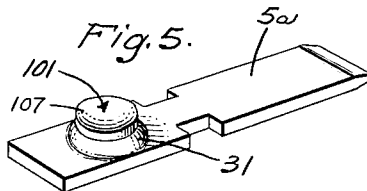
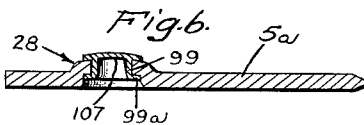


Fig. 6.



Inventor:
John R. Cooley.

by Thomas A. Briody
Attorney.

1

3,200,226

**ELECTRICAL CONTACT MEMBER HAVING A
RAISED CUP SHAPED WORK-HARDENED AREA**
John R. Cooley, Morrison, Ill., assignor to General
Electric Company, a corporation of New York
Filed Jan. 2, 1963, Ser. No. 249,043
4 Claims. (Cl. 200-166)

The present invention relates to electrical contact members, and more particularly to contact members which include a supporting strip with a contact mounted thereon.

To make prior art current-carrying members for electric switches, a wide variety of current-carrying metals and alloys have been utilized to support the contact elements or tips. For attaching these contact elements to their supporting strips, an aperture is usually first formed in the strip, and the contact element is thereafter fastened thereto. It has been found that when relatively soft metals and alloys, such as the brasses are used for the supporting strip material, the aperture of the strip is undesirably enlarged while the contact is being fastened to it. Such an undesirable enlargement of the contact aperture may, for example, be caused by the high pressures involved in securing a contact to a strip by means of extrusion. This undesirable enlargement of the contact aperture impedes the securement of the juncture between the contact element and the strip. For example, when a silver contact is extruded into an aperture of a brass supporting strip, it has been found that due to the very high pressures involved in extruding a silver slug into the aperture, the aperture has expanded radially, and as a result of this the silver contact element has not become securely fastened into intimate engagement with the brass strip. It has therefore been found desirable to provide an improved method for manufacturing electrical contact members, wherein the size of the aperture of a supporting strip is maintained and is not adversely effected by the high pressures involved in securing a contact element thereto. In such applications it has been additionally advantageous to provide an improved electrical contact member which includes a contact element that is of extremely economical construction.

An important object of this invention is to provide an improved electrical contact member which includes a contact element in intimate mechanical and electrical engagement with the supporting strip.

Another object of my invention is to provide an improved contact element which is intimately secured to a supporting contact strip and is a very economical construction.

A further object of my invention is to provide an improved electrical contact member wherein a contact element of maximum hardness is intimately associated with a supporting strip member.

In carrying out one aspect of my invention I have provided an electrical contact member which includes a supporting strip having an aperture formed therein and a contact button in intimate mechanical and electrical engagement with the strip. The supporting strip is formed with the area thereof surrounding the aperture work hardened. The contact button includes a head formed to the desired shape and engaging one side of the strip in an area surrounding the aperture, and a shank section extending through the aperture. The shank section of the contact button has its outer peripheral surface in intimate engagement with the wall of the strip aperture and it includes a flanged outer end in secure engagement with the side of the strip opposite the head, in an area surrounding the aperture. With such an arrangement, in accordance with the present invention, the shank section is of sub-

2

stantially hollowed out construction between the one side and the other side of the strip by means of a frusto-conical recess formed in the shank between its outer end and the head of the contact element. Such a structure for the electrical contact member provides an effective electrical contact button in secure interengagement with the supporting strip, while requiring a relatively small amount of silver material to produce the contact element.

Further aspects of my invention will become apparent hereinafter, and the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which I regard as my invention. The invention, however, as to organization and method of utilization, together with further objects and advantages thereof, may best be understood by reference to the following description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a cross sectional view through a forming apparatus in which the strip material upon which a contact element is to be subsequently fastened, is first formed and work hardened;

FIG. 1a is an enlarged cross-sectional view of the section of strip material formed and work hardened by the apparatus of FIG 1;

FIG. 2 is a sectional view through a punching apparatus in which the work hardened and preformed strip section has an aperture punched therein to enable it to be subsequently secured to a silver contact element;

FIG. 3 is a cross sectional view through an extrusion apparatus wherein a slug of silver wire is cold welded into intimate engagement with the strip;

FIG. 4 is a cross sectional view of a forming apparatus wherein the extruded silver contact element is properly shaped in its strip-like supporting member, to perform its desired electrical function;

FIG. 5 is a perspective view of a completed electrical contact member manufactured in accordance with one form of the invention;

FIG. 6 is a longitudinal sectional view of the contact member of FIG 5; and

FIG. 7 is a perspective view of the contact of FIG. 5 showing the bottom of the contact element.

Referring now more particularly to FIG. 1 of the drawing, the numeral 1 represents a contact bar or strip of aluminum, copper, brass, or other ductile and pressure weldable metal or metal alloy, upon which is to be formed a contact element or button of a different current-carrying metal which is also capable of pressure welding, such as, for example, silver or other precious or inert metals. As an initial operation for this purpose, the strip 1 is fed to a manufacturing station position, illustrated in FIG. 1. At this manufacturing station, the upper die member 3 is initially engaged with the upper surface or face 5 of the strip 1. As shown in FIG 1, the upper die member 3 includes a recess 7 formed upon its strip engaging face 9. The recess 7 has an inner surface generally parallel to the plane of the strip 1 (when member 3 engages the strip 1), and a substantially curved periphery 11 which has an outwardly concave configuration (FIG. 1a). When the upper die member 3 is positioned in engagement with the strip 1, the strip 1 is securely clamped between the upper die member 3 and a movable support 13. Plunger or lower die member 15 is thereupon punched into engagement with the clamped strip material 1, as shown in FIG. 1. The outermost end or face 17 of the plunger 15 is specially configured to include an upwardly facing convex surface 19 (viewing FIG. 1), a groove 21 of which surrounds the surface 19, and an outwardly facing rim 23 of which is continuous to and surrounds the groove 21. From the

3

outer periphery of the rim 23, the outer face 17 of the plunger 15 is stepped downwardly (FIG. 1) and radially outwardly from the axis of the plunger 15 to form annular transverse steps 25 and 27. As shown in FIG. 1, step 25 engages the bottom surface of strip 1 during the forming operation to position the plunger relative thereto. Step 27 cooperates with a mating step of the support 13 to position the plunger relative thereto.

As shown in FIG. 1, when the upper end 17 of the plunger 15 is closed toward upper die member 3, it cooperates with the recess 7 at the bottom end of the upper die member 3 and compresses the strip 1 to effect a cold flow of the strip material into the configuration shown in FIGS. 1 and 1a. The material of the strip 1 is thus displaced upwardly toward the body of die member 3 from its original position (viewing FIG. 1), and it is also, in general, displaced radially outwardly from the axis of the plunger 15. In viewing FIG. 1a, it will be noted that the strip material 1 is thus coined and work hardened by means of the co-action thereupon by plunger 15 and the upper die member 3. More particularly, as shown in FIG. 1a, the thin portion 26 between the two cooperating die members 3 and 15 causes the strip material to cold flow sideways or radially into peripheral area 28a of a raised platform 28. This causes substantial compression of the strip 1 between the confining die members 3 and 15, particularly in the peripheral area 28a of the raised platform 28, to work harden it.

The raised platform 28 includes on its upper side a generally flat surface 29 having its upper periphery 31 curved downwardly toward the general plane of the strip 1, in outwardly convex fashion. On the bottom side of the raised platform, viewing FIG. 1a, near the center thereof there is a shallow recessed fully conical surface 33 conterminous with an almost upright frusto-conical surface 35. The surface 35 merges into a downwardly and outwardly flared mouth 37, the purpose of which shall become apparent hereinafter. The bottom of the mouth 37 merges into a transverse surface 39 which, in general, surrounds the frusto-conical surface 33. Adjacent to the surface 39 a groove 41 is coined upwardly into the lower surface of the material by means of annular rim 23 of the plunger 15. The groove 41 has on its outer side a vertical wall 43 which is parallel to the axis of the plunger 15.

Due to the high confining pressures exerted by the plunger 15 upon strip 1, as previously mentioned, the strip 1 is effectively work hardened within the general area of the raised portion 28, which is designed to receive the contact. In addition, the groove 41 is coined into the strip metal to specifically work harden the material of the strip which is to be subsequently disposed directly underneath and near the periphery of the head of the formed contact. As shall be further understood hereinafter, the flared mouth 37 helps to direct the flow of the silver contact material during a subsequent operation and also provides a locking taper which enhances the removability of the plunger 15 from engagement with the formed and work-hardened strip material 1 (as shown in FIG. 1).

After the strip 1 has been formed and work hardened into the configuration shown in FIG. 1a, it is then passed by a means (not shown) to a second manufacturing station, where the operation illustrated schematically in FIG. 2 is then effected. As shown in FIG. 2 the raised portion 28 of the strip material 1 is clamped between an upper stripper member 45 and a lower die member 47. The upper stripper member 45 has a punch 49 which is arranged to reciprocate through an aperture 51 of the member 45. The lower die member 47 has a somewhat similar configuration to the plunger 15 shown in FIG. 1, except that it provides a central bore 53. Thus, as shown in FIG. 2, the outer face 55 of lower die member 47 includes a groove 57, which corresponds to the groove 21 of the plunger 15, and an outwardly facing rim 59, which corresponds to the outwardly facing rim 23, of the plunger

4

15. The lower die member 47 is seated in a lower strip-per structure 60, as shown in FIG. 2, for the punching operation.

With raised portion 28 of the strip 1 clamped between members 45 and 47, the punch 49 moves downwardly from above the strip 1 and into engagement with the raised portion 28 (as shown in FIG. 2) to remove the relatively thin coined section 26 thereof. After the removal of coined portion 26 of the strip material, the punch 49 is disengaged from the strip by a suitable means, such as the stripper member 45. The lower structure 60 is arranged to then lift the strip 1 from the lower die member 47, thereby allowing the strip 1 to be further advanced. The punching apparatus shown in FIG. 2, has thus provided a contact receiving aperture 65 for the raised and work-hardened portion 28 of the strip 1. This arrangement is then advanced to the next manufacturing operation, shown schematically in FIG. 3.

FIG. 3 sets forth one form of an extrusion, or cold welding apparatus which may be expeditiously utilized to secure a silver contact element to the work-hardened strip material 1, in accordance with my invention. In particular, the apparatus illustrated in FIG. 3 includes a stationary supporting block 67 having an aperture 69 formed therein. Above aperture 69 of the block 67, viewing FIG. 3, there is arranged a vertically movable clamping member 71. A vertical bore 73 is formed in the clamping member 71 for receiving a plunger 75, which is vertically movable with respect to the clamping member. For feeding contact material into the path of movement of the plunger 75, a transverse aperture 77 is cut through the side of the clamping member 71. Aperture 77 is perpendicular to the axis of movements of clamping member 71 and plunger 75, and it allows silver wire 79 to be suitably fed into the bore 73 of the clamping member 71 for compression by the plunger 75.

Within aperture 69 of the supporting block 67 and disposed underneath clamping member 71 and its telescoping plunger 75 (as shown in FIG. 3) there is positioned a lower die member 81. The lower die member 81 is specially constructed in accordance with the present invention to form an economical and improved silver contact element. To be more specific, as shown in FIG. 3, the lower die member 81 has an anvil shaped upper and innermost end face which includes a frusto-conical projection 83, a groove 85 which surrounds projection 83, a lateral step 87 conterminous with the outer wall of groove 85, and an upwardly facing rim 89 conterminous with the upper ledge of step 87. The projection 83 has a frusto-conical configuration to enable it to be readily removed from engagement with the extruded contact element, as shall be further understood hereinafter. The groove 85 on member 81 allows the formation of a clamping outer end on the shank of the extruded contact element (FIG. 3). The step 87 and rim 89 of the lower die member 81 conform respectively in size and configuration to groove 57 and rim 59 of the lower die member 47 of the apparatus shown in FIG. 2, to receive and cooperate with the recessed bottom of the raised section 28 of strip 1 (FIG. 1a).

For an explanation of the mode of operation of the extrusion apparatus illustrated schematically in FIG. 3, let us first suppose that the strip material 1 is advanced from the position and apparatus where it is shown in FIG. 2 to the position and apparatus where it is shown in FIG. 3. The strip 1 is first seated on the supporting block 67 and the raised section 28 of the strip is engaged by the lower die member 81, as illustrated in FIG. 3. The frusto-conical projection 83 of the lower die member 81 is thereupon disposed in the aperture 65 of the raised portion 28 of the strip 1 and the transverse lower rim 39 of the raised portion 28 of the strip (FIG. 1a) cooperates with step 87 of the lower die member 81. The upwardly facing rim 89 of the lower die member 81 also

5

cooperates with groove 41 (FIG. 1a) of the raised portion 28 of the strip. The work-hardened raised portion 28 of the strip 1 is thus snugly seated in cooperative and secure engagement with the anvil face of the lower die member 81, as shown in FIG. 3. The cooperation between the lower die member 81 and the recessed side of the raised portion 28 of the strip 1 serves to accurately support and position the strip on the die member 81 and substantially prevents any distortion of the strip when the silver is subsequently extruded through the hole 65 thereof.

After the raised portion 28 of the strip 1 is seated into cooperative engagement with the uppermost face of the lower die member 81, the clamping member 71 is then operated downwardly into engagement with the strip 1. The mouth of the clamping member includes an outwardly concave and partially transverse inner face 95 adjacent to the bore 73, and an annular transverse shoulder 96, which engage the strip 1. The curved periphery 31 of the work-hardened raised portion of the strip is engaged by the inner face 95 of the clamping member 71, and the flat surface 5 of the strip surrounding raised section 28, is engaged by the shoulder 96. After the clamping member 71 has engaged the strip, the plunger 75 moves from a position above aperture 77 to shear off a slug of silver wire within bore 73 of the clamping member. Further motion of the plunger 75 downwardly toward the lower die member 81 causes the slug of silver to be confined within a cavity formed by the aperture 65 of the strip 1, the anvil like upper face (including projection 83) of the lower die member 81, and the downwardly concave mouth 97 of the plunger 75. The contact element 101 is thereupon extruded through the strip aperture 65, as shown in FIG. 3.

As a result of the downward pressure exerted upon the plunger 75, the force of impact exerted upon the silver material of the slug causes a very great pressure to be exerted against the sides of the aperture 65 of the strip 1. This pressure has a tendency to cause the aperture 65 to enlarge radially from its center. An important aspect of the present invention involves the preclusion of any enlargement of the aperture 65 as the result of the extrusion pressures exerted upon the strip 1. It has been found that by means of the work hardening of the strip 1 (achieved by a previous operation) radial enlargement of the aperture 65 is substantially minimized. In addition, the secure cooperation between the anvil face of the lower die member 81 and the surfaces 39 and 41 of the raised portion 28 of the strip, provides a further and relatively positive means for preventing the enlargement of the aperture 65 of the strip during the extrusion operation.

In view of the fact that the frusto-conical projection 83 of the lower die member 91 is disposed in the aperture 65 of the strip during the extrusion of the silver contact element 101, a hollow shank 99 is thereby formed on the silver contact. This hollowed out part of the shank 99 is disposed generally in the plane of the raised section 28 of the strip and it effectively reduces the amount of silver material required to make the finished contact 101. It will thus be understood that the contact element 101, which is shown in finished form on a suitable switch supporting arm 5a in FIGS. 5-7, is of extremely economical construction.

After the extrusion of the silver contact 101 into engagement with the aperture 65 of the strip 1, as illustrated schematically in FIG. 3, the strip 1 is then further advanced to a final manufacturing station, the operation of which is schematically illustrated in FIG. 4. In the apparatus illustrated in FIG. 4, the contact 101 is aligned over an anvil like upper face of lower die member 103. The face of die member 103 closely resembles that of die member 81 (FIG. 3) except that the bottom 185a of the groove 185 next to the frusto-conical projection 183 is wider than the bottom of the groove 85 of the member

6

81. With the contact 101 disposed on and supported by the anvil face of member 103, a restriking punch 105 is forced downwardly into contact with head 107 of the contact 101. This final punching operation shapes the desired head 107 for the finished contact 101. In addition, the bottom 185a of groove 185 of the lower die member 103 has such a configuration as to allow the lower end 99a of the shank of the contact to flare radially outward and wrap itself around the downwardly and outwardly flared mouth 37 (FIG. 1a) of the raised portion 28 of the strip. The finished contact 101 is thus secured into intimate engagement with the contact strip 1.

It will now therefore be seen that my new and improved method of manufacturing an electrical contact member provides an improved mechanical and electrical connection between a contact of precious metal and a thin supporting member therefor. It will further be understood that this electrical contact member is low in cost and may be efficiently manufactured.

While in accordance with the patent statutes I have described what at present is considered to be the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from my invention, and I, therefore, aim in the following claims to cover all such equivalent variations as fall within the true spirit and scope of this invention.

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

1. An electrical contact member comprising a supporting strip having a cup shaped work-hardened area, said cup shaped area having a portion providing a raised platform extending above one face of said supporting strip and a portion providing a recessed bottom extending upwardly from the opposite face of said supporting strip, an aperture through said raised platform to said recessed bottom, said recessed bottom having an annular groove spaced outwardly from said aperture, and a contact button in intimate mechanical and electrical engagement with said strip, said contact button including a head engaging said platform and closing said aperture and a shank section extending through said aperture, said shank section having its outer surface in intimate engagement with the wall of said aperture and a flanged outer end in secure engagement with the side of said strip opposite said head in an area surrounding said aperture, said shank section being of substantially hollowed construction between the one side and the other side of said strip thereby to provide an electrical contact member of economical construction.

2. An electrical contact member comprising a supporting strip having two opposed sides, said supporting strip having an aperture therethrough opening through said two sides formed therein, and a contact button in intimate mechanical and electrical engagement with said strip, one of said sides of said supporting strip having an annular groove therein adjacent to and surrounding said aperture to allow for the insertion of a die member into said supporting strip adjacent said aperture during the assembly of said contact to maintain the size of the aperture, said contact button including a head engaging said other side of said strip in the area surrounding said aperture, and a shank section extending through said aperture, said shank section having its outer surface in intimate engagement with the wall of said aperture and a flanged outer end in secure engagement with said one side of said strip opposite said head in an area surrounding said aperture.

3. The electrical contact member of claim 2 where the aperture is formed in the supporting strip upon a raised section of said strip which is spaced from but parallel to the general plane of said strip.

4. An electrical contact member comprising a supporting strip having a cup shaped work-hardened area, said cup shaped area having a raised platform extending above

7

one face of said supporting strip and a recessed bottom extending upwardly from the opposite face of said supporting strip, an aperture formed through said raised platform to said recessed bottom, and a contact button in intimate mechanical and electrical engagement with said strip, said contact button including a head engaging said platform and closing said aperture and a shank section extending through said aperture, said shank section having its outer surface in intimate engagement with the wall of said aperture and a flanged outer end in secure engagement with the side of said strip opposite said head in an area surrounding said aperture.

8

References Cited by the Examiner

UNITED STATES PATENTS

1,744,810	1/30	Shallcross	200—166 X
1,806,815	5/31	Muther	200—166
2,700,087	1/55	Stevens	200—166
2,759,074	8/56	Pettit	200—166
2,890,315	6/59	Graves	200—166
2,937,434	5/60	Swift	29—155.55
3,034,641	5/62	Kochan	207—1
3,075,281	1/63	Spooner	29—155.55

BERNARD A. GILHEANY, *Primary Examiner.*