Sept. 20, 1960 D. O. WALTER ET AL 2,953,247

MANUFACTURE OF ELECTRICAL CONTACTS

Filed May 12, 1955 3 Sheets-Sheet 1

FIG.1.

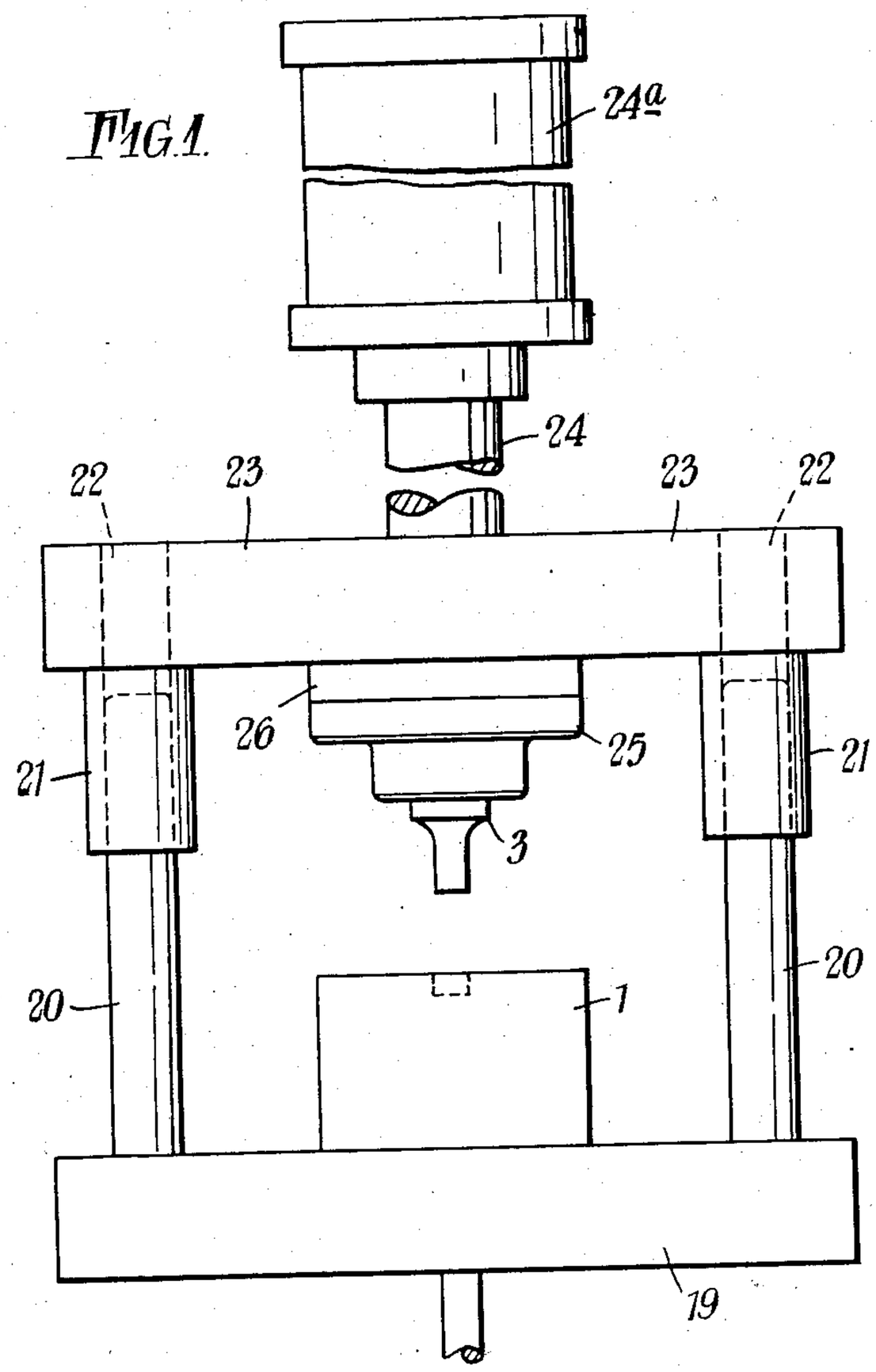


FIG.10a

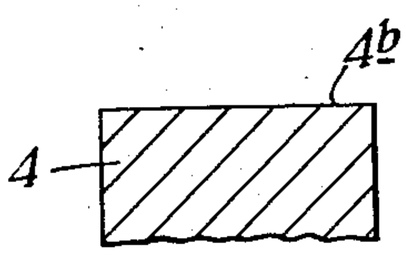
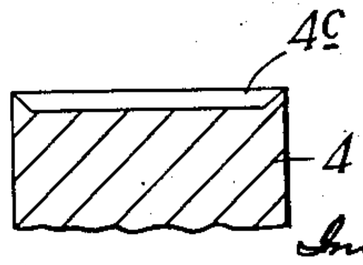


FIG.10b



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MANUFACTURE OF ELECTRICAL CONTACTS

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FIG. 2.

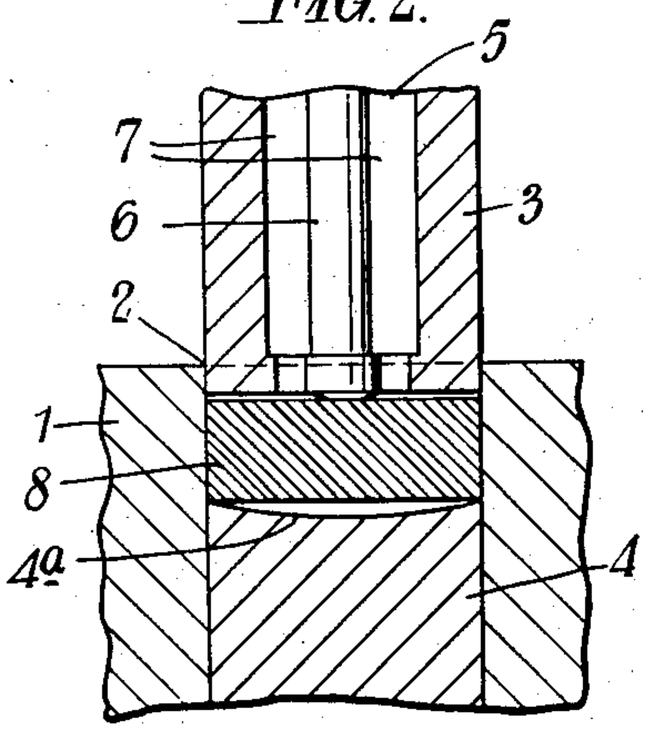


FIG. 3.

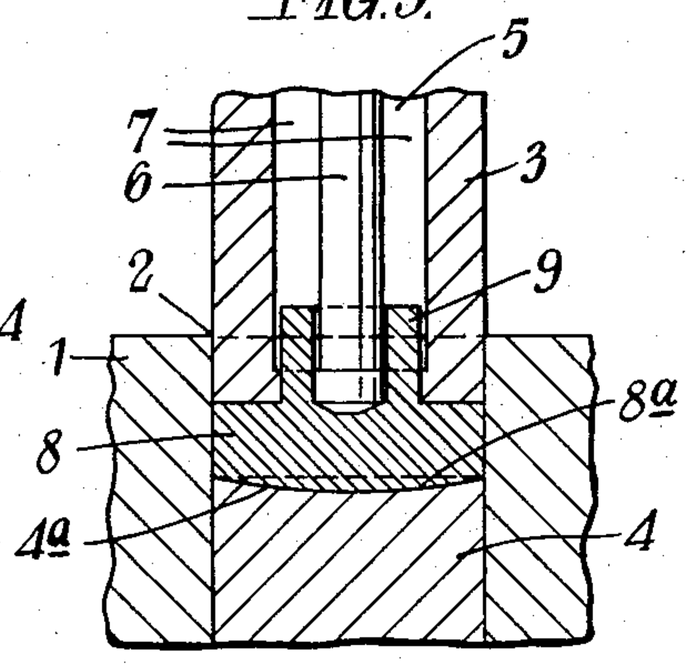


FIG. 4.

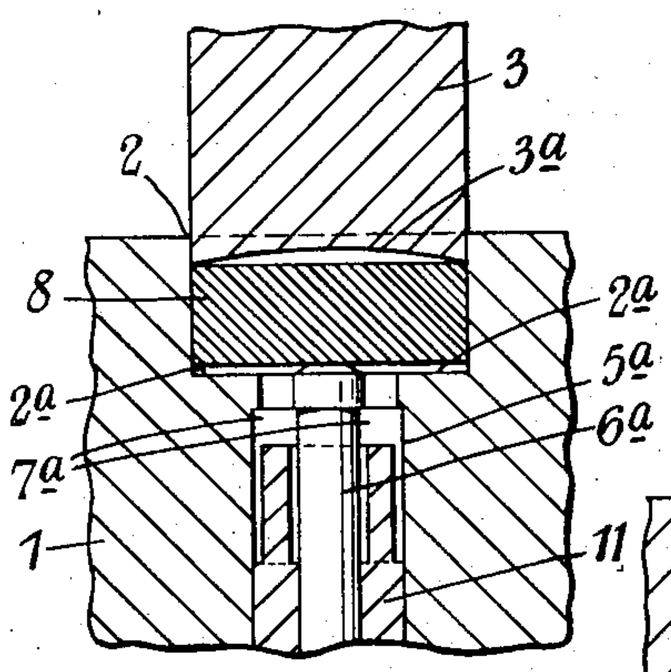
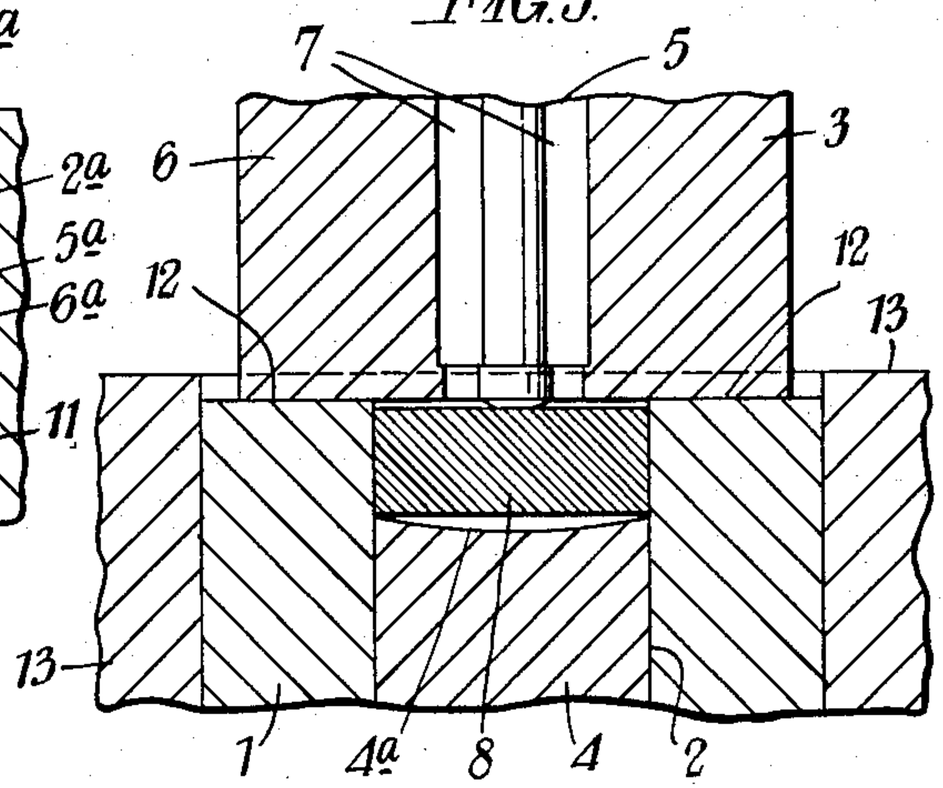


FIG. 5.



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MANUFACTURE OF ELECTRICAL CONTACTS

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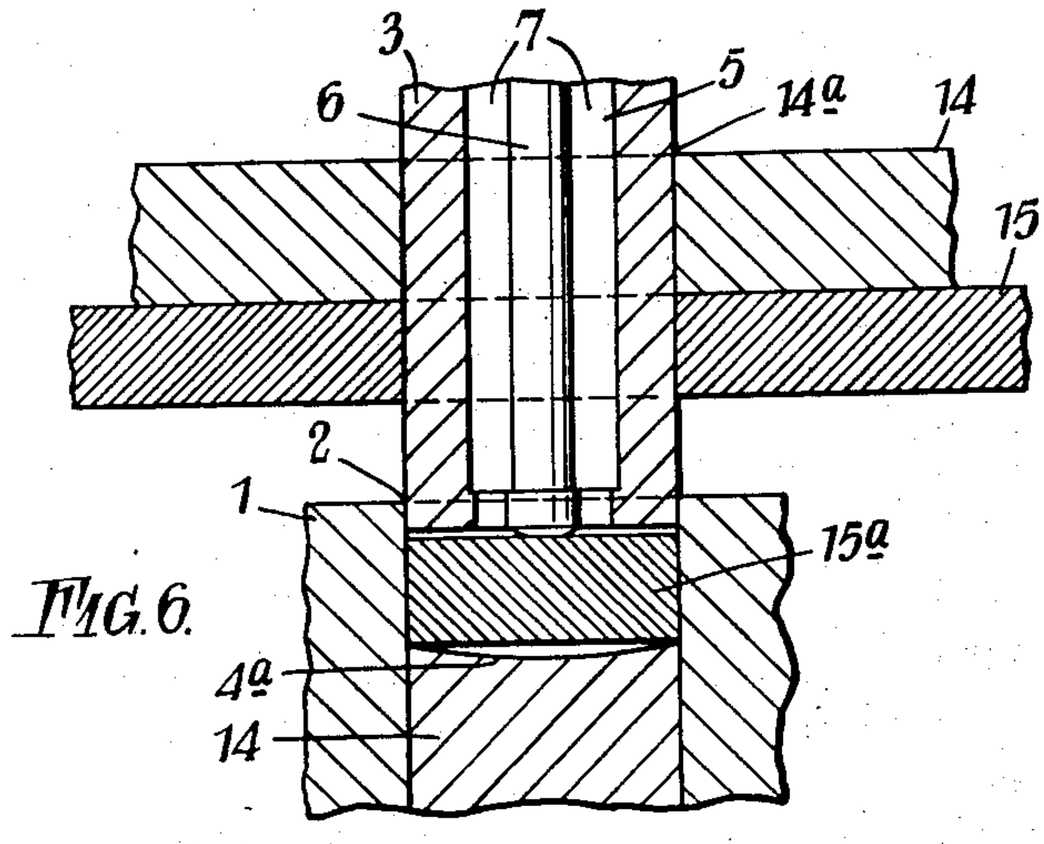


FIG. 6.

FIG. 7.

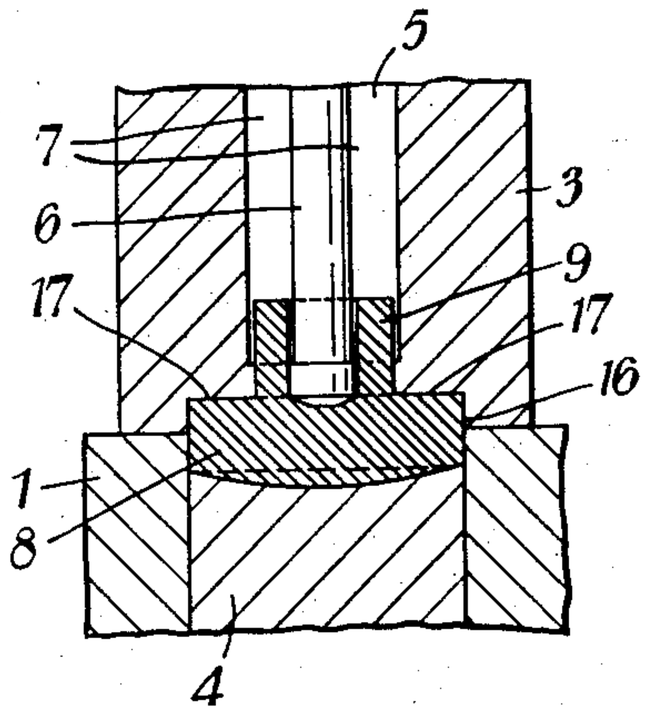


FIG. 8.

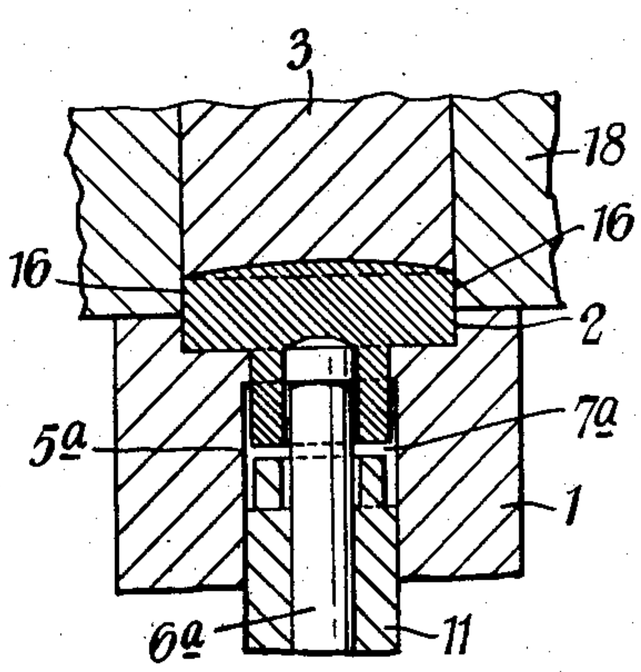
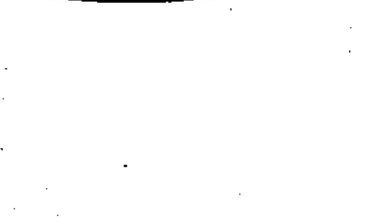


FIG. 9.



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MANUFACTURE OF ELECTRICAL CONTACTS

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2 Claims. (Cl. 207—10)

This invention relates to electrical contacts and to the manufacture thereof: more particularly the invention concerns electrical contacts of the kind generally designated in the art as a rivet-type contact; that is to say, contacts composed of a head portion forming a contact face and an integral shank or projection for attachment to a supporting member.

Rivet-type electrical contacts have hitherto usually been fabricated by heading wire by a cold-forging operation, by cutting a length from a solid rod of contact metal, such as silver, and machining a solid head portion on one end of the rod or by stamping out a circular disc or blank from a metallic strip and then either machining the blank to form a shank or subjecting the disc or blank to a single pressing operation to extrude the shank and finish the contact.

It has also been proposed to make rivet-type electrical contacts by a two-stage method involving applying pressure to a contact blank so as to cause material thereof to flow inwardly and upwardly from both the central and peripheral regions of the blank to form an embryo shank or projection and then applying further pressure to the deformed blank to re-form the blank to final dimensions and to complete the contact.

In order to facilitate the attachment of the contacts to a supporting member, particularly in cases where the shank is intended to be supported in an aperture formed in the support member, the tail end of the shank opposite to that carrying the head is sometimes split longitudinally over a portion of its length to form a bifurcated tail portion; or the tail end is hollowed out in any suitable manner such as by a punching operation.

Whilst rivet-type electrical contacts fabricated by any of the above procedures are satisfactory from the operational point of view, they all suffer from the disadvantage that in general the cost of manufacture is high owing to the necessity of employing a solid blank or rod of precious metal, such as silver, and the fact that, particularly in the case of contacts with bifurcated or partly hollowed shanks, at least two operations are required to form the finished contact.

Moreover, when the contact is fabricated by a single pressing or coining operation, difficulties are frequently experienced as a result of uneven distribution of the precious metal on the contact face due to the necessity of blanking a slug smaller in diameter than the finished part and then forcing the metal to move to the outer perimeter of a larger die cavity. Even when the contact is fabricated from a bimetallic blank consisting of a facing layer of precious metal, such as silver, and a backing layer of base metal, such as copper, the forming operation has a tendency to distort the contact face and even to cause formation of holes in the precious metal face.

The principal object of this invention is to overcome the above disadvantages and difficulties and to provide a simple and efficient method of fabricating rivet-type

electrical contacts which offers considerable advantages over the existing methods of manufacture.

Another object of the invention is to provide a method of making rivet-type electrical contacts of precious metal in which the amount of precious metal employed is reduced to a minimum.

A further object of the invention is to provide an improved method of manufacture of rivet-type electrical contacts by impact extrusion.

Another object of the invention is to enable rivet-type electrical contacts to be produced more cheaply and efficiently than hitherto from bi-metallic discs or blanks or from strip metal.

With these and other objects in view, therefore, the invention broadly comprises a method of making a rivet-type electrical contact which comprises the steps of applying pressure to a contact disc or blank in such manner as to extrude part of the material thereof to form a hollow tubular shank or projection and simultaneously or subsequently forming the remainder of the disc or blank to the required contour to form the head of the contact.

The features of the invention will be more readily understood by reference to the accompanying diagrammatic drawings, which are given solely by way of example and not in any way in the limitative sense, the scope of the invention being defined in, and by, the appended claims.

In the drawings, Figure 1 is an elevational view showing the general arrangement and manner of operation of an extrusion tool for use in the manufacture of rivet-type electrical contacts and to which the improvements in accordance with this invention may be applied for the purpose of carrying out the method of the invention for the production of novel hollow shank rivet-type contacts in accordance therewith.

Figures 2–8 are broken sectional views, drawn to a larger scale than Figure 1, of the punch and die elements only of the extrusion tool shown in Figure 1 illustrating various forms which these elements may take in accordance with, and for the purpose of carrying out, the method of the invention.

More specifically, Figure 2 is a broken sectional elevation showing a preferred embodiment of the invention and suitable for carrying out the method of the invention, showing the position of the parts at the commencement of the extrusion operation,

Figure 3 is a similar view to Figure 2, but showing the position of the parts at the end of the extrusion operation and the shank extruded from the contact disc,

Figure 4 is a similar view to Figure 2, but showing a modification,

Figure 5 is a similar view to Figure 2, but showing a further modification,

Figure 6 is a sectional view illustrating the use of the embodiment of Figure 1 to form contacts from strip material.

Figures 7 and 8 illustrate further detail modifications.

Figure 9 shows a contact formed with the extrusion tool of Figures 2 and 3 and

Figures 10*a* and 10*b* illustrate alternative shapes of the operative face of the ejector member for use in the extrusion tool of Figures 2 and 3.

Referring now to the drawings, and first to Figure 1, the extrusion tool shown generally in this figure, consists of a die element **1** mounted on a base member **19** upwardly from which extend a pair of arms **20** on each of which is slidable an open ended tubular sleeve **21** mounted in, and projecting downwardly from, apertures **22** formed in an upper frame member **23**, extending parallel to the base member **19**.

The member **23** is coupled through the medium of a

spigot **24** to a ram **24***a* or similar operating device so as to be displaceable towards and away from the die element **1** and is normally held by the ram spaced away from the die element **1**, as shown in Figure 1.

On the underside of the frame member **23** is mounted a punch element **3**, supported in a holder **25** bolted to the member **23** with the interposition of a pressure ation of the ram, the punch **3** exerts pressure on a contact blank located in the aperture in the die element **1** and extrudes a part of the material thereof into an annular orifice formed either in the punch **3** or in the die element **1** as will be hereinafter fully explained with reference to Figures 2–8.

4 indicates an ejector member operable within the die element **1** to eject an extruded contact from the die aperture at the end of an extrusion operation.

Referring now to Figures 2 and 3 there is shown the die element **1** having an opening **2** therein, the punch **3** adapted to form a close fit within the die opening **2**, and the ejector member **4** located and movable in the opening **2**.

The punch **3** is formed with a central circular bore **5** in which is centrally located a mandrel or pin **6** of smaller diameter than the diameter of the bore **5**, so as to form an annular orifice **7** in the said punch **3**. Figure 2 is a disc or blank of contact material located in the die opening **2** on top of the ejector member **4**. The operative surface of the ejector member **4** is made concave as shown at **4***a*.

The disc or blank may be formed of solid metal, such, for example, as copper, silver, gold, palladium or platinum by cutting from metallic strip or wire, of bimetal, consisting, for example, of a facing layer of silver, gold or other precious metal and a backing layer of base metal, such, for example, as copper, by cutting from a bi-metallic strip or of tri-metal, such, for example, as silver:copper:silver tri-metal.

Or, if desired, the disc or blank may consist of a metallic, bi-metallic or tri-metallic pressed and sintered powder compact.

To make a rivet-type contact according to the invention with the use of the above described extrusion tool, a contact blank **8**, which has been previously cut from strip metal or is in the form of a pressed and sintered powder compact, is placed in position in the die **1** as shown in Figure 2 and pressure is applied thereto by means of the punch **3**. Owing to the presence of the annular orifice **7** in the punch **3**, material of the blank **8** is caused to flow upwardly into the orifice **7** to form a hollow tubular projection **9** of circular cross-section, as clearly shown in Figure 3, which illustrates the position of the parts at the end of the extrusion operation. At the same time the lower face of the blank **8** is forced into the concavity **4***a* of the ejector member **4** and assumes a convex configuration as shown at **8***a* in Figure 3. The fabrication of the contact has thus been effected in one operation. The punch **3** is now withdrawn and the ejector member **4** moved upwardly in the die opening **2** to eject the finished contact **10**, which has the form shown in Figure 9.

If desired, the tail end of the shank of the extruded contact may be cut longitudinally over a portion of its length to provide bifurcations, which may be bent outwardly for soldering to a support member and also to provide terminal portions for the soldering thereto of lead wires.

The operative face of the ejector member **4** need not have the concave formation as shown at **4***a* in Figures 2 and 3, but may be flat as shown at **4***b* in Figure 10*a*, dish-shaped as shown at **4***c* in Figure 10*b* or may be convex.

In the modified construction shown in Figure 4, the annular orifice is formed in the die element **1** instead of in the punch **3**. As shown in this figure, the die **1** is formed with a die opening **2** in which is located the contact disc or blank **8** and into which the punch **3** enters.

Beneath the opening **2**, the die body **1** is formed with a

central bore **5***a* of smaller diameter than the opening and in which is located centrally a mandrel or pin **6***a* of smaller diameter than the diameter of the bore **5***a* to form an annular orifice **7***a*. The lower face of the die opening **2** thus forms an annular shoulder **2***a* on which the disc or blank **8** rests. **11** represents the ejector member which takes the form of a sleeve surrounding and movable along the mandrel or pin **6***a*. As with this arrangement the head of the contact is formed at the punch-engaging side of the blank **8**, the operative face of the punch **3** is shaped to conform to the required contour of the finished contact head and in Figure 4 is shown as having a concave face **3***a*.

In the use of this tool to form a rivet-type contact according to the invention, a preformed contact disc or blank **8** is placed in position as shown in Figure 4 and pressure is applied by the punch **3**. The upper face of the blank **8** is thereby given a convex configuration and, at the same time, material of the lower portion of the blank **8** is forced downwardly into the annular orifice **7***a* of the die body **1** to form a hollow tubular shank or projection. The punch is then withdrawn and the finished contact ejected from the die **1** by means of the sleeve-like ejector member **11**. The contact so formed will be similar to that produced by the extrusion tool of Figures 2 and 3 and as shown at **10** in Figure 9.

The modified construction shown in Figure 5 is similar to that shown in Figure 2, except that in this case the punch **3** does not enter the die opening **2** of the die element **1**, but is of larger diameter than the diameter of the opening **2**, and acts on the upper face of the die **1**, as shown at **12**.

To enable the punch **3** to act on the blank **8** and cause metal thereof to be extruded into the annular orifice **7** of the punch **3**, to form the tubular shank or projection, the die **1** is formed as a sleeve slidable over the ejector member **4** and surrounded by a stationary bearing ring **13**, which acts as a guide. The die **1** is normally spring-urged upwardly.

In the use of this modified construction of tool, the pressure of the punch **3** depresses the die **1** against the action of its spring and acts on the contact blank **8** to extrude metal thereof in a similar manner to that described in connection with Figures 2 and 3.

Figure 6 shows the manner in which the extrusion tool of Figures 2 and 3 may be employed for forming in one operation rivet-type contacts according to the invention, using continuous strip metal or bi-metal as the starting material.

With this method of procedure, instead of a contact disc or blank being preformed and placed in the opening **2** of the die **1**, as previously described, the punch **3** is caused, during its operative movement, to pass through an opening **14***a* in a stripper plate **14** located above, and in spaced relation to, the die **1** and beneath which is continuously fed transversely of the opening **14***a* a length of metal strip **15**. The punch **3** during its downward operative movement blanks out from this strip as it passes beneath punch **3** a disc **15***a*, which drops into position in the die opening **2** and is subsequently acted upon by the punch **3**, in the manner previously described, during further downward movement of the said punch **3**.

Figure 7 shows a construction similar to that of Figure 5, except that the meeting faces of the die **1** and punch **3** do not lie in the same plane as the upper surface of the contact blank **8**, but the latter projects above the upper surface of the die body **1** as shown at **16** and the operative face of the punch **3** is formed with an annular right-angled groove **17** adapted to surround and to receive therein said projecting portion **16** of the blank **8**. The height of the projecting portion **16** and the dimensions of the groove **17** are predetermined by the size of the contact to be extruded.

The modified construction shown in Figure 8 is similar to that shown in Figure 4 and the same reference num-

erals are used to indicate like parts in the two figures. The arrangement differs, however, from the Figure 3 arrangement in that the contact blank **8**, when located in the die opening **2**, projects above the upper face of the die body **1** and the projecting portion **16** of the blank **8** is embraced by an annular sleeve **18** which forms a guide in which the punch **3** operates, the sleeve **18** resting on the upper face of the die.

Although in the above description the extruded hollow shank has been described as being of circular cross-section, it is to be understood that it may have any other suitable cross-section, such as square or rectangular.

Moreover, if desired, the finishing of the contact head need not be effected during the extruding operation by conforming the head of the punch or the ejector member to the required final configuration of the contact head, but the final configuration may be obtained by a subsequent machining or finishing operation applied to the contact.

It is to be noted that, when a bi-metal blank or disc comprising a precious metal facing layer and a base metal backing layer is used, it is an advantageous feature of the invention that only material of the base metal backing is extruded to form the tubular shank, the precious metal contact facing layer remaining unaffected.

As will be readily appreciated, by means of the invention, we have provided a method of fabricating rivet-type electrical contacts, which is not only simple and efficient, but which, owing to the saving of material by making the shank hollow, reduces the initial cost of production. This is particularly important when the contact is made solely of precious metal. Moreover, the method of manufacture ensures that no distortion takes place at the contact face liable detrimentally to affect the functioning of the contact.

What we claim is:

1. A method of making a rivet-type electrical contact which comprises the steps of inserting into a die element a disc-like contact blank of a diameter substantially equal to that required of the head of the contact, and applying impact pressure to one face of said blank by means of a punch element having therein a central longitudinal bore and a pin locked in said bore of smaller diameter than the diameter of the bore whereby an annular space is formed in said punch between said pin and the wall of said bore, to cause part only of the metal of said blank to flow and enter said annular space in said punch to form a hollow tubular shank integral with and extending from the unextruded portion of said blank, said unextruded blank portion remaining unaffected to form the head of the contact.

2. A method of making a rivet-type electrical contact which comprises the steps of inserting into a die element a disk-shaped bi-metal contact blank composed of a base metal backing layer and a relatively thin precious metal facing layer, said blank having a diameter substantially equal to that of the head of the contact to be prdouced therefrom, and applying impact pressure to said base metal backing layer transverse to the surface thereof by means of a punch having therein a central longitudinal bore and a pin rigidly mounted concentrically in said bore, said pin having a smaller diameter than the diameter of the bore to define an annular space in said punch between said pin and the wall of said bore, the impact pressure causing metal of said base metal layer to be extruded into said annular space in said punch to form a hollow tubular shank integral with and extending from the unextruded portion of said blank.

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