

April 22, 1941.

F. W. MEBOLD

2,239,331

METHOD OF PRODUCING CONNECTOR PARTS

Filed Feb. 9, 1940

3 Sheets-Sheet 1

Fig. 1

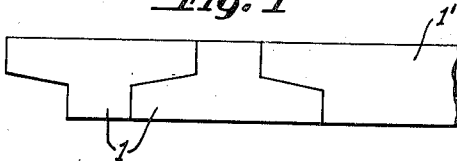


Fig. 2

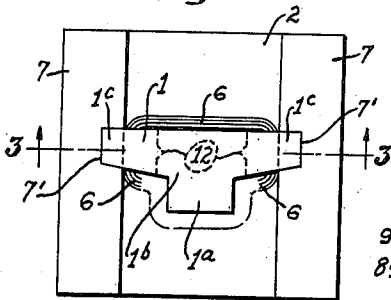


Fig. 3

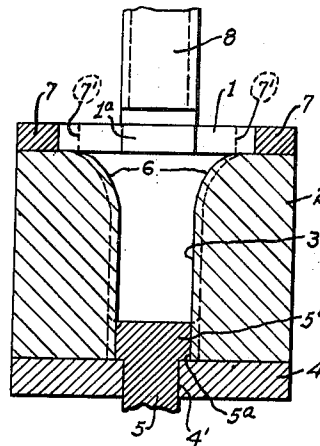
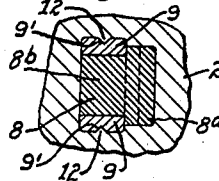


Fig. 7



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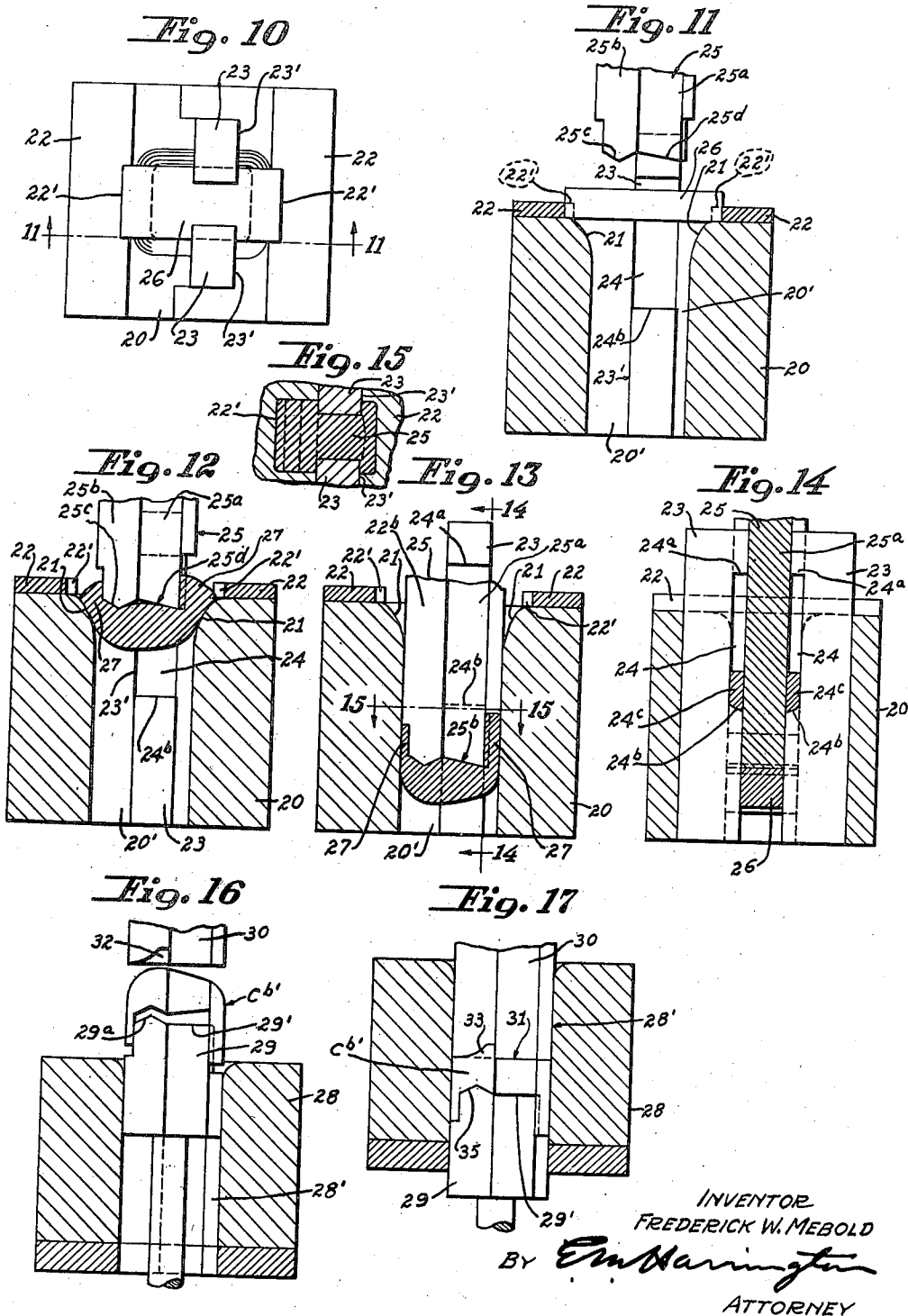
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Fig. 18

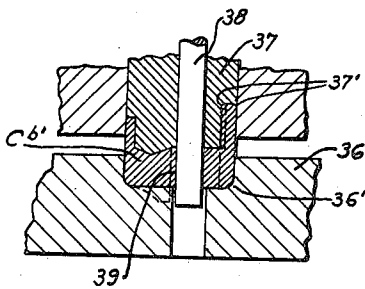


Fig. 19

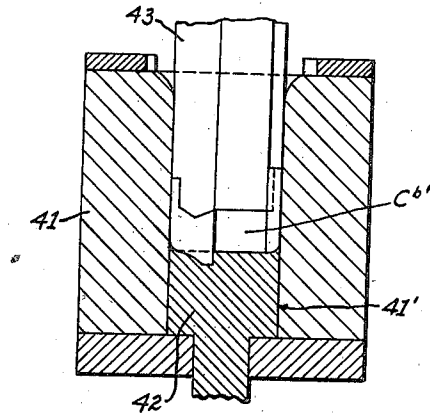


Fig. 20

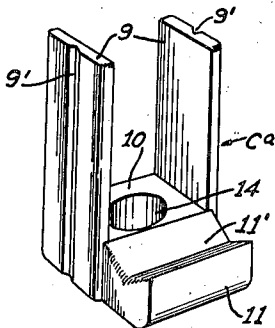


Fig. 21

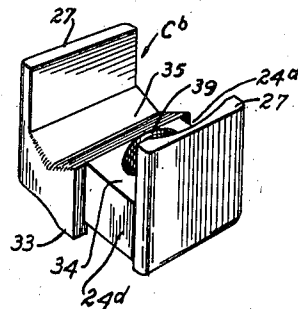
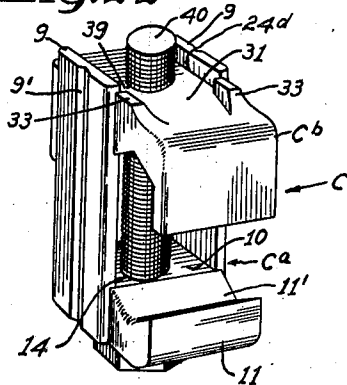


Fig. 22



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2,239,331

METHOD OF PRODUCING CONNECTOR PARTS

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Application February 9, 1940, Serial No. 318,090

9 Claims. (Cl. 29—155.5)

This invention relates to the manufacture of clamping members and more specifically to an improved method and means for producing connectors of the side opening type now employed to a considerable extent in the power transmission branch of the electrical industry for engaging electrical conductors, and for connecting electrical conductors together, the predominant object of the invention being to provide an improved method of producing parts of such side opening connectors through the use of which the cost of producing the connector parts is very greatly reduced. This object of the invention is accomplished by the provision of a unique manufacturing method in accordance with which relatively few machine operations are required to produce the finished connector parts and in the use of which there is practically no waste of the material from which the connector parts are formed.

Connectors of the type to which this invention relates must necessarily be made up of parts which are accurately made and which are provided with smooth, machine finishes, which heretofore could ordinarily be accomplished only by expensive casting and machining processes. In accordance with the present invention, however, the connector parts are produced from relatively soft, ductile metal, such as copper, or alloys having the required characteristics, each connector part being formed from a blank of material with the aid of punch and die means, and the operation of forming the part combining drawing, stoving, swaging, and extruding operations which results in the production of a connector part densified and hardened to the maximum without the use of heat treating or tempering operations. In the production of connector parts in accordance with the present invention the body of metal from which a connector part is being produced is worked in such manner that the grain structure of the metal is not disturbed, and as a result of this situation a perfect connector part, free from flaws or defects, is produced. Also because of the improved method of producing connector parts in accordance with this invention no machining of the parts is required after the parts have been produced.

Fig. 1 is a plan view of a strip of material and showing the manner in which blanks are struck therefrom which are employed in producing connector parts in accordance with this invention.

Fig. 2 is a plan view illustrating a die having

one of the blanks associated therewith prior to the commencement of the operation of forming a connector part from said blank.

Fig. 3 is a vertical section taken on line 3—3 of Fig. 2 with a punch included.

Fig. 4 is a vertical section resembling Fig. 3 but showing the improved method of producing a connector part when it has progressed beyond the initial stage illustrated in Fig. 3.

Fig. 5 is a vertical section resembling Fig. 4 but showing a later stage in the production of a connector part in accordance with the invention.

Fig. 6 is a vertical section taken on line 6—6 of Fig. 5.

Fig. 7 is a fragmentary horizontal section taken on line 7—7 of Fig. 6.

Fig. 8 is a fragmentary section illustrating the manner of providing a connector part being produced in accordance with the invention with an opening which constitutes a part thereof.

Fig. 9 is a plan view of a strip of material showing the manner of striking blanks therefrom which are employed in producing another part of a side opening connector.

Fig. 10 is a plan view illustrating a die employed in producing a connector part from one of the blanks illustrated in Fig. 9.

Fig. 11 is a vertical section taken on line 11—11 of Fig. 10 with a punch included.

Fig. 12 is a view similar to Fig. 11 but showing the improved method of producing a connector part when it has progressed beyond the initial stage illustrated in Fig. 11.

Fig. 13 is a view similar to Fig. 12 but illustrating a later stage of the production of a connector part in accordance with the invention.

Fig. 14 is a vertical section taken on line 14—14 of Fig. 13.

Fig. 15 is a fragmentary horizontal section on line 15—15 of Fig. 13.

Figs. 16 and 17 illustrate still later stages of the production of a connector part, the earlier stages of which are illustrated in Figs. 10, 11, 12, 13, 14, and 15.

Fig. 18 is a fragmentary section illustrating the manner of providing the connector part whose method of manufacture is illustrated in Figs. 9 to 17, inclusive, with an opening which constitutes a part thereof.

Fig. 19 illustrates a modified manner of producing the connector part to whose manufacture Figs. 9 to 17 relate.

Fig. 20 is a perspective of the connector part

whose method of production is illustrated in Figs. 1 to 8, inclusive.

Fig. 21 is a perspective of the connector part whose method of production is illustrated in Figs. 9 to 18, inclusive.

Fig. 22 is a perspective of an assembled side opening connector of the type to which this invention relates.

In the drawings, wherein are illustrated for the purpose of illustration, merely, various methods of producing connector parts in accordance with the invention, Figs. 1 to 8, inclusive illustrate the improved method of producing the connector part Ca shown in Fig. 20. In producing the connector part Ca blanks 1 are first struck from a strip of material 1' as shown in Fig. 1, said blanks being of such dimensions with respect to the strip of material 1' and of such shape that no material is wasted in their production.

In producing the connector part Ca a die 2 is employed which is provided with a cavity 3 formed therein, said cavity being of such shape that the connector part Ca may be produced therein. At its lower end the die 2 is provided with a plate 4 through which is formed an opening 4' that is aligned with the cavity 3 of the die. Operating through the opening 4' of the plate 4 is a shutter, or knock-out plunger 5, said shutter being provided with an enlarged head portion 5' that is located within the cavity 3 of the die 2 and having a shoulder 5z which contacts with the top face of the plate 4 to limit downward movement of the shutter with respect to the die. As shown in Figs. 3, 4, 5, and 6 the enlarged head portion 5' of the shutter provides the bottom of the cavity 3 of the die and the top face of said head portion is substantially flat. At the upper end of the die 2 the walls of the cavity 3 thereof are flared as shown in Figs. 2 to 6, inclusive, to provide substantially curved surfaces 6 which constitute very important features of the invention. Also at its top the die 2 is provided with opposed gage plates 7 which are notched as indicated at 7' in Fig. 2 to receive opposed end portions of a blank 1 which is associated with the die preparatory to the commencement of the operation of producing a connector part from said blank.

When one of the connector parts Ca is to be produced in accordance with this invention, one of the blanks 1 is supported by the top face of the die 2 at the flared upper end of the cavity 3 of said die, opposite end portions of said blank being received by the notches 7' of the gage plates 7 so as to maintain the blank in proper position with respect to the top, open end of the cavity of the die as shown in Figs. 2 and 3. With the blank arranged with respect to the die 2 as described, and as shown in Figs. 2 and 3, a punch 8 is moved against the blank 1 and into the cavity of the die carrying the metal of the blank into said cavity of the die. The punch 8 is elongated and is shaped in cross-section as shown in Fig. 7; that is to say said punch includes a portion 8a which is provided with a pointed lower end (see Fig. 6), and a narrower portion 8b whose opposite side faces are spaced from the corresponding side walls of the die cavity as shown in Fig. 7.

As the punch 8 moves against the blank 1 the pointed lower end of the punch portion 8a contacts with the portion 1a of the blank, while the lower portion of the punch portion 8b contacts

with the intermediate blank portion 1b which is located between the oppositely extended portions 1c of the blank. During initial movement of the punch into the cavity of the die the metal of the blank is worked by coacting faces of the die and punch to cause the portions 1c of the blank to assume the positions in which they are shown in Fig. 4, and as the punch continues its downward movement within the cavity of the die the metal of the portions 1c of the blank is forced to fill the spaces between the opposed side faces of the punch portion 8b and the corresponding side walls of the die cavity to provide the parallel elements 9 of the connector part Ca. Also the lower end face of the punch portion 8b in cooperation with the top face of the head portion of the shuttle 5 and the die cavity walls, forms the portion 10 of the connector part which bridges the lower ends of the parallel elements 9 of said connector part, while the lower, pointed end of the punch portion 8a cooperates with the top face of the head portion of the shuttle and with the die cavity walls to produce the portion 11 of the connector part Ca.

An extremely important feature of the invention resides in the fact that the operation of forming the connector part Ca combines drawing, extruding, and swaging, operations, and an operation which is known in the metal working art as "stoving," this term describing an action where metal is crowded into itself, or is subjected to a squeezing action or to compression. An important characteristic of the stoving action is that it maintains the grain structure of the metal in an undisturbed condition while the metal is being worked, as distinguished from drawing and other metal working operations which tend to break down the grain structure of the metal during working thereof. The stoving action referred to above is employed in producing the parallel elements 9 of the connector part Ca, and said action is produced by the manner in which the surfaces 6 of the die 2 and surfaces of the punch 8, which cooperate with said surfaces 6, act upon the portions of metal of which said parallel elements are being produced. In other words, when the parallel portions 9 are being formed the metal portions are subjected to a drawing action, but, at the same time said metal portions are subjected to a stoving action which crowds the metal portions being worked into themselves and thereby maintains the grain structure of said metal portions in an undisturbed condition, with the result that flaw-free parallel portions 9 of the maximum density and hardness are produced.

The extruding action, which forms a part of the operation of producing a connector part in accordance with this invention, results from the action of the punch 8 forcing the metal of which the connector part is being formed in all directions to fill the effective part-forming portion of the cavity 3 of the die, and the swaging action is produced by the formation of the V-shaped seat 11 in the top surface of the portion 11 of the connector part Ca by the pointed lower end of the punch portion 8a.

It is to be noted that opposed walls of the cavity 3 of the die 2 are provided with pointed projections 12, as shown to the best advantage in Figs. 2 and 7. These projections serve to provide the parallel elements 9 of the connector part Ca with depressions 9' which extend longitudinally thereof, as shown in Fig. 20, and which are substantially V-shaped in cross-section.

When the connector part Ca has been preliminarily formed in the die 2, as described above, said part is ejected from said die by upward movement of the shutter 5. The connector part is then introduced into a die 13, shown in Fig. 8, for the operation of punching a hole 14 (see Fig. 20) through the portion 19 of said connector part. The die 13 has a cavity 13' formed therein which receives a shutter 15, said shutter having an opening 15' formed longitudinally therethrough. Also the shutter 15 is provided with opposed cavities 16 shaped and dimensioned to receive the parallel elements 9 of the connector part Ca. When the connector part Ca is applied to the die 13 the parallel elements 9 thereof are introduced into the cavities 16 and the portion 19 of the connector part contacts with the top face of the shutter 15 as shown in Fig. 8. The die 13 includes a movable portion 17 through which an opening 17' is formed, and operating through this opening is a punch 18. The movable die portion 17 and the punch 18 are operated by suitable means (not shown) for moving said movable die portion and said punch relative to the stationary portion of the die and with respect to the shutter 15.

When the preliminary formed connector part Ca is to be provided with the hole 14, the movable die portion 17 and the punch 18 are withdrawn to a position in spaced relation with respect to the stationary die portion and the connector part is introduced in place as shown in Fig. 8. The operating mechanism associated with the die portion 17 and with the punch is then operated to move the movable die portion against the connector part Ca and to force the punch 18 through the portion 19 of said connector part to provide the hole 14. While the hole 14 is being formed as described certain sharp corners of the connector part Ca are being rounded off by the shutter 15 and the movable die portion 17, these corner rounding operations being performed in an obvious manner at the points indicated by the reference character 19 in Fig. 8.

The side opening connector, to the manufacture of which this invention relates, includes also a connector part Cb which is illustrated in perspective in Fig. 21, said connector part Cb being produced preliminarily with the aid of a die 20 illustrated in Figs. 10 to 14, inclusive. The die 20 is provided with a cavity 20' formed therein which is of the proper shape to form the connector part Cb and which is open at the top and bottom of the die, the walls of said cavity being flared at the top of the die to provide substantially curved faces 21. Mounted on the top surface of the die 20 is a pair of opposed gage plates 22 which are notched, as indicated at 22', to provide recesses adapted to receive opposed portions of a blank from which a connector part Cb is to be formed.

Associated with the die 20 is a pair of clippers 23 which are shaped as shown to the best advantage in Figs. 12, 13, and 14. In other words, each of said clippers comprises a bar which is rectangular in cross-section and said bars are supported in vertically extended recesses 23' formed in the die 20. The upper portion of each clipper and the lower portion thereof are wider than an intermediate portion located between said wider portions, as shown in Fig. 14, there being an opening 24 provided between the lower edge 24a of the upper, wider portion of each clipper and the top edge 24b of the lower, wider portion of said clipper. The top edges 24b of the lower wider portions of the clippers 23 (Fig. 14)

are cutting edges which serve a function to be hereinafter set forth.

Assembled with the die 20 is a punch 25 whose bottom portion is shaped so as to form the connector part Cb in the operation of the apparatus comprised of the die 20 and said punch 25. The punch 25 includes a portion 25a with opposite side faces of which the inner edges of the wider upper and lower portions of the clippers contact. The punch also includes a portion 25b which is provided with a pointed lower end 25c, and the lower edge of the portion 25a of said punch is disposed at a slight angle to the horizontal as shown at 25d in Fig. 12.

In producing a connector part Cb with the aid of the die, and punch assembly illustrated in Figs. 11 to 14, inclusive, a blank 26 is assembled with the die 20 as shown in Figs. 10 and 11; that is to say the blank rests on the top surface of the die with opposite end portions thereof disposed in the recesses 22' of the gage plates 22 and with the lower edges 24a of the upper, wider portions of the clippers overhanging the top face of the blanks. With the blank so positioned the punch 25 starts its downward movement against said blank and the metal of the blank is carried into the upper portion of the cavity 20' of the die as shown in Fig. 12. During movement of the material of the blank into the upper portion of the cavity of the die, the curved faces 21 of the die, together with faces of the punch which cooperate with said curved faces of the die, subject the portions of the metal of the die which forms the portions 27 of the connector part Cb to combined drawing and stoving actions. As a result of this situation the metal is crowded into itself while the portions 27 are being formed and as a consequence the grain structure of the metal is undisturbed while said portions 27 of the connector part Cb are being formed. The downward movement of the punch through the cavity of the die is continued, and as the body of metal from which the connector part is being produced moves past the cutting edges 24b of the clippers 23, portions 24c are sheared from said body of metal to provide the connector part with the recesses 24d which are located at opposite sides of the finished connector part Cb. After the shearing operation has been completed movement of the punch is continued until the preliminarily shaped connector part is discharged from the die cavity at the lower end thereof, the slugs of material 24c dropping from the die when the punch is moved upwardly after discharge of the connector part from the die, or being ejected by a succeeding blank.

When the preliminarily formed connector part is discharged from the cavity of the die 20 it appears as shown in Fig. 16, wherein said connector part is designated by the reference character Cb'. The preliminarily formed connector part is then subjected to an additional operation with the aid of the punch and die assembly shown in Figs. 16 and 17. The punch and die assembly shown in Figs. 16 and 17 comprises a die 28 having a cavity 28' formed therein in which is disposed for operation a shutter 29, said shutter being shaped at its top to conform generally to the shape of a portion of the preliminarily formed connector part Cb'. Also the punch and die assembly illustrated in Figs. 16 and 17 includes a punch 30 whose lower portion is shaped to complete the shaping of the connector part; in other words the bottom face of the punch 30 is flat to produce the flat face 31 of the connector part

Cb except for a pair of cavities 32 which form the lugs 33 on said connector part Cb.

When formation of the connector part Cb' is to be completed with the aid of the punch and die assembly illustrated in Figs. 16 and 17, the preliminarily formed connector part is arranged on the shutter 29 as shown in Fig. 16. The part-forming end portions of the shutter 29 and the punch 39, with the partially formed connector part disposed therebetween, are then moved into the cavity of the die 23 where pressure is applied to the partially formed connector part by the shutter and punch to give to the connector part its final form. It is to be noted that the angular face of the connector part Cb' which is formed by the lower end 25d of the punch portion 25a, shown in Figs. 12 and 13, is made horizontal in the final operation of forming the connector part Cb by the face 29' of the shutter 29 shown in Figs. 16 and 17, to provide the face 34 of the connector part Cb. This angular face is formed in the early stages of producing the connector part Cb only to assure, during the final state of producing the connector part, the presence in the proper position of sufficient metal to form the lugs 33 of said connector part Cb. Also, the pointed portion 29a of the shutter 29, shown in Figs. 16 and 17, obviously produces final shaping of the V-shaped seat 35 of the connector part Cb.

After the connector part Cb is removed from the punch and die assembly shown in Figs. 16 and 17 it is transferred to a perforating die assembly, such as that illustrated in Fig. 18, where the connector part is gripped between members 36 and 37 and certain corners thereof are rounded off as indicated at 36' and 37'. A punch 38 is then operated, by mechanism not shown, to form a hole 39 through a portion of the connector part, the wall of this hole, after removal of the connector part from the perforating die assembly, being provided with screwthreads as shown in Fig. 21.

The connector parts Ca and Cb are assembled as shown in Fig. 22 to produce the complete connector C, said complete connector including a headed bolt 40 which extends through the opening 14 of the connector part Ca and through the opening 29 of the connector part Cb in screw-threaded engagement with the screwthreaded wall thereof. Obviously rotation of the bolt 40 will adjust the connector part Cb relative to the connector part Ca, the parallel elements 9 of said connector part Ca guiding the connector part Cb during such movement. Thus the connector part Cb may be adjusted with respect to the connector part Ca so as to cause conductors, or other elongated elements to be clamped between the V-shaped seats 11' and 35 of the connector parts Ca and Cb respectively.

In Fig. 19 a modified method of producing the connector part Cb is illustrated which differs from the method shown in Figs. 10 to 17, inclusive, in that the method illustrated in Fig. 19 involves producing the connector part Cb in one continuous operation instead of in two separate operations as shown in Figs. 10 to 17, inclusive. In Fig. 19 a die 41 is employed which is provided with a die cavity 41' in which a shutter 42 is disposed and in which a punch 43 operates. In view of the explanation heretofore made regarding the formation of the connector part Cb, it is thought that the method of procedure in accordance with the method illustrated in Fig. 19 would be obvious to one skilled in the art to which the

invention relates, the punch and shutter of the assembly of Fig. 19 cooperating to produce the connector part during a single operation of the assembly.

The substantially curved surfaces 6 and 21, previously referred to herein, are preferably formed by a series of short, straight, angularly disposed face portions, which combine to produce what appears as curved surfaces. By so producing said curved surfaces minute angles are formed on the substantially curved surfaces which aid in the stoving operations.

I claim:

1. The herein described method of producing a connector part which includes spaced parallel portions and a bridge portion that connects said parallel portions, said method comprising forming said connector part with the aid of a punch and die assembly, said operation of forming said connector part including simultaneously performed drawing and stoving operations which form said parallel portions, and an extruding operation which forms said bridge portion.

2. The herein described method of producing a connector part which includes spaced parallel portions and a bridge portion that connects said parallel portions, said method comprising forming said connector part with the aid of a punch and die assembly, said operation of forming said connector part including simultaneously performed drawing and stoving operations which form said parallel portions, and extruding and swaging operations which form said bridge portion.

3. The herein described method of producing a connector part which includes spaced parallel portions and a bridge portion that connects said parallel portions, said method comprising forming said connector part with the aid of a punch and die assembly, said operation of forming said connector part including simultaneously performed drawing and stoving operations which form said parallel portion, and extruding and swaging operations which form said bridge portion, and a punching operation for providing said connector part with a hole.

4. The herein described method of producing a connector part which includes spaced parallel portions and a bridge portion that connects said parallel portions, said method comprising forming said connector part with the aid of a punch and die assembly, said operation of forming said connector part including simultaneously performed drawing and stoving operations which form said parallel portions, and extruding and swaging operations which form said bridge portion, and a separate punching operation for providing said connector part with a hole.

5. The herein described method of producing a part intended for use in a connector structure, comprising forming said part with the aid of a punch and die assembly, the operation of forming said part including simultaneously performed drawing, stoving, shearing, and extruding operations.

6. The herein described method of producing a part intended for use in a connector structure, comprising forming said part with the aid of a punch and die assembly, the operation of forming said part including simultaneously performed drawing, stoving, shearing, and extruding operations, and a swaging operation.

7. The herein described method of producing a connector part which includes spaced parallel portions and a bridge portion that connects said

parallel portions, said method comprising forming said connector part with the aid of a punch and die assembly, said operation of forming said connector part including simultaneously performed drawing and stoving operations which form said parallel portions, a shearing operation which removes from the body of metal being acted on portions thereof, and an extruding operation which forms said bridge portion.

8. The herein described method of producing a connector part which includes spaced parallel portions and a bridge portion that connects said parallel portions, said method comprising forming said connector part with the aid of a punch and die assembly, said operation of forming said connector part including simultaneously performed drawing and stoving operations which form said parallel portions, a shearing operation

which removes from the body of metal portions thereof, and extruding and swaging operations which form said bridge portion.

9. The herein described method of producing a connector part which includes spaced parallel portions and a bridge portion that connects said parallel portions, said method comprising forming said connector part with the aid of a punch and die assembly, said operation of forming said connector part including simultaneously performed drawing and stoving operations which form said parallel portions, a shearing operation which removes from the body of metal portions thereof, and extruding and swaging operations which form said bridge portion, and a separate punching operation for providing said connector part with a hole.

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