Nov. 14, 1939. F. W. MEBOLD 2,179,753

METHOD OF MAKING ELECTRICAL CONNECTORS

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Fig. 1

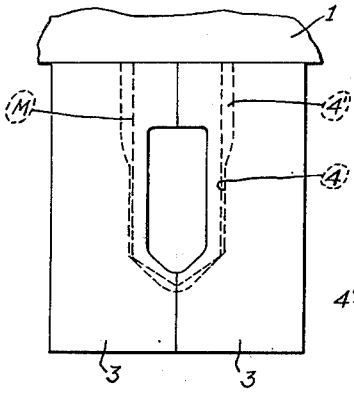

Fig. 2

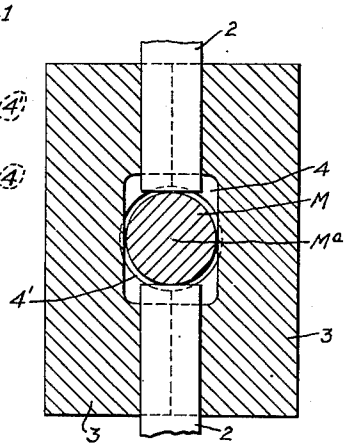

Fig. 3

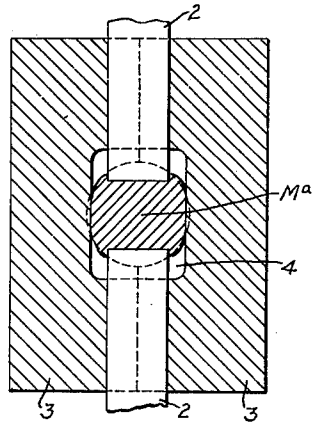

Fig. 4

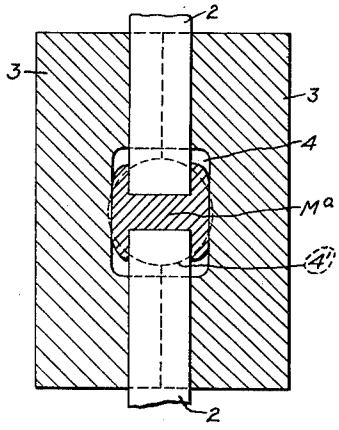

Fig. 5

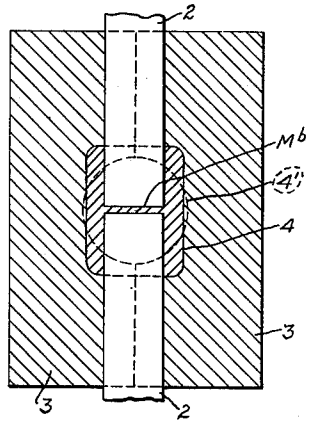

Fig. 6

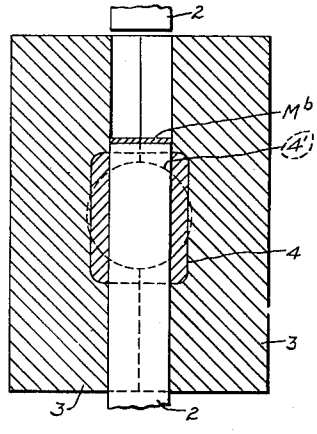

Fig. 7

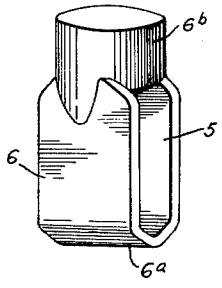

Fig. 8

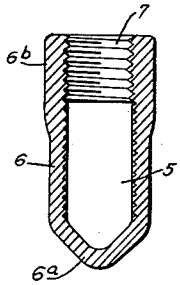

Fig. 9

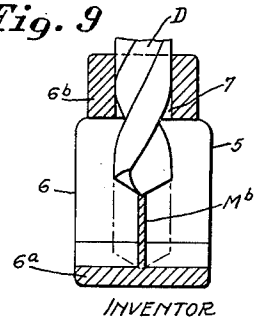

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Fig. 10

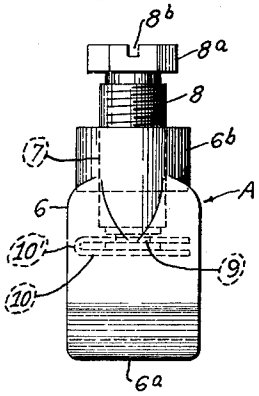


Fig. 11

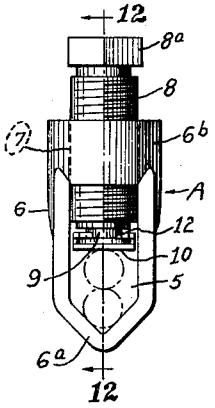


Fig. 12

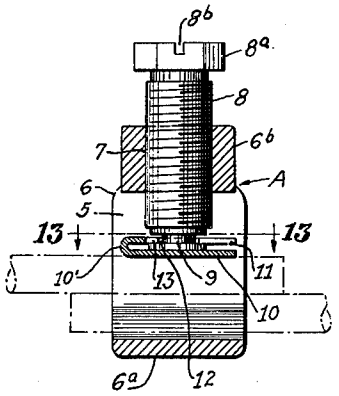


Fig. 13

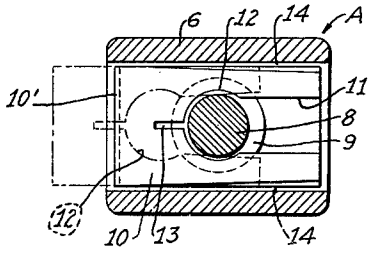


Fig. 14

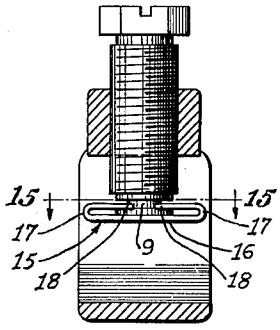
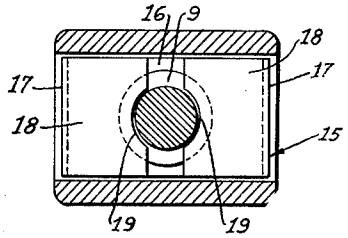


Fig. 15



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2,179,753

UNITED STATES PATENT OFFICE

2,179,753

METHOD OF MAKING ELECTRICAL CONNECTORS

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Application March 22, 1937, Serial No. 132,205

2 Claims. (Cl. 29—155.55)

This invention relates generally to clamping devices and the manufacture thereof and more specifically to improvements in connectors and their manufacture, such as are employed for mechanically and electrically connecting electrical conductors, the predominant objects of the invention being to provide an improved device of this type which is capable of performing its intended function in an improved and highly efficient manner, and to provide an improved method of manufacturing said device so that a durable and efficient device may be produced in an economical manner.

Fig. 1 is a plan view of a punch and die assembly employed in producing the improved device.

Figs. 2, 3, 4, 5, and 6 are sectional-elevations showing the punch and die assembly in five sequential, relative positions, each thereof illustrating a stage in the process of forming the device from a short rod section or billet of relatively soft, ductile metal.

Fig. 7 is a perspective of a partially completed part of the improved device.

Fig. 8 is a sectional view of a part of the device showing same as it appears when production of this particular part has been completed.

Fig. 9 is a sectional-elevation illustrating a modified manner of removing a certain unwanted web of material which is produced during the forming operations.

Fig. 10 is a side elevation of the completed connector.

Fig. 11 is an end elevation of the connector illustrated in Fig. 10.

Fig. 12 is a sectional-elevation taken on line 12—12 of Fig. 11.

Fig. 13 is a horizontal section taken on line 13—13 of Fig. 12.

Fig. 14 is a sectional-elevation of a modified form of the invention.

Fig. 15 is a horizontal section taken on line 15—15 of Fig. 14.

In producing the connectors of the type disclosed herein copper and brass are the metals generally used for this purpose, copper being best adapted for such use because of its relatively low cost and higher conducting properties. Prior to this invention connectors produced from brass were preferred by some manufacturers because of their greater hardness. However I prefer the use of copper in the manufacture of connectors by the process to be presently described because of its higher electrical conducting properties, and since by reason of its high ductility, this metal readily lends itself to the extruding operation which forms an important part in the present method. The extruding process as employed in connection with the present invention greatly increases the density of the metal and results in the production of an article having the maximum degree of hardness which copper is capable of having imparted to it.

Describing, now the method of making the body portion of the improved connector in detail, copper, or other suitable ductile metal, preferably in the form of a rod, is fed into a power press which includes cut-off means 1 (Fig. 1), punch parts 2, and die parts 3 (Figs. 1, 2, 3, 4, 5, and 6). The rod of metal is cut off to the proper length by the cut-off means 1 and as a result thereof a short rod section M of material is disposed in a cavity 4 produced by cavity portions formed in the opposed die parts 3. In this connection it is to be noted, as shown in Fig. 1, that the cut-off means 1 serves as a closure element of the cavity 4 at one end thereof, and by referring to Figs. 1 to 6 inclusive it will be noted that the cavity 4 is of the exact shape and dimensions of the body portion of the connector. The punch parts 2 are associated with the die parts 3 as shown clearly in Figs. 1 to 6 inclusive, and as shown in Figs. 2 to 6 inclusive said punch parts are arranged in opposed relation. The power press employed in producing the body portion of the improved connector includes means (not shown) for moving the inner adjacent ends of the associated punch parts 2 toward and from each other within the cavity of the associated die parts.

With the short section of material M disposed in the cavity 4 the punch parts are moved toward each other by mechanism of the power press that is not shown and which is intended to perform this function, and the material of which the body portion of the connector is being formed is extruded by the inwardly moving punch parts 2 to force the metal outwardly in all directions to completely fill the cavity in the die parts and force the metal into close contact with the walls of the cavity. By referring to Figs. 3, 4, and 5 it will be noted that in forcing the metal outwardly in all directions against the walls of the cavity the inwardly moving punch parts 2 force their way into the metal to provide an opening which in the completed body portion extends entirely through said body portion. This opening is shown clearly in Figs. 7 and 8 wherein it bears the reference character 5. The inner ends of the punch parts 2 move toward each other to gradually reduce the thickness of the portion Ma of the body of material in the cavity 4 as shown in

Figs. 2, 3, and 4, until as shown in Fig. 5 only a very thin web of material Mb remains. When this stage of the operation is reached the upper punch part 2 as illustrated in Fig. 6 is withdrawn and the associated punch part 2 is subjected to a quick inward movement against the web of material Mb with the result that said web of material is sheared loose from the opposed walls of the opening 5 as shown in Fig. 6.

Upon performance of the last-described step of removing the web of material Mb the die parts 3 are separated and the partially completed body portion of the connector is ejected. At this time the body portion appears as shown in Fig. 7; that is to say said body portion comprises a wire-embracing portion 6 through which the opening 5 extends, said wire-embracing portion having a tapered portion 6a at one end and having a solid boss portion 6b at its opposite end. Obviously the wire-embracing portion 6 of the body portion is formed in the portions of the cavity 4 of the die parts which are arranged at the sides and bottoms of the punch parts 2 as illustrated in Fig. 1, while the boss portion 6b is formed in the cavity portion 4' between the top faces of the punch parts and the cut-off means 1 as illustrated in said view.

After formation of the body portion of the connector has progressed to the stage illustrated in Fig. 7 the next step is to drill a hole 7 (Fig. 8) through the solid boss portion 6b and tap said hole so that it is provided with the proper screw-threads. The body portion of the connector is then completed and is ready to have the other parts of the connector assembled therewith to provide the complete connector.

Instead of removing the thin web of metal Mb from the opening 5 of the body portion of the connector as already described and as shown in Fig. 6 I may drill said web portion Mb out as shown in Fig. 9. This operation is performed at the same time the opening 7 is formed in the boss portion of the body portion of the connector, the operation of the drill D being continued after it has passed through the boss portion 6b and has formed the opening 7 until the web Mb has been entirely removed by said drill.

Referring now to Figs. 10, 11, 12, and 13 wherein is shown one form of the completed connector, A designates said completed connector generally. The connector A includes a body portion whose method of manufacture has already been described herein and screwthreadedly mounted in the screwtheaded opening 7 formed in the boss portion 6b of said body portion is a screwthreaded clamping element 8 having a noncircular head 8a adapted to receive a suitable tool for rotating the element. Preferably, though not necessarily, the noncircular head 8a of the screwthreaded element 8 is also provided with a kerf 8b which permits of a screwdriver being employed for rotating the screwthreaded element when desired.

The inner end portion of the screwthreaded element 8 is provided with an annular groove 9 which serves as means for attaching a seat 10 to said lower end portion of the screwthreaded element. The seat 10 comprises a strip of spring material which is bent double upon itself to provide substantially parallel leg portions as shown to the best advantage in Figs. 10 and 12, the upper leg of said strip of material being provided with a slot 11 which is open at one of its ends at an end of said upper leg and terminates at its opposite end in a slightly enlarged, substantially circular opening 12. Also extended from said circular opening in the opposite direction with respect to the slot 11 is a short, narrow slot 13 (Fig. 13). By referring to Fig. 13 it will be noted that the opposite side edges of the upper leg of the seat 10 are formed on slight tapers, said opposite side edges converging toward each other as they extend from the bridge end 10' of the seat to the opposite end of said upper leg. Because of this arrangement tapered spaces 14 are provided between the opposite edges of the upper leg of the seat 10 and the adjacent walls of the opening 5 of the body portion of the connector as shown clearly in Fig. 13.

In assembling the improved connector illustrated in Figs. 10, 11, 12, and 13, the screw-threaded element 8 is introduced into place in the screwthreaded opening 7 formed in the boss of the body portion of the connector. The seat is then applied to the lower end of the screw-threaded element by passing the end of the seat at which the slot 11 is open into the opening 5 of the body portion of the connector. The portions of the upper leg of the seat at the edges of the slot 11 are passed into the annular groove 9 formed in the inner end portion of the screw-threaded element and movement of these portions of said upper leg against the curved inner wall of said annular groove will cause the portions of the upper leg of the seat at opposite sides of the slot 11 to spread. The tapered spaces beyond the opposite edges of the upper leg of the seat permits the spreading referred to without interference from the adjacent walls of the opening 5 of the body portion of the connector, and the short slot 13 formed in the upper leg of the seat aids in providing said upper leg with the required resiliency to permit such spreading action. When the seat is moved inwardly into the opening 5 to its proper position in said opening the circular portion of the screwthreaded element at the base of the annular groove 9 will snap into the circular opening 12 formed in the upper leg of the seat at the inner end of the slot 11 whereupon the seat is securely attached to the screw-threaded element in a manner to permit said screwthreaded element to rotate with respect to the seat whereby said seat will move longitudinally of the opening 5 in the body portion of the connector as the screwthreaded element is screwed inwardly and outwardly relative to said opening 5.

In the use of the improved connector a pair of electrical conductors are arranged in the opening 5 of the body portion of the connector as suggested by dot and dash lines in Figs. 11 and 12. The screwthreaded element is then screwed inwardly of the body portion of the connector so as to clamp the conductors between the closed tapered portion 6a of the body portion of the connector and the seat 10 attached to said screw-threaded element whereby very secure mechanical attachment and efficient electrical connection of said conductors is obtained.

In the form of the invention illustrated in Figs. 14 and 15 a different form of seat is employed. This seat, which is designated generally by the reference character 15, comprises a strip of spring metal whose opposite end portions are doubled back upon the main body of the strip to provide a lower strip portion 16, opposite bridge portions 17 at opposite ends of the seat, and inwardly extended upper leg portions 18 which in use are substantially parallel with the lower strip portion 16. At the inner adjacent ends of

the upper leg portions 18 arcuate cut-out portions 19 are provided.

In applying this form of seat to the lower end of the screwthreaded element 8 the upper leg portions 18 are extended upwardly and inwardly at a slight angle, and through the instrumentality of a suitable tool applied to the bridge portions 17 of the seat said upper leg portions are pinched into place so that their innner portions enter the annular groove 9 of the screwthreaded element as shown in Fig. 15 with the curved faces of the arcuate cut-out portions 19 disposed in said annular groove adjacent to the curved face of the screwthreaded element located at the base of said annular groove.

By providing the screwthreaded elements forming parts of the structures shown in Figs. 10 to 13, inclusive and in Figs. 14 and 15 with seats, the inner ends of said screwthreaded elements are prevented from cutting into and marring conductors connected by the devices as was the case heretofore when no seats were employed. Also the seats serve as retainers for the screwthreaded elements which prevent said screwthreaded elements from being unintentionally entirely unscrewed from the devices.

I claim:

1. The method of forming a body portion of a connector from a body of ductile metal, which consists in arranging said body of metal in a cavity formed in die means, extruding said body of metal through the instrumentality of oppositely moving punch means so as to cause the metal to completely fill said cavity and produce oppositely extending opening portions in said body portion which are separated by a thin web of material and provide the body portion with a solid boss portion which is alined with said thin web of material, drilling an opening in said solid boss portion and as a part of the same drilling operation drilling out said thin web of material, and tapping the drilled opening in the boss portion.

2. The method of forming a body portion of a connector from a body of ductile metal, which consists in arranging said body of metal in a cavity formed in die means, extruding said body of metal through the instrumentality of moving punch means so as to cause the metal to completely fill said cavity and produce oppositely extending opening portions in said body portion which are separated by a thin web of material and provide the body portion with a solid boss portion which is alined with said thin web of material, drilling an opening in said solid boss portion and as a part of the same drilling operation drilling out said thin web of material, and tapping the drilled opening in the boss portion.

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