

April 5, 1966

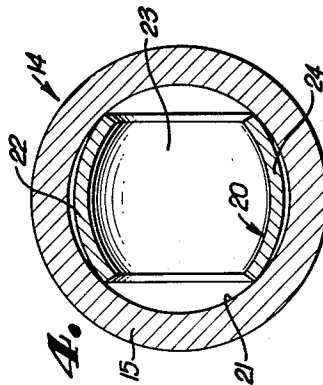
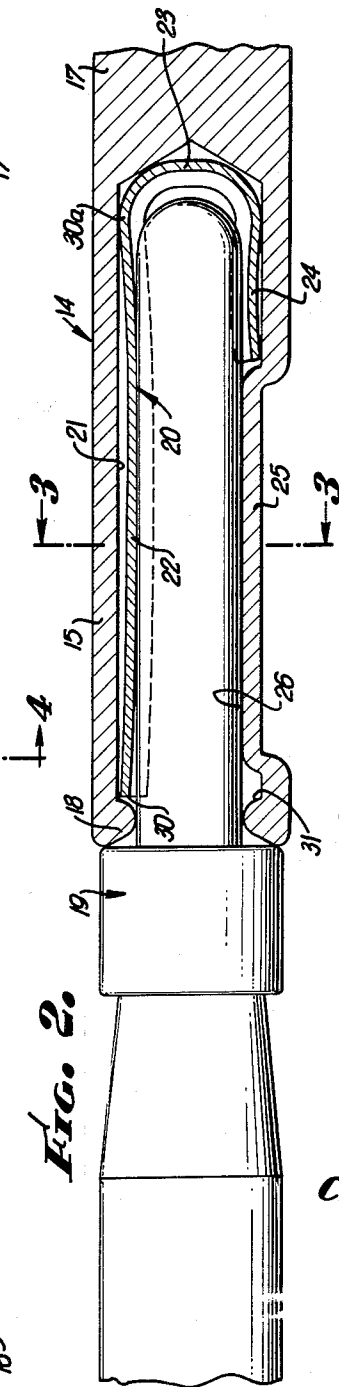
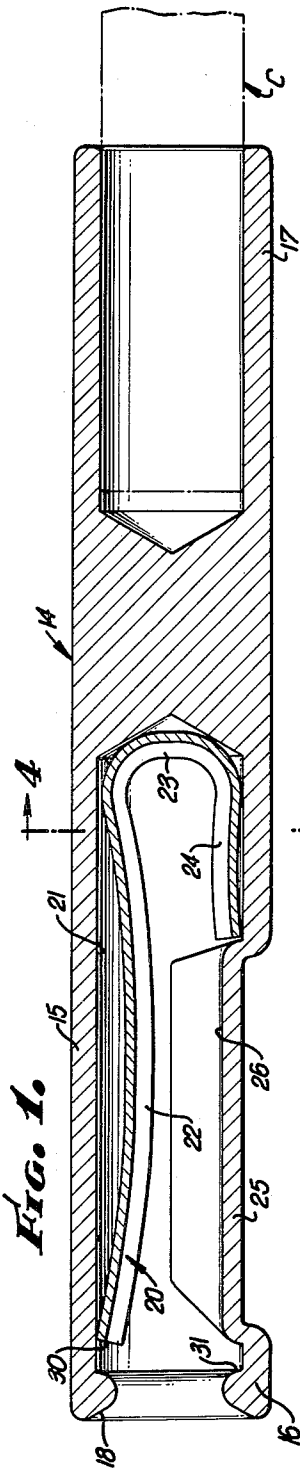
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3,243,868

METHOD FOR MAKING AN ELECTRICAL CONTACT SOCKET

Original Filed April 27, 1961

3 Sheets-Sheet 1



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FIG. 5.

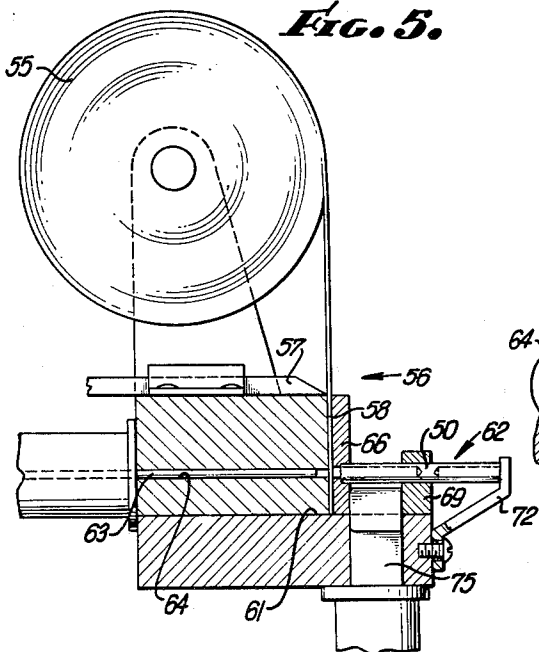


FIG. 6.

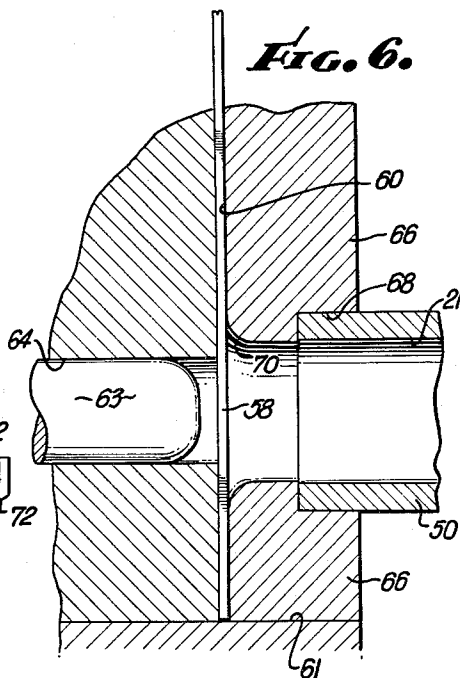


FIG. 8.

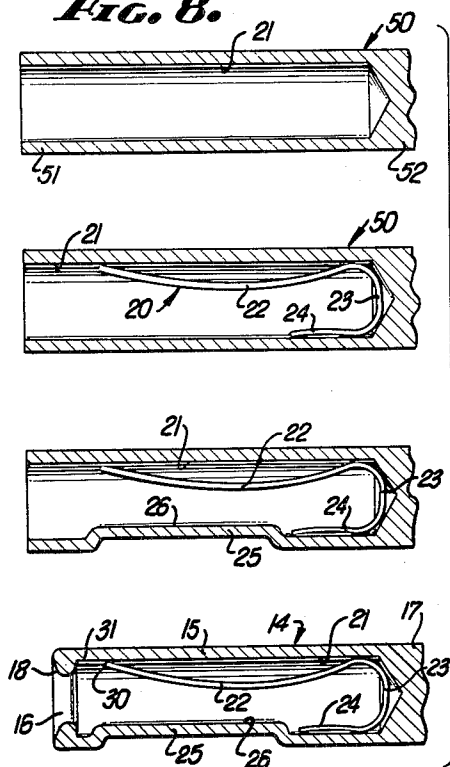
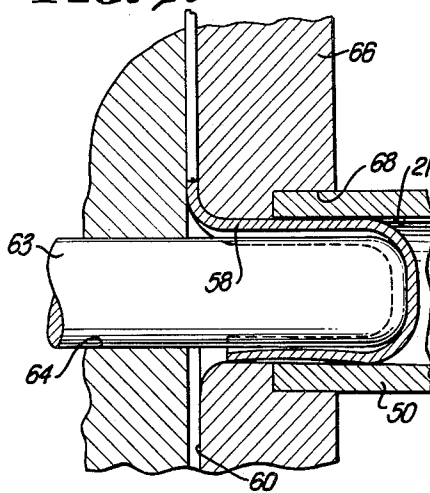


FIG. 7.



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FIG. 10.

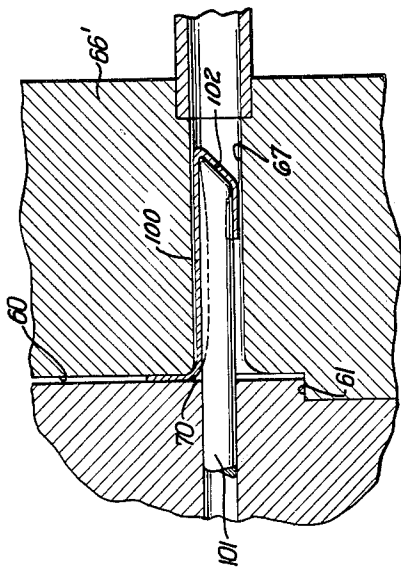


FIG. 9.

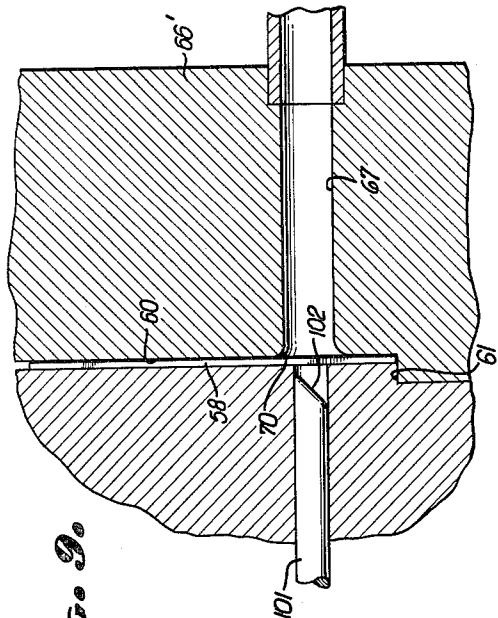
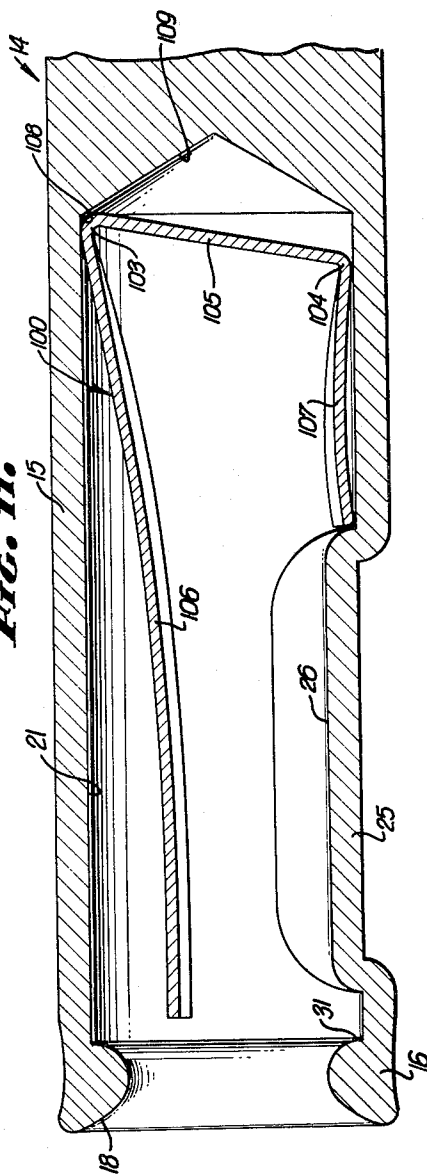


FIG. 11.



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3,243,868 METHOD FOR MAKING AN ELECTRICAL CONTACT SOCKET

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Original application Apr. 27, 1961, Ser. No. 106,044, now Patent No. 3,123,429, dated Mar. 3, 1964. Divided and this application July 25, 1962, Ser. No. 212,776
4 Claims. (Cl. 29—155.55)

The present application is a division of copending application Serial No. 106,044, filed April 27, 1961, issued as Patent No. 3,123,429 on March 3, 1964 for "Electrical Contact Socket, and Apparatus and Method for Making the Same."

This invention relates to the electrical connector art and in particular to an improved electrical contact socket for use with any standard or other suitable contact pin, as well as to one form of apparatus and one method for making the contact socket.

Elongated tubular or sleeve type socket contacts in general are well known, and there are various forms which function properly under congenial circumstances. Some of them depend for inherent spring action to assure a good frictional seating of the mating pin against constrictions in the body of the sleeve or pocket, or against the primary surface of the tubular member. In such cases the sleeve must possess the characteristics of a spring material, and some materials which offer suitable spring action are not the best conductors which might be selected. Furthermore, sockets or sleeves of this type are costly to manufacture.

There are other types known wherein the socket consists primarily of a solid tubular member provided with an auxiliary spring member, and in these types the spring member is usually of a rather complex shape specially formed and thereafter installed on the socket using special tooling. In these also, the primary function of the spring is a frictionally urge the mating pin into intimate electrical contact with a surface portion of the socket. Those sockets wherein the spring member is especially formed and subsequently installed may be satisfactory from an electrical standpoint, but they are expensive to produce, difficult to automate for production assembly, and they have the further disadvantage that they usually cannot be used on a crimp type socket which is forcibly inserted through a rubber insulator. The reason for the latter deficiency is that the rubber tends to tear the spring clip off the socket when the latter is being inserted.

A broad object of the present invention is to overcome the several disadvantages enumerated.

In more detail, an object of the present invention is to produce a contact socket which externally has the form of a tube without projecting appurtenances and wherein a spring is located entirely internally of the tubular portion, which spring provides the function of yieldably urging a mating pin into frictional and electrical contact with an internal wall surface of the tubular member.

A further object of the invention is to provide a contact socket of the type identified wherein the tubular primary electrical conductor portion of the socket contact can be made of the most suitable conductive material, either by drilling a rod or starting with a tubular form, and wherein the spring of a material having the desired characteristics is formed and inserted into the tube in one continuous operation. The latter offers marked advantages in the speed of manufacture, which can be accomplished on a compact automatic machine, with a consequent economy in the cost of manufacture.

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The foregoing and other objects and advantages of the invention will become more fully apparent from a consideration of the detailed description which follows taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a greatly magnified longitudinal section through a contact socket embodying the invention, utilizing a first form of spring.

FIG. 2 is a view similar to FIG. 1 illustrating a contact pin fully inserted into the socket.

FIG. 3 is a cross-section taken on the line 3—3 of FIG. 2.

FIG. 4 is a cross-section taken on the line 4—4 of FIG. 1.

FIGS. 5, 6 and 7 are vertical sectional views illustrating in simplified form the elements of an apparatus for forming the spring, inserting it in the socket and performing an indentation operation.

FIG. 8 is a series of a longitudinal cross-sectional views illustrating the sequential forms of the tube and spring assembly resulting from the steps of the method employed commencing with an empty tubular member and terminating with a finished contact socket.

FIGS. 9 and 10 are views generally similar to FIGS. 6 and 7 illustrating a second form of punch used for forming a second form of spring.

FIG. 11 is a longitudinal section of a socket with the second form of spring installed therein.

Referring now to FIG. 1, the finished contact socket 14 comprises an elongated tubular shell 15 comprising a pin receiving end 16 and a wire termination end 17. The termination technique may be anything suitable, as for example a cup as illustrated which can be employed either as a solder pot or for crimping, to effect connection with a conductor C shown in phantom. Initial formation of the tubular member 15 can be achieved by different optional methods or means, as for example either by drilling into a solid rod, or by employing a tubular shell having a cylindrical plane bore 21 (see FIG. 8).

The completed socket has a chamfered entrance ramp 18 formed by an internal bead for reception of a mating pin 19. The minimum diameter of the chamfered ramp 18 is less than the basic circular internal diameter of the tube 16 by a measurement which slightly exceeds the thickness of a spring to be described.

The spring, generally numbered 20, is of a ribbon leaf spring type and includes an elongated flatly bowed main portion 22 extending most of the length of the internal bore 21 of the tube 15, having a return bend 23 adjacent the inner end of the bore 21, and terminating with a relatively short, slightly bowed end section 24. As shown, both bows of the spring project convexly toward the axis of the tube.

The convex depth of the bowed portion 22 is sufficient to intrude into the cylindrical plane of the pin 19, so that when the pin is inserted into the socket this bowed portion of the spring will engage the contiguous surface of the pin and urge the pin diametrically toward the opposite internal surface of the tube 15.

The tube is preferably formed with an elongated indentation 25 in the nature of a crimp, which affords an extended surface 26 for contact with the pin. This surface 26 preferably is arcuate in cross-section, conforming in general to the cross-sectional circumferential contour of the pin (see FIG. 3).

A unique and important feature of the spring itself is its arcuate cross-sectional form of the sections 22 and 24 struck as generally illustrated in FIGS. 3 and 4. This form results from the means and method employed in fabricating and pushing the spring into position in the tube, and it offers the advantage of presenting a more

than tangential cross-sectional contact surface for engagement with the cylindrical surface of the pin as well as imparting a decided strength to the spring not found in a flat ribbon type spring of the same material and overall dimensions. The forward end 30 of the spring 20 terminates short of an internal annular abutment face 31 afforded by the rearward surface of the bead which provides chamfered entrance ramp 18, so that when the bow 22 of the spring 20 is flattened by insertion of the pin 19 there is an escape area for the spring to enter. This relationship of the forward end of the spring 30 and the annular abutment 31 also serves as a secondary obstacle to prevent withdrawal of the spring when the pin is withdrawn from the socket. The bend 23 and short section 24 of the spring provide the primary anchoring and locating means, the forward end of the section 24 being in relatively close proximity to the rear end of the indentation 25.

While this form of socket may be in practically any size, it has greatly significant value for application in the miniature and sub-miniature sizes such as size 20 and even smaller, size 20 being in the general magnitude of .040 inch pin diameter.

The general steps performed in fabricating the socket are illustrated in FIG. 8. Thus, in the first view we see a plain open ended tubular member 50 with a contact end 51 and a wire termination end 52. In the second view we observe that the spring 20 has been formed and pushed into position in the bore 21 of the tube. The third view illustrates formation of the indentation 25 which has been pressed into the wall of the tube to provide the pin contact section 26. The fourth and final view illustrates the result of a series of operations whereby the open pin end of the tube is spun or rolled in a bead to form the chamfered entrance ramp 18.

The method steps identified may be performed by hand, but for production purposes will be done by automatic machinery which is illustrated in elementary form in FIGS. 5, 6 and 7.

Thus, a roll of ribbon spring material such, for example, as stainless steel ribbon 55, is fed past a cutting station 56 where a reciprocating knife 57 severs the flat ribbon to free a length of steel ribbon 58 which is to form the spring.

This ribbon length 58 reposes in a guide slot 60 and rests against a stop 61 at a punching station generally designated 62. At this station a punch 63 adapted to advance and retract by any suitable power means and being guided in a punch guide 64 is advanced against the section of steel ribbon 58. The punching station 62 includes a spring forming die 66 having a cylindrical cavity 67 formed with a countersink 68 for reception of the forward end of tube 50. The tube is held in the axial position shown by any suitable means, as for example, a post 69, and against axial dislodgement by any suitable stop such as 72.

The punch is cylindrical in external form, and the clearance between the external diameter of the punch and the internal cylindrical diameter of the die cavity 67 is sufficiently close that as the punch 63 advances it draws the spring steel ribbon 58 over the slightly rounded corner surface 70 of the die entrance and also (except at the return bend 23) squeezes the ribbon from its initial flat condition into an arcuate cross-section. The center of the punch is substantially offset from the longitudinal center of the spring strip in order to provide the relatively long spring bow 22 and the relatively short end section 24. The diameter of the die cavity 67 is slightly less than that of the bore 21 in the tube, and they are axially aligned during formation of the spring.

The stroke of the punch is such that in one continuous forward movement the spring is formed by being drawn through the die 66 and is pushed into the open tube 50 until the bend 23 of the spring lodges against the in-

ner end of the bore 21. The metal of the spring strip is set with a bowed configuration by the drawing action, and although it is momentarily flattened while the punch is in the tube, upon withdrawal of the punch the spring will remain lodged in the tube 50, and the bow will assume its normal shape as generally illustrated in FIGS. 1 and 8. Thus the forward end 30 of the spring bow 22 and a rearward end portion 30a are in engagement with the wall of the tubular bore, and at least the end portions of the short bow 24 are seated against the tubular wall diametrically opposite the bow 22.

An indentation or crimping punch 75 is employed to form the indentation 25. This punch may be of standard or conventional type but should be utilized in a manner to assure orientation of the socket tube with respect to the crimping tool jaw so that the indentation 25 is made substantially diametrically opposite the long bow 22 of the spring.

At spinning and forming stations (not shown), the entrance ramp 18 is spun or formed at the mouth of the tube. This may be accomplished by known metal moving means and methods.

The second form of spring 100 and its relationship to the tubular shell are shown in FIGS. 9-11. This form is produced by a punch 101 reciprocating in a die 66' generally similar to the die 66. The punch 101 is formed with a bevelled forward end 102 shaped like a wedge. It imparts to the spring 100 relatively sharp angular bends 103 and 104 with a generally flat end leg 105. The bend 103 between the long bow 106 and the end leg 105 is preferably acute, and the bend 104 between the end leg and the short bow 107 is preferably obtuse.

The operations of forming this spring and inserting it in the tubular shell, and thereafter effecting modifications in the shape of the shell are the same as described for the first form of spring. The spring 100 may be used to particular advantage in the relatively larger sizes of contacts, such as 16 to 0.

The special configuration employed allows outside stresses, such as the mating pin contact, to be carried by all three segments of the spring member, namely the long bow 106, the end leg 105, and the short bow 107. The rear end bearing of the spring occurs where the bend 103 seats at the junction 108 of the bore 21 with its end wall 109, and also where the bend 104 seats against the wall of the bore diametrically opposite but slightly forward of the junction point 108.

While we have herein shown and described our invention in what we have conceived to be the most practical and preferred embodiments, it is recognized that departures may be made therefrom within the scope of our invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices, apparatus and methods.

What we claim as new and desire to secure by Letters Patent is:

1. The method of fabricating a contact socket member comprising the steps of: providing a tubular socket member with a bore open at the forward end and with a stop at the inner end, holding the open end of said tubular socket member in proximity to the discharge end of an open cylindrical die, positioning a strip of leaf spring material at the entrance end of the die, taking a punch having a diameter sufficiently close to the internal diameter of the die so that the annular space between punch and die is only slightly greater than the thickness of the leaf spring material, driving the punch against the leaf spring material in the direction of the die and thus forcing the leaf spring material through the die and re-forming it into a longitudinally elongated loop having at least one relatively long bow extending convexly toward the axis of the die and with a transversely arcuate cross-section and a relatively short end section diametrically opposing the long bowed section, and continuing advancement of

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the punch with its end engaging the looped end of the spring in process of formation until the spring has been advanced into and seated in the bore of the tubular socket member, then withdrawing the punch and leaving the spring in the tubular member.

2. The method of fabricating a contact socket member comprising the steps of: providing a tubular socket member with a bore open at the forward end and with a stop at the inner end, holding the open end of said tubular socket member in proximity to the discharge end of an open cylindrical die, positioning a flat strip of leaf spring material at the entrance end of the die with a relatively long section of the material extending beyond the axis of the die in one direction and a relatively short section of the material extending beyond the axis of the die in the opposite direction, driving a punch against the leaf spring material in the direction of the die and thus forcing the leaf spring material through the die and re-forming it into a longitudinally elongated loop having at least one relatively long bow extending convexly toward the axis of the die, and a relatively short end section diametrically opposing the long bowed section, continuing advancement of the punch with its end engaging the looped end of the spring in process of formation until the spring has been advanced into and seated in the bore of the tubular socket member, withdrawing the punch and leaving the spring in the tubular member, and then forming an internal bead at the open end of the tubular member with a chamfered forward face to provide an entrance ramp for a contact pin and with a stop shoulder internally of the tubular member for engagement by the forward end of the long bowed portion of the spring to aid in preventing withdrawal of the spring from the bore of the tube.

3. The method defined in claim 2 with the additional step, after the spring has been formed and seated in the bore of the tubular member and either before or after the step of forming the bead, of pressing an elongated indentation in the wall of the tube generally diametrically opposite the long bow of the spring.

4. The method of fabricating a contact socket member

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comprising the steps of: providing a tubular socket member with a bore open at the forward end and with a stop at the inner end, holding the open end of said tubular socket member in proximity to the discharge end of an open cylindrical die, positioning a flat strip of leaf spring material at the entrance end of the die with a relatively long section of the material extending beyond the axis of the die in one direction and a relatively short section of the material extending beyond the axis of the die in the opposite direction, driving a punch against the leaf spring material in the direction of the die and thus forcing the leaf spring material through the die and re-forming it into a longitudinally elongated loop having at least one relatively long bow extending convexly toward the axis of the die, and a relatively short end section diametrically opposing the long bowed section, continuing advancement of the punch with its end engaging the looped end of the spring in process of formation until the spring has been advanced into and seated in the bore of the tubular socket member, withdrawing the punch and leaving the spring in the tubular member, and then pressing an elongated indentation in the wall of the tube generally diametrically opposite the long bow of the spring.

References Cited by the Examiner

UNITED STATES PATENTS

964,202	7/1910	Bonnesen et al.	227—81
1,980,170	11/1934	Eaton	29—205 XR
1,991,467	2/1935	Sawin	29—203
2,751,872	6/1956	Hodes	113—46
2,761,406	9/1956	Schnell	113—46
2,861,324	11/1958	Klumpp	29—155.55
2,926,340	2/1960	Blain et al.	339—252 XR
2,974,400	3/1961	Sowa	29—155.55
2,978,800	4/1961	Blain	29—203

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