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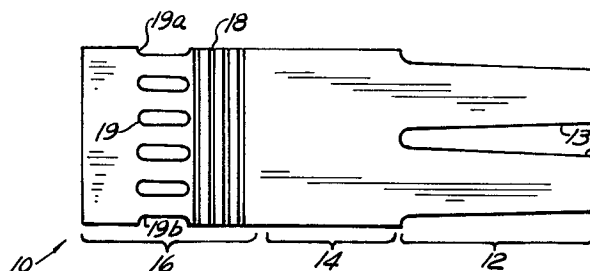
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⑤④ **Electrical contact with inner sleeve member and method of making the same.**

⑤⑦ An electrical contact (100) for use in terminating an electrical conductor, said contact including an inner elongated sleeve member (10) stamped from a flat sheet of conducting material and formed in a cylindrical shape, with its rear portion (16) including a plurality of slots (19) extending through the sleeve member and internal circumferential grooves (18). Each slot has an axis which extends parallel to the length of the sleeve. The grooves or grooved indentations (18) extend circumferentially around the inside periphery of the formed cylindrical contact sleeve. The grooved indentations are located in the rear conductor-receiving portion (16) of the sleeve, preferably forwardly of the slots.



ELECTRICAL CONTACT AND METHOD OF MAKING

TITLE MODIFIED
see front page

This invention relates to electrical connectors of the type having an outer shell or housing ; a plurality of electrical contacts, each of which are electrically a dielectric insert or insert assembly mounted to the housing for either fixedly or removably mounting the electrical contacts in the shell electrically isolated from other conductors. This invention is more particular-
5 ly related to an improved electrical contact assembly and a superior method of making the contact.

The present invention is related to and an improvement upon the invention disclosed in U.S. Patent 4,120,556, issued October 17, 1978 and
10 entitled "Electrical Contact Assembly". This patent is hereby specifically incorporated herein by reference and is herein sometimes referred to as the "Three-Piece Contact" patent.

The present invention is also related to U.S. Patent 4,072,394 to C. R. Waldron et al., for "Electrical Contact Assembly". This patent is also
15 specifically incorporated herein by reference, sometimes referred to as the "Alternate Three-Piece Contact" patent.

The present invention is also similar to US SN 158 655 filed June 11, 1980 in the names of D. L. Pfendler, H. K. Uhlig and E. J. Bright, also hereby specifically incorporated herein by reference.

A variety of electrical contacts have been suggested in the prior art. A variety of methods of making such contact also have been suggested in the prior art. Advantageously the contact will be inexpensive and simple to manufacture and assemble, having superior electrical properties, and have good mechanical characteristics (resistance to conductor "pull out" or unde-
20 sirable contact disassembly).
25

The three-Piece Contact patent describes an electrical contact (and method of making it) similar to the present invention. The electrical contact described therein, however, presents possible manufacturing and assembly difficulties which could lead to quality and reliability problems
30 in its electrical or mechanical properties. The contacts in that patent are

shown to have four slots. Typically, the sleeve (shown therein) is crimped in place by a conventional crimping mechanism having four radially spaced crimper members. When the crimping mechanisms and the sleeve slots are aligned the resulting attachment may be subject to mechanical and/or electrical failure. It is not feasible to insure a fixed orientation between slots and crimping mechanisms in today's manufacturing processes. Additionally, that patent shows a flat or slick precrimping internal sleeve, so the conductor is secured merely by the crimp of an otherwise flat sleeve.

In other embodiments, electrical contacts are machined from cylindrical metal stock. In these machined contacts, very close manufacturing tolerances (0.05 mm or less) are frequently desired to avoid oversized contact parts. An oversized contact may not be insertable into connector apertures designed to receive the contacts. Further, an insufficient clearance, caused by either an undersized or oversized part, could prevent proper electric or mechanical operation of the contact.

Machined contacts are also generally relatively expensive to manufacture when machine and operator costs are considered. Further, the weight of a machined contact is typically greater than the weight of a stamped and formed contact as described in present invention. While individual contact weight is generally small, an aircraft requires a very large number of contacts and every extra gram of aircraft equipment (e.g., in the contacts) displaces a gram of potential load, since the maximum weight for equipment and load is specified for the aircraft.

Machined contacts are also disadvantageous in that the machines producing them are time-consuming and difficult to set up and inherently produce a parts output which have a relatively wide dimensional range. This dimensional range requires a costly post-manufacture inspection, at which a significantly number of machined parts may be rejected or discarded as not meeting specifications. The reject problem significantly raises the costs of good parts.

Some prior art electrical contacts which are stamped and formed into a shape having a seam which is welded or brazed together. The added step of welding or brazing the seam adds an extra step to the manufacturing process and the step is difficult to accomplish accurately in view of the

small dimensions which are involved in contact manufacture.

Examples of such prior art contacts are shown in U.S. patents
2,689,337 ; 2,804,602 ; 3, 125,396 ; 3,137,925 ; 3,314,044. ; 3,316,528 ;
3,317,887 ; 3,648,224 ; 3,660,805 ; 3,721,943 ; 3,920,310 ; French patent
5 1,447,759 and German patent 60,347.

Such prior art contact designs accordingly present undesirable
limitations and disadvantages.

It is an object of the present invention to replace the expensive
machine contacts with a less expensive, yet high quality, stamped and formed
10 contact of the present invention.

It is also an object of the invention to provide an electrical
contact which, when stamped from sheet metal, formed into a cylindrical shape
and crimped to a conductor, makes a good mechanical attachment and good
electrical connection to the conductor.

15 It is still another object of this invention to provide an electrical
contact which can be fabricated rather easily in large quantities at low
cost with relatively low number of unacceptable parts.

It is still a further object of the present invention to provide
an inexpensive electrical contact which is of lower weight than machined
20 electrical contacts.

To this end, the invention proposes a method of making an electrical
contact having a forward contacts section and a rear conductor receiving
section characterized in that it comprises the steps of :

- stamping a piece from a flat sheet of metal in an elongated shape
25 with five slots extending lengthwise in the rear section and a plurality of
projections extending forwardly in the contact section ;
- providing groove-like indentations one side of the sheet in the
rear section forward of the lengthwise slots, said indentations extending
transverse to the slots ;
- 30 - forming said piece into cylindrical shape with the indentations
being internal, said piece having an axially-extending seam, a rear conductor
receiving section with axially-extending slots and internal radially-extending
groove-like indentations, and a forward contact section.

The invention also proposes an electrical contact stamped and for-
35 med from a sheet of metal, characterized in that it comprises a sleeve having
an open seam extending the entire length of said sleeve, parallel to the axis
thereof, between a forward contact section and a rear wire receiving section

having a plurality of amending slots in the wall thereof, with the longitudinal axis of each of said slots extending parallel to the longitudinal axis of said sleeve and being arranged symmetrically around the axis of the sleeve said sleeve also including a plurality of parallel grooved indentations formed
5 on the inside of the sleeve wall in the wire receiving section, each of said indentations extending around the sleeve at approximately a uniform distance from the sleeve end.

This invention is an electrical contact assembly and method of making it which overcomes the limitations of disadvantages of prior art electrical contacts. The present contact assembly includes an inner sleeve stamped to have a plurality of longitudinally slots in a conductor receiving rear
10 portion and advantageously includes a plurality of internal grooved indentations extending circumferentially around the conductor-receiving portion forwardly of the slots. The number of slots is chosen to be unequal to the number of radially-spaced crimping members in the crimping apparatus. The
15 number of slots and the number of crimping members is more advantageously chosen to avoid having a common factor or division. Accordingly, if four crimping members are used, five slots might be chosen, but six slots for example, would be less desirable as there would be a common factor or divisor
20 (of 2) with the number of crimping members.

The electrical contact of the present invention has the advantage that it is lower weight and higher quality than that of machined contacts of prior art.

The present invention also has the advantage that it has better
25 electrical and mechanical characteristics that the contact described in the Three-Piece Contact and Alternate Three-Piece Contact patents referred above.

The referred embodiment of the present invention is a three-piece electrical contact assembly including a sleeve that is stamped and formed from a piece of sheet metal and is characterized by a tubular inner sleeve
30 which has an unwelded seam and five longitudinal slots spaced symmetrically about the axis of the sleeve when the sleeve is formed into a tubular shape. A conductor is secured within the sleeve.

The foregoing and other objects, advantages and features of the present invention will become apparent to those skilled in the art, in view
35 of the following description and claims, taken in conjunction with the accompanying drawings wherein :

Figure 1 is a top view of a contact sleeve stamped as a flat piece, prior to forming into a three-dimensional cylindrical shape.

Figure 2 is a partial cross-sectional view of the contact sleeve of Figure 1, after it has been formed to its tubular or three-dimensional shape.

Figure 3 is a partial cross-sectional view of a second piece of the contact assembly of the present invention.

Figure 4 is a partial cross-sectional view of a third piece of the electrical contact assembly of the present invention.

Figure 5 shows a subassembly of the first and second pieces of the electrical contact assembly of the present invention.

Figure 6 is a partial cross-sectional view of the assembly of Figure 5, looking along the line VI-VI, looking in the direction of the arrows.

Figure 7 is a top view of the assembly portion of Figure 6, looking along the line VII-VII, looking in the direction of the arrows.

Figure 8 is a partial cross-section of the three-piece assembly.

Figure 9 is an alternate embodiment of the sleeve of Figure 1.

Figure 1 is a top view of a one-piece contact sleeve member 10 showing elements of the present invention. The sleeve member 10 is shown as it is initially formed, a flat piece of sheet metal or other electrically conducting material, stamped in substantially the shape shown.

The sleeve member 10 includes a forward contact section 12, a medial section 14, and a rear conductor-receiving section 16. The forward contact section 12 includes two (or, alternatively a plurality of) projections 13 which taper to narrower forward ends. The projections become spring fingers for receiving a male or pin-type electrical contact in both mechanical contact and an electrical circuit relationship after the sleeve member is formed into its three-dimensional cylindrical shape.

The medial section 14 spatially connects and electrically joins the forward contact section 12 and the rear conductor-receiving section 16. The rear conductor-receiving portion 16 includes a plurality of grooved depressions or indentations 18 extending transverse to the length of the sleeve member 10 and transverse to the axis of the cylindrically-shaped sleeve member 10 (when formed). These grooves 18 are formed on the inside side of the sleeve member 10 when it is formed into its three-dimensional cylindrical shape.

The rear section 16 also includes five (alternatively, plurality of) elongated slots 19 extending with their length generally aligned and parallel to the length of the sleeve member 10. When the sleeve member 10 is formed into its cylindrical shape, the five slots formed, as a first slot half 19a cooperates with a second slot half 19b to form a single slot. These slots and slot portions are separated by a uniform lateral spacing to provide a uniform angular (radial) separation of the slots when the contact sleeve portion is formed into its cylindrical shape.

Figure 2 shows the contact sleeve member 10 formed into a cylindrical shape by forming the sleeve 10. The sleeve member 10 is symmetrical about an axis which is parallel to the length of the sleeve portion and the slots. The forward contact section 12 has the spring fingers 13 converging to its forward end for receiving the pin-type contact therein. The grooved indentations 18 are shown in the cut-away portion extending circumferentially around the inside portion of the sleeve member 10 of Figure 2. The grooves 18 are preferably located forwardly on the slots 19, but within the rear contact receiving section 16.

A rear end portion 21 of the contact body is flared radially outwardly for more ease in inserting an electrical conductor therein. The slot halves 19a, 19b meet at a seam 22 to form a single slot, generally similar in shape to the other slots 19.

The contact sleeve portion 10 is crimped after a conductor is inserted into the rear end thereof to retain the conductor therein. Existing crimping apparatus are well known and generally have a plurality of radially spaced crimping elements, including four elements spaced 90 degrees apart in the preferred embodiment. Applicants' preferred contact structure is specifically disclosed to have a number of slots which is unequal to the number of crimping elements spaced radially about the axis of crimping for the apparatus. The present invention, therefore, provides arrangement in which the crimps of the sleeve made by the crimping apparatus will not coincide with and be super imposed upon a significant number slots. In this way, applicants insure that, regardless of the relative radial orientation between the crimping members of the crimping apparatus and the contact sleeve (which is random), a significant solid portion of the sleeve in the region of the slots will be crimped into the conductor to thereby retain the conductor within the contact sleeve. The contact sleeve is positioned within the crimping members

to insure that a portion of the crimping members extends into the region occupied by the grooved portions 18 to further retain the conductor within the sleeve member. By crimping the sleeve member 10 within the region of the groove portions 18, the conductor and groove portions 18 cooperate to additionally prevent external forces from pulling the conductor out of the sleeve member 10.

Figures 3 and 4 illustrate the second (liner) and third (hood) members 30, 40, respectively, of the three-piece contact of the present invention. These members 30, 40 are generally similar in structure and function to the members disclosed in the Three-Piece Contact Patent and Alternate Three-Piece Contact Patent. The structure of the members 30, 40 are not particularly relevant to the present invention, except that the present invention has preferred and alternate embodiments as described in the Three-Piece Contact Patent and Alternate Three-Piece Contact Patent, respectively. Reference should be made thereto for a fuller understanding of the present invention and its environment.

Figure 5 shows an initial assembly of the contact members 10, 30 in the present invention. Wall portions 11, 31 of the members 10, 30, respectively, are punched and bent inwardly to form an inspection aperture 50.

Figure 6 shows a cross-sectional view of the assembly of Figure 5. The sleeve 10 and the member 30 are shown, and have the inspection aperture 50 and indentations 52 shown. The aperture 50 allows a visual inspection of an inserted conductor to insure its proper preparation and positioning.

Figure 7 shows a top view of the member 30 in the vicinity of the inspection aperture 50 and better shows the preferred shape of the aperture 50.

Figure 8 shows a partial cross-sectional view of the entire assembly of a contact 100 showing the inner sleeve 10, the liner 30 and the hood 40.

Figure 9 shows an alternate structure for the sleeve portion. The alternate sleeve portion 10' has the same general configuration, to include the grooved portions 18. The slots 19', however, are uniformly spaced but do not include a single slot which is formed along the seam, by including half on one side, half on the other. The five slots are fully formed in the material even in its flat state.

While a preferred embodiment of the present invention has been disclosed with some particularity, it will be apparent to those skilled in the

art that changes may be made to the present preferred embodiment without departing from the spirit of the present invention. In some instances, certain features of the present invention may be used to advantage without the corresponding use of other features. For example, the number of slots is important
5 only to the extent that it is relative to the number of crimps applied there-
to to retain the conductor therein. To the extent that a different number of crimps is used to retain the conductor, it may be appropriate to chose a different number of slots. Additionally, the grooved portions need neither
10 be continuous nor extend completely circumferentially around the body. Accord-
ingly, it is intended that the illustrative and descriptive materials herein be used merely to illustrate the principles of the present invention and not to limit the scope thereof which is described solely by the appended claims.

CLAIMS

1 - A method of making an electrical contact having a forward contact section (12) and a rear conductor receiving section (12) characterized in that it comprises the steps of :

- stamping a piece (10) from a flat sheet of metal in an elongated shape with five slots (19) extending lengthwise in the rear section (16) and a plurality of projections (13) extending forwardly in the contact section (12) ;

- providing groove-like indentations (18) one side of the sheet in the rear section (16) forward of the lengthwise slots (19), said indentations (18) extending transverse to the slots (19) ;

- forming said piece (10) into cylindrical shape with the indentations (18) being internal, said piece having an axially-extending seam (22) a rear conductor receiving section (16) with axially-extending slots (19) and internal radially-extending groove-like indentations (18), and a forward contact section (12).

2 - An electrical contact stamped and formed from a sheet of metal, characterized in that it comprises a sleeve (10) having an open seam (22) extending the entire length a forward contact section (12) and a rear wire receiving section (16) having a plurality of axially-extending slots (19) in the wall thereof, with the longitudinal axis of each of said slots (19) extending parallel to the longitudinal axis of said sleeve (10) and being arranged symmetrically around the axis of the sleeve, said sleeve (10) also including a plurality of parallel grooved indentations (18) formed on the inside of the sleeve wall in the wire receiving section, each of said indentations (18) extending around the sleeve at approximately a uniform distance from the sleeve end.

3 - An electrical contact according to claim 2 characterized in that the parallel grooved indentations (18) extend around the sleeve (10) in a region apart from the region of the longitudinally-extending slots (19).

4 - An electrical contact according to claim 3 characterized in that the parallel grooved indentations (18) are located within the wire-receiving section (16) forwardly of the longitudinally-extending slots (19).

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FIG. 1

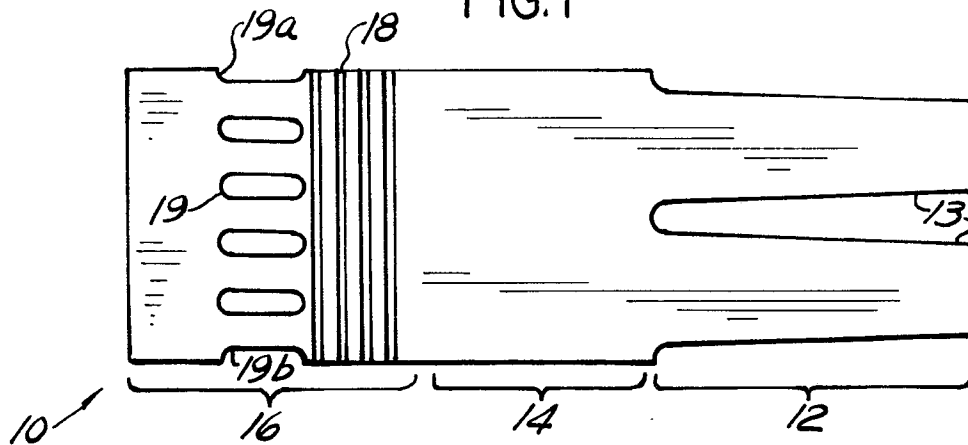


FIG. 2

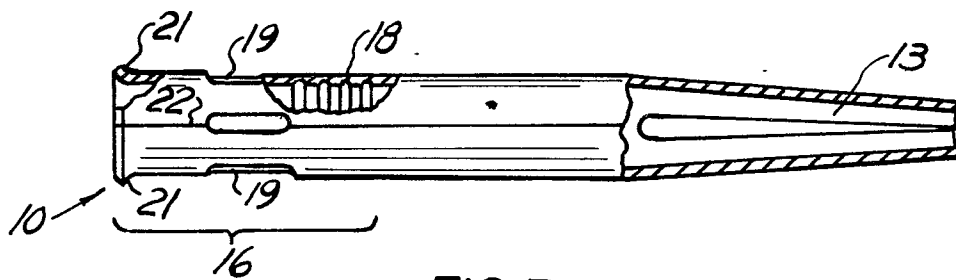


FIG. 3

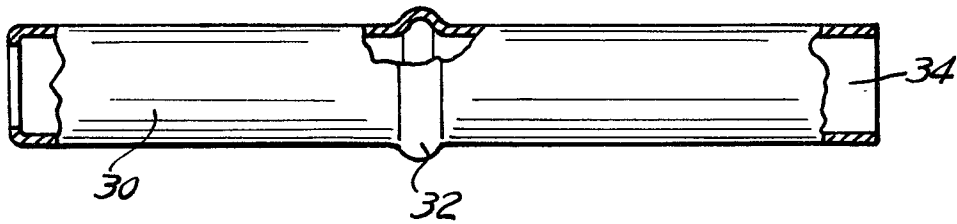


FIG. 4

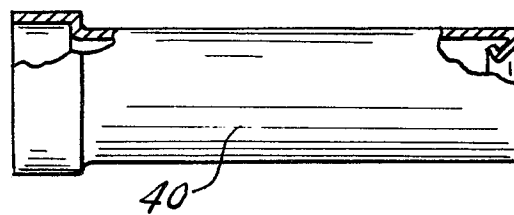


FIG.5

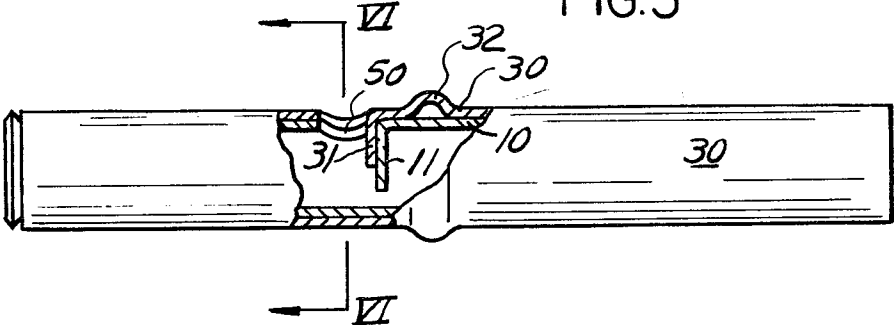


FIG.6

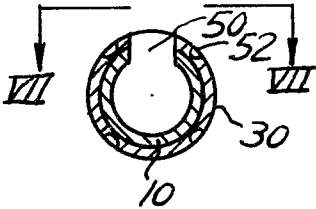


FIG.7

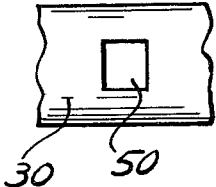


FIG.8

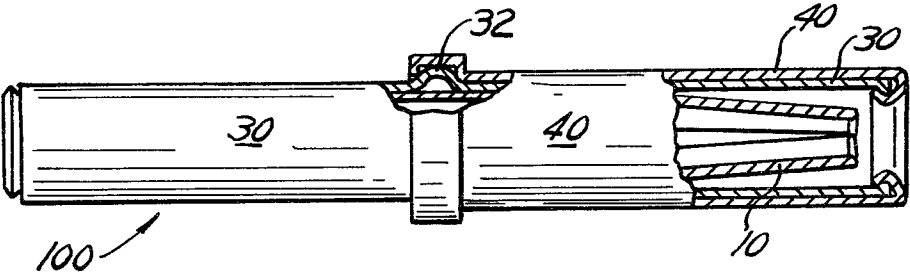
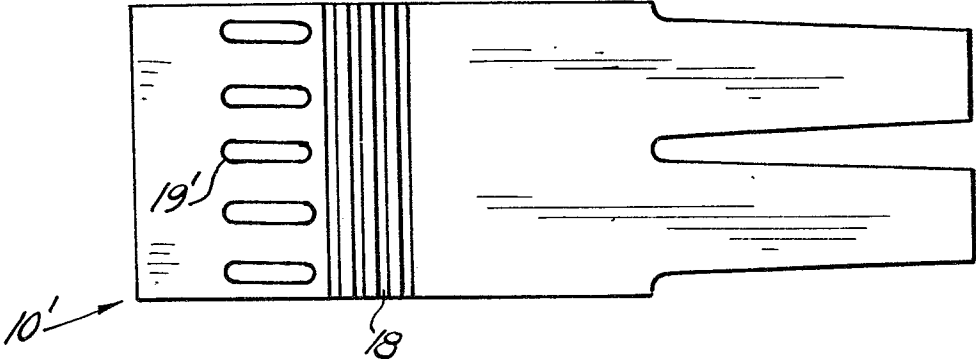
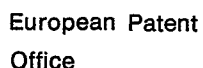


FIG.9





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