United States Patent [19]

Curr

[11] **3,721,943**

[45] **March 20, 1973**

[54] **ELECTRICAL CONNECTING DEVICE**

[75] Inventor: **Maurice D. Curr**, Idyllwild, Calif.

[73] Assignee: **The Deutsch Company, Electronic Components Division**, Banning, Calif.

[22] Filed: **Jan. 21, 1969**

[21] Appl. No.: **792,704**

[52] **U.S. Cl.**.....**339/94 M**, 339/217 S, 339/218 M, 339/258 P, 339/276 T

[51] **Int. Cl.** **H01r 13/52**

[58] **Field of Search**.....339/94, 153, 154, 177, 217, 339/218, 258, 276

[56] **References Cited**

UNITED STATES PATENTS

2,265,341	12/1941	Borchert	339/94 M
2,700,140	1/1955	Phillips	339/94 M
2,904,771	9/1959	Burtt et al.	339/184 M
3,292,117	12/1966	Bryant et al.	333/97
3,297,978	1/1967	Stark	339/177
3,336,569	8/1967	Nava	339/217
3,465,279	9/1969	Krehbiel	339/30

Primary Examiner—Joseph H. McGlynn
Attorney—Gausewitz, Carr & Rothenberg

[57] **ABSTRACT**

This invention includes a socket contact of sheet metal, which is formed to a tubular configuration from a flat piece having a malleable portion at one end and a resilient portion at the other. The malleable portion is crimped to an adjoining wire, while the resilient portion provides a spring force for gripping a mating pin. The latter element may be permanently mounted in the connector and extend through a sealing member such as rubber or glass. The pin extends outwardly for insertion into the socket contact of an adjoining connector section.

3 Claims, 17 Drawing Figures

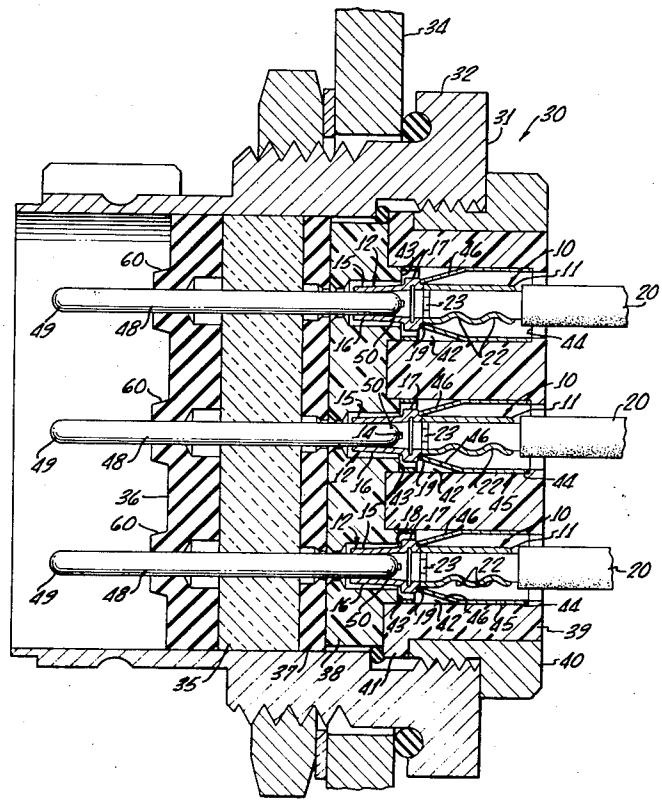
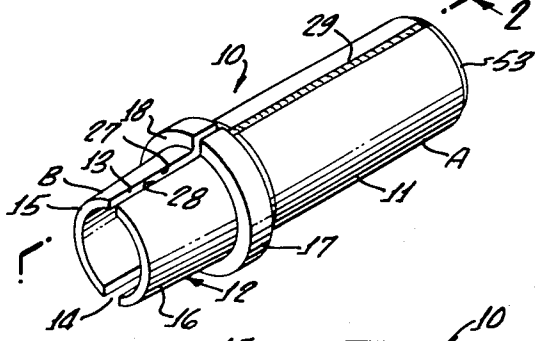


FIG. 1.



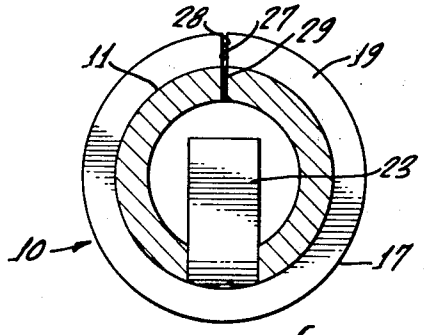


FIG. 4

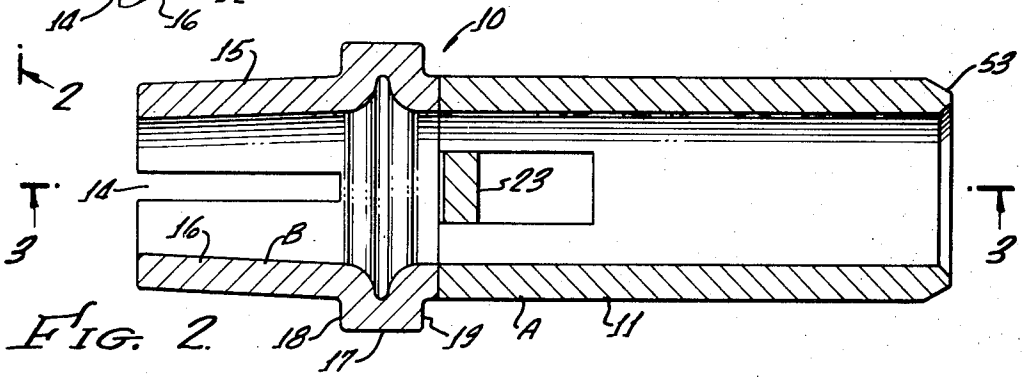


FIG. 2.

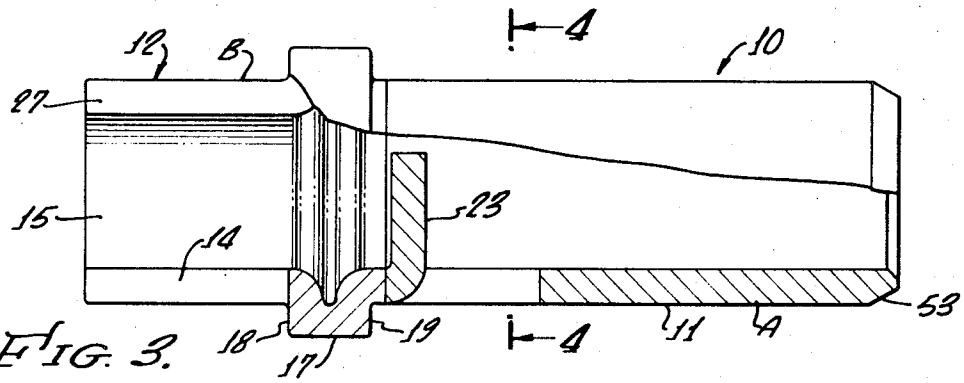


FIG. 3.

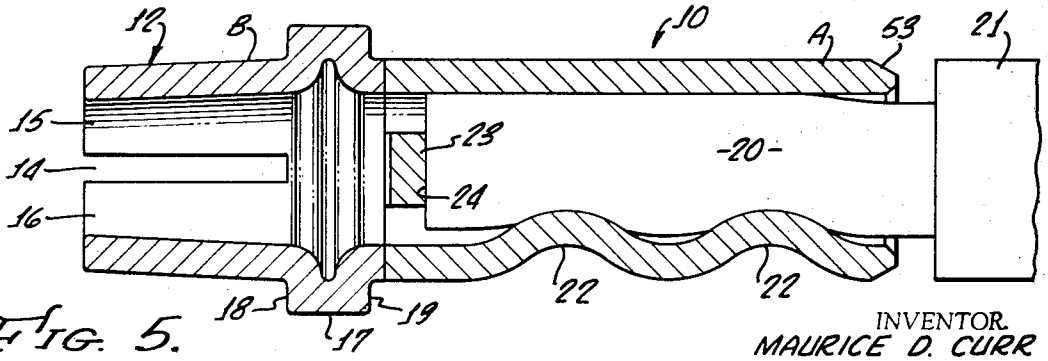


FIG. 5.

INVENTOR.
MAURICE D. CURR

BY

Jaureurty & Carr

ATTORNEYS.

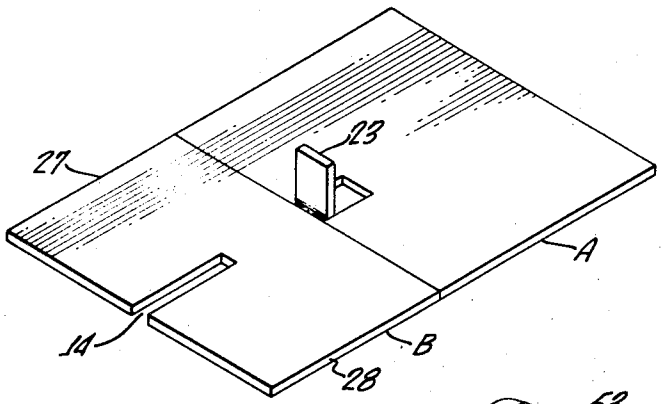


FIG. 10.

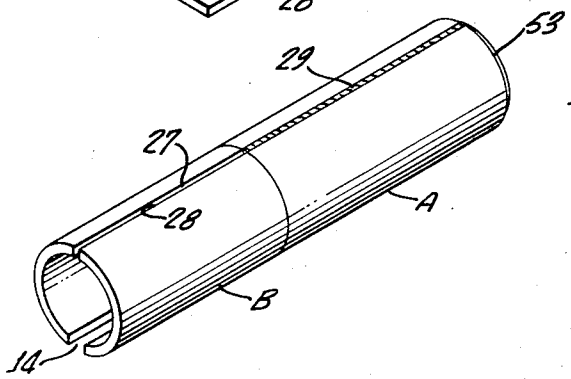


FIG. 11.

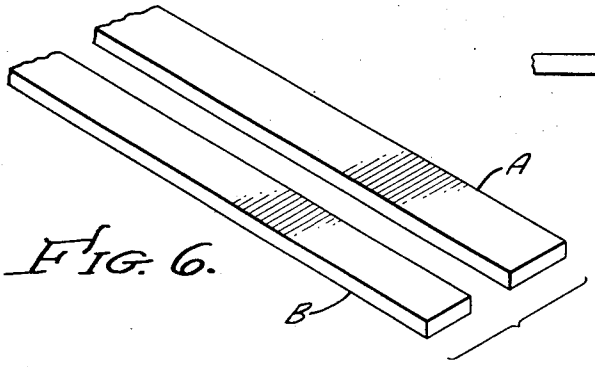


FIG. 6.

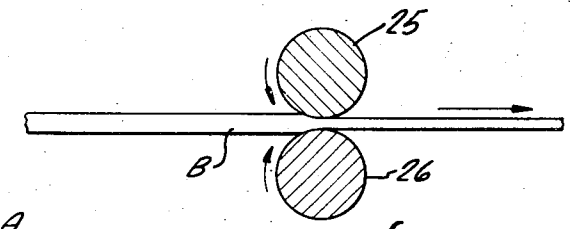


FIG. 8.

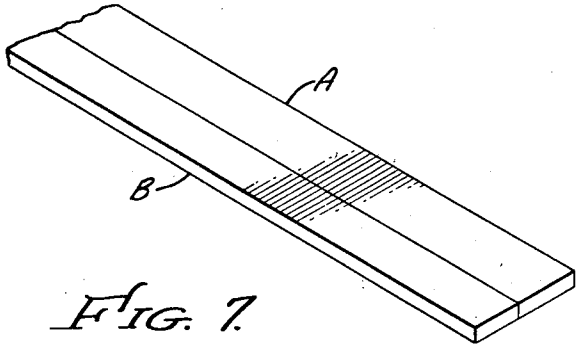


FIG. 7.

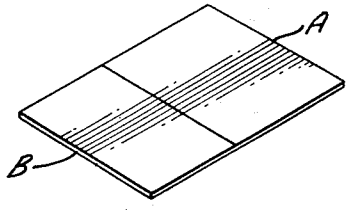


FIG. 9.

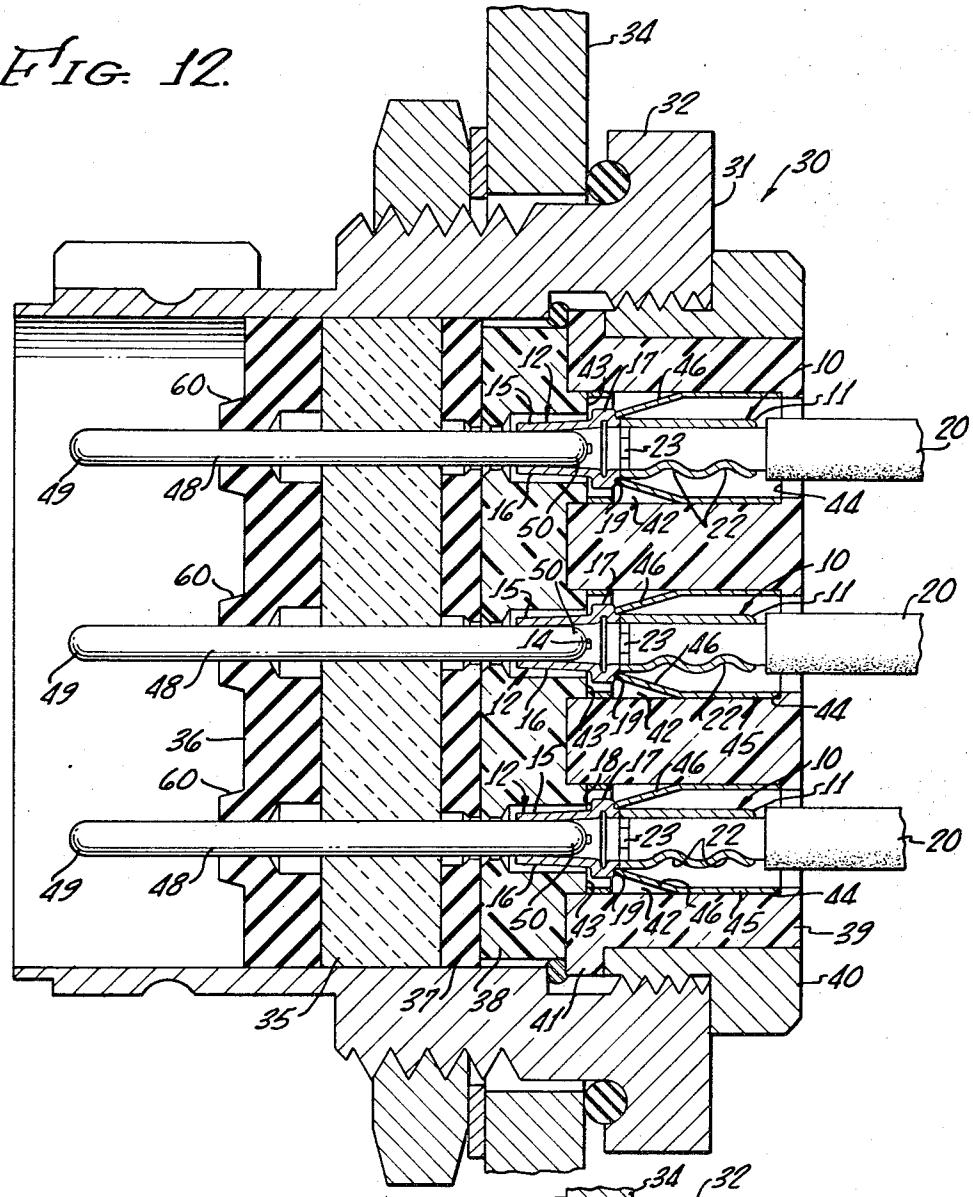
INVENTOR.
MAURICE D. CURR

BY

Dawson & Carr

ATTORNEYS.

FIG. 12.



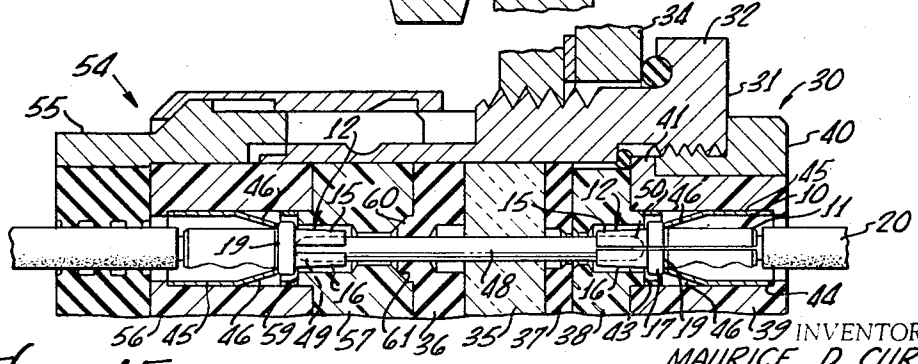


FIG. 15.

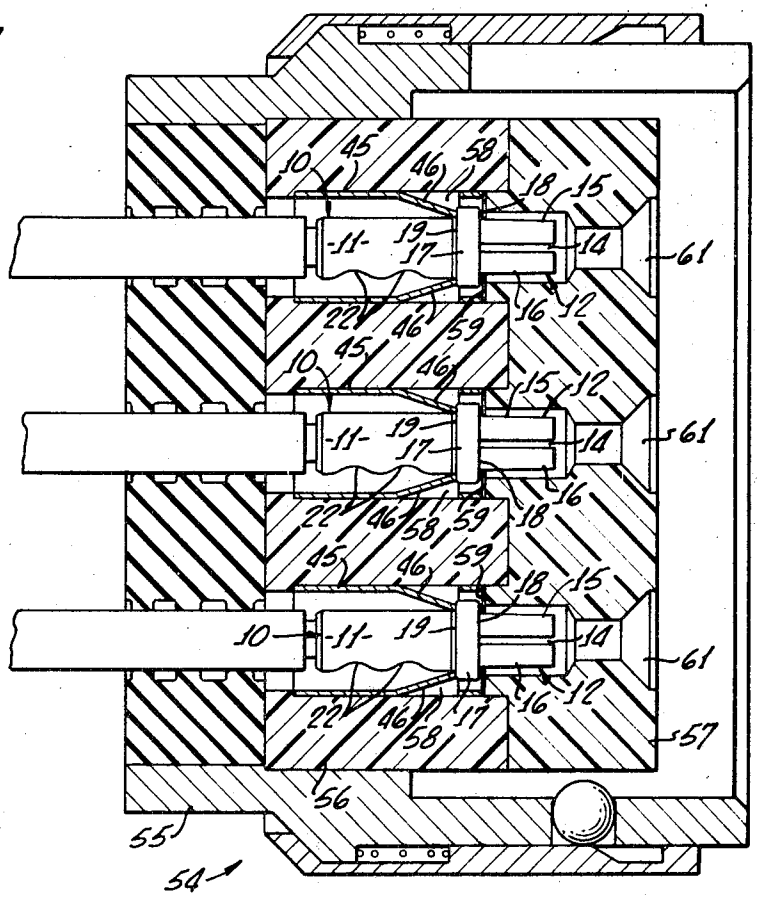
INVENTOR.
MAURICE D. CURR

BY

Jansewitz & Carr

ATTORNEYS.

FIG. 14



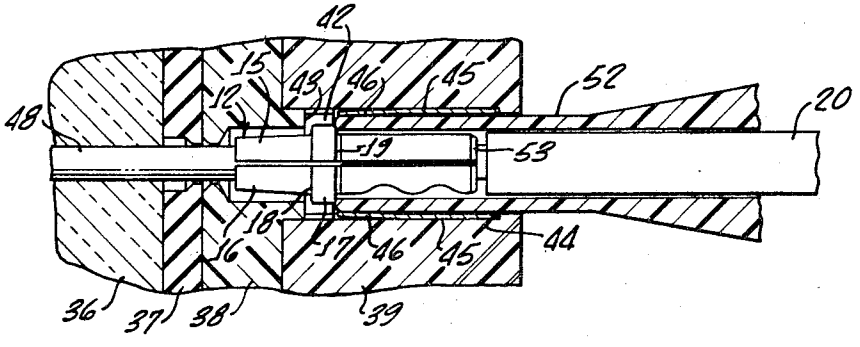


FIG. 13.

INVENTOR.
MAURICE D. CURR

BY

Jansenitz & Carr

ATTORNEYS.

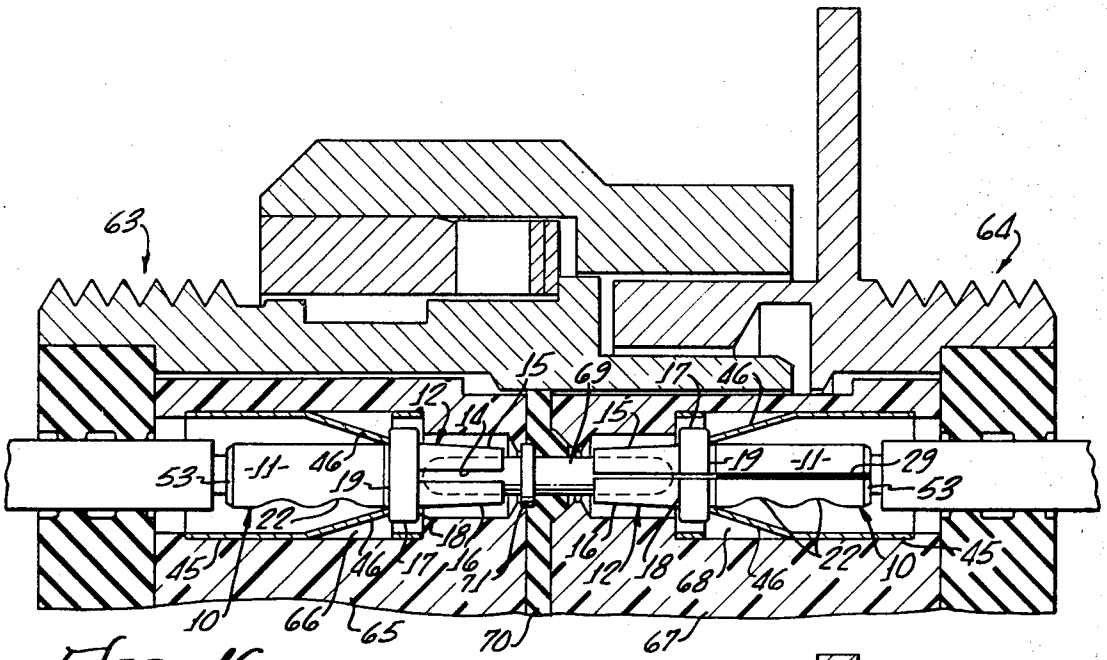


FIG. 16.

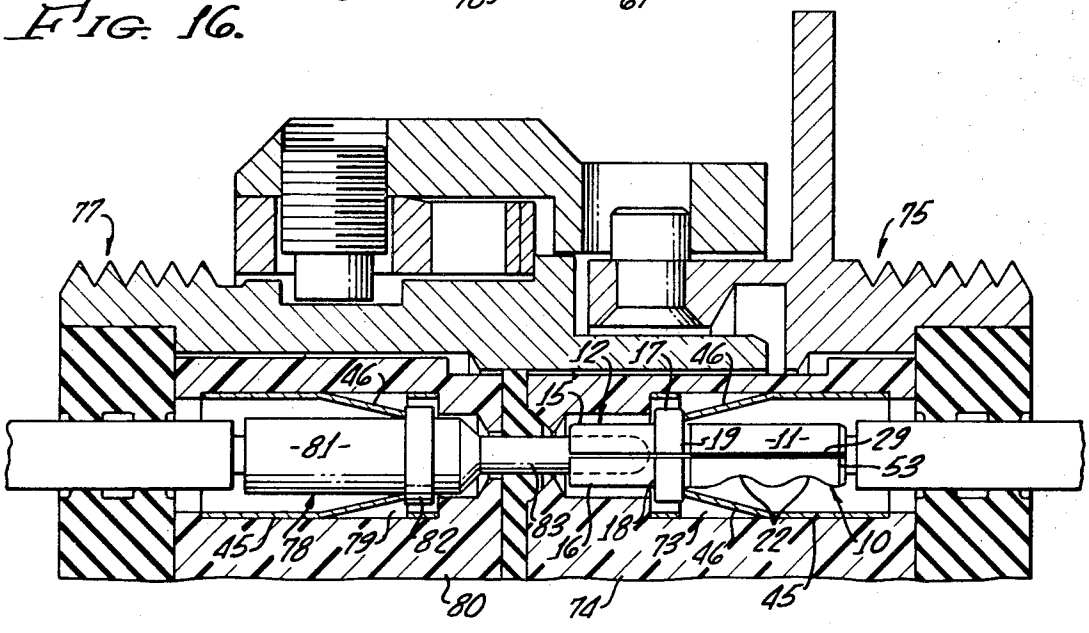


FIG. 17.

INVENTOR.
MAURICE D. CURR

BY

ATTORNEYS.

ELECTRICAL CONNECTING DEVICE

BACKGROUND OF THE INVENTION

1. The Field of the Invention

This invention relates to an electrical connector.

2. The Prior Art

There is a continuing need for electrical electrical connecting devices, particularly where the connectors must meet the rigid performance standards existing in the aerospace field. Problems are accentuated by the trend toward further miniaturization and the small size permitted the electrical connecting devices.

In these connectors, it is desirable to attach the wires to the contacts by crimping. This is a reliable and simple means of forming an attachment, requiring neither the skill nor the time necessary where the contacts are soldered to the wires. Mating contacts also require some resilient means in order that a firm engagement can be made between a pin contact and a socket into which it is inserted to accomplish an electrical connection. Therefore, on the one hand, for a crimped connection to a wire, the contact should be malleable in order that it can be deflected to grip the wire. On the other hand, resilience is needed where the pin and socket must be held together in firm engagement. Therefore, a crimped-type socket contact has required construction from a material having malleability, plus the inclusion of auxiliary spring elements for assuring that the mating pin will be appropriately engaged to accomplish the electrical connection. The malleable material for crimping will not provide the requisite resilience for firm contact engagement, so that the complexities and expense of the added spring arrangements have been necessary.

In hermetic connectors, there has been in the past no satisfactory means of providing crimped-type contacts. These connectors normally include glass inserts to accomplish the hermetic seal. This is done by fusing the contacts in the glass so that no leakage will take place around them. The contacts then become permanently and nonremovably fastened in the electrical connector. It is necessary, therefore, to solder each wire to its contact so mounted. This is a very slow and laborious operation, particularly for connectors of smaller sizes, requiring a high degree of skill. It presents even more of a problem from the servicing standpoint as the contacts cannot be taken from the connectors. It is necessary when separating a wire from the contact to melt the solder joint so that the wire can be removed. With the large bundle of wires entering an ordinary connector, and the lack of accessibility to inner portions of it, the joints of many additional wires must be melted and the wires removed in order to provide access to the one where the wire separation is needed. Following this, all the wires must be resoldered to their contacts.

SUMMARY OF THE PRESENT INVENTION

The present invention provides an improved arrangement whereby crimped-type contacts are able to provide a resilient force for engagement with mating pins. The invention also permits removable crimped contacts to be used with hermetic connectors. For all types of connectors, it provides a device of high performance and maximum reliability.

According to this invention, the socket contact is formed from a sheet metal piece made up of two sections welded together at their edges. One section is of malleable material, and the other is of resilient material. These are rolled to a tubular form, with the resilient end being split in order that it may provide opposed resilient jaws for gripping a pin inserted within it. The malleable end is attachable to the wire by a simple crimping operation. The contact may be provided with an internal stop for limiting the inward movement of the wire, and an external shoulder for use in positioning the contact in a connector.

The socket contact may mate with an elongated pin that extends between it and another socket contact. This pin is secured in the connector, and for hermetic connectors it is fused in the glass insert, where it is effectively sealed. Only the pin, therefore, is permanently attached to the connector, while the socket contact is readily removable from it. Forwardly inclined spring tabs are used in the retaining arrangement for the contact, permitting it to be removed and inserted from the rear. The pin so secured can be mated with conventional socket contacts. Conversely, the sheet metal socket contact of this invention can be joined to a conventional pin contact rather than the permanently mounted pin.

An object of this invention is to provide an improved electrical connecting device.

Another object of this invention is to provide a contact capable of resiliently engaging a mating electrically conductive member, while also being attachable to a wire by crimping.

A further object of this invention is to provide sealed connectors, including hermetic connectors, having removable contacts.

Yet another object of this invention is to provide an electrical connecting arrangement meeting highest performance standards, yet which is producible rapidly and at a low cost.

A further object of this invention is to provide an electrical connecting device facilitating servicing and maintenance.

An additional object of this invention is to provide an electrical connector device having versatility in the manner in which it may be mated with an adjoining part.

These and other objects will become apparent apparent from the following detailed description taken in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS:

FIG. 1 is a perspective view of a socket contact in accordance with this invention;

FIG. 2 is an enlarged longitudinal sectional view of the contact, taken along line 2—2 of FIG. 1;

FIG. 3 is a longitudinal sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is a transverse sectional view taken along line 4—4 of FIG. 3;

FIG. 5 is a view similar to FIG. 2, but with the contact attached to a wire by crimping;

FIG. 6 is a perspective view of malleable and resilient strips used for producing the contact;

FIG. 7 is a perspective view of the strips after joining at their edges;

FIG. 8 is an elevational view illustrating the rolling of the strips to reduce their thickness;

FIG. 9 is a perspective view of the blank for forming the contact cut from the strips;

FIG. 10 is a perspective view of the blank after cutting a slot and bending the stop tab;

FIG. 11 is a perspective view after the blank has been rolled to a tubular shape;

FIG. 12 is a longitudinal sectional view of the receptacle of a hermetic electrical connector made in accordance with this invention;

FIG. 13 is a fragmentary sectional view of the receptacle, illustrating the manner in which the contacts may be removed;

FIG. 14 is a longitudinal sectional view of a plug for mating with the receptacle of FIG. 12;

FIG. 15 is a fragmentary longitudinal sectional view showing the receptacle and plug in the mated position;

FIG. 16 is a longitudinal sectional view of the invention as applied to a connector which is not hermetic; and

FIG. 17 is a fragmentary sectional view of a connector in which the socket contact of this invention is mated with a conventional pin contact.

DESCRIPTION OF THE PREFERRED EMBODIMENT:

A socket contact **10** made in accordance with this invention, as may be seen in FIGS. **1**, **2**, **3** and **4**, includes a rearward cylindrical barrel portion **11** and a slightly frusto-conical forward end portion **12** that is convergent outwardly. The latter part of the contact is provided with opposed longitudinal slots **13** and **14** so that it has opposed jaw sections **15** and **16**. This end of the contact is adapted to receive a pin when in the mated condition for transmission of current between the contact and the pin. Intermediate the forward portion **12** and the rearward barrel portion **11** is a section **17** of enlarged diameter. This provides a substantially radial forward exterior shoulder **18** and a similar rearward shoulder **19**. These shoulders are utilized in positioning the contact in an electrical termination device, as will be described below.

The barrel end **11** of the contact **10** is adapted to receive the end of a wire **20** stripped of its insulation **21**, as seen in FIG. **5**. With the wire end in the contact barrel, the latter portion is deflected inwardly by a suitable tool to provide undulations **22** bearing against the wire. This crimps the barrel **11** so that it is attached to the wire **20** and forms an electrical circuit with it. A tab **23** extends radially across most of the width of the contact at the inner end of the barrel **11**. This acts as a stop that is engageable by the end surface **24** of the wire **20**, limiting the distance the wire **20** can be inserted into the contact **10**. This assures that the wire **20** remains within the barrel portion **11** of the contact and does not enter the forward section **12**. Therefore, the end of the wire **20** will not interfere with a pin to be inserted into the end **12** of the contact when it is in service.

In order to function satisfactorily as a contact having the desirable crimped-type connection to a wire, it is necessary that the barrel portion **11** possess malleability. At the same time, the forward portion **12** requires resilience in order that the opposed sections **15** and **16** can act as springs bearing inwardly and gripping the surface of a pin inserted between them. In order to obtain these contrasting qualities, the contact **10** is made of one section A of malleable material, which is used at the barrel end of the contact, and an additional section B of spring material for the opposite end. The sections A and B are integrally attached together at a location adjacent the enlarged portion **17**. Typically, the malleable material A may be brass, while the resilient material B is beryllium copper. It may be desirable for the latter portion to have a surface coating such as gold plating.

In obtaining material of this type, which is marketed under the trademark "Duo-Metal" by The Brush Beryllium Company, Reading, Penna., strips of the materials A and B first are prepared to a thickness somewhat greater than that desired for the gauge of the completed contact **10** (FIG. **6**). These strips are welded together along their longitudinal edges to form a wider strip with the materials A and B integrally attached (FIG. **7**). The assembled materials then repeatedly are passed through rollers, such as the rollers **25** and **26** shown in FIG. **8**, reducing the thickness of the strip. Subsequently, it is cut to form the flat sheet metal blank of FIG. **9** that is used to make the contact **10**.

The blank, which is of rectangular shape and predetermined dimensions, is provided with a cutout to serve as the slot **14** in the completed contact. Also, the stop tab **23** is cut and bent 90° relative to the surface of the blank, as shown in FIG. **10**. The blank then is rolled to a tubular shape, as seen in FIG. **11**, bringing its opposite longitudinal edges **27** and **28** into adjacency. The intermediate portion **17** of enlarged diameter also is formed and the frustoconical shape imparted to the forward portion **12**.

In addition, the edges **27** and **28** are joined in a suitable manner, such as by brazing, in the area of the barrel **11** of the contact. This provides a longitudinal brazed joint **29** along the barrel **11** so that the barrel is continuous around its circumference. This enables the barrel to be crimped to the end of the wire **20**, irrespective of the rotational position of the barrel relative to the crimping tool. Without this attachment, in some relative rotational positions, the action of the crimping tool would cause the edges **27** and **28** to become displaced with respect to each other, and a secure connection to the wire would not be made. With the barrel end made as an uninterrupted tubular element, rather than being split, however, there is no difficulty in the crimping operation, and the wire always will be appropriately secured to the contact.

As shown in FIG. **12**, several of the contacts **10** are associated in a completed section **30** of an electrical connector. In this arrangement, there is provided a rear-release type installation in which the contact can be both inserted and removed from the rearward end of the connector. This advantageous feature is present even though the connector illustrated is of the hermetic type normally requiring permanently mounted contacts and soldered connections of the wires to the contacts.

The connector section **30** shown in FIG. **12** is a stationary receptacle adapted to mate with a movable plug. The receptacle **30** includes a shell **31** having a flange **32** and a threaded exterior portion receiving a nut **33**, which holds the receptacle to a mounting panel **34**. The shell **31** is a tubular element within which are mounted various inserts. A glass insert **35** is included in providing the hermetic seal for the receptacle. On the

forward side of the glass insert **35** (to the left as shown in FIG. **12**) is a resilient rubber insert **36** that acts as an additional seal. A backing insert **37**, also of resilient material, is positioned on the opposite, or rearward, side of the glass insert **35**. The backing insert **37** is bonded to an insert **38** of substantially rigid dielectric material which, in turn, is bonded to an additional insert **39**, also of such material. A nut **40** surrounds and engages the flange **41** of the rear insert **39**, holding the insert assembly in the receptacle shell **31**.

The inserts **38** and **39** together provide openings **42** parallel to the axis of the receptacle **30**. The openings **42** are centrally enlarged to define spaced radial forward and rearward shoulders **43** and **44**, respectively. In each of these openings is a retainer clip **45**, which may be of the type shown in FIG. **14** of U. S. Pat. No. 3,158,424. The retainer clip **45** is a split tubular element received in the enlarged portion of the bore **42** so that it is prevented from axial movement by the shoulders **43** and **44**. It is provided with two inwardly and forwardly extending resilient retainer tabs **46**.

A contact **10** also is received in each of the openings **42** inside the retainer clip **45**. The forward shoulder **18** of the contact **10** is adjacent the forward shoulder **43** of the opening **42**, which thereby retains the contact against forward movement. The inner ends of the resilient spring tabs **46** are adjacent the rearward shoulder **19** of each contact **10**, which prevents rearward movement of the contact. Thus, the contacts **10** are secured within the bores **42**.

Continuations of the openings **42** are provided in the inserts **35**, **36** and **37**. Received within the openings in the latter inserts are elongated pins **48**, the ends **49** and **50** of which are hemispherical. The central portions of the pins are molded into the glass insert **35**. In this manner, the pins **48** are held in the receptacle **30**, parallel to the axis, with hermetic seals formed around them. The peripheries of the pins **48** also are engaged by the resilient insert **36** to provide a further seal. The pins **48** extend forwardly beyond the inserts **36** and **37** into the open forward tubular portion of the shell **31**. This provides longitudinally projecting pin ends for mating with adjacent socket contacts.

The opposite ends **50** of the pins **48** extend into the openings **42** and into the forward ends **12** of the contacts **10**. There, each pin **48** is gripped by the opposed resilient jaws **15** and **16** of the contact **10**, resulting in firm engagement with the pin and a low-resistance path for the flow of electric current. Entry of the pin **48** into the contact **10** is facilitated by the hemispherical end **50**, which effectively spreads the jaws **15** and **16** slightly as the pin enters the receptacle. In their free positions, the spacing between the ends of the jaws **15** and **16** is less than the diameter of the pin **48** so that the jaws will grip the pins.

The receptacle **30** constructed in this manner is of the hermetic type, yet at the same time the contacts carried by the receptacle are joined to their wires by crimping and are insertable and releasable from the rear. Thus, the hermetic connector receptacle avoids the use of soldered connections and permanently attached contacts. It is a simple matter to introduce the contacts **10** into the openings **42** in the receptacle by a standard tool for engagement with the pins **48**. This is accomplished by pushing each contact inwardly from the rearward end of the opening **42**, advancing it to the position shown in FIG. **12**. As this forward movement of the contact takes place, the forwardly and inwardly inclined spring tabs **46** are engaged and deflected outwardly by the enlarged portion **17** of the contact. After the rearward shoulder **19** of the contact has passed the forward ends of the spring tabs **46**, they are free to snap inwardly behind the shoulder **19** to retain the contact in the receptacle.

Release of the contact also is readily accomplished from the rear through the use of conventional tooling. This operation is shown in FIG. **13**, where a standard tubular releasing tool **52** is shown inserted into the rearward end of the opening **42**, prying the spring tabs **46** outwardly beyond the periphery of the enlarged portion **17** of the contact **10**. Preferably, as best seen in the enlarged views of FIGS. **2**, **3** and **5**, the corner **53** at the rearward end of the barrel **11** is beveled, which helps guide the tool **52** over the barrel without obstruction. With the tabs released, the contact is free for rearward removal merely by pulling outwardly on the wire **20**. Thus, the hermetic connector provides for both rearward insertion and release. The contacts and their mountings are the same for both sections of the hermetic connector, simplifying the manufacture and use of the connectors.

The plug **54** shown in FIG. **14** is adapted to mate with the receptacle of FIG. **12**. The mated position is illustrated in FIG. **15**, where the plug **54** and receptacle **30** are held together by any suitable coupling mechanism. The plug **54** is not a hermetically sealed unit, as normally only the receptacle must have such characteristics, although the plug **54** could be made hermetic if desired. The plug **54** includes a shell **55**, within which are inserts **56** and **47** of rigid plastic. These are provided with openings **58** similar to the openings **42** in the receptacle **30**. Within each opening **58** is a retainer clip **45** engaging and preventing rearward movement of a contact **10**. The shoulder **59** of the opening **58** limits forward movement of the contact in the plug.

The forward resilient insert **36** of the receptacle **30** is provided with forwardly extending frustoconical portions **60** around the pins **48**. In the mated position of the plug and receptacle, the protruding portions **60** are received and compressed in the more sharply tapered frustoconical recesses **61** at the forward ends of the openings **58** in the insert **57** of the plug **54**, forming an effective seal.

When the plug and receptacle are brought together, the ends **49** of the pins **48** slide into the forward end portions **12** of the contacts **10** in the plug. The opposing resilient jaws **15** and **16** of the contacts **10** in plug **54** resiliently bear against the peripheries of the pins **48**, thereby providing completed electrical circuits. Thus, in accordance with this invention, the elongated pin **48** provides an intermediate element that transmits electrical current from one socket contact to the other. The pin **48** provides a member that is rigidly mounted in one section of the connector and is readily sealed, even hermetically with a glass insert.

The invention is adapted for use in connectors other than hermetic connectors, where, again, it offers advantages of low cost, simplicity and reliability. Standardization of parts and tooling for the full range of electrical connector types is made possible. As shown

in FIG. 16, there is a plug 63 mated to a receptacle 64. The rigid plastic insert 65 of the plug 63 is provided with an opening 66 within which a retainer clip 45 and a contact 10 are received. Similarly, the insert 67 of the receptacle has an opening 68 with another retainer clip 45 and contact 10. An elongated pin 69 extends between the two contacts and is received in the outer ends 12 of each. The pin 69 in this instance is secured to the plug between the rigid insert 65 and a resilient insert 70 at the forward face of the plug. For this purpose, the pin 69 is provided with an enlarged portion 71 that defines an annular flange received in recesses in both the inserts 65 and 70. This provides a radially outwardly projecting element on the pin 69 which is retained by the inserts 65 and 70, and precludes axial movement of the pin. The flange portion 71 is secured when the inserts 65 and 70 are bonded together.

The contacts 10 also will mate satisfactorily with conventional pin contacts, rather than being utilized as discussed above where a single pin is used with a pair of socket contacts. As shown in FIG. 17, a contact 10 is mounted in an opening 73 in the insert 74 of a receptacle 75, held in place by a retainer clip 45. In the plug 77, however, a conventional pin contact 78 is held in the opening 79 in the insert 80 by means of the retainer clip 45. The contact 78 may be a machined part, rather than of sheet metal, including a hollow barrel 81, an enlarged intermediate portion 82 and a forward elongated pin end 83. The latter portion is received in the forward end 12 of the contact 10 in the receptacle, where, as before, the receptacle bears against the periphery of the pin and provides an electrical circuit.

For added versatility, the pins 48 or 69 of the previously described embodiments may be mated with conventional socket contacts rather than additional contacts 10.

I claim:

1. A hermetic electrical connector device comprising
a member defining an opening therethrough,
a substantially rigid insert of dielectric material received in said opening,
said insert having a forward end, a rearward end and at least one aperture extending therethrough,
a tubular contact in said aperture,
means positioning said contact in said aperture,
a wire extending into one end of said contact and connected thereto,
a glass insert in said opening beyond the opposite end of said contact,
an elongated pin extending through said glass insert,
said glass insert being fused to said pin so as to hold said pin rigidly and provide a hermetic seal therewith,
one end of said elongated pin extending into said opposite end of said contact,
the other end of said elongated pin extending outwardly beyond said glass insert for engagement with a mating electrically conductive device,
and an additional insert of resilient material in said opening adjacent said glass insert and extending around said elongated pin.

2. An electrical connector comprising
a tubular shell having a forward end and a rearward end,
a glass insert in said shell,
said glass insert having a forward side and a rearward side,
a plurality of spaced substantially parallel elongated pins, the central portions of said pins being received in said glass insert so that said pins are held rigidly and sealed with respect to said glass insert, one end portion of each of said pins extending outwardly from said forward side of said glass insert,
the opposite end portion of each of said pins extending outwardly from said rearward side of said glass insert,
a member of resilient material in said tubular shell engaging said forward side of said glass insert,
said member of resilient material having openings therethrough,
said one end portions of said pins extending through said openings in said member of resilient material and extending beyond said member of resilient material,
an insert of dielectric material in said shell adjacent said rearward side of said glass insert,
said dielectric insert having a plurality of first openings therethrough aligned with said pins,
a first contact in each of said openings,
each of said contacts having a forward end and a rearward end,
each of said forward ends receiving and engaging said opposite end portion of one of said pins,
a wire for each of said first contacts, each of said wires being received in and crimped to said rearward end of the contact therefor,
retainer means removably holding said first contacts in said openings,
said retainer means being releasable for allowing said contacts to be removed rearwardly from said openings,
a second dielectric member,
said second dielectric member having a plurality of openings therethrough,
a second socket contact in each of said openings in said second dielectric member,
each of said second contacts having a forward end and a rearward end,
said forward ends of said second contacts being adapted to receive said one end portions of said pins for forming an electrical connection therewith,
a second wire for each of said second contacts,
each of said second wires being received in and crimped to said rearward end of the second contact therefor,
and second retainer means removably holding said second socket contacts in said openings in said second dielectric member.

3. A device as recited in claim 2 including in addition a second member of resilient material interposed between said rearward side of said glass insert and said dielectric insert, said second member of resilient material having openings therethrough, said opposite end portions of said pins extending through said openings in said second member of resilient material.

* * * * *