Jan. 6, 1970 J. FERNANDES ETAL 3,488,432

ELECTRICAL CONNECTOR OF SINTERED POWDERED CONDUCTIVE MATERIAL

Original Filed June 7, 1966 3 Sheets-Sheet 1

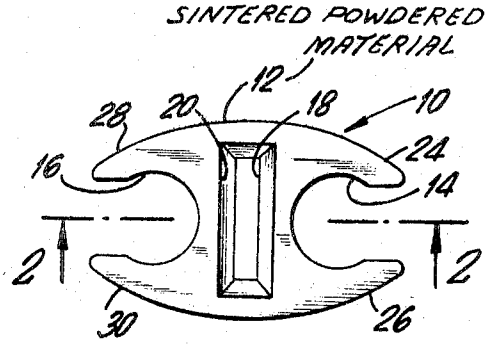


FIG. 1

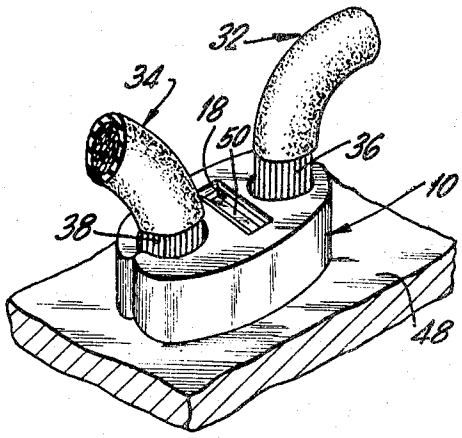


FIG. 4

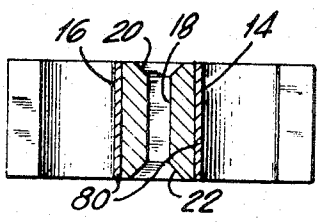


FIG. 2

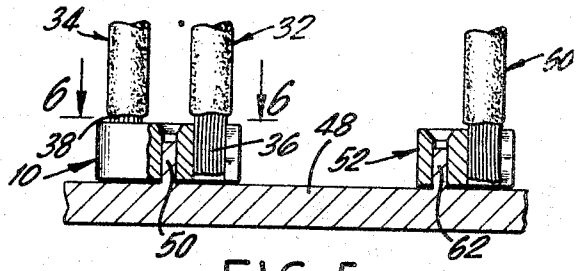


FIG. 5

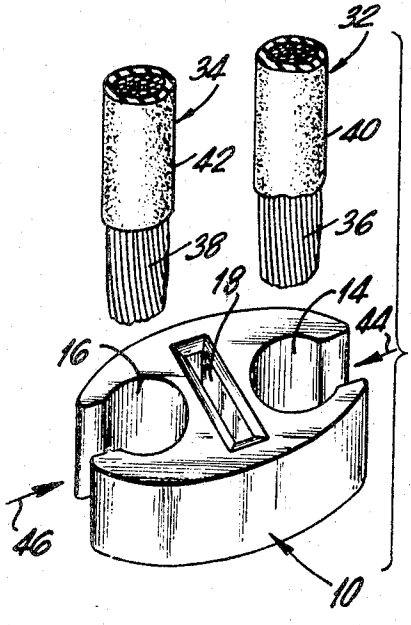


FIG. 3

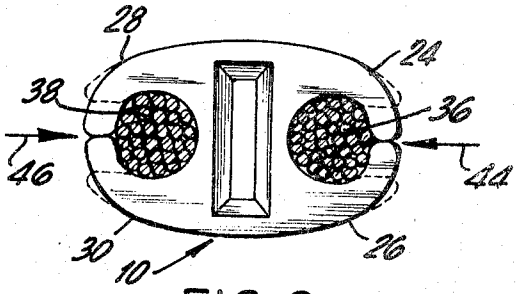


FIG. 6

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ELECTRICAL CONNECTOR OF SINTERED POWDERED CONDUCTIVE MATERIAL

Original Filed June 7, 1966 3 Sheets-Sheet 2

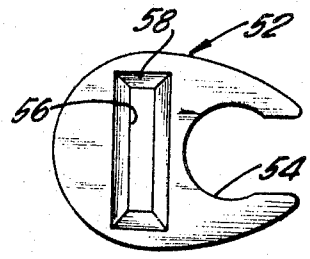


FIG.7

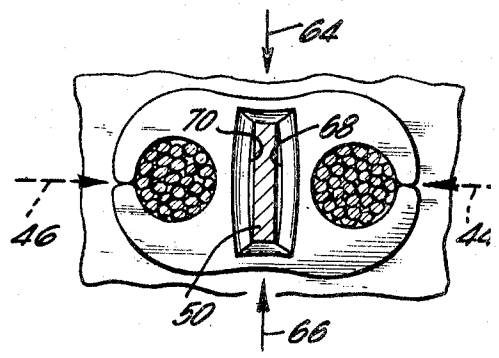


FIG.8

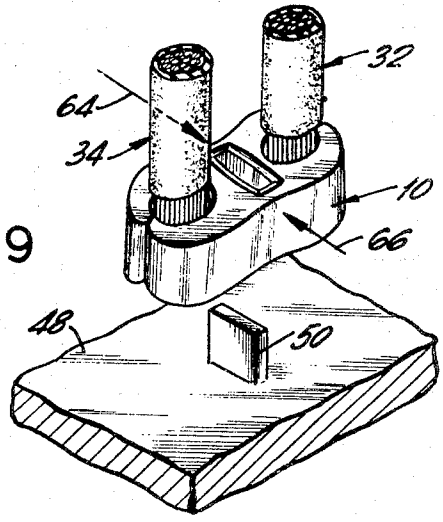


FIG.9

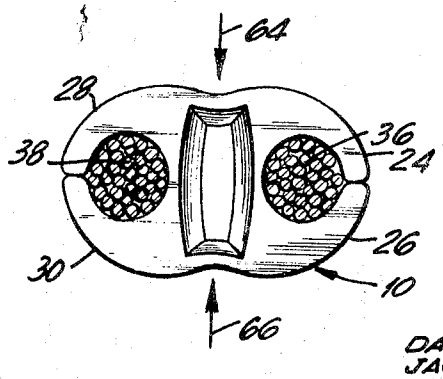


FIG.10

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ELECTRICAL CONNECTOR OF SINTERED POWDERED CONDUCTIVE MATERIAL

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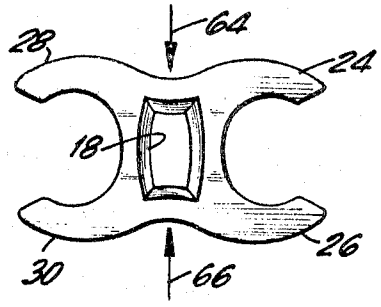


FIG. 12

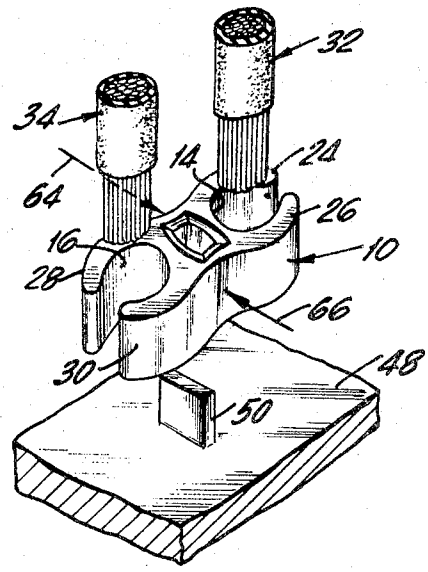


FIG. 11

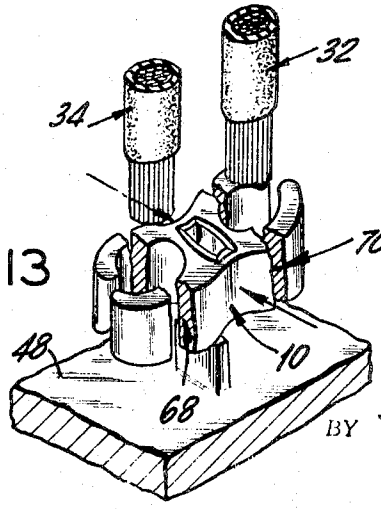


FIG. 13

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ELECTRICAL CONNECTOR OF SINTERED POWDERED CONDUCTIVE MATERIAL

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Continuation of application Ser. No. 555,745, June 7, 1966. This application Jan. 14, 1969, Ser. No. 792,225
Int. Cl. H02g 3/22
U.S. Cl. 174—71
4 Claims

ABSTRACT OF THE DISCLOSURE

An electrical connector of sintered conductive material having at least one outwardly opening notch to be crimped upon an electrical conductor. The connector has the following characteristics:

(1) That it may be assembled with a conductor by applying crimping forces along one direction;

(2) That the connector may be removed from the conductor by applying an uncrimping force to the connector in a direction perpendicular to the crimping force, and

(3) That the continued application of the uncrimping force causes the connector to shatter.

In a preferred embodiment, the connector is provided with two outwardly opening notches and a slot intermediate the notches. The notches are adapted to receive electrical conductors and slot a terminal tab.

This application is a continuation of co-pending application S.N. 555,745, filed June 7, 1966, for Solderless Electrical Connector, by Jacinto Fernandes and David J. Crimmins, now abandoned.

This invention relates generally to electrical connectors and more particularly to a new and improved solderless electrical connector.

In terminating electrical conductors to terminal strips or the like, it is general practice to solder the end of the conductor to a terminal on the strip. If it is thereafter desired to remove a conductor, it is necessary to apply heat to the soldered connection in order to liquify the solidified solder. Such a procedure may cause damage due to dripping molten solder and necessitates the use of a heating implement which may cause heat damage to components located in the chassis or instrument in which the conductor is used. Although solderless connectors have been used to terminate leads to terminal strips or the like, these connectors suffer the disadvantage that they are not easily removed without possible destruction of the terminal and/or wire lead. This is especially true where more than one conductor is terminated to a common terminal.

In order to obviate the disadvantages of electrical connectors presently in use, the solderless electrical connector of the present invention has been developed. In general, the electrical connector of the present invention comprises a body of conductive material having the following characteristics: first, that the connector may be assembled with a conductor by applying a crimping force in one direction; second, that the connector may be removed from the conductor by applying a force to the connector in a direction perpendicular to the crimping force; and third, continued application of a force in a direction perpendicular to the direction of the crimping force causes the connector to shatter. In one preferred embodiment of the present invention, the connector is provided with two outwardly opening notches for the reception of two conductors and a slot intermediate the notches for insertion onto a terminal tab. After two conductors have been positioned within the notches of this connector, crimping

forces are applied in opposing directions to close the arms of the connector about the conductors, thus to securely crimp the connector therewith. The connector is then positioned on a terminal tab and crimped thereto. Removal of the connector from the terminal tab is accomplished by applying to the midpoints of the connector opposing forces which are perpendicular to the crimping forces. Further application of these opposing forces causes the arms of the connector to open up, allowing removal of the conductors without damage thereto. Further application of these same forces causes the connector to shatter.

In another embodiment of the present invention, only one outwardly opening notch is provided for the reception of a single conductor, a slot being provided for insertion of the connector on a terminal tab. In still another embodiment of the present invention, two outwardly opening notches are provided for the reception of a pair of conductors, but no intermediate slot is provided.

It is thus an object of the present invention to provide a solderless connector which provides a positive electrical connection between connector and conductor and a low resistance connection.

It is a further object of the present invention to provide a solderless electrical connector which may be quickly and simply applied to the end of an electrical conductor and which may be easily removed without destruction to the lead or terminal to which the connector may be applied.

It is still another object of the present invention to provide a solderless electrical connector which is economical and may be easily manufactured.

It is yet another object of the present invention to provide a solderless electrical connector which is comprised of powdered metallic material, the connector having the characteristics that it may be crimped on to the electrical conductor when a force is applied in one direction, and that it may be removed from the electrical conductor when a force is applied in a direction perpendicular to the crimping force.

It is yet another object of the present invention to provide a solderless electrical connector which may be shattered for easy removal of conductors without causing damage to the conductors.

These and other objects will be readily apparent from the following description and drawings in which:

FIG. 1 is a side elevational view of a preferred embodiment of the present invention;

FIG. 2 is a plan sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is an exploded view of two conductors about to be assembled with the connector of FIG. 1;

FIG. 4 is a partially sectional perspective view of the connector of FIG. 1 assembled with a pair of conductors and inserted onto a terminal tab;

FIG. 5 is a partially sectional elevational view showing the assembly of FIG. 4;

FIG. 6 is a partially sectional plan view showing the connector of FIG. 1 crimped on to a pair of conductors, with arrows indicating opposing directions of the crimping forces;

FIG. 7 is a side elevational view of another embodiment of the present invention;

FIG. 8 is a partially sectional plan view showing forces being applied to the assembly of FIG. 4, said forces being perpendicular to the crimping forces shown in FIG. 3 to allow removal of the connector from the terminal tab;

FIG. 9 is a partially sectional exploded view showing removal of the connector conductor assembly from the terminal tab;

FIG. 10 is a partially sectional plan view of the connector conductor assembly of FIG. 9;

FIG. 11 is a partially sectional exploded view similar to FIG. 9, but showing the conductors removed from the connector;

FIG. 12 is a top plan view of the connector shown in FIG. 11; and

FIG. 13 is a partially sectional exploded view similar to that of FIG. 11 showing the connector shattered.

Referring now to FIGURES 1 and 2, there is shown a preferred embodiment of the solderless electrical connector of the present invention. As shown, solderless electrical connector **10** comprises a generally elliptically shaped body **12** having a pair of outwardly opening notches **14** and **16** disposed at opposite ends thereof. A slot **18** is provided intermediate notches **14** and **16**. Slot **18** is chamfered as at **20** and **22** to provide easy assembly of connector **10** with a terminal tab to be inserted into slot **18**. Notch **14** is formed between arms **24** and **26** of connector **10** and notch **16** is formed between arms **28** and **30** of connector **10**.

Connector **10** is made of conductive material having the following characteristics: first, the material is substantially malleable so that application of a crimping force in one direction permits crimping of the connector to a conductor; second, the material is such that application of a force perpendicular to the crimping force causes an opening up of the notch of the connector to allow disassembly of the connector from a conductor without damage to the conductor, and third, further application of a force perpendicular to the crimping force shatters the connector. It has been found that sintered powdered metallic material such as powdered copper, powdered aluminum or the like, exhibits the above characteristics. If connector **10** is made of powdered metal, the connector may be made by subjecting loose powdered metal placed in a mold of appropriate configuration to pressure and heat to sinter the powdered metal into a cohesive mass.

Referring to FIG. 3, there is shown a pair of electrical conductors **32** and **34**, respectively comprising stranded wire conductors **36** and **38** and insulation coverings **40** and **42**. Conductors **32** and **34** are respectively inserted into notches **14** and **16** of connector **10**, and crimping forces applied to the ends of connector **10** in opposing directions as shown by arrows **44** and **46**. As shown in FIG. 6, arms **24** and **26** of connector **10** have been closed about the stranded wire conductor portion **36** of electrical conductor **32**, and arms **28** and **30** of connector **10** have been closed about stranded wire conductor portion **38** of conductor **34**. Arms **24**, **26**, **28**, and **30** of connector **10** are shown in dotted lines before forces **44** and **46** have been applied and in solid lines after forces **44** and **46** have been applied.

Referring to FIG. 4, there is shown connector **10** crimped onto conductors **32** and **34** as assembled with a terminal strip **48** having terminal tab **50**. Connector **10** is assembled with strip **48** by inserting tab **50** into slot **18** of connector **10** and crimping connector **10** to tab **50** by further application of crimping forces **44** and **46**. This assembly of connector **10** with tab **50** of terminal strip **48** is more clearly shown in FIGURE 5.

In normal practice, connector **10** would be first positioned on terminal strip **48** by inserting tab **50** into slot **18** thereof. Thereafter, conductors **32** and **34** would be inserted into notches **14** and **16** of connector **10** and crimping forces **44** and **46** applied not only to crimp connector **10** to conductors **32** and **34**, but also to crimp connector **10** to tab **50** at the same time. It will be understood that the order of assembly of conductors **32** and **34** to connector **10** and connector **10** to terminal tab **50** is immaterial and any order may be used, depending upon the particular application.

Referring now to FIG. 7, there is shown another embodiment of the present invention. As shown, connector

52 is provided with a single outwardly opening notch **54** and a slot **56** having chamfered ends as at **58**. Connector **52** may be used where it is desired to have only one conductor connected to a terminal strip. This is shown more clearly at the right side of FIGURE 5. As shown, connector **52** is crimped to a conductor **60** and to tab **62** of strip **48**. Crimping is accomplished in the manner described hereinabove.

The connector of the present invention permits removal of conductors **32** and **34** from connector **10** and connector **10** from tab **50** without damage to the conductors or the terminal tab. FIGURES 8 through 13 show how this may be accomplished. As shown in FIGURE 8, forces are applied to connector **10** substantially midway between notches **14** and **16**. These forces are applied in opposing directions as shown by arrows **64** and **66**, said directions being perpendicular to the crimping forces as shown in dotted lines by arrows **44** and **46**. As shown in FIGURE 8, initial application of forces **64** and **66** causes sides **68** and **70** of slot **18** to bow, thus uncrimping connector **10** from tab **50** to allow easy removal of connector **10** from tab **50**. As shown in FIGURE 9, connector **10** is still crimped to conductors **32** and **34** but removed from tab **50**.

FIGURE 10 shows the deformation of connector **10** by the application of forces **64** and **66**. During this stage of application, arms **24**, **26**, **28** and **30** are still enclosed about conductors **32** and **34**.

As shown in FIGURE 11, connector **10** has been deformed further by the continuing application of forces **64** and **66**. Arms **24**, **26**, **28** and **30** have been opened up to uncrimp connector **10** from conductors **32** and **34**, thus permitting removal of conductors **32** and **34** from notches **14** and **16** of connector **10** without damage to the conductors. As shown in FIGURE 12, at this stage the sides of connector **10** are considerably depressed and slot **18** has taken on a substantially oblong shape.

Continued application of forces perpendicular to the crimping forces finally causes connector **10** to shatter. This is shown more clearly in FIGURE 13, wherein connector **10** is shown to be shattered as at **68** and **70**.

The uncrimping operation shown in FIGURES 8–13 may be summarized as follows: in the first stage, as shown in FIGURES 8, 9 and 10, forces are applied to connector **10** substantially midway between the notches thereof. These forces are perpendicular to the forces that had been applied to crimp connector **10** to conductors **32** and **34** and to tab **50**. During the initial application of these uncrimping forces, the slot of connector **10** is deformed to allow easy removal of connector **10** from tab **50**. At this stage, however, insufficient force has been applied to permit removal of conductors **32** and **34** from connector **10**. After removal of connector **10** from tab **50**, further application of the uncrimping forces causes further deformation of connector **10** such that arms **24**, **26**, **28** and **30** thereof are forced open to permit removal of conductors **32** and **34** from connector **10**. This stage is shown more clearly in FIGURES 11 and 12. In the final stage of the application of the uncrimping forces, connector **10** is shattered without causing physical damage to conductors **32** and **34**.

The uncrimping forces may be produced by any suitable tool such as a pair of pliers or the like. The uncrimping operation described above is simple in application and allows easy removal of conductors while minimizing physical damage thereof.

Although the embodiment of the present invention shown in FIG. 1 has a generally elliptical configuration, it will be understood that this invention is not to be limited to any one configuration, but that any configuration may be used which accomplishes the purposes described hereinabove. In similar manner, although the embodiments of the connector of the present invention have been described hereinabove as comprising sintered metallic material, it will be understood that the connector of

the present invention may be made of any conductive material which allows easy crimping of the connector to a conductor by the application of compressive forces in one direction and which allows removal of the conductors from the connector without physical damage to the conductors by the application of compressive forces perpendicularly to the crimping forces. It will also be understood that the configuration of the conductor-receiving notches of the connectors described hereinabove is unimportant to the present invention and any suitable configuration may be used which allows positive electrical connection between conductor and connector. Where it is desired to connect two conductors to each other, the intermediate slot of the embodiment shown in FIG. 1 may be omitted. In order to provide better electrical contact between the connector and a conductor, either or both may be tinned as, for example, tin coating **80** on connector **10** (FIG. 2). Similarly, the terminal tab upon which connector **10** may be inserted may also be tinned to improve electrical connection.

Although specific embodiments of the connector of the present invention have been described hereinabove and shown in the drawings, it will be understood that other embodiments evident to those skilled in the art are also comprehended to be within the scope of the present invention. Therefore, the scope of the present invention is not to be limited by such embodiments, but rather by the following claims.

What is claimed is:

1. A solderless electrical connection of sintered powdered conductive material comprising a body of substantially elliptical shape, said body having at least one substantially C-shaped outwardly opening notch provided at at least one end thereof and an elongated substantially rectangularly shaped slot adjacent said at least one notch and having its longitudinal axis transverse to the longitudinal axis of said body, said slot receiving a flat blade-like terminal tab to which said body is crimped, said at least one notch receiving at least one electrical conductor and being crimped thereto, said body having the characteristic that compressive crimping forces applied to said body at the ends thereof close said at least one notch, thereby crimping said body on said at least one electrical conductor placed within said outwardly opening notch, and further crimps said body to a terminal tab inserted into said slot, that uncrimping forces may be applied to said body in the region of said slot perpendicularly to said crimping forces to initially open up said slot to provide easy removal of said body from said tab, and that further application of said uncrimping forces causes said body to shatter.

2. The connector of claim **1** wherein said body is tinned.

3. A solderless electrical connection of sintered powdered conductive material comprising a body of substantially elliptical shape, said body having substantially C-shaped outwardly opening notches provided at opposed ends thereof and an elongated substantially rectangularly shaped slot intermediate said notches and having its longitudinal axis transverse to the longitudinal axis of said body, said slot receiving a flat blade-like terminal tab to which said body is crimped, each of said notches receiving an electrical conductor, and being crimped thereto, said body having the characteristic that compressive crimping forces applied to said body at the ends thereof close said notches, thereby crimping said body on said electrical conductors placed within said outwardly opening notches, and further crimp said body to a terminal tab inserted into said slot, that uncrimping forces may be applied to said body substantially midway between said notches perpendicularly to said crimping forces to initially open up said slot to provide easy removal of said body from said tab, and that further application of said uncrimping forces causes said body to shatter.

4. The connector of claim **3** wherein said body is tinned.

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DARRELL L. CLAY, Primary Examiner

U.S. Cl. X.R.

29—628; 174—94; 287—109; 339—276