Dec. 13, 1966 J. H. SAMPSON 3,291,894

ELECTRICAL COMPONENT WITH TERMINAL LUGS

Filed April 19, 1966 3 Sheets-Sheet 1

Fig. 1.

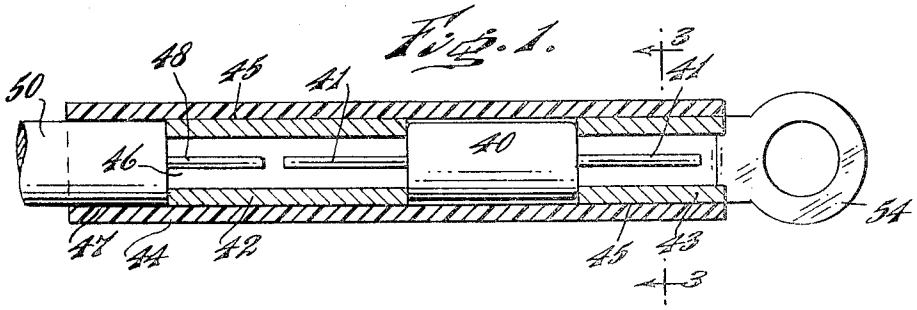


Fig. 2.

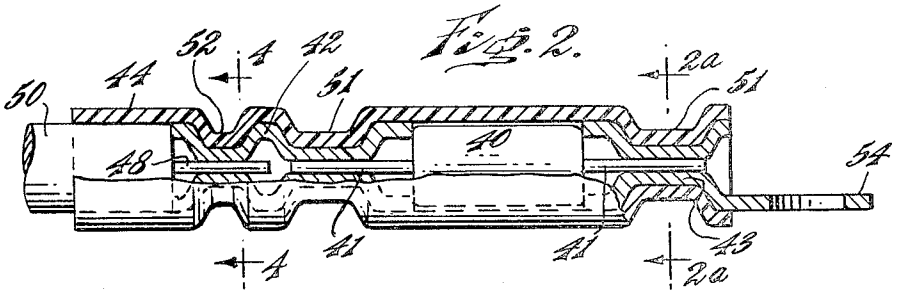


Fig. 2a.

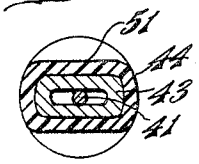


Fig. 3.

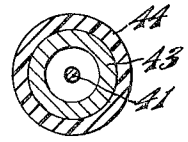


Fig. 4.

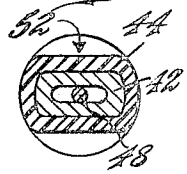


Fig. 8.

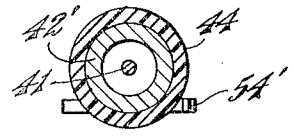
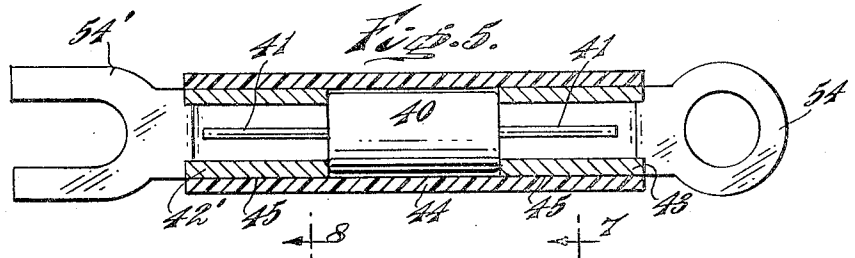


Fig. 5.



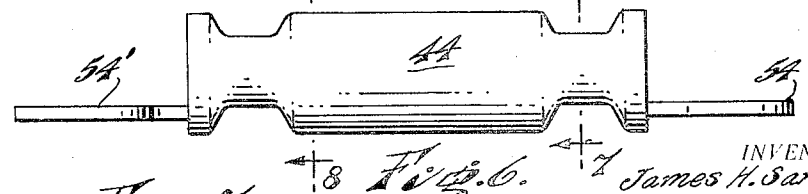
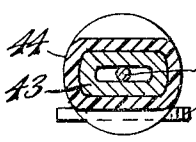


Fig. 6.

Fig. 7.



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ELECTRICAL COMPONENT WITH TERMINAL LUGS

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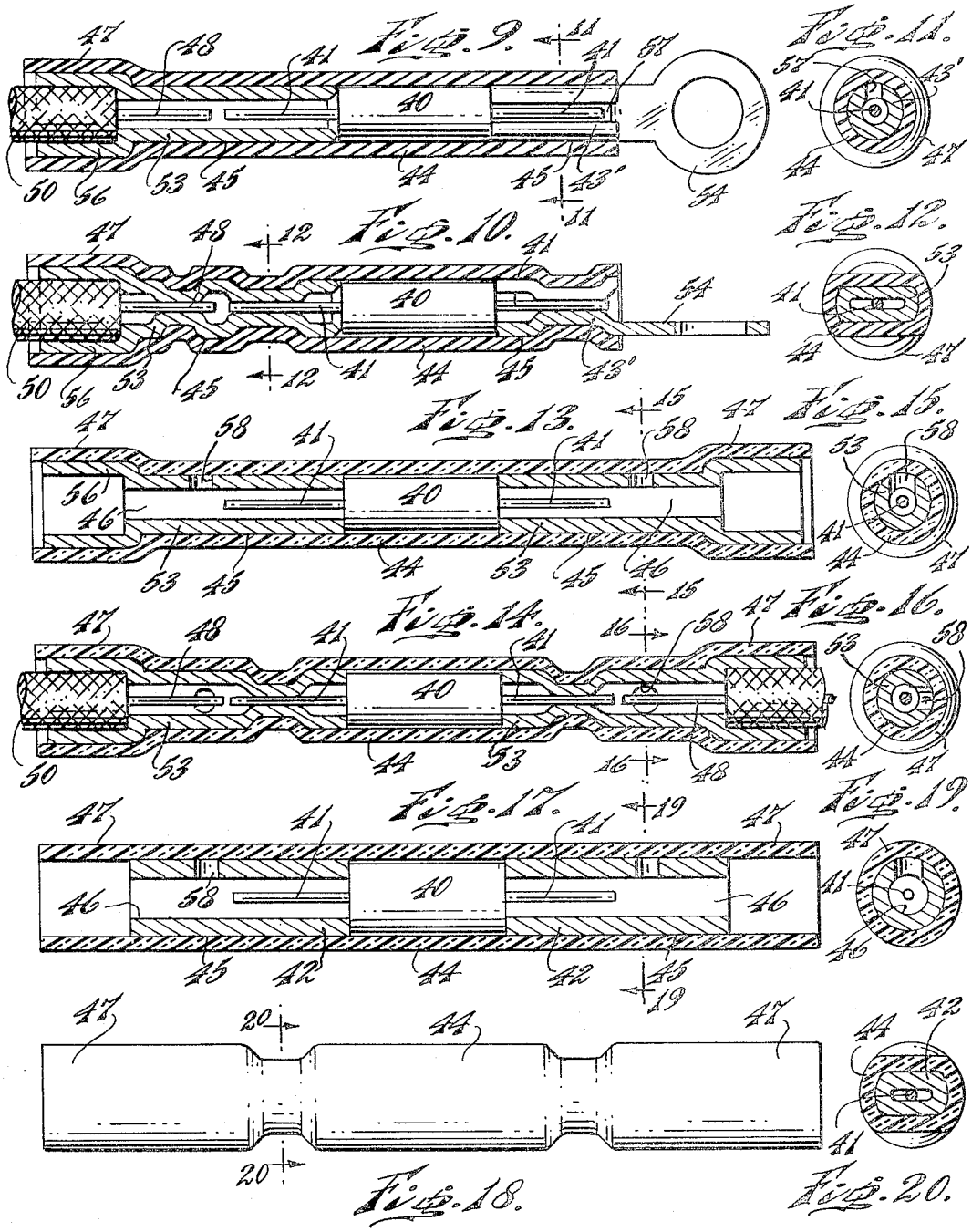

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ELECTRICAL COMPONENT WITH TERMINAL LUGS

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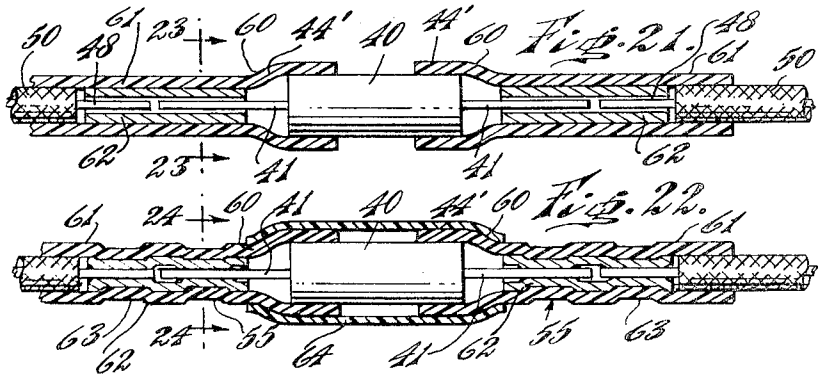

Fig. 21.

Fig. 23.

Fig. 22.

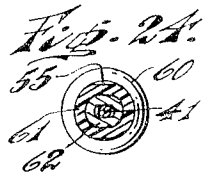

Fig. 24.

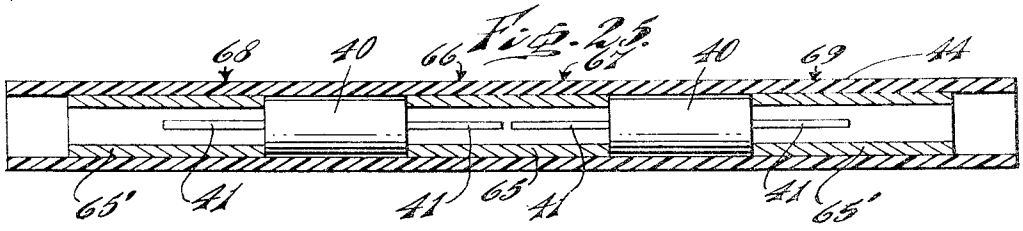

Fig. 25.

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3,291,894
ELECTRICAL COMPONENT WITH TERMINAL LUGS

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Filed Apr. 19, 1966, Ser. No. 543,678
16 Claims. (Cl. 174—52)

This application is a continuation-in-part of my earlier application Serial No. 326,968, filed November 29, 1963, now abandoned, for an Electrical Lug.

The present invention relates to an electrical connector containing an electrical component capable of connecting with terminals, binding posts, screw or bolt connecting and for connection with a wire or lead.

A purpose of this invention is to provide an electrical component in an electrical connector in order to avoid the necessity of separately mounting the component with respect to an electrical circuit.

A further purpose of this invention is to greatly reduce the cost of manufacture of these connectors and to eliminate the danger of failure in the making of such connectors which both support and protect an electrical component and make external electrical connection to it.

A further purpose of this invention is to eliminate the need for welding or soldering in the manufacture of these connectors in order to avoid damage to the electrical component by the high temperature created by such welding and soldering.

A further purpose of this invention is to provide a connector having a tubular elastomeric insulating body surrounding an electrical component with tubular electrical conductors fitting inside opposite ends of the body, wherein the tubular conductors are crimpable with and through the insulating body onto the wire terminals of the electrical component thereby eliminating the need for welding or soldering to achieve an electrical connection between the component and the connector.

A further purpose of this invention is to provide an opening within the tubular electrical conductors for receipt of electrical wires wherein the conductors are crimpable with and through the insulating body to connect the wires to the connector.

A further purpose of this invention is to permit inspection of the wires prior to and after crimping of the tubular conductors of the connector to the wires.

A further purpose of this invention is to permit encasing an electrical component of larger size than the tubular conductors by surrounding each conductor with an elastomeric tube that flares outwardly and surrounds a portion of the electrical component.

A further purpose is to utilize standard tubular electrical conductors to assembly the electrical connectors of this invention.

A further purpose is to guard against transmission of external longitudinal and tortional forces applied to the lead wires by making a crimp between the surrounding tubular body and the tubular conductors, the tubular body being deformable in order to retain its crimped impression.

A further purpose is to place a one-way current diode in the body of the connector to reduce the danger of serious consequences in making a mistake in the wiring of electrical mechanisms and further to protect the diode from damage during installation of the connector.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate one only of the numerous embodiments in which the invention may appear, selecting the form shown from the standpoints of convenience in illustration, satisfactory operation, and clear demonstration of the principles involved.

FIGURE 1 is a top view in section of an electrical connector assembled according to the objects of this invention and containing an electrical component prior to the crimping of tubular conductors to the terminals of the component and the lead wire.

FIGURE 2 is a side view partially broken away of the connector of FIGURE 1 subsequent to crimping the assembly and connection of a wire lead.

FIGURE 2*a* is a section of FIGURE 2 taken along the lines **2***a*—**2***a*.

FIGURE 3 is a section of FIGURE 1 taken along the lines **3**—**3**.

FIGURE 4 is a section of FIGURE 2 taken along the lines **4**—**4**.

FIGURE 5 is a view of a connector similar to FIGURE 1 having tubular conductors with terminal connections at both ends.

FIGURE 6 is a plan view of the outside of the connector of FIGURE 5 subsequent to crimping.

FIGURE 7 is a section of FIGURE 6 taken along the lines **7**—**7**.

FIGURE 8 is a section of FIGURE 6 taken along the lines **8**—**8**.

FIGURE 9 is a top sectional view similar to FIGURE 1 showing variations in the construction of the tubular conductors.

FIGURE 10 is a side sectional view of the connector of FIGURE 9 subsequent to crimping and connection of a wide lead.

FIGURE 11 is a section of FIGURE 9 taken along the lines **11**—**11**.

FIGURE 12 is a section of FIGURE 10 taken along the lines **12**—**12**.

FIGURE 13 is a sectional view of a modified connector prior to crimping that is capable of being connected to wires at both ends.

FIGURE 14 is a sectional view of the connector of FIGURE 13 subsequent to crimping with wire leads in position of crimpable connection with the connector.

FIGURE 15 is a section of FIGURE 13 taken along the lines **15**—**15**.

FIGURE 16 is a section of FIGURE 14 taken along lines **16**—**16**.

FIGURE 17 is a modified form of the electrical connector of this invention similar to that shown in FIGURE 1.

FIGURE 18 is an outside view of the assembled connector of FIGURE 17 subsequent to crimping.

FIGURE 19 is a section of FIGURE 17 taken along the lines **19**—**19**.

FIGURE 20 is a section of FIGURE 18 taken along the lines **20**—**20**.

FIGURE 21 is a modified form of an electrical connector wherein the tubular conductors are of a smaller size than the electrical component.

FIGURE 22 is a similar view of the connector of FIGURE 21 subsequent to crimping and including a protective cover for the electrical component.

FIGURE 23 is a section of FIGURE 21 taken along the lines **23**—**23**.

FIGURE 24 is a section of FIGURE 22 taken along the lines **24**—**24**.

FIGURE 25 is a variation of the electrical connector of this invention having electrical components arranged in series prior to crimping.

In the general prior art practice, electrical components such as diodes, transistors, resistors, capacitors, inductors and networks have been installed in an electrical circuit by soldering or otherwise connecting the leads of the components to binding posts which has proved to be difficult, expensive and not always reliable.

In many electrical circuits such as battery charging circuits and various control circuits for aircraft and guided missiles and in telemetering and numerous other electrical installations, it is desirable to install a diode in the circuit that will permit current to flow in one direction while blocking current flow in the opposite direction. One such device is the silicon diode which is extensively used because the forward resistance is very low while the back resistance is exceptionally high. In addition, the inverse voltage capacity is high.

An effort has been made as described in my previous application to produce an electrical connector in which these electrical components have their wire terminals soldered to oppositely disposed metallic electrical conductors that are capable of connecting directly to external wiring as through terminal lugs or crimped connections in order to form a single unitary connector thereby eliminating all of the above described parts. The connector then performs the function of supporting the component and of interposing it electrically between for example a terminal lug that is secured to a terminal and a wire lead.

However, in the assembly of electrical connectors of this character the soldering or welding of the wire terminals of the electrical component to the conductors has proved troublesome, costly and often injurious to the component and following this the injection molding of an electrical insulating material to fill the interior space between a surrounding body and the electrical conductors has proved quite expensive.

Furthermore, in electrical connectors of this type if an axial force is applied to it such as by twisting or pulling the external wiring, this is transmitted to the wire terminals of the electrical component causing a break to occur in the electrical connection.

I have discovered that electrical connectors can be constructed and assembled in a much improved and less expensive manner by eliminating the need for soldering the wire terminals of the component to the electrical conductors by crimping the tubular conductors onto the wire terminals of the component thereby creating an electrical connection between them. The crimping also locks the tubular conductors with respect to the surrounding insulating body to prevent relative rotation between the tubular conductors and the surrounding body and to prevent the tubular conductor from being pulled out of the insulating body.

Furthermore, I have found that the tubular electrical conductors can include a terminal connection or lug integral therewith which greatly reduces the cost of making these connectors. Any one of a variety of terminal lugs including ring tongue, block, hooked or forked spade connections and the like can readily be included in the assembly of the connectors. In addition, any combination of a terminal connection or lug, with a sleeve at the other end for connection to a wire lead can be made, or wire sleeve connections can be provided at both ends on the connector.

The outer open ends of the electrical tubular conductors form the sleeve for receipt of a lead wire, the tubular conductors then being crimpable with and through the insulating body to grip the wires and to complete the electrical connection between the wires and the component.

By constructing a connector according to the objects of this invention, the cost which formerly was on the order of $1.00 a piece can now be made for as low as a few cents a piece. Savings of over $20 have also been realized on the installation of a single resistor as the electrical component in an electrical connector.

The connectors of this invention can be in any suitable form and preferably the electrical component is a silicon diode enclosed therein with suitable current ratings, voltage ratings, terminal lug size and wire receiving size for the connector stamped thereon.

In the form of the connectors shown in FIGURES 1 to 3, there is an electrical component **40** which may be a diode, transistor, capacitor, resistor, inductor or a network and suitably of cylindrical form having at its opposite ends wire terminals **41** extending along the axis of the lug. Each of the wire terminals is surrounded by a tubular conductor **42** at one end and a conductor **43** at the other end, the tubular conductor engaging the ends of the electrical component respectively and extending generally in the axial direction of the electrical component **40**.

Each of the tubular conductors is suitably of an electrical conductive metal such as copper, bronze or aluminum. The conductors fit within a tubular insulating body **44** which is suitably elastomeric capable of undergoing deformation as will later be described. The material of the insulation may be rubber, synthetic rubber, polyvinyl chloride, polyvinyl chloride acetate or nylon. The insulating tubular body **44** makes a press fit on the ouside of the tubular conductors **42** and **43** as shown at **45** so that there is a considerable capability of force transmission from either one of the tubular conductors to the insulating body and vice versa without relative movement between them either rotationally or longitudinally.

As shown in FIGURE 1 the tubular conductor **42** is a straight tube having a butt end connecting sleeve extending beyond the wire terminal **41** in a direction away from the electrical component **40**. This provides an internal cavity **46** capable of receiving a wire **48** and being crimped onto the wire. The tubular insulating body **44** extends beyond the outer end of the tubular conductor **42** at **47** to form a shroud or protector for the insulation **50** of the wire lead **48**.

At the opposite end the tubular conductor **43** has extending therefrom a terminal lug **54** which is shown here for example as a ring tongue which can be attached to a screw or binding post.

Having asembled the connector as shown in FIGURE 1 without the wire, crimps **51** are then made at opposite ends through the tubular insulating body **44** causing the tubular conductors **42** and **43** to engage and grip the wire terminals **41** to establish electrical connection between the component **40** and the tubular conductors. By reason of the fact that the crimp remains in the plastic insulating body the crimp also creates a very firm connection longitudinally and torsionally between the tubular conductors and the plastic body **44**. The crimped connector is shown in section in FIGURE 2*a*.

When the connector is to be attached to a wire lead, a subsequent crimp is then made at **52** to complete the connection between a wire lead and the electrical component, the tubular conductor **42** engaging and gripping the wire **48** of the electrical lead. The connector crimped to a wire lead is shown in section in FIGURE 4.

In assembling the electrical connector of FIGURES 1 to 3, one of the tubular conductors is first placed into the plastic sleeve **44** and then the electrical component **40** is pushed into place against the edge of the tubular conductor. Then the second tubular conductor is force fitted into the opposite end of the sleeve against the other side of the component. The sleeve **44** is then crimped at the desired locations **51** and preferably simultaneously to connect the component to the tubular conductors. If it is desired to attach to the connector an electrical lead, a wire is placed within the space **46** at one end of the electrical connector. A subsequent crimp is then made at **52** to connect the electrical connector to the wire lead.

In FIGURES 5 to 8 there is shown a modified form of the invention having terminal lugs or connections integral with the tubular conductors at both ends of the connector. In this case the tubular conductor **42'** is provided with a forked spade **54'** and the tubular conductor **43** with a ring tongue **54**, both ends of the connector now being capable of being secured to binding posts or screws.

The form of FIGURES 9 to 12 provides a tubular

conductor 53 at one end which has a flared outer portion 56 that surrounds the insulation 50 of a lead wire 48. At the other end tubular conductor 43' has been modified to include a slot 57 so that the entire conductor can be made from a piece of rolled sheet metal without the need for soldering or welding.

In the forms shown in FIGURES 13 to 16 flared tubular conductors 53 are placed within both ends of the sleeve 44 and have been modified to include a lateral window or opening 58 opening into the cavity 46. In this case plastic body 44 is transparent so that it is possible to see whether the end of a lead wire 48 is properly seated before the connector is crimped to the wire. In FIGURE 14 the electrical connector is shown assembled by the crimping of the tubular conductors to the terminals of the electrical component, with suitable wire leads in position for subsequent crimpable connection between the conductors and the wires.

The form of FIGURES 17 to 20 has at both ends tubular conductors 42 that have been modified to include the window 58 to permit inspection of the end of a wire before and after crimping. The form is similar to the connector shown in FIGURE 1 but is capable of being connected to wires at both ends. The outside of the electrical connector subsequent to assembly but before connection to wire leads is shown in FIGURE 18.

In the form of FIGURES 21 to 24 there is shown an electrical component 40 that is received by a bell shaped elastomeric insulating tube 44' at each end that has a bell portion 60 connecting with a reduced tubular portion 61 that is in press fit engagement with tubular conductors 62 at each end. The tubular sleeve is crimped at 55 to grip the conductors to the wire terminals 41 and to lock the assembly in place around the component. It would also be crimped at suitable points 63 to grip the electrical conductors to the ends of wire leads. A suitable protective sleeve 64 may be shrunk fit over the assembly to provide protection for the electrical component as shown in FIGURE 22. This assembly would be convenient for existing electrical components of any size.

As shown in FIGURE 25 the principles of the invention can be used to enclose or seal a plurality of electrical components in series all electrically interconnected. Thus, in this form I show electrical components 40 extending endwise within an elastic tube 44 closely surrounding the components. At at intermediate point wire terminals 41 are connected in series by tubular connection 65 that is crimped at 66 and at 67 to engage the respective wire terminals of the components. At remote ends crimping is also done at 68 and at 69 to engage the outer wire terminals of the components. The outboard tubular conductors 65' are capable of receiving and being crimped about wire leads as shown in the foregoing figures.

The crimped tubular conductors of the electrical conductors thus hold the electrical component endwise against change of position both rotationally and longitudinally while making electrical connection to it, and hence guard gainst the transmission of twisting and pulling forces applied to the wiring to prevent destruction of the integrity of the connector. By crimping the tubular conductors with respect to the wire terminals to make electrical connection therewith instead of by soldering or welding to create such a connection, the most of manufacture of the connector and the probability of damage to the component have been greatly reduced. Furthermore, the electrical connectors are capable of being directly connected to electrical wire leads by further crimping the conductors about the wires or to terminal posts by providing a terminal lug on the end of the conductor.

In the preferred embodiment of this invention the electrical component comprises a silicon diode, the insulating body of transparent material and the tubular conductors including windows or openings which permit inspection of the wire leads that are to be inserted therein and connected to the electrical connector.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the product shown, and I therefore claim all such insofar as they fall within the reasonable spirit and scope of my invention.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In an electrical connector, an electrical component having wire terminals at its opposite ends, a pair of tubular crimpable electrical conductors in line with and one at each end of the electrical component, each tubular conductor surrounding a wire terminal of the electrical component and in crimped engagement therewith, and extending endwise beyond the wire terminals in a direction remote from the electrical component adapted to receive electrical connection thereto and a tubular insulating body surrounding the electrical component and surrounding at least a portion of each tubular conductor.

2. A connector of claim 1, in which the insulating body is in press fit engagement with the tubular conductor.

3. A connector of claim 1, in which the tubular conductors abut opposite ends of the electrical component and restrain it against moving longitudinally within the tubular body.

4. A connector of claim 1, in which the tubular insulating body is deformable and the tubular conductor is crimped to the wire terminals with and through the insulating body thereby preventing relative movement between the tubular conductors and insulating body.

5. A connector of claim 1, in which at least one of the tubular conductors extending beyond the wire terminal of the electrical component has a terminal lug integral therewith.

6. A connector of claim 5 in which both of the tubular conductors extending beyond the wire terminal of the electrical component have terminal lugs integral therewith.

7. A connector of claim 1, in which at least one of the tubular conductors extending beyond the wire terminal of the electrical component, forms a crimpable socket for gripping the end of a wire lead.

8. A connector of claim 7, in which both of the tubular conductors extending beyond the wire terminals of the electrical component form at each end of the connector a crimpable socket for gripping and connecting the ends of wire leads to the connector.

9. A connector of claim 7, in which at least one of the tubular conductors extends beyond the crimpable socket and flares outwardly within an outwardly flared portion of the insulating body forming a socket for receiving the insulation of the wire lead.

10. A connector of claim 1, in which at least one of the tubular conductors extending beyond the wire terminal of the electrical component within the insulating body forms a crimpable socket for receiving and gripping the end of a wire lead and includes a lateral opening in the socket portion of the tubular conductor, said insulating body being transparent, to permit inspection of the interior of the tubular conductor through said lateral opening.

11. In an electrical connector, an electrical component having wire terminals at opposite ends, a tubular conductor surrounding one of the terminal wires and in crimped engagement therewith extending beyond the wire terminal in a direction remote from the component forming a crimpable socket adapted to receive and grip the end of a wire lead, a second tubular conductor surrounding the opposite terminal and in crimped engagement therewith extending beyond the wire terminal and

including a terminal lug integral therewith for connection of the electrical connector to a terminal.

12. A connector of claim 11, in which the tubular conductor forming a crimpable socket for receiving the end of a wire lead includes a lateral opening in the socket portion of the tubular conductor, said insulating body being transparent, to permit inspection of the interior of the tubular conductor through said lateral opening.

13. In an electrical connector an electrical component having wire terminals at opposite ends, tubular conductors in line with the electrical component on opposite ends thereof surrounding the wire terminals and in crimped engagement therewith and a pair of insulating tubes, each surrounding a portion of one of the tubular connectors and an adjoining portion of the electrical component and in gripping engagement with said tubular connections.

14. A connector of claim 13, in which each of the insulating tubes has an outward flare interconnecting a smaller portion surrounding and engaging one of the tubular connections and a larger portion surrounding and engaging an outside portion of the electrical component.

15. A connector of claim 13, including a tubular covering surrounding the electrical component and a portion of each insulating tube.

16. In an electrical connector, a plurality of electrical components having wire terminals at opposite ends, tubular conductors in line with and between each component and one at opposite ends of said plurality of components, each tubular conductor surrounding the wire terminals of the components and in crimped engagement therewith, the end conductors extending beyond the terminals of the component and adapted to receive external electrical connection and a tubular insulating body surrounding the electrical components and the tubular conductors.

No references cited.

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