United States Patent [19]

Cherney et al.

[11] **3,865,460**

[45] **Feb. 11, 1975**

[54] **COMPONENT CONNECTOR**

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[73] Assignee: **Minnesota Mining and Mfg. Co.,** Saint Paul, Minn.

[22] Filed: **Apr. 30, 1973**

[21] Appl. No.: **355,456**

[52] **U.S. Cl.** **339/98**

[51] **Int. Cl.** **H01r 9/08**

[58] **Field of Search** 339/95, 97–99

[56] **References Cited**

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3,202,957	8/1965	Leach	339/98
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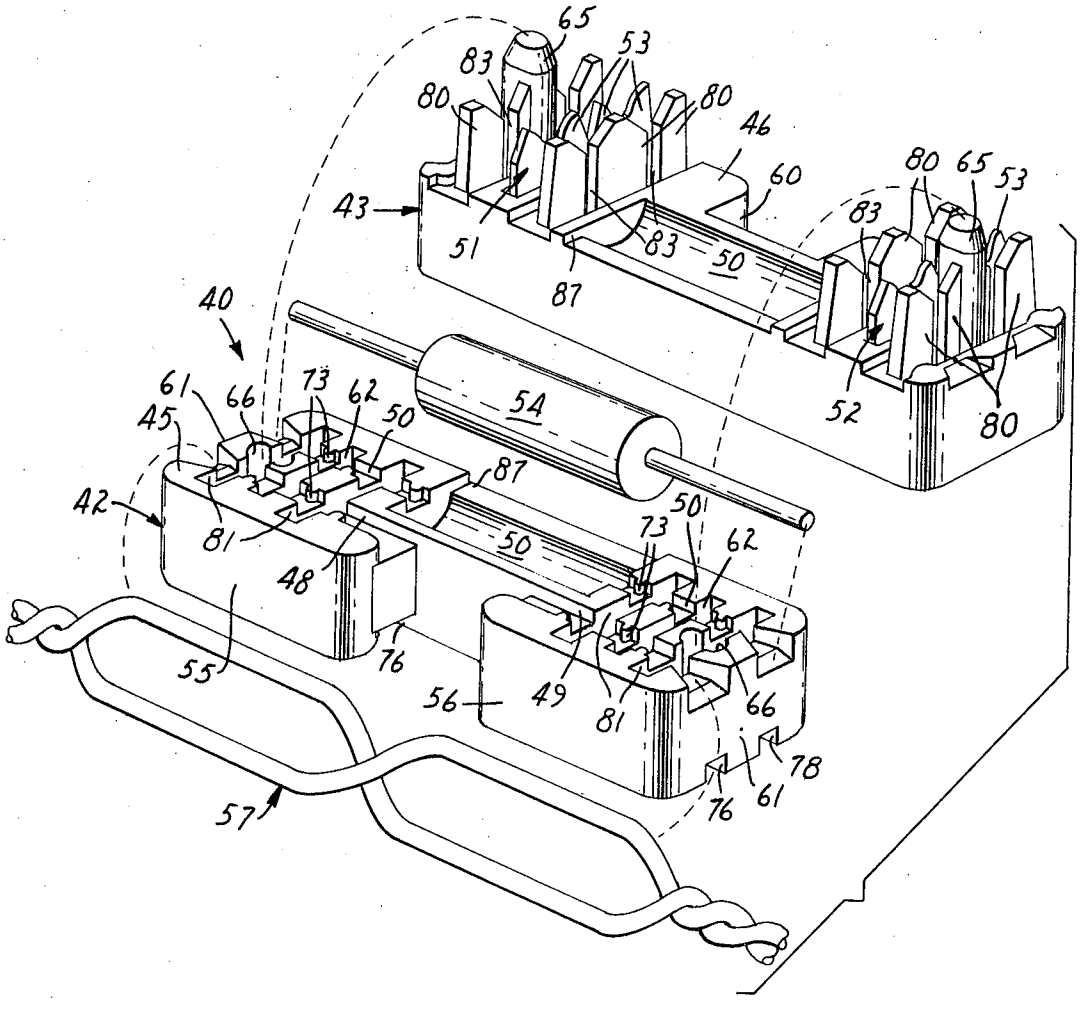
Attorney, Agent, or Firm—Alexander, Sell Steldt & DeLaHunt

[57] **ABSTRACT**

A versatile connector including a first portion having wire receiving channels and a component receiving cavity, and a second portion including conductive contact elements. The first portion has adjacent spaced projections each having one of the wire receiving channels extending across a surface thereof and being positioned adjacent a different end of the component receiving cavity. The projections may be inserted in adjacent expanded loops of a twisted pair of wires so that each channel receives a length of a different wire of the pair. When the connector is closed the contact elements make connections between the ends of a component in the cavity and the wire in the adjacent channel to connect the component across the wires.

7 Claims, 5 Drawing Figures



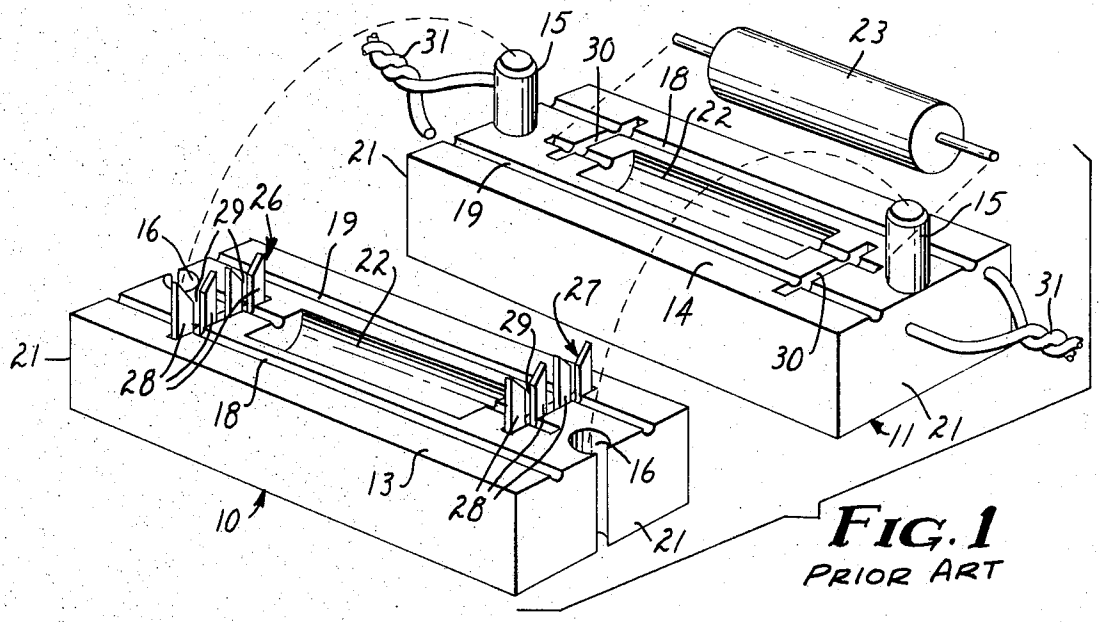


FIG. 1
PRIOR ART

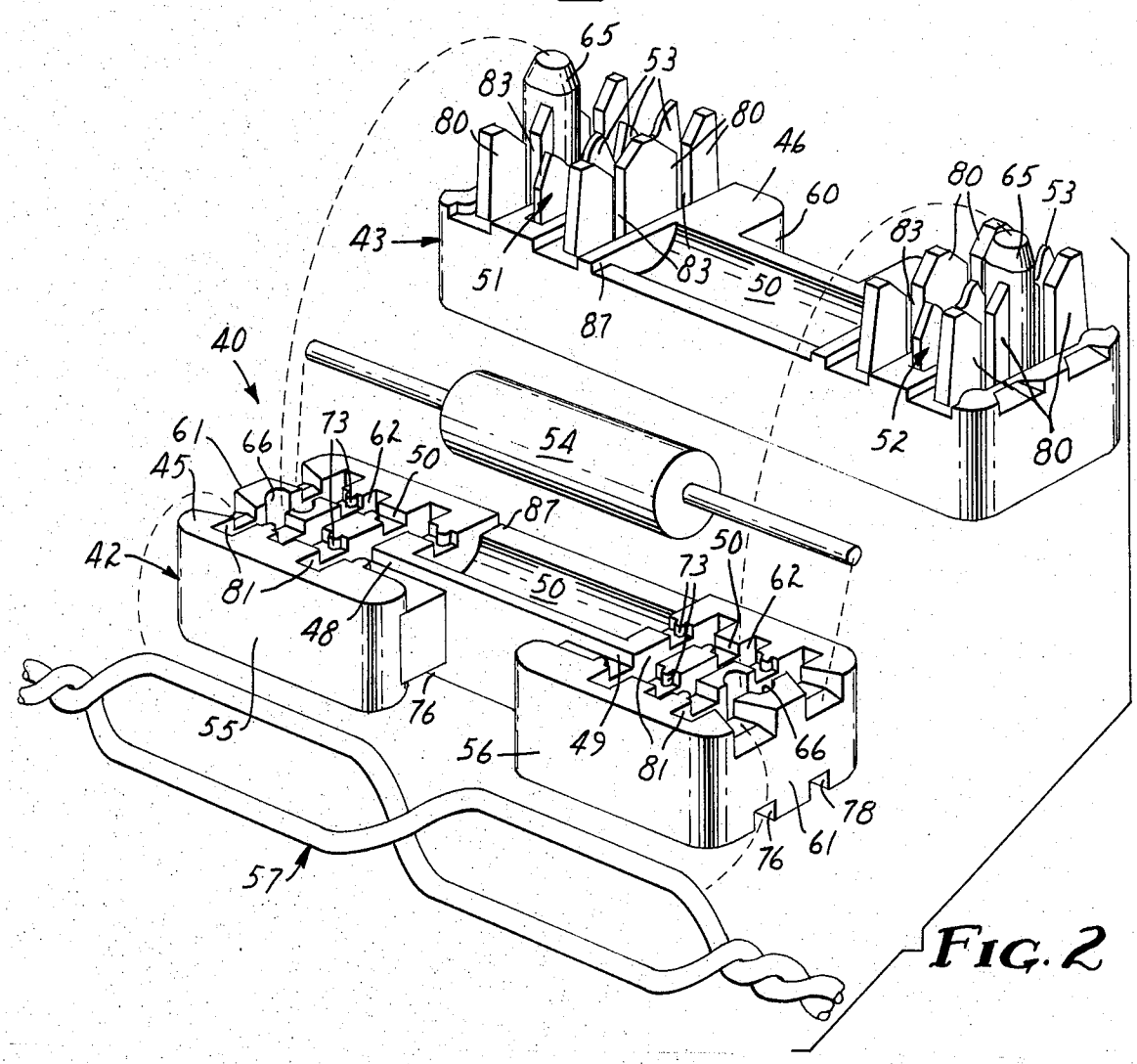


FIG. 2

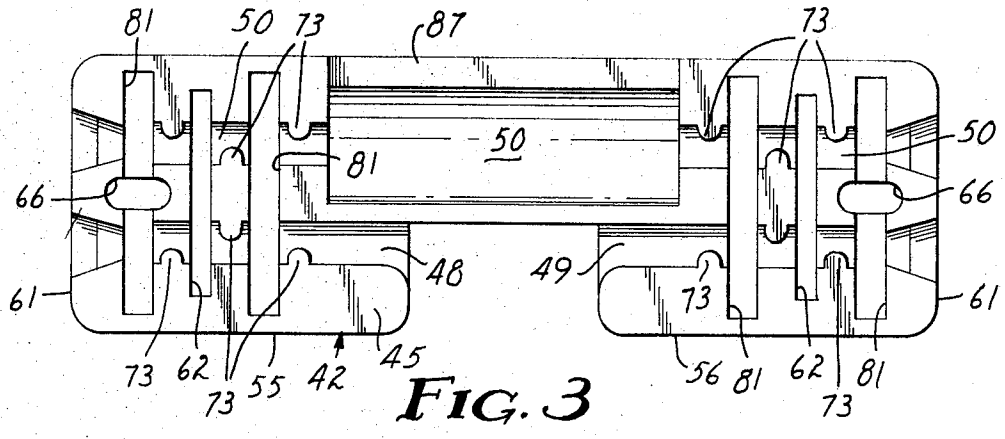


FIG. 3

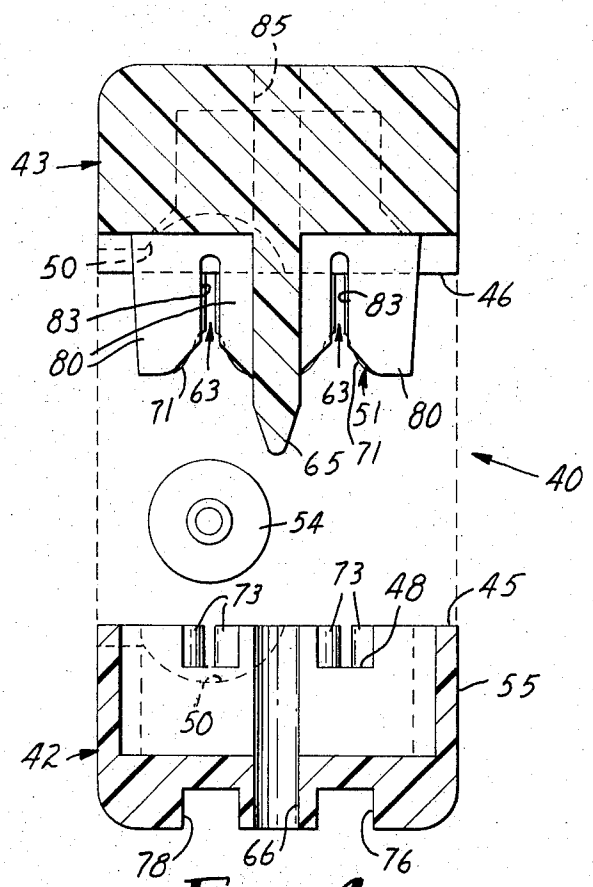


FIG. 4

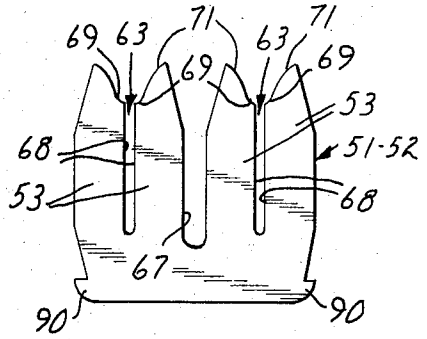


FIG. 5

COMPONENT CONNECTOR

BACKGROUND OF THE INVENTION

The present invention relates to a connector utilizing conductive contact elements having spaced wire engaging fingers adapted to make electrical connections between wires, and in one aspect to such a connector adapted to connect a component such as a resistor or a capacitor between wires.

There is often a requirement to connect a component such as a resistor, capacitor, or diode between wires of a circuit. Such connections are frequently made, for example between the wires of a twisted pair of wires to tune the interconnections between circuits on the back panels of a computer. Heretofore, such connections have typically been made by the tedious and time consuming method of stripping the wires, wrapping together the wires and component leads to be connected, applying solder to the joints, and covering the joints as with heat shrinkable tubing.

One computer manufacturer has proposed the use of connectors having conductive contact elements of the types disclosed in U.S. Pat. Nos. 3,202,957 and 3,388,370 to connect a component between the wires of a twisted pair. The proposed connector, pictorially illustrated in FIG. 1 of the drawing, includes a body of an insulating material having separable first and second body portions **10** and **11** with surfaces **13** and **14** respectively having planar portions adapted for contact in a closed position of the body portions **10** and **11**, and means including spaced cylindrical posts **15** on the second body portion **11** adapted to frictionally engage openings **16** in the first body portion **10** to guide the body portions **10** and **11** as the connector is closed and to maintain the body portions **10** and **11** in the closed position. The surfaces **13** and **14** are shaped to each provide portions of first and second spaced axially parallel wire receiving channels **18** and **19** extending between ends **21** of the connector, and an axially parallel stepped cylindrical cavity **22** between the channels **18** and **19** adapted to receive a component having lead wires projecting coaxially from its opposite ends. First and second planar conductive elements **26** and **27** are mounted in the first body portion **10** at opposite ends of the component cavity **22.** Each contact element **26** has fingers **28** defining spaced wire accepting slots **29** therebetween adapted to make an electrical connection between wires forced into the slots **29.** The contact elements **26** and **27** are positioned so that as the connector is closed the fingers **28** will enter openings **30** in the second body portion **11.** The slots **29** of the contact elements **26** and **27** are aligned so that as the connector is closed the fingers **28** of the first contact element **26** will engage and connect a wire in the first channel **18** with the lead wire at one end of a component **23** in the cavity **22,** while the other contact element **27** will engage and connect the lead wire at the opposite end of the component **23** and a wire in the second channel **19.** Thus if both the wires inserted in the channels **18** and **19** are continuous, such as when lengths of both wires of a twisted pair **31** are inserted therein, a component **23** in the cavity **22** will be connected in parallel between the wires; whereas if the ends of separate wires are placed in the channels **18** and **19** the component **23** will be connected in series with the wires.

This prior art connector requires that a large loop be made in a twisted pair as the length of the wire section

engaged in each of the channels **18** and **19** must be longer than the body of the component. If a component is to be connected in series along a wire, the wire must be severed, and the newly formed ends must be positioned respectively in the first and second channels **18** and **19** before the connector is closed.

SUMMARY OF THE INVENTION

The present invention provides a convenient and versatile connector for connecting a component in parallel between or in series with a pair of wires. The connector is adapted to engage small adjacent loops formed in a twisted pair to connect a component in parallel between the wires thereof. Additionally, the connector provides means whereby the connector may be attached to a continuing wire, after which the wire may be conveniently severed to place a compound in series with its severed ends, thereby not requiring the workman to position two wire ends in the connector.

According to the present invention there is provided a connector of the type with a body of an insulating material having first and second portions with surfaces adapted for contact and members adapted for engagement to maintain the surfaces in contact with the connector closed. The surface of the first portion is shaped to provide two wire accepting channels and a cavity adapted to receive an electrical component having axially extending contact wires at each end. Two spaced resilient contact elements each having fingers defining spaced wire accepting slots therebetween are mounted in the second portion and positioned to connect a component in the cavity across wires in the channels when the connector is closed, all as suggested in the prior art. In the improved connector according to the present invention however, the first portion has spaced projections extending from one side of the first portion with each projection adjacent a different end of the wire receiving cavity and having one of the channels extending across the portion of said surface thereon. The projections are adapted for insertion into adjacent opened loops of a twisted pair of wires to position a continuing length of each wire in a different one of the channels and afford connecting a component in parallel between the wires by closing the connector. Alternatively a wire may be positioned along both of the channels, the connector closed, and the length of wire severed in the space between the projections to place the component in series with the severed ends of the wire.

Additionally, the contact elements in the connector according to the present invention are specially designed so that they may be very small while still providing a positive electrical connection with wires of a large range of sizes. The edges of the fingers at the inlet end of each slot define cutting edges of a predetermined length extending generally normally away from the slot. The edges are arcuate from the ends of the cutting edges opposite the slot to provide diverging convex edges. The fingers will be resiliently spread when a wire segment is forced between the arcuate edges and the cutting edges will notch the wire segment to a predetermined depth to sever any insulation on the wire, and engage the wire as the wire segment is forced into the slot.

This contact element design along with the body configuration allows the connector according to the present invention to be made very small, thereby facilitating its use in compact electronic gear.

BRIEF DESCRIPTION OF THE DRAWING

Both the prior art and the present invention are illustrated in the accompanying drawing wherein like numbers refer to like parts throughout the several views, and wherein:

FIG. 1 is a perspective view of a suggested prior art component connector with its body portions separated and illustrated with a component and fragments of a twisted pair of wires to be connected by the connector;

FIG. 2 is a perspective view of a connector according to the present invention showing the body portions separated and illustrated with a component and a twisted pair of wires to be connected by the connector;

FIG. 3 is a plan view of the first body portion of the connector illustrated in FIG. 2;

FIG. 4 shows a section of the connector illustrated in FIG. 2 taken with the body portions separated and positioned one above the other; and

FIG. 5 is an enlarged plan view of one of the contact elements in the connector illustrated in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 2 through 5 there is illustrated a connector according to the present invention generally designated by the numeral **40.** The connector **40** has a body of an electrically insulating material having separable first and second body portions **42** and **43** with surfaces **45** and **46** respectively. The surfaces **45** and **46** have planar portions in contact when the connector **40** is closed. The surface **45** defines a pair of wire receiving channels **48** and **49,** and a portion of a component receiving cavity **50** defined between the portions **42** and **43** when the connector is closed. First and second conductive contact elements **51** and **52** each having spaced wire engaging fingers **53** are mounted in the second portion **43** in a position to connect a component **54** in the cavity **50** across wires positioned within the channels **48** and **49** of the connector **40** when the connector is closed.

The wire receiving channels **48** and **49** are coaxial and respectively extend across spaced projections **55** and **56** extending from one side of the first body portion **42.** Wires may be inserted in the channels **48** and **49** by inserting the projections **55** and **56** in adjacent expanded loops of a twisted pair of wires **57** whereupon each channel **48** or **49** receives a length of a different wire of the twisted pair **57.** As the portions **42** and **43** of the connector are closed the contact elements **51** and **52** will connect the component **54** in the cavity **50** in parallel across the wires of the twisted pair **57.** Alternatively, a wire may be inserted in the connector to extend across both of the wire receiving channels **48** and **49,** the portions **42** and **43** of the connector **40** closed to engage the contact elements **51** and **52,** and the wire severed in the opening between the projections **55** and **56** to place the component in the cavity **50** in series with the severed wire ends. Such severing of the wire is facilitated by an opening **60** in the second body portion **43** aligned with the opening between the projections **55** and **56** when the connector is closed.

The wire receiving channels **48** and **49** respectively extend from opposite ends **61** of the first body portion **42** to the opening between the projections **55** and **56.** The cavity **50** is axially parallel to the channels **48** and **49** and has a large cylindrical central portion adapted to receive the body of a component, and smaller coaxial portions formed in and extending to the ends **61** of the first body portion **42** from the central portion to receive wire leads projecting coaxially from opposite ends of a component.

The portions of the cavity **50** adapted to receive the wire leads of a component each extend through the ends **61** of the first body portion **42,** so that the connector **40** may be used to splice wires. Separate lengths of wires may be positioned end to end in the cavity **50** or a length of a continuing wire may be positioned through the cavity **50** and be interconnected with a wire or wires in the channels **48** and **49** via the contact elements **51** and **52.**

Each end of the cavity **50** is adjacent one of the wire receiving channels **48** or **49** on the projections **55** and **56.** The two contact elements **51** and **52** are mounted in the second body portion **43** in parallel spaced relationship at opposite ends of the portion of the component cavity **50** formed therein. As the connector is closed the fingers **53** of each of the contact elements **51** and **52** will move transverse of the portion of the intersected first or second channel **48** or **49** and cavity **50** in the first body portion **42** and into a clearance opening **62** therein with slots **63** between the fingers **53** of the contact element **51** aligned to make connection between a wire in the first channel **48** and the lead wire at the adjacent end of a component in the cavity **50,** while the slots **63** between the fingers **53** of the contact element **52** are aligned to make contact between a lead wire at the opposite end of the component in the cavity and a wire in the adjacent second channel **49.**

The second body portion **43** has spaced tapered posts **65** projecting at right angles from the surface **46** and adapted to slidably enter openings **66** in the first body portion **42** to provide means for guiding the contact elements **51** and **52** during closing of the connector. The posts **65** frictionally engage the openings **66** as the body portions **42** and **43** reach the closed position to maintain the body portions **42** and **43** in the closed position.

The closed elements **51** and **52,** best seen in FIG. **5,** are conductive resilient metal plate-like members including the spaced fingers **53.** On each contact element **51** and **52** the fingers **53** define two wire accepting slots **63** therebetween each adapted for forceful entry of a wire segment to form a positive electrical connection with the wire, and a central relief slot **67** to afford proper deflection of the inner two fingers **53** upon engagement of the wire segment. Each slot **63** includes an inner portion having parallel edges **68** for making a positive electrical connection with a wire. The edges of the fingers **53** at the inlet end of each slot **63** define cutting edges **69** of a predetermined length extending generally normally away from the parallel edges **68.** From the ends of the cutting edges **69** opposite the parallel edges **68** the edges of the fingers **53** are arcuate to provide diverging convex edges **71.** The fingers **53** will be resiliently spread when a wire segment is forced between the convex edges **71,** and the cutting edges **69** will notch the wire segments to a predetermined depth to sever any insulation on the wire and engage the wire as a wire segment is forced into the slot **63.** As the resilient fingers **53** are forced apart, they thus apply continual pressure against the conductor to maintain a positive electrical connection.

The connector also includes means for retaining wire ends in the channels **48** and **49** and components in the

cavity **50** prior to closing the connector **40.** The walls of the first body portion **42** defining the channels **48** and **49** and portions of the cavity **50** for receiving lead wires each include a series of three spaced rounded protrusions **73** which define a generally U-shaped path for a length of a wire therein. When the wire is pressed between the protrusions **73** it becomes bent slightly to fit around the protrusions **73,** and has sufficient resilience to be frictionally retained therebetween. Alternatively wire ends could be temporarily retained in the cavity **50** and channels **48** and **49** by coating their walls with a layer of contact adhesive.

Also, a groove **76** is formed along the surface of each of the projections **55** and **56** opposite the channels **48** and **49.** After the projections **55** and **56** have been inserted in opened adjacent loops of a twisted pair, the portions of the twisted pair adjacent the ends **61** of the connector may be pulled away from each other to seat the wires of the pair in the grooves **76** and channels **48** and **49.** The first body portion **42** will then be supported by the twisted pair, leaving the workman's hands free to position the second body portion **43** and close the connector **40.**

A groove **78** is also formed along the surface of the first body portion **42** opposite the cavity **50.** The groove **78** is adapted to receive one wire of a second twisted pair when a wire thereof is positioned across the cavity and around the ends **61** of the connector **40** to splice wires with the connector **40** in the manner suggested above.

The connector also includes means for relieving bending strain at the segment of the wires engaged by the contact elements **51** and **52.** The second body portion **43** of the connector **40** is formed with spaced pillars **80** flanking each side of the contact elements **51** and **52,** and positioned to enter openings **81** in the first body portion **42** as the connector **40** is closed. The pillars **80** have diverging end portions leading slots **83** therebetween aligned with the slots **63** in the contact elements **51** and **52** and sized and positioned to intersect the channels **48** and **49** and the cavity **50** to receive wires therein. The adjacent edges of the pillars **80** frictionally engage the wires and provide a strain relief to restrict relative movement of the wires at the contact elements **51** and **52,** thereby restricting wire breakage.

Other desirable features of the connector **40** include openings **85** in the second body portion **43** through which access may be had to the contact elements **51** and **52** in the closed connector **40** via a probe as may be desirable to test voltage, etc. Also, the edges of the body portions **42** and **43** adjacent the cavity **50** are spaced from each other when the connector **40** is closed to provide a window **87** into the component cavity **50** to afford visual inspection of the color coding on a component.

Although this invention is subject to variation without departure from the spirit thereof it is believed that the following specific example, adapted for connections with wires of from No. 22 AWG to No. 30 AWG will facilitate understanding: The body portions **42** and **43** are molded of an electrically insulating material such as a polycarbonate. The material is preferably flame retardant so the connector **40** can serve as a fire restricting enclosure for a flammable component. The connector **40** overall (when closed) is about 0.82 inch long, 0.26 inch thick in a direction normal to the surfaces **45** and **46** and 0.25 inch wide (including the projections **55** and **56**). Each of the projections **55** and **56** is about 0.32 inch long, projects about 0.1 inch toward the side of the connector **40,** and is about 0.14 inch thick in a direction normal to the surface **45.** The channels **48** and **49** and wire receiving portions of the cavity **50** have a maximum width of about 0.04 inch and a depth of 0.03 inch, with the protrusions **73** extending in about 0.014 inch and being spaced about 0.055 inch apart. The central portion of the cavity **50** has a 0.056 inch radius and is 0.32 inch long. The slots **83** between the pillars **80** are about 0.013 inch wide, with each pillar **80** being about 0.02 inch thick.

Each of the contact elements **51** or **52** is pressed into a socket in the second body portion **43** so that outwardly projecting barbs **90** on the end thereof opposite the fingers **53** (FIG. 5) will engage the walls of the socket. Each of the contact elements **51** or **52** is formed of 0.01 inch thick tin plated tempered phosphor bronze. The fingers are 0.034 inch wide adjacent the parallel edges **68,** which edges **68** are 0.093 inch long. The cutting edges **69** are about 0.006 inch long, each being disposed at an included angle of about 120° with the adjoining parallel edge **68.** This included angle is preferably in the range of 90° to 150° so that each cutting edge **69** is generally normal to the adjoining parallel edge **68.** Each of the convex edges **71** (which provide cam means for spreading the fingers **53** when a section of wire is forced therebetween) has a radius of about 0.029 inch and is disposed with the center of the radius on a line through the points of intersection for the convex and cutting edges **71** and **69.** The points of the fingers **53** are spaced about 0.05 inch apart.

We claim:

1. In a connector of the type comprising first and second body portions each having opposite end surfaces, opposite side surfaces, a mating surface, and an outer surface opposite said mating surface; and means for positioning and retaining the body portion in a closed position with said mating surfaces in contact, said first body portion having two channels in its mating surface each adapted to receive a wire, and said body portions having depressions in said mating surfaces defining, when said body portions are in their closed position, a cavity adapted to receive an electrical component having a contact wire extending from each of its ends, said connector further comprising two resilient contact members each mounted in said second body portion and having fingers defining spaced wire receiving slots therebetween, one contact element having fingers extending across one of said channels and one end of said cavity and the other contact element having fingers extending across the other of said channels and the other end of said cavity when said body portions are in said closed position so that said contact elements will electrically connect a component in said cavity to wires in said channels; the improvement, wherein:

the first body portion has two spaced projections defining one side surface and has an opening between said projections along said one side surface between said mating surface and said outer surface, one end of the component receiving cavity is adjacent one of said projections and the other end of the component receiving cavity is adjacent the other of said projections, and one of said channels extends across one of said projections from one of said end surfaces to said opening and the other of said channels extends across the other of said pro-

jections from the other of said end surfaces to said opening.

2. A connector according to claim 1 wherein the fingers of said contact elements are spaced to provide said slots between adjacent generally parallel edges thereof, and the edges of said fingers at the inlet end of each slot diverge generally normally away from said parallel edges to define cutting edges of a predetermined length and are arcuate from the ends of the cutting edges opposite the parallel edges to provide diverging convex edges, said fingers being adapted to be resiliently spread by a wire segment forced between said arcuate edges to cause said cutting edges to cut said wire segment to a predetermined depth and sever any insulation thereon, and to cause the parallel edges to resiliently engage said wire as said wire segment is forced into said slot.

3. A connector according to claim 2, wherein the included angle between each cutting edge and the adjoining parallel edge is about 120°.

4. A connector according to claim 1, wherein one of said body portions includes retaining means for retaining wires in said channels and retaining a component in said cavity prior to moving said body portions to their closed position.

5. A connector according to claim 4, wherein said retaining means includes sets of three spaced protrusions extending alternately from opposite sides into each of said channels and the portions of said cavity for accepting contact wires with the ends of the protrusions spaced in a direction normal to the centerline of the channel or cavity at a distance less than the diameter of a wire the connector is adapted to engage.

6. A connector according to claim 1, wherein said component cavity communicates between the end surfaces of said connector to afford electrically interconnecting a wire extending through said component cavity with wires in said channels.

7. A connector according to claim 1, wherein each of said projections has a groove in said outer surface parallel to the channel across said projection.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,865,460 Dated February 11, 1975

Inventor(s) Thomas M. Cherney and John O. Knudson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 17, change "compound" to -- component --.

Column 4, line 41, change "closed" to -- contact --.

Signed and sealed this 15th day of April 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

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* U S GOVERNMENT PRINTING OFFICE : 1969 O—366-334.