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Lawson

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[54] **SOLDERLESS CONNECTOR FOR INSULATED WIRES**

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[73] Assignee: **AMP Incorporated,** Harrisburg, Pa.

[22] Filed: **Aug. 31, 1973**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 262,801, June 14, 1972, abandoned.

[52] **U.S. Cl.** ..... **339/99 R**

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

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

[56] **References Cited**

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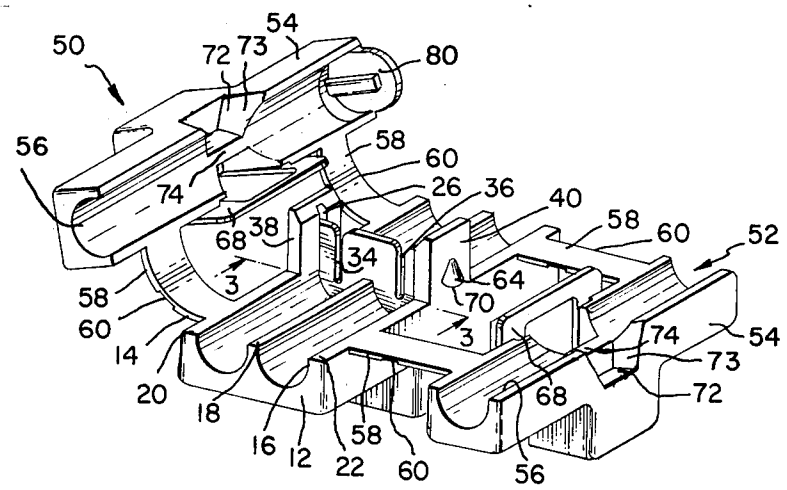
3,388,370	6/1968	Elm	339/98
3,576,518	4/1971	Bazelle, Jr. et al.	339/98

Primary Examiner—Joseph H. McGlynn
Attorney, Agent, or Firm—Gerald K. Kita

[57] **ABSTRACT**

A solderless insulated wire connector is disclosed which is formed of a unitary piece of dielectric material. The solderless connector includes a centrally disposed resilient electrical contact member which includes a pair of wire gripping notches, and a pair of flexibly hinged, self-locking cover portions for completely enclosing the contact member to complete a solderless connection. The contact member is mounted in a slot which is elongated to facilitate expansion of the contact member as wires are inserted into the wire gripping notches. The flexible hinges secured to the cover portions include sections of reduced thickness which cause the flexible hinges to bend at a particular spot, facilitating alignment of the cover portions with the base portions of the solderless connector structure.

6 Claims, 6 Drawing Figures



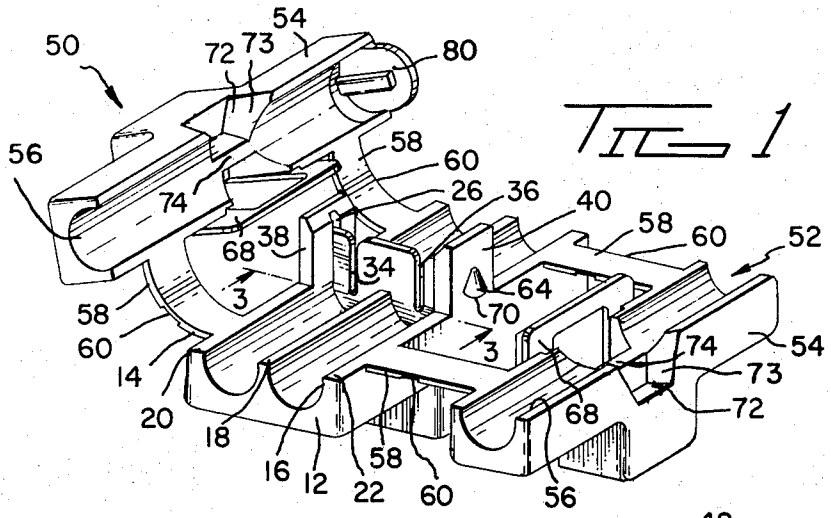


FIG 1

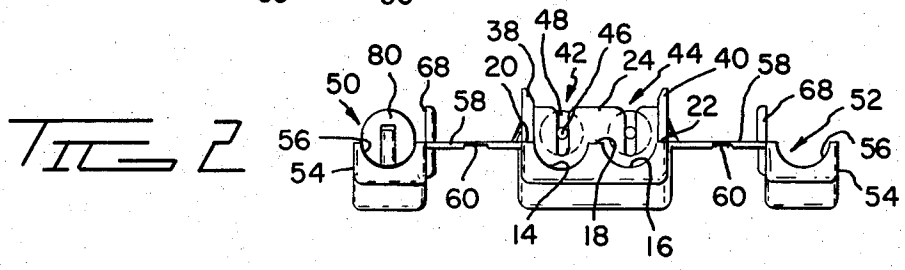


FIG 2

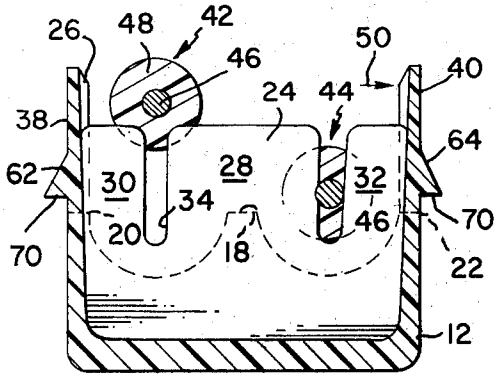


FIG 3

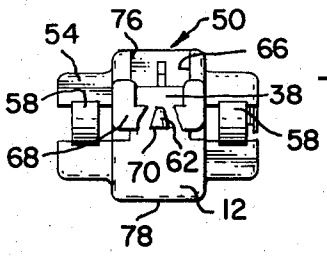


FIG 4

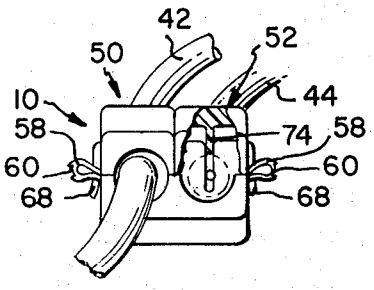


FIG 5

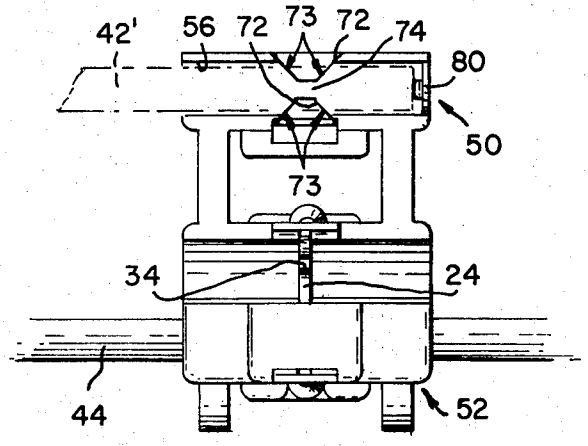


FIG 6

SOLDERLESS CONNECTOR FOR INSULATED WIRES

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part application of Ser. No. 262,801, filed June 14, 1972, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention:

This invention relates generally to wire connectors, and more particularly to connectors for making rapid, solderless connections between unstripped insulated wires.

2. Description of the Prior Art:

Many situations exist, in the automotive industry for example, in which a large number of connections must be made in a confined space among a plurality of insulated wires. In such circumstances it is most desirable to use solderless connectors which are compact, easily operable in confined spaces, and require the use of only a single tool, such as a conventional pliers. In addition, it is most desirable under such circumstances to be able to interconnect insulated wires without the need for stripping insulation from the wires before they are interconnected.

Many types of solderless connections exist which are generally capable of performing in the manner described hereinabove. However, while the solderless connectors available in the past have been capable of performing the general functions described hereinabove, they have often been subject to mechanical failure and are generally somewhat time-consuming to install. Naturally, mechanical reliability and long term endurance are most important in solderless connectors, especially those used in automotive vehicles, which are subject to extensive vibration, jostling, and widely varying environmental temperatures. Speed of installation is also a critical factor, since in many instances, it is most desirable to make large numbers of electrical connections in short time intervals.

Solderless connectors which are typical of those known in the past are disclosed in U.S. Pat. No. 3,388,370, to R. A. Elm, issued June 11, 1968, and U.S. Pat. No. 3,576,518 to J. H. Bazille, Jr. et al, issued Apr. 27, 1971. The solderless connectors disclosed in these patents include various features which tend to reduce their mechanical reliability, increase the time required to install them, and minimize the selectivity of their operation. For example, the Bazille, Jr. et al patent referenced above, discloses a resilient contact member which is firmly embedded in a slotted base member. Although the resilient contact member is intended to expand laterally as the wires to be connected are inserted into it, the device disclosed in the Bazille, Jr. et al, patent includes no opening or gap into which the resilient contact member can expand. Accordingly, upon expansion of the resilient contact member, the entire slotted housing of the device disclosed in this patent must expand. This expansion places a stress on the entire solderless contact structure, and can cause twisting or other types of mechanical distortion tending to misalign the self-locking boss and groove assembly disclosed in the patent. Clearly, these features reduce the mechanical reliability of the solderless connector disclosed in the Bazille, Jr. et al, patent.

Similarly, the devices disclosed in both of the above referenced patents include cover members secured to base portions by means of flexible resilient hinges. However, the hinges disclosed in each of these patents are constructed such that a misalignment can occur in the closure of the cover portion, causing the self-locking feature to operate improperly, or not at all. Overcoming this problem can result in time-consuming delays in the installation of the solderless connectors described in these patents.

In addition, the devices described in both of the above referenced patents include only a single cover portion which completely encloses the open top of the solderless connector assembly. However, the use of a single cover portion eliminates any selectivity in the operation of the solderless connectors disclosed in these patents. For example, it is impossible, using the devices disclosed in the above referenced patents, to place a first wire into the solderless connector, seal it in place with the cover portion, and subsequently place a second wire into the solderless connector without unsealing the first wire placed into the connector. Similarly, if it is desired to change one of the wires passing through a solderless connector of the type described in either of the above referenced patents, it is necessary to unseal both wires passing through the connector, rather than simply unsealing the wire to be replaced. Clearly, this shortcoming can render the simple operation of changing a connection much more complicated than is necessary.

In view of the problems set forth hereinabove, a need has arisen for an improved solderless connector of greater mechanical reliability, having a minimal installation time, and being capable of selective operation.

SUMMARY OF THE INVENTION

Accordingly, one object of this invention is to provide an improved solderless connector for insulated wires.

Another object of this invention is to provide a solderless connector of improved mechanical reliability.

Yet another object of this invention is to provide a novel solderless connector structure having a bifurcated cover portion.

A still further object of this invention is to provide an improved solderless connector including a resilient contact member, and having an extended slot to permit the resilient contact member to expand without warping or bending the body of the solderless connector.

A still further object of this invention is to provide an improved flexibile hinge structure for use with a solderless wire connector.

Yet another object of this invention is to provide a novel solderless connector having an improved self-locking structure.

Briefly, these and other objects of the invention are achieved by providing a solderless connector including a grooved base having a resilient contact member inserted into an extended slot therein. A pair of cover portions are secured to opposite sides of the grooved base portion by means of pairs of flexible hinge members. Each flexible hinge member includes a reduced portion for causing it to bend at a preselected location, thereby aligning each of the cover portions with an appropriate section of the grooved base member. A self-

locking feature is provided for holding each of the cover portions in place when the connector is fully closed.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a perspective view of a preferred embodiment of the instant invention;

FIG. 2 is an end view of the solderless connector of the instant invention in a fully open configuration;

FIG. 3 is a cut-away end view of the solderless connector of the present invention taken along the line 3—3 of FIG. 1, illustrating the mounting of the flexible connector member of the present invention;

FIG. 4 is a side view of the solderless connector structure of the present invention illustrating in more detail the self-locking feature thereof;

FIG. 5 is a partially cut-away end view of the solderless connector of the present invention illustrating a completed connection using the present invention; and

FIG. 6 is a plan view of the solderless connector of the present invention illustrated with one electrical wire connected electrically to the connector and with another electrical wire in readiness for connection to the connector.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views and more particularly to FIG. 1 thereof, a preferred embodiment of the solderless connector structure of the present invention is shown in perspective, and is designated generally by the reference numeral **10**. The solderless connector structure **10** includes a base portion **12** having first and second wire receiving grooves **14** and **16** formed therein. The wire receiving grooves or channels **14** and **16** are generally semi-circular in cross-sectional configuration, and have a diameter which is somewhat larger than conventional electrical wire having an insulation coating thereon. For example, the diameter of the wire receiving grooves **14** and **16** may be made large enough to accommodate **14** through **18** gauge solid or stranded wire having a vinyl or polyethylene insulation coating thereon. Clearly, the structure may be formed with grooves or larger or smaller diameters, depending upon the size wire to be used with it.

The wire receiving groove **14** is bounded by a central ridge **18**, located along the center line of the base portion **12**, and a side ridge **20**, located along one edge of the base portion **12**. Similarly, the wire receiving groove **16** is bound by the central ridge **18**, and another side ridge **22**, located at the opposite side of the base portion **12** from the side ridge **20**.

A contact member **24** is positioned within a slot **26** which extends across the width of the base portion **12** of the solderless connector structure **10**. The contact member **24**, which is shown in greater detail in FIG. **3**, is preferably constructed of a conventional highly conductive connector metal, such as phosphor bronze sheet or cartridge brass plate, having a thickness of approximately 0.032 inch. Such materials are characterized by high conductivity, and yet have great mechanical strength and are highly resilient. The contact member **24** includes a central body **28** having a pair of resilient fingers **30** and **32** formed integral with opposite sides of the central body **28**. A wire gripping notch or slot **34** separates the resilient finger **30** from the central body **28**, while an identical wire gripping notch or slot **36** separates the resilient finger **32** from the central body **28**. The slots have a width normally less than the diameter of the inner conductors of the wires to be inserted into the slots. The slots further taper outwardly at their upper ends.

As mentioned hereinabove, the contact member **24** is positioned within a slot **26**. The slot **26** extends across the width of the base portion **12** of the solderless connector structure **10**, and extends above the level of the ridges **18**, **20** and **22** into the inner surfaces of a pair of upstanding arms **38** and **40**, which are formed integral with the base portion **12**. As illustrated more clearly in FIG. **3**, the total width of the slot **26** is greater near the top of the upstanding arms **38** and **40** than near the lower portion thereof located in the base portion **12**. This extended width of the slot **26** provides room for the resilient fingers **30** and **32** to flex outwardly from the central body **28** of the contact member **24** when wires are inserted into the gripping notches **32** and **34**. For example, a pair of wires **42** and **44**, each containing a conductive central portion **46** surrounded by an insulator **48** are illustrated in FIG. **3**. The wire **46** is shown positioned above the wire gripping notch **34**, and the conductive inner portion **46** thereof is shown as having a diameter somewhat larger than the width of the wire gripping notch **34**. Similarly, the wire **44** is shown as inserted into the wire gripping notch **36**, in the position occupied by wires fully coupled to the solderless connector structure of the present invention. As shown in FIG. **3**, the contact member **24** has cut through the insulation **48** of the wire **44**, so that the conductive metal of the contact member **24** is directly in engagement with the conductive inner portion **46** of the wire **44**. In addition, insertion of the wire **44** into the wire gripping notch **36** has flexed the resilient finger **32** in the direction illustrated by an arrow **50**, so that the resilient finger **32** has occupied the wider upper portion of the slot **26**. Similarly, the resilient finger **30** will flex outwardly from the central body **28** of the contact member **24** as the wire **42** is inserted into the wire gripping notch **34**. However, as is clear from FIG. **3**, the outwardly flexed resilient fingers **30** and **32** do not cause a buckling or outward bending of the base portion **12** of the solderless connector structure **10** of the present invention, but merely occupy the widened portions of the slot **26**, provided for this very purpose. Accordingly, the structure of the present invention permits the insertion of wires into the contact member **24** without causing buckling or unnecessary bending of the base portion **12** of the solderless connector structure **10**.

Referring now to FIGS. **1** and **2**, the bifurcated cover and flexible hinge structure of the solderless connector of the present invention are shown in greater detail. More particularly, the bifurcated cover assembly of the present invention includes a pair of substantially identical cover sections **50** and **52**. Each cover section includes a body portion **54** including a wire receiving

groove or channel **56** therein. Each body portion **54** is substantially identical in general configuration to one half of the base portion **12** of the solderless connector structure **10**, and each wire receiving groove or channel **56** possesses substantially the same dimensions as the wire receiving grooves or channels **14** and **16**. Each of the cover sections **50** and **52** is joined to the body portion **12** by a pair of hinge arms or hinge elements **58**. Each hinge arm or element **58** includes an elbow section **60** of reduced thickness. The cover sections **50** and **52** joined by means of the hinged arms **58** to the base portion **12**, are preferably formed by conventional injection molding techniques from a single body of a tough, resilient flexibly polymeric insulating material. For example, the entire solderless connector structure **10** may be formed of a single piece of polypropylene, nylon, polycarbonate, or another suitable type of plastic material. Various types of additives may also be supplied to the polymeric material before the solderless connector structure is formed to provide the completed structure with various desirable characteristics. For example, a flame retardant material may be added to the polymeric plastic to reduce the susceptibility of the solderless connector structure to destruction by fire. Similarly, different types of pigments may be added to the polymer for identification purposes.

The solderless connector structure **10** of the present invention is initially manufactured in the form illustrated in FIG. **2**. That is, the hinge arms **58** are straight, and extend directly outwardly from opposite sides of the base portion **12**. Thus, when the solderless connector structure of the present invention is to be used, each of the hinge arms **58** must be bent in order that each of the cover sections **50** and **52** may be positioned over the open top of the base portion **12**. However, it is important that the cover sections **50** and **52** properly align themselves with appropriate sections of the base portion **12** each time the hinge arms **58** are bent. The reduced elbow portions **60** of each of the hinge arms **58** provide localized portions of reduced cross-sectional area to insure that the hinge arms always bend at a predictable point. Thus, the elbow portions **60** insure uniform bending of the hinge arms and a proper alignment or registration between the cover sections **50** and **52** and the base portion **12**. Accordingly, the cover portions **50** and **52** of the solderless connector structure **10** are self-aligning, thereby providing a feature which greatly facilitates the installation of the solderless connector of the present invention. The latching elements **68** engage against the outer surface of the corresponding upright **38** or **40**. The weakened portions **60** insure that hinges **58** buckle and prevent stiffness in the arms **58** which would cause the latching elements **68** to be pivoted past the uprights **38** and **40** and into the channels **14** and **16**.

The self-aligning feature is particularly advantageous when the solderless connector of the present invention is to be used in a confined environment, or in an environment in which the person installing the solderless connector structure cannot see the solderless connector as he is installing it. In such circumstances, the self-aligning feature greatly reduces the time required for installing the solderless connector, since it enables the installer to close the cover sections accurately and quickly without need for seeing them as they are being manipulated.

Referring now to FIG. **4**, the locking or latching structure of the present invention is shown in greater detail. More particularly, a locking boss **62** is shown formed integral with the upstanding arm **38** of base portion **12**, and extending outwardly therefrom. A similar locking boss is shown formed integral with the upstanding arm **40** in FIG. **1**. Each of the cover sections **50** and **52** includes a channel **66** in the body portion **54** thereof which is adapted to interfit with one of the upstanding arms **38** and **40**. Similarly, each of the cover sections **50** and **52** includes a resilient locking rung or latching element **68** which is adapted to engage a flat lower surface **70** at the base of each of the locking bosses **62** and **64**.

Each of the cover sections **50** and **52** is recessed, and more specifically, includes a groove **72** which is designed to fit over the upper edge portion of the contact member **24** when the cover sections are in their closed position. In the center of each groove **72** is a solid segment **74** which is designed to fit into one of the wire gripping notches **34** and **36** when the cover sections **50** and **52** are in their closed positions. The solid segments **74** engage the upper side of corresponding insulation covered wires in the corresponding channels **14** and **16** and tend to drive or to force the wires positioned in the wire gripping notches **34** and **36** more deeply into the gripping notches.

As shown more particularly in FIGS. **1** and **6**, the groove **72** in each of the cover sections **50** and **52** is outwardly flared from either side of the solid segment **74**. More particularly, the sidewalls **73** of the groove **72** are outwardly inclined with respect to each other preferably at an inclined angle of 90°. The sidewalls **73** of each of the grooves **72** converge toward each other adjacent to the solid segment **74** of each cover section. The least measured distance separating the converging sidewalls **73** is defined by the length of the solid segment **74**, which length is preferably twice the thickness of the brass plate contact member **24**, such that the corresponding contact member **24** will readily be received within the corresponding grooves **72** when the cover sections **50** and **52** are in their closed positions. The width of the contact member **24** will thereby be unrestricted within the grooves **72**, allowing it substantial freedom of entry therein without the sidewalls **73** confining the contact member **24**. The solid segment **74** extends the surface of the wire receiving grooves **56** across the corresponding grooves **72** purposely providing the grooves **72** with a discontinuous portion in the corresponding cover sections **50** and **52**. The solid segments **74** are specifically provided to force the wires into the wire gripping notches **34** and **36**. Accordingly, when the contact member **24** is received into the corresponding grooves **72**, substantial movement of the contact is permitted within the grooves due to a substantial clearance between the contact member and the outwardly flared configurations of the groove sidewalls **73**. The solid segments **74** accordingly support the wires along a continuous unbroken surface of the wire receiving grooves **56**, with the segments **74** ensuring that the wires are forcibly inserted into the wire gripping notches **34** and **36** when the cover sections **50** and **52** are in their closed positions, despite the possibility of substantial movement of the contact member **24** within the non-confining grooves **72**.

In operation, the solderless connector structure **10** of the present invention is presumed to be initially in an

open configuration, as illustrated in FIGS. 1 and 2. A first wire is then positioned at the top of one of the wire gripping notches 34 and 36. For example, as shown in FIG. 3, the wire 42 is positioned over the wire gripping notch 34. The wire may then be forced into the wire gripping notch by the direct application of pressure to the wire, at which time the edge portions of the contact member 24 surrounding the appropriate gripping notch or slot slice through the insulation 48 surrounding the wire, to forcibly swedge and compressively engage opposite sides of the inner conductor therein, and form a direct metal-to-metal contact with the inner conductive portion of the wire.

Alternatively, a wire may simply be positioned at the top of one of the wire gripping notches, and an appropriate cover section 50 or 52 may then be bent into a partially closed position, as shown in FIG. 4, so that it is positioned over the wire. In this position, it will be noted that the upstanding arm, 38 for example, is positioned in the channel 56, so that the cover section is appropriately aligned with the base portion 12. Pressure may then be applied to the top surface 76 of the cover section 50 and to the bottom surface 78 of the base portion 50 by means of a tool such as a pliers, forcing the wire into the wire gripping notch. In this case, as illustrated more clearly in FIG. 5, the solid segment 74 presses the wire into the appropriate wire gripping notch. When sufficient pressure is applied, the locking rung or latching element 68 passes over the locking boss 62, and is retained in position by the flat lower surface 70 of the locking boss. This completes the coupling of one wire to the solderless connector structure of the present invention. Clearly, two wires may simultaneously be clamped into the solderless connector structure of the present invention by performing the operation described above simultaneously using two wires, and appropriately positioning both cover sections 50 and 52. However, the separate cover sections of the present invention cause it to be substantially more flexible in operation, since a first wire may be completely locked in place at one time, and at a subsequent time a second wire may be locked into place. Furthermore, if it is desirable to change one of the wires passing through the solderless connector of the present invention, it is possible to open one of the cover sections, leaving the other cover section firmly locked in place, thereby eliminating the risk that the other wire passing through the connector may inadvertently become detached from the connector.

FIG. 5 illustrates the connector structure in its closed and locked condition. As illustrated in FIG. 5, once each of the cover sections 50 and 52 is completely closed, each locking rung or latching element 68 snaps into position over the appropriate locking boss 62 or 64, securing or locking the cover sections 50 and 52 individually in closed positions over the wires, and restraining the wires 42 and 44 within the solderless connector structure 10, and completing an insulated electrical connection between the wires.

The wire engaging surfaces 66 of the cover portions are generally semi-cylindrical grooves which cooperate with the channels 14 or 16 of the base portion which are also semi-cylindrical grooves, whereby when the covers are closed on the base portion, each of the wires therein are substantially fully enclosed in a generally cylindrical passageway.

With reference to FIGS. 1 and 6, the wire receiving cover portion 50 may be further provided with a relatively thin web 80 of dielectric material covering one end of the wire receiving groove 56 therein. Then as shown in FIG. 6, the cover portion 50 may be utilized to electrically terminate or connect the contact member 24 to the end portion of an insulation covered electrical wire 42' illustrated in phantom line in FIG. 6. The end portion of the wire 42' will be located against the surface of the wire receiving groove 56 with the terminal end of the wire against or adjacent to the web 80 thereby positively locating the wire 42' for proper location in the cover portion 50, such that upon enclosure of the cover portion 50, the end portion of the wire 42' will be terminated within the wire receiving notch 44 of the contact member 24. Thus with the connector 10 provided with the web 80 as shown in FIGS. 1 and 6, the wire 42' can only be terminated with its end portion within the connector 10. However, as shown in FIG. 5, when it is desired to terminate a wire 42 which is to extend entirely through the wire receiving groove 56 of the cover portion 50, the web 80 will be eliminated, during manufacture of the connector 10, or if provided, broken away or otherwise removed, to enable the wire 42 to extend entirely through the cover portion 50, such that upon enclosure of the cover portion 50, the wire 42 will be forcibly inserted and terminated electrically within the notch 34 of the contact member 24. Thus, the present invention may be utilized with or without the web 80 as desired.

The solderless connector structure of the present invention can be used to make both X and T connections between insulated wires. In making an X connection, two wires which pass completely through the connector structure are used. However, in making a T connection, one wire passing through the connector, and one wire which simply extends slightly beyond the contact member 24 is used. Closure of the cover sections 50 and 52 will then hold both wires firmly in position.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

What is claimed is:

1. An electrical connector for making an electrical connection between two insulation covered wires, comprising: a base of electrical insulation material having at least two parallel channels for receiving said insulation covered wires in spaced, side-by-side relation, a narrow, vertical supporting slot extending transversely across both said channels, an electrically conducting, resilient contact plate frictionally supported in said slot and having at least two upwardly opening contact slots respectively centered relative to said channels, said contact slots having, at said channels, a width normally less than the diameter of the inner conductors of said wires, and tapering outwardly at their upper ends, first and second covers of insulation material formed integrally with said base, located adjacent opposite sides of said base and flexibly connected to opposite sides of said base by integral hinge arms, each of which extends between the inner edge of one of said covers and the adjacent edge of said base, each of said covers being pivotable independently of the other by bending the intervening hinge arm to cause said cover to overlie only

one of said channels, each of said covers being recessed to receive the upper edge of said contact plate and having a wire engaging surface adapted to engage the upper side of an insulation covered wire in one of said channels and drive said wire downwardly into one of said contact slots, causing said contact plate to slice through said insulation and the sidewalls of the slot to forcibly swedge and compressively engage opposite sides of the inner conductor therein, cooperative latching elements integral with said base and with each of said covers to lock said covers individually in closed positions over the respective wires, thereby completing an insulated connection between said wires.

2. A connector as claimed in claim **1** wherein said base is provided with integral projecting upright portions having at their inner surfaces slots which frictionally engage and support the end edges of said contact plate.

3. A connector as claimed in claim **2** wherein the latch means in said base consist of cam projections integrally formed on the outer surfaces of said upright portions and the cooperating latch portions on said covers consist of hook-like members integrally formed at the inner sides of said covers.

4. A connector as claimed in claim **1** wherein the wire-engaging surface of each of said covers is in the form of a generally semi-cylindrical groove and the channels in said base are also in the form of generally semi-cylindrical grooves, whereby when said covers are closed on said base each of the wires therein is substantially fully enclosed in a generally cylindrical passageway.

5. A connector as claimed in claim **1** in which said hinge arms are provided with localized portions of reduced cross-sectional area to promote uniform bending of said hinge arms and facilitate accurate registration of said covers with the appropriate portions of said base.

6. A connector as claimed in claim **1** in which the recess in each of said covers is divided by a narrow segment of said wire engaging surface which is positioned to project into one of the contact slots in said contact plate upon closure of said cover and thereby insure movement of said insulation covered wire downwardly into said contact slot.

* * * * *