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Blevins

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[54] **SNAP-ON ELECTRICAL CONNECTOR**

[75] Inventor: **Terrence L. Blevins**, Marshalltown, Iowa

[73] Assignee: **Western Electric Company, Inc.**, New York, N.Y.

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[52] **U.S. Cl.** ..... **339/19**; 339/244 R; 339/248 S; 339/258 F

[51] **Int. Cl.**[2] **H01R 7/28**

[58] **Field of Search** 339/19, 59, 222, 244, 248, 339/249, 254, 256, 258

[56] **References Cited**

UNITED STATES PATENTS

2,145,166	1/1939	Douglas	339/254 R
2,869,093	1/1959	Benander	339/256 R
3,340,440	9/1967	Minter	317/101
3,426,310	2/1969	Takeuchi et al.	339/17
3,601,756	8/1971	Stroh	339/19
3,617,980	11/1971	Alkire	339/32

Primary Examiner—Roy Lake
Assistant Examiner—Neil Abrams
Attorney, Agent, or Firm—D. D. Bosben

[57] **ABSTRACT**

An M-shaped electrical connector is fabricated by initially forming one or more elongated slots in a flexible planar strip of electrically conductive material. The slotted strip then is bent into an M-shaped configuration so that each slot defines spaced center or intermediate legs spaced apart in a first direction for receiving first sections of one or more electrical conductors therebetween with a press-fit, and so that end portions of the slotted strip define outer legs spaced apart in a second direction perpendicular to the first direction for receiving and aligning second sections of the electrical conductors therebetween with a press-fit. Each slot in the planar strip may be enlarged intermediate its ends to define a flared entrance to the slot when the strip is formed into the M-shaped configuration. Adjacent ends of the conductors also may be beveled, and the outer legs of the connector may be formed with flared portions, to facilitate insertion of the electrical connector over the ends of the electrical conductors.

4 Claims, 4 Drawing Figures

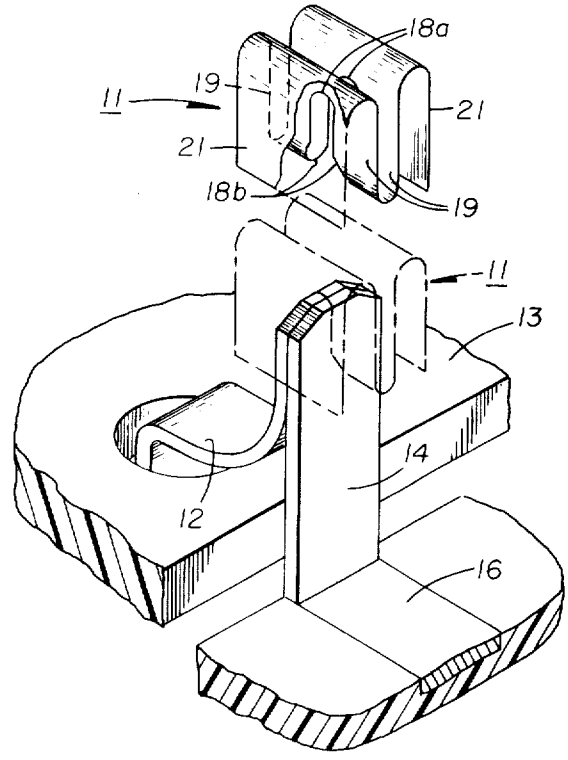


FIG. 1

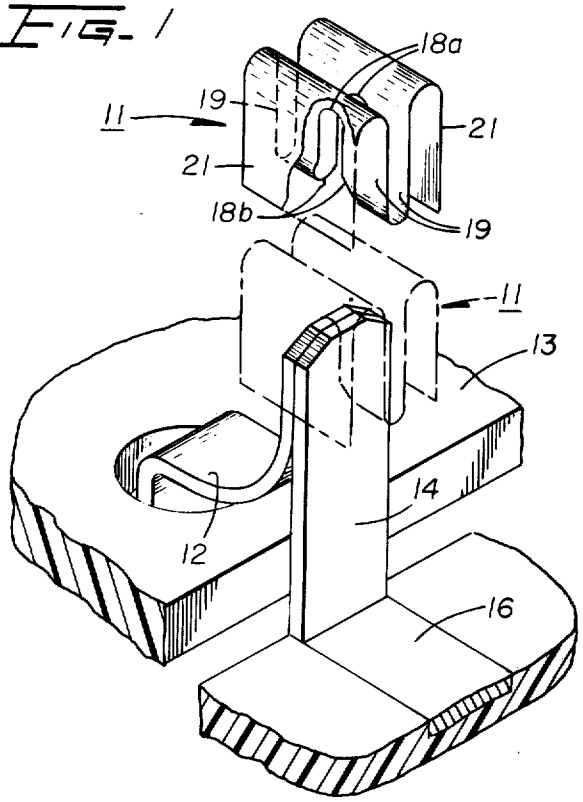


FIG. 2

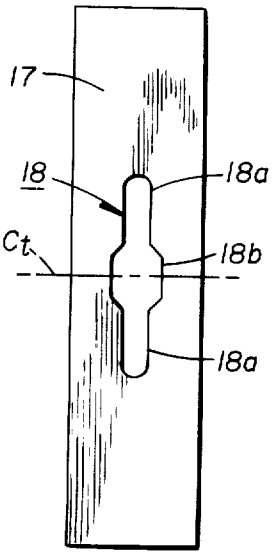


FIG. 3

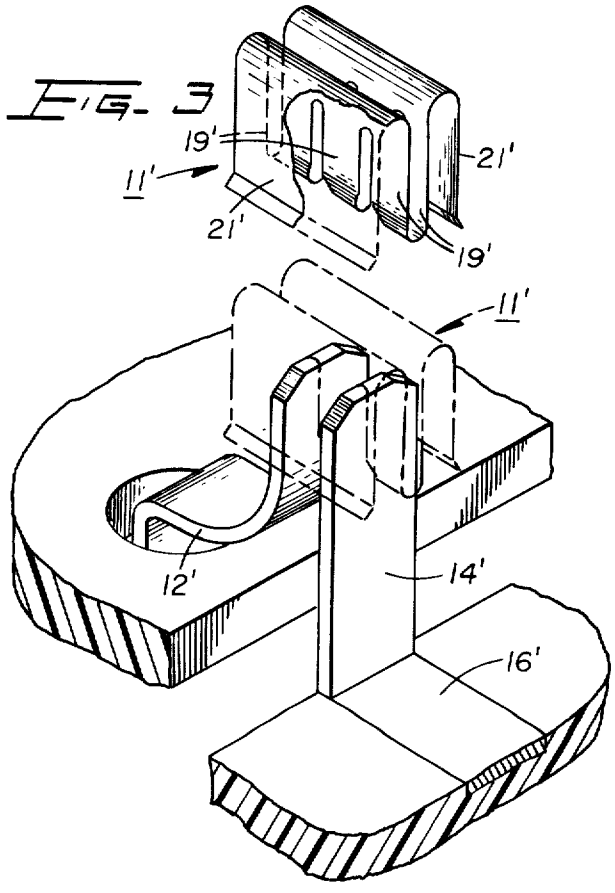
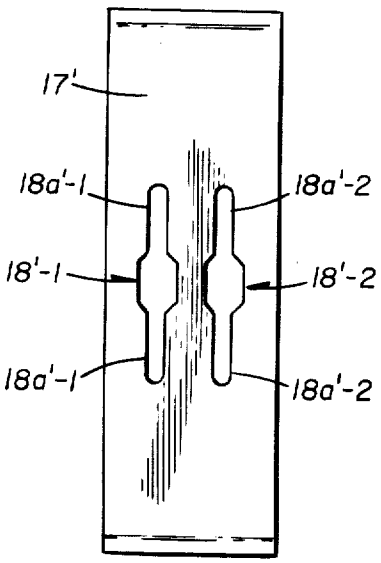


FIG. 4



SNAP-ON ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a snap-on electrical connector, and more particularly to an M-shaped electrical connector in which the connector can be snapped over the ends of two electrical conductors with a press-fit so as to apply gripping pressure to the conductors in directions perpendicular to one another simultaneously.

2. Description of the Prior Art

A frequent problem in the manufacture of electrical equipment is the inability to interconnect electrical conductors rapidly with a reliable electrical connection which can subsequently be readily disconnected as desired. For, example, it is common practice to gold plate terminals and then electrically interconnect them by capacitive discharge welding. This, however, sometimes results in poor welds and defective electrical connections because of misalignment of the terminals, improper mating of the opposed terminal surfaces and/or variations in the thickness of the gold plating on the opposed surfaces. Further, the welds between the terminals are difficult to break in order to separate the terminals, such as for subsequent repair of the equipment, after which it is difficult to reconnect the terminals together again.

Quick-connect type electrical connectors are known wherein the connector is formed by slotting a planar strip of flexible electrically conductive material and then bending the strip intermediate the ends of the slot to provide spaced legs between which an electrical conductor, such as a wire, can be press-fitted to establish an electrical connection. The U.S. Pat. No. 3,617,980, issued Nov. 2, 1971 to J. C. Alkire, also discloses an electrical connector clip which is folded from a single sheet metal stamping and which, when fastened to a printed circuit board, will accept and grip connector pins extending from above, below or across the board. The R. R. Stroh U.S. Pat. No. 3,601,756, issued Aug. 24, 1971, discloses a generally M-shaped electrical connector for making connection to a plurality of terminals and/or wires which are inserted axially into loops or folds of the connector. Similarly, the J. B. Minter U.S. Pat. No. 3,340,440, issued Sept. 5, 1967, and the K. Takeuchi et al. patent, issued Feb. 4, 1969, are directed to electrical connectors in which electrical conductor wires are bent into a tortuous M-shaped path for receiving terminals on a printed circuit board or other type electrical conductors between central legs of the thus formed electrical connectors, respectively.

SUMMARY OF THE INVENTION

In general, in accordance with this invention an electrical connector for establishing electrical contact between two or more electrical conductors includes a body of flexible electrically conductive material having an M-shaped configuration. Center or intermediate legs of the connector are slotted and spaced apart to receive first sections of the electrical conductors in tight-fitting engagement therebetween and to apply gripping pressure to the conductors in a first direction, while outer legs of the connector are spaced apart to receive second sections of the electrical conductors therebetween in tight-fitting engagement and to apply gripping pressure to the conductors in a second direction perpendicular to the first direction.

Preferably, the body of the electrical connector is fabricated from a single unitary planar strip of flexible electrically conductive material by initially forming one or more elongated slots in the strip so that first sections of the conductors subsequently will be receivable in portions of the slot(s), between center or intermediate legs defined thereby, with a press-fit. The planar strip then is formed into an M-shaped configuration by bending the strip in a first direction intermediate the ends of the slot(s) so that spaced center or intermediate legs of the connector are defined by the slot(s), and by bending end portions of the slotted strip in the opposite direction to define outer legs of the connector. A single slot may be formed in the strip for receiving the electrical conductors, or spaced parallel slots may be formed in the strip for receiving respective ones of the electrical conductors, as desired.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric view of an electrical connector in accordance with the invention;

FIG. **2** is a plan view of a planar electrically-conductive strip from which the electrical connector shown in FIG. **1** is fabricated;

FIG. **3** is a modified form of an electrical connector in accordance with the invention; and

FIG. **4** is a plan view of a planar electrically-conductive strip from which the electrical connector of FIG. **3** is fabricated.

DETAILED DESCRIPTION

Referring to FIG. **1**, the disclosed embodiment of the invention relates to an M-shaped electrical connector **11** for establishing electrical contact between a conductive, planar blade-like terminal **12** of rectangular cross-section on a printed circuit board **13** and a conductive, planar blade-like terminal **14** of rectangular cross-section extending adjacent the printed circuit board and connected to other associated circuitry **16.** The first terminal **12** has been inserted through an aperture in the printed circuit board **13** and one end has been soldered to a land area on the underside of the board in a known manner. The terminal **12** also is of a bent configuration so that a portion thereof adjacent its opposite end projects upward parallel to the adjacent edge of the board, for connection to the second terminal **14,** with opposed flat planar surfaces of the terminals of identical width in abutting and mating relationship. The upper ends of the terminals **12** and **14** have suitably beveled surfaces to facilitate assembly of the electrical connector **11** thereto by press-fitting of the connector over the ends of the terminals as shown in broken lines.

Referring to FIG. **2**, the electrical connector **11** is formed from a flat planar strip **17** of flexible electrically conductive material, such as a beryllium-bronze or beryllium-copper alloy, by initially forming an elongated continuous slot **18** in the strip symmetrically on opposite sides of its transverse centerline C_l. End portions **18***a* of the slot **18** are dimensioned to have a width which is slightly less than the combined thicknesses of the two terminals **12** and **14,** such as 0.002 of an inch, while a central portion **18***b* of the slot is formed with a width substantially greater than the width of the end portions **18***a*. The slot **18** may be formed in the strip **17** in any suitable manner, such as by blanking.

The slotted strip **17** then is formed into an M-shaped clip configuration as shown in FIG. **1**, such as in a suitable punch and die, with central portions of the strip being bent in a first direction about the transverse centerline C_l, and thus intermediate the ends of the slot **18**. As is clearly shown in FIG. **1**, the continuous slot **18** then defines a pair of spaced generally U-shaped center or intermediate legs **19**, with the slot running from the intersection of the branches of the legs and the slot end portions **18***a* extending over a major portion of the height of the legs and in opposed aligned relationship so that the legs can receive the terminals **12** and **14** therebetween with a press-fit. The enlarged central portion **18***b* of the slot **18** then provides a flared opening leading into the end portions **18***a* of the slot, to facilitate the reception of the terminals **12** and **14** in the slot end portions. In the forming of the slotted strip **17** into an M-shaped configuration, outer end portions of the strip also are bent, but in the opposite direction, to define outer planar parallel legs **21** spaced apart a distance slightly less than the width of terminals **12** and **14** so that, as is clearly shown in FIG. **1**, opposite edges of the terminals also will be receivable with a pressfit between opposed surface portions of the outer legs which are in alignment with the slot **18** and thus the aligned slot end portions **18***a*.

In assembling the electrical connector **11** over the ends of the terminals **12** and **14** as illustrated in broken lines in FIG. **1**, first surface sections of the terminals on opposite sides thereof become received in the end portions **18***a* of the slot **18** in tight-fitting engagement with the center or intermediate legs **19**, whereby these legs (i.e., the opposed walls of the slot end portions) exert pressure upon the terminals in a first direction normal to their mating surfaces, to press the mating surfaces into tight-fitting engagement. At the same time, the outer legs **21** of the electrical connector **11** receive the opposite edges (second sections) of the terminals **12** and **14** therebetween in tight-fitting engagement to align the edges and to exert pressure upon the edges in a second direction parallel to the mating surfaces of the terminals, and thus perpendicular to the pressure exerted by the center legs **19**. Accordingly, the electrical connector **11** can be readily fitted over the ends of the terminals **12** and **14** to secure them tightly together and in electrical contact with one another, with the terminals properly aligned and confined against relative movement, to form a reliable electrical connection. Further, the electrical connector **11** can be readily removed from the terminals **12** and **14** for disassembly of the printed circuit board **13** and the circuitry **16**, such as for a repair operation, and then reused to secure the terminals together again after the repair operation is completed.

FIGS. **3** and **4** disclose a modified form of the invention in which two elongated slots **18'-1** and **18'-2** are formed in a flat planar strip **17'** of flexible electrically conductive material, with end portions **18***a'*-**1** of the first slot having a width dimension such that they will be capable of subsequently receiving a terminal **12'** in tight-fitting engagement, and with end portions **18***a'*-**2** of the second slot having a width dimension such that they will be capable of subsequently receiving a second terminal tab **14'** in tight-fitting engagement. Thus, when the slotted terminal strip **17'** is bent into an M-shaped configuration as shown in FIG. **3**, to form an electrical connector **11'**, respective ones of the end portions **18***a'* of the slots **18'** are aligned in opposed relationship to define a series of three spaced, generally U-shaped center legs **19'** for receiving respective ones of the terminals **12'** and **14'** therebetween, while end portions of the strip define a pair of spaced outer planar legs **21'** having opposed surface portions aligned with respective ones of the slot end portions for receiving opposite edges of the terminals therebetween in the same manner as the electrical connector **11** shown in FIG. **1**. In FIG. **3**, end portions of the outer legs **21'** also are flared outwardly, in addition to the upper ends of the terminals **12'** and **14'** having beveled surfaces, to facilitate the positioning of the electrical connector **11'** over the terminals.

In conclusion, a novel snap-on electrical connector **11** or **11'** has been provided which is simple in construction and easy to fabricate, and which is capable of being readily positioned over the ends of the terminals **12, 14** or **12', 14'** to align the opposite edges of the terminals and to secure the terminals tightly together so as to establish a reliable electrical connection therebetween. The electrical connector **11** or **11'** also may readily be removed from the terminals **12, 14** or **12', 14'** for disassembly of the terminals from one another, such as for equipment repair purposes, and then be subsequently reused to connect the terminals together again.

What is claimed is:

1. An electrical connector assembly, which comprises:

a pair of adjacent electrical conductors;

a body of flexible electrically conductive material having an M-shaped configuration;

said body having center legs spaced apart in a first direction and having first sections of said electrical conductors disposed therebetween with said center legs engaging and applying gripping pressure to said conductors in the first direction; and

said body having outer legs spaced apart in a second direction perpendicular to said first direction and having second sections of said electrical conductors disposed therebetween with said outer legs engaging and applying gripping pressure to said conductors in the second direction.

2. An electrical connector assembly, as recited in claim **1**, in which:

said body includes a pair of the center legs separated in the first direction by a continuous slot having aligned end portions extending over a major portion of the height of the legs and having the first sections of said electrical conductors received therein.

3. An electrical connector assembly, as recited in claim **1**, in which:

said body has three of the center legs separated in the first direction by slots having the first sections of respective ones of said pair of electrical conductors received therein.

4. An electrical connection, which comprises:

a first conductive, planar blade-like terminal;

a second conductive, planar blade-like terminal having a planar surface abutting a planar surface of said first blade-like terminal and having a width identical to the width of the planar surface of said first blade-like terminal;

an M-shaped spring metal clip having outer legs which are substantially parallel to each other and normally spaced apart a distance less than the width of the planar surfaces of said first and second

blade-like terminals and positioned to forcibly engage the edges of said blade-like terminals; and

said M-shaped clip having center legs and a slot running from the intersection of branches of the center legs receiving said first and second blade-like terminals and having opposed slot walls pressing the planar surfaces of said first and second blade-like terminals together.

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