# United States Patent [19]

**Jarosek**

[11] **3,868,163**

[45] **Feb. 25, 1975**


[54] **BUS BAR**


[75] Inventor: **Gordon G. Jarosek**, Westminster, Calif.

[73] Assignee: **Lear Siegler, Inc.**, Santa Monica, Calif.



[22] Filed: **July 23, 1973**

[21] Appl. No.: **381,578**

**Related U.S. Application Data**

[63] Continuation of Ser. No. 221,905, Jan. 31, 1972, abandoned.

[30] **Foreign Application Priority Data**

| | | |
|---|---|---|
| Jan. 31, 1972 | Belgium | 127130 |
| Jan. 30, 1973 | Denmark | 491/73 |
| Jan. 18, 1973 | Great Britain | 2664/73 |
| Jan. 31, 1973 | France | 73.03353 |
| Jan. 25, 1973 | Germany | 2303537 |
| Jan. 22, 1973 | Netherlands | 7300894 |

[52] **U.S. Cl.** ..... **339/19**, 339/22 B, 339/242, 339/256 R

[51] **Int. Cl.** ..... **H01r 31/08**

[58] **Field of Search** ..... 339/13, 19, 22 B, 242, 339/252 P, 256, 276 SF; 29/193, 193.5; 113/119



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,688,735 | 9/1954 | Hubbell | 339/95 R X |
| 2,981,926 | 4/1961 | Boardman | 339/256 SP |
| 3,048,812 | 8/1962 | Heidler | 339/17 LC X |
| 3,439,315 | 4/1969 | Hamel et al. | 339/256 R X |
| 3,551,875 | 12/1970 | Jarosek | 339/19 |
| 3,558,289 | 1/1971 | Cervenka et al. | 29/193.5 |

FOREIGN PATENTS OR APPLICATIONS

| | | | |
|---|---|---|---|
| 1,321,959 | 2/1963 | France | 339/256 R |
| 1,930,544 | 1/1970 | Germany | 339/256 R |



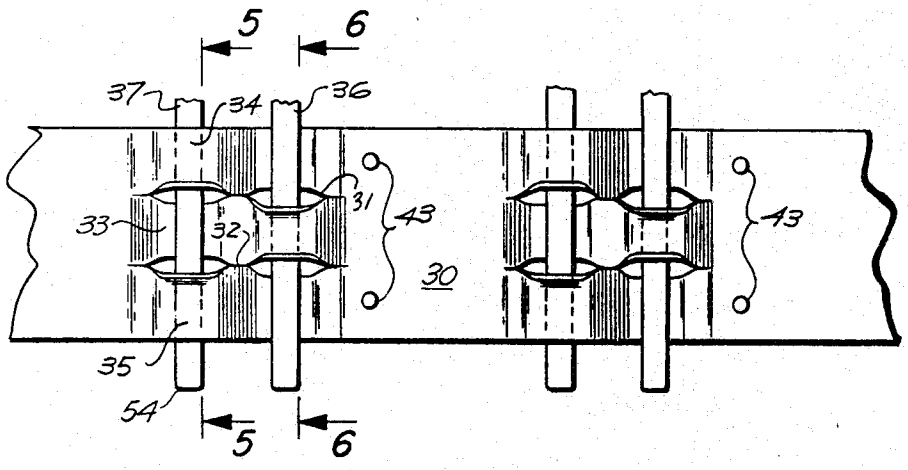
*Primary Examiner*—Roy D. Frazier
*Assistant Examiner*—Lawrence J. Staab
*Attorney, Agent, or Firm*—Christie, Parker & Hale



[57] **ABSTRACT**

A bus bar for electrically coupling a plurality of spaced-apart parallel terminal pins arranged in banks is constructed of flat strips of electrically conductive material. Internal longitudinal slits divide a portion of the strip into sections with every other section being deformed to form a first generally S-shaped bend and the remaining sections being deformed to form a second generally S-shaped bend oppositely directed from the first bend to define with a first bend a pair of passages capable of receiving terminal pins. The bus bar further includes indexing marks adjacent to each pair of the passages to facilitate the manufacture of the bar. The spacing between passage pairs is infinitely variable.


**10 Claims, 8 Drawing Figures**



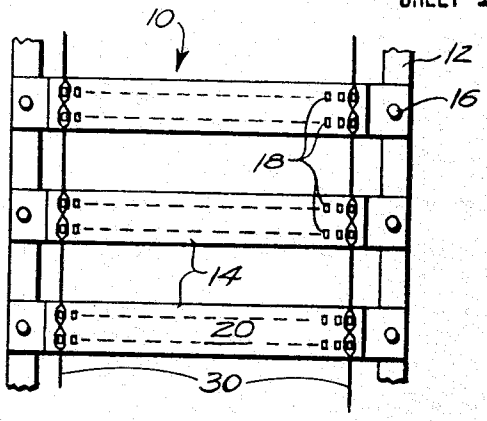



Fig 1

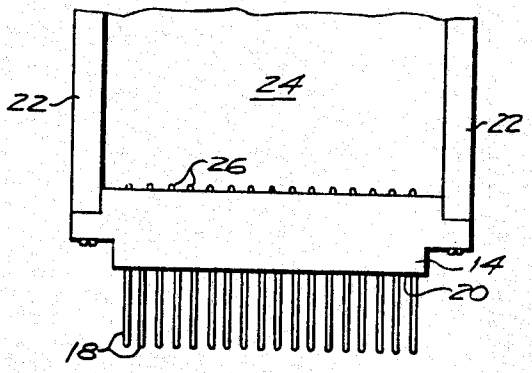



Fig 2

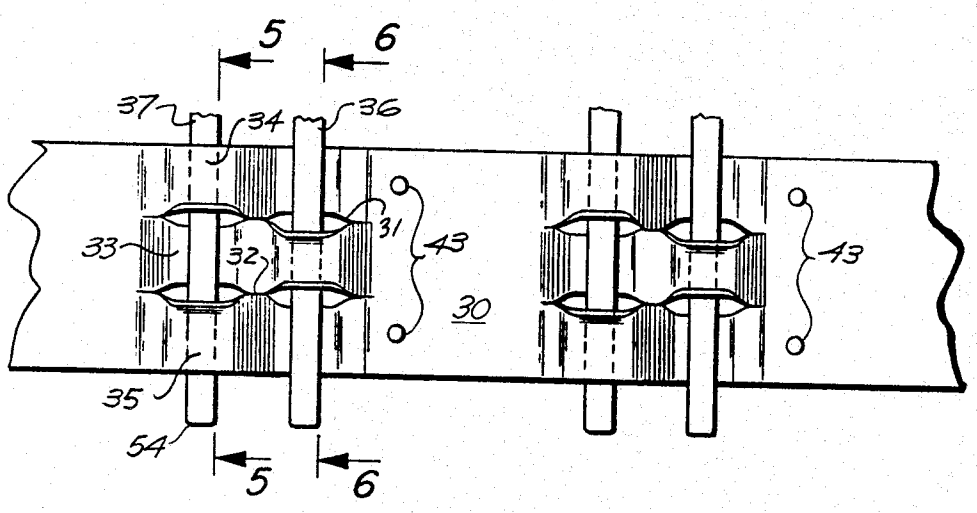



Fig 3

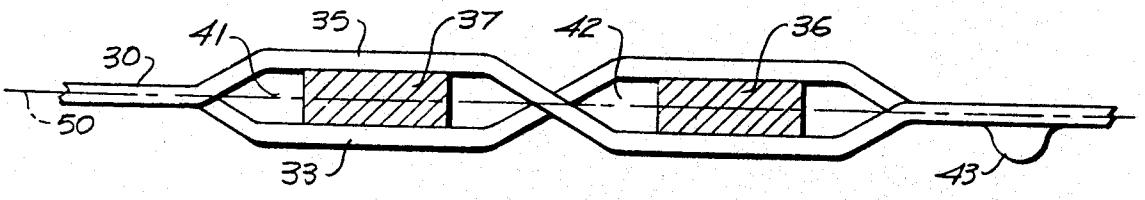



Fig 4

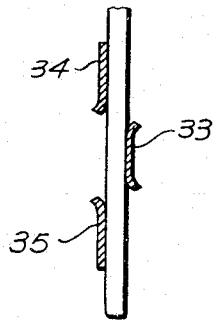



Fig 5

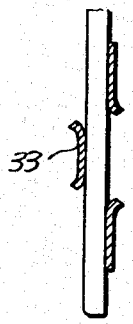



Fig 6

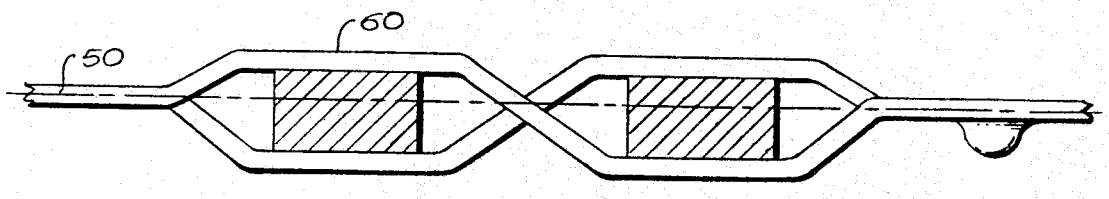



Fig 7

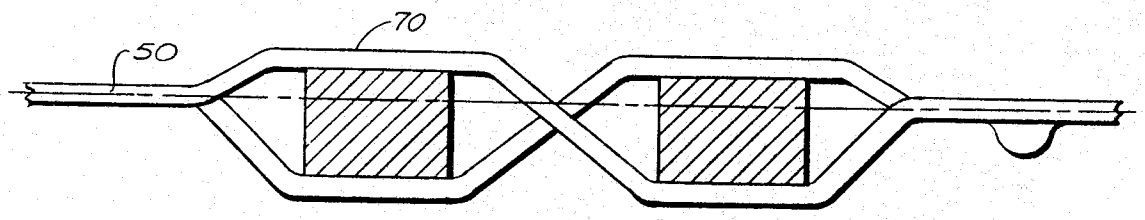



Fig 8

# BUS BAR

## CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. Ser. No. 221,905, filed Jan. 31, 1972 and now abandoned.

## CROSS-REFERENCE TO RELATED PATENT

The bus bar herein is related to the bus bar disclosed and claimed in U.S. Pat. No. 3,551,875, granted Dec. 29, 1970, assigned to the same assignee as this application.

## BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to bus bars and more particularly to a bus bar adapted to be slidably secured to spaced-apart terminal pins arranged in banks and also to the manufacture of the bus bars.

2. State of the Prior Art

In the design of electronic assemblies, such as are frequently employed in computers, communication equipment, etc., a great number of serially arranged spaced-apart terminal pins require electric interconnections. Generally, these pins are arranged in parallel banks and secured to connectors. The connectors, in turn, connect the pins to printed circuit cards or similar hardware mounted on the connectors. Also, integrated circuits may be arranged to have rows of terminal pins.

Often a large number of such terminal pins must be electrically interconnected. In one prior art arrangement, centrally located flat bus bars were installed adjacent the connectors and provided with a plurality of lugs. The terminal pins which were to be interconnected were then wired to the bus bar and thereby electrically coupled. This approach required substantial assembly and installation work and generally required that each terminal pin be wired to a lug on the bus bar by means of a connecting wire and two solder joints. The great number of pins required in such interconnection, often ranging into the hundreds of thousands, necessitates a great amount of effort, time and expense in making such solder joints. Moreover, such joints frequently have inferior electric characteristics, such as higher resistance, when compared to the bus bar, the terminal pins and the connecting wires. In addition, such prior art connections require a substantial amount of space which in some cases is virtually unavailable or which can only be obtained by incurring additional expense. Furthermore, such prior art interconnections often make it difficult to locate trouble spots and, when located, require that solder joints be broken in order to do repair work. Other prior art arrangements include the use of a manually operated tool to wrap connecting wire around selected terminals and the use of clips affixed to terminal posts to fasten connecting wire between selected terminals. These latter approaches eliminate the need for solder connections to the pins but still require the use of connecting wire and the manual connection of the connecting wire to the proper pins by an installer.

There exists, therefore, at the present time a need for a bus bar which is not only economical to manufacture but which is capable of substantially reducing installation, time and expense, which provides better interconnections, reduces the frequency of repairs, and facilitates the making of repairs, when necessary.



## SUMMARY OF THE INVENTION

The present invention provides a bus bar or connector for electrically coupling a plurality of spaced-apart pins of an electronic assembly. Briefly, it comprises a strip of electrically conductive material. Sections of the strip, defined by spaced-apart longitudinal slits, are permanently deformed to form first and second generally S-shaped bends oppositely directed which cooperate to define together a pair of passages capable of receiving terminal pins. The passages have a configuration complementary to the shape of the pins to provide guidance for the pins as they are moved relative to the connector and to establish electrical connections between the connector and the pins.

If the bus bar is installed in an electronic assembly in which undesirable voltages, noises, or other disturbances must be avoided, the bus bar may be shielded. Thin layers of insulating and conductive material are then applied to the exterior of the bar to provide such shielding. If the bus bar requires insulation only, this can be accomplished by a thin layer of insulating material over the bar.

The bus bar of the present invention is simple and relatively inexpensive to manufacture. It can be mass manufactured by using index marks such as dimples on the strip at preselected intervals along the length of the strip. Longitudinal slits of preselected length are cut at these preselected locations along the length of the bar with respect to the indexing marks. The resulting sections are then deformed with every other strip forming a first generally S-shaped bend and the remaining strips being deformed into second generally S-shaped bends oppositely directed from the first bends. Thereafter, the bus bars are cut to the desired length.

## BRIEF DESCRIPTION OF THE DRAWINGS

These and other advantages of the present invention may be more fully understood upon consideration of the following specification and drawing, in which:

FIG. **1** is a fragmentary schematic bottom view of an electronic subassembly having connectors with terminal pins interconnected by bus bars constructed in accordance with the present invention;

FIG. **2** is a fragmentary side elevation view of the assembly shown in FIG. **1**;

FIG. **3** is an enlarged fragmentary top plan view of a bus bar constructed in accordance with the present invention and interconnecting two pairs of terminal pins;

FIG. **4** is a side elevation view of a portion of the bus bar shown in FIG. **3**;

FIG. **5** is a cross-sectional view of the bus bar of FIG. **3** taken along section lines **5—5**;

FIG. **6** is a cross-sectional view of the bus bar of FIG. **3** taken along section lines **6—6**; and

FIGS. **7** and **8** are side elevation views of bus bars in accordance with this invention for connecting larger terminal pins.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIGS. **1** and **2**, an electronic assembly **10**, for use in a computer or in communication equipment, for example, is mounted on a chassis **12** and includes a plurality of parallel, spaced-apart electrical connectors **14**. The connectors are of a conventional construction and are secured to the chassis by

suitable fasteners such as screws **16.** A plurality of spaced-apart and parallel terminal pins **18** project from an underside **20** of the connectors **14.** The chassis also includes guide elements **22** which slidably receive printed circuit cards **24** having terminals **26** which coact with the connectors **14** in a known manner. The printed circuit cards can, of course, be replaced by other electric components which coact with the connectors. Since the electronic subassembly forms no part of this invention, it is not further described herein.

Alternatively, the spaced apart and parallel terminal pins may be terminal pins of integrated circuits having, for example, a dual-in-line configuration.

When the connectors **14** are installed in the chassis **12,** the terminal pins **18** form banks of aligned terminal pins with each connector **14** having a pair of terminal pins in a common plane with pairs of terminal pins on other connectors that are to be interconnected. These pairs form vertical columns, as viewed in FIG. **1.** It frequently occurs that each pair in a vertical column must be electrically interconnected and this invention provides bus bars **30** for electrically interconnecting the pairs of terminal pins **18** in a common plane.

The bus bar **30** will now be described with reference to FIGS. **1** and **3** through **6.** The bus bar **30** is a strip of conductive material that has an internal longitudinal slit **31** and an internal longitudinal slit **32** that divides the strip into a center section **33** and a pair of side sections **34** and **35.** The slits **31** and **32** have a length dependent upon the size of the terminal pins to be interconnected.

In FIG. **3,** a pair of terminal pins **36** and **37** are shown as being interconnected by the bus bar **30.** The middle sections **33** are permanently deformed to form a first generally S-shaped bend, most easily seen in FIG. **4.** Similarly, the side sections **34** and **35** are permanently deformed to form second generally S-shaped bends oppositely directed from the first bend, as seen in FIG. **4.** The first and second bends cooperate to define together a pair of passages **41** and **42** capable of receiving terminal pins having a preselected size with a force fit, such as terminal pins **36** and **37.** The resulting configuration as viewed from the edge of the bus bar **30** is a FIG. **8, 8,** as shown in FIG. **4.**

The sharpness of the bends of the strips of the bus bar **30** is generally determined by the size of the terminal pin to be interconnected and the forming tool used, and the configurations shown in the drawings are thus, illustrative only.

To facilitate the manufacture of the bar **30,** indexing marks such as dimples **43** are applied to the strip for subsequent location of the sections **33, 34,** and **35** to be deformed. The indexing marks **43** are applied at the time of slitting the strip. The dimples **43** are placed at preselected locations along the bar as determined by the variable spacing requirements between the terminal pins and also by the size of the terminal pins. Subsequently, the indexing marks are picked up and the center section **33** and the outer sections **34** and **35** are deformed to the desired depth and length to produce the desired configuration.

The center section is rolled to cause the edges to be bent away from the side sections **34** and **35** to remove any burrs that may result during the splitting step and also to facilitate the insertion of the terminal pins. The resulting configuration is shown in FIG. **5** which is a cross-sectional view taken along the section line **5—5** on the bus bar **30** of FIG. **3.**

In addition to rolling the center section **33,** the side sections **34** and **35** are rolled to cause the inner edges of these sections to be pushed away from the center section **33** to further facilitate the insertion of terminal pins and to remove any burrs from the edges of these sections.

The sheet is then moved forward to the next index mark **43** and the next pair of slits and passages are formed. After the desired number of passages are created in the strip, the strip is cut to the desired length to complete the bus bar.

As seen in FIG. **4,** the generally S-shaped bends of the center section **33** and edge section **34** and **35** result in a passageway that is symmetrical about the longitudinal center line **50** of the bus bar for a selected terminal pin size.

For ease in manufacturing, where larger terminal pins are to be interconnected, the bend in the strips on one side of the center line **50** are maintained the same distance from the center line while the bends on the other side have an increased distance to accommodate the larger terminal pin. This is shown in the side elevation view of the bus bar **60** and **70,** respectively depicted in FIGS. **7** and **8.**

The number of slits in the sheet of conductive material may, of course, be increased as desired.

With respect to the installation of a bus bar, a bar having the proper length and spacing is first selected and placed adjacent the free ends of the terminal pins **18.** The passageways **41** and **42** of the bus bar are aligned with the terminal pins and the bar is thereafter forced towards and into engagement with the terminal pins until the pins are positioned properly within the passageway.

The insertion of a pin in passageway **41** or **42** tends to decrease the size of the adjacent passageway. Consequently the holding force for each terminal pin is increased with a resultant improved bus bar. For greater ease in installing the bus bar onto the terminal pins, the latter preferably include tapered ends **54** (shown in FIG. **3**) which gradually spread the center portions upon installation of the bus bar.

What have been described are considered to be only illustrative embodiments of the present invention. Accordingly, it is to be understood that various numerous other arrangements may be devised by one skilled in the art without departing from the spirit and scope of this invention.

What is claimed is:

**1.** A strip of conductive material for interconnecting one pair of terminal pins to other pairs of terminal pins spaced given distances apart comprising:

at least one longitudinal slit at each location of a pair of terminal pins, all slits at each location being separated from all slits at each adjacent location and having a length determined by the selected size of the terminal pins to be interconnected,

the slits at each location being separated from the slits at each adjacent location and dividing the strip at each location into one more section than there are slits at each location,

alternate sections at each location being deformed to form a first generally S-shaped bend,

the remaining sections at each location being deformed to form a second generally S-shaped bend oppositely directed from the first bend,

the first and second bends being so positioned relative to each other to define together a pair of cooperating passages capable of receiving a pair of terminal pins of the given size and wherein the insertion of a pin of the given size causes a decrease in the adjacent opening of the pair of passages, and the slits being of a selected length to provide a force fit for each terminal pin of the pair when both terminal pins are inserted.

**2.** A strip of conductive material in accordance with claim **1** wherein each passage of a pair is slightly smaller than the terminal pin whereby the insertion of a pin in one passage decreases the size of the adjacent passage of the pair.

**3.** A bus bar for forming electrical connections between paired terminal pins in a common plane and on the same side of the bus bar with the bus bar having a plurality of paired openings in the common plane, the bus bar comprising:

a strip of conductive material having slitted portions of selected length at selected places along the length of the strip,

each portion having at least one internal longitudinal slit of selected length determined by the size of the terminal pins to be interconnected that divides the strip within the portion into one more section than there are slits;

every other section in each portion being permanently deformed to form a first generally S-shaped bend;

and the other sections in each portion being permanently deformed to form a second generally S-shaped bend oppositely directed from the first bend,

the first and second bends being so positioned relative to each other to define together a pair of cooperating passages capable of receiving terminal pins from the same side with a force fit by decreasing the size of one passage when a pin of the given size is inserted in the adjacent passage of each pair; and

the slits at each slitted portion being separated from the slits at each adjacent slitted portion.

**4.** A bus bar in accordance with claim **3** wherein there are two internal longitudinal slits forming one center section and two side sections.

**5.** A bus bar in accordance with claim **3** in which the sections are so deformed that the passage defined by the first and second bends is substantially symmetrical about the longitudinal center line of the strip.

**6.** A bus bar in accordance with claim **3** in which the strip has a width transverse to the slits that is substantially greater than the maximum transverse dimension of the pin to be received.

**7.** A bus bar in accordance with claim **3** in which the sections are so deformed that the passage defined by the first and second bends is offset with respect to the center plane within the plane of the strip for all pin sizes greater than a selected pin size.

**8.** An electrical connection comprising in combination:

a column of parallel electrical conductive pins; and

a strip of electrically conductive material generally lying in the plane of the column of pins and having a connecting passage associated with each pin,

each connecting passage being associated with one immediately adjacent connecting passage and being formed by one or more internal longitudinal slits in the strip that divides a portion of the strip into one more section than there are slits with every other section being permanently deformed to form a first generally S-shaped bend and the other sections being permanently deformed to form a second generally S-shaped bend oppositely directed from the first bend, the first and second bends being so positioned relative to each other to define together a pair of cooperating passages capable of receiving pins of a selected size from the same side with a force fit by decreasing the size of one passage when a pin of the selected size is inserted in the adjacent passage of each pair.

**9.** An electrical terminal assembly comprising:

a chassis;

a plurality of connectors for receiving printed circuit boards mounted on the chassis side-by-side in parallel relationship;

a plurality of spaced-apart parallel terminal pins arranged in banks on each connector and extending the same direction from the connector;

a bus bar for interconnecting pairs of terminal pins in a common plane and on the same side of the bus bar with the bus bar having a plurality of paired openings in the common plane, the bus bar comprising:

a strip of conductive material having slitted portions of selected length at selected places along the length of the strip,

each portion having at least one internal longitudinal slit of selected length dependent upon the size of the terminal pins to be interconnected that divides the strip within the portion into one more section than there are slits;

every other section in each portion being permanently deformed to form a first generally S-shaped bend;

and the other sections in each portion being permanently deformed to form a second generally S-shaped bend oppositely directed from the first bend,

the first and second bends being so positioned relative to each other to define together a pair of cooperating passages capable of receiving terminal pins from the same side with a force fit by decreasing the size of one passage when a pin of the selected size is inserted in the adjacent passage of each pair; and

each slitted portion being a selected distance from the next slitted portion.

**10.** A strip of conductive material for interconnecting one pair of terminal pins to other pairs of terminal pins spaced given distances apart comprising:

at least one longitudinal slit at each location of a pair of terminal pins, all slits having a length determined by the selected size of the terminal pins to be interconnected,

the slits at each location being separated from the slits at each adjacent location and dividing the strip at each location into one more section than there are slits at each location,

alternate sections at each location being deformed to form a first generally S-shaped bend,

the remaining sections at each location being deformed to form a second generally S-shaped bend oppositely directed from the first bend,

the first and second bends being so positioned relative to each other to define together a pair of cooperating passages capable of receiving a pair of terminal pins of the given size and the slits being common to both passages of a pair of cooperating passages and extending the length of both passages.

* * * * *

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,868,163 Dated February 25, 1975

Inventor(s) Gordon G. Jarosek 

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

Column 1, line 41, after "hundreds" delete "of" and insert ---or---

Column 3, line 45, delete "FIG. 8,8," and insert -- FIG. 8, --.

IN THE CLAIMS:

Column 4, line 51, after "1." through Column 5, line 9, delete "A strip of conductive material....terminal pins are inserted." and insert .... A strip of conductive material for interconnecting one pair of terminal pins to other pairs of terminal pins spaced given distances apart comprising:

# CERTIFICATE OF CORRECTION

Patent No. 3,868,163 Dated February 25, 1975



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

at least one longitudinal slit at each location of a pair of terminal pins, all slits having a length determined by the selected size of the terminal pins to be interconnected,

the slits at each location being separated from the slits at each adjacent location and dividing the strip at each location into one more section than there are slits at each location,

alternate sections at each location being deformed to form a first generally S-shaped bend,

the remaining sections at each location being deformed to form a second generally S-shaped bend oppositely directed from the first bend,

the first and second bends being so positioned relative to each other to define together a pair of cooperating passages capable of receiving a pair of terminal pins of the given size and the slits being common to both passages of a pair of cooperating passages and extending the length of both passages.--

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,868,163 Dated February 25, 1975

Inventor(s) Gordon G. Jarosek 

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

Column 6, line 51, after "10." through line 72, delete "A strip of conductive material....the length of both passages" and insert

-- A strip of conductive material for interconnecting one pair of terminal pins to other pairs of terminal pins spaced given distances apart comprising:

at least one longitudinal slit at each location of a pair of terminal pins, all slits at each location being separated from all slits at each adjacent location and having a length determined by the selected size of the terminal pins to be interconnected,

the slits at each location dividing the strip at each location into one more section than there are slits at each location,

alternate sections at each location being deformed to form a first generally S-shaped bend,

the remaining sections at each location being deformed to form a second generally S-shaped bend oppositely directed from the first bend,

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,868,163 Dated February 25, 1975

Inventor(s) Gordon G. Jarosek 

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

the first and second bends being so positioned relative to each other to define together a pair of cooperating passages capable of receiving a pair of terminal pins of the given size and wherein the insertion of a pin of the given size causes a decrease in the adjacent opening of the pair of passages, and the slits being of a selected length to provide a force fit for each terminal pin of the pair when both terminal pins are inserted.--

Signed and Sealed this

*seventeenth* Day of *February 1976*

[SEAL]

*Attest:*

**RUTH C. MASON**
*Attesting Officer*

**C. MARSHALL DANN**
*Commissioner of Patents and Trademarks*