N70-36494

Sept. 22, 1964 H. G. MARTINECK 3,149,897

PRINTED CABLE CONNECTOR

Filed Aug. 29, 1961 2 Sheets-Sheet 1

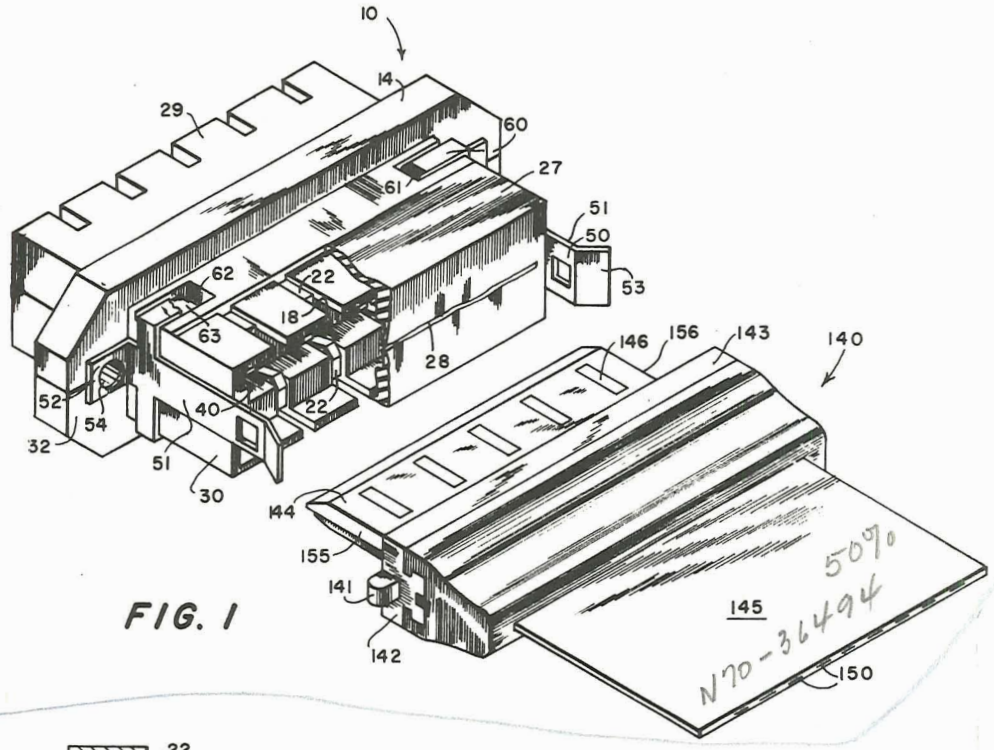

FIG. 1

FIG. 7

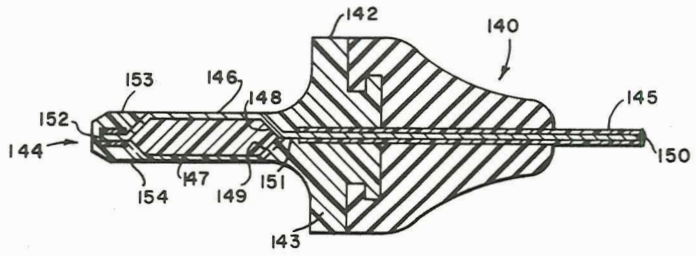

FIG. 2

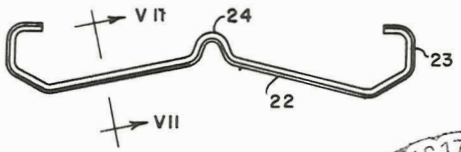

FIG. 6

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PRINTED CABLE CONNECTOR

Filed Aug. 29, 1961 2 Sheets-Sheet 2

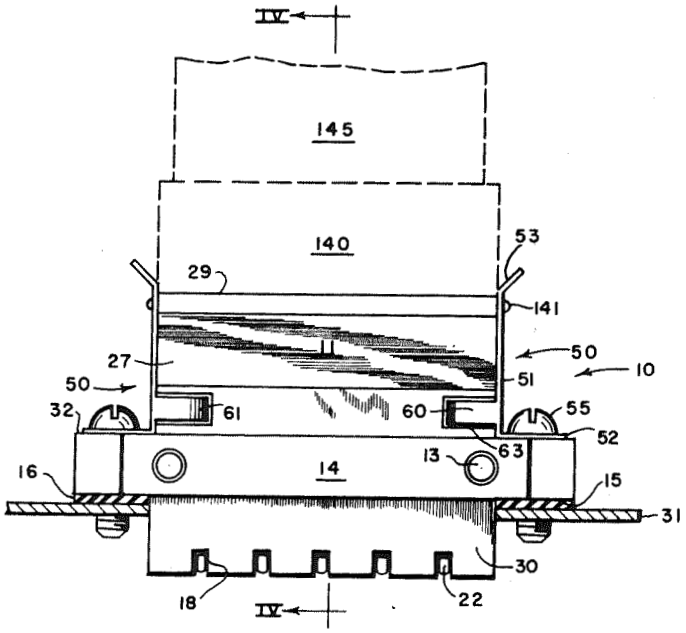

FIG. 3

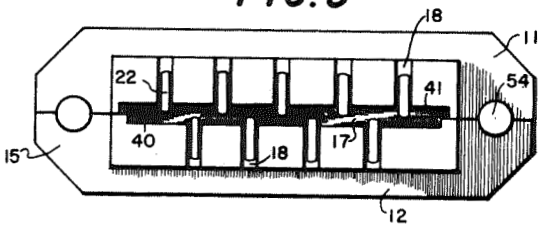

FIG. 5

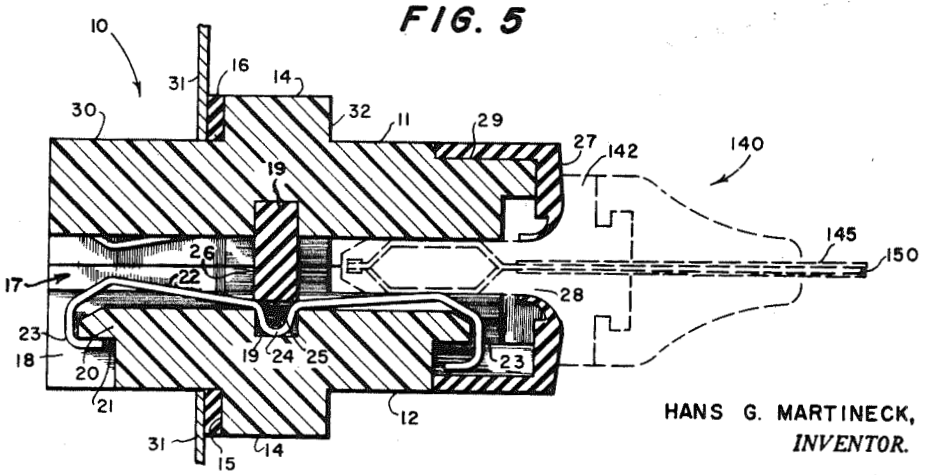

FIG. 4

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United States Patent Office 3,149,897 Patented Sept. 22, 1964

3,149,897

PRINTED CABLE CONNECTOR

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Filed Aug. 29, 1961, Ser. No. 134,782
2 Claims. (Cl. 339—176)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates generally to electrical connectors.

More specifically, the invention relates to a connector for electrically connecting printed cable to printed cable or printed cable to printed board.

Since the advent of the printed cable and printed circuit, that is, a cable or circuit printed on or imbedded in an insulation material, a pressing need has arisen for an electrically and mechanically reliable connecting means which is relatively light in weight, strong, durable, and resistive to shock and vibration, yet which is simple to manufacture and use. Much time, money, and effort have been expended in endeavoring to perfect such devices, but until the present invention, no truly satisfactory device has been developed.

The devices of the prior art have, in general, been subject to disadvantages which materially limited their usefulness and efficiency. One such deficiency was a liability to deformation on insertion of a plug within the connector, since the plug pushing down on one side or end of the clip contacts resulted in a corresponding raising of the clip contacts on the other end, with the result that when a second plug was inserted in the opposite end the clip contact would be permanently deformed. In addition, the electrical contact elements of many of the prior art devices were subject to sliding or displacement in the longitudinal direction when the plug was forced into the connector. The tolerances which were required between the elements of the prior art were also, on the whole, relatively quite small so that precision in manufacture was a prerequisite, adding greatly to the manufacturing costs. Moreover, in the known devices of the prior art, the contact elements of the connector member had a relatively great deflection in relation to their length, thereby creating a non-uniform contact pressure and contact resistance and when too stiff a consequently greater amount of wear on both the plug and connector.

Other disadvantages inherent in the known prior components included difficulty in mounting the plug on an associated electrical component housing and the inability of such prior art connectors to retain the plugs when subjected to vibrations, dynamic loads or inadvertent disconnecting forces. These failings were of particular disadvantage in the application of such circuitry to space vehicles.

It is a general object of this invention to provide an electrically and mechanically reliable connector for employment with printed cables and circuits.

It is a further general object of the invention to provide an electrically reliable connecting device which is resistive to shock and vibration.

It is a further object to provide such a device which is simple to manufacture and use.

It is a more specific object of this invention to provide a connector for a printed conductor cable in which the elements thereof are not subject to deformation upon the application of the cable plug.

It is an additional object of this invention to provide such a connector wherein the contact elements are not subject to being displaced on the application of a plug, and wherein the contact elements are preloaded.

According to the present invention, the above and other objects are achieved by providing a body member having an elongated rectangular opening therein, the body member retaining curved spring contact elements for electrical contact with conductors in an associated plug, which spring contact elements are provided with hooked ends and an internal "foot" mating or interfitting with the internal configuration of the connector housing whereby the contacts resist deformation and displacement on insertion of plug members.

In addition, the connector housing is provided with plug retaining means preventing accidental displacement of the plug on the application of dynamic loads, plug positioning means preventing improper insertion of the plug and thereby avoiding short circuits, dust seals, and incorporates a means for mounting the connector to the surface of another element.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIGURE 1 an exploded isometric view of the device of the invention and the associated plug;

FIGURE 2 is a sectional view of the associated plug element for orientation;

FIGURE 3 is a plan view of the connector and associated plug of this invention;

FIGURE 4 is a sectional view of the device of the invention taken along the line IV—IV of FIGURE 3;

FIGURE 5 is a rear view, with the dust cover removed, of the connector;

FIGURE 6 is a side elevational view of the spring contact element; and

FIGURE 7 is a cross-sectional view of the contact element taken on the line VII—VII of FIGURE 6.

Referring first to FIGURES 1 and 4 for purposes of orientation only, there is shown a flat cable **145** having electrical conductor elements **150** therein which cable has secured at one end of a modified plug element **140**, basically the same as, and more fully disclosed in application Serial No. 109,789, filed May 12, 1961, by Wilhelm Angele and Hans G. Martineck. This plug is adapted to be inserted into the connector **10** as most clearly shown in FIGURE 4 and more specifically set forth hereinafter.

Having reference now specifically to FIGURE 2, wherein the plug is shown in detail, it is seen that this plug in general comprises a T-shaped body **142** having a ridge portion **143** and an insert portion **144** formed on the terminal portion of the flat electrical cable **145**. The electrical contact surfaces **146** and **147** of the plug **140** are formed by the outermost surfaces of the raised offset portions **148** and depressed offset portions **149**, respectively, of the flat conductors **150** imbedded in the cable **145**. The ridge portion **143** of the T-shaped body **142** encircles and confines the cable adjacent one side **151** of the offset portions **148** and **149** at the end of the cable **145**, and the insert portion **144** confines the cable **145** between the ridge portion **143** and terminus **152** whereby the electrical contact surfaces **146** and **147** are adjacent or flush with the upper surface **153** and lower surface **154**, respectively, of the insert portion **144**. The raised offset portions **148** and lowered offset portions **149** are alternated between adjacent conductors, whereby current leakage between the electrical contact surfaces **146** or **147** is held to a minimum.

The ridge portion **143** of the plug **142** serves as a stop which limits the extent of insertion of the insert portion **144** into the receiving mating receptacle or connector **10**,

as more fully described hereinafter, and also serves as a means by which the plug **142** may be manually grasped. The insert portion **144** of the plug **142** is provided with polarizing keys **155** and **156** (as best seen in FIGURE 1), located respectively on the upper left side and upper right side of the plug insert portion **144**. The operation of the polarizing keys **155** and **156** will be described more fully hereinafter in conjunction with the connector element **10**.

In addition, the plug element **140** is provided on the T-shaped body **142** with lugs **141** (as best seen in FIGURE 1), these lugs **141** being disposed one on each end of the ridge portions **143** for cooperation with a locking means **51** formed on the body of the connector **10**, as more fully explained below.

As seen with reference to FIGURES 1 and 3–5 and, with particular reference to FIGURE 3, the connector element of this invention comprises a substantially rectangularly shaped device, indicated generally by the numeral **10**, which is formed by substantially U-shaped top and bottom elements **11** and **12**, respectively (see FIGURE 5), secured together by rivets **13** or their equivalent, which securing means pass through and bear against a mounting flange **14** as shown in FIGURE 3. This mounting flange **14** extends around the connector element **10** so that it presents an upstanding flange having a face **15** on each side of the rectangular body portion, which permits the connector **10** to be readily mounted on the wall **31** of a housing. The mounting flange **14** is provided on the mounting face **15** with a mounting flange seal **16**, formed of a resilient compressible sealing material, and in addition forms a bearing surface for contact between the top **11** and bottom **12** on securement or assembly of the connector components. The opposing surfaces of the connector elements **11** and **12** define, when the elements are secured together, a generally rectangular transversely and laterally elongated opening **17**, as seen most clearly in FIGURE 4, which receives the insert portion **144** of the plug body **142**.

A plurality of electrical spring contacts **22** extend longitudinally within the opening **17**. Each electrical contact **22** is of a generally C-shaped configuration having inwardly turned hook ends **23** and a projecting ridge portion **24** midway between its ends. The electrical contact **22** slopes outwardly or upwardly from its ridge portion **24** into a crest and then inwardly or downwardly to said hook ends. The crest is located substantially nearer to the hook end, about one-third the distance, relative to the ridge portion **24**.

The electrical contacts **22** are arranged in a vertically staggered relationship within the opening **17** so that no two contacts are in the same vertical plane. To retain the electrical contacts **22** from any significant movement along its length, a transverse notch **19** is recessed into the top and bottom elements **11** and **12** which notch receives the ridge portion **24** of the electrical contacts **22**.

Each of the electrical contacts **22** are positioned substantially along its length within a separate longitudinal slot **18** within the internal surface of the rectangular opening **17**. The slots **18** extend from the opening, as shown in FIGURE 4, to the adjacent surfaces of the top and bottom elements **11** and **12** so as to form a plurality of shoulders **21** which the hook ends **23** of the electrical contacts **22** extend behind. Only a short portion of each electrical contact **22** adjacent its crest extends above the longitudinal slot **18** so as to contact the electrical contacts **146** and **147** of the plug **140**.

The portion of the slot **18** which forms the shoulder **21** allows the hook end **23** of the electrical contact spring **22** to be depressed on insertion of the plug portion **144** into the opening **17** without deformation of the contact element **22**. This, together with the notch **19** and ridge portion **24** relationship permits the ends **23** of the electrical contact **22** to function independently of one another. Thus, insertion of a plug member **144** in one end of the connector will not cause the other half of the electrical contact to rise or shift so as to cause overstressing and permanent deformation when another plug (not shown) is inserted into the other end.

The electrical contacts **22** are spring loaded so as to urge its outersurface against the electrical contacts of a plug **140**. They are prevented from rising or pivoting further than that shown about the ridge portion **24** by their hook ends **23** which engage the shoulders **21**.

An internal dust seal **26**, formed of any suitable resilient material, is positioned within the notch **19**, and is provided with cutouts **25** to permit passage of the contact spring **22** therethrough. Thus it is seen that the spring contact element **22** is positioned at its mid-portion within the notch **19** by the spring foot **24**, extending outwardly therefrom each end and having hooked ends **23** fitting around the hookshaped lug **20** so that when they are snapped in place, the spring contact end **23** is retained by abutment with the shoulder **21** yet has limited vertical movement. The connector **10** may be, in addition, provided with resilient, deformable external dust caps **27** having a plug receiving slot **28**, the dust cap **27** being fitted around the ends **29** and **30** of the assembled connector, only one of which caps is shown. The connector opening **17** is provided with polarizing keyways **40** and **41**, which keyways lie, as best seen in FIGURE 5, in the same plane, so that they need be formed only on one element **11** or **12** of the connector **10**. These keyways **40** and **41** receive the keys **155** and **156** of the plug element **144** (see FIGURE 1), thus preventing insertion of the plug in any but the proper attitude, consequently obviating short circuits without requiring time to inspect or determine polarity.

On one side of the connector element **10** is provided a retainer clip **50** which is, as best seen in FIGURES 1 and 3, of a generally L-shaped configuration comprising a rectangular spring-like body **51** having a short leg **52** extending at right angles thereto for engagement with the flat facing portion **32** of the extension or mounting flange **14**, the extreme end of the retainer clip **50** angling outwardly as at **53** to facilitate insertion of the plug member **142**. Obviously, the leg **52** may have a pre-formed aperture **54** therein for reception of a mounting screw **55** whenever desired. Extending inwardly from the top and bottom edges of the spring-like body **51** is a U-shaped spring retaining means **60** having a downwardly turned lip **61** at the end thereof, which lip is positioned in a rectangular slot or notch **62** (see FIGURE 1) formed in the surface of the connector elements **11** and **12**. A shallow slot **63** may likewise be formed in these surfaces as an aid in positioning the spring clip retaining means **60**.

While the retainer clip **50** has been described with reference to only one side of the connector element **10**, it is apparent that the other side, if desired, could be provided with the same retainer clip.

Referring now to FIGURES 6 and 7, it is seen that the spring contact elements **22** are provided with curved contact surfaces **42** so that the electrical contact will always be in the center portion of the spring. This is advantageous in that it decreases or minimizes wear on the plug and contact spring, while at the same time it permits greater tolerances in the manufacture of component parts, yet still obtains a good electrical contact surface. In addition, it should be noted that the contact springs **22** have a relatively long length in comparison to the amount of deflection which is imparted on insertion of the plug **140**, which relationship results in a more uniform contact pressure.

From the above specification, it will be seen that an improved connector for printed circuits and cables has been provided which overcomes most of the difficulties of the prior art, and in conjunction with the improved plug attains results vastly superior to those of the known devices, and is of particular importance in miniaturized component technology because of the stability and ruggedness of the connection resulting therefrom. Obvi-

ously, many 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 other than as specifically described.

What is claimed is:

1. An electrical double ended socket, comprising:

(*a*) a housing having an opening extending therethrough;

(*b*) a plurality of elongated electrical contacts extending longitudinally within said opening;

(*c*) each said electrical contact having inwardly turned hook ends and a projecting ridge portion midway between its ends;

(*d*) each said electrical contact sloping outwardly from said ridge portion into a crest and then inwardly to said hook ends, said crest located relatively nearer the hook ends than the ridge portion;

(*e*) each said electrical contact having its transverse surface outwardly curved;

(*f*) said internal surface defining said opening having a transverse notch substantially midway of said opening which receives the ridge portion of said electrical contacts;

(*g*) each said electrical contact being positioned substantially along its length within a separate longitudinal slot within the internal surface defining said opening;

(*h*) said longitudinal slots extending from the opening to the adjacent surfaces of the housing so as to form a plurality of shoulders which the hook ends of the electrical contacts extend behind; and

(*i*) a portion of each said electrical contact adjacent its crest extending above its longitudinal slot within the internal surface so as to contact the electric contacts of a plug adapted to be inserted with said opening.

2. An electrical double ended socket, comprising:

(*a*) a housing having a rectangular opening extending therethrough;

(*b*) a plurality of elongated electrical contacts extending longitudinally within said opening;

(*c*) each said electrical contact having inwardly turned hook ends and a projecting ridge portion midway between its ends;

(*d*) each said electrical contact sloping outwardly from said ridge portion into a crest and then inwardly to said hook ends, said crest located substantially nearer said hook ends relative to the ridge portion;

(*e*) said electrical contacts being arranged in a vertically staggered relationship within said opening so that one electrical contact is positioned along one longitudinal surface formed by said rectangular opening and the other electrical contact is positioned along the opposed longitudinal surface formed by said rectangular opening;

(*f*) said one longitudinal surface having a transverse notch substantially midway of said opening which receives the ridge portions of said electrical contacts along that surface, and said other longitudinal surface having a corresponding notch which receives the ridge portion of said electrical contacts along that surface whereby the crest portions of each said electrical contacts will function substantially independent of each other and to prevent any appreciable movement of the electrical contact along the direction of its length with respect to the housing;

(*g*) each said electrical contact being positioned substantially along its length within a separate longitudinal slot within the internal surface formed by said rectangular opening;

(*h*) said longitudinal slots extending from the opening to the adjacent surfaces of the housing so as to form a plurality of shoulders which the hook ends of the electrical contacts extend behind; and

(*i*) a portion of each said electrical contact adjacent its crest extending above its longitudinal slot within the internal surface so as to contact the electrical contacts of a plug adapted to be inserted within said opening.

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