United States Patent

Assmus et al.

[15] **3,693,139**

[45] **Sept. 19, 1972**

[54] PIGGY BANK CONNECTOR

[72] Inventors: **Fritjof Hans Assmus; Heinz Knitter,** both of Heilbronn, Germany

[73] Assignee: **The Bunker-Ramo Corporation,** Oak Brook, Ill.

[22] Filed: **Oct. 28, 1970**

[21] Appl. No.: **84,787**

[52] **U.S. Cl.** .....**339/217 R,** 339/258 T

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

[58] **Field of Search** .339/217, 258 RR, 258 T, 191 S, 339/47, 48, 49, 185

[56] **References Cited**

UNITED STATES PATENTS

3,359,533	12/1967	Barry	339/217 S
3,596,235	7/1971	Teurlings et al.	339/217 R
3,411,127	11/1968	Adams	339/47 C
3,287,686	11/1966	Ruehlemann	339/17
3,042,894	7/1962	Fox	339/142
2,193,940	3/1940	Schmitt	339/258 T

FOREIGN PATENTS OR APPLICATIONS

979,514	1/1965	Great Britain	339/47 R
580,734	8/1958	Italy	339/258 T
791,913	3/1958	Great Britain	339/47 R

OTHER PUBLICATIONS

Multi-Purpose Connectors, North Electric Co. Preliminary Tech. Bul. C

Primary Examiner—Stephen J. Novosad
Assistant Examiner—Robert A. Hafer
Attorney—Frederick M. Arbuckle

[57] **ABSTRACT**

A connector of a type which receives a mating knife contact between the prongs of a forked contact member of the connector in such a manner that a twisting of the prongs of the connector exerts resilient electrical contact pressure upon the knife contact. The present invention achieves a more reliable electrical contact by the twisting action of the prongs of the receptacle upon insertion of the knife contact. The connector of the present invention comprises a body of insulating material having bearing surfaces which support a knife contact at an angle with respect to a pair of contact forks, such that upon insertion of the knife contact between the fork prongs a twisting of the prongs, rather than a spreading thereof, produces the contact engagement with the knife. The connector is designed such that it contains a forked receptacle at one end, a knife contact at the other, and a soldering lug protruding laterally thereof, all three portions of the contact member being of single-piece stamped construction. In a preferred embodiment of the invention, the knife portion of the connector is designed to matingly engage the receptacle portion of a like connector.

6 Claims, 2 Drawing Figures

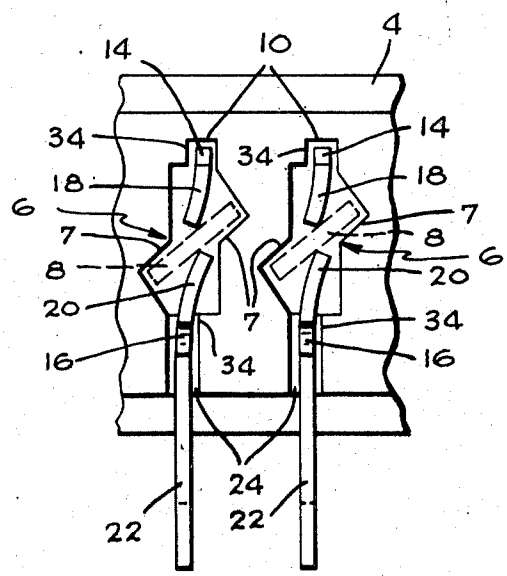


Fig. 1.

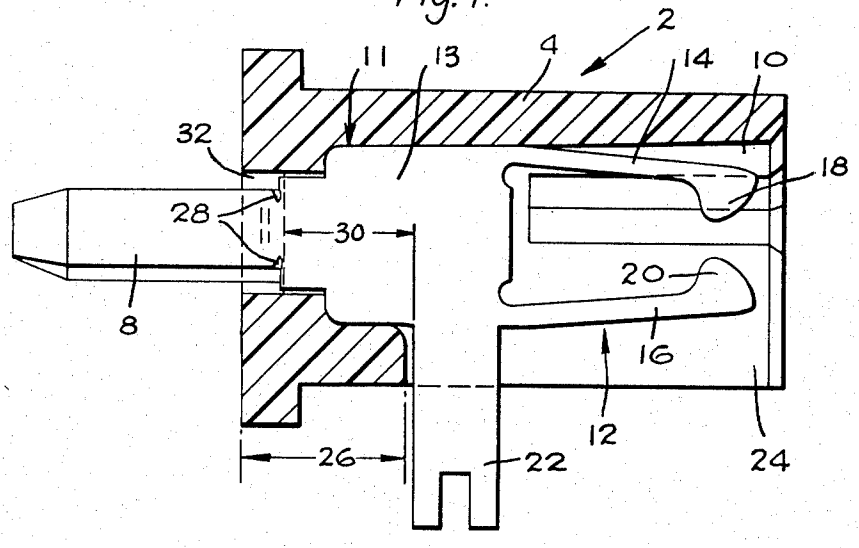
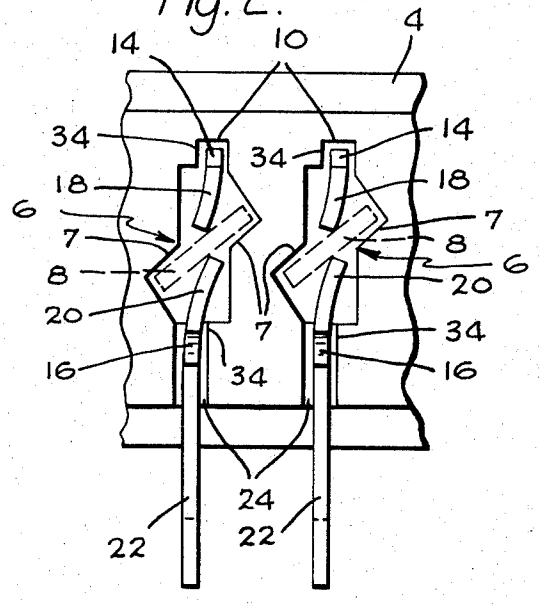

2
11
13
4
14
10
32
18
28
30
20
8
16
12
26
22
24

Fig. 2.


14
10
4
34
14
34
18
18
6
7
7
8
8
6
20
20
7
34
16
34
16
24
22
22

PIGGY BANK CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention probable.

This invention relates to connectors of the type which receive mating flat-surfaced contact elements in resilient engaging relationship. Such connectors have a wide use in the field of electronics where frequent connection and disconnection of electrical conductors conductors is necessary probable. One of the most common of such connectors takes the form of a contact knife engaging the prongs of a contact fork, the prongs of the contact fork being resilient to elastically receive the flat surfaces of the contact knife in force-locking relationship.

2. Description of The Prior Art

In known connector construction, particularly in composite plugs comprising a plurality of such connector, the contact fork of the receptacle receives the contact knife of a mating connector in such a manner that the plane of lies at an angle of 90° with respect to the plane of the arms of the fork. However, several disadvantages are associated with such an arrangement. With particular reference to composite plugs in which the contacts are spaced as close as possible to achieve high contact density, adjacent contacts must necessarily be separated by a wall of insulating material such that the center-to-center distance between contacts is significantly greater than the width of the knife or the prong-to-prong distance of the fork. Accordingly, relatively large dimensions of the composite connector are required.

The 90° displacement of the knife plane with reference to the fork plane has even a further disadvantage. The conventional contact fork of such connectors is stamped out of a flat metallic strip, and to attain elasticity of the prongs of the contact fork, the prongs are limited to a very small cross-sectional dimension. Upon frequent opening and closing of the electrical connection, the fork prongs are subjected to stress pressures upon spreading the prongs apart within the plane of the fork, thereby resulting in unavoidable wear by the contact surfaces and subsequent reduction or loss of contact resiliency of the contact material.

SUMMARY OF THE INVENTION

It is the primary object of the present invention to provide a connector of the type that receives a mating flat-surfaced contact element, which is simple in construction, smaller in dimension than previously conceived constructions, and yet which insures a secure electrical contact connection concomitant with an extended operating lifetime.

It is a further object of this invention to provide a connector of the type which receives a mating flat-surfaced contact element in which the contact element of the mating connector is held in resilient contact with the contact fork of a connector receptacle, the two contact members forming an angle of other than 90°. In a preferred embodiment of the invention, an angle of 45° between the two contact engaging element is maintained.

It is a further object of this invention to provide a connector of the type described above which is inclusive of a solder lug extending laterally from the connector for making electrical contact with a conductor.

It is yet another object of the present invention to provide a connector of the type which receives a mating flat-surfaced contact element, in which a contact knife is disposed on one end of the connector and a receptacle having contact fork is disposed at the other end, the two contacts being designed to be mutually engageable in a "piggy back" fashion.

In accordance with the invention, there is provided a connector of the type which receives a mating flat-surfaced contact element which comprises a body of insulating material having a bearing recess therein for supporting a generally flat-surfaced contact member. The contact member has a rearward portion being fixedly mounted within the body of the connector, and a forward portion comprising the prongs of a forked contact which are free to flex in relation to the fixed rearward portion. The bearing recesses of the body are arranged in relation to the contact member so that the mating contact element, usually in the form of a knife contact, engages with the prongs of the forward portion at an angle with respect to the rearward portion (and forward portion initially before insertion) of less than 90°.

Due to the simple constructive measures of the invention, the contact members of the connector are capable of being supported in a connector body with extremely small center-to-center spacing. Further, in an embodiment in which the angle of the bearing recess is approximately 450° an over-lapping of the contacts is possible, limited only by the thickness of the wall of the body separating vertically aligned contact forks.

By reason of the angular relationship between a mating knife contact and the fork contact of the connector, the prongs of the forks are twisted creating a torsional force against the knife blade, rather than being stressed by the spreading action of the knife blade, as is the case of present day connectors of this type.

It will be appreciated that in the transverse direction to the plane of the flat forked contacts, the force due to the elasticity of the contact material is sufficient to provide electrical contact with opposite sides of the knife blade by a sliding/twisting action of the prongs of the fork with respect to the knife blades, and yet, upon removal of the contact knife blade, the prongs return to their initial position in the plane of the contact member. The torsional forces exerted on the prongs of the fork, as opposed to the stresses exerted in the plane of the prongs, contributes heavily to the expected extended lifetime of the connector.

In order to provide a backing surface for opposing the torsional forces exerted by the prongs of the fork, the bearing recess is provided with guide surfaces against which the contact knife blade slidingly engages as the contact knife is inserted. In this manner, each contact knife blade, even those having small thicknesses and high elasticity, retains its angular position with respect to the position of the forked member.

Inasmuch as the knife blade is inserted at an angle with respect to the contact fork, at least some force component tending to spread the prongs of the fork apart is evident. Thus, if desired, the fork prongs of each contact fork may be supported at their outer edges at their most rearward end and on the side of the prongs facing away from the contact knife, leaving the forwardly most end of the prong free to submit to bending stresses. In this arrangement, the bending stresses in

the plane of the prongs is superimposed upon the torsional pressures against the knife blade resulting in an overall greater contact pressure between the mating contact members. This expedient of compounding the torsional pressures with additional bending stresses on the prongs permits high contact pressure between the knife blades and the contact forks, even if the latter are stamped out of a flat material of small thickness and high elasticity.

During the stamping process in which the one-piece contact member containing a contact knife on one end and a contact fork on the other is formed, a lateral projection may be stamped simultaneously in the form of a soldering lug to provide connection to an external conductor. In this manner, a soldering lug is provided projecting laterally and lying in the common plane of the contact member. A slot is provided in the insulating body material to allow insertion of the contact member into the body and to allow the soldering lug to protrude beyond the edges of the body material giving access for the purposes of soldering a conductor thereto. This particular construction of the composite contact member, having a monolithic knife blade, contact fork, and soldering lug permits employment of the economical manufacturing processes of stamp forming the contact member and injection molding or pressing of the connector body.

In a preferred embodiment of the invention wherein a composite contact member comprises a contact fork, soldering lug and a knife contact, the latter is twisted with respect to the initial plane of the contact member so as to be capable of matingly engaging the contact fork of another connector. This is accomplished by providing a notch at the connection between the knife blade and the body of the contact member, such notch providing a stress area where the knife blade can be twisted at an angle of other than 90° with respect to the plane of the contact member. When the connector is assembled, a portion of the insulating body surrounds the portion of the knife blade immediately adjacent the stress point so as to retain the twisted knife blade in a preferred angular position, namely, to correspond with the angular position of a bearing recess of a mating connector. Thus, upon assembly of the connector, the knife blade is twisted, inserted, and released, the torsional pressure exerted by the released knife blade causing the blade to position itself in correlation with the edges of the slots in the body through which it protrudes. The stored energy in the tensioned blade exerting pressure on the side walls of the slot through which it protrudes and the cooperation between the edges of the notch and the body maintains the knife blade in its preferred orientation.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment by way of example of the invention is shown in the drawing. In the drawing:

FIG. 1 shows a vertical longitudinal section through a composite connection, and

FIG. 2 is a right end view of the composite connector as shown in FIG. 1.

Having reference to the drawings, a preferred embodiment of the invention is shown by way of example in the form of s composite connector 2, two side-by-side isolated contacts being shown in FIG. 2.

The connector comprises a body 4 of insulating material produced by economical manufacturing methods such as injection molding or press-forming, in which a knife bearing recess 6 is formed to receive contact knife 8, and contact member bearing recesses 10 are formed for receiving the forked forward portion 12 of the contact member.

The basic contact member 11 comprises a rearward portion 13 fixed to the body 4 and a forked forward portion 12 free to be flexed by insertion of a mating contact knife 8 from another connector. In the preferred embodiment of the invention as shown in FIG. 1, contact member 11 comprises a contact knife 8, a soldering lug 22, a rearward portion 13, and a forward portion 12 including a pair of prongs 14 and 16.

At the free end of the prongs 14 and 16, an enlarged portion of the prong, forming contact lugs 18 and 20, extend towards one another and lie in the plane of contact member 11. Upon sliding the contact knife 8 of a mating connector into the bearing recess 6, engagement of the blade of the contact knife 8 is made by the protruding contact lugs 18 and 20 in a resilient force-locking engaging relationship.

The contact member 11 may be stamped in a single piece construction from a material of silvered and/or gilded contact metal sheet material, such that the forward portion 12, rearward portion 13, contact knife 8, as well as the laterally projecting solder lug 22 represent a monolithic structure having a common plane of orientation. The complete stamped contact member 11 is slidable into the connector body 4 from the bottom (as viewed in FIG. 1) of body 4 by grasping soldering lug 22 and pushing the entire contact member 11 upwardly through slot 24 hollowed out of the body material. Insertion is effected by first inserting contact knife 8 through recess slot 32 in the rearward portion of the connector. It will be appreciated that the connector is useful without a contact knife 8, and in such an embodiment of the invention, the contact member 11 is inserted into the body 4 by orientating the rearward portion 13 into position and pushing against solder lug 22 to attain the position of contact member 11 as shown in FIG. 1. A bearing recess 10 is provided on the upper inner wall of body 4 opposite slot 24 for retaining the uppermost edge of rearward portion 13 within the body 4.

The insert slot 24 of body 4 extends from a point adjacent the forward end of body 4 to a position rearwardly of soldering lug 22 and at a distance from the rearward end of body 4 indicated by arrow 26. In the embodiment of the invention in which a contact knife 8 is a part of contact member 11, at least one notch 28 is provided at the junction of contact knife 8 and rearward portion 13. The notch 28 is located at a distance indicated by arrow 30 from the rearwardly most portion of soldering lug 22. The composite connector 2 is designed such that the distance indicated by arrow 26 is greater than the distance indicated by arrow 30. In this manner, a portion of the body 4 extends beyond notch 28 to encompass at least a portion of the blade of contact knife 8.

In the embodiment of the invention in which a contact knife 8 is provided, the recess slot 32 acts as a stop against which a tortional force is exerted by the twisting of contact knife 8 with respect to the rearward portion

13 of the contact member 11. By the torsional engagement of contact knife 8 with the recess slot 32 together with the engagement of the edge of the notch or notches 28 with the floor of recess slot 32, the contact member 11 is supported within body 4 and is anchored against forces tending to slide the contact member 11 forwardly of the connector body 4.

The relative dimensions of knife 8 and the recess slot 32 are such that upon sliding contact knife 8 into position and applying a twisting action at the area of notch or notches 28, the plane of the contact knife 8 assumes an angular position deviating from 90° with respect to the plane of the rearward portion 13 of contact member 11. In a preferred embodiment of the invention, this angle is selected as 45° which has proven to be more advantageous than other possible angles.

In order to provide a "piggy back" capability, the angular position of knife bearing recess 6 is formed at an angle corresponding to the angle of contact knife 8.

With specific reference to FIG. 2, a plurality of connector contacts are shown. It can be seen that for each contact connection, upon insertion of contact knife 8 into the knife bearing recess 6, the angular relationship between contact knife 8 and the prongs 14 and 16 of the forward portion 12 of the connector member 11, causes the prongs 14 and 16 to twist, creating a torsional force against the knife blade. The torsional force exerted by the prongs 14 and 16 (or by the contact lugs 18 and 20 on the ends of the prongs) forces the contact knife 8 to rest in a sliding relationship on guide surfaces 7 of the corresponding knife bearing recess 6. The rearward portion 13 of contact member 11 is not subjected to the twisting forces applied to the prongs 14 and 16, since the rearward portion 13 is maintained in its plane of orientation by contact member bearing recesses 10.

In the embodiment of the invention shown in FIG. 1, the prongs 14 and 16 are shown diverging inwardly as they approach the forward portion of the connector 2. For greater strength at the juncture of the prongs and the rearward portion 13, a rearward portion of the prongs 14 and 16 can be restrained by contact member bearing recesses 10 by extending recesses 10 forwardly beyond the rearward portion 13.

It is further contemplated by the present invention to provide a planar stress force of the prongs in addition to the torsional forces exerted by the twisting of the prongs 14 and 16. Thus, by the divergence between the ends of prongs 14 and 16 and the recesses 10, upon insertion of the contact knife 8, in addition to the torsional forces applied to the contact lugs of prongs 14 and 16, an elastic force produced by the spreading apart of prongs 14 and 16 will be superimposed upon the substantially laterally directed torsional forces.

It is to be understood that the present invention is not limited to the embodiments shown in the drawing, especially in view of the selected angle of approximately 45° to represent an example of the contact orientations in a preferred embodiment. It is contemplated that the present invention can be successfully applied in connectors having multiple contact members aligned in the manner shown in FIG. 2. It is further contemplated that a reversal of the contact knife and pronged fork portion of the contact member can be reversed or substituted one for the other.

While there has been shown and described a specific embodiment of the invention so that one skilled in the art may understand the manner of practicing the same, it is to be understood that the scope of the invention is limited only by the claims.

What we claim is:

1. A connector of the type that receives a mating contact element having a pair of opposite, contact-engaging, flat surfaces, comprising:

a body of insulating material,

a contact-receiving cavity in said body,

a generally flat contact member at least partially disposed in said cavity and having a rearward portion and a forward portion, said rearward portion being fixedly disposed within said body and said forward portion comprising oppositely disposed prongs arranged to flex in relation to said rearward portion and to receive insertion therebetween of said mating contact element in a plane at an angle less than 90° with respect to the plane of said rearward portion, said prongs thereby being held in torsional engagement with said flat surfaces of said mating contact element, said cavity in said body having

guide surfaces laterally disposed from said prongs, said guide surfaces forming a bearing recess guiding and supporting said mating contact element at said angle less than 90° during insertion of said mating contact element, at least one of said guide surfaces bearing against at least one of said flat surfaces of said mating contact element upon such insertion.

2. The connector as claimed in claim 1, wherein said prongs include contact lugs on the forward ends of said prongs extending toward each other.

3. The connector as claimed in claim 1, including a knife contact integral with said rearward portion and extending away from said forward portion and out of said cavity in a rearward direction, said knife contact having at least one notch at said rearward portion permitting twisting of said knife contact at said notch to an angle of less than 90° with respect to the plane of said rearward portion, and said contact member being retained in said body by engagement of the twisted portion of said knife contact with said body.

4. The connector as claimed in claim 3, including a soldering lug extending laterally of said rearward portion, said body having a slot through which said lug protrudes.

5. has connector as claimed in claim 4, wherein said body ha a rearward end and a forward end, and wherein the distance from the rearward most edge of said slot to said rear end of said body is greater than the distance from the rearward most edge of said soldering lug to said notch.

6. The connector as claimed in claim 3, wherein said knife contact has cross-section dimensions enabling it to be received in and guided by the guide surfaces of a like connector, and to be received by the forward portion of a like contact member in said like connector.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,693,139 Dated September 19, 1972

Inventor(s) Fritjos Hans Assmus et al.

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

On the cover sheet insert -- [30] Foreign Application Priority Data October 30, 1969 Germany P19 54 765.0 --.
title of invention should read -- PIGGY BACK CONNECTOR --.

Signed and sealed this 1st day of May 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.