Jan. 30, 1968 W. A. GAMMEL, SR., ET AL 3,366,919

ELECTRICAL CONNECTOR

Filed Feb. 11, 1966

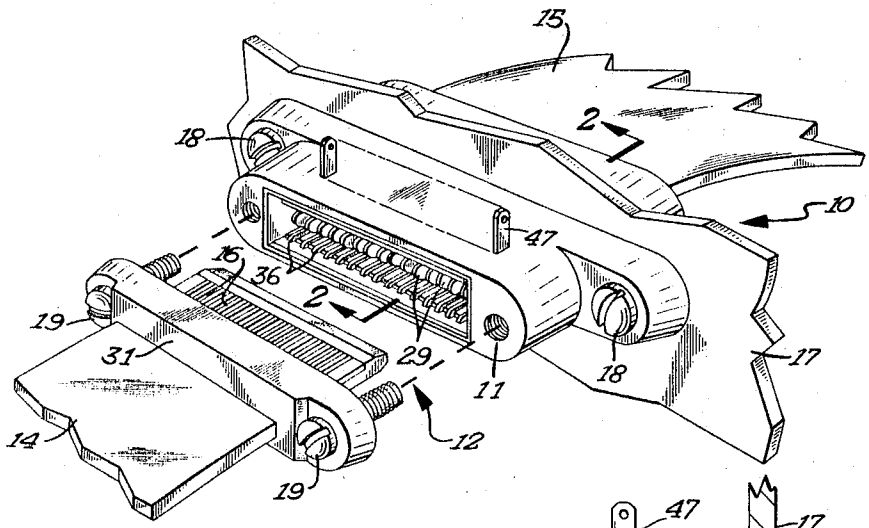


FIG 1

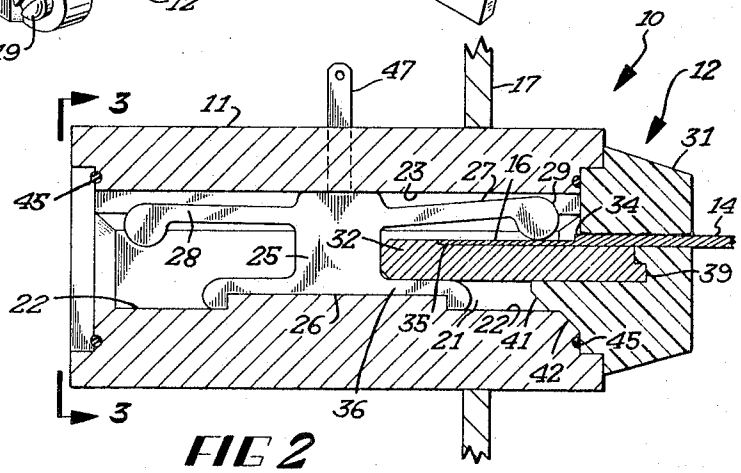


FIG 2

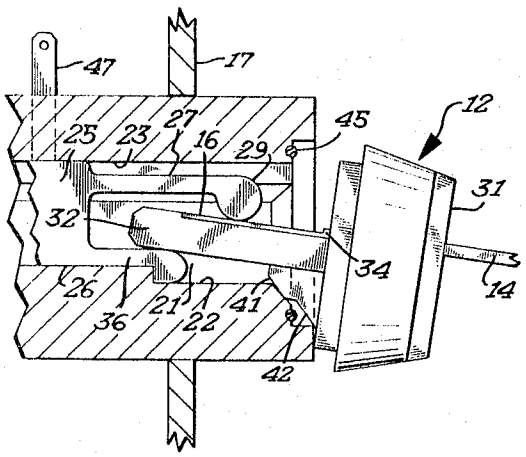


FIG 4

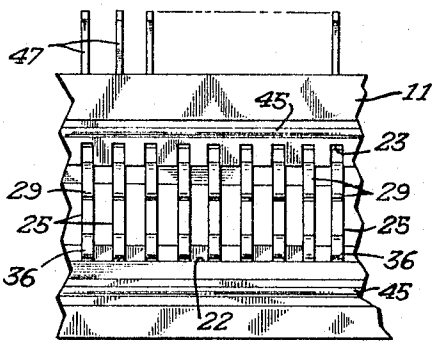


FIG 3

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ELECTRICAL CONNECTOR

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14 Claims. (Cl. 339—176)

ABSTRACT OF THE DISCLOSURE

An electrical connector for arranging electrical contact between multiple conductors in a connector assembly, and being particularly arranged to be utilized in connection with flexible multi-conductor electrical cable having a plurality of individual ribbon-type conductors disposed therein. The connector includes a male plug member and a receptacle for receiving the plug, the receptacle having a cavity formed therein for retaining individual contacts, the mouth portion of the cavity being relieved along one surface thereof so as to permit the plug member to be inserted in an angularly disposed relationship to the axis of the cavity, and when substantially fully inserted, cammed arcuately toward the individual contacts, and thereby engage the contacts.

The present invention relates generally to an improved electrical connector, and more specifically to an improved electrical connector adapted to arrange for electrical contact between multiple conductors in a connector assembly. The apparatus of the present invention has particular utility in application with flexible multi-conductor electrical cable, although it will be appreciated that the apparatus has utility in connection with printed circuitry boards of both flexible and rigid type as well.

In the preparation of electrical connectors it is generally desirable to prepare these devices with a relatively small mass, and it is also desirable to arrange them so as to provide for a high degree of reliability. It may also be desirable, in certain applications, to provide for protection from adverse environmental conditions such as dust, explosive atmosphere or the like. In the manufacture of electrical connectors of this type, particularly when minituarization or compact design is a factor or feature, various measures must be taken in order to insure contact reliability. For example, in the arranging of contacts to flexible multi-conductor cable, care must be taken in order to insure that proper mechanical and electrical contact is achieved between each conductor and a corresponding contact member of the connector element, this feature necessarily being accomplished without risking damage or destruction to the conductors by way of abrasion or other deleterious forces. In the present apparatus, this is accomplished by providing a male plug member which is adapted to be received in a female receptacle in such a way that the male plug may pivot within the receptacle in a direction toward the flexible contact members to an ultimate inserted position wherein the contact members are stressed away from their normal disposition, this pivotal motion occurring only after the male plug member has achieved its substantially inserted position. Therefore, the individual conductors are in contact with the contact members for only an extremely limited distance during insertion, and during this operation, the relative motion which occurs is substantially a wiping motion between the surfaces of the conductors and of the contact members.

It is therefore an object of the present invention to

provide an improved connector element which is adapted to provide reliable electrical contact between electrical conductors of relatively thin cross-sectional dimension, the reliable electrical contact being achieved with a minimum of frictional or abrasive forces acting between the surfaces of the conductor and the connector elements.

It is a further object of the present invention to provide an improved electrical connector apparatus which is reliable in its operation and which is versatile, it being appropriately arranged for utilization with flexible multi-conductor electrical cable, as well as for flexible or rigid printed wiring arrangements.

It is yet a further object of the present invention to provide an improved electrical connector device which is well adapted for use with flexible multi-conductor electrical cable, and which is adapted to maintain a contact environment which is free from dust, dirt, or other contaminating influences.

Other and further objects of the present invention will become apparent to those skilled in the art upon a study of the following specification, appended claims, and accompanying drawing wherein:

FIGURE 1 is a perspective view of a connector apparatus prepared in accordance with the present inventoin, and showing the portions of the connector in exploded view and coupled to a flexible multi-conductor electrical connector;

FIGURE 2 is a vertical sectional view taken along the line and in the direction of the arrows 2—2 of FIGURE 1;

FIGURE 3 is a detail view, partially broken away, taken along the line and in the direction of the arrows 3—3 of FIGURE 2; and

FIGURE 4 is a detail view, similar to a portion of the apparatus shown in FIGURE 2, and showing the disposition of the connector elements during the insertion operation.

In accordance with the preferred modification of the present invention, the connector apparatus generally designated 10 includes a receptacle body portion 11 together with a male plug member shown generally at 12. In the various figures, a section of flexible multi-conductor electrical cable is shown as at 14 and 15, the individual conductor members on the cable being shown as at 16—16 for example. The connector is shown mounted on a panel member 17 in FIGURE 1, the mounting screws 18—18 being employed for retaining the connector in its position on the mounting panel. Also, as indicated in FIGURE 1, the mounting or retaining screws 19—19 are utilized to retain the plug member 12 in its proper engaged relationship with the receptacle member 11.

Turning now to the details of construction of the connector, as particularly shown in FIGURES 2 and 3, the receptacle member 11 is provided with a contact cavity shown at 21, this cavity having a pair of opposed surfaces 22 and 23, these being spaced apart a sufficient distance to receive the male plug member therein. Also, disposed with the cavity area 21 are a plurality of contact members shown generally at 25. These contact members have a central body portion 26 together with a pair of legs 27 and 28 extending outwardly therefrom. At the free end of each of the legs 27 and 28, a contact head such as is shown at 29 is provided. The individual legs 27 and 28 have a bending axis which is generally parallel with the plane of the drawing as shown in FIGURES 2 and 4, these legs extending therefrom in a cantilevered manner about this bending axis and the central body portion 26. If desired, the head member may be provided with a precious metal coating or cladding at the point where the contact head engages the individual conductors. The members 25 are preferably fabricated from a substantially

resilient material such as beryllium copper, or the like, however it is appreciated that other materials may be utilized as well. While it is again normally expected that the materials will be conductive, and generally conductive throughout, it is also possible to fabricate the body portion from a metal which may thereafter be coated with an insulating film, the contacting portion at the head, of course, being free of any insulating film, if one is utilized.

It is generally preferred that the body 11 be molded of one piece construction. Again, it is possible to mold this assembly in several mating parts and the individual contact members may be thereby dropped into place. The contact members per se being in one piece provide versatility and thereby avoid close manufacturing tolerances. It is further appreciated that the contact member per se may be snapped into location in a stressed position within the blocks, thereby rendering its dimensions somewhat less than critical.

Again, the versatility of the receptacle portion provides electrical conversion from: (1) flexible multi-conductor electrical cable, (2) flexible circuit boards, (3) rigid circuit board or any combinations thereof to: (A) any of the assemblies mentioned in (1), (2) or (3) as well as to wire wrap, taper pin, taper receptacles, or conventional contact prongs. With this versatility it is, therefore, possible to employ the unit as a junction block or as a protected female receptacle.

Turning now to the structure of the male plug portion 12, it will be observed that this member includes a cap member 31 together with a tongue portion 32 being utilized to carry, support, and mount the individual flexible multi-conductor electrical cable 14 may employ a laminate structure with a coverlay portion thereon, and as indicated at 34, this coverlay is removed in order to expose the individual conductors to make contact with the heads 29, for example. As indicated in detail in FIGURE 2, the tongue member is relieved as at 35 in order to provide a channel of smooth relief section for receiving the flexible cable terminal section therein. It will be appreciated, however, that if desired, a modified form of tongue element 32 could be utlized whereby the conductor elements of the cable would follow around the entire periphery of the tongue, and be exposed on the lower and forward surfaces as well. In this connection, however, redundant contacts may be made along the surface of the lower contact leg member such as at 36 for example. This feature will enhance the reliability of the system, as will be readily appreciated. Also, the tip of the male plug member may be either chamfered, beveled or provided with a radius of curvature to enable its acceptance of the flexible cable and enhance its entry into the receptacle member.

In order to enhance the bonding between the cap 31 and the tongue 32, a recess is formed as at 39 in order to accommodate the tongue in proper disposition therein. Adhesive bonds many be employed to couple the circuitry member 14 to the cap member 31 and the tongue member 32, and adhesive bonding may also be utilized to couple the cap member 31 to the tongue member 32.

Referring now in detail to the lower portion of the cap member, it will be observed that a projection is provided which is identified at 41, and also a recess zone is shown in the receptacle structure as at 42. This structure takes on significance with a study of FIGURE 4 which shows that the male plug member is initially received in the cavity in a canted or tilted disposition, and is ultimately pivoted into its inserted form as shown in FIGURE 2, however, this pivot motion not occurring until entrance of the male plug member is substantially complete. This avoids any excessive abrasion of the contact head 29 on the surface of the conductors 16—16 of the cable 14. Also, as clearly shown in FIGURE 4, for example, an O-ring may be provided in a recess as shown at 45 in order to provide environmental protection for the individual contacts.

As indicated in FIGURE 2, it is possible to provide for external contacts of the various conventional types, such as wire-wrap prongs, taper pins or the like. A wire-wrap terminal is shown at 47 for convenience of illustration. Also, as illustrated in FIGURE 2, a bore is formed through the receptacle member 11, such as on the upper portion thereof in order to make mechanical and electrical contact possible between the wire-wrap terminal 47 and the central body portion 25 of the contact members. This feature obviously enhances the versatility of this connector device.

It will, of course, be understood that various changes may be made in the form, details, arrangements and proportions of the parts without departing from the scope of our invention as set forth in the appended claims.

We claim:

1. An electrical connector comprising, in combination, a male plug having a conductor bearing surface and a back surface generally opposed to said conductor bearing surface, and a female receptacle body, said female receptable body comprising:

(a) a body structure having a contact cavity therein with an axis generally parallel to the depth thereof and adapted to receive a male plug member therein, a plurality of contact members retained within said cavity, each of said contact members having a contact blade with a contact head at the free end thereof and a bending axis disposed generally parallel to the axis of said cavity, and means within said cavity for retaining said contact members therein,

(b) said contact retaining means having means for positioning said contact members in generally spaced parallel relationship within said contact cavity and with each contact head being disposed generally along a first side wall,

(c) said contact cavity having an inclined opening surface forming a recessed dimension at the mouth thereof opposite said contact member and along a dimension generally parallel to the bending axis of the contact blades of said contact members,

(d) means defining a fulcrum point within said cavity and disposed inwardly of said contact head member and along a second side wall generally oppositely disposed from said first side wall to engage said male plug member along said back surface, and

(e) means for pivoting said male plug within said cavity in a direction away from said relieved zone and towards said first side wall until said contact members are stressed along their respective bending axis towards said first side wall and into a contact engaging position, and means for retaining said plug in said contact engaging position, the arrangement being such that said male plug may enter said cavity to a point substantially adjacent the bottom surface thereof prior to the engagement of said conductors with the heads of said contact members.

2. The electrical connector as set forth in claim 1 being particularly characterized in that the receptacle body has first and second substantially identical cavities arranged in pairs, the contact members of said cavities being common and extending generally from a central body portion and into said first and second cavities.

3. The electrical connector apparatus as defined in claim 2 being particularly characterized in that said cavities are arranged in back-to-back relationship.

4. The electrical connector as defined in claim 1 being particularly characterized in that the mouth of said cavity has a shouldered recess, with the male plug having a head member thereon with mating shoulder protrusions adapted to abut said shouldered recess.

5. The electrical connector as defined in claim 1 being particularly characterized in that said second surface is provided with a contact leg disposed in generally spaced parallel relation to said contact member, an in electrical continuity with said contact member, and means for ex-

tending conductors in continuation from said conductor bearing surface to said back surface to make contact with said contact legs.

6. The electrical connector as defined in claim 5 being particularly characterized in that said fulcrum comprises the forward end of said contact legs.

7. The electrical connector as defined in claim 1 being particularly characterized in that a side wall of said receptacle is provided with bores for making electrical contact therethrough and to said contact members.

8. The electrical connector as defined in claim 1 being particularly characterized in that said receptacle body has first and second substantially identical cavities arranged in pairs and in back-to-back relationship, the contact members of said cavities being common and extending generally from a central body portion and into first and second cavities, a side wall of said receptacle being provided with through-bores for receiving electrical conductors for making electrical contact to said central body portions.

9. An electrical connector comprising, in combination, a male plug having a conductor bearing surface and a back surface generally opposed to said conductor bearing surface, and a female receptacle body, said male plug having an opening therein for receiving flexible multiconductor electrical cable and having means for retaining said cable along the conductor bearing surface of said plug, said female receptacle body comprising:

(a) a body structure having a contact cavity therein with an axis generally parallel to the depth thereof and adapted to receive a male plug member therein, a plurality of contact members retained within said cavity, each of said contact members having a contact blade with a contact head at the free end thereof and a bending axis disposed generally parallel to the axis of said cavity, and means within said cavity for retaining said contact members therein,

(b) said contact retaining means having means for positioning said contact members in generally spaced parallel relationship within said contact and with the contact heads being disposed generally along a first side wall,

(c) said contact cavity having an inclined surface forming a recessed opening dimension at the mouth thereof opposite said contact members and along a dimension generally parallel to the bending axis of said contact blades of the contact members and along a second side wall oppositely disposed from said first side wall,

(d) means defining a fulcrum point for said plug within said cavity and disposed inwardly of said contact head and along said second side wall to engage said male plug member along the back surface thereof,

(e) means for pivoting said male plug within said cavity in a direction away from said relieved zone and towards said first side wall until said contact members are engaged and stressed along their respective bending axis towards said first side wall, and means for retaining said plug in said contact engaging position, the arrangement being such that said male plug may enter said cavity to a point substantially adjacent the bottom surface thereof prior to the engagement of said conductors with the heads of said contact members.

10. The electrical connector as defined in claim 1 being particularly characterized in that seal means are provided along the mating surfaces between said receptacle and said plug.

11. The electrical connector as defined in claim 1 being particularly characterized in that said plug has a projection along one surface thereof for engaging the surface of said receptacle along the relieved opening portion of the mouth of said cavity.

12. The electrical connector as defined in claim 1 being further characterized in that locking means are provided for releasably securing said plug in said receptacle body.

13. The electrical connector as defined in claim 9 being particularly characterized in that said male plug member has an inclined surface area along the conductor bearing surface thereof for providing a generally planar conductor bearing surface having conductors arranged in generally parallelly coplanar relationship thereon.

14. The electrical connector as defined in claim 9 being particularly characterized in that said contact tip has a portion protruding away from said first side wall and toward said second side wall, the recessed opening dimension at the mount of said cavity being along said second side wall and being recessed sufficiently to permit said plug to extend into said cavity until the tip of said plug is adjacent the bottom surface of said cavity and while a separation gap exists between said contact tip and the conductors on said conductor bearing surface.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,366,919 January 30, 1968

Walter A. Gammel, Sr., et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 30, after "32" insert -- the tongue portion 32 --; column 4, line 74, for "an" read -- and --; column 5, line 40, after "contact" insert -- cavity --; column 6, line 35, for "mount" read -- mouth --.

Signed and sealed this 18th day of March 1969.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents