April 10, 1962 S. J. MAJEWSKI 3,029,411

CLOSED-ENTRY SPRING CONTACT

Filed Jan. 11, 1960

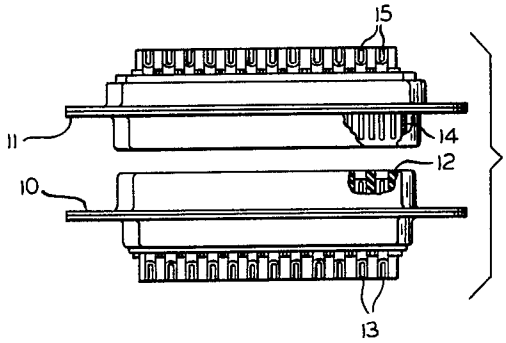


FIG. 1

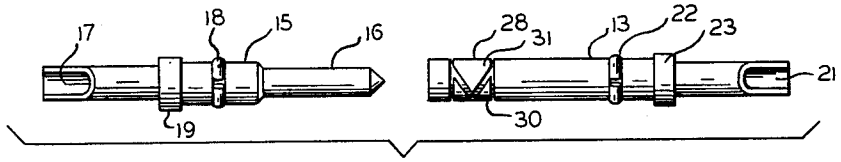


FIG. 2

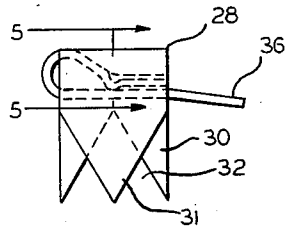


FIG. 3

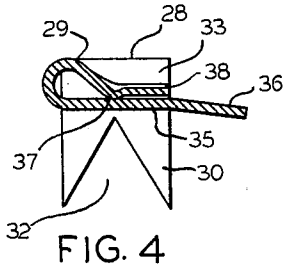


FIG. 4

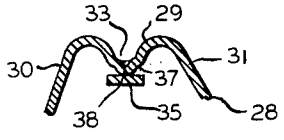


FIG. 5

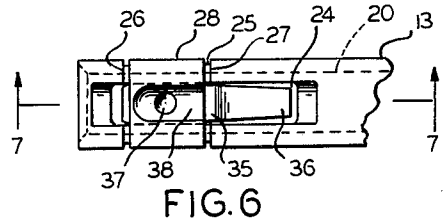


FIG. 6

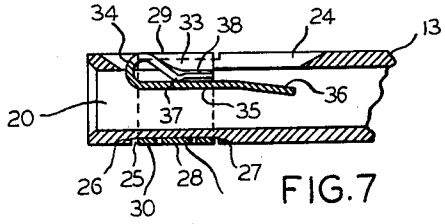


FIG. 7

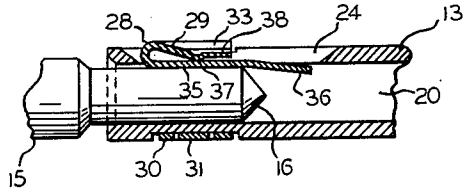


FIG. 8

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CLOSED-ENTRY SPRING CONTACT

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This invention relates to a contact structure adapted for use in a multiple contact connector, and more particularly to the female component of a closed-entry contact structure having cooperating male and female contacts.

Closed-entry multiple contact connectors comprise two cooperative mating elements. The first such element includes a connector body section equipped with multiple rows of female contacts, and the other such element includes a connector body section equipped with multiple rows of male contacts respectively aligned with the female contacts and adapted to establish electrical connection therewith when the two sections of the connector are brought into cooperating adjacency. All of the individual male and female contacts are adapted to be respectively connected to lead wires so that an electric circuit connection is effected between the various lead wires of the two connector elements when the male and female contacts are brought into cooperative relationship. Each two male and female contacts define a contact structure, and the male contact is equipped with an elongated prong adapted to be received within a complementary socket provided therefor in the female contact. The quality of the electric connection established therebetween depends upon a good frictional engagement of the prong with the socket. Additionally the connector elements may be connected and separated numerous times with a consequent wearing of the mating surfaces.

Accordingly, an object of the present invention is to provide a closed-entry contact structure adapted for use in multiple contact connectors, and in which a good frictional and electrical connection is defined between the male and female contacts initially and through long periods of use during which the components are separated and reconnected a multitude of times.

Another object of the invention is that of providing a female closed-entry contact having a resiliently supported contact member adapted to frictionally engage the prong of a male contact inserted into the socket of the female contact and thereby establish an electric connection therebetween, and in which the contact member is characterized by having an exceedingly good life cycle.

Still another object is in the provision of a female contact of the type described, wherein the contact member comprises a spring clip having legs circumjacent the cylindrical barrel of the contact member and resiliently holding the spring clip thereon, and in which the contact member comprises also a contact finger forming an integral part of such spring clip and arranged for frictional engagement with a cooperating male contact—the contact finger being substantially constrained against deflection upon initial insertion of the male contact into the associated socket, but being bodily displaceable in a radial direction upon such insertion against the resilient force of such legs; the life cycle of such spring clip being extended because the deflection resulting from insertion of the male contact into the socket is distributed in two resilient legs and because the requisite deflection occurs along the entire length of such legs, the latter feature also providing a substantially uniform frictional force exerted against such male contact both during the initial insertion thereof into the socket and during at least a portion of the subsequent movement thereof further into the socket.

A further object is that of providing a structure of the character described, and in which the spring clip has a main body part that is depressed centrally and extends radially into the socket through a longitudinally extending slot disposed therealong, and in which the main body part has a reinforcing rib extending substantially from end to end thereof and which is equipped intermediate its ends with a reinforcing projection extending toward the underlying contact finger in substantial abutment therewith so as to constrain the same against deflections independent of the spring clip in its entirety upon insertion of the female component into the contact socket.

Yet a further object is in the provision of a spring clip and contact substantially as described, and in which the contact finger is substantially longer than the main body part and inclines toward the center of the socket rearwardly of the main body part, but terminates within the projected dimensional limits of the slot so that it may be radially deflected by a male contact inserted its full length into the socket, whereby the frictional connection between the contact finger and male contact as provided by the spring clip is implemented by this extension of the contact finger.

Additional objects and advantages of the invention will become apparent as the specification develops.

An embodiment of the invention as illustrated in the accompanying drawing, in which—

FIGURE 1 is a side view in elevation of a multiple contact connector embodying the invention, and in which the two elements thereof are shown in spaced apart relation having portions thereof illustrated in section; FIGURE 2 is a side view in elevation of a closed-entry contact structure, and in which the male and female contacts thereof are illustrated in spaced apart relation; FIGURE 3 is an enlarged, side view in elevation of the spring clip that forms a part of the female contact; FIGURE 4 is a longitudinal sectional view taken substantially through the center of the spring clip illustrated in FIGURE 3; FIGURE 5 is a vertical sectional view taken along the line 5—5 of FIGURE 3; FIGURE 6 is an enlarged, broken top plan view of the female contact shown in FIGURE 2; FIGURE 7 is a broken longitudinal sectional view taken along the line 7—7 of FIGURE 6; and FIGURE 8 is a broken longitudinal sectional view similar to that of FIGURE 7, but illustrating the male contact partially inserted into the socket of the female contact.

The multiple contact connector illustrated in FIGURE 1 comprises two cooperative and mating elements respectively denoted with the numerals **10** and **11**. The element **10** includes a connector body section **12** formed of insulating material, and has a plurality of passages therein oriented in both longitudinally and transversely extending rows respectively receiving closed-entry female contacts **13** therein. Similarly, the element **11** includes a connector body section **14** which has a plurality of passages therein oriented in both longitudinally and transversely extending rows and respectively receiving closed-entry male contacts **15** therein. The connector elements **10** and **11** are adatped to be brought together into cooperative adjacency in which the male contacts **15** respectively engage and establish electric connection with the female contacts **13**.

Referring to FIGURE 2, it is seen that the male contact **15** is equipped with an elongated prong **16** at one end thereof, and at its other end has a passage or bore **17** adapted to receive the end of a lead wire which will then be connected both electrically and mechanically thereto in a solder joint formed by flowing molten solder into the bore **17** and about a lead wire disposed therein. Intermediate its ends, the male contact **15** is provided with a retainer **18** and spaced therefrom a shoulder or

abutment 19, and the retainer and abutment cooperate in automatically anchoring the contact within the body section 14 upon insertion of the male contact into the passage therefor in the body section. However, since this feature is not pertinent to the present invention, no further description thereof will be included.

The female contact 13, as shown best in FIGURES 7 and 8, is provided at the forward end thereof with a longitudinally extending socket 20 adapted to slidably receive the prong 16 of the male contact 15 therein. At its opposite end, the contact 13 is provided with a passage or bore 21 adapted to receive the end of a lead wire therein which will be electrically and mechanically connected to the contact in a solder joint formed by flowing molten solder into the bore and about the end of a lead wire disposed therein. Intermediate its ends, the contact 13 is provided with a retainer 22 and spaced longitudinally therefrom a shoulder 23, and the retainer and shoulder provide a snap-in anchorage of the contact within the passage therefor in the body section 12 of the connector element 10. As in the case of the male contact, this feature is not germane to the present invention and will not then be described in further detail.

The female contact 13 has a generally cylindrical barrel defining the socket 20 therein, and is provided with a longitudinally disposed slot 24 extending along the socket and opening thereinto. The slot 24 starts adjacent the forward end of the barrel, and adjacent its forward end portion the barrel is provided with a circumferentially extending channel 25—the longitudinally spaced terminal edges of which form abutment elements 26 and 27. Cooperative with the contact 13 is a spring clip 28 having a main body part 29 equipped with oppositely extending spring legs 30 and 31. The clip 29 is disposed within the channel 25, and the spring legs 30 and 31 are wrapped about the barrel of the contact 13 in circumjacency therewith. The longitudinally spaced edges of the clip 28 are in substantial engagement with the abutment elements 26 and 27, which then are effective to constrain the clip against substantial longitudinal displacements.

The leg 31 has a generally triangular configuration as is seen best in FIGURE 3 while the leg 30 has material removed from the central portion thereof to form a recess 32 corresponding in shape to the triangular configuration of the leg 31 so as to receive the same therein when the legs are wrapped about the barrel of the contact 13. The spring legs 30 and 31 resiliently anchor the spring clip to the contact 13, and the main body part 29 of the clip extends along the slot 24 in alignment therewith. Actually, the main body part 29 is depressed centrally, as shown at 33, and such depressed central portion extends through the slot 24 and into the socket 20. Formed integrally with the main body part 29 and extending forwardly therefrom, as shown at 34, and then doubled back upon itself in underlying arrangement with the main body part 29 is a contact finger 35 that extends along the slot 24 within the socket 20.

The contact finger 35 is substantially longer than the main body part 29, but terminates adjacent the rear end of the slot 24 and within the dimensional limits thereof—that is, just short of a plane substantially normal to the longitudinal axis of the socket 20 and located by the rear end of the slot 24. Rearwardly of the main body part 29, the contact finger 35 extends downwardly therefrom and toward the center of the socket 20, as shown at 36, and the main body part 29 has a reinforcement projection 37 extending toward the contact finger and into substantial engagement therewith to constrain the same against radial outward deflection independently of the spring clip in its entirety. More precisely, the main body part 29 throughout the centrally depressed area 33 thereof is provided with a longitudinally disposed rib 38 extending substantially from end to end of the main body part, and the reinforcing projection 37 is a generally annular protuberance formed centrally of the rib 38 intermediate the ends thereof.

Initially, and prior to the insertion of the prong 16 into the socket 20, the legs 30 and 31 are substantially contiguous throughout their lengths with the surface of the barrel enclosed thereby, and the contact finger 35 is located within the socket 20, as is shown most clearly in FIGURE 7. By referring to FIGURE 2, it will be noted that the triangularly-shaped end portion of the leg 31 is disposed within the recess 32 defined by the leg 30, and that the legs are dimensioned so that the adjacent edges thereof are spaced slightly from each other whereby the legs may tightly grip the barrel. Upon insertion of the prong 16 into the socket, the prong (and particularly the conically-shaped end thereof) engages the curved forward end of the contact finger 35 and tends to cam the same radially outwardly from the socket 30. Since the leg is in abutment with the protuberance 37 of the main body part of the clip and cannot then be deflected, and because the main body part is reinforced with the rib 38 and cannot then be deflected or distorted, the entire clip is displaced radially outwardly as shown in FIGURE 8; and such displacement is effected against the resilience of the legs 30 and 31.

The frictional force developed between the prong 16 and contact finger 35 is of substantially uniform magnitude following initial engagement of the prong with the finger, because thereafter the clip is not displaced either radially outwardly or inwardly throughout a complete cycle of insertion, retention and withdrawal. Furthermore, the initial displacement of the clip is effected against a substantially uniform valued force because the resilience of the spring legs 30 and 31 which tends to maintain the same in circumjacent coaxiality with the barrel is approximately constant throughout. More specifically, the incremental displacements of the clip that necessarily occur in the acceptance of the prong 16 within the socket 20 are characterized by uniform valued resistance. Therefore, repeated insertions and withdrawals of the prong into and from the socket does not result in a deterioration of the electrical connection established between the prong 16 and finger 35 and between the prong and lower surface portion of the socket 20—for even after the frictionally engaging surfaces wear, the gripping forces developed therebetween as a consequence of the resilience of the spring legs 30 and 31 remain the same.

In order to minimize somewhat the force resisting initial insertion of the prong into the socket, and to maximize the force tending to retain the prong within the socket, the rear end portion 36 of the contact finger 35 is turned downwardly and extends toward the center of the socket 20; and consequently, movement of the prong 16 from the partially inserted position thereof shown in FIGURE 8 into its fully inserted position brings the prong into engagement with this turned end portion of the contact finger, with the result that it is deflected upwardly or radially outwardly against the inherent resilience thereof, which necessarily increases the frictional engagement developed between the prong and contact finger. Since an increase in the retention force is attained in this manner, the force of the legs 30 and 31 resisting deflection thereof can be reduced.

It will be apparent that the length of the contact finger 35 is such that the end portion 36 thereof may be deflected outwardly and into the slot 24, and preferably (as shown in FIGURE 6) such end portion of the contact finger is tapered slightly and terminates in a reduced width so that the possibility of abutment of the end portion 36 with the edges of the slot 24 is obviated. The reinforcing rib 38 which extends substantially from end to end of the main body part 28 rigidifies the same, and in combination with the projection 37 affords an excellent restraint preventing deflection of the contact finger 35. It will be evident that the clip should be formed of a material which affords the requisite resilience and spring-

like characteristics, such as beryllium copper or Austenitic stainless steel with a Rockwell C-range hardness of from 35 to 40.

While in the foregoing specification an embodiment of the invention has been set forth in considerable detail for purposes of making an adequate disclosure thereof, it will be apparent to those skilled in the art that numerous changes may be made in such details without departing from the spirit and principles of the invention.

I claim:

1. In combination with the female contact of a closed-entry contact structure having both male and female contacts and being adapted for use in a multiple contact connector, said female contact having an elongated barrel provided at the forward end thereof with a longitudinally extending socket for receiving therein the prong of such male contact and also being provided with a slot extending longitudinally of said barrel and opening into said socket along one side thereof, a clip having a main body part equipped with spring legs circumjacent said barrel and resiliently constraining said clip thereon with said main body part being disposed along said slot and adjacent the forward end thereof, said main body part being equipped with an integral contact finger disposed in underlying relation therewith and extending along said slot within said socket for engagement with such prong-equipped contact, said contact finger being substantially greater in length than said main body part but terminating adjacent the rear end of said slot within the projected dimensional limits thereof and being inclined toward the center of said socket from said main body part and rearwardly thereof, said main body part being provided with a reinforcement projection extending therefrom toward said contact finger and into substantial engagement therewith so as to enable said contact finger to resist deflection upon initial insertion of such prong-equipped male contact into said socket whereupon both said contact finger and main body part are displaced radially outwardly against the resiliency of said spring legs.

2. The combination of claim 1 in which said female contact is equipped with a pair of longitudinally spaced abutment elements located on opposite sides of said clip and in substantial engagement therewith to constrain said clip against longitudinal displacements.

3. The combination of claim 1 in which said contact finger is formed integrally with said main body part and extends forwardly therefrom and is doubled back upon itself into the aforesaid underlying relation with said main body part.

4. The combination of claim 1 in which said main body part is depressed centrally and extends through said slot and into said socket, said central depression having the aforesaid reinforcement projection located therealong.

5. In combination with the female contact of a closed-entry contact structure having both a prong-equipped male contact and a female contact and being adapted for use in a multiple contact connector, said female contact having an elongated barrel provided at the forward end thereof with a longitudinally extending socket for receiving therein the prong of such male contact and also being provided with a slot extending longitudinally of said barrel and opening into said socket along one side thereof, said barrel also being provided with a circumferentially extending channel adjacent the forward end portion of said slot and terminating in longitudinally spaced abutment elements, a clip disposed within said channel and having a main body part equipped with a pair of oppositely extending spring legs wrapped about said barrel in circumjacency therewith and resiliently constraining said clip thereon with said main body part being disposed along said slot, the longitudinally spaced edges of said clip being in substantial engagement with said abutment elements so that said clip is constrained thereby against substantial longitudinal displacements, said main body part being depressed centrally and extending through said slot and into said channel and being equipped with an integral contact finger extending forwardly and upwardly from said central depression and being doubled back upon itself in underlying relation with said central depression and extending along said slot within said socket for engagement with the prong of such male contact, said central depression being provided with a longitudinally disposed reinforcing rib extending substantially from end to end of said main body part and being provided intermediate its ends with a reinforcement projection extending toward said contact finger and into substantial engagement therewith so as to enable said contact finger to resist deflection upon initial insertion of such prong-equipped male contact into said socket whereupon both said contact finger and main body part are displaced radially outwardly against the resiliency of said spring legs, said contact finger being substantially greater in length than said main body part but terminating adjacent the rear end of said slot within the projected dimensional limits thereof and being inclined toward the center of said socket from said main body part and rearwardly thereof.

6. The combination of claim 5 in which said reinforcing rib extends from said main body part toward said contact finger.

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