A hermaphroditic type electrical connector assembly that does not use the standard male and female connection. Instead of a single male pin, several fine wires are bundled together to form a brush contact. Similarly, the mating contact is comprised of several fine wires bundled into a brush. When the contacts are in mated relationship, the fine wires of the connector assembly are intermingled to complete the electrical circuit relationship between the mated contacts of the connector assembly.

20 Claims, 7 Drawing Figures
HERMAPHRODITIC ELECTRICAL CONTACT

BACKGROUND OF THE INVENTION

This invention relates to electrical connector assemblies for connecting a first plurality of electrical conductors in a predetermined circuit relationship with a second plurality of electrical conductors. This invention is more particularly related to a method and apparatus for improving the electrical circuit relationship between the contact members of a connector assembly. Specifically, the invention is related to hermaphroditic contacts for multiple-conductor cable connectors.

In order to link the operating units or components of an electrical installation, it is known to make use of multi-wire cables which are interconnected by means of terminal connectors. Such coupling devices are usually of the male and female type, the cable interconnections being made by properly mating male and female connectors. Departing from this standard approach, the inventor has invented a connector which utilizes hermaphroditic mating contacts.

SUMMARY OF THE INVENTION

This invention provides a new hermaphroditic-type of electrical contact. The invention is an electrical connector assembly characterized by electrical contacts which are comprised of a bundle of several burred-free wires having angled end portions. When the contact wires of each half of the connector assembly are in mated relationship, the bundled wires of one contact are intermingled with and in contact with the bundled wires of another contact, thereby establishing an electrical circuit relationship between the contacts. In one embodiment of the invention, the electrical contact comprises: an elongated conductor having an axial passage that includes an end passage portion that terminates in an opening at one end of the conductor and an interior passage portion, the end passage portion having a cross-sectional area larger than the cross-sectional area of the interior passage portion, and a plurality of electrical conducting wires axially mounted in the axial passage of the elongated conductor and extending a predetermined distance beyond the end of the elongated conductor. The electrical conducting wires are spaced from the wall of the end portion of the axial passage in the elongated conductor to permit the spreading of the wires within the end portion of the elongated conductor passage when the wires are in mated relationship with the wires of a similar electrical contact. The wires of the connector assembly are characterized by the fact that they are burred-free and the end portions of each wire have an angled surface for facilitating the intermingling of the wire with other wires.

Accordingly, it is an object of this invention to provide an electrical connector that relies upon hermaphroditic mating contacts to establish the electrical relationship between the plug and receptacle.

The above and other objects and features of the invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings and claims which form a part of this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram of a connector assembly showing a partial cross-section of the receptacle and plug that embody the objects of this invention.

FIG. 2 is a cross-sectional view of a preferred embodiment of a hermaphroditic electrical contact which characterizes this invention.

FIG. 3 is a magnified view of one of the contact wires shown in FIGS. 2, 4, 6, and 7.

FIG. 4 is a cross-sectional view of electrical contacts, which embody the principles of this invention, in mated relationship.

FIG. 5 is a cross-sectional view of another preferred embodiment of a hermaphroditic electrical contact which characterizes this invention.

FIG. 6 is a cross-sectional view of still another preferred embodiment of a hermaphroditic electrical contact which characterizes this invention.

FIG. 7 is a cross-sectional view of a double ended hermaphroditic electrical contact which embodies the principles of this invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to the drawings, FIG. 1 illustrates a connector assembly that is comprised of a first assembly 1 and a second assembly 2, both of which embody the principles of the invention.

The first assembly 1 comprises a housing 8 having a plurality of passages 23, a plurality of ducts 21 and 22 disposed in the passages 23, and an electrical connector contact 11 disposed in each of said ducts 21 and 22.

The housing 8 is generally comprised of a nonconducting material and may take any particular configuration.

The ducts 21 and 22 are disposed within the passages 23 in a predetermined manner so that some of the ducts 21 extend out of the passage 23 and other of the ducts 22 terminate within the passage 23. In this embodiment the position of the ducts 21 and 22 determine the male and female portion of the assembly 1.

Located within each duct 21, 22 in an electrical contact 11 similar to that shown in FIG. 2. The shoulder 17 of the electrical contact 11 assists in positioning the electrical contact 11 in its proper place within the duct 21, 22. In the first assembly, the electrical contact 11 is located in the ducts 21 that extend out of the passage 23 so that neither the housing 10 nor the wires 12 extend out of the duct 21. The electrical conductor 5 that is to be connected to another conductor is in electrical circuit relationship with the electrical contact 11.

Similarly, the second assembly 2 comprises a housing 9 having a plurality of passages 23 therein, a plurality of ducts 21 and 22 located in each of the housing passages 23, and an electrical contact 11 located in each of the ducts 21, 22. The shape of the housing 9 and the arrangement of the passages 23 are identical to the first assembly housing and passage arrangement so that the ducts 21 and 22 may enter the passage 23 in assemblies 8 and 9 in a predetermined relationship.

In the second assembly 2 there are a plurality of ducts 22 that terminate within the passage 23 of the second assembly 2. This is so the passages 23 may receive ducts 21 from the first assembly 1. There are also a plurality of ducts 21 that extend beyond the
passage 23 for mating with the passages 23 in the first assembly 1.

Located in each duct 21, 22 are electrical contacts 11. Extending beyond the duct 22 is a portion of the housing 10 and wires 12 of the electrical contact 11 that will be inserted into the duct 21 when duct 21 is inserted into passage 23 of the second assembly 2.

A second conductor 6 is in circuit relationship with the electrical contact 11 so that when the first assembly 1 is in mated relationship with the second assembly 2, the wires 12 of the first and second assembly are intermingled with and in contact with each other whereby the first electrical conductor 5 is in electrical circuit relationship with said second electrical conductor 6.

Although a plurality ofducts 21 and 22 and electrical contacts 11 are shown, this connector may also be used for connecting as few as two wires in electrical circuit relationship. Further, the first assembly 1 could be arranged such that all the ducts 21, 22 terminate within the passages 23 making it a receptacle while all the ducts 21 and 22 located in the second assembly 2 may extend beyond the housing making it a plug. However, the combination of male and female contacts in each assembly makes it possible to key one assembly to another so that only one mating relationship is possible. Also, the ducts 21 and 22 could be eliminated from the assembly and the electrical contacts 11 placed directly into a housing. In this regard, resilient inserts, adapted to receive and locate the contacts 11 in a predetermined position would comprise the connector assembly. In the embodiment shown in FIG. 1, the passages 23 and ducts 21 and 22 are used to align and position the electrical contacts 11.

FIG. 2 is a cross-sectional view of a preferred embodiment of an electrical connector contact 11 that embodies the principles of this invention. The elongated housing 10, which is fabricated from an appropriate conducting material, has an axial passage 14 in one end for receiving an electrical conductor (not shown). The other end of the housing 10 has an axial passage 13 of two different cross-sections, for receiving a plurality of wires 12. Generally, seven or more wires 12 fill the inner portion B of the passage 13 and are cramped at one or more points 19 into place. However, they may be soldered or brazed into position so long as all of the wires 12 are in electrical circuit relationship with one another. The end portion A of the passage 13 has a larger axial cross-sectional area than the axial cross-sectional area of the interior portion A of the passage 13. This larger cross-sectional area provides a space between the wires 12 and the inner wall of the end portion of the passage 13 for the spreading of wires 12 in a radial direction. The opening at the end portion of the passage 13 is chamfered inwardly to facilitate the passage of similar wires (not shown) into the end portion of the passage 13. When the wires of a similar assembly are axially in line with the wires 12 of this assembly, and an axial force is applied thereto, the wires of this assembly expand within the confines of the end portion A of the housing passage 13 as the wires of the other assembly enter the passage 13 and intermingle with the wires of this assembly. This action completes the electrical circuit relationship between the two assemblies.

Preferably, the distance D that the wires 12 extend beyond the housing 10 is less than the length of the end portion A of the housing passage 13. This will insure that when all wires 12 are in mated relationship with the wires of a similar contact they are surrounded by and supported by the housing 10. This confines the wires 12 to a given space and helps to prevent radical bending of the wires that prevents a wire from entering the passage 13 in the housing 10 when the contacts are placed in mated relationship.

FIG. 3 is a magnified view of one of the wires 12 that are mounted in a housing to accomplish the objects of this invention. In this embodiment, for ease of assembly, both ends of wire 12 have a tapered or an angled surface 3 to facilitate sliding movement upon contact with the wires of another connector. The wire shown may be of any conducting material depending upon the strength and conductivity requirements. An example of one preferred material is beryllium-copper wire having a silver coating thereon. When beryllium-copper is used, it is preferred that for a housing 11, having an outside diameter of about 0.060 inches, that the wires 12 have a length of about 0.375 inches and a diameter of about 0.006 inches. In this embodiment, wires having a diameter less than 0.01 inches and greater than 0.001 inches are preferred. As previously mentioned, for structural purposes, it may be desirable to limit the length of the wire 12 to a length that allows the wire 12 to extend a distance beyond the housing that is less than the length of the end portion (A, FIG. 2) of the passage (13, FIG. 2).

FIG. 4 illustrates hermaphroditic contacts, similar to the one shown in FIG. 2, in mated relationship. In this preferred embodiment, it is shown how the end portions A of the housing passages 13 confine the intermingled wires 12 to a specific space. Although it is not necessary that the ends of each housing 10 contact each other, it is preferred that they do. Such an arrangement prevents the buckling of the wires should an unusually high amount of axial force be exerted on the housings 10. Each of the housings 10 include a second axial passage 14 for receiving an electrical conductor (not shown).

FIG. 5 is a cross-sectional view of a preferred embodiment of a hermaphroditic electrical contact 11 which characterizes this invention. In this embodiment, the wires 12 are mounted in the axial passage 13 in the housing 10. However, the axial passage 13 is of uniform cross-section and there is no end portion which is spaced from the wires mounted therein. This type of contact may be mated with the electrical contacts shown in FIGS. 2, 6 or 7 and with contacts identical to that shown in this figure.

FIG. 6 is a cross-sectional view of still another preferred embodiment of a hermaphroditic electrical contact which characterizes this invention. In this embodiment, the wires 12 do not extend beyond the end of the housing 10, but terminate at or within the housing 10. The end portion A of the passage 13 has a larger cross-section than the interior passage portion B for containing the wires 12 to a predetermined space when mated with the wires of another contact. This type of contact is especially adapted to receive the contact shown in FIGS. 5 and 7 but may also receive the contact shown in FIG. 2.
FIG. 7 is a cross-sectional view of a double ended hermaphroditic electrical contact which embodies the principles of this invention. In this embodiment, the wires 12 of either end of the contact 11 can be mated with the contact wires 12 shown in FIGS. 2, 5, or 6 and with contacts identical to that shown in this figure. In this embodiment, a plurality of wires 12 are securely held in axial alignment with respect to each other by a conduit 10 which permits the extension of the wires 12 from both ends of the conduit 10. An electrical conductor can be attached to the contact at either end of the wires or to the conduit. Alternatively, the conduit 10 could be eliminated and the wires 12 brazed or soldered together so that the wires form a bundle of generally parallel wires.

While a preferred embodiment of the invention has been shown, it will be apparent to those skilled in the art that changes may be made to the invention as set forth in the appended claims, and, in some cases, certain features of the invention may be used to advantage without corresponding use of other features. For example, the configuration of any of the components of the preferred embodiments may take various forms (round, square, with shoulders, without shoulders, etc.) while the objects may still be achieved. Accordingly, it is intended that the illustrative and descriptive materials herein be used to illustrate the principles of the invention and not to limit the scope thereof.

Having described the invention, what is claimed is:

1. An electrical contact comprising:
   a conduit having an axial passage; and
   several electrical conducting wires axially aligned and axially mounted within the passage of said conduit so that said wires extend beyond one end of said conduit, each of said wires extending beyond the end of said conduit including an end portion that terminates in an acutely angled surface.

2. An electrical contact comprising:
   an elongated electrical conductor having an axial passage that includes an end portion that terminates in an opening at one end of said conductor and an interior passage portion, the end portion of said passage having a cross-sectional area larger than the cross-sectional area of the interior portion of said passage; and
   several electrical wires axially aligned and axially mounted in said axial passage and extending a predetermined distance beyond the end of said elongated conductor, said wires spaced from the wall of the end portion of said passage to permit the spreading of said wires within the end portion of said passage, each of said wires extending beyond the end of said conductors includes an end portion that terminates in a tapered end.

3. The combination as recited in claim 2 wherein the passage opening in said elongated conductor includes a portion that is tapered inwardly.

4. The combination as recited in claim 2 wherein the predetermined distance said wires extend beyond the end of said conductor is less than the length of the end portion of the axial passage.

5. An electrical connector assembly for connecting a first electrical conductor in predetermined electrical circuit relationship to a second electrical conductor, said connector assembly comprising:

   a first assembly which includes:
   a housing having a passage therethrough;
   a duct disposed in said housing passage, said duct having a first end which extends beyond said housing;
   an elongated conductor adapted to receive said first electrical conductor in one end, said elongated conductor having an axial passage that includes an end passage portion that terminates in an opening at one end of said conductor and an interior passage portion, the end passage portion having a cross-sectional area larger than the cross-sectional area of the interior passage portion; and
   a plurality of wires axially mounted in said axial passage and extending beyond the end of said conductor, said conductor mounted in said duct so that the end portion of said conductor, having said wires extending therefrom, does not extend out of the first end of said duct;

   a second assembly which includes:
   a housing having a passage therethrough, said passage adapted to receive the first end of said first assembly duct that extends beyond said first assembly housing;
   a duct disposed in said housing passage, said duct having a first end which terminates within said housing passage;
   an elongated conductor adapted to receive said second electrical conductor in one end, said elongated conductor having an axial passage that includes an end passage portion that terminates in an opening at one end of said conductor and an interior passage portion, the end passage portion having a cross-sectional area larger than the cross-sectional area of the interior passage portion; and
   a plurality of wires axially mounted in said axial passage and extending beyond the end of said conductor, said conductor mounted in said duct so that the end portion of said conductor, having said wires extending therefrom, extends out of the first end of said duct, so that when said first assembly is in mated relationship with said second assembly the wires of said first and second assembly are intermingled with and in contact with each other whereby said first electrical conductor is in electrical circuit relationship with said second electrical conductor.

6. The combination as recited in claim 5 for connecting a first plurality of electrical conductors in predetermined circuit relationship with a second plurality of electrical conductors, wherein said first assembly housing has a plurality of passages therethrough each having an elongated conductor, a plurality of wires and a duct wherein which extends beyond said housing and wherein said second assembly housing has a plurality of passages therethrough, arranged in the same manner as the passages in said first assembly housing, each having an elongated conductor, a plurality of wires and a duct therein that terminates within said second housing so that when said first assembly is in mated relationship with said second assembly said first plurality of conductors in said first assembly are in predetermined circuit relationship with said second plurality of conductors in said second assembly.
7. The combination as recited in claim 6 wherein said first assembly has at least one duct which terminates within a first housing passage which is also adapted to receive a duct from said second housing, and wherein said second housing includes at least one duct which extends beyond a second housing passage whereby said first and second assemblies include both male and female members.

8. An electrical connector assembly for connecting a first electrical conductor in predetermined electrical circuit relationship to a second electrical conductor, said connector assembly comprising:
   a first assembly which includes:
   an elongated conductor mounted in said housing passage and adapted to receive said first electrical conductor at one end, said elongated conductor having an axial passage that includes an end passage portion that terminates in an opening at the other end of said elongated conductor and an interior passage portion, the end passage portion having a cross-sectional area larger than the cross-sectional area of the interior passage portion; and
   a plurality of axially aligned wires axially mounted in said interior passage portion and extending through, out of, but spaced from the inside walls of the end passage portion of said elongated conductor, the other ends of said wires terminating in free ends each of which includes a tapered end portion, said elongated conductor mounted in said housing so that the end portion of said elongated conductor, having said wires therein, extends out of the first passage of said first assembly housing; and
   a second assembly which includes:
   a housing having a passage therethrough, said passage adapted to receive the wires of said first assembly that extends out of said first assembly housing passage;
   an elongated conductor adapted to receive said second electrical conductor at one end, said elongated conductor having an axial passage that includes an end passage portion that terminates in an opening at the other end of said elongated conductor and an interior passage portion, the end passage portion having a cross-sectional area larger than the cross-sectional area of the interior passage portion; and
   a plurality of axially aligned wires axially mounted in said interior passage portion of said second assembly elongated conductor and extending through, out of, but spaced from the walls of the end passage portion of said elongated conductor, the other ends of said wires terminating in free ends each of which includes a tapered end portion, said elongated conductor mounted in said second assembly housing so that the end portion of said conductor, having said wires therein, terminates within the passage of said second assembly housing, so that when said first assembly is in mated relationship with said second assembly the wires of said first and second assemblies are intermingled with and in contact with each other within the confines of said end portions of said elongated conductors of said first and second assemblies, whereby said first electrical conductor is in electrical circuit relationship with said second electrical conductor.

9. The combination as recited in claim 8 for connecting a first plurality of electrical conductors in predetermined circuit relationship with a second plurality of electrical conductors, wherein said first assembly housing has a plurality of passages therethrough each having mounted therein an elongated conductor adapted to receive one of said electrical conductors of said first plurality at one end and a plurality of wires mounted in each of the other ends of said elongated conductors, said elongated conductors of said first assembly having end portions that extend beyond said housing passage and wherein said second assembly housing has a plurality of passages therethrough, arranged in the same manner as the passages in said first assembly housing, each of said passages of said second housing having mounted therein an elongated conductor adapted to receive one of said electrical conductors of said second plurality at one end and a plurality of wires mounted in each of the other ends of said elongated conductors of said second assembly, said elongated conductors of said second assembly having end portions which terminate within said second housing so that when said first assembly is in mated relationship with said second assembly said first plurality of conductors in said first assembly are in predetermined circuit relationship with said second plurality of conductors in said second assembly.

10. The combination as recited in claim 8 wherein said first assembly has at least one elongated conductor which terminates within one of said first housing passages which is also adapted to receive an elongated conductor mounted in said second housing, and wherein said second housing includes at least one elongated conductor which extends beyond one of said second housing passages whereby said first and said second assemblies include both male and female members.

11. An electrical connector assembly for connecting a first electrical conductor in predetermined electrical circuit relationship to a second electrical conductor, said connector assembly comprising:
   a first assembly which includes:
   a housing having a passage therethrough;
   an elongated conductor, mounted in said housing passage and adapted to receive said first electrical conductor at one end, said elongated conductor having an axial passage that terminates in an opening at the other end of said conductor; and
   a plurality of axially aligned wires mounted in said axial passage and extending beyond the end of said elongated conductor, said elongated conductor mounted in said housing so that the end portion of said conductor, having said wires extending therefrom, extends out of the passage of said housing; and
   a second assembly which includes:
   a housing having a passage therethrough, said passage adapted to receive the end of said elongated conductor that extends beyond said first assembly housing;
an elongated conductor adapted to receive said second electrical conductor at one end, said elongated conductor having an axial passage that terminates in an opening at the other end of said elongated conductor and an interior passage portion, the end passage portion having a cross-sectional area larger than the cross-sectional area of the interior passage portion; and

a plurality of axially aligned wires axially mounted in said interior passage portion and extending into but spaced from the inside walls of the end passage portion of said elongated conductor, said elongated conductor mounted in said second assembly housing so that the end portion of said conductor, having said wires extending therefrom, terminates within the passage of said second assembly housing, so that when said first assembly is in mated relationship with said second assembly the wires of said first and second assemblies are intermingled with and in contact with each other whereby said first electrical conductor is in electrical circuit relationship with said second electrical conductor.

12. The combination as recited in claim 11 for connecting a first plurality of electrical conductors in predetermined circuit relationship with a second plurality of electrical conductors, wherein said first assembly housing has a plurality of passages therethrough each having mounted therein an elongated conductor adapted to receive one of said electrical conductors of said first plurality at one end and a plurality of wires mounted in each of the other ends of said elongated conductors, said elongated conductors of said first assembly having end portions which extend beyond said housing passage and whereby said second assembly housing has a plurality of passages therethrough, arranged in the same manner as the passages in said first assembly housing, each of said passages of said second housing having mounted therein an elongated conductor adapted to receive one of said electrical conductors of said second plurality at one end and a plurality of wires mounted in each of the other ends of said elongated conductor, said elongated conductors of said second assembly having end portions which terminate within said second housing so that when said first assembly is in mated relationship with said second assembly are in predetermined circuit relationship with said second plurality of conductors in said second assembly.

13. An electrical connector assembly as recited in claim 12 wherein each of said wires of said first and second assemblies includes a free end having a tapered end portion.

14. The combination as recited in claim 11 wherein said first assembly has at least one elongated conductor which terminates within one of said first housing passages which is also adapted to receive an elongated conductor mounted in said second housing, and wherein said second housing includes at least one elongated conductor which extends beyond one of said second housing passages whereby said first and second assemblies include both male and female members.

15. An electrical connector assembly as recited in claim 14 wherein each of said wires of said first and second assemblies includes a free end having a tapered end portion.

16. An electrical connector assembly as recited in claim 11 wherein each of said wires of said first and second assemblies includes a free end having a tapered end portion.

17. An electrical connector assembly for connecting a first electrical conductor in predetermined electrical circuit relationship to a second electrical conductor, said connector assembly comprising:

a first assembly which includes:

a housing having a passage therethrough;

an elongated conductor, mounted in said housing passage and adapted to receive said first electrical conductor at one end, said elongated conductor having an axial passage that terminates in an opening at the other end of said conductor; and

a plurality of axially aligned wires mounted in said axial passage, said wires terminating in a free end each having an acutely angled end portion; and

a second assembly which includes:

a housing having a passage therethrough;

an elongated conductor adapted to receive said second electrical conductor at one end, said elongated conductor having an axial passage that terminates in an opening at the other end of said conductor; and

a plurality of axially aligned wires axially aligned and mounted in said axial passage of said second assembly elongated conductor, said wires terminating in a free end each having an acutely angled end portion, said elongated conductor mounted in said second assembly housing so that the end portion of said conductor, having said wires mounted therein, terminates within the passage of said second assembly housing, whereby when said first assembly is placed in mated relationship with said second assembly the angled end portions at the free ends of said wires of each assembly facilitates the intermingling of said wires without the bending thereof so that said wires of said first assembly may be repeatedly placed in electrical circuit relationship with said wires of said second assembly.

18. The combination as recited in claim 17 for connecting a first plurality of electrical conductors in predetermined circuit relationship with a second plurality of electrical conductors, wherein said first assembly housing has a plurality of passages therethrough each having mounted therein an elongated conductor adapted to receive one of said electrical conductors of said first plurality at one end and a plurality of wires mounted in each of the other ends of said elongated conductors, said elongated conductors of said first assembly having end portions which extend beyond said housing and wherein said second assembly housing has a plurality of passages therethrough, arranged in the same manner as the passages in said first assembly housing, each of said passages of said second housing...
having mounted therein an elongated conductor adapted to receive one of said electrical conductors of said first plurality at one end and a plurality of wires mounted in each of the other ends of said elongated conductors, said elongated conductors of said second assembly having end portions which terminate within said second housing so that when said first assembly is in mated relationship with said second assembly said first plurality of conductors in said first assembly are in predetermined circuit relationship with said second plurality of conductors in said second assembly.

19. The combination as recited in claim 17 wherein said first assembly has at least one elongated conductor which terminates within one of said first housing passages which is also adapted to receive an elongated conductor mounted in said second housing, and wherein said second housing includes at least one elongated conductor which extends beyond one of said second housing passages whereby said first and second assemblies includes both male and female members.

20. The combination as recited in claim 18 wherein said first assembly has at least one elongated conductor which terminates within one of said first housing passages which is also adapted to receive an elongated conductor mounted in said second housing, and wherein said second housing includes at least one elongated conductor which extends beyond one of said second housing passages whereby said first and second assemblies include both male and female members.