This invention relates to coupling devices for connectors and more particularly to connectors adapted to carry a plurality of detachable electrical contacts. Such connectors typically include a dielectric support. At least the electric contacts of one group extend outwardly from the support. Typically such contacts are tubular in form. In accordance with this invention there is provided in combination with such a dielectric support a base made of a conductor material. The base is positioned adjacent to the dielectric support and defines a plurality of openings through which are allowed to extend the electric contacts. Those electric contacts which it is desired to maintain at a common ground level fit snugly in the openings of the conductor base. In this manner good electric contact engagement is provided between the grounded contacts of the connector and the conductor base. Those electric contacts which it is not desired to ground fit loosely in the openings to avoid being short-circuited by the conductor plate.
This application is a continuation of our application for U.S. Patent Ser. No. 817,476, filed Apr. 18, 1969, now abandoned.

BACKGROUND OF THE INVENTION

The problem of transient interference in audio and video circuits is familiar both to their designers and to their users. When an electric motor, razor, food mixer, etc. is operated in close proximity to such circuits the quality of reception becomes deleteriously affected. In modern aircraft and missiles, there are housed in close proximity thousands of sensitive guidance instruments, each capable of generating an electromagnetic field which is capable of inducing unwanted signals into the neighboring instruments.

In analog and hybrid computers the intelligence signals processed by the operational amplifiers and other computing networks have relatively small magnitudes. Thus, the input to a summing junction of an operational amplifier may be on the order of a few microvolts. It will be appreciated therefor that any interfering or unwanted signals appearing on the input lines of such computing networks may be comparable in magnitude to the signals themselves and hence greatly affect the accuracy of the computer's results.

A well-known practice employed to avoid the deleterious effects of transient, parasitic, or other unwanted signals generated by exogenous electromagnetic fields is to use pairs of coaxial conductors, each pair having a center conductor which is completely surrounded by an outer conductor, typically made of meshed wire. A dielectric material separates the two conductors. Coaxial wires produce in most instances a negligible external electromagnetic field and have essentially little susceptibility to external fields from other sources and/or from fields produced by adjacent pairs of coaxial conductors. For these and other reasons such coaxial lines are extensively employed as radio-frequency transmission lines, multi-channel telephone carrier and television program lines, and in other communications networks. Such coaxial lines are also now widely employed in analog and hybrid computers.

In installations containing numerous networks it is, of course, necessary to cut the coaxial wires and connect them to couplings or connectors so as to interconnect them with other coaxial wires. In the process of cutting coaxial lines the protection against unwanted signals provided by the outer conductor is substantially lost. A common expedient is to connect, as by soldering, each outer conductor of each pair of coaxial conductors to a common ground base. Those familiar with such a procedure will appreciate the expense both in time and money that such a practice requires. In addition, it is difficult to avoid "cold soldered joints" with a result that some coaxial wires are not properly grounded.

SUMMARY OF THE INVENTION

This invention will find application in connection with various types of commercially available coupling devices or connectors characterized by having a plurality of electrical contacts extending from a connector interface. While the invention is illustrated in connection with tubular contact elements, the invention is equally applicable with contacts of other configurations. To connect to a common ground all or some of the electric contacts in a multi-contact connector, there is provided preferably a flat base formed of a conductor material. A plurality of openings extend through the faces of the base. The inter-opening spacings are determined by the inter-contact spacings so as to allow all contacts to extend outwardly through the base. The diameter of the openings is made slightly larger than the outside diameter of the electric contacts so as to provide frictional mechanical engagement between the outer peripheral walls of the tubular contacts and the cylindrical walls defined by the openings in the base. Such frictional mechanical engagement also establishes a good electric connection between the outer tubular walls of the electric contacts and the conductor base.

In this manner the grounding of the desired number of electric contacts is accomplished automatically by the conductor base, thereby avoiding the necessity to individually ground each outer conductor of each pair of coaxial wires. Those electric contacts which it is not desired to have grounded are associated with openings having a diameter sufficiently large relative to the outside diameter of the tubular electric contacts as to avoid mechanical and hence electrical engagement between the electric contacts and the conductor base.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows schematically a multi-contact connector for interconnecting a plurality of coaxial wires wherein each outer conductor of each pair of coaxial wires is individually connected to ground through a grounding wire;

FIG. 2 shows the application of this invention to a commercially available multi-contact connector, shown partly in cross section, wherein a conductor base is provided to electrically engage those contacts in the connector which it is desired to have grounded; and

FIG. 3 is a view in perspective of the connector shown in FIG. 2 with the conductor base sandwiched between the two mating parts of the connector.

Referring to a typical prior art connector schematically shown as 10 in FIG. 1, it includes a socket part 12 and a plug part 14. Leading to the socket part 12 are a plurality of coaxial wires or lines 16. Each coaxial line 16 includes an outer conductor 18 typically made of meshed wire. Socket 12 is provided with a plurality of coaxial tubular contacts generally designated as 20. Each pair of such coaxial tubular contacts includes an outer tubular contact 22 and an inner contact 23. The outer conductor 18 is stretched over the outer peripheral wall of the tubular contact 22 and is mechanically secured thereto by a metal outer sleeve 24.

To each end of the outer coaxial conductor 18 is electrically soldered, as at 26, one end of an electric conductor 28, the other end of which is connected to a common ground 30. The job of individually interconnecting wires 28 with the outer connectors 18 is tedious, time consuming, and expensive. In addition, the soldered connections 26 frequently become unsoldered rendering the grounding of their corresponding coaxial lines 16 ineffective.

In accordance with this invention, the grounding of the electric contacts in a multi-contact connector can be accomplished automatically. While the invention is not limited to any type of connector or to any geometric shape for the electric contacts, it will be illustrated, for the sake of simplicity, in connection with a multi-contact connector generally designated as 40 having a
socket part 42 and a mating plug part 44. The terms socket and plug parts are used to indicate that both parts contain mating electric contacts which can be of the female, male (or a combination of both) type contacts.

The main function of connector 40 is, of course, to allow detachable electric interconnections between a plurality of electric lines 46 and another plurality of electric lines 48. Typically in applications where parasitic signals are unwanted, lines 46 and 48 are made of coaxial conductors. Thus, line 46 has a center conductor 50 and an outer conductor 52. Line 48 has a center conductor 54 and an outer conductor 56. The center conductor is electrically insulated in each coaxial line from its outer conductor by a dielectric material. The function of the connector is to establish electrical contact engagement between center conductors 50, 54, on one hand, and between outer conductors 52, 56, on the other hand.

Typically, center conductor 50 may be connected to an inner tubular female electric contact 60, and outer conductor 52 is electrically connected to an outer tubular male electric contact 62. Similarly, center conductor 54 is connected to an inner male electric contact 64, and outer conductor 56 is connected to an outer female contact 66. Contact 64 is inserted into contact 60 thereby allowing contact 66 to engage the external tubular wall of contact 62. The dimensions of contacts 64, 66 and of contacts 60, 62 are such as to provide detachable frictional engagement therebetween.

In addition to housing a plurality of contacts 62, forming part of a first group 63, the socket part 42 which has a dielectric base 70 also houses a second group 73 of electric contacts such as 72, each contact 72 having a close-ended tubular contact 74. A plurality of corresponding mating electric contacts such as 76 are provided in the dielectric base 78 of plug 44. Of course, more than two groups of electric contacts may be provided in each of the interconnecting parts 42 and 44.

The manner of interconnecting the coaxial conductors 50, 52 with the coaxial tubular female electric contacts 60, 62 depends on the type of connector employed. In the connector 40 illustrated in FIG. 2 the outer tubular contact 62 fits inside an opening 80 in the dielectric support 70. The outer coaxial conductor 52 is slipped over the outer peripheral wall of tubular contact 62. A cylindrical metallic sleeve 82 extends over both the coaxial line 46 and the tubular contact 62. In the final assembly, sleeve 82 is crimped to tube 62 thereby providing a good electric engagement between the outer conductor 52 and the outer male tubular contact 62. The center tubular female contact 60 is also crimpingly engaged to the center conductor 50 as at 84. The outer tubular contacts 62 and 72 of groups 63 and 73, respectively, are inserted into openings of well 86 formed in the dielectric support body 78 of plug 44 so that the connector interface 90 of socket 42 becomes adjacent disposed to the connector interface 92 of the plug 44.

As previously mentioned, connector 40 is a well-known, commercially available connector and need not be further described herein.

In accordance with this invention the necessity to individually ground each outer conductor 52 with a wire, such as wire 28 in FIG. 1, is completely avoided. Between the interfaces 90 and 92 of connector 40 is sandwiched a conductor base or plate 100 having at least as many openings, generally indicated as 102, as there are electric contacts in groups 63, 73 in the base support 70 of socket 42. The outer peripheral walls of tubular contacts 62 snugly fit inside their corresponding mated openings 110 to provide a good mechanical and electrical engagement between the walls of contacts 62 and the conductor base 100.

While it is desired to connect the first group 63 of contacts 62 to a common ground, it may be desired not to connect the second group 73 of contacts 74 to ground. For this reason the openings 114 through which extend contacts 74 are made of a larger diameter so as not to mechanically or electrically engage the outer walls of contacts 74.

When it is not desired to ground any electric contacts in the connector 40, conductor base 100 is removed by merely lifting it off from the contacts 62, 74. The thickness of base 100 as compared to the dimensions of the mated parts 42, 44 is relatively small, hence conductor plate 100 does not in any way interfere with the normal operation of the coupling device 40. Since each installation may house a plurality, sometimes several hundred or thousand of such coupling devices 40, each conductor plate 100 is individually connected to a common ground 118 by a wire 120.

Thus, it will be appreciated that in accordance with this invention only one grounded connection 118 is required for groups of coaxial lines 46 instead of individually grounding each coaxial line 46 feeding into connector 40.

While the invention has been illustrated in connection with particular type connectors and particular type electric contacts, it will be appreciated that the invention is not limited thereto and contacts other than tubular in form may be employed without departing from the scope of the invention as defined in the appended claims.

What I claim is:
1. A coaxial electrical connector assembly comprising:
   a. a pair of cooperable plug members carrying a plurality of coaxially-engageable, pin-and-socket connector elements in opposed end faces of the plug members;
   b. certain ones of the said connector elements having mating ends extending outwardly of said end face of said plug member, each said pin element having a conically-tapered, enlarged-diameter portion spaced inwardly from said mating end, said diameter of said tapered portion increasing in the direction away from said mating end;
   c. a thin, flexible metal grounding plane separate from said plug members disposed in between the opposed end faces of said plug members;
   d. the body of said grounding plane defining a sufficient number of insert-free, cylindrical holes to permit passage therethrough of all of the connector pin elements projecting outwardly from said plug member; and
   e. the diameters of the individual holes being made such that when the plug members are moved into mating engagement with each other, said tapered portions of said connector pin elements become engaged in wedging pressure contact with the encircling walls of their mating holes, of said ground-
ing plate while one side of said plate remains spaced from said end face of said plug member containing said pin elements, and while said other end face of said other plug member engages the opposite side of said plate, each such pressure contact establishing a mechanical and electrical contact with the grounding plate.

2. The connector assembly of claim 1 wherein certain others of the said pin connector elements having mating ends extending outwardly of said end face of said plug member, each said pin element having a cylindrical configuration, the diameter of each pin connector element being less than the diameter of each of said holes.

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