INTERCONNECTION DEVICE FOR ELECTRONIC SYSTEMS

ABSTRACT: An interconnection device for electronic systems which is intended to establish interchangeble combinations of electrical connections between at least two groups of contact points. The contact points to be interconnected are connector contacts electrically connected to conductors, these connectors are so designed as to cooperate with countercontacts arranged on at least one removable insulated printed circuit board.
3,609,462 INTERCONNECTION DEVICE FOR ELECTRONIC SYSTEMS

The invention relates to an interconnection device for electronic systems intended to establish interchangeable combinations of electrical connections between at least two groups of contact points.

Electronic systems very often involve a large number of conducting wires, frequently several hundred or sometimes even several thousand such wires. This multitude of wires is generally arranged in bundles; however, these bundles are cumbersome, relatively rigid, and very difficult to handle. Sometimes they are made into a ribbon cable assembly. These consist of a series of parallel electrical conductors countersunk in a flat, flexible insulating material. The interconnection devices presently used are relatively cumbersome and heavy and they do not offer all of the facility nor all of the flexibility which one might desire at the time of installation and in the course of operation. As a matter of fact, it is very often difficult to identify a wire and to disconnect and remove it for eventual replacement or, on the other hand, it is often very difficult to gain access to these wires in order to perform a test.

Moreover, the known interconnection devices do not possess sufficient tightness to protect against humidity.

This invention is intended to remedy these inconveniences and to provide interconnections with great flexibility and at the same time reduce manpower required both for installation and for checking the cable as well as to make any possible modifications in the cables.

The interconnection device set forth in this invention has a smaller volume and a lighter weight and at the same time can assure perfect tightness. This interconnection device is characterized by the fact that the electrical connections established between the contact points to be interconnected are printed on at least one removable circuit board.

The interconnection device set forth in this invention can be constructed easily, particularly in the form of a universal interconnection device having a large number of contact points, and being compact, with very easy accessibility to all of the contact points.

It can also be constructed in the form of reduced-capacity interconnection devices, in other words, one simple multiconnector, as set forth in the present disclosure.

The interconnection device set forth in this invention is particularly suitable for applications where a ribbed cable is used, although it is not limited for this particular use and can be equally well with the customary type of cables.

The terms "printed connection" or "printed circuit" usually mean an electrical circuit placed on a supporting surface by a suitable method. We shall use this term in order to refer to an electrical circuit which is carried by any general type of insulating support, the circuit being, for example, engraved on the insulating support.

The invention is set forth in the following specification and attached drawings:

FIG. 1 is a schematic view of a part of one possible embodiment of the invention;

FIG. 2 is a perspective view of an embodiment of the invention;

FIGS. 3 and 4 show, respectively, in perspective and in horizontal cross section another particular embodiment of this invention;

FIG. 5 illustrates yet another embodiment of this invention;

FIG. 6 is a perspective view of another embodiment of this invention.

FIG. 1 shows schematically a part of a simple form of the interconnection device according to the invention. Three groups of electrical connectors A, B, C are connected to three groups of conductors represented by three ribbon cables 1, 2, and 3, with one conductor being connected to one connector. The interconnections between the conductors belonging to groups 1, 2, and 3 are carried out by means of card 4 which is made of insulating material and on which we find printed, by any method, the desired electrical connections, such as 5a and 5b. These printed electrical connections terminate in contacts arranged along the edge of card 4; these contacts then engage the connectors of groups A, B, and C. These connectors may be any type suitable for being electrically connected to the contacts of card 4. This card may be replaced with extreme simplicity by another card bearing other printed electrical connections. The connections may thus be modified without modifying the cables.

Several assemblies, such as the one shown in FIG. 1, can be arranged side by side to form an interconnection device with a large number of contact points. Two groups of connectors, such as B, belonging to two different rows, for example, can be interconnected so as to produce a multiplication of the contact points appearing in group B. The row containing the connector groups A, B, and C in FIG. 1 may also contain any larger number of groups so as to increase the number of contact combinations possible, as illustrated in FIG. 2. We see that the interconnections can always be easily modified by simply replacing the corresponding cards.

FIG. 2 shows one form of the invention. A support 6, made of any material, bears n rows of groups of electrical connectors represented by rows a-d. Each row contains several groups of connectors, for example, groups A, B, C, and D. A printed-circuit card is inserted into each row a-d. The card 7 is shown on FIG. 2 for the sake of clarity. The cards are guided by guides 8 provided in guide blocks 9 which are made of any material and which can also easily be an integral part of support 6. The connectors of groups A and D, for example, are connected to the conductors of ribbon cables 10 and 11, respectively. The group of connectors B is connected to group B of another row, for example, row c, so as to provide for multiple connections between rows a and c. The connector group C is connected to group C of another row, for example, row b, so as to provide for another multiplication of contacts. It is thus possible, depending upon the requirements, to accomplish easily and detachably all desired interconnections and to modify them as just as easily afterward. This extreme flexibility is further increased by the fact that the cards may contain test contacts which will make it possible, provided the installation is in service, to make any measurement considered useful without there ever being any need to interrupt a connection or to touch the cables. In case of failure, special cards may also be provided which replace the normal connection cards in order to put in, for example, a series of loops which would make it possible to perform some tests very simply and very rapidly in order to locate a breakdown or any interruption in the system.

In one advantageous form of the invention, the electrical connectors, gathered in groups such as A, B, and C, are individually removable so that we can easily suppress one contact point and possibly remove the corresponding conductor. The latter is terminated on the movable electrical conductor which is introduced by means of simple insertion into a duct designed for this purpose and provided in a strip made of insulating material. The duct is designed so that, after the connector is introduced into it, a tight fit results. The whole assembly is enclosed by a box consisting of two parts 6 and 9 that are securely attached to each other to form a tight joint between them as shown schematically in FIG. 2.

FIGS. 3 and 4 show, respectively, in a perspective view and in a horizontal cross section, one particular form for three groups of contact points. In the support 12, which can be made of any material and which has a flattened, parallelepipedic form, we find mounted three groups of electrical connectors A, B, and C so that these connectors 12 are placed in one and the same plane. Connected to these connectors we now have three groups of conductors represented thereby three ribbon cables 13, 14, and 15. A printed-circuit card 16 is introduced, in the direction indicated by the arrow, and is made to engage in the three groups of connectors A, B, and C, thus establishing a detachable fashion and in an extremely reduced volume, the desired electrical connections formed by
the printed circuits on the card. According to one variation the electrical connectors of groups A, B, and C are individually removable and provide tight contact points in the appropriate ducts located in the insulating strips. FIG. 5 shows a perspective view and a partial vertical cross section of another version of this invention, intended to interconnect, in a detachable fashion, groups of contact points situated on different planes. The example in FIG. 5 shows four groups of contact points. The similarity to the version in FIGS. 3 and 4 is quite obvious. The difference resides in the fact that the connector groups D and E are situated in planes that are perpendicular to the plane in which the connector the connector groups A and B are located. The printed-circuit card bears protrusions 16 and 17 perpendicular to the plane of the card faces; these protrusions bear the electrical contacts in which we find terminated some electrical connections imprinted on the card and capable of engaging in the electrical connectors belonging to groups D and E, connected to the conductors or ribbon cables 18 and 19.

FIG. 6 shows a perspective view of another embodiment of this invention intended to interconnect two groups of contact points. This version is particularly suitable for providing a detachable and interchangeable connection between a ribbon cable and an assembly of contact points to which we have also connected insulated conductors or conductors from another ribbon cable. This device or multiconnector essentially consists of two strips 20 and 21, bearing electrical connectors which engage two opposite sides of a printed-circuit card 22. A strip 21 can be mounted on a panel, for example, represented schematically by the dotted line, which contains the panel cabling. The other strip 20, into which the printed-circuit card 22 is placed, constitutes the male portion of the multiconnector, connected to the end of the exterior ribbon cable 23. A multiconnector designed as shown will not only make it possible to modify the connections very easily according to the spirit of the invention, but also offers the great advantage over the connectors used so far. For example, it is not as heavy, not as cumbersome, and not as expensive. It is easier to place in position and it overcomes the troublesome groping necessary when deformed pins of the customary connectors are present. It is also easy to provide test sockets which, without any additional cables, make it possible to measure signals, check voltage levels, etc., during normal operation. All of the many possible interconnections can be made easily and they can be interchanged with the greatest of ease. Moreover, any contact point is always easily accessible and tests can be performed simply and quickly. Damaged connectors etc. can be repaired easily which reduces the shutdown time and increases the profitability of any electronic system. The use of the interconnection device according to this invention will make it possible because of the reduced size and weight of the device as compared to the known devices, to make the general cabling of electronic systems, much lighter. This applies particularly in cases where these systems are installed on movable boards, airborne or space vehicles, and also where the reduction in size and weight is of considerable, if not overriding, importance. If we realize that in a modern intercontinental aircraft, the electronic installation alone may contain several thousand connectors, the weight saving which can be achieved by using the device according to this invention is appreciable.

The versions described above are only intended to illustrate the essential principle of the invention which is by no means limited to these particular forms.

What is claimed is:

1. An interconnection device for establishing interchangeability combinations of electrical connections between a plurality of groups of electrical conductors in an electronic system comprising:
   a. a parallelepipedic mechanical support means;
   b. a plurality of electrical connectors arranged in parallel rows on one side of said support means;
   c. a plurality of boards made of insulating material wherein each board has a plurality of groups of electrical contacts positioned such that each group of said contacts makes electrical connections with one of said connectors in one of said parallel rows, each of said boards further comprising electrical connection strips thereon for interconnecting a number of individual contacts within said group and in different groups; and
   d. wire means for interconnecting a part of said plurality of electrical connectors in different ones of said parallel rows, groups of said electrical conductors of said electronic system connected to the remaining of said plurality of electrical connectors, each group of electrical conductors connected to one connector.

2. The apparatus of claim 1 wherein there are n electrical connectors in each row and wherein each of two of the n connectors in each row are connected to a group of said electrical conductors of said electronic system and the remaining n-2 connectors in each parallel row is connected to a remaining connector in another of said parallel rows.