

Description

Field of the Invention

This invention relates to terminations for multiconductor cables having interspersed, substantially co-planar, signal and ground conductors. The invention also relates to methods and apparatus for making such terminations.

Background of the Invention

One type of electrical cable frequently employed in modern electronic equipment, such as computers, is a planar or ribbon cable having a plurality of parallel, laterally spaced, co-planar signal wires interspersed with ground wires. There may be one ground wire between each laterally adjacent pair of signal wires, or there may be two or more ground wires between each pair of signal wires. The ground wires are co-planar with the signal wires. Each signal wire is electrically insulated from the adjacent ground wires, as well as from all of the other signal wires. The signal wires typically carry the useful electrical signals in the associated electronic apparatus. The ground wires are provided to allow increased signal transmission rates, to reduce interference between the signal wires, etc. Cables of this type are sometimes known as signal line transmission or SLT cables, and that designation will sometimes be employed herein.

SLT cables are typically relatively small. For example, an SLT cable having 20 signal wires, each separated from each adjacent signal wire by two ground wires, may be only approximately 2.54 cm. (one inch) wide. In order to terminate such cables (i.e., connect the cable to other apparatus), the many closely spaced signal and ground wires must be separated from one another and mechanically and electrically connected to other circuit elements. This is a difficult, tedious, and time-consuming task which is also subject to error. Methods and apparatus which have been devised to facilitate this process are relatively complex and expensive.

It is an object of this invention to provide terminations for SLT cables and a method and apparatus for making SLT cable terminations.

US-A-4169641 describes a cable termination which has a planar circuit board with a plurality of conductors disposed in a longitudinal array on a first major surface of the circuit board. A planar cable has a plurality of flat conductors embedded in insulating material and the insulation is removed at the underside to expose the conductors. A clip is fixed to the circuit board to extend over the cable and clamp the cable onto the circuit board. The

clip has cantilevered spring fingers which urge the exposed conductors of the cable against the conductors of the circuit board.

In one aspect, the invention provides a termination of an electrical cable having a plurality of interspersed co-planar signal and ground wires embedded in insulation in the form of a substantially planar insulating jacket, each wire having an uninsulated end portion extending from an end portion of the insulation jacket said termination comprising

a planar circuit board disposed substantially parallel to the plane of the cable and having a plurality of signal wire termination sites disposed in a longitudinal array on a first major surface of the circuit board, the lateral spacing between the signal wire termination sites corresponding to the lateral spacing between the signal wires in the cable;

means for mechanically and electrically connecting the uninsulated end portion of each signal wire to a respective one of the signal wire termination sites;

a bus member having a longitudinal mid-portion which overlies and spans the entire width of the end portion of the insulation and serves to clamp the end portion of the insulation jacket against the first major surface of the circuit board with the plane of the cable parallel to the plane of the circuit board;

and means for mechanically and electrically connecting the uninsulated end portion of each ground wire to the bus member.

In another aspect, the invention provides a method of terminating at least one electrical cable at a planar circuit board, the cable having a plurality of interspersed co-planar signal and ground wires embedded in insulation in the form of a substantially planar insulating jacket and the circuit board having a plurality of signal wire termination sites disposed in a longitudinal array on a first major surface of the circuit board, the lateral spacing of the signal wire termination sites corresponding to the lateral spacing of the signal wires in the cable, said method comprising the steps of:

cutting the cable insulation transverse to the longitudinal axis of the cable adjacent the end of the cable to be terminated;

sliding the severed end portion of the insulation along the wires away from the remainder of the insulation to expose a portion of each wire between the severed end portion and the remainder of the insulation;

positioning the cable relative to the circuit board so that the plane of the cable is parallel to the plane of the circuit board with the longitudinal axis of the cable substantially perpendicular to the longitudinal axis of the array of signal wire termination sites and with the exposed portion of each signal wire traversing a respective one of the signal

wire termination sites;

placing a bus member across the cable insulation upstream of the exposed portions of the wires;

securing the bus member to the circuit board to clamp the cable to the circuit board;

cutting the signal wires between the signal wire termination sites and the severed end portion of the insulation;

folding the severed end portion of the insulation back on the portion of the cable upstream of the bus member so that the exposed portions of the ground wires pass over the top of the bus member;

cutting the ground wires at the bus member;

mechanically and electrically connecting each signal wire to the associated signal wire termination site and

mechanically and electrically connecting each ground wire to the bus member.

In a further aspect, the invention provides apparatus for mechanically and electrically connecting an electrical cable to a planar circuit board, the cable having a plurality of interspersed co-planar signal and ground wires embedded in insulation in the form of a substantially planar insulating jacket, an end portion of which has been prepared by being severed and separated from the remaining insulation to expose a portion of each wire, and the circuit board having a plurality of signal wire termination sites disposed in a longitudinal array on a first major surface of the circuit board, the lateral spacing of the signal wire termination sites corresponding to the lateral spacing of the signal wires, said apparatus comprising:

a base for supporting and locating the circuit board relative to the prepared cable, means for applying a bus member across the cable upstream of the exposed portions of the wires and into the circuit board for securing the cable to the circuit board; means for separately locating and guiding the exposed ground and signal wires, signal wire cutting means for co-operating with the locating and guiding means to cut the signal wires at the termination sites and ground wire cutting means for co-operating with the locating and guiding means to cut the ground wires at the bus member.

An SLT cable termination according to the invention includes an electrical circuit board having a longitudinal array of laterally spaced signal wire termination sites on one or both of the major surfaces of the board. The end of an SLT cable is secured to the circuit board by means of an electrically conductive longitudinal bus member substantially parallel to the longitudinal axis of the termination site array. The plane of the cable is parallel to the first major surface, and the end portion of the cable insulation is sandwiched between the mid-portion of the bus member and a

first major surface of the board. The ends of the bus member extend down through the circuit board and are clinched against the opposite second major surface of the board. Uninsulated portions of the signal wires extend forwardly from the end portion of the cable insulation, and each of these signal wire portions is mechanically and electrically connected to a respective one of the signal wire termination sites, e.g. by solder. Uninsulated end portions of the ground wires are bent back over the mid-portion of the bus member and are mechanically and electrically connected to the bus member (e.g., by solder). If desired, a cover or housing member can be applied over the first major surface to protect the termination. The housing may include means for mechanically gripping the insulation of the cable upstream of the bus member to reinforce the mechanical connection between the cable and the circuit board. A second cable may be terminated on the opposite surface of the circuit board in the same manner. Both cables may extend from the circuit board in the same direction. In this way several terminations can be connected along a cable to provide a "daisy chain" of terminations.

The SLT terminations of this invention can be made by cutting through the insulation (but not the wires) of the cable adjacent its end. The severed end portion of the insulation is pulled away from the unsevered remainder of the insulation to expose a portion of the signal and ground wires, but the ends of the signal and ground wires preferably remain in the severed end portion of the insulation. A longitudinal wire guide is placed over the first major circuit board surface so that the guide is substantially parallel to the longitudinal axis of the signal wire termination site array and on the opposite side of that array from the bus member site. The SLT cable, prepared as described above, is placed on the circuit board so that the longitudinal axis of the cable is substantially perpendicular to the longitudinal axis of the signal wire termination site array, so that the uninsulated portions of the wires traverse the signal wire termination sites and the wire guide, and so that the unsevered end portion of the insulation is at the bus member site. The bus member is installed so that the unsevered end portion of the insulation is sandwiched between the mid-portion of the bus member and the circuit board and so that the end portions of the bus member pass through the circuit board and are clinched against the opposite side of the board. The signal wires (but not the ground wires) are cut between the signal wire termination site array and the wire guide. The severed end portion of the insulation is bent back adjacent to the unsevered remainder of the insulation upstream of the bus member so that the ground wires pass over the

mid-portion of the bus member. The ground wires passing over the bus member are cut at the bus member. Each signal wire is mechanically and electrically connected to a respective one of the signal wire termination sites (e.g. by solder). All of the ground wires are similarly mechanically and electrically connected to the top of the mid-portion of the bus member (e.g. by solder). If desired, the foregoing steps can be repeated to terminate a second SLT cable on the other side of the circuit board.

Apparatus for making the SLT cable terminations of this invention may comprise a base for supporting the circuit board with its first major surface exposed. A longitudinal wire guide is placed over the circuit board parallel to the longitudinal axis of the signal wire termination site array and with that array between the wire guide and the bus member site. An SLT cable, prepared as described above, is placed on the circuit board as described above. A bus member is placed across the unsevered end portion of the insulation with the end portions of the bus member extending down through holes in the circuit board. A signal wire cutter cuts the signal wires (but not the ground wires) between the wire guide and the signal wire termination site array. A ground wire cutter forces the bus member down against the cable so that the ends of the bus member are clinched against the other side of circuit board by the base. No ground wires are cut on this stroke of the ground wire cutter. The signal wire cutter and ground wire cutter are retracted. The severed end portion of the insulation is bent back as described above. The ground wire cutter is operated again to cut the ground wires on top of the bus member. Each signal wire is mechanically and electrically connected to a respective one of the signal wire termination sites (e.g. by solder), and all of the ground wires are similarly mechanically and electrically connected to the top of the bus member (e.g. by solder).

Further features of the invention, its nature and various advantages will be more apparent from the accompanying drawings and the following detailed description of the invention.

Brief Description of the Drawings

Figure 1 is a perspective view of an illustrative SLT cable termination constructed in accordance with the principles of this invention.

Figure 2 is a perspective view of another illustrative SLT cable termination constructed in accordance with the invention.

Figure 3 is a perspective view of the under side of the termination of Figure 2.

Figure 4a is a side elevational view of a portion of apparatus constructed in accordance with this invention which can be used to make the SLT cable terminations of this invention. Figure 4a shows an early stage in operating cycle of the apparatus.

Figures 4b and 4c are views similar to Figure 4a showing successive stages in the operating cycle of the apparatus.

Figure 5a is a perspective view of the apparatus of Figure 4 showing the same stage in the operating cycle as is shown in Figure 4a.

Figures 5a', 5b, and 5c are views similar to Figure 5a. Figure 5a' shows a stage in the operating cycle intermediate the stages shown in Figures 4a and 4b. Figures 5b and 5c show the same operating cycle stages as are shown in Figures 4b and 4c, respectively.

Figure 6 is an end elevational view of the apparatus of Figures 4 and 5 showing an operating cycle stage similar to the stage shown in Figures 4b and 5b.

Figure 7 is a partial cross sectional view taken along the line 7-7 in Figure 2.

Detailed Description of the Invention

As shown in Figures 2 and 3, an illustrative SLT cable termination 10 constructed in accordance with the principles of this invention includes SLT cable 20 which is mechanically and electrically connected to electrical circuit board 40. Cable 20 includes a plurality of parallel, laterally spaced, coplanar signal wires 22. Signal wires 22 are interspersed with co-planar ground wires 24, and all of wires 22 and 24 are electrically insulated from one another by a single insulating jacket 26.

The plane of cable 20 is parallel to the plane of circuit board 40. The end portion of insulating jacket 26 is mechanically secured to circuit board 40 by means of longitudinal metal bus member 60 which acts like a staple. The end portions 62 of bus member 60 pass through apertures in circuit board 40 and are clinched against the lower surface of the circuit board as shown in Figure 3.

The uninsulated end portion of each signal wire 22 is mechanically and electrically connected (e.g., by solder) to a respective one of signal wire termination sites 42, which are printed or otherwise conventionally formed in a longitudinal array on the upper major surface of circuit board 40. Signal wire termination sites 42 are typically electrically insulated from one another, and each is respectively connected to other circuit elements in any desired manner. For example, in the depicted embodiment, termination 10 is part of a plug-type connector. Each signal wire termination site 42 is therefore electrically connected to a respective one of termi-

nal contact sites 46 by printed circuit traces 44. Some of terminal contact sites 46 are on the upper surface of circuit board 40 (see Figure 2), while other terminal contact sites 46 are on the lower surface of that board (see Figure 3). Terminal housing 80 containing a plurality of plug-type connector terminals 82 can be mounted on the edge of circuit board 40 opposite cable 20 so that each terminal 82 electrically contacts a respective one of terminal contact sites 46.

The uninsulated end portion of each ground wire 24 is bent back over the top of the mid-portion of bus member 60 and mechanically and electrically secured (e.g., by solder) to the top of bus member 60. If desired, bus member 60 may be electrically connected to one of terminal contact sites 46, e.g., by soldering the clinched ends 62 of bus member 60 to bus contact site 50 (Figure 3) which is connected to the selected terminal contact site 46 in the same manner that signal wire termination sites 42 are connected to the other terminal contact sites 46. Also if desired, circuit board 40 may be sandwiched between upper and lower covers 90 and 92 as shown in Figure 2. Covers 90 and 92 may be held together by any suitable means such as bolts, screws, or rivets through holes 94. Upper cover 90 may help secure cable 20 to the termination by clamping the cable against circuit board 40. If desired, upper cover 90 may have ridges 97 transverse to the longitudinal axis of cable 20 and in contact with cable insulation 26 to better secure the cable to the termination (see Figure 7).

Terminations of the type described above can be made using the apparatus 100 shown in Figures 4-6. This apparatus includes a base 110 having a pair of upwardly projecting guide pins 112. Circuit board 40 is placed on base 110 with guide pins 112 in holes 94. Wire guide 120 pivots down on top of a portion of circuit board 40 to one side of the array of signal wire termination sites 42. The portion of wire guide 120 adjacent to the signal wire termination sites has a plurality of upwardly extending ground wire supports 124 which are separated from one another by downwardly extending signal wire slots 122. Each signal wire slot 122 is aligned with a respective one of the signal wires 22 in the cable to be terminated at circuit board 40. Each ground wire support 124 is similarly aligned with a respective one of ground wires 24. Preferably each ground wire support 124 has a shallow notch for receiving the associated ground wire.

Cable 20 is prepared for termination by cutting through insulation 26 (but not any of wires 22 or 24) perpendicular to the longitudinal axis of the cable. The portion 26a of the insulation beyond this cut is pulled away from the remaining insulation 26 to expose a length of wires 22 and 24 (see Figures

4a and 5a). However, the ends of wires 22 and 24 preferably remain in insulation portion 26a. Cable 20 is then placed on circuit board 40 and wire guide 120 so that (1) insulation portion 26a is on the side of ground wire supports 124 remote from signal wire termination sites 42, (2) the end of insulation portion 26 is between signal wire termination sites 42 and the site at which bus member 60 will be located, (3) each signal wire 22 traverses a respective one of signal wire termination sites 42 and passes through a respective one of signal wire slots 122, and (4) each ground wire 24 traverses a respective one of ground wire supports 124.

The next step in the operation of the apparatus is the insertion of bus member 60. Bus member 60 is initially U-shaped. The parallel legs 62 of the bus member are inserted downwardly into holes in circuit board 40 on respective opposite sides of cable 20. The mid-portion of bus member 60 traverses the end of cable insulation 26.

Next, the apparatus is operated to lower signal wire cutter 130 and ground wire cutter 140 (see Figure 5a'). Any suitable means such as a mechanical linkage or a hydraulic or pneumatic actuator 142 (Figure 6) can be used to lower and then subsequently raise cutters 130 and 140. Cutters 130 and 140 are fixed relative to one another by cutter support 160 and are guided for vertical motion by lateral extension of cutter support 160 into vertical slots 104 in the frame 102 of apparatus 100. Signal wire cutter 130 comes down immediately adjacent to the face of wire guide 120 which faces toward signal wire termination sites 42. Signal wire cutter 130 has a plurality of downwardly extending signal wire cutting teeth 132, each of which is aligned with a respective one of signal wire slots 122. Signal wire cutting teeth 132 are separated from one another by ground wire slots 134, each of which is aligned with a respective one of ground wires 24. Accordingly, all of signal wires 22 are cut or sheared by cooperation of the bottoms of signal wire slots 122 and signal wire cutting teeth 132. Ground wires 24 enter ground wire slots 134 and are therefore not cut by signal wire cutter 130. Signal wire cutting teeth 132 push the sheared ends of signal wires 22 which remain connected to main insulation 26 down onto signal wire termination sites 42.

At the same time that signal wire cutter 130 is cutting signal wires 22, ground wire cutter 140 comes down on top of the mid-portion of bus member 60. Ground wire cutter 140 forces bus member 60 downwardly so that it firmly clamps the end of insulation 26 against circuit board 40. The downward driving of bus member 60 in this manner also causes the lower ends of bus member legs 62 to be clinched or crimped against the under side of

circuit board 40. Anvil pockets 114 (Figure 4) may be provided in base 110 to guide the crimped bus member legs 62 in any desired direction. Spacer member 150, which is located between cutters 130 and 140, provides additional support and guidance for bus member 60 while the bus member is being driven by ground wire cutter 140. Spacer member 150 generally travels with cutters 130 and 140, but it is also capable of some vertical motion relative to the cutters. Spacer member 150 is resiliently biased downward relative to cutters 130 and 140 by prestressed compression coil springs 152 acting between spacer member 150 and cutter support 160. Spacer member 150 is guided for vertical motion relative to cutters 130 and 140 by pins 154 which extend through spacer member 150 and into slots 156 in cutters 130 and 140. Elements 152, 154, and 156 allow spacer member 150 to move upwardly relative to cutters 130 and 140 so that spacer member 150 does not interfere with completion of the downward stroke of cutters 130 and 140. It should be noted that on this stroke of the apparatus, ground wire cutter 140 does not contact or cut any wires.

As shown in Figures 4b and 5b, the next step in the operation of the apparatus is to raise cutters 130 and 140, to fold insulation portion 26a back over insulation 26, and to pivot wire guide 120 away from circuit board 40. Because signal wires 22 have been cut, the portions of those wires which extend from insulation 26 remain in place over signal wire termination sites 42. The cut-off end portions of signal wires 22 remain with insulation portion 26a. When insulation portion 26a is folded back as described above, it also carries with it the exposed portions of ground wires 24. Accordingly, ground wires 24 pass over the top of the mid-portion of bus member 60.

As shown in Figures 4c and 5c, the next step in the operation of the apparatus is to again lower cutters 130 and 140. The lower edge of cutter 140 comes down on top of the mid-portion of bus member 60, cutting through the ground wires 24 which pass over the top of the bus member. All the wires to insulation portion 26a have now been cut. Portion 26a can therefore be removed and discarded.

The next step in the operation of the apparatus is to raise cutters 130 and 140 again. The ends of signal wires 22 can now be soldered to their respective signal wire termination sites 42, and the ends of ground wires 24 can be soldered to the top of bus member 60. Thereafter, cable 20 and circuit board 40 can be removed from the apparatus, and covers 90 and 92 and other elements such as terminal housing 80 can be added.

If desired, cables can be terminated on both sides of circuit board 40 as shown in Figure 1. As

shown in that Figure, cable 20a is terminated on the upper surface of circuit board 40, and thereafter cable 20b is terminated on the lower surface of that board. Bus member 60a is used in the termination of cable 20a, and in order to avoid any interference with the termination of cable 20b, the ends 62a of bus member 60a are preferably crimped outwardly away from cable 20b. Similarly, bus member 60b is used in the termination of cable 20b, and in order to avoid any interference with the termination of cable 20b, the ends 62b of bus member 60b are preferably crimped outwardly away from cable 20a. The circuit board 40 in Figure 1 can be similar to the circuit board 40 described above in connection with the other Figures except that in Figure 1 the circuit board has signal wire termination sites on both of its major surfaces, as well as two sets of apertures for bus members 60a and 60b to pass through.

The termination shown in Figure 1 can be made by apparatus similar to that described above. Cable 20a is terminated as described above. Then the partially completed termination is turned over and reinserted in the apparatus. Base 110 is shifted slightly relative to cutters 130 and 140 along an axis parallel to the longitudinal axis of the cables so that cutter 140 will come down on bus member 60b even though bus member 60b is at a slightly different position than bus member 60a. Cable 20b is then terminated in the same manner as cable 20a. Thereafter, the termination is removed from the apparatus and other elements such as terminal housing 84 and covers 96 and 98 are added.

Claims

1. A termination of an electrical cable (20) having a plurality of interspersed co-planar signal and ground wires (22,24) embedded in insulation in the form of a substantially planar insulating jacket (26), each wire (22,24) having an uninsulated end portion extending from an end portion of the insulation jacket (26) said termination comprising

a planar circuit board (40) disposed substantially parallel to the plane of the cable and having a plurality of signal wire termination sites (42) disposed in a longitudinal array on a first major surface of the circuit board, the lateral spacing between the signal wire termination sites (42) corresponding to the lateral spacing between the signal wires (22) in the cable (20);

means for mechanically and electrically connecting the uninsulated end portion of each signal wire (22) to a respective one of the signal wire termination sites (42);

a bus member (60) having a longitudinal



circuit board 40. Anvil pockets 114 (Figure 4) may be provided in base 110 to guide the crimped bus member legs 62 in any desired direction. Spacer member 150, which is located between cutters 130 and 140, provides additional support and guidance for bus member 60 while the bus member is being driven by ground wire cutter 140. Spacer member 150 generally travels with cutters 130 and 140, but it is also capable of some vertical motion relative to the cutters. Spacer member 150 is resiliently biased downward relative to cutters 130 and 140 by prestressed compression coil springs 152 acting between spacer member 150 and cutter support 160. Spacer member 150 is guided for vertical motion relative to cutters 130 and 140 by pins 154 which extend through spacer member 150 and into slots 156 in cutters 130 and 140. Elements 152, 154, and 156 allow spacer member 150 to move upwardly relative to cutters 130 and 140 so that spacer member 150 does not interfere with completion of the downward stroke of cutters 130 and 140. It should be noted that on this stroke of the apparatus, ground wire cutter 140 does not contact or cut any wires.

As shown in Figures 4b and 5b, the next step in the operation of the apparatus is to raise cutters 130 and 140, to fold insulation portion 26a back over insulation 26, and to pivot wire guide 120 away from circuit board 40. Because signal wires 22 have been cut, the portions of those wires which extend from insulation 26 remain in place over signal wire termination sites 42. The cut-off end portions of signal wires 22 remain with insulation portion 26a. When insulation portion 26a is folded back as described above, it also carries with it the exposed portions of ground wires 24. Accordingly, ground wires 24 pass over the top of the mid-portion of bus member 60.

As shown in Figures 4c and 5c, the next step in the operation of the apparatus is to again lower cutters 130 and 140. The lower edge of cutter 140 comes down on top of the mid-portion of bus member 60, cutting through the ground wires 24 which pass over the top of the bus member. All the wires to insulation portion 26a have now been cut. Portion 26a can therefore be removed and discarded.

The next step in the operation of the apparatus is to raise cutters 130 and 140 again. The ends of signal wires 22 can now be soldered to their respective signal wire termination sites 42, and the ends of ground wires 24 can be soldered to the top of bus member 60. Thereafter, cable 20 and circuit board 40 can be removed from the apparatus, and covers 90 and 92 and other elements such as terminal housing 80 can be added.

If desired, cables can be terminated on both sides of circuit board 40 as shown in Figure 1. As

shown in that Figure, cable 20a is terminated on the upper surface of circuit board 40, and thereafter cable 20b is terminated on the lower surface of that board. Bus member 60a is used in the termination of cable 20a, and in order to avoid any interference with the termination of cable 20b, the ends 62a of bus member 60a are preferably crimped outwardly away from cable 20b. Similarly, bus member 60b is used in the termination of cable 20b, and in order to avoid any interference with the termination of cable 20b, the ends 62b of bus member 60b are preferably crimped outwardly away from cable 20a. The circuit board 40 in Figure 1 can be similar to the circuit board 40 described above in connection with the other Figures except that in Figure 1 the circuit board has signal wire termination sites on both of its major surfaces, as well as two sets of apertures for bus members 60a and 60b to pass through.

The termination shown in Figure 1 can be made by apparatus similar to that described above. Cable 20a is terminated as described above. Then the partially completed termination is turned over and reinserted in the apparatus. Base 110 is shifted slightly relative to cutters 130 and 140 along an axis parallel to the longitudinal axis of the cables so that cutter 140 will come down on bus member 60b even though bus member 60b is at a slightly different position than bus member 60a. Cable 20b is then terminated in the same manner as cable 20a. Thereafter, the termination is removed from the apparatus and other elements such as terminal housing 84 and covers 96 and 98 are added.

Claims

1. A termination of an electrical cable (20) having a plurality of interspersed co-planar signal and ground wires (22,24) embedded in insulation in the form of a substantially planar insulating jacket (26), each wire (22,24) having an uninsulated end portion extending from an end portion of the insulation jacket (26) said termination comprising

a planar circuit board (40) disposed substantially parallel to the plane of the cable and having a plurality of signal wire termination sites (42) disposed in a longitudinal array on a first major surface of the circuit board, the lateral spacing between the signal wire termination sites (42) corresponding to the lateral spacing between the signal wires (22) in the cable (20);

means for mechanically and electrically connecting the uninsulated end portion of each signal wire (22) to a respective one of the signal wire termination sites (42);

a bus member (60) having a longitudinal



mid-portion which overlies and spans the entire width of the end portion of the insulation and serves to clamp the end portion of the insulation jacket (26) against the first major surface of the circuit board with the plane of the cable (20) parallel to the plane of the circuit board (40);

and means for mechanically and electrically connecting the uninsulated end portion of each ground wire (24) to the bus member (60).

2. The termination according to claim 1 and further comprising a second cable (20b) similar to said cable (20a):

a second plurality of signal wire termination sites (42) disposed in a longitudinal array on a second major surface of the circuit board (40) which is opposite the first major surface, the lateral spacing between the second signal wire termination sites (42) corresponding to the lateral spacing between the signal wires (22) in the second cable (20b);

means for mechanically and electrically connecting the uninsulated end portion of each second cable signal wire (22) to a respective one of the second signal wire termination sites (42);

a second bus member (60b) having a longitudinal mid-portion which overlies and spans the entire width of the end portion of the insulation jacket (26) of the second cable (20b) and serves to clamp the end portion of the second cable insulation Jacket (26) against the second major surface of the circuit board (40) with the plane of the second cable (20b) parallel to the plane of the circuit board (40) and

means for mechanically and electrically connecting the uninsulated end portion of each second cable ground wire (24) to the second bus member (60b).

3. The termination according to claim 2 wherein both cables (20a, 20b) extend from the circuit board (40) in the same direction.

4. The termination according to claim 1,2 or 3, wherein the uninsulated end portions of the ground wires (24) of the or each cable (20,20a,20b) are bent back over, and are mechanically and electrically connected to, an upper surface of the associated bus member (60,60a,60b).

5. The termination according to any one of claims 1 to 4, wherein end portions (62,62a,62b) of the or each bus member (60,60a,60b) extend through the circuit board (40) adjacent each end of the bus member mid-portion and said

end portions (62,62a,62b) are clinched against the major surface of the circuit board (40) which is opposite the major surface facing the mid-portion of the bus member (60,60a,60b).

6. The termination according to any one of claims 1 to 5, wherein the means for mechanically and electrically connecting the uninsulated end portion of the signal wires (22,22a,22b) to the associated signal wire termination sites (42) and the means for mechanically and electrically connecting the uninsulated end portions of the ground wires (24,24a,24b) to the associated bus member (60,60a,60b) comprise solder joints.

7. The termination according to any one of claims 1 to 6, and further comprising a cover (90,92) overlying at least one of the major surfaces of the circuit board (40) together with the signal wire termination sites (42) and the bus member (60,60a,60b) associated with said surface and a portion of the associated cable (20,20a,20b) upstream from the bus member (60,60a,60b).

8. The termination according to claim 7, wherein the cover (90,92) is secured to the circuit board (40) so that the upstream portion of the associated cable (20,20a,20b) is clamped between the cover (90) and the circuit board (40).

9. The termination according to claim 8, wherein the portion of the cover (90,92) in contact with the upstream portion of the associated cable (20,20a,20b) is provided with ridges (97) transverse to the longitudinal axis of the cable for increasing the resistance of the termination to withdrawal of the cable (20,20a,20b).

10. A method of terminating at least one electrical cable (20) at a planar circuit board (40), the cable (20) having a plurality of interspersed coplanar signal and ground wires (22,24) embedded in insulation in the form of a substantially planar jacket (26) and the circuit board (40) having a plurality of signal wire termination sites (42) disposed in a longitudinal array on a first major surface of the circuit board (40), the lateral spacing of the signal wire termination sites (2) corresponding to the lateral spacing of the signal wires (22) in the cable (20); said method comprising the steps of:

cutting the cable insulation (26) transverse to the longitudinal axis of the cable (20) adjacent the end of the cable (20) to be terminated;

sliding the severed end portion of the in-



insulation along the wires away from the remainder of the insulation to expose a portion of each wire (22,24) between the severed end portion and the remainder of the insulation;

positioning the cable (20) relative to the circuit board (40) so that the plane of the cable (20) is parallel to the plane of the circuit board (40) with the longitudinal axis of the cable (20) substantially perpendicular to the longitudinal axis of the array of signal wire termination sites (42) and with the exposed portion of each signal wire (22) traversing a respective one of the signal wire termination sites (42);

placing a bus member (60) across the cable insulation upstream of the exposed portions of the wires (22,24);

securing the bus member (60) to the circuit board (40) to clamp the cable (20) to the circuit board (40); cutting the signal wires (22) between the signal wire termination sites (42) and the severed end portion of the insulation;

folding the severed end portion of the insulation back on the portion of the cable (20) upstream of the bus member (60) so that the exposed portions of the ground wires (24) pass over the top of the bus member (60);

cutting the ground wires (24) at the bus member (60);

mechanically and electrically connecting each signal wire (22) to the associated signal wire termination site (42) and

mechanically and electrically connecting each ground wire (24) to the bus member (60).

11. A method according to claim 10, wherein the circuit board (40) has a second plurality of signal wire termination sites (42) disposed in a longitudinal array on the second major surface of the circuit board (44) which is opposite the first major surface and a second cable (20b) similar to said at least one cable (20a) is terminated using the second signal wire termination sites (42), the lateral spacing of the second signal wire termination sites (42) corresponding to the lateral spacing of the signal wires (22) of the second cable (20b) and the method further comprising the further steps of:

cutting the second cable insulation jacket (26) in the same manner as the first cable (20a);

sliding the severed end portion of the second cable insulation in the same manner as the severed end portion of the first cable (20a);

positioning the second cable (20b) relative to the circuit board (40) so that the plane of the second cable (20b) is parallel to the plane of the circuit board (40) and the longitudinal axis of the second cable (20b) is substantially per-

pendicular to the longitudinal axis of array of the second signal wire termination sites (42), with the exposed portion of each second signal wire (22) traversing a respective one of the second signal wire termination sites (42);

placing a second bus member (60b) across the second cable insulation upstream of the exposed portions of the wires (22,24);

securing the second bus member to the circuit board (40) to clamp the second cable (20b) to the circuit board (40);

cutting the second cable signal wires (22) between the second signal wire termination sites (42) and the severed end portion of the second cable insulation;

folding the severed end portion of the second cable insulation back on the portion of the second cable upstream of the second bus member (60b) so that the exposed portions of the second cable ground wires (20b) pass over the top of the second bus member (60b);

cutting the second ground wires (24) at the second bus member (60b);

mechanically and electrically connecting each second cable signal wire (22) to the associated second signal wire termination site (42) and

mechanically and electrically connecting each second cable ground wire (24) to the second bus member (60b).

12. A method according to claim 10 or 11 wherein the ground wires (24) are cut along an upper surface of the associated bus member (60a,60b).

13. A method according to any one of claims 10 to 12, wherein the or each bus member (60,60a,60b) has legs (62,62a,62b) and the method further comprises passing the legs (62,62a,62b) through the circuit board (40) on each side of the associated cable (20), and securing the or each bus member (60,60a,60b) to the circuit board (40) by clinching the ends of the bus member legs (62,62a,62b) against the major surface of the circuit board (40) opposite to the major surface facing the main portion of the bus member (60,60a,60b).

14. A method according to any one of claims 10 to 13 wherein the signal wires (22) are soldered to the associated signal wire termination sites (42) and the ground wires (24) are soldered to the associated bus member (60,60a,60b).

15. A method according to any one of claims 10 to 14 and further comprising the step of attaching one or more covers (90,92) to the circuit board



(40) so that the or each array of signal wire termination sites (42) and the or each bus member (60,60a,60b) are enclosed between the cover (90,92) and the circuit board (40).

16. Apparatus for mechanically and electrically connecting an electrical cable (20) to a planar circuit board (40), the cable (20) having a plurality of interspersed co-planar signal and ground wires (22,24) embedded in insulation in the form of a substantially planar insulating jacket (26), an end portion of which has been prepared by being severed and separated from the remaining insulation to expose a portion of each wire, (22,24) and the circuit board (40) having a plurality of signal wire termination sites (42) disposed in a longitudinal array on a first major surface of the circuit board (40), the lateral spacing of the signal wire termination sites (42) corresponding to the lateral spacing of the signal wires (22); said apparatus comprising:

a base (110) for supporting and locating the circuit board (40) relative to the prepared cable (20);

means for applying a bus member (60) across the cable (20) upstream of the exposed portions of the wires and into the circuit board (40) for securing the cable (20) to the circuit board (40);

means (120,122,124) for separately locating and guiding the exposed ground and signal wires (22,24);

signal wire cutting means (130,160) for co-operating with the locating and guiding means (120,122,124) to cut the signal wires (22) at the signal wire termination sites (42) and

ground wire cutting means (140,160) for co-operating with the locating and guiding means to cut the ground wires at the bus member (60).

17. Apparatus according to claim 16 wherein the locating and guiding means comprises a wire guide (120) removably positioned over the first major surface of the circuit board (40) on the side of the signal wire termination sites (42) remote from the bus member (60), the wire guide (120) having upwardly extending ground wire supports (124) separated from one another by downwardly extending signal wire slots (122), each of the signal wire slots (122) being alignable with a respective one of the signal wires (22) and each of the ground wire supports (24) being alignable with a respective one of the ground wires (24), the bottom of each signal wire slot (122) initially holding the associated signal wire (22) up off the asso-

ciated signal wire termination site (42); and the signal wire cutting means comprises

a vertically reciprocable signal wire cutter (130) for cooperating with the signal wire slots (122) to shear the signal wires (22) when the signal wire cutter (130) is lowered immediately adjacent to the wire guide (120) and on the side of the wire guide (120) which is adjacent to the signal wire termination sites (42).

18. Apparatus according to claim 17 wherein the guide (120) further comprises a plurality of upwardly extending ground wire slots (134), each of which is alignable with a respective one of the ground wires (24) to prevent the signal wire cutter (130) from cutting any of the ground wires (24) as it shears the signal wires (22).

19. Apparatus according to claim 16, 17 or 18, wherein the means for applying the bus member (60) comprises a vertically reciprocable knife blade (14) substantially perpendicular to the longitudinal axis of the cable (20) which serves to drive the bus member (60) downwardly against the cable (20) and the circuit board (40).

20. Apparatus according to claim 19 wherein the bus member (60) has two legs (62), one of which projects through the circuit board (40) on each side of the cable (20), and wherein the means for securing the bus member (60) further comprises an anvil pocket (114) in the base (110) for receiving the end of each bus member leg (62) and, for clinching the bus member leg (62) against the lower surface of the circuit board (40) when the bus member (60) is driven against the cable (20) and the circuit board (40).

21. Apparatus according to any one of claims 16 to 20, wherein the means for cutting the ground wires comprises a vertically reciprocable knife blade (140) substantially perpendicular to the longitudinal axis of the cable (20) which comes down on the bus member (60) to cut the ground wires (24).

Patentansprüche

1. Anschluß eines elektrischen Kabels (20), welches eine Mehrzahl von verschachtelten, ko-planaren Signal- und Erdungsleitungen (22, 24) hat, welche in eine Isolierung in Form eines im wesentlichen planaren Isoliermantels (26) eingebettet sind, wobei jede Leitung (22, 24) einen unisolierten Endabschnitt hat, welcher sich



von einem Endabschnitt des Isoliermantels (26) wegerstreckt, wobei der Anschluß aufweist eine planare Schaltungsplatte (40), welche im wesentlichen parallel zu der Ebene des Kabels angeordnet ist und eine Mehrzahl von Signalleitungs-Anschlußstellen (42) hat, welche in einer Längsreihe auf einer ersten Hauptfläche der Schaltungsplatte angeordnet sind, wobei der Querabstand zwischen den Signalleitungs-Anschlußstellen (42) den Querabstand zwischen den Signalleitungen (22) im Kabel (20) entspricht;

eine Einrichtung zum mechanischen und elektrischen Verbinden des unisolierten Endabschnitts jeder Signalleitung (22) mit einer der zugeordneten Signalleitungs-Anschlußstellen (42);

ein Busteil (60), welches einen Längsmittelabschnitt hat, welcher über der gesamten Breite des Endabschnitts der Isolierung liegt und diese überspannt und dazu dient, den Endabschnitt des Isoliermantels (26) gegen die erste Hauptfläche der Schaltungsplatte zu klemmen, wobei die Ebene des Kabels (20) parallel zur Ebene der Schaltungsplatte (40) ist; und

eine Einrichtung zum mechanischen und elektrischen Verbinden des unisolierten Endabschnitts jeder Erdungsleitung (24) mit dem Busteil (60).

2. Anschluß nach Anspruch 1, welcher ferner ein zweites Kabel (20b) aufweist, welches ähnlich wie das Kabel (20a) ausgelegt ist:

eine zweite Vielzahl von Signalleitungs-Anschlußstellen (42), welche in einer Längsreihe auf einer zweiten Hauptfläche der Schaltungsplatte (40) angeordnet sind, welche der ersten Hauptfläche gegenüberliegt, wobei der Querabstand zwischen den zweiten Signalleitungs-Anschlußstellen (24) dem Querabstand zwischen den Signalleitungen (22) im zweiten Kabel (20b) entspricht;

eine Einrichtung zum mechanischen und elektrischen Verbinden des unisolierten Endabschnitts jeder zweiten Kabelsignalleitung (22) mit einer der zugeordneten zweiten Signalleitungs-Anschlußstellen (42);

ein zweites Busteil (60b) welches einen Längsmittelabschnitt hat, welcher über der gesamten Breite des Endabschnitts des Isoliermantels (26) des zweiten Kabels (20b) liegt und sich darüber spannt, sowie dazu dient, den Endabschnitt des zweiten Kabelisoliermantels (26) gegen die zweite Hauptfläche der Schaltungsplatte (40) zu klemmen, wobei die Ebene des zweiten Kabels (20b) parallel zur Ebene der Schaltungsplatte (40) ist; und

eine Einrichtung zum mechanischen und elektrischen Verbinden des unisolierten Endabschnitts jeder zweiten Kabelerdungsleitung (24) mit dem zweiten Busteil (60b).

3. Anschluß nach Anspruch 2, bei dem beide Kabel (20a, 20b) von der Schaltungsplatte (40) in dieselbe Richtung weisen.

4. Anschluß nach Anspruch 1, 2 oder 3, bei dem die unisolierten Endabschnitte der Erdungsleitungen (24) des oder jedes Kabels (20, 20a, 20b) über eine obere Fläche des zugeordneten Busteils (60, 60a, 60b) zurückgebogen und mechanisch und elektrisch hiermit verbunden sind.

5. Anschluß nach einem der Ansprüche 1 bis 4, bei dem die Endabschnitte (62, 62a, 62b) des oder jedes Busteils (60, 60a, 60b) durch die Schaltungsplatte (40) in der Nähe des jeweiligen Endes des Mittelteils des Busteils verlaufen, und bei dem die Endabschnitte (62, 62a, 62b) gegen die Hauptfläche der Schaltungsplatte (40) festgepreßt sind, welche der Hauptfläche gegenüberliegt, die dem Mittelabschnitt des Busteils (60, 60a, 60b) zugewandt ist.

6. Anschluß nach einem der Ansprüche 1 bis 5, bei dem die Einrichtung zum mechanischen und elektrischen Verbinden des unisolierten Endabschnitts der Signalleitungen (22, 22a, 22b) mit den zugeordneten Signalleitungs-Anschlußstellen (42) und die Einrichtungen zum mechanischen und elektrischen Verbinden der unisolierten Endabschnitte der Erdungsleitungen (24, 24a, 24b) mit dem zugeordneten Busteil (60, 60a, 60b) Lötverbindungen aufweisen.

7. Anschluß nach einem der Ansprüche 1 bis 6, welcher ferner eine Abdeckung (90, 92) aufweist, welche über wenigstens einer der Hauptflächen der Schaltungsplatte (40) zusammen mit den Signalleitungs-Anschlußstellen (42) und dem Busteil (60, 60a, 60b), welches dieser Fläche zugeordnet ist und einem Abschnitt des zugeordneten Kabels (20, 20a, 20b) stromauf von dem Busteil (60, 60a, 60b) liegt.

8. Anschluß nach Anspruch 7, bei dem die Abdeckung (90, 92) fest mit der Schaltungsplatte (40) derart verbunden ist, daß der stromaufwärtige Abschnitt des zugeordneten Kabels (20, 20a, 20b) zwischen der Abdeckung (90) und der Schaltungsplatte (40) eingespannt ist.

9. Anschluß nach Anspruch 8, bei dem der Abschnitt der Abdeckung (90, 92), welcher in



Kontakt mit dem stromaufwärtigen Abschnitt des zugeordneten Kabels (20, 20a, 20b) ist, mit Stegen (97) senkrecht zur Längsachse des Kabels zur Vergrößerung des Widerstandes des Anschlusses gegen ein Abziehen des Kabels (20, 20a, 20b) versehen ist.

10. Verfahren zum Anschließen wenigstens eines elektrischen Kabels (20) an einer planaren Schaltungsplatte (40), wobei das Kabel (20) eine Mehrzahl von verschachtelten, koplanaren Signal- und Erdungsleitungen (22, 24) hat, welche in die Isolierung in Form eines im wesentlichen planaren Mantels (26) eingebettet sind, und wobei die Schaltungsplatte (40) eine Mehrzahl von Signalleitungs-Anschlußstellen (42) hat, welche in einer Längsreihe auf einer ersten Hauptfläche der Schaltungsplatte (40) angeordnet sind, wobei der Querabstand der Signalleitungs-Anschlußstellen (2) dem Querabstand der Signalleitungen (22) im Kabel (20) entspricht, bei dem das Verfahren die folgenden Schritte aufweist:

Durchtrennen der Kabelisolierung (26) quer zur Längsachse des Kabels (20) in der Nähe des Endes des anzuschließenden Kabels (20);

Wegschieben des durchgetrennten Endabschnitts der Isolierung entlang den Leitungen von dem Restteil der Isolierung, um einen Abschnitt mit der Leitung (22, 24) zwischen dem durchgetrennten Endabschnitt und dem restlichen Teil der Isolierung freizulegen;

Positionieren des Kabels (20) relativ zur Schaltungsplatte (40) derart, daß die Ebene des Kabels (20) parallel zur Ebene der Schaltungsplatte (40) ist, wobei die Längsachse des Kabels (20) im wesentlichen senkrecht zur Längsachse der Reihe von Signalleitungs-Anschlußstellen (42) ist, und wobei der freigelegte Abschnitt jeder Signalleitung (22) sich quer zu einer der zugeordneten Signalleitungs-Anschlußstellen (42) erstreckt;

Vorsehen eines Busteils (60) auf der Kabelisolierung stromauf von den freigelegten Abschnitten der Leitungen (22, 24);

Befestigen des Busteils (60) an der Schaltungsplatte (40), um das Kabel (20) mittels einer Klemmverbindung mit der Schaltungsplatte (40) zu verbinden;

Durchtrennen der Signalleitungen (22) zwischen den Signalleitungs-Anschlußstellen (42) und dem durchgetrennten Endabschnitt der Isolierung;

Zurückfalten des durchgetrennten Endabschnitts der Isolierung auf den Abschnitt des Kabels (20) stromauf von dem Busteil (60) derart, daß die freigelegten Endabschnitte der Erdungsleitungen (24) über die Oberseite des

Busteils (60) gehen;

Durchtrennen der Erdungsleitungen (24) an dem Busteil (60);

mechanisches und elektrisches Verbinden jeder Signalleitung (22) mit der zugeordneten Signalleitungs-Anschlußstelle (42); und

mechanisches und elektrisches Verbinden jeder Erdungsleitung (24) mit dem Busteil (60).

11. Verfahren nach Anspruch 10, bei dem die Schaltungsplatte (40) eine zweite Vielzahl von Signalleitungs-Anschlußstellen (42) hat, welche in einer Längsreihe auf der zweiten Hauptfläche der Schaltungsplatte (44) angeordnet sind, welche der ersten Hauptfläche gegenüberliegt, und ein zweites Kabel (20b) ähnlich wenigstens einem Kabel (20a) unter Nutzung der zweiten Signalleitungs-Anschlußstellen (42) angeschlossen wird, wobei der Querabstand der zweiten Signalleitungs-Anschlußstellen (42) dem Querabstand der Signalleitungen (22) des zweiten Kabels (20b) entspricht, und wobei das Verfahren ferner die folgenden Schritte aufweist:

Durchtrennen des zweiten Kabelisolierrmantels (26) auf die gleiche Weise wie beim ersten Kabel (20a);

Zurückschieben des durchgetrennten Endabschnitts der zweiten Kabelisolierung auf dieselbe Weise wie der durchgetrennte Endabschnitt des ersten Kabels (20a);

Positionieren des zweiten Kabels (20b) relativ zur Schaltungsplatte (40) derart, daß die Ebene des zweiten Kabels (20b) parallel zur Ebene der Schaltungsplatte (40) ist, und die Längsachse des zweiten Kabels (20b) im wesentlichen senkrecht zur Längsachse der Reihe von zweiten Signalleitungs-Anschlußstellen (42) ist, und wobei der freigelegte Abschnitt jeder zweiten Signalleitung (22) sich quer zu einer der zugeordneten zweiten Signalleitungs-Anschlußstellen (42) erstreckt;

Vorsehen eines zweiten Busteils (60b) auf der zweiten Kabelisolierung stromauf von den freigelegten Abschnitten der Leitungen (22, 24);

Befestigen des zweiten Busteils an der Schaltungsplatte (40), um das zweite Kabel (20b) mittels Klemmen an der Schaltungsplatte (40) vorzusehen;

Durchtrennen der Signalleitungen (22) des zweiten Kabels zwischen den zweiten Signalleitungs-Anschlußstellen (42) und dem durchgetrennten Endabschnitt der zweiten Kabelisolierung;

Zurückfalten des durchgetrennten Endabschnitts der zweiten Kabelisolierung auf den Abschnitt des zweiten Kabels stromauf von



dem zweiten Busteil (60b) derart, daß die freigelegten Abschnitte der zweiten Kabelerdungsleitungen (20b) über die Oberseite des zweiten Busteils (60b) gehen;

Durchtrennen der zweiten Erdungsleitungen (24) an dem zweiten Busteil (60b);

mechanisches und elektrisches Verbinden jeder zweiten Kabelsignalleitung (22) mit der jeweils zugeordneten Signalleitungs-Anschlußstelle (42); und

mechanisches und elektrisches Verbinden jeder Erdungsleitung (24) des zweiten Kabels mit dem zweiten Busteil (60b).

12. Verfahren nach Anspruch 10 oder 11, bei dem die Erdungsleitungen (24) entlang einer oberen Fläche des zugeordneten Busteils (60a, 60b) durchgetrennt werden.

13. Verfahren nach einem der Ansprüche 10 bis 12, bei dem das oder jedes Busteil (60, 60a, 60b) Schenkel (62, 62a, 62b) hat, und das Verfahren ferner aufweist, daß die Schenkel (62, 62a, 62b) durch die Schaltungsplatte (40) an jeder Seite des zugeordneten Kabels (20) gehen und das oder jedes Busteil (60, 60a, 60b) an der Schaltungsplatte (40) dadurch festlegen, daß die Enden der Schenkel (62, 62a, 62b) der Busteile gegen die Hauptfläche der Schaltungsplatte (40) gepreßt werden, welche der Hauptfläche gegenüberliegt, die dem Hauptteil des Busteils (60, 60a, 60b) zugewandt ist.

14. Verfahren nach einem der Ansprüche 10 bis 13, bei dem die Signalleitungen (22) an den zugeordneten Signalleitungs-Anschlußstellen (42) angelötet werden und bei dem die Erdungsleitungen (24) an dem zugeordneten Busteil (60, 60a, 60b) angelötet werden.

15. Verfahren nach einem der Ansprüche 10 bis 14, welches ferner den Schritt aufweist, gemäß dem eine oder mehrere Abdeckungen (90, 92) auf der Schaltungsplatte (40) derart angebracht werden, daß die oder jede Reihe von Signalleitungs-Anschlußstellen (42) in das oder jedes Busteil (60, 60a, 60b) zwischen der Abdeckung (90, 92) und der Schaltungsplatte (40) eingeschlossen sind.

16. Vorrichtung zum mechanischen und elektrischen Verbinden eines elektrischen Kabels (20) mit einer planaren Schaltungsplatte (40), wobei das Kabel (20) mit einer planaren Schaltungsplatte (40), wobei das Kabel (20) eine Mehrzahl von verschachtelten, koplanaren Signal- und Erdungsleitungen (22, 24) hat, wel-

che in die Isolierung in Form eines im wesentlichen planaren Mantels (26) eingebettet sind, bei der ein Endabschnitt derselben dadurch bearbeitet wird, daß dieser von der restlichen Isolierung abgetrennt und gelöst wird, um einen Abschnitt dieser Leitung (22, 24) freizulegen, und bei der die Schaltungsplatte (40) eine Mehrzahl von Signalleitungs-Anschlußstellen (42) hat, welche in einer Längsreihe auf einer ersten Hauptfläche der Schaltungsplatte (40) angeordnet sind, wobei der Querabstand der Signalleitungs-Anschlußstellen (42) dem Querabstand der Signalleitungen (22) entspricht, und wobei die Vorrichtung aufweist:

eine Basis (110) zum Stützen und Platzieren der Schaltungsplatte (40) relativ zu dem vorbereiteten Kabel (20);

eine Einrichtung zum Anbringen eines Busteils (60) auf dem Kabel (20) stromauf von den freigelegten Abschnitten der Leitungen und zum Einbringen in die Schaltungsplatte (40), um das Kabel (20) fest mit der Schaltungsplatte (40) zu verbinden;

eine Einrichtung (120, 122, 124) zum gesonderten Anordnen und Führen der freigelegten Erdungs- und Signalleitungen (22, 24);

eine Signalleitungs-Schneideeinrichtung (130, 160), welche mit der Platzier- und Führungseinrichtung (120, 122, 124) zusammenarbeitet, um die Signalleitungen (22) an den Signalleitungs-Anschlußstellen (42) durchzutrennen; und

eine Erdungsleitungs-Schneideeinrichtung (140, 160), welche mit der Platzier- und Führungseinrichtung zusammenarbeitet, um die Erdungsleitungen an dem Busteil (60) durchzutrennen.

17. Vorrichtung nach Anspruch 16, bei der die Platzierungs- und Führungseinrichtung eine Leitungsführung (120) aufweist, welche lösbar auf der ersten Hauptfläche der Schaltungsplatte (40) auf der Seite der Signalleitungs-Anschlußstellen (42) von dem Busteil (60) entfernt liegend angeordnet ist, die Drahtführung (120) nach oben verlaufende Erdungsleitungsabstützungen (124) hat, welche voneinander durch nach unten verlaufende Signalleitungsschlitze (122) getrennt sind, wobei jeder Signalleitungsschlitz (122) zu einer der zugeordneten Signalleitungen (22) ausrichtbar ist, und wobei jede der Erdungsleitungsabstützungen (24) zu einer der zugeordneten Erdungsleitungen (24) ausrichtbar ist, wobei der Boden jedes Signalleitungsschlitzes (122) zu Beginn die zugeordnete Signalleitung (22) von der zugeordneten Signalleitungs-Anschlußstelle (42) abgerückt hält; und die Signalleitungs-Schneideeinrichtung



aufweist

einen vertikal hin- und hergehend beweglichen Signalleitungsschneider (130), welcher mit den Signalleitungsschlitz (122) zusammenarbeitet, um die Signalleitungen (22) abzuscheren, wenn der Signalleitungsschneider (130) unmittelbar angrenzend an die Drahtführung (120) und auf der Seite der Drahtführung (120) abgesenkt wird, welche an die Signalleitungs-Anschlußstellen (42) angrenzt.

18. Vorrichtung nach Anspruch 17, bei der die Führung (120) ferner eine Mehrzahl von nach oben verlaufenden Erdungsleitungsschlitz (134) aufweist, von denen jeder zu einem der zugeordneten Erdungsleitungen (24) ausrichtbar ist, um zu verhindern, daß der Signalleitungsschneider (130) irgendeine der Erdungsleitungen (24) durchtrennt, wenn die Signalleitungen (22) abgesichert werden.

19. Vorrichtung nach Anspruch 16, 17 oder 18, bei der die Einrichtungen zum Aufbringen des Busteils (60) ein vertikal hin- und hergehend bewegliches Schneidmesser (14) aufweist, welches im wesentlichen senkrecht zur Längsachse des Kabels (20) angeordnet ist und welches dazu dient, das Busteil (60) nach unten gegen das Kabel (20) und die Schaltungsplatte (40) zu bewegen.

20. Vorrichtung nach Anspruch 19, bei der das Busteil (60) zwei Schenkel (62) hat, von denen einer durch die Schaltungsplatte (40) auf jeder Seite des Kabels (20) vorsteht, und bei der die Einrichtungen zum Festlegen des Busteils (60) ferner eine amboßförmige Tasche (114) in der Basis (110) zur Aufnahme des Endes jedes Busteilschenkels (62) und zum Anpressen des Busteilschenkels (62) gegen die untere Fläche der Schaltungsplatte (40) aufweist, wenn das Busteil (60) gegen das Kabel (20) und die Schaltungsplatte (40) bewegt wird.

21. Vorrichtung nach einem der Ansprüche 16 bis 20, bei der die Einrichtung zum Durchtrennen der Erdungsleitungen ein vertikal hin- und hergehend bewegliches Schneidmesser (140) aufweist, welches im wesentlichen senkrecht zur Längsachse des Kabels (20) angeordnet ist und welches sich auf das Busteil (60) nach unten bewegt, um die Erdungsleitungen (24) durchzuschneiden.

Revendications

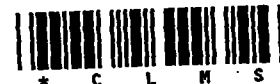
1. Terminaison de câble électrique (20), présentant une pluralité de brins conducteurs de si-

gnaux électriques (22) et de brins de masse (24) coplanaires et intercalés, noyés dans un isolant constitué d'une gaine isolante sensiblement plane (26), chaque brin (22, 24) présentant une extrémité non isolée dépassant de l'extrémité de la gaine isolante (26), ladite terminaison comprenant:

- une plaquette de circuit imprimé plane (20) disposée de façon sensiblement parallèle au plan du câble, et présentant une pluralité de sites de terminaison (42) pour brins conducteurs de signaux disposés dans une rangée longitudinale sur une première surface principale du circuit imprimé, la distance entre les sites de terminaison (42) pour brins conducteurs de signaux correspondant à la distance entre les brins conducteurs de signaux (22) dans le câble (20);
- des moyens pour relier mécaniquement et électriquement l'extrémité non isolée de chaque brin conducteur de signaux (22) au site correspondant parmi les sites de terminaison (42) pour brins conducteurs de signaux;
- un élément de bus (60) ayant une section médiane qui surplombe et couvre l'entière largeur de l'extrémité de l'isolant, et qui sert à fixer l'extrémité de la gaine isolante (26) sur la première surface principale du circuit imprimé, le plan du câble (20) étant parallèle au plan du circuit imprimé (40); et
- des moyens pour relier mécaniquement et électriquement l'extrémité non isolée de chaque brin de masse (24) à l'élément de bus (60).

2. Terminaison selon la revendication 1, comprenant en outre:

- un deuxième câble (20b) similaire audit câble (20a);
- une deuxième pluralité de sites de terminaison (42) pour brins conducteurs de signaux disposés selon une rangée longitudinale sur une deuxième surface principale du circuit de la plaquette de circuit imprimé (40), qui se trouve de l'autre côté de la première surface principale, la distance entre les seconds sites de terminaison (42) pour brins conducteurs de signaux correspondant à la distance entre les brins conducteurs de signaux (22) du second câble (20b);
- des moyens pour relier mécaniquement et électriquement l'extrémité non isolée de chaque brin conducteur de signaux (22) du second câble au site correspo-



- dant parmi les seconds sites de terminaison (42) pour brin conducteur de signaux;
- un deuxième élément de bus (60b) ayant une section médiane longitudinale qui surplombe et couvre la largeur entière de l'extrémité de la gaine isolante (26) du second câble (20b), et qui sert à fixer l'extrémité de la gaine isolante (26) du second câble sur la deuxième surface principale de la plaquette de circuit imprimé (40), le plan du second câble (20b) étant parallèle au plan de la plaquette de circuit imprimé (40); et
 - des moyens pour relier mécaniquement et électriquement l'extrémité non isolée de chaque brin de masse du second câble (24) au second élément de bus (60b).
3. Terminaison selon la revendication 2, dans laquelle les deux câbles (20a, 20b) s'étendent à partir de la plaquette circuit imprimé (40) dans la même direction.
 4. Terminaison selon la revendication 1, 2 ou 3, dans laquelle les extrémités non-isolées des brins de masse (24) de chaque câble (20, 20a, 20b) sont repliées, et sont mécaniquement et électriquement reliées à la surface supérieure de l'élément de bus correspondant (60a, 60b).
 5. Terminaison selon l'une quelconque des revendications 1 à 4, dans laquelle l'extrémité (62, 62a, 62b) du ou de chaque élément de bus (60, 60a, 60b) s'étend à travers la plaquette de circuit imprimé (40), au voisinage de chaque extrémité de la section médiane de l'élément de bus, et dans laquelle lesdites extrémités (62, 62a, 62b) sont rabattues contre la surface principale de la plaquette de circuit imprimé (40) qui se trouve du côté opposé de la surface principale en faisant face à la portion médiane de l'élément de bus (60, 60a, 60b).
 6. Terminaison selon l'une quelconque des revendications 1 à 5, dans laquelle les moyens pour relier mécaniquement et électriquement les extrémités non isolées des brins conducteurs de signaux (22, 22a, 22b) aux sites correspondants de terminaison (42) de brins conducteurs de signaux et les moyens pour relier mécaniquement et électriquement les extrémités non-isolées des conducteurs de masse (24, 24a, 24b) à l'élément de bus correspondant (60, 60a, 60b) comprennent des joints soudés.
 7. Terminaison selon l'une quelconque des revendications 1 à 6 et comprenant en outre un couvercle (90, 92) qui couvre au moins l'une des surfaces principales de la plaquette de circuit imprimé (40), ainsi que les sites de terminaison (42) des brins conducteurs de signaux et l'élément de bus (60, 60a, 60b) correspondant à ladite face et une partie du câble correspondant (20, 20a, 20b) en amont de l'élément de bus (60, 60a, 60b).
 8. Terminaison selon la revendication 7, dans laquelle le couvercle (90, 92) est fixé à la plaquette de circuit imprimé (40), de sorte que la partie amont du câble correspondant (20, 20a, 20b) soit pincée entre le couvercle (90) et la plaquette de circuit imprimé (40).
 9. Terminaison selon la revendication 8, dans laquelle la partie du couvercle (90, 92) en contact avec la partie amont du câble correspondant (20, 20a, 20b) est munie d'arêtes (97) transversales à l'axe longitudinal du câble, afin d'augmenter la résistance de la terminaison à l'encontre du retrait du câble (20, 20a, 20b).
 10. Procédé pour réaliser une terminaison d'au moins un câble électrique (20) sur une plaquette de circuit imprimé plane (40), le câble (20) présentant une pluralité de brins conducteurs de signaux (22) et de brins de masse (24) coplanaires et intercalés, noyés dans un isolant constitué d'une gaine (26) sensiblement plane, la plaquette de circuit imprimé (40) présentant une pluralité de sites de terminaison (42) pour les conducteurs de signaux, disposés en une rangée longitudinale sur une première surface principale de la plaquette de circuit imprimé (40), la distance entre les sites de terminaison pour brins conducteurs de signaux correspondant à la distance entre les brins conducteurs de signaux (22) sur le câble (20); ladite méthode comprenant les étapes consistant à:
 - couper l'isolant (26) du câble, transversalement à l'axe longitudinal du câble (20), à proximité de l'extrémité du câble (20) à terminer;
 - faire glisser la partie d'extrémité coupée de l'isolant le long des fils, en l'éloignant du reste de l'isolant, de façon à mettre à nu une partie de chaque brin conducteur de signaux (22, 24), entre la partie d'extrémité coupée et le reste de l'isolant;
 - disposer le câble (20) par rapport à la plaquette de circuit imprimé (40), de sorte que le plan du câble (20) soit parallèle au plan de la plaquette de circuit imprimé



- mé (40), avec l'axe longitudinal du câble (20) sensiblement perpendiculaire à l'axe longitudinal de la rangée de sites de terminaison (42) pour brins conducteurs de signaux, la partie mise à nu de chaque brin conducteur de signal (22) traversant le site correspondant parmi les sites de terminaison (42) pour brin conducteur de signal;
- disposer un élément de bus (60) en travers de l'isolant du câble, en amont des parties mises à nu du brin conducteur de signal (22, 24);
 - fixer l'élément de bus (60) à la plaquette de circuit imprimé (40), pour fixer le câble (20) à la plaquette de circuit imprimé (40);
 - couper les brins conducteurs de signaux (22) entre les sites de terminaison (42) pour brins conducteurs de signaux, et l'extrémité coupée de l'isolant;
 - replier l'extrémité coupée de la gaine d'isolation sur la partie du câble (20) en amont de l'élément de bus (60), de sorte que les parties mises à nu des brins de masse (24) passent par-dessus l'élément de bus (60);
 - couper les brins de masse (24) au niveau de l'élément de bus (60);
 - relier mécaniquement et électriquement chaque brin conducteur de signal (22) au site de terminaison correspondant (42) pour brin conducteur de signal; et
 - relier mécaniquement et électriquement chaque brin de masse (24) à l'élément de bus (60).
11. Procédé selon la revendication 10, dans lequel la plaquette de circuit imprimé (40) présente une deuxième pluralité de sites de terminaison pour brin conducteur de signal (42) disposés en une rangée longitudinale sur la deuxième face principale de la plaquette de circuit imprimé (44) qui se trouve de l'autre côté de la première face principale, et dans lequel un second câble (20b) similaire audit premier câble (20a) est terminé en utilisant les seconds sites de terminaison (42) pour brins conducteurs de signaux, la distance entre lesdits seconds sites de terminaison (42) pour brins conducteurs de signaux correspondant à la distance entre les conducteurs de signaux (22) du second câble (20b), ladite méthode comprenant en outre des étapes consistant à:
- couper la gaine d'isolation du second câble, de la même manière que celle du premier câble (20a);
 - faire glisser la partie d'extrémité coupée de l'isolant du second câble de la même façon que pour la partie d'extrémité coupée du premier câble (20a);
 - positionner le second câble (20b) par rapport à la plaquette de circuit imprimé (40), de sorte que le plan du second câble (20b) soit parallèle au plan de la plaquette de circuit imprimé (40), et que l'axe longitudinal du second câble (20b) soit sensiblement perpendiculaire à l'axe longitudinal de la rangée des seconds sites de terminaison (42) pour brins conducteurs de signaux, les parties mises à nu de chacun des seconds brins conducteurs de signaux (22) traversant le site correspondant parmi les seconds sites de terminaison (42) pour brins conducteurs de signaux;
 - disposer un deuxième élément de bus (60b) en travers de l'isolant du deuxième câble, en amont de la partie mise à nu des brins (22, 24);
 - fixer le deuxième élément de bus à la plaquette de circuit imprimé (40), pour fixer le second câble (20b) à la plaquette de circuit imprimé (40);
 - couper les brins conducteurs de signaux (22) du second câble entre les seconds sites de terminaison (42) pour brins conducteurs de signaux et la partie coupée de l'isolant du second câble;
 - replier la partie coupée de l'isolant du second câble sur la partie du second câble en amont du second élément de bus (60b), de sorte que les parties mises à nu des brins de masse du second câble (20b) passent par-dessus le second élément de bus (60b);
 - couper les seconds brins de masse (24) au niveau du second élément de bus (60b);
 - relier mécaniquement et électriquement chacun des brins conducteurs de signaux (22) du second câble au second site de terminaison correspondant (42) de brin conducteur de signaux, et
 - relier mécaniquement et électriquement chaque brin de masse (24) du second câble au deuxième élément de bus (60b).
12. Procédé selon la revendication 10 ou 11, dans lequel les brins de masse (24) sont coupés le long de la surface supérieure de l'élément de bus correspondant (60a, 60b).



13. Procédé selon l'une quelconque des revendications 10 à 12, dans lequel le ou chacun des éléments de bus (60, 60a, 60b) présente des jambes (62, 62a, 62b), et dans lequel le procédé comprend en outre l'étape consistant à passer les jambes (62, 62a, 62b) à travers la plaquette de circuit imprimé (40), de chaque côté du câble correspondant (20), et à fixer le ou chacun des éléments de bus (60, 60a, 60b) à la plaquette de circuit imprimé (40) en rabattant les extrémités des jambes (62, 62a, 62b) de l'élément de bus contre la surface principale de la plaquette de circuit imprimé (40) qui se trouve de l'autre côté de la surface principale faisant face à la partie principale de l'élément de bus (60, 60a, 60b).
14. Procédé selon l'une quelconque des revendications 10 à 13, dans lequel les brins conducteurs de signaux (22) sont soudés aux sites de terminaison associés (42) pour brins conducteurs de signaux, et dans lequel les brins de masse (24) sont soudés à l'élément de bus correspondant (60, 60a, 60b).
15. Procédé selon l'une quelconque des revendications 10 à 14 et comprenant en outre l'étape consistant à fixer un ou plusieurs couvercles (90, 92) sur la plaquette de circuit imprimé (40) de sorte que la ou chaque rangée de site de terminaison (42) pour brins conducteurs de signaux et que le ou chaque élément de bus (60, 60a, 60b) soient compris entre le couvercle (90, 92) et la plaquette de circuit imprimé (40).
16. Dispositif pour relier mécaniquement et électriquement un câble électrique (20) à une plaquette de circuit imprimé plane (40), câble (20) présentant une pluralité de brins conducteurs de signaux (22) et de brins de masse (24) coplanaires et intercalés, noyés dans un isolant constitué d'une gaine isolante sensiblement plane (26), une extrémité de ladite gaine ayant été préparée en étant coupée et séparée du reste de l'isolant, afin de mettre à nu une partie de chaque conducteur (22, 24), et la plaquette de circuit imprimé (40) présentant une pluralité de sites de terminaison (42) pour brins conducteurs de signaux, disposés selon une rangée longitudinale sur une première surface principale de la plaquette de circuit imprimé (40), la distance entre les sites de terminaison (42) pour brins conducteurs de signaux correspondant à la distance entre les brins conducteurs de signaux (22), ledit appareil comprenant:
- une base (110) destinée à supporter et positionner la plaquette de circuit imprimé (40) par rapport au câble préparé (20);
 - des moyens pour appliquer un élément de bus (60) en travers du câble (20) en amont de la partie mise à nu des brins conducteurs, et dans la plaquette de circuit imprimé, afin de fixer le câble (20) à la plaquette de circuit imprimé (40);
 - des moyens (120, 122, 124) pour séparément disposer et guider les parties mises à nu des brins conducteurs de signaux et de masse (22, 24);
 - des moyens (130, 160) de coupe des brins conducteurs de signaux, coopérant avec les moyens pour disposer et guider (120, 122, 124) afin de couper les brins conducteurs de signaux (22) au niveau des sites de terminaison (42) pour brins conducteurs de signaux; et
 - des moyens (140, 160) de coupe des brins de masse, pour coopérer avec les moyens pour disposer et guider, afin de couper les brins de masse au niveau de l'élément de bus (60).
17. Dispositif selon la revendication 16, dans lequel les moyens pour disposer et guider comprennent un guide de brin conducteur (120) disposé de façon amovible au-dessus de la première surface principale de la plaquette de circuit imprimé (40), du côté des terminaisons (42) pour brins conducteurs de signaux qui est éloigné de l'élément de bus (60), le guide pour brin conducteur (120) présentant des supports (124) de brins de masse s'étendant vers le haut et séparés l'un de l'autre par des fentes (122) pour brins conducteurs de signaux s'étendant vers le bas, chacune des fentes (122) pour conducteurs de signaux étant susceptible d'être alignée sur le brin correspondant parmi les brins conducteurs de signaux (22), et chacun des supports (124) pour brins de masse étant susceptible d'être aligné sur le brin correspondant parmi les brins de masse (24), la partie inférieure de chaque fente (122) pour brins conducteurs de signaux maintenant initialement le brin conducteur de signal correspondant (22) éloigné du site de terminaison correspondant (42) de brin conducteur de signal, les moyens de coupe de brins conducteurs de signaux comprenant:
- un couteau pour brins conducteurs de signaux (130) susceptible de se déplacer alternativement dans la direction verticale, pour coopérer avec les fentes (122) pour brins conducteurs de signaux afin

de cisailer les brins conducteurs de signaux (22), lorsque le couteau (130) de brins conducteurs de signaux est descendu au voisinage immédiat du guide pour brin conducteur (120) et sur la face du guide pour brin conducteur (120) qui est adjacente aux sites de terminaison (42) pour brins conducteurs de signaux.



18. Dispositif selon la revendication 17, dans lequel le guide (120) comprend en outre une pluralité de fentes (134) pour brins de masse s'étendant vers le haut, chacune de ces fentes étant susceptible d'être alignée avec le brin correspondant parmi les brins de masse (24), de façon à empêcher que le couteau de brins conducteurs de signaux (130) ne coupe l'un des brins de masse (24) lorsqu'il cisaille les brins conducteurs de signaux (22). 5 10 15 20
19. Dispositif selon l'une des revendications 16, 17 ou 18, dans lequel les moyens pour appliquer l'élément de bus (60) comprennent une lame de couteau (14) susceptible de se déplacer alternativement dans la direction verticale de façon sensiblement perpendiculaire à l'axe longitudinal du câble (20), qui sert à conduire l'élément de bus (60) vers le bas contre le câble (20) et la plaquette de circuit imprimé (40). 25 30
20. Dispositif selon la revendication 19, dans lequel l'élément de bus (60) présente deux jambes (62), chacune de ces jambes dépassant à travers la plaquette de circuit imprimé (40) de chaque côté du câble (20), et dans lequel les moyens destinés à fixer l'élément de bus (60) comprennent en outre une poche formant enclume (114) dans la base (110) destinée à recevoir l'extrémité de chaque jambe (62) de l'élément de bus, et destinée à rabattre la jambe de l'élément de bus (62) contre la surface inférieure de la plaquette de circuit imprimé (40) lorsque l'élément de bus (60) est conduit contre le câble (20) et la plaquette de circuit imprimé (40). 35 40 45
21. Dispositif selon l'une quelconque des revendications 16 à 20, dans lequel les moyens de coupe des brins de masse comprennent une lame de couteau (140) susceptible de se déplacer alternativement dans la direction verticale de façon sensiblement perpendiculaire à l'axe longitudinal du câble (20), et qui descend sur l'élément de bus (60) pour couper les brins de masse (24). 50 55