Conductors are connected to terminals in a preloaded electrical connector by means of a fixture having a conductor jig removably mounted thereon. The conductors are located in slots in the jig and the jig is thereafter removed from the fixture and placed in a conductor insertion apparatus which transfers the conductors from the jig to the terminals in the connector and connects the individual conductors to the terminals.

12 Claims, 10 Drawing Figures
This application discloses and claims a jig and fixture adapted for use with, and in combination with, conductor connecting apparatus of the general type disclosed in application Ser. No. 147,578. The instant application is also related to application Ser. No. 312,394 which discloses an apparatus for connecting the corresponding terminal positions of a plurality of conductors to each other.

BACKGROUND OF THE INVENTION

Application Ser. No. 147,578 discloses and claims an apparatus for inserting each of a plurality of conductors into each of a plurality of contact terminals which are contained in an electrical connector. In accordance with the teachings of application Ser. No. 147,578, a conductor positioning means is provided on the apparatus, the positioning means being adapted to receive and locate the conductors which are to be connected to the terminals in the connector. In the use of this known type of connecting apparatus, the technician is thus required to position the wires in the apparatus prior to actuation of the apparatus and connection of the wires to the terminals.

In accordance with the practice of the instant invention, a fixture is provided which has one or more conductor positioning jigs removable mounted thereon. The technician can thus position the conductors in the removable conductor jig at a location remote from the conductor inserting apparatus. The inserting apparatus has a mounting means therein which is adapted to receive the conductor positioning jig so that after the conductors have been located in the jig, the jig is removed from the fixture, positioned on the inserting apparatus, and the inserting apparatus is then actuated to connect the conductors to the terminals in the connector.

It is accordingly an object of the invention to provide an improved system for connecting predetermined conductors to specifically pre-determined contact terminals in a connecting device such as an electrical connector. It is a further object to provide an improved conductor positioning fixture and jig means in combination with an improved conductor connecting apparatus for connecting conductors to terminals. A further object is to facilitate and expedite the operation of connecting conductors to terminals in a connecting device.

These and other objects of the invention are achieved in preferred embodiments thereof which are briefly described in the foregoing abstract, which are described in detail below and which are shown in the accompanying drawing in which:

FIG. 1 is a perspective view of a multi-contact connector of the type for which the disclosed embodiment of the invention is specifically intended.

FIG. 2 is a fragmentary sectional perspective view of the connector of FIG. 1 showing one contact terminal and exploded from the connector housing.

FIG. 3 is a perspective view of a conductor inserting apparatus in accordance with the invention, the jig holding arm on the lefthand side of the apparatus being positioned against the connector mounted in the apparatus and the jig holding arm on the righthand side being in its remote position relative to the connector, the conductor positioning jig being exploded from this righthand jig holding arm.

FIG. 4 is a perspective view of a conductor positioning fixture having conductor positioning jigs removable mounted thereon in accordance with the invention and illustrating the manner in which conductors from a cable are positioned in jigs.

FIG. 5 is a perspective view, with parts broken away of a conductor positioning jig in accordance with the invention.

FIG. 6 is a plan view of the tool of FIG. 3 showing the jig holding arms in their remote positions relative to the connector holding means and showing the manner in which the conductor positioning jigs are mounted on the jig holding arms.

FIG. 7 is a view similar to FIG. 6 but showing the conductor positioning jigs mounted on the jig holding arms.

FIG. 8 is a sectional view taken through the connector holding means of the tool of FIG. 3 illustrating the location of the conductor holding jigs relative to the connector immediately prior to transfer of the conductors to the connector.

FIG. 9 is a perspective view of a modified form of fixture and jig for connecting conductors to each of a plurality of terminals in a plurality of electrical connectors.

FIG. 10 is a schematic view of a plurality of electrical connectors and conductors connected to corresponding terminal positions in the connectors.

Referring first to FIGS. 1 and 2, the disclosed embodiment of the invention is particularly intended to connect the wires of a multi-conductor cable to the wire receiving portion 6 of terminals 8 of an electrical connector. The connector of is of a type 10 described in detail in application Ser. No. 147,578. It is to be understood that the principles of the invention as described above are also applicable to apparatus for connecting other types of conductors, such as flat conductors in a flat conductor cable, to terminal positions in other types of electrical connecting devices.

The connector 10 comprises a housing 12 having a rearward side 14 and a mating side 16. A ledge 18 extends centrally from the rearward side 14 and spaced apart barriers 20, 20' are provided on the upper and lower surfaces 21, 21' of this ledge. An electrical contact terminal 8 is located between each pair of adjacent barriers and has a shank portion 24 which extends through a cavity 22 in the housing. Each terminal has a contact section 26 at its forward end which is adapted to engage a complementary contact terminal in a complementary electrical connector.

The conductor-receiving portion 6 at the rearward end of each terminal comprises spaced apart parallel plate sections 28, 30, which are connected to each other at their upper ends by means of parallel connecting straps 32. Wire-receiving slots 34 extend downwardly into each plate section so that an individual wire 2 can be connected to the terminal upon movement of the wire laterally of its axis between the connecting straps 32, and into the slots 34. When a plurality of wires in a cable 4 are to be connected to the terminals in the connector 10, it is usually required that predeter-
minated wires be connected to predetermined terminals. For example, it is common practice in the telephone industry to employ cables 4 which contain a plurality of twisted pairs of wires and when these wires are connected to these terminals in the connector, the wires of each pair are connected to corresponding terminals on the upper and lower sides 21, 21' of the ledge 18. In accordance with the invention, the wires of the cable 4 are located in predetermined positions in wire positioning jigs 38, 38' (FIG. 4) when the wires of the cables 4 are to be connected to the terminals in the connector. These wiring jigs are mounted on a wiring fixture 36 from which they are later removed and placed in an insertion apparatus as described below.

Wire positioning jig 38 (FIG. 5) is advantageously produced as an integral molded part comprising parallel sides 42, 43 and parallel ends 44, these sides and ends defining a central opening 45. The jig 38 has an upper face 46 as viewed in FIG. 5 and a lower face 48, from which flanges 60, 62 depend. The side 43 has an inwardly directed flange 50 on the upper side of which are provided a plurality of spaced-apart barriers 52, each pair of adjacent barriers defining a wire receiving slot 53. An additional flange 54 is provided on the side 43 beneath the flange 50 for strengthening purposes. The side 42 is provided with barriers 58 on its upper side which define slots 57. The slots 57 are in alignment with the slots 53 so that an individual wire can be positioned in an aligned pair of slots and the wire will extend across the central opening 45 of the jig. It will be noted from FIGS. 5 and 8 that the floors or inner ends of the slots 53 slope towards the central opening 45 and the inner ends or floors of the slots 57 slope away from the central openings 45. As will become apparent as this description proceeds, this inclination in the inner ends of the slots locates the wires in an advantageous position for insertion into the conductor receiving portions 6 of the terminals when the jig is mounted on the insertion tool. The depending flanges 60, 62 on the lower face 48 of the jig are spaced apart by a distance such that the jig can be mounted on jig supporting surfaces portions of the fixture and on similar jig supporting surfaces of the insertion apparatus shown in FIG. 3. The ends 44 are also provided with aligned holes 64 for the reception of a locking dowel as will be described below.

The fixture 36 comprises a relatively wide base 66 having side flanges 68 which have inwardly directed lips 70 at their upper ends. A jig holding block 72 extends between these side flanges and has an integral base plate 74 which projects beneath the lips 70 of the sides. The jig holder may be locked in any desired position on the base 66 by means of locking screws 76 which clamp the ends of the plate 74 against the surface of the base 66.

Jig holder block 72 is notched as shown at 78 on its upper side adjacent to its ends 88, the length of these notches being sufficient to snugly receive a wiring jig as shown best in FIG. 4. Advantageously, a dowel rod 82 having an enlarged end 84, is inserted through aligned holes in the jig holder block 88, through a channel 86 in the central portion of the jig holder, and through the holes 64 of the jigs to lock the jigs to the jig holder during a lacing operation.

The cable 4 is clamped adjacent to the jig holder and the jigs by means of a clamp 90 mounted on a block 106 which in turn is mounted on the base 66. Clamp 90 comprises a clamping arm 92 on the end of which there is provided a clamping foot 94 that clamps the end of the sheath of the cable against the upper surface of block 106. Clamping arm 92 is pivoted at 98 to a clamping lever 96 and has a depending ear which is pivoted at 100 to an L-shaped bracket 102 on the upper surface of the block 106. Intermediate its ends, the lever 96 is pivoted to a link 104 which in turn is pivotally connected to the bracket 102. In FIG. 4, the clamp 90 is in clamping engagement with the cable and the cable can be released by merely lifting or swinging the righthand end of the lever 96 upwardly.

When the conductors 2 of a cable 4 are to be positioned in the wiring jigs preparatory to connection of these conductors to the terminals in a connector, the jigs 38, 38' are mounted on the jig block 72 with the barriers 52 proximate to the clamp 90. The covering sheath is then stripped back from the cable and the end portion of the cable is clamped against the block 106. If the conductors are in the form of twisted pairs the technician then selects a twisted pair from the bundle of conductors, separates the two wires of the pair, and positions one wire in each of the jigs 38, 38'. If the object is to connect the wires to corresponding terminals on the upper and lower sides of the ledge 18 of the connector, the two conductors of the pair are located in corresponding positions in the two jigs; for example, the technician might locate one wire of each pair in the outermost positions of the jigs which are adjacent to the ends 88, 88' of the jig block. He would then locate one wire of the second pair in the next adjacent position of the two jigs and continue until all of the wires had been placed in the wiring jigs. At the conclusion of this lacing process, the ends of the conductors will extend beyond the projecting end portions 58 of the barriers 56 as shown in FIG. 4.

The conductor insertion apparatus in accordance with the invention (FIG. 3) comprises a base 108 having a pair of spaced-apart columns 110, 112 extending therefrom. The rearward column as viewed in FIG. 3, 112, has an upward extending projection 114 which has a forwardly facing locating surface 116 for the electrical connector 10 to which the conductors or wires are to be attached. This extension also has a forwardly projecting arm 118 which is upwardly turned at its free end 120 for the purpose of supporting and locating the lower end, as viewed in FIG. 3, of the connector. Steel plates 122, 122' are secured to the oppositely directed sides of the extension 114 and these plates have inwardly directed end portions 124, 124' which bear against the surfaces 21, 21' of the connector. It will thus be apparent that the connector is mounted in the apparatus of FIG. 3 by clamping it downwardly and between the opposed surfaces of the plates 122, 122'. The plates 122 have openings 126 which extend around and intersect the edge 123, these openings being in alignment with the terminals in the connector and having a width which is slightly greater than the diameter of the individual wires. The inner edges 127 of these openings serve as fixed shear for trimming the wire ends at the time of insertion into the terminals as will also be described below.

The jigs 38, 38' are mounted on jig holding arms 128, 128' which have inner ends 129 extending between the columns 110, 112 and pivoted on a common pivot pin 130 which extends between these columns. The jig holding arm 128 in FIG. 3 is in its remote, or open, po
sition while the jig holding arm 128', which has a wiring jig mounted thereon, is in its closed position. The arms 128 and the inserting levers 150 described below each side of the columns 110, 112 are identical so that a description of the jig holding arm and inserter on the right hand side in FIG. 3 will suffice for both.

The jig holding arm 128 has a central opening 132 extending axially therealong and is recessed on its forward facing side 134 so that the wire holding jig 38 can be mounted thereon with the flange 62 disposed in the recess 134 and with the flange 60 on the opposite side of the arm. When the jig is so mounted on the arm, the central opening 45 in the jig will be in alignment with the opening 132 in the arm. The outer end of the arm 128 has an end plate 136 secured thereto by fasteners 138 and the inner end has an integral upstanding boss or block which provides an outwardly facing locating surface 140 for the jig. It will thus be apparent that the jig can be mounted on the arm 128 by merely aligning it with the arm and moving it against the upwardly facing side 141. The opposed surfaces 140 and 143 will locate the jig on the arm so that the conductors in the jig will be in alignment with the terminals in the connector when the jig arm is swung inwardly and against the connector (as illustrated by the jig arm 128' in FIG. 3).

The individual wires are transferred from the holding jigs to the conductor-receiving positions of the terminals by individual insertion pins 142 which are mounted in a recess 144 in a tooling plate 146. The tooling plate in turn is secured by fasteners 148 to a lever arm 150 which, like the jig holding arm 128, has an inner end 152 pivoted to the pivot pin 130. The thickness of the plate 146 is slightly less than the width of the opening 45 so that after the jig holding arm 128 has been moved to its closed position, the lever 150 can be swung in upwardly so that the tool holder plate 146 will move through opening 132 and the individual pins 142 will push the conductors from the wire jig into the slots in the conductor receiving portions of the terminals. During such movement of the tooling plate 146, the edge 154 of this plate functions as a movable shearing edge in cooperation with the fixed shearing edge 127 of the plates 122 and the portions of the conductors which extend beyond these edges are trimmed at the time of wire insertion.

In operation, and after the wires have been latched through the wire holding jigs 38, 38', the individual jigs are positioned on the jig arms 128, 128' as indicated in FIG. 6. The insertion operation is then carried out by simply swinging both of the jig arms to their closed positions (illustrated by the jig arms 128' in FIG. 3) and then swinging the levers 150, 150' arcuately upwardly to their closed positions. All of the wires in both of the jigs are then trimmed and inserted into the terminals of the connector. FIG. 8 shows the positions of the tool holder plates 146, 146' after they have entered the openings 132, 132' in the jig holder arms and immediately prior to engagement of the insertion pins 142, 142' with the wires.

A salient advantage of the invention is that a substantial increase in the productivity of the insertion apparatus of FIG. 3 is achieved for the reason that the most time-consuming portion of the entire process of connecting the wires to the terminals is that of selecting the wires from the cable and positioning these wires in the wire holding jigs. The process of locating the jigs on the jig arms 128 and closing the jig arms and the levers 150 is carried out in an extremely brief period as compared to the time required for the wire positioning operation. In a cable manufacturing plant then, several technicians can be employed in the cable lacing or positioning operation and each technician will require only a wiring fixture and wiring jigs as shown in FIG. 4. Only one relatively expensive insertion tool is required for these several wire lacing technicians and this tool can be operated almost continuously.

A further significant advantage of the invention is that the jigs having wires laced therethrough can be inspected prior to their being placed on the insertion apparatus so that if any mistakes were made in the lacing operation, they can be corrected before the jigs are placed on the insertion apparatus. The inspection of the laced jigs can be carried out by an inspector or by an inspecting apparatus capable of electrically determining that the corresponding positions of the two jigs 38, 38' have been laced with wires of an associated wire pair in the cable.

FIG. 9 shows a modified form of lacing fixture in accordance with the invention in which several jig mounting blocks 72, 72a, 72b are mounted on the base 66, each block being slightly lower, relative to the base 66, than the immediately preceding block. In accordance with this embodiment, cables of the type shown in FIG. 10 can be produced which have a plurality of connectors 10, 10a, and 10b thereon. To produce this type of a cable, each wire is laced through three wiring jigs indicated as 38, 38a, 38b or 38', 38a', 38b'. After this lacing operation has been completed, the jigs 38, 38' are placed in a conventional insertion apparatus as shown in FIG. 3 and the connector 10 is installed on the ends of the wires. The wiring jigs 38a, 38a' are then mounted on a modified type of insertion apparatus which does not have means for shearing the wires at the time of insertion so that the connector 10a is installed on the wires intermediate the wire ends. The wiring jigs 38b, 38b' are then mounted on a conventional insertion apparatus as described and the connector 10b is installed on the ends of the wires. Reference is made to application Ser. No. 312,394 for further details of apparatus or assembly tools which do not have shearing means for shearing the wires.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only.

What is claimed is:

1. A conductor positioning jig for use with an apparatus having means for simultaneously connecting each of a plurality of electrical conductors to each of a plurality of terminal positions in an electrical connecting device, said jig comprising: a frame member having substantially parallel sides and substantially parallel ends, said frame having a central opening defined by said sides and said ends, said frame having oppositely directed faces, conductor positioning means on one of said faces, said conductor positioning means comprising surface portions of said sides for receiving a plurality of conductors and locating and holding said conductors in side-by-side parallel relationship in bridging relationship to said opening, and
locating means on the other one of said faces for locating said jig on said apparatus.

2. A conductor-positioning jig intended for use with a conductor positioning fixture and a conductor insertion apparatus, said jig comprising:
   a rectangular frame having parallel sides and parallel ends and having oppositely directed faces, said frame having a central opening defined by said sides and ends,
   conductor positioning means on one of said faces, said conductor positioning means comprising a plurality of spaced apart slots on each of said sides, said slots extending transversely of said sides and said opening, said slots being in alignment with each other on said sides, and
   locating means on the other one of said faces for locating said jig on said fixture and on said insertion apparatus whereby, upon positioning said jig on said fixture, each of a plurality of conductors can be positioned in said slots with the axes of said conductors extending transversely of, and across, said opening, and upon positioning said jig on said apparatus, said conductors can be inserted into the conductor receiving slots of electrical terminals in a connecting device mounted on said apparatus upon movement of insertion means through said opening, against said conductors and towards said terminals.

3. A jig as set forth in claim 2, one of said sides having a first plurality spaced apart integral barriers on one of said faces, said slots extending from one of said sides, said barriers defining said slots.

4. A jig as set forth in claim 3, the other one of said sides on said one face having a plurality of spaced-apart barriers extending laterally of said frame from said other side, said second plurality of barriers defining said slots in said other side.

5. A jig as set forth in claim 4, said locating means comprising locating flanges extending from said sides.

6. Fixture and jig means for use in selectively connecting each of a plurality of electrical conductors to each of a plurality of side-by-side terminals in a connecting device such as a multi-contact electrical connector, said jig means comprising:
   a generally rectangular frame member comprising sides and ends, said frame member having a central opening therein,
   a plurality of aligned wire positioning means on each of said sides, said positioning means extending transversely with respect to said sides and said opening,
   said fixture means comprising:
      fixture frame means,
      conductor clamping means for clamping said conductors on said fixture frame means, and
   a jig means support on said fixture frame means proximate to said clamping means, said jig means being removably mounted on said jig means support whereby,
   upon clamping said conductors in said clamping means and positioning said conductors in predetermined positioning means in said jig means, said jig means and said conductors thereafter can be removed from said fixture means and said jig means can be positioned on a conductor transferring and inserting apparatus for transferring said conductors from said jig means and attaching said conductors to said terminals of said connecting device.

7. Fixture and jig means as set forth in claim 6 and a second jig means, said second jig means being substantially similar to said jig means said second jig means being removably mounted on said jig means support beside said jig means.

8. Fixture and jig means and second jig means as set forth in claim 7, said jig means and said second jig means being adjacent to each other in end-to-end relationship on said jig means support, said clamping means being between said jig means and said second jig means.

9. Fixture and jig means as set forth in claim 6, said wire positioning means comprising slots on said sides.

10. A fixture and at least one pair of conductor positioning jigs, for locating each of a plurality of conductors in predetermined positions relative to each other preparatory to insertions of said conductors into contact terminals in an electrical connecting device, said jigs being removably mounted on said fixture, each of said jigs comprising:
    a rectangular frame having parallel sides and parallel ends, said frame having oppositely directed faces and having a central opening defined by said sides, and said ends,
    conductor positioning means on one of said faces, said conductor positioning means comprising a plurality of spaced-apart slots on each of said sides, said slots extending transversely of said sides and said opening, corresponding slots on said sides being in alignment with each other, and
    locating means on the other one of said faces for locating said jig on said fixture, said fixture comprising:
      a jig support, said support having spaced apart supporting surface portions for supporting said jigs in spaced apart end-to-end relationship to each other, and
      conductor clamping means on said fixture, said conductor clamping means being proximate to, and between said jigs whereby, upon clamping said conductors in said clamping means and positioning said conductors in said conductor receiving means of said jigs, said jigs can be removed from said fixture and positioned on a conductor insertion apparatus for transferring said conductors from said jigs to contact terminals in a connecting device mounted on said insertion apparatus.

11. A fixture and a plurality of jigs for the conductors of a multi-conductor cable, each of said jigs comprising:
    a generally rectangular frame member comprising parallel sides and parallel ends, said frame member having a central opening therein,
    a plurality of aligned slots in each of said sides, said slots extending transversely with respect to said sides and said opening, said fixture comprising:
      a plurality of jig supports, each of said supports having at least one of said jigs removably mounted thereon, said supports being spaced-apart and parallel to each other on a mounting base, said jigs being in alignment with each other on said supports,
      cable claiming means on said mounting means proximate to one end thereof, said cable mounting
means being disposed proximate to an end one of
said supports whereby, upon clamping a cable in
said mounting means and positioning the individual
conductors in said cable in corresponding aligned
slots in each of said jigs, and upon removal of said
jigs from said fixture and placement of said jigs in
an assembly apparatus for connecting said conduc-
tors to terminal positions in an electrical device,
said conductors are each connected to correspond-
ing terminal positions in each of said electrical de-
vices.

12. Apparatus for connecting each of a plurality of
conductors to each of a plurality of electrical contact
terminals contained in a multi-contact electrical con-
nektör or the like, each of said electrical contact termi-
nals comprising a plate-like portion having a conduc-
tor-receiving slot extending into one side thereof, said
plate-like portions of said terminals being arranged in
side-by-side co-planar relationship, said apparatus
comprising:

connector holding means for holding said electrical
connector in a predetermined position,

conductor jig means having means for releasably
holding said conductors in parallel spaced-apart
relationship with said conductors located relative
to each other in positions corresponding to the
spacing between said conductor receiving slots in

said plate-like portions of said contact terminals,
said conductors being movable laterally of their axes from one side of said conductor jig means.

an inserting means, said inserting means being nor-
mally disposed remote from said connector holding
means and being movable along a predetermined
path towards and away from a connector held in
said connector holding means, said inserting means
having means for moving individual conductors lat-
erally of their axes and into each of said conductor
receiving slots, and conductor jig mounting means
for removably mounting said conductor jig means
on said path adjacent to said connector holding
means with said one side of said conductor jig
means proximate to, and spaced from, said plate-
like portions whereby, upon loading said conduc-
tors in said conductor jig means, mounting said
connector in said connector holding means,
mounting said conductor jig means in said conduc-
tor jig mounting means, and upon movement of
said inserting means along said path and towards
said connector, said conductors are moved from
said conductor jig means laterally of their axes and
into said slots in said plate-like portions of said ter-
minals.

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