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Manufacturing a wiring harness

The present invention has application to applying electrical terminals to a plurality of wire leads, assembling the terminated leads into cavities in a connector housing, and cutting and stripping the wires so the operations may be repeated. More particularly, the terminals are applied to the leads at a first center-to-center spacing and inserted into cavities in a connector at a second center-to-center spacing in a housing.

Lead making machines are well known. Generally wires are fed one at a time either manually or automatically to a crimping station where electrical terminals are applied. See, e.g., US-A-3,804,603 and US-A-3,686,752. More recently, multi-function machines have been developed which terminate pre-cut and stripped leads and insert the terminated ends one at a time into cavities in a connector housing whose position is indexed to receive the leads. See, e.g., US-A-4,074,424. The next step was a machine which cut and stripped the wire before terminating and inserting. See, e.g., US-A-4,087,908. In this patent the wires are still terminated one at a time and inserted into a connector housing one at a time.

US-A-4,043,017 represents a major advancement in the art insofar as it discloses an apparatus which terminates a plurality of wires en masse to insulation displacing terminals located in a connector housing. A shuttle is utilized which transports the pre-cut leading ends to a template where the spacing is modified by rolling into thru-slots in the template; punches then descend into the slots to push the leads into the terminals in the connector housing below. Other pertinent prior art includes US-A-3,871,072, which discloses wire spreading by use of a template and substantial variation of lead length by forming bights in the wires. Leading ends of the wires are then sheared to insure proper length differentiation prior to a termination operation.

None of the prior art cited discloses apparatus which can cut and strip a plurality of wires en masse, terminate them en masse, and insert the terminated ends into a connector housing en masse.

According to one aspect of the invention, apparatus for mass terminating the leading ends of a plurality of wires to a like plurality of terminals comprises: an operating zone having a terminating station therein; a wire delivery shuttle which is reciprocable along a first path from said operating zone to a point remote therefrom, said shuttle having a leading end closest to said operating zone, said shuttle having a like plurality of elongated wire guide tubes in a planar parallel array, said tubes having a first fixed spacing, each guide tube comprising two telescoping parts, the innermost part extending to the leading end of the shuttle, each guide tube closely accommodating a single

wire, said shuttle having releaseable wire gripping means effective to hold the wires stationary with respect to the outermost of the telescoping parts, whereby, said shuttle may reciprocate along said path toward and away from said operating zone and deliver said leading ends of said wires to said operating zone in a planar array at said first fixed spacing, said leading ends being extruded from the guide tubes into the operating zone for termination by stopping the leading end of the shuttle at the operating zone and collapsing the telescoping parts by continued movement of the shuttle while the wire gripping means holds the wires stationary with respect to the outermost of the telescoping parts.

According to another aspect of the invention, a method of terminating the leading ends of a plurality of wires to a like plurality of terminals having a second fixed spacing in a linear array and inserting the terminals on the leading ends into a like plurality of cavities having a first fixed spacing in a linear array in a connector housing comprises the steps of:

gripping said wires in a planar parallel array at said first fixed spacing at portions thereof remote from said leading ends and delivering said ends to a terminating station, said wires being gripped so that the ends are in a rectilinear array when the wires are parallel between said gripped portions and said ends,

deflecting said wires transversely of the planar array at a point between said terminating station and said gripped portions, the innermost wires being deflected more than the outermost wires, said ends thereby being rearranged into an arcuate array when the wires are parallel between said gripped portions and said ends,

spreading said ends to a second fixed spacing in a planar guide template having grooves therein, said grooves having first portions at said first fixed spacing remote from said terminating station and second portions at said second fixed spacing adjacent to said terminating station, said second spacing being sufficient to align ends to a rectilinear array when the wires are spread into the grooves, said wires being spread into the grooves by a wiper assembly which wipes the wires into the grooves from the first portions towards the second portions,

positioning a like plurality of terminals at said second fixed spacing at said terminating station adjacent said leading ends and terminating said ends to said terminals,

restoring said leading ends to said first fixed spacing and inserting said terminals on said leading ends into cavities in a connector housing at an insertion station, said terminals on the leading ends being inserted by relative axial movement between the terminals and the housing.

According to a further aspect of the invention, a method of terminating the leading ends of a plurality of wires to a like plurality of terminals having second fixed spacing in a rectilinear array and inserting the terminals on the leading ends into a like plurality of cavities having a first fixed spacing in a rectilinear array in a connector housing comprises the steps of:

gripping said wires on portions thereof remote from said leading ends and advancing said wires axially in a planar parallel array having a first fixed spacing with the leading ends in a rectilinear array along a path to a terminating station,

deflecting said wires transversely of the planar array at point between said terminating station and said gripped portions, the innermost leads in said array being deflected more than the outermost leads, said leading ends thereby being rearranged into an arcuate array with the ends of the innermost leads at the concavity of the arcuate array,

spreading said leading ends to a second fixed spacing, said ends being spread enough to restore them from said arcuate array to a rectilinear array,

positioning a like plurality of terminals at said second fixed spacing at said terminating station adjacent said leading ends and terminating said leading ends to said terminals,

retracting said wires from said terminating station along said path and reversing said deflection and reversing said spreading to that said terminals on said leading ends are restored to said first fixed spacing in a rectilinear array at a point remote from the terminating station,

positioning said connector housing on said path between said remote point and said terminating station,

advancing said wires until said terminals on said leading ends are inserted in said cavities.

These features will be apparent to those skilled in the art after a consideration of the following detailed description taken by way of example in conjunction with the accompanying drawings.

Figure 1 is a perspective of the harness making apparatus.

Figure 2A—J are perspectives of the wire, terminals, and connector block showing the operations performed by the apparatus.

Figure 3A is a plan view of the apparatus at rest.

Figure 3B is a plan view of the apparatus during termination.

Figure 3C is a plan view of the apparatus during cutting and stripping.

Figure 4 is a front view of the termination station and terminating linkage prior to terminal feed or wire feed.

Figure 5 is a side view of the terminating station and linkage corresponding to Figure 4.

FIGURE 6 is a plan view of the termination station as the shuttle and wire manifold approach.

FIGURE 6A is a side cross section taken along line 6A—6A of Figure 4 showing the terminating station with the shuttle forward, immediately prior to wire feed.

FIGURE 6B is similar to Figure 6A and shows the wires immediately after feed.

FIGURE 6C is similar to 6B, after terminals are fed, wire is compensated, and template is moved up to trap wires.

FIGURE 6D shows wires after wiping the template.

FIGURE 6E shows crimping and shearing of terminal from carrier strip.

FIGURE 6F shows the retraction of tooling for termination.

FIGURE 6G shows withdrawal of terminated leads into header on wire carriage.

FIGURE 7A is an enlarged fragmentary cross section of action in Figure 6E showing gripping of wire immediately prior to termination.

FIGURE 7B is similar to 7A, immediately following termination and shearing of the carrier strip.

FIGURE 7C is an enlarged fragmentary perspective of the wire gripping tooling and carrier strip shear.

FIGURE 8 is an enlarged fragmentary perspective of a part in the header showing terminal orientation features.

FIGURE 9A is a front view of the terminating station showing the compensator tooling package in the down position.

FIGURE 9B is a cross section of the compensator tooling taken behind the view of Figure 9A along line 9B—9B of Figure 6C, showing the cam and lever with the compensator tooling raised.

FIGURE 10A is a front view of the terminal feed apparatus as the terminals are advanced.

FIGURE 10B is a side cross section taken along line 10B—10B of Figure 10A.

FIGURE 11 is a front view of the housing feed as it moves into the path of the wire shuttle with a housing clamped in place.

FIGURE 12A is a side view of the shearing station as the shuttle returns from inserting wires into the connector housing.

FIGURE 12B is a side view of the shearing station as the wire is clamped and the strip and shear blades meet the wire.

FIGURE 12C is a side view of the shearing station as the shuttle and clamp withdraw the severed wire from the blades.

FIGURE 13 is a timing diagram.

Referring to Figure 1, the harness making apparatus 10 and control box 13 therefor are mounted to a base. A shuttle 14 is fixed to a shuttle carriage 15 which is journaled to a straight cylindrical rail 16 on which the carriage travels, whereby the shuttle 14 travels on a first path paralleling the rail 16 and delivers wires 12 through compensator 80. A continuous strip of electrical terminals 22 is delivered from a reel 24 to a termination station behind the compensator 80 where terminals are fixed to the

leading ends of wires 12. A drive shaft 26 carrying a fly-wheel 27 is mounted to a frame 25 which is fixed to base 11. The drive shaft 26 causes terminating ram 28 to reciprocate vertically over the terminating station, which fixes terminals to the wires 12 by the action of an applicator 30, the height of which is adjusted by adjuster 29. Subsequent to termination, the shuttle 14 moves backward on the linear path from the compensator 80 and housing carriage 32 journaled to rail 36 carries a dielectric connector housing on a second path into the first path where it defines an insertion station. The connector housing is not shown in Figure 1, but would be fixed to the carriage 32 by clamp 34 and is thus carried to the insertion station. The shuttle 14 then moves forward to insert the terminated wires into the housing, the shuttle carriage 15 being stopped by a stop 36 fixed to the housing carriage 32. The shuttle 14 then moves backward through strip and shear station 40 trailing the wires behind, and the wires are sheared as both the trailing ends and new leading ends are stripped of insulation.

Referring now to Figures 2A through 2J, a more detailed description of the operative steps performed on the wires 12 will be given. Figure 2A shows the wires 12 traveling on the first path prior to arrival at the terminating station 20 and also shows the terminal strip 22 which is comprised of terminals 42 fixed to a carrier strip 44. Figure 2B shows the leading ends 46 of wire 12 as they arrive at the terminating station over a section of carrier strip 44 from which terminals were previously sheared.

Note that the center-to-center spacing of the wires 12 is smaller than the center-to-center spacing of the terminals 42. Figure 2C shows the movement of the terminal strip to the terminating station so that a section of the strip having terminals thereon lies beneath the leading ends of the wires. The wires are simultaneously deflected various amounts transversely of their axes so that the leading ends 46 lie in a concave arcuate array as shown. This will hereinafter be referred to as compensation. Figure 2D shows the spreading of the wires in the plane of their delivery so the leading ends are again in a straight array and lying directly over the terminals 42 ready for termination. The leading ends 46 are then moved down and crimped to the terminals as shown in Figure 2E, and the carrier strip is simultaneously sheared from the terminals. The spreading and compensation are then reversed and the terminated wires are withdrawn restoring the wires to their original center-to-center spacing as shown in Figure 2F. A connector housing 48 is also shown prior to arrival at an insertion station on the first path via a second path normal to the first path. Figure 2G shows the housing 48 in position at the insertion station. Note that the terminal receiving cavities 49 in the housing 48 have the same center-to-center spacing as the terminated wires, which permits insertion by

moving the terminated leads forward again on the first path as Figure 2H. The wires thus inserted in the housing are then held stationary thereby, and are cut and scored at a point remote therefrom, as shown in Figure 2I. The wires are then pulled from the surrounding insulation bits at the score lines to leave stripped ends as shown in Figure 2J.

The Shuttle

The shuttle 14 will now be described in conjunction with Figures 3A, 3B, and 3C. Shuttle 14 is a telescoping device comprising of inner or forward wire guide tubes 56 which slide into respective outer or rear wire guide tubes 57. The inner wire guide tubes 56 lie in a planar parallel array and are flanked on either side by an inner spring tube 64 while the outer wire guide tubes are flanked on either side by an outer spring tube 65. The spring tubes 64, 65 are likewise flanked by inner and outer frame tubes 66, 67. All inner tubes 56, 64, 66 are connected to a header 60 at the leading end of the shuttle 14 while the outer tubes 57, 65 are mounted at their forward ends in a cross member 70 which is fixed between outer tubes 67. The inner tubes are slideably mounted in the header 60 for reception in the outer tubes. Note that variations of the outer or rear wire guide tubes 57 are possible. While discrete tubes are shown, it is also possible to machine channels into blocks which could be placed together to form adjacent tubes for receiving the inner or forward tubes 56. The inner spring tubes 64 are surrounded by springs (shown in Figure 6) which bear against the header 60 and cross member 70. The header has ports 62 (not visible) in the forward face thereof which are aligned with the wire guide tubes 56, 57. The rear end of the shuttle has a clamp 54 mounted therein which is controlled by a clamp handle 55 which cams the clamp down onto wires in the shuttle. One of the inner frame tubes 66 extends through its outer frame tube 67 and has a stop collar 72 mounted thereon and a pin 73 mounted vertically therethrough at its end. A lever 74 is pivotably mounted to the shuttle 14 so that it clears the collar 72 mounted to the frame tube 66 but can bear against pin 73. A stop screw 76 fixedly mounted with respect to a rail 201 is positioned to bear against the opposite end of lever 74. The rail 201 is movable with respect to rail 16, and is arranged to bear against the shuttle carriage 15 to shift the entire shuttle 14 backwards during the wire stripping operation, as will be described later.

The operation of the shuttle 14 will now be described. Figure 3A depicts the shuttle in its fully retracted position with leading ends of wires 12 protruding from the header 60. The wires are clamped so their position is stationary in the outer guide tubes 57. As the carriage 15 advances from the position of Figure 3A, the lever 74 pivots from its position against stop screw 76 and the springs surrounding inner

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spring tubes 64 urge the header 60 away from the cross member 70 until the stop collar 72 surrounding the inner frame tube 66 bears against the rear end of the outer frame tube 67. The header 60 thus moves forward relative to the cross member 70 until the leading ends of the wires are inside the header. The shuttle 14 advances until it reaches compensator 80. The header is aligned thereagainst by notch 61 in the header 60 which mates with a profiled post 81 on the face of the compensator. Continued forward movement of the shuttle causes the wires 12 to be extruded from the header 60 as the inner guide tubes 56 telescope into the outer guide tubes 57.

Figure 3B depicts the shuttle fully advanced with the wires fully extruded from the header through the compensator 80 and positioned over the template 82. Note that lever 74 has rotated to a neutral position clear of the stop collar 72. The terminating and inserting operations which then follow will be described under "Operating Zone".

Figure 3C depicts the shuttle after the wires 12 are inserted into a connector housing held by clamp 34 and the shuttle has retracted until it clears the strip and shear station 40 through which it passes. The clamp handle 55 is in the open position as the clamp 54 has been released to the wires may be held fixed by the connector housing as the shuttle retracts and the wires pass through the wire guide tubes 56, 57. The wires are then clamped again by clamp 54 so insulation stripping may be performed, as will be described under "Strip and Shear".

Operating Zone

The operating zone contains the tooling which performs the operations of compensation, wire spreading, and termination. All of these operations are effected by tooling which is linked to the drive shaft 26. Figure 4 is a front view of the apparatus which shows the operating zone, ram 28, applicator 30, compensator 80, terminal feed linkage, and part of the linkage for wire spreading and compensation. Barrel cam 90 has a slot in one flat surface thereof which controls the motion of terminal feed follower 94 and a slot in the opposed flat surface which controls the motion of the wire spreading follower 95. Barrel cam 91 has a slot therein which controls the motion of wire compensating follower 96. The followers 94, 95, 96 are connected to respective connecting rods 98, 99, 100 which reciprocate as the drive shaft 26 rotates. The terminal feed connecting rod 98 causes bell crank 102 to oscillate about pivot 104 and act on link 106 which causes arm 108 to reciprocally drive the terminal feed carriage 114. Arm 108 pendulums about pivot 110 and imparts a linear motion to carriage 114 by means of a slot 112 in the arm 108 which acts on a follower 113 fixed to the carriage 114. The carriage 114 feeds the terminal strip (not visible) to the terminating station. Also visible in

Figure 4 are a drag mechanism 124 and anti-back-up mechanism 120, which will be described in greater detail in conjunction with Figures 10A and 10B.

Figure 5 is a side view detailing the linkages for wire spreading and compensating. Wire spreading connecting rod 99 imparts a linear motion to wiper carriage 138 by means of cranks 130 and 134 mounted on oscillatory jackshaft 132 which reciprocally drive link 136 which is connected to carriage 138. Wire compensating connecting rod 100 acts on link 148 through cranks 142 and 146 mounted on oscillatory jackshaft 144; link 148 acts on link 152 through bell crank 150 which pivots about pivot 151. Link 152 actuates compensator 80 as will be described in detail in conjunction with Figures 6A through 6G.

Figure 6 depicts the leading end of shuttle 14 as it approaches the operating zone and the wall 160 in front of the compensator 60. The wall has an entry 161 therein which accepts the header 60 and latches 192 which cooperate with ramps 190 to hold the header in place when notch 61 mates with post 81. The latches have wheels 194 to minimize latching resistance and springs 193 to urge the latches over the ends of ramps 190.

The compensator 80 rides vertically between upper front plate 168 and upper rear plate 170 in which guide wheels 162 are mounted. The cutaway section of the compensator top member 173 and lifter 174 thereon in Figure 6 shows the spacers 166 and blades 164 which align with serrate openings in the lower edges of upper plates 168, 170.

The guide template 82 lies adjacent the compensator 80 and has grooves 83 therein with first portions aligned with the compensator blades 164 and the serrate openings in plates 168, 170. The grooves 83 diverge to second portions thereof which align with profiled notches 185 in shear 184. The notches 185 in turn are aligned with anvils 188 on which the leading ends of wires are terminated.

Figures 6A through 6G show the operations of compensation, wire spreading, and termination, which will now be described in detail. Referring first to Figures 6A, link 152 oscillates under the action of bell crank 150 as previously described and is pivotally attached to crank 154 which is fixedly attached to shaft 155. The shaft 155 carries a cam 156 and a follower 158. The cam 156 bears on follower 86 which is borne by template mounting block 88 which carries template 82 and pivots about pivot 85. This cross section of the template is taken through a groove 83 and shows the raised edge 84 adjacent to upper rear compensator plate 170. Follower 158 rides in cam slot 172 in lower rear compensator plate 171. Compensator blades 164 are borne between lower front and lower rear compensator plates 169 and 171. The spacers 166 are also borne between the lower plates 169 and 171 and fit

into grooves in top member 173. These features also appear in Figures 9A and 9B.

Figure 6B corresponds to Figure 2B and is similar to Figure 6A but shows the wires as they are extruded from the header 60 and into the operating zone under the forward movement of the shuttle previously described. Wires are trapped between the template 82 and lid 87 but are not aligned in the grooves 83.

Figure 6C corresponds to Figure 2C. Here downward movement of the link 152 effects upward movement of the template 82 and compensator blades 164 by the action of cam 156 and follower 158. Note that plates 169, 171 move with the compensator blades 164, which pass upward through plates 168, 170 which are stationary. The compensator blade shown in section here is the longest and thus imparts the greatest deflection to the wire, which is trapped in the serrate openings in the lower edges of upper plates 168, 170. The wire is further trapped in the grooves 83 between the raised edge 84 of the template 82 and wiper 139 which is carried by wiper carriage 138. The lid 87 is pivoted upward by the action of the compensator lifter 174. The terminal feed linkage previously described simultaneously advances the terminal strip 22 so that individual terminals 42 lie on the anvils 188 and the carrier strip 44 lies in shear slot 186. A resiliently mounted terminal clamp 180 holds the terminal strip 22 in position as it is advanced the carriage 114.

Figure 6D corresponds to Figure 2D and shows the action of the wiper 139 as it wipes the wires into grooves 83 in template 82 and into profiled notches 185 in the top of the shear 184 so that the leading ends of the wires are positioned over the terminals 42. Applicator 30, shown poised over the terminating station, is comprised of an insulation crimper 181, wire crimper 182, and gripping member 183. Crimpers which act on individual terminals are separated by fingers which appear to best advantage in Figure 4.

Figure 6E corresponds to Figure 2E and shows the termination of the wire to the terminal as the applicator 30 descends and the crimpers 181, 182 crimp the insulation and wire barrels respectively. The gripping member 183 grips the wires firmly in the profiled notches in the top of the shear 184 while it bears down on the resiliently mounted shear, pressing the carrier strip 44 against the top of the shear slot 186 and severing the connection between the terminals 42 and the strip 44. The fingers separating the crimpers travel between the anvils.

Referring to Figure 6F, the link 152 (Figure 6A) has travelled upward again and effected the return of the template and compensator to the position of Figure 6A. The applicator 30 has returned upward by the continued rotation of the drive shaft, and the terminated ends of the wires spring upward with the shear 184 against

the resiliency of the terminal clamp 180. The wiper 139 has returned, and the lid 187 has fallen as the compensator 80 descended.

Figure 6G depicts the withdrawal of the terminated wire from the operating zone into the header 60 under the action of the retreating shuttle.

Figure 7A details the terminating station immediately prior to termination. The gripping member 183 has just met the wire 12 in the profiled notch 185 in the top of the shear 184 and holds it firmly therein preventing rotation of the wire during termination. Figure 7B shows the terminating operation as the crimpers 181, 182 crimp the insulation and wire barrels and the shear is depressed severing the terminal from the carrier strip as the shear slot 186 passes below the top of the anvil 188. Figure 7C details the notch in the top of the shear 184.

Figure 8 details a terminal as applied to the leading end of a wire, and further details the profile of port 62 in header 60. The header is comprised of two pieces machined as shown. The port has 45 degree bevels so that a tab 43 on the bottom of the terminal will cause it to be aligned in the header as the shuttle retreats and the telescoping tubes expand to draw the terminated leads in the header.

Figure 9A is a front view of the compensator 80 and corresponds to Figure 6A. Link 152 is in the raised position so that cam 156 has not yet pivoted up to raise the compensator. The upper front compensator plate 168 and ramp plate 179 are cut away exposing the top member 173 in which the spacers 166 are mounted.

Figure 9B is a cross section taken along line 9B-9B of Figure 6C and shows the compensator linkage when the compensator is up with the wires in the operating zone. Follower 158 has lifted the compensator by its motion through cam slot 172 in the rear plate 171 and cam 156 has acted on follower 177 to lift template 82 trapping the wires in grooves 178.

Figure 10A is a front view of the terminal feed apparatus as the terminals are advanced. The linkage which advances carriage 144 was discussed in conjunction with Figure 4. Note the holes 103 in bell crank 102 and the threaded rod in link 106 which permit adjustment of the linkage so that the terminals will be precisely placed on the anvils prior to descent of the applicator. The terminal strip 22 is advanced by feed pawl 118 at the leading edge of carriage 114. The pawl 118 bears on an individual terminal during advance and springs away from the strip during retreat. The strip is prevented from backing up during the retreat of the carriage by anti-back-up mechanism 120, which comprises anti-back-up pawl 121 and a release 122 which permits withdrawal of the terminal strip 22 from the apparatus. A drag mechanism 124, also on the terminal feed path, assures that the terminal strip 22 will not advance beyond the travel of feed pawl 118. Figure 10B is a cross section of Figure 10A and

shows the cylindrical rail 115 which determines the travel of the carriage 114, which is journaled to the rail by bearing 116.

The sequence of the above described steps which occur in the operating zone is described graphically in the timing diagram, Figure 13.

Insertion Station

As discussed in conjunction with Figure 1, an insertion station is defined by the area on the first path where the connector housing is carried on a second path for insertion of terminated leads. Figure 11 details the housing carriage 32. The connector housing 48 is fixed to the carriage 14 by clamp 34 whereby it is held securely at the insertion station. The carriage travels on rail 36 which is fixed to wall 160, which also appears in Figures 3A, 3B, and 3C. Once the housing 48 is in place at the insertion station, the shuttle again moves forward until the header abuts the housing and telescoping tubes collapse until the termination leads are extruded fully into cavities 49. Here the proper radial alignment of the terminals as described in conjunction with Figure 8 is important, as the terminals 42 will not mate with the cavities 49 unless so aligned.

Strip and Shear

The strip and shear station is defined by the area on the first path which lies between upper and lower scoring blades 206, 207 and the upper and lower shear blades 208, 209 is shown in Figure 12A.

After the terminated leads are inserted in the housing as previously described, clamp 54 (Figure 3B) on the shuttle is released and the shuttle is retracted over the wires until the header 60 clears the strip and shear station. A grooved lever 200 is tripped as the shuttle passes, whereby the center-to-center spacing of the wires is maintained at the strip and shear station. The clamp 54 is reapplied when the header is in the position of Figure 12A.

Once the wires are securely positioned between the lever 200 and the header 60, a clamp 202 with jaws in its surface rises to meet the wires while an opposed tamper 204 descends to tamp the wires into the jaws. The scoring blades 206, 207 comes together to cut only the insulation on either side of the shear blades 208, 209, which come together to completely shear the wires. An actuator 198 then descends to pivot lever 200 out of the first path to the position of Figure 12B.

A movable rail 201 is then shifted as shown in Figure 12C. The rail bears on shuttle carriage 15 to pull the leading ends 46 of a new set of wires from the strip and shear station. Jawed clamp 202 is pivoted as shown to pull the trailing ends 50 of the terminated wires from the strip and shear station.

The foregoing description is directed to but one embodiment of the invention and modifications may be made thereto without

departing from the scope of the invention. For example, different templates could be used for different wire spacing, or other profiles could be used for the ports in the header for radial orientation of other types of terminals. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective against the prior art.

Claims

1. Apparatus (10) for mass terminating the leading ends (46) of a plurality of wires (12) to a like plurality of terminals (42) comprises:

an operating zone having a terminating station therein;

a wire delivery shuttle (14) which is reciprocable along a first path from said operating zone to a point remote therefrom, said shuttle (14) having a leading end (60) closest to said operating zone,

said shuttle (14) having a like plurality of elongated wire guide tubes in a planar parallel array, said guide tubes having a first fixed spacing, each guide tube comprising two telescoping parts (56, 57), the innermost part (56) extending to the leading end (60) of the shuttle, each guide tube closely accommodating a single wire, said shuttle (14) having releaseable wire-gripping means (54) effective to hold the wires (12) stationary with respect to the outermost (57) of the telescoping parts, whereby, said shuttle (14) may reciprocate along said path toward and away from said operating zone and deliver said leading ends (46) of said wires (12) to said operating zone in a planar array at said first fixed spacing, said leading ends (46) being extruded from the guide tubes (56) into the operating zone for termination by stopping the leading end (60) of the shuttle (14) at the operating zone and collapsing the telescoping parts (56, 57) by continued movement of the shuttle (14) while the wire gripping means (54) holds the wires (12) stationary with respect to the outermost (57) of the telescoping parts.

2. The apparatus (10) of claim 1 wherein said operating zone has wire spreading means therein aligned with said path and adjacent to said terminating station, whereby, said shuttle (14) may deliver said wires (12) to said terminating station at a second fixed spacing.

3. The apparatus (10) of claim 2 wherein said wire spreading means comprises a planar guide template (82) having a plurality of grooves (83) therein, said grooves (83) having first portions spaced at said first fixed spacing remote from said terminating station and second portions spaced at said second fixed spacing adjacent to said terminating station, said spreading means further comprising a wiper assembly (139) which wipes the wires (12) into the grooves (83) from the first portions toward the second portions.

4. The apparatus (10) of claim 3 wherein said operating zone has wire deflecting means



shows the cylindrical rail 115 which determines the travel of the carriage 114, which is journaled to the rail by bearing 116.

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Once the wires are securely positioned between the lever 200 and the header 60, a clamp 202 with jaws in its surface rises to meet the wires while an opposed tamper 204 descends to tamp the wires into the jaws. The scoring blades 206, 207 comes together to cut only the insulation on either side of the shear blades 208, 209, which come together to completely shear the wires. An actuator 198 then descends to pivot lever 200 out of the first path to the position of Figure 12B.

A movable rail 201 is then shifted as shown in Figure 12C. The rail bears on shuttle carriage 15 to pull the leading ends 46 of a new set of wires from the strip and shear station. Jawed clamp 202 is pivoted as shown to pull the trailing ends 50 of the terminated wires from the strip and shear station.

The foregoing description is directed to but one embodiment of the invention and modifications may be made thereto without

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an operating zone having a terminating station therein;

a wire delivery shuttle (14) which is reciprocable along a first path from said operating zone to a point remote therefrom, said shuttle (14) having a leading end (60) closest to said operating zone,

said shuttle (14) having a like plurality of elongated wire guide tubes in a planar parallel array, said guide tubes having a first fixed spacing, each guide tube comprising two telescoping parts (56, 57), the innermost part (56) extending to the leading end (60) of the shuttle, each guide tube closely accommodating a single wire, said shuttle (14) having releaseable wire gripping means (54) effective to hold the wires (12) stationary with respect to the outermost (57) of the telescoping parts, whereby, said shuttle (14) may reciprocate along said path toward and away from said operating zone and deliver said leading ends (46) of said wires (12) to said operating zone in a planar array at said first fixed spacing, said leading ends (46) being extruded from the guide tubes (56) into the operating zone for termination by stopping the leading end (60) of the shuttle (14) at the operating zone and collapsing the telescoping parts (56, 57) by continued movement of the shuttle (14) while the wire gripping means (54) holds the wires (12) stationary with respect to the outermost (57) of the telescoping parts.

2. The apparatus (10) of claim 1 wherein said operating zone has wire spreading means therein aligned with said path and adjacent to said terminating station, whereby, said shuttle (14) may deliver said wires (12) to said terminating station at a second fixed spacing.

3. The apparatus (10) of claim 2 wherein said wire spreading means comprises a planar guide template (82) having a plurality of grooves (83) therein, said grooves (83) having first portions spaced at said first fixed spacing remote from said terminating station and second portions spaced at said second fixed spacing adjacent to said terminating station, said spreading means further comprising a wiper assembly (139) which wipes the wires (12) into the grooves (83) from the first portions toward the second portions.

4. The apparatus (10) of claim 3 wherein said operating zone has wire deflecting means



adjacent said guide template (82) remote from said terminating station, said deflecting means comprising a plurality of blades (164) at said first fixed spacing, said blades (164) moving transversely of the planar array to deflect the wires (12), the innermost leads in said array being deflected more than the outermost leads, whereby, a planar array of wires with the leading ends (46) delivered to the template (82) in a rectilinear array is modified to non-planar array with the leading ends (46) in an arcuate array with the innermost leads at the concavity of the arcuate array, and the wire spreading means restores the leading ends (46) to a rectilinear array as the wires (12) are spread into the grooves (83) in the template (82) by the wiper assembly (139).

5. The apparatus (10) of claim 1 which further comprises:

an insertion station on said first path between said operating zone and said point remote therefrom,

connector housing feed means for feeding a connector housing (48) having cavities (49) therein at said first fixed spacing to said insertion station, said housing feed means comprising a reciprocable housing transfer carriage (32) travelling on a second path substantially normal to said first path, said second path extending from said insertion station on said first path to a point remote therefrom, said carriage (32) having securing means (34) for securing said connector housing (48) to said carriage (32) and for positioning said housing (48) at said insertion station with said cavities (49) aligned to axially receive the terminals (42) on the leading ends (46) of the wires (12), whereby,

said shuttle (14) may pass through said insertion station toward said operating zone to terminate the leading ends (46) of the wires (12) when said housing transfer carriage (32) is remote from said insertion station, said carriage (32) may be advanced to said insertion station when said shuttle (14) is remote from said operating zone, and said shuttle (14) may axially insert the terminals (42) on the leading ends (46) of wires (12) into cavities (49) in the connector housing (48) at said first fixed spacing.

6. The apparatus (10) of claim 5 which further comprises a shearing station on said first path remote from said insertion station and said operating zone, said shearing station having an open position which allows passage of said shuttle (14) therethrough, whereby, said terminals (42) on the leading ends (46) may be inserted into said housing (48) at said insertion station, said gripping means (54) may be released, said shuttle (14) may be moved on said first path away from said insertion station until said shuttle (14) clears the shearing station, and the wires (12) may be sheared at a point remote from the insertion station.

7. A method of terminating the leading ends

(46) of a plurality of wires (12) to a like plurality of terminals (42) having a second fixed spacing in a linear array and inserting the terminals (42) on the leading ends (46) into a like plurality of cavities (49) having a first fixed spacing in a linear array in a connector housing (48) comprises the steps of:

gripping said wires (12) in a planar parallel array at said first fixed spacing at portions thereof remote from said leading ends (46) and delivering said ends (46) to a terminating station, said wires (12) being gripped so that the ends (46) are in a rectilinear array when the wires (12) are parallel between said gripped portions and said ends (46).

deflecting said wires (12) transversely of the planar array at a point between said terminating station and said gripped portions, the innermost wires being deflected more than the outermost wires, said ends (46) thereby rearranged into an arcuate array when the wires (12) are parallel between said gripped portions and said ends.

spreading said ends (46) to a second fixed spacing in a planar guide template (82) having grooves (83) therein, said grooves (83) having first portions at said first fixed spacing remote from said terminating station and second portions at said second fixed spacing adjacent to said terminating station, said second spacing being sufficient to align ends (46) to a rectilinear array when the wires (12) are spread into the grooves (83), said wires (12) being spread into the grooves (83) by a wiper assembly (139) which wipes the wires (12) into the grooves (83) from the first portions toward the second portions,

positioning a like plurality of terminals (42) at said second fixed spacing at said terminating station adjacent said leading ends (46) and terminating said ends (46) to said terminals (42),

restoring said leading ends (46) to said first fixed spacing and inserting said terminals (42) on said leading ends (46) into cavities (49) in a connector housing (48) at an insertion station, said terminals (42) on the leading ends (46) being inserted by relative axial movement between the terminals (42) and the housing (48).

8. The method of claim 7 wherein said leading ends (46) of said wires (12) are delivered to said terminating station by axial movement.

9. The method of claim 7 wherein said leading ends (46) of said wires (12) are delivered from said terminating station to said insertion station by axial movement.

10. The method of claim 8 or claim 9 wherein said axial movements are effected by a shuttle (14) having a like plurality of elongated wire guide tubes in a planar parallel array at said first fixed spacing, each guide tube having two telescoping parts (56, 57) and closely accommodating a single wire (12), said shuttle





(14) having releaseable wire gripping means (54) effective to hold the wires (12) stationary with respect to the outermost of the telescoping parts (57), said shuttle (14) being reciprocable along the axes of the wires (12), said ends (46) being delivered by collapsing the telescoping parts (56, 57) to extrude the ends (46) from the innermost part (56) as the shuttle (14) moves and the gripping means (54) holds the wires (12) stationary with respect to the outermost (57) of the telescoping parts.

11. A method of terminating the leading ends (46) of a plurality of wires (12) to a like plurality of terminals (42) having second fixed spacing in a rectilinear array and inserting the terminals (42) on the leading ends (46) into a like plurality of cavities (49) having a first fixed spacing in a rectilinear array in a connector housing (48) comprises the steps of:

gripping said wires (12) on portions thereof remote from said leading ends (46) and advancing said wires (12) axially in a planar parallel array having a first fixed spacing with the leading ends (46) in a rectilinear array along a path to a terminating station,

deflecting said wires (12) transversely of the planar array at a point between said terminating station and said gripped portions, the innermost leads in said array being deflected more than the outermost leads, said leading ends (46) thereby being rearranged into an arcuate array with the ends (46) of the innermost leads at the concavity of the arcuate array,

spreading said leading ends (46) to a second fixed spacing, said ends (46) being spread enough to restore them from said arcuate array to a rectilinear array,

positioning a like plurality of terminals (42) at said second fixed spacing at said terminating station adjacent said leading ends (46) and terminating said leading ends (46) to said terminals (42),

retracting said wires (12) from said terminating station along said path and reversing said deflection and reversing said spreading so that said terminals (42) on said leading ends (46) are restored to said first fixed spacing in a rectilinear array at a point remote from the terminating station,

positioning said connector housing (48) on said path between said remote point and said terminating station,

advancing said wires (12) until said terminals (42) on said leading ends (46) are inserted in said cavities (49).

Revendications

1. Appareil (10) pour la terminaison en masse des extrémités avant (46) de plusieurs fils (12) sur un nombre identique de bornes (42), qui comprend:

une zone de travail dans laquelle se trouve un poste de terminaison;

une navette (14) de distribution de fils qui peut exécuter un mouvement alternatif le long d'un premier trajet, de ladite zone de travail jusqu'à un point qui en est éloigné, ladite navette (14) ayant une extrémité avant (60) plus rapprochée de ladite zone de travail,

ladite navette (14) ayant un nombre identique de tubes allongés de guidage de fils formant une rangée parallèle plane, lesdits tubes de guidage ayant un premier espacement fixe, chaque tube de guidage comprenant deux parties télescopiques (56, 57), la partie intérieure (56) s'étendant jusqu'à l'extrémité avant (60) de la navette, chaque tube de guidage logeant étroitement un seul fil, ladite navette (14) ayant des moyens (54) de prise libérables des fils pouvant maintenir les fils (12) immobiles par rapport à celle (57) des parties télescopiques située à l'extérieur, de manière que ladite navette (14) puisse exécuter un mouvement alternatif le long dudit trajet pour se rapprocher et s'éloigner de ladite zone de travail et distribuer lesdites extrémités avant (46) desdits fils (12) dans ladite zone de travail en une rangée plane, audit premier espacement fixe, lesdites extrémités avant (46) étant extrudées des tubes (56) de guidage dans la zone de travail pour la terminaison, par arrêt de l'extrémité avant (60) de la navette (14) dans la zone de travail et repli des parties télescopiques (56, 57) sous l'effet de la poursuite du mouvement de la navette (14), tandis que les moyens (54) de prise des fils maintiennent les fils (12) immobiles par rapport à celle (57) des parties télescopiques située à l'extérieur.

2. Appareil (10) selon la revendication 1, dans lequel ladite zone de travail comporte des moyens d'étalement des fils alignés sur ledit trajet et adjacents audit poste de terminaison, de manière que ladite navette (14) puisse distribuer lesdits fils (12) audit poste de terminaison, à un second espacement fixe.

3. Appareil (10) selon la revendication 2, dans lequel, lesdits moyens d'étalement des fils comprennent un gabarit plan (82) de guidage présentant plusieurs gorges (83), lesdites gorges (83) ayant des premiers tronçons espacés dudit premier espacement fixe, éloignés dudit poste de terminaison, et des seconds tronçons espacés dudit second espacement fixe, adjacents audit poste de terminaison, lesdits moyens d'étalement comprenant en outre un ensemble de balayage (139) qui introduit les fils (12) par balayage dans les gorges (83), des premiers tronçons vers les seconds tronçons.

4. Appareil (10) selon la revendication 3, dans lequel ladite zone de travail comporte des moyens de déviation des fils adjacents audit gabarit (82) de guidage éloignés dudit poste de terminaison, lesdits moyens de déviation comprenant plusieurs lames (164) audit premier espacement fixe, lesdites lames (164) se déplaçant transversalement à la rangée plane pour dévier les fils (12), les conducteurs





intérieurs de ladite rangée étant déviés d'avantage que les conducteurs extérieurs de manière qu'une rangée plane de fils, dont les extrémités avant (46) sont distribuées au gabarit (82) en une rangée rectiligne, soit modifiée pour former une rangée non plane dont les extrémités avant (46) forment une rangée courbe, les conducteurs intérieurs étant situés dans la concavité de la rangée courbe, et les moyens d'étalement des fils rétablissent les extrémités avant (46) suivant une rangée rectiligne pendant que les fils (12) sont étalés dans les gorges (83) du gabarit (82) par l'ensemble (139) de balayage.

5. Appareil (10) selon la revendication 1, qui comprend en outre:

un poste d'insertion situé sur ledit premier trajet, entre ladite zone de travail et ledit point qui en est éloigné,

des moyens d'alimentation en boîtiers de connecteurs destinés à faire avancer un boîtier (48) de connecteur présentant des cavités (49) audit premier espacement fixe, vers ledit poste d'insertion, lesdits moyens d'alimentation en boîtiers comprenant un chariot (32) de transfert de boîtiers pouvant exécuter un mouvement alternatif sur un second trajet sensiblement perpendiculaire audit premier trajet, ledit second trajet s'étendant dudit poste d'insertion sur ledit premier trajet jusqu'à un point qui en est éloigné, ledit chariot (32) ayant des moyens (34) de fixation destinés à fixer ledit boîtier (48) de connecteur audit chariot (32) et à positionner ledit boîtier (48) dans ledit poste d'insertion afin que lesdites cavités (49) soient alignées pour recevoir axialement les bornes (42) portées par les extrémités avant (46) des fils (12), de manière que, ladite navette (14) puisse passer à travers ledit poste d'insertion vers ladite zone de travail pour terminer les extrémités avant (46) des fils (12) lorsque ledit chariot (32) de transfert de boîtiers est éloigné dudit poste d'insertion, ledit chariot (32) puisse être avancé vers ledit poste d'insertion lorsque ladite navette (14) est éloignée de ladite zone de travail, et ladite navette (14) puisse insérer axialement les bornes (42) portées par les extrémités avant (46) des fils (12) dans des cavités (49) du boîtier (48) de connecteur, audit premier espacement fixe.

6. Appareil (10) selon la revendication 5, qui comprend en outre un poste de cisaillement situé sur ledit premier trajet, éloigné dudit poste d'insertion et de ladite zone de travail, ledit poste de cisaillement ayant une position ouverte qui permet sa traversée par ladite navette (14), de manière que lesdites bornes (42) portées par les extrémités avant (46) puissent être insérées dans ledit boîtier (48) dans ledit poste d'insertion, lesdits moyens (54) de prise puissent être libérés, ladite navette (14) puisse être éloignée, sur ledit premier trajet, dudit poste d'insertion jusqu'à ce que ladite navette (14) dégage le

poste de cisaillement, et les fils (12) puissent être cisailés en un point éloigné du poste d'insertion.

7. Procédé de terminaison des extrémités avant (46) de plusieurs fils (12) sur un nombre identique de bornes (42) ayant un second espacement fixe dans une rangée linéaire, et d'insertion des bornes (42) sur les extrémités avant (46) dans un nombre identique de cavités (49), présentant un premier espacement fixe en une rangée linéaire, d'un boîtier (48) de connecteur, comprenant les étapes qui consistent:

à prendre lesdits fils (12) en une rangée parallèle plane, audit premier espacement fixe, par des tronçons de ces fils éloignés desdites extrémités avant (46) et à distribuer lesdites extrémités (46) à un poste de terminaison, lesdits fils (12) étant pris de manière que les extrémités (46) forment une rangée rectiligne lorsque les fils (12) sont parallèles entre lesdits tronçons pris et lesdites extrémités (46),

à dévier lesdits fils (12) transversalement à la rangée plane, en un point situé entre ledit poste de terminaison et lesdits tronçons pris, les fils intérieurs étant davantage déviés que les fils extérieurs, lesdites extrémités (46) étant ainsi redispesées en une rangée courbe lorsque les fils (12) sont parallèles entre lesdits tronçons pris et lesdites extrémités,

à étaler lesdites extrémités (46) à un second espacement fixe, dans un gabarit plan (82) de guidage présentant des gorges (83), lesdites gorges (83) ayant des premiers tronçons, audit premier espacement fixe, éloignés dudit poste de terminaison, et des seconds tronçons, audit second espacement fixe, adjacents audit poste de terminaison, ledit second espacement étant suffisant pour aligner les extrémités (46) en une rangée rectiligne lorsque les fils (12) sont étalés dans les gorges (83), lesdits fils (12) étant étalés dans les gorges (83) par un ensemble (139) de balayage qui introduit les fils (12) dans les gorges (83) par balayage, des premiers tronçons vers les seconds tronçons, à positionner un nombre identique de bornes (42), audit second espacement fixe, dans ledit poste de terminaison, à proximité immédiate desdites extrémités avant (46) et à terminer lesdites extrémités (46) sur lesdites bornes (42),

à rétablir lesdites extrémités avant (46) audit premier espacement fixe et à insérer lesdites bornes (42) portées par lesdites extrémités avant (46) dans des cavités (49) d'un boîtier (48) de connecteur dans un poste d'insertion, lesdites bornes (42) portées par les extrémités avant (46) étant insérées par un mouvement axial relatif entre les bornes (42) et le boîtier (48).

8. Procédé selon la revendication 7, dans lequel lesdites extrémités avant (46) desdits fils (12) sont distribuées audit poste de terminaison par un mouvement axial.

9. Procédé selon la revendication 7, dans lequel lesdites extrémités avant (46) desdits fils





(12) sont distribuées dudit poste de terminaison audit poste d'insertion par un mouvement axial.

10. Procédé selon la revendication 8 ou la revendication 9, dans lequel lesdits mouvements axiaux sont effectués par une navette (14) comportant un nombre identique de tubes allongés de guidage des fils formant une rangée parallèle plane audit premier espacement fixe, chaque tube de guidage ayant deux parties télescopiques (56, 57) et logeant étroitement un seul fil (12), ladite navette (14) comportant des moyens de prise libérables (54) des fils pouvant maintenir les fils (12) immobiles par rapport à celle, située à l'extérieur, des parties télescopiques (57), ladite navette (14) pouvant exécuter un mouvement alternatif le long des axes des fils (12), lesdites extrémités (46) étant distribuées par repli des parties télescopiques (56, 57) pour extruder les extrémités (46) de la partie intérieure (56) lorsque la navette (14) se déplace, et les moyens (54) de prise maintiennent les fils (12) immobiles par rapport à celle (57), située à l'extérieur, des parties télescopiques.

11. Procédé de terminaison des extrémités avant (6) de plusieurs fils (12) sur un nombre identique de bornes (42) ayant un second espacement fixe, en une rangée rectiligne, et d'insertion des bornes (42) portées par les extrémités avant (46) dans un nombre identique de cavités (49) ayant un premier espacement fixe, en une rangée rectiligne, d'un boîtier (48) de connecteurs, comprenant les étapes qui consistent:

à prendre lesdits fils (12) par des tronçons de ces fils éloignés desdites extrémités avant (46) et à faire avancer lesdits fils (12) axialement, dans une rangée parallèle plane ayant un premier espacement fixe, les extrémités avant (46) formant une rangée rectiligne, le long d'un trajet jusqu'à un poste de terminaison,

à dévier lesdits fils (12) transversalement à la rangée plane, en un point situé entre ledit poste de terminaison et lesdits tronçons pris, les conducteurs intérieurs de ladite rangée étant déviés davantage que les conducteurs extérieurs, lesdites extrémités avant (46) étant ainsi redispesées en une rangée courbe dans laquelle les extrémités avant (46) des conducteurs intérieurs sont situées à la concavité de la rangée courbe,

à étaler lesdites extrémités avant (46) à un second espacement fixe, lesdites extrémités (46) étant étalées suffisamment pour les ramener de ladite rangée courbe à une rangée rectiligne,

à positionner un nombre identique de gorges (42), audit second espacement fixe, dans ledit poste de terminaison, à proximité des extrémités avant (46) et à terminer lesdites extrémités avant (46) sur lesdites bornes (42),

à rétracter lesdits fils (12) dudit poste de terminaison le long dudit trajet et à inverser ladite déviation et inverser ledit étalement afin

que lesdites bornes (42) portées par lesdites extrémités avant (46) soient rétablies audit premier espacement fixe, en une rangée rectiligne, en un point éloigné du poste de terminaison,

à positionner ledit boîtier (48) de connecteur su ledit trajet entre ledit point éloigné et ledit poste de terminaison,

à faire avancer lesdits fils (12) jusqu'à ce que lesdites bornes (42) portées par lesdites extrémités avant (46) soient insérées dans lesdites cavités (49).

Patentansprüche

1. Vorrichtung (10) zum in Massenfertigung erfolgenden Anschließen der Vorderenden (46) einer Mehrzahl von Drähten (12) an eine entsprechende Mehrzahl von Anschlußklemmen (42), dadurch gekennzeichnet,

daß eine Arbeitszone mit einer in ihr angeordneten Anschlußstation vorgesehen ist,

daß ein Drahtzuliefer-Pendler (14) entlang eines ersten Weges von der Arbeitszone zu einem von dieser entfernten Punkt hin- und herbewegbar ist, wobei der Pendler (14) ein der Arbeitszone am nächsten kommendes Führungsende (60)

aufweist, daß der Pendler (14) in einem ebenen Parallelfeld eine entsprechende Mehrzahl gestreckter Drahtführungsrohre aufweist, die einen ersten fixen Abstand besitzen, und von denen jedes zwei Teleskopteile (56, 57) aufweist, deren am weitesten innen gelegener Teil (56) sich zu dem Führungsende (60) des Pendlers hin erstreckt, daß jedes Führungsrohr einen einzelnen Draht eng umgibt, daß der Pendler (14) eine lösbare Drahtgreifvorrichtung (54) aufweist, die im Betrieb die Drähte (12) in Bezug auf den am weitesten außen gelegenen Teleskopteil (57) stationär hält,

wodurch der Pendler (14) entlang des Weges in Richtung auf die Arbeitszone und von der Arbeitszone fort hin- und herzugehen vermag und die Vorderenden (46) der Drähte (12) in einem ebenen Feld unter Einhaltung des ersten fixen Abstands der Arbeitszone zuzuführen vermag, wobei die Vorderenden (46) aus den Führungsrohren (56) zum Anbringen von Anschlußklemmen dadurch in die Arbeitszone ausgetragen werden, daß das Führungsende (60) des Pendlers (14) an der Arbeitszone gehalten wird und die Teleskopteile (56, 57) durch fortgesetzte Bewegung des Pendlers (14) zusammengeschoben werden, während die Drahtgreifvorrichtung (54) die Drähte (12) in Bezug auf den am weitesten außen liegenden Teleskopteil (57) stationärhält.

2. Vorrichtung (10) nach Anspruch 1, dadurch gekennzeichnet, daß die Arbeitszone in sich eine Drahtspreizvorrichtung aufweist, die mit dem Weg ausgerichtet ist und benachbart zu der Anschlußstation angeordnet ist, wodurch der Pendler (14) die Drähte der Anschlußstation mit einem zweiten fixen Abstand zuzuführen vermag.





3. Vorrichtung (10) nach Anspruch 2, dadurch gekennzeichnet, daß die Drahtspreizvorrichtung eine planare Führungsschablone (82) mit mehreren darin ausgebildeten Nuten (83) aufweist, daß die Nuten (83) erste Abschnitte aufweisen, die in Entfernung von der Anschlußstation entsprechend dem ersten fixen Abstand beabstandet sind, und zweite Abschnitte aufweisen, die neben der Anschlußstation entsprechend dem zweiten fixen Abstand beabstandet sind, und daß die Spreizvorrichtung außerdem eine Streichanordnung (139) aufweist, die die Drähte (12) von den ersten Abschnitten in Richtung auf die zweiten Abschnitte in die Nuten (83) streicht.

4. Vorrichtung (10) nach Anspruch 3, dadurch gekennzeichnet, daß die Arbeitszone neben der Führungsschablone (82) an einer von der Anschlußstation entfernten Stelle eine Draht-Ablenkvorrichtung aufweist, daß die Ablenkvorrichtung mehrere Blätter (164) mit dem ersten fixen Abstand aufweist, daß sich die Blätter (164) quer zu dem ebenen Feld bewegen, um die Drähte (12) abzulenken, daß die innenliegenden Leitungen innerhalb des Feldes mehr abgelenkt werden als die außenliegenden Leitungen, wodurch ein ebenes Feld von Drähten, das mit den Vorderenden (46) der Schablone (82) in Form eines geradlinigen Feldes zugeführt wird, in ein nichtebenes Feld umgesetzt wird, wobei die Vorderenden (46) in einem gekrümmten Feld mit den am weitesten innen liegenden Leitungen in der Konkavität des gekrümmten Feldes liegen, und daß die Draht-Spreizvorrichtung die Vorderenden (46) in ein geradliniges Feld zurücksetzt, wenn die Drähte (12) von der Streichanordnung (139) in die in der Schablone (82) vorgesehenen Nuten (83) gespreizt werden.

5. Vorrichtung (10) nach Anspruch 1, dadurch gekennzeichnet, daß an dem ersten Weg zwischen der Arbeitszone und dem von dieser entfernten Punkt eine Einführstation vorgesehen ist, daß eine Verbindergehäuse-Zuführung vorgesehen ist, die der Einführstation ein Verbindergehäuse (48) zuführt, in welchem den ersten fixen Abstand aufweisende Hohlräume (49) vorgesehen sind, daß die Gehäuse-Zuführung einen hin- und hergehenden Gehäuse-Transferschlitten (32) aufweist, der sich auf einem zweiten Weg bewegt, welcher auf dem ersten Weg senkrecht steht, daß sich der zweite Weg von der Einführstation an dem ersten Weg zu einem von der Station entfernten Punkt erstreckt, daß der Schlitten (32) eine Sicherungseinrichtung (34) aufweist, zum Sichern des Verbindergehäuses (48) an dem Schlitten (32) sowie zum Positionieren des Gehäuses (48) an der Einführstation derart, daß die Hohlräume (49) so ausgerichtet sind, daß sie die an den Vorderenden (46) der Drähte (12) befindlichen Anschlußklemmen (42) axial aufnehmen, wodurch der Pendler (14) die Einführstation in Richtung auf die Arbeitszone durchlaufen kann,

um die Vorderenden (46) der Drähte (12) mit Anschlußklemmen zu versehen, wenn der Gehäuse-Transferschlitten (32) von der Einführstation entfernt ist, der Schlitten (32) zu der Einführstation hingeführt werden kann, wenn der Pendler (14) von der Arbeitszone entfernt ist, und der Pendler (14) die auf den Vorderenden (46) der Drähte (12) befindlichen Anschlußklemmen (42) unter Beibehaltung des ersten fixen Abstandes axial in die in dem Verbindergehäuse (48) vorgesehenen Hohlräume (49) einführen kann.

6. Vorrichtung (10) nach Anspruch 5, dadurch gekennzeichnet, daß an dem ersten Weg an einer von der Einführstation und der Arbeitszone entfernten Stelle eine Scherstation vorgesehen ist, die eine Offenstellung aufweist, die ein Durchlaufen des Pendlers (14) durch die Scherstation gestattet, wodurch die an den Vorderenden (46) befindlichen Anschlußklemmen (42) an der Einführstation in das Gehäuse (48) eingeführt werden können, die Greifvorrichtung (54) gelöst werden kann, der Pendler (14) auf dem ersten Weg von der Einführstation fortbewegt werden kann, bis der Pendler (14) die Scherstation verlassen hat, und die Drähte (12) an einem von der Einführstation entfernten Punkt gesichert werden können.

7. Verfahren zum Anschließen der Vorderenden (46) einer Mehrzahl von Drähten (12) an einer entsprechenden Mehrzahl von Anschlußklemmen (42), die in einem linearen Feld einen zweiten fixen Abstand besitzen, und zum Einführen der auf den Vorderenden (46) befindlichen Anschlußklemmen (42) in eine entsprechende Mehrzahl von Hohlräumen (49), die einen ersten fixen Abstand in einem linearen Feld eines Verbindergehäuses (48) aufweisen, gekennzeichnet durch folgende Schritte:

die Drähte (12) werden mit dem ersten fixen Abstand in einem ebenen Parallelfeld an von den Vorderenden (46) entfernten Abschnitten gegriffen, und die Enden (46) werden einer Anschlußstation zugeführt, wobei die Drähte (12) derart gegriffen werden, daß die Enden (46) in einem geradlinigen Feld liegen, wenn die Drähte (12) zwischen den gegriffenen Abschnitten und den Enden (46) parallel sind,

die Drähte (12) werden quer zu dem ebenen Feld an einem Punkt zwischen der Anschlußstation und den gegriffenen Abschnitten abgelenkt, wobei die innenliegenden Drähte mehr abgelenkt werden als die außenliegenden Drähte, so daß die Enden (46) zu einem gekrümmten Feld neugeordnet werden, wenn die Drähte (12) zwischen den gegriffenen Abschnitten und den Enden parallel sind, die Enden (46) werden in einer planaren Führungsschablone (82) mit darin ausgebildeten Nuten (83) auf einen zweiten fixen Abstand aufgespreizt, wobei die Nuten (83) an einer von der Anschlußstation entfernten Stelle erste Abschnitte mit dem ersten fixen Abstand aufweisen und an einer in der Nähe der Anschlußstation befindlichen Stelle zweite Abschnitte



mit dem zweiten fixen Abstand aufweisen, welcher ausreicht, um die Enden (46) zu einem geradlinigen Feld auszurichten, wenn die Drähte (12) in die Nuten (83) aufgespreizt werden, und wobei die Drähte in die Nuten (83) durch eine Streichanordnung (139) aufgespreizt werden, welche die Drähte (12) von den ersten Abschnitten in Richtung auf die zweiten Abschnitte in die Nuten (83) streicht.

an der Anschlußstation wird benachbart zu den Vorderenden (46) eine entsprechende Anzahl von Anschlußklemmen (42) mit dem zweiten fixen Abstand positioniert, und die Enden (46) werden an die Anschlußklemmen (42) angeschlossen,

die Vorderenden (46) werden auf den ersten fixen Abstand zurückgestellt, und die Anschlußklemmen (42) an den Vorderenden (46) werden an einer Einführstation in Hohlräume (49) eingeführt, die in einem Verbindergehäuse (48) ausgebildet sind, wobei die Anschlußklemmen (42) an den Vorderenden (46) durch eine relative Axialbewegung zwischen den Anschlußklemmen (42) und dem Gehäuse (48) eingeführt werden.

8. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß die Vorderenden (46) der Drähte (12) der Anschlußstation durch Axialbewegung zugeführt werden.

9. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß die Vorderenden (46) der Drähte (12) von der Anschlußstation durch Axialbewegung der Einführstation zugeführt werden.

10. Verfahren nach Anspruch 8 oder 9, dadurch gekennzeichnet, daß die Axialbewegungen durch einen Pendler (14) bewirkt werden, der eine entsprechende Mehrzahl von gestreckten Drahtführungsrohren mit dem ersten fixen Abstand in einem ebenen Parallelfeld aufweist, daß jedes Führungsrohr zwei Teleskopteile (56, 57) aufweist und einen einzelnen Draht (12) eng umgibt, daß der Pendler (14) eine lösbare Drahtgreifvorrichtung (54) aufweist, die im Betrieb die Drähte (12) in Bezug auf den am weitesten außenliegenden Teleskopteil (57) stationär hält, daß der Pendler (14) entlang der Achsen der Drähte (12) hin- und herbewegbar ist, daß die Enden (46) dadurch zugeführt werden, daß die Teleskopteile (56, 57) zusammengeschoben werden, um die Enden (46) aus dem am weitesten innenliegenden Teil (56) auszutragen, wenn sich der Pendler (14) bewegt und die Greifvorrichtung (54) die Drähte (12) bezüglich des am weitesten außenliegenden (57) Teleskop-

teils stationär hält.

11. Verfahren zum Anschließen der Vorderenden (46) einer Mehrzahl von Drähten (12) an einer entsprechenden Mehrzahl von Anschlußklemmen (42), die in einem linearen Feld einen zweiten fixen Abstand besitzen, und zum Einführen der auf den Vorderenden (46) befindlichen Anschlußklemmen (42) in eine entsprechende Mehrzahl von Hohlräumen (49), die einen ersten fixen Abstand in einem linearen Feld eines Verbindergehäuses (48) aufweisen, gekennzeichnet durch folgende Schritte:

die Drähte (12) werden an von den Vorderenden (46) entfernten Abschnitten gegriffen und in einem ebenen Parallelfeld mit einem ersten fixen Abstand entlang eines Weges axial einer Anschlußstation zugeführt, wobei die Vorderenden (46) in einem geradlinigen Feld liegen,

die Drähte (12) werden quer zu dem ebenen Feld an einem Punkt zwischen der Anschlußstation und den gegriffenen Abschnitten abgelenkt, wobei die inneren Leitungen in dem Feld mehr abgelenkt werden als die äußeren Leitungen, wodurch die Vorderenden (46) zu einem gekrümmten Feld neu geordnet werden, in welchem die Enden (46) der inneren Leitungen an der Konkavität des gekrümmten Feldes liegen,

die Vorderenden (46) werden zu einem zweiten fixen Abstand aufgespreizt, indem sie weit genug gespreizt werden, um das gekrümmte Feld in ein geradliniges Feld zurückzubilden,

an der Anschlußstation wird in der Nachbarschaft der Vorderenden (46) eine entsprechende Mehrzahl von Anschlußklemmen (42) mit dem zweiten fixen Abstand positioniert, und die Vorderenden (46) werden an die Anschlußklemmen (42) angeschlossen,

die Drähte (12) werden entlang des Weges von der Anschlußstation zurückgezogen, die Ablenkung wird rückgängig gemacht, und das Aufspreizen wird rückgängig gemacht, so daß die Anschlußklemmen (42) an den Vorderenden (46) an einem von der Anschlußstation entfernten Punkt auf den ersten fixen Abstand in einem geradlinigen Feld zurückgestellt werden,

an dem Weg zwischen dem entfernten Punkt und der Anschlußstation wird das Verbindergehäuse (48) positioniert,

die Drähte (12) werden vorgerückt, bis die auf den Vorderenden (46) befindlichen Anschlußklemmen (42) in die Hohlräume (49) eingeführt sind.

