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(54) A METHOD OF AND APPARATUS FOR POSITIONING WIRES AT A WORK ZONE

(71) We, AMP INCORPORATED, a corporation organised and existing under the laws of the State of New Jersey, United States of America, of Eisenhower Boulevard, Harrisburg, State of Pennsylvania, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to methods of and apparatus for positioning at a work zone, in a predetermined spaced array, the free ends of a plurality of electrical conductor wires.

According to one aspect of the present invention, a method of positioning at a work zone, in a predetermined spaced array, the free ends of a plurality of electrical conductor wires, comprises the steps of positioning the wires so that portions of the wires immediately adjacent their free ends overlie a surface of a template with their free ends extending beyond a forward end of the template to the work zone, securing the wires at a position adjacent an end of the template, exerting a force on the wires so that the portion of each wire overlying the template is forced into an individual groove in the surface of the template, the grooves being spaced apart a predetermined distance equivalent to the required spacing of the free ends of the electrical conductor wires and extending from the forward end towards the opposite end of the template.

According to a further aspect of the present invention, an apparatus for positioning at a work zone, in a predeter-

mined spaced array, the free ends of a plurality of electrical conductor wires, comprises a template having a plurality of grooves spaced apart a distance equivalent to the required spacing of the free ends of the electrical conductor wires on a first surface, each groove extending from a forward end towards an opposite rear end of the template and adapted to receive only one wire, means adjacent one end of the template for securing the wires so that portions of the wires immediately adjacent their free ends overlie the first surface with their free ends extending beyond the forward end of the template to the work zone and a member movable relatively with respect to the template between the forward and rear ends for engaging and forcing the wires, when positioned on the first surface, into individual grooves.

Embodiments of the invention will now be described, by way of example, reference being made to the Figures of the accompanying diagrammatic drawings, in which:—

Figure 1 is a perspective view of an apparatus for positioning at a work zone in a predetermined array, the free ends of a plurality of wires;

Figure 2 is an end elevation of the apparatus of Figure 1;

Figure 3 is a detail in cross-section of a template and roller forming part of the apparatus of Figure 1;

Figure 4 is a detail in cross-section of a trimming mechanism forming part of the apparatus of Figure 1;

Figure 5 is a detail in cross-section of a

crimping mechanism forming part of the apparatus of Figure 1;

Figure 6 is a detail in cross-section similar to Figure 3 but showing a modified template;

Figure 7 is a perspective view of a further modified template;

Figure 8 is a detail in cross-section of the template of Figure 7.

Figure 9 is a perspective view of a still further modified template;

Figure 10 is a perspective view of an apparatus forming a second embodiment of the invention;

Figure 11 to 13 are schematic side views of the apparatus of Figure 10 in various operational conditions;

Figure 14 is a schematic plan view of an apparatus forming a third embodiment of the invention;

Figure 15 is a detail in cross-section of part of the apparatus of Figure 14;

Figure 16 is a perspective view of an apparatus forming a fourth embodiment of the invention;

Figure 17 is a sectional plan view of a portion of the apparatus of Figure 16;

Figure 18 is a cross-section taken on line 18-18 of Figure 17; and

Figure 19 is an exploded perspective view of a part of the apparatus of Figure 16.

As shown in Figures 1 and 2, an apparatus 10 includes a base 12 on which is mounted a frame 14 including a pair of uprights 16 (only one shown) supporting a horizontal top plate 18. The top plate 18 has a pair of grooves 20 on its under surface 22 extending from a rearward end 24 to a forward end 26. Adjacent the forward end 26 a recess 28 is formed in the upper surface 27 of the plate 18, which recess 28 receives a template support 30 for supporting a template 32. On its upper surface 34, the template 32 has a plurality of spaced grooves 33, extending rearwardly from a forward end 36 and communicating with a relatively deep recess 38 extending forwardly from a rear end 40 of the template 32. The transition between the grooves 33 and recess 38 defines a step 39 (see Figure 3). Mounted on the plate 18 immediately adjacent the rear end 40 is a securing mechanism 42 including a stationary member 44 and a member 46 pivotally mounted to the plate 18 for movement towards and away from the member 44.

A carriage 48 is mounted on the top plate 18 and includes a pair of opposed side flanges 50, 52 interconnected by a transverse web 54. Each flange 50, 52 carries a pair of spaced stub shafts 55 each shaft supporting a bevelled wheel 56, the rim of which engages in a groove 20. Each flange 50, 52 also carries a further stub shaft 57 which supports a roller 58 engaging the

upper surface 27 of the top plate 18.

A piston and cylinder device 64 is mounted on a plate 66 upstanding from the plate 18 and the piston 68 of the device 64 is connected via linkage 70 to the web 54.

Mounted for movement with the carriage 48 is a generally U-shaped member 72 fixed to the web 54, which member 72 defines a vertically orientated channel 74. Slidably mounted in the channel 74 is a block 76 which is coupled at its upper end 78 to the piston 84 of a piston and cylinder device 86. The device 86 is supported by a bracket 82 secured to the top of the member 72. A bracket 88 is slidably mounted to the lower end of the block 76 and rotatably supports a member in the form of a roller 90.

The bracket 88 is pivotally connected to one end of a link 91 an intermediate part of which is pivotally mounted on a pin 92 extending from the block 76. The opposite end of link 91 is pivotally connected by a pin 94 to one end of a second link 96. The opposite end of link 96 is pivotally mounted on a pin 98 which in turn is mounted eccentrically on a rotatable member 100. The member 100 is rotatable by drive means in a housing 102 which is mounted in an aperture in the web 54. The drive means is driven through a power line 106.

As indicated by the chain-dotted lines in Figure 1, adjacent the forward end 36 of the template 32 is a work zone 132 at which the ends of wires are trimmed and then terminated.

Referring also to Figure 3, a plurality of discrete wires 2 forming a cable 4 have the cable insulation 6 removed at portions of the wires immediately adjacent their free ends 8 so that the individual wires 2 can be separated and their free ends 8 arranged in a predetermined spaced array.

Referring to Figures 4 and 5, means for trimming the wire ends 8 includes an upper, vertically movable blade 134 and a lower fixed blade 136. The blades 134, 136 are arranged so that they are parallel to end 36 of the template 32.

Terminals 142 are crimped to the trimmed ends of the wires 2 by a stationary anvil 138 and a vertically movable die 140. The anvil 138 supports a plurality of spaced apart terminals 142 each having an open barrel ferrule 146 for crimp connection to individual wires 2. In order to move the wire ends 8 into their respective ferrules 146, the template support 30 is moved downwardly in the recess 28 prior to the die 140 moving towards the anvil 138.

In use, the wires 2 constituting the cable 4 are positioned so that portions of the wires 2 immediately adjacent their free ends 8 overlie the upper surface 34 with the insulated cable being received in the recess 38. Prior to this, member 46 is pivoted away

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from member 44 to permit entry therebetween of the cable 4. Thereafter the member 46 is moved towards the member 44 to secure the wires adjacent the rear end 40 of the templates 32. Next, the roller 90 is positioned over the cable 4 in the recess 38 and moved downwardly towards the surface 34 by actuation of piston and cylinder device 86. After the roller 90 engages the cable 4, the piston and cylinder device 64 is actuated causing the carriage 48 and thus the roller 90 to move from the rearward end 40 to the forward end 36 of the template 32. As the roller 90 is moving from end 40 to the end 36 it is caused to oscillate transversely of the grooves 33 by the rotatable member 100 and each wire 2 is progressively forced into an individual groove 33. To reiterate, as the roller 90 moves from end 40 to the forward end 36 of the template 32 it exerts a compressive force on the wires 2 so that the portion of each wire overlying the template 32 is forced into an individual groove 33.

The free ends 8 of the wires 2 extending beyond the forward end 36 of the template 32 are then trimmed by actuation of the blade 134 and subsequently the template support 30 is moved downwardly so that the trimmed free ends of the wires 2 are located in the ferrules 146 of terminals 142 positioned on the anvil 138. Finally, the ferrules 146 are crimped about the respective free ends 8 of the wires 2 by the die 140 and the anvil 138.

Modifications can be made to the apparatus 10. For example, to reduce the height of the step 39 between the grooves 33 and the recess 38 a ramp 35 may be provided in the base of the recess 38 (see Figure 6). In a further form (see Figures 7 and 8), the template 32 is provided with a plunger 150 located in a bore 152 at the forward end of the recess 38. The plunger 150 is biased upwardly as shown by a spring 153 and has at its upper end a pair of spaced members 155 defining a notch 154 in which the wires 2 are received. The members 155 are inclined towards the forward end 36 and extend normally above the upper surface 34. When the roller 90 is caused to descend by the piston and cylinder device 86 or caused to move horizontally by actuation of the piston and cylinder device 64 to engage the plunger 150, the plunger 150 moves downwardly against the action spring 153 so that notch 154 is in alignment with the rear ends of the grooves 33.

The roller 90 can be replaced, for example by a rigid plate.

Where it is necessary to terminate wires extending from a cable which wires must be of different lengths, a template 32' as shown in Figure 9 is used. As shown, the grooves 33' are of different overall lengths.

A second embodiment of the invention is

shown in Figures 10 to 13. The apparatus 10' of Figures 10 to 13 includes a template 32' having grooves 33' of varying overall lengths, a securing mechanism 42', a roller 90' to position wires 2' within the grooves 33' and varying overall lengths, a securing mechanism 42', a roller 90' to position wires 2' within the grooves 33' and wire trimming means and terminal crimping means at work zones 132'. The wires 2' which are to be disposed in the grooves 33' are initially mounted on a plurality of supply spools 200, the spools being journaled about a support shaft 202. Portions of the wires 2' extend through spaced apart apertures in the wire guide block 206. Before the start of each cycle of the apparatus 10' the wires 2' are trimmed in a common plane which lies parallel to the wire guide block 206 and the rear end 40' of the template 32', the wire trim line being indicated by the broken line 212 (see Figure 10). At the start of the operation of the apparatus 10' the free ends of the wires 2' are engaged by the securing mechanism 42' which includes upper and lower spaced apart jaws 214, 216. The two jaws are pivoted with respect to each other and are swung to an open position and then brought to a closed position when the end portions of the wires 2' lie between the jaws, to securely engage the wire ends. After the end portions of the wires 2' have been initially engaged by the securing mechanism 42', the jaws 214, 216 while still in their closed position, are caused to move horizontally across the template 32' from the rear end 40' to the forward end 36' to the position indicated by the broken lines 214, 216 in Figure 10 thereby positioning the wires so that portions of the wires 2' immediately adjacent their free ends overlie the upper surface 34' of the template 32'. The template 32' is mounted above a support surface 220 by a plurality of springs 222 which are disposed about vertically extending rods 224. Each of the rods 224 is adapted to pass through a corresponding aperture 226 in the support surface 220. The wire guide block 206 is also secured to the support surface 220 by a mounting member 228. When the securing mechanism 42' initially engages the end portions of the wires 2' and moves the end portions across the template 32', the template 32' is disposed in an intermediate position (see Figure 11). (The means for holding the template 32' in the intermediate position are not illustrated in the Figures). After the end portions of the wires 2' have been moved across the template 32' by the jaws 214, 216 the template 32' is moved upwardly to the position shown in Figure 12.

As the template 32' moves up to the position shown in Figure 12 that portion of the wires 2' immediately adjacent the jaws

214, 216 will be positioned in the ends of the plurality of spaced apart grooves 33'. After the ends of the wires 2' have been positioned in the ends of the grooves 33' adjacent the forward end 36' of the template 32', the roller 90' is operated. The roller 90' engages the template 32', and moves from the forward end 36' of the template 32' towards the rear end 40' of the template. As the roller 90' moves from one end to the other of the template 33', it will exert a force on the wires 2' so that the portion of each wire overlying the template 32' is forced into an individual groove 33' in the surface 34' of the template 32'. After the roller 90' has moved to the rear end 40' of the template 32', the wire trimming means will be brought into operation. The wire trimming means includes an upper movable shear blade 134' and a lower movable shear blade 136'. The lower movable shear blade 136' is initially held in a lower position as indicated in Figure 11 but is moved to its raised position as the template 32' is moved upwardly. To shear the wire 2' it is then only necessary, while the lower shear blade 136' is held in its raised position, to move the upper shear blade 134' downwardly. As the shear blade 134' moves downwardly it will shear the wires 2' along the wire trim line 212. After the wires 2' have been sheared to varying lengths, terminals 142' are crimped to one or the other or as shown both ends of the sheared wires 2'. If terminals are to be applied to both ends, the terminals 142' are supported by anvils 138' at each end of the template 32'. Dies 140' are then moved downwardly to crimp the ferrules of the terminals 142' about the ends of the wires which project beyond either end 40', 36' of the template 32'. As the dies 140' move downwardly, wire clamp plates 244, which are interconnected with each of the dies 140' engage the leads adjacent the end of the template 32' and force the template downwardly from the raised position to a lowered position (see Figure 13). As the template 32' attains its lowermost position the terminals are crimped about the ends of the wires 2'. Means can be provided to shift the blades 134', 136' away from the end of the template 32' as the dies 140' move downwardly.

In a third embodiment, the apparatus 10a shown in Figures 14 and 15 includes a template 32a having a plurality of spaced apart grooves 33a which extend from a rear end 40a of the template 32a to a leading end 36a, the grooves 33a being of varying overall length. A securing mechanism 42a is provided to hold a workpiece 230 from which wires 2a extend adjacent the end 40a of the template 32a with portions of the wires 2a being disposed in those portions of the grooves 33a immediately adjacent said

end 40a of the template. The securing mechanism 42a consists of a pair of clamp members 214a, 216a. After the workpiece 230 has been disposed in its initial position indicated in Figure 14 it is then necessary to dispose the wires 2a in the grooves 33a and to this end a roller 90a is biased toward the template 32a to engage the wires and is caused to move from the end 40a of the template 32a towards the end 36a and as the roller 90a moves from one end to the other it will position portions of the wires 2a into the plurality of grooves 33a, the free ends 8a of the wires 2a extending beyond the end 36a after the roller 90a has progressively forced the wires into the spaced apart grooves 33a. After this portion of the operation has been completed, subsequent work operations may be performed upon the free ends 8a of the wires 2a at a work zone 132a. For example, the wires 2a can be trimmed by blades 134a, 136a and terminals 142a crimped by means of a die 140a and an anvil 138a on the trimmed ends of the wires 2a.

In a still further embodiment shown in Figures 16 to 19, an apparatus 10b includes a frame 14b having upper and lower plates 12b, 18b which are spaced apart by front and rear members 15, 17. Mounted on the upper plate 12b is a template 32b similar to the template 32 shown in the apparatus of Figure 1 having grooves 33b communicating with a recess 38b. The template 32b additionally has a plurality of through apertures 110 which intersect each of the grooves 33b.

Mounted adjacent the upper surface 34b of the template 32b is a carriage 48b including a pair of spaced apart rollers 90b, 93b which are mounted for relative movement with respect to the template 32b. One end of each of the rollers 90b, 93b is mounted in a downwardly extending portion 111, 112 respectively, of spaced apart arms 113, 114. The arms 113, 114 extend outwardly from a support element 115. The other end of each roller 90b, 93b is secured to the support element 115. The support element 115 is pivotally mounted on an end of a rod 116, connected to a piston (not shown) of a double acting hydraulic piston and cylinder device 64b mounted upon the upper surface of the upper plate 12b. Also mounted on the upper plate 12b is a securing mechanism 42b, including upper and lower arms 44b, 46b, each of the arms being pivotably mounted about a stub shaft 117 welded to the plate 12b. The portions of the arms 44b, 46b remote from the stub shaft 117 have seats which are adapted to engage a multi-wire cable 4b and to hold it in place when the arms 44b and 46b are in the position shown in Figure 16.

The apparatus 10b so far described, with the exception of the apertures 110 and the

spaced apart rollers 90b, 93b, generally
parallels the apparatus 10 shown in Figure 1.
When using the apparatus 10b in order to
position at a work zone, in a predetermined,
5 spaced array, a plurality of wires 2b ex-
tending from the cable 4b it is necessary first
to extend the piston and cylinder device 64b
to the left as seen in Figure 16 to a point
where the roller 93b is to the left of the
10 plurality of grooves 33b and then to rotate
the support element 115 about the axis of
the rod 116 to facilitate the loading of the
cable 4b into the recess 38b. In order to
ensure that the support element 115 is in its
15 lower position when the rollers 90b, 93b pass
over the plurality of grooves 33b, a cam
assembly 118 is provided. The cam assembly
118 has a cam track 119 which co-operates
with a cam follower 120 on the support
20 element 115. The cam track 119 is, in turn,
rigidly mounted upon a support structure
121 secured to the upper surface of the plate
12b by bolts 122. The bolts 122 pass through
apertures in the end of the support structure
25 121 and rubber grommets 123 which are
disposed between the support structure 121
and the upper surface of the upper plate
12b.

Thus, after the rod 116 has been extended
30 to a point where the cam follower 120 clears
the cam track 119 the support element 115
can be rotated in an anti-clockwise direction
as viewed in Figure 16 to facilitate loading of
the multi-wire cable 4b. The upper arm 44b
35 of the securing mechanism 42b is then
rotated about the stub shaft 117 to a raised
position. The end of the multi-wire cable 4b
is then placed in the seat (not shown) of the
lower arm 46b and the recess 38b so that the
40 wires 2b are positioned with their portions
immediately adjacent their free ends
overlying the surface 34b of the template
32b with their free ends 8b extending
beyond a forward end 36b of the template
45 32b. The upper arm 44b is then swung to its
lowered position to hold securely the cable
4b within the recess 38b and the support
element 115 is then swung to its lower
operative position. The piston and cylinder
50 device 64b is then retracted thereby causing
the rod 116 to move from the left to the right
as shown in Figure 16. As the rod 116 moves
progressively to the right the rollers 90b,
93b are biased into engagement with the
55 wires 2b which are overlying the plurality of
grooves 33b by the cam track 119 and the
rubber grommets 123 which are slightly
compressed during the movement of the
rollers over the template 32b. The rollers
60 90b, 93b exert a force progressively on the
wires 2b so that they are forced into the
grooves as the rollers 90b, 93b move from the
left to the right. It may be desirable to
oscillate transversely the rollers 90b, 93b as
65 they move across the template 32b to ensure

that the wires 2b will be forced into their
respective grooves 33b, this oscillation being
found necessary with certain types of wire
insulation. No means to oscillate these
members have been shown in Figure 16.
However, the oscillating means shown in
Figure 1 can be applied.

Once the roller 90b has passed the
apertures 110, that is, to the right in Figure
16, the relative lengths of the wires 2b can
be varied by initially engaging an inter-
mediate portion of selected wires 2b with
a push rod 156 and then moving the push
rod 156 through the aperture 110 in the
template 32b to form a bight in the selected
wires 2b. Thus, when it is desired to vary the
length of four wires 2b when making a cable
assembly for a telephone hand set, two wires
will be engaged by push rods 156 to lengthen
these wires while the other two wires are not
engaged, and after the two wires have
been lengthened the ends of the wires will be
sheared in a common plane and terminals
crimped thereto.

As shown in Figures 16 to 19, four push
rods 156 are provided each having a
bifurcated upper end portion 157 which is
adapted to engage the wires 2b. A lower
portion of each push rod 156 is provided
with a stop in the form of a notch 158. Each
of the push rods 156 is mounted for sliding
movement in spaced apart apertures in a
mounting bar 159. Rigidly secured to the
mounting bar 159 is a latch mounting bar
160 having a plurality of spaced apart
apertured ears 161, each of the ears 161
supporting a transversely extending pivot
pin 162. Mounted on the pivot pin 162
between associated pairs of ears 161 are a
plurality of latch arms 163. Each latch arm
163, as can best be seen from Figures 18 and
19 has a lower cam surface 164 and an upper
tang 165 which is adapted to engage the
notch 158 in an associated push rod 156.
Each of the latch arms 163 has its tang 165
normally biased towards a notch 158 by a
compression spring 166 which is mounted
below the pivot pin 162 between a lower
portion of the latch arm 163 and the latch
mounting bar 160. The push rod mounting
bar 159 and the latch mounting bar 160 are
mounted for vertical sliding movement
between a pair of spaced apart gibs 167
(Figure 17), each of the gibs 167 extending
between a lower plate 18b.

A piston and cylinder device 168 is
provided to cause the push rods 156 to move
through the apertures 110. The device 168 is
supported on the upper surface of the lower
plate 18b by a mounting block 169. The
piston rod 170 of the device 168 is provided
with a yoke 171 at its outer end, the yoke 171
carrying a pivot pin 172 which is adapted to
engage one end of a bell crank lever 173. An
intermediate portion of the bell crank lever

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110

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173 is pivotally mounted on a pivot pin 174 which passes through spaced apart portions of a bell crank mounting block 175 which is in turn mounted on the upper surface of the lower plate 18b. The outer end of the bell crank 173 carries a pivot pin 176 (Figure 19) about which a roller 177 is journaled. The roller 177 is disposed within an elongate aperture 178 in the back of the push rod mounting bar 159.

If all of the latch arms 163 were engaged in all of the various notches 158 then all of the push rods 156 would be raised during the retraction of the device 168. Therefore, means are provided to selectively disengage various of the latch arms 163. A control box 180 is provided in the vicinity of an operator's station, the control box 180 having a plurality of wire position buttons 181 equal in number to the various push rods 156. Each of the buttons 181 is connected to an electrical solenoid 182 by a lead 183 so that when the button 181 is actuated the solenoid 182 associated with the particular button 181 is caused to be energised. Thus there are four solenoids 182, one for each of the push rods 156. Each of the solenoids 182 has an outwardly extending shaft 184 which is normally biased outwardly by a spring mounted within the solenoid. Upon actuation of the solenoid 182, the shaft 184 is retracted until stops 185 on the shaft 184 engage the outer end of the solenoid. Each of the shafts 184 is connected to a pivotally mounted latch release 186. The latch release 186 is mounted on a shaft 187, the shaft 187 in turn being supported by a pair of brackets 188 which are secured to the bottom of the plate 18b. Annular spacers 189 are disposed between the pivoted latch releases 186 to hold them in their proper oriented position with respect to the various latch arms 163. End shaft 184 is connected to the lower end of a latch release 186 by a pivot pin 190. The upper end of each latch release 186 is provided with a surface 191 (Figure 18) which is adapted to engage the cam surface 164 of a latch arm 163. When it is desired to have two wires out of four which are to be shorter than the others, the operator determines in which of the two grooves 33b the shorter wires are located, presses the appropriate buttons 181 which causes the latch releases 186 to pivot in a clockwise direction as shown in Figures 16 and 18 to engage the corresponding latch arms 163 and swing them in an anti-clockwise sense to release their respective tangs 165 from the notches 158 on the push rods 156. The operator then actuates the device 168 causing the push rod mounting bar 159 and latch arms 163 to be raised. Those push rods 156 with notches 158 still engaged by tangs 165 will also be raised with the mounting bar 159. The

remaining push rods 156 are maintained in their lower position by a hold down spring 192.

As each of the push rods 156 which are still engaged by the latch arms 163 is raised, its upper bifurcated end 157 will initially pass through the associated aperture 119, and the end 157 will then engage the wire 7 disposed in the associated groove 33b. Continued upward movement will cause the push rod to form a bight (Figures 16 and 19) in the associated wire. After the bights are formed in the selected wires 2b, the free ends 8b of the wires can be trimmed and terminals and terminals applied to the free ends at a work zone as described with reference to the earlier embodiments of the invention.

In Figures 16 and 19, the trimming and crimping means have not been illustrated for purposes of clarity. Other work operations could be performed upon the free ends 8b of the wires 2b at the work zone, for example, stripping the insulation from the ends of the wires 2b and applying colour identification bands.

The stroke of the push rods 156 can be varied by varying the stroke of the device 168. Alternatively, the stroke can be adjusted by mounting the latch mounting bar 160 on the push rod mounting bar 159 for vertical adjustment with the tang 165 of the latch arms 163 being disposed below the notches 158 when the latch mounting bar 160 is in its lowered position to permit the latch arms 163 to move upwardly varying amounts before the notches 158 are engaged.

In a modification, the push rods 156 can be caused to move downwardly through their respective apertures 110 in which case the lower ends of the push rods will be bifurcated.

WHAT WE CLAIM IS:—

1. A method of positioning at a work zone, in a predetermined spaced array, the free ends of a plurality of electrical conductor wires, comprising the steps of:

a) positioning the wires so that portions of the wires immediately adjacent their free ends overlie a surface of a template with their free ends extending beyond a forward end of the template to the work zone,

b) securing the wires at a position adjacent an end of the template,

c) exerting a force on the wires so that the portion of each wire overlying the template is forced into an individual groove in the surface of the template, the grooves being spaced apart a predetermined distance equivalent to the required spacing of the free ends of the electrical conductor wires and extending from the forward end towards the opposite end of the template.



173 is pivotally mounted on a pivot pin 174 which passes through spaced apart portions of a bell crank mounting block 175 which is in turn mounted on the upper surface of the lower plate 18b. The outer end of the bell crank 173 carries a pivot pin 176 (Figure 19) about which a roller 177 is journaled. The roller 177 is disposed within an elongate aperture 178 in the back of the push rod mounting bar 159.

If all of the latch arms 163 were engaged in all of the various notches 158 then all of the push rods 156 would be raised during the retraction of the device 168. Therefore, means are provided to selectively disengage various of the latch arms 163. A control box 180 is provided in the vicinity of an operator's station, the control box 180 having a plurality of wire position buttons 181 equal in number to the various push rods 156. Each of the buttons 181 is connected to an electrical solenoid 182 by a lead 183 so that when the button 181 is actuated the solenoid 182 associated with the particular button 181 is caused to be energised. Thus there are four solenoids 182, one for each of the push rods 156. Each of the solenoids 182 has an outwardly extending shaft 184 which is normally biased outwardly by a spring mounted within the solenoid. Upon actuation of the solenoid 182, the shaft 184 is retracted until stops 185 on the shaft 184 engage the outer end of the solenoid. Each of the shafts 184 is connected to a pivotally mounted latch release 186. The latch release 186 is mounted on a shaft 187, the shaft 187 in turn being supported by a pair of brackets 188 which are secured to the bottom of the plate 18b. Annular spacers 189 are disposed between the pivoted latch releases 186 to hold them in their proper oriented position with respect to the various latch arms 163. End shaft 184 is connected to the lower end of a latch release 186 by a pivot pin 190. The upper end of each latch release 186 is provided with a surface 191 (Figure 18) which is adapted to engage the cam surface 164 of a latch arm 163. When it is desired to have two wires out of four which are to be shorter than the others, the operator determines in which of the two grooves 33b the shorter wires are located, presses the appropriate buttons 181 which causes the latch releases 186 to pivot in a clockwise direction as shown in Figures 16 and 18 to engage the corresponding latch arms 163 and swing them in an anti-clockwise sense to release their respective tangs 165 from the notches 158 on the push rods 156. The operator then actuates the device 168 causing the push rod mounting bar 159 and latch arms 163 to be raised. Those push rods 156 with notches 158 still engaged by tangs 165 will also be raised with the mounting bar 159. The

remaining push rods 156 are maintained in their lower position by a hold down spring 192.

As each of the push rods 156 which are still engaged by the latch arms 163 is raised, its upper bifurcated end 157 will initially pass through the associated aperture 119, and the end 157 will then engage the wire disposed in the associated groove 33b. Continued upward movement will cause the push rod to form a bight (Figures 16 and 19) in the associated wire. After the bights are formed in the selected wires 2b, the free ends 8b of the wires can be trimmed and terminals and terminals applied to the free ends at a work zone as described with reference to the earlier embodiments of the invention.

In Figures 16 and 19, the trimming and crimping means have not been illustrated for purposes of clarity. Other work operations could be performed upon the free ends 8b of the wires 2b at the work zone, for example, stripping the insulation from the ends of the wires 2b and applying colour identification bands.

The stroke of the push rods 156 can be varied by varying the stroke of the device 168. Alternatively, the stroke can be adjusted by mounting the latch mounting bar 160 on the push rod mounting bar 159 for vertical adjustment with the tang 165 of the latch arms 163 being disposed below the notches 158 when the latch mounting bar 160 is in its lowered position to permit the latch arms 163 to move upwardly varying amounts before the notches 158 are engaged.

In a modification, the push rods 156 can be caused to move downwardly through their respective apertures 110 in which case the lower ends of the push rods will be bifurcated.

WHAT WE CLAIM IS:—

1. A method of positioning at a work zone, in a predetermined spaced array, the free ends of a plurality of electrical conductor wires, comprising the steps of;

a) positioning the wires so that portions of the wires immediately adjacent their free ends overlie a surface of a template with their free ends extending beyond a forward end of the template to the work zone,

b) securing the wires at a position adjacent an end of the template,

c) exerting a force on the wires so that the portion of each wire overlying the template is forced into an individual groove in the surface of the template, the grooves being spaced apart a predetermined distance equivalent to the required spacing of the free ends of the electrical conductor wires and extending from the forward end towards the opposite end of the template.



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2. A method as claimed in claim 1, in which the wires are secured at a position adjacent the end of the template opposite the forward end of the template, the force being applied by a member moving from the opposite end to the forward end of the template.

3. A method as claimed in claim 2, in which the member additionally oscillates generally transversely of the grooves simultaneously with movement from the opposite to the forward end of the template.

4. A method as claimed in any one of claims 1 to 3, in which the free ends of the wires extending beyond the forward end of the template are trimmed.

5. A method as claimed in claim 1, in which each wire extends from a separate spool and a portion is de-reeled from the spool across the template, and secured at a position adjacent the forward end of the template, the force being applied by a member moving from the forward end of the template to an opposite rear end of the template, the wires being severed from their respective spools at a position rearwardly of the rear end of the template.

6. A method as claimed in any one of claims 1 to 3, in which push rods are passed through selected through apertures in the template which apertures each intersect an individual groove in the surface of the template, each push rod having a free end which engages a wire in the groove and forms a bight in the wire.

7. An apparatus for positioning at a work zone, in a predetermined spaced array, the free ends of a plurality of electrical conductor wires, comprising a template having a plurality of grooves spaced apart a distance equivalent to the required spacing of the free ends of the electrical conductor wires on a first surface, each groove extending from a forward end towards an opposite rear end of the template and adapted to receive only one wire, means adjacent one end of the template for securing the wires so that portions of the wires immediately adjacent their free ends overlie the first surface with their free ends extending beyond the forward end of the template to the work zone and a member movable with respect to the template between the forward and rear ends for engaging and forcing the wires, when positioned on the first surface, into individual grooves.

8. An apparatus as claimed in claim 7, in which each groove communicates with a recess adjacent the rear end of the template, the recess being adapted to accommodate a cable from which end portions of the wires extend, the securing means being mounted adjacent the rear end and including a pair of co-operating members relatively movable

between an open position and a closed cable gripping position.

9. An apparatus as claimed in claim 8, in which a bore is provided in the recess at the forward end of the recess adjacent the grooves, a plunger is located in the bore and biased outwardly of the bore by a spring, at its end extending from the bore and into the recess, the plunger has a pair of spaced members which define between them a notch for receiving the wires.

10. An apparatus as claimed in claim 7, 8 or 9, in which the template is mounted in a recess in a surface of a plate, the plate supporting a carriage which is movable along the surface between opposed forward and rear ends of the plate, the carriage including a U-shaped member defining a channel in which a block is slidable in a direction perpendicular to the direction of movement of the carriage, the end of the block immediately adjacent the surface of the plate slidably supporting a bracket which carries the relatively movable member which is in the form of a roller.

11. An apparatus as claimed in claim 10, in which the bracket is connected by a linkage to a pin which is mounted eccentrically on a rotatable member.

12. An apparatus as claimed in claim 7, 8 or 9, in which the relatively movable member is a rigid plate.

13. An apparatus as claimed in any one of claims 7 to 12, in which at least some of the grooves are of different lengths.

14. An apparatus as claimed in claim 7, in which the grooves extend from the forward end of the template to the opposite rear end, some at least of the grooves being of different lengths, the securing means including a pair of co-operating jaws relatively movable between an open position and a closed wire gripping position, the securing means being movable between a first position adjacent the rear end of the template and a second position adjacent the forward end of the template for positioning the portions of the wires over the first surface of the template.

15. An apparatus as claimed in claim 14, in which wire trimming means is provided adjacent the rear end of the template for severing the portions of each wire overlying the first surface of the template from the remainder of the wire.

16. An apparatus as claimed in claim 7 or 8, in which there are provided in the template through apertures, each aperture intersecting a groove, and push rods, each push rod being mounted for movement through an aperture to engage a wire when positioned in the corresponding groove to form a bight in the wire.

17. An apparatus as claimed in claim 16, in which each push rod is bifurcated at one



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5 end for engaging a wire and includes a notch engageable selectively by a latch arm, the latch arms being mounted for movement with a latch mounting bar, the latch mounting bar being movable between a first position remote from the template and a second position at which selected latch arms engage their respective notches and move the corresponding push rods through their respective apertures.

10 18. A method of positioning at a work zone, in a predetermined spaced array, the free ends of a plurality of electrical conductor wires, substantially as hereinbefore described with reference to the Figures of

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the accompanying drawings.

19. An apparatus for positioning at a work zone, in a predetermined spaced array, the free ends of a plurality of electrical conductor wires, constructed and arranged, 20 substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 5; or Figures 1 to 5 as modified by Figure 6; or Figures 7 and 8 or Figure 9; or Figures 10 to 13; or Figures 14 and 15; or Figures 16 to 25 19 of the accompanying drawings.

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