

[54] CABLE TERMINATING MACHINE

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[51] Int. Cl. H01r 43/00, H02g 1/12

[58] Field of Search. 29/203 D, 203 R; 81/9.51

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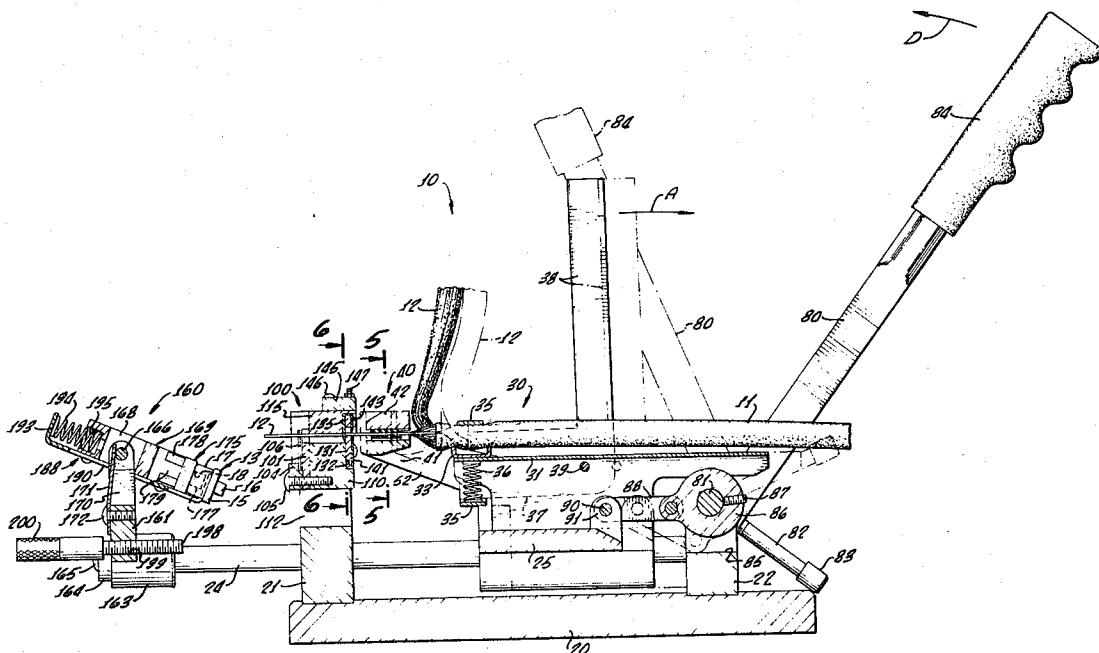
Primary Examiner—Thomas H. Eager

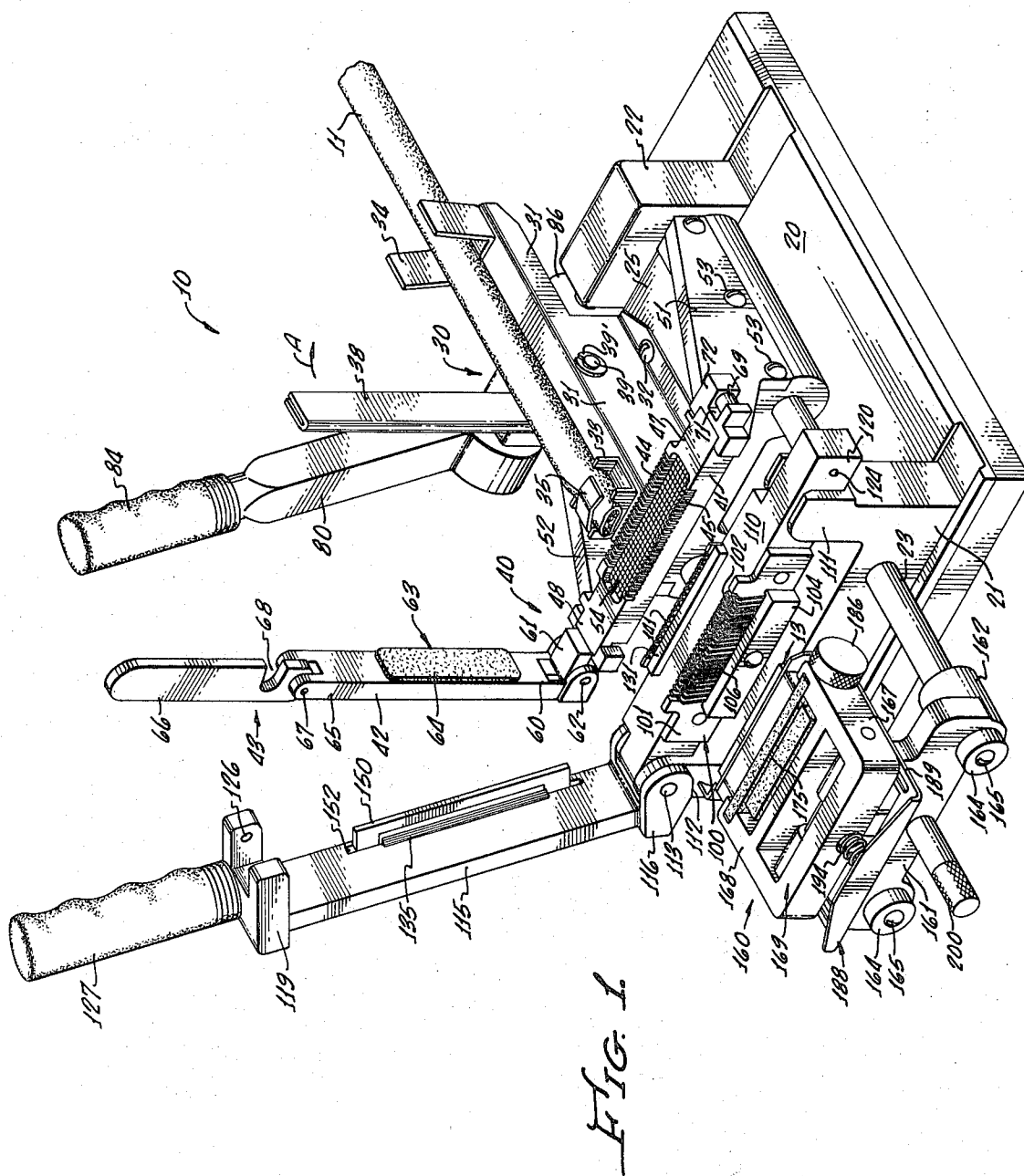
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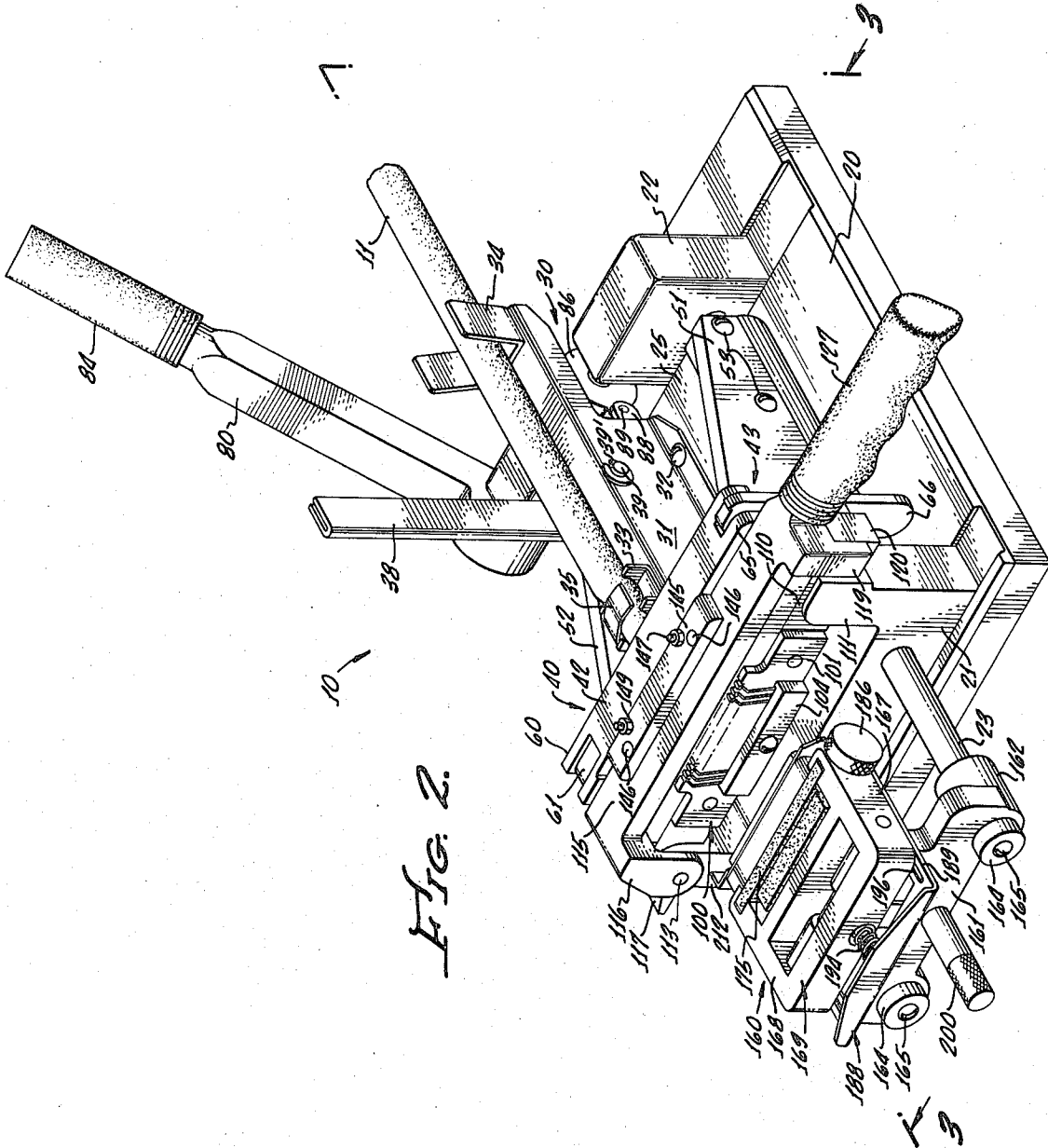
[57] ABSTRACT

A cable terminating machine for preparing a cable, of the type including a plurality of insulated strands of wire, for connection to a connector, of the type including a plurality of spaced, parallel contacts, and for supporting the strands and the connector during interconnection. The cable terminating machine includes apparatus for supporting the individual strands of wire in spaced apart, parallel relationship, at the ends thereof and at a point spaced from the ends thereof. Positioned between these two supporting points, the apparatus includes cutting means for cutting each of the strands along a common plane and for simultaneously removing a small amount of insulation from the end of each strand. Apparatus is also included for supporting the connector with the contacts thereof in position to receive the stripped ends of the strands so that all of such strands may be connected to the contacts simultaneously.

22 Claims, 14 Drawing Figures







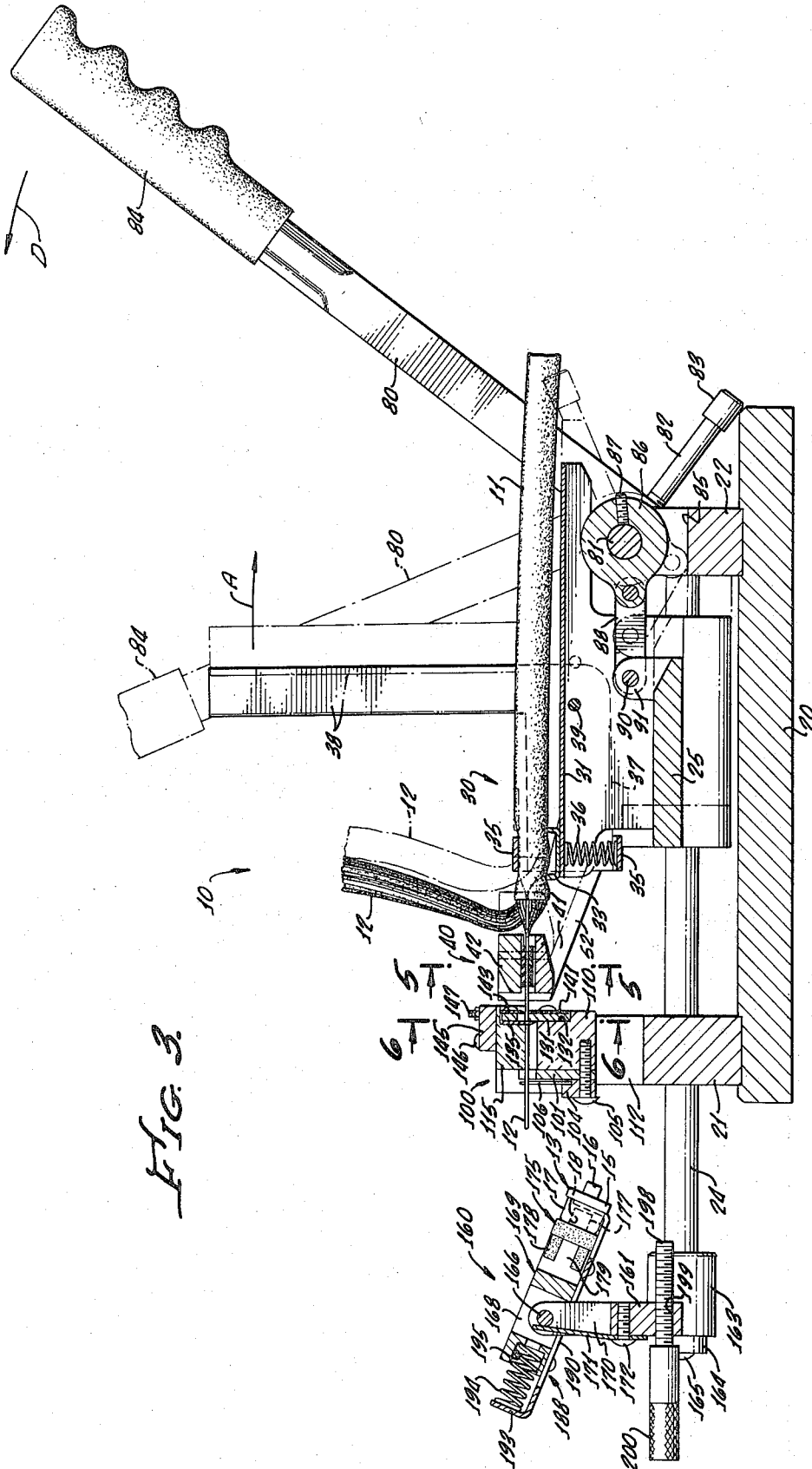


FIG. 11.

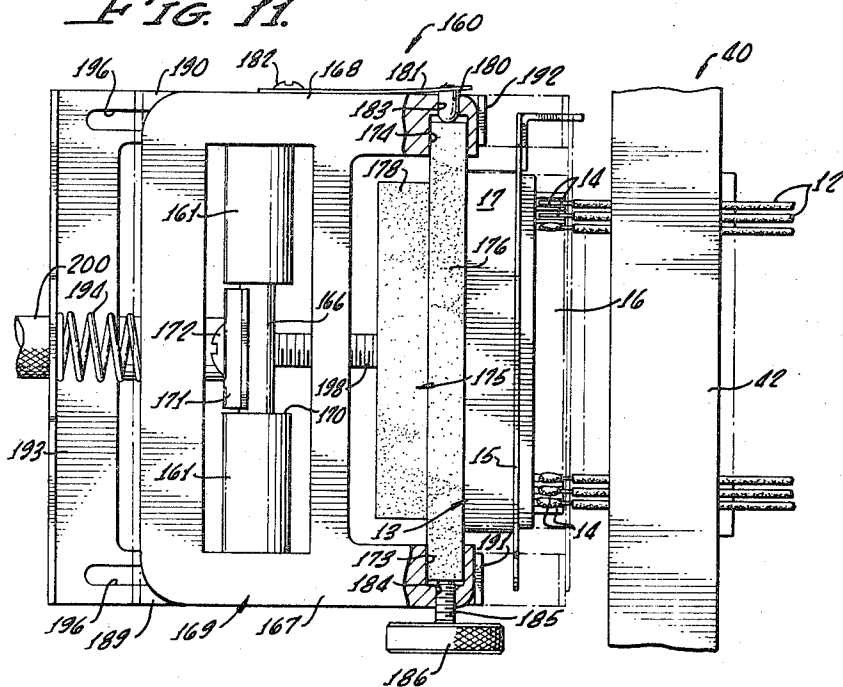


FIG. 4.

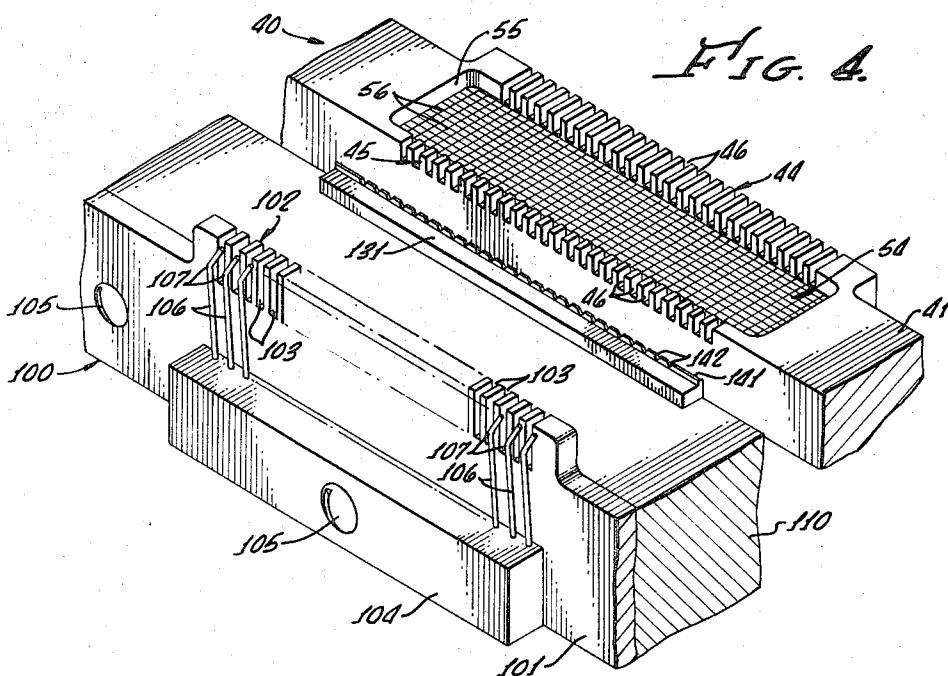


FIG. 5.

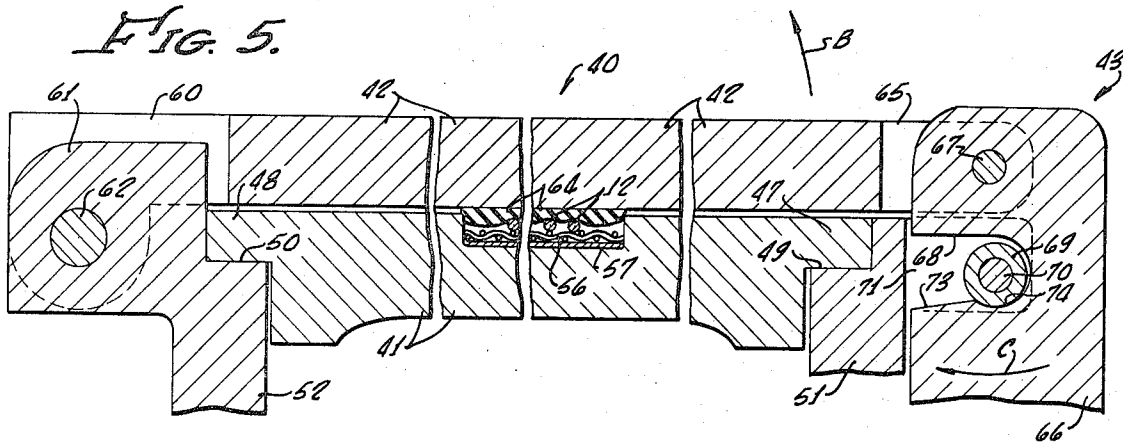


FIG. 6.

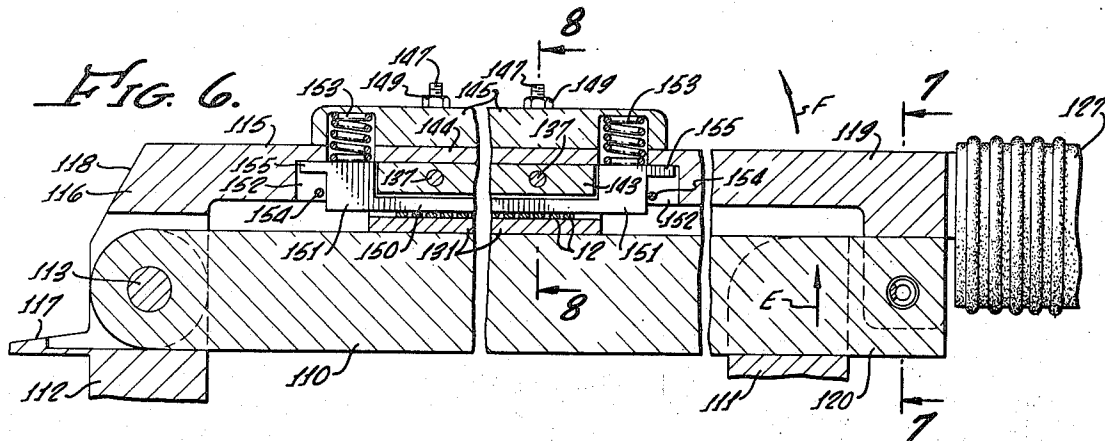


FIG. 7.

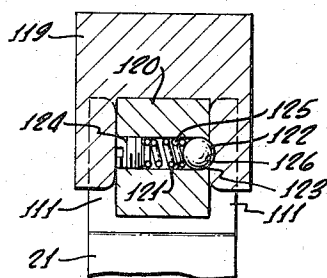
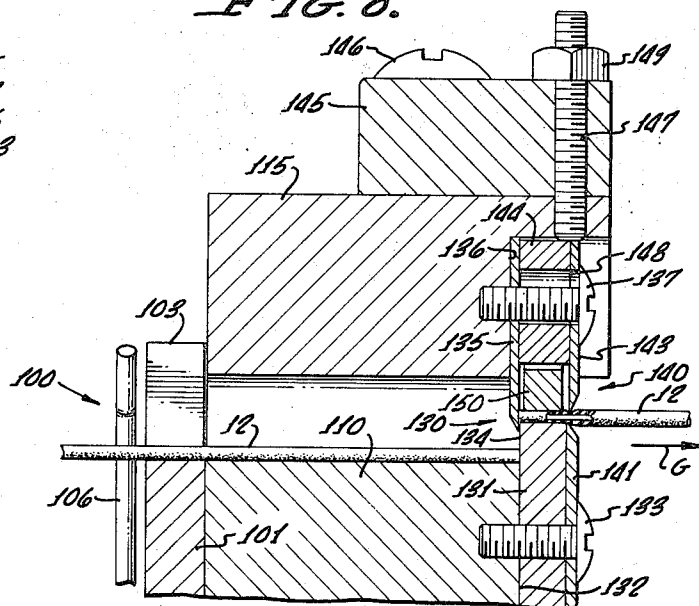
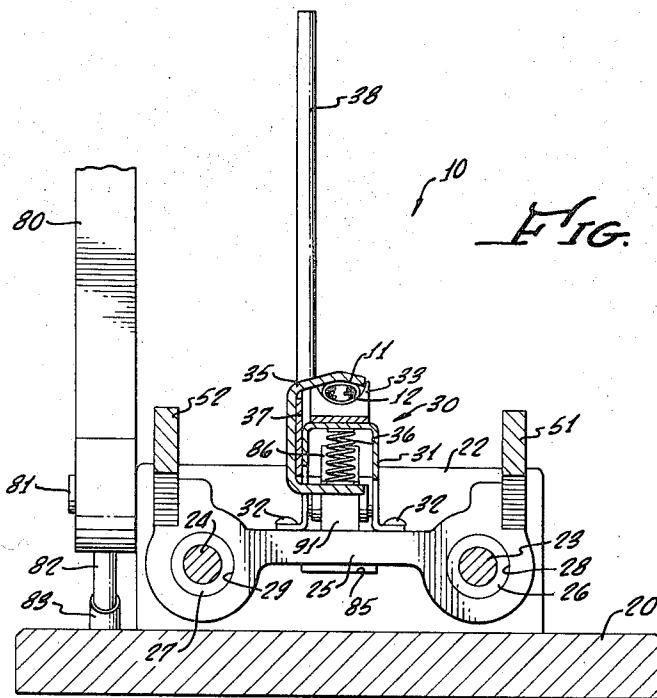
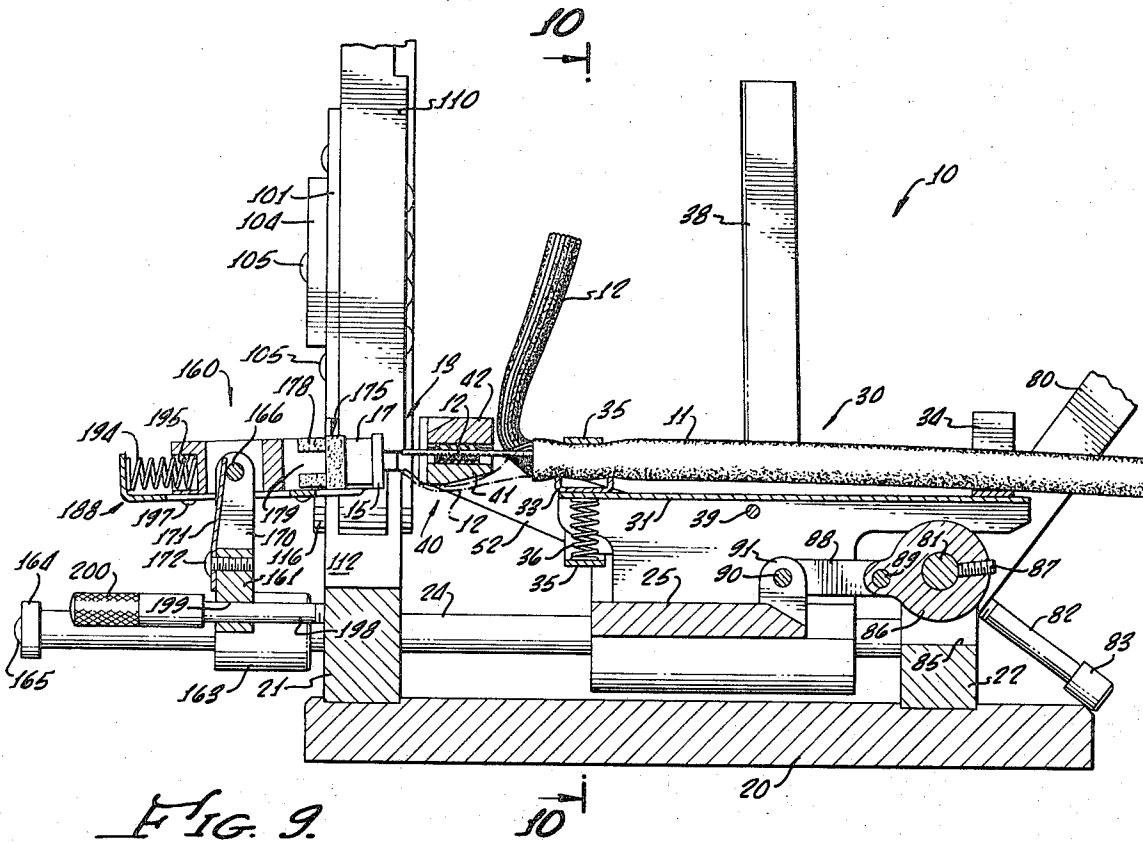


FIG. 8.





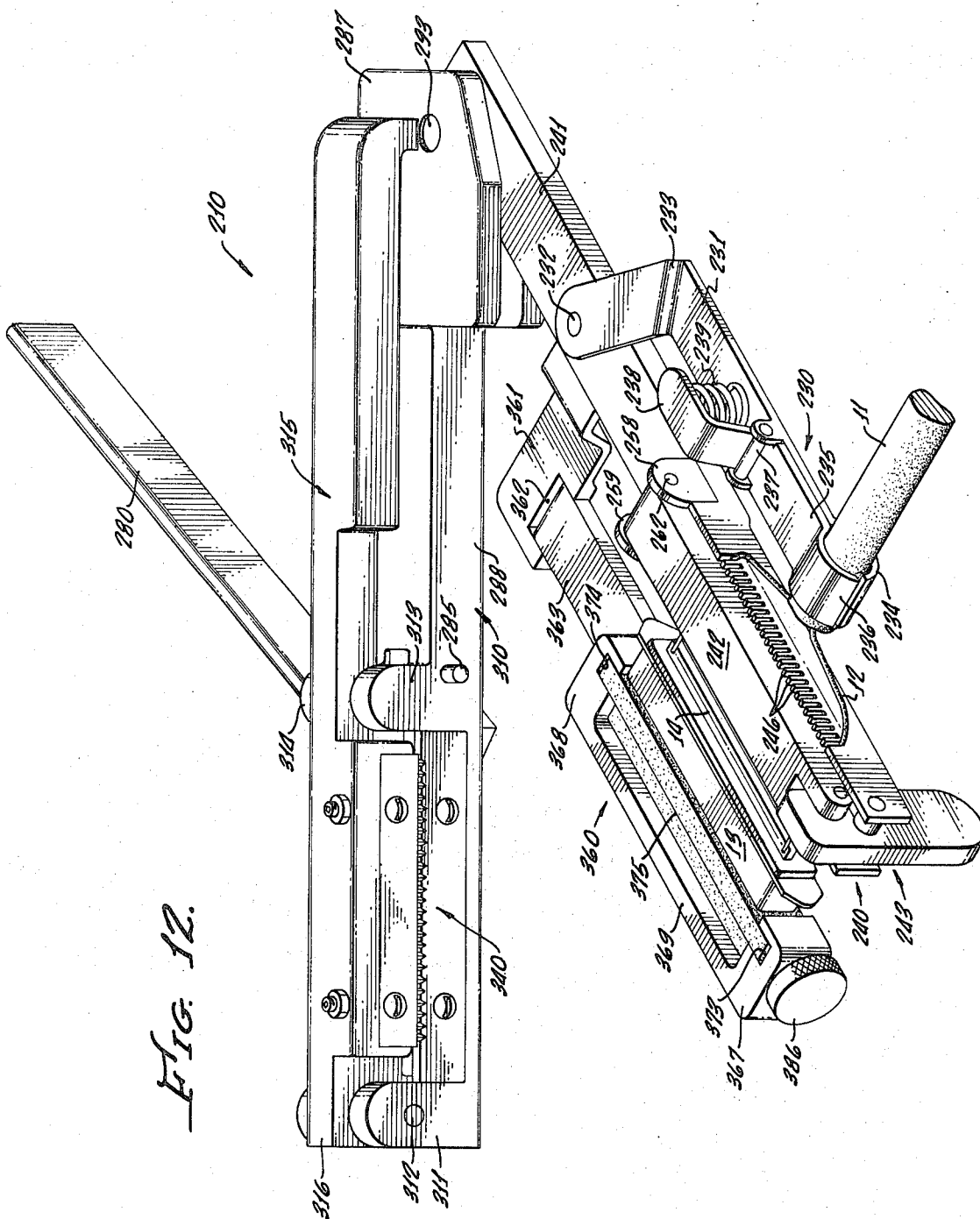


FIG. 12.

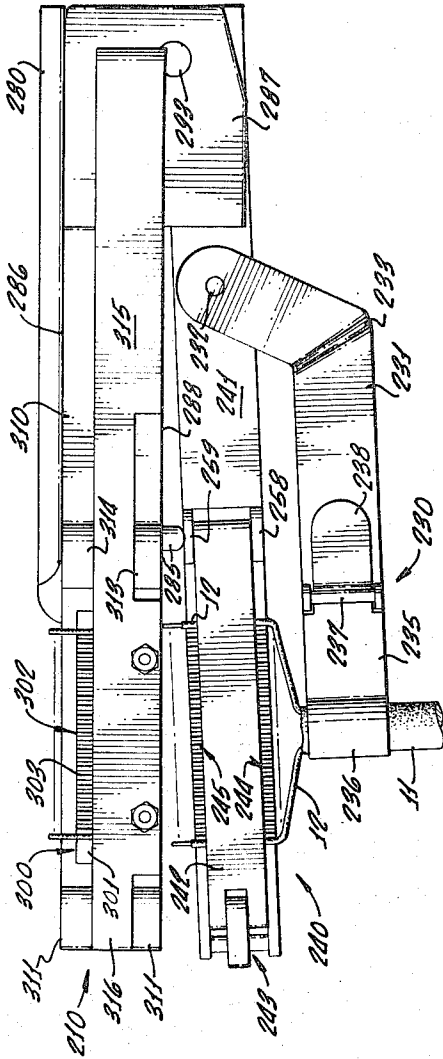


FIG. 14.

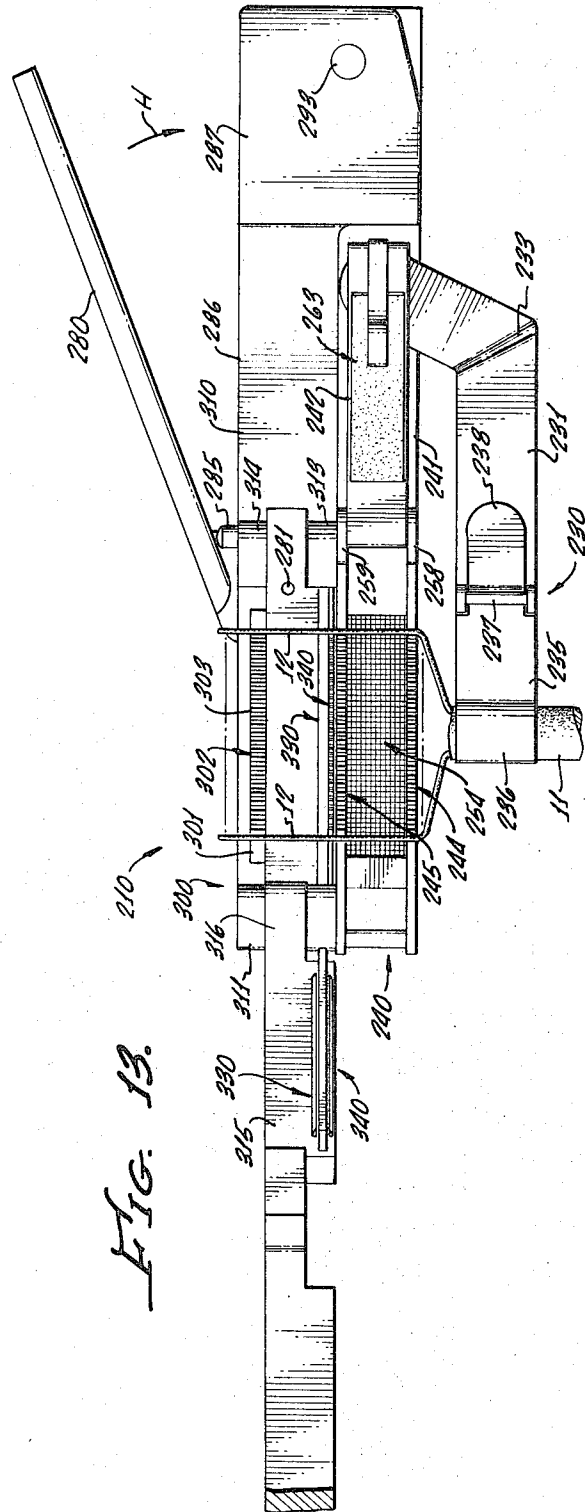


FIG. 13.

CABLE TERMINATING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a cable terminating machine and, more particularly, to a machine for preparing a cable, of the type including a plurality of insulated strands of wire, for connection to a connector, of the type including a plurality of spaced, parallel contacts.

2. Description of the Prior Art

Many industries have a common problem of sending information in the form of electrical signals from one location to another over electrical leads. As the amount of information transmitted increases, so do the number of such electrical leads. By way of example, the telephone system uses massive numbers of individual leads for conducting telephone messages from one point to another. As the electrical leads which carry these messages reach terminal points, it becomes necessary to terminate each wire so that it may be readily interconnected with wires coming from other locations.

The individual leads are normally bunched in cables, each lead being separately insulated to prevent electrical conduction therebetween. Cables of this type are often terminated by connecting the individual strands of wire to a connector of the type including a plurality of spaced, parallel contacts. Where this is done, a substantial problem is created by the necessity of separately connecting the individual strands of wire to the individual contacts of the connector. In the past, complicated and expensive machinery has been required to perform this task and even with such machinery, the process has generally been cumbersome and time consuming.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a cable terminating machine which substantially simplifies the problem of preparing a cable, of the type including a plurality of insulated strands of wire, for connection to a connector, of the type including a plurality of spaced, parallel contacts. The present cable terminating machine is simple and inexpensive, yet completes the cable termination process in a rapid and efficient manner. According to one embodiment of the invention, the cable terminating machine is small and lightweight, but designed for permanent location at a manufacturing plant or on a mobile facility, such as a truck. According to a second embodiment of the invention, there is provided a portable cable terminating machine of the type which is readily carried in the pocket or tool box of a worker in the field for use where required.

Briefly, the present cable terminating machine for preparing a cable, of the type including a plurality of insulated strands of wire, for connection to a connector, of the type including a plurality of spaced, parallel contacts, comprises first means for supporting the cable, second means connected to the first means for separately supporting the individual strands of wire, at a point spaced from the ends thereof, in spaced apart, parallel relationship, the spacing between the strands being equal to the spacing between the contacts of the connector, third means for separately supporting the individual strands of wire adjacent the ends thereof in

said spaced apart, parallel relationship, first cutting means positioned intermediate the second and third wire support means for cutting each of the parallel strands along a common plane, second cutting means positioned intermediate the second wire support means and the first cutting means for cutting the insulation without cutting the central conductive portion of the strands, and means for moving the first and second wire support means relative to the third wire support means and the first and second cutting means to simultaneously remove an amount of insulation from each of the strands equal to the spacing between the first and second cutting means. Also included is means for supporting and retaining the connector with the contacts thereof aligned with the stripped ends of the strands to permit simultaneous interconnection of the strands and the contacts.

OBJECTS

It is therefore an object of the present invention to provide a cable terminating machine.

It is a further object of the present invention to provide a machine for preparing a cable, of the type including a plurality of insulated strands of wire, for connection to a connector, of the type including a plurality of spaced, parallel contacts.

It is a still further object of the present invention to provide apparatus for cutting a plurality of insulated strands of wire along a common plane and for simultaneously removing a portion of the insulation from the end of each strand.

Still other objects, features, and attendant advantages of the present invention will become apparent to those skilled in the art from a reading of the following detailed description of the preferred embodiments, constructed in accordance therewith, taken in conjunction with the accompanying drawings wherein like numerals designate like parts in the several figures and

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a first embodiment of cable terminating machine constructed in accordance with the teachings of the present invention, showing a first position of some of the relatively movable parts thereof;

FIG. 2 is a perspective view similar to FIG. 1 but showing a second position of some of the relatively movable parts of the cable terminating machine;

FIG. 3 is a longitudinal sectional view taken along the line 3—3 in FIG. 2;

FIG. 4 is an enlarged perspective view of a portion of the machine of FIGS. 1—3;

FIGS. 5 and 6 are enlarged sectional views taken along the lines 5—5 and 6—6, respectively, in FIG. 3;

FIG. 7 is a sectional view taken along the line 7—7 in FIG. 6;

FIG. 8 is an enlarged partial sectional view taken along the line 8—8 in FIG. 6;

FIG. 9 is a sectional view similar to FIG. 3 but showing another position of some of the relatively movable parts of the cable terminating machine of FIGS. 1 and 2;

FIG. 10 is a sectional view taken along the line 10—10 in FIG. 9;

FIG. 11 is a top plan view of a portion of the present machine in the same position as shown in FIG. 9;

FIG. 12 is a perspective view of a second embodiment of cable terminating machine constructed in accordance with the teachings of the present invention; and

FIGS. 13 and 14 are top plan views of the machine of FIG. 12 showing various positions of the relatively movable parts thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings and, more particularly, to FIGS. 1-3 and 10 thereof, there is shown a first embodiment of cable terminating machine, generally designated 10, for preparing a cable 11 of the type including a plurality of insulated strands of wire 12 for connection to a connector 13, of the type including a plurality of spaced, parallel contacts 14. Broadly speaking, cable terminating machine 10 operates to position strands 12 in spaced apart, parallel relationship corresponding to the spacing between the contacts 14 of connector 13, to cut each of strands 12 along a common plane, to remove a portion of the insulation from the end of each of strands 12, and to support connector 13 relative to the stripped ends of strands 12 so that each of strands 12 may be readily connected to a corresponding one of contacts 14.

More particularly, cable terminating machine 10 includes a generally rectangular base 20 which supports two vertically extending, generally rectangular support members 21 and 22 in spaced apart, parallel relationship at opposite ends thereof. Extending between supports 21 and 22 are a pair of rails or guides 23 and 24 which are held in spaced apart, parallel relationship. First ends of rails 23 and 24 terminate at support 22 whereas the other ends of rails 23 and 24 extend through and beyond support 21. Supports 21 and 22 and rails 23 and 24 are all rigidly connected to each other and to base 20 for supporting the rest of the structure of cable terminating machine. It is significant to note that all remaining parts of cable terminating machine are movable relative either to rails 23 and 24 or relative to supports 21 or 22.

Cable terminating machine 10 includes several major subassemblies. A first subassembly, generally designated 30, operates to support cable 11 to permit further operation thereon. A second subassembly, generally designated 40, operates to separately support the individual strands of wire 12, at a point spaced from the ends thereof, in spaced apart, parallel relationship, with a spacing equal to the spacing between contacts 14 of connector 13. Support means 30 and 40 are commonly mounted so as to be movable in a uniform manner along rails 23 and 24. More specifically, machine 10 includes a generally horizontal plate 26 which is enlarged at the opposite sides thereof to surround rails 23 and 24. Bearings 26 and 27 mounted within bores 28 and 29, respectively, in the enlarged sides of plate 25 permit sliding movement of plate 25 relative to rails 23 and 24, as will be explained more fully hereinafter.

Supporting means 30 may comprise a generally U-shaped, elongated channel 31, the opposite ends of which are rigidly connected to plate 25, such as by screws 32, with the axis of channel 31 parallel to rails 23 and 24. The upper surface of channel 31 provides an area on which cable 11 rests and includes a pair of

generally U-shaped receptacles 33 and 34 at the opposite ends thereof to prevent lateral movement of cable 11. To prevent removal of cable 11, support means 30 includes a generally C-shaped clamp 35, the top of which is held above receptacle 33 by a spring 36 connected between the bottom thereof and the center portion of channel 31, thereby pinching cable 11 between clamp 35 and receptacle 33. On the other hand, in order to permit insertion and removal of cable 11, clamp 35 is connected to one end of a bar 37, the other end of which is made integral with a lever arm 38 which extends vertically, above channel 31, on one side thereof. Bar 37 and arm 38 are pivotably connected to channel 31 by means of a pin 39, one end of which is connected to arm 38 and the other end of which extends through channel 31 and is secured by a conventional C-clamp 39'. Thus, by rotating arm 38 around pin 39 in the direction of arrow A in FIGS. 1 and 3, clamp 35 is elevated, compressing spring 36, and permitting removal of cable 11 from between clamp 35 and receptacle 33. However, when arm 38 is released, spring 36 holds clamp 35 tightly against the top of cable 11 thereby supporting cable 11 during the terminating operation.

With reference now to FIGS. 1, 3, 4, and 5, support means 40 includes a lower support bar 41, an upper support bar 42 pivotably mounted relative to lower support bar 41 so as to be movable into and out of contact therewith, and means, generally designated 43, for releasably locking together lower and upper support bars 41 and 42, respectively. Lower support bar 41 has first and second horizontally spaced rows 44 and 45 of aligned grooves 46, the spacing between adjacent grooves 46 in each of rows 44 and 45 being equal to the spacing between contacts 14 of connector 13. Lower support bar 41 is mounted perpendicular to channel 31, spaced a short distance from receptacle 33, so as to receive the individual strands of wire 12 exiting cable 11. More specifically, the opposite ends 47 and 48 of lower support bar 41 are adapted to be seated within recesses 49 and 50, respectively, positioned at the ends of arms 51 and 52, respectively, the other ends of which are rigidly connected to the enlarged sides of plate 25, such as by screws 53. That is, arms 51 and 52 extend from plate 25, approximately above rails 23 and 24, respectively, and terminate a short distance beyond the end of channel 31 and receptacle 33 so as to support ends 47 and 48 of lower support bar 31. Thus, the individual strands of wire 12 leaving cable 11 may be inserted into the individual grooves 46 in rows 44 and 45, rows 44 and 45 holding strands 12 in spaced apart, parallel relationship.

It should be noted that lower support bar 41 is removable from recesses 49 and 50 in arms 51 and 52, respectively, to permit the individual strands of wire 12 from cable 11 to be positioned in rows 44 and 45 of grooves 46 without tying up machine 10. In other words, strands 12 may be inserted into grooves 46 at a separate location and thereafter be brought to machine 10 whereupon lower support bar 41 is positioned between arms 51 and 52 and cable 11 is connected to support means 30, as described previously.

Lower support bar 41 also includes first friction means, generally designated 54, positioned within a recess 55 in the upper surface thereof, between rows 44 and 45 of grooves 46. Friction means 54 may include a wire mesh 56 resting on a piece of cloth 57, the latter

providing flexibility to the structure and the former functioning in a manner to be described more fully hereinafter.

One end 60 of upper support bar 42 is generally U-shaped to straddle a post 61 connected to the end of arm 52. A pin 62 extends through end 60 of upper support bar 42 and post 61 so as to render upper support bar 42 pivotal relative to post 61 and lower support bar 41. Upper support bar 42 is movable from a first position, shown in FIGS. 2 and 5, in contact with and parallel to lower support bar 41, in the direction of arrow B, seen in FIG. 5, to a second position, shown in FIG. 1, spaced from and generally perpendicular to lower support bar 41.

Upper support bar 42 includes second friction means, generally designated 63, which is engagable with first friction means 54 when lower and upper support bars 41 and 42, respectively, are in contact, to securely hold strands 12, thereby preventing movement thereof through grooves 46. More specifically, friction means 63 may include a rubber pad 64 having dimensions generally equal to the dimensions of recess 55 in lower support bar 41 and so positioned on the bottom surface of upper support bar 42 so that pad 64 extends into recess 55 in lower support bar 41 when lower and upper support bars 41 and 42, respectively, are in contact, as shown in FIG. 5. When in this position, the individual strands of wire 12 are firmly held between wire mesh 56 and rubber pad 64, preventing movement of wires 12.

Locking means 43 releasably holds lower and upper support bars 41 and 42, respectively, together during the operation of machine 10. More specifically, end 65 of upper support bar 42 is generally U-shaped to receive one end of a locking lever 66. A pin 67 extending through end 65 of upper support bar 42 and the one end of locking lever 66 permits pivotal movement of one relative to the other. Locking lever 66 has a notch 68 in the bottom thereof, adjacent pin 67, notch 68 cooperating with a roller 69 mounted on a pin 70 positioned within a U-shaped slot 71 in a post 72 connected to the end of arm 51. As shown most clearly in FIG. 5, when upper support bar 42 is brought down into contact with lower support bar 41, locking lever 66 is rotatable around pin 67 in a direction indicated by the arrow C to cause roller 69 to project into notch 68. The shape of notch 68 is such that roller 69 rolls on an inclined surface 73, pulling upper support bar 42 downward until roller 69 seats into an arcuate seating recess 74 within notch 68. This firmly locks upper support bar 42 to lower support bar 41, with friction means 54 and 63 on opposite sides of the individual strands of wire 12. On the other hand, when it is desired to release wires 12, locking lever 66 is rotated in a direction opposite to arrow C, freeing upper support bar 42 and permitting its rotation around pin 62 in the direction of arrow B.

Referring now to FIGS. 1-3, 9, and 10, support means 30 and 40 are movable with plate 25 along rails 23 and 24 under the control of a stripping lever 80. That is, movement of stripping lever 80 from a first position shown in solid lines in FIG. 3, to a second position, shown in phantom in FIG. 3, slides plate 25 and support means 30 and 40 along rails 23 and 24. More specifically, one end of stripping lever 80 is mounted on a shaft 81 which extends through support 22. Stripping lever 80 is locked to shaft 81 by a threaded stud

82 which extends through the one end of stripping lever 80 and contacts shaft 81. The other end of stud 82 includes a cap 83 and stud 82 is positioned relative to stripping lever 80 so that in one position of lever 80, cap 83 rests on base 20 preventing rotation of lever 80 beyond the position shown in solid lines in FIG. 3. The other end of stripping lever 80 includes a handle 84 for the manipulation thereof.

Support 22 has a central slot 85 in the upper surface thereof, slot 85 being aligned with channel 31 of support means 30. Shaft 81 extends through slot 85 and supports a ring 86 which is locked to shaft 81, within slot 85, by a set screw 87. Opposite ends of a pair of arms 88 are connected by pins 89 and 90, respectively, to ring 86 and a post 91 made integral with the upper surface of plate 25 and positioned between the sides of channel 31. Thus, with stripping lever 80 in the position shown in solid lines in FIGS. 2, 3, and 9, arms 88 are horizontal and plate 25 is spaced from support 22. However, as stripping lever 80 is rotated in the direction of arrow D to the position shown in solid lines in FIG. 1 and in phantom in FIG. 3, shaft 81 is rotated to rotate pin 89 in a counterclockwise direction, as viewed in FIG. 3, thereby pulling arms 88 toward support 22. This has the effect of moving plate 25 along rails 23 and 24 to the position shown in phantom in FIG. 3 where plate 25 rests against support 22, preventing further rotation of stripping lever 80. Such movement of plate 25 moves first and second support means 30 and 40, which are rigidly mounted thereon, for reasons which will appear more fully hereinafter.

Referring now to FIGS. 1-4 and 6-8, cable terminating machine 10 includes means, generally designated 100, for separately supporting the individual strands of wire 12, at a point adjacent the ends thereof, in the same spaced apart, parallel relationship as they are supported by support means 40. Support means 100 includes a plate 101 having a single row 102 of grooves 103 spaced along the upper surface thereof. Support means 100 also includes a bar 104 which is connected to plate 101 by a screw 105, bar 104 supporting first ends of a plurality of flexible wires 106. The other ends of wires 106 are bent through an angle of approximately 45°, at 107. As shown most clearly in FIG. 4, wires 106 are positioned relative to row 102 of grooves 103 so that the ends thereof, beyond bends 107, cut across the individual grooves 103. Thus, as the individual strands of wire 12 are positioned within grooves 103, wires 106 are deflected slightly, applying a lateral pressure to the individual strands 12, preventing their removal from grooves 103.

Cable terminating machine 10 further comprises a second lower support bar 110 pivotably mounted relative to support 21. More specifically, support 21 incorporates first and second U-shaped upright members 111 and 112 at the opposite ends thereof, through which extends lower support bar 110. A pin 113 extending through upright member 112 and lower support bar 110 pivotably supports lower support bar 110 for rotation from a first position, shown in FIGS. 1, 2, and 6, in the direction of arrow E, seen in FIG. 6, to a vertical position, shown in FIG. 9. As shown most clearly in FIGS. 1 and 4, bar 104 and plate 101 of support means 100 are connected to the side of lower support bar 110 farthest from lower support bar 41. In addition, not only are lower support bars 41 and 110 held in spaced apart, parallel relationship, but the individual

grooves 103 in plate 101 are aligned with the individual grooves 46 in both of rows 44 and 45.

Cable terminating machine 10 further comprises a second upper support bar 115 pivotably mounted relative to lower support bar 110 so as to be movable into and out of contact therewith. More particularly, one end 116 of upper support bar 115 is generally U-shaped to straddle U-shaped upright 112 of support 21. By extending pin 113 through end 116 of upper support bar 115, upper support bar 115 is pivotal with lower support bar 110 therearound from a first position, shown in FIG. 6, in the direction of arrow F, seen in FIG. 6, to a second, vertical position shown, in FIG. 9. Upright 112 may have a seating abutment 117 made integral therewith to receive the surface 118 at end 116 of upper support bar 115 to support upper support bar 115 when it is in its vertical position.

The other end 119 of upper support bar 115 is also generally U-shaped so as to extend around the end 120 of lower support bar 110. As shown most clearly in FIG. 7, end 120 of lower support bar 110 has a bore 121 extending laterally therethrough for receipt of a ball 122 which is movable therein. One end of bore 121 has a reduced diameter, at 123, so that ball 122 may extend only partially beyond the side edge of end 120 of lower support bar 110. The other end of bore 121 is internally threaded to receive a set screw 124, a spring 125 being positioned in bore 121, between ball 122 and set screw 124. End 119 of upper support bar 115 has a groove 126 therein, so positioned that when lower and upper support bars 110 and 115, respectively, are in contact, ball 122 projects into groove 126 where it is held by spring 125, thereby locking lower and upper support bars 110 and 115, respectively. On the other hand, lower and upper support bars 110 and 115, respectively, may be readily separated by pulling them apart, whereby ball 122 is forced into bore 121, compressing spring 125, permitting removal of end 120 of lower support bar 110 from end 119 of upper support bar 115.

Referring primarily to FIGS. 1, 3, 4, 6, and 8, cable terminating machine 10 further comprises first cutting means, generally designated 130, positioned intermediate wire support means 40 and 100, for cutting each of the parallel strands of wire 12 along a common plane. Cutting means 130 comprises a plate 131 positioned within a recess 132 in the side of lower support bar 110 opposite from plate 101, plate 131 being connected to lower support bar 110 by a plurality of screws 133. Plate 131 is a generally rectangular member, the side 134 of which in contact with lower support bar 110 providing a cutoff edge and defining the plane for cutting strands 12. Cutting means 130 also includes a blade 135 positioned within a recess 136 in one side of upper support bar 115 and held there by a plurality of screws 137. Blade 135 is positioned relative to plate 131 so that the edge thereof passes immediately adjacent side 134 of plate 131. Therefore, and as shown most clearly in FIG. 8, as upper support bar 115 is brought down into contact with lower support bar 110, blade 135 slides along side 134 of plate 131 thereby cutting all of strands 12 along a plane defined by blade 135.

Cable terminating machine 10 further comprises second cutting means, generally designated 140, positioned intermediate wire support means 40 and cutting means 130, for cutting the outer insulative cover of

strands 12 without cutting the central conductive portion thereof. Second cutting means 140 includes a blade 141 mounted on lower support bar 110, between side 134 of plate 131 and row 45 of grooves 46. More specifically, blade 141 may be positioned in contact with the side of plate 131 opposite to side 134 and may be held thereby screws 133. In this manner, the thickness of plate 131 establishes the required spacing between side 134 and blade 141. In any event, and as shown most clearly in FIG. 4, blade 141 has a plurality of notches 142 in the upper edge thereof, the base of notches 142 being coplanar with or positioned slightly above the upper surface of plate 131. Notches 142 are aligned with grooves 46 of rows 44 and 45 of support means 40 as well as with grooves 103 of row 102 of support means 100. In this manner, each wire 12 extending between support means 40 and 100 is positioned within one of grooves 142. The depth of grooves 142 is sufficient to contain the inner conductor portion of strands 12 but insufficient to contain the non-conductive insulation therearound.

Second cutting means 140 further includes a second blade 142 mounted on upper support bar 115 in such a manner as to cooperate with blade 141 to cut the insulation around the central conductor portion of strands 12. More specifically, blade 143 may be positioned within recess 136 in upper support bar 115 and held in spaced apart, parallel relationship relative to blade 135 by a spacer block 144. By providing aligned holes in blades 135 and 137 and spacer block 144, screws 137 may secure all three elements to upper support bar 115.

The relationship between blades 143 and 141 of second cutting means 140 is such that when lower and upper support bars 110 and 115, respectively, are in contact, as shown in FIGS. 6-8, the cutting edge of blade 143 is positioned just above the upper cutting edge of blade 141. In this manner, blades 141 and 143 cut into the insulation portion of strands 12 without disturbing the central conductor portions thereof, the latter being contained within notches 142. Thus, if wires 12 are now moved in the direction of arrow G, seen in FIG. 8, the conductor portions of strands 12 will slide through notches 142, leaving a length of insulation between blades 135 and 143.

Since the relative positions of blades 141 and 143 of second cutting means 140 is critical, means are provided for adjusting this relationship. Such means consist of a plate 145 connected to the upper surface of upper support bar 115 by screws 146, plate 145 supporting a plurality of threaded studs 147 which extend vertically therethrough and into the top of upper support bar 115. Studs 147 are positioned so as to enter recess 136, directly above blade 143. In addition, the holes 148 in blade 143 through which screws 137 extend are elongated vertically to permit vertical movement of blade 143 relative to screws 137. Thus, to adjust the position of blade 143, screws 137 are loosened and studs 147 rotated to force blade 143 downwardly, toward blade 141. When the desired position of blade 143 is located, screws 137 are tightened, as are a plurality of nuts 149 positioned on studs 147. It should also be noted that plate 131 and block 144 may be exchanged for similar elements having different widths so as to adjust the amount of insulation removed from strands 12.

When upper support bar 115 is elevated relative to lower support bar 110 after the stripping operation, as will be described more fully hereinafter, it is likely that the stripped lengths of insulation will remain wedged between blades 135 and 143. In order to eject these stripped lengths of insulation, cable terminating machine includes a slidable bar 150 positioned between blades 135 and 143, below block 144. As shown most clearly in FIG. 8, the width of bar 150 is narrower than the spacing between blades 135 and 143 whereas the height thereof is less than the portion of blade 143 which extends below block 144. This permits bar 150 to be elevated into the area between blades 135 and 143 so that it will not interfere with the cutting and stripping operation.

The ends 151 of bar 150 are enlarged and extend within slots 152 in upper support bar 115, slots 152 being positioned at the opposite ends of recess 136. A pair of springs 153 positioned between ends 151 of bar 150 and plate 145 exert a downward force on ends 151 of bar 150. Outward movement of bar 150 is limited by a pair of pins 154 extending laterally across upper support bar 115, through slots 152, pins 154 engaging tabs 155 connected to ends 151 of bar 150. Thus, when upper support bar 115 is separated from lower support bar 110, as shown in FIG. 1, springs 153 push bar 150 outwardly so that it extends beyond the edges of blades 135 and 143. On the other hand, when upper support bar 115 is moved into contact with lower support bar 110, as shown in FIGS. 6 and 8, springs 153 are compressed, permitting bar 150 to be withdrawn into the area between blades 135 and 143.

Referring now to FIGS. 1-3, 9, and 11, cable terminating machine 10 further comprises means, generally designated 160, for supporting and retaining connector 13 and for manipulating connector 13 so as to bring contacts 14 thereon into alignment with the now stripped ends of strands 12 of cable 11. More specifically, retaining means 160 is mounted for movement along rails 23 and 24, between the ends thereof and support 21. Retaining means 160 comprises a vertically positioned plate 161 connected at its opposite lower ends to a pair of cylindrical sleeves 162 and 163. Sleeves 162 and 163 surround rails 23 and 24, respectively, to render plate 161 movable along rails 23 and 24. Stops 164 connected to the ends of rails 23 and 24 by screws 165 prevent removal of sleeves 162 and 163 from rails 23 and 24, respectively.

The upper end of plate 161 has a shaft 166 extending horizontally therethrough, shaft 166 being rotatable relative to plate 161 and terminating in the opposite sides 167 and 168 of a generally A-shaped connector holder 169. Set screws or other means may be employed to prevent rotation of shaft 166 relative to holder 169. However, shaft 166 is rotatable relative to plate 161 so as to make holder 169 pivotable between a downwardly tilted position, shown in FIG. 3, and a generally horizontal or slightly upwardly tilted position, shown in FIG. 9.

In order to prevent movement of holder 169 once it is placed in the desired position, plate 161 has a slot 170 in the upper surface thereof so as to expose shaft 166 at a point intermediate the opposite ends thereof. A leaf spring 171 secured to plate 161 by a screw 172, rests against shaft 166 thereby applying a pressure thereto so as to require more than a nominal force to rotate holder 169.

The open ends of sides 167 and 168 of holder 169 have opposed slots 173 and 174, respectively, in the inner surfaces thereof, slots 173 and 174 extending from the top of holder 169 to a point spaced slightly from the bottom thereof. Slots 173 and 174 are adapted to receive the opposite ends of an adapter 175. That is, adapter 175 has a central, generally rectangular section 176, the opposite ends of which rest in slots 173 and 174 in sides 167 and 168, respectively, of holder 169. Adapter 175 is the member which supports connector 13 and, as such, the exact configuration thereof will depend upon the configuration of connector 13. For example, connector 13 may be a conventional telephone connector having a central portion 15 and opposite sides 16 and 17. Side 16 is generally a terminal block made from an insulating material and having a row of electrical contacts 14 on the upper and lower surfaces thereof which are connected to strands 12. Side 17 has two possible configurations, one for the male connector and one for the female connector. As shown in FIGS. 3 and 11, the female connector defines a generally rectangular opening 18 having a row of electrical contacts on the upper and lower walls thereof which connect with contacts 14 on the surfaces of side 16. The male connector, not shown, has a side 17 appearing similar to side 16 of connector 13 but having suitable contacts on the upper and lower surfaces thereof for engaging the contacts in recess 18 of the female connector. As a result, one embodiment of adapter 175 has two sections 177 and 178 on opposite sides of central section 176. Section 177 is the male section and consists simply of a rectangular bar which extends into recess 18 in side 17 of a female connector 13. Section 178, on the other hand, is the female section and consists of a pair of rectangular bars which define a slot 179 to receive the side 17 of a male connector 13. Thus, adapter 175 may be positioned between sides 167 and 168 of holder 169 with either section 177 or section 178 facing support 21, depending upon whether a male or female connector 13 is being wired.

Retaining means 160 of cable terminating machine 10 also includes means for manipulating adapter 175 and connector 13 so as to bring contacts 14 into alignment with the now stripped ends of strands 12. Such means include a pin 180 connected to one end of a leaf spring 181, the other end of leaf spring 181 being connected to side 168 of holder 169 by a screw 182. Side 168 of holder 169 has a hole 183 therein which communicates with slot 174. Spring 181 is so positioned that pin 180 extends through hole 183 and into slot 174, placing a first lateral force on central section 176 of adapter 175. Side 167 of holder 169 has a threaded hole 184 therein which communicates with slot 173 and is generally coaxial with hole 183 in side 168. Hole 184 receives the threaded shaft 185 of a thumbscrew 186, shaft 185 placing a second lateral force on central section 176 of adapter 175 in a direction opposite to the force applied by pin 180. Thus, as shaft 185 is withdrawn from hole 184 by rotating thumbscrew 186, pin 180 and spring 181 push adapter 175 downwardly, as viewed in FIG. 11. On the other hand, as shaft 185 is extended into slot 173 by rotation of thumbscrew 186, the force of spring 181 is overcome, forcing adapter 175 upwardly, as viewed in FIG. 11.

Retaining means 160 of cable terminating machine 10 also includes ejector means, generally designated

188, for removing connector 13 from adapter 175 after all strands of wire 12 have been connected to contacts 14. More specifically, ejector means 188 is a generally A-shaped flat plate having the same general dimensions as holder 169. The sides 189 and 190 of ejector plate 188 extend beneath sides 167 and 168, respectively, of holder 169, the free ends 191 and 192 of sides 189 and 190, respectively, being bent at a 90° angle relative thereto so as to extend between the ends of sides 167 and 168 of holder 169 and central section 15 of connector 13. The central portion 193 of ejector plate 188 extends beyond the end of holder 169 and is also bent upwardly through an angle of 90° relative to sides 189 and 190 so as to support one end of a spring 194. The other end of spring 194 extends into a circular hole 195 in the central portion of holder 169, spring 194 maintaining ejector plate 188 in the position shown in solid lines in FIG. 11 with ends 191 and 192 in contact with sides 167 and 168, respectively, of holder 169. In order to render ejector plate 188 movable relative to holder 169, ejector plate 188 has a plurality of elongated slots 196 in sides 189 and 190, slots 196 receiving screws 197 which extend into sides 167 and 168 of holder 169. In this manner, ejector plate 188 may be moved to the position shown in phantom in FIG. 11, with screws 197 sliding through slots 196. In this position, ends 191 and 192 contact central portion 15 of connector 13, pushing connector 13 off of adapter 175.

As stated previously, retaining means 160 is movable along rails 23 and 24 from a position in contact with stops 164 to a position adjacent support 21. In order to control the exact position of retaining means 160 relative to support 21, retaining means 160 includes a threaded shaft 198 which extends through an internally threaded hole 199 in plate 161. Rotation of shaft 198 by means of a knob 200 adjusts the relative positions of the end of shaft 198 and the end of sleeves 162 and 163, it being the end of shaft 198 which rests against support 21 to establish the position of retaining means 160 relative to support 21.

OPERATION

Cable terminating machine 10 is operative to substantially simplify the problem of preparing a cable, of the type including a plurality of insulated strands of wire, for connection to a connector, of the type including a plurality of spaced, parallel contacts, and for supporting such cable and connector during interconnection. This is achieved, generally speaking, by supporting the individual strands of wire 12 at spaced points along the lengths thereof to permit all such strands to be cut along a common plane. Simultaneously with this first cutting operation, the insulation around each central conductor portion is stripped from the end thereof. Thereafter, the individual strands, having a portion of the ends thereof stripped, are held while the connector is brought into contact therewith, each contacting one of contacts 14. This permits all strands 12 to be connected to all contacts 14 simultaneously.

More specifically, FIG. 1 shows the starting position of cable terminating machine 10, ready to receive cable 11, with the exception of stripping lever 80 which must be moved to the position shown in FIG. 2. A portion of the outer insulative cover of cable 11 is removed so as to expose the individual strands of wire 12. Cable 11 is then positioned in receptacles 33 and 34 by manipulating arm 38 in the direction of arrow A so as to elevate

clamp 35 from receptacle 33. As shown most clearly in FIG. 9, cable 11 is positioned so that only the individual strands of wire 12 extend beyond receptacle 33, the outer cover of cable 11 terminating approximately at receptacle 33.

When cable 11 is so positioned, arm 38 is released whereupon spring 36 moves clamp 35 downward, securely locking cable 11 between receptacle 33 and clamp 35. The individual strands of wire 12 are now ready for positioning within support means 40 and 100. Each strand of wire 12 is positioned, in its proper order, in grooves 46 of rows 44 and 45 of support means 40, such strands extending above wire mesh 56 of friction means 54. At this time, lower support bar 110 is positioned horizontally with end 119 in upright 111 on post 21. Upper support bar 115 is elevated as is upper support bar 42. As shown most clearly in FIG. 3, retaining means 160 is positioned adjacent stops 164, away from support means 40 and 100. Also at this time, handle 84 is in the position shown in solid lines in FIGS. 2 and 3, where plate 25 is closest to post 21.

As each strand of wire 12 is positioned within grooves 46 of rows 44 and 45 of support means 40, such strands may be positioned over lower support bar 110 to engage the mating grooves 103 of row 102 of support means 100. As the end of each strand 12 is inserted into one of grooves 103, wires 106 are deflected thereby locking the individual strands 12 in place, preventing removal thereof. It should also be noted that when each strand of wire 12 is properly located in the mating grooves 46 and 103 of rows 44, 45, and 102, each strand 12 extends through one of notches 142 in blade 141 of cutting means 140.

As mentioned previously, lower support bar 41 is removable from between arms 51 and 52 so that the individual strands of wire 12 may be positioned within grooves 46 of rows 44 and 45 at another location, separate from cable terminating machine 10. If this is done first, cable 11 is brought to machine 10 with lower support bar 41 and positioned on support means 30 and arms 51 and 52, respectively, at the same time. Thereafter, it is only necessary to position the ends of each of such strands in grooves 103 of row 102.

With all of strands 12 properly situated in rows 44, 45, and 102, upper support bar 42 may be pivoted in a direction opposite to arrow B, seen in FIG. 5, to bring rubber pad 64 of friction means 63 in contact with the individual strands of wire 12. With upper support bar 42 so positioned, as shown in FIG. 5, locking lever 66 of locking means 43 is manipulated in the direction of arrow C to extend roller 69 into notch 68, thereby preventing separation of lower and upper support bars 41 and 42, respectively.

With the individual strands of wire 12 firmly locked between friction means 54 and 63, and with the ends of strands 12 which extend beyond support means 40 held securely in grooves 103 of support means 100, it is now possible to accurately cut each of strands 12 along a common plane. This is done by moving a handle 127 connected to end 119 of upper support bar 115 from the position shown in FIG. 1 to the position shown in FIG. 2, in a direction opposite to arrow F, seen in FIG. 6. As upper support bar 115 comes into contact with lower support bar 110, blade 135 of first cutting means 130 moves past side 134 of plate 131, cutting each of wires 12 along a plane defined by blade 135. At the same time, the edge of blade 143 comes approxi-

mately into contact with the edge of blade 141 of second cutting means 140 thereby cutting into the insulation surrounding the conductor portion of wire 12, but not cutting the conductor which is now enclosed within notches 142 in blade 141. At this time, bar 150 is pushed upwardly by the individual strands of wire 12 so as not to interfere with the cutting and stripping operation. It should also be noted that at this time, ball 122 snaps into groove 126 in end 119 of upper support bar 115 thereby releasably interconnecting lower and upper support bars 110 and 115, respectively. Machine 10 is now in the position shown in FIG. 2 and shown in solid lines in FIG. 3.

Movement of handle 84 of stripping lever 80 in the direction of arrow D, seen in FIG. 3, rotates ring 86 thereby pulling arm 88 and plate 25 toward support 22. This has the effect of moving support means 30 and 40, which are mounted on plate 25, relative to support means 100 and cutting means 130 and 140, to the position shown in phantom in FIG. 3. The individual strands of wire 12 are also moved in the direction of arrow G leaving the portion of strands 12 beyond blade 135 on lower support bar 110 and leaving a portion of the insulation on plate 131, between blades 135 and 143. As shown most clearly in FIG. 11, what remains is a portion of each of strands 12 extending beyond support means 40 with an amount of insulation removed from the end of each of strands 12 equal to the spacing between cutting means 130 and 140.

Cable terminating machine 10 is now ready for moving the stripped ends of strands 12 into contact with contacts 14 of connector 13. This is achieved by first rotating handle 127 of upper support bar 115 in the direction of arrow F, seen in FIG. 6. Since lower and upper bars 110 and 115, respectively, are now interconnected by reason of the engagement of ball 122 in groove 126, lower support bar 110 also moves in the direction of arrow F with upper support bar 115. This position of lower and upper support bars 110 and 115 is shown in FIG. 9 where it is seen that there is now an unobstructed area between support means 40 and connector retaining means 160. Stripping lever 80 is moved back to the position shown in FIG. 9, thereby manipulating support means 30 and 40 to its position closest to support 21.

Prior to this time, and as shown most clearly in FIG. 3, holder 169 was tipped downwardly with connector 13 mounted on adapter 175. With reference to FIGS. 9 and 11, plate 161 is now moved along rails 23 and 24 until the end of shaft 198 contacts support 21. Holder 169 is now rotated around shaft 166 until contacts 14 engage the stripped ends of strands 12. The exact longitudinal position of holder 169 and connector 13 relative to support means 40 and strands 12 may be adjusted by turning knob 200.

Typically, individual contacts 14 are semicircular in cross section thereby forming a plurality of receptacles into which the stripped ends of strands 12 are seated. If the lateral position of adapter 175 and connector 13 is such that all of the stripped ends of strands 12 do not fall into the receptacles at the same time, thumbscrew 186 on the side of holder 169 may be rotated back and forth to shift connector 13 laterally thereby permitting each of strands 12 to fall into its associated receptacle.

At this time, since all of the individual strands of wire 12 are firmly supported in contact with the individual

contacts 14 of connector 13, conventional methods may be used to interconnect strands 12 and contacts 14, such as by soldering. When this procedure is completed, connector 13 may be removed from adapter 175 by simultaneously pulling holder 169 towards stops 164 while simultaneously pushing in on central portion 193 of ejector means 188. Ends 191 and 192 of ejector means 188 engage central portion 15 of connector 13, removing connector 13 from adapter 175.

Locking lever 66 of locking means 43 may now be rotated in a direction opposite to arrow C, seen in FIG. 5, thereby disconnecting lower and upper support bars 41 and 42. Then, by rotating upper support bar 41 in the direction of arrow B, seen in FIG. 5, friction means 63 is separated from friction means 54, permitting removal of the individual strands of wire 12 from grooves 46 in rows 44 and 45. Thereafter, by moving arm 38 in the direction of arrow A, cable 11 may be removed from first support means 30, completing the connection process.

Alternatively, and as described previously, connector 13 may be of the type including two rows of contacts 14 on the upper and lower surfaces of side 16 thereof. Therefore, during the previous step, only half of strands 12 would have been connected to connector 13. During this procedure, the remaining strands 12 would have been folded out of the way, such as shown in FIG. 3. Therefore, at the present time, it becomes necessary to connect the remaining strands 12 to the other set of contacts 14 of connector 13. This may readily be achieved by leaving cable 11 within support means 30 but by removing lower support bar 41 from arms 51 and 52. With lower support bar 41 so removed, arm 38 may be moved in the direction of arrow A simply to permit rotation of cable 11 through an angle of 180°. This has the effect of also rotating connector 13 through the same angle. Lower support bar 41 is then returned to its position within recesses 49 and 50 in arms 51 and 52, respectively, with the strands previously connected to connector 13 positioned below lower support bar 41.

Lower support bar 110 is now separated from upper support bar 115, as described previously, and returned to the position shown in FIG. 1, with end 120 thereof resting within upright 111. When lower support bar 110 is separated from upper support bar 115, bar 150 will be urged outwardly by springs 153 to remove the pieces of insulation positioned between blades 135 and 143. The ends of strands of wire 12 will still be positioned within grooves 103, but these may now be removed and discarded. This essentially represents the starting position of cable terminating machine 10 and the procedure is ready to be repeated by positioning the remaining strands 12 in grooves 46 in rows 44 and 45 and in grooves 103 in row 102. Upper support bar 42 is then locked to lower support bar 41 by locking means 43 and upper support bar 115 is moved into contact with lower support bar 110. Stripping lever 80 is then moved in the direction of arrow D to again cut and strip the remaining strands of wire 12. Thereafter, lower and upper support bars 110 and 115 are elevated to the position shown in FIG. 9 and stripping lever 80 is returned to the position shown in FIG. 9. Plate 161 is then slid forward, with holder 169 tilted downwardly, as shown in FIG. 3. Connector 13 is now positioned below lower support bar 41 and may be readily mounted on adapter 175, in the manner described pre-

viously, such as by extending side 177 of adapter 175 into recess 18 in side 17 of connector 13. Thereafter, holder 169 may be rotated around shaft 166, as described previously, to bring the remaining stripped wire ends into contact with the second set of contacts 14. At this time, the already connected wires pass immediately below lower support bar 41, as shown in phantom in FIG. 9.

The remaining steps are identical to those previously described. The ends of strands 12 are soldered to connector 13 and plate 161 is moved along rails 23 and 24 while simultaneously manipulating ejector means 188 to remove connector 13 from adapter 175. Thereafter, upper support bar 42 is released and elevated, freeing the strands positioned within grooves 46 in rows 44 and 45. Lower support bar 41 may now be rotated through an angle of 90° and pulled between the two rows of strands 12. Then, by manipulating arm 38, cable 11 may be removed from support means 30, thereby completing the cable terminating process.

DESCRIPTION OF ALTERNATE EMBODIMENT

As mentioned previously, the embodiment of FIGS. 1-11 of cable terminating machine 10 is small and lightweight, but designed for permanent location at a manufacturing plant or on a mobile facility, such as a truck. Accordingly, cable terminating machine 10 has a substantial base 20 and is designed with this use in mind. However, it is possible to modify cable terminating machine 10 so as to eliminate some of the bulkier portions thereof to form a portable cable terminating machine having the same principles of operation but of a type which may be readily carried in the pocket or tool box of a worker in the field for use where required.

Referring now to FIGS. 12-14, there is shown such a portable cable terminating machine, generally designated 210, for preparing cable 11 for connection to connector 13 and for supporting strands 12 and connector 13 during interconnection. Since cable terminating machine 210 is, in all material respects, identical to cable terminating machine 10, it will not be described in great detail. However, the parts of cable terminating machine 210 which correspond to parts of cable terminating machine 10 will be given similar numbers, increased by a factor of 200.

The primary difference between cable terminating machines 10 and 210 is that base 20, supports 21 and 22, and rails 23 and 24 of cable terminating machine 10 have been eliminated in cable terminating machine 210. Instead, cable terminating machine 210 includes first and second lower support bars 241 and 310 which have been substantially elongated and interconnected by means of a pin 293 for pivotal movement relative to each other. By mounting all remaining components on either support bar 241 or support bar 310, elements 20-24 of cable terminating machine 10 may be eliminated.

Cable terminating machine 210 includes means, generally designated 230, for supporting cable 11 to permit further operation thereon. A second subassembly, generally designated 240, operates to separately support the individual strands of wire 12, at a point spaced from the ends thereof, in spaced apart, parallel relationship, with a spacing equal to the spacing between contacts 14 of connector 13. In order to render support means 30 and 40 commonly movable in a uniform manner,

support means 230 includes an arm 231 connected to a central portion of lower support bar 241, such as by a rivet 232. Arm 231 extends at an angle relative to lower support bar 241 and is then bent, at 233, so that the remainder of arm 231 extends parallel to lower support bar 231, on one side thereof. The free end 234 of arm 231 has a semicircular cross-section so as to receive the bottom half of cable 11. Cable 11 is held on end 234 of arm 231 by means of a second arm 235 positioned above arm 231 with the semicircular end 236 thereof directly above end 234 of arm 231. Arm 235 passes beneath a pin 237 supported directly above the upper surface of arm 231, the other end 238 of arm 235 being bent through two angles so as to be spaced from but parallel to the upper surface of arm 231. A spring 239 positioned between end 238 of arm 235 and the upper surface of arm 231 biases end 236 of arm 235 in contact with cable 11. On the other hand, end 238 of arm 235 may be forced towards arm 231, compressing spring 239, to elevate end 236 thereof to permit removal of cable 11.

Support means 240 includes lower support bar 241 and upper support bar 242 pivotably mounted relative to lower support bar 241 so as to be movable into and out of contact therewith, and means, generally designated 243, for releasably locking together lower and upper support bars 241 and 242, respectively. As was the case in cable terminating machine 10, lower support bar 241 has first and second horizontally spaced rows 244 and 245 of aligned grooves 246 on opposite sides thereof, the spacing between adjacent grooves 246 in each of rows 244 and 245 being equal to the spacing between contacts 14 of connector 13. It should also be noted that ends 234 and 236 of arms 231 and 235 are mounted so as to be approximately centered with respect to rows 244 and 245 of grooves 246.

In the case of cable terminating machine 210, rows 244 and 245 of grooves 246 are made integral with lower support bar 241. Positioned between such two rows is first friction means 254 which may be identical to friction means 54 of cable terminating machine 10.

Positioned at the ends of rows 244 and 245 are a pair of tabs 258 and 259 which support the opposite ends of a pin 262. Pin 262 passes through one end of upper support bar 242 so as to render upon support bar 252 pivotable relative to lower support bar 241 in the same manner as described previously with respect to cable terminating machine 10.

Upper support bar 242 includes second friction means, generally designated 263, which may be identical to friction means 63 of cable terminating machine 10. Furthermore, locking means 243 of cable terminating machine 210 may be identical to locking means 43 of cable terminating machine 10 so as to releasably hold lower and upper support bars 241 and 242, respectively, together during the operation of machine 210. In this position, friction means 254 and 263 are in contact on opposite sides of strands 12, thereby preventing movement thereof through grooves 246.

Cable terminating machine 210 includes means, generally designated 300, for separately supporting the individual strands of wire 12 at a point adjacent the ends thereof in the same spaced apart, parallel relationship as they are supported by support means 240. Support means 300 is essentially identical to support means 100 of cable terminating machine 10 and includes a plate

301 having a single row 302 of grooves 303 spaced along the upper surface thereof, plate 301 being connected to one side of lower support bar 310. Support means 300 may also include a plurality of flexible wires (not shown) similar to flexible wires 106 of cable terminating machine 10 and supported in the same manner relative to grooves 303 of row 302. As shown most clearly in FIG. 13, plate 301 of support means 300 is connected to the side of lower support bar 310 farthest from lower support bar 241, with the individual grooves 303 in row 302 aligned with the individual grooves 246 in both of rows 244 and 245. Furthermore, as stated previously, the other ends of lower support bars 241 and 310 are elongated and interconnected by means of a pin 293 so that they may be brought in contact with each other, as shown in FIG. 13, or separated by a substantial distance, as shown in FIG. 12.

Cable terminating machine 210 further comprises a second upper support bar 315 pivotably mounted relative to lower support bar 310 so as to be movable into and out of contact therewith in the same manner as described previously with respect to lower and upper support bars 110 and 115, respectively, of cable terminating machine 10. More specifically, the end 311 of lower support bar 310 opposite to pin 293 is generally U-shaped to receive one end 316 of upper support bar 315. A pin 312 extends through end 316 of upper support bar 315 and terminates in end 311 of lower support bar 310. A central portion of lower support bar 310, on the other side of plate 301 from end 311, includes a pair of upwardly extending tabs 313 and 314 between which upper support bar 315 extends when in the position shown in FIG. 12. Upper support bar 315 may include a locking mechanism, such as the ball 122 positioned in end 120 of lower support bar 110 of cable terminating machine 10 so as to releasably lock together lower and upper support bars 310 and 315.

As shown most clearly in FIGS. 12 and 13, cable terminating machine 210 comprises first means, generally designated 330, positioned intermediate wire support means 240 and 300 for cutting each of the parallel strands of wire 12 along a common plane and second cutting means, generally designated 340, positioned intermediate wire support means 240 and cutting means 330 for cutting the insulation around wires 12 without cutting the central conductor portion thereof. Since cutting means 330 and 340 of cable terminating machine 210 may be identical to cutting means 130 and 140, respectively, of cable terminating machine 10, no further discussion thereof will be provided.

Support means 310 and cutting means 330 and 340 are movable relative to support means 230 and 240 so as to provide the stripping action described previously with regard to cable terminating machine 10. More specifically, cable terminating machine 210 includes a stripping lever 280 which is pivotably connected to the bottom of lower support bar 310 by any suitable means, such as a pin 281. Stripping lever 290 is movable between a first position shown in FIG. 13 and a second position shown in FIG. 14. Stripping lever 280 controls the relative positions of lower support bars 241 and 310 by means of a pin 285 which extends through lower support bar 310, approximately beneath tabs 313 and 314. Pin 285 has a length which is slightly greater than the width of lower support bar 310 and is adapted to contact one side of lower support bar 241 and one side of stripping lever 280. Thus, when lower support bars

241 and 310 are in contact and parallel, as shown in FIG. 13, pin 285 extends beyond side 286 of lower support bar 310 and holds stripping lever 280 in the position shown in FIG. 13 where the end thereof is spaced from end 287 of lower support bar 310. However, when it is desired to separate wire support means 240 and 300 to remove the insulation from the end of each of strands 12, stripping lever 280 is manipulated in the direction of arrow H to the position shown in FIG. 14. This forces pin 285 through lower support bar 310 where it exits from side 288 thereof. Since it is this side 288 of lower support bar 310 which is in contact with lower support bar 241, pin 285 has the effect of separating lower support bars 241 and 310, as shown in FIG. 14, thus exposing the stripped ends of strands 12.

Referring now exclusively to FIG. 12, cable terminating machine 210 further comprises means, generally designated 360, for supporting and retaining connector 13 with contacts 14 aligned with the now stripped ends of wires 12 of cable 11. More specifically, retaining means 360 is a simplified version of retaining means 160 of cable terminating machine 10, mounted so as to be pivotal relative to lower support bar 241. Retaining means 360 includes a bracket 361, one end of which is connected to the bottom surface of lower support bar 241, such as by means of rivet 232. Thus, bracket 361 is stationary relative to lower support bar 241 and arm 231. Bracket 361 has a slot 362 in one side thereof, into which extends an arm 363. Arm 363 is pivotably mounted within slot 362 by means of a pin, not shown. The other end of arm 363 is connected to a C-shaped holder 369, the opposite sides 367 and 368 of which have opposed slots 373 and 374, respectively, therein which receive the opposite ends of an adapter 375. Adapter 375 is identical to adapter 175 of cable terminating machine 10 and is supported within holder 369 in the same manner as adapter 175 is supported within holder 169. Adapter 375 supports connector 13 which may be moved laterally by turning a thumbscrew 386 which operates in a manner identical to thumbscrew 186 of cable terminating machine 10.

OPERATION OF ALTERNATE EMBODIMENT

The operation of cable terminating machine 210 is identical to that of cable terminating machine 10. FIG. 13 shows the starting position of cable terminating machine 210 where lower support bars 241 and 310 are in contact and wherein arm 363 of retaining means 330 is pivoted downwardly, such as at a 90° angle relative to lower support bars 241. Upper support bars 242 and 315 are pivoted to their vertical positions and stripping lever 280 is positioned at an angle relative to lower support bar 310.

A portion of the outer insulated cover of cable 11 is again removed so as to expose the individual strands of wire 12 and cable 11 is positioned between ends 234 and 236 of arms 231 and 235, respectively, of support means 230, as shown. With cable 11 so positioned, end 238 of arm 235 is released whereupon spring 239 moves arm 235 downwardly, securely locking cable 211 between arms 231 and 235. The individual strands of wire 12 are now ready for positioning within support means 240 and 300. Each strand of wire 12 is positioned in its proper order in grooves 246 of rows 244 and 245 of support means 240 and in grooves 303 of row 302 of support means 300, strands 12 extending above friction means 254.

With all strands 12 properly situated in rows 244, 245, and 302, upper support bar 242 may be pivoted downwardly to the position shown in FIGS. 12 and 13 to bring friction means 263 into contact with the upper sides of the individual strands of wire 12. With upper support bar 242 so positioned, locking means 243 is activated to lock upper support bar 242 to lower support bar 241.

It is now possible to accurately cut each strand of wire 12 along a common plane. This is done by moving upper support bar 315 from the position shown in FIG. 13 to the position shown in FIGS. 12 and 14, in contact with lower support bar 310. As explained previously, as upper support bar 315 comes into contact with lower support bar 310, cutting means 330 cuts each of strands 12 along a common plane. At the same time, cutting means 340 cuts into the insulation surrounding the conductor portion of strands 12, without cutting such conductor portions.

Movement of stripping lever 280 in the direction of arrow H, seen in FIG. 13, moves lower support bar 310 relative to lower support bar 241 to the positions shown in FIG. 14. This has the effect of moving support means 230 and 240 relative to support means 300 and cutting means 330 and 340. The individual strands of wire 12 are removed from cutting means 340, leaving a portion of the insulation therebehind. As shown in FIG. 14, what remains is a portion of each of strands 12 extending beyond support means 240 with an amount of insulation removed from the end of each of strands 12 equal to the spacing between cutting means 330 and 340.

Cable terminating machine 210 is now ready for moving the stripped ends of strands 12 into contact with contacts 14 of connector 13. This is achieved by separating support means 240 and 300 to approximately the positions shown in FIG. 12 and by rotating holder 369 and adapter 375 upwardly until contacts 14 engage the stripped ends of strands 12. If all of the stripped ends of strands 12 do not contact all of contacts 14, thumbscrew 386 may be manipulated to shift adapter 375 and connector 13 laterally, as described previously.

At this time, all of the individual strands 12 may be interconnected to contacts 14 of connector 13 and thereafter removed from cable terminating machine 210 in a manner which should be obvious in view of the similar discussion given with respect to cable terminating machine 10.

It can therefore be seen that in accordance with the present invention, there is provided cable terminating machines which substantially simplify the problem of preparing a cable, of the type including a plurality of insulated strands of wire, for connection to a connector, of the type including a plurality of spaced, parallel contacts. The present cable terminating machines are simple and inexpensive, yet complete the cable termination process in a rapid and efficient manner. Cable terminating machine 10 is small and lightweight, but designed for permanent location at a manufacturing plant or on a mobile facility, such as a truck. Cable terminating machine 210, on the other hand, is portable and readily carried in the pocket or tool box of a worker in the field for use when required.

While the invention has been described with respect to the preferred physical embodiments constructed in accordance therewith, it will be apparent to those

skilled in the art that various modifications and improvements may be made without departing from the scope and spirit of the invention. Accordingly, it is to be understood that the invention is not to be limited by the specific illustrative embodiments, but only by the scope of the appended claims.

I claim:

1. A cable terminating machine for preparing a cable, of the type including a plurality of insulated strands of wire, for connection to a connector, of the type including a plurality of spaced, parallel contacts, comprising:

first means for supporting said cable;

second means connected to said first means for separately supporting the individual strands of said wire, at a point spaced from the ends thereof, in spaced apart, parallel relationship, the spacing between said strands being equal to the spacing between said contacts of said connector;

third means for separately supporting said individual strands of wire, adjacent the ends thereof, in said spaced apart, parallel relationship;

first cutting means positioned intermediate said second and third wire support means for cutting each of said parallel strands along a common plane;

second cutting means positioned intermediate said second wire support means and said first cutting means for cutting the outer insulative cover of said strands without cutting the central conductor portion thereof; and

means for moving said first and second support means relative to said third wire support means and said first and second cutting means to simultaneously remove an amount of cover from the ends of each of said strands equal to the spacing between said first and second cutting means.

2. A cable terminating machine according to claim 1 wherein said second wire support means comprises:

a lower support bar including first and second horizontally spaced rows of aligned grooves, the spacing between said grooves in each of said rows being equal to the spacing between said contacts of said connector;

an upper support bar pivotably mounted relative to said lower support bar so as to be movable into and out of contact therewith; and

means for releasably locking together said upper and lower support bars.

3. A cable terminating machine according to claim 2 wherein said second wire support means further comprises:

first friction means positioned between said first and second rows of grooves on said lower support bar; and

second friction means mounted on said upper support bar and engagable with said first friction means when said upper and lower support bars are in contact to securely hold said strands of wire, thereby preventing movement thereof through said grooves.

4. A cable terminating machine according to claim 3 wherein said lower support bar has a recessed area in the upper surface thereof, between said first and second rows of grooves, wherein said first friction means comprises a first friction element positioned within said recess in said lower support bar, and wherein said second friction means comprises a second friction element

secured to the lower surface of said upper support bar and having dimensions generally equal to the dimensions of said recessed area in said lower support bar and positioned so as to extend into said recessed area when said lower and upper support bars are in contact.

5 5. A cable terminating machine according to claim 2 wherein said third wire support means comprises:

a lower support bar including a third row of grooves, the spacing between said grooves being equal to the spacing between said contacts of said connector, said third row of grooves being positioned in spaced apart, parallel relationship relative to said first and second rows of grooves with the individual grooves in said third row aligned with the individual grooves in said first and second rows.

6. A cable terminating machine according to claim 1 further comprising:

a lower support bar mounted so as to be movable relative to said first cable support means and said second wire support means, said third wire support means being mounted on or made integral with one side of said lower support bar, and wherein said third wire support means comprises:

a plate having a plurality of grooves in the upper surface thereof for receiving said ends of said strands of wire, the spacing between said grooves being equal to the spacing between said contacts of said connector.

7. A cable terminating machine according to claim 6 wherein said third wire support means further comprises:

means for locking said ends of said strands in said grooves in said plate.

8. A cable terminating machine according to claim 6 further comprising:

an upper support bar pivotably mounted relative to said lower support bar so as to be movable into and out of contact therewith, and wherein said first cutting means comprises:

a first cutting element mounted adjacent the other side of said lower support bar; and

a second cutting element mounted on said upper support bar and cooperating with said first cutting element for simultaneously cutting each of said strands when said upper and lower support bars are in contact.

9. A cable terminating machine according to claim 8 wherein said first cutting element comprises a generally rectangular, elongated plate mounted adjacent said other side of said lower support bar, and wherein said second cutting element comprises a blade mounted on said upper support bar and positioned relative to said plate so that said blade passes immediately adjacent one side of said plate thereby cutting all of said strands along a plane defined by said blade.

10. A cable terminating machine according to claim 8 wherein said second cutting means comprises:

a third cutting element mounted adjacent said other side of said lower support bar, between said first cutting element and said second wire support means, said third cutting element including a blade having a plurality of notches in the edge thereof for receiving said individual strands of wire, said notches having a depth and width sufficient to contain said central conductor portion of said strands but not said outer insulative cover; and

a fourth cutting element mounted on said upper support bar and cooperating with said blade of said third cutting element for cutting said cover without cutting said conductor portion.

11. A cable terminating machine according to claim 10 further comprising:

means operatively connected to said upper support bar and positioned between said second cutting element and said fourth cutting element for automatically ejecting the stripped lengths of cover trapped therebetween.

12. A cable terminating machine according to claim 1 further comprising:

means for supporting and retaining said connector relative to said first and second support means; and

means for moving said retaining means relative to said first and second support means to align the contacts thereof with said ends of said strands of wire.

13. A cable terminating machine according to claim 12 wherein said third wire support means and said first and second cutting means are movable away from said second wire support means to permit alignment of said retaining means with said end of said strands.

14. A cable terminating machine according to claim 12 wherein said retaining means is movable laterally and longitudinally relative to said ends of said strands of wire to permit accurate engagement of said ends with said contacts.

15. A cable terminating machine for preparing a cable of the type including a plurality of insulated strands of wire for connection to the individual contacts of a connector comprising:

first means for supporting said cable;

second means rigidly connected to said first means for separately supporting each of said strands of wire, at a point spaced from the ends thereof, in spaced apart, parallel relationship;

third means for separately supporting each of said strands of wire, adjacent the ends thereof, in said spaced apart, parallel relationship, said third means also supporting first cutting means positioned intermediate said second and third wire support means, said first cutting means including:

a first blade having a plurality of notches in the edge thereof for receiving said individual strands, said notches having a depth and width sufficient to contain the central conductor portion of said strands but not the cover therearound; and

a cutting element spaced from said first blade, on the side thereof nearer said third wire support means;

second cutting means movable into and out of contact with said first cutting means, said second cutting means including:

a second blade cooperating with said cutting element for simultaneously cutting each of said strands along a common plane; and

a third blade cooperating with said first blade for cutting said cover without cutting said conductor portion; and

means for moving said first and second support means relative to said third support means and said first and second cutting means to simultaneously remove an amount of cover from the ends if each

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of said strands equal to the spacing between said first and second blades.

16. A cable terminating machine according to claim 15 wherein said second wire support means comprises:

a first bar having first and second horizontally spaced rows of aligned grooves on opposite sides thereof;

a second bar pivotably mounted relative to said first bar so as to be movable into and out of contact therewith; and

means for releasably locking together said first and second bars.

17. A cable terminating machine according to claim 16 wherein said second wire support means further comprises:

first friction means positioned between said first and second rows of grooves on said first bar; and

second friction means mounted on said second bar and engagable with said first friction means when said first and second bars are in contact to securely hold said strands of wire, thereby preventing movement thereof through said grooves.

18. A cable terminating machine according to claim 16 wherein said third wire support means comprises: a third bar having a third row of grooves therein, said third row of grooves being positioned in spaced apart, parallel relationship relative to said first and second rows of grooves, on the other side of said

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first and second cutting means, with the individual grooves in said third row aligned with the individual grooves in said first and second rows.

19. A cable terminating machine according to claim 15 further comprising:

means operatively connected between said second and third blades of said second cutting means for automatically ejecting the stripped lengths of cover from therebetween.

20. A cable terminating machine according to claim 15 further comprising:

means for supporting and retaining said connector relative to said first and second support means; and

means for moving said retaining means relative to said first and second support means to align the contacts thereof with said ends of said strands of wire.

21. A cable terminating machine according to claim 20 wherein said third wire support means and said first and second cutting means are movable away from said second wire support means to permit alignment of said retaining means with said ends of said strands.

22. A cable terminating machine according to claim 20 wherein said retaining means is movable laterally and longitudinally relative to said ends of said strands of wire to permit accurate engagement of said ends with said contacts.

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