United States Patent [19]

Enright et al.

[11] **3,713,214**

[45] **Jan. 30, 1973**

[54] WIRE SPLICE ASSEMBLY STATION

[75] Inventors: **Dennis J. Enright**, St. Paul; **Richard D. Kahabka**, Burnsville; **Donald F. Miller**, St. Paul, all of Minn.

[73] Assignee: **Minnesota Mining and Manufacturing Company**, St. Paul, Minn.

[22] Filed: **Nov. 23, 1970**

[21] Appl. No.: **91,779**

Related U.S. Application Data

[62] Division of Ser. No. 823,598, May 12, 1969, abandoned.

[52] **U.S. Cl.** **29/628,** 29/200, 29/203, 140/113

[51] **Int. Cl.** **H01r 43/00**

[58] **Field of Search** .....29/628, 629, 203 P, 203 DT, 29/200 P; 140/111, 113

[56] **References Cited**

UNITED STATES PATENTS

2,450,974	10/1948	Mallina	29/629
3,394,454	7/1968	Logan	29/629
3,593,403	7/1971	Gurley	140/113 UX
1,738,710	12/1929	Jones	29/629 UX

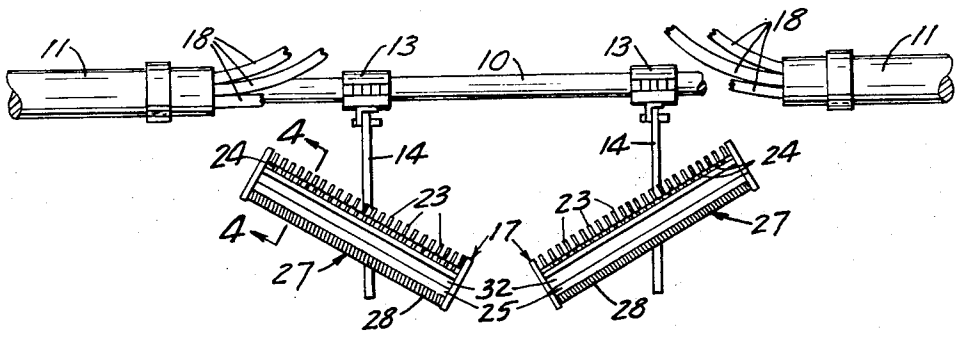
Primary Examiner—Robert L. Spicer, Jr.

Attorney—Kinney, Alexander, Sell, Steldt & Delahunt

[57] **ABSTRACT**

Apparatus and method are described for splicing together the corresponding wire-ends of opposing sections of communications cables using solderless U-connector multiple-layer modules in an assembly station including module supporting means, wire-guiding and wire-separating means, and wire-retaining means.

7 Claims, 6 Drawing Figures



PATENTED JAN 30 1973

3,713,214

SHEET 1 OF 2

FIG. 1

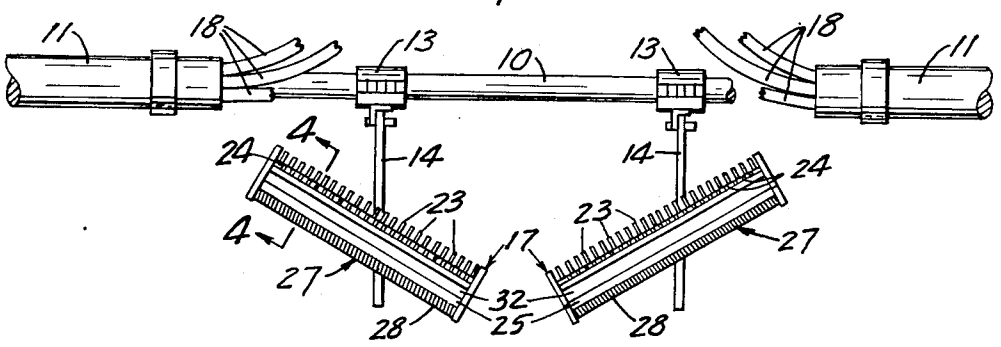


FIG. 2

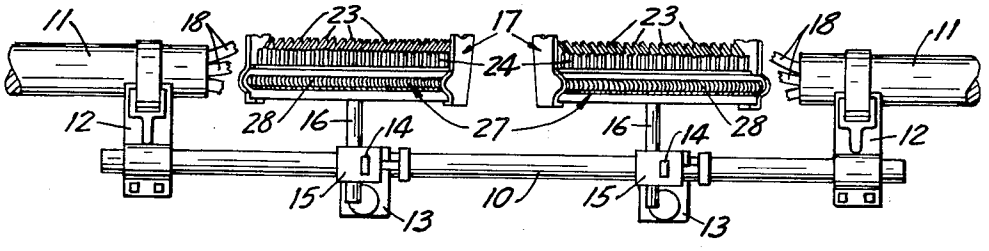
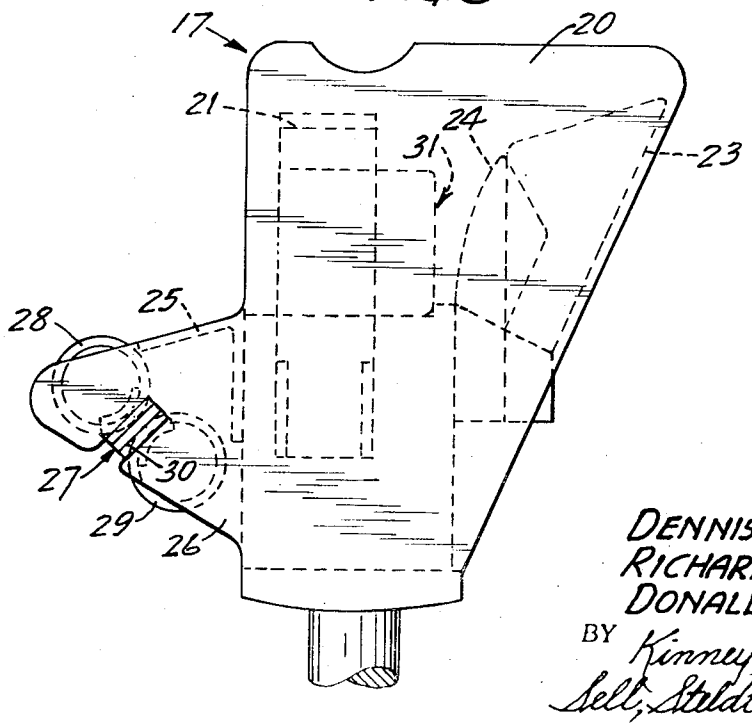


FIG. 3



INVENTORS
DENNIS J. ENRIGHT
RICHARD D. KAHABKA
DONALD F. MILLER
BY Kinney, Alexander, Sell, Steldt & DeLaHunt
ATTORNEYS

FIG. 4

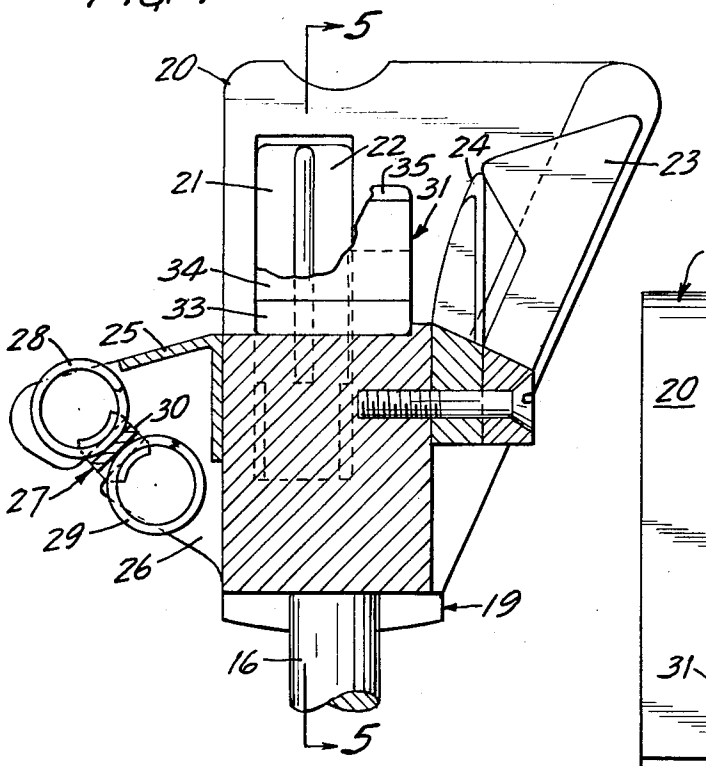


FIG. 5

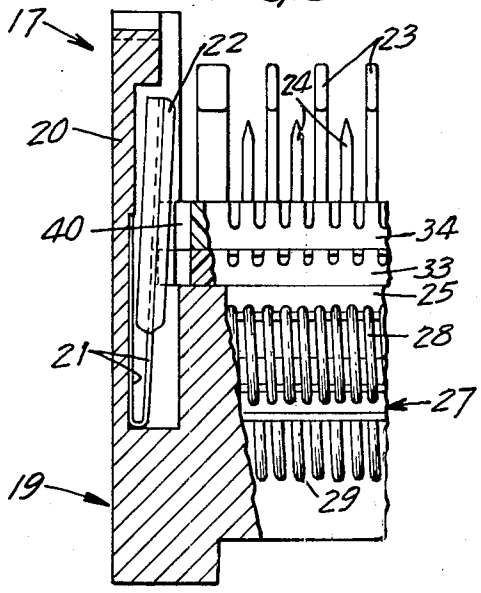
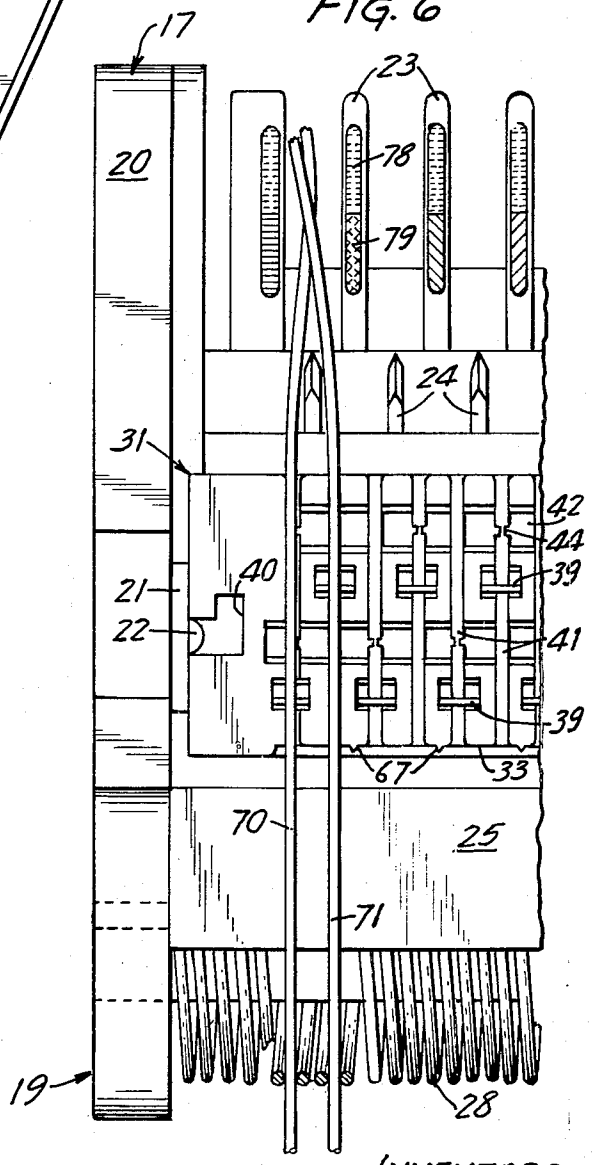


FIG. 6



INVENTORS
DENNIS J. ENRIGHT
RICHARD D. KAHABKA
DONALD F. MILLER
BY Kinney, Alexander
Sell, Steldt & De La Hunt
ATTORNEYS

WIRE SPLICE ASSEMBLY STATION

RELATED U.S. APPLICATION

This application is a division of copending application Ser. No. 823,598 filed May 12, 1969 now abandoned.

This invention relates to the splicing of communications cables. There is provided means and method for making electrical connection between corresponding wire-ends of such cables in a simple, rapid and effective manner, with production of a neatly and compactly assembled, easily traced and tested splice assembly. Stripping of insulation and soldering of wire-ends is avoided. Identity of wires and wire-pairs is easily determined and maintained. A minimum of space is required. All loose wire-ends and connectors are eliminated.

More particularly, the present invention relates to assembly station means for supporting the splicing modules during preparation and completion of the splice. In one important aspect the invention relates to assembly station means comprising module supporting and retaining frame means together with wire guide means and wire-pair separator means. In another aspect there is included frame means for holding the assembly station and cable-ends in position for convenient handling of the several components during the splicing operation.

In the drawing,

FIG. 1 is a plan view, and FIG. 2 a view in front elevation, showing somewhat schematically a presently preferred form of cable-splicing assembly with cable-ends in position for splicing, and including two sorting and splicing stations,

FIG. 3 is an end elevation of one of the sorting and splicing stations of FIGS. 1 and 2 and supporting a splicing module shown in dotted outline;

FIG. 4 is a transverse sectional elevation of the station and module of FIG. 3 taken approximately at line 4—4 of FIG. 1, and FIG. 5 is a partial longitudinal sectional elevation taken at line 5-5 of FIG. 4; and

FIG. 6 is a partial plan view of a sorting and splicing station with the base member of the splicing module in position for entry of wire-ends and with a first pair of wire-ends in position.

FIGS. 1 and 2 illustrate the general positioning of the several parts just prior to splicing together the corresponding conductors of two opposing cable-ends. A tubular frame member 10 is attached between opposing cable ends 11 by clamps 12 and in turn supports clamps 13, braces 14, clamps 15 and pins 16, the latter supporting the sorting and splicing stations 17 which will thus be seen to be capable of rotary, horizontal, and vertical adjustment. Additional support for the frame 10 may be supplied if necessary, for example in the form of extended leg or support members similarly clamped to the frame; but the relatively rigid cable ends themselves ordinarily provide adequate support.

Each cable end contains a number of wire-bundles 18. A typical bundle may contain 25 pairs of twisted color-coded plastic insulated copper wires. Other cables may contain 50 or 100 pairs, of twisted paper- or pulp-insulated wires; and the stations 17 and the connector modules are designed to accept the full number of pairs or some convenient sub-multiple. The position of the stations 17 shown in FIGS. 1 and 2 is particularly

convenient for use by two splicers working together in making fold-back splices, but other positions may be preferred in particular instances. Thus, the two stations may be supported in fixed axial alignment for more convenient operation by an individual splicer; e.g. in making a "no-slack" splice.

The sorting and splicing station 17 is illustrated in more detail in FIGS. 3,4 and 5. A main frame 19 supported on pin 16 terminates in opposing generally triangularly shaped end pieces 20 inwardly vertically channeled to receive a folded flat spring member 21 having an elongate protruding ridge 22 extending towards the opposite end member 20 and serving as a retaining guide for the connector module as will subsequently be described in more detail. The frame 19 is further provided with a series of hook-shaped wire-guides 23 and knife-edged separators 24 aligned in staggered arrangement as more particularly shown in FIGS. 5 and 6. Along the opposite side of the frame 19 there is supplied a narrow shelf 25 between end plates 26 which additionally carry a reversible spring assembly 27 consisting of two elongate coil spring members 28, 29 supported on a resilient frame 30 removably retained within slots in the end plates 26.

A splicing module 31 is supported on the sorting and splicing station 17 in the general position shown at 32 in FIG. 1 and comprises a base member 33, at least 1 body member 34, and a cover member 35 as seen in FIG. 4. Each of these members is extended at both ends to provide a slotted terminal portion wherein an L-shaped slot 40 provides means for aligning and securing the member between the spring members 21 in the ends 20 of the main frame 19.

With the apparatus in readiness as generally shown in FIGS. 1 and 2, and with a module base member 33 in the position 32, an opposing pair of wire-bundles 18 is first anchored in position for making a fold-back splice and with the wire-pair ends positioned for easy access to the appropriate sorting and splicing station 17, the remaining bundles being temporarily retained out of the way. The several wire-pairs of the first of the two bundles are then separately withdrawn and placed between appropriate guides 23, and the individual wires are separated on the separators 24 as shown in FIG. 6 for wires 70, 71 of a first wire-pair. The wire-ends are then laid across the base 33 in the appropriate channels 41, and the end portions are held taut by being inserted between convolutions of the spring 28. In this procedure it is convenient to make the tip connection at the left and the ring connection at the right of the separator 24 in each instance, the ridges 67 indicating the positions of successive wire-pairs. Sufficient guides, separators and channels are provided to accommodate all or a sub-group of the wire-pairs of a bundle.

After the wires of the first bundle are thus located, a body member 34 is placed in alignment over the assembly and forced into contact. Each wire is thereby forced into permanent connection with its contact element and the surplus end is severed by a corresponding blade and is discarded. Alternatively, the application of the closing force may be withheld pending completion of the assembly.

The appropriate wire-pairs of the second of the two wire-bundles are then similarly located and separated,

with the wires again being laid in the appropriate channels in the upper surface of the body **34** and the extended ends of the wires being again temporarily retained in the coil spring **28**. The cover **35** is then positioned and pressed into place. Each wire is thus forced into spring compression reserve contact with its contact element and the surplus end removed. The corresponding wires of the two opposing bundles are thus effectively spliced together. The free wire-end segments are removed from the retainer and discarded. The completed module is then easily removed from the station **17** by simply retracting the spring retainers **21** and lifting the module from the station.

Although other means of imparting the necessary closing force to the module may be used, it is convenient to employ a hydraulic press, which may consist of a rigid frame having retaining end members fitting around the end pieces **20** of the station **17** and one or more self-retracting hydraulic cylinders for applying pressure through a face plate against the upper surface of the module or sub-component thereof, hydraulic pressure being supplied through suitable pump means.

It is sometimes desirable to connect wires of different diameters within a single module, or in different modules. The reversible spring assembly **27** provides for fully adequate retention of wires of any diameter which may effectively be connected, by providing both a tightly wound and a loosely wound coiled spring and means for reversing the position of the two.

Selection of the various wire-pairs of a wire-bundle in accordance with a predetermined color code is conveniently accomplished by reference to color code markings supplied on the exposed upper face of the wire guides **23**, for example at the colored areas **78, 79** as indicated in FIG. **6**. The upper flat surface of the cover **35** of the connector module affords a means for marking the position of specific wires or wire-pairs for convenience in subsequent testing or interconnecting operations. Similarly, the shelf **25** may be provided with an indicia-receiving surface so that the position of particular wire-pairs may be indicated thereon. In an example, a strip of pressure-sensitive adhesive tape placed upon the shelf **25** and marked in accordance with the position of the wires prior to or during the assembly operation may subsequently be removed and applied directly to the completed module, thereby preserving a record of the wire positions.

What is claimed is as follows:

1. An assembly station adapted for use in a modular splicing of communications cables including modules having an interfitting elongate base, body and cover members, said station comprising elongate frame means for supporting said module base, body and cover members in stacked alignment, guide means extending from said frame means for guiding a plurality of wire-pairs toward an appropriate pair of wire-receiving grooves in said module, and separator means extending from said frame means for separating tip and ring wires of each of said wire-pairs for positioning in the appropriate grooves of each said pair of grooves.

2. The assembly station of claim **1** wherein each said guide means includes separator means for designating a specific one of a bundle of separately coded wire-pairs.

3. The assembly station of claim **1** including holding means for temporarily retaining free wire-ends of said wire-pairs laid across a said module member.

4. The station of claim **3** wherein said holding means comprises a reversible assembly of two coil spring wire-retaining members of different coil spacings.

5. The station of claim **1** wherein said frame means includes upright end members each supporting a spring-mounted clamp member for aligning and removably retaining the base, body and cover members of a said module.

6. The assembly station of claim **1** further including support means for supporting said frame means, and adjustable clamp means and main frame means for adjustably locating said assembly station in relation to said cables.

7. The assembly station of claim **1** wherein said elongate frame means includes face plate means in a position parallel and adjacent to the position of said module, for receiving indicia to indicate the position of specific wires in said module during assembly thereof.

* * * * *