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Description

The present invention pertains to improved methods and apparatus for fabricating electrical harness of the type comprising a plurality of electrical connectors terminated to a common plurality of insulated electrical conductors.

Manufacturers of electronic and electrical products today employ electrical harnesses having mass termination connectors with insulation displacement type electrical contacts. One particular type of harness in use today is the "daisy-chain" cable harness having several connectors terminated to a common cable segment. One example of an apparatus for conveniently forming daisy-chain harnesses is described in our EP-A 206 464 (prior art according to Art. 5.4(3) EPC). In that application, an apparatus is described for terminating a plurality of mating pairs of electrical connector parts to a continuous flat cable segment. Termination is accomplished by compressing a predetermined cable portion between a pair of connector parts, one of which has a plurality of insulation displacing terminals positioned therein. Each connector part is located on a rotatable indexing turret, the turrets being movable toward each other to effect termination. In the preferred embodiment, the cable is advanced past the turret in a vertical direction, with the resulting partially formed cable harness being advanced downwardly past the turret. Eventually, after termination of the final connector, the cable harness is cut free for transport to a remote location. The above-described cable harness apparatus is fully automated, for economy of manufacture.

It is an object of the present invention to provide a method and apparatus for testing electrical harnesses in a fully automated fashion.

The present invention provides a method of fabricating a double-ended electrical harness including a plurality of insulated electrical conductors terminated to first and second electrical connectors.

The method includes the steps of terminating a first portion of the conductors to the first connector at a termination station, advancing the terminated first connector past the termination station to present a second portion of the conductors to the termination station, and terminating the second portion of the conductors to the second connector at the termination station. The conductors are cut a predetermined distance beyond the second connector at or after the second termination step to form an intermediate harness product having a test tab consisting of a portion of said insulated electrical conductors projecting beyond said second connector. Said intermediate harness product is then advanced along a delivery track extending past conductor stripping, testing, and trimming stations which strip at least a portion of the insulated conductors of the test tab, test the cable harness by wiping the stripped electrical conductors against a test probe so as to perform electrical testing thereon, generating an output signal in said test probe indicative of desired and undesired conditions of said test result, and trim said intermediate harness in re-

sponse to the output signal to form a finished harness.

The present invention also provides a double-ended harness fabrication machine that terminates a plurality of insulated electrical conductors to first and second electrical connectors. The machine comprises a termination station, means for terminating a first portion of the conductors to the first electrical connector at the termination station, means for advancing the terminated first connector past the termination station to present a second portion of the conductors to the termination station, means for terminating the second portion of the conductors to the second connector at the termination station, means for cutting the conductors a predetermined distance beyond the second connector to form an intermediate harness product having a test tab consisting of a portion of the insulated electrical conductors projecting beyond the second connector, a conductor stripping station for at least partially stripping the insulated conductors of the test tab, a testing station including a test probe for testing the harness product by wiping the stripped electrical conducts thereof as said harness product is advanced therepast, generating an output signal indicative of desired and undesired conditions of the test results, a selectively actuatable trimming station trimming the conductors adjacent the second connector to form a double-ended cable harness, in response to said output signal from said testing station, a delivery track, and means for advancing said harness product from said termination station along said delivery track to said stripping, testing and trimming stations.

One way of carrying out the present invention will now be described by way of example and not by way of limitation with reference to drawings which show one embodiment of apparatus according to the present invention for performing a method of the present invention.

In the drawings, wherein like elements are referenced alike,

FIG. 1 is a plan view of the electrical cable harness testing and delivery apparatus of the present invention showing harness ejection, strip, test, and cable trimming stations;

FIG. 2 is a cross sectional elevational view taken along the lines 2-2 of FIG. 1;

FIG. 3 is an elevation view of the cable stripping station of FIG. 1;

FIG. 4 is an elevation view of the short test station of FIG. 1; and

FIG. 5 is an elevation view of the cable trimming station of FIG. 1.

Referring now to the drawings, and initially to FIG. 1, a machine for fabricating cable harnesses is generally shown at 10 comprising four work stations 20, 22, 24 and 26. Briefly, an intermediate cable harness product 30 is formed above the first eject and delivery station 20, and is ejected along a delivery track 28 communicating between all four work stations. The intermediate cable harness product 30 consists of a cable harness 32, and a protruding ca-

ble portion or test tab 34 used for testing. The cable harness product is then advanced to the second work station 22 where the electrical insulation is stripped from the conductors of the test tab portion of the cable. Thereafter, the intermediate cable harness product is advanced past the third work station 24 where the harness is electrically tested. The protruding test tab portion of the intermediate cable product is then selectively removed at the fourth work station 26.

Referring now to FIGS. 1 and 2, the first work station 20 will be described in greater detail. The electrical cable harness is formed above eject station 20 according to the principles shown and described in our EP-A 206 464. Briefly, insulated electrical conductors 40 are stored on a reel 42 and are paid out in a downward vertical direction indicated by arrow 44. Conductors 40 pass through a conventional cable feed mechanism 46 and a cable guide 48 so as to enter a termination station 50 where they are compressed between two mating connector parts 52, 54. The first connector part 52 has a plurality of insulation displacing terminals, and the second connector part 54 is a mating cover which provides a compressive terminating force and an alignment between conductors 40 and the terminals of connector part 52. A first termination head 56 carries the first connector part 52 and an opposed termination head 58 carries the second connector part 54. Termination heads 56, 58 are mounted on respective indexing turntables 60, 61. As described in the above mentioned European patent application, turntable 60 and the termination head 56 is moveable between a connector loading station, not shown in the figure, and termination station 50. Upon loading of the two connector parts 52, 54, and the feeding of conductors 40 so that a predetermined first conductor portion is presented to termination station 50, actuator 62 is energized to extend plunger 64, thereby extending termination head 56 toward the opposed termination head 58. Accordingly, the conductors 40 are compressed between the connector parts 52, 54 so as to effect termination of conductors 40 therebetween.

Upon termination, heads 56, 58 are retracted and conductors 40, along with the first terminated connector assembly, is advanced downwardly so that a second predetermined conductor portion is presented to termination station 50. Thereafter, the termination cycle described above is repeated as many times as needed to form the desired daisy-chain harness, as explained in said EP-A 206 464.

Upon termination of the last connector assembly for a given harness configuration, the two opposed turntables are indexed to present cable cutting knives to termination station 50. With a compression stroke similar to that required for cable termination, the conductors 40 are effectively severed at station 50. However, as contemplated by the present invention, upon termination of the final connector assembly, termination heads 56, 58 are retracted and conductors 40 are again fed a predetermined amount so as to form the conductor test tab 34 which protrudes beyond the final electrical connector of a given harness assembly. The cable

cutting operation thereby forms test tab 34, while freeing the resulting intermediate harness product for further processing.

With reference to the lower portion of FIG. 2, the emerging cable harness is fed downwardly past eject station 20, which is provided with a pair of opposed extensible gripping arms 72, 74 which are actuated by solenoids 72', 74', respectively. Solenoids 72', 74', are activated to close the gap between gripping arms 72, 74 through which the cable harness descends (either under the force of gravity, or a positive feed system). Gripping arms 72, 74 provide a reference stop surface for the final connector of intermediate harness product 30.

As can be seen in the lower portion of FIG. 2, the section line A-A is taken between termination station 50 and the eject and delivery station 20. This section A-A comprises the right hand portion of FIG. 1, the termination station 50 and its associated subassemblies being omitted for purpose of clarity. Referring now to the right hand portion of FIG. 1, the final electrical connector designated by the numeral 80, which appears at the trailing end of intermediate harness product 30, is shown captivated between gripping arms 72, 74. When in their closed position, gripping arms 72, 74 comprise a slotted delivery track extension portion 82 which mates with the aforementioned delivery track 28.

As indicated in FIG. 1, the section 2-2 is taken to one side of eject and delivery station 20, so that a portion of delivery track 28 appears in the cross-section of FIG. 2. With reference to that cross section, delivery track 28 can be seen to comprise a pair of spaced-apart rail portions 86, 88 forming an intermediate slot 90 for receiving the trailing portion of intermediate harness product 30. Slot 90 can be configured to receive either a portion of conductors 40, or a portion of connector 80. In either event, the trailing end of intermediate harness product 30 is confined to slide along rails 86, 88.

Referring again to the lower portion of FIG. 2, endless drive belts 92, 94 are disposed within rails 86, 88 so as to communicate with slot 90. Drive belts 92, 94 engage the trailing end of intermediate harness product 30 so as to drivingly engage the product for lateral advancement along delivery track 28. In the preferred embodiment, the drive belts engage connector 80, although conductors 40 could also be engaged to provide lateral transport.

At station 20 (see Fig. 1), a solenoid 96 is energized to extend ejector member 98, thereby laterally ejecting connector 80 and intermediate harness product 30 from track portion 82 onto delivery track 28, whereupon drive belts 92, 94 engage intermediate harness product 30 for lateral advancement toward second station 22.

Referring now to FIGS. 1 and 3, the second work station generally indicated at 22 is seen to comprise a pair of notched stripping blades 100, 102, mounted for reciprocation transverse to conductors 40 by their associated solenoids 104, 106. Upon closing or blades 100, 102 so as to at least partially sever the electrical insulation of conductors 40, a third solenoid 108 is energized to raise the stripping blades 100, 102 (and their associated apparatus) in a direc-

tion away from connector 80 so as to at least partially strip conductor test tab portion 34. Solenoids 104, 106 and blades 100, 102 are attached to a unitary support structure generally indicated at 110, mounted for reciprocation in a vertical direction along guide pins 112, 114. Upon being raised, blades 100, 102 are retracted, and an associated gripping apparatus for holding connector 80 against the lifting force of solenoid 108 (not shown in the drawings) is released, so as to release intermediate harness product 30 for further travel toward the third working station 24.

Referring now to FIGS. 1 and 4, the third electrical testing station shown generally at 24 comprises a pair of adjacent electrically separated test probes 120, 122 which wipe against the stripped portion of test tab 34 as intermediate harness product 30 is advanced past station 24. In the preferred embodiment, test probes 120, 122 measure the electrical resistance between a pair of adjacent conductors 40, and generate an electrical signal proportional to the measured resistance, at output terminals 124, 126. Test probes 120, 122 are spaced-apart a predetermined distance approximately equal to the center line spacing of conductors 40, such that test probe 120 contacts one stripped conductor, while probe 122 wipes against its immediately adjacent neighbouring conductor.

By measuring the resistance between a pair of immediately adjacent conductors, the presence and absence of an electrical short in the intermediate harness product 30 can be detected. For example, at the output terminals, a high resistance indicates a desirable absence of a short, and a lower resistance indicates the undesired presence of a short between adjacent conductors of the cable harness. As will be seen immediately below, if a desired absence of an electric short is indicated at output terminals 124, 126, the output signal causes control unit 127 to generate a permissive command at the fourth work station 26 so as to sever the test tab 34 from the intermediate harness product 30, to thereby finish the fabrication of a harness 32. Alternatively, if an undesired presence of a short is indicated in an intermediate harness product 30, control unit 127 generates an interlock signal responsive to the low resistance signal at output terminals 124, 126, to prevent severing of test tab 34 so that, upon presentation of the intermediate harness product to a final delivery station, a ready visual indication of the undesired test result will be apparent to an operator.

Although the above-described test station employs resistance measuring equipment, other electrical testing arrangements can be employed. For example, a ground plane could be positioned between the probes 120, 122 and the anvil 128 supporting stripped conductors 40, so that the capacitance between adjacent conductors and between the conductors and the ground plane can be measured. Alternatively, probe 120 could be energized with a test voltage, and the presence or absence of the test voltage or a portion thereof could be detected at the upstream probe 22.

In either event, regardless of the electrical test result, the intermediate harness product 30 is trans-

ferred to the fourth work station generally indicated at 26, for selective severing of conductor tab portion 34. Referring now to FIGS. 1 and 5, work station 26 can be seen to comprise a moveable cable trimming blade 130 which is driven against an anvil portion 132 by a solenoid 134. In the preferred embodiment, intermediate harness products 30 are transported two-at-a-time along the cable harness machine 10 and accordingly, a duplicate set of severing blades, anvil portions, and solenoids are provided at the fourth work station 26, indicated by numerals 130', 132' and 134', respectively. Conductors 40 are passed through the gap 136 formed between cut-off blade 130 and anvil portion 132. If an undesired electrical test result is indicated at output terminals 124, 126, an interlock signal is generated, preventing actuation of solenoid 134. Accordingly, intermediate harness product 30 is allowed to pass through the fourth work station 26 with the test tab 34 remaining attached, providing a ready visual indication of the undesired test result.

However, if the desired test signal is generated at the third work station 24, a permissive actuation signal is applied to solenoid 134 so that severing blade 130 severs the conductors or test tab 34 immediately adjacent the connector 80, to provide a ready visual indication of the desired test result generated at the third work station 24.

Referring again to FIG. 5, fourth work station 26 can be seen to comprise a conventional lever arm assembly interconnecting the armature 140 of solenoid 134 and the pivotal mounting 142 of severing blade 130. Also shown in FIG. 5 is a moveable stop pin 144 raised and lowered by solenoid 146 to provide a convenient stop surface blocking the path of the connector along the delivery track, providing relative alignment between the connector 80 and severing blade 130.

As can be seen from the above, a completely automated testing and harness delivery system is provided in the cable harness machine described with reference to the drawings. The harness is conveniently electrically tested, and a ready visual indication of the test results is imparted to the harness assembly. Although the harness delivery system is shown mounted in a vertical plane, a similar arrangement, horizontally oriented, could be provided according to the present invention. Also, crimp or pierce type terminals could be employed in the termination of the electrical connectors to the conductors 40 which could be separately formed.

Claims

1. A method of fabricating a double-ended electrical harness (32) including a plurality of insulated electrical conductors (40) terminated to first and second two-piece electrical connectors (52, 54) characterised by the steps of:
terminating a first portion of the conductors (40) to the first connector (52, 54) at a termination station (50),
advancing the terminated first connector (52, 54) past the termination station (50) to present a second

portion of the conductors (40) to the termination station (50),
 terminating the second portion of the conductors (40) to the second connector (52, 54) at the termination station (50),
 cutting the conductors (40) a predetermined distance beyond the second connector (52, 54) at or after the second termination step, to form an intermediate harness product (30) having a test tab (34) consisting of a portion of said insulated electrical conductors (40) projecting beyond said second connector (52, 54);
 advancing said product along a delivery track (28) which extends past conductor stripping (22), testing (24), and trimming (26) stations;
 stripping at least a portion of the insulated conductors (40) of the test tab (34);
 testing the harness (32) by wiping the stripped electrical conductors against a test probe (120, 122) so as to perform electrical testing thereof;
 generating an output signal in said test probe (120, 122) indicative of desired and undesired conditions of said test result; and
 actuating said trimming station (26) in response to the output signal to form a finished harness (32).

2. The method of claim 1 wherein said testing step comprises the step of testing successive pairs of adjacent harness conductors (40) by measuring the electrical resistance therebetween, whereby the presence of an undesired shorting condition and a desired absence of a shorting condition is detected.

3. The method of claim 1 wherein said step of advancing said intermediate harness product (30) comprises engaging an external surface of said second electrical connector with an endless drive belt (92, 94) disposed in said track (28) so that said test tab (34) projects beyond said track (28), being rendered accessible to said test probe (120, 122).

4. The method of claim 1 further comprising the step of preventing actuation of said trimming station (26), in response to an undesired test condition output signal at said testing station (24).

5. The method of claim 3 wherein said terminated first and second connectors (52, 54) are advanced downwardly past the termination station (50) at least partially under the force of gravity, and said product is advanced in a direction along the delivery track (28) generally transverse to the length of said intermediate harness product (30), so that substantial portions of said product (30) are maintained beneath said delivery track (28) so as not to interfere with said stripping, testing and trimming steps.

6. The method of claim 5 further comprising the steps of:
 passing the harness (30) downwardly through a selectively closable gap (72, 74); and
 closing said gap (72, 74) immediately prior to said cutting step so as to block passage of said second connector (52, 54) therethrough, whereby said product (30) is allowed to fall upon completion of said cutting step, thereby trapping said product in said gap.

7. The method of claim 6 wherein the step of closing said gap comprises the step of drawing opposed gripping arms (72, 74) toward each other to form a

track extension (82) matable with said delivery track (28), thereby providing a continuous path for said intermediate harness product (30).

8. The method of claim 7 further comprising the step of pushing said second connector (52, 54) from said track extension (82) to said delivery track (28) so as to engage said second connector (52, 54) with said drive belt (92, 94).

9. A double-ended electrical harness fabrication machine (10) that terminates a plurality of insulated electrical conductors (40) to first and second electrical connectors (52, 54), characterised by a termination station (50),

means for terminating a first portion of the conductors (40) to the first electrical connector (52, 54) at the termination station (50),

means for advancing the terminated first connector past the termination station (50) to present a second portion of the conductors (40) to the termination station (50),

means for terminating the second portion of the conductors (40) to the second connector (52, 54) at the termination station (50),

means for cutting the conductors (40) a predetermined distance beyond the second connector (52, 54) to form an intermediate harness product (30) having a test tab (34) consisting of a portion of the insulated electrical conductors (40) projecting beyond the second connector (52, 54);

a conductor stripping station (22) for at least partially stripping the insulated conductors (40) of the test tab (34);

a testing station (24) including a test probe (120, 122) for testing the harness product (30) by wiping the stripped electrical conductors (40) thereof as said product is advanced therepast, and generating an output signal in said test probe (120, 122) indicative of desired and undesired conditions of the test results;

a selectively actuatable trimming station (26) for trimming the conductors (40) adjacent the second connector (52, 54) to form a double-ended electrical harness (32), in response to said output signal from said testing station (24);

a delivery track (28) extending to said stripping, testing, and trimming stations (22, 24, 26); and
 means (92, 94) for advancing said product (30) from said termination station (50) along said delivery track (28) to said stripping, testing and trimming stations (22, 24, 26).

10. The machine of claim 9 wherein said test probe (120, 122) establishes electrical contact with pairs of adjacent harness conductors (40) and measures the electrical resistance therebetween, generating a first output signal indicating the undesired test condition of electrical shorting between adjacent conductors (40), and a second output signal indicating a desired test condition of the absence of such shorting the machine further including means (127) responsive to an undesired output signal at said testing (24) station for preventing actuation of said trimming station (26).

11. The machine of claim 9 or 10 wherein said delivery track (28) includes a central slot (90) for receiving and guiding a portion of said product (30), and at

least one driven endless belt (92, 94) disposed adjacent said slot (90) for drivingly engaging an outside surface of said product (30) between said stripping, testing and trimming stations (22, 24, 26).

12. The machine of claim 11 wherein said terminated connectors are advanced downwardly past the termination station (50) at least partially under the force of gravity, and said product is advanced along the delivery track (28) in a direction generally transverse to the product length, so that substantial portions of said product are maintained beneath said delivery track so as not to interfere with said stripping, testing and trimming steps, said machine (10) further comprising:

selectively closeable gap means (72, 74) positioned below said termination station (50) and closeable in response to cutting of said conductors (40) so as to block the passage of said second connector (52, 54) therethrough, thereby allowing said product (30) to fall upon cutting of said conductors, and to thereby be trapped in said gap (72, 74).

13. The machine of claim 12 wherein said selectively closeable gap means comprises opposed gripping arms (72, 74) movable toward each other to form a track extension (82) mateable with said delivery track (28) to thereby form a continuous path for said product (30).

14. The machine of claim 13 further comprising means (96, 98) for pushing said second connector (52, 54) from said track extension (82) to said delivery track (28) so as to engage said second connector (52, 54) with said drive belt (92, 94).

Patentansprüche

1. Verfahren zum Herstellen eines zweiendigen elektrischen Kabelbaumes (32), der eine Mehrzahl von isolierten, an erste und zweite zweiteilige elektrische Verbinder (52, 54) angeschlossenen elektrischen Leitern (40) aufweist, gekennzeichnet durch die Schritte, daß

ein erster Bereich der Leiter (40) an den ersten Verbinder (52, 54) in einer Anschlußstation (50) angeschlossen wird,

der angeschlossene erste Verbinder (52, 54) an der Anschlußstation (50) vorbei vorbewegt wird, um einen zweiten Bereich der Leiter (40) der Anschlußstation (50) darzubieten,

der zweite Bereich der Leiter (40) an den zweiten Verbinder (52, 54) in der Anschlußstation (50) angeschlossen wird,

die Leiter (40) in einem vorbestimmten Abstand jenseits des zweiten Verbinders (52, 54) bei der nach dem zweiten Anschlußschritt zur Bildung eines Kabelbaum-Zwischenprodukts (30) mit einer Testfahne (34) abgeschnitten werden, die aus einem Bereich der isolierten, über den zweiten Verbinder (52, 54) hinaus vorstehenden elektrischen Leiter (40) besteht,

das Zwischenprodukt entlang einer Förderbahn (28) vorbewegt wird, die sich an einer Leiterabstreifstation (22), einer -teststation (24) und einer -abtrennstation (26) vorbeierstreckt, zumindest ein Bereich der isolierten Leiter (40) der Testfahne (34) abgestreift wird,

der Kabelbaum (32) durch Entlanggleiten der abgestreiften Leiter an einer Testsonde (120, 122), um deren elektrisches Testen durchzuführen, getestet wird,

ein Ausgangssignal in der Testsonde (120, 122) erzeugt wird, das gewünschte und ungewünschte Zustände des Testergebnisses anzeigt, und die Abtrennstation (26) als eine Folge des Ausgangssignals zur Bildung eines fertigen Kabelbaums (32) betätigt wird.

2. Verfahren nach Anspruch 1, bei dem der Testschritt aus dem Schritt besteht, daß aufeinanderfolgende Paare aneinandergrenzender Kabelbaumleiter (40) durch Messung des elektrischen Widerstands zwischen diesen getestet werden, wodurch das Vorhandensein eines unerwünschten Kurzschlußzustands und das gewünschte Fehlen eines Kurzschlußzustands festgestellt wird.

3. Verfahren nach Anspruch 1, bei dem der Schritt der Vorbewegung des Kabelbaum-Zwischenprodukts (30) darin besteht, daß eine Außenfläche des zweiten elektrischen Verbinders mit einem in der Förderbahn (28) angeordneten Endlosbandantrieb (92, 94) erfaßt wird, derart, daß die Testfahne (34) über die Förderbahn (28) vorsteht und für die Testsonde (20, 22) zugänglich gemacht wird.

4. Verfahren nach Anspruch 1, mit dem weiteren Schritt, daß eine Betätigung der Abtrennstation (26) als Folge eines einen unerwünschten Testzustand anzeigenden Ausgangssignals in der Teststation (24) verhindert wird.

5. Verfahren nach Anspruch 3, bei dem die angeschlossenen ersten und zweiten Verbinder (52, 54) an der Anschlußstation (50) vorbei abwärts zumindest teilweise unter Schwerkraft vorbewegt werden und das Zwischenprodukt in einer Richtung entlang der Förderbahn (28) vorbewegt wird, die im allgemeinen quer zur Länge des Kabelbaum-Zwischenprodukts (30) verläuft, so daß erhebliche Bereiche des Zwischenprodukts (30) unterhalb der Förderbahn (28) gehalten werden, derart, daß sie die Schritte des Abstreifens, des Testens und des Abtrennens nicht störend beeinflussen.

6. Verfahren nach Anspruch 5, mit den weiteren Schritten, daß der Kabelbaum (30) abwärts durch einen wahlweise schließbaren Spalt (72, 74) geleitet und der Spalt (72, 74) unmittelbar vor dem Schneidschritt geschlossen wird, um so den Durchgang des zweiten Verbinders (52, 54) durch diesen hindurch zu blockieren, wodurch das Zwischenprodukt (30) bei Beendigung des Schneidschrittes fallen kann und dadurch das Produkt im Spalt gefangen wird.

7. Verfahren nach Anspruch 6, bei dem der Schritt des Spaltschließens den Schritt umfaßt, daß einander gegenüberliegende Greifarme (72, 74) aufeinander zu zur Bildung einer mit der Förderbahn (28) in Übereinstimmung bringbaren Bahnverlängerung (82) gezogen werden und dadurch eine fortlaufende Strecke für das Kabelbaum-Zwischenprodukt (32) bereitstellen.

8. Verfahren nach Anspruch 7, mit dem weiteren Schritt, daß der zweite Verbinder (52, 54) von der Bahnverlängerung (82) zur Förderbahn (28) geschoben wird, derart, daß der zweite Verbinder (52, 54) mit dem Bandantrieb (92, 94) in Eingriff kommt.

9. Maschine (10) zur Herstellung eines zweiendigen elektrischen Kabelbaums, die eine Mehrzahl isolierter elektrischer Leiter (40) an erste und zweite elektrische Verbinder (52, 54) anschließt, gekennzeichnet durch

eine Anschließstation (50),

eine Einrichtung zum Anschließen eines ersten Bereichs der Leiter (40) an den ersten elektrischen Verbinder (52, 54) in der Anschließstation (50),

eine Einrichtung zum Vorbewegen des angeschlossenen ersten Verbinders an der Anschließstation (50) vorbei, um einen zweiten Bereich der Leiter (40) der Anschließstation (50) darzubieten,

eine Einrichtung zum Anschließen des zweiten Bereichs der Leiter (40) an den zweiten Verbinder (52, 54) in der Anschließstation (50),

eine Einrichtung zum Durchschneiden der Leiter (40) in einem vorbestimmten Abstand jenseits des zweiten Verbinders (52, 54) zur Bildung eines Kabelbaum-Zwischenprodukts (30) mit einer Testfahne (34), die aus einem Bereich der isolierten, über den zweiten Verbinder (52, 54) hinaus vorstehenden elektrischen Leiter (40) besteht,

eine Leiterabstreifstation (22) zum zumindest teilweisen Abstreifen der isolierten Leiter (40) der Testfahne (34),

eine Teststation (24), die eine Testsonde (120, 122) zum Testen des Kabelbaumprodukts (30) durch Entlanggleiten dessen abgestreifter elektrischer Leiter (40) beim Vorbeigang des Produkts an dieser aufweist und ein Ausgangssignal in der Testsonde (120, 122) als Anzeige gewünschter und unerwünschter Zustände der Testergebnisse erzeugt,

eine wahlweise betätigbare Abtrennstation (26) zum Abtrennen der Leiter (40) nahe dem zweiten Verbinder (52, 54) zur Bildung eines zweiendigen elektrischen Kabelbaums (32) als eine Folge des Ausgangssignals von der Teststation (24),

eine Förderbahn (28), die sich zur Abstreif-, zur Test- und zur Abtrennstation (22, 24, 26) erstreckt,

und eine Einrichtung (92, 94) zum Vorbewegen des Erzeugnisses (30) von der Anschließstation (50) entlang der Förderbahn (28) zur Abstreif-, zur Test- und zur Abtrennstation (22, 24, 26).

10. Maschine nach Anspruch 9, bei der die Testsonde (120, 122) einen elektrischen Kontakt mit Paaren benachbarter Kabelbaumleiter (40) herstellt und den elektrischen Widerstand zwischen diesen mißt sowie ein erstes, den unerwünschten Testzustand eines elektrischen Kurzschlusses zwischen benachbarten Leitern (40) anzeigendes Ausgangssignal und ein zweites, einen gewünschten Testzustand des Fehlens eines derartigen Kurzschlusses anzeigendes Ausgangssignal erzeugt, wobei die Maschine des weiteren eine Einrichtung (127) aufweist, die auf ein unerwünschtes Ausgangssignal in der Teststation (24) zur Verhinderung einer Betätigung der Abtrennstation (26) anspricht.

11. Maschine nach Anspruch 9 oder 10, bei der die Förderbahn (28) einen zentralen Schlitz (90) zur Aufnahme und Führung eines Bereichs des Pro-

dukts (30) aufweist und zumindest ein angetriebenes Endlosband (92, 94) dem Schlitz (90) benachbart für einen Antriebseingriff mit einer Außenfläche des Produkts (30) zwischen der Abstreif-, der Test- und der Abtrennstation (22, 24, 26) angeordnet ist.

12. Maschine nach Anspruch 11, bei der die angeschlossenen Verbinder abwärts an der Anschließstation (50) vorbei zumindest teilweise unter Schwerkraft vorbewegt werden und das Produkt entlang der Förderbahn (28) in einer Richtung vorbewegt wird, die im allgemeinen quer zur Produktlänge verläuft, derart, daß erhebliche Bereiche des Produkts unterhalb der Förderbahn gehalten sind, so daß sie nicht mit den Schritten des Abstreifens, des Testens und des Abtrennens in Störeinriff geraten, wobei die Maschine (10) des weiteren eine wahlweise schließbare Spalteinrichtung (72, 74) umfaßt, die unter der Anschließstation (50) angeordnet und als Folge des Durchschneidens der Verbinder (40) schließbar ist, um den Durchgang des zweiten Verbinders (52, 54) durch diese zu blockieren und dadurch dem Produkt (30) die Möglichkeit zu geben, beim Durchtrennen der Leiter zu fallen und dadurch in dem Spalt (72, 74) gefangen zu werden.

13. Maschine nach Anspruch 12, bei der die wahlweise schließbare Spalteinrichtung einander gegenüberliegende Greifarme (72, 74) umfaßt, die zur Bildung einer mit der Förderbahn (28) in Übereinstimmung bringbaren Bahnverlängerung (82) aufeinander zu bewegbar sind, um dadurch eine fortlaufende Strecke für das Produkt (30) zu bilden.

14. Maschine nach Anspruch 13, ferner mit einer Einrichtung (96, 98) zum Schieben des zweiten Verbinders (52, 54) von der Bahnverlängerung (82) zur Förderbahn (28), um den zweiten Verbinder (52, 54) mit dem Bandantrieb (92, 94) in Eingriff zu bringen.

Revendications

1. Méthode de fabrication d'un faisceau (39) de conducteurs électriques à double extrémité équipée comprenant une pluralité de conducteurs électriques (40) isolés raccordés à un premier et à un second connecteurs électriques (52, 54) caractérisée en ce qu'il comporte les étapes consistant à raccorder une première partie des conducteurs (40) à un premier connecteur (52, 54) à un poste de raccordement (50), avancer le premier connecteur raccordé (52, 54) au-delà du poste de raccordement (50) pour présenter une seconde partie des conducteurs (40) au poste de raccordement (50), à raccorder la seconde partie des conducteurs (40) au second connecteur (52, 54) au poste de raccordement (50) à couper les conducteurs (40) à une distance prédéterminée au-delà du second connecteur (52, 54) à ou après la seconde étape de raccordement, pour former un faisceau intermédiaire (30) possédant une prise de test (34) constituée d'une partie des conducteurs électriques isolés (40) s'étendant au-delà du second connecteur (52, 54), à avancer le faisceau intermédiaire le long d'une glissière d'alimentation (28) qui s'étend au-delà d'un dénudeur de conducteurs (22) et des postes de test (24) et de

calibrage (26), à dénuder au moins une partie des conducteurs isolés (40) de la prise de test (34), à tester le faisceau de conducteurs (32) en mettant en contact les conducteurs électriques dénudés contre une sonde de test (120, 122) de façon à réaliser leur test électrique, à produire un signal de sortie sur la sonde de test (120, 122) représentant les résultats du test en fonction de conditions désirées ou non désirées, à mettre en œuvre le poste de calibrage (26) en réponse au signal de sortie de façon à constituer en faisceau (32) terminé.

2. Méthode suivant la revendication 1, caractérisée en ce que l'étape de test comprend l'étape de test des paires successives des conducteurs adjacents du faisceau (40) en mesurant la résistance électrique entre-eux, cette mesure permettant de détecter la présence, non souhaitée, de courts-circuits et l'absence, souhaitée, de courts-circuits.

3. Méthode suivant la revendication 1, caractérisée en ce que l'étape consistant à avancer le faisceau intermédiaire (30) comprend la mise en contact de la surface externe du second connecteur électrique avec une courroie d'entraînement sans fin (92, 94) disposée dans la glissière (28) de façon que la prise de test (34) sorte de la glissière (28) de façon à la rendre accessible à la sonde de test (120, 122).

4. Méthode suivant la revendication 1, caractérisée en ce qu'elle comprend l'étape consistant à empêcher l'actionnement du poste de calibrage (26) lorsque la station de test (24) émet un signal de sortie de condition de test défavorable.

5. Méthode suivant la revendication 3, caractérisée en ce que les premier et second connecteurs raccordés (50, 54) sont avancés vers le bas au-delà du poste de raccordement (50), au moins partiellement sous la force de la gravité, et ledit faisceau est avancé le long de la glissière d'alimentation (28), sensiblement en travers de l'axe longitudinal du faisceau intermédiaire (30) de façon que des parties substantielles du faisceau (30) soient maintenues au-dessus de la glissière d'alimentation (28) de façon à ne pas interférer avec les étapes de dénudage, de test et de calibrage.

6. Méthode suivant la revendication 5, caractérisée en ce qu'elle comprend les étapes consistant à faire passer le faisceau (30) vers le bas au travers d'un intervalle (72, 74) sélectivement obturable, à obturer cet intervalle (72, 74) immédiatement avant l'étape de coupage, de façon à bloquer le passage du second connecteur (52, 54) à travers lequel le faisceau (30) peut passer, de façon à maintenir celui-ci dans ledit intervalle.

7. Méthode suivant la revendication 6, caractérisée en ce que l'étape d'obturation dudit intervalle comprend l'étape consistant à rapprocher des bras de serrage opposés (72, 74) l'un vers l'autre pour former une prolongation ajustable avec la glissière d'alimentation (28) pour fournir un chemin continu au faisceau intermédiaire.

8. Méthode suivant la revendication 7, caractérisée en ce qu'elle comprend l'étape consistant à pousser le second connecteur (52, 54) de la glissière d'extension (82) dans le rail d'alimentation (28) de façon à mettre en contact le second connecteur avec la courroie d'entraînement (92, 94).

9. Machine de fabrication d'un faisceau de conducteurs électriques à double extrémité équipée, qui connecte une série de conducteurs électriques isolés (40) à un premier et un second connecteurs électriques (52, 54) caractérisée en ce qu'elle comporte une station de raccordement (50), des moyens pour raccorder une première partie des conducteurs (40) à un premier connecteur électrique (52, 54) au poste de raccordement (50) des moyens pour avancer le premier connecteur raccordé (52, 54) au-delà du poste de raccordement (50) pour présenter une seconde partie des conducteurs (40) au poste de raccordement (50), des moyens pour raccorder la seconde partie des conducteurs (40) au second connecteur (52, 54) au poste de raccordement (50) des moyens pour couper les conducteurs (40) à une distance prédéterminée au-delà du second connecteur (52, 54) pour former un faisceau intermédiaire (30) possédant une prise de test (34), constituée d'une partie des conducteurs électriques isolés (40) s'étendant au-delà du second connecteur (52, 54), un poste de dénudage de conducteurs (22) pour dénuder, au moins partiellement, les conducteurs isolés (40) de la prise de test (34), un poste de test (24) comportant une sonde de test (120, 122) pour tester le faisceau (30) en mettant en contact les conducteurs électriques (40) dénudés lorsque le faisceau est avancé et produisant un signal de sortie sur ladite sonde de test (120, 122) représentant les résultats du test en fonction des conditions désirées et non désirées, une station de calibrage actionnable de façon sélective, destinée à calibrer les conducteurs adjacents (40) du second connecteur (52, 54) pour former un faisceau de conducteurs électriques à double extrémité équipée en réponse au signal de sortie du poste de test (24), une glissière d'alimentation (28) s'étendant vers les postes de dénudage, de test et de calibrage, des moyens (92, 94) pour faire avancer le faisceau (30) à partir de la station de raccordement (50) le long de la glissière d'alimentation (28) vers les postes de dénudage, de test et de calibrage.

10. Machine suivant la revendication 9, caractérisée en ce que une sonde de test (120, 122) établit un contact électrique avec des paires adjacentes des conducteurs (40) du faisceau et mesure la résistance électrique entre ces conducteurs, et produit un signal électrique indicatif d'une condition de test souhaitée entre les conducteurs adjacents (40), et un second signal de sortie indicatif de l'absence d'une condition de test souhaitée, la machine comprenant de plus des moyens (127) reliés au signal de sortie non souhaité au poste de test (24), permettant d'empêcher la mise en œuvre réalisée du poste de calibrage (26).

11. Machine suivant la revendication 9 ou 10, caractérisée en ce que la glissière d'alimentation (28) comprend une fente centrale (90) destinée à recevoir à guider une portion du faisceau (30), et au moins une courroie d'entraînement sans fin (92, 94) disposée de façon adjacente à la fente (90) pour entraîner par contact une surface externe du faisceau (30) entre les postes de dénudage, de test et de calibrage (22, 24, 26).

12. Machine suivant la revendication 11, caracté-

risée en ce que les connecteurs de raccordement sont avancés vers le bas, au-delà du poste de raccordement (50), au moins partiellement sous la force de la gravité, et le faisceau de câble est avancé le long de la glissière d'alimentation (28), dans une direction sensiblement transversale à l'axe longitudinal du faisceau, de façon à ce que des parties substantielles de celui-ci soient maintenues au-dessus de la glissière d'alimentation (28) de façon à ne pas interférer avec les étapes de dénudage de test et de calibrage, la machine (10) comprenant de plus un intervalle (72, 74), obturable, positionné sous le poste de raccordement (50) et obturable en réponse à la coupe des conducteurs (40) de façon à bloquer le passage du second connecteur (52, 54) à travers lequel le faisceau peut passer, de façon à maintenir celui-ci dans ledit intervalle (72, 74).

13. Machine suivant la revendication 12, caractérisée en ce que l'intervalle obturable de façon sélective comprend des bras de serrage (72, 74) déplaçables l'un vers l'autre pour former une prolongation ajustable avec la glissière d'alimentation (28) pour fournir un chemin continu au faisceau (30).

14. Machine suivant la revendication 13, caractérisée en ce qu'elle comprend des moyens (96, 98) pour pousser le second connecteur (52, 54) du rail d'extension (82) dans la glissière d'alimentation (28) de façon à mettre en contact le second connecteur avec la courroie d'entraînement (92, 94).

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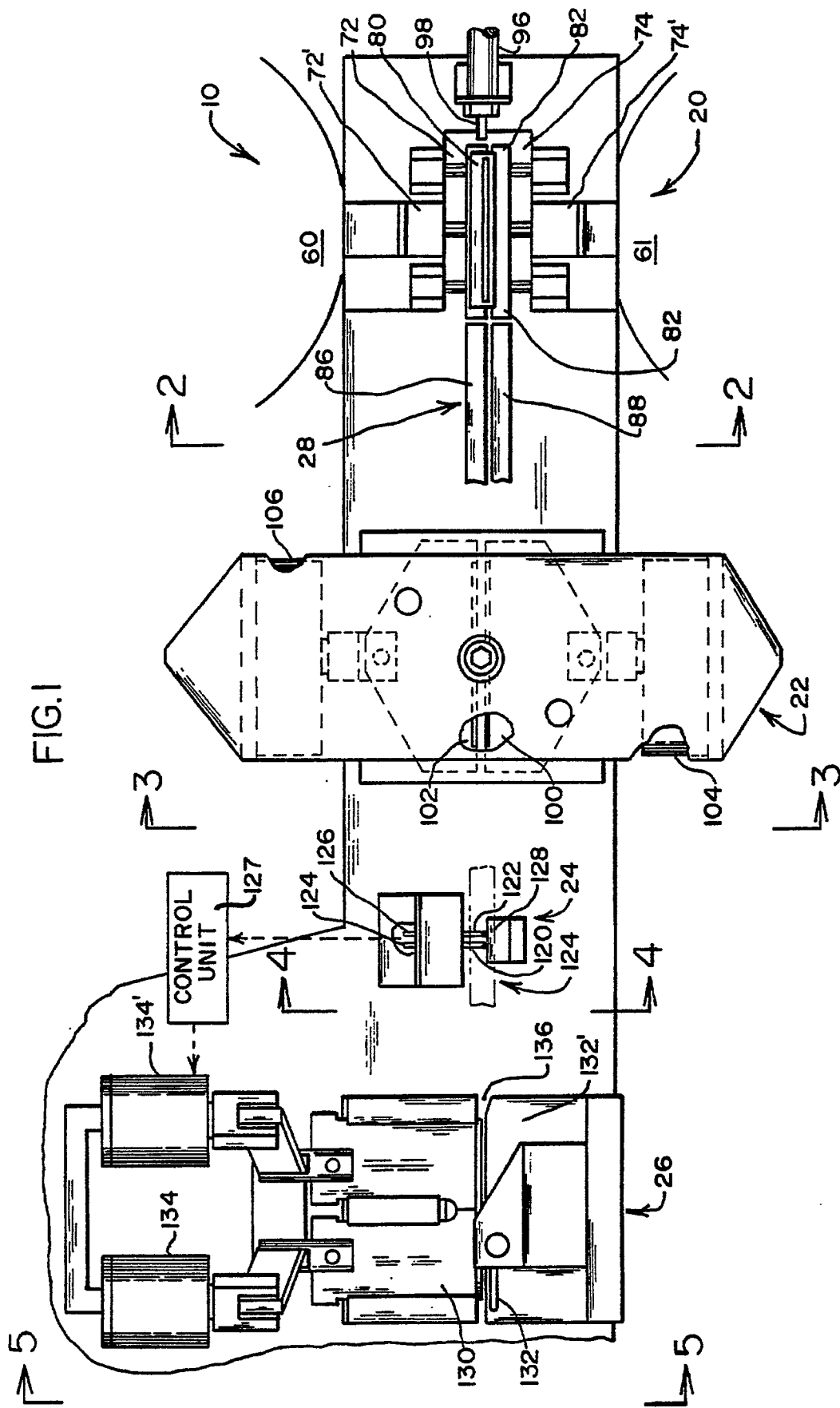
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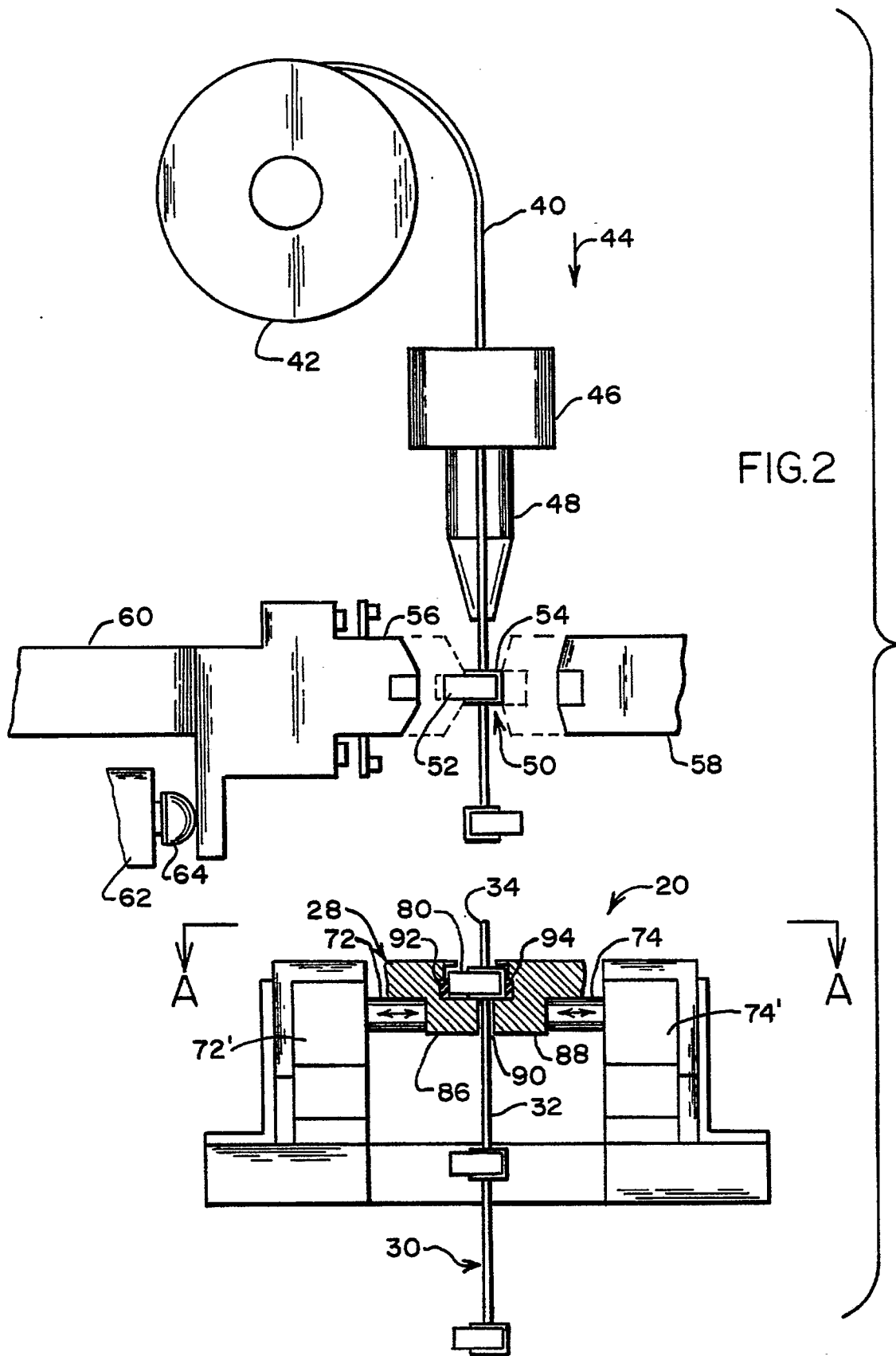
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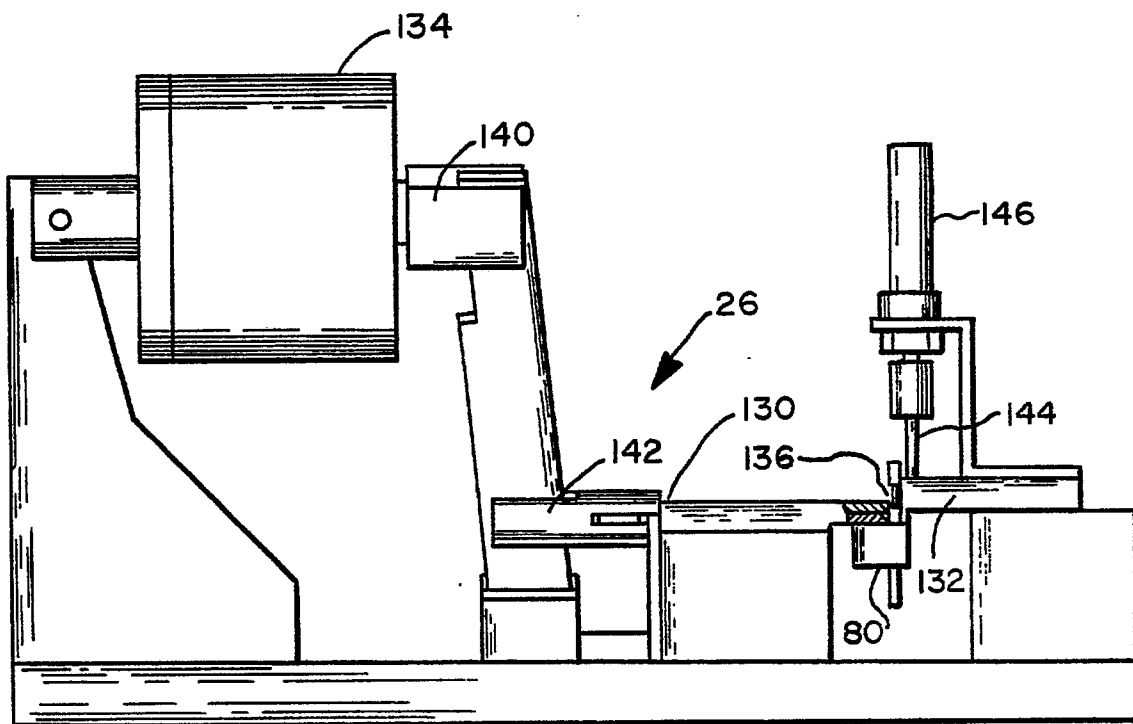


FIG.5