May 20, 1969 J. W. PETERSON ETAL 3,444,607

APPARATUS FOR ASSEMBLING ELECTRICAL CONNECTORS

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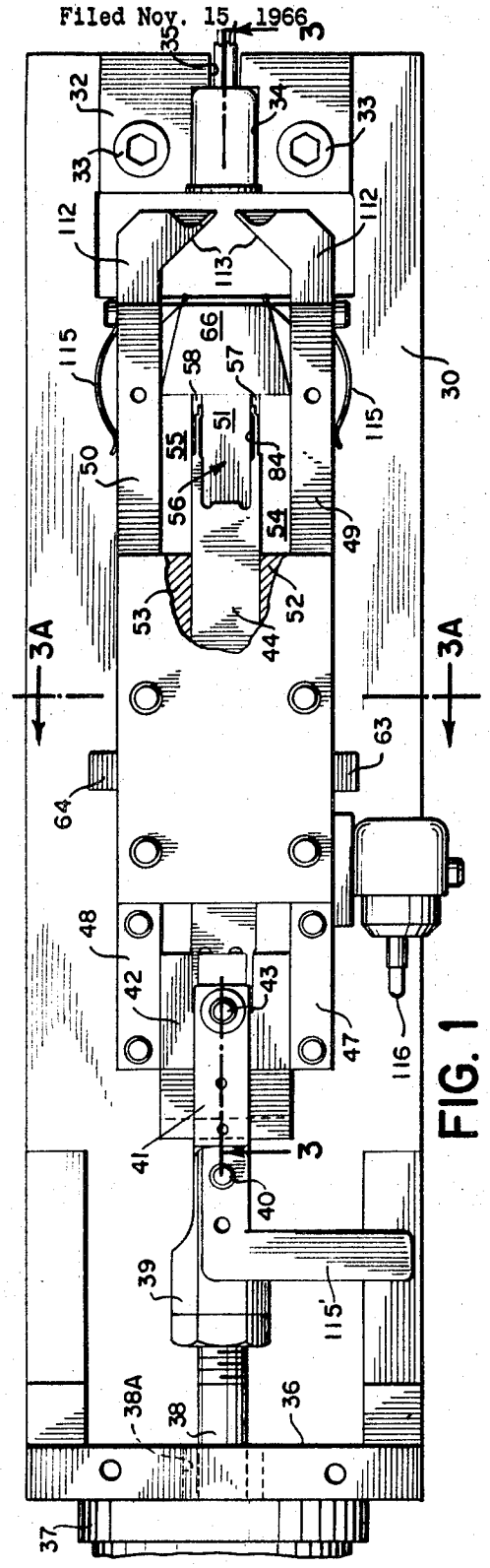


FIG. 1

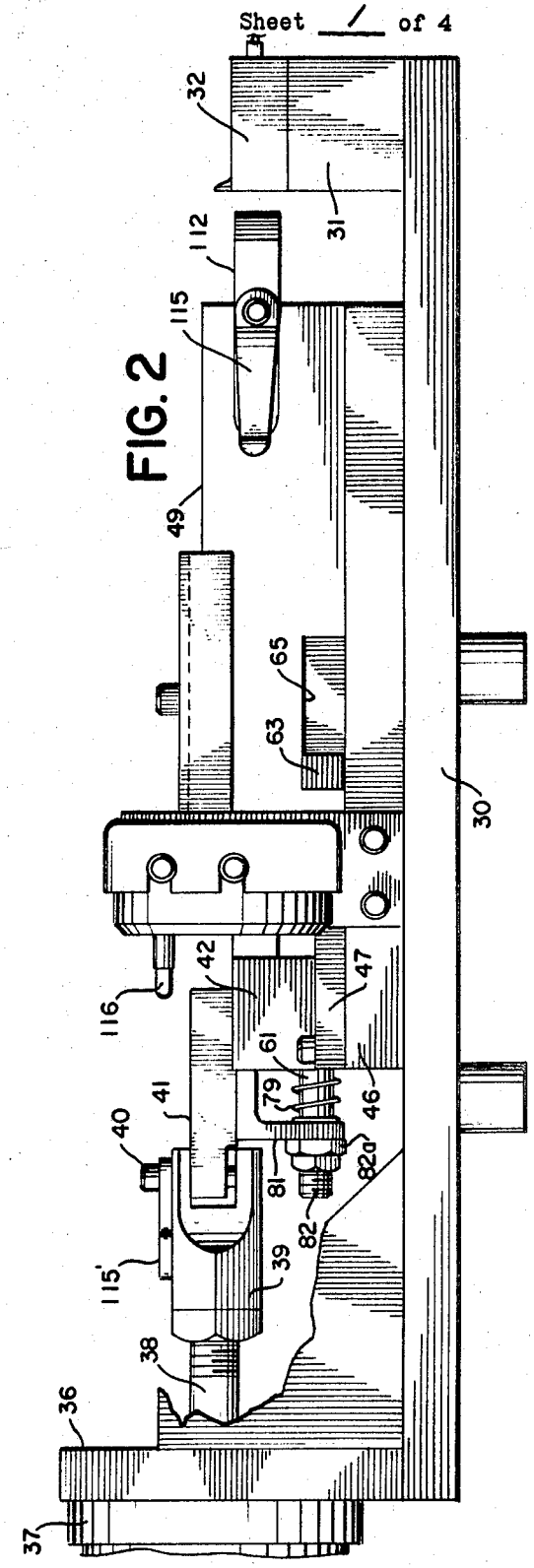


FIG. 2

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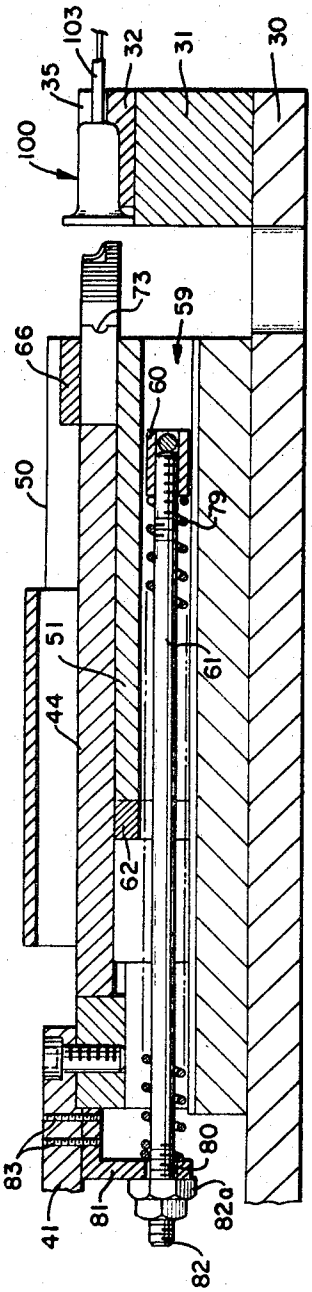



FIG. 3

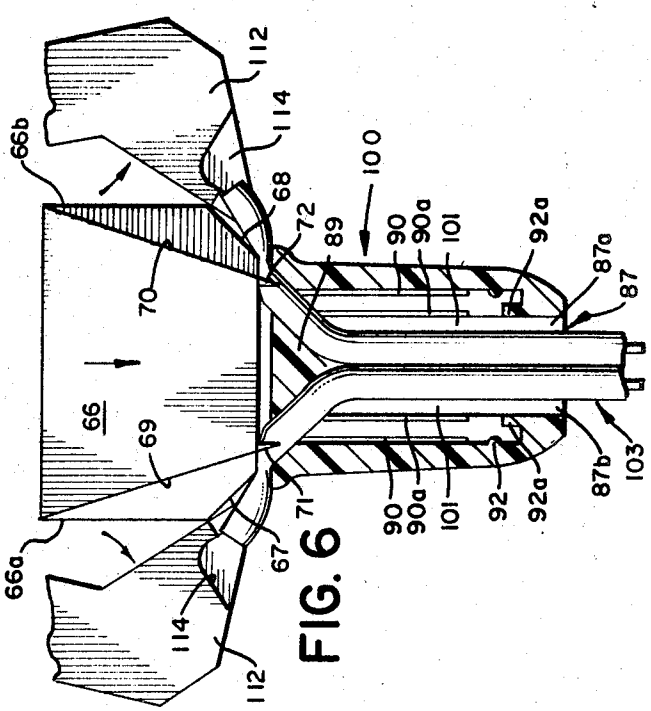



FIG. 6

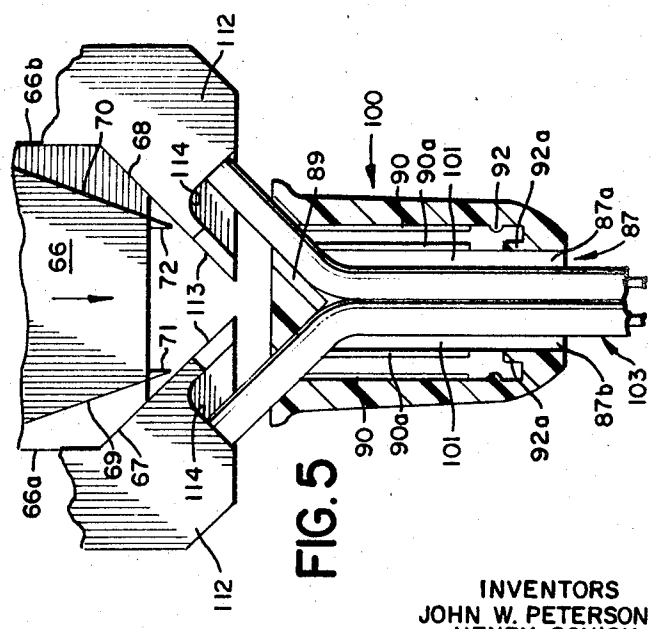



FIG. 5

INVENTORS
JOHN W. PETERSON
HENRY SCHICK

BY Darby & Darby

ATTORNEYS

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FIG. 3A

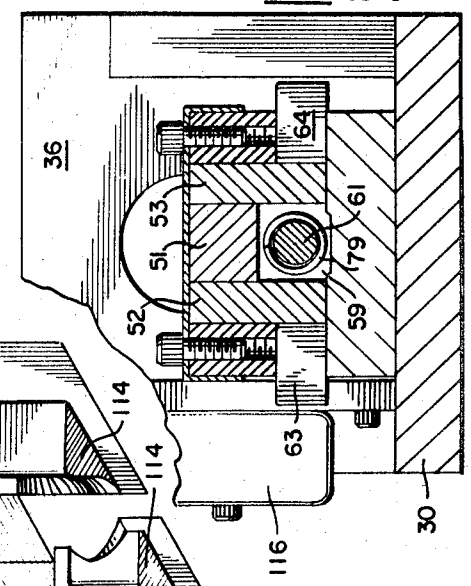



FIG. 4

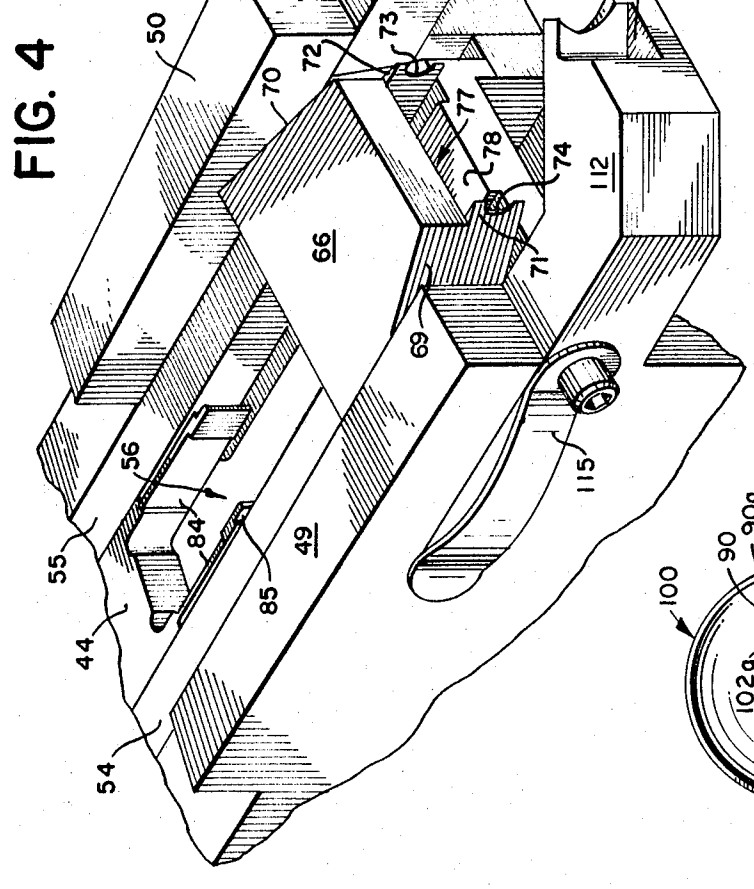
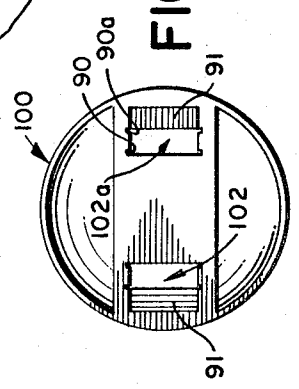



FIG. 13




INVENTORS
JOHN W. PETERSON
HENRY SCHICK

BY

Darby & Darby

ATTORNEYS

May 20, 1969 J. W. PETERSON ETAL 3,444,607

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FIG. 7

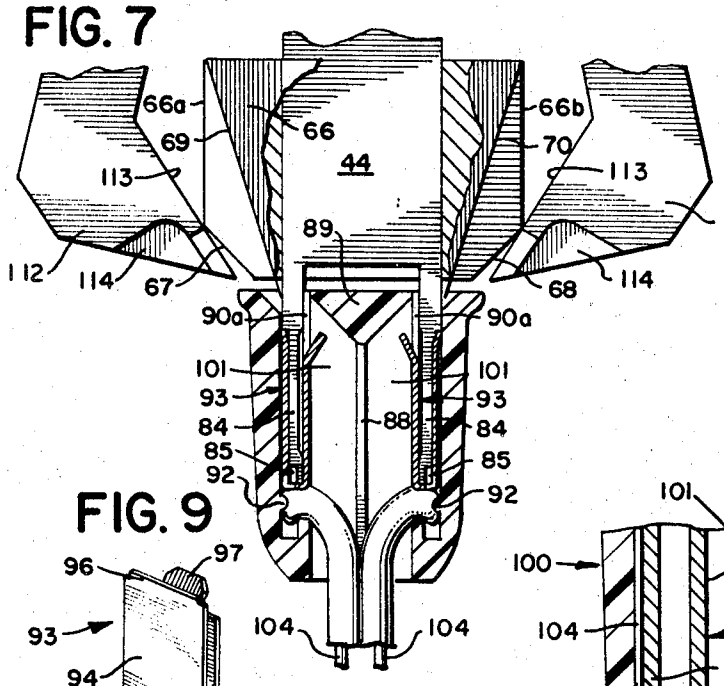



FIG. 8

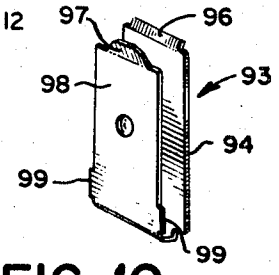



FIG. 9




FIG. 10

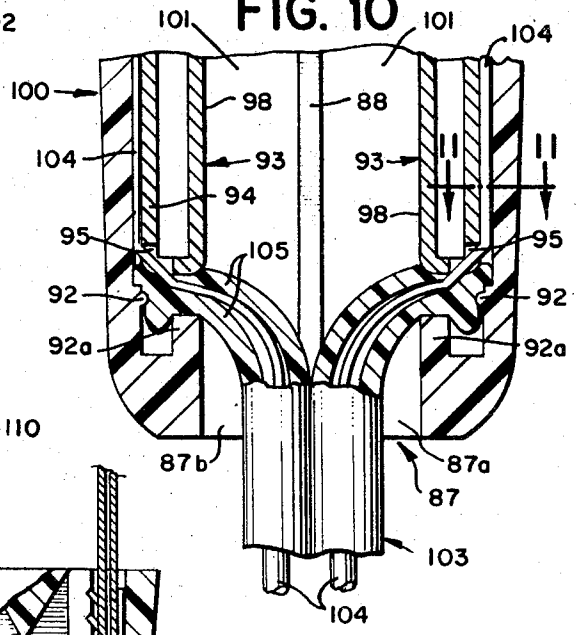
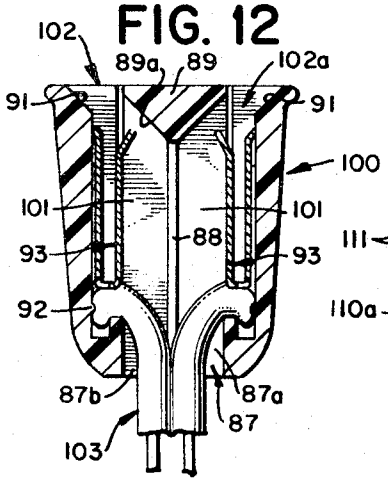



FIG. 12



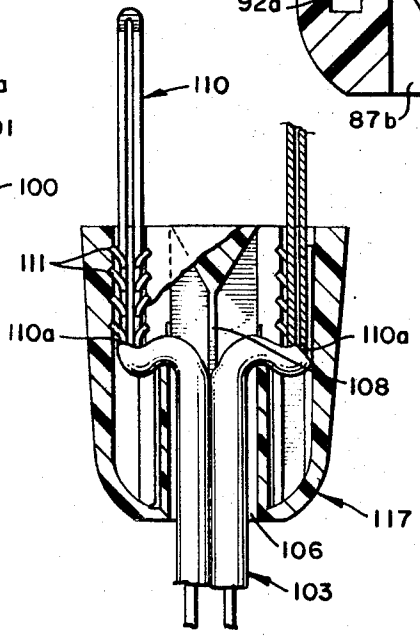
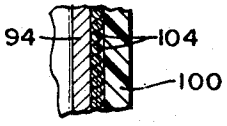




FIG. 14

FIG. 11




INVENTORS
JOHN W. PETERSON
HENRY SCHICK

BY Darby & Darby

ATTORNEYS

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# APPARATUS FOR ASSEMBLING ELECTRICAL CONNECTORS

John W. Peterson, Douglaston, and Henry Schick, Commack, N.Y., assignors to Gilbert Manufacturing Co., Inc.

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Int. Cl. H01r 43/00
U.S. Cl. 29—203
5 Claims

## ABSTRACT OF THE DISCLOSURE

Apparatus for assembling electrical connectors wherein the apparatus includes a pair of channels for orienting the contacts relative to the body of a connector which contains a pair of electrically conductive wires, a pair of arms for separating and locating the electrically conductive wires and a pair of sharp edges which partially sever the insulation of the electrical wires prior to assembly.

This application relates to novel electrical connectors and to an apparatus and method for assemblying the same to a line cord.

In the past, apparatus for assembly of electrical connectors such as male and female connectors used commonly with household alternating current (AC) or direct current (DC) for use with line cords, required that the insulation be stripped from the wires entering the connector in order to provide a secure electrical junction with the electrical contacts of the unit. The stripping of insulation required a separate operation which increased the cost of these items, particularly the common household type of connector.

The electrical connector of the invention described herein is of two types, a male and a female. The male connector or plug includes a housing member having therein an interior chamber. An opening on one side of the housing admits the line cord while a pair of openings on a second side of the housing is provided to receive the plug elements. The plug elements have a U-shaped configuration and are provided with a plurality of barbs at or near the open end to prevent withdrawal of the plug element when it is inserted in the housing. Further, at least one side of the open end of the plug element is provided with a relatively sharp edge to permit it to strip the insulation from the line cord during assembly of the apparatus. Each contact of the plug assembly engages the conductor of a line cord half, by means of frictional contact between the contact, the conductor and one of the walls of the housing.

The female connector or socket of the present invention includes a housing member having a hollow center space and an opening on one side to admit the line cord. A pair of openings is provided on a second side to receive the socket contacts. Each of the contact openings is substantially rectangular in configuration and the two opposite sides of the opening are sloped at an angle to the housing top surface so that the perpendicular distance between the sloped surfaces is greater than the width of the perpendicular opening into the housing, in order to permit the line cord to pass through the opening and at the same time retain a perpendicular passage into the socket within the allowable tolerances.

A pair of electrically conducting socket elements are located within the housing and are substantially U-shaped with the open end of the U accessible to the projecting prongs of a male plug, through the provided openings. Each of the conductive elements is further provided with a notch near the closed end of the U, the notch being in contact with the conductor element of the line cord and being designed to strip the insulation from the line cord during the assembly operation. In the assembled socket the conductor element of each line cord section is frictionally engaged between the housing and the socket element.



Included within the present invention is a novel method of assemblying the connector elements. The method includes the use of the plug or socket conductive elements to simultaneously strip the insulation from the line cord at the same time as the unit is assembled. A novel apparatus is also provided herein for retaining the housing with a line cord in a proper assembly position while at the same time feeding the contacts into the housing and simultaneously stripping the insulation from the line cord.

Connectors and apparatus for assemblying the same of the present invention have the advantage of simplicity of construction including reduced labor in assembly and improved quality. In addition, by sloping the opposing surfaces of the contact opening of the female receptacle it is possible to use a larger line cord than would normally be usable. For example, if the opposing surfaces of the opening are sloped at 45°, it is possible to use a line cord having a diameter of .125 inch with insulation and at the same time retain a perpendicular opening of .105 inch. The connector of the present invention further eliminates the separate stripping operation of the line cord which is often required prior to assembly of the completed apparatus.

An object of the present invention is to provide a machine for assemblying the connector that does not require a separate stripping operation for the line cord prior to assembly.

The invention will be described in greater detail in the specification below and in the drawings in which:

FIG. 1 is a top plan view, shown partly broken away, of the apparatus used to assembly the female electrical connector of our present invention;

FIG. 2 is a side elevational view of the apparatus of FIG. 1, partly broken away;

FIG. 3 is a sectional view along lines **3—3** of the apparatus of FIG. 1;

FIG. 3A is a sectional view along lines **3A–3A** of the apparatus of FIG. 1;

FIG. 4 is an enlarged perspective view of the apparatus of FIG. 1 showing the female contact inserting mechanism;

FIG. 5 is an enlarged plan view of the operating mechanism before the conductors are inserted in the female socket and a cross-sectional view of the socket with the line cord inserted:

FIG. 6 is an enlarged plan view of the operating mechanism showing the insulation of the line cords at the beginning of the stripping operation;

FIG. 7 is a plan view showing the female contact elements being inserted in the connector housing;

FIG. 8 is a perspective enlarged view of one side of the female contact element;

FIG. 9 is a perspective enlarged view of the female contact element showing the opposite side of the view shown in FIG. 8;

FIG. 10 is a plan sectional enlarged view showing the female conductors inserted in the connector housing;

FIG. 11 is a cross-sectional view along line **11—11** of FIG. 10;

FIG. 12 is an enlarged sectional view showing the assembled female electrical connector unit;

FIG. 13 is a view along line **13—13** of the assembled female connectors shown in FIG. 12;

FIG. 14 is an enlarged plan sectional view showing a male connector.

Referring to FIGS. 1–3A the apparatus for assemblying the connector includes a base plate **30** having a mounting block **31** mounted at one end. Affixed to the top of mount-

ing block 31 is a connector housing holding block 32 which has therein a recess 34 designed to accommodate and receive a connector housing or shell. A slot 35 located at the rear of the block leads from the exterior of the block into recess 34 and is of sufficient size to allow the line cord of a connector assembly to lie horizontally in the slot 35 out of the way of the operator of the device. The connector holding block 32 is secured to the mounting block by means of a pair of bolts 33.

At the opposite end of the base plate 30 from the connector mounting block is an upstanding endwall 36 which supports a pneumatic cylinder 37 having a piston shaft 38 which projects through an aperture 38A in said end wall 36. A clevis 39 is attached to the operating end of the pneumatic piston shaft 38 and is in turn attached by means of pin 40 to a driving block 41. A second block 42 is attached to driving block 41 by a screw 43. Attached to the end of driving block 42 opposite driving block 41 (FIG. 3), by means of pin 45, is a contact inserter 44. As will be explained in more detail below contact inserter 44 is directly controlled by the shaft 38 of pneumatic cylinder 37 and with each stroke of the cylinder shaft forces a pair of contact elements into the connector housing.

A bed piece 46 is attached to the center of base 30 of the apparatus. Attached vertically to the top of the sides of bed 46 is a pair of retaining walls 47, 48, 49 and 50. Walls 47, 48, 49 and 50 together with bed 46 form a channel which guides the operation of the contact inserting mechanism.

Located within the channel formed by the side walls and the base is a line cord insulation piercing and restraining member 51 as best shown in FIG. 6. The member 51 has two side walls 52 and 53 which form an open channel 59 on the bottom of the member as shown in FIGS. 3A. A small channel 56 is formed in the top surface of member 51 by upstanding side walls 54 and 55, running substantially the length of the member 51. A pair of grooves 57 and 58 are formed in the bottom wall of channel 56. Each of the grooves is located at the side of the channel and extends back approximately half of the length of the channel from the inserting end of the channel.

Also located in channel 59 at the bottom of member 51 is a threaded socket 60 designed to retain a shaft 61 as will be described in detail below. Socket 60 is attached to member 51 by a fixed connection. Also affixed to member 51 at its rear end is a guide block 62. The guide block 62 contains horizontally outwardly extending lugs 63 and 64. These lugs are designed to slide within slot 65 in side wall 49 and a similar slot in side wall 50. The lugs 63 and 64 limit the longitudinal travel of block 51.

Affixed to the front end of block 51 by any conventional means is an insulation cutting and restraining element 66. The lower portion of cutter 66 has outside walls 66*a* and 66*b* that are substantially parallel to the side walls of block 51. The front edges 67 and 68 of end walls 66*a* and 66*b* are tapered approximately half way down the length of cutter 66. The top half of cutter 66 is cut back at the corners to form narrow tapered side walls 69 and 70 on the upper half of the element.

A pair of cutter elements 71 and 72 project from an extension of walls 69 and 70. The cutters 71 and 72 each have a sharp front edge provided with notches 73 and 74 at their centers. A passageway 77 is located horizontally in cutter 66 and has a rectangular cross-section which is defined on its side walls by the interior walls 69 and 70. The height of the passage 77 is the same as the height of cutter element 71 and 72 and the passage extends the length of the cutter 66. The lower surface of the passage is a continuation of surface 78 on part 51.

Referring to FIG. 3, rod 61 is affixed to receptacle 60 by means of screw threads. Receptacle 60 is in turn affixed to block 51 so that movement of rod 61 forward also moves receptacle 60 in the horizontal direction causing block 51 to move longitudinally within the limits allowed by lugs 63 and 64.



A spring 79 is circumferentially mounted on rod 61 and is restrained at one end by receptacle 60. The end of rod 61 opposite from the receptacle 60 passes through a hole 80 which is provided in the vertical leg of an angle 81. Angle 81 is in turn attached to block 41 by means of screws 83. Rod 61 is fitted with a threaded end 82 and a nut 82*a* mounted on the threads prevents the end of rod 61 from passing through hole 80 when the rod moves in forward direction. Spring 79 abuts angle 81 allowing rod 61 to move rearwardly through hole 80 but limiting its forward movement.

In operation when pneumatic shaft 38 moves forward, angle 81 is also forced forward. Angle 81 therefore pushes spring 79 forward in turn moving receptacle 60 and block 51. On the return stroke of the pneumatic shaft 38 angle 81 engages nut 82 pulling the entire rod 61, receptacle 60 and block 51 rearwardly.

Referring to FIGS. 1–3A and 6, a contact inserter 44 is provided in channel 56 of block 51. The inserter 44 is substantially the same size as the channel and is designed to have a sliding fit therein. The rear end of inserter 44 has a fixed attachment to block 42 by means of pins 45.

The front end of inserter 44 is provided with a pair of outwardly extending contact inserting arms 84. The arms 84 are designed to override small grooves 57 and 58 in channel 56. Each of the inserter arms 84 is provided with a recessed cutout 85 located on the forward outside portion of the arm. The purpose of these cutouts is explained below.

The elements and assembly of the female connector of our construction are shown in FIGS. 5–13. The receptacle housing 100 may be made of any conventional material such as polyethylene, polypropylene or any of the other conventional plastics or rubbers and is provided with any desired exterior configuration. The interior of housing 100 is formed with pair of hollow chambers 101. A pair of separators 88 are located opposite each other on the interior of the side walls of the chamber and extend part way into the chamber with a space therebetween. The separators 88 also extend part way the length of the housing 100 and terminate at the line cord receiving end 87 to form a pair of passageways 87*a* and 87*b* in opening 87, each passage accommodating one of the two halves of a line cord 103. The opposite ends of separators 88 terminate in a solid triangular shaped piece 89 which forms two entrances 102, 102*a* for the male plug and through which the female contact elements are inserted. Sides 91 of the two entrances 102, 102*a* are tapered inwardly at an angle, for example, of 45° with respect to exterior surface 89*a*. This permits a larger diameter wire to be used as will be described in greater detail below.

The housing 100 is further provided with a pair of longitudinal channels 90 and 90*a* located on each side of the interior of the housing to act as a guide for contact elements 93. As shown in FIGS. 12 and 13 the provision of sloped passageways 102 and 102*a* permits use of a larger diameter line cord than could be accommodated by a perpendicular contact opening in the absence of a slope. For example, if the width of the perpendicular opening is .105 inch then by sloping surfaces 89*a* and 91 at 45°, a line cord of .125 inch can be accommodated. A projection 92, the function of which will be explained below, is provided in channels 90 and 90*a* near the line cord receiving end.

The electrical contact element 93 for the socket is shown in detail in FIGS. 8 and 9. It includes a folded over or U-shaped piece of any conventional conducting material such as brass. The leg 94 of the element that is toward the outside wall of the body 100 is slightly wider than the interior leg 98 and is provided at its top edge with an outwardly extending lip 96 of reduced width which acts as a guide for the male contact upon insertion. Guide lugs 99 extend outwardly in the plane of leg 98 from the lower edge of leg 98 near the closed end of the U and are designed to engage channel 90 in housing 100.

The outer leg 94 is also provided with a notch 95 at

the base of the U punched out with sharp corners to sever or push back the insulation of the line cord during the assembly operation.

The operation of the apparatus for assemblying the female connector is shown within FIGS. 4 through 8. A socket housing **100** is placed in receptacle **34** of block **32**. A line cord **103** is split in two halves and fed through opening **87**, each half in turn passing out of the housing through its respective opening **102**, **102***a* by virtue of the increased size of the opening permitted by the use of a 45° angle, on surfaces **89***a* and **91**. At this stage the halves of the line cord naturally tend to separate outwardly on both sides of the exterior of the connector housing.

Pneumatic cylinder **37** is then actuated by a conventional switch mechanism forcing shaft **38** forward. At the same time two electrical contact elements **93** are fed into slots **57** and **58** by a conventional feed mechanism (not shown). The entire operating assembly moves forward forcing contact inserter **44** forward with cutting element **66**.

As tapered surfaces **68**, **69** of cutter **66** move forward they engage corresponding tapered surfaces **113** on spreaders **112**. Spreaders **112** are hinged to supporting wall **49** by means of a conventional hinge and are held in a normal closed position extending parallel to wall **49** by means of springs **115**. Springs **115** act to resist motion in the outward direction by the spreaders.

As shown in FIG. 5, spreaders **112** each engage half of the line cord in notch **114** when the housing and line cord assembly is placed in position for insertion of the contact. As cutter **66** moves forward surfaces **67** and **68** engage surfaces **113** spreading the line cord so that cutting blade **71** and **72**, which cut the insulation of the line cord, can act on the cord. Cutting blades **71** and **72** partially sever the insulation of the line cord without severing the metallic conductor and at the same time maintain the cord in spread position.

When the cord insulation has been severed, lugs **63** and **64** will have reached the forward position of slot **65** and **65***a* and forward motion of block **51** will be stopped. At this point contact inserter **44** which has previously picked up contact elements **93** will continue moving forward acting against spring **60** which acts against angle **81**. The contacts **93** will pass through opening **77** in cutter **66**, as is shown in FIG. 7. As previously disclosed, each contact **93** has a notch **95** near the base of the U. This notch is positioned facing outwardly on the arms **84** of the inserter and overlapping recess **85** of arm **84**. As the inserter moves forward, notch **95** will engage the previously severed insulation of the line cord and will continue to force the line cord inwardly stripping the wire of the insulation at the same time and forcing it inwardly toward the base of the housing while leaving the wire in place.

Inserter **44** continues forward progressively stripping the insulation of the line cord and frictionally engaging the stripped wire of the line cord between leg **94** and the interior surface of the outside wall of the socket housing thereby making electrical contact between the wire and the contact element. The forward travel of the inserter is controlled by angle **115** which is attached to clevis **39**. Angle **115** at the forward end of its stroke closes a push-pull limit switch **116** which readies the apparatus for another cycle.

An assembled socket shown in FIGS. 10–12 comprises a line cord **103**, a connector body **100** and a pair of contacts **93**. In the assembled unit one end of the line cord **103** passes through opening **87** which is where it is split so that each wire of the line cord passes into one of the chambers **101** of the housing. The wire **104** of each half of the line cord passes upwardly and is wedged against the interior wall of the housing by means of contact **93**. The outer wall **94** of the contact is in groove **90** and is held against the inside wall of the housing while the interior wall **98** is substantially free to pivot, being held at its bottom end only by projection **99** which lies in groove **90***a*. The insulation **105** of line cord **103** is compressed downwardly at the bottom of the housing and is held in place by means of the pressure of the contact **93**, projection **92**, the wall of the housing **100** and lip **92***a* in the base of the housing. The notch **95**, in the completed article, abuts the insulation of line cord **103**. The line cord wire **104** essentially free of insulation, is compressed between the inside wall of the housing **100** and leg **94** of the contact as shown in FIG. 11.

In an assembled unit contact **93** has a spring action which allows it to grip the male plug with a tight electrical contact when the male contact is inserted into the socket between legs **94** and **98**.

The assembled socket has the advantage of permitting the use of a larger line cord element than would normally be accommodated by the specific size of socket opening permitted by the electrical specifications. Further use of a notch **95** at the base of the U-shaped contact permits assembly of the electrical connector without pre-stripping the line cord. The disclosed socket provides secure electrical contact between the contact element and the line cord. The assembly method is simple to perform so that virtually unskilled labor may be employed and eliminates any necessity for a soldered or mechanically attached connection between the cord and the contact element of the socket.

The above description has been primarily with reference to the assembly of a female socket. In order to adapt the device shown and described to insert a male contact member in a male connector assembly, leg **84** of inserter **44** is modified to provide a U-shaped opening facing toward the front of the assembly. The U-shaped leg will then be capable of receiving a contact element **110** as shown in FIG. 14 in its cavity and forcing it forward in the same manner as element **93**. Contact **110** is also provided with a sharp edge **110***a* to simultaneously strip insulation from the line cord during assembly like edge of notch **95** of the female connector. The switch **116** must be adjusted to provide for the changed travel that is required with the male member. Once element **110** has been inserted into the housing, barbs **111** will prevent it from moving outwardly. Line cord **103** is stripped of insulation in the same manner as described with respect to the female contact **93** and wire **104** will be frictionally engaged between male member **110** and the wall of the housing.

The assembled male connector is shown in FIG. 14 and has the same general configuration as its female counterpart. Entrance **106** of the housing **117** admits the line cord **103** which is split by separators **108** which extend part way down the length of the plug housing. Wire **104** located in each line cord half is frictionally engaged with the male contact element **110**. The contact element **110** is a U-shaped piece of conductive material such as brass having a series of outwardly facing barbs **111** at its open end which prevent removal of the contact after assembly. The male contacts are inserted in the opposite manner from the female contacts, i.e., closed end facing outward.

While preferred embodiments of the invention have been described above, it will be understood that these are illustrative only, and the invention is limited solely by the appended claims.

We claim:

**1.** Apparatus for assembling an electrical connector comprising in combination means for retaining a connector housing body having a pair of openings therein and a pair of insulated wires extending one from each opening, means for spreading the ends of the pairs of wires apart and retaining them in a spread position, means for partially piercing the insulation on said wires while in said spread position adjacent said openings and means for inserting an electrical contact into each of said pair of openings and simultaneously stripping the insulation from the wires and effecting electrical contact between the contacts and the wire.

**2.** Apparatus according to claim **1** in combination with an electrical connector, said connector comprising a housing body retained by the means for retaining the housing

body, said housing being further provided with an opening on one side and a pair of openings on a second side, a 2 part insulated electrical line cord located in said first opening and a pair of electrical contacts, each of said contacts being located in one of the pair of openings, and being provided with a sharp edge interior of the housing, each of said electrical contacts being in electrical connection with half of the line cord, whereby during assembly the means for inserting said electrical contacts forces said sharp edge of said contact against the partially pierced insulation and simultaneously strips said insulation and inserts said contact.

3. Apparatus according to claim 2 wherein the electrical contacts are U-shaped, with the opening of the U toward the outside of the housing, and the sharp edge for partially removing the insulation from the insulated wire comprises a notch having at least one sharp edge located near the base of the U, said notch being located on the side of the U in contact with the line cord so as to abut said insulation.

4. Apparatus according to claim 2 wherein the electrical contact is rectangular in shape, having two long sides and two short sides, and the means for partially removing the insulation from the insulated wire comprises a sharp edge on one of the short sides of said contact, said sharp edge being located on the side of the contact in electrical connection with the line cord.

5. Apparatus according to claim 1 in combination with



an electrical connector, said connector comprising a housing body retained by the means for retaining the housing body, a line cord and a pair of electrical contacts, said housing being further provided with an opening on one side and a pair of openings on a second side, each of said second pair of openings having at least two sides sloped from the perpendicular, said sloped sides being parallel to each other, and the sides of the opening on the perpendicular through which the contacts are inserted is less than the perpendicular distance between the sloped sides whereby during assembly the wires can be spread apart and held in the spread position by the sloped openings and a line cord larger in diameter than the perpendicular opening can be utilized.

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THOMAS H. EAGER, *Primary Examiner.*

U.S. Cl. X.R.

29—206, 628; 339—97