Dec. 2, 1969 R. SENIOR 3,482,205

RECESSED CONTACT ELECTRICAL CONNECTOR

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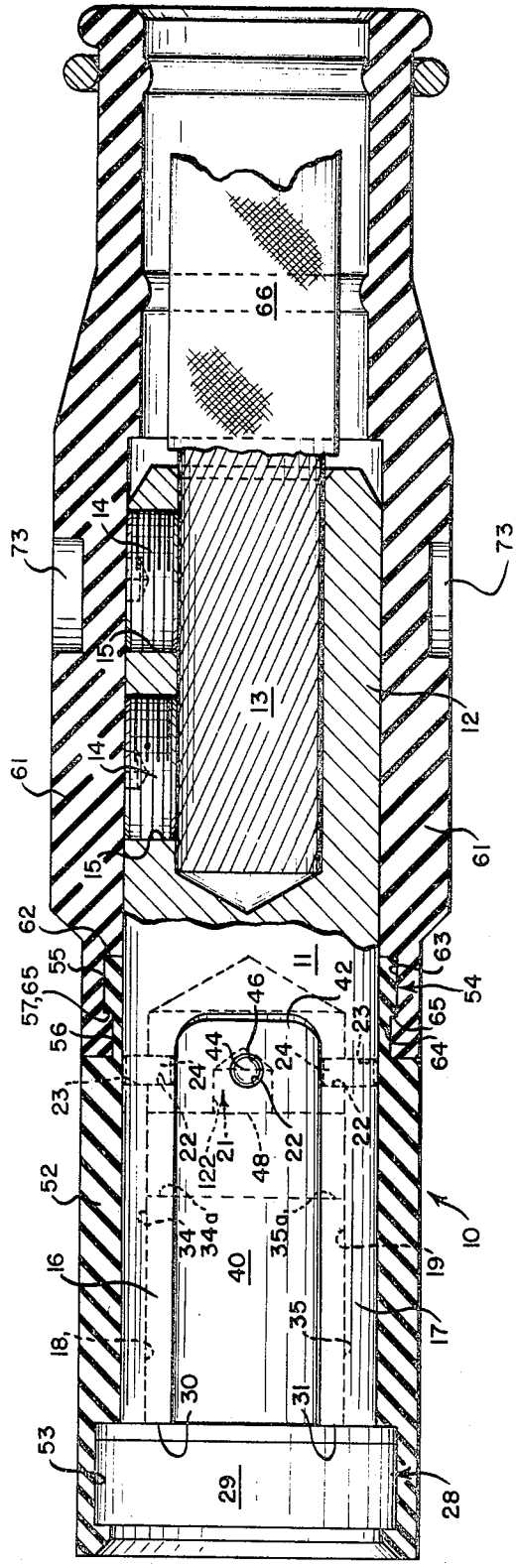
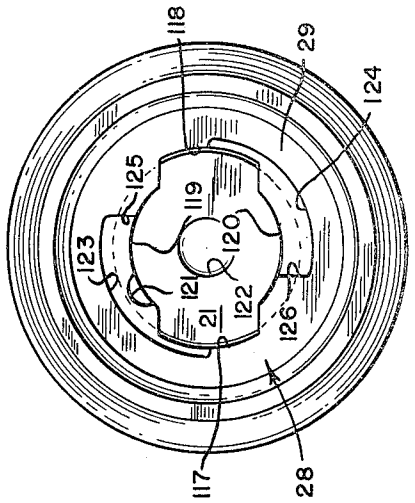


FIG. 1

FIG. 3



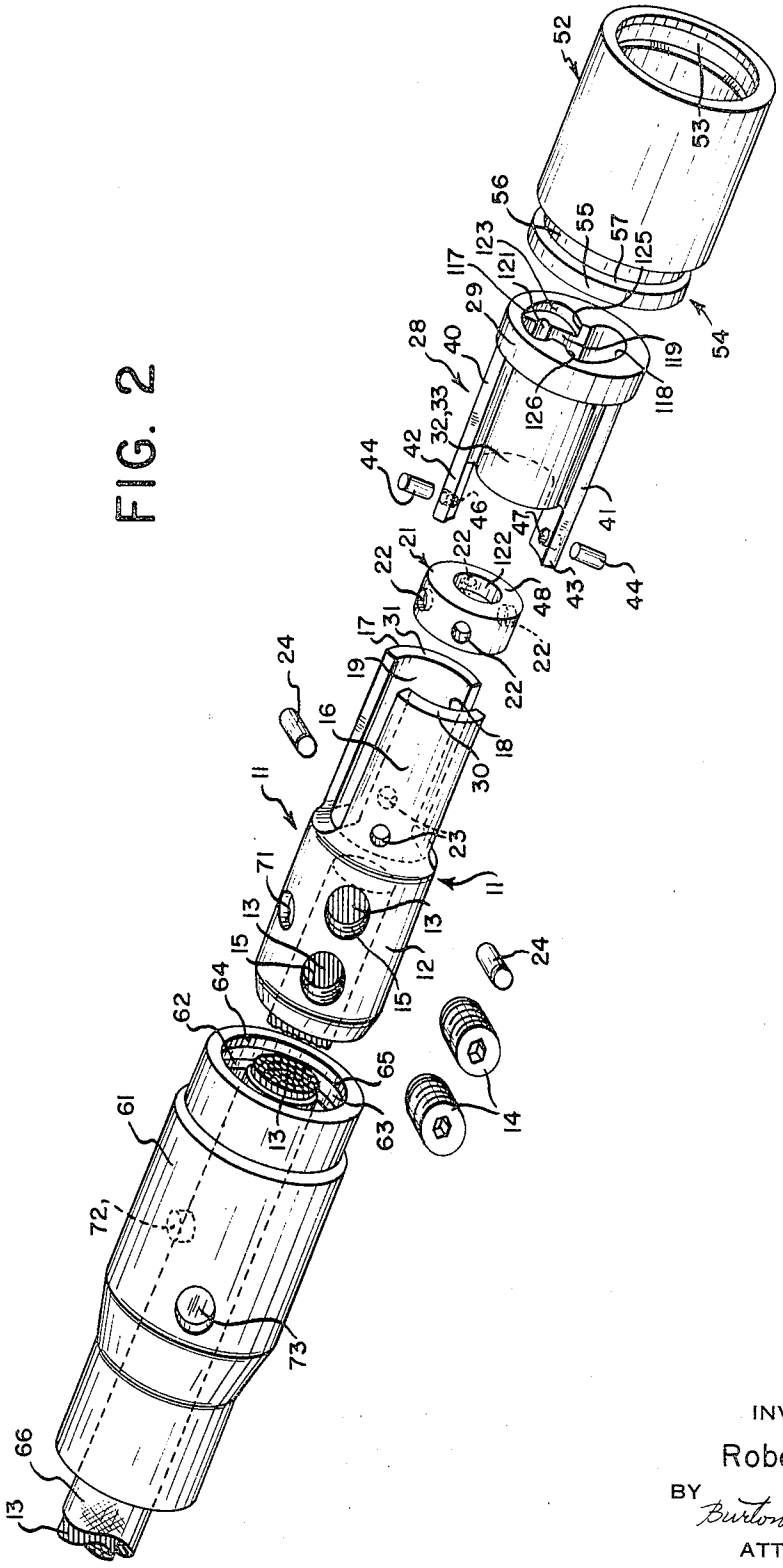
INVENTOR
Robert Senior
BY Burton Perlman
ATTORNEYS

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RECESSED CONTACT ELECTRICAL CONNECTOR

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FIG. 2



INVENTOR
Robert Senior
BY Burton Perlman
ATTORNEYS

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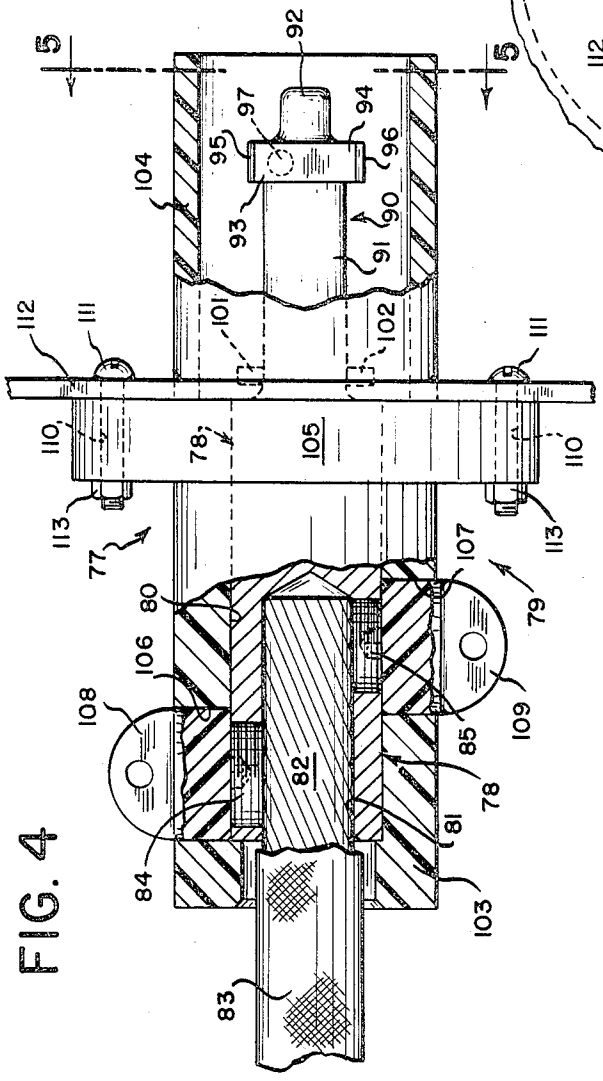


FIG. 4

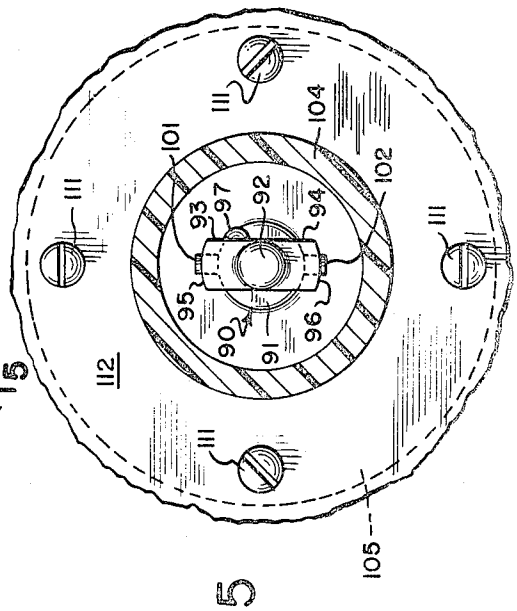


FIG. 5

INVENTOR
Robert Senior
BY Burton Perlman
ATTORNEYS

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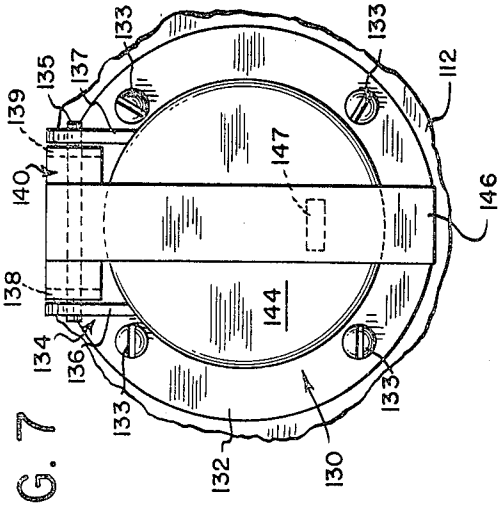


FIG. 7

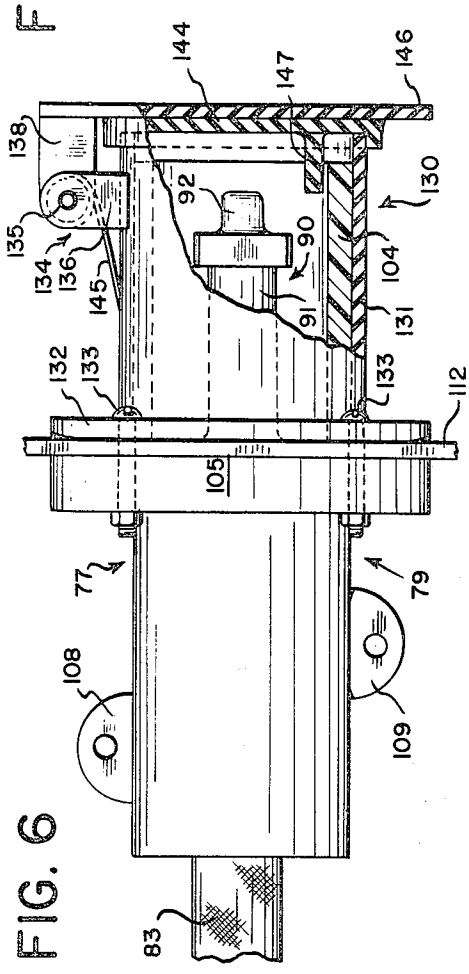


FIG. 6

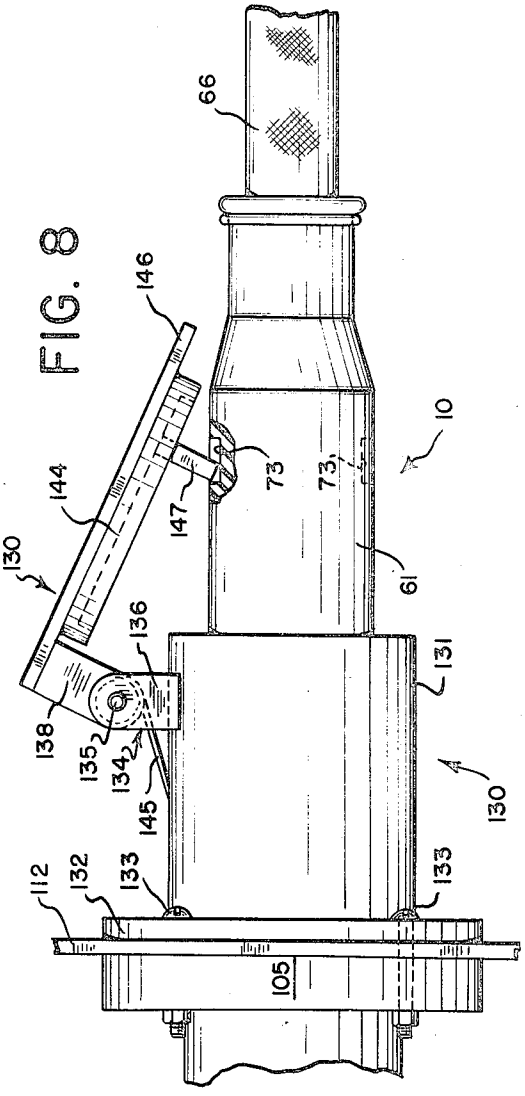


FIG. 8

INVENTOR
Robert Senior
BY Burton Perlman
ATTORNEYS

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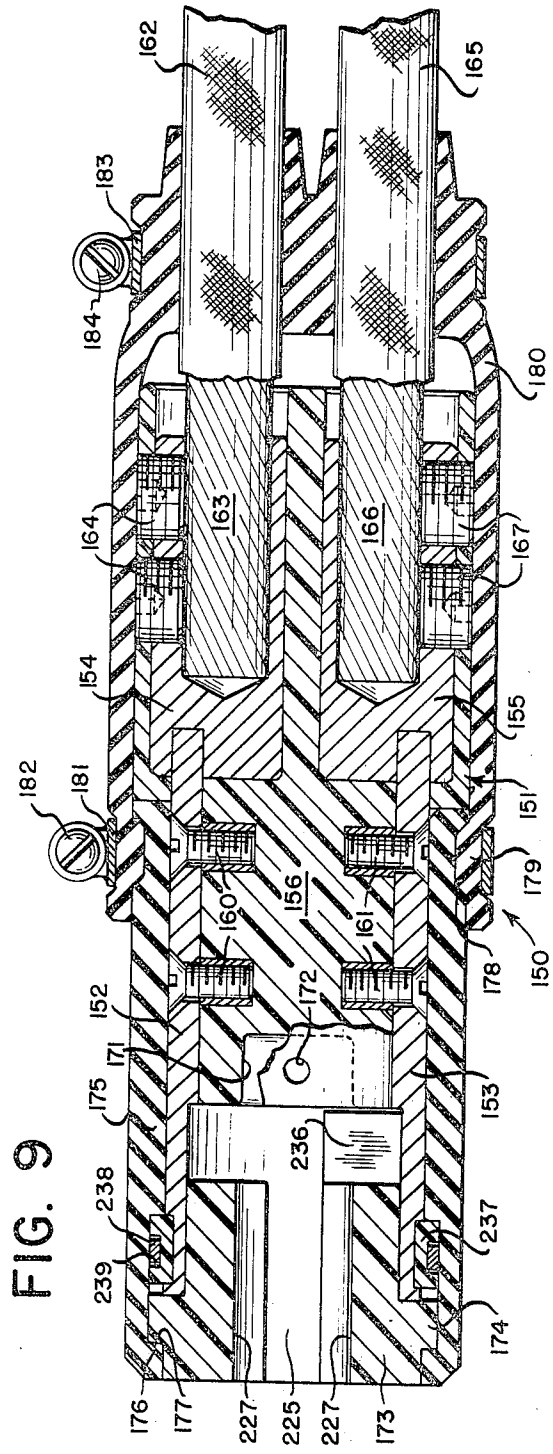


FIG. 9

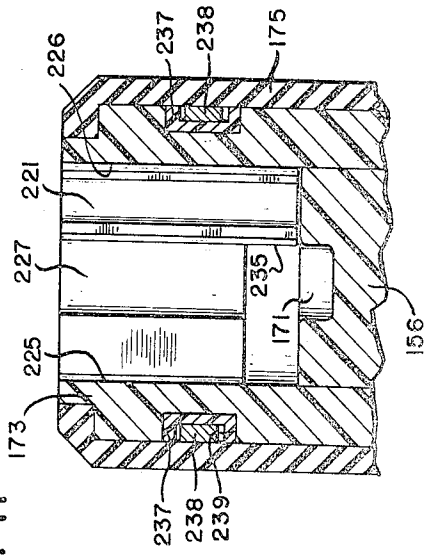


FIG. 11

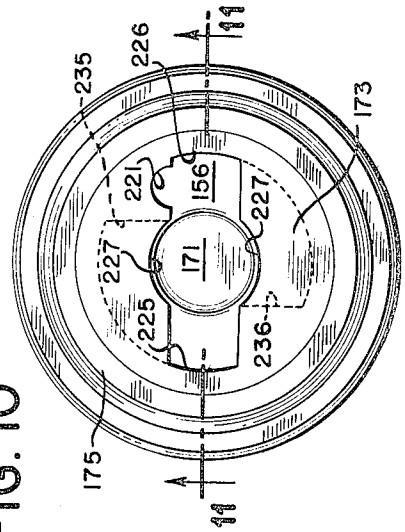


FIG. 10

INVENTOR
Robert Senior
BY Burton Perlman
ATTORNEYS

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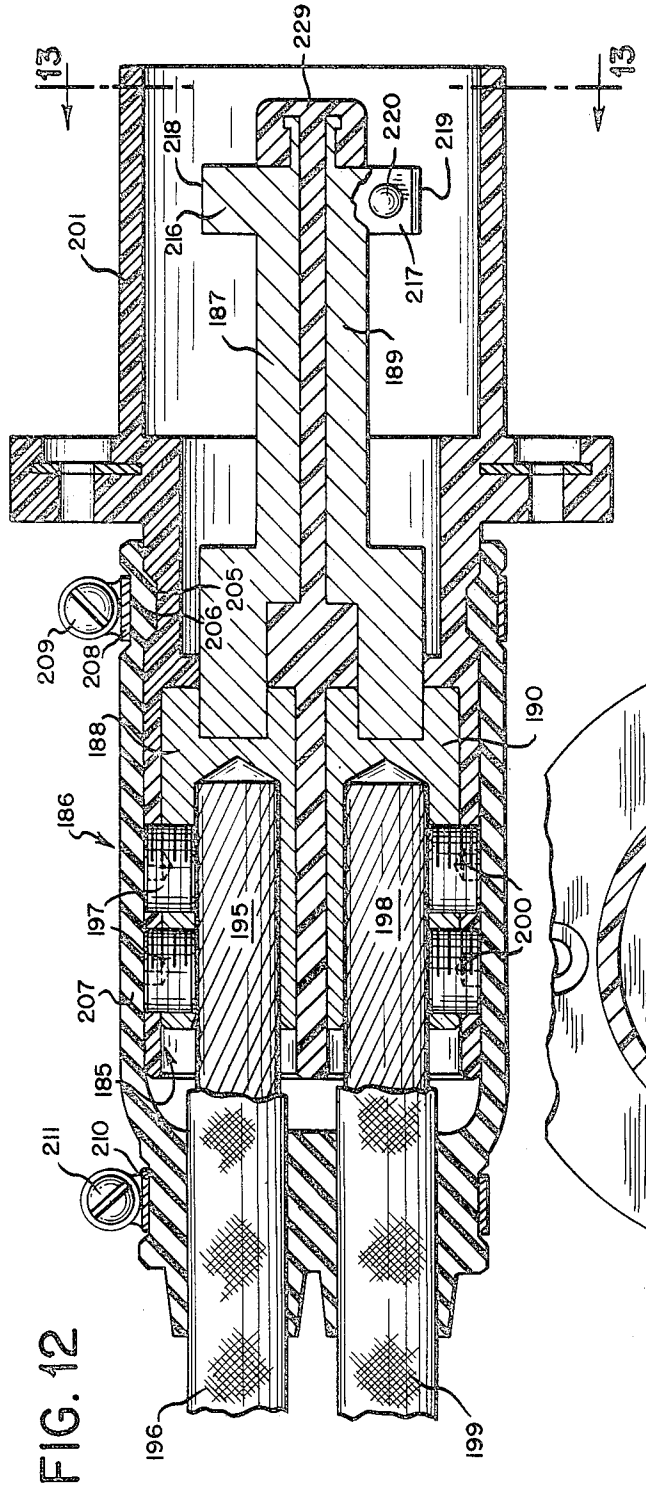


FIG. 12

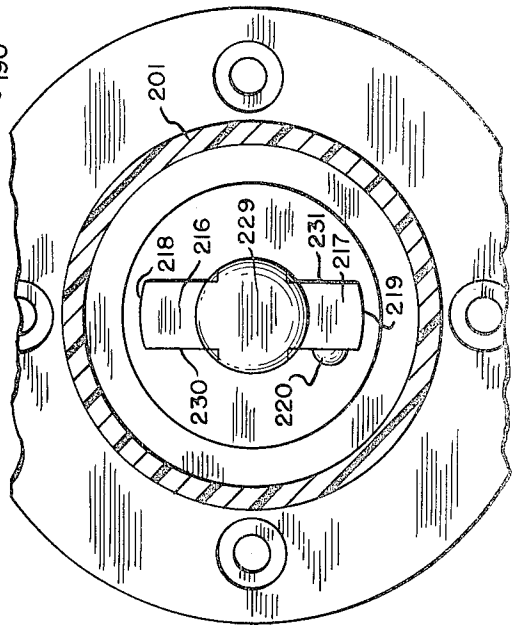


FIG. 13

INVENTOR
Robert Senior
BY Burton Perlman
ATTORNEYS

United States Patent Office 3,482,205
Patented Dec. 2, 1969

3,482,205

RECESSED CONTACT ELECTRICAL CONNECTOR

Robert Senior, Cincinnati, Ohio, assignor to Empire Products, Inc., Cincinnati, Ohio, a corporation of Ohio

Filed Apr. 10, 1967, Ser. No. 629,624
Int. Cl. H01r 13/50
U.S. Cl. 339—189 2 Claims

ABSTRACT OF THE DISCLOSURE

A pair of male and female electrical cable connectors are provided, the female connector being constructed of conductive and insulative portions. The conductive portions are so disposed relative to the insulative portions that it is almost impossible for an operator to make accidental contact with a conductive surface on the female connector, so that the connector may be more safely used by an operator. Means for preventing accidental contact with the male connector is also provided, as is means for supporting interengaged connectors. Multiple electrical circuits may be simultaneously connected.

This invention relates to the electrical connector art, that is, the art concerned with the releasable interconnection of electrical cables. Interengagement of electrical cables is a common necessity in various fields of endeavor where a power source is situated remotely with respect to the place where electrical power must be applied, or where the application of power is through means which are not stationary. This is the case, for example, where welding operations are carried out or where movable electrically powered machinery is employed.

In the applications where it is contemplated that the present invention will be applied, electrical cables of substantial size are employed, and some of the cable connecting means known in the prior art which might be turned to provide a structure solving the problem with which the present invention is concerned are unsuitable because they are adaptable only for use with electrical wires of small size and could not be adapted for sizable cables.

The primary objective of the present invention is to provide cable connectors which are safer in use than connectors which are otherwise commonly employed. In achieving this objective, it was recognized that in common practice it is the female connector in electrical cable connectors which is electrically live, while the male connector is electrically inactive until connection is made with the female. This being the case, attention was directed at providing a female connector simple in construction and therefore economic to manufacture. Moreover, by reason of the simplicity of its construction the likelihood of malfunction is minimized. What is here provided contrasts dramatically with those devices provided in the prior art for the same purpose, for known electrical connectors constructed for the primary purpose of achieving safety are complex in structure, relatively expensive to manufacture, and subject to mechanical failure or malfunction.

In addition to the foregoing, the present invention is characterized in that means are provided to minimize mechanical stress upon the connectors when they are in interengaged relationship. By providing such means the primary objective of safety is augmented by reducing the possibility of separation of interengaged connectors when such separation is not desired by the operator.

Still another objective herein is to provide a connector characterized as described above by the use of which a plurality of electrical circuits may be simultaneously completed when a single female-male connector is interengaged.

How these and many other objectives are to be implemented will become clear through a consideration of the accompanying drawings wherein:

FIG. 1 shows a section view of an assembly of elements comprising a female connector assembly in accordance with the present invention;

FIG. 2 is an exploded perspective view of the assembly of FIG. 1;

FIG. 3 shows an end view of the assembly in FIG. 1 looking towards the left end ignoring the section lines of FIG. 1;

FIG. 4 shows a side view of a male connector assembly with parts in section according to the present invention, it being understood that this assembly may be introduced into female connector assembly, and upon engagement the insulating sleeve of FIG. 1 will be disposed in part within the insulating sleeve in FIG. 4;

FIG. 5 shows a view at 5—5 in FIG. 4;

FIG. 6 shows a closure unit in place over an end of the male connector assembly of FIGS. 4 and 5;

FIG. 7 is a view looking at the right end of FIG. 6; and

FIG. 8 is a view similar to that of FIG. 6 of the closure unit in place upon a male connector assembly, with cover elevated to permit interengagement between male and female connectors, means in such cover to support connectors during engagement being visible.

FIG. 9 is a section view of a female connector assembly according to a second embodiment;

FIG. 10 is a view looking at the left end of the female connector assembly of FIG. 9;

FIG. 11 is a section at 11—11 in FIG. 10;

FIG. 12 is a section view of a male connector assembly according to the second embodiment;

FIG. 13 is a view of the assembly of FIG. 12, taken at 13—13 therein.

The drawings show a female connector assembly **10**. The separate elements comprising such assembly may best be seen in the exploded view of FIG. 2. Female conductor element **11** has hollow tubular base portion **12** into which the conductive strands **13** of an electrical cable may be inserted, being retained therein by set screws **14** which may be threaded into tapped holes **15**. Female conductor element **11** is formed with a pair of arms **16** and **17** projecting from base portion **12**. Arms **16** and **17** are arcuate in cross-section with concave interior surfaces **18** and **19** respectively, are disposed oppositely to each other, and are separated from each other by a pair of spaces.

Cylindrical button **21** of non-conductive material is disposed between the arms **16** and **17**. The diameter of button **21** is such that the button rests in close proximity to concave interior contact surface **18** and **19**. Depressions **22** are present in the periphery of button **21**. Holes **23** have been pierced in arms **16** and **17** and pins **24** are passed through holes **23** in arms **16** and **17** into registering depressions **22** in button **21** in order to maintain button **21** in position at the bottom of arms **16** and **17**.

Non-conductor element **11**. Collar portion **29** of element **28**, when such element **28** is assembled with conductor element **11**, is in contact with end surfaces **30** and **31** of arms **16** and **17**, respectively. When elements **28** and **11** are so assembled, arcuate surfaces **32** and **33** of walls **34** and **35**, such walls having free ends **34***a* and **35***a* respectively, are in snug contact with the interior contact surfaces **18** and **19** of arms **16** and **17**, while spacer portions **40** and **41** having depending skirts **42** and **43** respectively, lie in the spaces between arms **16** and **17**. Pins **44** may be passed through holes **46** and **47** in skirts **42** and **43** and then into depressions **22** in button **21** whereby insert element **28** is secured in place in assembly with female conductor element **11**. It will be appreciated that when the assembly of female conductor

element **11**, non-conductive button **21** and non-conductive insert element **28** is made, the only portion of interior contact surfaces **18** and **19** not sheathed with the insulation provided by button **21** and insert element **28** is that between end surface **48** of button **21** and the free ends **34***a* and **35***a* of walls **34** and **35**.

The female connector assembly **10** is provided with an insulating sleeve in two parts. The first part **52** is disposed over the portion of female conductor element **11** where arms **16** and **17** of such conductor occur and insert element **28** is in place. Sleeve part **52** has an interior annular recess at **53** which recess accommodates collar portion **29** of the insert element **28**. There is present at the other end of sleeve part **52** joinder portion **54** of reduced diameter from the balance of sleeve part **52**. Joinder portion **54** is subdivided into part **55** of major diameter and part **56** of minor diameter, shoulder **57** being the place where the change in diameter in joinder portion **54** occurs.

The interior of the second part **61** of insulating sleeve in female connector assembly **10** is formed to accommodate joinder portion **54** of the first part **52**, and has corresponding internal annular surfaces to receive such portions of joinder portion **54**. Thus, wall **62** butts against the free end of joinder portion **54** while annular recesses **63** and **64** accommodate part **55** of major diameter, and part **56** of minor diameter respectively of joinder portion **54**. Between internal annular recesses **63** and **64** in sleeve portion **61** is a shoulder **65** which serves to retain the two insulating sleeve portions assembled by entering into interfering contact with shoulder **57** in joinder portion **54**.

In practice, female conductor element **11**, button **21**, and insert element **28** are assembled and first part **52** of the insulating sleeve is slipped over the end of such assembly to assume the relationship heretofore indicated with collar portion **29** of the insert element **28** disposed within annular recess **53** of sleeve part **52**. Second part **61** of the insulating sleeve is meanwhile pushed up on a cable **66** for which cable the female connector assembly **10** will provide the terminus, the conductive strands **13** within cable **66** being introduced into hollow tubular base portion **12** and there secured in place by means of set screws **14**. After the cable **66** and the conductor element **11** are firmly joined, portion **61** of the insulating sleeve may manually be pulled down and over the exposed metal surface of female conductor element **11** until wall **62** in its forward end butts against the free end of joinder portion **54** in sleeve part **52**, and internal recesses **63** and **64**, and shoulder **65** receive corresponding surfaces **55** and **56** and shoulder **57** of first part **52** of the insulating sleeve.

A cavity **71** in conductor element **11** is provided to receive pin **72** (see FIG. 2) formed into the internal wall of second part **61** of the insulating sleeve, and when such part **61** is assembled with the remainder of the female connector assembly **10**, sleeve part **61** is rotated until pin **72** falls into cavity **71**. This engagement serves to lock the female conductor element **11** and associated parts, button **21** and insert element **28**, firmly within part **61** of the insulating sleeve and also provides a known orientation between hole **73** provided in external surface of sleeve portion **61**, and exposed portions of internal surfaces of arms **16** and **17**, for a purpose hereinafter to be discussed. Also reserved for later discussion is the configuration of the various interior surfaces of insert element **28**.

FIGS. 4 and 5 are views showing the male connector assembly **77** which consists of male conductor element **78** housed within external insulator structure **79**. Male conductor element **78** has hollow larger end **80** providing a receptacle **81** into which the conductor **82** of a cable **83** may be introduced, such conductor there being secured in place by means of set screws **84** and **85**.

Reduced end **90** of male conductor element **78** is the portion designed to enter into electrical engagement conductive surfaces in famelace conductor element **11**. Such reduced end **90** has a stem portion **91** and a terminal node **92**. Between stem portion **91** and node **92** are a pair of short, oppositely extending arms **93** and **94**, each of which terminates in an arcuately shaped surface **95** and **96** respectively, which surfaces are disposed axially with reference to male conductor element **78**. It is these surfaces, **95** and **96** in conductor element **78**, which are depended upon to make electrical contact with the other conductor element **11** (see FIGS. 1 and 3) and ultimately to make electrical contact between cables **66** and **83**. Protuberance **97** is present on one of the oppositely extending arms, in the embodiment shown in the drawings, on arm **93**. Protuberance **97** is important in regulating the interengagement of male and female conductor elements as will hereinafter appear. A pair of spokes **101** and **102** extend from opposite sides of stem portion **91** and are present for the purpose of governing the extent to which mutual rotation of conductor elements will be permitted upon interengagement, as will also be more fully described hereafter.

External insulator structure **79** in the male connector assembly **77** is made up of rear portion **103**, forward portion **104**, and between them, annular flange **105**. Rear portion **103** is pierced at **106** and **107** to permit the insertions of set screws **84** and **85** to retain cable **83** within male conductor element **78**. After the set screws are in place, appropriate plugs, **108** and **109** may be inserted at **106** and **107** in order in order to afford protection against contact with the set screws.

Forward portion **104** consists of a hollow cylinder within which reduced end **90** of a male conductor element **78** is present, such conductor element **78** being spaced from the internal wall of such forward portion **104**. Annular flange **105** has apertures through which bolts **111** may be passed in order that male connector assembly may be mounted upon the wall **112** as, for example, of a machine housing, the bolts **111** passing through wall **112** as well as aperatures **110** in annular flange **105**, and being secured by means of nuts **113**.

As has been described, the embodiment of the present invention here illustrated consists of a male connector assembly **78** mounted on the wall of a machine housing which provides the terminus for one cable **83**, and a female connector assembly **11** terminating a second cable **66**, which assemblies may be interengaged. While the external configuration of insert element **28** in the female connector assembly **10** was described in detail above, description of the internal configuration thereof was left until this point because such configuration governs interengagement of the assemblies. As may best be seen in FIG. 3, in the passageway through the interior of insert element **28** the dimension betwen surfaces **117** and **118** is greater than it is between surfaces **119** and **120**. Groove **121** is present in surface **119**.

Now let us relate reduced end **90** of male conductor element **78** to the internal passageway through insert element **28**. The forward end of such reduced end **90**, at which node **92** and arms **93** and **94** occur, can be introduced into the passageway in only one manner, to-wit: with arms **93** and **94** extending in the direction between surfaces **117** and **118**, and the male connection will only pass into this passageway when this disposition is made so that protuberance **97** may slide into and along groove **121**. When proper mutual orientation of male conductor element **77** and the internal passageway of insert element **28** and female connector assembly **10** has been made as outlined, the male conductor element **78** may be introduced into the passageway until terminal node **92** enters depression **122** in button **21**. When this occurs, protuberance **97** will have passed out of the bottom of groove **121** so that male conductor element **78** is free to turn relative to female connector assembly **10**.

It will be appreciated that surface **119** is the internal surface of the wall in insert element **28** for which arcuate

surface 33 is the external surface, while internal surface 120 is the internal surface of arcuate wall for which arcuate surface 32 is the external surface. Similarly, internal surface 117 is the internal surface of spacer portion 40, while internal surface 118 is the internal surface of spacer portion 41. A study of FIG. 2 will consequently disclose that when arcuate surfaces 95 and 96 on arms 93 and 94 respectively of male conductor assembly 78 are inserted as far as they can go into the internal passageway of female connector assembly 10, but not until such complete insertion, such surfaces may be rotated out of contact with depending skirts 42 and 43 of spacer portions 40 and 41 respectively.

When they are so rotated, the surfaces 95 and 96 will come into contact with the portions of internal surfaces 18 and 19 of arms 16 and 17 in female conductor element 11 not sheathed by non-conductive walls of insert element 28, and, by reason of the interfering presence of the free ends 34*a* and 35*a* of the walls 34 and 35 in insert element 28, may not be withdrawn from such engagement. Upon such rotation, a limit to the amount of rotation is provided by reason of the presence of quadrant recesses 123 and 124 which cooperate with spokes 101 and 102 extending from stem portion 91 of the male conductor element 78. A limit to such rotation is fixed when such spokes come into contact with limit surfaces 125 and 126 (FIG. 3) in quadrant recesses 123 and 124 respectively. Locking engagement of male and female connector assemblies may be simply carried out in the manner described, and release thereof is also a simple matter of mutual rotation of components in the opposite direction and withdrawal for separation thereof.

I have shown a female connector assembly which may with safety be left exposed. Because of the masking of all save a restricted area of conductive surface, it would be extremely difficult for a person to touch an electrically live surface. It may be desirable to provide safety protection for the amle connector assembly as well. This may be done by means of a cover unit such as is illustrated in FIGS. 6–8, the unit being generally indexed 130. The unit has a barrel portion 131 within which would fit the forward portion 104 of external insulator structure 79 of male connector assembly 77. Flange portion 132 has bolts 133 by means of which such flange portion can be secured to wall 112 and annular flange 105 (FIG. 6). Bracket 134 is fastened to barrel portion 131 as by welding, and rod 135 passes through arms 136 and 137 in bracket 134 as well as arms 138 and 139 in bracket 140, bracket 140 being appropriately secured to cover 144. Spring 145 loads bracket 140, normally urging cover 144 to cover the open end of barrel portion 131 of the cover unit.

The cover 144 may be lifted away from covering position against the pressure of spring 145 by exerting appropriate pressure upon handle 146. When cover 144 is so raised that male connector assembly 77 may be interengaged with female connector assembly 10, and locking engagement has been achieved in the manner heretofore indicated, by reason of the orientation which holes 73 must assume upon such interengagement, one of the holes 73 will be in a position to receive depending lug 147 which projects from the inside of cover 144. Such disposition of lug 147 within hole 173 will prevent counter-rotation of the female connector assembly 10 relative to the male under conditions where this is not desired, as where a large inductive load is applied to the circuit, which can cause a free cable to "kick." In addition entry of lug 147 into such hole will serve to retain the male connector assembly in engagement with the female connector assembly 10 without undue stress and strain thereupon.

The embodiment of the invention illustrated in FIGS. 1–8 and described in connection therewith enables the making of electrical connection between two single cables. In addition, it is possible by utilizing the present invention to make simultaneous electrical contact of a plurality of electrical circuits by the interengagement of a single male connector assembly with a single female connector assembly. Thus, the making of electrical contact between two pairs of electrical cables is illustrated in FIGS. 9–13. The female connector assembly of this embodiment is indexed 150. The female conductor element 151 is composite in structure, consisting of a pair of contact arms 152 and 153, each of such arms being in electrical contact with a conductive cable sleeve 154 and 155 respectively. For purposes of this description it will be convenient to refer to a contact arm together with the cable sleeve with which it is in contact as a "couple."

The couple made up of contact arm 152 and cable sleeve 154 is maintained in the same structure with couple made up of contact arm 153 and cable sleeve 155 by securing each couple to a molded plastic body 156, which molded plastic body 156 insulates the two couples from each other. Screws 160 secure the first couple to the plastic body 156, while screws 161 do the same for the second couple. Any suitable plastic dielectric capable of being molded to the desired shape may be employed in making the molded plastic body 156. I have found diallyl phthalate suitable for this purpose.

Cable 162 having interior conductors 163 is secured within conductive cable sleeve 154 by means of screws 164. Likewise, a second cable 165 having interior conductors 166 is secured within conductive cable sleeve 155 by means of screws 167.

Because of the molded plastic body 156 which is present in this embodiment, and which serves as a core for the female conductor element 151, it is unnecessary to have a separate button element such as is shown at 21 in the first embodiment of FIGS. 1–8. Instead, a cup 171 is formed directly into plastic body 156 with depressions 172 adjacent such cup, cup 171 defining a bottom to a passage between contact arms 152 and 153. At the open or free ends of contact arms 152 and 153 there is present non-conductive insert element 173 having collar portion 174 which butts against the free ends of contact arms 152 and 153. There is an internal passageway through insert element 173, and the configuration of such internal passageway is such as to accommodate the male conductor element which will hereafter be described.

The female connector assembly 150 includes external insulator sleeve means in two parts, part 175 being disposed about the portion of the composite female conductor element 151 where contact arms 152 and 153, as well as insert element 173 occur. There is an internal shoulder 176 in sleeve part 175 which mates with a like shoulder in insert element 173, so that when sleeve part 175 is in place on the female conductor element 151, it serves to retain insert element 173 within the assembly. Annular groove 178 in sleeve part 175 accommodates annular ring 179 integrally formed on the internal surface of the second part, indexed 180, of external insulating sleeve in the female connector assembly 150. Clamp 181 which may be tightened or loosened by means of screw 182, when in the tightened condition as shown in FIG. 9 secures the second sleeve part 180 securely in place with respect to the first sleeve part 175.

A second clamp 183, tightened or loosened by means of screw 184, holds second part 180 of the external sleeve securely in place with respect to cables 162 and 165 which pass therethrough.

Male conductor element 185 having contours mating with those of the internal passageway through insert element 173, is a part of male connector assembly 186. Male conductor element 185 is composite, consisting of contact member 187, which is in electrical contact with cable sleeve 188, and a second contact member 189 in electrical contact with cable sleeve 190. Couples consisting of contact member 187 and cable sleeve 188, and contact member 189 and cable sleeve 190, are separated and

insulated from each other by means of molded plastic body **191**. Again, diallyl phthalate is a suitable material for such plastic body.

Conductors **195** within cable **196** are retainer within cable sleeve **188** by means of set screws **197** while conductors **198** within cable **199** are retained within cable sleeve **190** by means of set screws **200**.

In addition to male conductor element **185**, male connector assembly **186** has external insulating means consisting of a two-part sleve, first part **201** being cylindrical and the internal wall being spaced from the portion of male conductor element **185** where contact members **187** and **189** occur. Annular channel **205** in first part **201** accepts an annular ring which comprises an integral portion of the second part **207** of the external sleeve whereby through cooperation of clamp **208**, which may be tightened by means of screws **209**, the two parts **201** and **207** of the external sleeve are firmly united. A second clamp **210**, which may be tightened by means of screw **211**, tightens the other end of second part **207** of the external sleeve about cables **196** and **199**.

As was heretofore suggested, description of the interrelationship of female and male connector assemblies **150** and **186** respectively has been deferred until this point, after general descriptions of these assemblies has been made. Contact members **187** and **189** each has a lateral extension **216** and **217** respectively, culminating in respective contact surfaces **218** and **219**. Guide pin **220** is present on lateral extension **217** for the purpose of making it possible for assembly **186** to enter the passageway in insert element **173** in only one fashion.

Insert element **173** (FIG. 10) includes a keyway **221** along which guide pin **220** may pass, it not being possible to interengage the connector assemblies unless guide pin **220** enters the keyway **221**, and thereby control may be easily maintained over which of the two cables terminated by female connector assembly **150** is put into contact with which of the two cables terminated by male connector assembly **186**.

Passageway in insert **173** has a greater dimension, extending between surfaces **225** and **226** (FIG. 10), and a lesser dimension, extending between surfaces **227** and **228**. It will be seen that male conductor element **186** may be introduced into passageway in insert **173** with contact surfaces **218** and **219** facing surfaces **225** and **226** respectively. Introduction may continue until forward end **229** of male connector element reaches the bottom of cup **171**. At that point contact surfaces **218** and **219** will be facing a dielectric surface. It becomes necessary, in order to achieve contact with any portion of contact arms **152** and **153**, to rotate male conductor element approximately 90° to bring contact surfaces **218** and **218** in male conductor into contact with contact arms **152** and **153** in female conductor. Rotation is stopped at this point as surfaces **230** and **231** in male conductor element **185** come into contact with stop surfaces **235** and **236**, respectively.

In order to assure that following such rotation, good electrical contact will be assured, a dielectric collar **237** encircles contact arms **152** and **153**. Retainer ring **238** passes about such collar, being within channel **239** in such collar. The function of collar **237** is to insulate retainer ring **238** from contact arms **152** and **153**. By means of ring **238**, the spreading of contact arms **152** and **153** under the pressure of lateral extensions **216** and **217** is inhibited, and a counterforce tending to urge contact arms **152** and **153** towards each other, and in a direction tending to assure good electrical contact, is exerted.

While specific embodiments of the present invention have been shown in the drawings and described in the specification, it is apparent that changes and modifications may be made therein and as so changed or modified the resultant structures may still be within the ambit of the present invention.

I claim:

1. Electrical cable coupling structure comprising cooperating first and second electrical connector assemblies:

said first electrical connector assembly including
- a base portion including means for receiving and retaining a cable in electrical contact,
- a stem portion,
- a cross arm on said stem portion, and
- a contact surface on said cross arm, said contact surface being axially disposed relative to said stem portion and having an axial dimension,

said second electrical connector assembly including
- a base portion including means for receiving and retaining a cable in electrical contact, and
- a barrel portion extending from said second electrical connector assembly base portion, said barrel portion having an internal passageway therein into which said cross arm and contact surface of said first assembly may be introduced, said barrel portion comprising
  - a plurality of spaced arcuate conductive arms extending from said second electrical connector assembly base portion, and
  - an insulative insert element,
    - spacer portions in said insert element disposed between said spaced arcuate conductive arms, the interior surfaces of at least one of said arcuate arms and an adjacent spaced portion providing a substantially continuous surface whereby said contact surface on said cross arm may be rotated smoothly from contact with a spacer portion to contact with an arcuate arm, upon rotation of one of said assemblies relative to the other, and
    - wall portions in said insert element disposed between said spacer portions, and of shorter length than said spacer portions, said wall portions overlaying a portion of the interior surfaces of said spaced arcuate conductive arms and leaving a band of the interior surfaces of said spaced arcuate conductive arms uncovered, said contact surface moving into said band after said cross arm is inserted into said passageway and one of said assemblies is rotated relative to the other, the axial length of said band being greater than the axial dimension of said contact surface of said first assembly, axial movement of said contact surface relative to said barrel portion when said contact surface is in contact with an arcuate arm being obstructed by one of said wall portions.

2. In a female electrical connector assembly for accommodating a male connector assembly having a stem portion bearing a cross arm terminating in a contact surface,

a female conductor element comprising
- a base portion having means therein for receiving and retaining a cable in electrical contact, and
- a plurality of spaced arcuate arms extending from said base portion, and

a non-conductive insert element having
- a plurality of arcuate spacer portions, each disposed between two of said arcuate contoured arms, the interior surfaces of at least one arcuate arm and an adjacent arcuate spacer portion providing a substantially continuous surface whereby said contact surface on said cross arm may be rotated smoothly from con-

tact with a spacer portion to contact with an arcuate arm,

a plurality of arcuate arm sheathing walls disposed between arcuate spacer portions, said walls lying interiorly of said arcuate arms in said female conductor element, said walls being of lesser length than said spacer portions, whereby a portion of at least one of said arcuate arms adjacent said base portion is left exposed by said sheathing walls, and

an internal passageway through said insert element into which said cross arm may be inserted.

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JOSEPH H. McGLYNN, Assistant Examiner

RICHARD E. MOORE, Primary Examiner

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