

[54] **ELECTRICAL CONNECTORS WITH INTERCHANGEABLE COMPONENTS**

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[22] Filed: **Mar. 8, 1973**

[21] Appl. No.: **339,050**

[52] U.S. Cl. **339/31 R; 339/59 M; 339/89 M; 339/101; 339/103 R; 339/132 R; 339/136 R; 339/184 M**

[51] Int. Cl. **H01r 13/48**

[58] Field of Search **339/31-33, 339/42, 47-49, 59-62, 64, 75, 89, 90, 91, 184, 101-103, 119, 125, 129, 131, 132, 134, 135, 136, 176, 192, 196, 206, 207, 256**

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Primary Examiner—James T. McCall

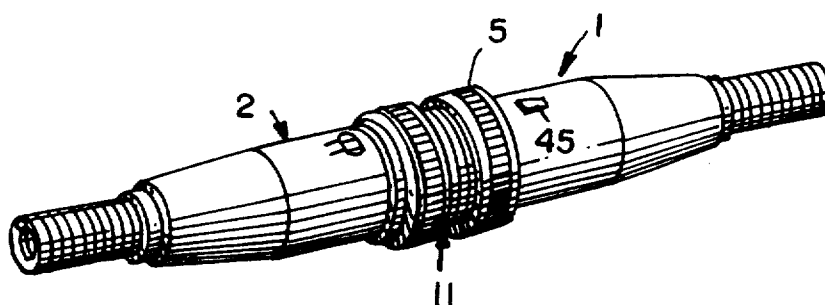
Assistant Examiner—Terrell P. Lewis

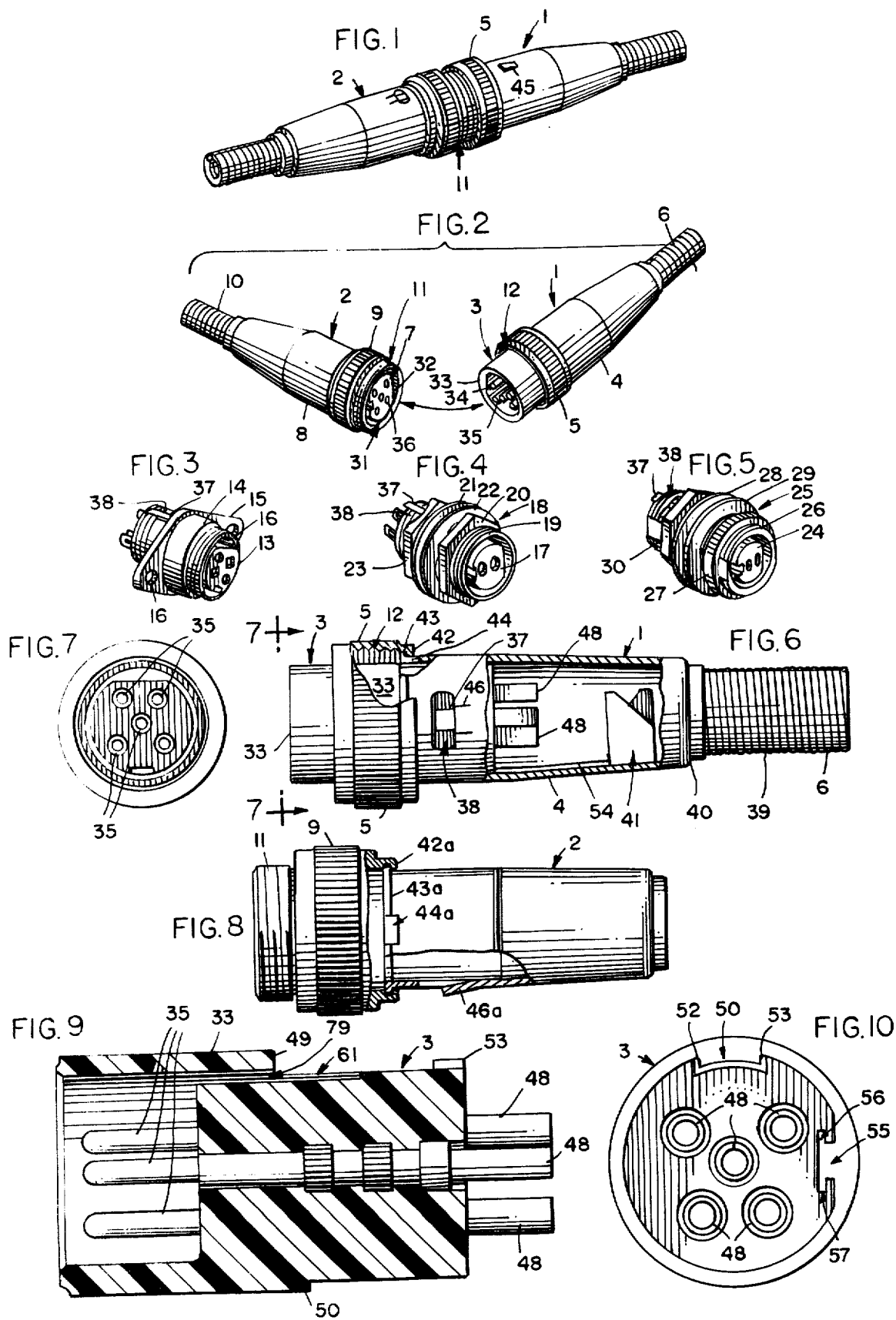
Attorney, Agent, or Firm—Johnston, Keil, Thompson & Shurtleff

[57] **ABSTRACT**

Electrical connectors are provided consisting of housings and different types of molded male and female inserts which can be readily assembled with said housings and removed therefrom and are interchangeable so that many different connection combinations can be obtained. Another feature is the provision of means for locking said inserts in place in said housings. A further feature is the provision of a connector having a removable strain relief cable clamp which also functions as a ground connection.

4 Claims, 29 Drawing Figures





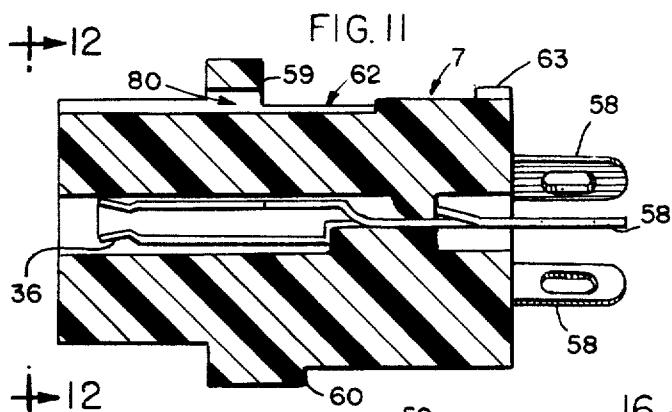
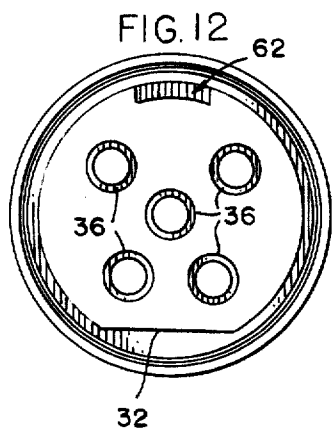


FIG. 15

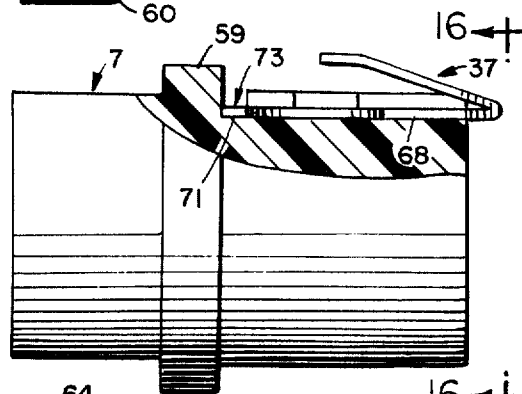


FIG. 13

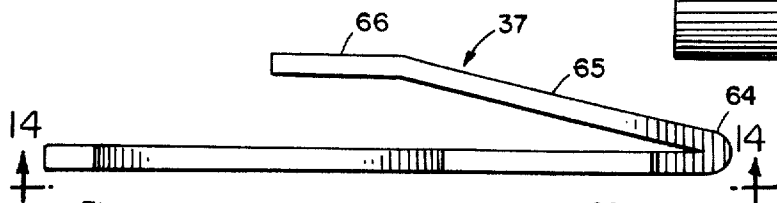


FIG. 14

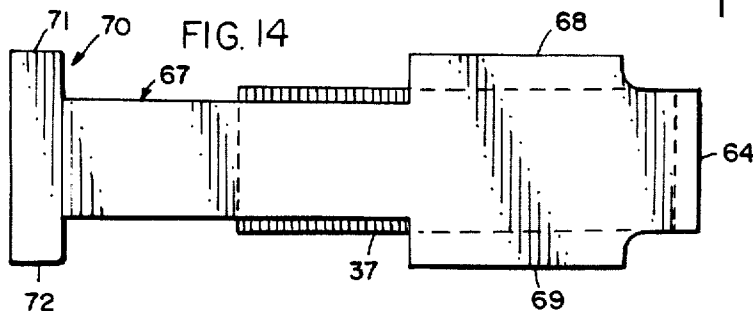


FIG. 16

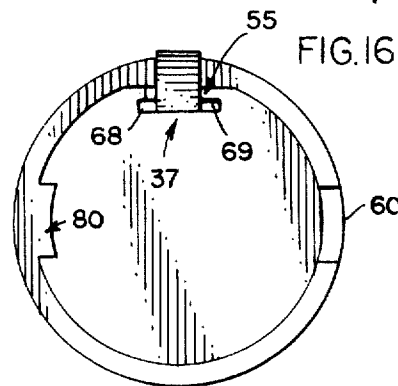


FIG. 17

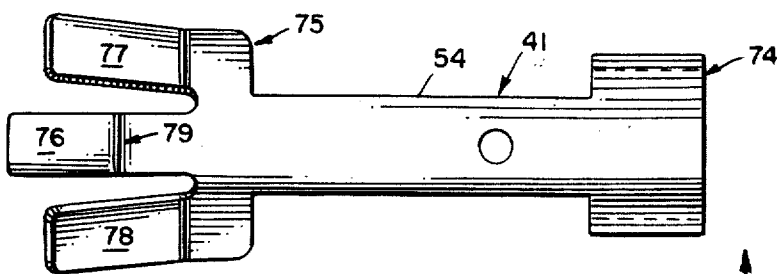


FIG. 18

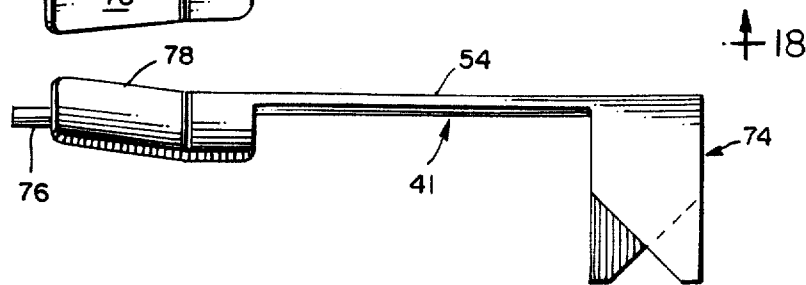


FIG. 19

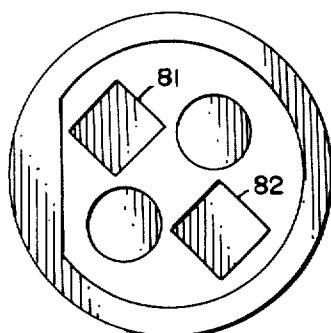


FIG. 20

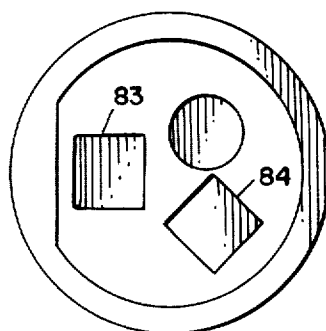


FIG. 21

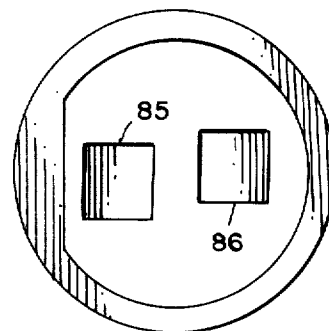


FIG. 22

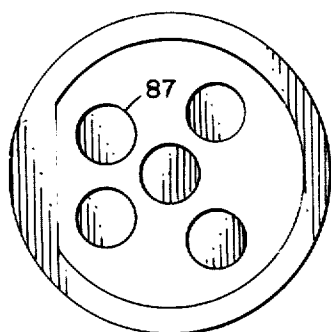


FIG. 23

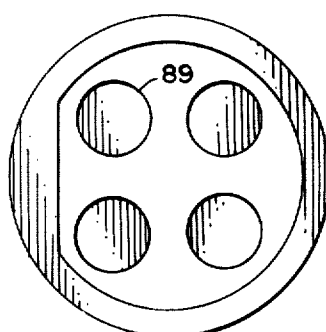


FIG. 24

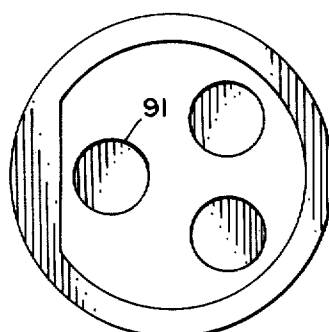


FIG. 26

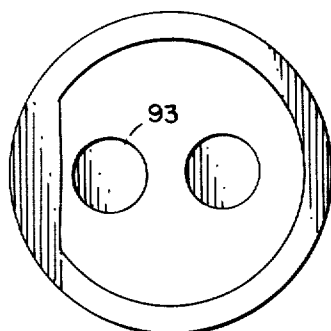


FIG. 25

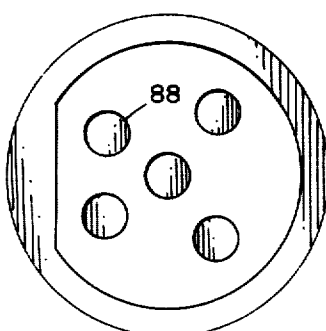


FIG. 27

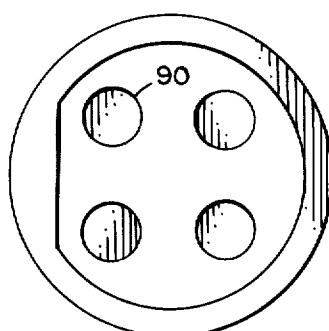


FIG. 28

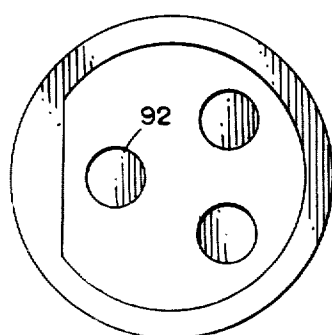
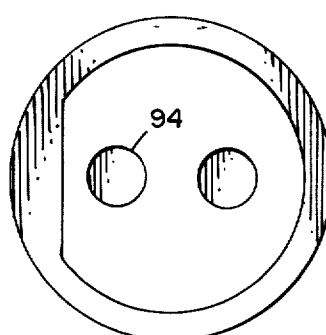


FIG. 29



ELECTRICAL CONNECTORS WITH INTERCHANGEABLE COMPONENTS

BACKGROUND

In test equipment and in audio and communications equipment there is a need for electrical connectors which are relatively small but at the same time are capable of being assembled and disassembled with a minimum amount of effort. There is also a need for electrical connectors having interchangeable parts so that the same housings can be employed for different types of electrical connections.

OBJECTS

One of the objects of the present invention is to provide new and improved electrical connectors consisting of housings and molded male and female inserts which when selectively assembled make up mating connector units.

Another object of the invention is to provide electrical connectors of the type described consisting of cord-plug assemblies which can be connected together by coupling means operable independently of the actual electrical connections.

A further object of the invention is to provide new and improved electrical connectors which can be used with panel mounted receptacles.

Still a further object of the invention is to provide electrical connectors of the type described which can be assembled into housings and retained by a spring latch and at the same time are readily removable by applying external pressure to the latch and pushing the inserts forward axially of the housings.

An additional object of the invention is to provide a new and improved electrical connector containing a new and improved type of cable clamp.

Another object of the invention is to provide new and improved inserts for the housing of an electrical connector comprising a plurality of either male or female electrical components embedded in a self-supporting molded electrical insulating material with terminals connected to said contact components projecting rearwardly from said insert and latch means comprising a bent resilient strip fixed to a side of said insert, said latch means being adapted to restrain axial movement of said insert after it has been inserted into the housing.

An additional object of the invention is to provide an insert of the type described containing means to restrain rotary movement of the insert after it has been inserted into the housing.

Other objects and advantages of the invention will appear from the following description in conjunction with the accompanying drawings.

THE DRAWINGS

In the drawings:

FIG. 1 is a perspective view of an electrical cord-plug assembly illustrating one embodiment of the invention;

FIG. 2 is perspective view of the electrical cord-plug assembly of FIG. 1 with the male and female components separated;

FIG. 3 is a perspective view of a flange-mounted receptacle housing illustrating another embodiment of the invention;

FIG. 4 is a perspective view of a rear-of-panel-mounted receptacle housing illustrating another embodiment of the invention;

FIG. 5 is a perspective view of a front-of-panel mounted receptacle housing illustrating another embodiment of the invention;

FIG. 6 is a side view with parts broken away, and partly in section, of a male connector component containing a loose coupler ring;

FIG. 7 is an end view taken along the line 7,7 of FIG. 6;

FIG. 8 is a side view with parts broken away, and partly in section of a housing component showing the fixed coupler ring without the insert;

FIG. 9 is an enlarged sectional view of a molded male insert illustrating one embodiment of the invention;

FIG. 10 is a rear view of the insert shown in FIG. 9;

FIG. 11 is an enlarged sectional view of a female insert;

FIG. 12 is an end view taken along the line 12,12 of FIG. 11;

FIG. 13 is a side view of a latch which is used in connection with each of the inserts to hold the inserts against axial movement when they are inserted into the housings;

FIG. 14 is a bottom plan view taken along the line 14,14 of FIG. 13;

FIG. 15 is a side view with parts broken away, and partly in section of an insert showing the manner in which the latch of FIG. 13 is assembled on the insert;

FIG. 16 is a rear view taken along the line 16,16 of FIG. 15;

FIG. 17 is a plan view of a cord clamp which is employed in association with inserts of the type herein described;

FIG. 18 is a side view taken along the line 18,18 of the cord clamp shown in FIG. 17;

FIGS. 19 and 29 are end views of various types of female and male inserts illustrating different contact components which can be employed interchangeably in the practice of the invention.

BRIEF SUMMARY OF THE INVENTION

In accordance with the invention electrical connectors are provided comprising two housings each having a tubular opening therein, a pair of mating molded male and female inserts each interchangeably receivable in said openings, latch means associated with said inserts and said housings for holding each insert in its respective opening after it has been inserted, and means operable from the exterior of said housings for releasing said latch means to permit withdrawal of each said insert from its respective opening.

One of the aforesaid housings is provided with coupling means adapted to connect the housings together independently of the electrical connections formed between the inserts.

Among the features of the invention are the provision of a new and improved latch means which is associated with the inserts and is adapted to prevent axial movement of the inserts after they have been assembled with the housings, new and improved means for preventing rotary movement of the inserts after they have been assembled with the housings, and new and improved cord clamps which are associated with the inserts and are also adapted to contact the housings in order to provide ground connections.

DETAILED DESCRIPTION OF THE INVENTION

In the embodiment of the invention illustrated in

FIGS. 1 and 2, a male electrical connector 1 and a female electrical connector 2 are assembled to make up a mating connector unit in the form of the cord-plug illustrated in FIG. 1. The male connector 1 contains a male insert 3 which is inserted into housing 4 containing a coupler ring 5 and a strain relief spring 6.

Electrical connector 2 contains a female insert 7 which is inserted into housing 8. A fixed knurled ring 9 is disposed on the surface of housing 8 and a strain relief spring 10 extends rearwardly from the interior of housing 8. In order to make an electrical connection the male and female inserts 3 and 7 are connected together in mating relationship. The forward external surface of fixed ring 9 contains threads 11 and the internal surface of coupler ring 5 contains threads 12. The coupler ring 5 is adapted to slide on the outer surface of housing 4 for a limited distance so that the internal threads 12 can engage external threads 11 after the inserts have been mated, thereby producing a locked interconnection as shown in FIG. 1 wherein the inserts are connected electrically and the housings are connected independently by the coupler ring 5.

In the embodiment illustrated in FIG. 3 a female insert 13 is disposed in a housing 14 containing a flange 15 with holes 16, 16 therein so that the receptacle can be mounted in a panel opening by connecting the flange 15 to the sides adjacent the front of the opening. This connection can be made by screws or other suitable fastenings means inserted through holes 16, 16.

In the embodiment illustrated in FIG. 4 a female insert 17 is disposed in a housing 18 containing external threads 19 adapted to receive a nut 20. The threaded housing 18 also contains washers 21 and 22 and a hexagonal portion 23. This housing is mounted in an opening in a panel by removing washer 22 and nut 20 and inserting it through the opening from the rear of the panel. Thereafter washer 22 is replaced and nut 20 is replaced and tightened in order to secure the housing in the panel. Washer 21 is preferably a lock washer containing serrations adapted to engage the rear of the panel in order to assist in holding the housing in place.

In FIG. 5 female insert 24 is disposed in housing 25 which is externally threaded at 26 and contains a fixed knurled flange 27 and washers 28 and 29. The threaded housing also contains a removable nut 30 at the rear thereof. This connector is adapted to be mounted in an opening in a panel by removing the washer 28 and the nut 30 and inserting the housing through an opening from the front of the panel. Thereafter the washer 28 is replaced followed by the nut 30 and the latter is tightened to secure the receptacle in the panel. Here again, at least one of the washers 28 and 29 preferably has a serrated surface adjacent the panel so as to secure the receptacle in place more firmly.

In connector 2, as shown in FIG. 2, there is an annular space 31 between the inner side of the forward part of fixed ring 9 and the outer side of insert 7. One side 32 of insert 7 is flat. In connector 1 the tubular portion 33 of insert 3 is adapted to fit in the annular space 31 around insert 7 of connector 2 and the flat side 34 of insert 3 is adapted to fit against the flat side 32 of insert 7. Thus, the two inserts can readily be aligned with one another and the male contacting elements 35 can readily be engaged with the female contacting elements 36. In the embodiment illustrated in FIGS. 2, 6, 7, 9, 10, 11 and 12 there are five contacting elements in each connector but it will be understood that the num-

ber of electrical contacting elements can be varied as hereinafter described.

One of the features of the invention resides in the latching mechanism which makes it possible to use the same housing or different housings of the type illustrated in FIGS. 1 to 5 with the same or different inserts interchangeably. This mechanism consists of a spring member 37 as shown in FIG. 6 which, when the insert is mounted in the housing, exerts an outward pressure into an opening 38 in the housing. Thus, when the insert 3 is pressed rearwardly into the front of housing 4 it reaches a point where the resultant spring latch 37 extends or projects into opening 38, thus making it impossible to remove the insert by pulling it axially. However, the insert can be removed merely by pressing inwardly on spring latch 37 and pulling outwardly on the forward part of insert 3. The insert 3 can also be removed by pressing inwardly on latch spring 37 and pushing against the strain relief spring 39. The latter consists of a wire coil which is enlarged at one end so that it can be inserted into housing 4 and the enlarged end will seat against the abutment 40. However, when strain relief spring 39 is pushed inwardly it will contact cord clamp 41 which is associated with insert 3 thereby causing insert 3 to be moved axially from the front end of housing 4.

In FIG. 6, which illustrates housing 4, it will be seen that loose coupler ring 5 has at the inner side thereof an inwardly extending flange 42 and that housing 4 contains an outwardly extending flange 43. Outwardly extending flange 43 also contains a recessed or cut-out portion at 44. In addition, housing 4 contains two generally rectangular areas 45 (see FIG. 1) and 46 which are cut on three sides and normally project slightly outwardly from the surface of housing 4. The forward movement of coupler ring 5 is limited by flange 42 of the coupler striking against flange 43 of the housing 4 and the backward movement is limited by cut portions 45 and 46.

In FIG. 8, fixed ring 9 contains an inwardly extending flange 42a which is secured to outwardly extending flange 43a of housing 2. Flange 42a has a cut-out portion 44a.

As shown in FIG. 9 the insert 3 is made of a self-supporting molded electrical insulating material with male contact elements 35 projecting forwardly therefrom and embedded therein so that the terminals 48 project rearwardly and can be connected to wires in a suitable cable which is inserted into the connector through strain relief spring 39. When insert 3 is inserted into housing 4 from the front end thereof the portion 49 proceeds rearwardly until it strikes against the flange 43 and at this point the position of the insert should also be such that abutment 50 enters recess 44, thereby preventing rotary movement of the insert. It may be noted that the abutment 50 is a relatively narrow rearwardly projecting portion of insert 3 which is located around the circumference of the insert approximately 90° counterclockwise from the latch spring 37.

In the rear view of insert 3 shown in FIG. 10 it will be seen that there is a recessed area 51, the sides 52 and 53 of which form a passageway adapted to act as a guide for the elongated portion 54 of cable clamp 41. Recess 55 which is located approximately 90° away from recess 51 around the circumference of insert 3 as shown in FIG. 10 contains undercut areas 56 and 57 to receive spring latch 37.

The construction of a typical female insert 7 is illustrated in FIGS. 11 and 12 wherein the contact elements 36 are embedded in a self-supporting molded electrical insulating material with the terminals 58 extending rearwardly. In the structure of the insert shown in FIG. 11 the portion 59 has the same function as the portion 49 in the insert illustrated in FIG. 9. The abutment 60 is received by cut-out portion 44a of FIG. 8 and has the same function as the abutment 50 in the male insert shown in FIG. 9.

Insert 3 shown in FIG. 9 contains a recess 61 and insert 7 in FIGS. 11 and 12 contains a recess 62. Insert 7 also contains a structure 63 similar to the structure 53 in insert 3.

As previously indicated each of the inserts contains a latch member 37. The latch member 37 as shown in FIGS. 13 and 14 comprises an elongated strip bent at an intermediate point 64 to provide an upwardly extending portion 65 having a flat end portion 66. The base portion 67 is flat and contains outwardly extending sides 68 and 69 and a T-shaped configuration 70 at the end having outwardly extending portions 71 and 72. This spring latch is adapted to be inserted into a channel with undercut sides in the insert as illustrated by the channel 55 in FIG. 10 so that the outwardly extending portions 68 and 69 slide in the undercut sides 56 and 57 while the T-shaped portion 70 rides on top of the overhanging sides of channel 55 until the T-shaped portion reaches the abutment 49 in FIG. 9 or 59 in FIG. 15. The space between side abutment 49 and the inner end of the channel is sized so that when the ends 71 and 72 or T-shaped portion 70 ride over the top of the channel into said space they will drop down and become firmly seated in the area 73 as shown in FIG. 15. Thus spring latch 37 is tightly held on the surface of the insert and occupies the position shown in FIG. 15.

Cord clamp 41 which is illustrated in FIGS. 17 and 18 consists of an elongated strip 54 having a U-shaped clamp 74 at one end thereof adapted to receive an electrical cable and a three-pronged configuration 75 at the other end. The central prong 76 is longer than the two side prongs 77 and 78 and is depressed downwardly at 79. The side prongs 77 and 78 project upwardly and are adapted to contact the inner side of the housings 4 or 8 so that the cord clamp may be used to establish a ground connection. The cord clamp is placed on the outer surface of the insert by inserting the central prong into the opening 79 (FIG. 9) or 80 (FIG. 11). This opening is disposed around the circumference of the insert approximately 90° from the position of spring latch 37 and 180° from the abutment 60 (FIG. 16, 50 in FIG. 9).

In assembling the unit the strain relief spring is inserted into the housing until it projects from the rear thereof. An electrical cable of the desired type is inserted through the strain relief spring 39 and the ends are connected to the terminals 48 of the insert. The cord clamp 41 is then placed on the insert with the U-shaped portion 74 surrounding the cable and the insert is moved rearwardly into the tubular front opening of the housing until the latch spring 37 snaps into opening 38. At the same time the portions 49 or 59 will come to rest against the outer flange 43 of the housing and the abutments 50 or 60 will project into recess 44, thereby preventing rotary movement of the insert after the axial movement has been stopped by latch spring

37. In the embodiments illustrated in FIGS. 3, 4 and 5 the latch spring 37 engages openings in the housing of a panel mounted receptacle whereas in FIGS. 1 and 2 the latch spring 37 engages openings in a cord plug. In all of these cases the coupler ring 5 is adapted to engage threads on the housing of the receptacle so that the two connectors can be firmly secured independently of the connection established by the interfitting contact of the male and female inserts. To remove the inserts from their respective housings the latch 37 in each case must be depressed and the insert pushed forward.

Because of the manner in which the inserts can be assembled and removed from the same housing a large number of different types of electrical connections are possible. The versatility of the invention is illustrated by FIGS. 19 to 29 which are end views of inserts with different pin and receptacle locations. In FIG. 19 pins 81 and 82 are shunted. In FIG. 20 pins 83 and 84 are shunted. In FIG. 21 both of the pins 85 and 86 are shunted. On the inserts with the shunted circuits the contacts are normally closed and break contact upon pin insertion.

FIG. 22 illustrates a female insert containing five receptacles 87 adapted to be used with the male insert shown in FIG. 26 containing five pins 88.

FIG. 23 illustrates a female insert containing four receptacles 89 adapted to be used with a male insert of the type shown in FIG. 27 containing four pins 90.

FIG. 24 illustrates a female insert containing three receptacles 91 adapted to be used with a male insert of the type shown in FIG. 28 containing three pins 92.

FIG. 25 illustrates a female insert containing two receptacles 93 adapted to be used with a male insert of the type shown in FIG. 29 containing two pins 94.

From the foregoing description it will be seen that there are five different housings and eleven different inserts. Any of the eleven inserts can be used with any of the five housings so that 55 different assemblies are possible. The receptacle housings are usually die cast of any suitable metal and plated. The socket contacts and the contact pins are made from metals usually employed for electrical connections of this type. The cable clamp, the strain relief spring, the mounting hardware and the latch can be made from steel which is preferably plated with a suitable metal. The cable clamp 41 can be used with inserts in any of the housings shown in FIGS. 1 to 5. Other variations and modifications can be made without departing from the invention.

The invention is hereby claimed as follows:

1. An electrical connector comprising two housings each having a tubular opening therein, a pair of mating molded male and female inserts each interchangeably receivable in said openings, latch means associated with said inserts and said housings for holding each insert in its respective opening after it has been inserted, and means operable from the exterior of said housings for releasing said latch means to permit withdrawal of each said insert from its respective opening, said connector comprising coupling means to connect said housing together independently of said inserts and comprising a rotatable internally threaded ring mounted on one of said housings, the threads of which are engageable with external threads mounted on the other of said housings, said ring being slidable axially on said housing a predetermined distance so as to project beyond said opening, said distance in an out-

ward direction with respect to said opening being limited by the inner side of an inwardly extending flange on the inner end of said ring contacting an outwardly extending flange adjacent the end of said housing and in an inward direction by an outwardly extending portion of said housing contacting the outer side of said flange on said ring, said outwardly extending portion comprising at least one cut resilient portion of said housing.

2. An electrical connector comprising two housings each having a tubular opening therein, a pair of mating molded male and female inserts each interchangeably receivable in said openings, latch means associated with said inserts and said housings for holding each insert in its respective opening after it has been inserted, and means operable from the exterior of said housings for releasing said latch means to permit withdrawal of each said insert from its respective opening, at least one of said inserts comprising an electrically conducting clamp mounted on the external surface of said insert, extending axially beyond the cable receiving end of said insert so as to support said cable, and providing a ground connection with said housing, said cable clamp comprising an elongated electrically conducting strip having at one end a three-pronged configuration consisting of a central prong which is a prolongation of said elongated strip and a side prong on opposite sides of said central prong, said central prong being longer than said side prongs and being offset downwardly with its outer end received in an opening in said insert and said side prongs extending in an upward direction to contact the inner side of the housing, and said member having at its other end a generally U-shaped configuration to receive and hold a cable.

3. An electrical connector comprising two housings each having a tubular opening therein, a pair of mating molded male and female inserts each interchangeably receivable in said openings, latch means associated

with said inserts and said housings for holding each insert in its respective opening after it has been inserted, and means operable from the exterior of said housings for releasing said latch means to permit withdrawal of each said insert from its respective opening, said latch means comprising a resilient member connected to said insert, and an opening in the side of said housing, said resilient member projecting into and engaging a side of said side opening to lock said insert in said housing against axial movement, and said resilient member being adapted to be depressed by external pressure through said opening to unlock said insert and permit removal of said insert by sliding it axially in said housing.

4. A connector as claimed in claim 3 in which said resilient member comprises an elongated strip bent at an intermediate section to provide an upwardly extending portion to project into said opening in said housing and a flat portion to connect to said insert, said insert comprising a channel with undercut sides on the surface thereof sized to receive said flat portion, said channel being open at both ends and extending from the terminal end of said insert toward the electrical contactor end of said insert, an abutment on the surface of said insert spaced from the contactor end of said channel, outwardly extending portions on opposite sides of said flat strip adjacent said bent portion sized to be received by said undercut portions of said sides and a T-shaped configuration on the end of said flat portion sized to fit in said space between said abutment and the inner end of said channel whereby said flat strip can be inserted into said channel from the terminal end of said insert with said outwardly extending portions in the undercut area and said T-shaped end above said channel and moved forwardly until said T-shaped end snaps into said space at the end of said channel.

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