United States Patent [19]

Bailey et al.

[11] **3,926,499**

[45] **Dec. 16, 1975**

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

[75] Inventors: **James R. Bailey**, Chicago; **Vernon W. Lavigne**, Rolling Meadows, both of Ill.

[73] Assignee: **Switchcraft, Inc.**, Chicago, Ill.

[22] Filed: **Dec. 13, 1974**

[21] Appl. No.: **532,590**

Related U.S. Application Data

[62] Division of Ser. No. 339,050, March 8, 1973, Pat. No. 3,885,849.

[52] **U.S. Cl.** ..... **339/136 R**

[51] **Int. Cl.**[2] **H01R 13/46**

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

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Primary Examiner—Joseph H. McGlynn
Assistant Examiner—Craig R. Feinberg
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.

8 Claims, 29 Drawing Figures

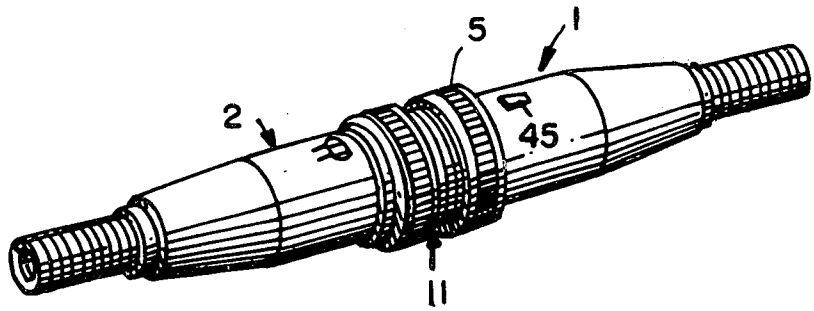


FIG. 1

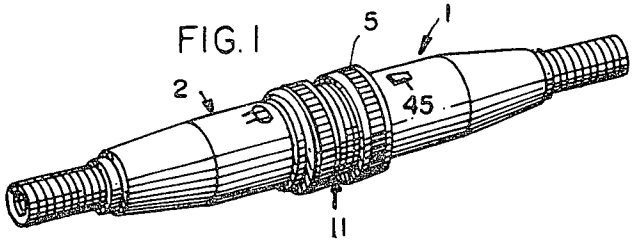


FIG. 2

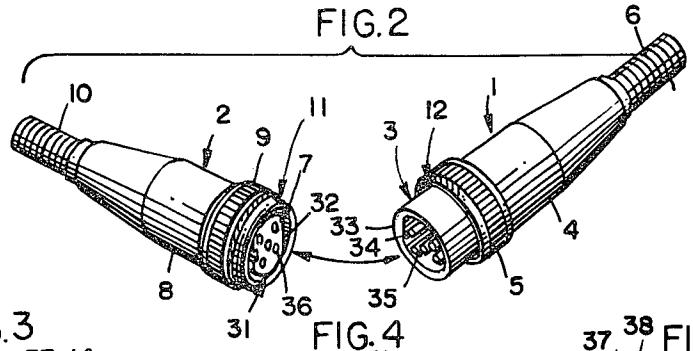


FIG. 3

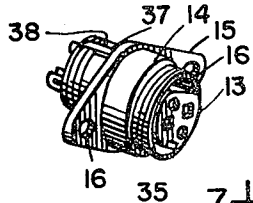


FIG. 4

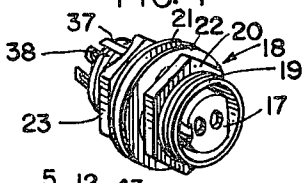


FIG. 5

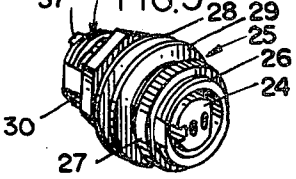


FIG. 7

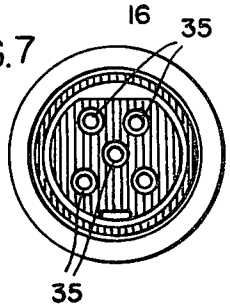


FIG. 6

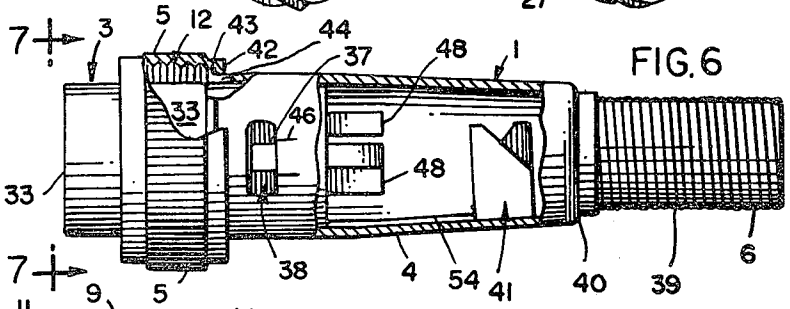


FIG. 8

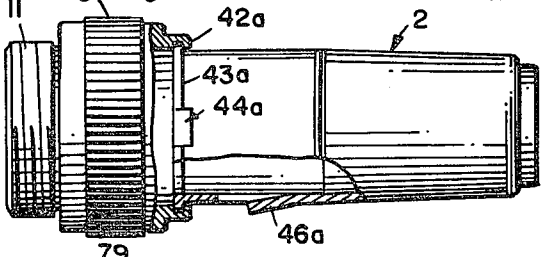


FIG. 9

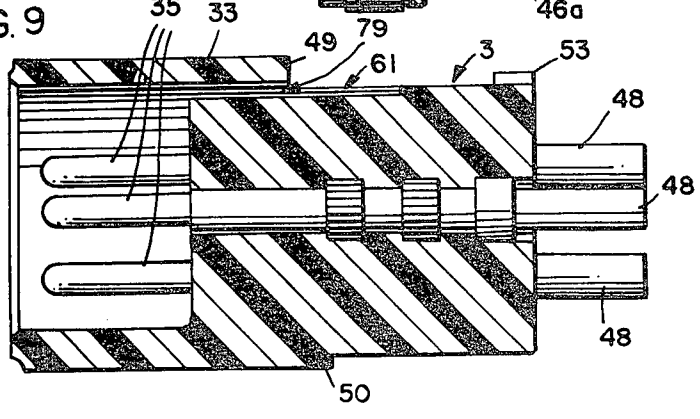


FIG. 10

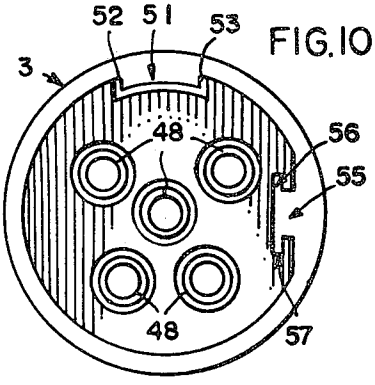


FIG. 12

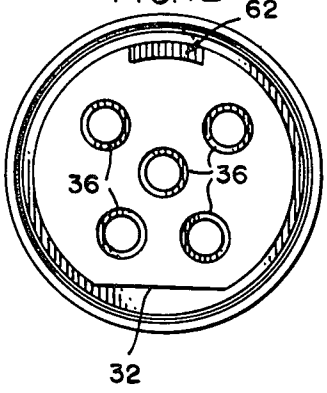


FIG. 11

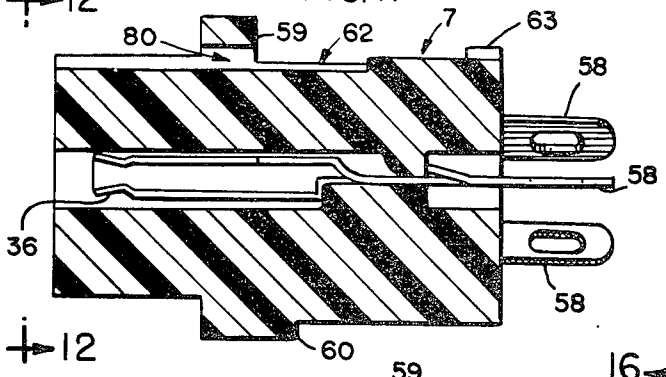


FIG. 15

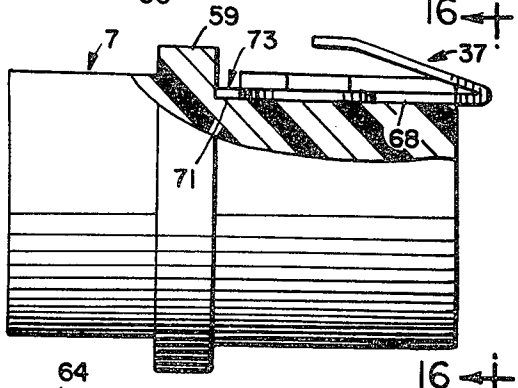


FIG. 13

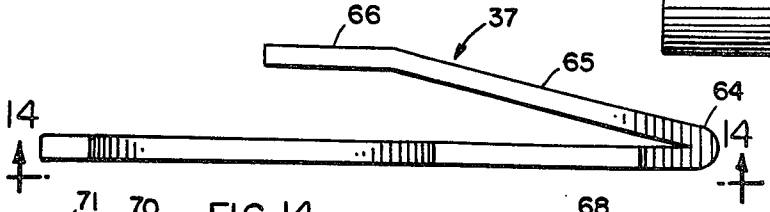


FIG. 14

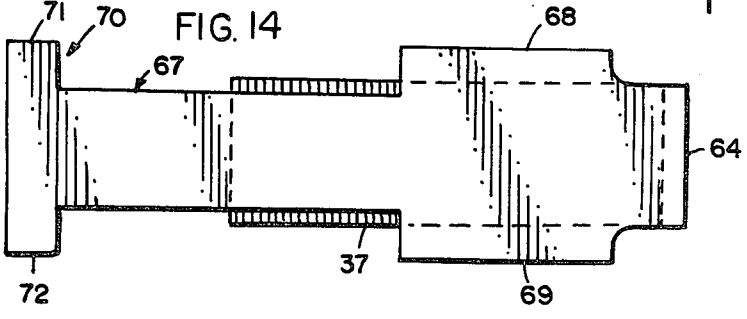


FIG. 16

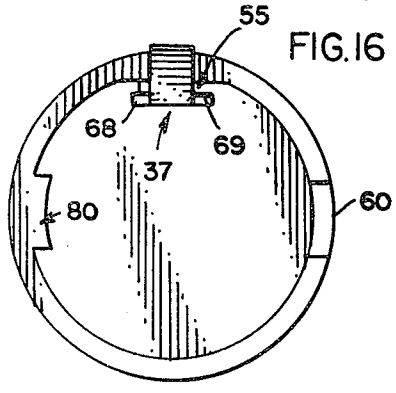


FIG. 17

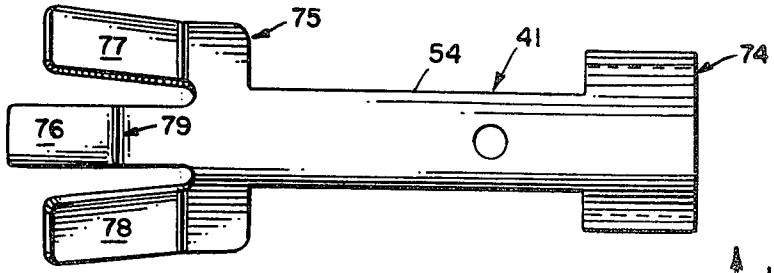


FIG. 18

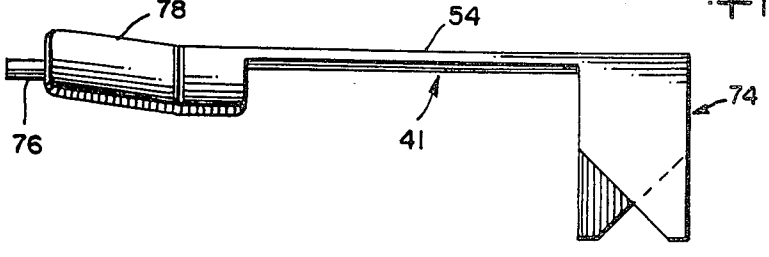


FIG. 19

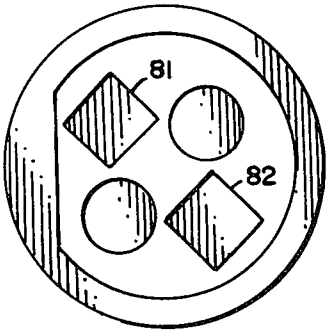


FIG. 20

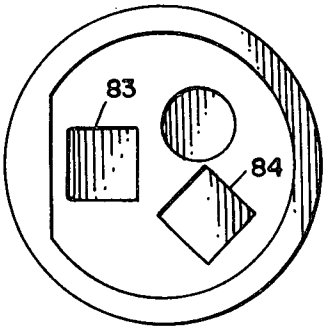


FIG. 21

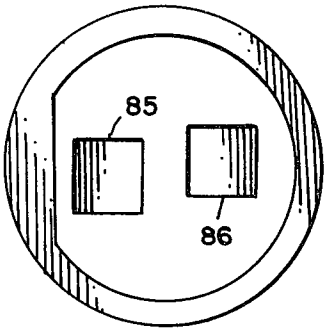


FIG. 22

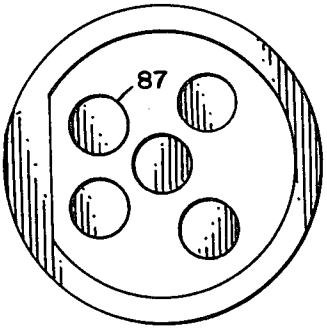


FIG. 23

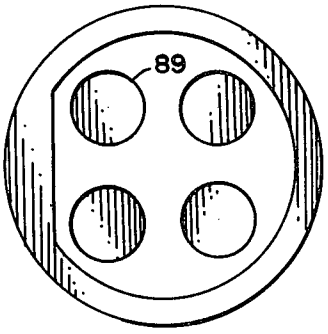


FIG. 24

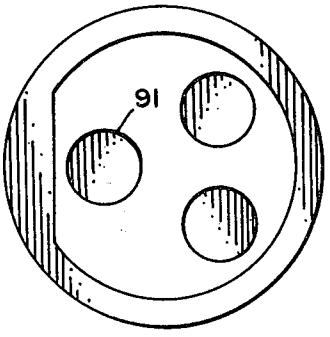


FIG. 26

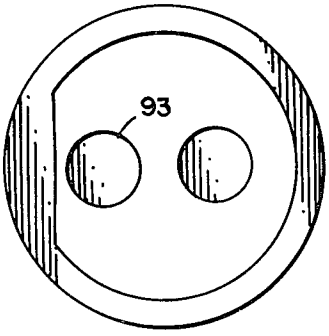


FIG. 25

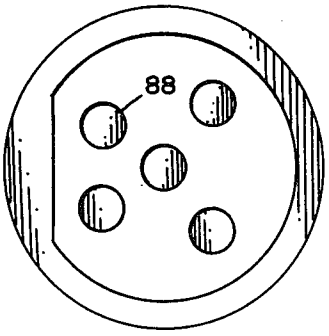


FIG. 27

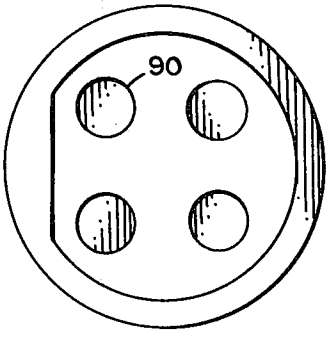


FIG. 28

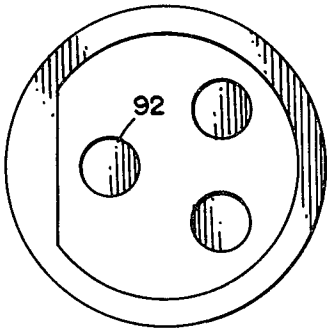
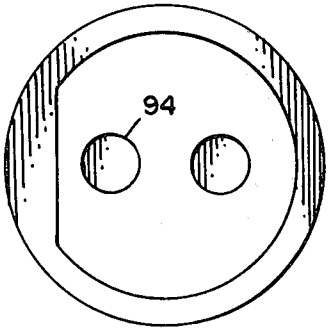


FIG. 29



ELECTRICAL CONNECTORS WITH INTERCHANGEABLE COMPONENTS

This application is a division of copending application Ser. No. 339,050, filed Mar. 8, 1973, now U.S. Pat. No. 3,885,849.

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 a 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 to 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 inventtion 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 serations 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 serated 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 number 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 **42*a*** which is secured to outwardly extending flange **43*a*** of housing **2**. Flange **42*a*** has a cut-out portion **44*a***.

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 **44***a* 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** of 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.

we claim:

1. An insert for the housing of an electrical connector having a side opening and a tubular front to rear opening to receive said insert, said insert comprising a plurality of either male or female electrical contact 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 and adapted to exert resilient pressure in a plane perpendicular to the longitudinal axis of said insert, said resilient strip being an elongated strip bent at an intermediate section to provide an upwardly extending portion to project into said side 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.

2. An insert as claimed in claim **1** which contains a transversely extending offset portion at its surface at an intermediate point with respect to the longitudinal axis of said insert to limit the inward movement of said insert when it is placed in said housing.

3. An insert as claimed in claim **1** comprising means on the surface of said insert to restrain rotary movements of said insert when it is inserted into said housing.

4. An insert as claimed in claim **2** comprising an opening in said offset portion to receive one end of a cable clamp.

5. An insert as claimed in claim **1** comprising on the external surface thereof a channel with undercut sides to receive said resilient strip.

6. An electrical connector comprising a housing having a tubular front to rear opening and a side opening, an insert receivable in said front to rear opening in engagement with the sides thereof, said insert containing at the forward end a plurality of either male or female electrical contact 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 fixed to the side of said insert comprising a bent resilient strip one end of which projects into said side opening in said housing to lock said insert against axial movement and is depressable by external pressure through said side opening to permit unlocking of said latch means and removal of said insert by sliding it forwardly from said housing, said resilient strip being an elongated strip bent at an intermediate section to provide an upwardly extending portion to project into said side 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.

7. An electrical connector as claimed in claim **6** comprising a cable clamp made from an elongated strip one end of which is received in an opening in the outer surface of said insert and also contacts the inner surface of said housing and the opposite end of which projects rearwardly and is adapted to partially encircle an electrical cable the ends of which are connected to said terminals.

8. An electrical connector as claimed in claim **6** wherein the outer surface of said insert and said housing comprise interfitting means which restrain said insert against rotary movement but not against axial movement.

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