Sept. 5, 1961 R. H. ELLIS ET AL 2,999,221

SNAP-IN CONTACTS FOR ELECTRICAL CONNECTORS

Filed Aug. 2, 1960 2 Sheets-Sheet 1

FIG. 1.

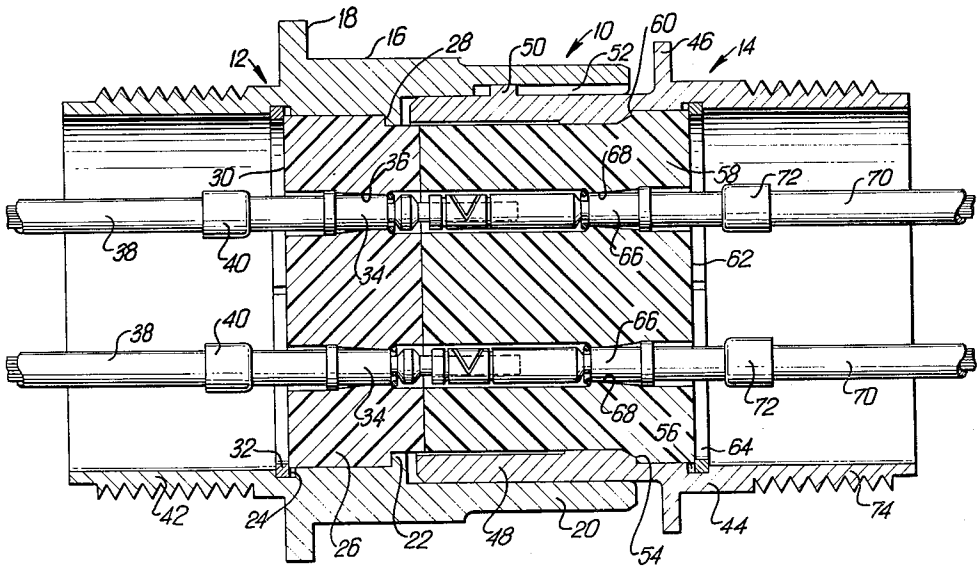

FIG. 2.

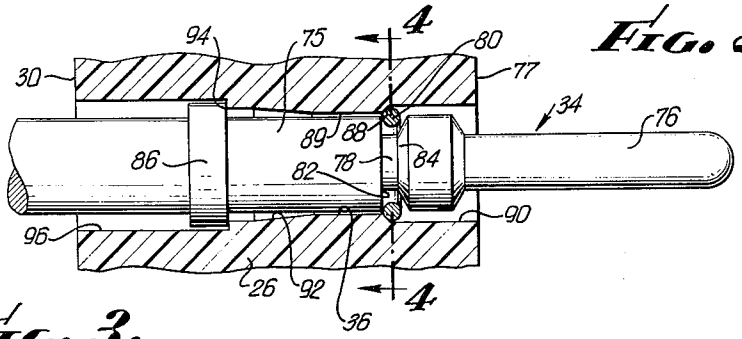

FIG. 3.

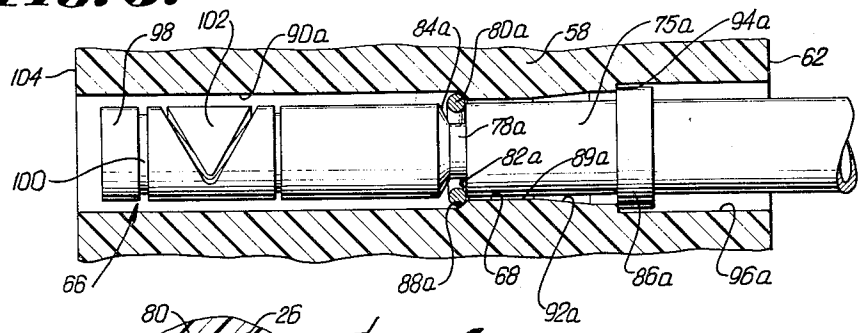

FIG. 4.

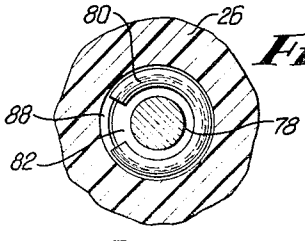

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FIG. 5.

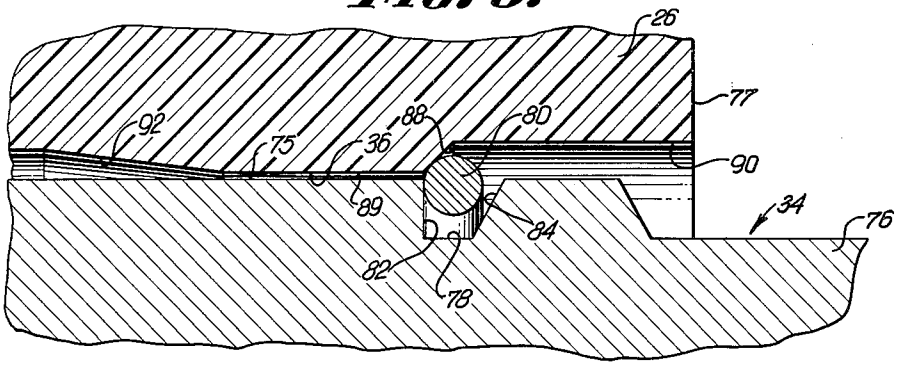


FIG. 6.

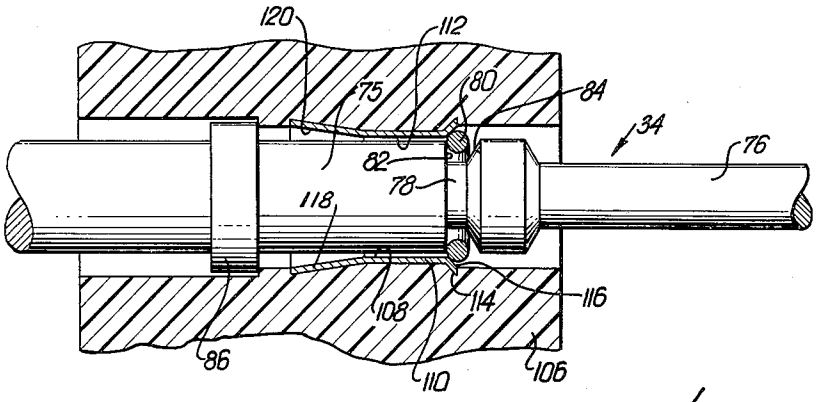
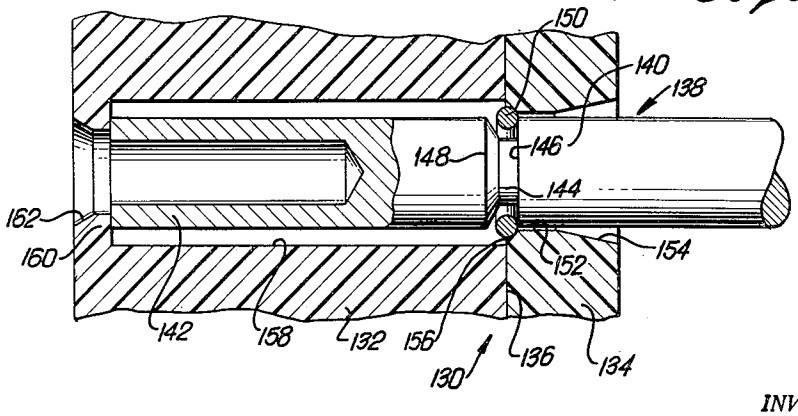


FIG. 7.



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SNAP-IN CONTACTS FOR ELECTRICAL CONNECTORS

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16 Claims. (Cl. 339—176)

The present invention relates generally to electrical connectors having mating connector members with pin and socket contact elements or terminals mounted therein, respectively, and the invention relates more particularly to a novel electrical connector construction wherein the contact elements or terminals can be snapped into and out of their operative positions in the connector bodies.

In many electrical connector applications it would be advantageous to be able to snap the pin and socket contact terminals into and out of their operative positions in the connector body portions. For example, where a connector has numerous terminals, and especially in the case of a miniature connector where the terminals are close to each other, the work involved in crimping or soldering the ends of the conductor wires to the terminals is intricate and tedious, and it is therefore desirable to be able to attach the wires to the terminals, as by crimping or soldering, on the bench, and thereafter to snap the terminals into their operative positions in the connector body portions. It is desirable to be able to remove the individual contact terminals from the connector portions without completely disassembling the connector portions for a number of reasons, such as to permit correction of circuit errors, or to allow modification of the electrical circuits embodying the connector without having to use a new connector and without requiring re-attachment of the conductor wires to the individual contact terminals. Removability of the individual contact terminals from the connector body portions further permits replacement of damaged connector parts, including damaged terminals, without requiring that all of the individual contacts be replaced, and without in any way disturbing the circuitry embodying the connector.

One of the principal problems which must be contended with in connection with contact terminals which are adapted to be inserted into a connector body after the ends of the conductor wires have been connected to the terminals as by crimping or soldering, is to provide engaging means between the individual terminals and the connector body which will securely hold the terminals in fixed positions in the body during engagement and disengagement of the connector members. In order to prevent undesired shifting or dislodging of individual terminals during engagement or disengagement of the connector members, prior art devices of this general type have provided engaging means between the individual terminals and the connector body portions which cause the terminals to be permanently locked in their operative positions in the body portions so that the terminals could not be removed without dismantling or disassembling the connector members or without using special removal tools which require undesirable working clearances in the connector members.

Because of these and other problems in the art, it is an object of the present invention to provide an electrical connector having pin and socket terminals which may be snapped into and out of their operative positions in the connector body portions without dismantling or disassembling the connector members and without requiring special tools.

Another object of the present invention is to provide an electrical connector having pin and socket contact terminals which are insertable from the rear or conductor

ends of the connector body portions into axial bores through the connector body portions, the pin and socket terminals each having an annular groove thereon in which is mounted a resilient retaining ring, the retaining ring being compressed radially-inwardly as the terminal is inserted into its respective bore in a connector body portion, and then snapping radially-outwardly in front of an annular surface in the body portion which will normally hold the terminal against rearward movement in the connector under the rearwardly directed force imposed upon the terminal by the coupling thereof with a mating terminal, this annular body portion surface being inclined forwardly and radially-outwardly so that upon the application to the terminal of a rearwardly-directed terminal-removal driving force greater than the coupling driving force, the retaining ring will be cammed radially-inwardly against this body portion surface to permit withdrawal of the terminal from the body portion.

Another object of the present invention is to provide an electrical connector of the character described wherein the forwardly-directed annular retaining face in each terminal-receiving bore of the connector body tapers forwardly and outwardly so as to provide a cam surface for constricting the retaining ring radially-inwardly to a smaller diameter upon the application of a sufficient rearward force to the terminal for removal of the terminal from the body, and wherein the opposed, rearwardly-facing surface of the terminal groove likewise tapers forwardly and radially-outwardly, but at a steeper angle relative to the axis of the terminal and terminal bore than the retaining face and the bore, whereby the rearward removal force on the terminal will cause this tapered terminal groove surface to apply a radially-outwardly directed expanding force to the retaining ring which tends to oppose the radially-inwardly directed camming force of the tapered bore surface, whereby the difference in the angles of taper relative to the axis between the said rearwardly-facing groove surface and forwardly-facing bore surface will provide an accurate control over the amount of rearward force on the terminal which is required to remove the terminal from the bore. The tapers of said bore and groove surface, in addition to thus controlling the amount of removal or withdrawal force required on the terminal, also prevent damage to the ring, the terminal and the body portion of the connector by eliminating sharp engaging corners upon the application of the relatively heavy removal force to the terminal.

A further object of the present invention is to provide an electrical connector of the character described wherein each terminal-receiving bore of the connector body portions is provided with a rearwardly and outwardly-flaring annular entrance ramp which is relatively gradual so as to constrict the retaining ring into the terminal groove, thereby permitting easy insertion of the terminals into the terminal-receiving bores in the connector bodies; control of the slope of this annular entrance ramp and of the forwardly-facing side of the terminal groove which forces the retaining ring against the entrance ramp providing accurate control over the amount of insertion force required.

It is thus a general object of the present invention to provide an electrical connector having contact elements or terminals which may be snapped into and out of their operative positions in the connector body portions, the terminals being retained in the connector bodies by retaining rings mounted in respective annular grooves on the terminals, wherein the angular relationship of the controlling surfaces on the terminals and in the terminal-receiving bores are such that the terminals can be readily inserted into the bores with a predetermined, relatively light insertion force, and the terminals can be withdrawn or pushed out of the bores with a predetermined, rela-

tively heavy removal force on the terminals, and wherein continued insertion and removal of the terminals will not cause any undue wear or damage, and removal can be accomplished by merely applying a removal or extraction force to individual terminals without requiring special tools or excessive clearances in a connector to accommodate such special tools.

Further objects and advantages of the present invention will appear during the course of the following part of this specification wherein the details of construction and the mode of operation of several preferred embodiments of the invention are described with reference to the accompanying drawing, in which:

FIG. 1 is an axial section of an electrical connector embodying the present invention and showing the two connector members thereof operatively interengaged;

FIG. 2 is a detail axial section on an enlarged scale, illustrating a pin contact terminal operatively engaged in a terminal-receiving bore in one of the connector members;

FIG. 3 is a detail axial section on an enlarged scale illustrating a socket terminal operatively positioned in the other connector member;

FIG. 4 is a transverse section along the line 4—4 in FIG. 2;

FIG. 5 is a greatly enlarged detail axial section illustrating a portion of the structure shown in FIG. 2 so as to particularly illustrate the relationship of the surfaces in the terminal groove which receives the retaining ring and in the terminal-receiving bore, in a presently-preferred form of the invention;

FIG. 6 is a detail axial section similar to FIG. 2, but illustrating an alternative form of the invention embodying a molded-in contact retention sleeve; and

FIG. 7 is an axial section generally similar to FIG. 3, but illustrating an application of the present invention wherein the connector body includes a plurality of insulation block members.

Referring to the drawings, and at first particularly to FIG. 1 thereof, the present invention has been illustrated in connection with a connector **10** of generally conventional overall design. The connector **10** includes a receptacle connector member **12** and a plug connector member **14** which is receivable in the receptacle member **12**.

The receptacle connector member **12** includes an open-ended tubular shell **16** having an outer flange **18** for mounting purposes, and having a forward skirt portion **20** adapted to receive the plug connector member **14**. The receptacle shell **16** is provided with an inside flange **22** disposed to the rear of the forward skirt portion **20**, and is also provided with an inside groove **24** disposed rearwardly of the flange **22**. An insulation body **26** is mounted within shell **16**, the body **26** having a forwardly-facing shoulder **28** which engages against inside flange **22** so as to limit the insulation body **26** against forward movement in the shell **16**. The periphery of rear face **30** of insulation body **26** is engaged by a snap ring **32** which seats in groove **24** so as to hold the insulation body **26** against rearward movement in the shell **16**.

A plurality of pin contact elements or terminals **34** are operatively positioned in respective axial bores **36** through insulation body **26**, these pin contact elements or terminals **34** being removably-engaged in the respective axial bores **36** in the manner hereinafter described in detail. Although the connector **10** illustrated in the drawings has the pin contact terminals mounted in the receptacle member **12** and the socket contact terminals mounted in the plug connector member **14**, it will be obvious to those skilled in the art that the socket terminals could be supported in the receptacle connector member and the pin terminals could be supported in the plug connector member, without in any way departing from the present invention.

A plurality of conductor wires **38** are both mechanically and electrically connected to the pin contact terminals **34** by engagement of the ends of conductors **38** in solder or crimping cups **40** at the rear ends of the contact terminals **34**.

The receptacle shell **16** may be provided with an externally-threaded rear portion **42** which is adapted to receive a conventional internal sealing grommet and an end bell, these parts being of conventional construction and therefore not being shown in the drawings.

The plug connector member **14** includes an open-ended tubular shell **44** having an outer mounting flange **46**, and having a forward skirt portion **48** adapted to fit within the skirt portion **20** of the receptacle connector member **12**. A key **50** projects outwardly from the plug skirt portion **48** and is receivable in an axial slot **52** within the receptacle skirt portion **20** so as to provide correct alignment between the plug and receptacle connector members.

The plug shell **44** is provided with a rearwardly-facing inside surface **54** to the rear of the forward skirt portion **48**, and is provided with an inside groove **56**, spaced rearwardly from the surface **54**. Insulation body **58** is disposed within the plug shell **44**, and is positioned therein by engagement of the rearwardly-facing shell surface **54** against a forwardly-directed shoulder **60** on the insulation body **58**, and by engagement of the periphery of rear face **62** of the body **58** against a snap ring **64** which seats within the shell groove **56**.

A plurality of socket contact elements or terminals **66** are removably-mounted within a plurality of respective axial bores **68** through insulation body **58** in the manner hereinafter described in detail. A plurality of electrical conductors **70** are connected to solder or crimping cups **72** comprising the rear end portions of the respective socket terminals **66**. The plug shell **44** is provided with an externally-threaded rear portion **74** for receiving sealing grommet and bell members of conventional construction (not shown).

Referring now to FIGS. 2, 4 and 5, which illustrate in detail the principal features of the present invention, each terminal **34** includes a generally-cylindrical body portion **75**, with a pin contact portion **76** of reduced diameter extending forwardly thereof. The reduced pin portion **76** extends forwardly beyond the front face **77** of insulation body **26** so as to be exposed for engagement in a respective socket terminal **66**.

Each terminal **34** is provided with an annular groove **78** in the cylindrical body portion **75** thereof for receiving a resilient retaining ring **80**. The presently-preferred retaining ring **80** comprises a split metal ring having a substantial gap between the ends of the ring at the split, and may be composed of stainless steel, beryllium copper or other spring metal. It is to be understood, however, that the ring **80** may be composed of other resilient or spring materials having adequate structural strength, and in the case of some plastic materials having the desired qualities of toughness, resiliency and memory, it may be desirable to employ a closed annular ring rather than a split ring.

In its relaxed or unstressed condition, the retaining ring **80** is of such a size that it will extend partly inside of and partly outside of the annular groove **78**; i.e., the inside diameter of the ring will be substantially less than the diameter of the cylindrical body portion **75** of terminal **34**, and the outer diameter of the ring **80** will be substantially greater than the diameter of the cylindrical body portion **75**. Prior to engagement of the terminal **34** in the body of the connector, the ring **80** is mounted on the terminal in the groove **78** by merely sliding the ring **80** over the pin portion **76** of terminal **34** and then expanding the ring over the forward part of the cylindrical body portion **75** and in to the groove **78**.

The rear side of groove **78** is defined by forwardly-directed face **82** which is preferably planar and disposed at right angles to the axis of the terminal so as to provide a positive abutting face against which the ring **80** will

seat as the terminal is pushed into bore 36 from the rear of insulation body 26. Some rearwardly and outwardly-directed taper could be employed in the forwardly-directed groove face 82, if desired, but insertion of the terminal in the terminal-receiving bore is facilitated by having this face 82 steep relative to the axis of the terminal, and preferably at substantially right angles thereto.

The front side of the groove 78 is defined by rearwardly-directed face 84 which inclines forwardly and radially-outwardly from the bottom of groove 78 so as to face in a rearward, radially-outward direction, the purpose of this incline of the face 84 being explained in detail hereinafter.

The terminal 34 is also provided with an external flange 86 which is positioned substantially to the rear of groove 78 and which serves to limit the forward travel of the terminal in the bore 36.

The bore 36 is provided with a forwardly and radially-inwardly directed face or shoulder 88 which inclines forwardly and radially-outwardly from the most constricted portion 89 of bore 36 to a forward counterbore 90 extending forwardly to the front face 77 of insulation body 26.

By inclining the forwardly-directed bore face or shoulder 88 so that it extends forwardly and radially-outwardly from the most constricted portion 89 of the bore, this forwardly-directed face 88 provides a cam surface against which the retaining ring 80 is compressed radially-inwardly within the terminal groove 78 when the terminal is pulled or pushed rearwardly, so that the ring 80 will be reduced in diameter to a size permitting the ring to pass rearwardly through the constricted portion 89 of the bore 36, allowing complete rearward extraction of the terminal 34 from the body of the connector. If the forwardly-directed bore face 88 were at right angles to the axis, it would permanently lock the terminal in its seated position within the body, and attempts to remove the terminal by merely pushing or pulling it rearwardly would tend to shear and damage the ring, and also would damage the holding face in the bore, and the opposed portion of the terminal.

Although the amount of incline of the bore face 88 relative to the axis of the bore is not in any way critical, it has been found in one example of the invention that an angle of incline of approximately 45 degrees relative to the axis provides excellent results.

The forwardly and radially-outwardly directed incline of the rearwardly-facing face 84 in the terminal groove 78 serves several important functions. First, by controlling the steepness of the incline of groove face 84 relative to the incline of bore face 88, the amount of force required to withdraw the terminal from the body may be accurately controlled. This is for the reason that while the forwardly-directed bore face 88 tends to cam the ring 80 radially-inwardly, the rearwardly-directed opposing face 84 of the terminal tends to cam the ring radially-outwardly. By having the angle of incline of the terminal face 84 greater relative to the axis than the angle of the bore face 88, the cam atcion of the bore face 88 will be greater than the cam action of the terminal face 84, with the net result that the ring 80 will be cammed inwardly to permit removal of the terminal from the connector body. The amount of removal force required will depend upon just how much steeper the angle of incline of the terminal face 84 is as compared with the angle of incline of the bore face 88, relative to the axis. Thus, it is the difference between the angles of incline relative to the axis of the terminal face 84 and the bore face 88 which controls the amount of removal force required. In the embodiment of the invention shown in FIGS. 2 and 5, the angle of incline of the groove face 84 relative to the axis is about 60 degrees, which provides a differential angle of about 15 degrees between the grooved surface 84 and the bore surface 88.

For a particular pre-selected amount of terminal removal force, the relationship between the angles of incline of the terminal groove face 84 and the bore face 88 will be controlled in part according to the size and composition of the ring 80. The amount of removal force for which the surfaces 84 and 88 are set will depend upon the size and usage of the connector, and also upon the number of terminals in the connector. Thus, where the pin and socket contacts of the connector members are coupled together with a relatively heavy frictional connection, it is desirable to have the surfaces 84 and 88 set at a relatively small differential angle so as to require a relatively heavy force for removing each individual terminal. In this manner, the terminals are not likely to become accidentally dislodged upon interengagement of the connector portions. However, where the pin and socket terminals are coupled together with a relatively light frictional engaging force, which is usually the case where a large number of terminals are employed in the connector, then a larger differential angle may be provided between the surfaces 84 and 88 to permit easier removal of the individual terminals when desired, without possibility of accidental dislodging of the terminals when the connector portions are engaged.

Rearwardly of the annular entrance ramp 92, the bore 36 is provided with a rearwardly-facing annular surface 94, a rear counterbore 96 extending rearwardly from surface 94 to the rear face 30 of the insulation body 26. The flange 86 on terminal 34 abutts against this rearwardly-facing surface 94 of the insulation body 26 so as to limit forward travel of the terminal in the bore beyond the position shown in FIGS. 2 and 5, wherein the terminal groove 78 is proximate the surface 88 in the body.

The contacts 34 may be removed from bore 36 by impact on a mating contact, or by a straight push or pull on the contact. It will be apparent that no special tools are required, and that therefore, no undesirable, space-consuming excessive clearances are required in the forward part of the insulation body around the terminal to permit insertion of such a tool for collapsing the retaining ring. Accordingly, all portions of the bores 36 may be relatively small in diameter, and a maximum number of terminals may be provided in a connector of a given cross-sectional size.

FIG. 3 of the drawings illustrates the present invention as applied to one of the socket terminals 66 in the insulation body 58 of plug connector member 14. The socket terminal may have a forward socket portion of any desired type, the socket portion 98 of the illustrated terminal 66 being of the type which has an external portion 100 of reduced diameter about which is disposed a spring-gripping member 102, a portion of which extends through the wall of the socket terminal so as to resiliently engage a respective pin contact element. Socket terminals of this general type are shown and described in co-pending application, Serial No. 744,947, "Socket Terminals for Electrical Connectors," filed June 27, 1958. The forward end of socket terminal 66 is preferably recessed slightly inside of, or to the rear of the forward face 104 of insulation body 58.

It will be apparent from FIG. 3 of the drawings that the application of the present invention to a socket terminal is identical to the application to a pin terminal. Thus, the retaining ring 80*a* is disposed within annular terminal groove 78*a* which is defined between a forwardly-directed face 82*a* preferably disposed at approximately right angles to the axis of the terminal, and a rearwardly and radially-outwardly facing face 84*a* which extends from the bottom of the groove forwardly and radially-outwardly at an incline relative to the axis of the terminal, this annular groove 78*a* being disposed in a generally cylindrical body portion 75*a* of the terminal.

As the socket terminal 66 is inserted into the insulation body 58 through the rear face 62 thereof, the ring 80*a* is cammed radially-inwardly by the gradually slop-

ing annular entrance ramp 92*a* and rides past the most constricted portion 89*a* of the bore, snapping radially-outwardly just in front of forwardly and inwardly-directed annular face 88*a* in the bore so as to lock the terminal in position. A counterbore portion 90*a* of the bore 68 extends forwardly from the annular surface 88*a* to the forward face 104 of insulation body 58. The rearwardly and outwardly-directed annular inclined face 84*a* in the terminal groove and the opposed forwardly and inwardly-directed annular inclined face 88*a* in the bore bear the same relationship to each other as the corresponding faces shown in FIGS. 3 and 5, and provide the same operation and advantages.

The socket terminal 66 is limited in its forward travel through insulation body 58 by engagement of flange 86*a* against rearwardly-facing surface 94*a* in the bore, the flange 86*a* being accommodated in rear counterbore 96*a* which extends rearwardly from surface 94*a* to the rear face 62 of the insulation body.

FIGURE 6 of the drawings illustrates a modified form of the present invention which employs a molded-in contact retention sleeve composed of metal which lines the portion of each terminal-receiving bore that engages and cooperates with the retaining ring. This molded-in contact retention sleeve is suitable for an insulation body of any insulating material, but is particularly desirable where the insulation body is composed of an elastomer material which, because of its resilience, might otherwise be damaged by the retaining ring, or might result in an unpredictable withdrawal force required to remove a terminal.

The contact terminal illustrated in FIG. 6 is one of the pin contact terminals which are shown in detail in FIGS. 2 and 5 and does not require further description. The insulation body 106 illustrated in FIG. 6, which may be of a resilient elastomer material, is provided with axial bore 108 within which metal contact retention sleeve 110 is mounted. The contact retention sleeve 110 is preferably molded into place so as to be securely bonded in its operative position in the insulation body. The contact retention sleeve 110 includes a cylindrical wall portion 112 which forms its most constricted portion, and is outwardly-flared at its forward end 114 so as to provide a forwardly and inwardly-directed face 116 which is inclined and functions similarly to the corresponding face 88 of the insulation body 26, best shown in FIGS. 2 and 5.

The contact retention sleeve 110 is also provided, to the rear of its cylindrical portion 112, with a rearwardly-flared portion 118, so as to provide the gradually inclined annular entrance ramp 120.

The remainder of the axial bore 108 through insulation body 106, both in front of and to the rear of the contact retention sleeve 110, is substantially the same as bore 36 of insulation body 26 as best shown in FIGS. 2 and 5 of the drawings.

It will be apparent that the contact retention sleeve 110 improves the durability and serviceability of the device, particularly where the insulation body does not have adequate strength or is resilient, by reinforcing the working surface portions of the terminal-receiving bore of the insulation body.

In FIG. 7 of the drawings, the present invention has been illustrated in connection with a two-piece insulation body 130 consisting of a front insulation block 132 and a rear insulation block 134, the blocks 132 and 134 engaging each other at interface 136.

In FIG. 7 the contact terminal comprises a socket terminal 138 having a cylindrical body portion 140 and a forward socket portion 142. Annular groove 144 is provided in the cylindrical body portion 140, and is defined between forwardly-directed face 146 which is preferably at right angles to the axis of the terminal, and rearwardly and radially-outwardly directed face 148 which inclines forwardly and radially-outwardly from the bottom of groove 144. The groove faces 146 and 148 correspond, respectively, to the faces 82 and 84 of the embodiment shown in FIGS. 2 and 5.

Contact retaining ring 150 is disposed in the groove 144, and in its unstressed condition, a portion of the ring 150 lies within the groove 144, while a portion of the ring 150 extends radially-outwardly beyond the cylindrical surface of the terminal.

The rear insulation block 134 is provided with axial bore 152 which has a gradual flare in its rear end to provide annular entrance ramp 154, and is provided with a short, relatively steep, front flare 156 which terminates at the interface 136. The flare 156 corresponds in incline, and in function, with the forwardly and inwardly-directed surface 88 in the insulation body 26, as best shown in FIGS. 2 and 5 of the drawings.

The front insulation block 132 is provided with an axial bore 158 which is aligned with the bore 152 of rear insulation block 134. The bore 158 extends rearwardly to the interface 136 at a diameter which is preferably approximately the same as the diameter of the outermost portion of the front flare 156 in the bore 152 of the rear block 134. The front insulation block 132 is provided adjacent its front face with a radially-inwardly directed flange 160 which serves as an abutment limiting the extent of forward travel of the terminal 138 in the insulation body. It is preferred to provide a forward flare 162 in flange 160 as a guide for a pin contact element which is being moved into coupling engagement with the socket contact terminal 138.

While the instant invention has been shown and described herein in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is therefore not to be limited to the details disclosed herein, but is to be accorded the full scope of the claims.

We claim:

1. In an electrical connector the combination of: an insulator member having a conductor end and a contact end and a bore extending through the insulator member from end to end; an elongated contact terminal mounted in said bore; non-yielding stop means limiting the position of said terminal in said bore in the direction of the contact end; and yieldable stop means limiting the position of said terminal in said bore in the direction of the conductor end, said yieldable stop means comprising an annular shoulder formed in said insulator bore angularly inclined relative to the axis thereof so as to face radially-inwardly and toward said contact end and a bore section of restricted diameter adjoining said shoulder toward the conductor end, a compressible ring of an outside diameter when expanded to lodge against said shoulder and of a diameter when compressed sufficiently small to slide through the bore section of restricted diameter, a groove in said terminal receiving said ring and sufficiently deep to accommodate said ring when compressed, the wall of said groove facing the conductor end providing a driving face for engagement with said ring, said driving face being angularly inclined relative to the bore axis so as to face radially-outwardly and toward said conductor end and having an angle of inclination relative to the axis of the bore greater than the angle of inclination of the shoulder of the insulator member, whereby axial driving force toward the conductor end imposed upon the terminal by the coupling thereof with a mating terminal is not sufficient to dislodge the terminal in the bore but application of a terminal removal driving force greater than the coupling driving force will force the terminal groove face against the ring, whereby the ring will be cammed by the shoulder into compressed circumference and into the bore section of restricted diameter and the terminal may thereupon be completely withdrawn from the insulator.

2. The combination as defined in claim 1, wherein said bore flares outwardly from said bore section of reduced

diameter toward said conductor end of the insulator member so as to provide an annular entrance ramp in the insulator which is angularly inclined relative to the bore axis, whereby as the terminal is inserted into the bore from the conductor end of the insulator, the ring will be driven by the wall of the groove facing the contact end of the insulator against said entrance ramp so as to be cammed by the entrance ramp into compressed circumference and through said bore section of restricted diameter, the ring expanding adjacent said shoulder in the insulator body.

3. The combination as defined in claim 2, wherein said shoulder of the insulator member has a greater angle of inclination relative to the bore axis than the angle of inclination of said entrance ramp, whereby insertion of the terminal into the insulator bore from said conductor end will be easier than withdrawal of the terminal from the insulator.

4. The combination as defined in claim 2, wherein said shoulder of the insulator member has a greater angle of inclination relative to the bore axis than the angle of inclination of said entrance ramp, and said groove wall facing the contact end is disposed at an angle relative to the bore axis at least as great as the angle of inclination of said groove wall facing the conductor end, whereby insertion of the terminal into the insulator bore from said conductor end will be easier than withdrawal of the terminal from the insulator.

5. The combination as defined in claim 4 wherein said groove wall facing the contact end is disposed substantially at right angles to the terminal axis.

6. The combination as defined in claim 1, which includes a metal sleeve member disposed in said bore in said insulator member so as to line a portion of the bore, said metal sleeve member having a portion of restricted diameter with its inside surface forming said bore section of restricted diameter, a portion of said sleeve member ajoining said portion of restricted diameter flaring outwardly toward said contact end of the insulator with its inside surface forming said shoulder in the bore, and a portion of said sleeve member adjoining said portion of restricted diameter flaring outwardly toward said conductor end with its inside surface forming said entrance ramp.

7. The combination as defined in claim 6 wherein said insulator member is composed of resilient material.

8. In an electrical connector the combination of: an insulator member having a conductor end and a contact end and a bore extending through the insulator member from end to end; an elongated contact terminal mounted in said bore; non-yielding stop means limiting the position of said terminal in said bore in the direction of the contact end; and yieldable stop means limiting the position of said terminal in said bore in the direction of the conductor end, said yieldable stop means comprising a metal sleeve member positioned coaxially within the insulator bore so as to line a portion of the insulator bore, a section of the inside surface of said sleeve member defining an annular shoulder angularly inclined relative to the axis of the bore so as to face radially-inwardly and toward said contact end and a section of the inside surface of said sleeve member adjoining said shoulder toward the conductor and being of restricted diameter, a compressible ring of an outside diameter when expanded to lodge against said shoulder and of a diameter when compressed sufficiently small to slide through said sleeve section of restricted diameter, a groove in said terminal receiving said ring and sufficiently deep to accommodate said ring when compressed, the wall of said groove facing the conductor end providing a driving face for engagement with said ring, said driving face being angularly inclined relative to the bore axis so as to face radially-outwardly and toward said conductor end and having an angle of inclination relative to the axis of the bore greater than the angle of inclination of the shoulder of the sleeve member, whereby axial driving force toward the conductor end imposed upon the terminal by the coupling thereof with a mating terminal is not sufficient to dislodge the terminal in the bore but application of a terminal removal driving force greater than the coupling driving force will force the terminal groove face against the ring, whereby the ring will be cammed by the shoulder into compressed circumference and into the sleeve section of restricted diameter and the terminal may thereupon be completely withdrawn from the insulator.

9. The combination as defined in claim 8 wherein a section of the inside surface of said metal sleeve member adjoining said section of restricted diameter toward the conductor end flares outwardly from said restricted section toward the conductor end so as to form an annular entrance ramp, whereby as the terminal is inserted into the bore from the conductor end of the insulator, the ring will be driven by the wall of the groove facing the contact end of the insulator against said entrance ramp so as to be cammed by the entrance ramp into compressed circumference and through said sleeve section of restricted diameter, the ring expanding adjacent said shoulder.

10. The combination as defined in claim 8 wherein said insulator member is composed of resilient material.

11. An electrical connector comprising: a tubular shell having a front end portion adapted to be coupled with a mating connector member and having a rear end; an insulation body mounted in said shell, said body having a front end and a rear end, said body having a plurality of aligned bores extending therethrough from end to end; a plurality of elongated contact terminals mounted in said body in the respective bores; stop means defining forwardmost positions of said terminals in the respective bores; each insulator bore having an annular shoulder formed therein which is inclined relative to the bore axis so as to face forwardly and radially-inwardly; an annular grove in each terminal, the rearwardly facing wall of each groove being inclined relative to the axis of the bore so as to face rearwardly and radially-outwardly, said terminal grooves being adjacent said shoulder in the body with said rearwardly facing groove wall forward of the shoulder in said forward-most positions of the terminals; and a plurality of compressible retaining rings mounted in the respective terminal grooves, each ring normally extending radially-outwardly beyond the confines of its respective groove in front of the respective body shoulder so as to lodge against the shoulder upon the application of a rearwardly directed force to the terminal and being compressible into the groove to a sufficiently reduced diameter to slide rearwardly past the shoulder; said rearwardly facing wall of each groove having a steeper angle of incline relative to the axis of the bore than the respective shoulder, whereby the rearwardly directed driving force imposed upon each terminal by the coupling thereof with a mating terminal is not sufficient to dislodge the terminal in its respective bore but application of a rearwardly directed removal driving force greater than the coupling driving force on each terminal will force the rearwardly facing groove wall against the respective ring, whereby the respective ring will be cammed by the respective shoulder into compressed circumference and rearwardly past the shoulder and the terminal may thereupon be completely withdrawn from the body.

12. An electrical connector member as defined in claim 11 wherein said insulation body comprises a front insulation block and a rear insulation block, said insulation blocks having an interface between them which is disposed in a plane at right angles to the axes of the bores, said annular shoulders having their outer peripheral edges defined at said interface and extending rearwardly and radially-inwardly from the interface into the rear insulation block.

13. An electrical connector member as defined in claim 11 wherein a portion of each of said bores to the rear

of the respective said shoulder flares rearwardly and radially-outwardly so as to provide an annular entrance ramp which is inclined relative to the axis of the respective bore, whereby as said terminals are inserted into the respective bores from the rear end of the insulator body, the respective said rings are constricted by respective entrance ramps radially-inwardly within the respective terminal grooves, and then expand radially-outwardly in front of the respective said shoulders.

14. An electrical connector member as defined in claim 13, wherein said shoulders each have a greater angle of inclination relative to the bore axes than the angle of inclination of the respective said entrance ramp, whereby insertion of the terminals into the respective insulation body bores from said rear end of the body will be easier than withdrawal of the terminals from the body.

15. An electrical connector member as defined in claim 14 which includes a plurality of metal sleeve members disposed in the respective said bores in said insulation body so as to line a portion of each bore, said metal sleeve members each having an annular inside surface portion forming said shoulder and each having an annular inside surface portion spaced rearwardly of the respective shoulder forming said entrance ramp, each of said metal sleeve members having an intermediate annular inside surface portion of restricted diameter between said shoulder and said entrance ramp.

16. A multi-contact electrical connector comprising: a receptacle connector member and a plug connector member, each of said connector members having a tubular shell with front and rear ends, the front ends thereof being interengageable; an insulator member mounted in each shell, each body having a front end and a rear end, and each insulator member having a plurality of aligned bores extending therethrough from end to end; a plurality of elongated pin contact terminals mounted in one of said insulators in the respective bores and a plurality of complementary socket contact terminals mounted in the other insulator in the respective bores, said pin contact terminals being adapted to be interengaged with respective socket contact terminals for making a plurality of independent circuits when said connector members are interconnected; non-yielding stop means limiting the position of each terminal in its respective bore in the forward direction; and yieldable stop means limiting the position of each terminal in its respective bore in the rearward direction, said yieldable stop means comprising an annular shoulder formed in each of said insulator bores angularly inclined relative to the axis thereof so as to face radially-inwardly and forwardly and a bore section in each bore of restricted diameter adjoining the respective said shoulder toward the rear end, a compressible ring in each bore of an outside diameter when expanded to lodge against the respective said shoulder and of a diameter when compressed sufficiently small to slide through the respective bore section of restricted diameter, a groove in each of said terminals receiving the respective said ring and sufficiently deep to accommodate said ring when compressed, the wall of each groove facing rearwardly providing a driving face for engagement with the respective said ring, each of said driving faces being angularly inclined relative to the bore axis so as to face radially-outwardly and toward the rear end and having an angle of inclination relative to the axis of the bore greater than the angle of inclination of the respective shoulder in the insulator member, whereby axial driving force toward the rear imposed upon each terminal by the coupling thereof with a complementary mating terminal upon interconnection of the connector members is not sufficient to dislodge the terminal in its bore but application of a terminal removal driving force to a terminal greater than the coupling force will force the terminal groove face against the respective ring, whereby the ring will be cammed by the respective shoulder into compressed circumference and into the respective bore section of restricted diameter and the terminal may thereupon be completely withdrawn from the insulator.

No references cited.