

Dec. 29, 1970

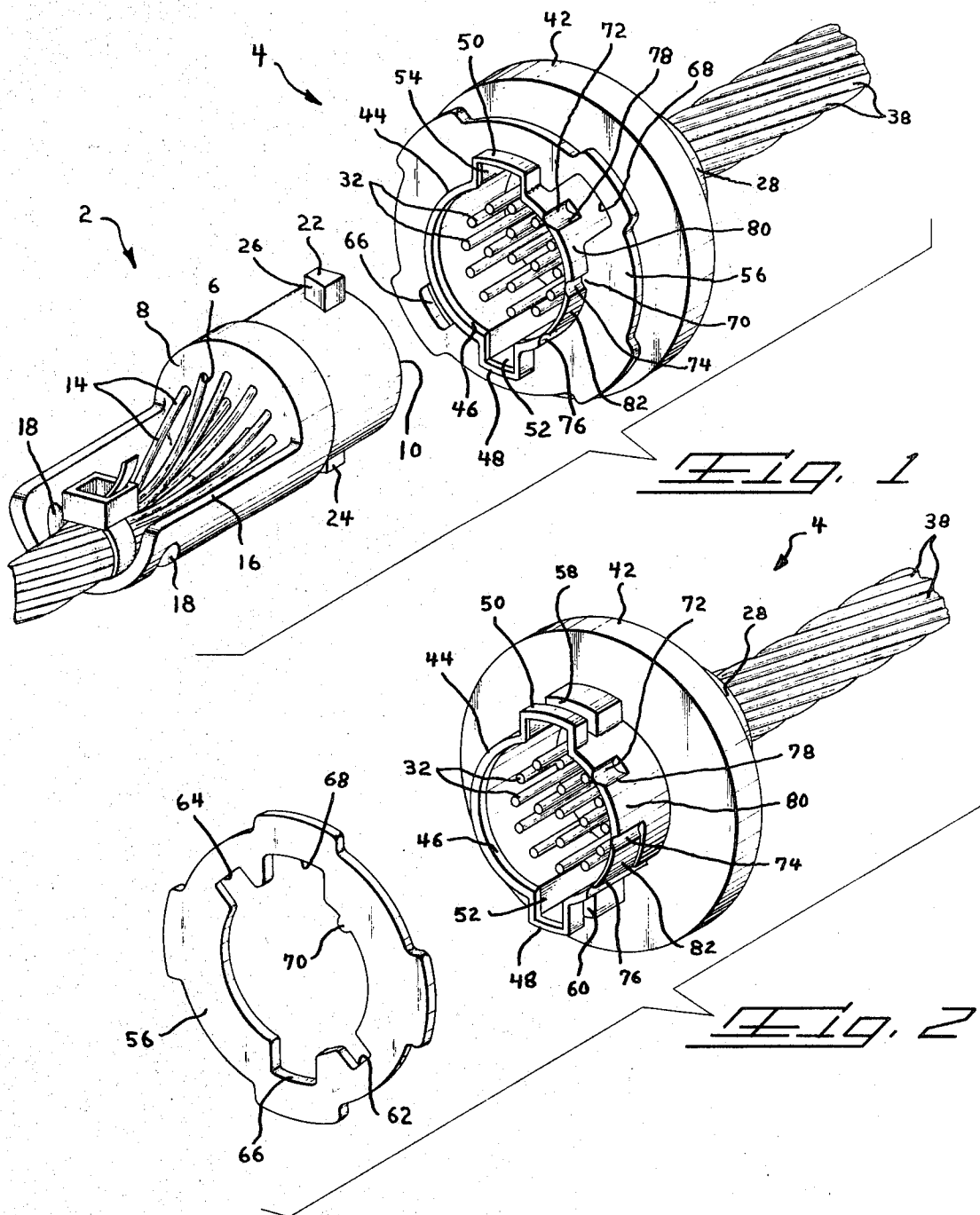
R. G. HARTWELL

3,551,880

ELECTRICAL CONNECTOR HAVING IMPROVED LOCKING MEANS

Filed Sept. 23, 1968

2 Sheets-Sheet 1



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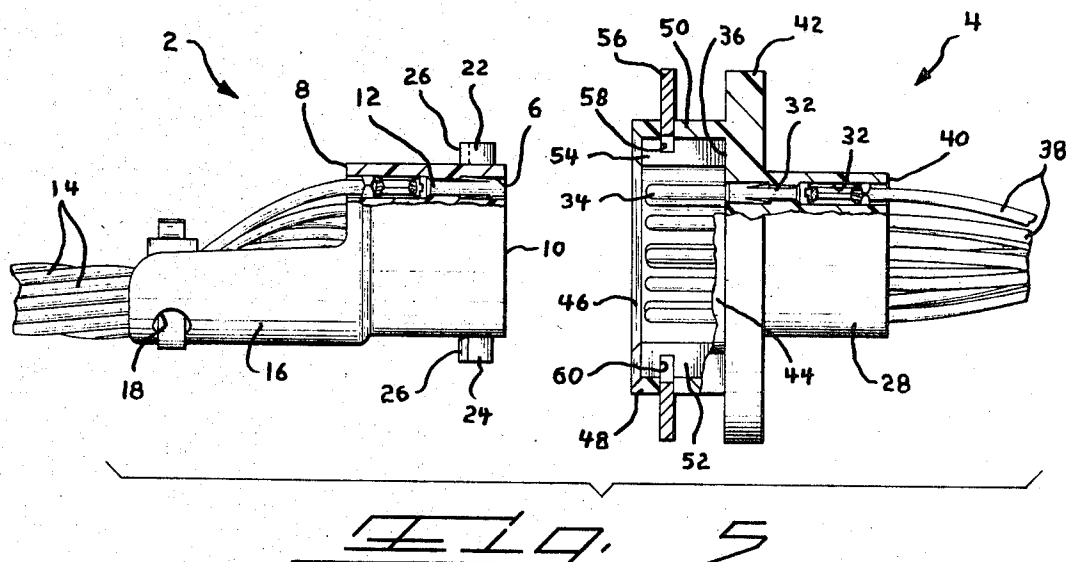
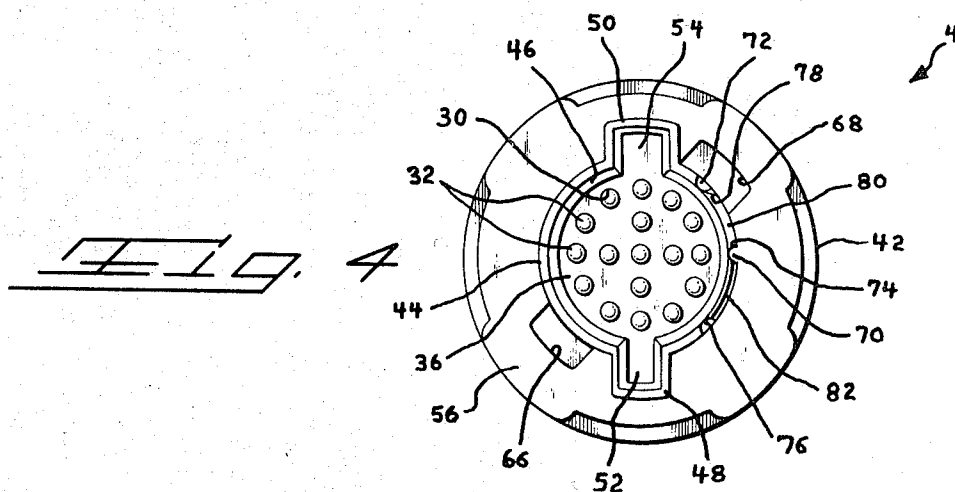
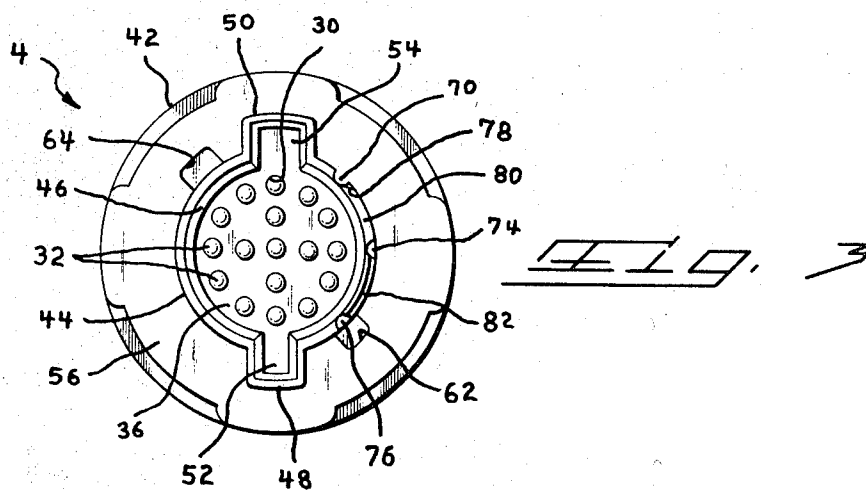
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ELECTRICAL CONNECTOR HAVING IMPROVED LOCKING MEANS

Ronald Groff Hartwell, Hummelstown, Pa., assignor to
AMP Incorporated, Harrisburg, Pa.
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4 Claims

ABSTRACT OF THE DISCLOSURE

Multi-contact electrical connector comprises cylindrical plug and cylindrical socket or receptacle having hood extending therefrom which is adapted to receive the plug. Both parts are molded of a relatively firm insulating material such as polycarbonate or a modified polysulfone and have contacts mounted in their body portions which are engaged with each other when the connector parts are coupled. Hood portion of the receptacle has an axially extending slot and plug portion has a radially extending boss which is adapted to move into the slot when the parts are engaged with each other. A locking ring is mounted rotatably on the hood for rotation in its own plane and has a notch therein which, when the locking ring is in one position, permits passage of the boss or ear on the plug and which, when in a second position, prevents movement of the boss past the plane of the locking ring. The locking ring thereby functions to hold the parts in assembled relationship and prevents accidental disengagement.

BACKGROUND OF THE INVENTION

The instant invention relates to circular connectors of the type comprising a plug and a receptacle, the receptacle having a circular hood extending from its mating face which hood is adapted to receive the plug when the parts are engaged with each other. The connectors of this type which are commonly available usually have metal shells for both the plug and the receptacle within which inserts of insulating material are mounted, the inserts in turn containing the contact terminals by means of which the electrical connections are made when the parts of the connector are engaged with each other. It is also common in connectors of this type to provide a coupling or locking ring on the hood of the receptacle portion, the function of this nut being to draw the parts together while they are being engaged and to hold them in assembled relationship thereby to prevent accidental decoupling of the parts. Circular connectors of the type described above are extremely rugged and highly reliable although they are relatively expensive because of the fact that each connector part comprises both a metal shell and an insulating insert which must be mounted in the shell.

The present invention is directed to the achievement of a relatively low cost circular connector having most, if not all, of the desirable features of presently available connectors of this type. It is accordingly an object of the invention to provide an improved circular connector. A further object is to provide a connector structure having principal parts which can be manufactured by conventional molding processes. A still further object is to provide a connector having a locking ring which can be assembled to the receptacle portion of the connector by a relatively simple assembling step. A still further object is to provide a molded connector of a relatively high quality plastic material such as polycarbonate which is resistant to adverse environmental conditions and which will withstand abusive usage without deterioration of its electrical function.

These and other objects of the invention are achieved in a preferred embodiment thereof comprising a connector

plug and a connector receptacle, the plug comprising a simple molded cylinder of polycarbonate, a modified polysulfone, or similar material, having a plurality of contact receiving cavities extending therethrough from its rearward face to its mating face and having contact sockets mounted in these cavities. The receptacle part of the connector assembly comprises a generally cylindrical body portion having cavities therein in which contact pins are mounted which are adapted to make the contact sockets of the plug portion of the connector assembly. A circular hood extends from the mating face of the receptacle in surrounding relationship to the projecting ends of the contact pins, the inside diameter of this hood being such that it will relatively snugly receive the plug when the parts are engaged with each other. The plug portion of the connector assembly is provided with a radially extending boss or ear adjacent to its mating face and a slot is provided in the hood of the receptacle which is adapted to receive this ear. This slot and ear arrangement thereby functions to polarize the connector parts when they are engaged. A relatively simple locking ring is rotatably mounted on the external surface of the hood of the receptacle part and has a radially extending notch on its inside edge. When this notch is in alignment with the slot in the hood, the parts can be engaged with each other since the ear or boss on the plug will be permitted to move past the plane of the coupling ring. After the parts have been substantially completely engaged with each other, the locking ring is rotated so that laterally facing surface portions of the ring are against the ear or boss on the plug part of the connector. When the ring is in its rotated position, it thus prevents unintentional or accidental separation of the connector parts from each other.

In the drawings:

FIG. 1 is a perspective view of a preferred form of connector assembly in accordance with the invention showing the parts in alignment with, but separated from, each other;

FIG. 2 is a perspective view of the receptacle portion of the connector with the locking ring exploded from the receptacle hood and illustrating the manner in which the locking ring is assembled to the hood;

FIG. 3 is an end view of the mating face of the receptacle portion of the connector and showing the relative position of the locking ring immediately after it has been mounted on the hood of the receptacle but prior to its being rotated to its assembled position;

FIG. 4 is a view similar to FIG. 3 but showing the relative position of the locking ring after it has been rotated to its assembled position;

FIG. 5 is a side view of the connector assembly in accordance with the invention.

A preferred form of connector assembly in accordance with the invention comprises a plug part 2 and a receptacle part 4, each of these parts comprising a unitary molding of a relatively high quality, relatively firm plastic insulating material such as a polycarbonate or a modified polysulfone as described below. The plug 2 has a plurality of contact receiving cavities 6 extending from its rearward side 8 axially therethrough to its mating face 10, these cavities being adapted to receive contact terminals 12 in the form of conventional contact sockets. These sockets are crimped or otherwise secured to conductors 14 which extend from the rearward side of the connector body and which are supported on the upper surface of an arcuate flange 16 which is integral with, and which extends rearwardly from, the rearward side of the connector. A pair of spaced apart openings 18 are provided in the flange 16 adjacent to its end and a suitable clamping means extends around the conductors 14 and through these openings to clamp the conductors against the surface of the flange and function as a strain relief for the

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conductors. In the disclosed embodiment, this clamping means comprises a simple bundle tie device of the type used to tie bundles of conductors in a cable.

A pair of radially extending locking ears or bosses 22, 24 are provided on two opposite sides of the body portion of the plug 2. The right-hand sides of these bosses, as viewed in FIG. 5, are spaced inwardly from the plane of the mating face 10 and the left-hand sides of these bosses define rearwardly facing shoulders 26 which cooperate with a locking ring described below when the plug is mated to the receptacle portion of the connector. It should be noted at this point that the shoulders 26 define planes which extend obliquely with respect to the axis of the body portion 6 of the connector rather than normally of this axis.

The receptacle part of the connector comprises a generally cylindrical body portion 28 having cavities 30 extending therethrough from the rearward side 40 of the body portion to the mating face 36 thereof, these cavities being of substantially the same shape as the cavities in the plug portion described above. Contact pins 32 are mounted in these cavities and are secured to wires 38 which extend axially from the rearward side 40 of the connector. The pins 32 have contact end portions 34 of reduced diameter which extend beyond the mating face 36 so that when the mating faces 10, 36 of the two connector parts move against each other, the end portions 34 of the contact pins will enter the socket contacts 12 contained in the plug part 2.

A radially extending flange 42 is provided on the body portion 28 of the receptacle adjacent to the mating face 36 and a cylindrical hood 44 extends axially from the left-hand side of this flange as viewed in FIG. 5 and surrounds the projecting ends 34 of the contact pins 32. The hood 44 has an inside diameter which is substantially equal to, but slightly greater than, the diameter of the body portion 6 of the plug and is adapted to receive the plug when the two parts are mated with each other. In order to facilitate mating of the connector parts, the left-hand edge of the hood is advantageously beveled as shown at 46.

A pair of diametrically opposed hollow ribs 48, 50 are provided on the hood which define diametrically opposed slots or keyways 52, 54 on opposite sides of the hood. It will be noted that the slot 54 is relatively wider than the slot 52 and that the boss or ear 22 is relatively wider than the ear 24. The ear 22 has a cross section which conforms to the cross section of the slot 54 and the ear 24 has a cross section which conforms to the cross section of the slot 52. This arrangement polarizes the connector parts with respect to each other and permits engagement only when they are in the proper orientation.

A locking ring 56 is mounted on the external surface of the hood 44 for limited rotation with respect thereto in order to permit coupling of the two connector parts and to lock the parts in engagement with each other in a manner described below. This locking ring is relatively thin and may be a simple stamped part of sheet metal or may be stamped or molded from a relatively firm plastic material. Transversely extending notches 58, 60 are provided in the ribs 48, 50 to receive the inner peripheral portions of the locking ring as shown in FIG. 5, the width of these notches 58, 60 being slightly greater than the thickness of the locking ring to permit rotation of the ring in a manner described below.

A first pair of diametrically opposed radially extending recesses or notches 62, 64 are provided on the inner edge of the locking ring 56, the notch or recess 64 having a cross section conforming to the cross section of the slot 52 and the ear 24, and the notch 62 having a cross section conforming to the slot 54 and the ear 22. It will thus be apparent that when the locking ring is in an orientation such that the notch 64 is in alignment with the slot 54 and the notch 62 is in alignment with the slot 52, the plug can be moved relatively into the hood 44 until the ears 22, 24

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move past the plane of the rearwardly facing side of the locking ring. The ring can then be rotated through a slight angle after the connector parts have been assembled to each other to locate surface portions of the locking ring against the rearwardly facing shoulders 26 of the ears thereby to lock the parts to each other. The transversely extending shoulders 26 of the ears 22, 24 cooperate with the ring during such rotation of the ring to draw the two parts of the connector into close engagement with each other thereby to insure complete engagement of the contact pins 34 with the sockets 12 contained in the plug portion of the connector assembly. The ring 56 thus functions as a coupling ring as well as a locking ring.

The locking ring can be assembled to the hood 44 of the receptacle by virtue of a second set of diametrically opposed notches 66, 68. The arcuate extent and the depth of these notches is sufficient to permit axial movement of the ring over the external surface of the hood and over the ribs 48, 50 when these notches are aligned with the ribs. It will thus be apparent that the notches 66, 68 are provided only for the purpose of permitting assembly of the ring to the connector receptacle.

Locking ring 56 is also provided with an inwardly directed protrusion 70 adjacent to the notch 68 which forms part of a detent device as described below. The normal inside diameter of the locking ring is substantially equal to, and slightly greater than, the outside diameter of the hood 44 so that the distance between this protrusion and the opposite inner edge of the ring is less than the outside diameter of the hood. It is therefore desirable to provide a first axially extending groove 72 on the external surface of the hood to permit relative movement of the ring over the hood. After the ring has been assembled to the hood as shown in FIG. 3, it is rotated in a clockwise direction until the protrusion 70 is moved into a second axially extending groove 74 on the external surface of the hood, the hood portion 80 being flexed and deformed slightly during such rotation of the ring to permit passage thereover of the protrusion 70. As shown in FIG. 2, the right-hand side of the groove 72 has a relatively gentle slope towards the surface of the hood, as indicated at 78 to facilitate rotation of the ring from the orientation which is required for assembly (FIG. 3) to its position when the protrusion 70 is located in the groove 74 (FIG. 4).

When the locking ring 56 is in the orientation of FIG. 4 with the protrusion 70 extending into the groove 74, the notches 62, 64 are in alignment with the slots 52, 54 and the parts of the connector can be engaged with each other. After such engagement, the ring can be rotated further to locate surface portions of the locking ring against the shoulders 26 of the ears 22, 24, and to locate the protrusion 70 in a shallow groove 76 on the surface of the hood. The two grooves 74, 76 and the protrusion 70 thus function as a detent means for releasably latching the locking ring 56 in either of its two normal positions. The ring can be turned manually from either position to the other position, however, a slight force must be exerted on the ring so that unintentional or accidental rotation of the ring is prevented.

The external surface of the hood 44 is generally cylindrical, however, it is desirable to provide a slightly reduced wall thickness in this hood on the path followed by the protrusion 70 when the locking ring is rotated from the groove 72 to the groove 74. It is also desirable to provide a reduction in the wall thickness along the path between the groove 74, 76 over which the protrusion moves when the ring is moved between its locking and unlocking positions. The external diameter of the hood should be such that the ring can be moved from the orientation or position it occupies immediately after it is moved onto the hood (FIG. 3) to the position it occupies when the protrusion is received in the groove 74 only with some difficulty, for example by the use of a pair of pliers or other assembly tool. If this is done, it

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becomes virtually impossible to remove the ring from the receptacle portion of the connector manually and the parts will be held in their assembled relationship. The dimensions of the parts should be such that the ring can be rotated between its located and unlocked positions without undue difficulty, that is, without the aid of special tools, but the resistance to rotation of the ring should be such that unintentional or undesired rotation of the ring will not take place. These features can be achieved, for example, by shaving slightly the zone 80 of the external surface of the hood between the groove 72, 74 and shaving to a slightly greater extent the zone 82 between the grooves 74, 76.

As previously noted, the connector parts are advantageously molded of a relatively high grade plastic material. Suitable materials include Noryl (a modified polysulfone produced by the General Electrical Company), or polycarbonate. These materials have good strength, are resistant to weathering, and are relatively firm or hard so that the connector parts will provide adequate protection for the contacts contained therein. As previously mentioned, when the ring is assembled to the hood of the receptacle, some slight flexure of the hood will take place during the first rotational movement of the ring, that is when the protrusion is moved from the groove 72 to the groove 74. The material from which the receptacle is molded should not be so rigid that it will crack under this slight flexure. Many plastic materials, other than those mentioned above, are commercially available which are suitable, from the standpoint of their mechanical properties, for connectors in accordance with the invention, for example, relatively firm nylon and semi-rigid polyvinyl chloride.

A salient advantage of the invention is that substantially all of the advantages of previously known high priced circular connectors are achieved even though the connector in accordance with the invention comprises only two molded parts and one additional part (the locking ring) which may be either molded or stamped and formed from sheet metal. By virtue of this fact, connectors in accordance with the invention can be manufactured at a cost which is only a small fraction of the manufacturing cost for conventional circular connectors in which an insulating insert is mounted in a metallic cylindrical shell member.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only.

What is claimed is:

1. An electrical connector assembly comprising a plug part and a receptacle part, said plug part comprising a cylindrical plug body portion having a radially extending locking ear thereon adjacent to its mating side, said ear providing a rearwardly facing shoulder lying in a plane extending transversely of the axis of said plug body portion, said receptacle part comprising a cylindrical receptacle body portion, a circular hood extending axially from the periphery of said receptacle body portion

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on the mating side thereof, said hood being adapted to receive said plug body portion, said hood having at least one axially extending rib thereon, said rib being hollow and defining an axially extending slot opening into the area enclosed by said hood, said slot being adapted to receive said ear,

- a locking ring rotatably mounted on said hood, a transversely extending rib notch in said rib, said ring having its inner edge portions extending into said rib notch, said ring having a first radially extending ring notch extending from its inner edge, said first ring notch having a cross section conforming to the cross section of said slot,
- a second radially extending ring notch in said ring, said second ring notch having a cross section sufficiently large to permit passage of said rib there-through whereby

said locking ring can be assembled to said receptacle hood by aligning said second ring notch with said rib and moving said ring over said hood in the axial direction of said hood until said ring is disposed in said rib notch, and said plug part can be engaged with said receptacle part when said locking ring is in a first rotational position in which said first ring notch is in alignment with said slot thereby to permit movement of said ear past said locking ring, and said locking ring can thereafter be rotated to a second rotational position in which surface portions of said ring are disposed against said shoulder thereby to locking said plug part to said receptacle part.

2. A connector as set forth in claim 1 wherein said plug part and said receptacle part each comprise a one piece molding of insulating material.

3. A device as set forth in claim 1 including detent means effective between said locking ring and said hood, said detent means being effective to latch said ring in either of two positions on said hood, said first ring notch being in alignment with said slot when said ring is in one position and said ring notch being out of alignment with said slot when said ring is in its other position.

4. A device as set forth in claim 3 wherein said detent means comprises a detent ear extending radially inwardly from the internal side of said ring and recess means in said hood adapted to receive said ear when said ring is in one of said positions.

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MARVIN A. CHAMPION, Primary Examiner

J. H. MCGLYNN, Assistant Examiner