United States Patent [19]

Horak

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[54] **ENTRANCE CONNECTOR HAVING A FLOATING INTERNAL SUPPORT SLEEVE**

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[52] **U.S. Cl.** ..... **339/143 R**; 339/177 R

[51] **Int. Cl.** **H01r 17/04**; H01r 13/46

[58] **Field of Search** ..... 174/75 C, 78, 88 C, 89; 339/94 C, 143, 177, DIG. 3

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[57] **ABSTRACT**

The connector has a nut section and a pin section which screw together. An internal support sleeve within the nut section of the connector floats relative to that section until the pin section of the connector has been fully screwed into the nut section. When a prepared coaxial cable has been inserted into the nut section, and said nut section has been screwed tightly onto the pin section, firm electrical contact will be made to the cable.

11 Claims, 3 Drawing Figures

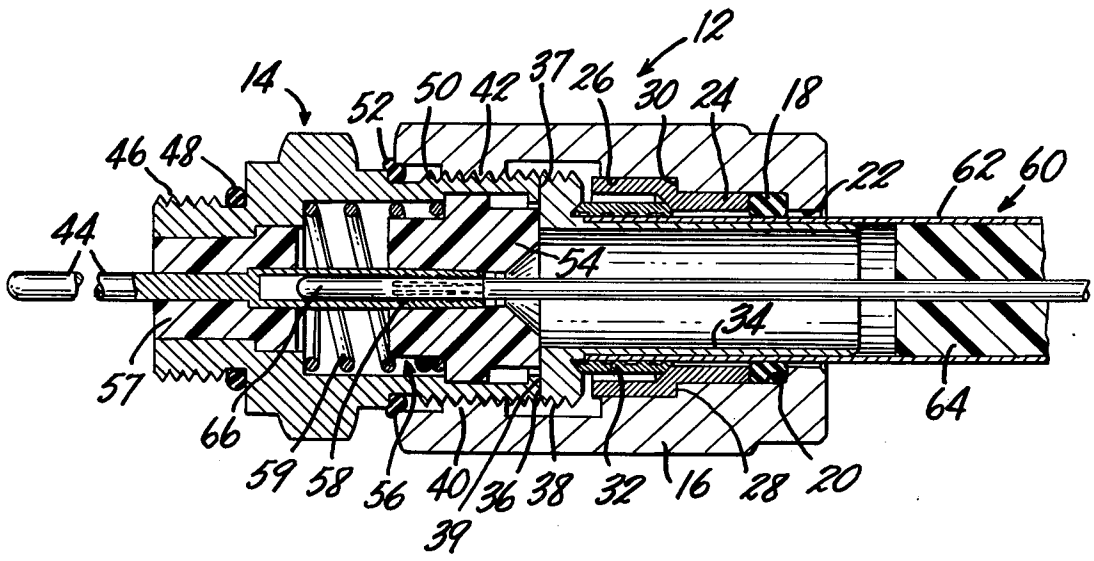

FIG. 1

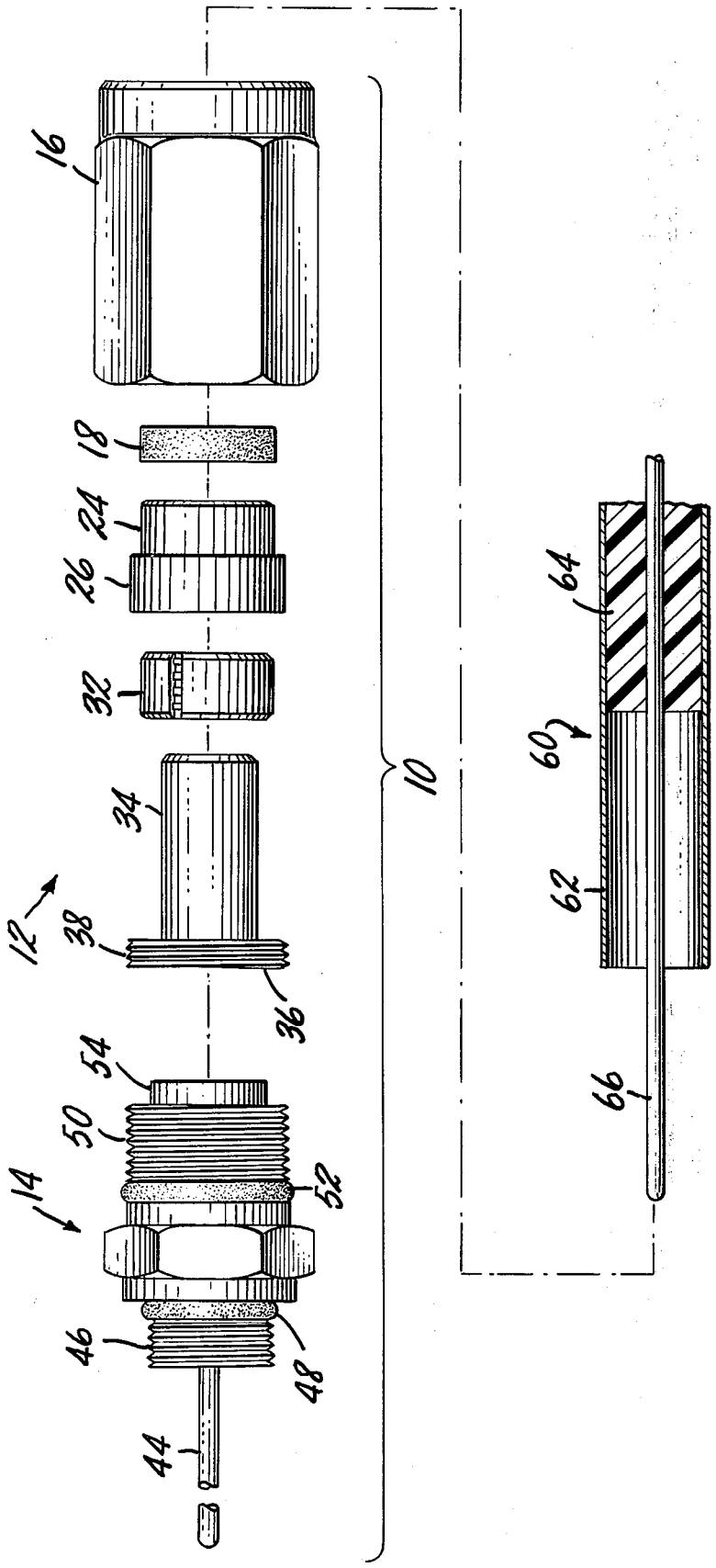

FIG. 2

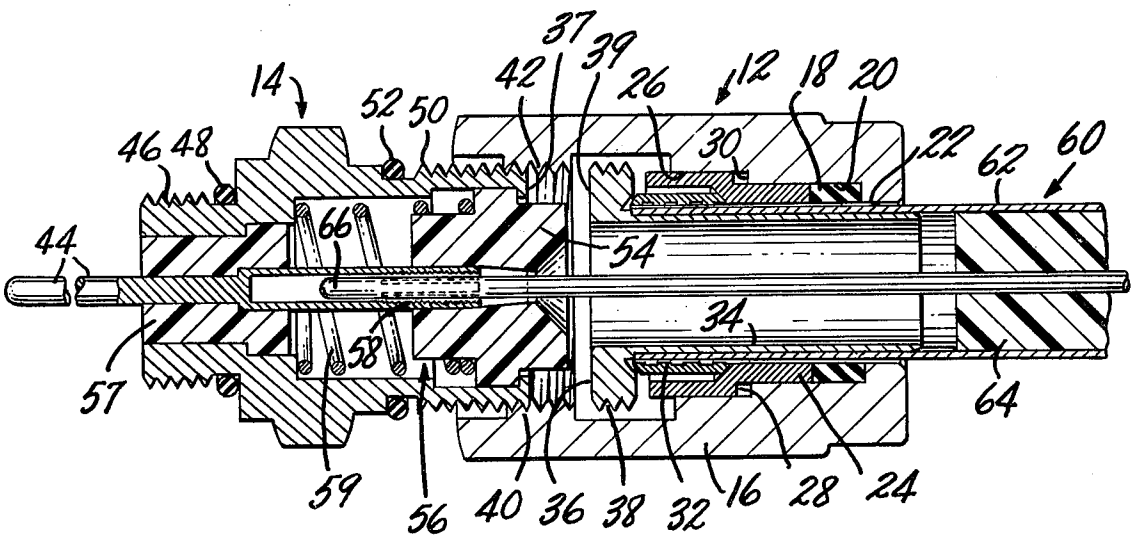
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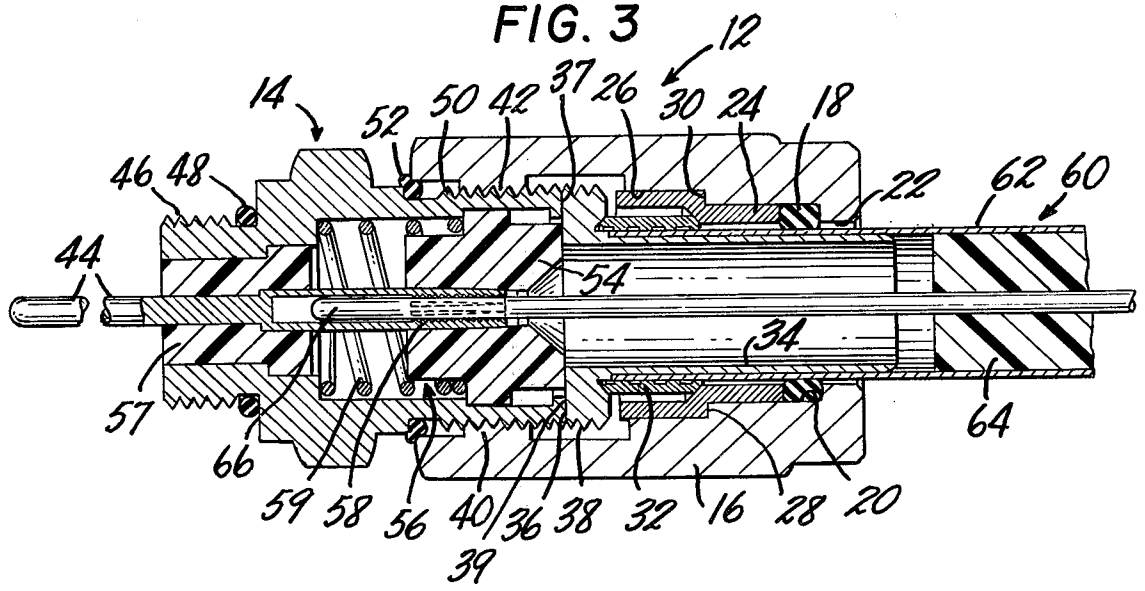
FIG. 3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ENTRANCE CONNECTOR HAVING A FLOATING INTERNAL SUPPORT SLEEVE

BACKGROUND OF THE INVENTION

The present invention relates to a cable connector having a floating internal support sleeve for use with coaxial cable. More particularly, the present invention relates to a cable connector for use in CATV systems having a support sleeve which fits within the outer, conductive cable jacket of a coaxial cable and supports the jacket from the inside when a compressible ferrule is secured to the outside of the jacket.

The cable-connector interface imposes the dominant consideration of long-term radio frequency interference (RFI) effectiveness in a CATV system. The mechanics of the interface indicate that stress can reduce contact pressure between the cable and clamp. This, and other phenomena further deteriorate shielding effectiveness. It has been found that internal support sleeves inserted beneath the cable jacket are helpful in maintaining the required contact pressure.

Typical aluminum cable connectors contain a compressible ferrule in the form of a split ring which fits over the cable jacket and secures the outer surface of the jacket to the connector. Once secured, this connection is typically subjected to alternate tension and compression as well as rotational and vibrational forces. These forces, combined with temperature variations, air pollutants, and varying humidity conditions, serve to gradually deteriorate the contact.

In order to better maintain contact with the cable jacket, it has been found that the removal of the polyethylene foam dialectric between the outer jacket and the central conductor and the replacement thereof with a cylindrical steel sleeve provides a secure support for sandwiching the cable jacket with the compressible ferrule. Initially, such sleeves were made as small, separate cylindrical members. These were easily dropped, lost, or even discarded by indifferent technicians. Inspection of the assembled connector to determine the presence of these separate sleeves is virtually impossible because the sleeves when properly inserted are not visible.

The foregoing problems of separate support sleeves led to the solution of constructing cable connectors with built-in support sleeves. When using such connectors, the cable was generally prepared in advance by coring out the polyethylene foam from between the outer jacket and the central conductor. The cable would then be inserted into the cable connector so that the support sleeve would fit under the jacket into the cored out section. Unfortunately, such prior art cable connectors had their support sleeves fixed in position. This created a problem when the nut section of such connectors was screwed onto the pin section in order to actuate the mechanism internal to the pin section which grabs the internal conductor of the cable. A torsional force would be exerted upon the cable as the connector was screwed together. This resulted from the fact that the pin section of the cable firmly attached itself to the central conductor of the cable while the nut section of the connector was firmly attached to the cable jacket and the nut section of the connector was still being screwed onto the pin section. This torsional force weakens both the central conductor of the cable, and the connection to the cable jacket, and moreover

makes it difficult to fasten the nut section to the pin section of the connector.

SUMMARY OF THE INVENTION

A coaxial entrance connector comprises a pin section adapted to contact the internal conductor of a coaxial cable and a nut section adapted to be joined to the pin section and to make electrical contact with the outer jacket of a coaxial cable. The nut section comprises a body having an internal cavity with a substantially tubular opening leading through one end of the body into the cavity. A coaxial cable can be passed through the tubular opening into the cavity. A compressible ferrule within the cavity is adapted to be clamped onto the outer conductive jacket of a coaxial cable and to make electrical contact with the outer jacket. A substantially cylindrical support sleeve extends from the cavity through the compressible ferrule and into the opening. The nut section further comprises means for preventing the support sleeve from sliding out of the cavity through the opening while allowing for free rotation of the support sleeve and means for clamping the compressible ferrule onto the outer jacket of a coaxial cable inserted through the opening into the cavity and onto the support sleeve, whereby the outer jacket of the cable would be sandwiched between the compressible ferrule and the support sleeve.

BRIEF DESCRIPTION OF THE DRAWINGS

In the Drawings:

FIG. **1** is a side view of the component parts of the entrance connector of the present invention and a sectional view of a coaxial cable prepared for insertion into the connector;

FIG. **2** is a sectional view of the entrance connector partially attached to the cable; and

FIG. **3** is a sectional view of the entrance connector fully assembled and attached to the cable.

DETAILED DESCRIPTION

Referring generally to FIGS. **1** and **2** a side view and a cross-sectional view of the cable connector **10** of the present invention are shown. The connector **10** comprises a nut section **12** and a pin section **14.** The nut section **12** comprises a body **16,** of a conductive metal such as aluminum. The internal portion of the conductive body **16** is machined to have a number of sections, each having different internal diameters. The nut section **12** further comprises a rubber ring **18** having an outside diameter substantially equal to the inside diameter of the first section **20** of the body **16.** The inside diameter of the ring **18** is substantially equal to the diameter of an opening **22** at one end of the nut section **12** through which the cable will be passed when attached to the connector **10.** Adjacent the ring **18,** a cylindrical mandril **24** having two distinct outside diameters is fitted. The outside diameter of the portion of the mandril **24** adjacent the ring **18** is substantially equal to the inside diameter of the first section **20** of the body **16.** The outside diameter of the mandril at the end farthest from the ring **18** is substantially equal to the inside diameter of the second section **26** of the inside of the body **16.** Thus, a shoulder **28** is formed on the outer surface of the mandril **24** which prevents the mandril **24** from sliding further into the body **16** than will be permitted by the interface **30** between the first section **20** and the second section **26** of the body **16.** The inter-

nal diameter of the mandril 24 at the end adjacent the ring 18 is substantially equal to that of the internal diameter of ring 18. The internal diameter of the mandril 24 at the end farthest from the opening 22 is larger to allow for the insertion of a compressible ferrule 32 in the form of a split ring having a ridged interior with an internal diameter substantially the same as the opening 22. The central section of the interior surface of the mandril 24 and the ends of the ferrule 32 are bevelled as shown.

The nut section 12 further comprises a hard internal support sleeve 34 made of a tough material, such as steel. The support sleeve 34 has a substantially cylindrical, thin wall which is bevelled at the end extending through the opening 22. At the end farthest from the opening 22 there is a section 36 which is substantially washer-like and which contains external threads 38. The surface of the washer-like section 36 adjacent the cylindrical portion of the support sleeve 34 is bevelled to receive the bevelled edge of the ferrule 32.

The conductive body 16 further comprises a threaded section 40 at the end farthest from the opening 22 which contains internal threads 42. These internal threads 42 match external threads 38 on the washer-like section 36 of the support sleeve 34.

A cross-sectional view of the end of a cable 60 prepared for insertion into the cable connector 10 is shown beneath the nut section 12. The cable 60 comprises a cylindrical outer conductive jacket 62, an internal conductor 66, with a polyethylene foam dielectric 64 therebetween. When the cable 60 is prepared for insertion into the connector 10, the internal conductor 66 extends beyond the end of the outer conductive jacket 62 and the polyethylene foam 54 is cored out to a distance at least equal to the length of the internal support sleeve 34.

The pin section 14 of the connector 10 is of a type well known in prior art. This section 14, constructed of a conductive metal such as aluminum, has a pin 44 and a first external threaded section 46 which are used for CATV connections when the cable connector 10 is assembled. There is a first rubber O-ring 48 on the external threads 46. The O-ring 48 is used to provide a weather-proof seal when the connector 10 is assembled and attached in an installation. A second external threaded section 50 and O-ring 52 are used to connect and seal the pin section 14 to the nut section 12. These external threads 50 match the internal threads 42 of the nut section 12. The insulating portion 54 of the spring-loaded internal conductor holder 56 contained within the pin section 14 extends outward from the threaded section 50 when there is no pressure applied to the insulating portion 54. The internal conductor holder 56 further comprises a conductive jaw 58 which is electrically connected to the pin 44. The jaw 58 is adapted to grip the internal conductor 66 of a coaxial cable 60 inserted therein. Surrounding the jaw 58 there is a spring 59 which rests upon an insulator 57 holding the pin 44. The spring 59 serves to urge the insulating portion 54 of the internal conductor holder 56 away from the jaw 58. The end of the jaw 58 and of the portion of the insulating portion 54 of the internal conductor holder 56 contacting the jaw 58 are bevelled so that when pressure external to the pin section 14 is applied to the insulating portion 54, the jaw 58 will be closed so as to bite or grab the internal conductor portion of a coaxial cable placed therein.

In FIG. 2, the connector 10 is shown partially tightened onto a cable 60 inserted through the opening 22 into the nut section 12. The cable 60 is pushed onto the support sleeve 34 so that the conductive jacket 62 extends to the washer-like section 36 of the support sleeve 34. The support sleeve 34 is free to float within the nut section 12 without being frictionally impeded by other surfaces within the nut section 12. In this position, the compressible ferrule 32 does not press onto the outer surface of the conductive jacket 62. Thus, the cable 60 is not forced to twist when the nut section 12 is turned.

The internal conductor 66 of the cable is shown inserted through the insulating portion 54 of the conductor holder 56 in the pin section 14. As there is no pressure upon the insulating portion 54, the spring 59 prevents the insulating portion 54 from closing the jaws 58. Thus, the jaws 58 are maintained in an open position to receive the inner conductor 66.

Referring generally to FIG. 3, the connector 10 is shown assembled to the cable 60. When the pin section 14 is screwed into the nut section 12, the insulating portion 54 of the internal conductor holder 56 within the pin section 14 contacts the washer-like section 36 of the support sleeve 34. Further screwing together of the nut section 12 and the pin section 14 causes pressure to be applied to the insulating portion 54 of the internal conductor holder 56 which in turn causes the jaws 58 to clamp down onto the internal conductor 66 thereby making a secure electrical contact therewith. In addition, the pressure on the washer-like section 36 of the support sleeve 34 causes the compressible ferrule 32 to be forced into the mandril 24. Initially, this action causes the mandril 24 to seat with its shoulder 28 in contact with the interface 30 between the first internal section 20 and the second internal section 26 of the nut section 12. This action causes the ring 18 to be compressed longitudinally. Such compression forces the ring 18 to expand inward radially thereby providing a weather-proof seal with the conductive jacket 62 of the cable 60.

Further pressure on the flat face 39 of the support sleeve 34 forces the compressible ferrule 32 further within the mandril 24. The split ring of the ferrule 32 will be compressed onto the outer jacket 62 of the cable 60 making secure contact with the outer jacket 62. The O-ring 52 on the pin section 14 will be compressed, further sealing the connector 10 and protecting it from the adverse effects of the elements. In addition, the insulating portion 54 of the internal conductor holder 56 will be forced within the pin section 14 until it is flush with the flat face 37 of the conductive portion of the pin section 14 surrounding the insulating portion 54. The flat face 39 of the washer-like section 36 will be contacted by the flat face 37 of the pin section 14 when the pin section 14 has been fully screwed into the nut section 12. The contact between the faces 37, 39 will extend 360° to provide a metal-to-metal seal.

In order to prevent the introduction of RFI in a signal carried by the cable 60, it is necessary to insure that the signal-carrying central conductor 66 of the cable 60 is always surrounded by a continuous metal shield. Ordinarily, the shield is provided by the outer conductive jacket 62. However, when the cable is joined to a connector there is a possibility of the introduction of RFI.

In the connector 10 of the preferred embodiment, the possibility of RFI introduction is eliminated by the

metal-to-metal seal between the faces **37, 39** of the pin section **14** and the support sleeve **34.** Additional security from RFI is obtained in the preferred embodiment by using a conductive rubber for the ring **18.** Thus, when the ring **18** is compressed onto the outer jacket **62** of the cable **60** to provide weather sealing, RFI is eliminated at the same time. While the use of a conductive rubber ring **18** is preferred for additional protection from RFI, the metal-to-metal seal between the faces **37, 39** of the pin section **14** and the support sleeve **34** generally provides adequate RFI shielding.

The cable **60** with the attached connector **10** can be used in applications by attaching the pin section **14** to a suitable female connector adapted to receive the pin **44** and the threads **46.** The O-ring **48** will seal the connection and protect it from the elements.

I claim:

1. A coaxial entrance connector comprising:

a. a pin section adapted to contact the internal conductor of a coaxial cable comprising:
   i. spring-loaded conductive jaws adapted to close upon and frictionally engage the internal conductor; and
   ii. jaw actuating means within said pin section for closing said jaws upon said internal conductor; and

b. a nut section joined to said pin section to make electrical contact with the outer jacket of a coaxial cable comprising:
   i. a body;
   ii. a cavity internal to said body;
   iii. a substantially tubular first opening at one end of said body extending into said cavity through which a coaxial cable can be passed;
   iv. a substantially tubular second opening into said body having internal threads therein which coact with external threads on said pin section to join the pin section to the nut section;
   v. a compressible ferrule within said cavity adapted to be clamped onto the outer conductive jacket of a coaxial cable and to make electrical contact with said outer conductive jacket;
   vi. a substantially cylindrical support sleeve extending from said cavity through said compressible ferrule and into said first opening;
   vii. means for clamping said compressible ferrule onto the outer jacket of a coaxial cable inserted through said first opening into said cavity and onto said support sleeve, whereby the outer jacket of the cable will be sandwiched between said compressible ferrule and said support sleeve; and
   viii. a washer-like section on the end of said support sleeve within said cavity having external threads thereon adapted to be screwed through said internal threads of said second opening for preventing said support sleeve from sliding out of said cavity through said first opening while allowing for free rotation of said support sleeve.

2. The coaxial entrance connector of claim **1** further comprising means for sealing said cavity when a coaxial cable has been passed through said first opening.

3. The coaxial entrance connector of claim **2** wherein said means for sealing said cavity comprises a rubber ring adapted to be compressed onto the outer jacket of a coaxial cable.

4. The coaxial entrance connector of claim **3** wherein said rubber ring is constructed of a conductive rubber and is adapted to contact the outer jacket of a coaxial cable passed through said opening and thereby seal said first cavity and prevent the introduction of RFI at said first opening.

5. The coaxial entrance connector of claim **1** wherein said pin section further comprises a substantially tubular conductive portion spaced from and adapted to surround the internal conductor of a coaxial cable.

6. The coaxial entrance connector of claim **5** wherein said outer conductive portion of said pin section has a flat face adapted to contact a flat face of said support sleeve thereby forming a metal-to-metal seal.

7. The coaxial entrance connector of claim **6** wherein said metal-to-metal seal extends for 360° around the internal conductor of a coaxial cable, whereby the introduction of RFI at said seal is precluded.

8. The coaxial entrance connector of claim **1,** wherein said jaw actuating means comprises a substantially cylindrical, spring-loaded insulating member having a central bore therein, the bore having an internal bevelled portion into which said jaws extend, said jaws comprising a split, conductive tube whereby external pressure on said insulating portion causes said jaws to close.

9. The coaxial entrance connector of claim **8,** wherein said jaws have ridged internal surfaces adapted to frictionally engage an internal conductor of a coaxial cable when said jaws are closed thereon.

10. The coaxial entrance connector of claim **8,** wherein said support sleeve is adapted to actuate said spring-loaded jaws.

11. The coaxial entrance connector of claim **8,** wherein the bore of said insulating portion is bevelled on the outside to guide the internal conductor of a coaxial cable into said bore.

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