IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF ARKANSAS
CENTRAL DIVISION

PPC BROADBAND, INC.

Plaintiff,

v.

Case No.: 4:22-cv-163-LPR

PERFECTVISION MANUFACTURING, INC.

Defendant.

This case assigned to District Judge Rudofsky
and to Magistrate Judge Ray

COMPLAINT

PPC Broadband, Inc. ("PPC"), by its attorneys, Mitchell, Williams, Selig, Gates & Woodyard, P.L.L.C. and Barclay Damon LLP, files the following Complaint against Defendant PerfectVision Manufacturing, Inc. ("PerfectVision"), and alleges as follows:

Nature of Action

1. This action for patent infringement, brought under the Patent Laws of the United States, 35 U.S.C. § 1 *et seq.*, seeks relief arising out of PerfectVision's willful infringement of U.S. Patent Nos. 7,114,990 (the "'990 Patent"), 7,479,035 (the "'035 Patent"), 7,955,126 (the "'126 Patent"), 8,172,612 (the "'612 Patent"), and 10,756,455 (the "'455 Patent") (collectively, the "Patents-in-Suit").

2. PPC is the owner of the Patents-in-Suit by assignment, including the right to sue for past infringement.

3. PPC asserts infringement of all of the Patents-in-Suits against PerfectVision for its unauthorized making, using, offering to sell, selling, and/or importing of coaxial cable

connector products marked as enhanced continuity connectors, including at least such connectors sold using PerfectVision's SignaLoc® tradename (the "Accused Products").

The Parties

4. PPC is a corporation organized and existing under the laws of the State of Delaware, with its principal place of business at 6176 East Molloy Road, East Syracuse, New York.

5. PerfectVision, is a corporation organized and existing under the laws of the State of Arkansas and has its principal place of business at 16101 La Grande Drive, Little Rock, Arkansas.

Jurisdiction and Venue

6. This Court has subject matter jurisdiction over the asserted claims pursuant to 28 U.S.C. §§ 1331 and 1338, and 35 U.S.C. § 281.

7. This Court has personal jurisdiction over PerfectVision because PerfectVision is an Arkansas corporation, because PerfectVision has its principal place of business in Arkansas, and/or because Arkansas has been conducting and/or is presently conducting business in the Eastern District of Arkansas on a regular basis.

8. In addition, this Court has personal jurisdiction over PerfectVision because it has knowingly and actively engaged in acts that have infringed and will infringe the claims of the Patents-in-Suit in the Eastern District of Arkansas.

9. Venue is proper in the Eastern District of Arkansas pursuant to 28 U.S.C. § 1400. PerfectVision is incorporated in Arkansas and has its principal place of business in the Eastern District of Arkansas, and therefore reside in Arkansas and/or the Eastern District of Arkansas for the purposes of the statute.

Factual Allegations

Background

10. PPC is a worldwide leader in the design and manufacture of products for the cable and telecommunication industries. PPC invests a substantial amount of capital in product development and improvement to maintain its position as a leading producer of innovative connective technology products. As a result of this investment, PPC has hundreds of issued patents, and has an established track record of strictly enforcing its patents against competitors, including against PerfectVision.

11. PerfectVision uses, imports, offers for sale, and/or sells the Accused Products in Arkansas and elsewhere in the United States. Such use, importation, offers for sale, and/or sale of the Accused Products is in direct competition with PPC's coaxial connector products, including its best-in-class SignalTight® continuity coaxial connectors.

Patents-in-Suit

12. The Patents-in-Suit claim priority to U.S. patent application Serial No. 11/043,844, filed on January 25, 2005, which was published as U.S. Patent Application Publication No. US2006/0166552 on July 27, 2006.

13. The '990 Patent was filed on January 25, 2005, and issued on October 3, 2006. The '990 Patent is attached hereto as Exhibit A.

14. The '035 Patent was filed on October 2, 2006, and issued on January 20, 2009. The '035 Patent is attached hereto as Exhibit B.

15. The '126 Patent was filed on December 11, 2008, and issued on June 7, 2011. The '126 Patent is attached hereto as Exhibit C.

16. The '612 Patent was filed on May 27, 2011, and issued on May 8, 2012. The '612 Patent is attached hereto as Exhibit D.

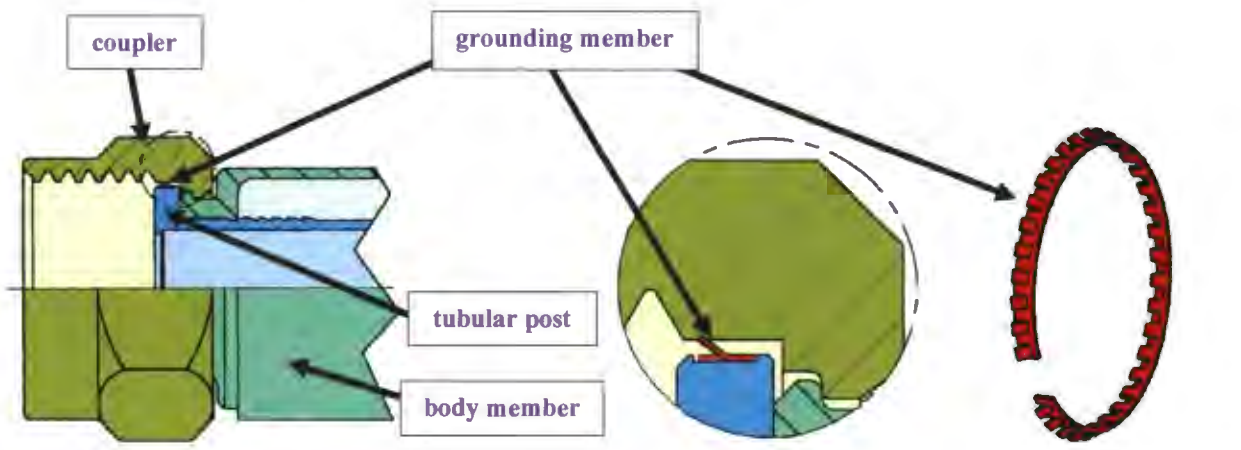
17. The '455 Patent was filed on January 28, 2014, and issued on August 25, 2020. The '455 Patent is attached hereto as Exhibit E.

18. The Patents-in-Suit are directed to a problem in the cable and telecommunications industries. A significant cost driver for cable television and high-speed internet service providers is the cost of having to send technicians to customers' homes and businesses to address service interruptions. One of the most common problems these technicians find once on site is that the coaxial cable connectors are loose. When connectors are loose the ground path through the metal components of the connector to the outer conductor of the coaxial cable can become broken or unstable as the components can separate as the cable or the equipment is moved. When this happens, service is degraded or lost altogether, thus necessitating a service call by a technician.

19. As the Patents-in-Suit explain in their respective specifications: "When connecting the end of a coaxial cable to a terminal of a television set, equipment box, or other appliance, it is important to achieve a reliable electrical connection between the outer conductor of the coaxial cable and the outer conductor of the appliance terminal. This goal is usually achieved by ensuring that the coupler of the connector is fully tightened over the connection port of the appliance. When fully tightened, the head of the tubular post of the connector directly engages the edge of the outer conductor of the appliance port, thereby making a direct electrical ground connection between the outer conductor of the appliance port and the tubular post; in turn, the tubular post is engaged with the outer conductor of the coaxial cable. However, in many cases, it is difficult for an installer to reach the connection ports of the appliance with a wrench, and in some instances, it is even difficult for the installer to reach such connection ports with his or her fingers. As a result, it can often happen that type F connectors are not fully

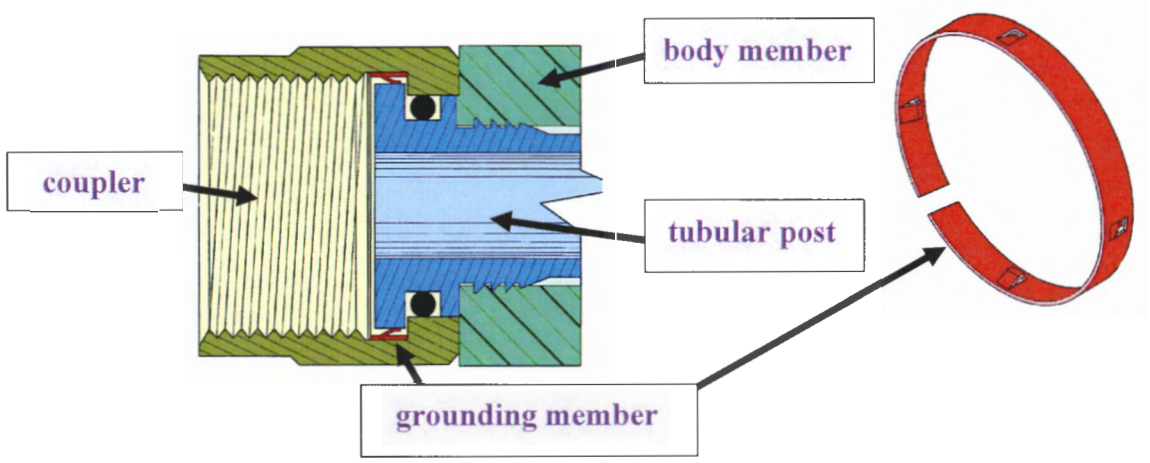
tightened to the appliance port. In such a loose connection system, wherein the coupler of the coaxial connector is not drawn tightly to the appliance port connector, a gap exists between the outer conductor of the appliance port and the tubular post of the connector. Unless an alternate ground path exists, poor signal quality, and RFI leakage, will result . . . . It is therefore an object of the present invention to provide a coaxial cable connector for connecting a coaxial cable to a connection port of an appliance, the coaxial cable connector being of the type that includes a tubular post and a coupler, such as a rotatable coupler, which ensures a reliable ground connection between the tubular post of the connector and an outer conductor of the appliance port, even if the coupler is not fully tightened onto the appliance port." (*E.g.*, '990 Patent, Col. 1, line 47 to Col. 2, line 49.)

20. Although the specific scope of the invention is delineated by the various elements in the claims, as illustrated in the exemplary annotated patent figures below, the Patents-in-Suit accomplish this objective by placing a grounding member (red) in between the tubular post (blue) and the coupler (green) that creates an electrical pathway between those two components even when the connector is not fully tightened onto the appliance port.



Accused Products

21. The following annotated figures from PerfectVision's own patent application (filed almost seven years ***after*** the Patents-in-Suit) illustrate the nearly identical internal construction of PerfectVision's accused SignaLoc® coaxial cable connector design, including, but not limited to, PerfectVision's model PV6USLP connectors. Indeed, as indicated PerfectVision's accused SignaLoc® places a grounding member (red) in between the tubular post (blue) and the coupler (green) that creates an electrical pathway between those two components even when the connector is not fully tightened onto the appliance port.



PerfectVision's Knowledge of the Patents-in-Suit

22. On information and belief, PerfectVision is a sophisticated company in the industry that keep appraised of relevant patents (either alone or through the actions of its related companies).

23. PerfectVision has been aware of one or more of the Patents-in-Suit since at least November 30, 2011, when PerfectVision filed a patent application on the design of its accused SignaLoc® connector. In that application (U.S. Patent Application No. 13/373,782) PerfectVision's then Chief Executive Officer is listed as the first named inventor. PerfectVision

is listed as assignee, and PerfectVision included a recitation of what was disclosed in the asserted '990 and '035 Patents. That recitation is incomplete and misleading (likely so that PerfectVision would be able to argue that its supposed invention was new and novel despite coming almost seven years ***after*** the invention in the Patents-in-Suit), but, in any event, leaves no room for doubt that PerfectVision was aware of the asserted '990 and '035 Patents at least by 2011, if not earlier.

24. Further, at least by 2016 (when all of the Patents-in-Suit other than the '455 Patent had already issued) it is believed that PerfectVision either hired or retained as a consultant William Lutz, one of the named inventors on the Patents-in-Suit. It is believed Mr. Lutz assisted with design improvements to PerfectVision's SignaLoc® connector, even appearing as the first named inventor on a continuation-in-part application filed by PerfectVision in the family of patents PerfectVision was seeking on its SignaLoc® connector design (U.S. Patent Application No. 15/201,232). Certainly Mr. Lutz was fully aware of his earlier invention in the Patents-in-Suit at that time, and that patent application also included recitation of what was disclosed in the '990 and '035 Patents, misleading as it was.

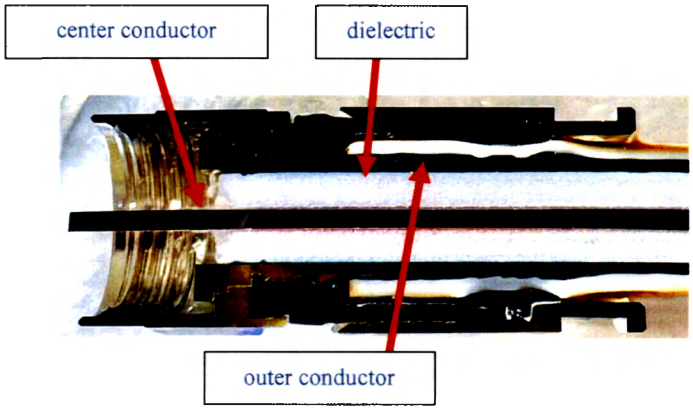
25. Upon information and belief, based on its prior knowledge of the '990 and '035 Patents, and based on its work with Mr. Lutz, who as noted above is one of the named inventors on the Patents-in-Suit, PerfectVision knew or should have known of the asserted '126, '612, and '455 Patents on or about the date each such patent issued, and knew or should have known that its manufacture, use, importation, offer for sale, and/or sale of the Accused Products infringed each of the Patents-in-Suit on or about the time each of the Patents-in-Suit issued and/or on or about the time the PerfectVision made, used, imported, offered for sale and/or sold the Accused Products.

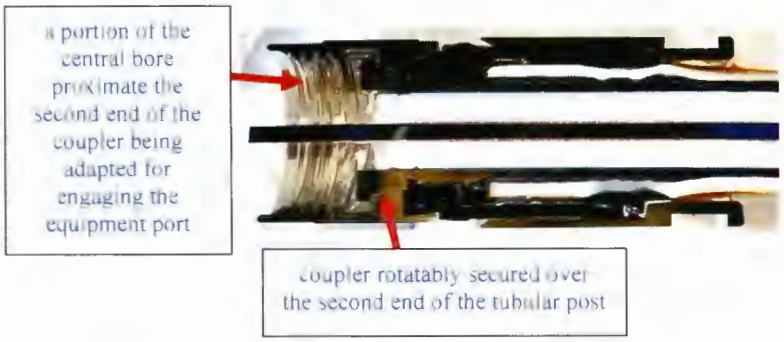
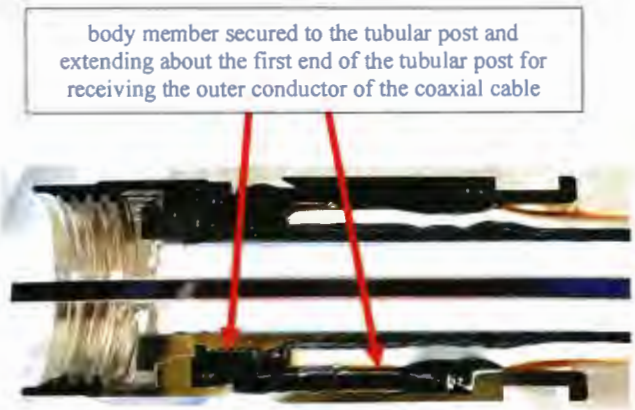
26. Moreover, on January 27, 2022, PPC sent PerfectVision a cease-and-desist letter explaining in detail how PerfectVision's SignaLoc® connector infringed the Patents-in-Suit and demanding that it stop infringing. That letter is attached hereto as Exhibit F. On information and belief, PerfectVision has continued to infringe the Patents-in-Suit as alleged herein.

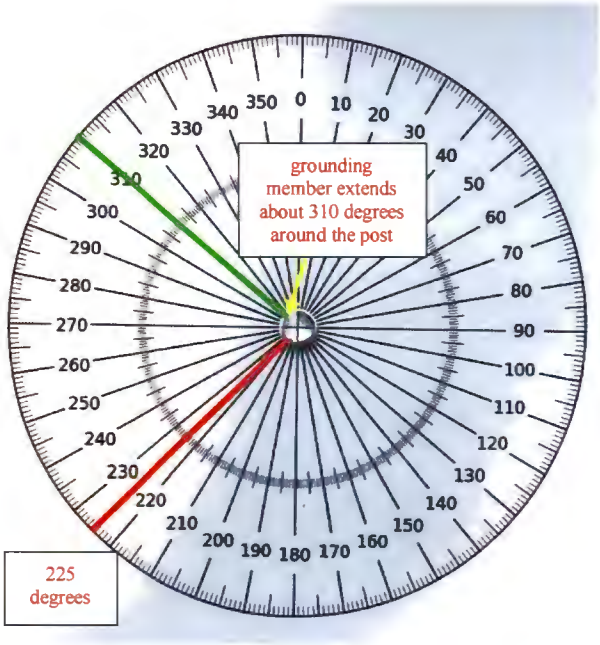
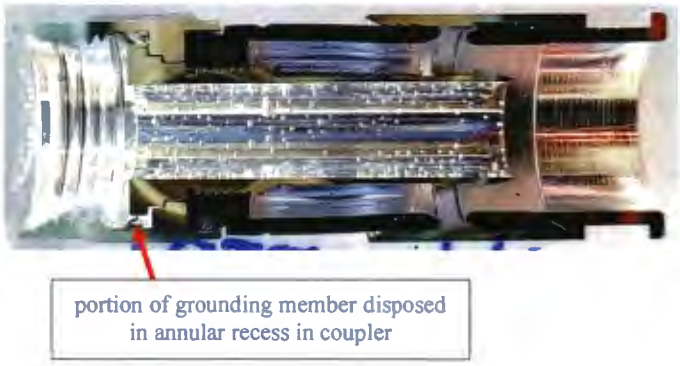
COUNT I
(Infringement of '990 Patent)

27. PPC repeats and reasserts all of the foregoing allegations as if they were stated in full herein.

28. As illustrated in the representative chart below, PerfectVision has directly infringed and continues to directly infringe at least Claim 6 of the '990 Patent, within the meaning of 35 U.S.C. § 271(a) and either literally or under the doctrine of equivalents, by using, selling, offering for sale, and or importing the Accused Products in the United States, without license or authorization by PPC.

'990 Patent, Claim 6	**SignaLoc® Connector**
1. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:	The SignaLoc® line of coaxial cable connectors are cable connectors for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor. (*See* https://www.perfect-vision.com/WebSupport/webstore/spec-sheets/PV6USLP.PDF.) 

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;	
b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;	
c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member contacts the coupler; and	 

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween.	
2. The coaxial cable connector recited by claim 1 wherein said grounding member is arcuately shaped to extend around the tubular post over at least 225 degrees.	
5. The coaxial cable connector recited by claim 2 wherein the central bore of the coupler includes an annular recess proximate to the first end of the coupler, and wherein at least portions of said grounding member are disposed within the annular recess.	

6. The coaxial cable connector recited by claim 5 wherein the tubular post includes an enlarged shoulder at the second end thereof extending inside the coupler, and wherein the annular recess and said grounding member surround the enlarged shoulder of the tubular post when the coaxial cable connector is assembled onto the prepared end of the coaxial cable.	 tubular post includes enlarged shoulder at the second end and extends inside the coupler; annular recess and grounding member surround the enlarged shoulder when assembled on the cable

29. The Accused Products include each of the elements of at least Claim 6 of the '990 Patent and PerfectVision's manufacture, importation, use, offer for sale and/or sale of such products in the United States constitutes infringement of the '990 Patent.

30. PerfectVision's infringement has caused and continues to cause PPC irreparable harm and damages in an amount to be proven at trial.

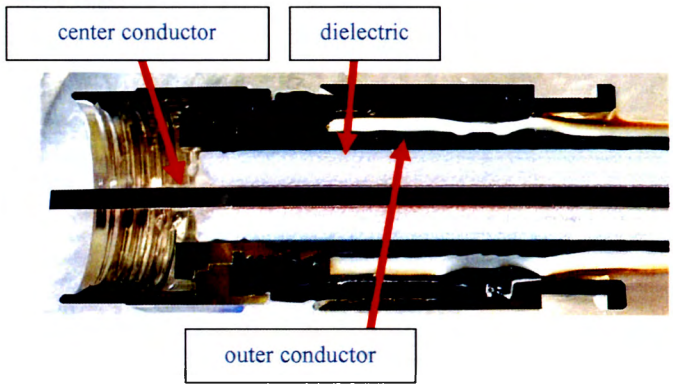
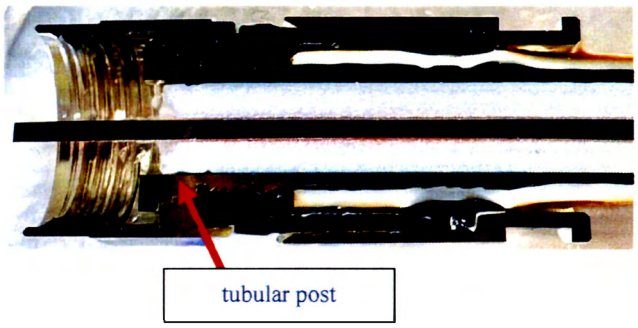
31. Upon information and belief, PerfectVision's unlawful infringing activity will continue unless and until it is enjoined by this Court from further infringement, and, at least since the commencement of this suit, such infringement has been willful, egregious, deliberate, and/or intentional. PerfectVision's continuing infringement since the commencement of this suit will cause PPC further irreparable harm and damages, and entitle it to recover, among other things, treble damages, attorney's fees, and costs.

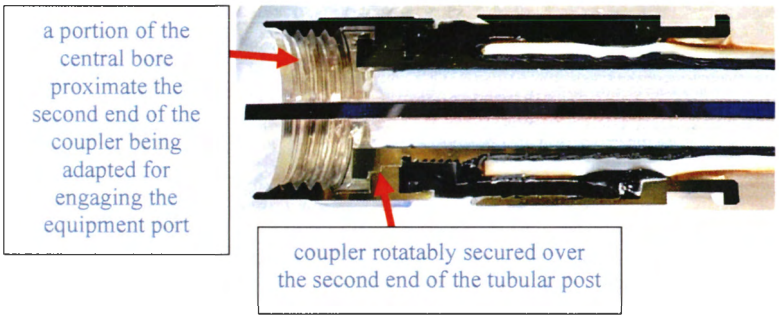
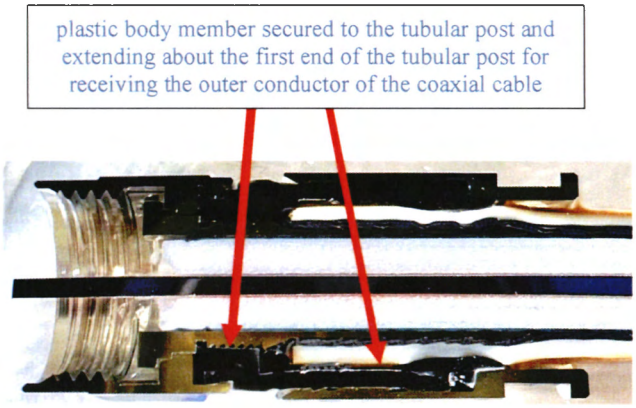
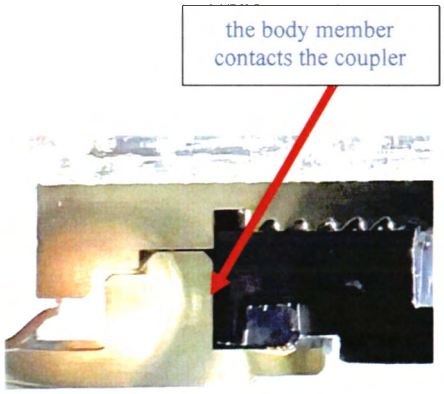
COUNT II
(Infringement of '035 Patent)

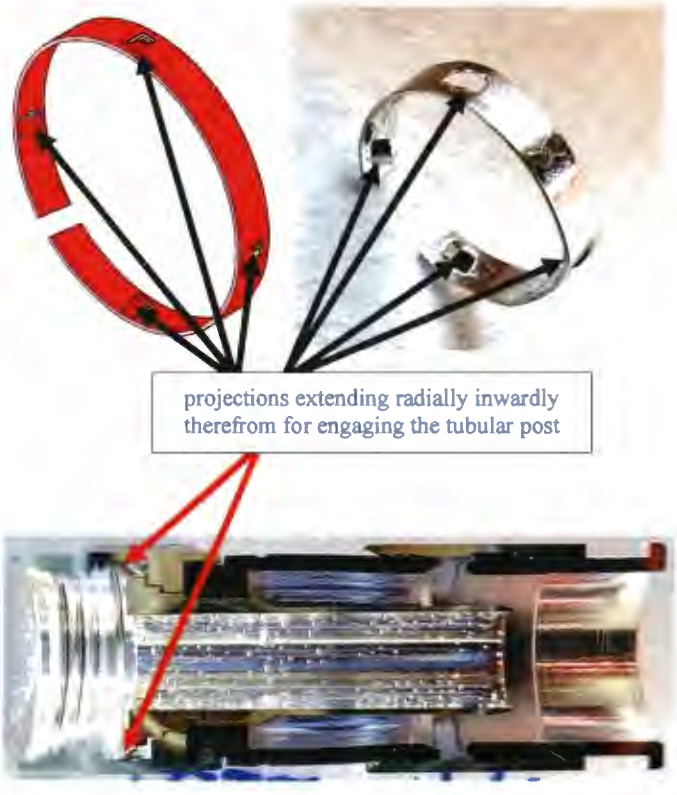
32. PPC repeats and reasserts all of the foregoing allegations as if they were stated in full herein.

33. As illustrated in the representative chart below, PerfectVision has directly infringed and continue to directly infringe at least Claim 11 of the '035 Patent, within the

meaning of 35 U.S.C. § 271(a) and either literally or under the doctrine of equivalents, by using, selling, offering for sale, and or importing the Accused Products in the United States, without license or authorization by PPC.

'035 Patent, Claim 11	**SignaLoc® Connector**
1. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising:	The SignaLoc® line of coaxial cable connectors are cable connectors for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor. (*See* https://www.perfect-vision.com/WebSupport/webstore/spec-sheets/PV6USLP.PDF.) 
a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof	

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;	
c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member is comprised of plastic, wherein the body member contacts the coupler; and	 

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween.	
9. The coaxial cable connector recited by claim 1 wherein said grounding member is generally circular.	
11. The coaxial cable connector recited by claim 9 wherein said grounding member has a plurality of projections extending radially inwardly therefrom for engaging the tubular post.	

34. The Accused Products include each of the elements of at least Claim 11 of the '035 Patent and PerfectVision's manufacture, importation, use, offer for sale and/or sale of such products in the United States constitutes infringement of the '035 Patent.

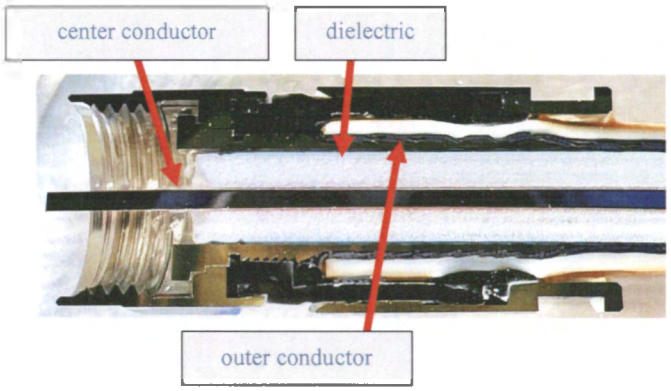
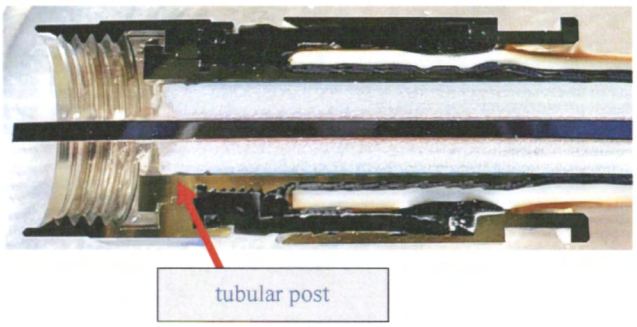
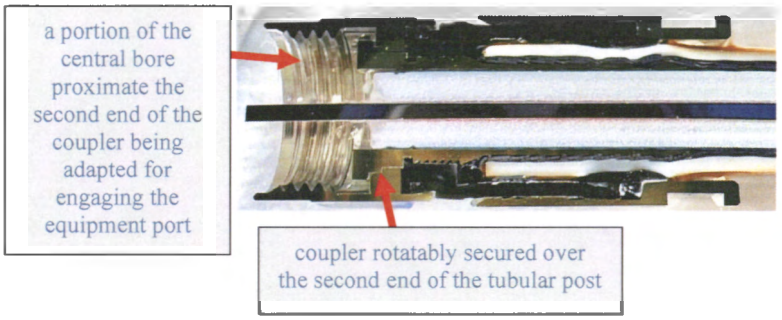
35. PerfectVision's infringement has caused and continues to cause PPC irreparable harm and damages in an amount to be proven at trial.

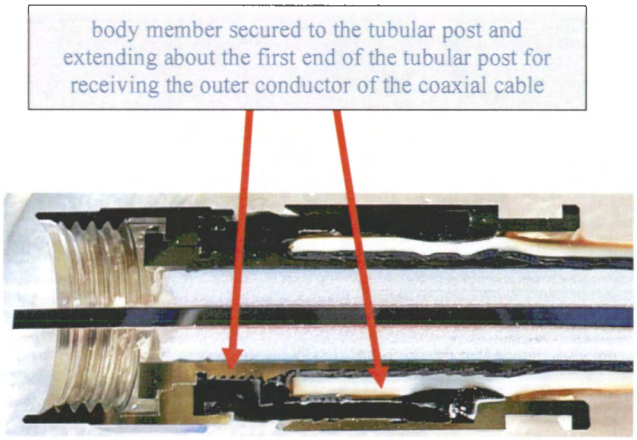
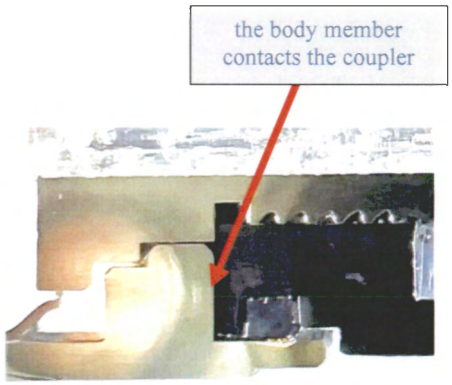
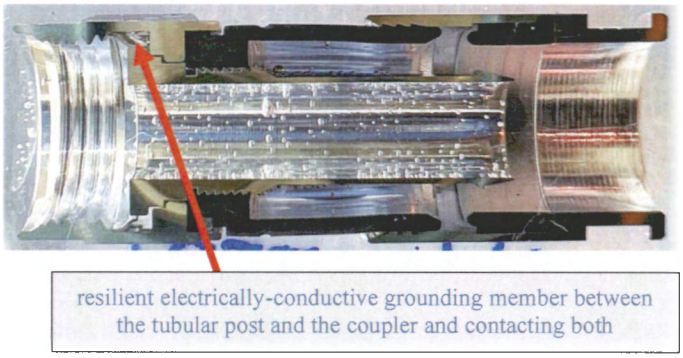
36. Upon information and belief, PerfectVision's unlawful infringing activity will continue unless and until it is enjoined by this Court from further infringement, and, at least since the commencement of this suit, such infringement has been willful, egregious, deliberate, and/or intentional. PerfectVision's continuing infringement since the commencement of this suit will cause PPC further irreparable harm and damages, and entitle it to recover, among other things, treble damages, attorney's fees, and costs.

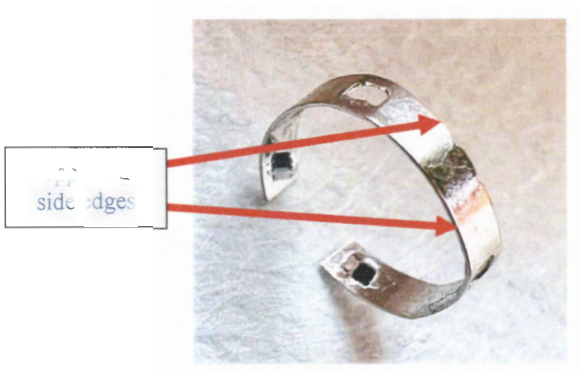
COUNT III
(Infringement of '126 Patent)

37. PPC repeats and reasserts all of the foregoing allegations as if they were stated in full herein.

38. As illustrated in the representative chart below, PerfectVision has directly infringed and continue to directly infringe at least Claim 6 of the '126 Patent, within the meaning of 35 U.S.C. § 271(a) and either literally or under the doctrine of equivalents, by using, selling, offering for sale, and or importing the Accused Products in the United States, without license or authorization by PPC.

'126 Patent, Claim 6	SignaLoc® Connector
6. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:	The SignaLoc® line of coaxial cable connectors are cable connectors for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor. (*See* https://www.perfect-vision.com/WebSupport/webstore/spec-sheets/PV6USLP.PDF.) 
a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;	
b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;	

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member contacts the coupler; and	 
d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween;	

wherein the grounding member comprises a circumferential band comprising a section that approximates a hollow cylinder, the circumferential band having first and second opposing side edges.	

39. The Accused Products include each of the elements of at least Claim 6 of the '126 Patent and PerfectVision's manufacture, importation, use, offer for sale and/or sale of such products in the United States constitutes infringement of the '126 Patent.

40. PerfectVision's infringement has caused and continues to cause PPC irreparable harm and damages in an amount to be proven at trial.

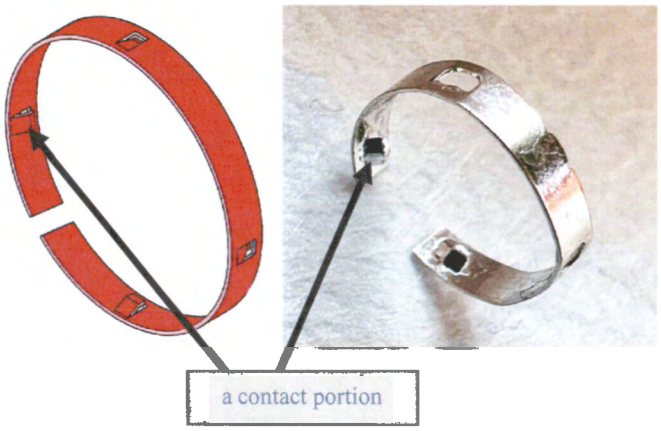
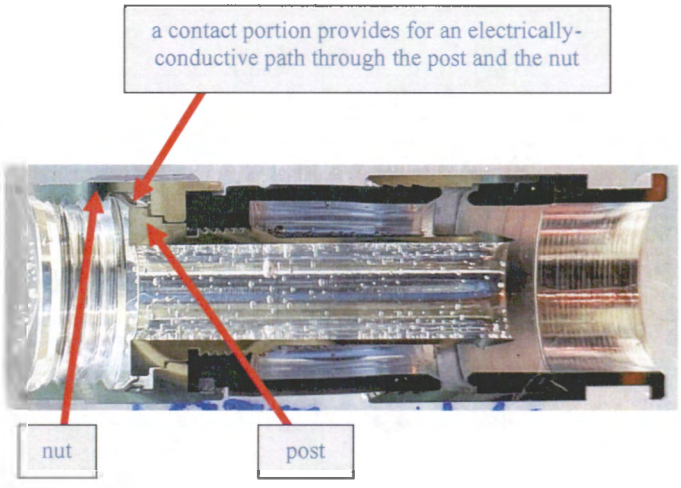
41. Upon information and belief, PerfectVision's unlawful infringing activity will continue unless and until it is enjoined by this Court from further infringement, and, at least since the commencement of this suit, such infringement has been willful, egregious, deliberate, and/or intentional. PerfectVision's continuing infringement since the commencement of this suit will cause PPC further irreparable harm and damages, and entitle it to recover, among other things, treble damages, attorney's fees, and costs.

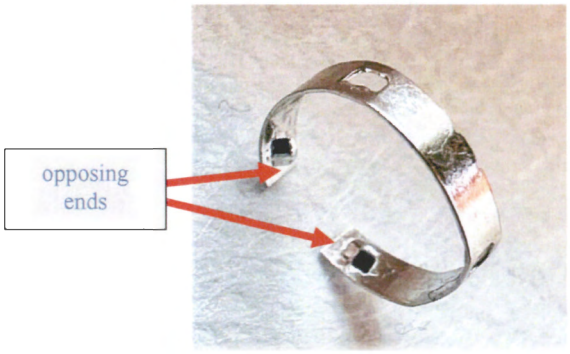
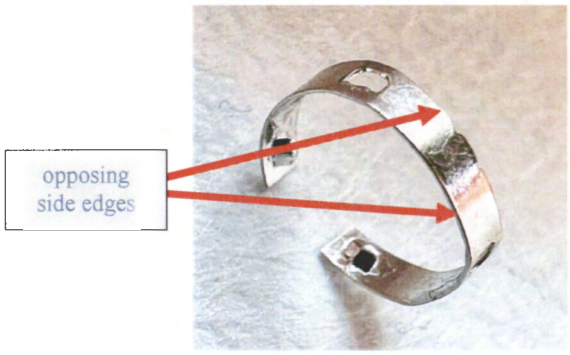
COUNT IV
(Infringement of '612 Patent)

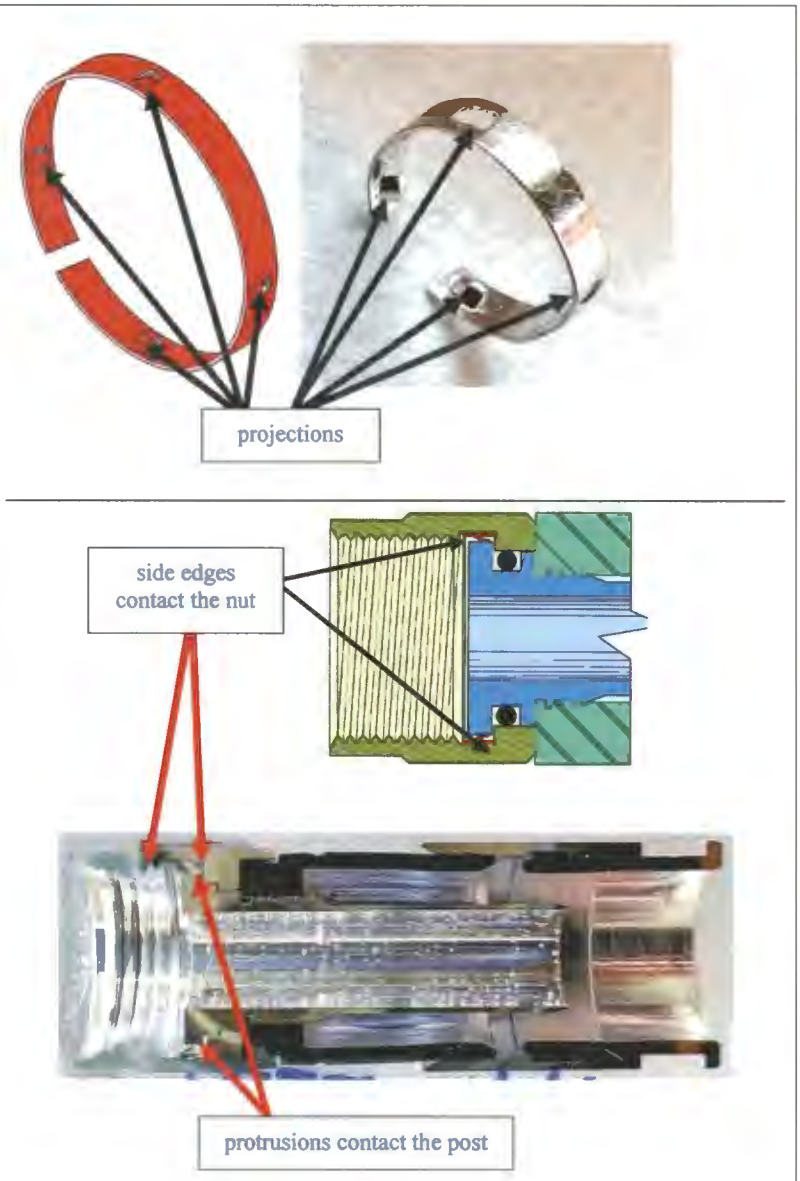
42. PPC repeats and reasserts all of the foregoing allegations as if they were stated in full herein.

43. As illustrated in the representative chart below, PerfectVision has directly infringed and continue to directly infringe at least Claim 23 of the '612 Patent, within the

meaning of 35 U.S.C. § 271(a) and either literally or under the doctrine of equivalents, by using, selling, offering for sale, and or importing the Accused Products in the United States, without license or authorization by PPC.

'612 Patent, Claim 23	**SignaLoc® Connector**
9. A grounding member for a coaxial cable connector having a post and a nut, comprising a generally arcuate shaped member, composed at least partially of electrically conductive material, and a contact portion of the generally arcuate shaped member, wherein:	The SignaLoc® line of coaxial cable connectors include a grounding member for a coaxial cable connector having a post and a nut, comprising a generally arcuate shaped member, composed at least partially of electrically conductive material, and a contact portion of the generally arcuate shaped member. 
the at least one contact portion provides for an electrically-conductive path through the post and the nut;	

the generally arcuate shaped member comprises a circumferential metallic band: and	
the circumferential metallic band has a general circular shape and approximates a section of a hollow cylinder that extends between first and second opposing ends.	
19. The grounding member of claim 9, wherein the circumferential metallic band has first and second opposing side edges extending along a length of the circumferential metallic band.	

23. The grounding member of claim 19, wherein the contact portion comprises a plurality of projections, and wherein the first and second side edges contact a first one of a group of members that includes the nut and the post, and the plurality of projections contact a second one of the group of members that includes the nut and the post.	

44. The Accused Products include each of the elements of at least Claim 23 of the '612 Patent and PerfectVision's manufacture, importation, use, offer for sale and/or sale of such products in the United States constitutes infringement of the '612 Patent.

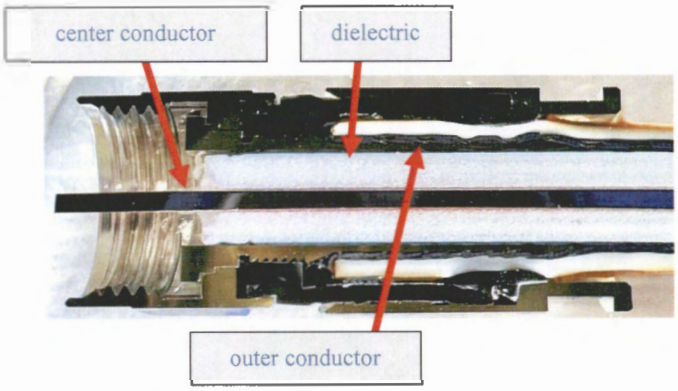
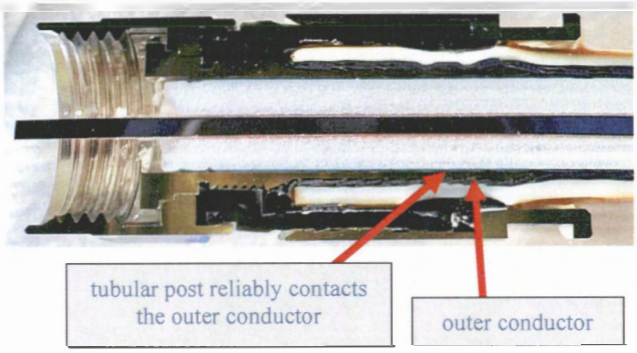
45. PerfectVision's infringement has caused and continues to cause PPC irreparable harm and damages in an amount to be proven at trial.

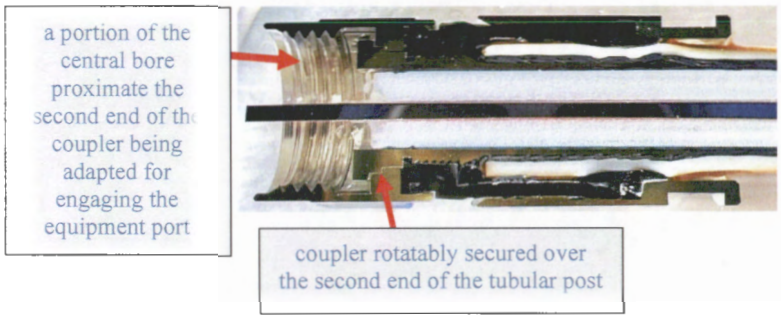
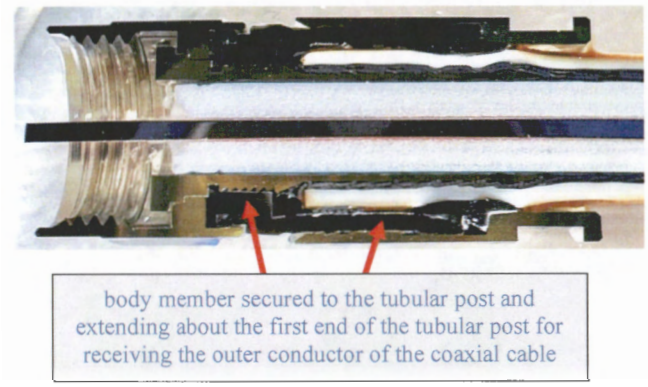
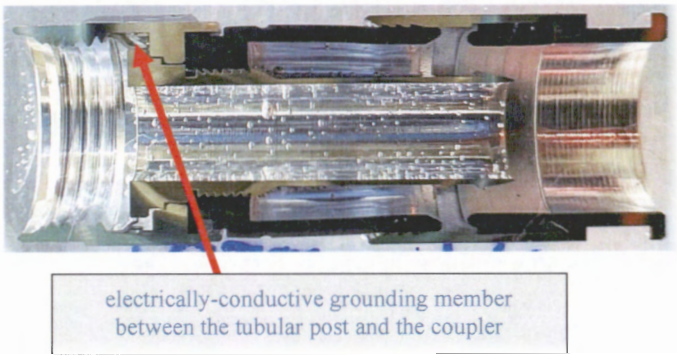
46. Upon information and belief, PerfectVision's unlawful infringing activity will continue unless and until it is enjoined by this Court from further infringement, and, at least since the commencement of this suit, such infringement has been willful, egregious, deliberate, and/or intentional. PerfectVision's continuing infringement since the commencement of this suit will cause PPC further irreparable harm and damages, and entitle it to recover, among other things, treble damages, attorney's fees, and costs.

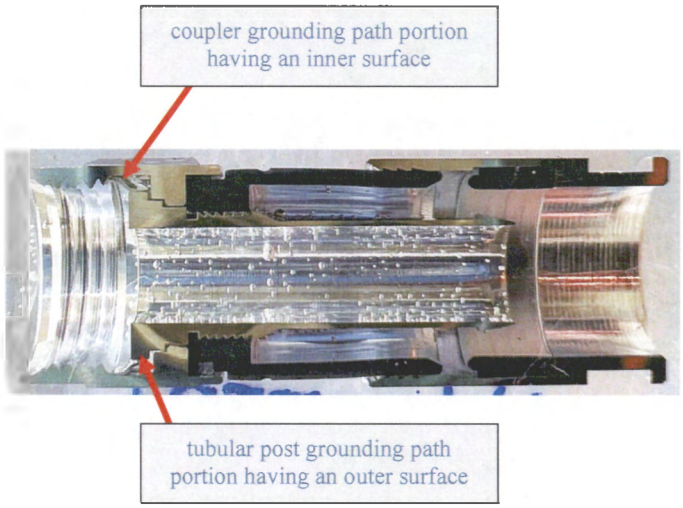
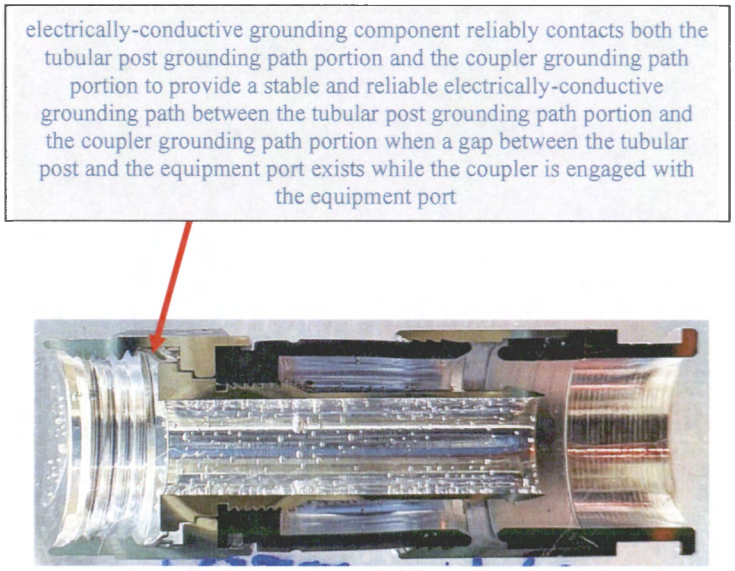
COUNT V
(Infringement of '455 Patent)

47. PPC repeats and reasserts all of the foregoing allegations as if they were stated in full herein.

48. As illustrated in the representative chart below, PerfectVision has directly infringed and continue to directly infringe at least Claim 5 of the '455 Patent, within the meaning of 35 U.S.C. § 271(a) and either literally or under the doctrine of equivalents, by using, selling, offering for sale, and or importing the Accused Products in the United States, without license or authorization by PPC.

'455 Patent, Claim 5	SignaLoc® Connector
5. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising:	The SignaLoc® line of coaxial cable connectors are cable connectors for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor. (*See* https://www.perfect-vision.com/WebSupport/webstore/spec-sheets/PV6USLP.PDF.) 
a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor to reliably contact the outer conductor, and having a second end opposite the first end;	 **PRODUCT CHARACTERISTICS** - Designed with patented grounding insert to provide enhanced continuity and minimize signal ingress/egress. (*See* https://www.perfect-vision.com/WebSupport/webstore/spec-sheets/PV6USLP.PDF.)

a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;	
a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable; and	
an electrically-conductive grounding component disposed between the tubular post and the coupler;	

wherein the tubular post includes a tubular post grounding path portion having an outer surface, and the coupler includes a coupler grounding path portion having an inner surface; and	
wherein the electrically-conductive grounding component reliably contacts both the tubular post grounding path portion and the coupler grounding path portion to provide a stable and reliable electrically-conductive grounding path between the tubular post grounding path portion and the coupler grounding path portion when a gap between the tubular post and the equipment port exists while the coupler is engaged with the equipment port.	 SignaLoc® Continuity Connector **PRODUCT CHARACTERISTICS** - Designed with patented grounding insert to provide enhanced continuity and minimize signal ingress/egress. (*See* https://www.perfect-vision.com/WebSupport/webstore/spec-sheets/PV6USLP.PDF.)

49. The Accused Products include each of the elements of at least Claim 5 of the '455 Patent and PerfectVision's manufacture, importation, use, offer for sale and/or sale of such products in the United States constitutes infringement of the '455 Patent.

50. PerfectVision's infringement has caused and continues to cause PPC irreparable harm and damages in an amount to be proven at trial.

51. Upon information and belief, PerfectVision's unlawful infringing activity will continue unless and until it is enjoined by this Court from further infringement, and, at least since the commencement of this suit, such infringement has been willful, egregious, deliberate, and/or intentional. PerfectVision's continuing infringement since the commencement of this suit will cause PPC further irreparable harm and damages, and entitle it to recover, among other things, treble damages, attorney's fees, and costs.

Prayer for Relief

WHEREFORE, PPC prays for judgment in its favor and against PerfectVision, as follows:

A. Entry of judgment that PerfectVision infringed one or more claims of the Patents-in-Suit;

B. Entry of judgment that preliminarily and/or permanently enjoins the PerfectVision and its representatives, assigns or successors, or any subsidiaries, parents, divisions, agents, servants, employees thereof, and/or those in privity with PerfectVision from infringing the Patents-in-Suit;

C. An award of compensatory damages for PPC as a result of infringement, as provided in 35 U.S.C. § 284, the extent of which will be determined at trial, but in no event less than a reasonable royalty, together with interest and costs;

D. A determination that PerfectVision's acts of infringement of one or more claims of the Patents-in-Suit have been, and continue to be, egregious and/or willful, and that PPC is entitled to an award of enhanced damages of up to three times the amount of actual damages pursuant to 35 U.S.C. § 284;

E. A determination that, pursuant to 35 U.S.C. § 285, this is an exceptional case and that PPC be awarded its reasonable attorney's fees;

F. An award of interest on any judgment rendered in this action;

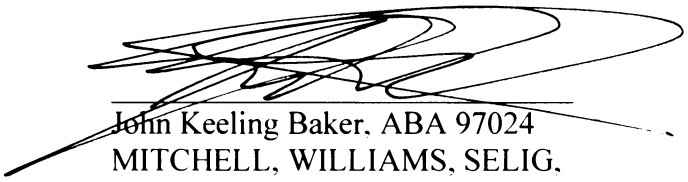
G. An award of PPC's costs in this action; and

H. Such other and further relief as is just and proper.

Jury Demand

PPC demands a trial by jury on all issues so triable.

Dated: February 18, 2022.



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US007114990B2

(12) **United States Patent**
Bence et al.

(10) **Patent No.: US 7,114,990 B2**
(45) **Date of Patent: Oct. 3, 2006**

(54) **COAXIAL CABLE CONNECTOR WITH GROUNDING MEMBER**

(75) Inventors: **Bruce D. Bence**, Glendale, AZ (US); **Donald A. Burris**, Peoria, AZ (US); **Brian L. Kisling**, Phoenix, AZ (US); **John A. Kooiman**, Mesa, AZ (US); **William B. Lutz**, Glendale, AZ (US); **William F. McDade**, Glendale, AZ (US); **Thomas D. Miller**, Peoria, AZ (US); **Lee Yung Chuan**, Sanchong (TW)

(73) Assignee: **Corning Gilbert Incorporated**, Glendale, AZ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/043,844**

(22) Filed: **Jan. 25, 2005**
(Under 37 CFR 1.47)

(65) **Prior Publication Data**

US 2006/0166552 A1 Jul. 27, 2006

(51) **Int. Cl.**
H01R 9/05 (2006.01)

(52) **U.S. Cl.** **439/583**; 439/322

(58) **Field of Classification Search** 439/578, 439/583, 584, 320, 322, 314
See application file for complete search history.

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Primary Examiner Tulsidas C. Patel
Assistant Examiner Vladimir Imas
(74) *Attorney, Agent, or Firm*—Joseph M. Homa; Marvin A. Glazer

(57) **ABSTRACT**

A coaxial cable connector includes tubular post, a coupler secured over an end of the tubular post for securing the connector to an appliance, and an outer body secured to the tubular post. An electrical grounding path is maintained between the coupler and the tubular post whether or not the coupler is tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler. Alternatively, the connector includes conductive grease at a point where mating portions of the tubular post and coupler have closely matching dimensions.

34 Claims, 8 Drawing Sheets

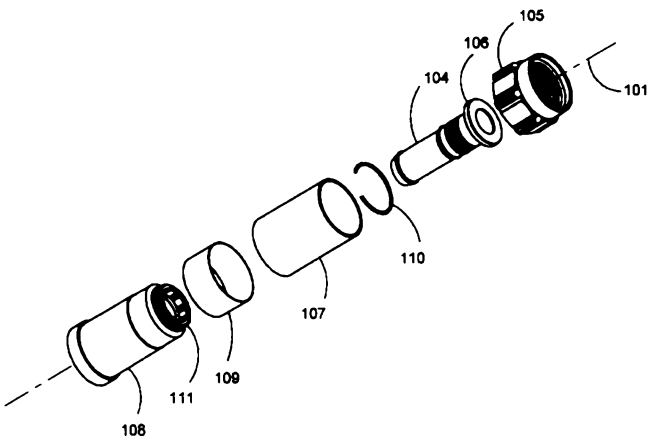

EXHIBIT
A

U.S. PATENT DOCUMENTS

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6,716,062	B1	4 2004	Palinkas et al.	439 578

* cited by examiner

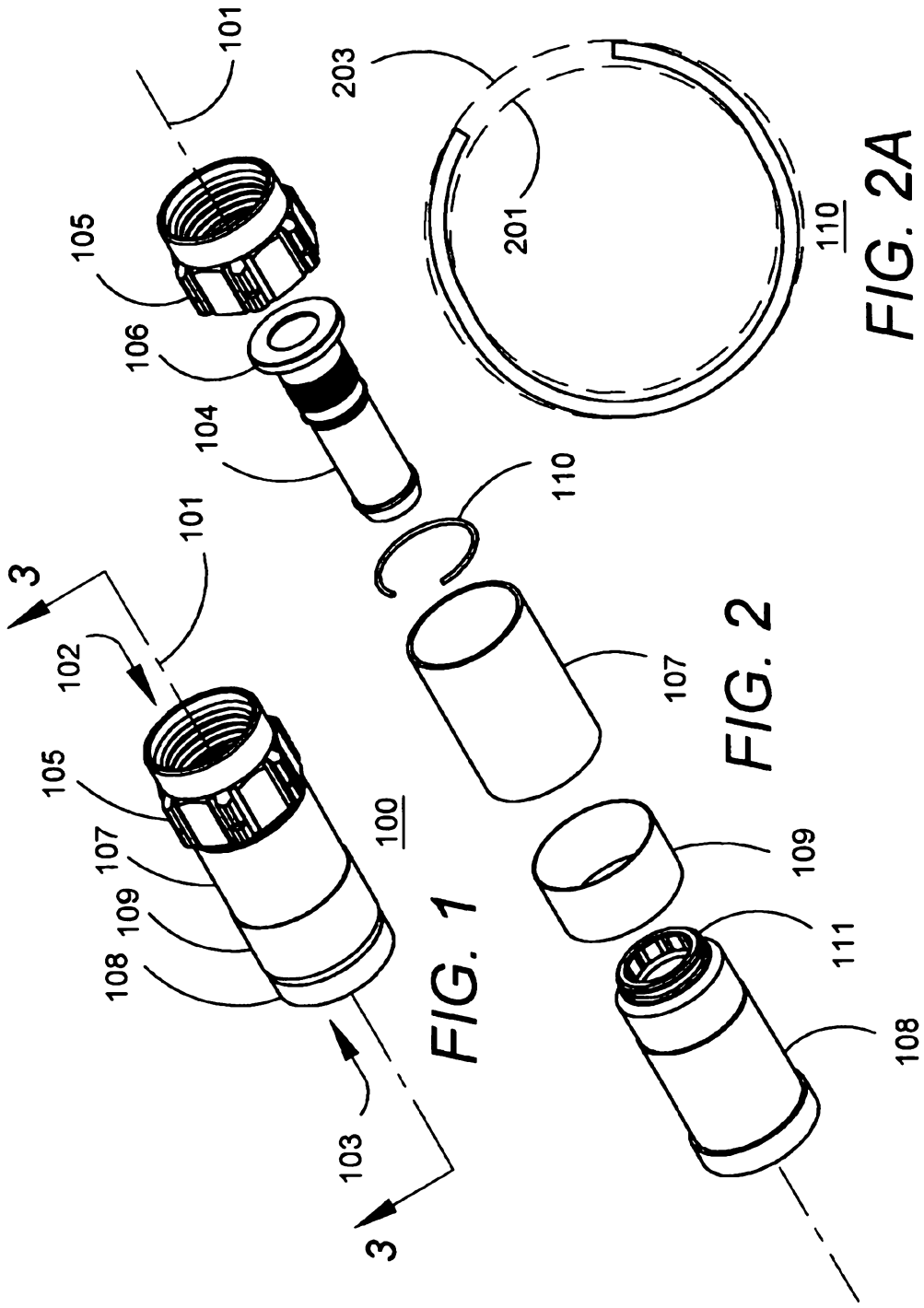

FIG. 1

FIG. 2

FIG. 2A

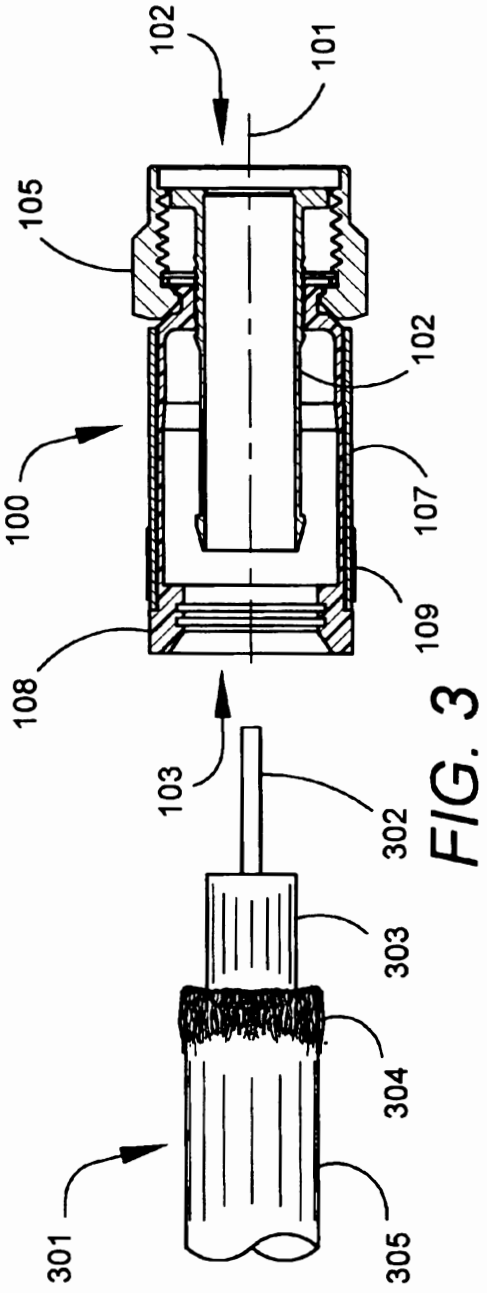

FIG. 3

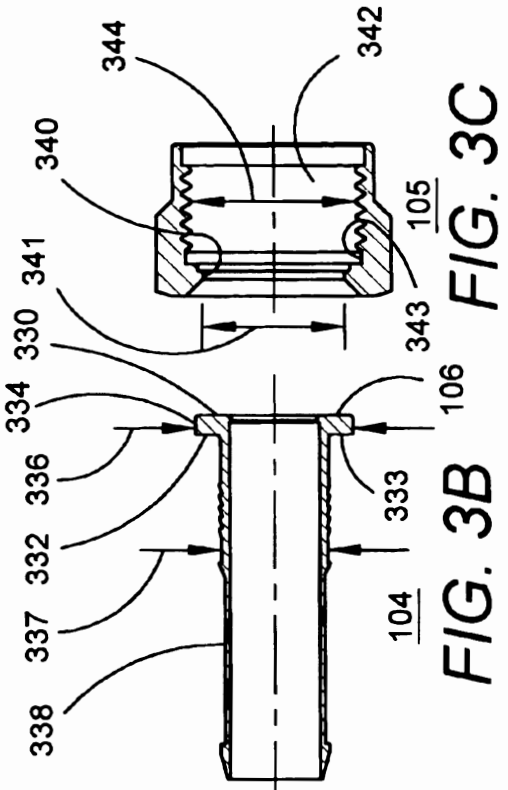

FIG. 3B

FIG. 3C

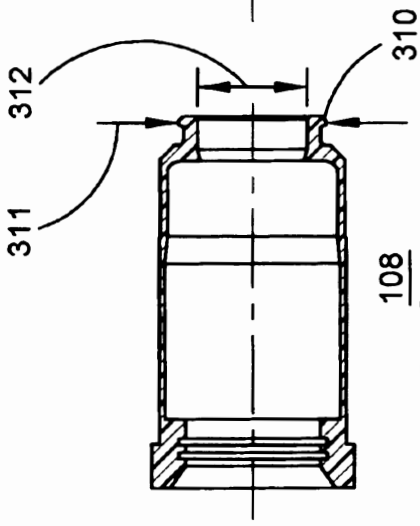

FIG. 3A

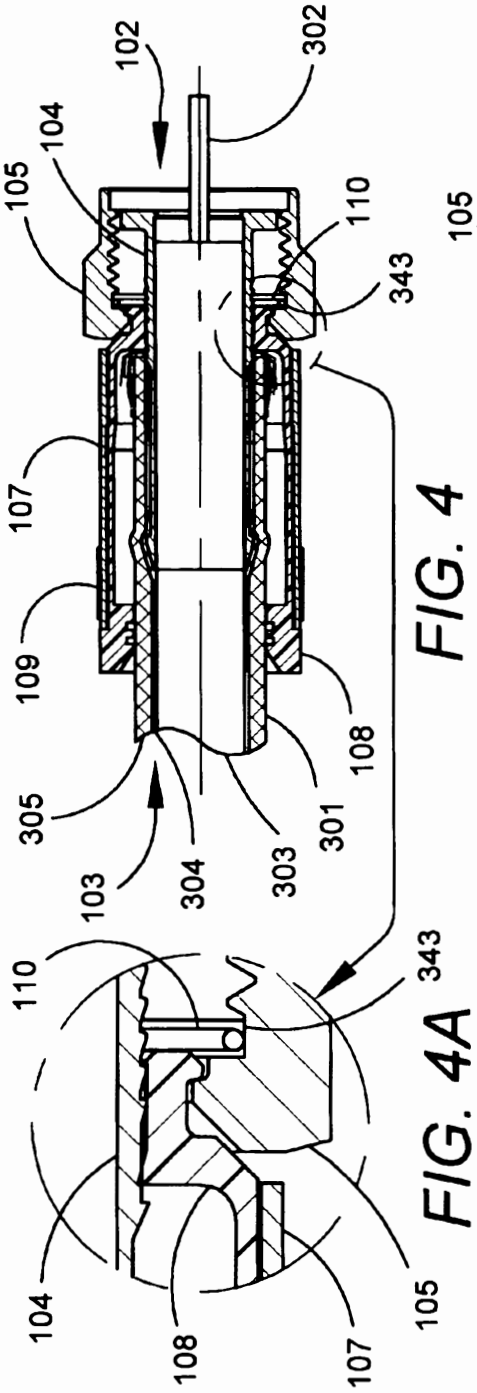

FIG. 4

FIG. 4A

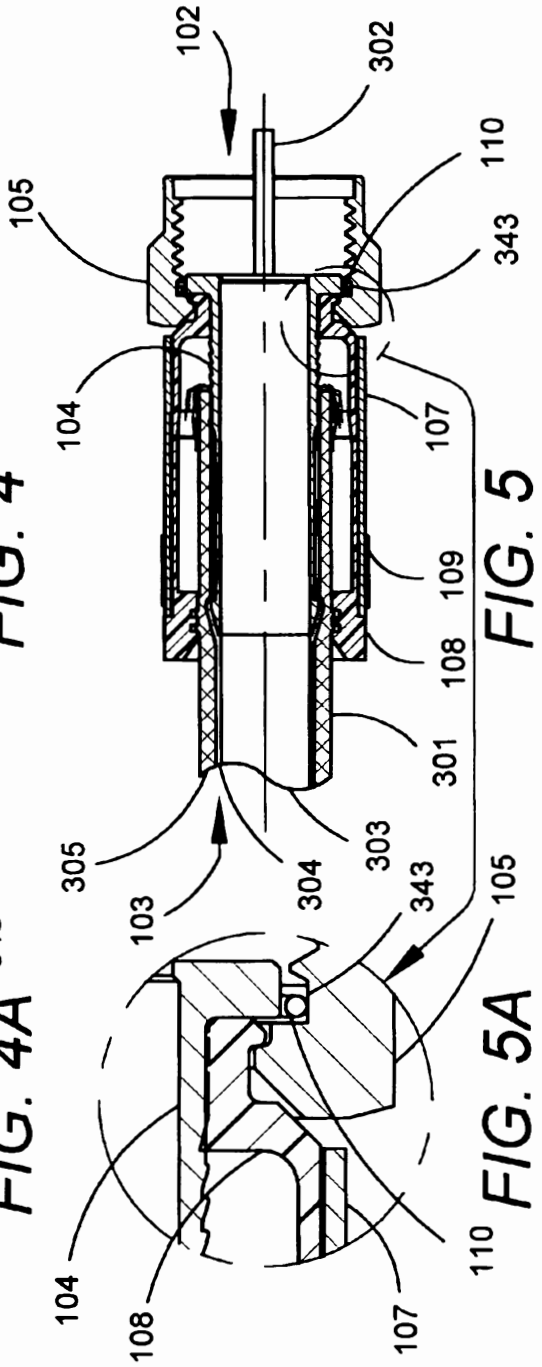

FIG. 5

FIG. 5A

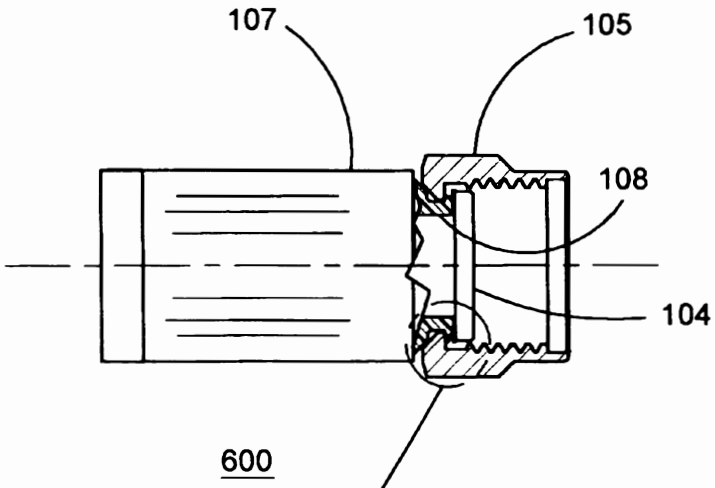

FIG. 6

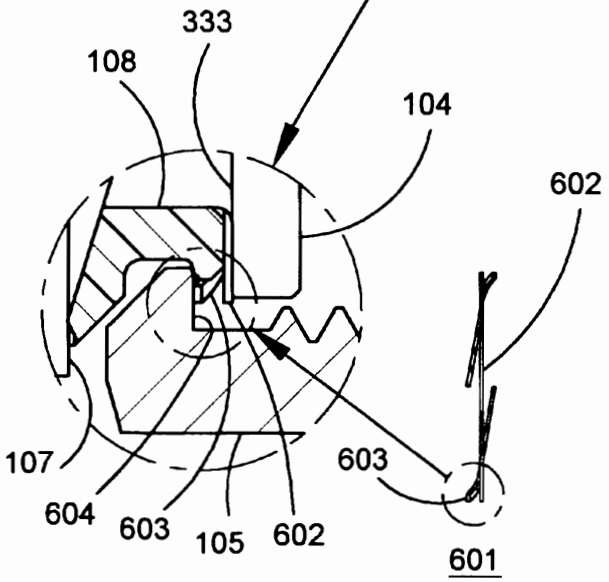

FIG. 6A

FIG. 6B

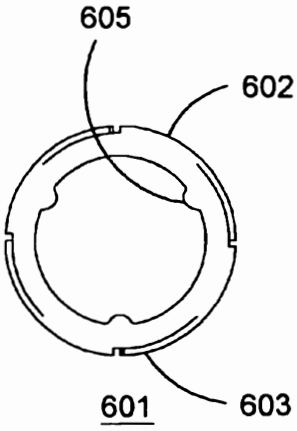

FIG. 6C

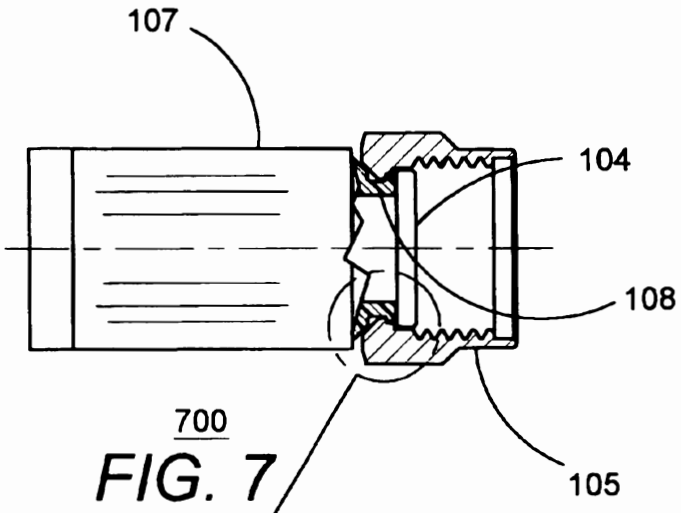

FIG. 7

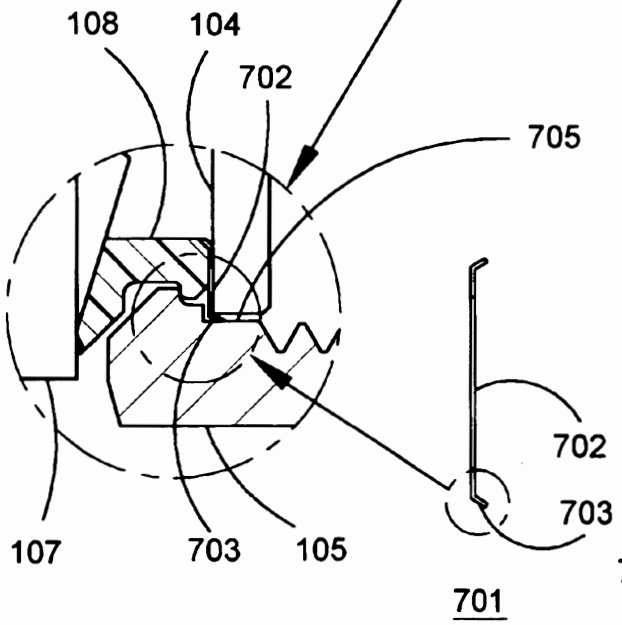

FIG. 7A

FIG. 7B

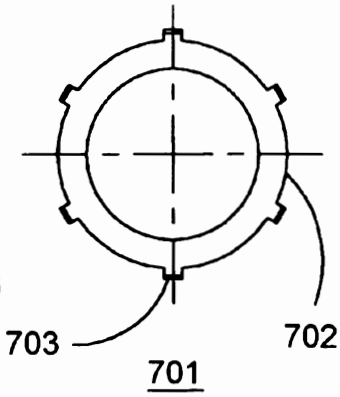

FIG. 7C

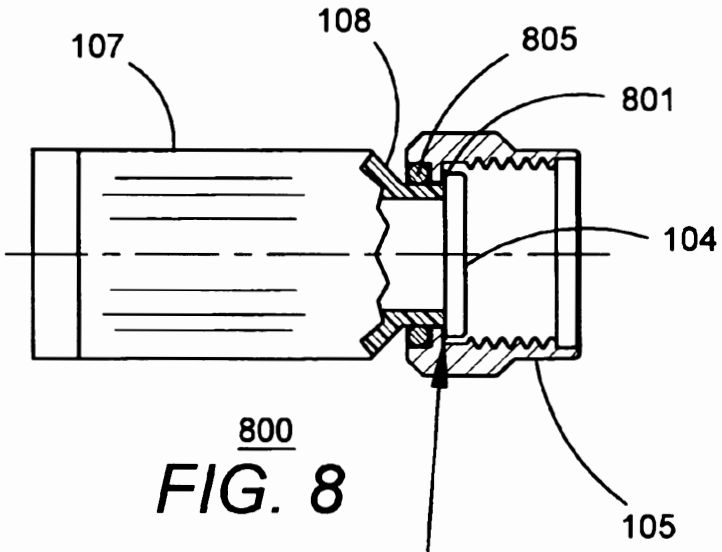

FIG. 8

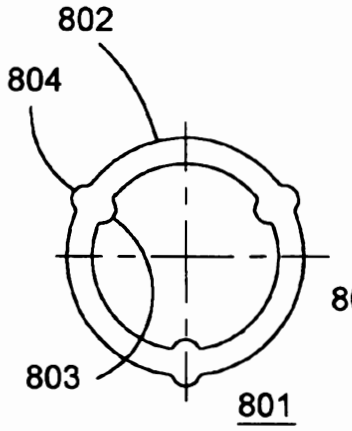

FIG. 8B

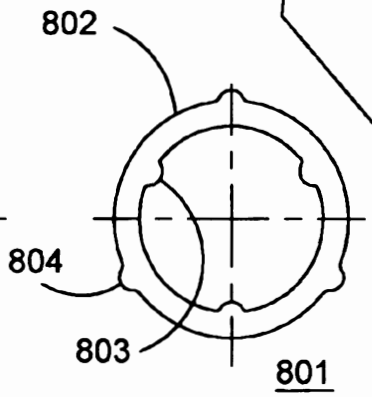

FIG. 8C

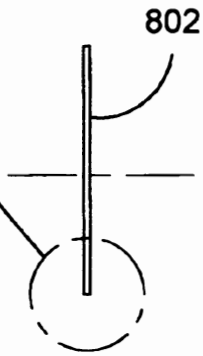

FIG. 8A

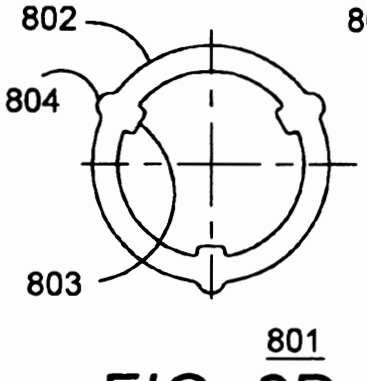

FIG. 8D

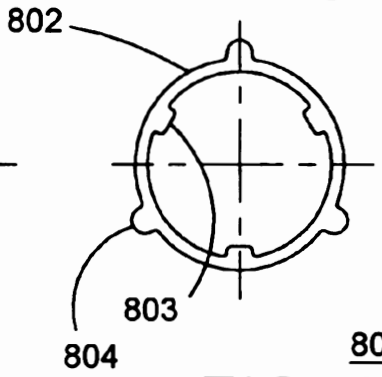

FIG. 8E

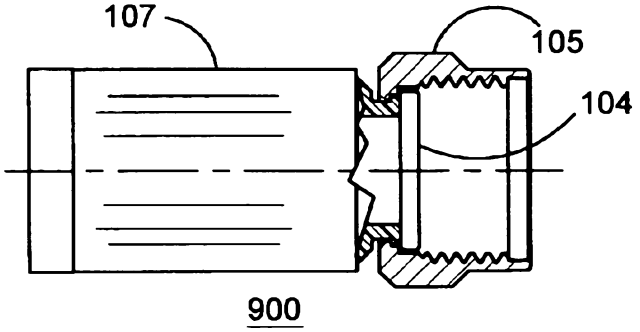

FIG. 9

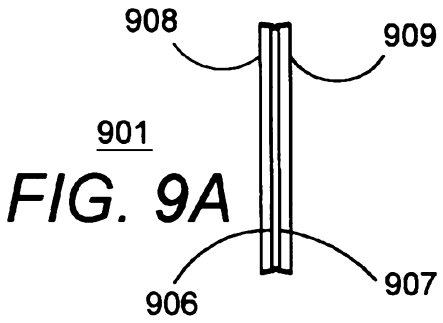

FIG. 9A

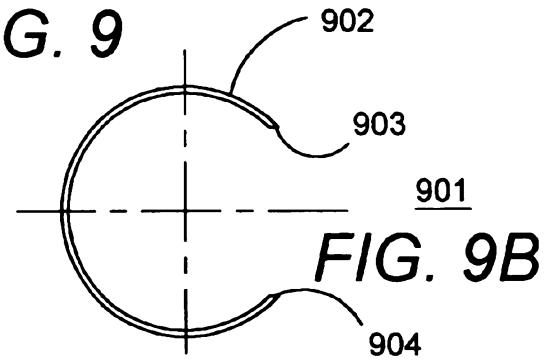

FIG. 9B

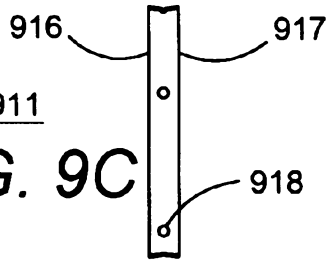

FIG. 9C

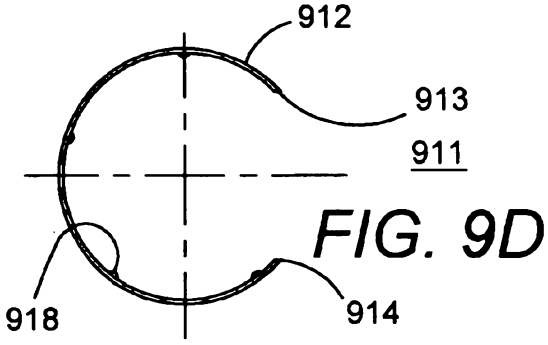

FIG. 9D

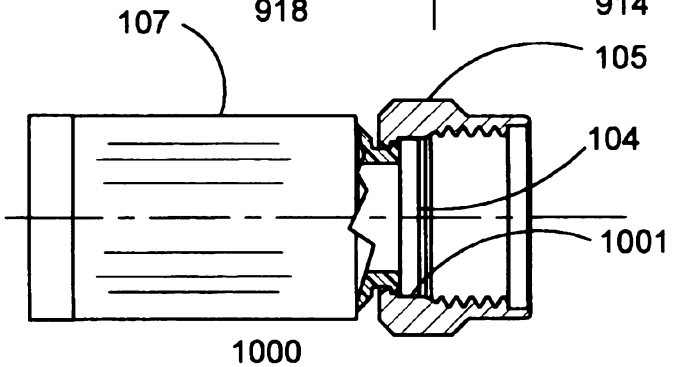

FIG. 10

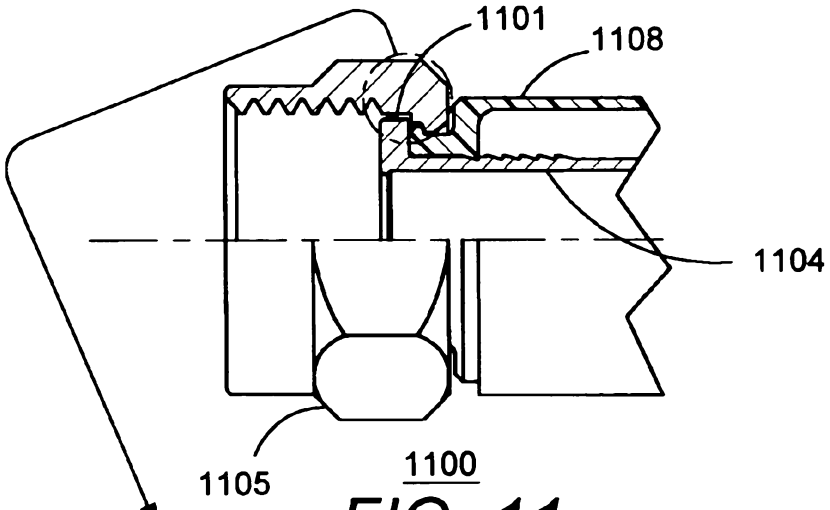

FIG. 11

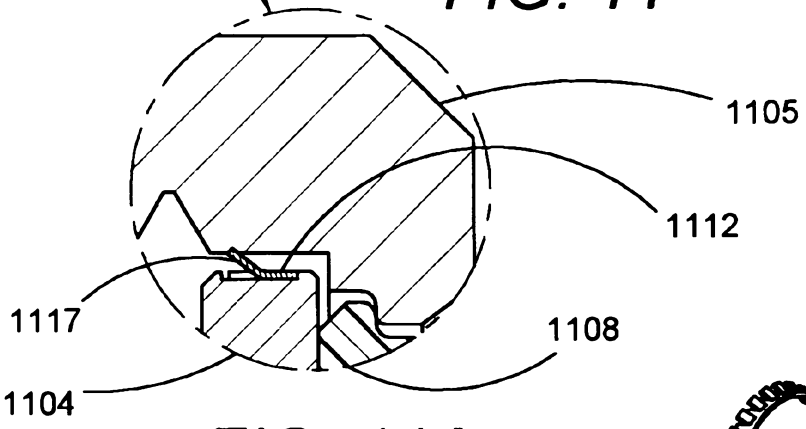

FIG. 11A

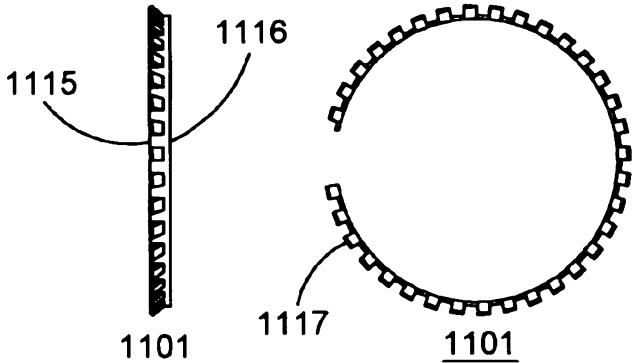

FIG. 11B

FIG. 11C

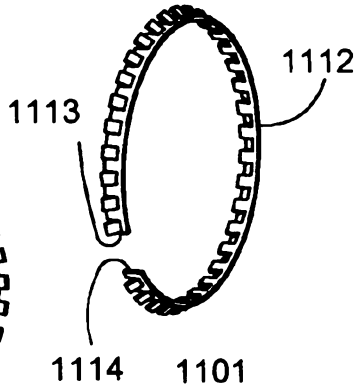

FIG. 11D

COAXIAL CABLE CONNECTOR WITH GROUNDING MEMBER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to electrical connectors, and more particularly to coaxial cable connectors capable of being connected to a terminal.

2. Description of the Related Art

Coaxial cable connectors, such as type F connectors, are used to attach coaxial cable to another object or appliance, e.g., a television set or VCR having a terminal adapted to engage the connector. The terminal of the appliance includes an inner conductor and a surrounding outer conductor.

Coaxial cable includes a center conductor for transmitting a signal. The center conductor is surrounded by a dielectric material, and the dielectric material is surrounded by an outer conductor; this outer conductor may be in the form of a conductive foil and/or braided sheath. The outer conductor is typically maintained at ground potential to shield the signal transmitted by the center conductor from stray noise, and to maintain a continuous desired impedance over the signal path. The outer conductor is usually surrounded by a plastic cable jacket that electrically insulates, and mechanically protects, the outer conductor. Prior to installing a coaxial connector onto an end of the coaxial cable, the end of the coaxial cable is typically prepared by stripping off the end portion of the jacket to bare the end portion of the outer conductor. Similarly, it is common to strip off a portion of the dielectric to expose the end portion of the center conductor.

Coaxial cable connectors of the type known in the trade as "F connectors" often include a tubular post designed to slide over the dielectric material, and under the outer conductor of the coaxial cable, at the prepared end of the coaxial cable. If the outer conductor of the cable includes a braided sheath, then the exposed braided sheath is usually folded back over the cable jacket. The cable jacket and folded-back outer conductor extend generally around the outside of the tubular post and are typically received in an outer body of the connector; this outer body of the connector is usually fixedly secured to the tubular post. A coupler is rotatably secured around the tubular post and includes an internally-threaded region for engaging external threads formed on the outer conductor of the appliance terminal.

When connecting the end of a coaxial cable to a terminal of a television set, equipment box, or other appliance, it is important to achieve a reliable electrical connection between the outer conductor of the coaxial cable and the outer conductor of the appliance terminal. This goal is usually achieved by ensuring that the coupler of the connector is fully tightened over the connection port of the appliance. When fully tightened, the head of the tubular post of the connector directly engages the edge of the outer conductor of the appliance port, thereby making a direct electrical ground connection between the outer conductor of the appliance port and the tubular post; in turn, the tubular post is engaged with the outer conductor of the coaxial cable.

However, in many cases, it is difficult for an installer to reach the connection ports of the appliance with a wrench, and in some instances, it is even difficult for the installer to reach such connection ports with his or her fingers. As a result, it can often happen that type F connectors are not fully tightened to the appliance port. In such a loose connection system, wherein the coupler of the coaxial connector is not drawn tightly to the appliance port connector, a gap exists between the outer conductor of the appliance port and the tubular post of the connector. Unless an alternate ground path exists, poor signal quality, and RFI leakage, will result.

As mentioned above, the coupler is rotatably secured about the head of the tubular post. The head of the tubular post usually includes an enlarged shoulder, and the coupler typically includes an inwardly-directed flange for extending over and around the shoulder of the tubular post. In order not to interfere with free rotation of the coupler, manufacturers of such F-style connectors routinely make the outer diameter of the shoulder (at the head of the tubular post) of smaller dimension than the inner diameter of the central bore of the coupler. Likewise, manufacturers routinely make the inner diameter of the inwardly-directed flange of the coupler of larger dimension than the outer diameter of the non-shoulder portion of the tubular post, again to avoid interference with rotation of the coupler relative to the tubular post. In a loose connection system, wherein the coupler of the coaxial connector is not drawn tightly to the appliance port connector, an alternate ground path may fortuitously result from contact between the coupler and the tubular post, particularly if the coupler is not centered over, and axially aligned with, the tubular post. However, this alternate ground path is not stable, and can be disrupted as a result of vibrations, movement of the appliance, movement of the cable, or the like.

Alternatively, there are some cases in which such an alternate ground path is provided by fortuitous contact between the coupler and the outer body of the coaxial connector, provided that the outer body is formed from conductive material. This alternate ground path is similarly unstable, and may be interrupted by relative movement between the appliance and the cable, or by vibrations. Moreover, this alternate ground path does not exist at all if the outer body of the coaxial connector is constructed of non-conductive material. Such unstable ground paths can give rise to intermittent failures that are costly and time-consuming to diagnose.

OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide a coaxial cable connector for connecting a coaxial cable to a connection port of an appliance, the coaxial cable connector being of the type that includes a tubular post and a coupler, such as a rotatable coupler, which ensures a reliable ground connection between the tubular post of the connector and an outer conductor of the appliance port, even if the coupler is not fully tightened onto the appliance port.

It is another object of the present invention to provide such a coaxial cable connector which maintains a reliable ground path between the coupler and the tubular post, at least following installation of such connector onto the end of a coaxial cable.

It is still another object of the present invention to provide such a coaxial connector that can be manufactured economically.

These and other objects of the present invention will become more apparent to those skilled in the art as the description thereof proceeds.

SUMMARY OF THE INVENTION

Briefly described, the present invention relates to a coaxial cable connector comprising a tubular post, a coupler and a grounding means for providing an electrically conductive path between the post and the coupler. In accordance

with a preferred embodiment thereof, the present invention relates to a coaxial cable connector for coupling a prepared end of a coaxial cable to a threaded female equipment port, and including a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor thereof. A coupler is rotatably secured over the second end of the tubular post, and includes a central bore, at least a portion of which is threaded for engaging the female equipment port. An outer body is secured to the tubular post and extends about the first end of the tubular post for receiving the outer conductor, and preferably the cable jacket, of the coaxial cable.

In a preferred embodiment of the present invention, a resilient, electrically-conductive grounding member is disposed between the tubular post and the coupler. This grounding member engages both the tubular post and the coupler for providing an electrically-conductive path therebetween, but without restricting rotation of the coupler relative to the tubular post.

For some preferred embodiments, the grounding member is generally arcuately shaped to extend around the tubular post over an arc of at least 225°, and may extend for a full 360°. This arcuately shaped grounding member may be in the form of a generally circular broken ring, or C-shaped member, as by bending a strip of metal wire into an arc. Preferably, the grounding member has a shape that is out-of-round, and more preferably oblong, rather than circular, in order to ensure reliable electrical contact with both the coupler and the tubular post. In order to retain the grounding member inside the coupler, the inner bore of the coupler may include an annular recess proximate to the end of the coupler that encircles the tubular post; at least portions of the grounding member are engaged with the annular recess to prevent the grounding member from being axially displaced within the coupler.

As mentioned above, the tubular post may include an enlarged shoulder at the head thereof. In one preferred embodiment of the present invention, the grounding member surrounds the enlarged shoulder of the tubular post, at least when the coaxial cable connector is assembled onto the prepared end of a coaxial cable, whereby at least portions of the grounding member engage the outer surface of such enlarged shoulder.

In one embodiment of the present invention, the grounding member is generally circular and includes a plurality of projections extending outwardly therefrom for engaging the coupler. In another embodiment of the present invention, the grounding member is generally circular and includes a plurality of projections extending inwardly therefrom for engaging the tubular post.

In yet another embodiment of the present invention, the tubular post includes an enlarged shoulder extending inside the coupler, and including a first radial face that faces the opposite end of the tubular post. The coupler includes a flange directed inwardly toward the tubular post; this inwardly directed flange including a second radial face that faces toward the connection port of the appliance to which the coaxial cable is to be connected. The grounding member is disposed between the first radial face and the second radial face. In this embodiment, the grounding member is resilient relative to the longitudinal axis of the connector, and is compressed between the first radial face and the second radial face to maintain sliding electrical contact between the shoulder of the tubular post (via its first radial face) and the flange of the coupler (via its second radial face).

The coaxial connector of the present invention may also include a sealing ring seated within the coupler for rotatably engaging the body member to form a seal therebetween.

In an alternate embodiment of the present invention, conductive grease is substituted for a discrete grounding member. In this embodiment, an outer dimension of a portion of the tubular post is caused to be commensurate with an inner dimension of an adjacent portion of the coupler. While the gap between such adjacent portions, coupled with the lubrication provided by the conductive grease, is sufficient to permit rotation of the coupler relative to the tubular post, the conductive grease nonetheless functions to maintain reliable electrical coupling across such gap.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described with greater specificity and clarity with reference to the following drawings, in which:

FIG. **1** is a perspective view of an F connector in accordance with the preferred embodiment of the invention, including a body and a coupling nut;

FIG. **2** is an exploded view of the F connector of FIG. **1**, including a preferred embodiment of a grounding member;

FIG. **2**A is an enlarged plan view of the preferred embodiment of the grounding member of FIG. **2**;

FIG. **3** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3**—**3**, and a side view of a prepared coaxial cable ready to be inserted into a back end of the F connector;

FIG. **3**A is a cross-sectional view of the body of the F connector of FIG. **1** through cut-line **3**—**3**;

FIG. **3**B is a cross-sectional view of a tubular post of the F connector of FIG. **1**, through cut-line **3**—**3**;

FIG. **3**C is a cross-sectional view of the coupling nut of the F connector of FIG. **1** through cut-line **3**—**3**;

FIG. **4** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3**—**3**, and cross-sectional view of the prepared coaxial cable fully inserted into the back end thereof, prior to axial compression of the F connector;

FIG. **4**A is an enlargement of a portion of FIG. **4**;

FIG. **5** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3**—**3**, and a cross-sectional view of the prepared coaxial cable fully inserted into the back end thereof, subsequent to axial compression of the F connector;

FIG. **5**A is an enlargement of a portion of FIG. **5**;

FIG. **6** is a partial cross-sectional view of a first alternate embodiment of an F connector having a first alternate grounding member;

FIG. **6**A is an enlargement of a portion of FIG. **6**;

FIG. **6**B is a slightly enlarged side view of the first alternate grounding member of FIG. **6**;

FIG. **6**C is a slightly enlarged plan view of the first alternate grounding member of FIG. **6**;

FIG. **7** is a partial cross-sectional view of a second alternate embodiment of an F connector having a second alternate grounding member;

FIG. **7**A is an enlargement of a portion of FIG. **7**;

FIG. **7**B is a slightly enlarged side view of the second alternate grounding member of FIG. **7**;

FIG. **7**C is a slightly enlarged plan view of the second alternate grounding member of FIG. **7**;

FIG. **8** is a partial cross-sectional view of a third alternate embodiment of an F connector having a third alternate grounding member;

FIG. **8**A is a slightly enlarged side view of the third alternate grounding member of FIG. **8**;

FIGS. **8**B–**8**E are slightly enlarged plan views of four styles of the third alternate grounding member of FIG. **8**;

FIG. **9** is a partial cross-sectional view of a fourth alternate embodiment of an F connector having one of a fourth alternate grounding member and a fifth alternate grounding member;

FIG. **9**A is a slightly enlarged side view of the fourth alternate grounding member of FIG. **9**;

FIG. **9**B is a slightly enlarged plan view of the fourth alternate grounding member of FIG. **9**;

FIG. **9**C is a slightly enlarged side view of the fifth alternate grounding member of FIG. **9**;

FIG. **9**D is a slightly enlarged plan view of the fifth alternate grounding member of FIG. **9**;

FIG. **10** is a partial cross-sectional view of a fifth alternate embodiment of an F connector having conductive grease that acts as a grounding member;

FIG. **11** is a partial cross-sectional view of a front end of a sixth alternate embodiment of an F connector having a sixth alternate grounding member;

FIG. **11**A is an enlargement of a portion of FIG. **11**;

FIG. **11**B is a side view of the sixth alternate grounding member of FIG. **11**;

FIG. **11**C is a plan view of the sixth alternate grounding member of FIG. **11**; and

FIG. **11**D is a perspective view of the sixth alternate grounding member of FIG. **11**.

For simplicity and clarity of illustration, the drawing figures illustrate the general manner of construction, and descriptions and details of well-known features and techniques are omitted to avoid unnecessarily obscuring the invention. Furthermore, elements in the drawing figures are not necessarily drawn to scale.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** is a perspective view of an F connector **100** in accordance with the preferred embodiment of the invention. The F connector **100** (hereinafter, "connector") has a longitudinal axis **101**. The connector has a front end **102** and a back end **103**.

FIG. **2** is an exploded view of the connector **100**. The connector **100** includes tubular post **104**, a coupling nut **105** rotatably secured over an end **106** of the tubular post for securing the connector to an appliance (not shown), and a body **108** secured to the tubular post. A shell **107** and a label **109** are secured to the body **108**. Preferably, the body **108** is made entirely of acetal plastic. Alternatively, the body **108** is made of brass, plated with nickel. The shell **107** adds strength to the plastic body **108** and protects the plastic body from ultraviolet light. The tubular post **104** is preferably metallic, and more preferably, made of brass, with a tin plating; as tin is more conductive than nickel. The coupling nut **105** is preferably metallic, and more preferably, formed from brass, plated with nickel or with another non-corrosive material.

In the embodiment shown in the drawings, the coupling nut **105** is rotatably secured over an end **106** of the tubular post **104** via a neck **111** of the body **108**. Advantageously, an electrical grounding path is constantly maintained between the coupling nut **105** and the tubular post **104**, including, in particular, when the coupling nut **105** of the connector **100** is not tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member **110** disposed between the tubular post **104** and the coupling nut **105**.

FIG. **2**A is an enlarged plan view of the preferred embodiment of the grounding member **110**. In the preferred embodiment of the present invention, the electrically-conductive grounding member **110** is disposed between the tubular post **104** and the coupling nut **105**. The grounding member **110** contacts both the tubular post **104** and the coupling nut **105** for providing an electrically-conductive path therebetween, but without restricting rotation of the coupling nut relative to the tubular post. A preferred embodiment of the grounding member **110** shown in FIG. **2**A is a spring member, or circlip, disposed between the coupling nut **105** and the tubular post **104**, which establishes a stable ground path between the coupling nut and the post, and which is preferably constructed of a wire-type material. The grounding member **110** is retained in the coupling nut **105** by an annular recess **343** (see FIG. **3**C) in the coupling nut. The spring action of the grounding member **110** serves to form a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut **105** to rotate. The grounding member **110** is resilient and is generally arcuately shaped. The grounding member **110** extends around the tubular post **104** over an arc of at least 225°, and may extend for a full 360°. The arcuately shaped grounding member **110** may be in the form of a generally circular broken ring, or C-shaped member, as by bending a strip of metal wire into an arc. Preferably, the grounding member **110** is a C-shaped metal clip that has an arcuate curvature that is non-circular. The grounding member **110** has a minimum diameter **201** and a maximum diameter **203**. Preferably, the grounding member **110** is made of stainless steel wire that has a wire diameter of between 0.010-inch and 0.020-inch; in a preferred embodiment, the wire diameter is about 0.016-inch. Stainless steel is a preferred metal for the grounding member **110** because it need not be plated for corrosion resistance.

FIG. **3** is a cross-sectional view of the connector **100** through cut-line **3**—**3** of FIG. **1**, and a side view of a prepared coaxial cable **301** ready to be inserted into a back end **103** of the connector. The center conductor **302** of the coaxial cable **301** is surrounded by a dielectric material **303**, and the dielectric material is surrounded by an outer conductor **304** that may be in the form of a conductive foil and/or braided sheath. The outer conductor **304** is usually surrounded by a plastic cable jacket **305** that electrically insulates, and mechanically protects, the outer conductor.

FIG. **3**A is a cross-sectional view of the body **108** of FIG. **1** through cut-line **3**—**3**. FIG. **3**B is a cross-sectional view of the tubular post **104** of FIG. **1** through cut-line **3**—**3**. FIG. **3**C is a cross-sectional view of the coupling nut **105** of FIG. **1** through cut-line **3**—**3**. Referring now to FIGS. **3**, **3**A, **3**B and **3**C, the body **108** has a lip **310** at a front end of the body. The lip **310** has an outer diameter **311** and an inner diameter **312**. The coupling nut **105** is rotatably secured about a head **330** at the front end of the tubular post **104**. The head **330** of the tubular post **104** usually includes an enlarged shoulder **332**. The coupling nut **105** typically includes an inwardly-directed flange **340** that extends over and around the shoulder **332** of the tubular post **104**. In order to retain the grounding member **110** inside the coupling nut **105**, the inner, or central, bore **342** of the coupling nut **105** may include an annular recess **343** that is proximate to the end of the coupling nut that encircles the tubular post **104**. At least portions of the grounding member **110** are engaged with the annular recess **343** to prevent the grounding member from being axially displaced within the coupling nut **105**. The tubular post **104** may include an enlarged shoulder **332** at the

head **330** thereof. The shoulder **332** has a first radial face **333** that faces the back end of the tubular post **104**. In one preferred embodiment of the present invention, the grounding member **110** surrounds the enlarged shoulder **332** of the tubular post **104**, at least when the connector **100** is assembled onto the prepared end of a coaxial cable **301**. At least portions of the grounding member **110** contact the outer surface **334** of such enlarged shoulder **332**.

The coupling nut **105** has an inwardly-directed flange near the back end of the coupling nut. The coupling nut **105** has an inner diameter **341** at a back end of the coupling nut. In order to retain the back end of the coupling nut **105** on the front end of the body **108**, the inner diameter **341** of the coupling nut has a dimension less than the outer diameter of the lip **310** of the body **108**. In order not to interfere with free rotation of the coupling nut **105**, the outer diameter **336** of the shoulder **332** (at the head **330** of the tubular post **104**) is of smaller dimension than the inner diameter **344** of the central bore of the coupling nut **105**. Likewise, the inner diameter **341** of the inwardly-directed flange **340** of the coupling nut **105** is of larger dimension than the outer diameter **337** of the non-shoulder portion **338** of the tubular post **104**, again to avoid interference with rotation of the coupling nut **105** relative to the tubular post.

FIG. **4** is a cross-sectional view of the connector **100** through cut-line **3**—**3**, and cross-sectional view of the prepared coaxial cable **301** fully inserted into the back end **103** thereof, prior to axial compression of the connector. FIG. **4**A is an enlargement of a portion of FIG. **4**. Referring now to FIGS. **4** and **4**A, the resilient, electrically-conductive grounding member **110** is shown disposed between the tubular post **104** and the coupling nut **105**. The grounding member **110** is disposed in the annular recess **343** that encircles the tubular post **104**.

FIG. **5** is a cross-sectional view of the connector **100** through cut-line **3**—**3**, and a cross-sectional view of the prepared coaxial cable **301** fully inserted into the back end **103** thereof, subsequent to axial compression of the connector. FIG. **5**A is an enlargement of a portion of FIG. **5**. Referring now to FIGS. **5** and **5**A, as a result of axial compression by a standard compression tool (not shown), the tubular post **104** slides (to the right in the drawings) relative to the other components of the connector **100** and relative to the cable **301**, such that the shoulder **332** of the tubular post is radially inward of the grounding member **110**. At least a portion of the grounding member **110** engages the coupling nut **105** at the annular recess **343** of the coupling nut, and at least another portion of the grounding member engages tubular post **104** at the shoulder **332** of the tubular post. The tubular post **104** is in electrical contact with the outer conductor **304** of the cable **301** along the back portion of the tubular post, and the coupling nut **105** may engage the outer conductor of an appliance port (not shown). Therefore, when the connector **100** is fastened to an appliance port, there is maintained an electrical grounding path between the outer conductor **304** of the cable **301** and the outer conductor of the appliance port, whether or not the coupling nut **105** of the connector is tightly fastened to the appliance port.

FIG. **6** is a partial cross-sectional view of a first alternate embodiment of a connector **600** having a first alternate grounding member **601** (see FIGS. **6**A—**6**C), shown subsequent to axial compression. FIG. **6**A is an enlargement of a portion of the first alternate embodiment of the connector **600** showing a portion of the first alternate grounding member **601**. FIG. **6**B is a slightly enlarged side view of the first alternate grounding member **601**. FIG. **6**C is a slightly enlarged plan view of the first alternate grounding member **601**. Referring now to FIGS. **6**, **6**A, **6**B and **6**C, the first alternate grounding member **601** is a spring finger grounding member retained between the coupling nut **105** and the tubular post **104**. The first alternate grounding member **601** is constructed of a thin cross section of material such beryllium copper. The first alternate grounding member **601** comprises a ring portion **602** and a plurality of fingers **603** that project at approximately a 30° angle from the plane of the ring. The spring action of the fingers **603** extend to, and make contact with, a radial surface **604** near the back end of the coupling nut **105** that faces the front end of the coupling nut, which serve to connect a ground path from the coupling nut to the tubular post while allowing the coupling nut to rotate. The first alternate grounding member **601** has optional internal lugs **605** that contact the outer diameter **337** of the non-shoulder portion of the tubular post.

FIG. **7** is a partial cross-sectional view of a second alternate embodiment of a connector **700** having a second alternate grounding member **701** (see FIGS. **7**A—**7**C). FIG. **7**A is an enlargement of a portion of the second alternate embodiment of the connector **700**, showing a portion of the second alternate grounding member **701**. FIG. **7**B is a slightly enlarged side view of the second alternate grounding member **701**. FIG. **7**C is a slightly enlarged plan view of the second alternate grounding member **701**. Referring now to FIGS. **7**, **7**A, **7**B and **7**C, the second alternate grounding member **701** is a radial grounding member retained between the coupling nut **105** and the tubular post **104**. The second alternate grounding member **701** is constructed of a thin cross section of metallic material such as beryllium copper. The second alternate grounding member **701** comprises a ring portion **702** and a plurality of fingers **703** extending radially from the ring portion at about a 45° angle from the plane of the ring portion. The spring action of the fingers **703** extend to inner-diameter surfaces **705** of the coupling nut **105** and serve to connect a ground path from the coupling nut to the tubular post **104** while allowing the coupling nut to rotate.

FIG. **8** is a partial cross-sectional view of a third alternate embodiment of a connector **800** having a third alternate grounding member **801** (see FIGS. **8**A—**8**E). FIG. **8**A is a slightly enlarged side view of the third alternate grounding member **801**. FIGS. **8**B—**8**E are slightly enlarged plan views of four styles of the third alternate grounding member **801**. Referring now to FIG. **8** and FIGS. **8**A—**8**E, the third alternate grounding member **801** is a conductive member retained between the coupling nut **105** and the tubular post **104**. The third alternate grounding member **801** is constructed of a thin cross section of metallic material such as brass or beryllium copper. The third alternate grounding member **801** comprises a ring **802** with multiple points of contact, or internal lugs, **803** around the inner perimeter of the ring and with multiple external lugs **804** around the outer perimeter of the ring. The lugs **803** and **804** serve to connect a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate. FIGS. **8**B—**8**E show four styles with regard to the shape of the lugs **803** and **804** and the position of the lugs on the ring **802**. FIG. **8** also exhibits an alternate embodiment comprising a sealing ring **805** for forming a moisture seal between the coupling nut **105** and the body **108** of the connector **801**. The sealing ring **805** is disposed between the back end of the coupling nut **105** and the body **108** for forming a seal therebetween. Preferably, the sealing ring **805** is made from ethylene propylene. Use of the sealing ring **805** is not limited to use in connectors having the third alternate grounding member

801. The third alternate grounding member 801 may also be used in connectors without the sealing ring 805.

FIG. 9 is a partial cross-sectional view of a fourth alternate embodiment of a connector 900 having one of a fourth alternate grounding member 901 and a fifth alternate grounding member 911 (see FIGS. 9A 9D). FIG. 9A is a slightly enlarged side view of the fourth alternate grounding member 901. FIG. 9B is a slightly enlarged plan view of the fourth alternate grounding member 901. FIG. 9C is a slightly enlarged side view of the fifth alternate grounding member 902. FIG. 9D is a slightly enlarged plan view of the fifth alternate grounding member 911. The fourth and fifth alternate embodiments of the grounding member 901 and 911, respectively, comprise a C-shaped ring between the coupling nut 105 and the tubular post 104. The C-shaped ring is constructed of a thin cross section of metallic material such as beryllium copper or stainless steel. It is retained by a groove in the coupling nut. The spring action of the C-shaped ring serves to connect a ground path from the coupling nut 105 to the tubular post 104 while allowing the coupling nut to rotate. The fourth alternate grounding member 901 includes a circumferential metallic band 902, which has a general circular shape and approximates a section of a hollow cylinder, that extends between first 903 and second 904 opposing ends. The band 902 has first 906 and second 907 opposing side edges extending along its length. The fourth alternate grounding member 901 includes a first generally radial wall 908 extending from the first side edge 906 of the band in a first radial direction, and a second generally radial wall 909 extending from the second side edge 907 of the band generally in said first radial direction. The band 902 contacts a first one of the group of members that includes the coupling nut 105 and the tubular post 104. The first 908 and second 909 radial walls contact the second of the group of members that includes the coupling nut 105 and the tubular post 104. The fifth alternate grounding member 911 includes a metallic band 912 extending along its length between first 913 and second 914 opposing ends, and extending along its width between first 916 and second 917 side edges. The band 912 is formed along its length into a generally circular shape. The band 912 is formed along its width into a generally concave shape with the side edges 916 and 917 projecting generally in a first radial direction. The fifth alternate grounding member 911 includes a plurality of projections 918 extending from the band 912 in a second radial direction opposite to the first radial direction. The first 916 and second 917 side edges of the band 912 contact a first one of the group of members that includes the coupling nut and the tubular post. The plurality of projections 918 contact the second of the group of members that includes the coupling nut 105 and the tubular post 104.

FIG. 10 is a partial cross-sectional view of a fifth alternate embodiment of a connector 1000 having conductive grease (not shown) that acts as a grounding member. The ground path is established by means of a close fit between the coupling nut 105 and the tubular post 104. The conductive grease is disposed at a grease annular ring 1001 where mating portions of the tubular post 104 and coupling nut 105 have closely matching dimensions. Preferably, the conductive grease is a silver-loaded silicon lubricating material. The conductive grease serves to connect a ground path from the coupling nut 105 to the tubular post 104 while allowing the coupling nut to rotate.

FIG. 11 is a partial cross-sectional view of a front end of a sixth alternate embodiment of an F connector 1100 that includes a body 1108, and which has a sixth alternate grounding member 1101. FIG. 11A is an enlargement of a portion of FIG. 11. FIG. 11B is a side view of the sixth alternate grounding member 1101. FIG. 11C is a plan view of the sixth alternate grounding member 1101. FIG. 11D is a perspective view of the sixth alternate grounding member 1101. Referring now to FIG. 11 and FIGS. 11A 11D, the sixth alternate grounding member 1101 includes a circumferential metallic band 1112 extending between first 1113 and second 1114 opposing ends. The band 1112 has a generally circular shape that approximates a section of a hollow cylinder. The first 1113 and second 1114 ends of the band 1112 are disposed generally proximate to each other and are directed generally toward one another. The band 1112 has first and second opposing side edges 1115 and 1116, respectively, extending along its length. The band generally defines a section of a cylindrical surface. The sixth alternate grounding member 1101 includes a plurality of projections 1101 extending from at least one of the first and second side edges 1115 and 1116 of the band 1112. The plurality of projections 1117 extend away from the cylindrical surface defined by the band 1112. The band 1112 contacts a first one of the group of members that includes the coupling nut 1105 and the tubular post 1104. The plurality of projections 1117 contact the second of the group of members that includes the coupling nut 1105 and the tubular post 1104.

In preferred embodiments, the present invention provides a coaxial cable connector that ensures a reliable grounding path without creating undue interference with free rotation of the coupler relative to the remaining components of the connector; however, the present invention can also provide a reliable grounding path between a post and a coupler that does not rotate. Advantageously, a connector in accordance with the invention works with standard installation tools and with standard compression tools. The present invention can be used with both axially-compressible connectors as well as with older-style crimp-ring connectors. In some embodiments, the present invention is compatible with the use of a sealing ring for forming a moisture seal between the coupler and the outer body of the connector.

While the present invention has been described with respect to preferred embodiments thereof, such description is for illustrative purposes only, and is not to be construed as limiting the scope of the invention. Various modifications and changes may be made to the described embodiments by those skilled in the art without departing from the true spirit and scope of the invention as defined by the appended claims. For example, the grounding member can have a shape other than generally circular, such as square, hexagonal, octagonal, oval, etc.

We claim:

1. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving

the outer conductor of the coaxial cable, wherein the body member contacts the coupler; and

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween.

2. The coaxial cable connector recited by claim **1** wherein said grounding member is arcuately shaped to extend around the tubular post over at least 225 degrees.

3. The coaxial cable connector recited by claim **2** wherein said grounding member is configured to form a broken ring.

4. The coaxial cable connector recited by claim **2** wherein said grounding member is formed from metal wire.

5. The coaxial cable connector recited by claim **2** wherein the central bore of the coupler includes an annular recess proximate to the first end of the coupler, and wherein at least portions of said grounding member are disposed within the annular recess.

6. The coaxial cable connector recited by claim **5** wherein the tubular post includes an enlarged shoulder at the second end thereof extending inside the coupler, and wherein the annular recess and said grounding member surround the enlarged shoulder of the tubular post when the coaxial cable connector is assembled onto the prepared end of the coaxial cable.

7. The coaxial cable connector recited by claim **1** wherein said grounding member is generally circular.

8. The coaxial cable connector recited by claim **7** wherein said grounding member has a plurality of projections extending radially outwardly therefrom for engaging the coupler.

9. The coaxial cable connector recited by claim **7** wherein said grounding member has a plurality of projections extending radially inwardly therefrom for engaging the tubular post.

10. The coaxial cable connector recited by claim **1** wherein the tubular post includes an enlarged shoulder at the second end thereof extending inside the coupler, the enlarged shoulder including a first radial face that faces the first end of the tubular post, the coupler including a radially inwardly directed flange proximate the first end thereof directed inwardly toward the tubular post, the inwardly directed flange including a second radial face that faces the second end of the coupler, said grounding member being disposed between the first radial face and the second radial face for electrically coupling the tubular post to the coupler.

11. The coaxial cable connector recited by claim **10** wherein the grounding member includes a central, generally circular body member disposed generally within a plane, the grounding member including a plurality of resilient spring fingers extending out of said plane and being compressed between the first radial face of the tubular post and the second radial face of the coupler.

12. The coaxial cable connector recited by claim **11** wherein said plurality of spring fingers includes at least a first spring finger and a second spring finger, and wherein said first and second spring fingers extend out of said plane in opposing directions.

13. The coaxial cable connector recited by claim **1** wherein the grounding member includes:

a. a circumferential metallic band extending between first and second opposing ends, the band having a generally circular shape, and approximating a section of a hollow cylinder, the first and second ends of the band being disposed generally proximate to each other and being directed generally toward one another, the band having first and second opposing side edges extending along its length;

b. a first generally radial wall extending from the first side edge of the band in a first radial direction; and

c. a second generally radial wall extending from the second side edge of the band generally in said first radial direction;

wherein the band contacts a first one of the group of members that consists of the coupler and the tubular post, and wherein the first and second radial walls contact the second of the group of members that consists of the coupler and the tubular post.

14. The coaxial cable connector recited by claim **13** wherein the band has a plurality of apertures formed therein.

15. The coaxial cable connector recited by claim **13** wherein the band has dimples formed therein, the dimples extending away from the band in a second radial direction opposite to said first radial direction.

16. The coaxial cable connector recited by claim **1** wherein the grounding member includes:

a. a metallic band extending along its length between first and second opposing ends, and extending along its width between first and second side edges, the band being formed along its length into a generally circular shape, the band being formed along its width into a generally concave shape with the side edges projecting generally in a first radial direction, the first and second ends of the band being disposed generally proximate to each other and being directed generally toward one another; and

b. a plurality of projections extending from the band in a second radial direction opposite to the first radial direction;

wherein the first and second side edges of the band contact a first one of the group of members that includes the coupler and the tubular post, and wherein the plurality of projections contact the second of the group of members that includes the coupler and the tubular post.

17. The coaxial cable connector recited by claim **16** wherein the band has a plurality of apertures formed therein to create the plurality of projections.

18. The coaxial cable connector recited by claim **16** wherein the plurality of projections is dimples.

19. The coaxial cable connector recited by claim **1** wherein the grounding member includes:

a. a circumferential metallic band extending between first and second opposing ends, the band having a generally circular shape, and approximating a section of a hollow cylinder, the first and second ends of the band being disposed generally proximate to each other and being directed generally toward one another, the band having first and second opposing side edges extending along its length, the band generally defining a section of a cylindrical surface; and

b. a plurality of projections extending from at least one of the first and second side edges of the band, the plurality of projections extending away from the cylindrical surface defined by the band;

wherein the band contacts a first one of the group of members that includes the coupler and the tubular post, and wherein the plurality of projections contact the second of the group of members that includes the coupler and the tubular post.

20. The coaxial cable connector recited by claim **19** wherein the plurality of projections are formed by cutting

slots into the band from one of the first and second side edges of the band, and by displacing portions of the band lying between adjacent slots.

21. The coaxial cable connector recited by claim **2** further including a sealing ring disposed between the first end of the coupler and the body member for forming a seal therebetween.

22. The coaxial cable connector recited by claim **2** wherein said grounding member is a C-shaped metal clip.

23. The coaxial cable connector recited by claim **22** wherein said C-shaped metal clip has an arcuate curvature that is non-circular to maximize contact with both the coupler and the tubular post.

24. The coaxial cable connector recited by claim **22** wherein said C-shaped metal clip is made of wire.

25. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof, the tubular post including a grounding path portion having an outer surface of a predetermined outer diameter;

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port, the coupler including a grounding path portion having an inner surface of a predetermined inner diameter, the grounding path portion of the coupler being disposed adjacent to the grounding path portion of the tubular post when the coaxial cable connector is installed onto the coaxial cable, and wherein the predetermined inner diameter closely approximates the predetermined outer diameter while permitting rotation of the coupler relative to the tubular post;

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable; and

d. conductive grease disposed proximate to the respective grounding path portions of the tubular post and coupler for electrically coupling such grounding path portions.

26. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member contacts the coupler; and

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween;

wherein the tubular post, the body member, the grounding member, and the coupler are disposed about a common longitudinal axis;

wherein the grounding member comprises a ring portion and a plurality of fingers extending from the ring portion.

27. The coaxial cable connector of claim **26** wherein the plurality of fingers extend radially from the ring portion.

28. The coaxial cable connector of claim **26** wherein the plurality of fingers contacts the coupler.

29. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member contacts the coupler; and

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween;

wherein the tubular post, the body member, the grounding member, and the coupler are disposed about a common longitudinal axis;

wherein the grounding member comprises a spring projecting portion that extends away from a plane perpendicular to the longitudinal axis.

30. The coaxial cable connector of claim **29** wherein the spring projecting portion contacts the coupler.

31. The coaxial cable connector of claim **29** wherein the grounding member comprises first and second spring projecting portions that project from said plane in opposing longitudinal directions.

32. The coaxial cable connector of claim **29** wherein a substantial portion of the grounding member lies in the perpendicular plane.

33. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore

proximate the second end of the coupler being adapted for engaging the equipment port;

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable; and

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween;

wherein the tubular post, the body member, the grounding member, and the coupler are disposed about a common longitudinal axis;

wherein the grounding member comprises a central body portion, a first spring finger, and a second spring finger, wherein the central body portion is disposed generally within a plane perpendicular to the longitudinal axis, and wherein the first and second spring fingers extend from the central body portion and project from said plane in opposing directions.

34. The coaxial cable connector of claim **33** wherein a substantial portion of the grounding member lies in the perpendicular plane.

* * * * *

US007114990C1

(12) EX PARTE REEXAMINATION CERTIFICATE (10124th)

United States Patent

Bence et al.

(10) Number: US 7,114,990 C1

(45) Certificate Issued: Apr. 18, 2014

(54) **COAXIAL CABLE CONNECTOR WITH GROUNDING MEMBER**

(75) Inventors: **Bruce D. Bence**, Glendale, AZ (US); **Donald A. Burris**, Peoria, AZ (US); **Brian L. Kisling**, Phoenix, AZ (US); **John A. Kooiman**, Mesa, AZ (US); **William B. Lutz**, Glendale, AZ (US); **William F. McDade**, Glendale, AZ (US); **Thomas D. Miller**, Peoria, AZ (US); **Lee Yung Chuan**, Sanchong (TW)

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Appl. No.:	**11/043,844**
Filed:	**Jan. 25, 2005**

(51) **Int. Cl.**
H01R 9/05 (2006.01)

(52) **U.S. Cl.**
USPC **439/583**; 439/322

(58) **Field of Classification Search**
None
See application file for complete search history.

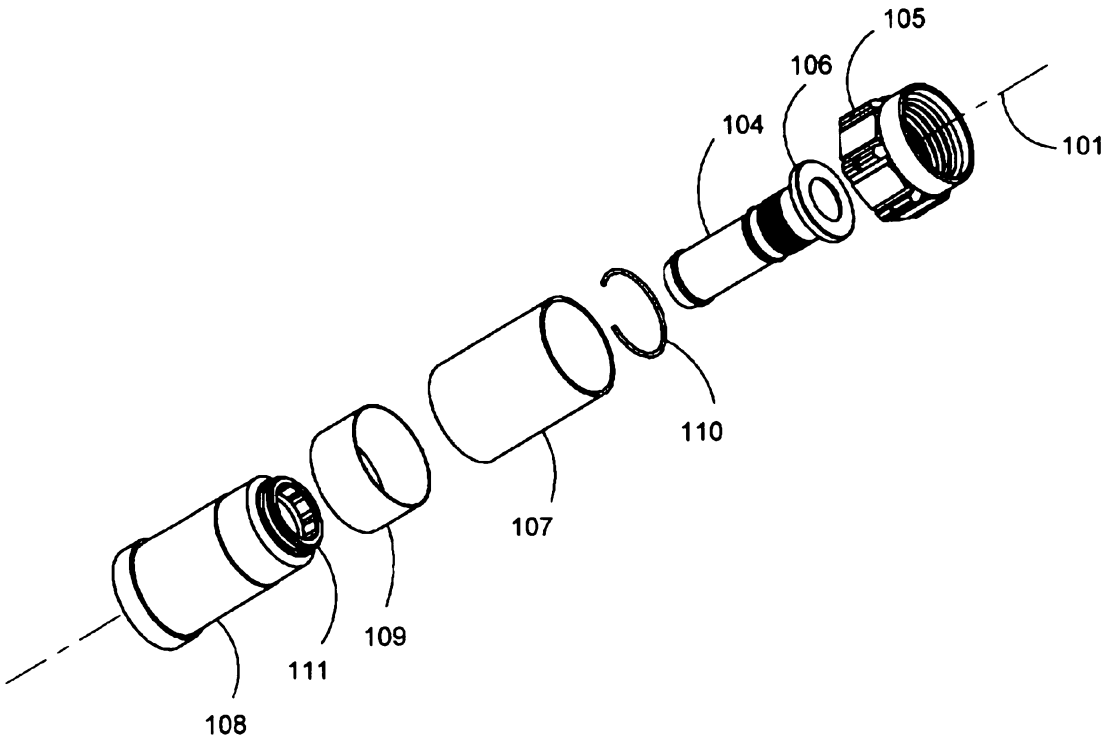
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 90/012,749, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner – Linh M. Nguyen

(57) **ABSTRACT**

A coaxial cable connector includes tubular post, a coupler secured over an end of the tubular post for securing the connector to an appliance, and an outer body secured to the tubular post. An electrical grounding path is maintained between the coupler and the tubular post whether or not the coupler is tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler. Alternatively, the connector includes conductive grease at a point where mating portions of the tubular post and coupler have closely matching dimensions.



EX PARTE REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims **1-5**, **7-12**, **22**, **24** and **26-34** is confirmed.

New claims **35-38** are added and determined to be patentable.

Claims **6**, **13-21**, **23** and **25** were not reexamined.

35. The coaxial cable connector of claim 1 wherein the resilient, electrically conductive grounding member provides the electrically-conductive path between the coupler and the tubular post without restricting rotation of the coupler relative to the tubular post.

36. The coaxial cable connector of claim 26 wherein the resilient, electrically conductive grounding member provides the electrically-conductive path between the coupler and the tubular post without restricting rotation of the coupler relative to the tubular post.

37. The coaxial cable connector of claim 29 wherein the resilient, electrically conductive grounding member provides the electrically-conductive path between the coupler and the tubular post without restricting rotation of the coupler relative to the tubular post.

38. The coaxial cable connector of claim 33 wherein the resilient, electrically conductive grounding member provides the electrically-conductive path between the coupler and the tubular post without restricting rotation of the coupler relative to the tubular post.

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US007114990C2

(12) EX PARTE REEXAMINATION CERTIFICATE (11141st)

United States Patent

Bence et al.

(10) Number: US 7,114,990 C2

(45) Certificate Issued: Jun. 30, 2017

(54) **COAXIAL CABLE CONNECTOR WITH GROUNDING MEMBER**

(75) Inventors: **Bruce D. Bence**, Glendale, AZ (US); **Donald A. Burris**, Peoria, AZ (US); **Brian L. Kisling**, Phoenix, AZ (US); **John A. Kooiman**, Mesa, AZ (US); **William B. Lutz**, Glendale, AZ (US); **William F. McDade**, Glendale, AZ (US); **Thomas D. Miller**, Peoria, AZ (US); **Lee Yung Chuan**, Sanchong (TW)

(73) Assignee: **CORNING INCORPORATED**, Corning, NY (US)

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H01R 43/20	(2006.01)
H01R 103/00	(2006.01)
H01R 13/52	(2006.01)

(52) **U.S. Cl.**
CPC ***H01R 9/05*** (2013.01); ***H01R 24/44*** (2013.01); ***H01R 43/20*** (2013.01); *H01R 13/5202* (2013.01); *H01R 13/5216* (2013.01); *H01R 2103/00* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

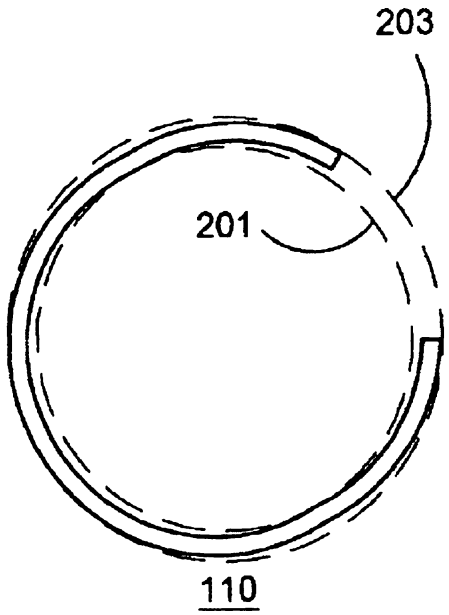
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 90/013,380, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner – Christina Y Leung

(57) **ABSTRACT**

A coaxial cable connector includes tubular post, a coupler secured over an end of the tubular post for securing the connector to an appliance, and an outer body secured to the tubular post. An electrical grounding path is maintained between the coupler and the tubular post whether or not the coupler is tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler. Alternatively, the connector includes conductive grease at a point where mating portions of the tubular post and coupler have closely matching dimensions.



EX PARTE REEXAMINATION CERTIFICATE

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

Claims **1-5**, **7-12**, **22**, **24** and **26-34** are cancelled.

Claims **6**, **13-21**, **23**, **25** and **35-38** were not reexamined.

* * * * *

US007479035B2

(12) **United States Patent**
Bence et al.

(10) **Patent No.: US 7,479,035 B2**
(45) **Date of Patent: Jan. 20, 2009**

(54) **ELECTRICAL CONNECTOR WITH GROUNDING MEMBER**

(75) Inventors: **Bruce D. Bence**, Glendale, AZ (US); **Donald A. Burris**, Peoria, AZ (US); **Brian L. Kisling**, Phoenix, AZ (US); **John A. Kooiman**, Peoria, AZ (US); **William B. Lutz**, Glendale, AZ (US); **William F. McDade**, Glendale, AZ (US); **Thomas D. Miller**, Peoria, AZ (US); **Lee Yung Chuan**, Sanchong (TW)

(73) Assignee: **Corning Gilbert Inc.**, Glendale, AZ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 32 days.

(21) Appl. No.: **11/541,903**

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(Under 37 CFR 1.47)

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Related U.S. Application Data

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(51) **Int. Cl.**
H01R 9/05 (2006.01)

(52) **U.S. Cl.** **439/583**

(58) **Field of Classification Search** 439/578, 439/583, 584, 320, 322, 314
See application file for complete search history.

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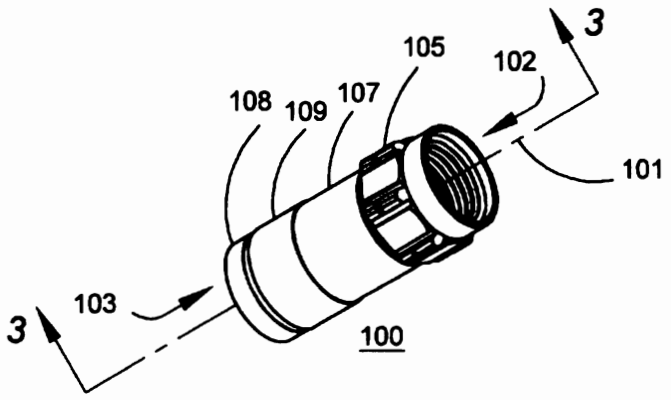
Primary Examiner—T C Patel
Assistant Examiner—Vladimir Imas
(74) *Attorney, Agent, or Firm*—Joseph M. Homa; Matthew J. Mason

(57) **ABSTRACT**

A coaxial cable connector includes tubular post, a coupler secured over an end of the tubular post for securing the connector to an appliance, and an outer body secured to the tubular post. An electrical grounding path is maintained between the coupler and the tubular post whether or not the coupler is tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler. Alternatively, the connector includes conductive grease at a point where mating portions of the tubular post and coupler have closely matching dimensions.

17 Claims, 8 Drawing Sheets



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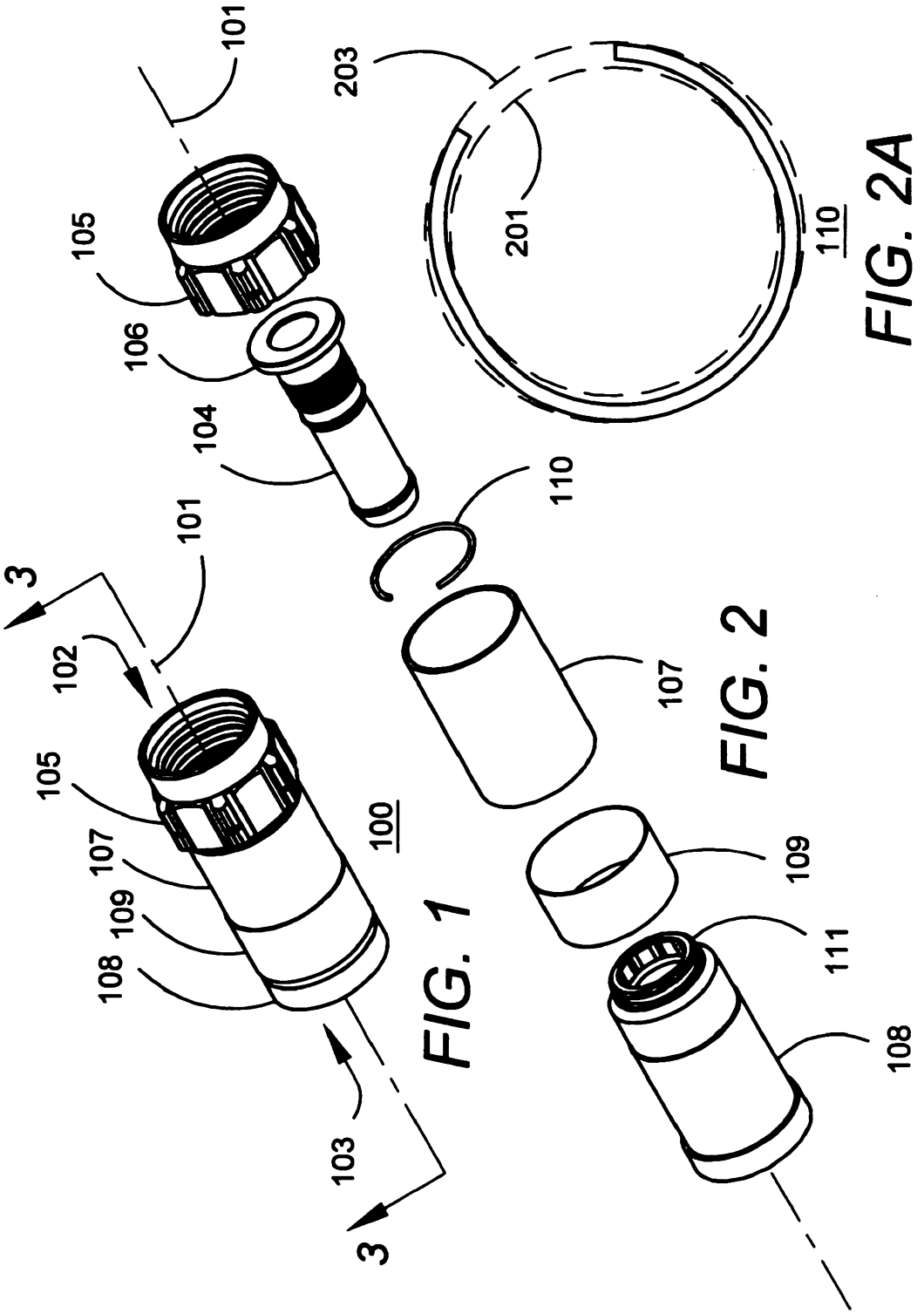

FIG. 1

FIG. 2

FIG. 2A

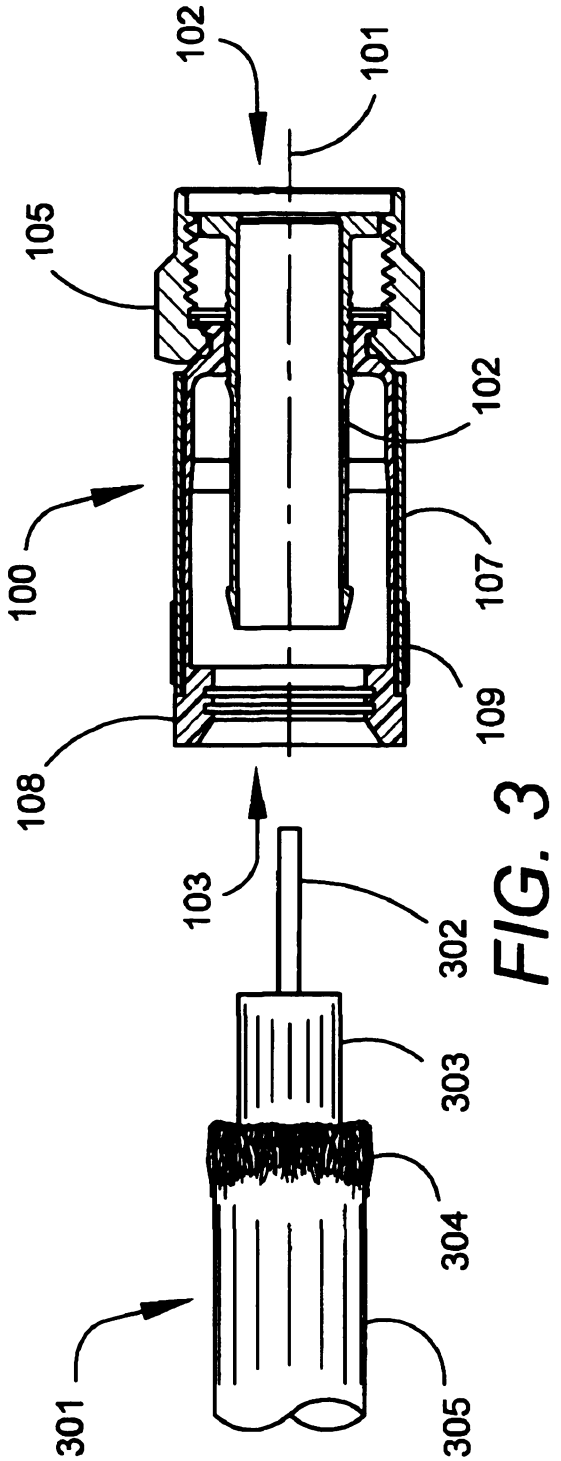

FIG. 3

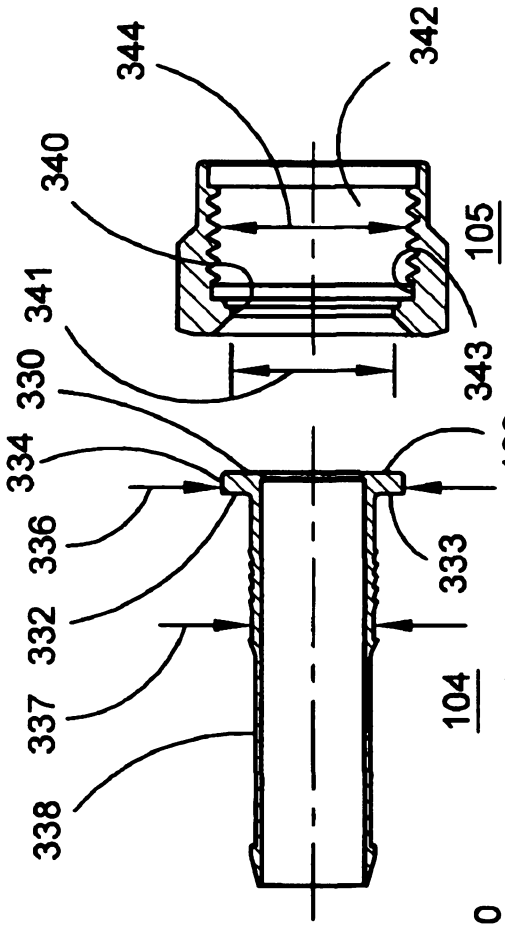

FIG. 3B

FIG. 3C

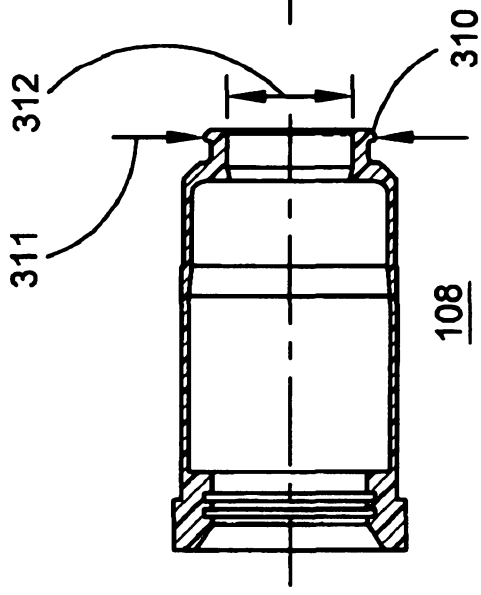

FIG. 3A

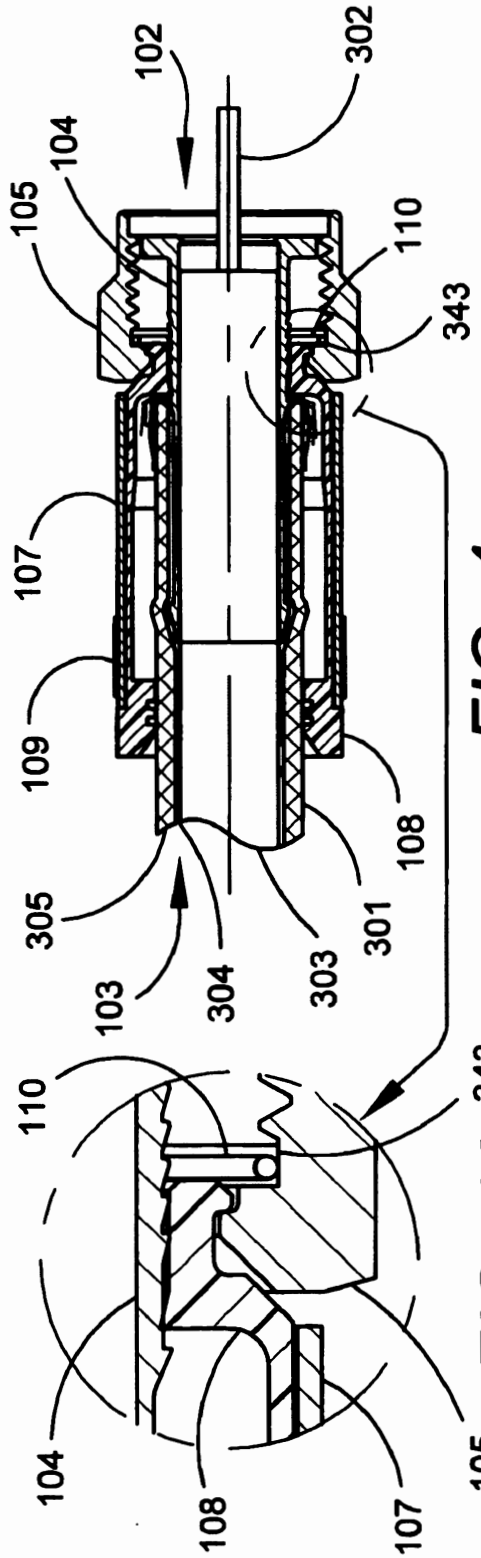

FIG. 4

FIG. 4A

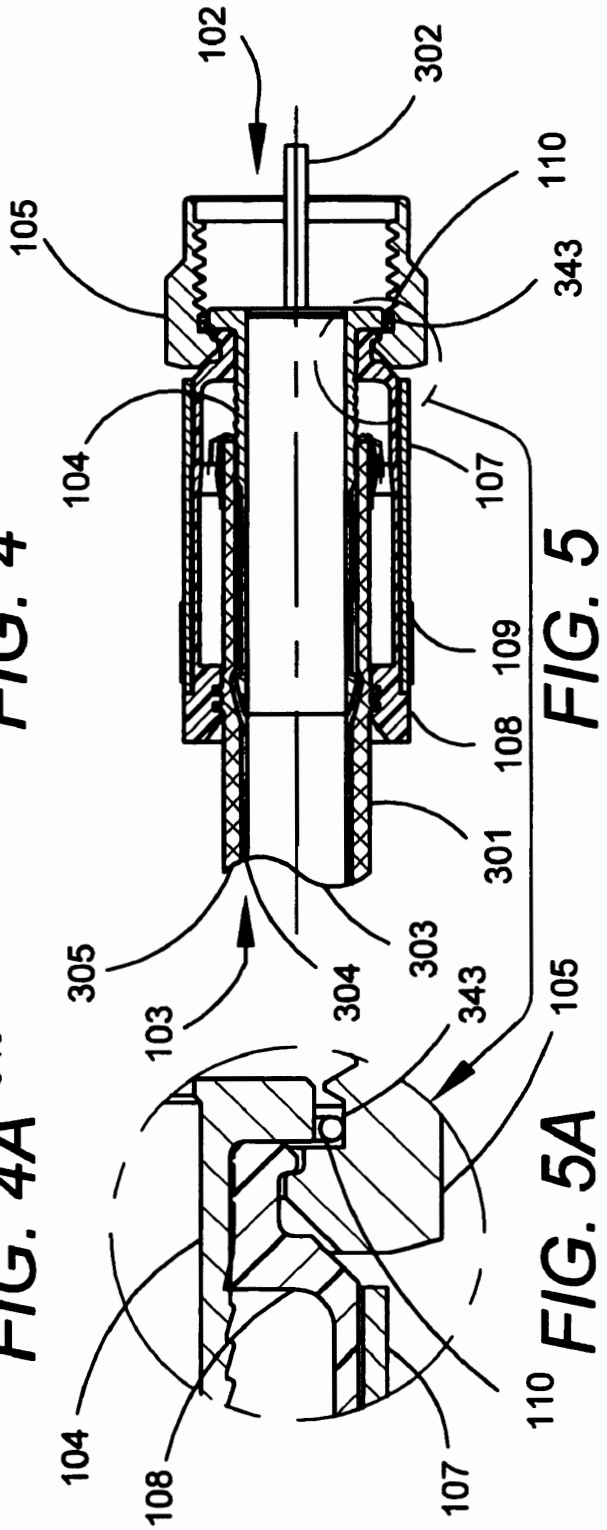

FIG. 5

FIG. 5A

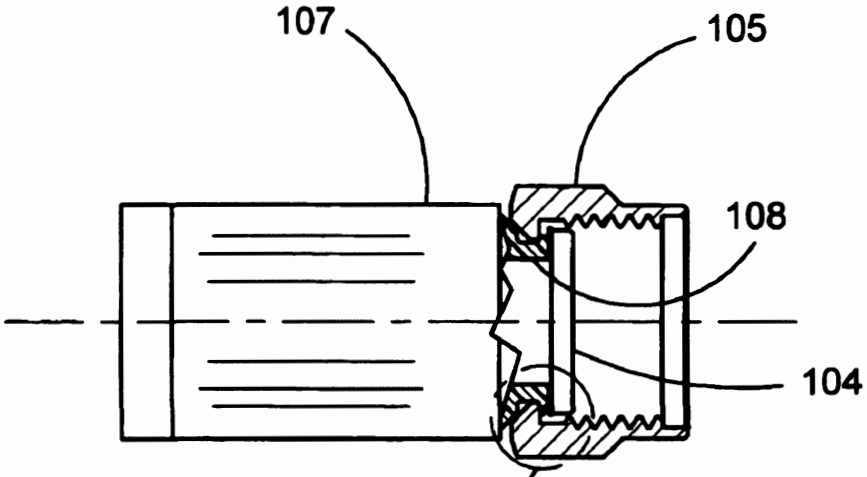

FIG. 6

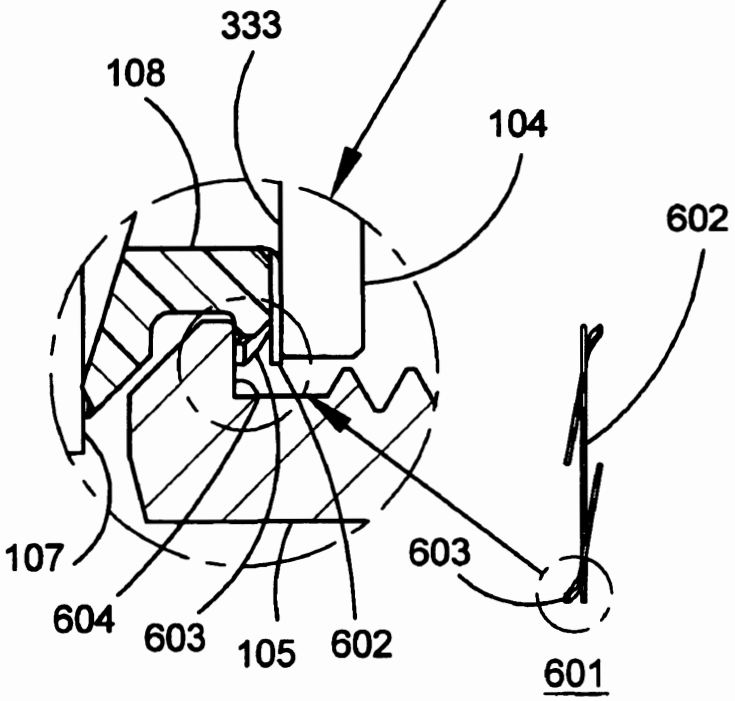

FIG. 6A

FIG. 6B

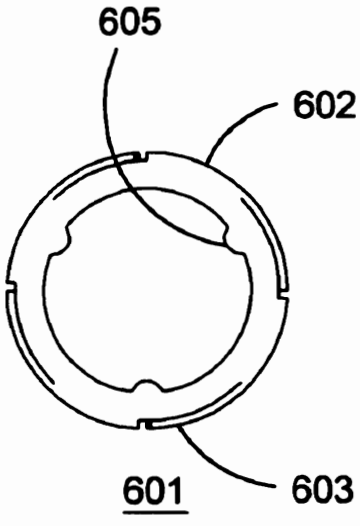

FIG. 6C

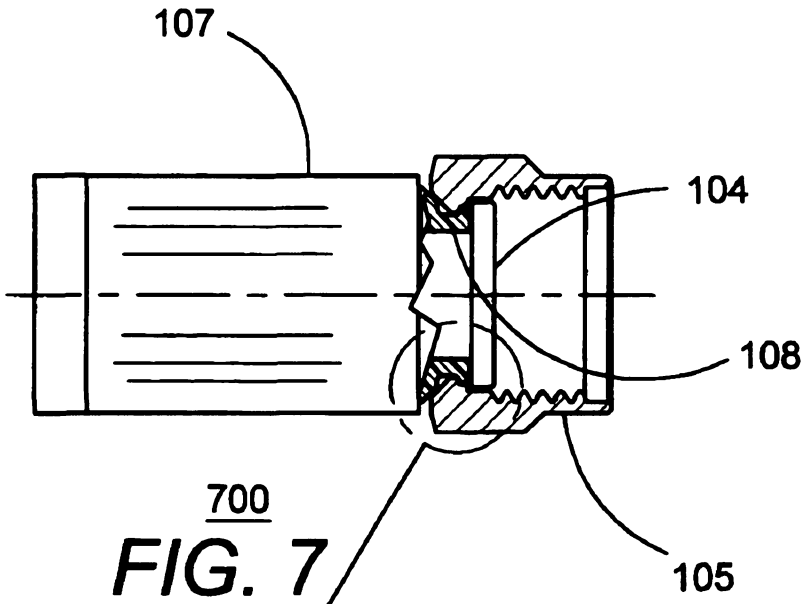

FIG. 7

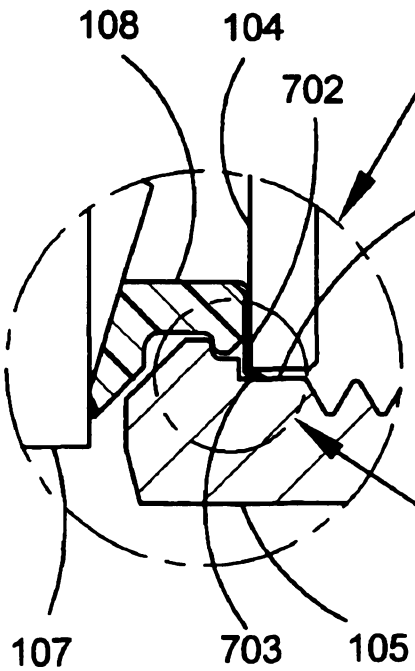

FIG. 7A

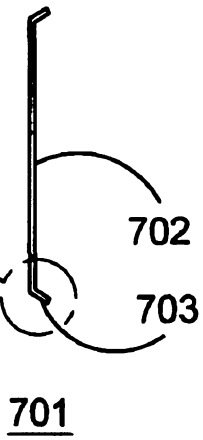

FIG. 7B

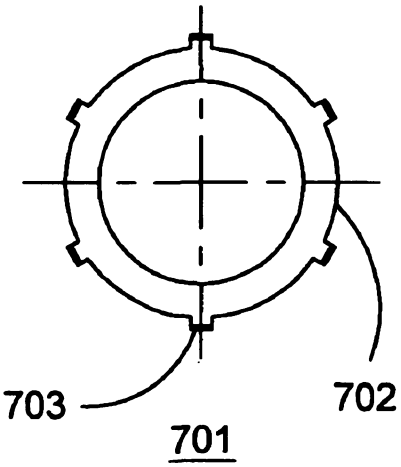

FIG. 7C

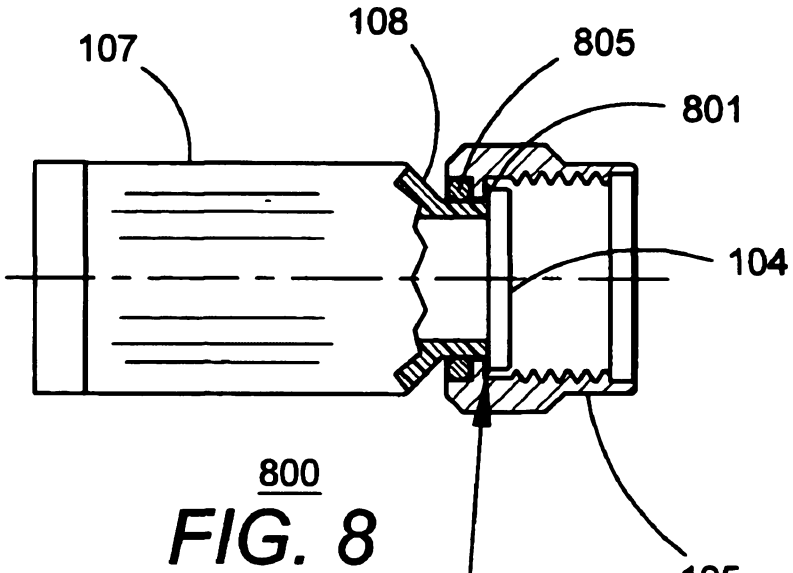

FIG. 8

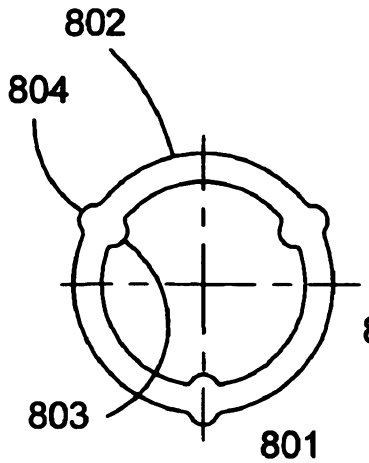

FIG. 8B

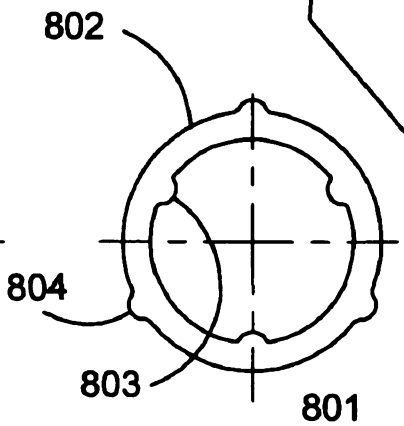

FIG. 8C

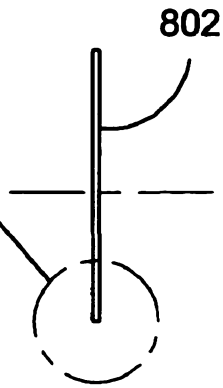

FIG. 8A

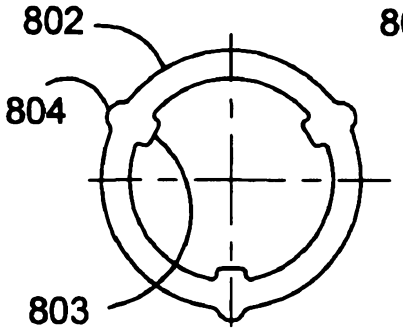

FIG. 8D

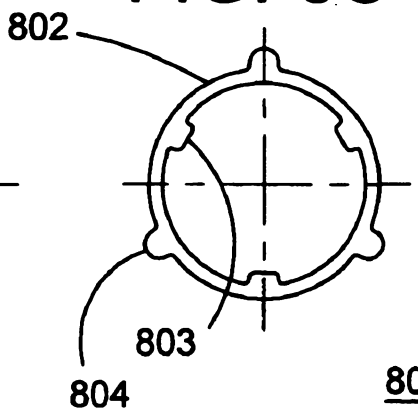

FIG. 8E

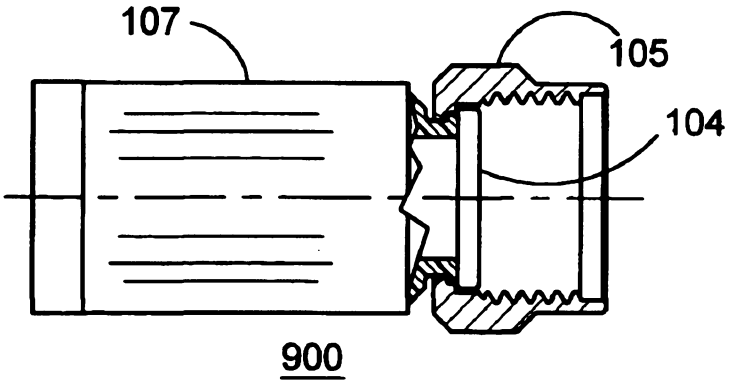

FIG. 9

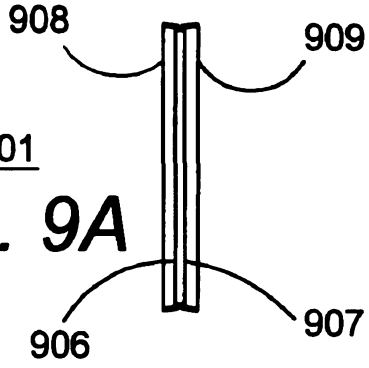

FIG. 9A

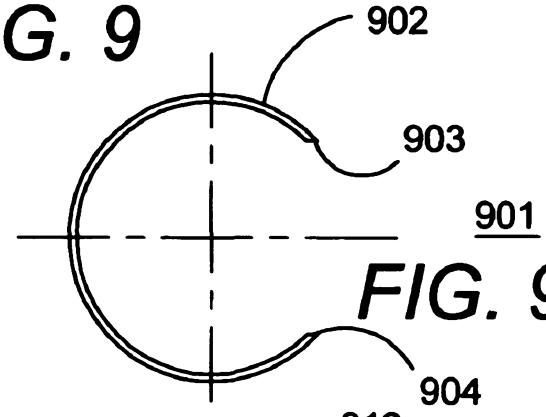

FIG. 9B

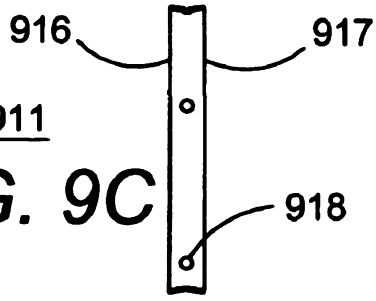

FIG. 9C

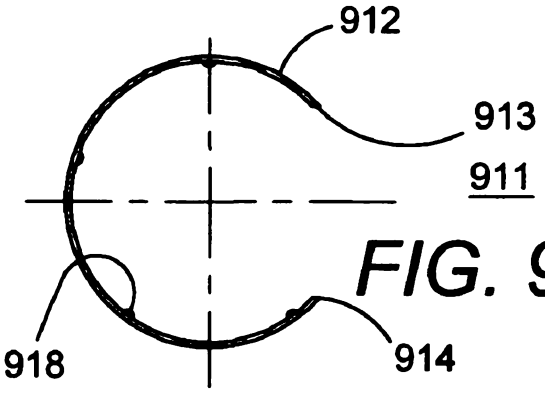

FIG. 9D

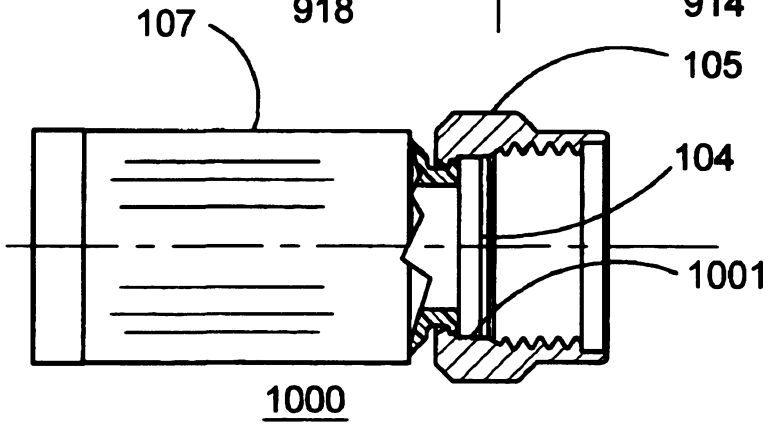

FIG. 10

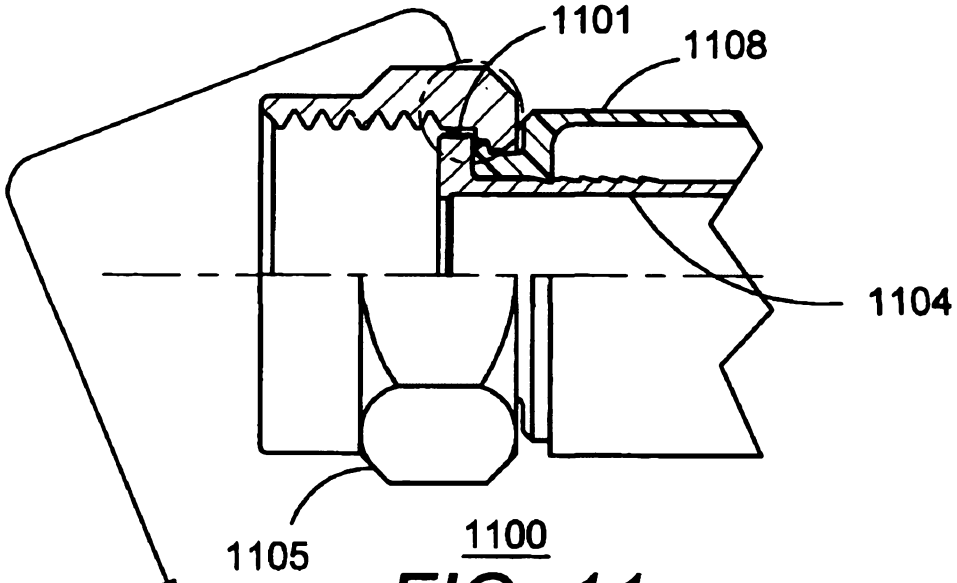

FIG. 11

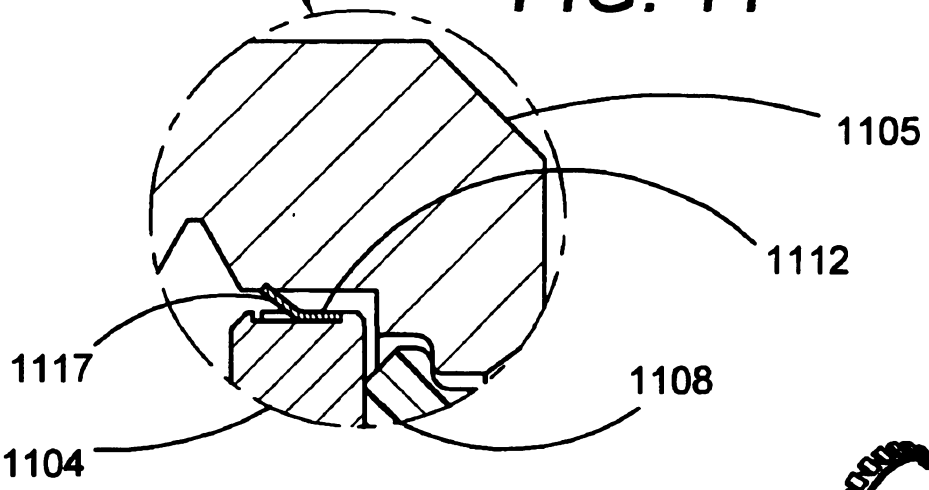

FIG. 11A

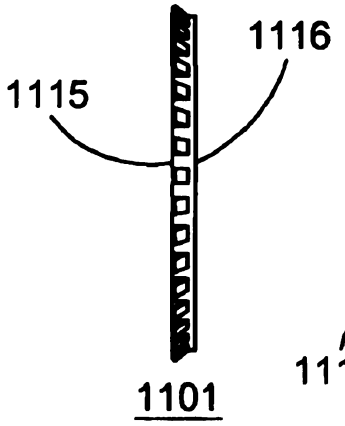

FIG. 11B

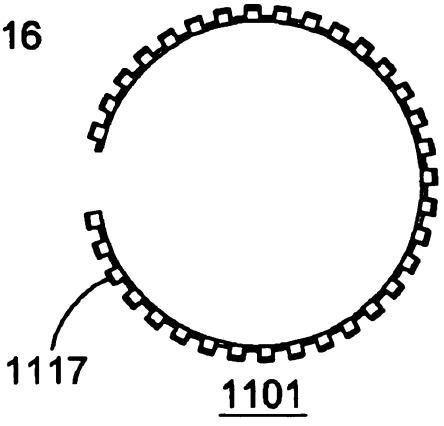

FIG. 11C

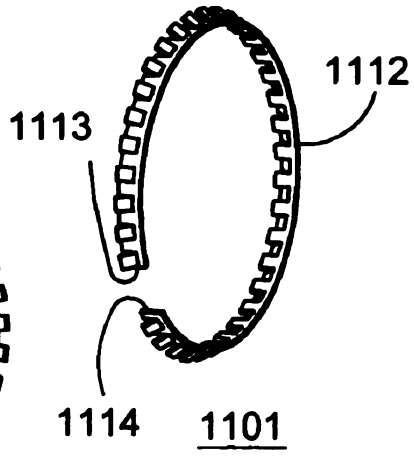

FIG. 11D

ELECTRICAL CONNECTOR WITH GROUNDING MEMBER

This application claims the benefit of U.S. patent application Ser. No. 11/043,844, filed Jan. 25, 2005, now U.S. Pat. No. 7,114,990 the benefit of priority is hereby claimed.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to electrical connectors, and more particularly to coaxial cable connectors capable of being connected to a terminal.

2. Description of the Related Art

Coaxial cable connectors, such as type F connectors, are used to attach coaxial cable to another object or appliance, e.g., a television set or VCR having a terminal adapted to engage the connector. The terminal of the appliance includes an inner conductor and a surrounding outer conductor.

Coaxial cable includes a center conductor for transmitting a signal. The center conductor is surrounded by a dielectric material, and the dielectric material is surrounded by an outer conductor; this outer conductor may be in the form of a conductive foil and/or braided sheath. The outer conductor is typically maintained at ground potential to shield the signal transmitted by the center conductor from stray noise, and to maintain a continuous desired impedance over the signal path. The outer conductor is usually surrounded by a plastic cable jacket that electrically insulates, and mechanically protects, the outer conductor. Prior to installing a coaxial connector onto an end of the coaxial cable, the end of the coaxial cable is typically prepared by stripping off the end portion of the jacket to bare the end portion of the outer conductor. Similarly, it is common to strip off a portion of the dielectric to expose the end portion of the center conductor.

Coaxial cable connectors of the type known in the trade as "F connectors" often include a tubular post designed to slide over the dielectric material, and under the outer conductor of the coaxial cable, at the prepared end of the coaxial cable. If the outer conductor of the cable includes a braided sheath, then the exposed braided sheath is usually folded back over the cable jacket. The cable jacket and folded-back outer conductor extend generally around the outside of the tubular post and are typically received in an outer body of the connector; this outer body of the connector is usually fixedly secured to the tubular post. A coupler is rotatably secured around the tubular post and includes an internally-threaded region for engaging external threads formed on the outer conductor of the appliance terminal.

When connecting the end of a coaxial cable to a terminal of a television set, equipment box, or other appliance, it is important to achieve a reliable electrical connection between the outer conductor of the coaxial cable and the outer conductor of the appliance terminal. This goal is usually achieved by ensuring that the coupler of the connector is fully tightened over the connection port of the appliance. When fully tightened, the head of the tubular post of the connector directly engages the edge of the outer conductor of the appliance port, thereby making a direct electrical ground connection between the outer conductor of the appliance port and the tubular post; in turn, the tubular post is engaged with the outer conductor of the coaxial cable.

However, in many cases, it is difficult for an installer to reach the connection ports of the appliance with a wrench, and in some instances, it is even difficult for the installer to reach such connection ports with his or her fingers. As a result, it can often happen that type F connectors are not fully

tightened to the appliance port. In such a loose connection system, wherein the coupler of the coaxial connector is not drawn tightly to the appliance port connector, a gap exists between the outer conductor of the appliance port and the tubular post of the connector. Unless an alternate ground path exists, poor signal quality, and RFI leakage, will result.

As mentioned above, the coupler is rotatably secured about the head of the tubular post. The head of the tubular post usually includes an enlarged shoulder, and the coupler typically includes an inwardly-directed flange for extending over and around the shoulder of the tubular post. In order not to interfere with free rotation of the coupler, manufacturers of such F-style connectors routinely make the outer diameter of the shoulder (at the head of the tubular post) of smaller dimension than the inner diameter of the central bore of the coupler. Likewise, manufacturers routinely make the inner diameter of the inwardly-directed flange of the coupler of larger dimension than the outer diameter of the non-shoulder portion of the tubular post, again to avoid interference with rotation of the coupler relative to the tubular post. In a loose connection system, wherein the coupler of the coaxial connector is not drawn tightly to the appliance port connector, an alternate ground path may fortuitously result from contact between the coupler and the tubular post, particularly if the coupler is not centered over, and axially aligned with, the tubular post. However, this alternate ground path is not stable, and can be disrupted as a result of vibrations, movement of the appliance, movement of the cable, or the like.

Alternatively, there are some cases in which such an alternate ground path is provided by fortuitous contact between the coupler and the outer body of the coaxial connector, provided that the outer body is formed from conductive material. This alternate ground path is similarly unstable, and may be interrupted by relative movement between the appliance and the cable, or by vibrations. Moreover, this alternate ground path does not exist at all if the outer body of the coaxial connector is constructed of non-conductive material. Such unstable ground paths can give rise to intermittent failures that are costly and time-consuming to diagnose.

OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide a coaxial cable connector for connecting a coaxial cable to a connection port of an appliance, the coaxial cable connector being of the type that includes a tubular post and a coupler, such as a rotatable coupler, which ensures a reliable ground connection between the tubular post of the connector and an outer conductor of the appliance port, even if the coupler is not fully tightened onto the appliance port.

It is another object of the present invention to provide such a coaxial cable connector which maintains a reliable ground path between the coupler and the tubular post, at least following installation of such connector onto the end of a coaxial cable.

It is still another object of the present invention to provide such a coaxial connector that can be manufactured economically.

These and other objects of the present invention will become more apparent to those skilled in the art as the description thereof proceeds.

SUMMARY OF THE INVENTION

Briefly described, the present invention relates to a coaxial cable connector comprising a tubular post, a coupler and a grounding means for providing an electrically conductive

path between the post and the coupler. In accordance with a preferred embodiment thereof, the present invention relates to a coaxial cable connector for coupling a prepared end of a coaxial cable to a threaded female equipment port, and including a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor thereof. A coupler is rotatably secured over the second end of the tubular post, and includes a central bore, at least a portion of which is threaded for engaging the female equipment port. An outer body is secured to the tubular post and extends about the first end of the tubular post for receiving the outer conductor, and preferably the cable jacket, of the coaxial cable.

In a preferred embodiment of the present invention, a resilient, electrically-conductive grounding member is disposed between the tubular post and the coupler. This grounding member engages both the tubular post and the coupler for providing an electrically-conductive path therebetween, but without restricting rotation of the coupler relative to the tubular post.

For some preferred embodiments, the grounding member is generally arcuately shaped to extend around the tubular post over an arc of at least 225°, and may extend for a full 360°. This arcuately shaped grounding member may be in the form of a generally circular broken ring, or C-shaped member, as by bending a strip of metal wire into an arc. Preferably, the grounding member has a shape that is out-of-round, and more preferably oblong, rather than circular, in order to ensure reliable electrical contact with both the coupler and the tubular post. In order to retain the grounding member inside the coupler, the inner bore of the coupler may include an annular recess proximate to the end of the coupler that encircles the tubular post; at least portions of the grounding member are engaged with the annular recess to prevent the grounding member from being axially displaced within the coupler.

As mentioned above, the tubular post may include an enlarged shoulder at the head thereof. In one preferred embodiment of the present invention, the grounding member surrounds the enlarged shoulder of the tubular post, at least when the coaxial cable connector is assembled onto the prepared end of a coaxial cable, whereby at least portions of the grounding member engage the outer surface of such enlarged shoulder.

In one embodiment of the present invention, the grounding member is generally circular and includes a plurality of projections extending outwardly therefrom for engaging the coupler. In another embodiment of the present invention, the grounding member is generally circular and includes a plurality of projections extending inwardly therefrom for engaging the tubular post.

In yet another embodiment of the present invention, the tubular post includes an enlarged shoulder extending inside the coupler, and including a first radial face that faces the opposite end of the tubular post. The coupler includes a flange directed inwardly toward the tubular post; this inwardly directed flange including a second radial face that faces toward the connection port of the appliance to which the coaxial cable is to be connected. The grounding member is disposed between the first radial face and the second radial face. In this embodiment, the grounding member is resilient relative to the longitudinal axis of the connector, and is compressed between the first radial face and the second radial face to maintain sliding electrical contact between the shoulder of the tubular post (via its first radial face) and the flange of the coupler (via its second radial face).

The coaxial connector of the present invention may also include a sealing ring seated within the coupler for rotatably engaging the body member to form a seal therebetween.

In an alternate embodiment of the present invention, conductive grease is substituted for a discrete grounding member. In this embodiment, an outer dimension of a portion of the tubular post is caused to be commensurate with an inner dimension of an adjacent portion of the coupler. While the gap between such adjacent portions, coupled with the lubrication provided by the conductive grease, is sufficient to permit rotation of the coupler relative to the tubular post, the conductive grease nonetheless functions to maintain reliable electrical coupling across such gap.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described with greater specificity and clarity with reference to the following drawings, in which:

FIG. **1** is a perspective view of an F connector in accordance with the preferred embodiment of the invention, including a body and a coupling nut;

FIG. **2** is an exploded view of the F connector of FIG. **1**, including a preferred embodiment of a grounding member;

FIG. **2A** is an enlarged plan view of the preferred embodiment of the grounding member of FIG. **2**;

FIG. **3** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3-3**, and a side view of a prepared coaxial cable ready to be inserted into a back end of the F connector;

FIG. **3A** is a cross-sectional view of the body of the F connector of FIG. **1** through cut-line **3-3**;

FIG. **3B** is a cross-sectional view of a tubular post of the F connector of FIG. **1**, through cut-line **3-3**;

FIG. **3C** is a cross-sectional view of the coupling nut of the F connector of FIG. **1** through cut-line **3-3**;

FIG. **4** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3-3**, and cross-sectional view of the prepared coaxial cable fully inserted into the back end thereof, prior to axial compression of the F connector;

FIG. **4A** is an enlargement of a portion of FIG. **4**;

FIG. **5** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3-3**, and a cross-sectional view of the prepared coaxial cable fully inserted into the back end thereof, subsequent to axial compression of the F connector;

FIG. **5A** is an enlargement of a portion of FIG. **5**;

FIG. **6** is a partial cross-sectional view of a first alternate embodiment of an F connector having a first alternate grounding member;

FIG. **6A** is an enlargement of a portion of FIG. **6**;

FIG. **6B** is a slightly enlarged side view of the first alternate grounding member of FIG.**6**;

FIG. **6C** is a slightly enlarged plan view of the first alternate grounding member of FIG. **6**;

FIG. **7** is a partial cross-sectional view of a second alternate embodiment of an F connector having a second alternate grounding member;

FIG. **7A** is an enlargement of a portion of FIG. **7**;

FIG. **7B** is a slightly enlarged side view of the second alternate grounding member of FIG. **7**;

FIG. **7C** is a slightly enlarged plan view of the second alternate grounding member of FIG. **7**;

FIG. **8** is a partial cross-sectional view of a third alternate embodiment of an F connector having a third alternate grounding member;

FIG. **8A** is a slightly enlarged side view of the third alternate grounding member of FIG. **8**;

FIGS. **8B-8E** are slightly enlarged plan views of four styles of the third alternate grounding member of FIG. **8**;

FIG. **9** is a partial cross-sectional view of a fourth alternate embodiment of an F connector having one of a fourth alternate grounding member and a fifth alternate grounding member;

FIG. **9A** is a slightly enlarged side view of the fourth alternate grounding member of FIG. **9**;

FIG. **9B** is a slightly enlarged plan view of the fourth alternate grounding member of FIG. **9**;

FIG. **9C** is a slightly enlarged side view of the fifth alternate grounding member of FIG. **9**;

FIG. **9D** is a slightly enlarged plan view of the fifth alternate grounding member of FIG. **9**;

FIG. **10** is a partial cross-sectional view of a fifth alternate embodiment of an F connector having conductive grease that acts as a grounding member;

FIG. **11** is a partial cross-sectional view of a front end of a sixth alternate embodiment of an F connector having a sixth alternate grounding member;

FIG. **11** A is an enlargement of a portion of FIG. **11**;

FIG. **11** B is a side view of the sixth alternate grounding member of FIG. **11**;

FIG. **11C** is a plan view of the sixth alternate grounding member of FIG. **11**; and

FIG. **11D** is a perspective view of the sixth alternate grounding member of FIG. **11**.

For simplicity and clarity of illustration, the drawing figures illustrate the general manner of construction, and descriptions and details of well-known features and techniques are omitted to avoid unnecessarily obscuring the invention. Furthermore, elements in the drawing figures are not necessarily drawn to scale.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** is a perspective view of an F connector **100** in accordance with the preferred embodiment of the invention. The F connector **100** (hereinafter, "connector") has a longitudinal axis **101**. The connector has a front end **102** and a back end **103**.

FIG. **2** is an exploded view of the connector **100**. The connector **100** includes tubular post **104**, a coupling nut **105** rotatably secured over an end **106** of the tubular post for securing the connector to an appliance (not shown), and a body **108** secured to the tubular post. A shell **107** and a label **109** are secured to the body **108**. Preferably, the body **108** is made entirely of acetal plastic. Alternatively, the body **108** is made of brass, plated with nickel. The shell **107** adds strength to the plastic body **108** and protects the plastic body from ultraviolet light. The tubular post **104** is preferably metallic, and more preferably, made of brass, with a tin plating; as tin is more conductive than nickel. The coupling nut **105** is preferably metallic, and more preferably, formed from brass, plated with nickel or with another non-corrosive material.

In the embodiment shown in the drawings, the coupling nut **105** is rotatably secured over an end **106** of the tubular post **104** via a neck **111** of the body **108**. Advantageously, an electrical grounding path is constantly maintained between the coupling nut **105** and the tubular post **104**, including, in particular, when the coupling nut **105** of the connector **100** is not tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member **110** disposed between the tubular post **104** and the coupling nut **105**.

FIG. **2A** is an enlarged plan view of the preferred embodiment of the grounding member **110**. In the preferred embodiment of the present invention, the electrically-conductive grounding member **110** is disposed between the tubular post **104** and the coupling nut **105**. The grounding member **110** contacts both the tubular post **104** and the coupling nut **105** for providing an electrically-conductive path therebetween, but without restricting rotation of the coupling nut relative to the tubular post. A preferred embodiment of the grounding member **110** shown in FIG. **2A** is a spring member, or circlip, disposed between the coupling nut **105** and the tubular post **104**, which establishes a stable ground path between the coupling nut and the post, and which is preferably constructed of a wire-type material. The grounding member **110** is retained in the coupling nut **105** by an annular recess **343** (see FIG. **3C**) in the coupling nut. The spring action of the grounding member **110** serves to form a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut **105** to rotate. The grounding member **110** is resilient and is generally arcuately shaped. The grounding member **110** extends around the tubular post **104** over an arc of at least 225°, and may extend for a full 360°. The arcuately shaped grounding member **110** may be in the form of a generally circular broken ring, or C-shaped member, as by bending a strip of metal wire into an arc. Preferably, the grounding member **110** is a C-shaped metal clip that has an arcuate curvature that is non-circular. The grounding member **110** has a minimum diameter **201** and a maximum diameter **203**. Preferably, the grounding member **110** is made of stainless steel wire that has a wire diameter of between 0.010-inch and 0.020-inch; in a preferred embodiment, the wire diameter is about 0.016-inch. Stainless steel is a preferred metal for the grounding member **110** because it need not be plated for corrosion resistance.

FIG. **3** is a cross-sectional view of the connector **100** through cut-line **3-3** of FIG. **1**, and a side view of a prepared coaxial cable **301** ready to be inserted into a back end **103** of the connector. The center conductor **302** of the coaxial cable **301** is surrounded by a dielectric material **303**, and the dielectric material is surrounded by an outer conductor **304** that may be in the form of a conductive foil and/or braided sheath. The outer conductor **304** is usually surrounded by a plastic cable jacket **305** that electrically insulates, and mechanically protects, the outer conductor.

FIG. **3A** is a cross-sectional view of the body **108** of FIG. **1** through cut-line **3-3**. FIG. **3B** is a cross-sectional view of the tubular post **104** of FIG. **1** through cut-line **3-3**. FIG. **3C** is a cross-sectional view of the coupling nut **105** of FIG. **1** through cut-line **3-3**. Referring now to FIGS. **3**, **3A**, **3B** and **3C**, the body **108** has a lip **310** at a front end of the body. The lip **310** has an outer diameter **311** and an inner diameter **312**. The coupling nut **105** is rotatably secured about a head **330** at the front end of the tubular post **104**. The head **330** of the tubular post **104** usually includes an enlarged shoulder **332**. The coupling nut **105** typically includes an inwardly-directed flange **340** that extends over and around the shoulder **332** of the tubular post **104**. In order to retain the grounding member **110** inside the coupling nut **105**, the inner, or central, bore **342** of the coupling nut **105** may include an annular recess **343** that is proximate to the end of the coupling nut that encircles the tubular post **104**. At least portions of the grounding member **110** are engaged with the annular recess **343** to prevent the grounding member from being axially displaced within the coupling nut **105**. The tubular post **104** may include an enlarged shoulder **332** at the head **330** thereof. The shoulder **332** has a first radial face **333** that faces the back end of the tubular post **104**. In one preferred embodiment of the present

invention, the grounding member **110** surrounds the enlarged shoulder **332** of the tubular post **104**, at least when the connector **100** is assembled onto the prepared end of a coaxial cable **301**. At least portions of the grounding member **110** contact the outer surface **334** of such enlarged shoulder **332**.

The coupling nut **105** has an inwardly-directed flange near the back end of the coupling nut. The coupling nut **105** has an inner diameter **341** at a back end of the coupling nut. In order to retain the back end of the coupling nut **105** on the front end of the body **108**, the inner diameter **341** of the coupling nut has a dimension less than the outer diameter of the lip **310** of the body **108**. In order not to interfere with free rotation of the coupling nut **105**, the outer diameter **336** of the shoulder **332** (at the head **330** of the tubular post **104**) is of smaller dimension than the inner diameter **344** of the central bore of the coupling nut **105**. Likewise, the inner diameter **341** of the inwardly-directed flange **340** of the coupling nut **105** is of larger dimension than the outer diameter **337** of the non-shoulder portion **338** of the tubular post **104**, again to avoid interference with rotation of the coupling nut **105** relative to the tubular post.

FIG. **4** is a cross-sectional view of the connector **100** through cut-line **3-3**, and cross-sectional view of the prepared coaxial cable **301** fully inserted into the back end **103** thereof, prior to axial compression of the connector. FIG. **4A** is an enlargement of a portion of FIG. **4**. Referring now to FIGS. **4** and **4A**, the resilient, electrically-conductive grounding member **110** is shown disposed between the tubular post **104** and the coupling nut **105**. The grounding member **110** is disposed in the annular recess **343** that encircles the tubular post **104**.

FIG. **5** is a cross-sectional view of the connector **100** through cut-line **3-3**, and a cross-sectional view of the prepared coaxial cable **301** fully inserted into the back end **103** thereof, subsequent to axial compression of the connector. FIG. **5A** is an enlargement of a portion of FIG. **5**. Referring now to FIGS. **5** and **5A**, as a result of axial compression by a standard compression tool (not shown), the tubular post **104** slides (to the right in the drawings) relative to the other components of the connector **100** and relative to the cable **301**, such that the shoulder **332** of the tubular post is radially inward of the grounding member **110**. At least a portion of the grounding member **110** engages the coupling nut **105** at the annular recess **343** of the coupling nut, and at least another portion of the grounding member engages tubular post **104** at the shoulder **332** of the tubular post. The tubular post **104** is in electrical contact with the outer conductor **304** of the cable **301** along the back portion of the tubular post, and the coupling nut **105** may engage the outer conductor of an appliance port (not shown). Therefore, when the connector **100** is fastened to an appliance port, there is maintained an electrical grounding path between the outer conductor **304** of the cable **301** and the outer conductor of the appliance port, whether or not the coupling nut **105** of the connector is tightly fastened to the appliance port.

FIG. **6** is a partial cross-sectional view of a first alternate embodiment of a connector **600** having a first alternate grounding member **601** (see FIGS. **6A-6C**), shown subsequent to axial compression. FIG. **6A** is an enlargement of a portion of the first alternate embodiment of the connector **600** showing a portion of the first alternate grounding member **601**. FIG. **6B** is a slightly enlarged side view of the first alternate grounding member **601**. FIG. **6C** is a slightly enlarged plan view of the first alternate grounding member **601**. Referring now to FIGS. **6**, **6A**, **6B** and **6C**, the first alternate grounding member **601** is a spring finger grounding member retained between the coupling nut **105** and the tubular post **104**. The first alternate grounding member **601** is constructed of a thin cross section of material such beryllium copper. The first alternate grounding member **601** comprises a ring portion **602** and a plurality of fingers **603** that project at approximately a 30° angle from the plane of the ring. The spring action of the fingers **603** extend to, and make contact with, a radial surface **604** near the back end of the coupling nut **105** that faces the front end of the coupling nut, which serve to connect a ground path from the coupling nut to the tubular post while allowing the coupling nut to rotate. The first alternate grounding member **601** has optional internal lugs **605** that contact the outer diameter **337** of the non-shoulder portion of the tubular post.

FIG. **7** is a partial cross-sectional view of a second alternate embodiment of a connector **700** having a second alternate grounding member **701** (see FIGS. **7A-7C**). FIG. **7A** is an enlargement of a portion of the second alternate embodiment of the connector **700**, showing a portion of the second alternate grounding member **701**. FIG. **7B** is a slightly enlarged side view of the second alternate grounding member **701**. FIG. **7C** is a slightly enlarged plan view of the second alternate grounding member **701**. Referring now to FIGS. **7**, **7A**, **7B** and **7C**, the second alternate grounding member **701** is a radial grounding member retained between the coupling nut **105** and the tubular post **104**. The second alternate grounding member **701** is constructed of a thin cross section of metallic material such as beryllium copper. The second alternate grounding member **701** comprises a ring portion **702** and a plurality of fingers **703** extending radially from the ring portion at about a 45° angle from the plane of the ring portion. The spring action of the fingers **703** extend to inner-diameter surfaces **705** of the coupling nut **105** and serve to connect a ground path from the coupling nut to the tubular post **104** while allowing the coupling nut to rotate.

FIG. **8** is a partial cross-sectional view of a third alternate embodiment of a connector **800** having a third alternate grounding member **801** (see FIGS. **8A-8E**). FIG. **8A** is a slightly enlarged side view of the third alternate grounding member **801**. FIGS. **8B-8E** are slightly enlarged plan views of four styles of the third alternate grounding member **801**. Referring now to FIG. **8** and FIGS. **8A-8E**, the third alternate grounding member **801** is a conductive member retained between the coupling nut **105** and the tubular post **104**. The third alternate grounding member **801** is constructed of a thin cross section of metallic material such as brass or beryllium copper. The third alternate grounding member **801** comprises a ring **802** with multiple points of contact, or internal lugs, **803** around the inner perimeter of the ring and with multiple external lugs **804** around the outer perimeter of the ring. The lugs **803** and **804** serve to connect a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate. FIGS. **8B-8E** show four styles with regard to the shape of the lugs **803** and **804** and the position of the lugs on the ring **802**. FIG. **8** also exhibits an alternate embodiment comprising a sealing ring **805** for forming a moisture seal between the coupling nut **105** and the body **108** of the connector **801**. The sealing ring **805** is disposed between the back end of the coupling nut **105** and the body **108** for forming a seal therebetween. Preferably, the sealing ring **805** is made from ethylene propylene. Use of the sealing ring **805** is not limited to use in connectors having the third alternate grounding member **801**. The third alternate grounding member **801** may also be used in connectors without the sealing ring **805**.

FIG. **9** is a partial cross-sectional view of a fourth alternate embodiment of a connector **900** having one of a fourth alternate grounding member **901** and a fifth alternate grounding

member **911** (see FIGS. **9A-9D**). FIG. **9A** is a slightly enlarged side view of the fourth alternate grounding member **901**. FIG. **9B** is a slightly enlarged plan view of the fourth alternate grounding member **901**. FIG. **9C** is a slightly enlarged side view of the fifth alternate grounding member **902**. FIG. **9D** is a slightly enlarged plan view of the fifth alternate grounding member **911**. The fourth and fifth alternate embodiments of the grounding member **901** and **911**, respectively, comprise a C-shaped ring between the coupling nut **105** and the tubular post **104**. The C-shaped ring is constructed of a thin cross section of metallic material such as beryllium copper or stainless steel. It is retained by a groove in the coupling nut. The spring action of the C-shaped ring serves to connect a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate. The fourth alternate grounding member **901** includes a circumferential metallic band **902**, which has a general circular shape and approximates a section of a hollow cylinder, that extends between first **903** and second **904** opposing ends. The band **902** has first **906** and second **907** opposing side edges extending along its length. The fourth alternate grounding member **901** includes a first generally radial wall **908** extending from the first side edge **906** of the band in a first radial direction, and a second generally radial wall **909** extending from the second side edge **907** of the band generally in said first radial direction. The band **902** contacts a first one of the group of members that includes the coupling nut **105** and the tubular post **104**. The first **908** and second **909** radial walls contact the second of the group of members that includes the coupling nut **105** and the tubular post **104**. The fifth alternate grounding member **911** includes a metallic band **912** extending along its length between first **913** and second **914** opposing ends, and extending along its width between first **916** and second **917** side edges. The band **912** is formed along its length into a generally circular shape. The band **912** is formed along its width into a generally concave shape with the side edges **916** and **917** projecting generally in a first radial direction. The fifth alternate grounding member **911** includes a plurality of projections **918** extending from the band **912** in a second radial direction opposite to the first radial direction. The first **916** and second **917** side edges of the band **912** contact a first one of the group of members that includes the coupling nut and the tubular post. The plurality of projections **918** contact the second of the group of members that includes the coupling nut **105** and the tubular post **104**.

FIG. **10** is a partial cross-sectional view of a fifth alternate embodiment of a connector **1000** having conductive grease (not shown) that acts as a grounding member. The ground path is established by means of a close fit between the coupling nut **105** and the tubular post **104**. The conductive grease is disposed at a grease annular ring **1001** where mating portions of the tubular post **104** and coupling nut **105** have closely matching dimensions. Preferably, the conductive grease is a silver-loaded silicon lubricating material. The conductive grease serves to connect a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate.

FIG. **11** is a partial cross-sectional view of a front end of a sixth alternate embodiment of an F connector **1100** that includes a body **1108**, and which has a sixth alternate grounding member **1101**. FIG. **11A** is an enlargement of a portion of FIG. **11**. FIG. **11B** is a side view of the sixth alternate grounding member **1101**. FIG. **11C** is a plan view of the sixth alternate grounding member **1101**. FIG. **11D** is a perspective view of the sixth alternate grounding member **1101**. Referring now to FIG. **11** and FIGS. **11A-11D**, the sixth alternate grounding member **1101** includes a circumferential metallic band **1112** extending between first **1113** and second **1114** opposing ends. The band **1112** has a generally circular shape that approximates a section of a hollow cylinder. The first **1113** and second **1114** ends of the band **1112** are disposed generally proximate to each other and are directed generally toward one another. The band **1112** has first and second opposing side edges **1115** and **1116**, respectively, extending along its length. The band generally defines a section of a cylindrical surface. The sixth alternate grounding member **1101** includes a plurality of projections **1101** extending from at least one of the first and second side edges **1115** and **1116** of the band **1112**. The plurality of projections **1117** extend away from the cylindrical surface defined by the band **1112**. The band **1112** contacts a first one of the group of members that includes the coupling nut **1105** and the tubular post **1104**. The plurality of projections **1117** contact the second of the group of members that includes the coupling nut **1105** and the tubular post **1104**.

In preferred embodiments, the present invention provides a coaxial cable connector that ensures a reliable grounding path without creating undue interference with free rotation of the coupler relative to the remaining components of the connector; however, the present invention can also provide a reliable grounding path between a post and a coupler that does not rotate. Advantageously, a connector in accordance with the invention works with standard installation tools and with standard compression tools. The present invention can be used with both axially-compressible connectors as well as with older-style crimp-ring connectors. In some embodiments, the present invention is compatible with the use of a sealing ring for forming a moisture seal between the coupler and the outer body of the connector.

While the present invention has been described with respect to preferred embodiments thereof, such description is for illustrative purposes only, and is not to be construed as limiting the scope of the invention. Various modifications and changes may be made to the described embodiments by those skilled in the art without departing from the true spirit and scope of the invention as defined by the appended claims. For example, the grounding member can have a shape other than generally circular, such as square, hexagonal, octagonal, oval, etc.

LIST OF REFERENCE NUMERALS

100 F connector ("connector")
101 Longitudinal axis
102 Front end
103 Back end
104 Tubular post
105 Coupling nut
106 End of tubular post
107 Shell
108 Body
109 Label
110 Grounding member
111 Neck
201 Minimum diameter
203 Maximum diameter
301 Coaxial cable
302 Center conductor
303 Dielectric material
304 Outer conductor
305 Jacket
310 Lip of body
311 Outer diameter of lip body
312 Inner diameter of lip of body

330 Head of tubular post
332 Shoulder of tubular post
333 First radial face of shoulder of tubular post
334 Outer surface of shoulder
336 Outer diameter of shoulder
337 Outer diameter of non-shoulder portion of post
338 Non-shoulder portion of post
340 Inwardly-directed flange of coupling nut
341 Inner diameter of inwardly-directed flange
342 Bore of coupling nut
343 Annular recess of coupling nut
344 Inner diameter of bore of coupling nut
600 First alternate connector
601 First alternate grounding member
602 Ring portion of first alternate grounding member
603 Fingers of first alternate grounding member
604 Radial surface of coupling nut
605 Internal lugs of first alternate grounding member
700 Second alternate connector
701 Second alternate grounding member
702 Ring portion of second alternate grounding member
703 Fingers of second alternate grounding member
800 Third alternate connector
801 Third alternate grounding member
802 Ring portion of third alternate grounding member
803 Internal lugs of third alternate grounding member
804 External lugs of third alternate grounding member
805 Sealing ring
900 Fourth alternate connector
901 Fourth alternate grounding member
902 Band of fourth alternate grounding member
903 First end of band
904 Second end of band
906 First side edge of band
907 Second side edge of band
908 First radial wall of band
909 Second radial wall of band
911 Fifth alternate grounding member
1000 Fifth alternate connector
1001 Grease annular ring
1100 Sixth alternate connector
1101 Sixth alternate grounding member
1104 Tubular post of sixth alternate connector
1105 Coupling nut of sixth alternate connector
1108 Body of sixth alternate connector
1112 Band of sixth alternate grounding member
1113 First end of band
1114 Second end of band
1115 First side edge of band
1116 Second side edge of band
1117 Projections on band

We claim:

1. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising:

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member is comprised of plastic, wherein the body member contacts the coupler; and

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween.

2. The connector of claim **1** wherein the body member is comprised of acetal plastic.

3. The connector of claim **1** wherein the tubular post comprises an enlarged shoulder, and the grounding member is disposed between the enlarged shoulder and the coupler.

4. The connector of claim **1** wherein the coupler comprises an inwardly-directed flange, and the grounding member is disposed between the inwardly-directed flange and the second end of the coupler.

5. The coaxial cable connector recited by claim **1** wherein said grounding member is arcuately shaped to extend around the tubular post over at least 225 degrees.

6. The coaxial cable connector recited by claim **1** wherein said grounding member is formed from metal wire.

7. The coaxial cable connector recited by claim **1** wherein the central bore of the coupler includes an annular recess proximate to the first end of the coupler, and wherein at least portions of said grounding member are disposed within the annular recess.

8. The coaxial cable connector recited by claim **1** wherein the tubular post includes an enlarged shoulder at the second end thereof extending inside the coupler, and wherein the annular recess and said grounding member surround the enlarged shoulder of the tubular post when the coaxial cable connector is assembled onto the prepared end of the coaxial cable.

9. The coaxial cable connector recited by claim **1** wherein said grounding member is generally circular.

10. The coaxial cable connector recited by claim **9** wherein said grounding member has a plurality of projections extending radially outwardly therefrom for engaging the coupler.

11. The coaxial cable connector recited by claim **9** wherein said grounding member has a plurality of projections extending radially inwardly therefrom for engaging the tubular post.

12. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising:

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof:

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port:

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member is comprised of plastic: and

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the

grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween:

wherein the tubular post includes an enlarged shoulder at the second end thereof extending inside the coupler, the enlarged shoulder including a first radial face that faces the first end of the tubular post, the coupler including a radially inwardly directed flange proximate the first end thereof directed inwardly toward the tubular post, the inwardly directed flange including a second radial face that faces the second end of the coupler, said grounding member being disposed between the first radial face and the second radial face for electrically coupling the tubular post to the coupler; and

wherein the grounding member includes a central, generally circular body member disposed generally within a plane, the grounding member including a plurality of resilient spring fingers extending out of said plane and being compressed between the first radial face of the tubular post and the second radial face of the coupler.

13. The coaxial cable connector recited by claim **12** wherein said plurality of spring fingers includes at least a first spring finger and a second spring finger, and wherein said first and second spring fingers extend out of said plane in opposing directions.

14. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising:

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member is comprised of plastic; and

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween;

wherein the grounding member includes:

a. a circumferential metallic band extending between first and second opposing ends, the band having a generally circular shape, and approximating a section of a hollow cylinder, the first and second ends of the band being disposed generally proximate to each other and being directed generally toward one another, the band having first and second opposing side edges extending along its length;

b. a first generally radial wall extending from the first side edge of the band in a first radial direction; and

c. a second generally radial wall extending from the second side edge of the band generally in said first radial direction;

wherein the band contacts a first one of the group of members that consists of the coupler and the tubular post, and wherein the first and second radial walls contact the second of the group of members that consists of the coupler and the tubular post.

15. The coaxial cable connector recited by claim **1** wherein said grounding member is a C-shaped metal clip.

16. The coaxial cable connector recited by claim **15** wherein said C-shaped metal clip has an arcuate curvature that is non-circular to maximize contact with both the coupler and the tubular post.

17. The coaxial cable connector recited by claim **1** wherein a front end of the body contacts the coupler, the front end of the body comprising a lip having an outer diameter and the coupler having an inner diameter, wherein the inner diameter of the coupler has a dimension less than the outer diameter of the lip of the body in order to retain the first end of the coupler on the front end of the body.

* * * * *

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Bence et al.

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(54) **ELECTRICAL CONNECTOR WITH GROUNDING MEMBER**

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See application file for complete search history.

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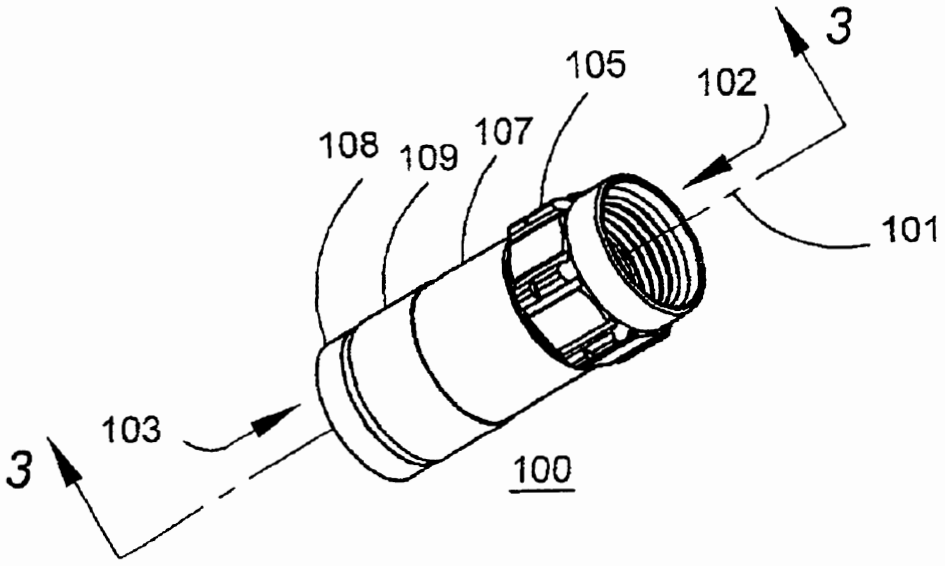
(57) **ABSTRACT**

A coaxial cable connector includes tubular post, a coupler secured over an end of the tubular post for securing the connector to an appliance, and an outer body secured to the tubular post. An electrical grounding path is maintained between the coupler and the tubular post whether or not the coupler is tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler. Alternatively, the connector includes conductive grease at a point where mating portions of the tubular post and coupler have closely matching dimensions.

12 Claims, 8 Drawing Sheets



EXHIBIT
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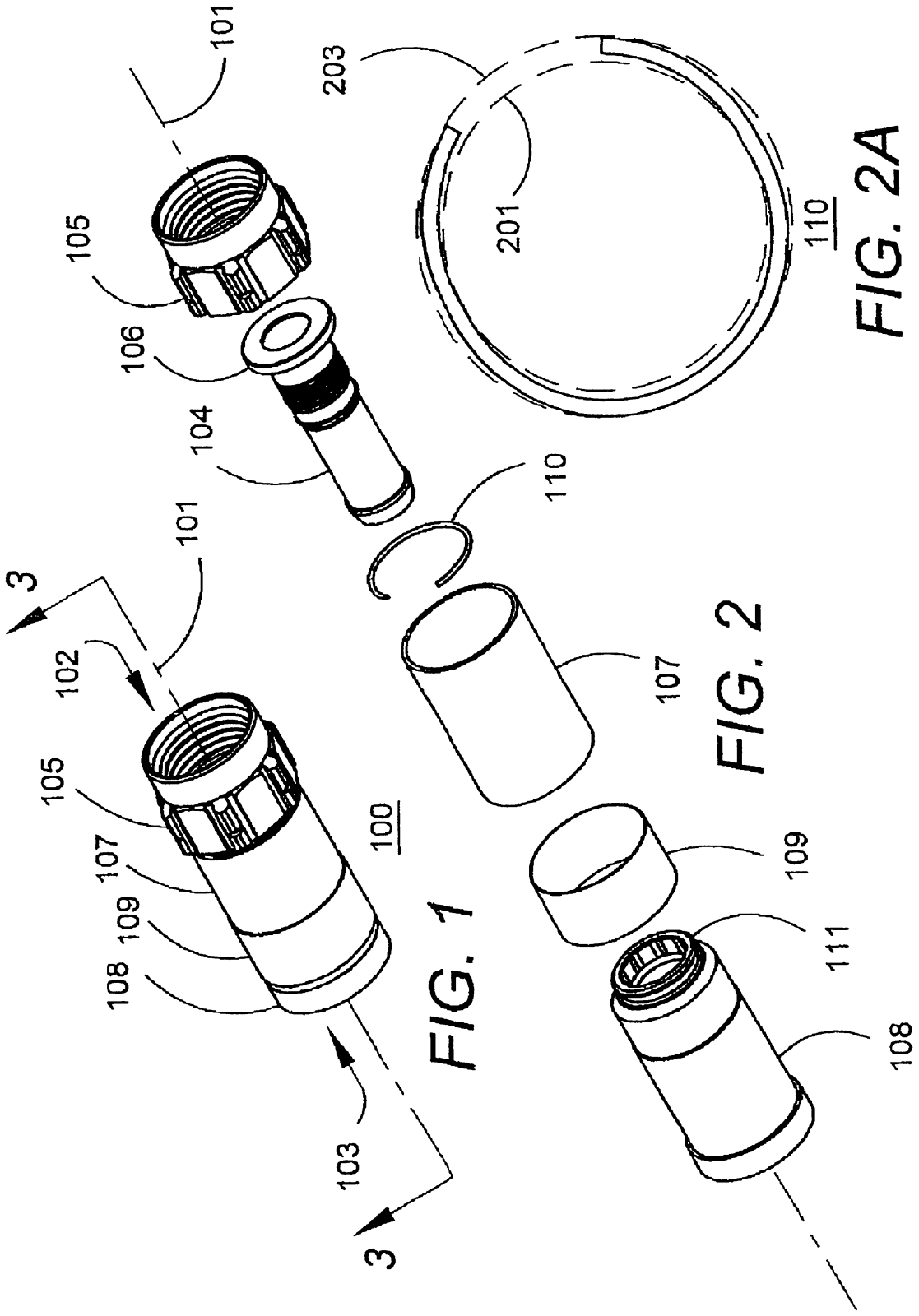

FIG. 1

FIG. 2

FIG. 2A

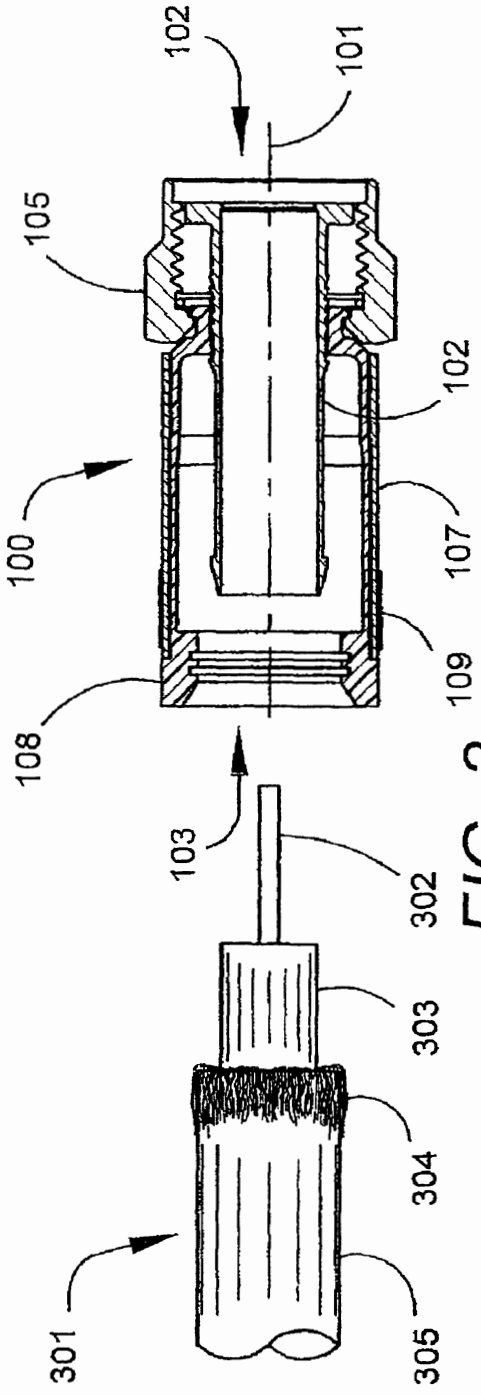

FIG. 3

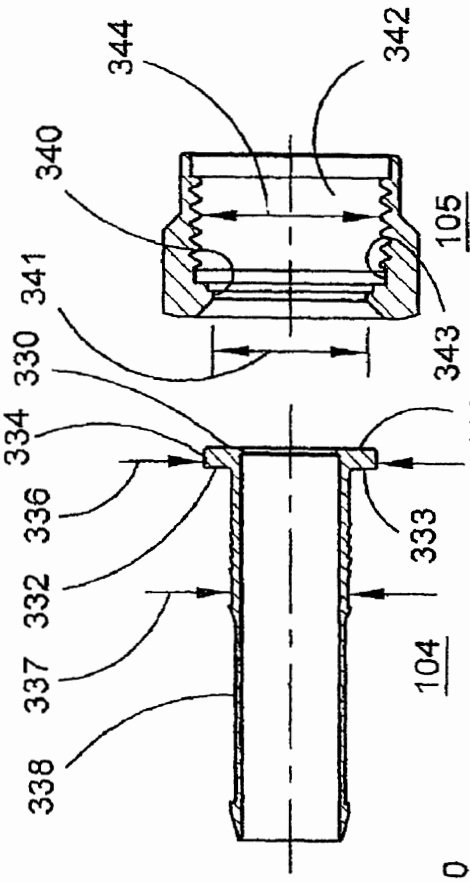

FIG. 3B

FIG. 3C

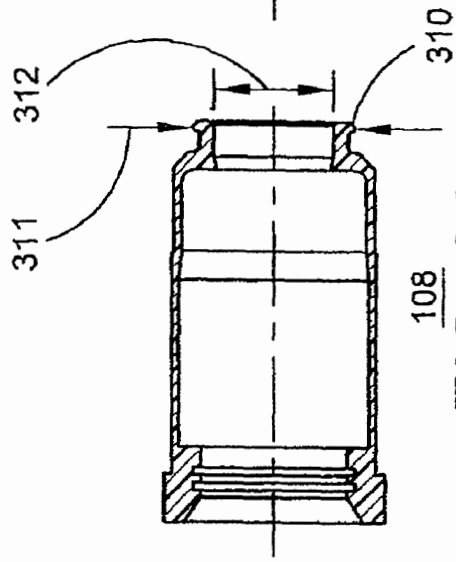

FIG. 3A

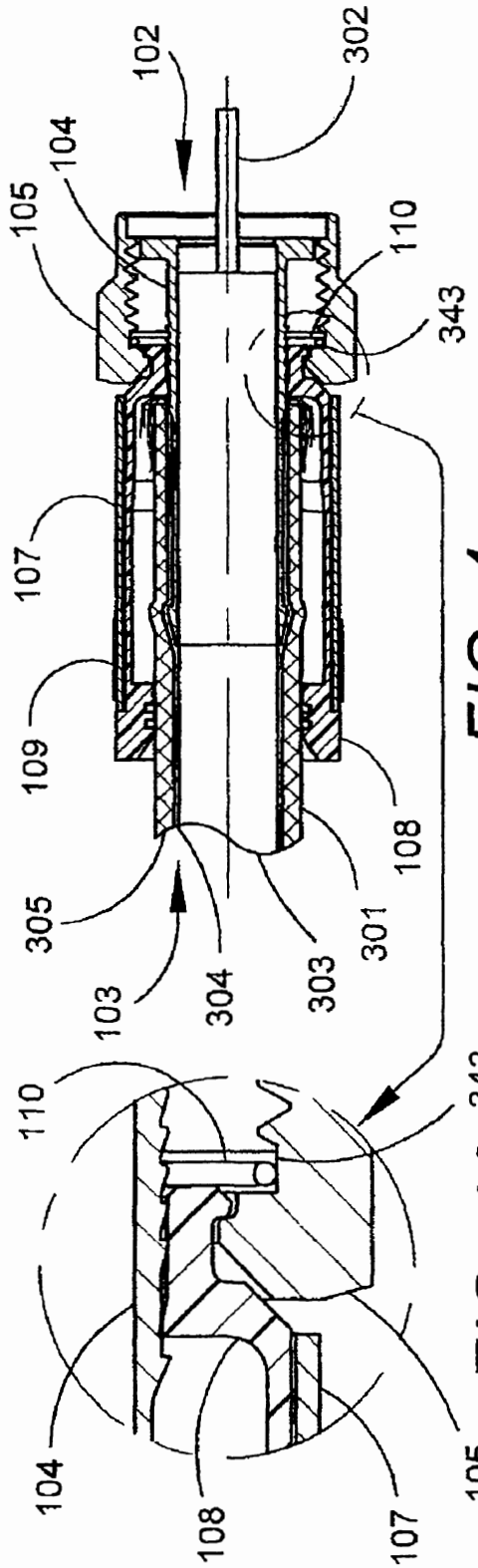

FIG. 4

FIG. 4A

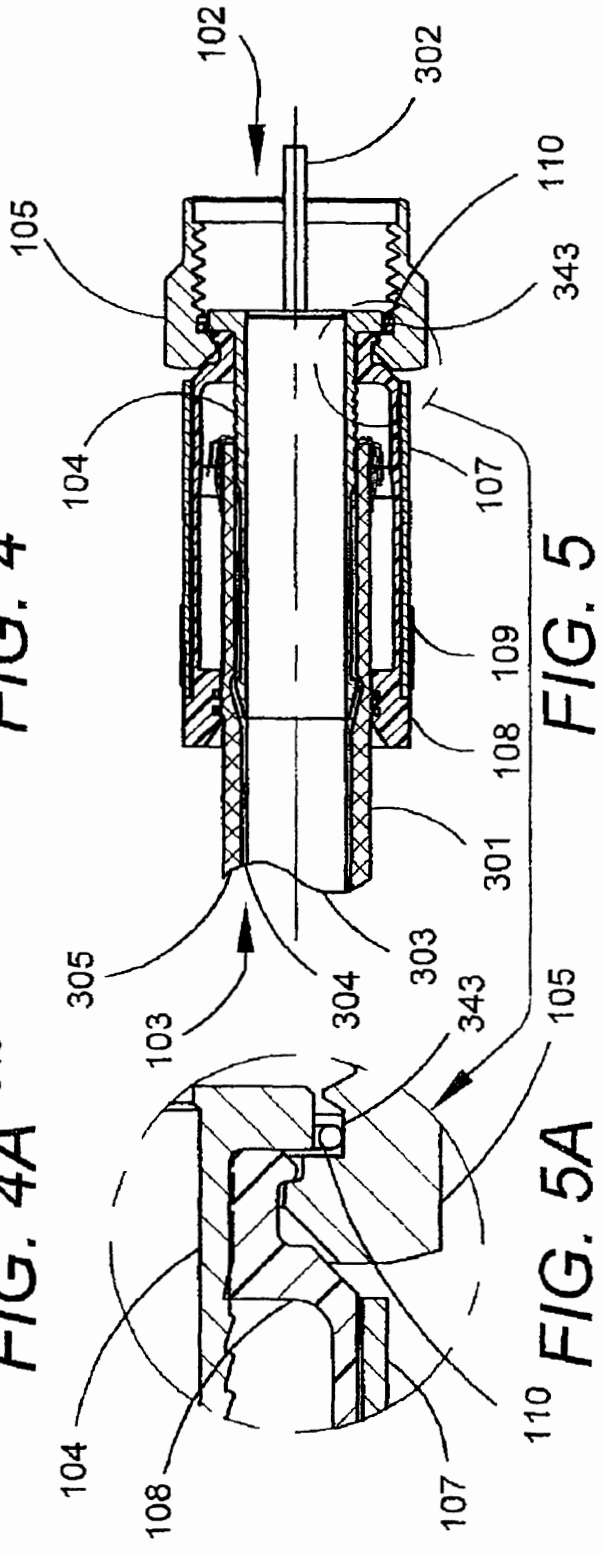

FIG. 5

FIG. 5A

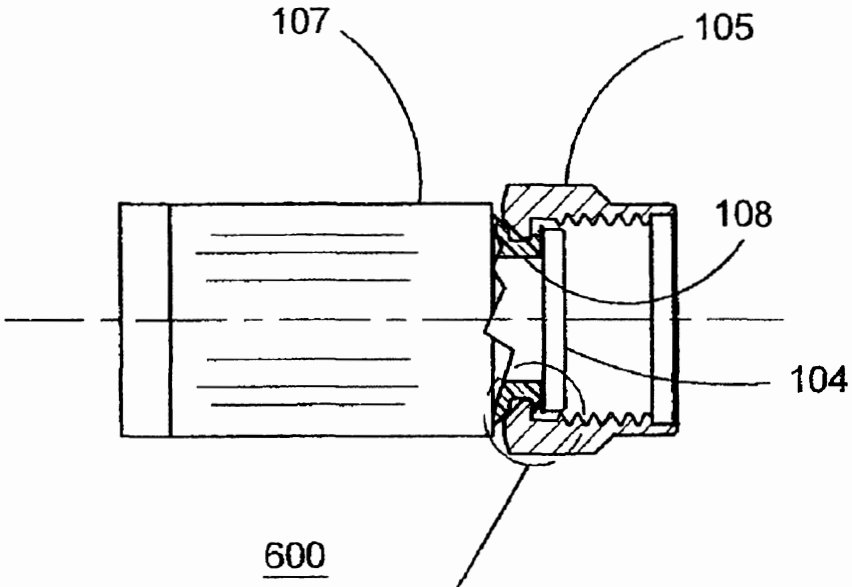

FIG. 6

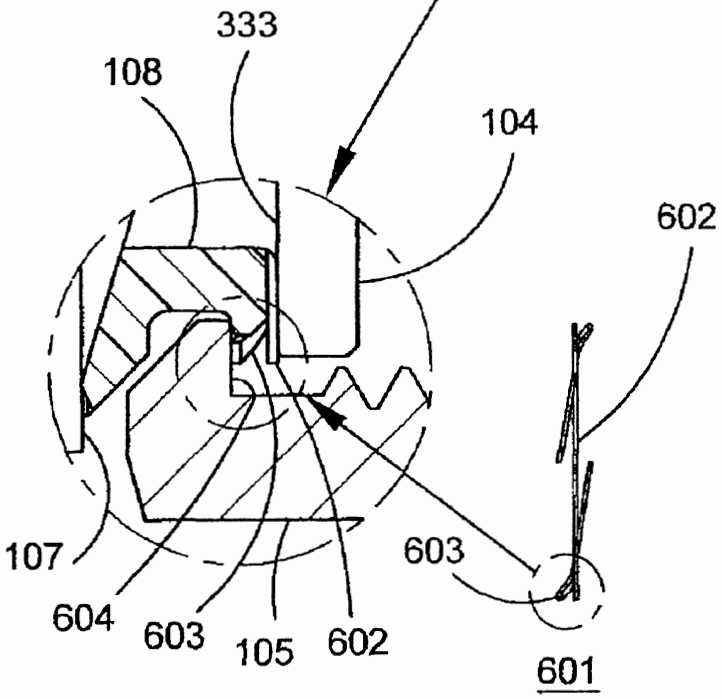

FIG. 6A

FIG. 6B

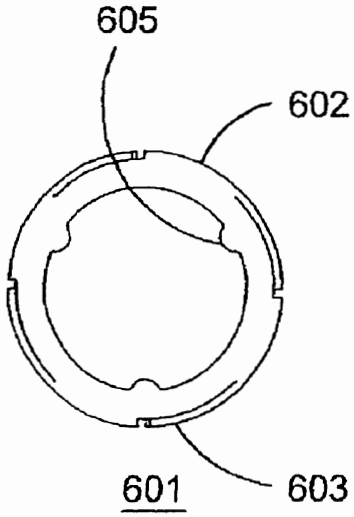

FIG. 6C

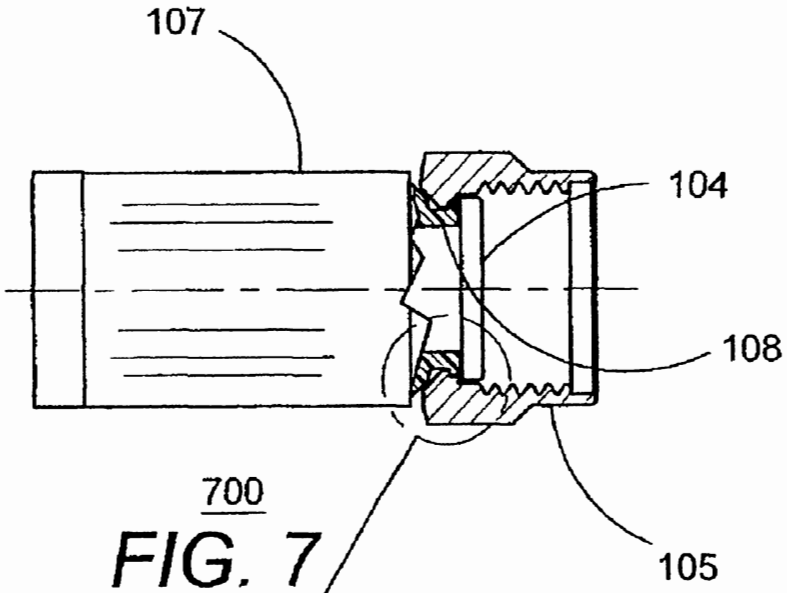

FIG. 7

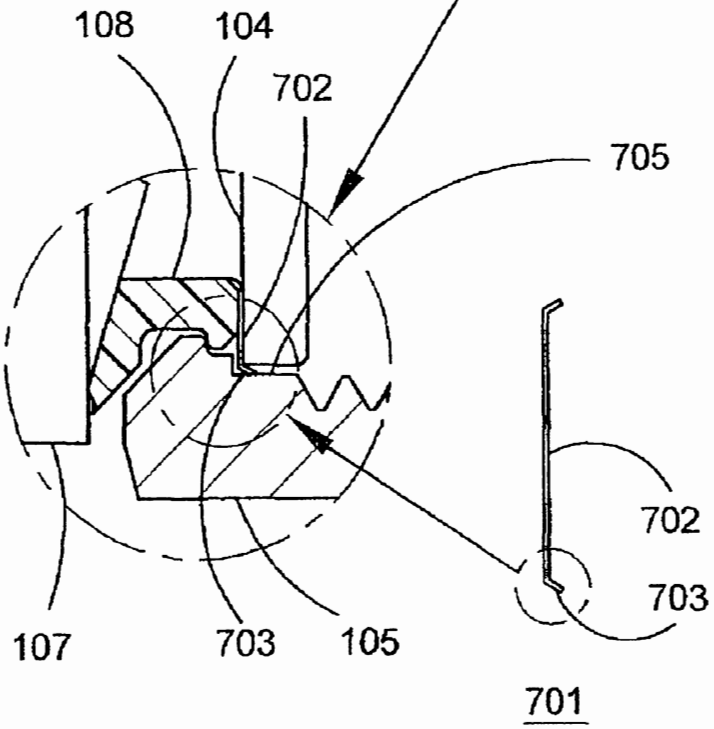

FIG. 7A

FIG. 7B

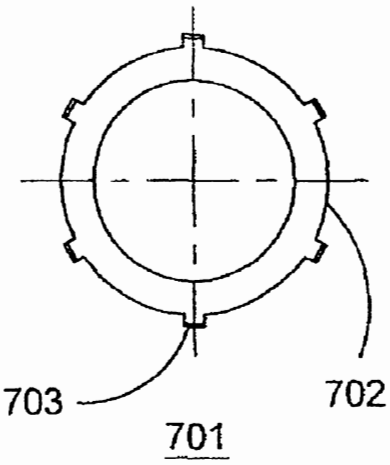

FIG. 7C

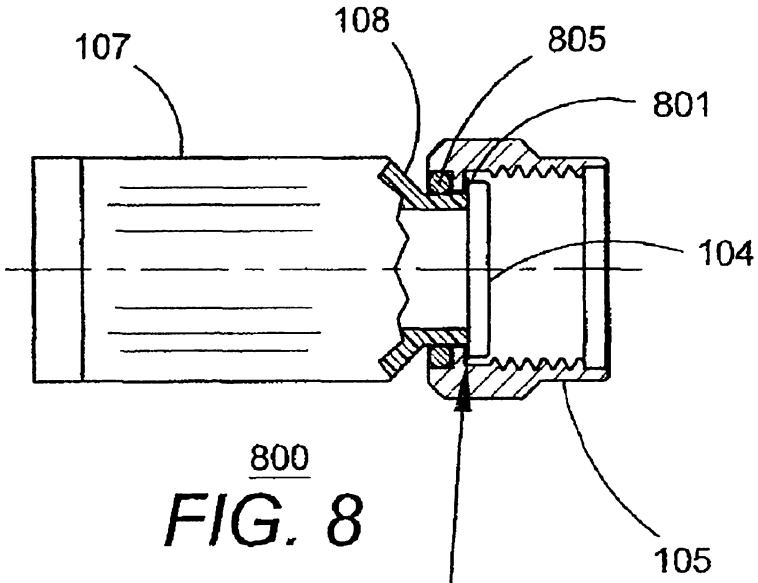

FIG. 8

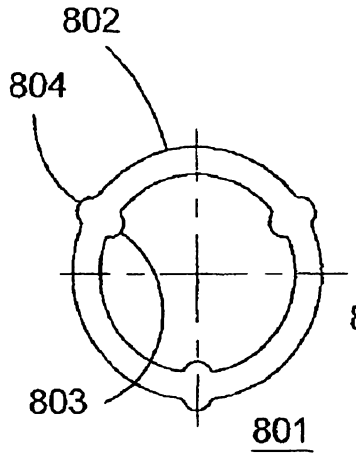

FIG. 8B

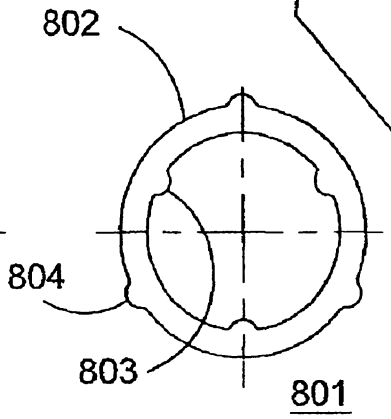

FIG. 8C

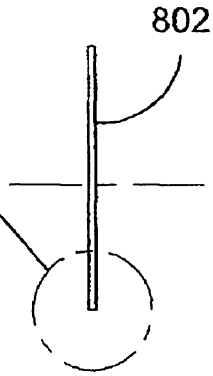

FIG. 8A

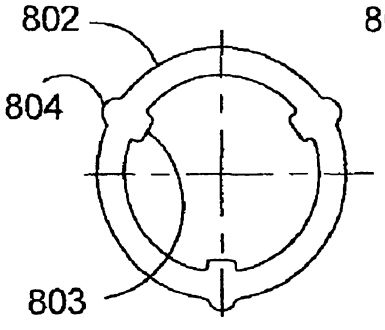

FIG. 8D

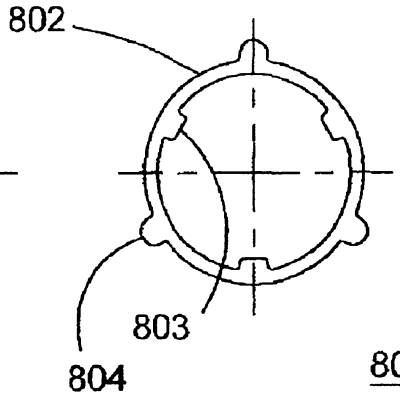

FIG. 8E

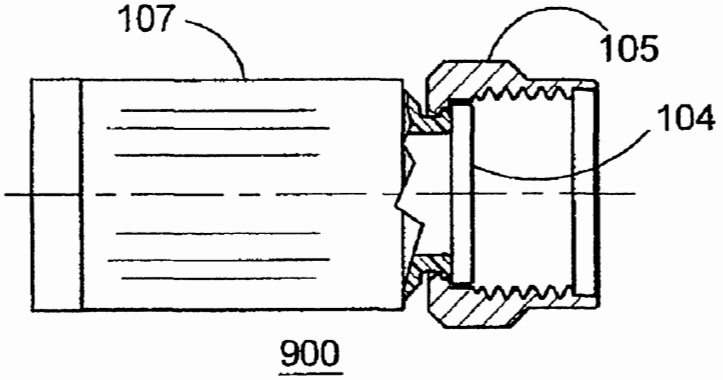

FIG. 9

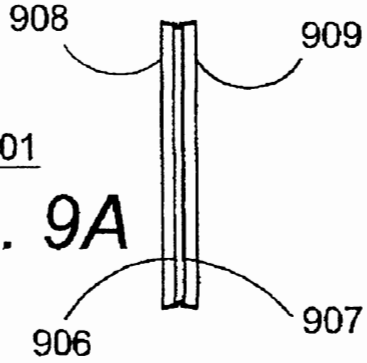

FIG. 9A

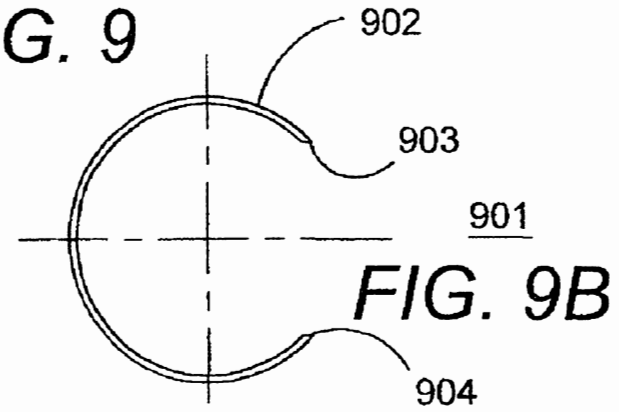

FIG. 9B

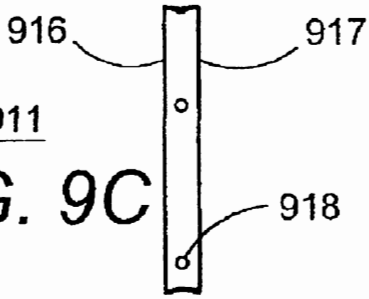

FIG. 9C

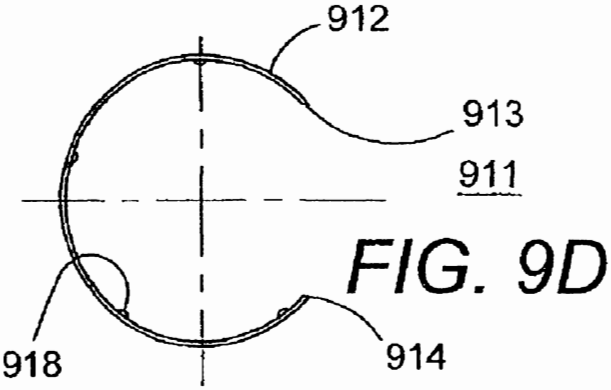

FIG. 9D

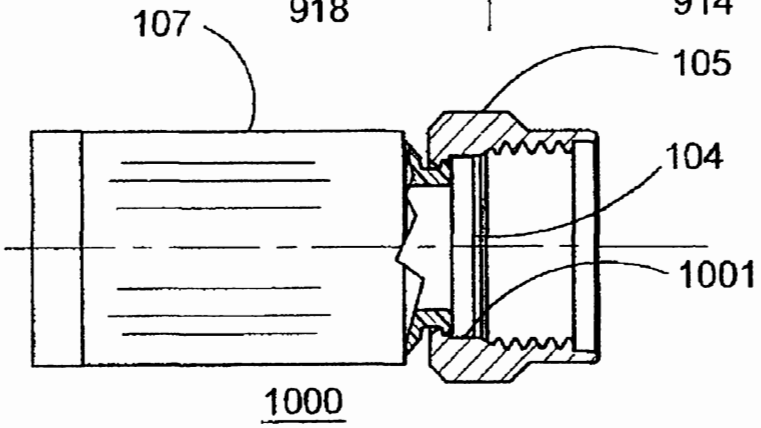

FIG. 10

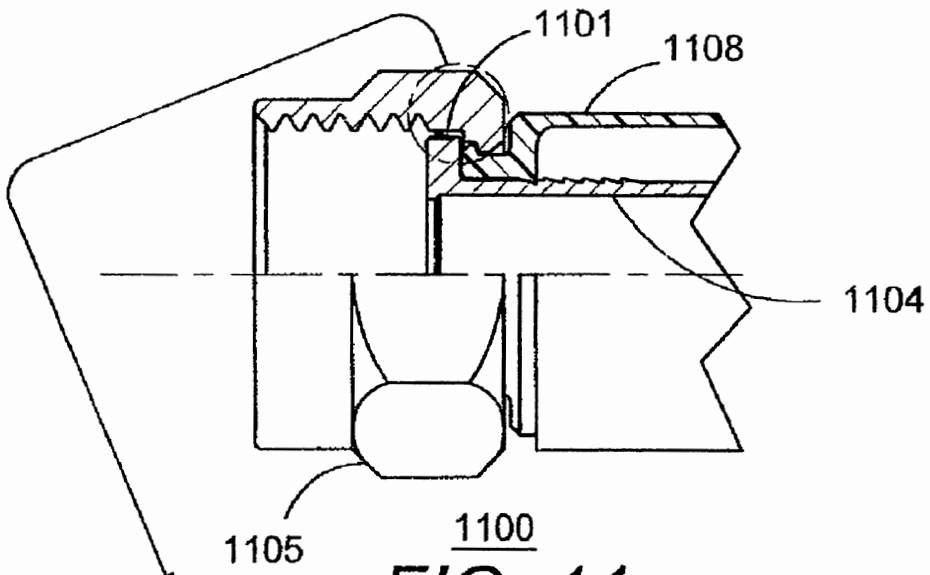

FIG. 11

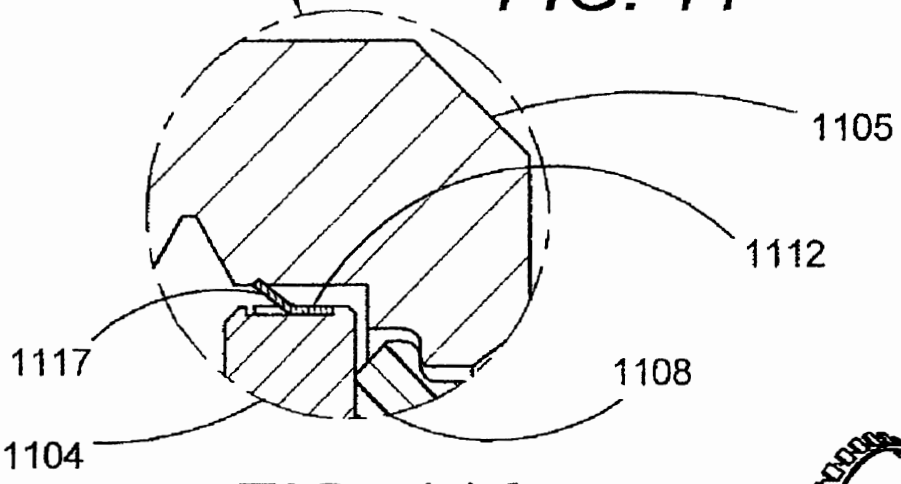

FIG. 11A

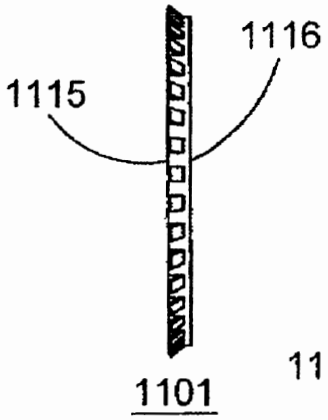

FIG. 11B

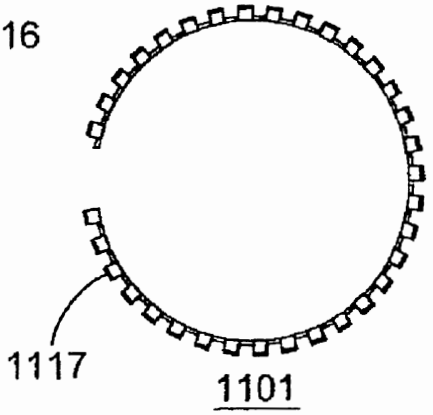

FIG. 11C

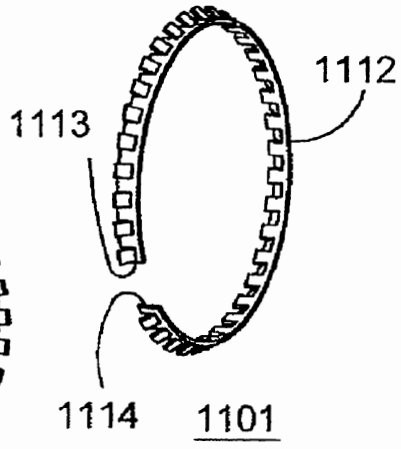

FIG. 11D

ELECTRICAL CONNECTOR WITH GROUNDING MEMBER

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 11/541,903 filed on Oct. 2, 2006 now U.S. Pat. No. 7,479,035 which claims the benefit of priority of U.S. patent application Ser. No. 11/043,844, filed Jan. 25, 2005, entitled, "Electrical Connector With Grounding Member".

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to electrical connectors, and more particularly to coaxial cable connectors capable of being connected to a terminal.

2. Description of the Related Art

Coaxial cable connectors, such as type F connectors, are used to attach coaxial cable to another object or appliance, e.g., a television set or VCR having a terminal adapted to engage the connector. The terminal of the appliance includes an inner conductor and a surrounding outer conductor.

Coaxial cable includes a center conductor for transmitting a signal. The center conductor is surrounded by a dielectric material, and the dielectric material is surrounded by an outer conductor; this outer conductor may be in the form of a conductive foil and/or braided sheath. The outer conductor is typically maintained at ground potential to shield the signal transmitted by the center conductor from stray noise, and to maintain a continuous desired impedance over the signal path. The outer conductor is usually surrounded by a plastic cable jacket that electrically insulates, and mechanically protects, the outer conductor. Prior to installing a coaxial connector onto an end of the coaxial cable, the end of the coaxial cable is typically prepared by stripping off the end portion of the jacket to bare the end portion of the outer conductor. Similarly, it is common to strip off a portion of the dielectric to expose the end portion of the center conductor.

Coaxial cable connectors of the type known in the trade as "F connectors" often include a tubular post designed to slide over the dielectric material, and under the outer conductor of the coaxial cable, at the prepared end of the coaxial cable. If the outer conductor of the cable includes a braided sheath, then the exposed braided sheath is usually folded back over the cable jacket. The cable jacket and folded-back outer conductor extend generally around the outside of the tubular post and are typically received in an outer body of the connector; this outer body of the connector is usually fixedly secured to the tubular post. A coupler is rotatably secured around the tubular post and includes an internally-threaded region for engaging external threads formed on the outer conductor of the appliance terminal.

When connecting the end of a coaxial cable to a terminal of a television set, equipment box, or other appliance, it is important to achieve a reliable electrical connection between the outer conductor of the coaxial cable and the outer conductor of the appliance terminal. This goal is usually achieved by ensuring that the coupler of the connector is fully tightened over the connection port of the appliance. When fully tightened, the head of the tubular post of the connector directly engages the edge of the outer conductor of the appliance port, thereby making a direct electrical ground connection between the outer conductor of the appliance port and the tubular post; in turn, the tubular post is engaged with the outer conductor of the coaxial cable.

However, in many cases, it is difficult for an installer to reach the connection ports of the appliance with a wrench, and in some instances, it is even difficult for the installer to reach such connection ports with his or her fingers. As a result, it can often happen that type F connectors are not fully tightened to the appliance port. In such a loose connection system, wherein the coupler of the coaxial connector is not drawn tightly to the appliance port connector, a gap exists between the outer conductor of the appliance port and the tubular post of the connector. Unless an alternate ground path exists, poor signal quality, and RFI leakage, will result.

As mentioned above, the coupler is rotatably secured about the head of the tubular post. The head of the tubular post usually includes an enlarged shoulder, and the coupler typically includes an inwardly-directed flange for extending over and around the shoulder of the tubular post. In order not to interfere with free rotation of the coupler, manufacturers of such F-style connectors routinely make the outer diameter of the shoulder (at the head of the tubular post) of smaller dimension than the inner diameter of the central bore of the coupler. Likewise, manufacturers routinely make the inner diameter of the inwardly-directed flange of the coupler of larger dimension than the outer diameter of the non-shoulder portion of the tubular post, again to avoid interference with rotation of the coupler relative to the tubular post. In a loose connection system, wherein the coupler of the coaxial connector is not drawn tightly to the appliance port connector, an alternate ground path may fortuitously result from contact between the coupler and the tubular post, particularly if the coupler is not centered over, and axially aligned with, the tubular post. However, this alternate ground path is not stable, and can be disrupted as a result of vibrations, movement of the appliance, movement of the cable, or the like.

Alternatively, there are some cases in which such an alternate ground path is provided by fortuitous contact between the coupler and the outer body of the coaxial connector, provided that the outer body is formed from conductive material. This alternate ground path is similarly unstable, and may be interrupted by relative movement between the appliance and the cable, or by vibrations. Moreover, this alternate ground path does not exist at all if the outer body of the coaxial connector is constructed of non-conductive material. Such unstable ground paths can give rise to intermittent failures that are costly and time-consuming to diagnose.

OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide a coaxial cable connector for connecting a coaxial cable to a connection port of an appliance, the coaxial cable connector being of the type that includes a tubular post and a coupler, such as a rotatable coupler, which ensures a reliable ground connection between the tubular post of the connector and an outer conductor of the appliance port, even if the coupler is not fully tightened onto the appliance port.

It is another object of the present invention to provide such a coaxial cable connector which maintains a reliable ground path between the coupler and the tubular post, at least following installation of such connector onto the end of a coaxial cable.

It is still another object of the present invention to provide such a coaxial connector that can be manufactured economically.

These and other objects of the present invention will become more apparent to those skilled in the art as the description thereof proceeds.

SUMMARY OF THE INVENTION

Briefly described, the present invention relates to a coaxial cable connector comprising a tubular post, a coupler and a grounding means for providing an electrically conductive path between the post and the coupler. In accordance with a preferred embodiment thereof, the present invention relates to a coaxial cable connector for coupling a prepared end of a coaxial cable to a threaded female equipment port, and including a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor thereof. A coupler is rotatably secured over the second end of the tubular post, and includes a central bore, at least a portion of which is threaded for engaging the female equipment port. An outer body is secured to the tubular post and extends about the first end of the tubular post for receiving the outer conductor, and preferably the cable jacket, of the coaxial cable.

In a preferred embodiment of the present invention, a resilient, electrically-conductive grounding member is disposed between the tubular post and the coupler. This grounding member engages both the tubular post and the coupler for providing an electrically-conductive path therebetween, but without restricting rotation of the coupler relative to the tubular post.

For some preferred embodiments, the grounding member is generally arcuately shaped to extend around the tubular post over an arc of at least 225°, and may extend for a full 360°. This arcuately shaped grounding member may be in the form of a generally circular broken ring, or C-shaped member, as by bending a strip of metal wire into an arc. Preferably, the grounding member has a shape that is out-of-round, and more preferably oblong, rather than circular, in order to ensure reliable electrical contact with both the coupler and the tubular post. In order to retain the grounding member inside the coupler, the inner bore of the coupler may include an annular recess proximate to the end of the coupler that encircles the tubular post; at least portions of the grounding member are engaged with the annular recess to prevent the grounding member from being axially displaced within the coupler.

As mentioned above, the tubular post may include an enlarged shoulder at the head thereof. In one preferred embodiment of the present invention, the grounding member surrounds the enlarged shoulder of the tubular post, at least when the coaxial cable connector is assembled onto the prepared end of a coaxial cable, whereby at least portions of the grounding member engage the outer surface of such enlarged shoulder.

In one embodiment of the present invention, the grounding member is generally circular and includes a plurality of projections extending outwardly therefrom for engaging the coupler. In another embodiment of the present invention, the grounding member is generally circular and includes a plurality of projections extending inwardly therefrom for engaging the tubular post.

In yet another embodiment of the present invention, the tubular post includes an enlarged shoulder extending inside the coupler, and including a first radial face that faces the opposite end of the tubular post. The coupler includes a flange directed inwardly toward the tubular post; this inwardly directed flange including a second radial face that faces toward the connection port of the appliance to which the coaxial cable is to be connected. The grounding member is disposed between the first radial face and the second radial face. In this embodiment, the grounding member is resilient relative to the longitudinal axis of the connector, and is compressed between the first radial face and the second radial face to maintain sliding electrical contact between the shoulder of the tubular post (via its first radial face) and the flange of the coupler (via its second radial face).

The coaxial connector of the present invention may also include a sealing ring seated within the coupler for rotatably engaging the body member to form a seal therebetween.

In an alternate embodiment of the present invention, conductive grease is substituted for a discrete grounding member. In this embodiment, an outer dimension of a portion of the tubular post is caused to be commensurate with an inner dimension of an adjacent portion of the coupler. While the gap between such adjacent portions, coupled with the lubrication provided by the conductive grease, is sufficient to permit rotation of the coupler relative to the tubular post, the conductive grease nonetheless functions to maintain reliable electrical coupling across such gap.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described with greater specificity and clarity with reference to the following drawings, in which:

FIG. **1** is a perspective view of an F connector in accordance with the preferred embodiment of the invention, including a body and a coupling nut;

FIG. **2** is an exploded view of the F connector of FIG. **1**, including a preferred embodiment of a grounding member;

FIG. **2**A is an enlarged plan view of the preferred embodiment of the grounding member of FIG. **2**;

FIG. **3** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3-3**, and a side view of a prepared coaxial cable ready to be inserted into a back end of the F connector;

FIG. **3**A is a cross-sectional view of the body of the F connector of FIG. **1** through cut-line **3-3**;

FIG. **3**B is a cross-sectional view of a tubular post of the F connector of FIG. **1**, through cut-line **3-3**;

FIG. **3**C is a cross-sectional view of the coupling nut of the F connector of FIG. **1** through cut-line **3-3**;

FIG. **4** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3-3**, and cross-sectional view of the prepared coaxial cable fully inserted into the back end thereof, prior to axial compression of the F connector;

FIG. **4**A is an enlargement of a portion of FIG. **4**;

FIG. **5** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3-3**, and a cross-sectional view of the prepared coaxial cable fully inserted into the back end thereof, subsequent to axial compression of the F connector;

FIG. **5**A is an enlargement of a portion of FIG. **5**;

FIG. **6** is a partial cross-sectional view of a first alternate embodiment of an F connector having a first alternate grounding member;

FIG. **6**A is an enlargement of a portion of FIG. **6**;

FIG. **6**B is a slightly enlarged side view of the first alternate grounding member of FIG. **6**;

FIG. **6**C is a slightly enlarged plan view of the first alternate grounding member of FIG. **6**;

FIG. **7** is a partial cross-sectional view of a second alternate embodiment of an F connector having a second alternate grounding member;

FIG. **7**A is an enlargement of a portion of FIG. **7**;

FIG. **7**B is a slightly enlarged side view of the second alternate grounding member of FIG. **7**;

FIG. **7**C is a slightly enlarged plan view of the second alternate grounding member of FIG. **7**;

FIG. **8** is a partial cross-sectional view of a third alternate embodiment of an F connector having a third alternate grounding member;

FIG. **8**A is a slightly enlarged side view of the third alternate grounding member of FIG. **8**;

FIGS. **8**B-**8**E are slightly enlarged plan views of four styles of the third alternate grounding member of FIG. **8**;

FIG. **9** is a partial cross-sectional view of a fourth alternate embodiment of an F connector having one of a fourth alternate grounding member and a fifth alternate grounding member;

FIG. **9**A is a slightly enlarged side view of the fourth alternate grounding member of FIG. **9**;

FIG. **9**B is a slightly enlarged plan view of the fourth alternate grounding member of FIG. **9**;

FIG. **9**C is a slightly enlarged side view of the fifth alternate grounding member of FIG. **9**;

FIG. **9**D is a slightly enlarged plan view of the fifth alternate grounding member of FIG. **9**;

FIG. **10** is a partial cross-sectional view of a fifth alternate embodiment of an F connector having conductive grease that acts as a grounding member;

FIG. **11** is a partial cross-sectional view of a front end of a sixth alternate embodiment of an F connector having a sixth alternate grounding member;

FIG. **11**A is an enlargement of a portion of FIG. **11**;

FIG. **11**B is a side view of the sixth alternate grounding member of FIG. **11**;

FIG. **11**C is a plan view of the sixth alternate grounding member of FIG. **11**; and

FIG. **11**D is a perspective view of the sixth alternate grounding member of FIG. **11**.

For simplicity and clarity of illustration, the drawing figures illustrate the general manner of construction, and descriptions and details of well-known features and techniques are omitted to avoid unnecessarily obscuring the invention. Furthermore, elements in the drawing figures are not necessarily drawn to scale.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** is a perspective view of an F connector **100** in accordance with the preferred embodiment of the invention. The F connector **100** hereinafter, "connector") has a longitudinal axis **101**. The connector has a front end **102** and a back end **103**.

FIG. **2** is an exploded view of the connector **100**. The connector **100** includes tubular post **104**, a coupling nut **105** rotatably secured over an end **106** of the tubular post for securing the connector to an appliance (not shown), and a body **108** secured to the tubular post. A shell **107** and a label **109** are secured to the body **108**. Preferably, the body **108** is made entirely of acetal plastic. Alternatively, the body **108** is made of brass, plated with nickel. The shell **107** adds strength to the plastic body **108** and protects the plastic body from ultraviolet light. The tubular post **104** is preferably metallic, and more preferably, made of brass, with a tin plating; as tin is more conductive than nickel. The coupling nut **105** is preferably metallic, and more preferably, formed from brass, plated with nickel or with another non-corrosive material.

In the embodiment shown in the drawings, the coupling nut **105** is rotatably secured over an end **106** of the tubular post **104** via a neck **111** of the body **108**. Advantageously, an electrical grounding path is constantly maintained between the coupling nut **105** and the tubular post **104**, including, in particular, when the coupling nut **105** of the connector **100** is not tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member **110** disposed between the tubular post **104** and the coupling nut **105**.

FIG. **2**A is an enlarged plan view of the preferred embodiment of the grounding member **110**. In the preferred embodiment of the present invention, the electrically-conductive grounding member **110** is disposed between the tubular post **104** and the coupling nut **105**. The grounding member **110** contacts both the tubular post **104** and the coupling nut **105** for providing an electrically-conductive path therebetween, but without restricting rotation of the coupling nut relative to the tubular post. A preferred embodiment of the grounding member **110** shown in FIG. **2**A is a spring member, or circlip, disposed between the coupling nut **105** and the tubular post **104**, which establishes a stable ground path between the coupling nut and the post, and which is preferably constructed of a wire-type material. The grounding member **110** is retained in the coupling nut **105** by an annular recess **343** (see FIG. **3**C) in the coupling nut. The spring action of the grounding member **110** serves to form a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut **105** to rotate. The grounding member **110** is resilient and is generally arcuately shaped. The grounding member **110** extends around the tubular post **104** over an arc of at least 225°, and may extend for a full 360°. The arcuately shaped grounding member **110** may be in the form of a generally circular broken ring, or C-shaped member, as by bending a strip of metal wire into an arc. Preferably, the grounding member **110** is a C-shaped metal clip that has an arcuate curvature that is non-circular. The grounding member **110** has a minimum diameter **201** and a maximum diameter **203**. Preferably, the grounding member **110** is made of stainless steel wire that has a wire diameter of between 0.010-inch and 0.020-inch; in a preferred embodiment, the wire diameter is about 0.016-inch. Stainless steel is a preferred metal for the grounding member **110** because it need not be plated for corrosion resistance.

FIG. **3** is a cross-sectional view of the connector **100** through cut-line **3**-**3** of FIG. **1**, and a side view of a prepared coaxial cable **301** ready to be inserted into a back end **103** of the connector. The center conductor **302** of the coaxial cable **301** is surrounded by a dielectric material **303**, and the dielectric material is surrounded by an outer conductor **304** that may be in the form of a conductive foil and/or braided sheath. The outer conductor **304** is usually surrounded by a plastic cable jacket **305** that electrically insulates, and mechanically protects, the outer conductor.

FIG. **3**A is a cross-sectional view of the body **108** of FIG. **1** through cut-line **3**-**3**. FIG. **3**B is a cross-sectional view of the tubular post **104** of FIG. **1** through cut-line **3**-**3**. FIG. **3**C is a cross-sectional view of the coupling nut **105** of FIG. **1** through cut-line **3**-**3**. Referring now to FIGS. **3**, **3**A, **3**B and **3**C, the body **108** has a lip **310** at a front end of the body. The lip **310** has an outer diameter **311** and an inner diameter **312**. The coupling nut **105** is rotatably secured about a head **330** at the front end of the tubular post **104**. The head **330** of the tubular post **104** usually includes an enlarged shoulder **332**. The coupling nut **105** typically includes an inwardly-directed flange **340** that extends over and around the shoulder **332** of the tubular post **104**. In order to retain the grounding member **110** inside the coupling nut **105**, the inner, or central, bore **342** of the coupling nut **105** may include an annular recess **343** that is proximate to the end of the coupling nut that encircles the tubular post **104**. At least portions of the grounding member **110** are engaged with the annular recess **343** to prevent the grounding member from being axially displaced within the

coupling nut **105**. The tubular post **104** may include an enlarged shoulder **332** at the head **330** thereof. The shoulder **332** has a first radial face **333** that faces the back end of the tubular post **104**. In one preferred embodiment of the present invention, the grounding member **110** surrounds the enlarged shoulder **332** of the tubular post **104**, at least when the connector **100** is assembled onto the prepared end of a coaxial cable **301**. At least portions of the grounding member **110** contact the outer surface **334** of such enlarged shoulder **332**.

The coupling nut **105** has an inwardly-directed flange near the back end of the coupling nut. The coupling nut **105** has an inner diameter **341** at a back end of the coupling nut. In order to retain the back end of the coupling nut **105** on the front end of the body **108**, the inner diameter **341** of the coupling nut has a dimension less than the outer diameter of the lip **310** of the body **108**. In order not to interfere with free rotation of the coupling nut **105**, the outer diameter **336** of the shoulder **332** (at the head **330** of the tubular post **104**) is of smaller dimension than the inner diameter **344** of the central bore of the coupling nut **105**. Likewise, the inner diameter **341** of the inwardly-directed flange **340** of the coupling nut **105** is of larger dimension than the outer diameter **337** of the non-shoulder portion **338** of the tubular post **104**, again to avoid interference with rotation of the coupling nut **105** relative to the tubular post.

FIG. **4** is a cross-sectional view of the connector **100** through cut-line **3-3**, and cross-sectional view of the prepared coaxial cable **301** fully inserted into the back end **103** thereof prior to axial compression of the connector. FIG. **4**A is an enlargement of a portion of FIG. **4**. Referring now to FIGS. **4** and **4**A, the resilient, electrically-conductive grounding member **110** is shown disposed between the tubular post **104** and the coupling nut **105**. The grounding member **110** is disposed in the annular recess **343** that encircles the tubular post **104**.

FIG. **5** is a cross-sectional view of the connector **100** through cut-line **3-3**, and a cross-sectional view of the prepared coaxial cable **301** fully inserted into the back end **103** thereof, subsequent to axial compression of the connector. FIG. **5**A is an enlargement of a portion of FIG. **5**. Referring now to FIGS. **5** and **5**A, as a result of axial compression by a standard compression tool (not shown), the tubular post **104** slides (to the right in the drawings) relative to the other components of the connector **100** and relative to the cable **301**, such that the shoulder **332** of the tubular post is radially inward of the grounding member **110**. At least a portion of the grounding member **110** engages the coupling nut **105** at the annular recess **343** of the coupling nut, and at least another portion of the grounding member engages tubular post **104** at the shoulder **332** of the tubular post. The tubular post **104** is in electrical contact with the outer conductor **304** of the cable **301** along the back portion of the tubular post, and the coupling nut **105** may engage the outer conductor of an appliance port (not shown). Therefore, when the connector **100** is fastened to an appliance port, there is maintained an electrical grounding path between the outer conductor **304** of the cable **301** and the outer conductor of the appliance port, whether or not the coupling nut **105** of the connector is tightly fastened to the appliance port.

FIG. **6** is a partial cross-sectional view of a first alternate embodiment of a connector **600** having a first alternate grounding member **601** (see FIGS. **6**A-**6**C), shown subsequent to axial compression. FIG. **6**A is an enlargement of a portion of the first alternate embodiment of the connector **600** showing a portion of the first alternate grounding member **601**. FIG. **6**B is a slightly enlarged side view of the first alternate grounding member **601**. FIG. **6**C is a slightly enlarged plan view of the first alternate grounding member **601**. Referring now to FIGS. **6**, **6**A, **6**B and **6**C, the first alternate grounding member **601** is a spring finger grounding member retained between the coupling nut **105** and the tubular post **104**. The first alternate grounding member **601** is constructed of a thin cross section of material such beryllium copper. The first alternate grounding member **601** comprises a ring portion **602** and a plurality of fingers **603** that project at approximately a 30° angle from the plane of the ring. The spring action of the fingers **603** extend to, and make contact with, a radial surface **604** near the back end of the coupling nut **105** that faces the front end of the coupling nut, which serve to connect a ground path from the coupling nut to the tubular post while allowing the coupling nut to rotate. The first alternate grounding member **601** has optional internal lugs **605** that contact the outer diameter **337** of the non-shoulder portion of the tubular post.

FIG. **7** is a partial cross-sectional view of a second alternate embodiment of a connector **700** having a second alternate grounding member **701** (see FIGS. **7**A-**7**C). FIG. **7**A is an enlargement of a portion of the second alternate embodiment of the connector **700**, showing a portion of the second alternate grounding member **701**. FIG. **7**B is a slightly enlarged side view of the second alternate grounding member **701**. FIG. **7**C is a slightly enlarged plan view of the second alternate grounding member **701**. Referring now to FIGS. **7**, **7**A, **7**B and **7**C, the second alternate grounding member **701** is a radial grounding member retained between the coupling nut **105** and the tubular post **104**. The second alternate grounding member **701** is constructed of a thin cross section of metallic material such as beryllium copper. The second alternate grounding member **701** comprises a ring portion **702** and a plurality of fingers **703** extending radially from the ring portion at about a 45° angle from the plane of the ring portion. The spring action of the fingers **703** extend to inner-diameter surfaces **705** of the coupling nut **105** and serve to connect a ground path from the coupling nut to the tubular post **104** while allowing the coupling nut to rotate.

FIG. **8** is a partial cross-sectional view of a third alternate embodiment of a connector **800** having a third alternate grounding member **801** (see FIGS. **8**A-**8**E). FIG. **8**A is a slightly enlarged side view of the third alternate grounding member **801**. FIGS. **8**B-**8**E are slightly enlarged plan views of four styles of the third alternate grounding member **801**. Referring now to FIG. **8** and FIGS. **8**A-**8**E, the third alternate grounding member **801** is a conductive member retained between the coupling nut **105** and the tubular post **104**. The third alternate grounding member **801** is constructed of a thin cross section of metallic material such as brass or beryllium copper. The third alternate grounding member **801** comprises a ring **802** with multiple points of contact, or internal lugs, **803** around the inner perimeter of the ring and with multiple external lugs **804** around the outer perimeter of the ring. The lugs **803** and **804** serve to connect a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate. FIGS. **8**B-**8**E show four styles with regard to the shape of the lugs **803** and **804** and the position of the lugs on the ring **802**. FIG. **8** also exhibits an alternate embodiment comprising a sealing ring **805** for forming a moisture seal between the coupling nut **105** and the body **108** of the connector **801**. The sealing ring **805** is disposed between the back end of the coupling nut **105** and the body **108** for forming a seal therebetween. Preferably, the sealing ring **805** is made from ethylene propylene. Use of the sealing ring **805** is not limited to use in connectors having the third

alternate grounding member **801**. The third alternate grounding member **801** may also be used in connectors without the sealing ring **805**.

FIG. **9** is a partial cross-sectional view of a fourth alternate embodiment of a connector **900** having one of a fourth alternate grounding member **901** and a fifth alternate grounding member **911** (see FIGS. **9**A-**9**D). FIG. **9**A is a slightly enlarged side view of the fourth alternate grounding member **901**. FIG. **9**B is a slightly enlarged plan view of the fourth alternate grounding member **901**. FIG. **9**C is a slightly enlarged side view of the fifth alternate grounding member **902**. FIG. **9**D is a slightly enlarged plan view of the fifth alternate grounding member **911**. The fourth and fifth alternate embodiments of the grounding member **901** and **911**, respectively, comprise a C-shaped ring between the coupling nut **105** and the tubular post **104**. The C-shaped ring is constructed of a thin cross section of metallic material such as beryllium copper or stainless steel. It is retained by a groove in the coupling nut. The spring action of the C-shaped ring serves to connect a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate. The fourth alternate grounding member **901** includes a circumferential metallic band **902**, which has a general circular shape and approximates a section of a hollow cylinder, that extends between first **903** and second **904** opposing ends. The band **902** has first **906** and second **907** opposing side edges extending along its length. The fourth alternate grounding member **901** includes a first generally radial wall **908** extending from the first side edge **906** of the band in a first radial direction, and a second generally radial wall **909** extending from the second side edge **907** of the band generally in said first radial direction. The band **902** contacts a first one of the group of members that includes the coupling nut **105** and the tubular post **104**. The first **908** and second **909** radial walls contact the second of the group of members that includes the coupling nut **105** and the tubular post **104**. The fifth alternate grounding member **911** includes a metallic band **912** extending along its length between first **913** and second **914** opposing ends, and extending along its width between first **916** and second **917** side edges. The band **912** is formed along its length into a generally circular shape. The band **912** is formed along its width into a generally concave shape with the side edges **916** and **917** projecting generally in a first radial direction. The fifth alternate grounding member **911** includes a plurality of projections **918** extending from the band **912** in a second radial direction opposite to the first radial direction. The first **916** and second **917** side edges of the band **912** contact a first one of the group of members that includes the coupling nut and the tubular post The plurality of projections **918** contact the second of the group of members that includes the coupling nut **105** and the tubular post **104**.

FIG. **10** is a partial cross-sectional view of a fifth alternate embodiment of a connector **1000** having conductive grease (not shown) that acts as a grounding member. The ground path is established by means of a close fit between the coupling nut **105** and the tubular post **104**. The conductive grease is disposed at a grease annular ring **1001** where mating portions of the tubular post **104** and coupling nut **105** have closely matching dimensions. Preferably, the conductive grease is a silver-loaded silicon lubricating material. The conductive grease serves to connect a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate.

FIG. **11** is a partial cross-sectional view of a front end of a sixth alternate embodiment of an F connector **1100** that includes a body **1108**, and which has a sixth alternate grounding member **1101**. FIG. **11**A is an enlargement of a portion of FIG. **11**. FIG. **11**B is a side view of the sixth alternate grounding member **1101**. FIG. **11**C is a plan view of the sixth alternate grounding member **1101**. FIG. **11**D is a perspective view of the sixth alternate grounding member **1101**. Referring now to FIG. **11** and FIGS. **11**A-**11**D, the sixth alternate grounding member **1101** includes a circumferential metallic band **1112** extending between first **1113** and second **1114** opposing ends. The band **1112** has a generally circular shape that approximates a section of a hollow cylinder. The first **1113** and second **1114** ends of the band **1112** are disposed generally proximate to each other and are directed generally toward one another. The band **1112** has first and second opposing side edges **1115** and **1116**, respectively, extending along its length. The band generally defines a section of a cylindrical surface. The sixth alternate grounding member **1101** includes a plurality of projections **1101** extending from at least one of the first and second side edges **1115** and **1116** of the band **1112**. The plurality of projections **1117** extend away from the cylindrical surface defined by the band **1112**. The band **1112** contacts a first one of the group of members that includes the coupling nut **1105** and the tubular post **1104**. The plurality of projections **1117** contact the second of the group of members that includes the coupling nut **1105** and the tubular post **1104**.

In preferred embodiments, the present invention provides a coaxial cable connector that ensures a reliable grounding path without creating undue interference with free rotation of the coupler relative to the remaining components of the connector; however, the present invention can also provide a reliable grounding path between a post and a coupler that does not rotate. Advantageously, a connector in accordance with the invention works with standard installation tools and with standard compression tools. The present invention can be used with both axially-compressible connectors as well as with older-style crimp-ring connectors. In some embodiments, the present invention is compatible with the use of a sealing ring for forming a moisture seal between the coupler and the outer body of the connector.

While the present invention has been described with respect to preferred embodiments thereof, such description is for illustrative purposes only, and is not to be construed as limiting the scope of the invention. Various modifications and changes may be made to the described embodiments by those skilled in the art without departing from the true spirit and scope of the invention as defined by the appended claims. For example, the grounding member can have a shape other than generally circular, such as square, hexagonal, octagonal, oval, etc.

LIST OF REFERENCE NUMERALS

F connector ("connector")
101 Longitudinal axis
102 Front end
103 Back end
104 Tubular post
105 Coupling nut
106 End of tubular post
107 Shell
108 Body
109 Label
110 Grounding member
111 Neck
201 Minimum diameter
203 Maximum diameter
301 Coaxial cable
302 Center conductor

303 Dielectric material
304 Outer conductor
305 Jacket
310 Lip of body
311 Outer diameter of lip body
312 Inner diameter of lip of body
330 Head of tubular post
332 Shoulder of tubular post
333 First radial face of shoulder of tubular post
334 Outer surface of shoulder
336 Outer diameter of shoulder
337 Outer diameter of non-shoulder portion of post
338 Non-shoulder portion of post
340 Inwardly-directed flange of coupling nut
341 Inner diameter of inwardly-directed flange
342 Bore of coupling nut
343 Annular recess of coupling nut
344 Inner diameter of bore of coupling nut
600 First alternate connector
601 First alternate grounding member
602 Ring portion of first alternate grounding member
603 Fingers of first alternate grounding member
604 Radial surface of coupling nut
605 Internal lugs of first alternate grounding member
700 Second alternate connector
701 Second alternate grounding member
702 Ring portion of second alternate grounding member
703 Fingers of second alternate grounding member
800 Third alternate connector
801 Third alternate grounding member
802 Ring portion of third alternate grounding member
803 Internal lugs of third alternate grounding member
804 External lugs of third alternate grounding member
805 Sealing ring
900 Fourth alternate connector
901 Fourth alternate grounding member
902 Band of forth alternate grounding member
903 First end of band
904 Second end of band
906 First side edge of band
907 Second side edge of band
908 First radial wall of band
909 Second radial wall of band
911 Fifth alternate grounding member
1000 Fifth alternate connector
1001 Grease annular ring
1100 Sixth alternate connector
1101 Sixth alternate grounding member
1104 Tubular post of sixth alternate connector
1105 Coupling nut of sixth alternate connector
1108 Body of sixth alternate connector
1112 Band of sixth alternate grounding member
1113 First end of band
1114 Second end of band
1115 First side edge of band
1116 Second side edge of band
1117 Projections on band

We claim:

1. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member contacts the coupler; and

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween;

wherein the tubular post includes an enlarged shoulder at the second end thereof extending inside the coupler and wherein at least a portion of the grounding member contacting the tubular post surrounds the enlarged shoulder of the tubular post.

2. The coaxial cable connector of claim **1**, wherein at least a portion of the grounding member does not contact the tubular post and is angled relative to the portion of the grounding member that contacts the tubular post.

3. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member contacts the coupler; and

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween;

wherein the coaxial cable connector extends along a longitudinal axis and at least a portion of the grounding member contacting the tubular post coextends with the tubular post along a length parallel to the longitudinal axis.

4. The coaxial cable connector of claim **3**, wherein at least a portion of the grounding member does not contact the tubular post and is angled relative to the portion of the grounding member that contacts the tubular post.

5. The coaxial cable connector of claim **4**, wherein the portion of the grounding member that is angled relative to the portion of the grounding member that contacts the tubular post is angled radially outward.

6. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member contacts the coupler; and

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween;

wherein the grounding member comprises a circumferential band comprising a section that approximates a hollow cylinder, the circumferential band having first and second opposing side edges.

7. The coaxial cable connector of claim **6**, wherein the section that approximates a hollow cylinder comprises a cylindrical surface that extends to one of first and second opposing side edges and wherein the other of first and second opposing side edges extends away from the cylindrical surface.

8. The coaxial cable connector of claim **7**, wherein the coaxial cable connector extends along a longitudinal axis and the cylindrical surface coextends with the tubular post along a length parallel to the longitudinal axis.

9. The coaxial cable connector of claim **3**, wherein the grounding member comprises metal.

10. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:

a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;

b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;

c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member contacts the coupler; and

d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween;

wherein the grounding member is a radial grounding member.

11. The coaxial cable connector of claim **10**, wherein the grounding member comprises a thin cross section of metallic material.

12. The coaxial cable connector of claim **11**, wherein the grounding member comprises beryllium copper.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,955,126 B2
APPLICATION NO. : 12/332925
DATED : June 7, 2011
INVENTOR(S) : Bence et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,

Related U.S. Application Data

Item (63) "Continuation of application No. 11/541,903, filed on Oct. 2, 2006, now Pat. No. 7,479,035." should be -- Continuation of application No. 11/541,903, filed on Oct. 2, 2006, now Pat. No. 7,479,035 which is a Continuation of application No. 11/043,844, filed on Jan. 25, 2005, now Pat. No. 7,114,990. --.

Signed and Sealed this
Eighth Day of November, 2011

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

US008172612B2

(12) **United States Patent**
Bence et al.

(10) **Patent No.: US 8,172,612 B2**
(45) **Date of Patent: May 8, 2012**

(54) **ELECTRICAL CONNECTOR WITH GROUNDING MEMBER**

(75) Inventors: **Bruce D. Bence**, Glendale, AZ (US); **Donald A. Burris**, Peoria, AZ (US); **Brian L. Kisling**, Phoenix, AZ (US); **John A. Kooiman**, Peoria, AZ (US); **William B. Lutz**, Glendale, AZ (US); **William F. McDade**, Glendale, AZ (US); **Thomas D. Miller**, Peoria, AZ (US); **Lee Yung Chuan**, Sanchong (TW)

(73) Assignee: **Corning Gilbert Inc.**, Glendale, AZ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/117,843**

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Related U.S. Application Data

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(51) **Int. Cl.**
H01R 9/05 (2006.01)

(52) **U.S. Cl.** **439/578**

(58) **Field of Classification Search** 439/578, 439/583, 584, 320, 322, 314

See application file for complete search history.

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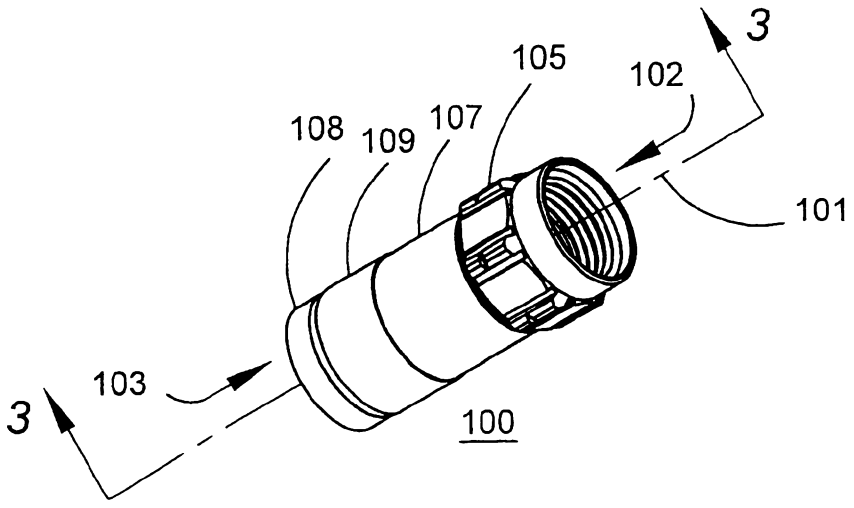
(57) **ABSTRACT**

A coaxial cable connector includes tubular post, a coupler secured over an end of the tubular post for securing the connector to an appliance, and an outer body secured to the tubular post. An electrical grounding path is maintained between the coupler and the tubular post whether or not the coupler is tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler. Alternatively, the connector includes conductive grease at a point where mating portions of the tubular post and coupler have closely matching dimensions.

23 Claims, 8 Drawing Sheets



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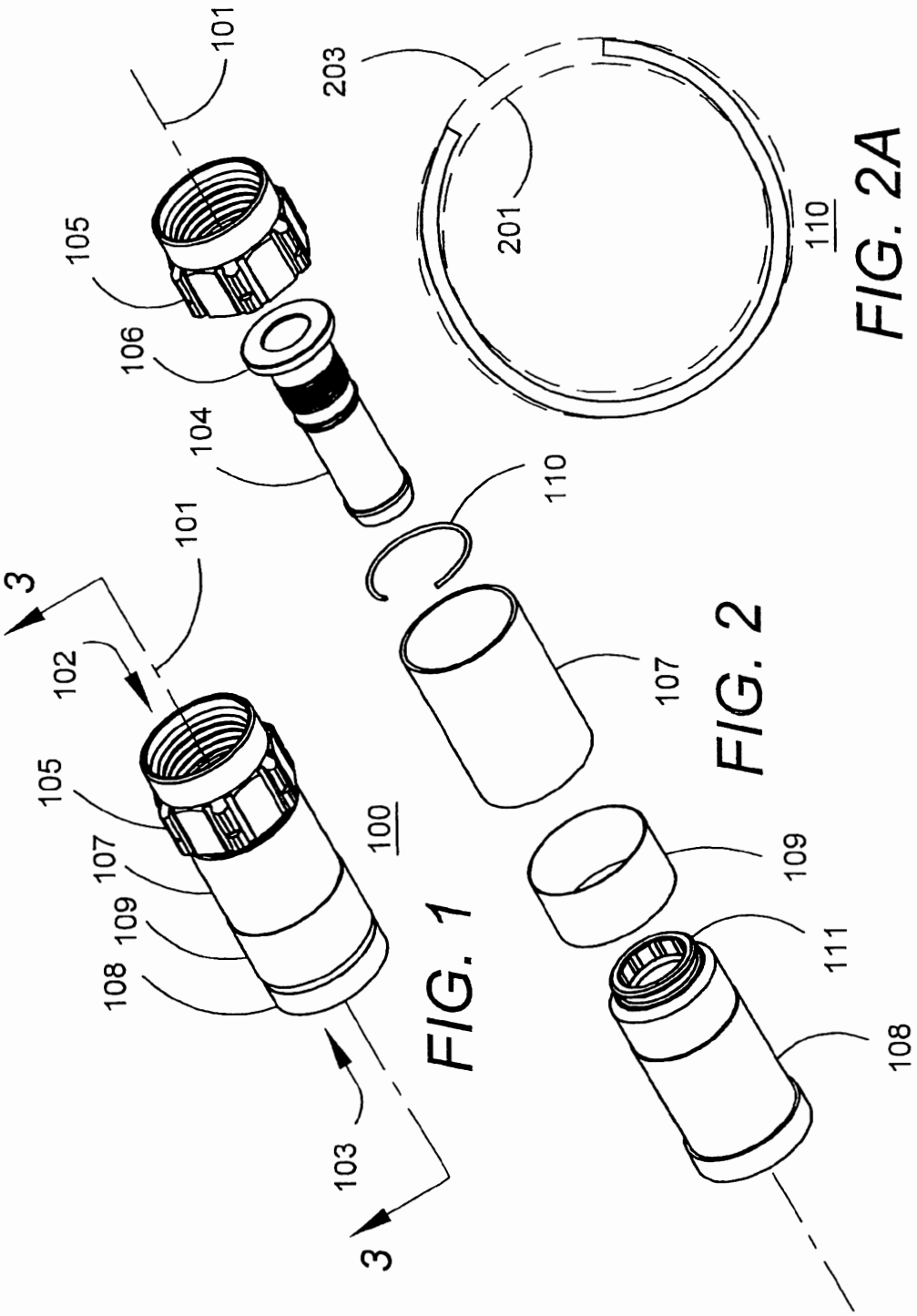


FIG. 1

FIG. 2

FIG. 2A

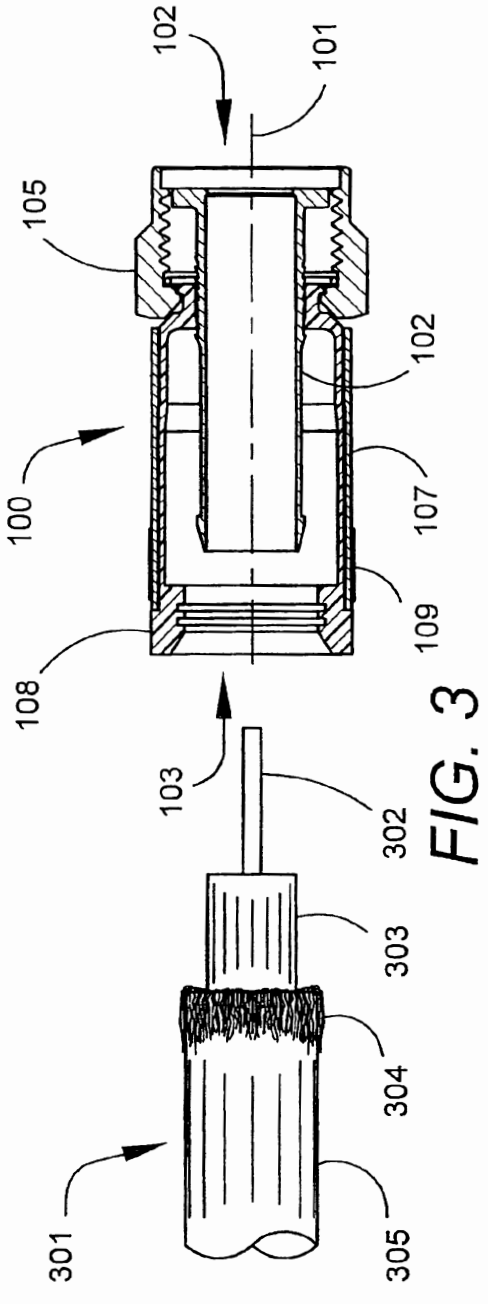


FIG. 3

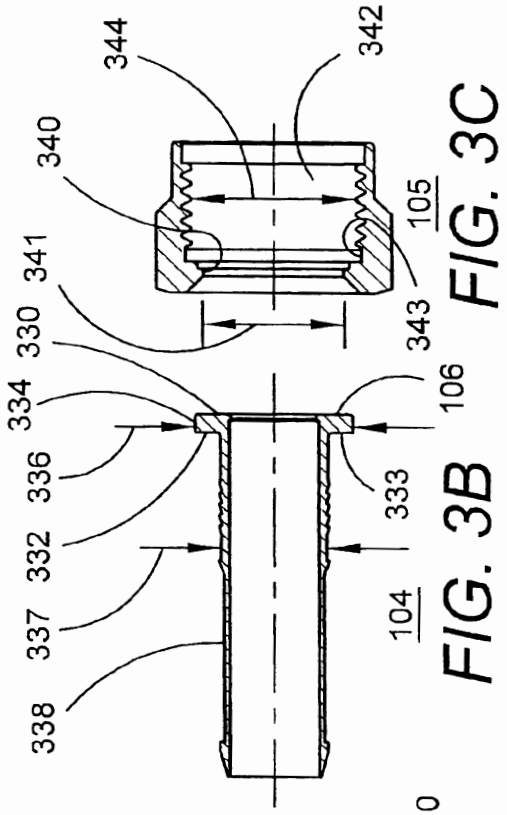


FIG. 3B

FIG. 3C

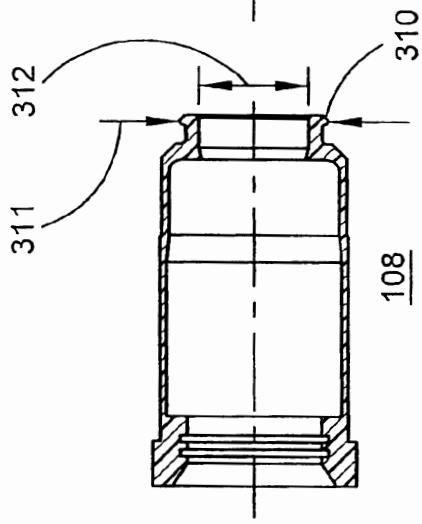


FIG. 3A

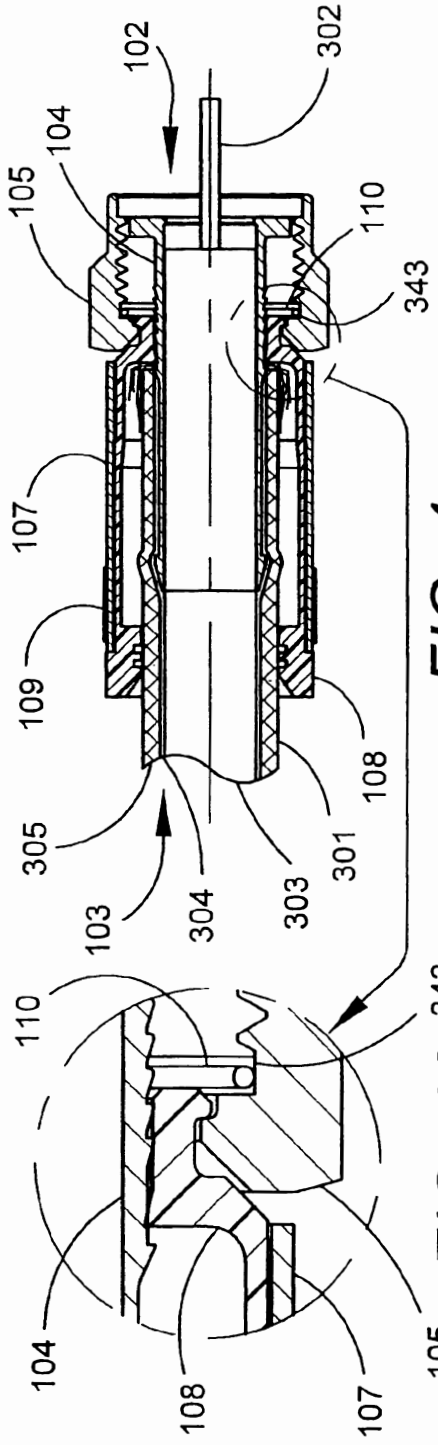


FIG. 4

FIG. 4A

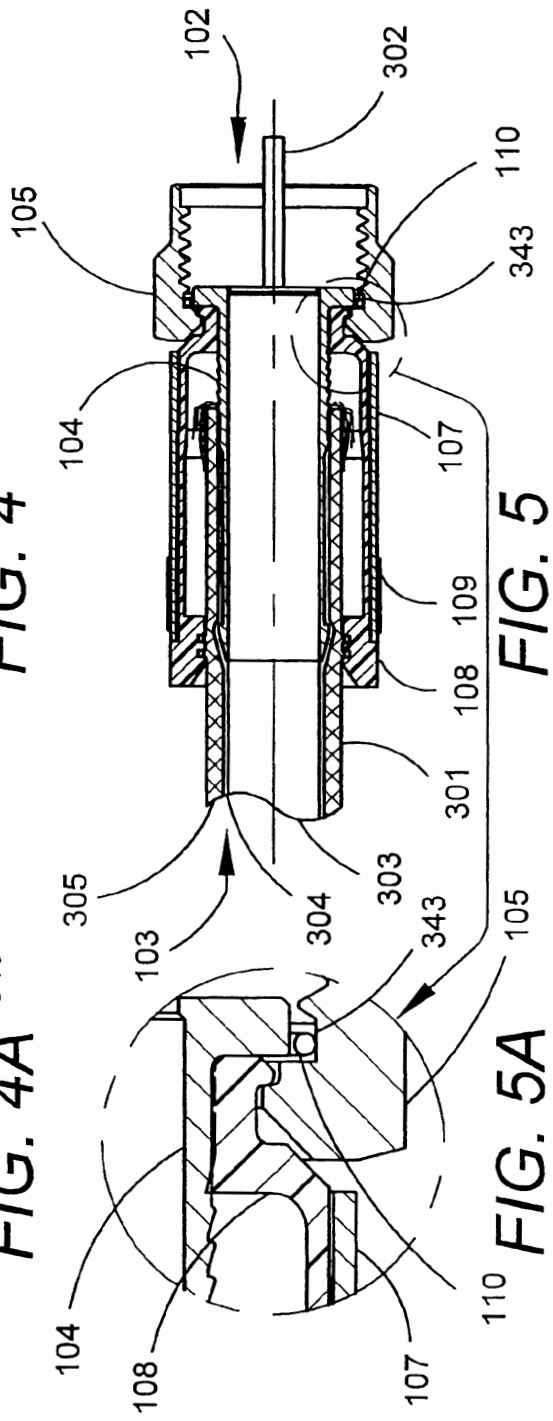


FIG. 5

FIG. 5A

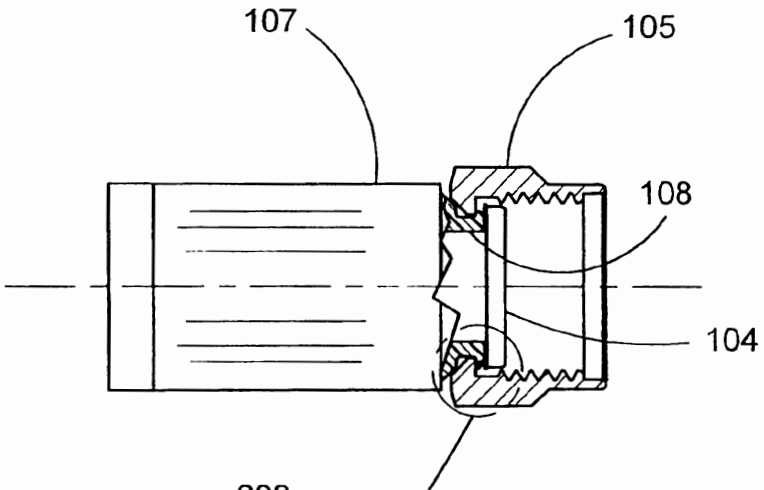


FIG. 6

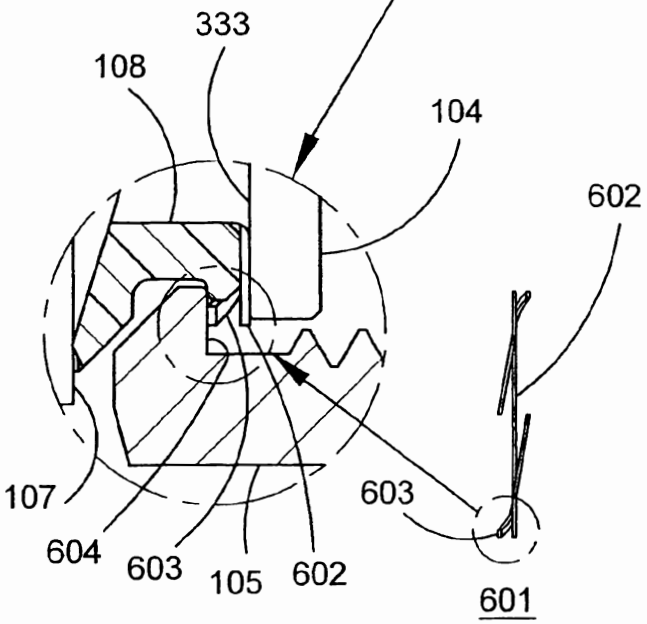


FIG. 6A

FIG. 6B

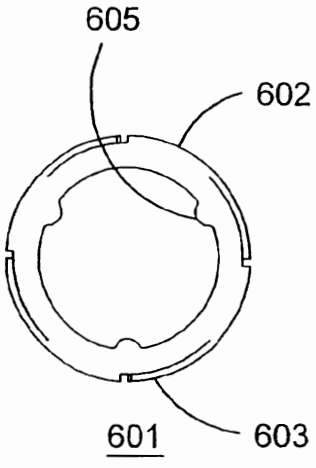


FIG. 6C

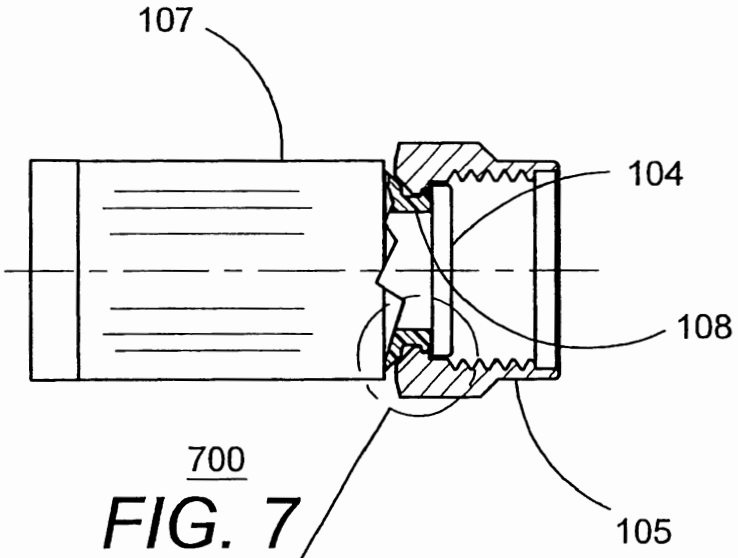


FIG. 7

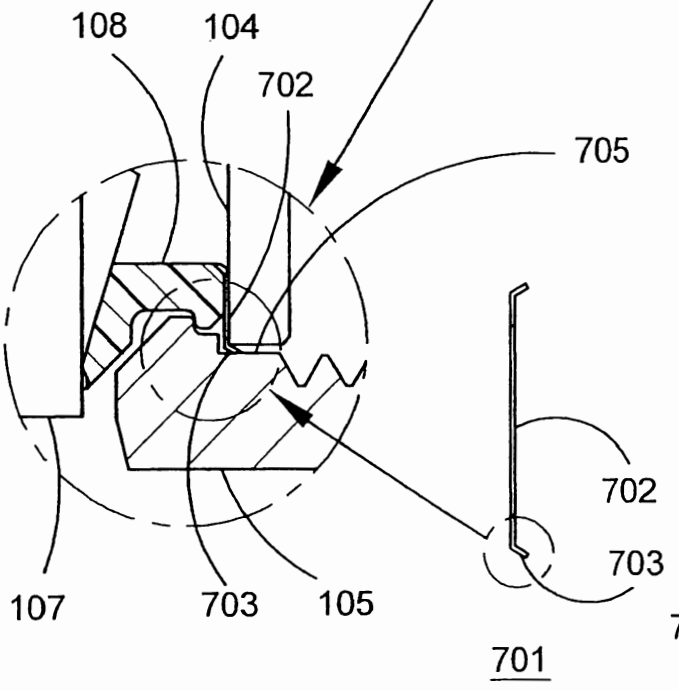


FIG. 7A

FIG. 7B

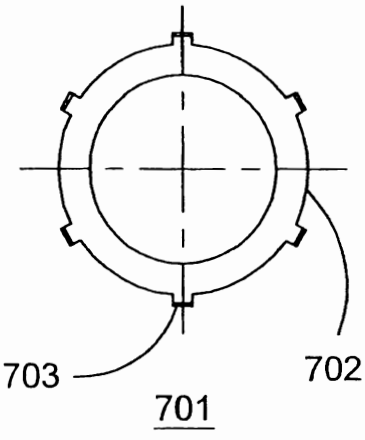


FIG. 7C

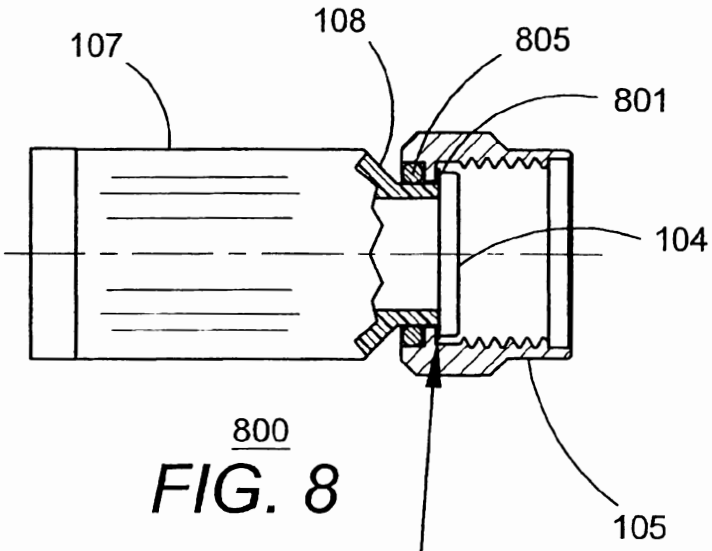


FIG. 8

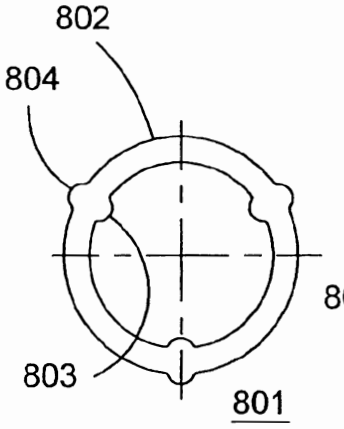


FIG. 8B

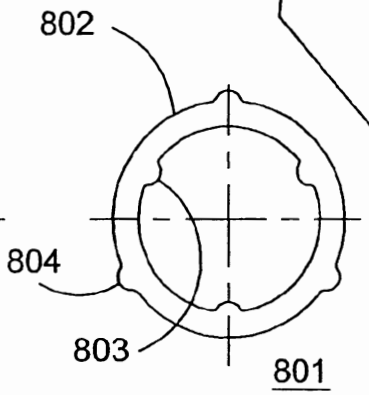


FIG. 8C

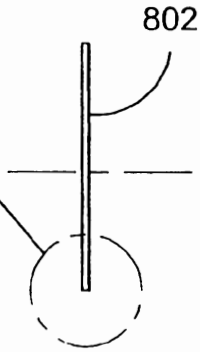


FIG. 8A

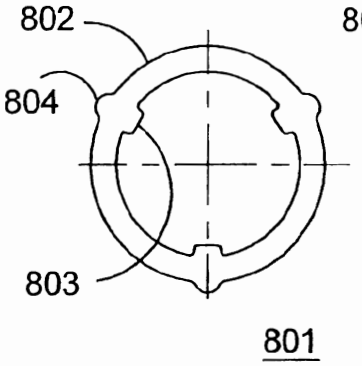


FIG. 8D

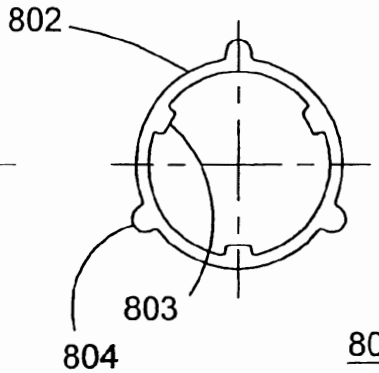


FIG. 8E

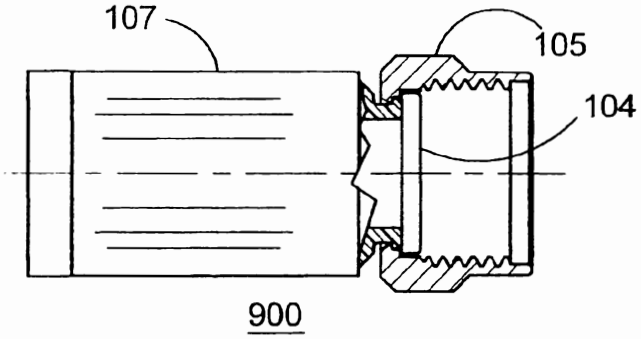


FIG. 9

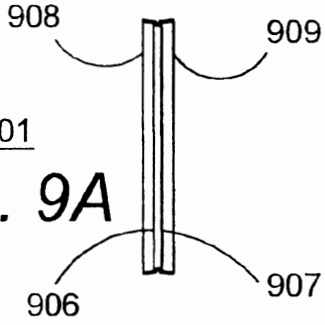


FIG. 9A

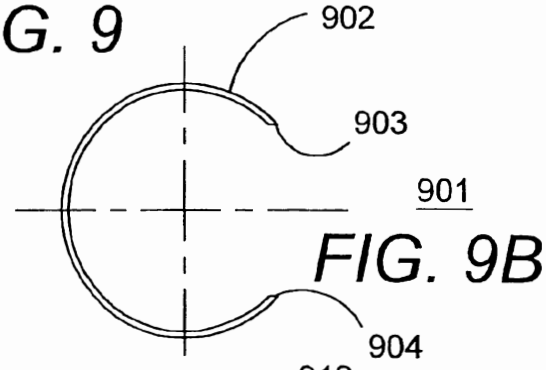


FIG. 9B

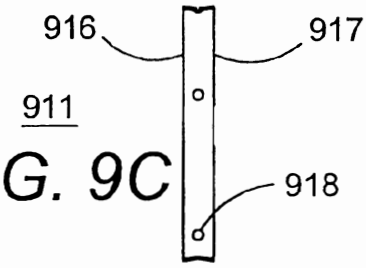


FIG. 9C

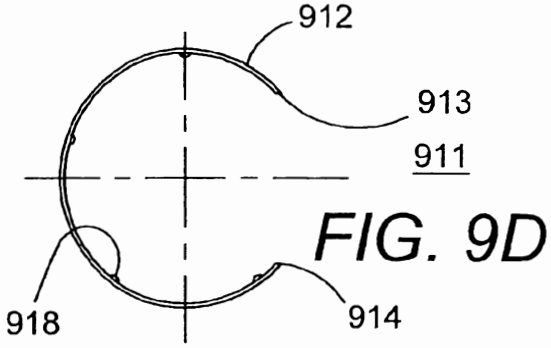


FIG. 9D

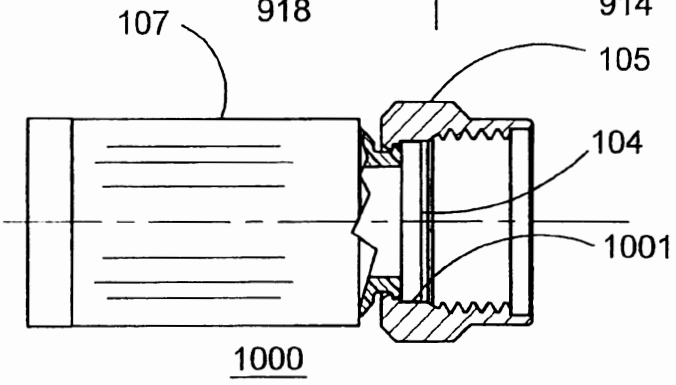


FIG. 10

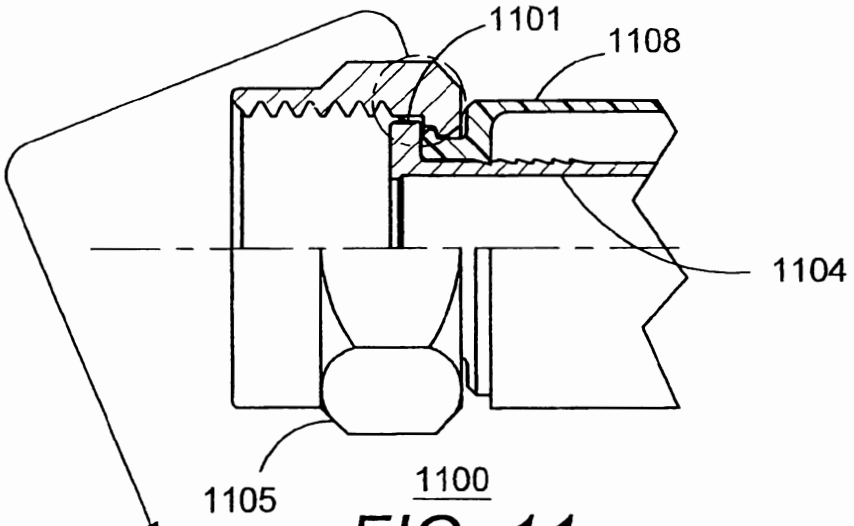


FIG. 11

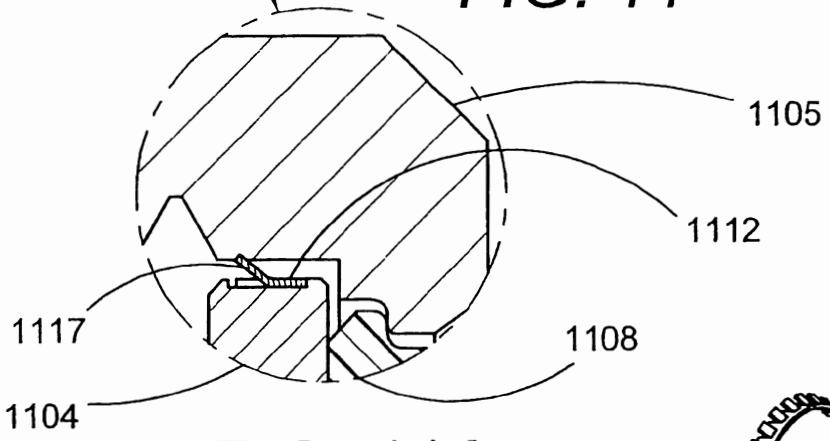


FIG. 11A

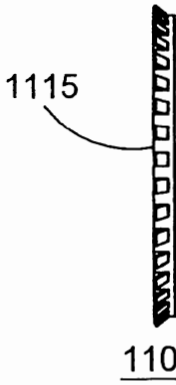


FIG. 11B

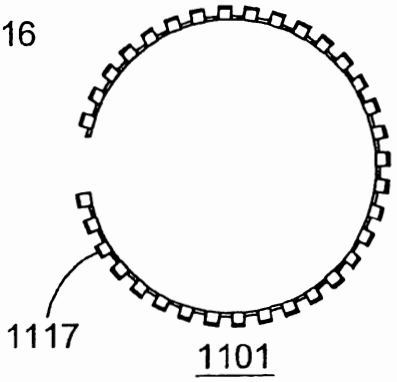


FIG. 11C

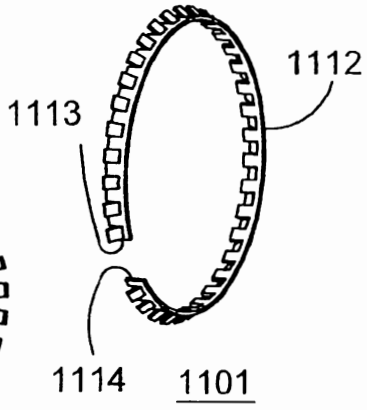


FIG. 11D

ELECTRICAL CONNECTOR WITH GROUNDING MEMBER

This application is a continuation of U.S. patent application Ser. No. 12/332,925 filed on Dec. 11, 2008, now U.S. Pat. No. 7,955,126, which is a continuation of U.S. patent application Ser. No. 11/541,903 filed on Oct. 2, 2006, now U.S. Pat. No. 7,479,035, which claims the benefit of priority to U.S. patent application Ser. No. 11/043,844 filed on Jan. 25, 2005, the content of which is relied upon and incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to electrical connectors, and more particularly to coaxial cable connectors capable of being connected to a terminal.

2. Description of the Related Art

Coaxial cable connectors, such as type F connectors, are used to attach coaxial cable to another object or appliance, e.g., a television set or VCR having a terminal adapted to engage the connector. The terminal of the appliance includes an inner conductor and a surrounding outer conductor.

Coaxial cable includes a center conductor for transmitting a signal. The center conductor is surrounded by a dielectric material, and the dielectric material is surrounded by an outer conductor; this outer conductor may be in the form of a conductive foil and/or braided sheath. The outer conductor is typically maintained at ground potential to shield the signal transmitted by the center conductor from stray noise, and to maintain a continuous desired impedance over the signal path. The outer conductor is usually surrounded by a plastic cable jacket that by the center conductor from stray noise, and to maintain a continuous desired impedance over the signal path. The outer conductor is usually surrounded by a plastic cable jacket that electrically insulates, and mechanically protects, the outer conductor. Prior to installing a coaxial connector onto an end of the coaxial cable, the end of the coaxial cable is typically prepared by stripping off the end portion of the jacket to bare the end portion of the outer conductor. Similarly, it is common to strip off a portion of the dielectric to expose the end portion of the center conductor.

Coaxial cable connectors of the type known in the trade as "F connectors" often include a tubular post designed to slide over the dielectric material, and under the outer conductor of the coaxial cable, at the prepared end of the coaxial cable. If the outer conductor of the cable includes a braided sheath, then the exposed braided sheath is usually folded back over the cable jacket. The cable jacket and folded-back outer conductor extend generally around the outside of the tubular post and are typically received in an outer body of the connector; this outer body of the connector is usually fixedly secured to the tubular post. A coupler is rotatably secured around the tubular post and includes an internally-threaded region for engaging external threads formed on the outer conductor of the appliance terminal.

When connecting the end of a coaxial cable to a terminal of a television set, equipment box, or other appliance, it is important to achieve a reliable electrical connection between the outer conductor of the coaxial cable and the outer conductor of the appliance terminal. This goal is usually achieved by ensuring that the coupler of the connector is fully tightened over the connection port of the appliance. When fully tightened, the head of the tubular post of the connector directly engages the edge of the outer conductor of the appliance port, thereby making a direct electrical ground connection between the outer conductor of the appliance port and the tubular post; in turn, the tubular post is engaged with the outer conductor of the coaxial cable.

However, in many cases, it is difficult for an installer to reach the connection ports of the appliance with a wrench, and in some instances, it is even difficult for the installer to reach such connection ports with his or her fingers. As a result, it can often happen that type F connectors are not fully tightened to the appliance port. In such a loose connection system, wherein the coupler of the coaxial connector is not drawn tightly to the appliance port connector, a gap exists between the outer conductor of the appliance port and the tubular post of the connector. Unless an alternate ground path exists, poor signal quality, and RFI leakage, will result.

As mentioned above, the coupler is rotatably secured about the head of the tubular post. The head of the tubular post usually includes an enlarged shoulder, and the coupler typically includes an inwardly-directed flange for extending over and around the shoulder of the tubular post. In order not to interfere with free rotation of the coupler, manufacturers of such F-style connectors routinely make the outer diameter of the shoulder (at the head of the tubular post) of smaller dimension than the inner diameter of the central bore of the coupler. Likewise, manufacturers routinely make the inner diameter of the inwardly-directed flange of the coupler of larger dimension than the outer diameter of the non-shoulder portion of the tubular post, again to avoid interference with rotation of the coupler relative to the tubular post. In a loose connection system, wherein the coupler of the coaxial connector is not drawn tightly to the appliance port connector, an alternate ground path may fortuitously result from contact between the coupler and the tubular post, particularly if the coupler is not centered over, and axially aligned with, the tubular post. However, this alternate ground path is not stable, and can be disrupted as a result of vibrations, movement of the appliance, movement of the cable, or the like.

Alternatively, there are some cases in which such an alternate ground path is provided by fortuitous contact between the coupler and the outer body of the coaxial connector, provided that the outer body is formed from conductive material. This alternate ground path is similarly unstable, and may be interrupted by relative movement between the appliance and the cable, or by vibrations. Moreover, this alternate ground path does not exist at all if the outer body of the coaxial connector is constructed of non-conductive material. Such unstable ground paths can give rise to intermittent failures that are costly and time-consuming to diagnose.

OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide a coaxial cable connector for connecting a coaxial cable to a connection port of an appliance, the coaxial cable connector being of the type that includes a tubular post and a coupler, such as a rotatable coupler, which ensures a reliable ground connection between the tubular post of the connector and an outer conductor of the appliance port, even if the coupler is not fully tightened onto the appliance port.

It is another object of the present invention to provide such a coaxial cable connector which maintains a reliable ground path between the coupler and the tubular post, at least following installation of such connector onto the end of a coaxial cable.

It is still another object of the present invention to provide such a coaxial connector that can be manufactured economically.

These and other objects of the present invention will become more apparent to those skilled in the art as the description thereof proceeds.

SUMMARY OF THE INVENTION

Briefly described, the present invention relates to a coaxial cable connector comprising a tubular post, a coupler and a grounding means for providing an electrically conductive path between the post and the coupler. In accordance with a preferred embodiment thereof, the present invention relates to a coaxial cable connector for coupling a prepared end of a coaxial cable to a threaded female equipment port, and including a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor thereof. A coupler is rotatably secured over the second end of the tubular post, and includes a central bore, at least a portion of which is threaded for engaging the female equipment port. An outer body is secured to the tubular post and extends about the first end of the tubular post for receiving the outer conductor, and preferably the cable jacket, of the coaxial cable.

In a preferred embodiment of the present invention, a resilient, electrically-conductive grounding member is disposed between the tubular post and the coupler. This grounding member engages both the tubular post and the coupler for providing an electrically-conductive path therebetween, but without restricting rotation of the coupler relative to the tubular post.

For some preferred embodiments, the grounding member is generally arcuately shaped to extend around the tubular post over an arc of at least 225°, and may extend for a full 360°. This arcuately shaped grounding member may be in the form of a generally circular broken ring, or C-shaped member, as by bending a strip of metal wire into an arc. Preferably, the grounding member has a shape that is out-of-round, and more preferably oblong, rather than circular, in order to ensure reliable electrical contact with both the coupler and the tubular post. In order to retain the grounding member inside the coupler, the inner bore of the coupler may include an annular recess proximate to the end of the coupler that encircles the tubular post; at least portions of the grounding member are engaged with the annular recess to prevent the grounding member from being axially displaced within the coupler.

As mentioned above, the tubular post may include an enlarged shoulder at the head thereof. In one preferred embodiment of the present invention, the grounding member surrounds the enlarged shoulder of the tubular post, at least when the coaxial cable connector is assembled onto the prepared end of a coaxial cable, whereby at least portions of the grounding member engage the outer surface of such enlarged shoulder.

In one embodiment of the present invention, the grounding member is generally circular and includes a plurality of projections extending outwardly therefrom for engaging the coupler. In another embodiment of the present invention, the grounding member is generally circular and includes a plurality of projections extending inwardly therefrom for engaging the tubular post.

In yet another embodiment of the present invention, the tubular post includes an enlarged shoulder extending inside the coupler, and including a first radial face that faces the opposite end of the tubular post. The coupler includes a flange directed inwardly toward the tubular post; this inwardly directed flange including a second radial face that faces toward the connection port of the appliance to which the coaxial cable is to be connected. The grounding member is disposed between the first radial face and the second radial face. In this embodiment, the grounding member is resilient relative to the longitudinal axis of the connector, and is compressed between the first radial face and the second radial face to maintain sliding electrical contact between the shoulder of the tubular post (via its first radial face) and the flange of the coupler (via its second radial face).

The coaxial connector of the present invention may also include a sealing ring seated within the coupler for rotatably engaging the body member to form a seal therebetween.

In an alternate embodiment of the present invention, conductive grease is substituted for a discrete grounding member. In this embodiment, an outer dimension of a portion of the tubular post is caused to be commensurate with an inner dimension of an adjacent portion of the coupler. While the gap between such adjacent portions, coupled with the lubrication provided by the conductive grease, is sufficient to permit rotation of the coupler relative to the tubular post, the conductive grease nonetheless functions to maintain reliable electrical coupling across such gap.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described with greater specificity and clarity with reference to the following drawings, in which:

FIG. **1** is a perspective view of an F connector in accordance with the preferred embodiment of the invention, including a body and a coupling nut;

FIG. **2** is an exploded view of the F connector of FIG. **1**, including a preferred embodiment of a grounding member;

FIG. **2**A is an enlarged plan view of the preferred embodiment of the grounding member of FIG. **2**;

FIG. **3** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3**-**3**, and a side view of a prepared coaxial cable ready to be inserted into a back end of the F connector;

FIG. **3**A is a cross-sectional view of the body of the F connector of FIG. **1** through cut-line **3**-**3**;

FIG. **3**B is a cross-sectional view of a tubular post of the F connector of FIG. **1**, through cut-line **3**-**3**;

FIG. **3**C is a cross-sectional view of the coupling nut of the F connector of FIG. **1** through cut-line **3**-**3**;

FIG. **4** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3**-**3**, and cross-sectional view of the prepared coaxial cable fully inserted into the back end thereof, prior to axial compression of the F connector;

FIG. **4**A is an enlargement of a portion of FIG. **4**;

FIG. **5** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3**-**3**, and a cross-sectional view of the prepared coaxial cable fully inserted into the back end thereof, subsequent to axial compression of the F connector;

FIG. **5**A is an enlargement of a portion of FIG. **5**;

FIG. **6** is a partial cross-sectional view of a first alternate embodiment of an F connector having a first alternate grounding member;

FIG. **6**A is an enlargement of a portion of FIG. **6**;

FIG. **6**B is a slightly enlarged side view of the first alternate grounding member of FIG. **6**;

FIG. **6**C is a slightly enlarged plan view of the first alternate grounding member of FIG. **6**;

FIG. **7** is a partial cross-sectional view of a second alternate embodiment of an F connector having a second alternate grounding member;

FIG. **7**A is an enlargement of a portion of FIG. **7**;

FIG. **7**B is a slightly enlarged side view of the second alternate grounding member of FIG. **7**;

FIG. **7**C is a slightly enlarged plan view of the second alternate grounding member of FIG. **7**;

FIG. **8** is a partial cross-sectional view of a third alternate embodiment of an F connector having a third alternate grounding member;

FIG. **8**A is a slightly enlarged side view of the third alternate grounding member of FIG. **8**;

FIGS. **8**B-**8**E are slightly enlarged plan views of four styles of the third alternate grounding member of FIG. **8**;

FIG. **9** is a partial cross-sectional view of a fourth alternate embodiment of an F connector having one of a fourth alternate grounding member and a fifth alternate grounding member;

FIG. **9**A is a slightly enlarged side view of the fourth alternate grounding member of FIG. **9**;

FIG. **9**B is a slightly enlarged plan view of the fourth alternate grounding member of FIG. **9**;

FIG. **9**C is a slightly enlarged side view of the fifth alternate grounding member of FIG. **9**;

FIG. **9**D is a slightly enlarged plan view of the fifth alternate grounding member of FIG. **9**;

FIG. **10** is a partial cross-sectional view of a fifth alternate embodiment of an F connector having conductive grease that acts as a grounding member;

FIG. **11** is a partial cross-sectional view of a front end of a sixth alternate embodiment of an F connector having a sixth alternate grounding member;

FIG. **11**A is an enlargement of a portion of FIG. **11**;

FIG. **11**B is a side view of the sixth alternate grounding member of FIG. **11**;

FIG. **11**C is a plan view of the sixth alternate grounding member of FIG. **11**; and

FIG. **11**D is a perspective view of the sixth alternate grounding member of FIG. **11**.

For simplicity and clarity of illustration, the drawing figures illustrate the general manner of construction, and descriptions and details of well-known features and techniques are omitted to avoid unnecessarily obscuring the invention. Furthermore, elements in the drawing figures are not necessarily drawn to scale.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** is a perspective view of an F connector **100** in accordance with the preferred embodiment of the invention. The F connector **100** (hereinafter, "connector") has a longitudinal axis **101**. The connector has a front end **102** and a back end **103**.

FIG. **2** is an exploded view of the connector **100**. The connector **100** includes tubular post **104**, a coupling nut **105** rotatably secured over an end **106** of the tubular post for securing the connector to an appliance (not shown), and a body **108** secured to the tubular post. A shell **107** and a label **109** are secured to the body **108**. Preferably, the body **108** is made entirely of acetal plastic. Alternatively, the body **108** is made of brass, plated with nickel. The shell **107** adds strength to the plastic body **108** and protects the plastic body from ultraviolet light. The tubular post **104** is preferably metallic, and more preferably, made of brass, with a tin plating; as tin is more conductive than nickel. The coupling nut **105** is preferably metallic, and more preferably, formed from brass, plated with nickel or with another non-corrosive material.

In the embodiment shown in the drawings, the coupling nut **105** is rotatably secured over an end **106** of the tubular post **104** via a neck **111** of the body **108**. Advantageously, an electrical grounding path is constantly maintained between the coupling nut **105** and the tubular post **104**, including, in particular, when the coupling nut **105** of the connector **100** is not tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member **110** disposed between the tubular post **104** and the coupling nut **105**.

FIG. **2**A is an enlarged plan view of the preferred embodiment of the grounding member **110**. In the preferred embodiment of the present invention, the electrically-conductive grounding member **110** is disposed between the tubular post **104** and the coupling nut **105**. The grounding member **110** contacts both the tubular post **104** and the coupling nut **105** for providing an electrically-conductive path therebetween, but without restricting rotation of the coupling nut relative to the tubular post. A preferred embodiment of the grounding member **110** shown in FIG. **2**A is a spring member, or circlip, disposed between the coupling nut **105** and the tubular post **104**, which establishes a stable ground path between the coupling nut and the post, and which is preferably constructed of a wire-type material. The grounding member **110** is retained in the coupling nut **105** by an annular recess **343** (see FIG. **3**C) in the coupling nut. The spring action of the grounding member **110** serves to form a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut **105** to rotate. The grounding member **110** is resilient and is generally arcuately shaped. The grounding member **110** extends around the tubular post **104** over an arc of at least 225°, and may extend for a full 360°. The arcuately shaped grounding member **110** may be in the form of a generally circular broken ring, or C-shaped member, as by bending a strip of metal wire into an arc. Preferably, the grounding member **110** is a C-shaped metal clip that has an arcuate curvature that is non-circular. The grounding member **110** has a minimum diameter **201** and a maximum diameter **203**. Preferably, the grounding member **110** is made of stainless steel wire that has a wire diameter of between 0.010-inch and 0.020-inch; in a preferred embodiment, the wire diameter is about 0.016-inch. Stainless steel is a preferred metal for the grounding member **110** because it need not be plated for corrosion resistance.

FIG. **3** is a cross-sectional view of the connector **100** through cut-line **3**-**3** of FIG. **1**, and a side view of a prepared coaxial cable **301** ready to be inserted into a back end **103** of the connector. The center conductor **302** of the coaxial cable **301** is surrounded by a dielectric material **303**, and the dielectric material is surrounded by an outer conductor **304** that may be in the form of a conductive foil and/or braided sheath. The outer conductor **304** is usually surrounded by a plastic cable jacket **305** that electrically insulates, and mechanically protects, the outer conductor.

FIG. **3**A is a cross-sectional view of the body **108** of FIG. **1** through cut-line **3**-**3**. FIG. **3**B is a cross-sectional view of the tubular post **104** of FIG. **1** through cut-line **3**-**3**. FIG. **3**C is a cross-sectional view of the coupling nut **105** of FIG. **1** through cut-line **3**-**3**. Referring now to FIGS. **3**, **3**A, **3**B and **3**C, the body **108** has a lip **310** at a front end of the body. The lip **310** has an outer diameter **311** and an inner diameter **312**. The coupling nut **105** is rotatably secured about a head **330** at the front end of the tubular post **104**. The head **330** of the tubular post **104** usually includes an enlarged shoulder **332**. The coupling nut **105** typically includes an inwardly-directed flange **340** that extends over and around the shoulder **332** of the tubular post **104**. In order to retain the grounding member **110** inside the coupling nut **105**, the inner, or central, bore **342** of the coupling nut **105** may include an annular recess **343** that is proximate to the end of the coupling nut that encircles the tubular post **104**. At least portions of the grounding mem-

ber **110** are engaged with the annular recess **343** to prevent the grounding member from being axially displaced within the coupling nut **105**. The tubular post **104** may include an enlarged shoulder **332** at the head **330** thereof. The shoulder **332** has a first radial face **333** that faces the back end of the tubular post **104**. In one preferred embodiment of the present invention, the grounding member **110** surrounds the enlarged shoulder **332** of the tubular post **104**, at least when the connector **100** is assembled onto the prepared end of a coaxial cable **301**. At least portions of the grounding member **110** contact the outer surface **334** of such enlarged shoulder **332**.

The coupling nut **105** has an inwardly-directed flange near the back end of the coupling nut. The coupling nut **105** has an inner diameter **341** at a back end of the coupling nut. In order to retain the back end of the coupling nut **105** on the front end of the body **108**, the inner diameter **341** of the coupling nut has a dimension less than the outer diameter of the lip **310** of the body **108**. In order not to interfere with free rotation of the coupling nut **105**, the outer diameter **336** of the shoulder **332** (at the head **330** of the tubular post **104**) is of smaller dimension than the inner diameter **344** of the central bore of the coupling nut **105**. Likewise, the inner diameter **341** of the inwardly-directed flange **340** of the coupling nut **105** is of larger dimension than the outer diameter **337** of the non-shoulder portion **338** of the tubular post **104**, again to avoid interference with rotation of the coupling nut **105** relative to the tubular post.

FIG. **4** is a cross-sectional view of the connector **100** through cut-line **3-3**, and cross-sectional view of the prepared coaxial cable **301** fully inserted into the back end **103** thereof, prior to axial compression of the connector. FIG. **4**A is an enlargement of a portion of FIG. **4**. Referring now to FIGS. **4** and **4**A, the resilient, electrically-conductive grounding member **110** is shown disposed between the tubular post **104** and the coupling nut **105**. The grounding member **110** is disposed in the annular recess **343** that encircles the tubular post **104**.

FIG. **5** is a cross-sectional view of the connector **100** through cut-line **3-3**, and a cross-sectional view of the prepared coaxial cable **301** fully inserted into the back end **103** thereof, subsequent to axial compression of the connector. FIG. **5**A is an enlargement of a portion of FIG. **5**. Referring now to FIGS. **5** and **5**A, as a result of axial compression by a standard compression tool (not shown), the tubular post **104** slides (to the right in the drawings) relative to the other components of the connector **100** and relative to the cable **301**, such that the shoulder **332** of the tubular post is radially inward of the grounding member **110**. At least a portion of the grounding member **110** engages the coupling nut **105** at the annular recess **343** of the coupling nut, and at least another portion of the grounding member engages tubular post **104** at the shoulder **332** of the tubular post. The tubular post **104** is in electrical contact with the outer conductor **304** of the cable **301** along the back portion of the tubular post, and the coupling nut **105** may engage the outer conductor of an appliance port (not shown). Therefore, when the connector **100** is fastened to an appliance port, there is maintained an electrical grounding path between the outer conductor **304** of the cable **301** and the outer conductor of the appliance port, whether or not the coupling nut **105** of the connector is tightly fastened to the appliance port.

FIG. **6** is a partial cross-sectional view of a first alternate embodiment of a connector **600** having a first alternate grounding member **601** (see FIGS. **6**A-**6**C), shown subsequent to axial compression. FIG. **6**A is an enlargement of a portion of the first alternate embodiment of the connector **600** showing a portion of the first alternate grounding member **601**. FIG. **6**B is a slightly enlarged side view of the first alternate grounding member **601**. FIG. **6**C is a slightly enlarged plan view of the first alternate grounding member **601**. Referring now to FIGS. **6**, **6**A, **6**B and **6**C, the first alternate grounding member **601** is a spring finger grounding member retained between the coupling nut **105** and the tubular post **104**. The first alternate grounding member **601** is constructed of a thin cross section of material such as beryllium copper. The first alternate grounding member **601** comprises a ring portion **602** and a plurality of circumferential fingers **603** that project at approximately a 30° angle from the plane of the ring. As is clearly illustrated in FIGS. **6**B and **6**C, the circumferential spring members **603** are arranged symmetrically about the ring portion and project from respective base portions in a plane of the ring to respective movable portions displaced from the plane of the ring along a circumferential path of the ring. The respective base and movable portions of each circumferential spring member **603** lie along a common circumferential path and, collectively, the circumferential spring members **603** track a common circumference of the grounding member **601** and do not extend radially inwardly toward a center of the grounding member **601**. This configuration is also clearly illustrated in FIGS. **6**B and **6**C. The spring action of the fingers **603** extend to, and make contact with, a radial surface **604** near the back end of the coupling nut **105** that faces the front end of the coupling nut, which serve to connect a ground path from the coupling nut to the tubular post while allowing the coupling nut to rotate. The first alternate grounding member **601** has optional internal lugs **605** that contact the outer diameter **337** of the non-shoulder portion of the tubular post.

FIG. **7** is a partial cross-sectional view of a second alternate embodiment of a connector **700** having a second alternate grounding member **701** (see FIGS. **7**A-**7**C). FIG. **7**A is an enlargement of a portion of the second alternate embodiment of the connector **700**, showing a portion of the second alternate grounding member **701**. FIG. **7**B is a slightly enlarged side view of the second alternate grounding member **701**. FIG. **7**C is a slightly enlarged plan view of the second alternate grounding member **701**. Referring now to FIGS. **7**, **7**A, **7**B and **7**C, the second alternate grounding member **701** is a radial grounding member retained between the coupling nut **105** and the tubular post **104**. The second alternate grounding member **701** is constructed of a thin cross section of metallic material such as beryllium copper. The second alternate grounding member **701** comprises a ring portion **702** and a plurality of fingers **703** extending radially from the ring portion at about a 45° angle from the plane of the ring portion. The spring action of the fingers **703** extend to inner-diameter surfaces **705** of the coupling nut **105** and serve to connect a ground path from the coupling nut to the tubular post **104** while allowing the coupling nut to rotate.

FIG. **8** is a partial cross-sectional view of a third alternate embodiment of a connector **800** having a third alternate grounding member **801** (see FIGS. **8**A-**8**E). FIG. **8**A is a slightly enlarged side view of the third alternate grounding member **801**. FIGS. **8**B-**8**E are slightly enlarged plan views of four styles of the third alternate grounding member **801**. Referring now to FIG. **8** and FIGS. **8**A-**8**E, the third alternate grounding member **801** is a conductive member retained between the coupling nut **105** and the tubular post **104**. The third alternate grounding member **801** is constructed of a thin cross section of metallic material such as brass or beryllium copper. The third alternate grounding member **801** comprises a ring **802** with multiple points of contact, or internal lugs, **803** around the inner perimeter of the ring and with multiple external lugs **804** around the outer perimeter of the ring. The

lugs **803** and **804** serve to connect a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate. FIGS. **8B-8E** show four styles with regard to the shape of the lugs **803** and **804** and the position of the lugs on the ring **802**. FIG. **8** also exhibits an alternate embodiment comprising a sealing ring **805** for forming a moisture seal between the coupling nut **105** and the body **108** of the connector **801**. The sealing ring **805** is disposed between the back end of the coupling nut **105** and the body **108** for forming a seal therebetween. Preferably, the sealing ring **805** is made from ethylene propylene. Use of the sealing ring **805** is not limited to use in connectors having the third alternate grounding member **801**. The third alternate grounding member **801** may also be used in connectors without the sealing ring **805**.

FIG. **9** is a partial cross-sectional view of a fourth alternate embodiment of a connector **900** having one of a fourth alternate grounding member **901** and a fifth alternate grounding member **911** (see FIGS. **9A-9D**). FIG. **9A** is a slightly enlarged side view of the fourth alternate grounding member **901**. FIG. **9B** is a slightly enlarged plan view of the fourth alternate grounding member **901**. FIG. **9C** is a slightly enlarged side view of the fifth alternate grounding member **902**. FIG. **9D** is a slightly enlarged plan view of the fifth alternate grounding member **911**. The fourth and fifth alternate embodiments of the grounding member **901** and **911**, respectively, comprise a C-shaped ring between the coupling nut **105** and the tubular post **104**. The C-shaped ring is constructed of a thin cross section of metallic material such as beryllium copper or stainless steel. It is retained by a groove in the coupling nut. The spring action of the C-shaped ring serves to connect a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate. The fourth alternate grounding member **901** includes a circumferential metallic band **902**, which has a general circular shape and approximates a section of a hollow cylinder, that extends between first **903** and second **904** opposing ends. The band **902** has first **906** and second **907** opposing side edges extending along its length. The fourth alternate grounding member **901** includes a first generally radial wall **908** extending from the first side edge **906** of the band in a first radial direction, and a second generally radial wall **909** extending from the second side edge **907** of the band generally in said first radial direction. As is clearly illustrated in FIG. **9A**, the radial walls **908**, **909** extend away from the side edges **906**, **907** along a radial path that extends radially from the width that is defined between the first and second side edges **906**, **907**. The band **902** contacts a first one of the group of members that includes the coupling nut **105** and the tubular post **104**. The first **908** and second **909** radial walls contact the second of the group of members that includes the coupling nut **105** and the tubular post **104**. The fifth alternate grounding member **911** includes a metallic band **912** extending along its length between first **913** and second **914** opposing ends, and extending along its width between first **916** and second **917** side edges. The band **912** is formed along its length into a generally circular shape. The band **912** is formed along its width into a generally concave shape with the side edges **916** and **917** projecting generally in a first radial direction. The fifth alternate grounding member **911** includes a plurality of projections **918** extending from the band **912** in a second radial direction opposite to the first radial direction. The first **916** and second **917** side edges of the band **912** contact a first one of the group of members that includes the coupling nut and the tubular post. The plurality of projections **918** contact the second of the group of members that includes the coupling nut **105** and the tubular post **104**.

FIG. **10** is a partial cross-sectional view of a fifth alternate embodiment of a connector **1000** having conductive grease (not shown) that acts as a grounding member. The ground path is established by means of a close fit between the coupling nut **105** and the tubular post **104**. The conductive grease is disposed at a grease annular ring **1001** where mating portions of the tubular post **104** and coupling nut **105** have closely matching dimensions. Preferably, the conductive grease is a silver-loaded silicon lubricating material. The conductive grease serves to connect a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate.

FIG. **11** is a partial cross-sectional view of a front end of a sixth alternate embodiment of an F connector **1100** that includes a body **1108**, and which has a sixth alternate grounding member **1101**. FIG. **11A** is an enlargement of a portion of FIG. **11**. FIG. **11B** is a side view of the sixth alternate grounding member **1101**. FIG. **11C** is a plan view of the sixth alternate grounding member **1101**. FIG. **11D** is a perspective view of the sixth alternate grounding member **1101**. Referring now to FIG. **11** and FIGS. **11A-11D**, the sixth alternate grounding member **1101** includes a circumferential metallic band **1112** extending between first **1113** and second **1114** opposing ends. The band **1112** has a generally circular shape that approximates a section of a hollow cylinder. The first **1113** and second **1114** ends of the band **1112** are disposed generally proximate to each other and are directed generally toward one another. The band **1112** has first and second opposing side edges **1115** and **1116**, respectively, extending along its length. The band generally defines a section of a cylindrical surface. The sixth alternate grounding member **1101** includes a plurality of projections **1101** extending from at least one of the first and second side edges **1115** and **1116** of the band **1112**. The plurality of projections **1117** extend away from the cylindrical surface defined by the band **1112**. The band **1112** contacts a first one of the group of members that includes the coupling nut **1105** and the tubular post **1104**. The plurality of projections **1117** contact the second of the group of members that includes the coupling nut **1105** and the tubular post **1104**.

In preferred embodiments, the present invention provides a coaxial cable connector that ensures a reliable grounding path without creating undue interference with free rotation of the coupler relative to the remaining components of the connector; however, the present invention can also provide a reliable grounding path between a post and a coupler that does not rotate. Advantageously, a connector in accordance with the invention works with standard installation tools and with standard compression tools. The present invention can be used with both axially-compressible connectors as well as with older-style crimp-ring connectors. In some embodiments, the present invention is compatible with the use of a sealing ring for forming a moisture seal between the coupler and the outer body of the connector.

While the present invention has been described with respect to preferred embodiments thereof, such description is for illustrative purposes only, and is not to be construed as limiting the scope of the invention. Various modifications and changes may be made to the described embodiments by those skilled in the art without departing from the true spirit and scope of the invention as defined by the appended claims. For example, the grounding member can have a shape other than generally circular, such as square, hexagonal, octagonal, oval, etc.

LIST OF REFERENCE NUMERALS

100 F connector ("connector")
101 Longitudinal axis

102 Front end
103 Back end
104 Tubular post
105 Coupling nut
106 End of tubular post
107 Shell
108 Body
109 Label
110 Grounding member
111 Neck
201 Minimum diameter
203 Maximum diameter
301 Coaxial cable
302 Center conductor
303 Dielectric material
304 Outer conductor
305 Jacket
310 Lip of body
311 Outer diameter of lip body
312 Inner diameter of lip of body
330 Head of tubular post
332 Shoulder of tubular post
333 First radial face of shoulder of tubular post
334 Outer surface of shoulder
336 Outer diameter of shoulder
337 Outer diameter of non-shoulder portion of post
338 Non-shoulder portion of post
340 Inwardly-directed flange of coupling nut
341 Inner diameter of inwardly-directed flange
342 Bore of coupling nut
343 Annular recess of coupling nut
344 Inner diameter of bore of coupling nut
600 First alternate connector
601 First alternate grounding member
602 Ring portion of first alternate grounding member
603 Fingers of first alternate grounding member
604 Radial surface of coupling nut
605 Internal lugs of first alternate grounding member
700 Second alternate connector
701 Second alternate grounding member
702 Ring portion of second alternate grounding member
703 Fingers of second alternate grounding member
800 Third alternate connector
801 Third alternate grounding member
802 Ring portion of third alternate grounding member
803 Internal lugs of third alternate grounding member
804 External lugs of third alternate grounding member
805 Sealing ring
900 Fourth alternate connector
901 Fourth alternate grounding member
902 Band of fourth alternate grounding member
903 First end of band
904 Second end of band
906 First side edge of band
907 Second side edge of band
908 First radial wall of band
909 Second radial wall of band
911 Fifth alternate grounding member
1000 Fifth alternate connector
1001 Grease annular ring
1100 Sixth alternate connector
1101 Sixth alternate grounding member
1104 Tubular post of sixth alternate connector
1105 Coupling nut of sixth alternate connector
1108 Body of sixth alternate connector
1112 Band of sixth alternate grounding member
1113 First end of band
1114 Second end of band
1115 First side edge of band
1116 Second side edge of band
1117 Projections on band

We claim:

1. A coaxial cable connector having a grounding member, a post and a nut, the grounding member comprising:

a metallic band comprising first and second side edges and a width extending between the first and second side edges, said metallic band comprising of a pair of opposing radial walls extending away from the first and second side edges along a pair of radial paths extending radially from the width and being composed at least partially of electrically conductive material, and

a contact portion defined by the radial wall, wherein the contact portion contacts the group members that includes the post and the nut and provides for an electrically-conductive path through the post and the nut.

2. A grounding member for a coaxial cable connector having a post and a nut, comprising:

a ring portion composed at least partially of electrically conductive material, and

a contact portion composed at least partially of a plurality of circumferential spring members projecting from respective base portions in a plane of the ring to respective movable portions displaced from the plane of the ring along a circumferential path of the ring, wherein

the spring members are arranged symmetrically about the ring portion,

respective base and movable portions of each circumferential spring member lie predominantly along a common circumferential path, and

the contact portion provides for an electrically-conductive path through the post and the nut.

3. The grounding member of claim **2**, wherein the ring portion extends at least partially around the post, and wherein the at least one contact portion contacts the nut, and wherein the at least one contact portion contacts the post.

4. The grounding member of claim **2**, wherein the contact portion is a plurality of fingers extending radially from the ring portion.

5. The grounding member of claim **4**, wherein the plurality of fingers extend at about a 45° angle from the plane of the ring portion.

6. The grounding member of claim **4**, wherein the plurality of fingers project at approximately a 30° angle from the plane of the ring.

7. The grounding member of claim **2** wherein, collectively, the circumferential spring members track a common circumference of the grounding member.

8. The grounding member of claim **2** wherein the circumferential spring members do not extend radially inwardly toward a center of the grounding member.

9. A grounding member for a coaxial cable connector having a post and a nut, comprising a generally arcuate shaped member, composed at least partially of electrically conductive material, and a contact portion of the generally arcuate shaped member, wherein:

the at least one contact portion provides for an electrically-conductive path through the post and the nut;

the generally arcuate shaped member comprises a circumferential metallic band; and

the circumferential metallic band has a general circular shape and approximates a section of a hollow cylinder that extends between first and second opposing ends.

10. The grounding member of claim **9**, wherein the generally arcuate shaped member is C-shaped member.

11. The grounding member of claim 10, wherein the C-shaped member defines a circular broken ring extending over an arc of about at least 225 degrees.

12. The grounding member of claim 10, wherein the C-shaped member is a metal clip that has an arcuate curvature that is non-circular.

13. The grounding member of claim 9, wherein the generally arcuate shaped member is a stainless steel wire having a wire diameter of between about 0.010-inch and 0.020-inch.

14. The grounding member of claim 13, wherein the stainless steel wire has a diameter of about 0.016-inch.

15. The grounding member of claim 9, wherein at least a portion of the generally arcuate member positions in an annular recess in the nut.

16. The grounding member of claim 15, wherein the contact portion engages the nut at the annular recess.

17. The grounding member of claim 9, wherein the contact portion comprises internal lugs around an inner perimeter of the generally arcuate member, and wherein the internal lugs contact the post.

18. The grounding member of claim 9, wherein the contact portion comprises external lugs around an outer perimeter of the generally arcuate member, wherein the external lugs contact the nut.

19. The grounding member of claim 9, wherein the circumferential metallic band has first and second opposing side edges extending along a length of the circumferential metallic band.

20. The grounding member of claim 19, wherein the circumferential metallic band includes a first generally radial wall extending from the first side edge in a first radial direction, and a second generally radial wall extending from the second side edge generally in the first radial direction.

21. The grounding member of claim 20, the circumferential metallic band contacts a first one of the group of members that includes the nut and the post, and wherein the first and second radial walls contact the second of the group of members that includes the nut and the post.

22. The grounding member of claim 19, wherein the circumferential metallic band is formed along a width into a generally concave shape with the first and second side edges projecting generally in a first radial direction.

23. The grounding member of claim 19, wherein the contact portion comprises a plurality of projections, and wherein the first and second side edges contact a first one of a group of members that includes the nut and the post, and the plurality of projections contact a second one of the group of members that includes the nut and the post.

* * * * *

US008172612C1

(12) EX PARTE REEXAMINATION CERTIFICATE (10300th)

United States Patent

Bence et al.

(10) Number: US 8,172,612 C1

(45) Certificate Issued: Sep. 26, 2014

(54) **ELECTRICAL CONNECTOR WITH GROUNDING MEMBER**

(75) Inventors: **Bruce D. Bence**, Glendale, AZ (US); **Donald A. Burris**, Peoria, AZ (US); **Brian L. Kisling**, Phoenix, AZ (US); **John A. Kooiman**, Peoria, AZ (US); **William B. Lutz**, Glendale, AZ (US); **William F. McDade**, Glendale, AZ (US); **Thomas D. Miller**, Peoria, AZ (US); **Lee Yung Chuan**, Sanchong (TW)

(73) Assignee: **Corning Gilbert Inc.**, Glendale, AZ (US)

Reexamination Request:
No. 90/012,835, Apr. 11, 2013

Reexamination Certificate for:

Patent No.:	**8,172,612**
Issued:	**May 8, 2012**
Appl. No.:	**13/117,843**
Filed:	**May 27, 2011**

Related U.S. Application Data

(63) Continuation of application No. 12/332,925, filed on Dec. 11, 2008, now Pat. No. 7,955,126, which is a continuation of application No. 11/541,903, filed on Oct. 2, 2006, now Pat. No. 7,479,035, which is a continuation of application No. 11/043,844, filed on Jan. 25, 2005, now Pat. No. 7,114,990.

(51) **Int. Cl.**
H01R 9/05 (2006.01)

(52) **U.S. Cl.**
USPC **439/578**

(58) **Field of Classification Search**
CPC H01R 9/05
USPC 439/578
See application file for complete search history.

(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 90/012,835, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

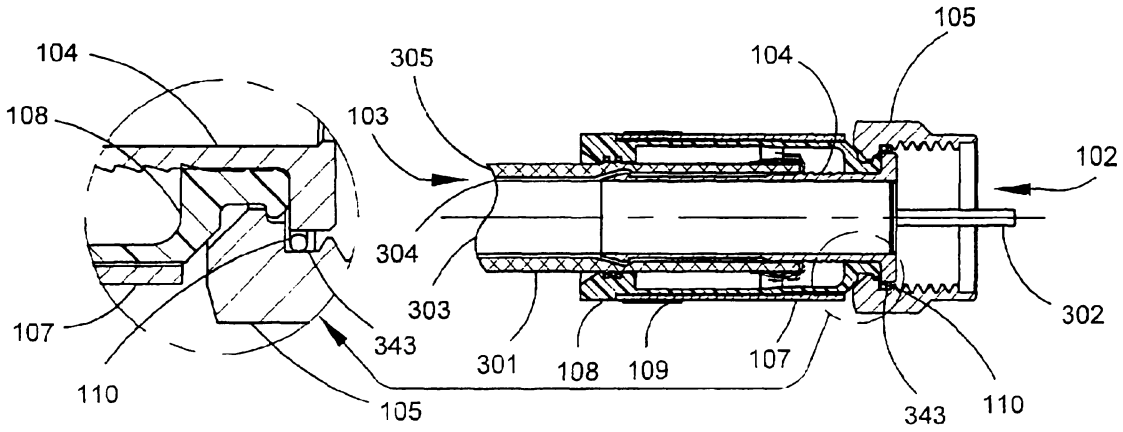
Primary Examiner – John S Heyman

(57) **ABSTRACT**

A coaxial cable connector includes tubular post, a coupler secured over an end of the tubular post for securing the connector to an appliance, and an outer body secured to the tubular post. An electrical grounding path is maintained between the coupler and the tubular post whether or not the coupler is tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler. Alternatively, the connector includes conductive grease at a point where mating portions of the tubular post and coupler have closely matching dimensions.

Attention is directed to the decision of *Corning Gilbert Incorporated* v. *John Mezzalingua Associates Incorporated*, US District Court Civil Docket U.S District - Arizona (Phoenix Division) 2:12cv2208 relating to this patent. This reexamination may not have resolved all questions raised by this decision. See 37 CFR 1.552(c) for *ex parte* reexamination and 37 CFR 1.906(c) for *inter partes* reexamination.

At the time of issuance and publication of this certificate, the patent remains subject to pending reexamination control number 90/012,300 filed May 21, 2012. The claim content of the patent may be subsequently revised if a reexamination certificate issues from the reexamination proceeding.



EX PARTE REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

Claim **16** is determined to be patentable as amended.

New claims **24-26** are added and determined to be patentable.

Claims **1-15** and **17-23** were not reexamined.

16. The grounding member of claim **15**, wherein the contact portion engages the nut at the annular recess, *wherein the grounding member contacts an axially extending outer surface of a flange of the post, wherein the axially extending outer surface of the flange of the post is radially spaced from the annular recess by the grounding member, wherein the axially extending outer surface is arranged between a forward facing surface of the flange of the post and a rearward facing surface of the flange of the post.*

24. The grounding member of claim 16, wherein the contact portion comprises a plurality of projections extending radially outwardly from the axially extending outer surface of the flange of the post, and contacting the annular recess.

25. A coaxial cable connector, comprising:

a nut, a post, and the grounding member of claim 16,

wherein the grounding member electrically contacts the annular recess of the nut and the axially extending outer surface of the flange of the post so as to provide a ground path between the nut and the post.

26. The coaxial cable connector of claim 25, wherein the contact portion comprises a plurality of projections extending radially outwardly from the axially extending outer surface of the flange of the post, and contacting the annular recess.

* * * * *

US008172612C1

(12) EX PARTE REEXAMINATION CERTIFICATE (10583rd)

United States Patent

Bence et al.

(10) Number: US 8,172,612 C1

(45) Certificate Issued: May 4, 2015

(54) **ELECTRICAL CONNECTOR WITH GROUNDING MEMBER**

(75) Inventors: **Bruce D. Bence**, Glendale, AZ (US); **Donald A. Burris**, Peoria, AZ (US); **Brian L. Kisling**, Phoenix, AZ (US); **John A. Kooiman**, Peoria, AZ (US); **William B. Lutz**, Glendale, AZ (US); **William F. McDade**, Glendale, AZ (US); **Thomas D. Miller**, Peoria, AZ (US); **Lee Yung Chuan**, Sanchong (TW)

(73) Assignee: **Corning Incorporated**

Reexamination Request:
No. 90/012,300, Jun. 29, 2012

Reexamination Certificate for:

Patent No.:	**8,172,612**
Issued:	**May 8, 2012**
Appl. No.:	**13/117,843**
Filed:	**May 27, 2011**

Related U.S. Application Data

(63) Continuation of application No. 12/332,925, filed on Dec. 11, 2008, now Pat. No. 7,955,126, which is a continuation of application No. 11/541,903, filed on Oct. 2, 2006, now Pat. No. 7,479,035, which is a continuation of application No. 11/043,844, filed on Jan. 25, 2005, now Pat. No. 7,114,990.

(51) **Int. Cl.**

H01R 9/05	(2006.01)
H01R 24/44	(2011.01)
H01R 43/20	(2006.01)
H01R 103/00	(2006.01)
H01R 13/52	(2006.01)

(52) **U.S. Cl.**
CPC ***H01R 9/05*** (2013.01); ***H01R 24/44*** (2013.01); ***H01R 43/20*** (2013.01); *H01R 2103/00* (2013.01); *H01R 13/5202* (2013.01); *H01R 13/5216* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

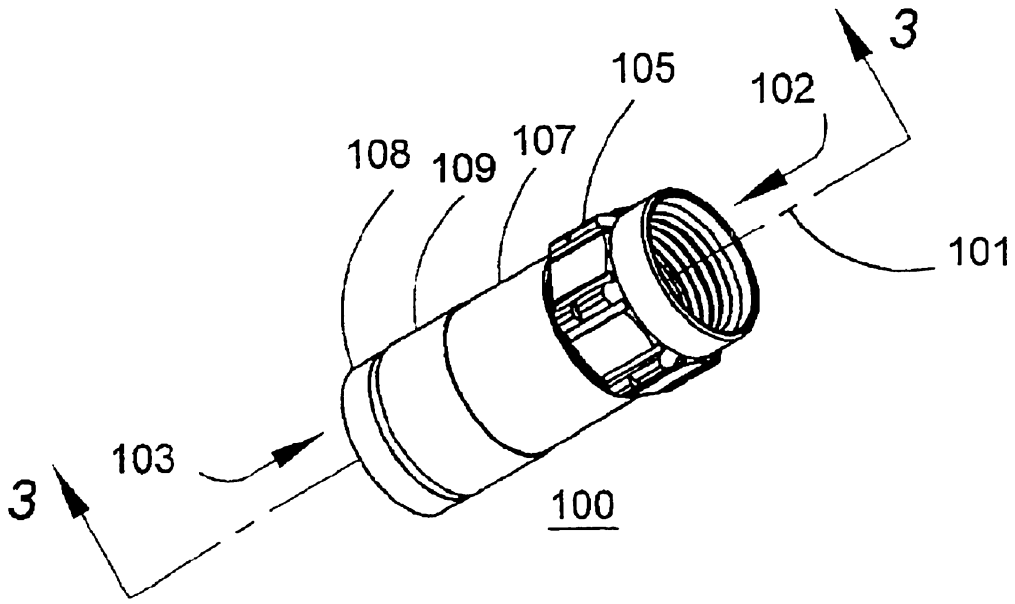
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 90/012,300, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner — Yuzhen Ge

(57) **ABSTRACT**

A coaxial cable connector includes tubular post, a coupler secured over an end of the tubular post for securing the connector to an appliance, and an outer body secured to the tubular post. An electrical grounding path is maintained between the coupler and the tubular post whether or not the coupler is tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler. Alternatively, the connector includes conductive grease at a point where mating portions of the tubular post and coupler have closely matching dimensions.



EX PARTE REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

Claims **2-11**, **15** and **19** are cancelled.

Claims **1**, **12-14**, **16-18** and **20-23** were not reexamined.

* * * * *

US010756455B2

(12) **United States Patent**
Bence et al.

(10) **Patent No.: US 10,756,455 B2**
(45) **Date of Patent: Aug. 25, 2020**

(54) **ELECTRICAL CONNECTOR WITH GROUNDING MEMBER**

(71) Applicant: **Corning Optical Communications RF LLC**, Glendale, AZ (US)

(72) Inventors: **Bruce D. Bence**, Glendale, AZ (US); **Donald A. Burris**, Peoria, AZ (US); **Brian L. Kisling**, Phoenix, AZ (US); **John A. Kooiman**, Peoria, AZ (US); **William B. Lutz**, Glendale, AZ (US); **William F. McDade**, Glendale, AZ (US); **Thomas D. Miller**, Peoria, AZ (US); **Lee Yung Chuan**, Sanchong (TW)

(73) Assignee: **Corning Optical Communications RF LLC**, Glendale, AZ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 93 days.

(21) Appl. No.: **14/166,653**

(22) Filed: **Jan. 28, 2014**

(65) **Prior Publication Data**

US 2014/0148051 A1 May 29, 2014

Related U.S. Application Data

(63) Continuation of application No. 13/438,532, filed on Apr. 3, 2012, now Pat. No. 8,690,603, which is a (Continued)

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H01R 9/05 (2006.01)
H01R 24/44 (2011.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H01R 9/05*** (2013.01); ***H01R 24/44*** (2013.01); ***H01R 43/20*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H01R 9/0521; H01R 9/0524; H01R 2103/00; H01R 24/564; H01R 24/40
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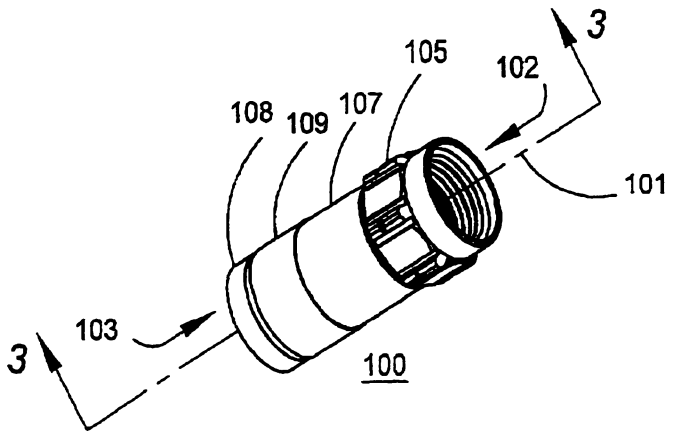
Primary Examiner — Abdullah A Riyami
Assistant Examiner — Vladimir Imas
(74) *Attorney, Agent, or Firm* — Tamika A. Crawl-Bey

(57) **ABSTRACT**

A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector including: a post including a first end adapted to be inserted into a prepared end of the coaxial cable between the dielectric material and the outer conductor, wherein the post includes a second end including an enlarged shoulder, wherein the enlarged shoulder has a radial face that faces away from the first end of the post, wherein the radial face is substantially flat; a body member adjacent to the post; a coupler including an internally-threaded region for engaging the equipment port; and a grounding member contacting the post and the coupler,
(Continued)



EXHIBIT
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wherein the grounding member provides an electrically-conductive grounding path through the post and the coupler while allowing the coupler to rotate, wherein the grounding member includes at least one resilient portion.

15 Claims, 8 Drawing Sheets

Related U.S. Application Data

continuation of application No. 13/117,843, filed on May 27, 2011, now Pat. No. 8,172,612, which is a continuation of application No. 12/332,925, filed on Dec. 11, 2008, now Pat. No. 7,955,126, which is a continuation of application No. 11/541,903, filed on Oct. 2, 2006, now Pat. No. 7,479,035, which is a continuation of application No. 11/043,844, filed on Jan. 25, 2005, now Pat. No. 7,114,990.

(51) **Int. Cl.**

H01R 43/20	(2006.01)
H01R 13/52	(2006.01)
H01R 103/00	(2006.01)

(52) **U.S. Cl.**
CPC *H01R 13/5202* (2013.01); *H01R 13/5216* (2013.01); *H01R 2103/00* (2013.01)

(58) **Field of Classification Search**
USPC 439/583, 584, 320, 322, 314
See application file for complete search history.

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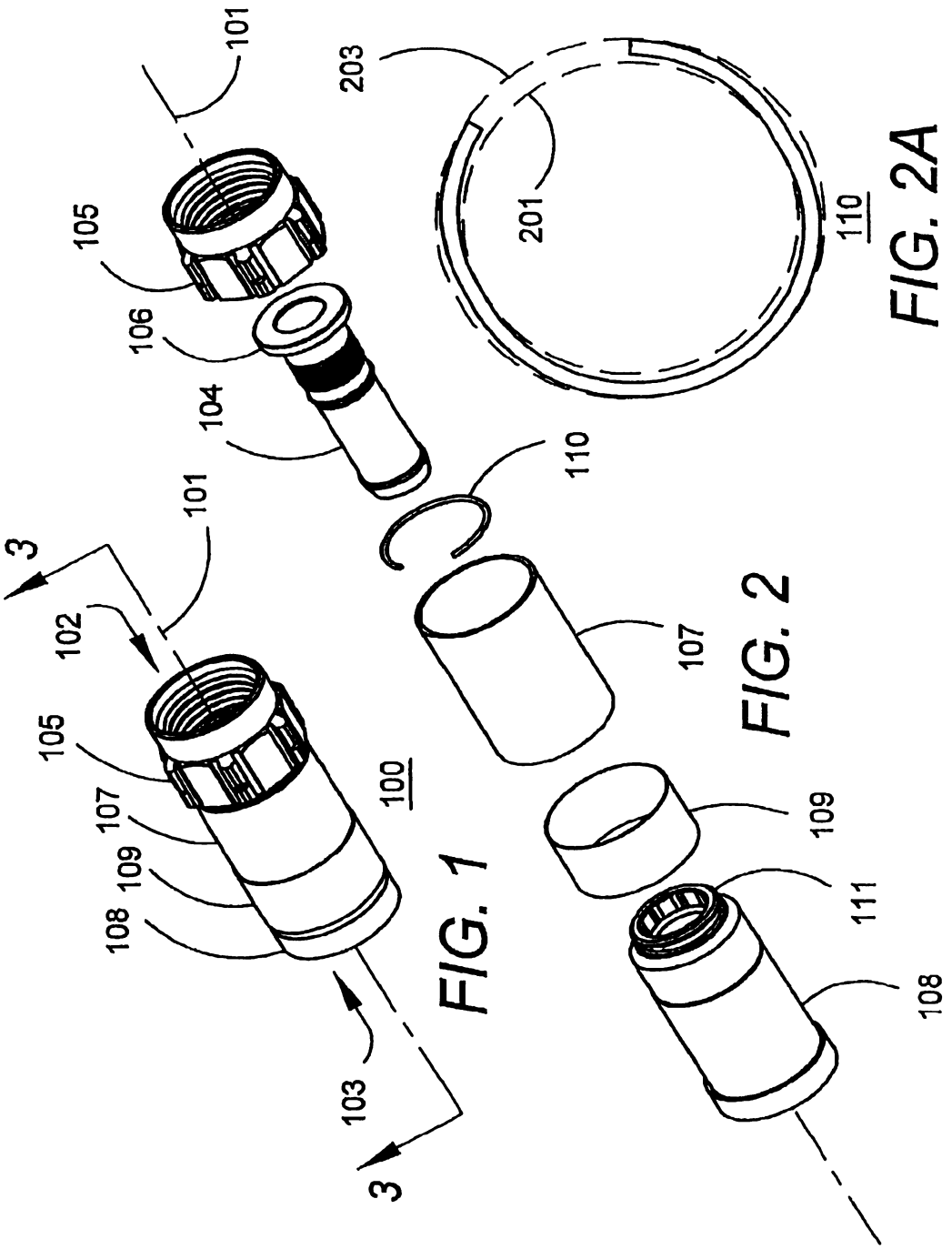

FIG. 1

FIG. 2

FIG. 2A

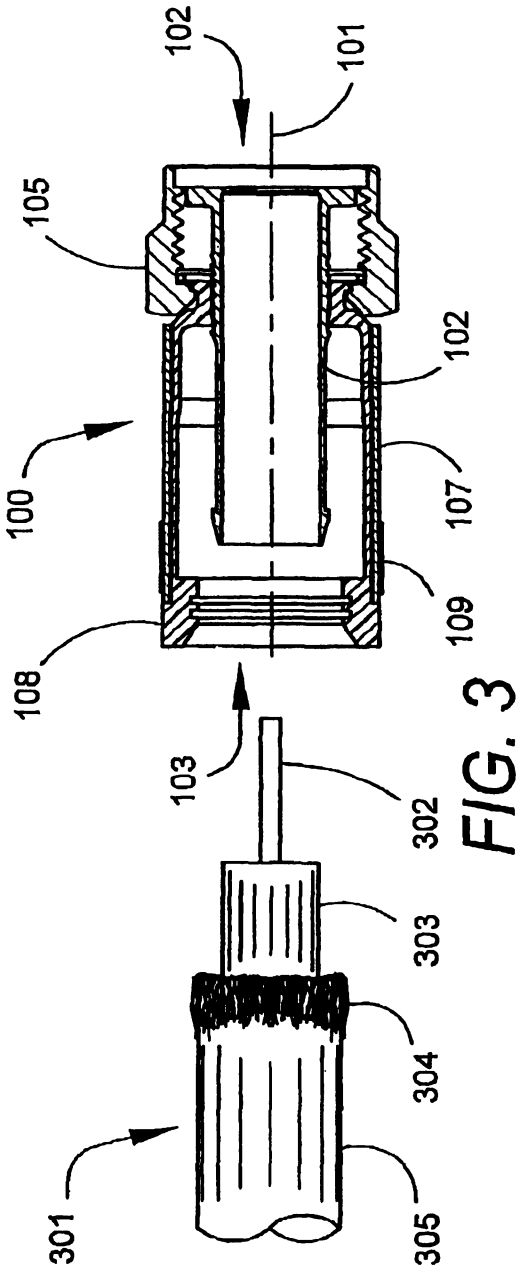

FIG. 3

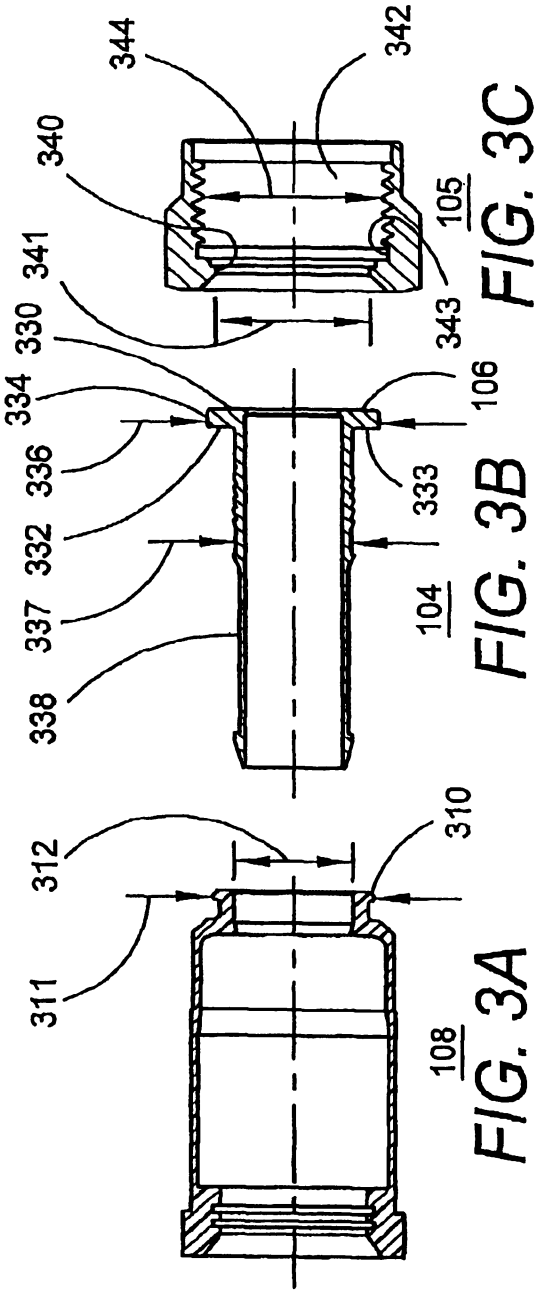

FIG. 3C

FIG. 3B

FIG. 3A

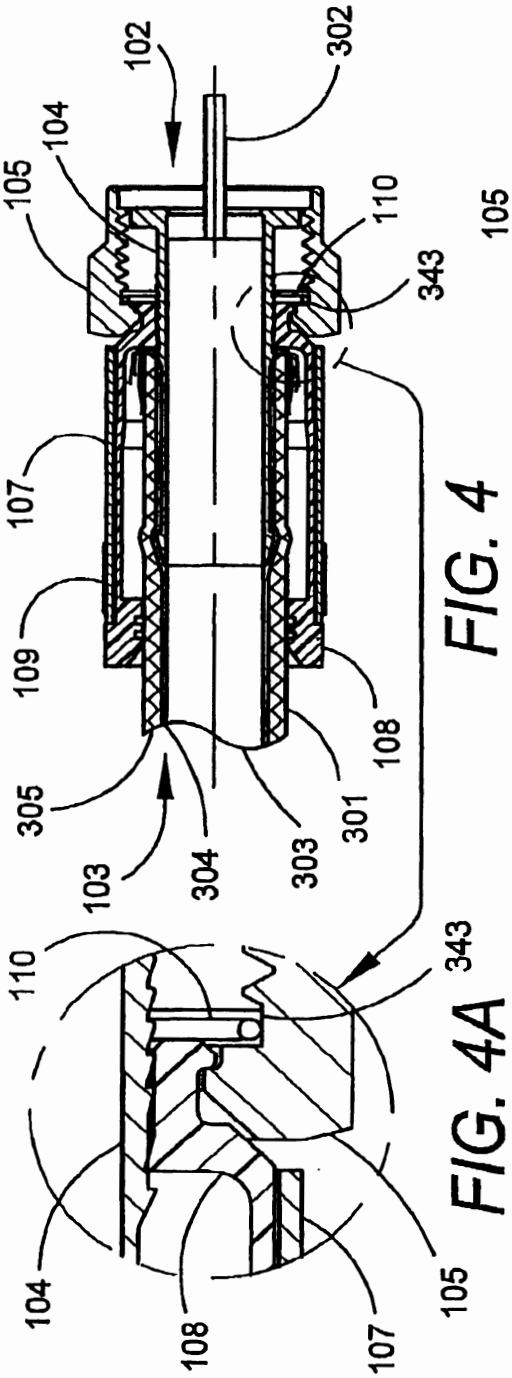

FIG. 4

FIG. 4A

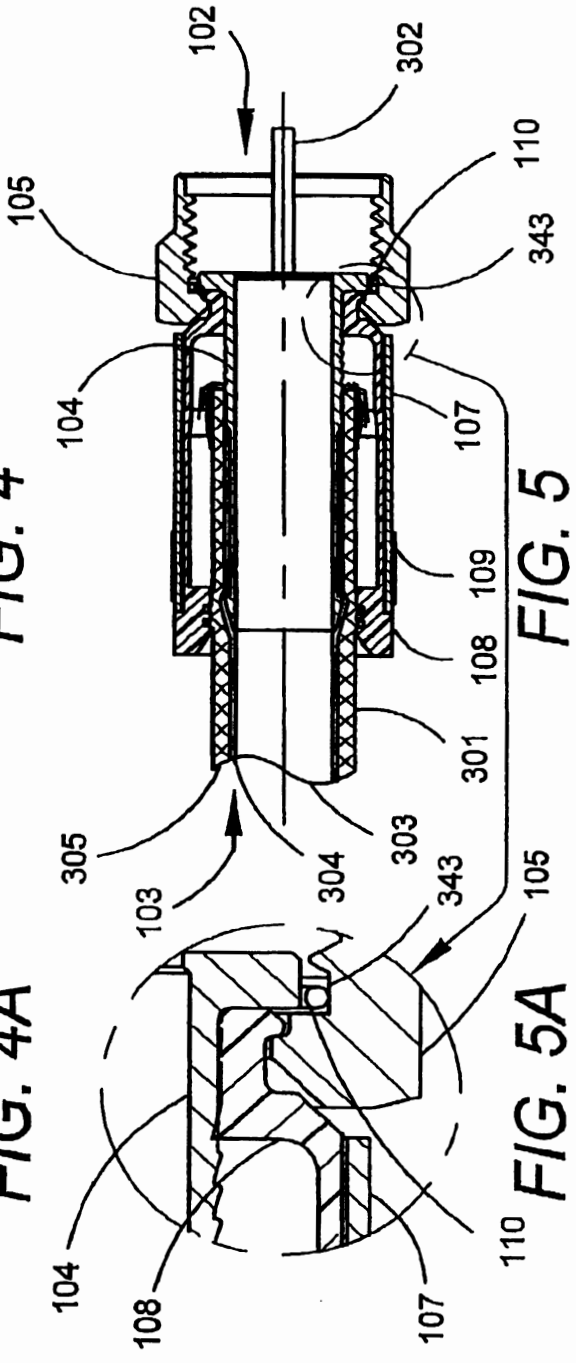

FIG. 5

FIG. 5A

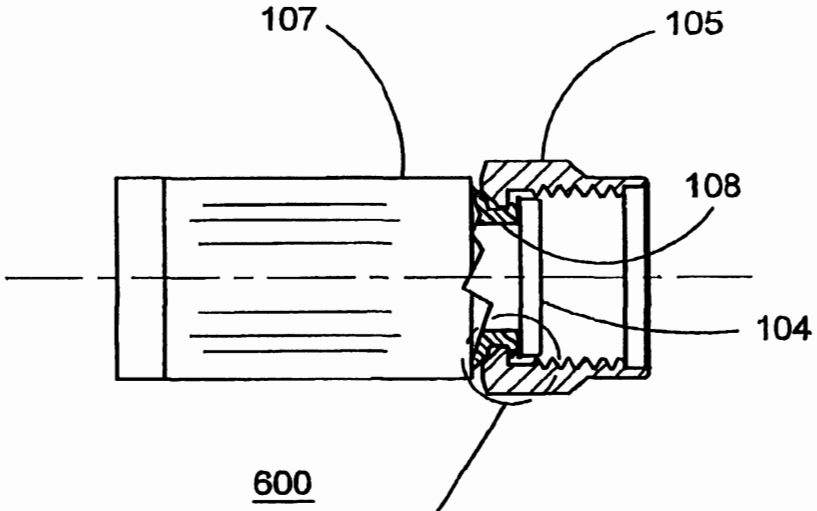

FIG. 6

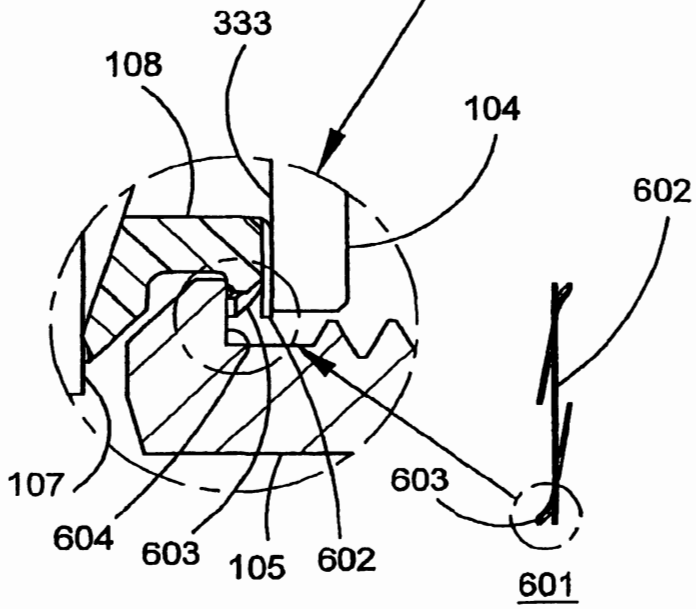

FIG. 6A

FIG. 6B

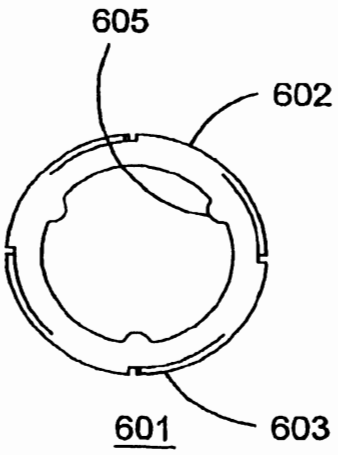

FIG. 6C

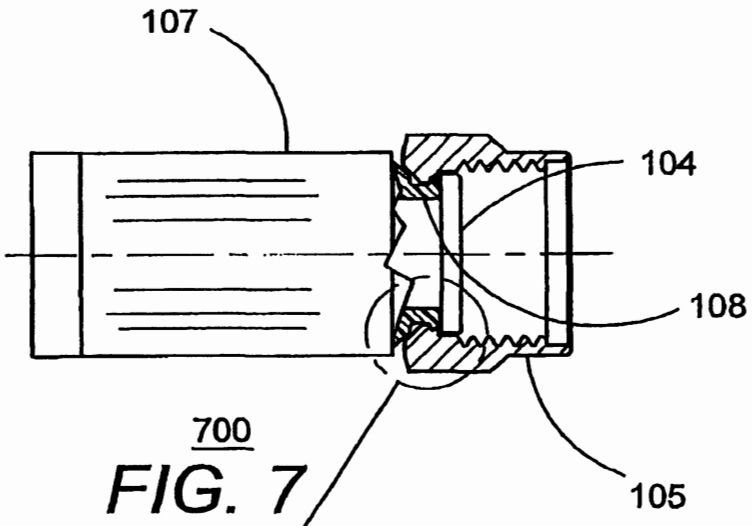

FIG. 7

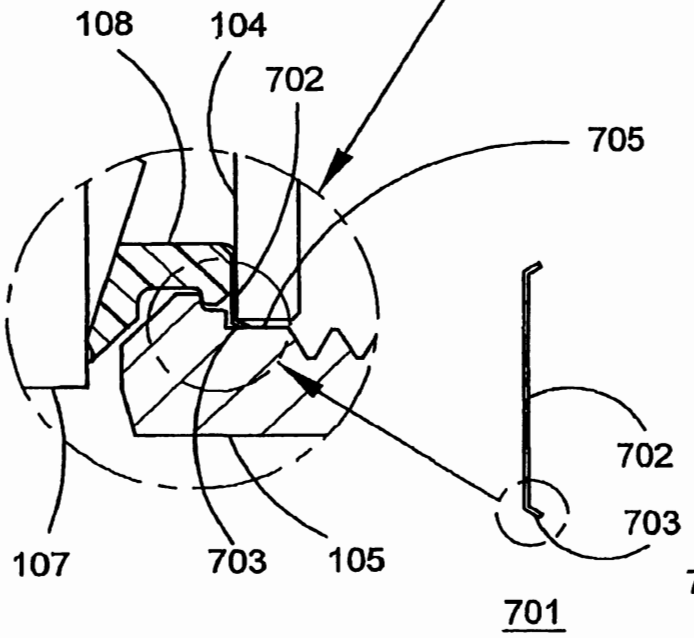

FIG. 7A

FIG. 7B

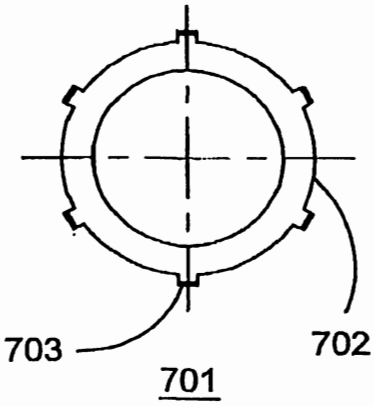

FIG. 7C

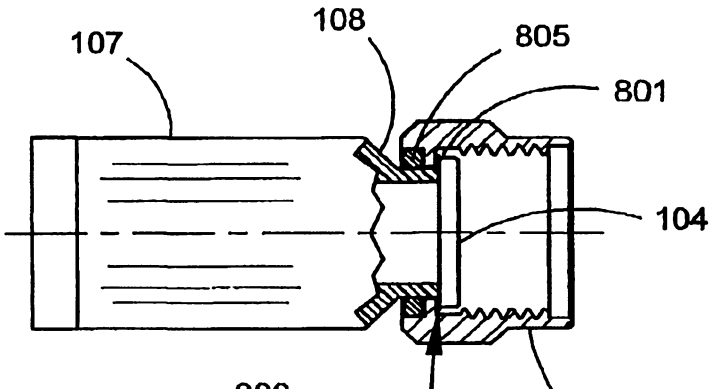

FIG. 8

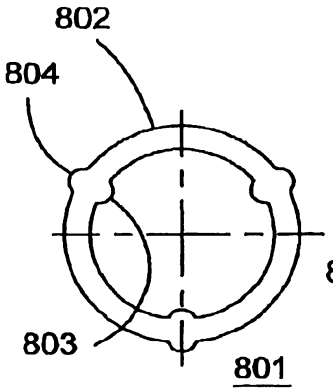

FIG. 8B

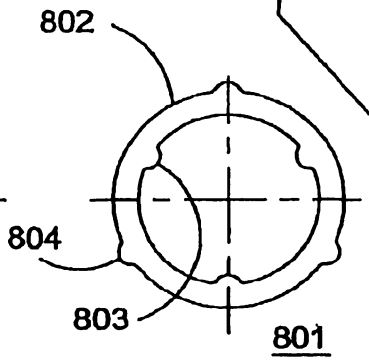

FIG. 8C

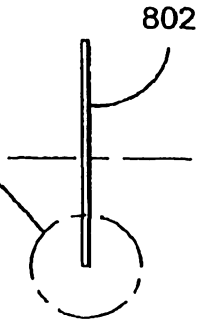

FIG. 8A

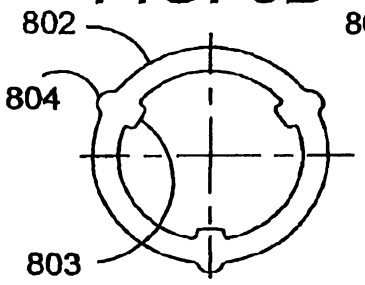

FIG. 8D

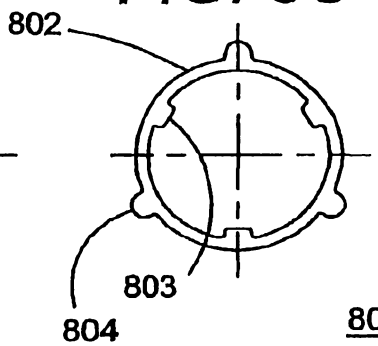

FIG. 8E

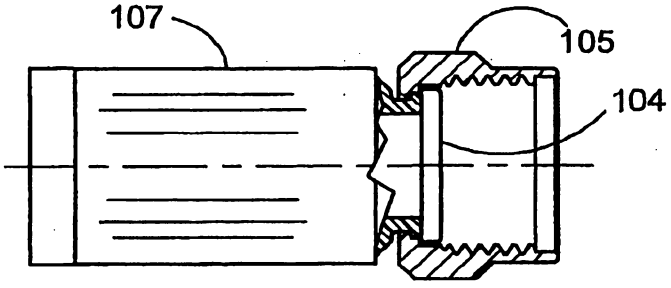

FIG. 9

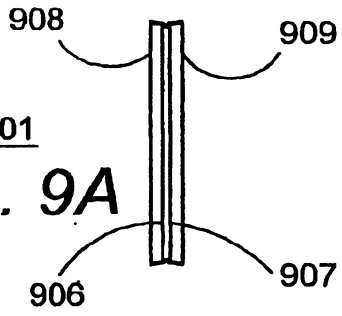

FIG. 9A

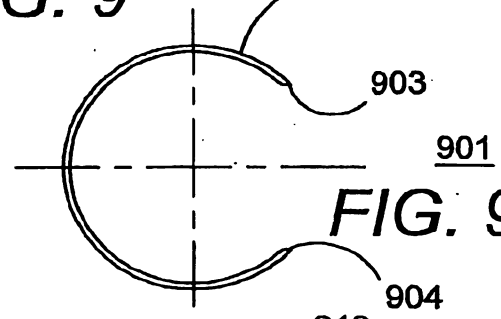

FIG. 9B

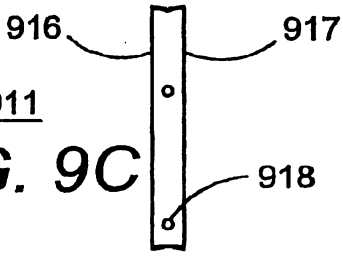

FIG. 9C

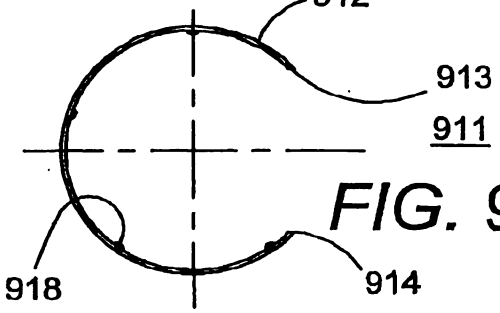

FIG. 9D

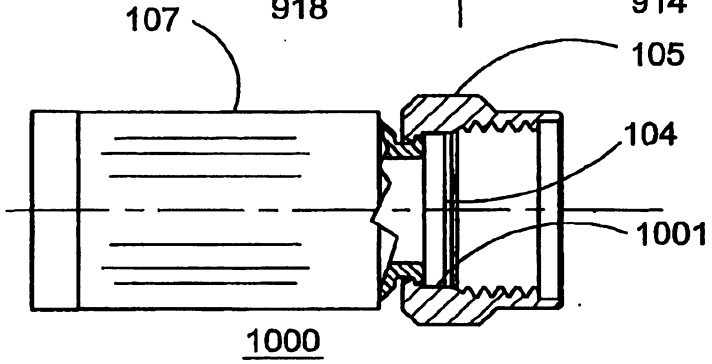

FIG. 10

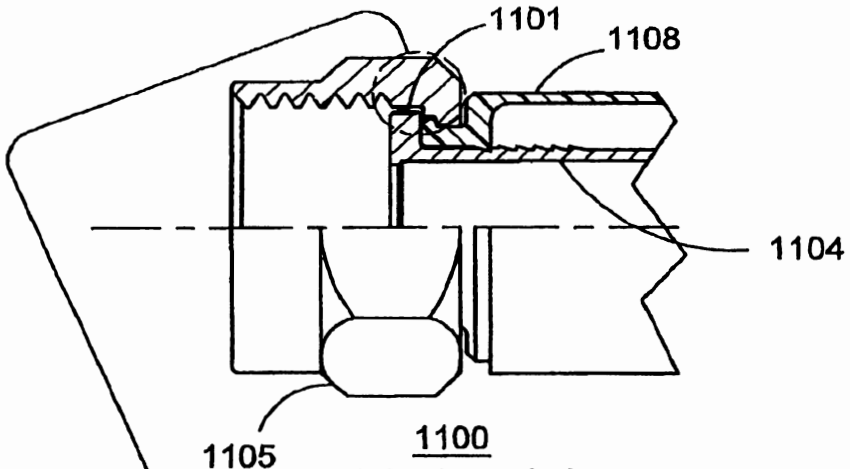

FIG. 11

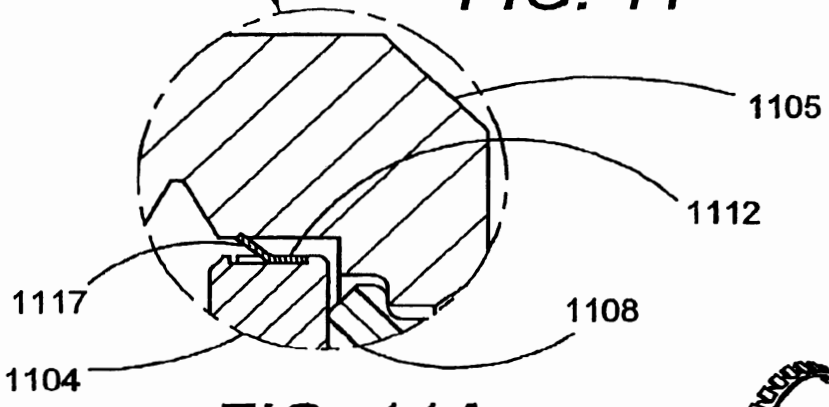

FIG. 11A

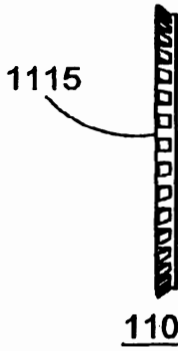

FIG. 11B

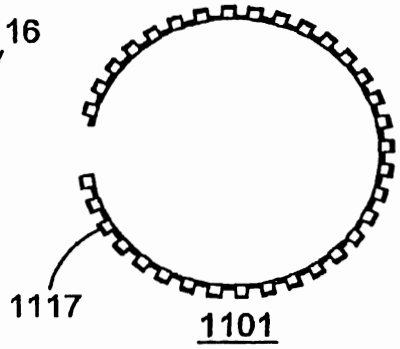

FIG. 11C

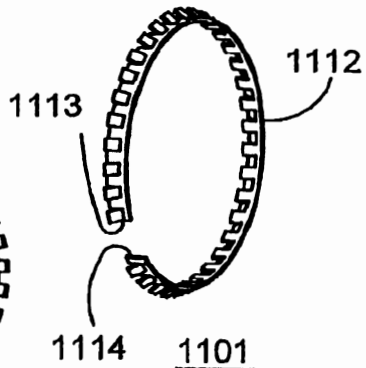

FIG. 11D

ELECTRICAL CONNECTOR WITH GROUNDING MEMBER

This application is a continuation of U.S. patent application Ser. No. 13/438,532, filed Apr. 3, 2012, which is a continuation of U.S. patent application Ser. No. 13/117,843 filed on May 27, 2011, now U.S. Pat. No. 8,172,612, which is a continuation of U.S. patent application Ser. No. 12/332,925 filed on Dec. 11, 2008, now U.S. Pat. No. 7,955,126, which is a continuation of U.S. patent application Ser. No. 11/541,903 filed on Oct. 2, 2006, now U.S. Pat. No. 7,479,035, which is a continuation of U.S. patent application Ser. No. 11/043,844 filed on Jan. 25, 2005, now U.S. Pat. No. 7,114,990, the contents of which are relied upon and incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to electrical connectors, and more particularly to coaxial cable connectors capable of being connected to a terminal.

2. Description of the Related Art

Coaxial cable connectors, such as type F connectors, are used to attach coaxial cable to another object or appliance, e.g., a television set or VCR having a terminal adapted to engage the connector. The terminal of the appliance includes an inner conductor and a surrounding outer conductor,

Coaxial cable includes a center conductor for transmitting a signal. The center conductor is surrounded by a dielectric material, and the dielectric material is surrounded by an outer conductor; this outer conductor may be in the form of a conductive foil and/or braided sheath. The outer conductor is typically maintained at ground potential to shield the signal transmitted by the center conductor from stray noise, and to maintain a continuous desired impedance over the signal path. The outer conductor is usually surrounded by a plastic cable jacket that by the center conductor from stray noise, and to maintain a continuous desired impedance over the signal path. The outer conductor is usually surrounded by a plastic cable jacket that electrically insulates, and mechanically protects, the outer conductor. Prior to installing a coaxial connector onto an end of the coaxial cable, the end of the coaxial cable is typically prepared by stripping off the end portion of the jacket to bare the end portion of the outer conductor. Similarly, it is common to strip off a portion of the dielectric to expose the end portion of the center conductor.

Coaxial cable connectors of the type known in the trade as "F connectors" often include a tubular post designed to slide over the dielectric material, and under the outer conductor of the coaxial cable, at the prepared end of the coaxial cable. If the outer conductor of the cable includes a braided sheath, then the exposed braided sheath is usually folded back over the cable jacket. The cable jacket and folded-back outer conductor extend generally around the outside of the tubular post and are typically received in an outer body of the connector; this outer body of the connector is usually fixedly secured to the tubular post. A coupler is rotatably secured around the tubular post and includes an internally-threaded region for engaging external threads formed on the outer conductor of the appliance terminal.

When connecting the end of a coaxial cable to a terminal of a television set, equipment box, or other appliance, it is important to achieve a reliable electrical connection between the outer conductor of the coaxial cable and the outer conductor of the appliance terminal. This goal is usually achieved by ensuring that the coupler of the connector is fully tightened over the connection port of the appliance. When fully tightened, the head of the tubular post of the connector directly engages the edge of the outer conductor of the appliance port, thereby making a direct electrical ground connection between the outer conductor of the appliance port and the tubular post; in turn, the tubular post is engaged with the outer conductor of the coaxial cable.

However, in many cases, it is difficult for an installer to reach the connection ports of the appliance with a wrench, and in some instances, it is even difficult for the installer to reach such connection ports with his or her fingers. As a result, it can often happen that typo F connectors are not fully tightened to the appliance port. In such a loose connection system, wherein the coupler of the coaxial connector is not drawn tightly to the appliance port connector, a gap exists between the outer conductor of the appliance port and the tubular post of the connector. Unless an alternate ground path exists, poor signal quality, and RFI leakage, will result.

As mentioned above, the coupler is rotatably secured about the head of the tubular post. The head of the tubular post usually includes an enlarged shoulder, and the coupler typically includes an inwardly-directed flange for extending over and around the shoulder of the tubular post. In order not to interfere with free rotation of the coupler, manufacturers of such F-style connectors routinely make the outer diameter of the shoulder (at the head of the tubular post) of smaller dimension than the inner diameter of the central bore of the coupler. Likewise, manufacturers routinely make the inner diameter of the inwardly-directed flange of the coupler of larger dimension than the outer diameter of the non-shoulder portion of the tubular post, again to avoid interference with rotation of the coupler relative to the tubular post. In a loose connection system, wherein the coupler of the coaxial connector is not drawn tightly to the appliance port connector, an alternate ground path may fortuitously result from contact between the coupler and the tubular post, particularly if the coupler is not centered over, and axially aligned with, the tubular post. However, this alternate ground path is not stable, and can be disrupted as a result of vibrations, movement of the appliance, movement of the cable, or the like.

Alternatively, there are some cases in which such an alternate ground path is provided by fortuitous contact between the coupler and the outer body of the coaxial connector, provided that the outer body is formed from conductive material. This alternate ground path is similarly unstable, and may be interrupted by relative movement between the appliance and the cable, or by vibrations. Moreover, this alternate ground path does not exist at all if the outer body of the coaxial connector is constructed of non-conductive material. Such unstable ground paths can give the to intermittent failures that are costly and time-consuming to diagnose.

OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide a coaxial cable connector for connecting a coaxial cable to a connection port of an appliance, the coaxial cable connector being of the type that includes a tubular post and a coupler, such as a rotatable coupler, which ensures a reliable ground connection between the tubular post of the connector and an outer conductor of the appliance port, even if the coupler is not fully tightened onto the appliance port.

It is another object of the present invention to provide such a coaxial cable connector which maintains a reliable

ground path between the coupler and the tubular post, at least following installation of such connector onto the end of a coaxial cable.

It is still another object of the present invention to provide such a coaxial connector that can be manufactured economically.

These and other objects of the present invention will become more apparent to those skilled in the art as the description thereof proceeds.

SUMMARY OF THE INVENTION

Briefly described, the present invention relates to a coaxial cable connector comprising a tubular post, a coupler and a grounding means for providing an electrically conductive path between the post and the coupler. In accordance with a preferred embodiment thereof, the present invention relates to a coaxial cable connector for coupling a prepared end of a coaxial cable to a threaded female equipment port, and including a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor thereof. A coupler is rotatably secured over the second end of the tubular post, and includes a central bore, at least a portion of which is threaded for engaging the female equipment port. An outer body is secured to the tubular post and extends about the first end of the tubular post for receiving the outer conductor, and preferably the cable jacket, of the coaxial cable.

In a preferred embodiment of the present invention, a resilient, electrically-conductive grounding member is disposed between the tubular post and the coupler. This grounding member engages both the tubular post and the coupler for providing an electrically-conductive path therebetween, but without restricting rotation of the coupler relative to the tubular post.

For some preferred embodiments, the grounding member is generally arcuately shaped to extend around the tubular post over an arc of at least 225°, and may extend for a full 360°. This arcuately shaped grounding member may be in the form of a generally circular broken ring, or C-shaped member, as by bending a strip of metal wire into an arc. Preferably, the grounding member has a shape that is out-of-round, and more preferably oblong, rather than circular, in order to ensure reliable electrical contact with both the coupler and the tubular post. In order to retain the grounding member inside the coupler, the inner bore of the coupler may include an annular recess proximate to the end of the coupler that encircles the tubular post; at least portions of the grounding member are engaged with the annular recess to prevent the grounding member from being axially displaced within the coupler.

As mentioned above, the tubular post may include an enlarged shoulder at the head thereof. In one preferred embodiment of the present invention, the grounding member surrounds the enlarged shoulder of the tubular post, at least when the coaxial cable connector is assembled onto the prepared end of a coaxial cable, whereby at least portions of the grounding member engage the outer surface of such enlarged shoulder.

In one embodiment of the present invention, the grounding member is generally circular and includes a plurality of projections extending outwardly therefrom for engaging the coupler. In another embodiment of the present invention, the grounding member is generally circular and includes a plurality of projections extending inwardly therefrom for engaging the tubular post.

In yet another embodiment of the present invention, the tubular post includes an enlarged shoulder extending inside the coupler, and including a first radial face that faces the opposite end of the tubular post. The coupler includes a flange directed inwardly toward the tubular post; this inwardly directed flange including a second radial face that faces toward the connection port of the appliance to which the coaxial cable is to be connected. The grounding member is disposed between the first radial face and the second radial face. In this embodiment, the grounding member is resilient relative to the longitudinal axis of the connector, and is compressed between the first radial face and the second radial face to maintain sliding electrical contact between the shoulder of the tubular post (via its first radial face) and the flange of the coupler (via its second radial face).

The coaxial connector of the present invention may also include a sealing ring seated within the coupler for rotatably engaging the body member to form a seal therebetween.

In an alternate embodiment of the present invention, conductive grease is substituted for a discrete grounding member. In this embodiment, an outer dimension of a portion of the tubular post is caused to be commensurate with an inner dimension of an adjacent portion of the coupler. While the gap between such adjacent portions, coupled with the lubrication provided by the conductive grease, is sufficient to permit rotation of the coupler relative to the tubular post, the conductive grease nonetheless functions to maintain reliable electrical coupling across such gap.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described with greater specificity and clarity with reference to the following drawings, in which:

FIG. **1** is a perspective view of an F connector in accordance with the preferred embodiment of the invention, including a body and a coupling nut;

FIG. **2** is an exploded view of the F connector of FIG. **1**, including a preferred embodiment of a grounding member;

FIG. **2A** is an enlarged plan view of the preferred embodiment of the grounding member of FIG. **2**;

FIG. **3** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3-3**, and a side view of a prepared coaxial cable ready to be inserted into a back end of the F connector;

FIG. **3A** is a cross-sectional view of the body of the F connector of FIG. **1** through cut-line **3-3**;

FIG. **3B** is a cross-sectional view of a tubular post of the F connector of FIG. **1**, through cut-line **3-3**;

FIG. **3C** is a cross-sectional view of the coupling nut of the F connector of FIG. **1** through cut-line **3-3**;

FIG. **4** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3-3**, and cross-sectional view of the prepared coaxial cable fully inserted into the back end thereof, prior to axial compression of the F connector;

FIG. **4A** is an enlargement of a portion of FIG. **4**;

FIG. **5** is a cross-sectional view of the F connector of FIG. **1** through cut-line **3-3**, and a cross-sectional view of the prepared coaxial cable fully inserted into the back end thereof, subsequent to axial compression of the F connector;

FIG. **5A** is an enlargement of a portion of FIG. **5**;

FIG. **6** is a partial cross-sectional view of a first alternate embodiment of an F connector having a first alternate grounding member;

FIG. **6A** is an enlargement of a portion of FIG. **6**;

FIG. **6B** is a slightly enlarged side view of the first alternate grounding member of FIG.**6**;

FIG. **6**C is a slightly enlarged plan view of the first alternate grounding member of FIG. **6**;

FIG. **7** is a partial cross-sectional view of a second alternate embodiment of an F connector having a second alternate grounding member;

FIG. **7**A is an enlargement of a portion of FIG. **7**;

FIG. **7**B is a slightly enlarged side view of the second alternate grounding member of FIG. **7**;

FIG. **7**C is a slightly enlarged plan view of the second alternate grounding member of FIG. **7**;

FIG. **8** is a partial cross-sectional view of a third alternate embodiment of an F connector having a third alternate grounding member;

FIG. **8**A is a slightly enlarged side view of the third alternate grounding member of FIG. **8**;

FIGS. **8**B-**8**E are slightly enlarged plan views of four styles of the third alternate grounding member of FIG. **8**;

FIG. **9** is a partial cross-sectional view of a fourth alternate embodiment of an F connector having one of a fourth alternate grounding member and a fifth alternate grounding member;

FIG. **9**A is a slightly enlarged side view of the fourth alternate grounding member of FIG. **9**;

FIG. **9**B is a slightly enlarged plan view of the fourth alternate grounding member of FIG. **9**;

FIG. **9**C is a slightly enlarged side view of the fifth alternate grounding member of FIG. **9**;

FIG. **9**D is a slightly enlarged plan view of the fifth alternate grounding member of FIG. **9**;

FIG. **10** is a partial cross-sectional view of a fifth alternate embodiment of an F connector having conductive grease that acts as a grounding member;

FIG. **11** is a partial cross-sectional view of a front end of a sixth alternate embodiment of an F connector having a sixth alternate grounding member;

FIG. **11**A is an enlargement of a portion of FIG. **11**;

FIG. **11**B is a side view of the sixth alternate grounding member of FIG. **11**;

FIG. **11**C is a plan view of the sixth alternate grounding member of FIG. **11**; and

FIG. **11**D is a perspective view of the sixth alternate grounding member of FIG. **11**.

For simplicity and clarity of illustration, the drawing figures illustrate the general manner of construction, and descriptions and details of well-known features and techniques are omitted to avoid unnecessarily obscuring the invention. Furthermore, elements in the drawing figures are not necessarily drawn to scale.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** is a perspective view of an F connector **100** in accordance with the preferred embodiment of the invention. The F connector **100** (hereinafter, "connector") has a longitudinal axis **101**. The connector has a front end **102** and a back end **103**.

FIG. **2** is an exploded view of the connector **100**. The connector **100** includes tubular post **104**, a coupling nut **105** rotatably secured over an end **106** of the tubular post for securing the connector to an appliance (not shown), and a body **108** secured to the tubular post. A shell **107** and a label **109** are secured to the body **108**. Preferably, the body **108** is made entirely of acetal plastic. Alternatively, the body **108** is made of brass, plated with nickel. The shell **107** acids strength to the plastic body **108** and protects the plastic body from ultraviolet light. The tubular post **104** is preferably metallic, and more preferably, made of brass, with a tin plating; as tin is more conductive than nickel. The coupling nut **105** is preferably metallic, and more preferably, formed from brass, plated with nickel or with another non-corrosive material.

In the embodiment shown in the drawings, the coupling nut **105** is rotatably secured over an end **106** of the tubular post **104** via a neck **111** of the body **108**. Advantageously, an electrical grounding path is constantly maintained between the coupling nut **105** and the tubular post **104**, including, in particular, when the coupling nut **105** of the connector **100** is not tightly fastened to the appliance. The electrical grounding path is provided by a resilient, electrically-conductive grounding member **110** disposed between the tubular post **104** and the coupling nut **105**.

FIG. **2**A is an enlarged plan view of the preferred embodiment of the grounding member **110**. In the preferred embodiment of the present invention, the electrically-conductive grounding member **110** is disposed between the tubular post **104** and the coupling nut **105**. The grounding member **110** contacts both the tubular post **104** and the coupling nut **105** for providing an electrically-conductive path therebetween, but without restricting rotation of the coupling nut relative to the tubular post. A preferred embodiment of the grounding member **110** shown in FIG. **2**A is a spring member, or circlip, disposed between the coupling nut **105** and the tubular post **104**, which establishes a stable ground path between the coupling nut and the post, and which is preferably constructed of a wire-type material. The grounding member **110** is retained in the coupling nut **105** by an annular recess **343** (see FIG. **3**C) in the coupling nut. The spring action of the grounding member **110** serves to form a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut **105** to rotate. The grounding member **110** is resilient and is generally arcuately shaped. The grounding member **110** extends around the tubular post **104** over an arc of at least 225°, and may extend for a full 360°. The arcuately shaped grounding member **110** may be in the form of a generally circular broken ring, or C-shaped member, as by bending a strip of metal wire into an arc. Preferably, the grounding member **110** is a C-shaped metal clip that has an arcuate curvature that is non-circular. The grounding member **110** has a minimum diameter **201** and a maximum diameter **203**. Preferably, the grounding member **110** is made of stainless steel wire that has a wire diameter of between 0.010-inch and 0.020-inch; in a preferred embodiment, the wire diameter is about 0.016-inch. Stainless steel is a preferred metal for the grounding member **110** because it need not be plated for corrosion resistance.

FIG. **3** is a cross-sectional view of the connector **100** through cut-line **3**-**3** of FIG. **1**, and a side view of a prepared coaxial cable **301** ready to be inserted into a back end **103** of the connector. The center conductor **302** of the coaxial cable **301** is surrounded by a dielectric material **303**, and the dielectric material is surrounded by an outer conductor **304** that may be in the form of a conductive foil and/or braided sheath. The outer conductor **304** is usually surrounded by a plastic cable jacket **305** that electrically insulates, and mechanically protects, the outer conductor.

FIG. **3**A is a cross-sectional view of the body **108** of FIG. **1** through cut-line **3**-**3**. FIG. **3**B is a cross-sectional view of the tubular post **104** of FIG. **1** through cut-line **3**-**3**. FIG. **3**C is a cross-sectional view of the coupling nut **105** of FIG. **1** through cut-line **3**-**3**. Referring now to FIGS. **3**, **3**A, **3**B and **3**C, the body **108** has a lip **310** at a front end of the body. The lip **310** has an outer diameter **311** and an inner diameter **312**. The coupling nut **105** is rotatably secured about a head **330**

at the front end of the tubular post **104**. The head **330** of the tubular post **104** usually includes an enlarged shoulder **332**. The coupling nut **105** typically includes an inwardly-directed flange **340** that extends over and around the shoulder **332** of the tubular post **104**. In order to retain the grounding member **110** inside the coupling nut **105**, the inner, or central, bore **342** of the coupling nut **105** may include an annular recess **343** that is proximate to the end of the coupling nut that encircles the tubular post **104**. At least portions of the grounding member **110** are engaged with the annular recess **343** to prevent the grounding member from being axially displaced within the coupling nut **105**. The tubular post **104** may include an enlarged shoulder **332** at the head **330** thereof. The shoulder **332** has a first radial face **333** that faces the back end of the tubular post **104**. In one preferred embodiment of the present invention, the grounding member **110** surrounds the enlarged shoulder **332** of the tubular post **104**, at least when the connector **100** is assembled onto the prepared end of a coaxial cable **301**. At least portions of the grounding member **110** contact the outer surface **334** of such enlarged shoulder **332**.

The coupling nut **105** has an inwardly-directed flange near the back end of the coupling nut. The coupling nut **105** has an inner diameter **341** at a back end of the coupling nut. In order to retain the buck end of the coupling nut **105** on the front end of the body **108**, the inner diameter **341** of the coupling nut has a dimension less than the outer diameter of the lip **310** of the body **108**. In order not to interfere with free rotation of the coupling nut **105**, the outer diameter **336** of the shoulder **332** (at the head **330** of the tubular post **104**) is of smaller dimension than the inner diameter **344** of the central bore of the coupling nut **105**. Likewise, the inner diameter **341** of the inwardly-directed flange **340** of the coupling nut **105** is of larger dimension than the outer diameter **337** of the non-shoulder portion **338** of the tubular post **104**, again to avoid interference with rotation of the coupling nut **105** relative to the tubular post.

FIG. **4** is a cross-sectional view of the connector **100** through cut-line **3-3**, and cross-sectional view of the prepared coaxial cable **301** fully inserted into the back end **103** thereof, prior to axial compression of the connector. FIG. **4A** is an enlargement of a portion of FIG. **4**. Referring now to FIGS. **4** and **4A**, the resilient, electrically-conductive grounding member **110** is shown disposed between the tubular post **104** and the coupling nut **105**. The grounding member **110** is disposed in the annular recess **343** that encircles the tubular post **104**.

FIG. **5** is a cross-sectional view of the connector **100** through cut-line **3-3**, and a cross-sectional view of the prepared coaxial cable **301** fully inserted into the back end **103** thereof, subsequent to axial compression of the connector. FIG. **5A** is an enlargement of a portion of FIG. **5**. Referring now to FIGS. **5** and **5A**, as a result of axial compression by a standard compression tool (not shown), the tubular post **104** slides (to the right in the drawings) relative to the other components of the connector **100** and relative to the cable **301**, such that the shoulder **332** of the tubular post is radially inward of the grounding member **110**. At least a portion of the grounding member **110** engages the coupling nut **105** at the annular recess **343** of the coupling nut, and at least another portion of the grounding member engages tubular post **104** at the shoulder **332** of the tubular post. The tubular post **104** is in electrical contact with the outer conductor **304** of the cable **301** along the back portion of the tubular post. and the coupling nut **105** may engage the outer conductor of an appliance port (not shown). Therefore, when the connector **100** is fastened to an appliance port, there is maintained an electrical grounding path between the outer conductor **304** of the cable **301** and the outer conductor of the appliance port, whether or not the coupling nut **105** of the connector is tightly fastened to the appliance port.

FIG. **6** is a partial cross-sectional view of a first alternate embodiment of a connector **600** having a first alternate grounding member **601** (see FIGS. **6A-6C**), shown subsequent to axial compression. FIG. **6A** is an enlargement of a portion of the first alternate embodiment of the connector **600** showing a portion of the first alternate grounding member **601**. FIG. **6B** is a slightly enlarged side view of the first alternate grounding member **601**. FIG. **6C** is a slightly enlarged plan view of the first alternate grounding member **601**. Referring now to FIGS. **6**, **6A**, **6B** and **6C**, the first alternate grounding member **601** is a spring finger grounding member retained between the coupling nut **105** and the tubular post **104**. The first alternate grounding member **601** is constructed of a thin cross section of material such beryllium copper. The first alternate grounding member **601** comprises a ring portion **602** and a plurality of fingers **603** that project at approximately a 30° angle from the plane of the ring. The spring action of the fingers **603** extend to, and make contact with, a radial surface **604** near the back end of the coupling nut **105** that faces the front end of the coupling nut, which serve to connect a ground path from the coupling nut to the tubular post while allowing the coupling nut to rotate. The first alternate grounding member **601** has optional internal lugs **605** that contact the outer diameter **337** of the non-shoulder portion of the tubular post.

FIG. **7** is a partial cross-sectional view of a second alternate embodiment of a connector **700** having a second alternate grounding member **701** (see FIGS. **7A-7C**). FIG. **7A** is an enlargement of a portion of the second alternate embodiment of the connector **700**, showing a portion of the second alternate grounding member **701**. FIG. **7B** is a slightly enlarged side view of the second alternate grounding member **701**. FIG. **7C** is a slightly enlarged plan view of the second alternate grounding member **701**. Referring now to FIGS. **7**, **7A**, **7B** and **7C**, the second alternate grounding member **701** is a radial grounding member retained between the coupling nut **105** and the tubular post **104**. The second alternate grounding member **701** is constructed of a thin cross section of metallic material such as beryllium copper. The second alternate grounding member **701** comprises a ring portion **702** and a plurality of fingers **703** extending radially from the ring portion at about a 45° angle from the plane of the ring portion. The spring action of the fingers **703** extend to inner-diameter surfaces **705** of the coupling nut **105**, and serve to connect a ground path from the coupling nut to the tubular post **104** while allowing the coupling nut to rotate.

FIG. **8** is a partial cross-sectional view of a third alternate embodiment of a connector **800** having a third alternate grounding member **801** (see FIGS. **8A-8E**), FIG. **8A** is a slightly enlarged side view of the third alternate grounding member **801**. FIGS. **8B-8E** are slightly enlarged plan views of four styles of the third alternate grounding member **801**. Referring now to FIG. **8** and FIGS. **8A-8E**, the third alternate grounding member **801** is a conductive member retained between the coupling nut **105** and the tubular post **104**. The third alternate grounding member **801** is constructed of a thin cross section of metallic material such as brass or beryllium copper. The third alternate grounding member **801** comprises a ring **802** with multiple points of contact, or internal lugs, **803** around the inner perimeter of the ring and with multiple external lugs **804** around the outer perimeter of the ring. The lugs **803** and **804** serve to connect

a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate. FIGS. **8**B-**8**E show four styles with regard to the shape of the lugs **803** and **804** and the position of the lugs on the ring **802**. FIG. **8** also exhibits an alternate embodiment comprising a sealing ring **805** for forming a moisture seal between the coupling nut **105** and the body **108** of the connector **801**. The sealing ring **805** is disposed between the back end of the coupling nut **105** and the body **108** for forming a seal therebetween. Preferably, the sealing ring **805** is made from ethylene propylene. Use of the sealing ring **805** is not limited to use in connectors having the third alternate grounding member **801**. The third alternate grounding member **801** may also be used in connectors without the sealing ring **805**.

FIG. **9** is a partial cross-sectional view of a fourth alternate embodiment of a connector **900** having one of a fourth alternate grounding member **901** and a fifth alternate grounding member **911** (see FIGS. **9**A-**9**D). FIG. **9**A is a slightly enlarged side view of the fourth alternate grounding member **901**. FIG. **9**B is a slightly enlarged plan view of the fourth alternate grounding member **901**. FIG. **9**C is a slightly enlarged side view of the fifth alternate grounding member **902**. FIG. **9**D is a slightly enlarged plan view of the fifth alternate grounding member **911**. The fourth and filth alternate embodiments of the grounding member **901** and **911**, respectively, comprise a C-shaped ring between the coupling nut **105** and the tubular post **104**. The C-shaped ring is constructed of a thin cross section of metallic material such as beryllium copper or stainless steel. It is retained by a groove in the coupling nut. The spring action of the C-shaped ring serves to connect a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate. The fourth alternate grounding member **901** includes a circumferential metallic band **902**, which has a general circular shape and approximates a section of a hollow cylinder, that extends between first **903** and second **904** opposing ends. The band **902** has first **906** and second **907** opposing side edges extending along its length. The fourth alternate grounding member **901** includes a first generally radial wall **908** extending from the first side edge **906** of the band in a first radial direction, and a second generally radial wall **909** extending from the second side edge **907** of the band generally in said first radial direction. The band **902** contacts a first one of the group of members that includes the coupling nut **105** and the tubular post **104**. The first **908** and second **909** radial walls contact the second of the group of members that includes the coupling nut **105** and the tubular post **104**. The fifth alternate grounding member **911** includes a metallic band **912** extending along its length between first **913** and second **914** opposing ends, and extending along its width between first **916** and second **917** side edges. The band **912** is formed along its length into a generally circular shape. The band **912** is formed along its width into a generally concave shape with the side edges **916** and **917** projecting generally in a first radial direction. The fifth alternate grounding member **911** includes a plurality of projections **918** extending from the band **912** in a second radial direction opposite to the first radial direction. The first **916** and second **917** side edges of the band **912** contact a first one of the group of members that includes the coupling nut and the tubular post. The plurality of projections **918** contact the second of the group of members that includes the coupling nut **105** and the tubular post **104**,

FIG. **10** is a partial cross-sectional view of a fifth alternate embodiment of a connector **1000** having conductive grease (not shown) that acts as a grounding member. The ground path is established by means of a close fit between the coupling nut **105** and the tubular post **104**. The conductive grease is disposed at a grease annular ring **1001** where mating portions of the tubular post **104** and coupling nut **105** have closely matching dimensions. Preferably, the conductive grease is a silver-loaded silicon lubricating material. The conductive grease serves to connect a ground path from the coupling nut **105** to the tubular post **104** while allowing the coupling nut to rotate.

FIG. **11** is a partial cross-sectional view of a front end of a sixth alternate embodiment of an F connector **1100** that includes a body **1108**, and which has a sixth alternate grounding member **1101**. FIG. **11**A is an enlargement of a portion of FIG. **11**. FIG. **11**B is a side view of the sixth alternate grounding member **1101**. FIG. **11**C is a plan view of the sixth alternate grounding member **1101**. FIG. **11**D is a perspective view of the sixth alternate grounding member **1101**. Referring now to FIG. **11** and FIGS. **11**A-**11**D, the sixth alternate grounding member **1101** includes a circumferential metallic band **1112** extending between first **1113** and second **1114** opposing ends. The band **1112** has a generally circular shape that approximates a section of a hollow cylinder. The first **1113** and second **1114** ends of the band **1112** are disposed generally proximate to each other and are directed generally toward one another. The band **1112** has first and second opposing side edges **1115** and **1116**, respectively, extending along its length. The band generally de fines a section of a cylindrical surface. The sixth alternate grounding member **1101** includes a plurality of projections **1101** extending from at least one of the first and second side edges **1115** and **1116** of the band **1112**. The plurality of projections **1117** extend away from the cylindrical surface defined by the band **1112**. The band **1112** contacts a first one of the group of members that includes the coupling nut **1105** and the tubular post **1104**. The plurality of projections **1117** contact the second of the group of members that includes the coupling nut **1105** and the tubular post **1104**.

In preferred embodiments, the present invention provides a coaxial cable connector that ensures a reliable grounding path without creating undue interference with free rotation of the coupler relative to the remaining components of the connector; however, the present invention can also provide a reliable grounding path between a post and a coupler that does not rotate. Advantageously, a connector in accordance with the invention works with standard installation tools and with standard compression tools. The present invention can be used with both axially-compressible connectors as well as with older-style crimp-ring connectors. In some embodiments, the present invention is compatible with the use of a sealing ring for forming a moisture seal between the coupler and the outer body of the connector.

While the present invention has been described with respect to preferred embodiments thereof, such description is for illustrative purposes only, and is not to be construed as limiting the scope of the invention. Various modifications and changes may be made to the described embodiments by those skilled in the art without departing from the true spirit and scope of the invention as defined by the appended claims. For example, the grounding member can have a shape other than generally circular, such as square, hexagonal, octagonal, oval, etc.

LIST OF REFERENCE NUMERALS

100 F connector ("connector")
101 Longitudinal axis
102 Front end

103 Back end
104 Tubular post
105 Coupling nut
106 End of tubular post
107 Shell
108 Body
109 Label
110 Grounding member
111 Neck
201 Minimum diameter
203 Maximum diameter
301 Coaxial cable
302 Center conductor
303 Dielectric material
304 Outer conductor
305 Jacket
310 Lip of body
311 Outer diameter of lip body
312 Inner diameter of lip of body
330 Head of tubular post
332 Shoulder of tubular post
333 First radial face of shoulder of tubular post
334 Outer surface of shoulder
336 Outer diameter of shoulder
337 Outer diameter of non-shoulder portion of post
338 Non-shoulder portion of post
340 Inwardly-directed flange of coupling nut
341 Inner diameter of inwardly-directed flange
342 Bore of coupling nut
343 Annular recess of coupling nut
344 Inner diameter of bore of coupling nut
600 First alternate connector
601 First alternate grounding member
602 Ring portion of first alternate grounding member
603 Fingers of first alternate grounding member
604 Radial surface of coupling nut
605 Internal lugs of first alternate grounding member
700 Second alternate connector
701 Second alternate grounding member
702 Ring portion of second alternate grounding member
703 Fingers of second alternate grounding member
800 Third alternate connector
801 Third alternate grounding member
802 Ring portion of third alternate grounding member
803 Internal lugs of third alternate grounding member
804 External lugs of third alternate grounding member
805 Sealing ring
900 Fourth alternate connector
901 Fourth alternate grounding member
902 Band of fourth alternate grounding member
903 First end of band
904 Second end of band
906 First side edge of band
907 Second side edge of band
908 First radial wall of band
909 Second radial wall of band
911 Fifth alternate grounding member
1000 Fifth alternate connector
1001 Grease annular ring
1100 Sixth alternate connector
1101 Sixth alternate grounding member
1104 Tubular post of sixth alternate connector
1105 Coupling nut of sixth alternate connector
1108 Body of sixth alternate connector
1112 Band of sixth alternate grounding member
1113 First end of band
1114 Second end of band
1115 First side edge of band
1116 Second side edge of band
1117 Projections on band

We claim:

1. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising:

a post including a first end adapted to be inserted into a prepared end of the coaxial cable between the dielectric material and the outer conductor, wherein the post includes a second end including an enlarged shoulder, wherein the enlarged shoulder has a radial face that faces away from the first end of the post, wherein the radial face is substantially flat;

a body member adjacent to the post;

a coupler including an internally-threaded region for engaging the equipment port and an inwardly directed flange having a forward face; and

a grounding member configured to be inserted forward of at least a portion of the forward face of the inwardly directed flange of the coupler and rearward of the radial face of the post, the grounding member contacting the post and the coupler and configured to provide an electrically-conductive grounding path through the post and the coupler while allowing the coupler to rotate,

wherein the grounding member includes a first portion configured to contact the coupler while allowing the coupler to rotate and a second portion configured to contact the post, the first and second portions of the grounding member existing in a plane of the grounding member,

wherein the second portion of the grounding member comprises a plurality of internal lugs configured to contact the post.

2. The coaxial cable connector of claim 1, wherein the grounding member is formed from a metal.

3. The coaxial cable connector of claim 1, wherein the body member is formed from a plastic.

4. The coaxial cable connector of claim 1, wherein the first portion of the grounding member comprises a plurality of external lugs configured to contact the coupler.

5. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising:

a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor to reliably contact the outer conductor, and having a second end opposite the first end;

a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;

a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable; and

an electrically-conductive grounding component disposed between the tubular post and the coupler;

wherein the tubular post includes a tubular post grounding path portion having an outer surface, and the coupler includes a coupler grounding path portion having an inner surface; and

wherein the electrically-conductive grounding component reliably contacts both the tubular post grounding path portion and the coupler grounding path portion to provide a stable and reliable electrically-conductive grounding path between the tubular post grounding path portion and the coupler grounding path portion when a gap between the tubular post and the equipment port exists while the coupler is engaged with the equipment port.

6. The coaxial cable connector of claim **5**, wherein the electrically-conductive grounding component is at least one of a resilient electrically-conductive grounding member and electrically-conductive grease.

7. The coaxial cable connector of claim **5**, wherein the electrically-conductive grounding component is an arcuately shaped resilient electrically-conductive grounding member configured to extend around the tubular post over at least 225 degrees.

8. The coaxial cable connector of claim **5**, wherein the coupler includes an annular recess configured to engage and retain the electrically-conductive grounding component.

9. The coaxial cable connector of claim **1**, wherein the grounding component is a resilient electrically-conductive grounding member having engagement portions configured to reliably contact the tubular post grounding path portion and engagement portions configured to reliably contact the coupler grounding path portion.

10. The coaxial cable connector of claim **9**, wherein the engagement portions of the resilient electrically-conductive grounding member configured to reliably contact the tubular post grounding path portion are internal lugs distributed along an inner perimeter of the resilient electrically-conductive grounding member.

11. The coaxial cable connector of claim **9**, wherein the engagement portions of the resilient electrically-conductive grounding member configured to reliably contact the coupler grounding path portion extend outward from non-engagement portions of the resilient electrically-conductive grounding member.

12. The coaxial cable connector of claim **9**, wherein the engagement portions of the resilient electrically-conductive grounding member configured to reliably contact a shoulder of the tubular post located at the second end of the tubular post, the shoulder of the tubular post comprising the tubular post grounding path portion.

13. The coaxial cable connector of claim **9**, wherein at the engagement portions of the resilient electrically-conductive grounding member are resilient.

14. The coaxial cable connector of claim **11**, wherein the engagement portions of the resilient electrically-conductive grounding member configured to reliably contact the coupler grounding path portion extend away from a plane defined by the non-engagement portions of the resilient electrically-conductive grounding member.

15. The coaxial cable connector of claim **5**, wherein the grounding component is retained between the tubular post and the coupler.

* * * * *

BARCLAY DAMON LLP

Douglas J. Nash
Partner

January 27, 2022

By Email and UPS Overnight Delivery

Daryl Miller
Chief Executive Officer
PerfectVision Manufacturing, Inc.
16101 La Grande Drive
Little Rock, Arkansas 72223

RE: PerfectVision's Infringement Patents Owned by PPC Broadband, Inc.

Dear Mr. Miller:

We represent PPC Broadband, Inc. ("PPC"). PPC owns U.S. Patent Nos. 7,114,990 (the "'990 Patent"), 7,479,035 (the "'035 Patent"), 7,955,126 (the "'126 Patent"), 8,172,612 (the "'612 Patent"), and 10,756,455 (the "'455 Patent") (the "Asserted Patents") (each of which is enclosed herewith), including the right to sue for damages related to past infringement. Pursuant to 35 U.S.C. § 287(a), PPC hereby provides notice that PerfectVision Manufacturing, Inc. ("PV") has infringed and continues to infringe one or more claim in each of the Asserted Patents by making, using, selling, offering to sell and/or importing its SignaLoc® line of coaxial cable connectors in the United States.

The following representative figures illustrate the internal construction of PV's SignaLoc® coaxial cable connector design:

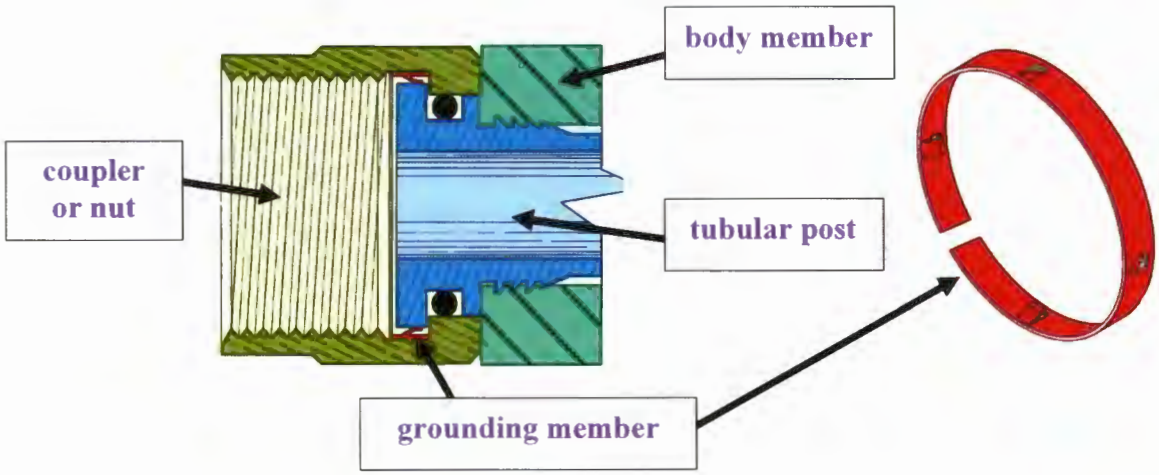

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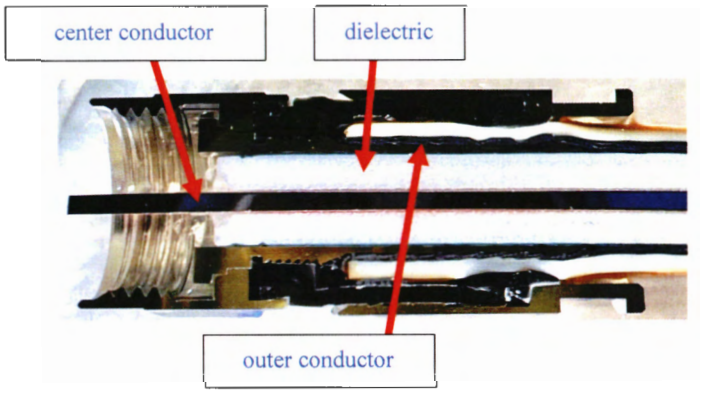
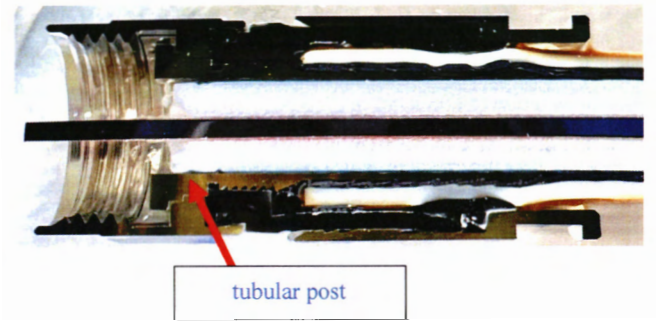
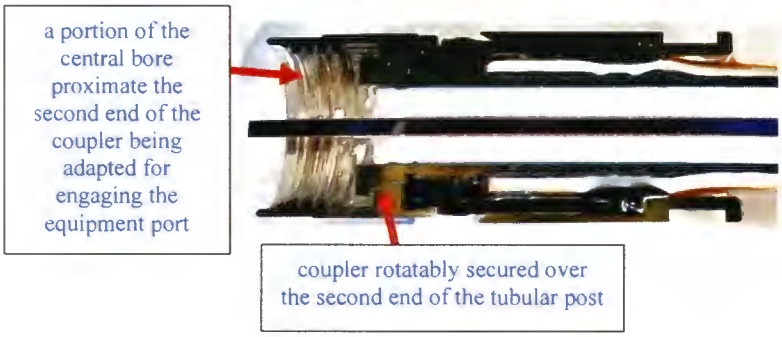
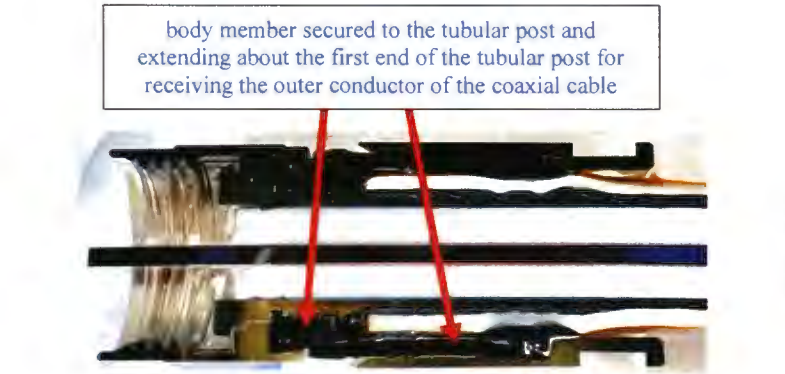
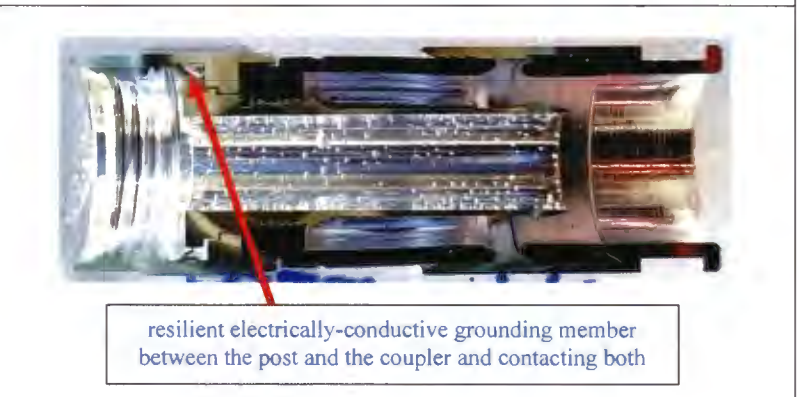
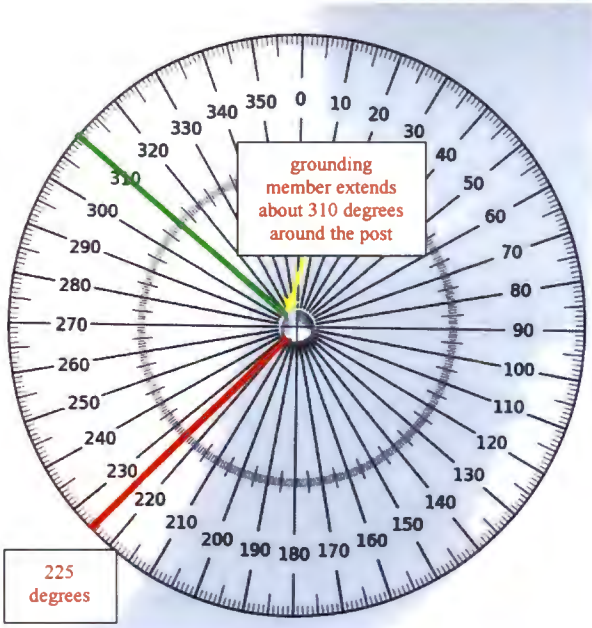
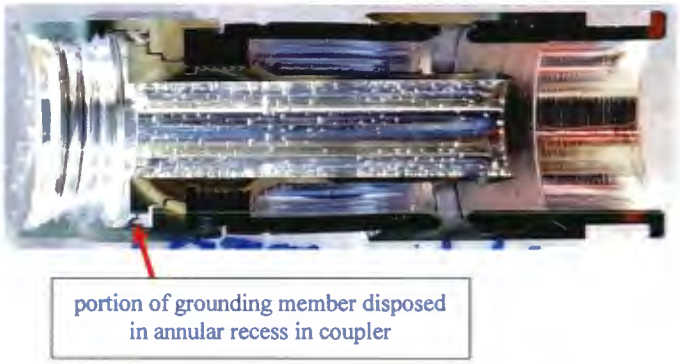
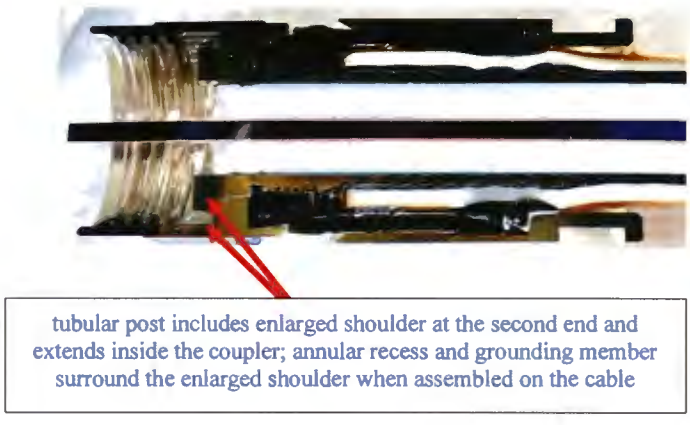
EXHIBIT
F

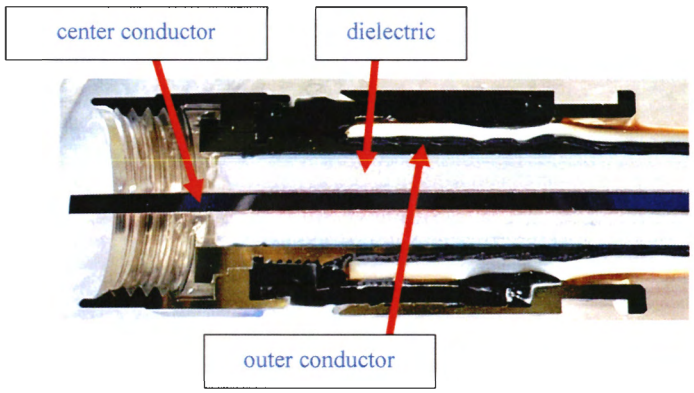
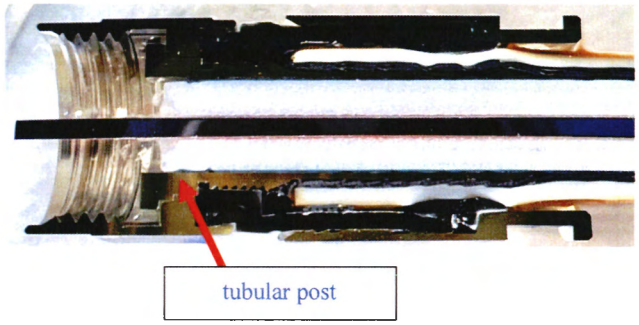
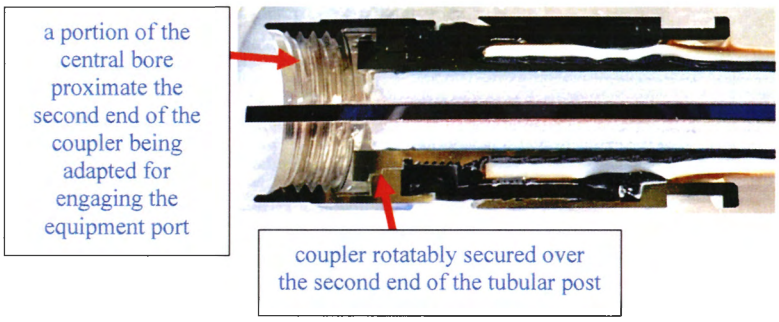
Without limitation, and as shown in the charts below, the SignaLoc® connectors infringe at least the following exemplary claims in the Asserted Patents:

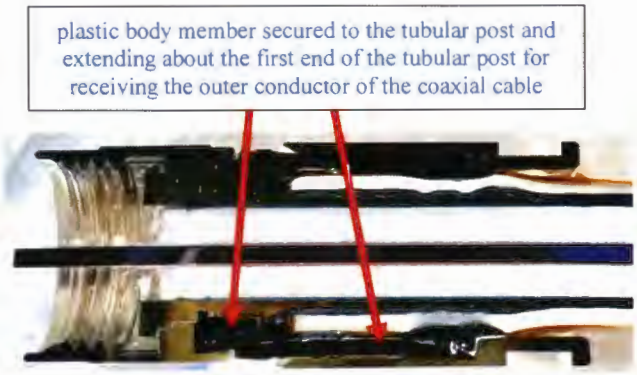
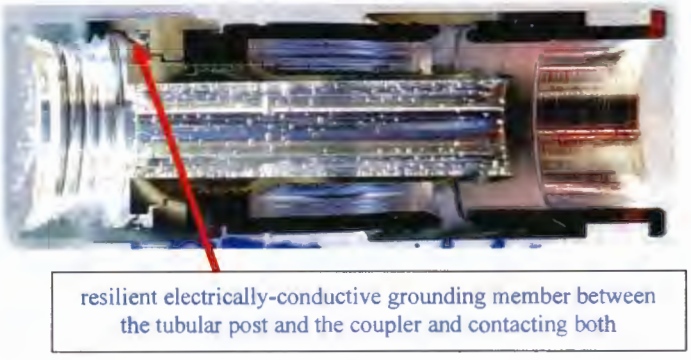
- Claim 6 in the '990 Patent;
- Claim 11 in the '035 Patent;
- Claim 6 in the '126 Patent;
- Claim 23 in the '612 Patent; and
- Claim 5 in the '455 Patent.

'990 Patent, Claim 6	**SignaLoc® Connector**
1. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:	The SignaLoc® line of coaxial cable connectors are cable connectors for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor. (See https://www.perfect-vision.com/WebSupport/webstore/spec-sheets/PV6USLP.PDF.) 
a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;	

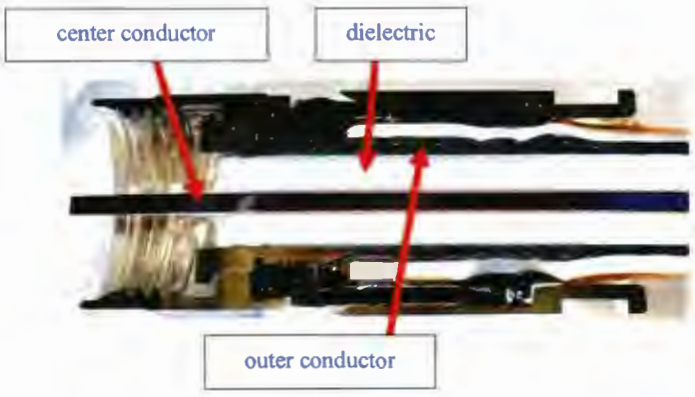
b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;	
c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member contacts the coupler; and	 
d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween.	

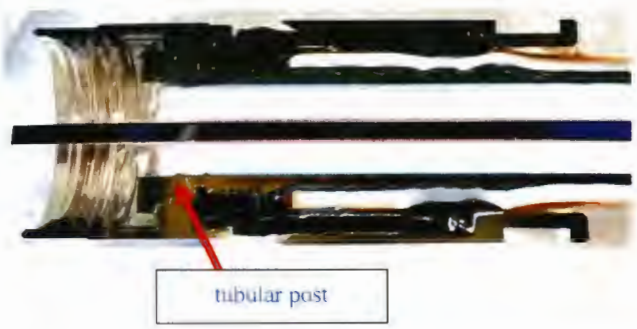
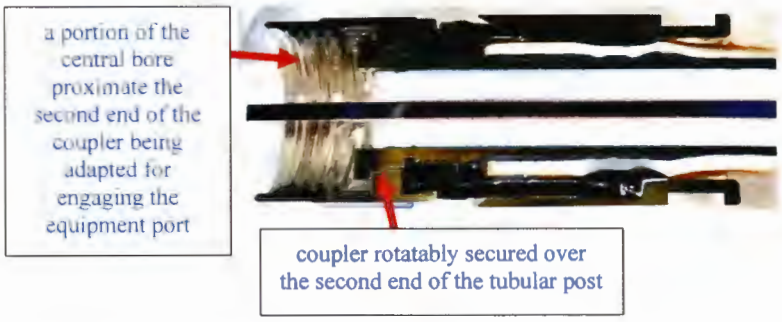
2. The coaxial cable connector recited by claim 1 wherein said grounding member is arcuately shaped to extend around the tubular post over at least 225 degrees.	
5. The coaxial cable connector recited by claim 2 wherein the central bore of the coupler includes an annular recess proximate to the first end of the coupler, and wherein at least portions of said grounding member are disposed within the annular recess.	
6. The coaxial cable connector recited by claim 5 wherein the tubular post includes an enlarged shoulder at the second end thereof extending inside the coupler, and wherein the annular recess and said grounding member surround the enlarged shoulder of the tubular post when the coaxial cable connector is assembled onto the prepared end of the coaxial cable.	

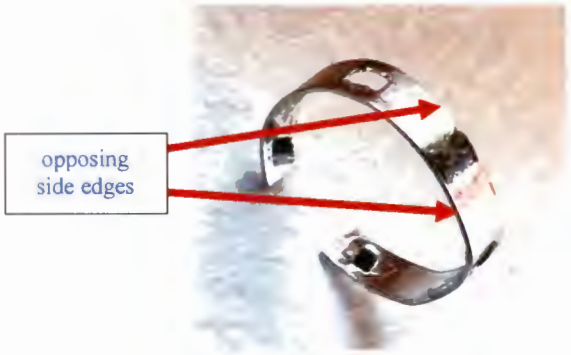
'035 Patent, Claim 11	SignaLoc® Connector
1. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising:	The SignaLoc® line of coaxial cable connectors are cable connectors for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor. (*See* https://www.perfect-vision.com/WebSupport/webstore/spec-sheets/PV6USLP.PDF.) 
a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof	
b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port:	

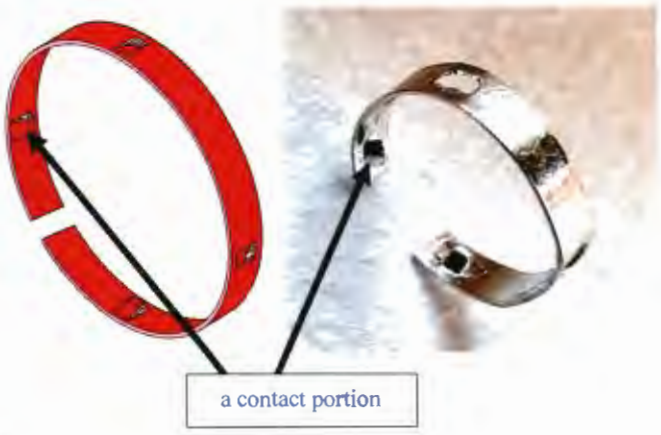
c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member is comprised of plastic, wherein the body member contacts the coupler; and	 
d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween.	
9. The coaxial cable connector recited by claim 1 wherein said grounding member is generally circular.	

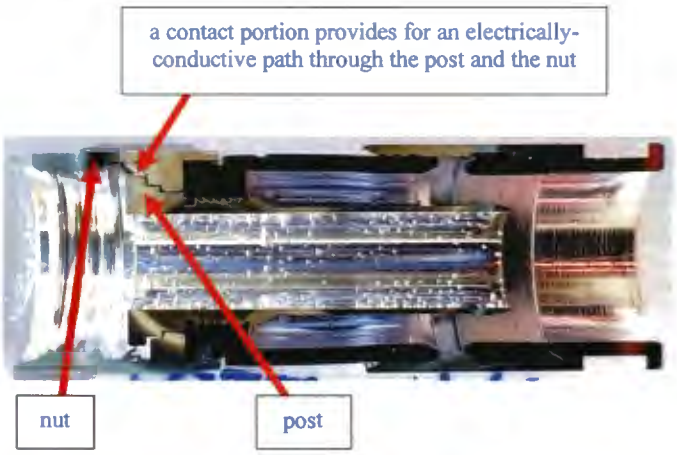
11. The coaxial cable connector recited by claim 9 wherein said grounding member has a plurality of projections extending radially inwardly therefrom for engaging the tubular post.	

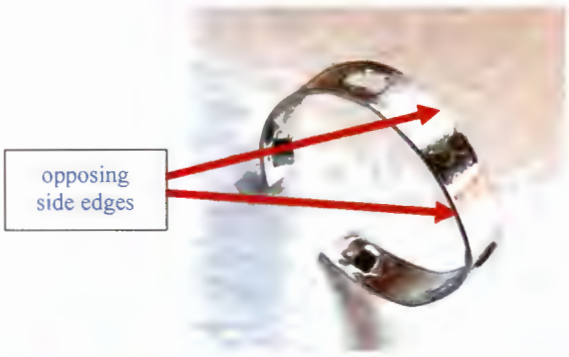
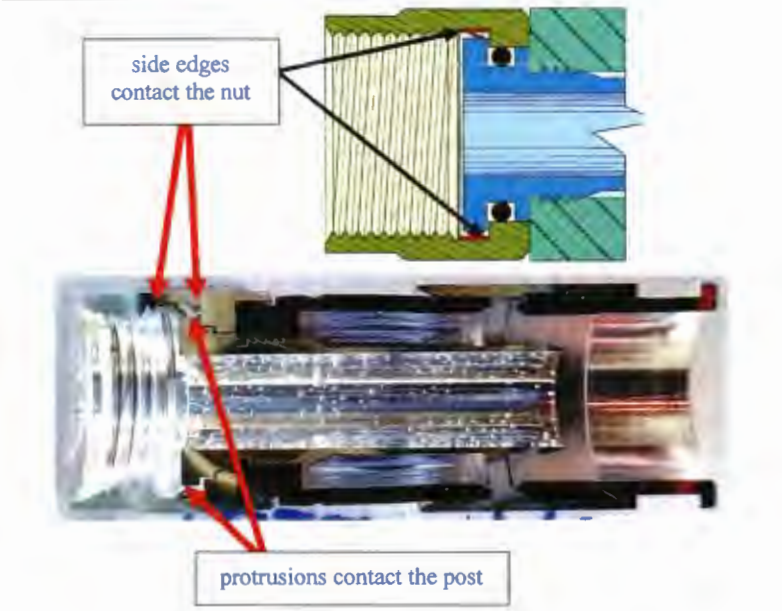
'126 Patent, Claim 6	**SignaLoc® Connector**
6. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising in combination:	The SignaLoc® line of coaxial cable connectors are cable connectors for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor. (*See* https://www.perfect-vision.com/WebSupport/webstore/spec-sheets/PV6USLP.PDF.) 

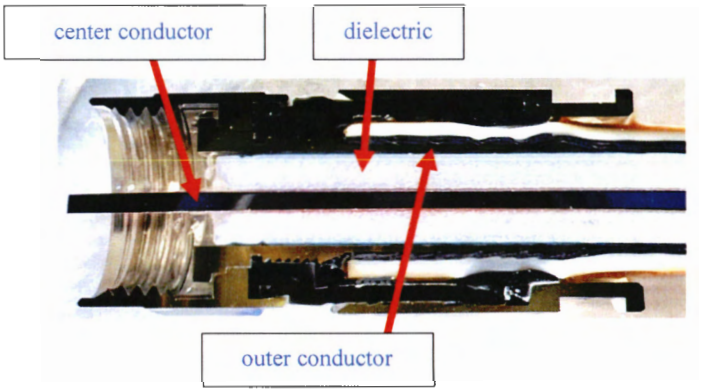
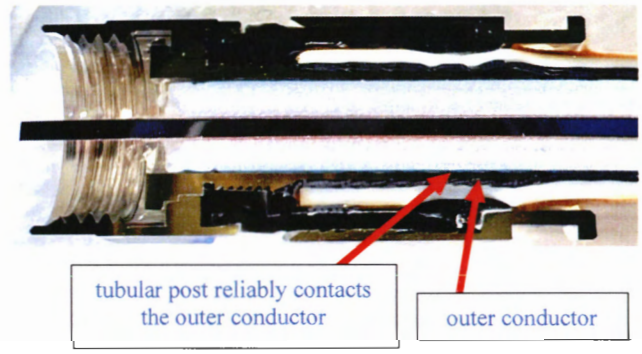
a. a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor, and having a second end opposite the first end thereof;	
b. a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;	
c. a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable, wherein the body member contacts the coupler; and	

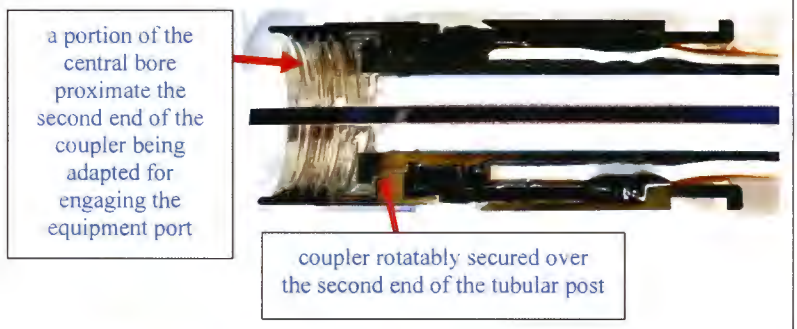
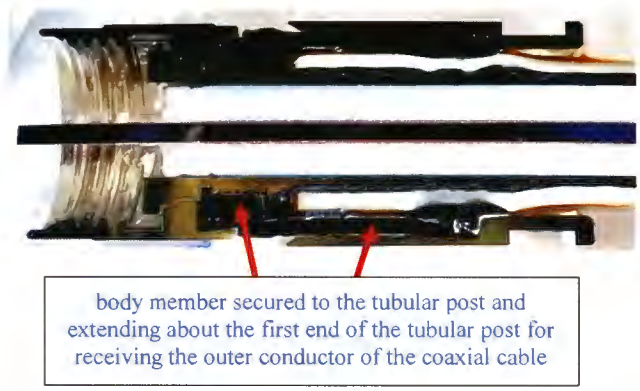
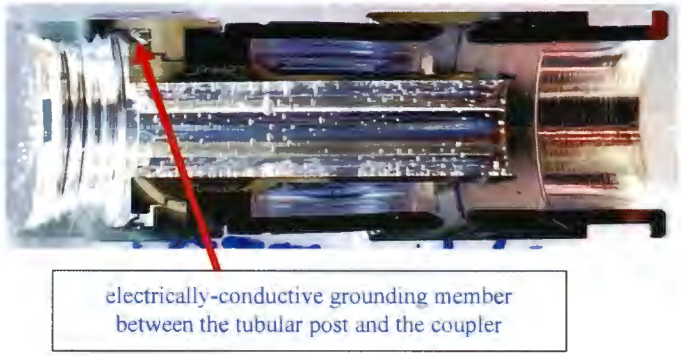
d. a resilient, electrically-conductive grounding member disposed between the tubular post and the coupler, the grounding member contacting both the tubular post and the coupler for providing an electrically-conductive path therebetween;	
wherein the grounding member comprises a circumferential band comprising a section that approximates a hollow cylinder, the circumferential band having first and second opposing side edges.	

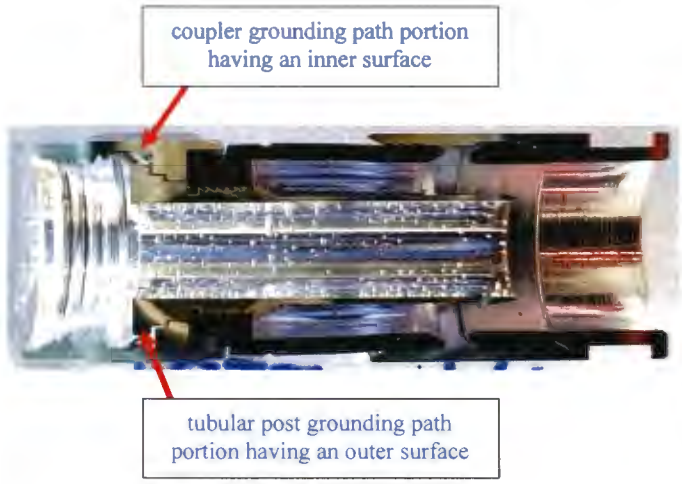
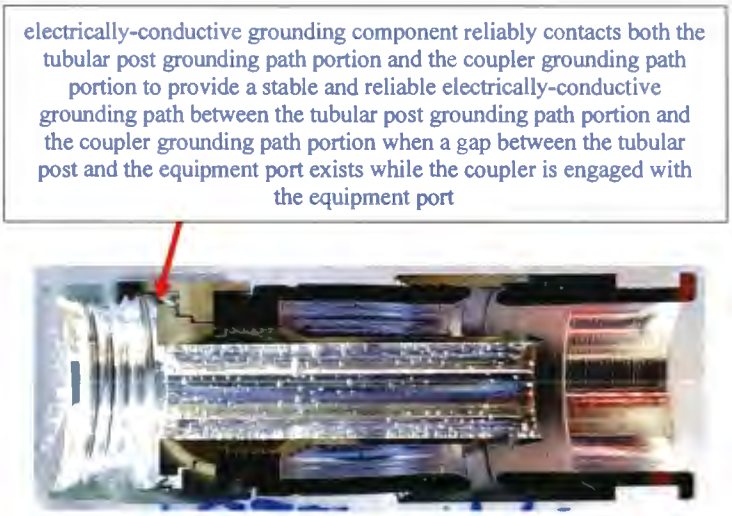
'612 Patent, Claim 23	SignaLoc® Connector
9. A grounding member for a coaxial cable connector having a post and a nut, comprising a generally arcuate shaped member, composed at least partially of electrically conductive material, and a contact portion of the generally arcuate shaped member, wherein:	The SignaLoc® line of coaxial cable connectors include a grounding member for a coaxial cable connector having a post and a nut, comprising a generally arcuate shaped member, composed at least partially of electrically conductive material, and a contact portion of the generally arcuate shaped member. 

the at least one contact portion provides for an electrically-conductive path through the post and the nut;	
the generally arcuate shaped member comprises a circumferential metallic band; and	
the circumferential metallic band has a general circular shape and approximates a section of a hollow cylinder that extends between first and second opposing ends.	

19. The grounding member of claim 9, wherein the circumferential metallic band has first and second opposing side edges extending along a length of the circumferential metallic band.	
23. The grounding member of claim 19, wherein the contact portion comprises a plurality of projections, and wherein the first and second side edges contact a first one of a group of members that includes the nut and the post, and the plurality of projections contact a second one of the group of members that includes the nut and the post.	 

'455 Patent, Claim 5	SignaLoc® Connector
5. A coaxial cable connector for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor, the coaxial cable connector comprising:	The SignaLoc® line of coaxial cable connectors are cable connectors for coupling a coaxial cable to an equipment port, the coaxial cable including a center conductor surrounded by a dielectric material, the dielectric material being surrounded by an outer conductor. (*See* https://www.perfect-vision.com/WebSupport/webstore/spec-sheets/PV6USLP.PDF.) 
a tubular post having a first end adapted to be inserted into the prepared end of the coaxial cable between the dielectric material and the outer conductor to reliably contact the outer conductor, and having a second end opposite the first end:	 **PRODUCT CHARACTERISTICS** - Designed with patented grounding insert to provide enhanced continuity and minimize signal ingress/egress. (*See* https://www.perfect-vision.com/WebSupport/webstore/spec-sheets/PV6USLP.PDF.)

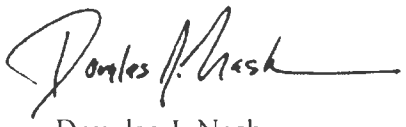
a coupler having a first end rotatably secured over the second end of the tubular post, and having an opposing second end, the coupler including a central bore extending therethrough, a portion of the central bore proximate the second end of the coupler being adapted for engaging the equipment port;	
a body member secured to the tubular post and extending about the first end of the tubular post for receiving the outer conductor of the coaxial cable; and	
an electrically-conductive grounding component disposed between the tubular post and the coupler;	

wherein the tubular post includes a tubular post grounding path portion having an outer surface, and the coupler includes a coupler grounding path portion having an inner surface; and	
wherein the electrically-conductive grounding component reliably contacts both the tubular post grounding path portion and the coupler grounding path portion to provide a stable and reliable electrically-conductive grounding path between the tubular post grounding path portion and the coupler grounding path portion when a gap between the tubular post and the equipment port exists while the coupler is engaged with the equipment port.	 SignaLoc® Continuity Connector **PRODUCT CHARACTERISTICS** - Designed with patented grounding insert to provide enhanced continuity and minimize signal ingress/egress. (*See* https://www.perfect-vision.com/WebSupport/webstore/spec-sheets/PV6USLP.PDF.)

Against this backdrop, PPC demands that PV cease and desist from further infringement of the Asserted Patents by immediately stopping the production, use, sale, offer for sale and importation of the SignaLoc® line of coaxial cable connectors in the United States, along with any other connectors of similar design made, used, sold, offered for sale and or imported in the United States. PPC further demands that PV provide PPC with a full accounting of all sales of SignaLoc® and similar connectors over the past six (6) years in the United States along with the number of such connectors currently in production, in inventory and in transit to the United States. Finally, PPC demands that PV disclose to PPC the name and address of the company or companies that PV has used over the past six (6) years to manufacture the SignaLoc® line of coaxial cable connectors sold in the United States. PPC reserves all rights if these demands are not met within two (2) weeks of PV's receipt of this letter.

If PV retains counsel in this matter, please provide this letter to such counsel and let us know so we will know to whom to direct future correspondence. We look forward to hearing back from you or your counsel promptly.

Very truly yours,



Douglas J. Nash

cc: Christopher W. Day, Esq.