

United States Patent

Lankford et al.

[15] 3,675,181

[45] July 4, 1972

[54] COAXIAL CONNECTOR MEANS AFFORDING ALTERNATE 90° SEIZURE

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[22] Filed: May 14, 1970

[21] Appl. No.: 37,275

[52] U.S. Cl. 339/32 R, 339/94 C, 339/177 R,
339/272 R
[51] Int. Cl. H01r 27/00, H01r 17/04
[58] Field of Search 174/71 C, 75 C, 88 C, 89;
333/84 R, 97, 33; 339/60 C, 89 C, 90 C, 91 P, 94 C,
126 J, 177, 272 R, 272 A, 88 C, 32, 33

[56] References Cited

UNITED STATES PATENTS

3,530,425 9/1970 Vachhani 339/177 R

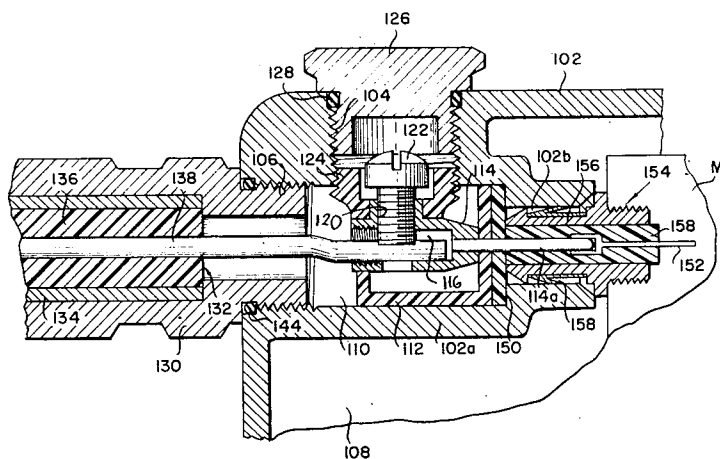
2,751,558 6/1956 Grieg et al. 333/97
2,267,371 12/1941 Buschbeck 333/33
3,024,438 3/1962 Trush 339/272 R
2,238,834 4/1941 Travers 339/177 E

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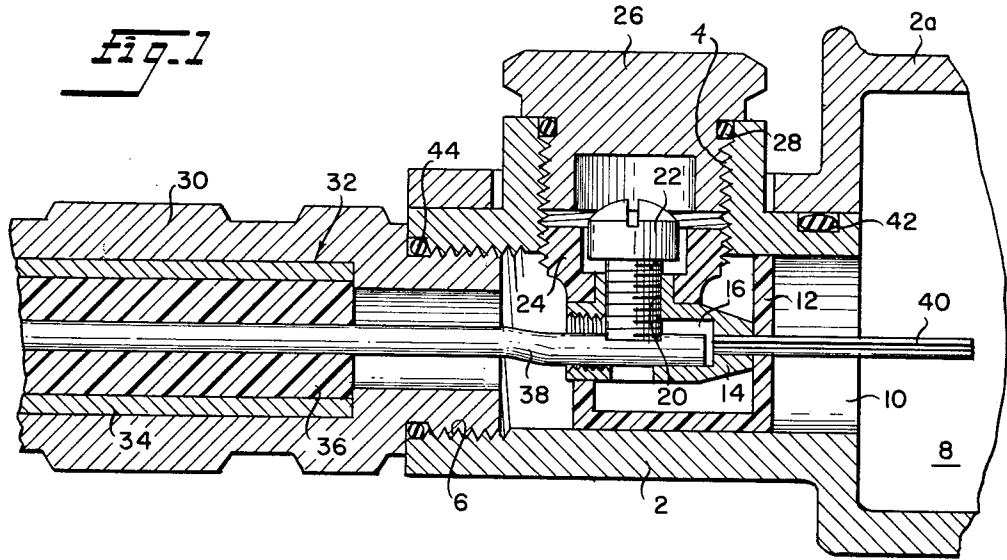
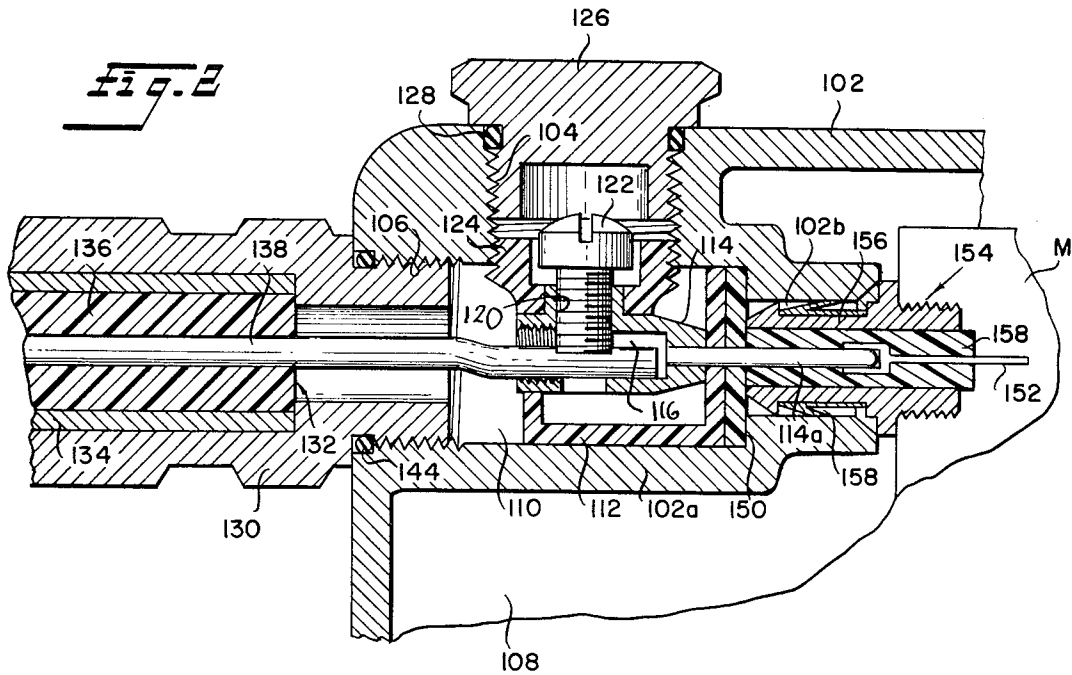
[57] ABSTRACT

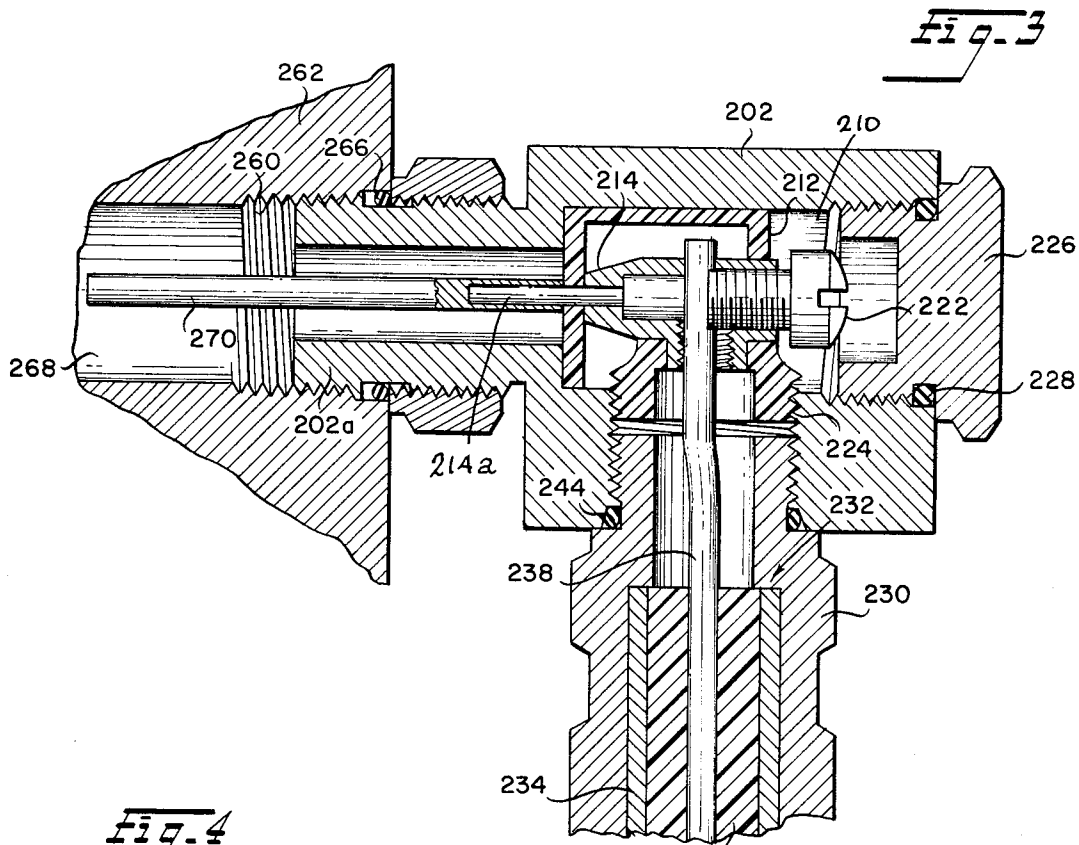
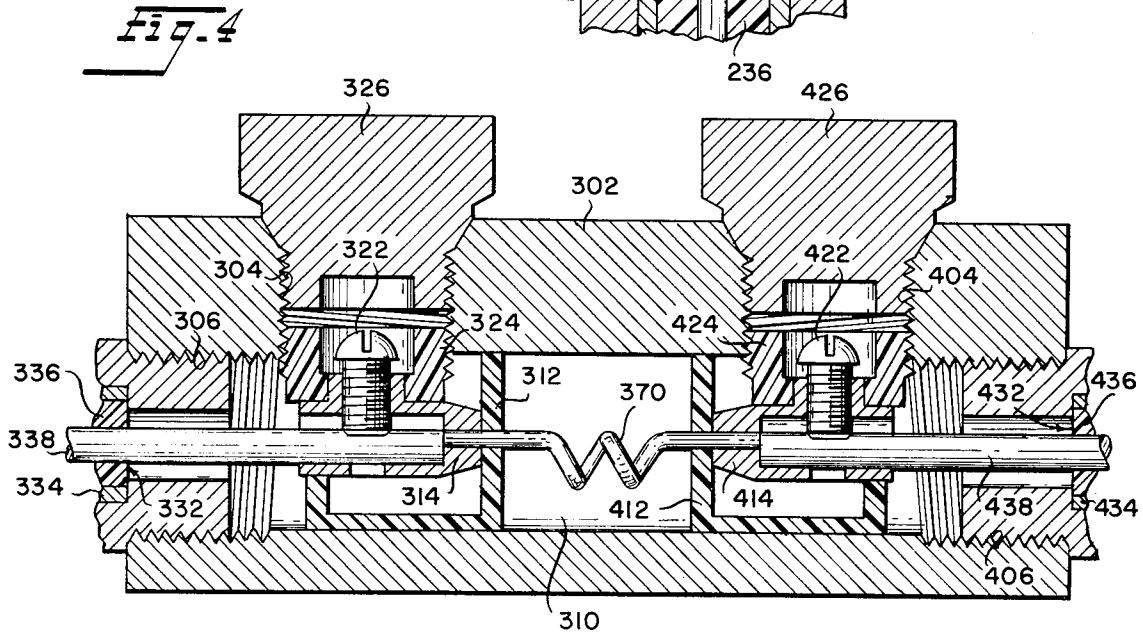
Improved coaxial connector means adapted to seize the center conductor of a coaxial cable, said connector being designed to afford alternate insertion and seizure of the cable through either of two orthogonally arranged openings in the connector body. According to a first embodiment, the connector means are integrally formed in a corner portion of an amplifier housing, while in a second embodiment, the connector means are in the form of a separate right-angle connector block adapted for threaded connection with the housing. In a third embodiment, the universal 90° seizure means are in the form of a splice block for splicing together the ends of a pair of coaxial cables.

3 Claims, 4 Drawing Figures



PRIOR ART





COAXIAL CONNECTOR MEANS AFFORDING ALTERNATE 90° SEIZURE

The present invention relates to connector means for seizing the inner conductor of a coaxial cable and for supporting this conductor against severe mechanical withdrawal forces relative to a housing.

In the cable television industry (CATV), a coaxial cable is generally used for distributing television signals from a central location to a subscriber's home. Normally the cable is attached to telephone poles in unbroken lengths of 1,000 feet or more. The coaxial cable is usually of the "semi-rigid" type including a solid tubular outer conductor of soft aluminum, an inner conductor of solid copper, and an intermediate spacer layer of plastic foam insulating material.

Since this cable is exposed to atmosphere, it is not unusual for the cable to encounter temperature extremes which range from +140° to -40° F. As is well known, the coefficients of expansion of copper and aluminum are relatively large, and consequently when 1,000 feet or more of the "semi-rigid" cable is suspended in a relatively straight line, variations in length of several inches are quite common.

As evidenced by the patents to Travers U.S. Pat. No. 2,238,834, Turene U.S. Pat. No. 2,549,647, Mineck U.S. Pat. No. 3,354,420 and Florer U.S. Pat. No. 3,465,281, various types of coaxial connectors are well known in the patented prior art. It has been found in practice that the pin-vise type of connector possesses the inherent drawback that expansion and contraction of the cable results in intermittent electrical contact between the conductor parts, and often permanent damage of the connector parts is produced. Furthermore, in connectors of the type in which the center conductor of a coaxial cable is seized by screw means, it has been found that after a short period of time, the screw retainer will normally loosen somewhat as a consequence of a phenomenon known as "cold flow." This undesirable result will generally cause the central conductor to pull loose from the connector during expansion and contraction of the cable.

Another problem facing the cable TV industry today is that in order to meet community requirements, the cables must be concealed in underground ducts, thus creating installation problems where space is a premium, and components are arranged at various angles relative to each other, (as distinguished from the prior overhead type of installation where the coaxial cable is directly connected to a housing in a straight-in manner).

Still another problem is the testing of the electronic equipment within the equipment housings. This is presently done either by opening the housing to obtain access to internal test points, or by providing separate external test point connectors. The first approach subjects the equipment to environmental contamination and also to the carelessness of the technician making the tests. The use of external test point connectors increases the cost of the units and raises doubt as to the validity of the test readings because of the possibility of test point calibration errors.

In order to alleviate the above and other requirements of the prior art, Entron, Inc., assignee of the present invention, developed a basic type of coaxial connector that has been extensively marketed under the "multee or SMT" label. This basic prior connector afforded universal 90° seizure of a central conductor of a cable between two alternate orthogonally arranged positions relative to a housing. While this initial connector has proved to be most successful from both commercial and functional viewpoints, it is desirable to modify the basic connector instruction to increase the versatility of its applicability to various additional installations, and to improve its waterproofing, structural supporting and electrically conducting characteristics without reducing the ease of connection of the components at selected orientations.

Accordingly, a primary object of the present invention is to provide improved connector means for connecting a coaxial cable to one corner of an amplifier housing at either of two orthogonally arranged positions. Improved seal means are provided for sealing the seizing lead-in chamber from the main

equipment chamber of the housing, and plug-in connector means are positively connected with the rigidly supported lead-in pin of the conductive insert to electrically connect the cable central conductor with an electrical module.

A second object of the invention is to provide a right-angled connector body that is adapted to afford alternate 90° seizure positions between a coaxial cable and a housing to which the connector body is threadably attached in a sealed manner. A further object of the invention is to provide a coaxial connector of the splice type for connecting the center conductors of a pair of cables that are arranged either colinearly end-to-end, in a parallel manner side-by-side with their free ends adjacent each other, or in an orthogonally arranged relationship.

Other objects and advantages of the invention will become apparent from a study of the following specification, when viewed in the light of the accompanying drawing, in which:

FIG. 1 illustrates in longitudinal cross-section a basic universal connector arrangement of the prior art;

FIG. 2 is a longitudinal sectional view of a first improved modification for electrically connecting a coaxial cable with a module contained in an amplifier housing;

FIG. 3 is a longitudinal sectional view of a second improved modification in the form of a universal right-angled connector; and

FIG. 4 is a longitudinal sectional view of a universal splice block embodiment of the invention.

Referring first to FIG. 1, it is known in the prior art to provide connector means for connecting two conductors that are arranged either orthogonally or colinearly. More particularly, the housing 2 is cast from a conductive metal, such as aluminum, and contains at one end a pair of orthogonally arranged threaded identical openings 4 and 6 that communicate with the housing inner chamber 8 via passage 10. Removably mounted in the passage 10 is a cradle 12 formed of a non-conductive insulating material (such as Lexan), which cradle supports a conductive insert 14. The insert 14 contains orthogonally arranged longitudinal and transverse threaded bores 16 and 20, respectively. The bore 20 and the free end of bore 16 are of the same diameter and are adapted to alternately receive the cable seizing screw 22. Threadably connected at one end with the threaded opening 4 is a retainer 24 formed of a suitable non-conductive material. At its other end, the retainer is arranged concentrically about a tubular lateral projection on the conductive insert, whereby the insert and cradle are rigidly mounted in the passage 10. At its free extremity, the threaded opening 4 is closed by a water and pressure-proof aluminum plug 26 and the compressed O-ring seal 28.

Threadably connected with the opening 6 is a standard entrance connector 30 in which is arranged the free end of the coaxial cable 32 having an outer conductor 34, the intermediate spacer insulation layer 36, and a central inner conductor 38. The inner conductor 38 is clamped in the longitudinal bore 16 of the insert by the seizing screw 22, whereby current is conducted from center conductor 38 to an electrical module contained in the housing 2 via screw 22, insert 14 and the insert projecting portion 40, which portion, in the embodiment of FIG. 1, is in the form of a conductive roll spring pin. The housing 2 is electrically connected with the outer ground conductor 34 via connector 30, said housing having a cover portion 2a that is closed and hermetically sealed by the compressed O-ring 42. The housing is further sealed by the O-ring 44 that is compressed by connector 30 to seal the bore 6.

In the initial condition illustrated in FIG. 1, the cable is arranged longitudinally of the passage 10. Assume now that for reasons of space or location of the components, it is desired to arrange the cable at right angles to the passage 10. Following removal of plug 26 and screw 22 from bore 4 and subsequent removal of connector 30 and cable 32 from bore 6, the parts are reversed and central conductor 38 is introduced in bore 20 of insert 14. Connector 30 is then threadably connected in bore 4, screw 22 is threaded within the free end of insert bore 16 to seize the central conductor 38, and plug 26 is threadably connected in bore 6 to compress O-ring 28 and thereby hermetically seal the housing chamber 8.

Referring now to the improved construction of FIG. 2, the housing 102 contains electronic equipment, such as an amplifier, including modules M, a corner portion of the housing containing a pair of orthogonally arranged openings 104, 106 that communicate with a longitudinal passage 110 defined by housing internal wall portion 102a. As in the basic embodiment of FIG. 1, the conductive insert 114 is rigidly supported in the longitudinal passage 110 by the synthetic plastic cradle 112 and the retainer 124, the center conductor 138 of cable 132 being seized by the screw 122. The parts are interchangeable, so that upon removal of the plug 126 and screw 122, the cable 132 and connector 130 can be removed from bore 106 and then be inserted in bore 104. The central conductor is then seized by screw 122, and bore 106 is closed by plug 126.

In accordance with the present invention, improved means are provided for supporting and electrically connecting the module M with the conductive insert 114. More particularly, the portion 114a of conductive insert 114 is in the form of a solid conductive pin that extends through and is supported by the resilient washer seal 150 that is compressed between the cradle 112 and the wall portion 102a to further seal the housing chamber 108 from atmosphere. At its free end, the pin 114a is electrically connected with the center conductor 152 of a coaxial plug-in connector 154 that is threadably connected at one end with the module M. The conductive outer shell portion 156 of the connector is spaced from the inner conductor by the insulation spacer 158, the free end of the connector being slidably inserted in a corresponding bore 102b contained in housing wall 102a. The radially outwardly biased spring fingers 158 afford electrical connection between the conductive shell 156 and the housing wall. It is apparent that the central conductor 138 is connected with the module terminal 152 via screw 122, insert 114 and pin 114a, and the ground conductor 134 is connected with the module container via connector 130, housing 102, spring fingers 158 and connector shell 156. The compressed washer seal prevents in a positive manner the entry of moisture into the inner housing chamber 108, thereby protecting the expensive electronic modules M even if water should somehow enter the cable seizing passage 110 during assembly or reversing of the coaxial cable relative to the conductive insert.

Referring now to FIG. 3, a second embodiment is disclosed in which the connector body 202 is provided at one end with the externally threaded projecting portion 202a that is received in the threaded bore 260 of the housing 262. In general, the remaining structure of the connecting means is similar to that illustrated in FIG. 2, like parts being identified by corresponding reference numerals of the "200" series. Mounted on the threaded portion 202a is a lock nut 264 that tightly connects the connector block with the housing. The O-ring seal 266 is compressed in the undercut groove to further seal the housing chamber 268, said groove being so undercut as to take up variations that occur as a function of the direction in which the connector is turned. The elongated conductor 270 is bored at one end for concentric connection with the pin 214a that extends from the insert 214 through the corresponding opening contained in cradle 212.

Referring now to the splice block embodiment of FIG. 4, the body 302 is provided at each end with a pair of orthogonally arranged openings 304, 306 and 404, 406, respectively, that communicate with the longitudinal central chamber 310.

In the illustrated condition, the cables 332 and 432 are colinearly arranged end to end, the central conductors being connected via screw 322, conductive insert 314, coil 370, insert 414, and screw 422. The outer conductors are connected via screw connector 330, splice block body 302 and connector 430. The coil 370 in this splice creates a π network that causes the splice to have an unusual match characteristic. Return loss is better than 30 db from 5 to 300 mHz. While the cables have been illustrated as being arranged end-to-end, it is apparent that the versatile splice block alternately permits connection of orthogonally arranged cables, or cables that are arranged in

a parallel manner with their free ends adjacent each other.

The various modifications of the present invention offer several important advantages. First, the connector is adapted to accept standard cable of various sizes. The cable connections may be in-line, orthogonal, parallel, or a combination thereof suitable for strand, pedestal or underground mounting. Testing of rf level and voltage may be accomplished at any port by removing the waterproof plug and inserting a test probe which contacts the head of the seizing screw. Complete installation of the amplifiers, splitters, tap offs, etc. is accomplished without exposing the circuitry to the environment, and the circuitry may be removed or replaced without disturbing the cable installation. A further advantage of the invention is that an operator, merely by using a conventional screw driver and an open end wrench, can readily open the waterproof cover, loosen or tighten the seizing screw, and/or relocate the angular relationship between the cables. By the use of the right angle seizing means, the cables can be connected to the rear of the amplifier housing, thus permitting closer clearance to phone lines and visible access for using the test probe on the sides of the amplifier.

Other modifications may be made in the described apparatus without deviating from the inventive concepts as set forth above.

What is claimed is:

1. Connector means adapted for electrical and mechanical connection with a coaxial cable having spaced concentrically arranged center and tubular outer conductors arranged on opposite sides of a tubular layer of insulation, said center conductor including a bare end portion extending axially beyond said insulation layer and said outer conductor, said connector means comprising

a conductive housing 102 containing a chamber and including a corner portion, and an internal transverse wall 102a cooperating with the walls of said corner portion to define a seizing chamber 110, said housing corner portion containing a pair of orthogonally arranged openings 104, 106 communicating at one end with said seizing chamber, each of said openings having a diameter that is greater than that of said center conductor;

seizing means operable when said center conductor is inserted through either one of said openings and the outer conductor is in electrical connection with said housing for securing said bare end portion in said seizing chamber, said seizing means including a conductive insert body 114 containing at one end an axial bore 116, said insert body also containing intermediate its ends a transverse bore 120 in communication at one end with said axial bore, said bores being internally threaded and having diameters greater than that of said center conductor 138, insulating support means 112, 124 rigidly supporting said insert body within said seizing chamber in a position in which said bores are colinear with said orthogonally arranged openings, respectively;

electrical conductor means 114a extending through an opening 102b contained in said internal transverse wall for electrically connecting said insert body with an electrical module contained in said housing chamber; and seal means for sealing said housing chamber from atmosphere via said seizing chamber.

2. Apparatus as defined in claim 1, wherein said seal means includes a resilient seal member 150 arranged in said seizing chamber across said transverse wall opening 102b, said seal means being compressed between said support means and said transverse wall, said seal means containing an opening for receiving said electrical conductor means.

3. Apparatus as defined in claim 2, wherein said electrical conductor means further includes a conductive pin 114a connected at one end with said conductive insert body, and plug-in connector means 154 extending from said housing chamber within said transverse wall opening for connection with said conductive pin.

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