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(71) Applicant:
Ford Global Technologies, Inc.
Dearborn, Michigan 48126 (US)

(72) Inventors:
- **Miles, Dean Anthony Edward**
  West Malling, Kent ME19 6RJ (GB)
- **Turnpenny, Geoffrey Brian**
  Brentwood, Essex CM14 5JD (GB)
- **Lepley, Geoffrey Peter**
  Canvey Island, Essex SS8 8BT (GB)

(74) Representative:
Messulam, Alec Moses et al
A. Messulam & Co. Ltd.,
43-45 High Road
Bushey Heat, Herts WD23 1EE (GB)

(54) RF connector assembly for a circuit board

(57) The present invention relates to a radio frequency (rf) connector assembly (1) for a circuit board (2), and in particular to an rf connector assembly. The connector assembly (1) comprises an elongate housing (3) that has a longitudinal axis (12) extending along the length of the housing (3) between a base end (6) and a top end (4) of the housing; a pair of rf connectors (13,14) held by the housing (3), each connector having a connection axis (28,29); and connection pins (19,20) that are connected electrically to the rf connectors (13,14) and which extend from the housing (3) for connection to a circuit board (2). The rf connectors (13,14) are spaced along the longitudinal axis (12) and face laterally outwards from the housing (3) with connection axes (28,29) that are transverse to the longitudinal axis (12); and the connection pins (19,20) extend from the housing (3) so that when the connector assembly (1) is mounted to a circuit board (2), the longitudinal axis (12) is transverse to the circuit board (2). The housing (3) is adapted to receive a first one (14) of the rf connectors through an opening (106) to the base end (6), and to receive a second one (13) of the rf connectors through another opening (144) to the front face (10).

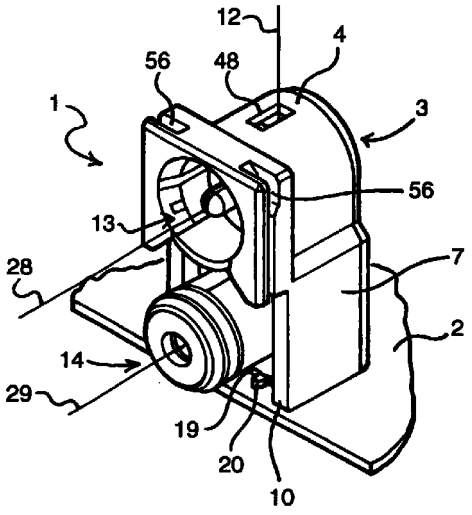

Fig. 1

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Description

[0001] The present invention relates to a radio frequency (rf) connector assembly for a circuit board, and in particular to an rf connector assembly.

[0002] An electronic radio device sometimes needs to have more than one rf connector by which corresponding rf connections can be made between the device, another device, or a radio antenna. For example, in motor vehicle it is known to use two radio antennas, one of which is incorporated in a rear window as part of a heater element for demisting the rear window, with the other antenna being a short "whip" antenna, usually mounted on the vehicle's roof. The use of a short whip antenna together with the window antenna provides a compact and unobtrusive antenna system for a motor vehicle, with good sensitivity and directional coverage.

[0003] Individual coaxial rf cables run from the two antenna to the motor vehicle radio, which then has behind a dashboard two corresponding rf connectors that extend through a sheet steel chassis to make connection with matching connectors at the ends of the coaxial cables. The connections that are normally made are via two connectors that conform to the standard ISO 10599-1. This standard provides only for a female type socket connector that is affixed either to a chassis or circuit board, with a corresponding male type plug connector at the end of a flexible coaxial cable. The female connector may be fixed to the chassis or to a circuit board. During assembly of the radio chassis within the vehicle dashboard, an assembly worker manually connects each cable to its rf connector on the radio.

[0004] Two problems have been noted with this approach. First, it is usually cheaper to have an rf connector fixed directly to a circuit board rather than separately to the chassis, but the use of two rf connectors spaced along the edge of a circuit board takes up a considerable extent of the available width of the circuit board and/or chassis for making such connections. This problem is made worse by the fact that radios now need several connectors with numerous connections for power, speakers, and auxiliary units, such as CD players, graphic equalisers, vehicle security systems and the like. Because these connections are often made to the same circuit board as the rf connections, there may not be enough space to fit edge connectors for all the necessary connections.

[0005] A second problem stems from the fact that an assembly worker might connect the rf cables to the wrong female rf connectors, in which case the radio receivers for each antenna will not be matched to the connected antenna. In this case, the radio may work poorly, or not at all.

[0006] It is an objet of the present invention to provide a more convenient rf connector assembly for a circuit board.

[0007] Accordingly, the invention provides a connector assembly for a circuit board, the connector assembly comprising:

i) an elongate housing, the housing having a base end and a top end, and between said ends a front face and a longitudinal axis, the longitudinal axis extending along the length of the housing, and the front face and the base end each having an opening thereto;

ii) a pair of rf connectors, said connectors being assembled to the housing and held by the housing spaced along the longitudinal axis, and each connector having a connection axis, the connection axes each facing laterally outwards from the housing through the opening to the front face in a direction transverse to the longitudinal axis; and

iii) connection pins, the connection pins being connected electrically to the rf connectors and extending from the opening to the base end of the housing for connection to a circuit board so that when the connector assembly is mounted to a circuit board, the longitudinal axis is transverse to the circuit board; characterized in that

the housing is adapted to receive a first one of the rf connectors through the opening to the base end, and to receive a second one of the rf connectors through the opening to the front face.

[0008] The connector assembly may then be mounted to an edge of a circuit board, in which case, the rf connectors will extend along an axis transverse, and preferably perpendicular, to the surface of the circuit board.

[0009] In the case of a radio device comprising such a circuit board inside a radio chassis, the rf connectors can be made accessible outside the chassis, for example by an aperture through the chassis. Corresponding rf connections may be made to the device, for example via matching connectors at the ends of rf cables.

[0010] It will most commonly be the case that the connection axes are perpendicular to the longitudinal axis of the housing.

[0011] The term "connection pins" as used herein includes not only pins that extend from the housing and that may be inserted in through-plated holes in a circuit board, but also other types of connection including surface mount pads or connections.

[0012] A first one of the connectors will be closer to the base end and a second one of the connectors will be closer to the top end. These connectors may be polarised, for example forming a male/female pair.

[0013] The invention will now be described by way of example, with reference to the accompanying draw-

ings, in which:

Figure 1 is a perspective view of a connector assembly according to a preferred embodiment of the invention, affixed to a circuit board, with a male/female pair of rf connectors facing laterally outwards at an edge of the circuit board;

Figure 2 is an exploded view of the connector assembly if Figure 1, showing a housing and components of each rf connector;

Figures 3, 4, 5 and 6 are respectively side, top, front and bottom views of the connector assembly of Figure 1;

Figure 7 is a cross-section through the connector assembly, taken along line VII-VII of Figure 5;

Figure 8 is a plan view of a portion of the circuit board of Figure 1, showing through-plated holes and plated ground and signal connections for connection to the connector assembly; and

Figure 9 is a perspective view of part of the chassis of a radio device, with a number of connectors in a back panel of the device, including the connector assembly of Figure 1.

[0014] Figure 1 shows a perspective view of a connector assembly 1 that has been soldered to the edge of a printed circuit board 2. A connector assembly 1 consists of a number of components, which are shown in exploded view in Figure 2, and in more detail in Figures 3-7. The connector assembly 1 comprises an elongate connector housing 3 moulded in 30% glass-filled nylon. The housing 3 has a closed top end 4 and an open bottom end 6 between which extend two opposite closed sides 7,8 and a closed back 9 of generally three-sided rectangular form in cross-section. An open front face 10 extends from the open base 6 towards the closed top 4. The open base 6 and open front face 10 provide access to an open volume within the housing that extends around a longitudinal axis 12 that extends the length of the housing 3.

[0015] When assembled, the connector assembly 1 includes a male/female pair of rf connectors 13,14. The female connector 14 is a socket that conforms to the standard ISO 10599-1, and the male connector 13 is a socket adapted from a plug for the same standard. The female connector 14 has a lower outer case 16 formed in pressed brass within which is a female insulator 17 formed in high-density polyethylene within which is a female pin 18 formed in pressed copper.

[0016] The lower outer case 16 has two pins 19 which extend downwards in a direction parallel with the longitudinal axis 12, and the female pin 18 has a similar downwards extending pin 20. As can be seen from Figure 8, the circuit board 2 has matching plated through-holes two of which 119 are connected to a ground plane 22 shown in hashed outline, and another plated through-hole 120 which is electrically connected to a plated rf signal line 23. When the connector assembly 1 is soldered to the circuit board 2, the connector open base 6 sits on the board 2 and the lower outer case pins 19 and the pin 20 of the female pin 18 are soldered within the corresponding plated through-holes 119,120.

[0017] The male rf connector 13 comprises an upper outer case 24 formed in pressed brass. A male insulator 25 is formed in high-density polyethylene, and is held within the upper outer case 24. A male pin 26 formed in pressed brass is held within the male insulator 25 which separates the male pin from the upper outer case 24.

[0018] The male rf connector 13 has a connection axis 28 which is perpendicular to the longitudinal axis 12, and which extends through the middle of the front face 10. The female rf connector 14 has a similar connection axis 29 which is spaced longitudinally from and parallel with the connection axis 28 for the male rf connector 13.

[0019] The male rf connector 13 has a downwardly extending shaft parallel with the longitudinal axis 12 that consists of a cylindrical hollow outer aluminium shielding sleeve 30 from the upper outer case 24, an inner cylindrical hollow dielectric spacer 31 from the male insulator 25, and an innermost wire 32 from the male pin 26. The wire 32 terminates in a pin 33 whilst the sleeve 30 terminates in another pin 34, both of which pins extend longitudinally downwards through the housing open base 6 when the male rf connector 13 is held within the housing 3.

[0020] As can be seen from Figure 8, the circuit board 2 has a through plated hole 133 that is electrically connected to the ground plane 22, and another through plated hole 134 which is electrically connected to a plated rf signal line 36. When the connector assembly 1 is soldered to the circuit board 2 the male rf connector pins 33,34 are soldered to the corresponding plated through-holes 133,134.

[0021] The housing open base 6 and pins 19,20,33,34 therefore define the orientation between the longitudinal axis 12 and the circuit board 2.

[0022] The housing assembly 1 is assembled in the following manner. The male insulator 25 has a rear flap 38 hingedly connected to a top face 39 of the male insulator at a thin bridge 40 which serves as a hinge. The rear flap 38 lifts up whereupon the male pin 26 can be inserted axially into the surrounding male insulator 25. The downwardly projecting sleeve 30 of the upper outer case 24 is initially open along a front seam 42. The male insulator 25 can then be inserted axially into the upper outer case 24 whereupon the open sleeve 30 is crimped around the cylindrical dielectric spacer 31 of the male insulator 25.

[0023] The housing front face 10 has an opening

144. The front face opening 144 has an upper portion which is part circular leading to a part cylindrical recess 44, and a lower portion which is essentially rectangular. The recess 44 is concentric with the connection axis 28 and has an open slot 45 along a lower side than runs parallel with the connection axis 28. The upper outer case 24 has a similar cylindrical shape with outwardly flared tangs 46 that grip the walls of the cylindrical recess 44 when the upper outer case 24 is inserted into the cylindrical recess 44. The downwardly projecting sleeve passes through the rectangular opening 144 to the slot 45 when the upper outer case 24 is inserted axially into the cylindrical recess.

[0024] Because the slot 45 has a width less than the diameter of the upper outer case 24, the cylindrical recess 44 therefore acts as a retention feature to retain the female rf connector within the housing 3 in a longitudinal direction 12, as well as permitting the male rf connector 13 to be assembled to the housing through the open front face 10 of the housing 3.

[0025] The upper outer case 24 also has a snap-fit feature in the form of a small flap 47 upwardly and forwardly directed from an uppermost portion of the upper outer case 24. The flap 47 snaps resiliently into a snap-fit engagement with a matching aperture 48 in the housing upper face 4, when the upper outer case 24 seats within the cylindrical recess 44. The male rf connector 13 is thereby held within the housing 3 also in a direction along the connection axis 28.

[0026] The downwardly projecting sleeve 30 can, however, still pivot slightly forwards and back. The sleeve 30 is then held more securely in place by the lower female rf connector 14 once this is held within the housing 3.

[0027] The female rf connector 14 is assembled in the following way. First, the female insulator 17 is inserted axially within the lower outer case 16. The female insulator 17 has a rear flap 41 hingedly connected to a top face 43 of the male insulator at a thin bridge 49 which serves as a hinge. The rear flap 41 lifts up whereupon the female pin 18 can be inserted axially into the surrounding female insulator 17.

[0028] The female insulator 17 has a back plate 50 that extends transverse to the connection axis 29. The lower outer case 16 has its own back plate 51 that is essentially the same extent as the female insulator back plate 50. The housing 3 has a pair of inwardly opposed channels 52 that are parallel with the longitudinal axis 12 and which extend upwards on inner surfaces of side walls 7,8 from the open base 6 just inside of the open front face 10. The pair of channels 52 form a close sliding fit with the back plates 50,51 as the female rf connector 14 is inserted upwards along the longitudinal axis 12 into the housing 3 through an approximately square opening 106 to the base 6. The base square opening 106 meets the rectangular portion of the front face opening 144 along a front base edge of the housing.

[0029] The channels 52 therefore act as a retention feature that permits the female rf connector 14 to be assembled with the housing 3 and that retain the female rf connector 14 to the housing 3 in a direction along the connection axis 29. The channels also permit the female rf connector 14 to be assembled to the housing 3 through the open base end 6.

[0030] The lower outer case back plate 51 has along its lower corners two small flaps 53 each of which engage resiliently in a snap-fit engagement with a similar small lip 54 at the open ends of the channels 52. The lips 54 therefore serve as a snap-fit feature for the female rf connector 14 to retain the female rf connector 14 within the housing 3 in a direction along the longitudinal axis 12.

[0031] When the male and female rf connectors 13,14 are held within the housing 3, the sleeve 30 of the male rf connector 13 extends behind the female rf connector 14 so that the female rf connector 14 helps to retain the male rf connector 13 to the housing 3 in a direction along the connection axis 28 for the male rf connector.

[0032] The housing 3 has a pair of external and oppositely outward directed slots or channels 56 that extend along an upper half of the two side faces 7,8 in a direction parallel with the longitudinal axis 12 of the housing 3.

[0033] Figure 9 shows a portion of a radio device 100 having a sheet steel chassis 60 with a back plate 59. The channels 56 are just wide enough to receive the sheet steel around a corresponding cut-out 58 in the chassis back plate 59, and therefore act as a location feature to locate the housing assembly with respect to the chassis back plate 59.

[0034] The rf connector assembly 1 is therefore securely held at its base by soldered connections to the circuit board 2, and at its top by engagement of the radio device chassis 60 with the channels 56.

[0035] The chassis 60 has other cut-outs 62,63 for a CD player connector 64, a power connector 65, an auxiliaries connector 66 and a speakers connector 67. It will be noted that these connectors 64-67 take up most of the available area on the back plate 59 of the chassis 60. The vertically stacked arrangement of the polarised rf connectors 13,14 fits into the remaining area on the chassis back plate 59.

[0036] The audio device 100 may then be inserted into a dashboard of a motor vehicle (not shown), after connection of antenna cables (not shown) to the rf connectors 13,14. Because the connectors 13,14 are polarised as a male/female pair, each antenna cable will be connected to the correct rf connector.

[0037] The connector assembly as described above therefore provides a compact and convenient dual rf connector.

Claims

1. A connector assembly (1) for a circuit board (2), the connector assembly (1) comprising:

   i) an elongate housing (3), the housing (3) having a base end (6) and a top end (4), and between said ends (4,6) a front face (10) and a longitudinal axis (12), the longitudinal axis (12) extending along the length of the housing (3), and the front face (10) and the base end (6) each having an opening (144,106) thereto;

   ii) a pair of rf connectors (13,14), said connectors (13,14) being assembled to the housing (3) and held by the housing (3) spaced along the longitudinal axis (12), and each connector (13,14) having a connection axis (28,29), the connection axes (28,29) each facing laterally outwards from the housing (3) through the opening (144) to the front face (10) in a direction transverse to the longitudinal axis (12); and

   iii) connection pins (19,20,33,34), the connection pins (19,20,33,34) being connected electrically to the rf connectors (13,14) and extending from the opening (106) to the base end (6) of the housing (3) for connection to a circuit board (2) so that when the connector assembly (1) is mounted to a circuit board (2), the longitudinal axis (12) is transverse to the circuit board (2); characterized in that

      the housing (3) is adapted to receive a first one (14) of the rf connectors through the opening (106) to the base end (6), and to receive a second one (13) of the rf connectors through the opening (144) to the front face (10).

2. A connector assembly (1) as claimed in Claim 1, in which the second connector (13) extends behind the first connector (14) when both rf connectors (13,14) are held by the housing (3), so that the first connector (14) helps to retain the second connector (13) to the housing (3) in a direction along the connection axis (28) for the second connector (13).

3. A connector assembly (1) as claimed in Claim 1 or Claim 2, in which the first connector (14) is closer to the base end (6) and the second connector (13) is closer to the top end (4).

4. A connector assembly (1) as claimed in any preceding claim, in which the housing (3) has a first connector retention feature (52) that permits the first connector (14) to be received by the housing (3) and that retains the first connector (14) to the housing (3) in a direction along the connection axis (29) of the first connector (14).

5. A connector assembly (1) as claimed in Claim 4, in which the first connector retention feature is a pair of inwardly opposed channels (52) within the housing (3).

6. A connector assembly (1) as claimed in Claims 4 or Claim 5, in which a first snap-fit feature (52,53) is provided between the first connector (14) and the housing (3) so that the first connector (14) is received by the housing (3) in a snap-fit engagement.

7. A connector assembly (1) as claimed in any preceding claim, in which the housing (3) has a second connector retention feature (44) that permits the second connector (13) to be received by the housing (3) and that retains the second connector (13) to the housing (3) in a direction along the longitudinal axis (12).

8. A connector assembly (1) as claimed in Claim 7, in which a second snap-fit feature (47,48) is provided between the second connector (13) and the housing (3) so that the second connector (13) is assembled to the housing (3) in a snap-fit engagement.

9. A connector assembly (1) as claimed in any preceding claim, in which the connector assembly (1) has a location feature (56) for locating the housing (3) with respect to an external plate (59), the location feature including at least one channel (56) that extends longitudinally on an external surface (7,8) of the housing (3).

10. A connector assembly (1) as claimed in Claim 9, in which the location feature is a pair of oppositely outwards facing slots (56) near the top end (4) of the housing (3).

11. A circuit board (2) comprising an edge-mounted connector assembly (1) with a pair of rf connectors (13,14), in which the connector assembly (1) is as claimed in any preceding claim.

12. A radio device (100), comprising a chassis (60) with at least one electronic circuit board (2) therein, the circuit board (2) having mounted thereon a connector assembly (1) with a pair of rf connectors (13,14) that are accessible outside the chassis (60) and by which corresponding rf connections may be made to the device (100), in which the connector assembly (1) is as claimed in any of Claims 1 to 10.

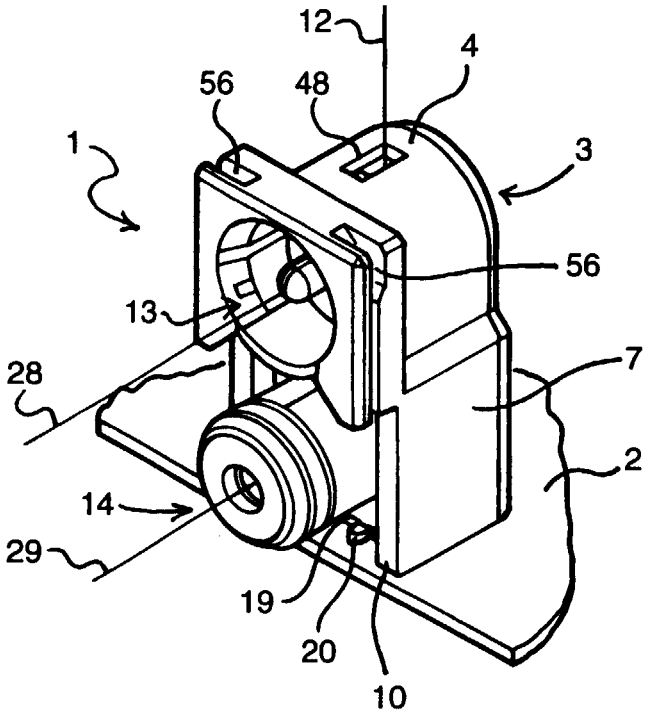
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Fig. 1

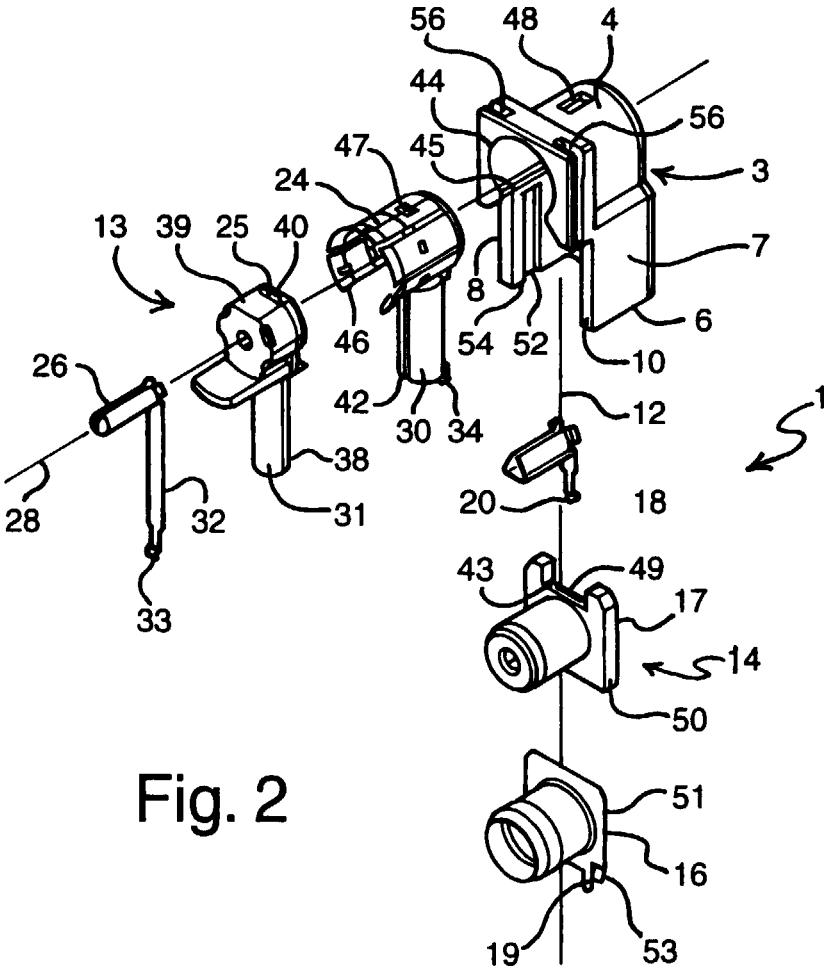
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Fig. 2

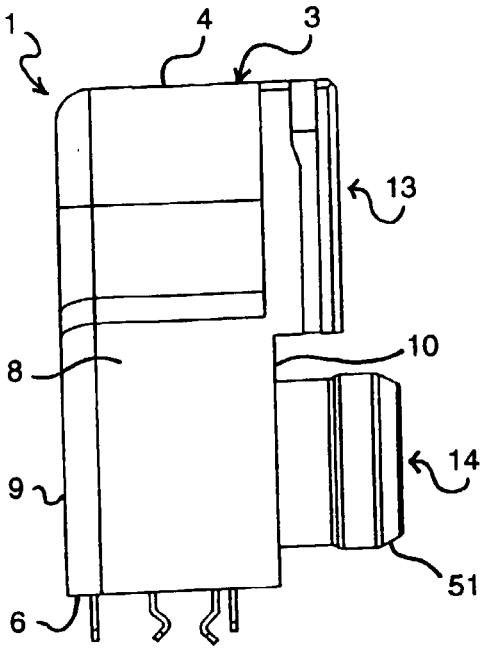

Fig. 3

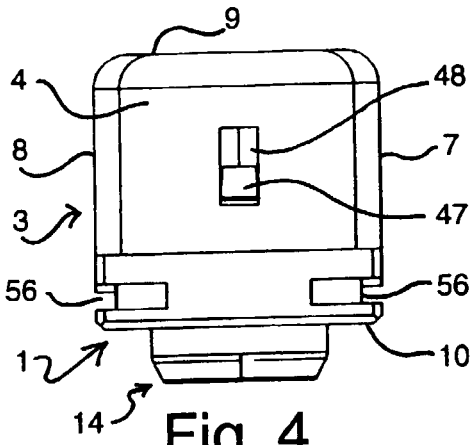

Fig. 4

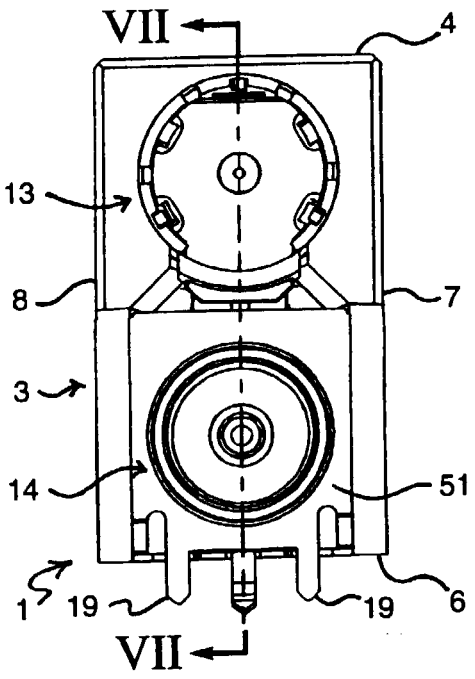

Fig. 5

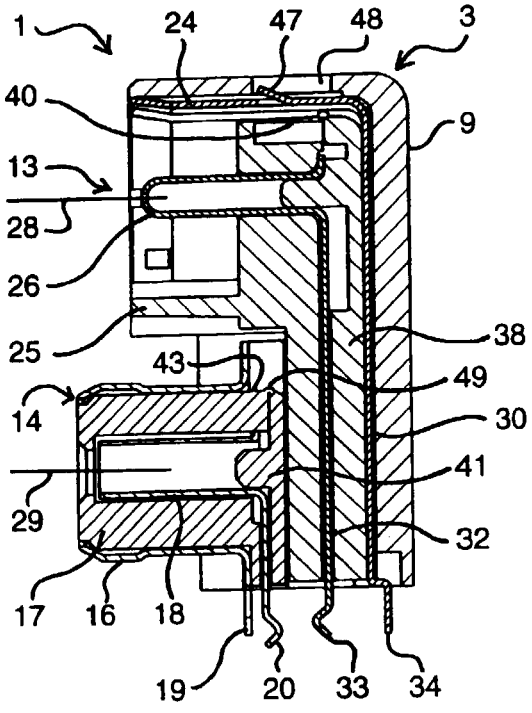

Fig. 7

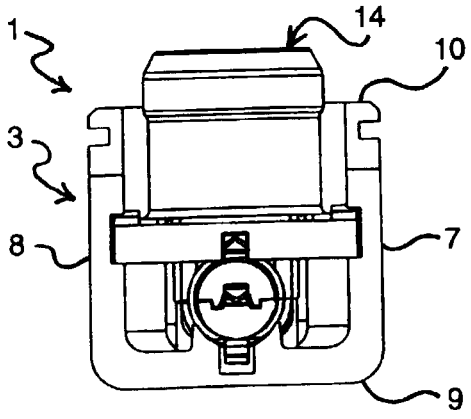

Fig. 6

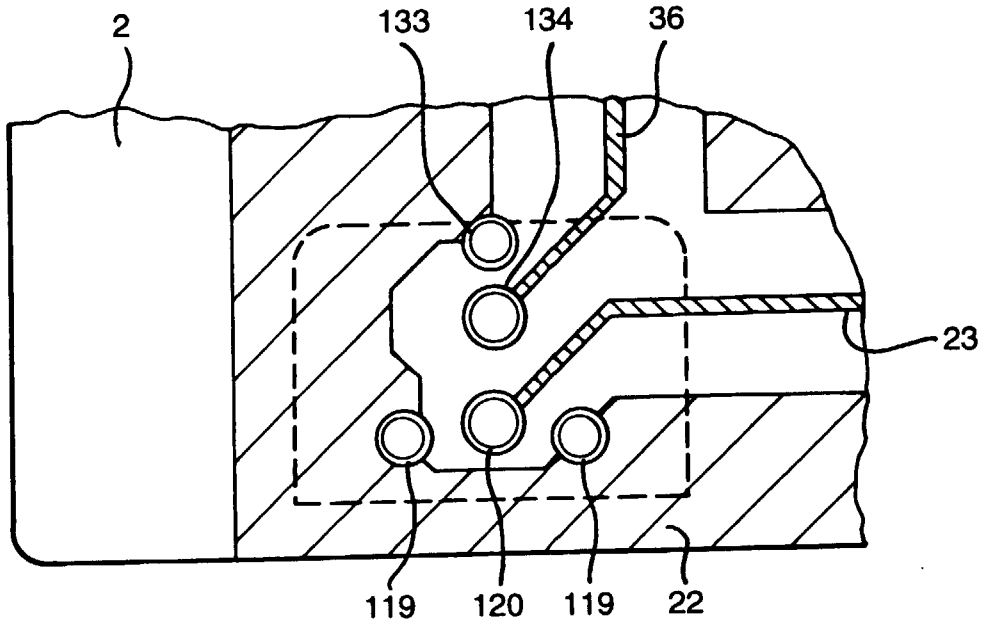

Fig. 8

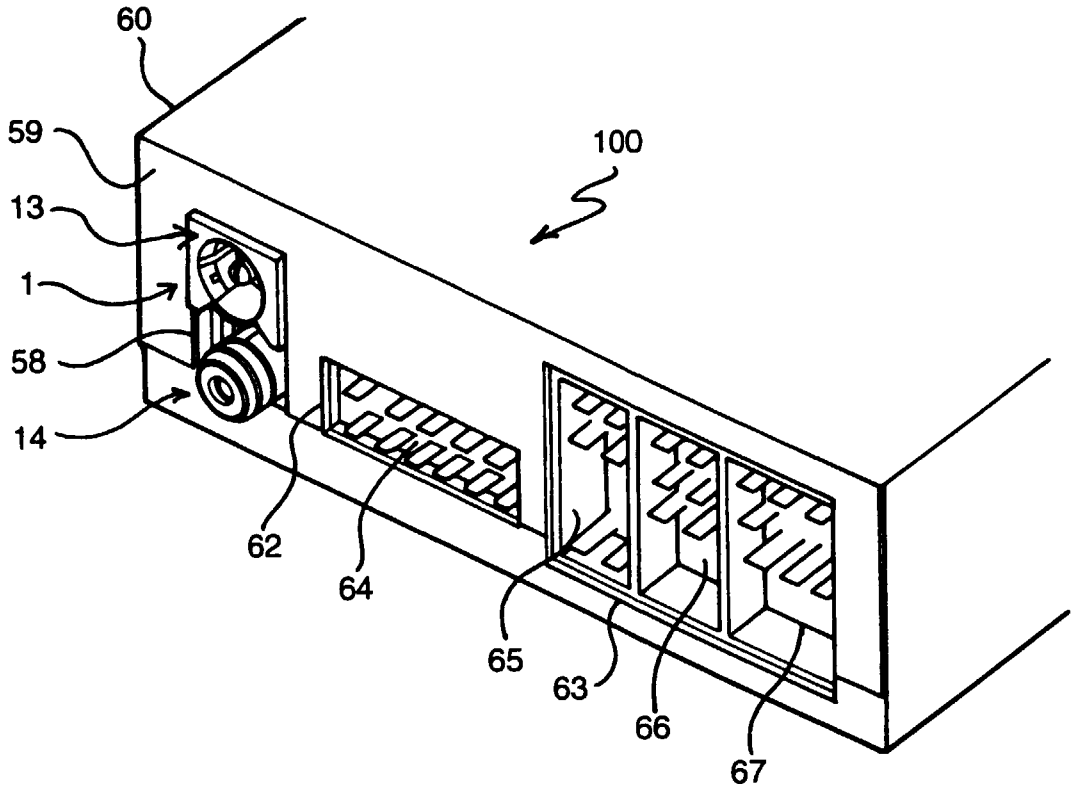

Fig. 9