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(54) **Electrical connection and method of building it**

(57) An electrical connection between contacts of a housing (12, 14) and contacts of a PCB (16) arranged

within the housing, the PCB being cramped between housing parts (12, 14) connected by means of screw connection (55) is used to build an antenna coupler (10).

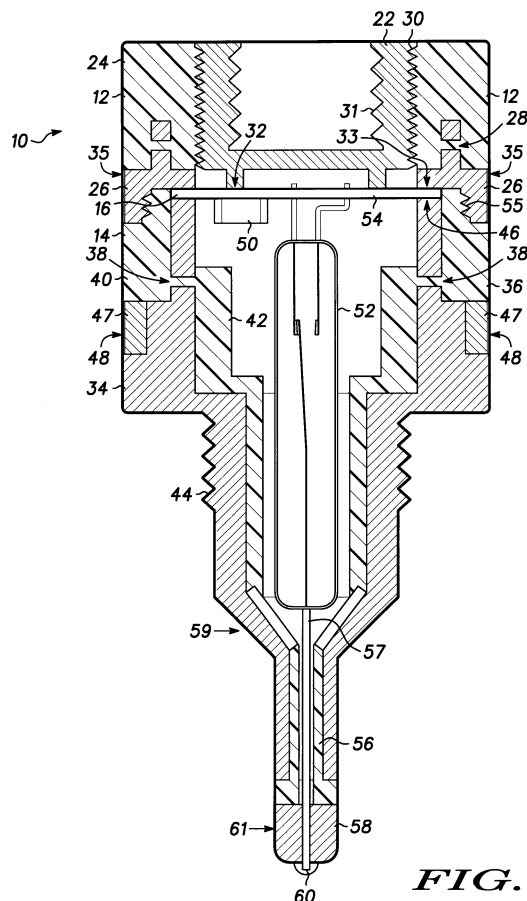


FIG. 1

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Description

Field of the invention

5 **[0001]** This invention relates to an electrical connection between contacts of a housing and contacts of a printed circuit board (PCB) arranged within the housing and a method of building such an electrical connection.

Background to the invention

10 **[0002]** In a two way radio or a mobile telephone, which are collectively referred to as radio device, in a vehicular cradle it is often needed to direct radio frequency (RF) radiation either to its antenna rod or to an outside cable connected to the cradle. In the prior art this is achieved by a switch within the device which guides the radiation to the device's antenna if not activated. If the device is inserted into the cradle the switch is activated and it guides the radiation to the outside cable via a plug in the cradle. Often an impedance conversion is required either to the antenna branch or to the outside cable which in the prior art is provided on a printed circuit board within the device.

15 **[0003]** Coaxial cables as well as antenna rods are widely used for conveying RF signals. Despite the simple radial symmetric construction of such cables conventional branches therefrom are unsymmetrical and branch housings have to be positioned accordingly with respect to the branching cable or rod, e.g. branch housings built as plug-in parts for BNC-couplings.

20 **[0004]** The present invention arose in an attempt to alleviate these problems.

Summary of the invention

25 **[0005]** According to the invention there is provided an electrical connection between contacts of a housing and contacts of a printed circuit board (PCB) arranged within the housing, the PCB being cramped between housing parts connected by means of screw connection.

[0006] Preferably strip conductors of the PCB are formed as contacts. Advantageously strip conductors of the PCB form concentric ring contacts. This allows cramping the PCB between housing parts by screwing together these housing parts. Advantageously contacts are gold plated.

30 **[0007]** Preferably the PCB has a circular periphery. This allows a small PCB and a suited small housing.

[0008] Preferably the PCB contains a filter or an impedance transforming circuit. This allows to place a filter within a coax cable. An impedance transforming circuit allows an electrical connection between RF conductors of different wave resistance.

35 **[0009]** Preferably the PCB contains a reed switch. This allows to place a remotely activated switch within a cable or rod or antenna for conditionally providing electrical connections to a branch.

[0010] Preferably the contacts of the housing are rings of metal. Such rings are mechanically strong and easy to manufacture and to mount due to the axial symmetry.

[0011] Preferably the contacts of the housing are partly embedded in plastic, this allows to build one-piece housing parts having contacts by casting plastic.

40 **[0012]** Electrically isolated housing parts that isolate the contacts of each housing part and allow plastic threads in each housing part which provide both pressure on the cramped PCB and a watertight connection between the housing parts.

[0013] Preferably the housing comprises outside circular contacts. This allows an axially symmetric antenna adapter. Such an adapter can be screwed between a radio and an antenna and has not to be azimuthally positioned to a branching direction.

45 **[0014]** Thus, the invention allows to provide a vehicular cradle for a radio or a mobile telephone, wherein, when the radio is inserted, a switch within an antenna adapter is actuated and an electrical connection of the radio or mobile telephone is switched from its antenna to the vehicular cradle.

50 **[0015]** A method of building an electrical connection between contacts of a housing and contacts of a printed circuit board (PCB) comprising the steps

- arranging the PCB between two housing parts having at least one contact each and being adapted to be put together such that each contact of each housing part faces a respective contact of the PCB;
- putting together the two housing parts until the PCB is cramped between the housing parts.

55

[0016] Preferably the method of building an electrical connection comprises the additional step

- mounting an auxiliary housing part to the two housing parts already put together such that an auxiliary contact of

the PCB touches a respective contact of the auxiliary housing part.

[0017] Advantageously putting together housing parts is performed by screwing.

[0018] Preferably the method of building an electrical connection comprises the additional step

- fixing housing parts to each other.

[0019] Advantageously fixing housing parts to each other is performed by glueing or pinching.

[0020] Mounting an antenna adapter evolves in the same way with suited housing parts.

Brief description of the drawings

[0021] Figure 1 shows an antenna coupler comprising an electrical connection in accordance with the invention.

[0022] Figure 2 shows a PCB for the electrical connection in accordance with the invention in top view.

[0023] Figure 3 shows the antenna coupler comprising the electrical connection in accordance with the invention used to couple a radio device to a roof mounted antenna or to an antenna mounted on the radio device; and a part of a radio cradle in cross-section.

Specific description of a preferred embodiment

[0024] With reference to figure 1, antenna coupler 10 comprises first housing part 12, second housing part 14, and PCB 16, PCB 16 is cramped between housing parts 12 and 14.

[0025] First housing part 12 comprises inner metal ring 22, first plastic housing 24, and first outer metal ring 26. First plastic housing 24 is plastic moulded through holes 28 in first outer metal ring 26 and isolates it from inner metal ring 22. Inner metal ring 22 is connected to first plastic housing 24 by threads 30 which connection is fixed by glue. Inner metal ring 22 comprises first housing thread 31 for screw connecting first housing part 12 with an antenna (not shown). Inner metal ring 22 has gold plated first contact surface 32 and first outer metal ring 26 has gold plated second contact surface 33 and gold plated third contact surface 35.

[0026] Second housing part 14 comprises metal body 34 and second plastic housing 36 which is plastic moulded through holes 38 in metal body 34 such that it has outer plastic portion 40 and inner plastic portion 42. Metal body 34 comprises second housing thread 44 for screw connecting second housing part 14 with a radio (not shown). Metal body 34 comprises gold plated fourth contact surface 46 and second outer metal ring 47 gold having plated fifth contact surface 48. Preferably, first housing thread 31 and second housing thread 44 are matching such that an antenna (not shown) with matching thread can be screwed into either antenna coupler 10 or the radio (not shown).

[0027] PCB 16 comprises components 50 and reed switch 52. PCB 16 comprises board 54 in form of a disk with has a circular periphery. Board 54 has circular strip conductors on both sides in contact with contacts 32, 33, and 46.

[0028] First housing part 12 and second housing part 14 are screw-connected by threads 55 which connection is fixed by glue. Reed switch wire 57 extends through tube section 56 of inner plastic portion 42 and through metal tube 58 of second housing part 14. Metal body 34 comprises flank 59 formed outwardly suitable to activate an external switch (not shown) within a radio, which switch is activated only if antenna coupler 10 but not an antenna is screw-connected to the radio. Reed switch wire 57 is soldered to metal tube 58 at its free end 60. Metal tube 58 preferably comprises gold plated outer cylinder wall 61. Those of skill in the art will know that instead of flank 59 metal tube 58 could activate the external switch (not shown) within the radio.

[0029] Thus, an electrical connection is provided between contacts of a housing 12, 14 and contacts of PCB 16 arranged within the housing, PCB 16 being cramped between housing parts 12, 14 connected by means of screw connection, threads 55. Surfaces 32, 33, 46 of the inner contacts are gold-plated. Additionally, first outer metal ring 26 and second outer metal ring 47 form outside circular contacts which have also gold-plated surfaces 35, 48.

[0030] A method of building an electrical connection between contacts of a housing and contacts of PCB 16 comprising the steps

- arranging PCB 16 between two housing parts 12, 14 having at least one contact each and being adapted to be put together such that each contact of each housing part faces a respective contact of PCB 16;
- putting together housing parts 12, 14 until PCB 16 is cramped between housing parts 12, 14.

[0031] This electrical connection and method of building it allow to mount an antenna adapter in a very simple way from substantially axial symmetric parts. First housing part 12, second housing part 14 and PCB 16 including reed switch 52 are pre-manufactured independently; arranged; housing parts 12 and 14 are put together by screwing until PCB 16 is cramped between them; metal tube 58 is shifted over reed switch wire 57 and squeezed to inner plastic

portion 42; reed switch wire 57 is soldered to metal tube 58 at its free end 60.

[0032] In a preferred embodiment the method of building an electrical connection comprises the additional step

- mounting an auxiliary housing part to the two housing parts already put together such that an auxiliary contact of the PCB touches a respective contact of the auxiliary housing part.

[0033] In the above description it is assumed that inner metal ring 22 is premounted to first housing part 12. In another preferred embodiment metal ring 22 is mounted after first housing part 12 has been mounted to second housing part 14 with PCB 16 inbetween. Then, inner metal ring 22 is mounted as an auxiliary housing part 22 to the two housing parts already put together such that an auxiliary contact 64 of PCB 16 touches a respective contact 32 of the auxiliary housing part 22.

[0034] In a preferred embodiment the method of building an electrical connection comprises the additional step

- fixing housing parts to each other.

[0035] Advantageously, the fixing of housing parts to each other is performed by glueing.

[0036] Specifically, glue is applied to threads 30 and threads 55 before the respective parts are screwed together and the glue cures afterwards such that the respective parts are fixed.

[0037] Figure 2 shows circular PCB 16 of Fig. 1 for the electrical connection comprising circular strip conductors. Fig. 2 a) shows the side of PCB 16 facing first housing part 12, the side comprising first strip conductor 62, second strip conductor 64 and ducts 66, 68, 70, Fig. 2b) shows the side of PCB 16 facing second housing part 14, the side comprising third strip conductor 72, components 50 and ducts 66, 68, 70. Reed switch 52 of Fig. 1 is not shown for simplicity but is to be connected to ducts 68 and 70. Conductor strips 62, 64 and 72 can contact 33,35,46.

[0038] Figure 3 shows antenna coupler 10 comprising the electrical connection in accordance with the invention used to couple radio device 80 to roof mounted antenna 82 or to antenna 84 mounted on radio device 80. Radio device 80 is shown located in cradle 86 which is fixed to a dashboard of motor vehicle 88 having a roof mounted antenna 82. It will be referred to details of antenna coupler 10 shown in Fig. 1.

[0039] Radio device 80 is a two way radio which (when not placed in the cradle 86) is usable as a handheld portable radio. Antenna 84 is a conventional portable radio antenna which is helically wound. It terminates at its lower end with a conventional male screw-threaded connector comprising first housing thread 31. Cradle 86 comprises a box-like structure having formed in its front face recess 90.

[0040] Recess 90 is shaped to receive radio device 80 and includes electrical contacts to enable the required type of connection to circuitry in a carrier. The circuitry includes battery charging circuits for charging a battery of the radio device 80 and for connection to a loudspeaker and microphone (not shown) mounted in vehicle 88. Recess 90 also includes a locking mechanism to retain the radio device 1 in the recess. This mechanism is operated by means of an external locking lever 92 to lock the radio device 80 into recess 90 or to subsequently release it.

[0041] Antenna 84 can be directly screw-connected to radio device 80 or via antenna coupler 10 therebetween as shown in Fig. 3. In case of direct connection the abovementioned switch within the radio is inactivated such that antenna 84 is electrically connected to radio device 80 via the screw-connection.

[0042] In case of connection via antenna coupler 10 the abovementioned switch within the radio is activated such that antenna 84 is conditionally electrically connected to radio device 80 via metal tube 58 and reed switch 52 if radio device 80 is not positioned in cradle 86.

[0043] If radio device 80 is positioned in cradle 86 then reed switch 52 is activated by magnets (not shown) within cradle 86. Then, antenna 82 is electrically connected to radio device 80 via metal tube 58, reed switch 52 and first outer metal ring 26. First outer metal ring 26 is contacted at third contact surface 35 by first prong 94 of cradle 86 and guides the signal to an antenna cable (not shown) to antenna 82. A ground connection is established between radio device 80 and the antenna cable via the screw-connection of metal body 34 which is contacted at fifth contact surface 48 by second prong 96 of cradle 86.

[0044] According to differences between antenna impedance of antenna 84 and cable impedance of the antenna cable within the vehicle, impedances are transformed by circuits. Generally, radio device 80 and antenna 84 are matched to antenna impedance. Thus, one impedance transforming circuit within radio device 80 is used to transform to cable impedance if antenna coupler 10 is inserted, i.e. switched in by flank 59. Another impedance transforming circuit formed by components 50 on PCB 16 transforms back to antenna impedance if reed switch 52 is inactive.

[0045] Whilst in the above described embodiment two prongs are provided one on third contact surface 35 and one on fifth contact surface 48 in alternative embodiments more than one prong per contact surface may be used. This may reduce the contact resistance.

[0046] The coupler may also be used to couple the radio to test equipment by placing the radio into a cradle in which the prongs are connected to the test equipment rather than a further antenna.

[0047] The radio and the coupler will typically be part of a communication system which will include a number of other units mobile and portable.

Reference numbers

[0048]

antenna coupler 10	components 50
first housing part 12,	reed switch 52.
second housing part 14,	board 54
PCB 16	threads 55.
inner metal ring 22,	tube section 56
first plastic housing 24,	Reed switch wire 57
first outer metal ring 26,	metal tube 58
holes 28	flank 59
threads 30.	free end 60.
first housing thread 31	outer cylinder wall 61.
first contact surface 32	first strip conductor 62,
second contact surface 33	second strip conductor 64
third contact surface 35.	ducts 66, 68, 70.
second plastic housing 36	third strip conductor 72,
holes 38	radio device 80
outer plastic portion 40	roof mounted antenna 82
inner plastic portion 42,	antenna 84
second housing thread 44	cradle 86
fourth contact surface 46	motor vehicle 88
second outer metal ring 47	its front face recess 90.
fifth contact surface 48.	locking lever 92
	first prong 94
	second prong 96

Claims

1. An electrical connection between contacts of a housing (12, 14) and contacts of a printed circuit board (PCB) (16) arranged within the housing, the PCB being cramped between housing parts (12, 14) connected by means of screw connection (55).
2. An electrical connection as claimed in claim 1 wherein strip conductors (62, 64, 72) of the PCB (16) are formed as contacts.
3. An electrical connection as claimed in claim 1 or claim 2 wherein strip conductors (62, 64, 72) of the PCB form concentric ring contacts.
4. An electrical connection as claimed in claim 1, claim 2 or claim 3 wherein the PCB (16) has a circular periphery.
5. An electrical connection as claimed in any previous claim wherein the PCB (16) contains a filter and/or an impedance transforming circuit and/or a reed switch (52).
6. An electrical connection as claimed in any previous claim wherein contacts of the housing are rings (22, 26) of metal.
7. An electrical connection as claimed in any previous claim wherein the contacts of the housing (12, 14) are partly embedded in plastic.
8. An electrical connection as claimed in any previous claim wherein the contacts of different housing parts (12, 14) are electrically isolated.
9. An electrical connection as claimed in any previous claim comprising outside circular contacts (26, 47).

10. An antenna adapter comprising an electrical connection as claimed in any of claims 1 to 9.

11. A radio comprising an antenna adapter as claimed in claim 10.

12. A vehicular cradle comprising a radio as claimed in claim 11.

13. A vehicle comprising a vehicular cradle as claimed in claim 12.

14. A method of building an electrical connection between contacts of a housing and contacts of a printed circuit board (PCB) comprising the steps

- arranging the PCB between two housing parts having at least one contact each and being adapted to be put together such that each contact of each housing part faces a respective contact of the PCB;
- putting together the two housing parts until the PCB is cramped between the housing parts.

15. A method of building an electrical connection as claimed in claim 14, comprising the additional step

- mounting an auxiliary housing part to the two housing parts already put together such that an auxiliary contact of the PCB touches a respective contact of the auxiliary housing part.

16. A method of building an electrical connection as claimed in claim 14 or 15, wherein putting together housing parts is performed by screwing.

17. A method of building an electrical connection as claimed in claim 14, 15, or 16, comprising the additional step

- fixing housing parts to each other.

18. A method of building an electrical connection as claimed in claim 17, wherein fixing housing parts to each other is performed by glueing or pinching.

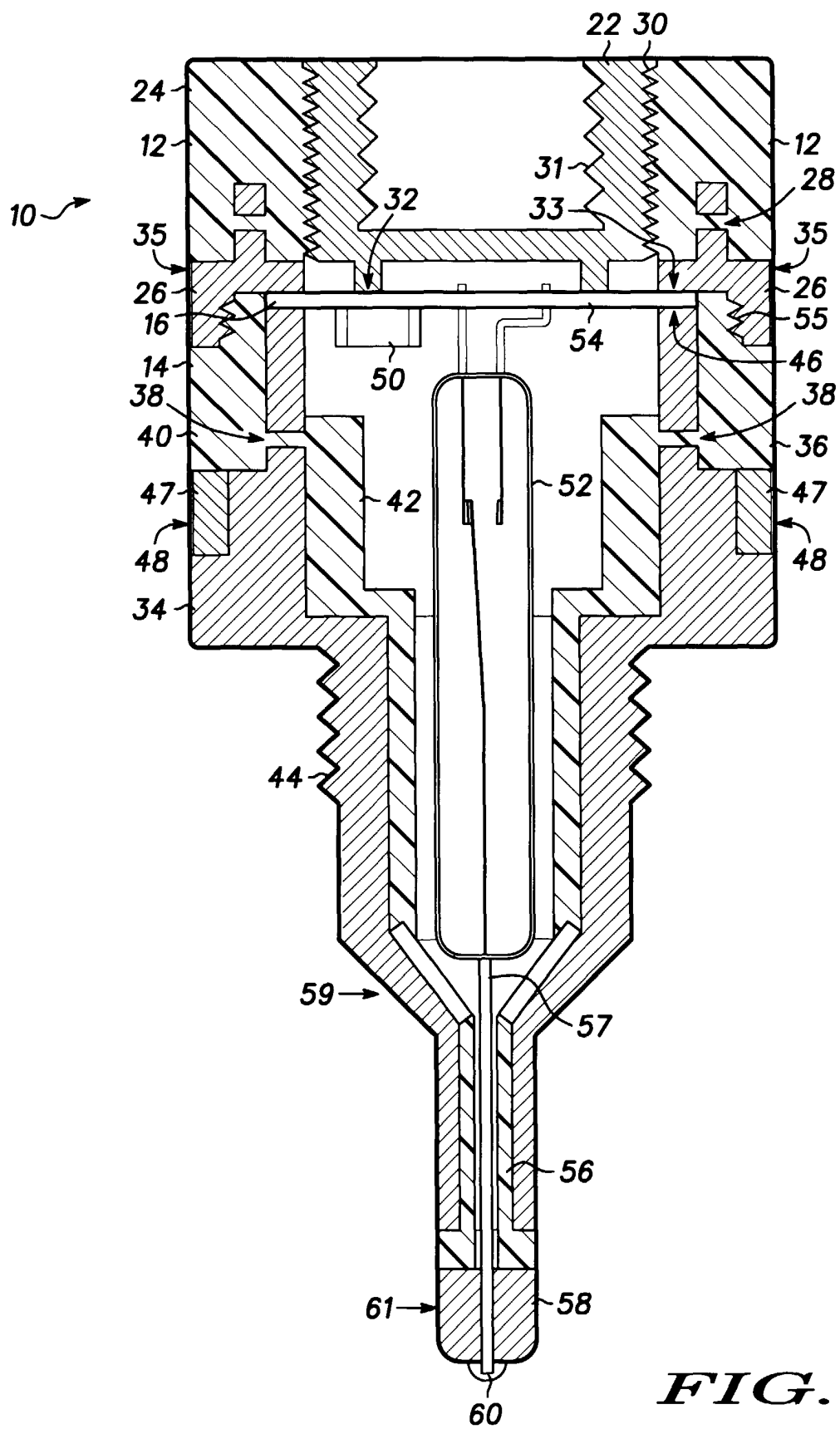


FIG. 1

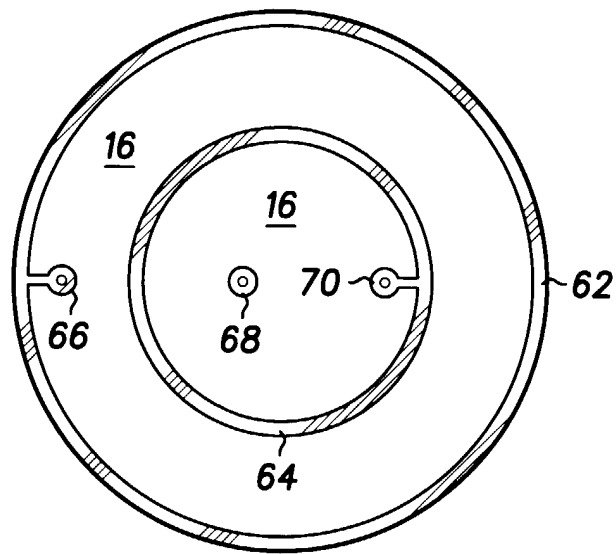


FIG. 2A

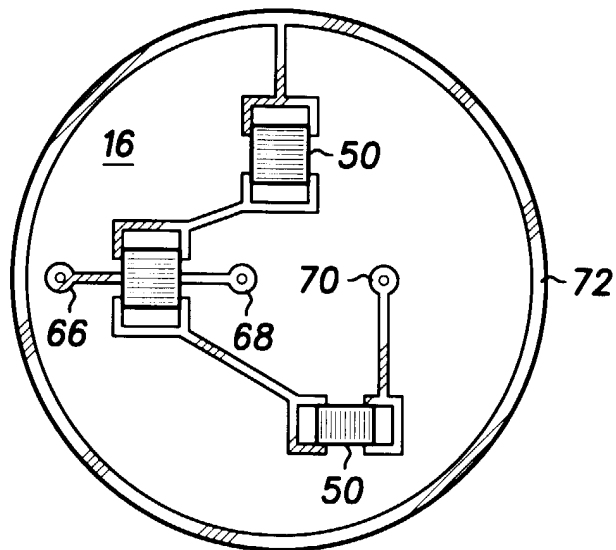


FIG. 2B

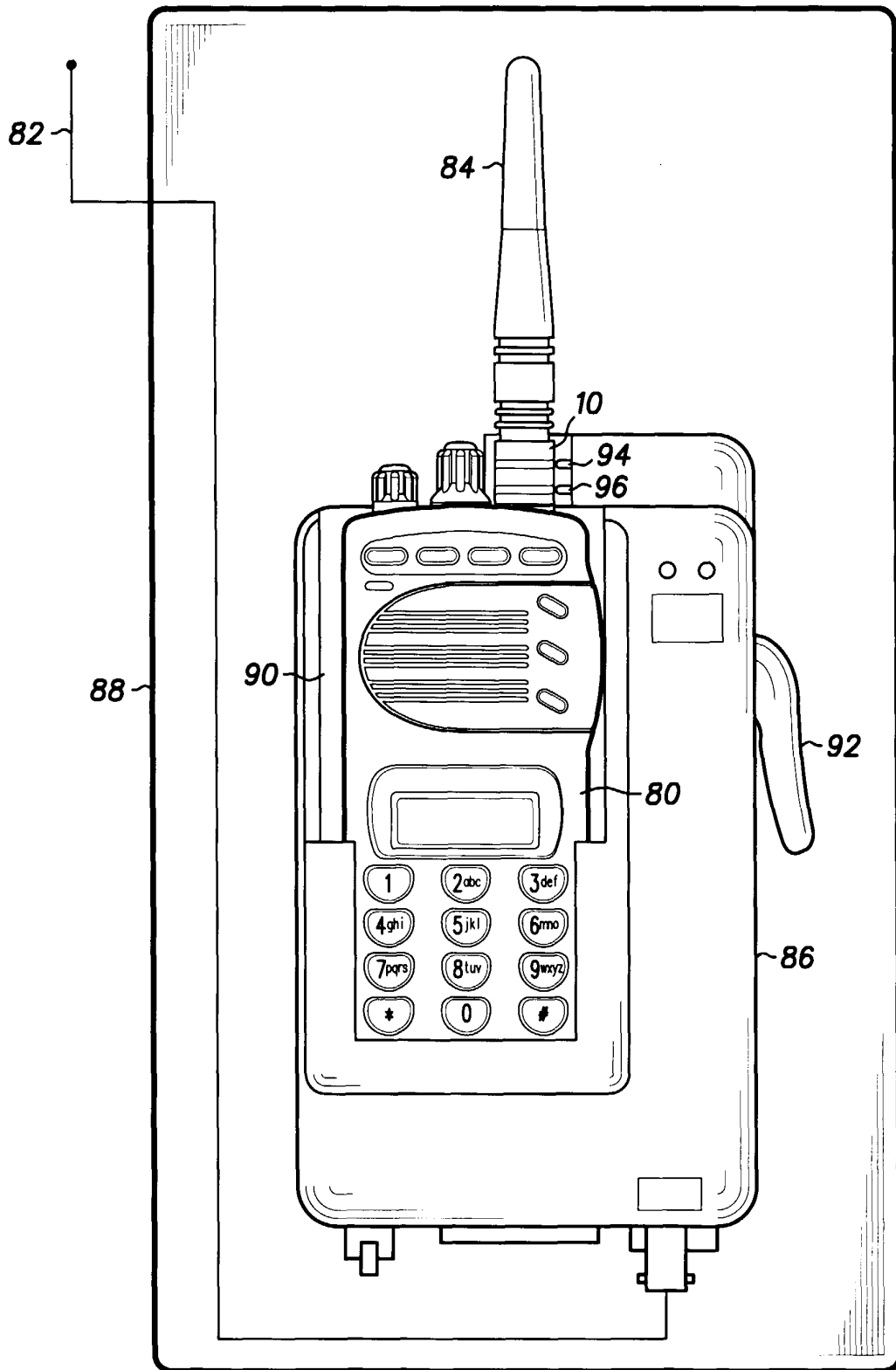


FIG. 3