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(54) ELECTRONIC FILTER ASSEMBLY

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Publication Classification

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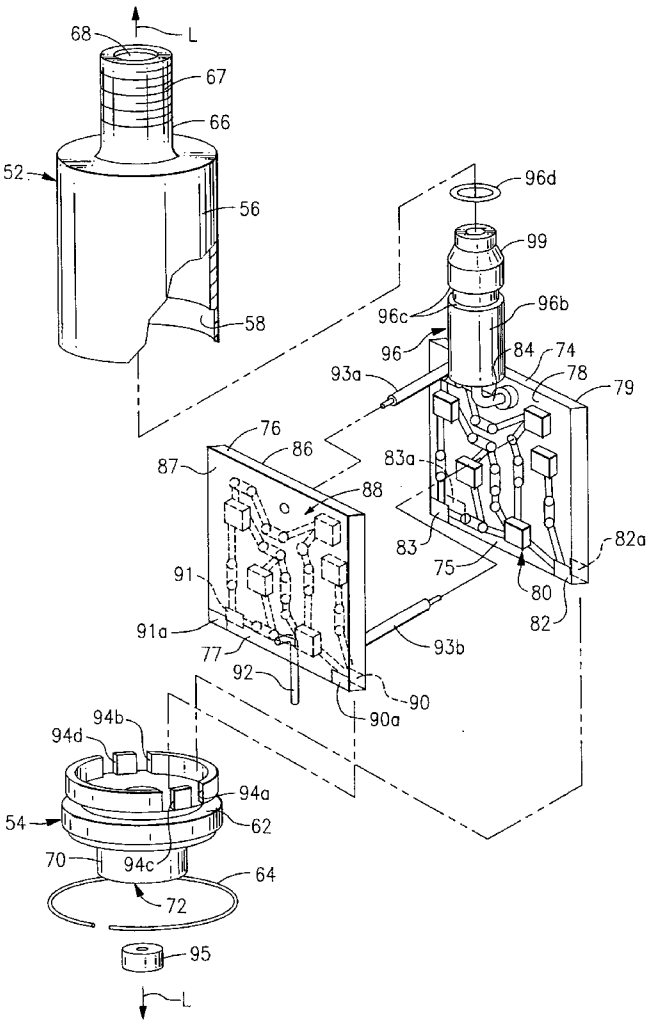
(57) ABSTRACT

An electronic filter comprises a housing having input and output ends. The housing has a body and a connector. The connector is located at the input end of the housing. A circuit board is located within the body. A collet assembly is located within the connector to receive electrical signals and conduct them to the circuit board. The collet assembly includes an insulator, a conductor, and an elastomeric sealing member. The insulator is located within the connector. The insulator contains a generally cylindrical opening through its length. The conductor extends through the opening of the insulator. The conductor has an input end adjacent the input end of the housing and an output end adjacent the circuit board. The conductor has a hollow interior at its input end. The sealing member surrounds the insulator in compressed engagement with the insulator and the surrounding connector.



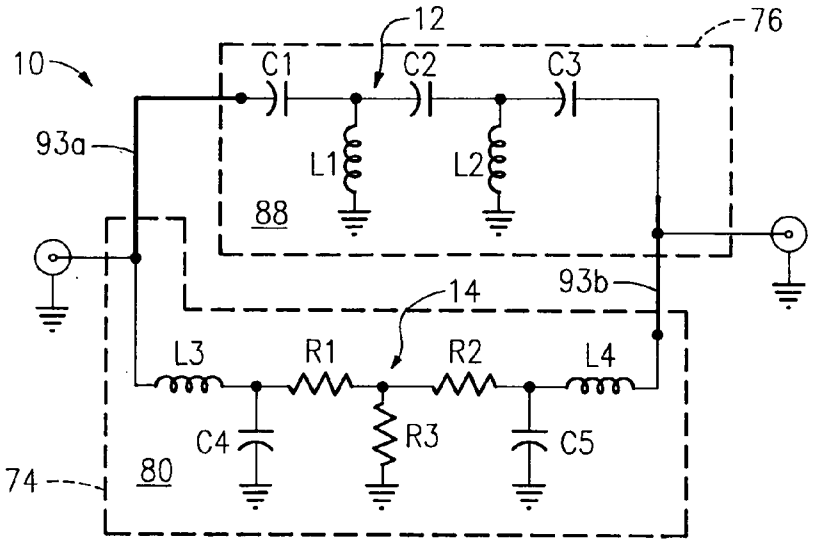


FIG.1

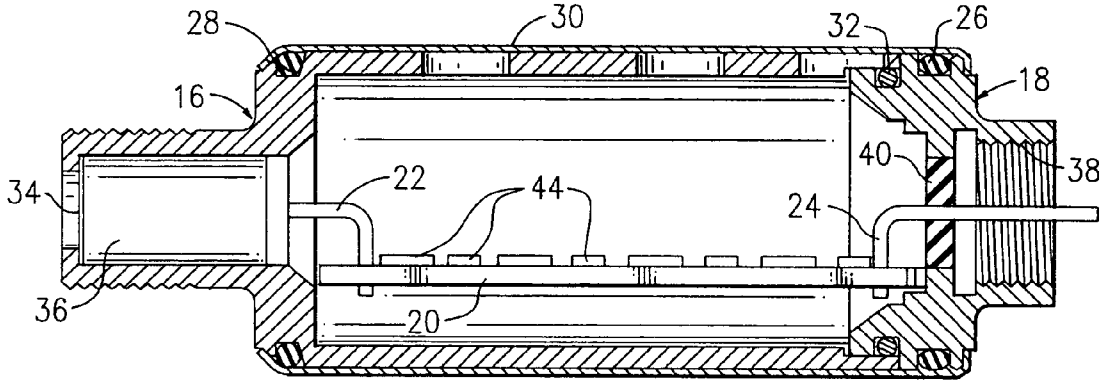


FIG.2
Prior Art

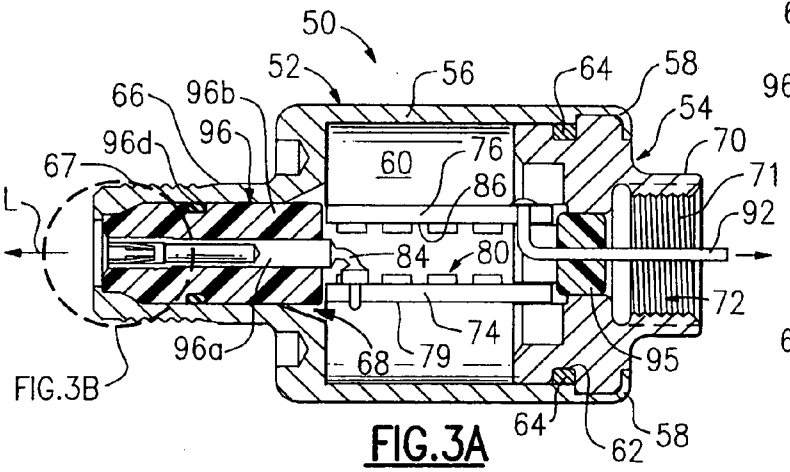


FIG.3A

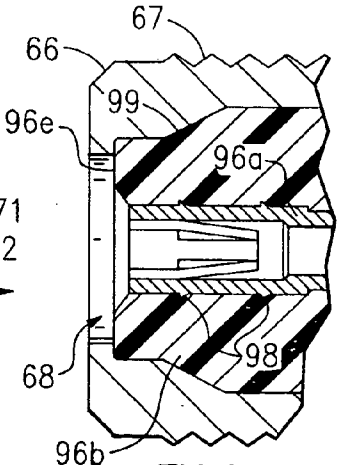
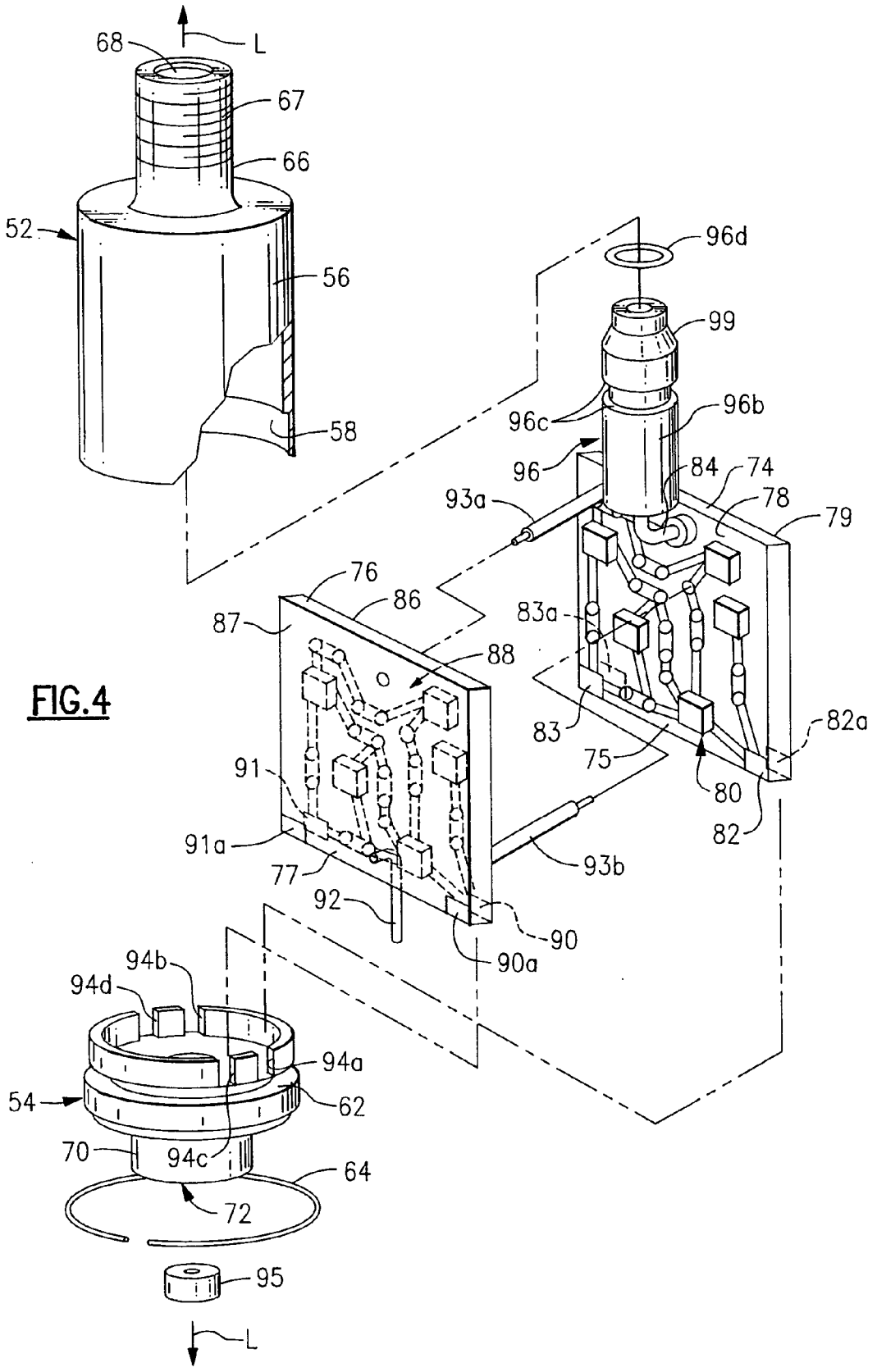


FIG.3B


68
L
67
66
52
56
58
96d
99
96c
96b
96
84
74
78
79
93a
76
86
87
88
83a
83
75
82a
80
82
91
91a
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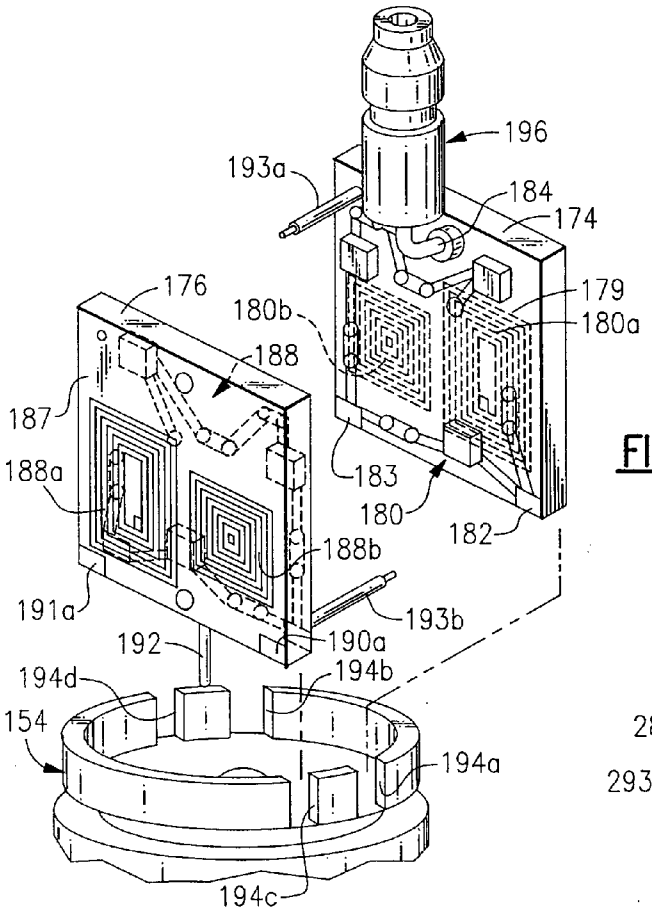
90a
93b
94b
94d
94a
54
62
70
94c
64
72
95
L

FIG.4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193a
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174
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180b
179
180a
188
187
183
188a
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188b
191a
193b
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190a
194b
194d
154
194a
194c

FIG.5

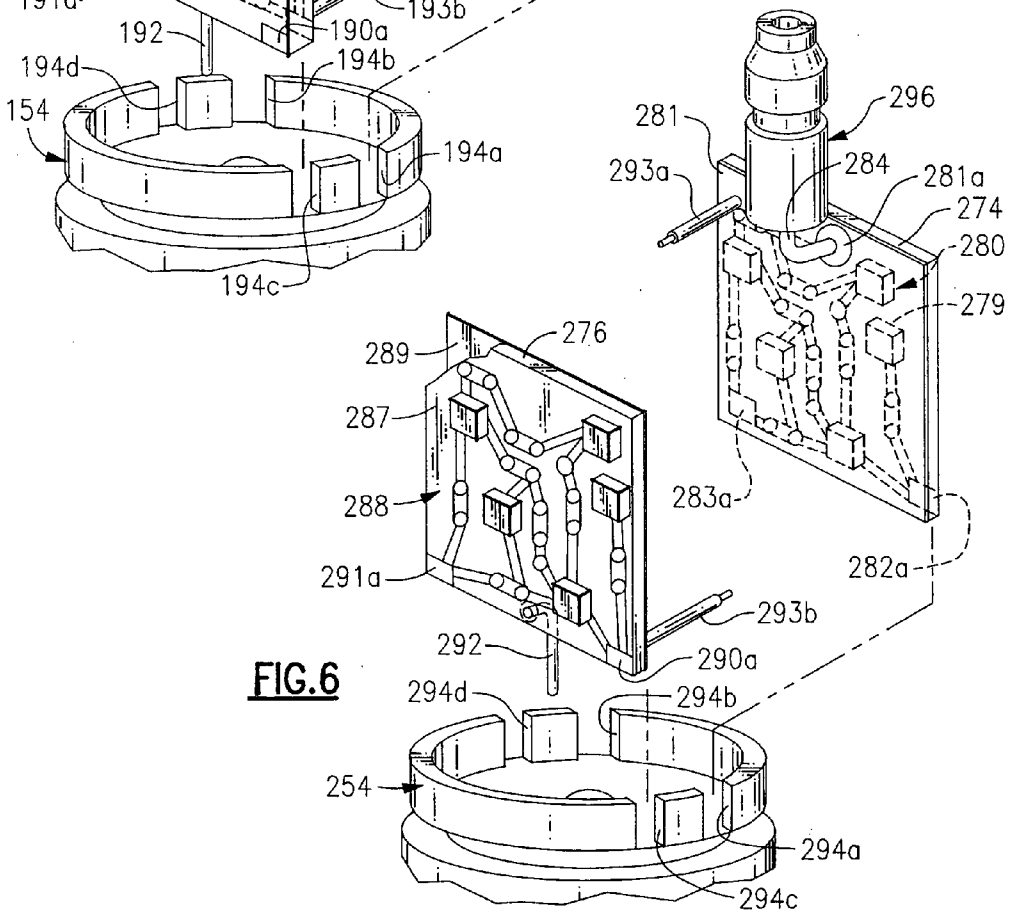
296
281
293a
284
281a
274
280
279
276
289
287
283a
288
282a
291a
293b
292
290a
294d
294b
254
294a
294c

FIG.6

ELECTRONIC FILTER ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. application Ser. No. 10/721,492, filed Nov. 25, 2003, which is a continuation of U.S. application Ser. No. 09/898,543, filed Jun. 29, 2001, now U.S. Pat. No. 6,674,343, which is a continuation of application Ser. No. 09/382,064, filed Aug. 24, 1999, now U.S. Pat. No. 6,323,743.

BACKGROUND OF THE INVENTION

[0002] 1. Technical Field

[0003] The present invention relates generally to electronic filters used in the cable television industry, and relates more particularly to the construction and assembly of such filters.

[0004] 2. Background Art

[0005] Typical electronic filter constructions in the cable television (CATV) industry involve a considerable number of parts, such as, for example, one or more circuit boards, connecting wires or leads, filter circuit components, isolation plates, blocks or chambers, input and output terminals, moisture barrier seals or plugs, connector housings, sub-housings or caps, o-rings, outer housing sleeves, and potting material. This elaborate array of parts constrains efforts to: minimize the size and weight of the filters; reduce material and labor costs associated with assembly of the filters; and simplify and automate the assembly process. Examples of such filter constructions are shown and described in: U.S. Pat. No. 5,278,525 to Palinkas; U.S. Pat. No. 4,901,043 to Palinkas; U.S. Pat. No. 4,701,726 to Holdsworth; U.S. Pat. No. 4,451,803 to Holdsworth et al; U.S. Pat. No. 3,579,156 to Parfitt; and U.S. Pat. No. 3,065,434 to Calderhead.

[0006] For such CATV filters as highpass and lowpass filters, diplex filters, windowed highpass filters, and step attenuator (or return path) filters, tunable filter circuits and shielding between filter components and circuits are not normally required. Thus, for these types of filters, an opportunity is presented to simplify filter components, construction and assembly. U.S. Pat. No. 5,745,838 to Tresness et a. discloses (FIGS. 8-10) a filter construction for a return path filter called a "step attenuator." This construction is also shown in **FIG. 2** herein, as representing the prior art construction for this type of filter. While simplification was achieved in U.S. Pat. No. 5,745,838, the construction still required two major o-rings around the male and female terminal caps and an outer housing sleeve (See **FIG. 2** herein); and, manual assembly of these parts was still required.

[0007] Many diplex, windowed highpass, and return path filters (See, e.g., embodiments shown in FIGS. 1-5 of U.S. Pat. No. 5,745,838), have dual (or "parallel") circuit paths. For example, **FIG. 1**, herein, shows a simplified step attenuator circuit **10** containing a forward (or highpass) path **12** and a return (or lowpass) path **14**. Cascaded or elongated circuit board arrangements such as shown in U.S. Pat. No. 5,770,983 to Zennamo, Jr. et al., U.S. Pat. No. 4,901,043 to Palinkas, U.S. Pat. No. 4,701,726 to Holdsworth, U.S. Pat. No. 4,451,803 to Holdsworth et al., U.S. Pat. No. 3,579,156 to Parfitt, and U.S. Pat. No. 3,065,434 to Calderhead, are not optimum platforms for such dual path filters. A more optimum platform would be to have two circuit boards disposed in a parallel arrangement.

[0008] U.S. Pat. No. 5,278,525 to Palinkas discloses parallel circuit boards for a CATV notch filter (or "trap"), rather than for a dual path filter. The construction includes a considerable number of extra parts, such as an isolation shield, circuit board housings, tuning screw housings, o-rings, and an outer housing sleeve.

[0009] In most CATV applications, the filters are installed outdoors. Thus, it is important that the filter construction be moisture resistant. Efforts to make filters moisture resistant have included enclosing the filter in an outer housing sleeve and employing o-rings between the filter and the outer housing sleeve. See, e.g., U.S. Pat. No. 5,745,838 to Tresness et al., U.S. Pat. No. 5,278,525 to Palinkas, U.S. Pat. No. 4,701,726 to Holdsworth, and U.S. Pat. No. 4,451,803 to Holdsworth et al. Such an approach requires the additional parts and expense of o-rings and outer housing sleeves, and may require manual assembly of such parts.

[0010] A prime path for moisture penetration into the filter is through the terminal fittings or connectors. While efforts to prevent moisture penetration through filter connectors (such as disclosed in U.S. Pat. No. 5,278,525 to Palinkas) have been satisfactory, there remains a need to improve moisture resistance through these connector paths.

[0011] Another consideration in CATV filter construction is to establish a good and reliable electrical ground between the filter circuit or circuits and the filter housing. Electrical ground has been established by soldering or fitting isolation shields or blocks between the circuit boards and the filter housing, or by soldering wires or leads between the circuit board and housing. See, for example, U.S. Pat. No. 4,701,726 to Holdsworth. However, such methods usually require additional components or manual assembly steps.

OBJECTS AND SUMMARY OF THE INVENTION

[0012] It is therefore an object of the present invention to provide an electronic filter construction that avoids the limits and problems associated with the prior art.

[0013] It is another object of the present invention to provide an electronic filter construction that is more suitable for automated assembly than previous filter constructions.

[0014] It is a further object of the present invention to provide an electronic filter construction that requires less parts than previous filter constructions.

[0015] It is still another object of the present invention to reduce material and labor costs associated with the assembly of an electronic filter;

[0016] It is still a further object of the present invention to reduce the size and weight of an electronic filter; and

[0017] It is still yet another object of the present invention to provide an electronic filter construction that has improved moisture resistance.

[0018] These and other objects are attained in accordance with the present invention wherein there is provided an electronic filter assembly of the type that includes a female terminal cap and a collet assembly. The female terminal cap

has a fitting portion and contains a terminal passage through the fitting portion. The collet assembly is secured in and substantially closes the terminal passage of the female terminal cap. The collet assembly comprises an insulator, a collet terminal, and a seal. The insulator is made from a single piece of insulator material and contains a bore therethrough. The collet terminal extends through the bore of the insulator. The seal is located inside the terminal passage of the female terminal cap, between the collet terminal and the female terminal cap.

[0019] In a more specific embodiment, an electronic filter comprises a conductive housing having input and output ends. The housing has a body portion and a female connector. The female connector is located at the input end of the housing and has a diameter less than that of the body portion. A circuit board is located within the body portion of the housing. A collet assembly is located within the female connector to receive electrical signals and conduct them to the circuit board. The collet assembly includes an insulator member, a conductor, and an elastomeric sealing member. The insulator member is located within the female connector. The insulator member contains a generally cylindrical opening through its length. The conductor extends through the opening of the insulator member. The conductor has an input end adjacent the input end of the housing and an output end adjacent the circuit board. The conductor has a hollow interior at its input end. The elastomeric sealing member surrounds the insulator member in compressed engagement with the insulator member and the surrounding female connector, to provide a moisture seal between the insulator member and the female connector.

BRIEF DESCRIPTION OF THE DRAWING

[0020] Further objects of the present invention will become apparent from the following description of the preferred embodiment with reference to the accompanying drawing, in which:

[0021] **FIG. 1** is a schematic diagram of a dual-path filter circuit;

[0022] **FIG. 2** is a longitudinal cross-sectional view of a filter constructed in accordance with the teachings of the prior art;

[0023] **FIG. 3A** is a longitudinal cross-sectional view of a filter constructed in accordance with the present invention;

[0024] **FIG. 3B** is an enlarged cross-sectional view of the circled area in **FIG. 3A**;

[0025] **FIG. 4** is an exploded view of the filter shown in **FIG. 3A**;

[0026] **FIG. 5** is an exploded view showing a modification to the filter of **FIG. 4**; and

[0027] **FIG. 6** is an exploded view showing another modification to the filter of **FIG. 4**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0028] The filter assembly of the present invention is especially suited for dual (or parallel) path filter circuits. As understood in the art, dual path circuits include at least two separate circuit paths. Examples of dual path filters are diplex, windowed highpass, and some step attenuator filters. Referring now to **FIG. 1**, there is shown a schematic of a dual path filter circuit **10**, having a highpass circuit path **12** and a lowpass circuit path **14**. Circuit **10** is a simplified version of a step attenuator circuit described in U.S. Pat. No. 5,745,838 to Tresness et al., incorporated herein by reference. The present invention is not limited to filter assemblies for any particular filter circuit. Circuit **10** is presented only as an example of a dual path circuit. An understanding of circuit **10** is not necessary for an understanding of the present invention.

[0029] **FIG. 2** shows a sectional view of a conventional filter construction. The construction includes a female terminal cap **16**, a male terminal cap **18**, an elongated circuit board **20**, a female terminal **22**, a male terminal **24**, o-rings **26** and **28**, and an outer housing sleeve **30**. Terminal caps **16** and **18** are soldered together by way of a solder ring **32**. Female terminal **22** is connected to a female connector assembly **34** which includes a sealing member **36**. Male terminal **24** extends through an internally threaded fitting **38** contained in cap **18**. Terminal **24** is tightly fitted through a sealing wafer **40** secured inside cap **18**. The filter shown in **FIG. 2** is of the type that does not require shielding or tunable filter components. As a result, low profile, surface mounted filter components **44** are used. It is apparent from **FIG. 2** that this conventional construction produces an enormous amount of wasted internal space, and the elongated shape of circuit board **20** constrains efforts to reduce the length of the filter.

[0030] The conventional filter construction of **FIG. 2** is contrasted markedly by the filter construction of the present invention, shown in **FIG. 3A**. **FIG. 3A** depicts the preferred embodiment of the present invention. It does not include the outer housing sleeve and accompanying o-rings. The elimination of these parts simplifies the assembly and allows the filter manufacturer to adopt a more automated assembly process.

[0031] The preferred construction will now be described in detail with reference to **FIGS. 3A, 3B** and **4**. A filter **50** includes a female terminal cap **52** and a male terminal cap **54**. Caps **52** and **54** are disposed along a longitudinal axis L, in opposing relation to each other. Caps **52** and **54** are made of any suitable conductive metal typically used in the filter industry. Cap **52** includes a cylindrical portion **56** having an extension or crimping sleeve **58**. Cylindrical portion **56** extends to cap **54**, and sleeve **58** is crimped around cap **54**, to form a filter housing with an interior volume **60** (**FIG. 3A**). Cap **54** contains an external circumferential groove **62** (**FIGS. 3A and 4**). Caps **52** and **54** are sealed together using a solder ring **64** received in groove **62**. A circumferential solder joint is established with ring **64**, by way of induction soldering. The solder joint also establishes a good electrical ground connection between caps **52** and **54**. Induction soldering is preferred because it can be implemented as an automated assembly step. As a result of the above-described crimping and soldering, a secure physical and electrical connection is established between caps **52** and **54**.

[0032] Female terminal cap **52** includes a fitting portion **66** containing external threads **67** and a terminal passage **68**. Male terminal cap **54** includes a fitting portion **70** containing internal threads **71** and a terminal passage **72**. Passages **68** and **72** each establish a passageway between interior volume **60** and the exterior of filter **50**.

[0033] As shown in **FIG. 3A**, a pair of filter circuit boards **74, 76** are enclosed in interior volume **60**. Circuit boards **74, 76** are arranged substantially parallel to each other and to longitudinal axis L. In this disclosure and in the claims, the term "parallel" is not intended to mean precisely parallel. The term includes orientations that may produce acute angles between the circuit boards.

[0034] As best shown in **FIG. 4**, circuit board **74** includes—(i) front and rear surfaces **78, 79**, (ii) a filter circuit **80** located on front surface **78**, (iii) a pair of ground contacts **82, 83** electrically connected to circuit **80**, and (iv) a terminal **84** electrically coupled to circuit **80**. Circuit board **76** includes—(i) front and rear surfaces **86, 87**, (ii) a filter circuit **88** located on front surface **86**, (iii) a pair of ground contacts **90, 91** electrically connected to circuit **88**, and (iv) a terminal **92** electrically coupled to circuit **88**. It is preferred that another, corresponding pair of ground contacts be located on the rear surfaces of boards **74, 76**, respectively (see corresponding contacts **82***a*, **83***a* and **90***a*, **91***a* in **FIG. 4**). These corresponding pairs of contacts are likewise electrically connected to their respective filter circuits (**80, 88**). Circuit **80** is connected to circuit **88** by way of jumper wires **93***a*, **93***b* (**FIG. 4**), to form a complete filter circuit (such as shown in **FIG. 1**). Circuits **80, 88** are preferably implemented with all surface mounted filter components, including fixed-tuned chip (ceramic medium) inductors and/or ferrite core inductors.

[0035] Dual filter circuit **10** (**FIG. 1**) can be neatly arranged on circuit boards **74, 76**, as indicated by the broken lines in **FIG. 1**. As represented in **FIG. 1**, circuit board **74** contains circuit path **14** which is embodied in circuit **80**, and circuit board **76** contains circuit path **12** which is embodied in circuit **88**. These paths are joined together by jumper wires **93***a*, **93***b* (**FIG. 1**). It is to be noted that the present invention is not limited to dual path circuits or to the separation of dual circuit paths on respective circuit boards. Any operable arrangement may be employed. When we refer to a "filter circuit" or "circuit" on a circuit board, in this disclosure and in the claims, it is intended to mean any arrangement of a circuit component or circuit components, whether or not constituting a complete or identifiable filter circuit. The example presented in this disclosure is merely to illustrate the suitability of the parallel circuit board arrangement to a dual path circuit.

[0036] Circuit boards **74, 76** are mounted directly to male terminal cap **54**. As best shown in **FIG. 4**, circuit boards **74, 76** have mating ends **75, 77**, respectively, and the ground contacts are located at the mating ends. Terminal cap **54** contains two pairs of opposed notches **94***a*, **94***b* and **94***c*, **94***d*. For the purpose of this disclosure and the claims, the term "groove" shall include its normally intended meanings and, in addition, it shall include notch pairs, such as notch pairs **94***a*, **94***b* and **94***c*, **94***d*. Thus, e.g., notch pair **94***a*, **94***b* may be properly referred to herein as groove **94***a*, **94***b*. Grooves **94***a*, **94***b* and **94***c*, **94***d* are configured to receive, in a tight press fit, the mating ends of circuit boards **74, 76**, respectively. This tight press fit secures the circuit boards in position.

[0037] Circuits **80, 88** are electrically coupled to terminal cap **54** via the ground contacts, and thus establish a common electrical ground for circuits **80, 88**. Ground contacts **82, 82***a* and **83, 83***a* are in registration and direct contact with notches **94***a* and **94***b*, respectively, and ground contacts **90, 90***a* and **91, 91***a* are in registration and direct contact with notches **94***c* and **94***d*, respectively. Each of the ground contacts is coated with solder when circuit boards **74, 76** are produced. The solder coating ensures a tight fit between the contacts and the notches.

[0038] In fact, during assembly, the some of the solder is sheared off during insertion of boards **74, 76** into notches process **94***a*, **94***b* and **94***c*, **94***d*. The ground contacts are soldered to the notches by induction soldering (another automated assembly step). This arrangement establishes a good ground connection between the circuit boards and cap **54**.

[0039] Terminal **92** is a male connector terminal which extends through and is operatively supported inside terminal passage **72**. A potting wafer **95**, made of low density polyethylene, is inserted into and substantially closes off terminal passage **72**. Wafer **95** contains an open bore through which terminal **92** tightly fits. Once installed, wafer **95** seals passage **72**, substantially preventing moisture from entering filter **50** through passage **72**.

[0040] Terminal **84** includes a female terminal assembly **96** which extends through and is operatively supported inside terminal passage **68**. Terminal assembly **96** includes a female connector element or collet terminal **96***a*, a polypropylene insulator **96***b* containing an external o-ring groove **96***c* (**FIG. 4**), and an o-ring **96***d* seated in groove **96***c*. Assembly **96** is inserted into and substantially closes off terminal passage **68**. Insulator **96***b* and o-ring **96***d*, together, seal passage **68**, substantially preventing moisture from entering the filter between passage **68** and insulator **96***b*. Insulator **96***b* contains an open bore through which collet terminal **96***a* tightly fits.

[0041] As shown in **FIG. 3B**, collet terminal **96***a* has a pair circumferential (360°), protruding barbs or ribs **98**. Collet **96***a* is press fitted through the bore of insulator **96***b*, causing barbs **98** to penetrate and anchor into insulator **96***b* (**FIG. 3B**). "Penetration" of barbs **98** may or may not include breaking into the insulator material—typically, the barbs will penetrate the insulator by deforming the insulator material. The barbs, and their penetration into the insulator, help prevent moisture from entering filter **50**, between the bore of insulator **96***b* and collet **96***a*.

[0042] As shown in **FIGS. 3B and 4**, insulator **96***b* has a cone-shaped nose **99**, which allows o-ring **96***d* to be easily slipped over the insulator and seated in groove **96***c*. This cone-shape allows o-ring **96***d* to be installed on the insulator by an automated assembly step. In some filter constructions, it may be preferable to have collet **96***a* extend through the insulator to the point where it is flush with an insulator face **96***e* (See **FIG. 3B**). The construction, as above-described, may eliminate the need for potting material inside the filter, in most applications.

[0043] Referring now to **FIG. 5**, there is shown a modification to the embodiment of **FIG. 4**. Like parts are indicated by like reference numbers. The modification concerns the placement of printed circuit inductors on the rear surface of each circuit board. As shown in **FIG. 5**, circuits **180, 188** each include a pair of printed inductors **180***a*, **180***b* and **188***a*, **188***b*, respectively, etched on respective rear surfaces **179** and **187**. Inductors **180***a*, **180***b* and **188***a*, **188***b* may

serve, for example, as inductors L3, L4 and L1, L2, respectively, in the circuit shown in **FIG. 1**. In this embodiment, the capacitors of circuits **180**, **188** would remain on the front surfaces of circuit boards **174**, **176**. The embodiment of **FIG. 5** is otherwise the same as the embodiment of **FIGS. 3A, 3B** and **4**.

[**0044**] Referring now to **FIG. 6**, there is shown another modification of the embodiment of **FIG. 4**. Like parts are indicated by like reference numbers. In some applications, it may be desirable to have a certain degree of electromagnetic shielding between circuit boards. This can be achieved by locating the filter circuits on the rear surfaces of the circuit boards and locating ground planes on the front surfaces of the boards. As shown in **FIG. 6**, circuits **280**, **288** are located on rear surfaces **279**, **287**, respectively, and ground planes **281**, **289** are located on the front surfaces of boards **274**, **276**, respectively. The ground planes provide shielding between circuits **280**, **288**. Ground planes **281**, **289** are grounded by their direct physical contact with notches **294***a*, **294***b* and **294***c*, **294***d*, respectively, when boards **274**, **276** are seated in the notches. Thus, separate ground contacts are not necessary on the front surfaces of the boards. As shown in **FIG. 6**, ground contacts **282***a*, **283***a* and **290***a*, **291***a* are located on the rear surfaces of boards **274** and **276**, respectively.

[**0045**] A circular opening **281***a* is contained in ground plane **281** to allow terminal **284** to be connected to board **274** without shorting to ground. A similar opening is provided in ground plane **289** for terminal **292**. Openings are also contained in the ground planes to accommodate jumper wires **293***a*, **293***b*. The embodiment of **FIG. 6** is otherwise the same as the embodiment of **FIGS. 3A, 3B** and **4**.

[**0046**] While the preferred embodiment of the invention has been particularly described in the specification and illustrated in the drawing, it should be understood that the invention is not so limited. Many modifications, equivalents, and adaptations of the invention will become apparent to those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. An electronic filter assembly of the type that includes a female terminal cap having a fitting portion and containing a terminal passage through the fitting portion, and a collet assembly secured in and substantially closing the terminal passage of said female terminal cap, wherein said collet assembly comprises:

an insulator, made from a single piece of insulator material, containing a bore therethrough;

a collet terminal extending through the bore of the insulator; and

a seal located inside the terminal passage of said female terminal cap, between the collet terminal and said female terminal cap.

2. The electronic filter assembly of claim 1, wherein the collet terminal has at least one barb which penetrates the insulator material of the insulator, to help prevent moisture from entering said filter housing between the bore of the insulator and the collet terminal.

3. The electronic filter assembly of claim 1, wherein the insulator of said collet assembly has a substantially cone-shaped nose portion.

4. An electronic filter assembly of the type that includes a female terminal cap having a fitting portion and containing a terminal passage through the fitting portion, and a collet assembly secured in and substantially closing the terminal passage of said female terminal cap, wherein said collet assembly comprises:

an elongated insulator, made from a single piece of insulator material, containing a hole therethrough;

a collet terminal extending substantially through the hole of the insulator, the collet terminal having a female end surrounded by the insulator and tightly fitted in the hole of the insulator, such that the female end is insulated from the fitting portion of said female terminal cap; and

a seal located inside the terminal passage of said female terminal cap, between the collet terminal and said female terminal cap.

5. An electronic filter assembly of the type that includes a female terminal cap having a fitting portion and containing a terminal passage through the fitting portion, and a collet assembly secured in and substantially closing the terminal passage of said female terminal cap, wherein said collet assembly comprises:

an insulator, made from a single piece of insulator material, containing an axially directed hole therethrough;

a collet terminal extending substantially through the hole of the insulator, the collet terminal having a female end surrounded by the insulator and tightly fitted in the hole of the insulator, such that the female end is insulated from the fitting portion of said female terminal cap; and

a seal located inside the terminal passage of said female terminal cap, between the collet terminal and said female terminal cap.

6. An electronic filter assembly of the type that includes a female terminal cap having a fitting portion and containing a terminal passage through the fitting portion, a collet assembly secured in and substantially closing the terminal passage of said female terminal cap, and a circuit board, wherein said collet assembly comprises:

an insulator, made from a single piece of insulator material, containing a hole therethrough;

a collet terminal extending substantially through the hole of the insulator, the collet terminal having a female end and a coupling end, the female end being surrounded by the insulator and tightly fitted in the hole of the insulator, such that the female end is insulated from the fitting portion of said female terminal cap, the coupling end being coupled to said circuit board; and

a seal located inside the terminal passage of said female terminal cap, between the collet terminal and said female terminal cap.

7. An electronic filter as recited in claim 6, wherein said coupling end has a neck-shaped portion.

8. An electronic filter assembly of the type that includes a female terminal cap having a fitting portion and containing a terminal passage through the fitting portion, and a collet assembly secured in and substantially closing the terminal passage of said female terminal cap, wherein said collet assembly comprises:

an insulator, made from a single piece of insulator material, containing a hole therethrough;

a collet terminal extending substantially through the hole of the insulator, the collet terminal having a female end surrounded by the insulator and tightly fitted in the hole of the insulator, such that the female end is insulated from the fitting portion of said female terminal cap, the collet terminal having at least one barb which penetrates the insulator material of the insulator; and

a seal located inside the terminal passage of said female terminal cap, between the collet terminal and said female terminal cap.

9. An electronic filter assembly of the type that includes a female terminal cap having a fitting portion and containing a terminal passage through the fitting portion, a collet assembly secured in and substantially closing the terminal passage of said female terminal cap, and a circuit board, wherein said collet assembly comprises:

an insulator, made from a single piece of insulator material, containing an axially-directed hole therethrough;

a collet terminal extending substantially through the hole of said insulator, said collet terminal having a female end surrounded by said insulator and a coupling end coupled to said circuit board,

said collet terminal further having a barb engaging the insulator material of said insulator inside the hole of said insulator, the barb having an inclined side; and

a seal located inside the terminal passage of said female terminal cap, between said collet terminal and said female terminal cap.

10. An electronic filter as recited in claim 8, further comprising a circuit board, said collet terminal further comprising a coupling end which is coupled to said circuit board.

11. An electronic filter assembly of the type that includes a female terminal cap having a fitting portion and containing a terminal passage through the fitting portion, and a collet assembly secured in and substantially closing the terminal passage of said female terminal cap, wherein said collet assembly comprises:

an insulator, made from a single piece of insulator material, containing a hole therethrough, the insulator having a substantially cone-shaped nose portion,

a collet terminal extending substantially through the hole of the insulator, the collet terminal having a female end and a coupling end, the female end being surrounded by the insulator and tightly fitted in the hole of the insulator, such that the female end is insulated from the fitting portion of said female terminal cap, the coupling end being integrally formed with said female end and electrically connected with a circuit board; and

a seal located inside the terminal passage of said female terminal cap, between the collet terminal and said female terminal cap.

12. An electronic filter assembly of the type that includes a female terminal cap having a fitting portion and containing a terminal passage through the fitting portion, and a collet assembly secured in and substantially closing the terminal passage of said female terminal cap, wherein said collet assembly comprises:

an insulator, made from a single piece of insulator material, containing a hole therethrough, the insulator having distal and proximal ends, said hole axially extending through the insulator and opening at the distal and proximal ends, the female end of said collet terminal opening at the distal end;

a collet terminal extending substantially through the hole of the insulator, the collet terminal having a female end surrounded by the insulator and tightly fitted in the hole of the insulator, such that the female end is insulated from the fitting portion of said female terminal cap; and

a seal located inside the terminal passage of said female terminal cap, between the collet terminal and said female terminal cap.

13. An electronic filter comprising:

a conductive housing having input and output ends, said housing having a body portion and a female connector, the female connector being located at the input end of said housing and having a diameter less than that of the body portion;

a circuit board within the body portion of said housing; and

a collet assembly within the female connector to receive electrical signals and conduct them to the circuit board, the collet assembly including

an insulator member within the female connector, the insulator member containing a generally cylindrical opening through its length,

a conductor extending through the opening of the insulator member, the conductor having an input end adjacent the input end of said housing and an output end adjacent the circuit board, the conductor having a hollow interior at its input end, and

an elastomeric sealing member surrounding the insulator member in compressed engagement with the insulator member and the surrounding female connector, to provide a moisture seal between the insulator member and the female connector.

14. The electronic filter of claim 13, wherein the input end of the conductor is surrounded by the insulator member and is tightly fitted in the opening of the insulator member.

15. The electronic filter as recited in claim 13, wherein said female connector is cylindrical.

16. An electronic filter comprising:

a conductive housing having input and output ends, said housing having a cylindrical body portion and a cylindrical female connector at the input end of said housing;

at least one printed circuit board within the body portion of said housing; and

a collet assembly within the female connector to receive electrical signals and conduct them to said printed circuit board, the collet assembly including

an insulator member, the insulator member containing a generally cylindrical bore through its length,

a conductor extending through the bore of the insulator member, the conductor having an input end adjacent the input end of said housing and an output end

adjacent said printed circuit board, the conductor having a hollow interior at its input end, and

an elastomeric sealing member surrounding the insulator member in compressed engagement with the insulator member and the surrounding female connector, to provide a moisture seal between the insulating member and the female connector.

17. The electronic filter of claim 16, wherein the insulator member has a reduced diameter over a portion of its length, and the elastomeric sealing member surrounds the reduced diameter portion.

18. The electronic filter of claim 16, wherein the conductor is a unitary member which extends beyond the length of the insulator member and is connected to the printed circuit board.

19. The electronic filter of claim 18, wherein the conductor has a reduced diameter portion beyond the length of the insulator member.

20. An electronic filter comprising:

a conductive housing having input and output ends, said housing having a cylindrical body portion and a threaded female connector at the input end of said housing, a printed circuit board within the body portion of said housing; and

a collet assembly within the female connector to receive electrical signals and conduct them to said printed circuit board, the collet assembly including

only a single substantially cylindrical insulator member that extends through at least a portion of the female connector in close proximity to an interior surface of the female connector, the insulator member containing a generally cylindrical bore through its length,

a conductor extending through the cylindrical bore of the insulator member, the conductor having an input end adjacent the input end of said housing and an output end connected to said printed circuit board, the conductor having a hollow interior at its input end, and

an elastomeric sealing member in compressed engagement with the interior surface of the surrounding female connector to provide a moisture seal against the interior surface thereof,

the insulator member surrounding at least the input end of the conductor.

21. An electronic filter comprising:

a conductive housing having input and output ends, said housing having a cylindrical body portion and a cylindrical threaded female connector, said connector being located at the input end of said housing; and

a printed circuit board within the housing, the threaded female connector enclosing a cylindrical space that contains only a single cylindrical insulator member, an elastomeric sealing member, and an elongated conductor member, the cylindrical insulator member containing a generally cylindrical bore through its length, the elongated conductor extending through the bore of the insulator member, the conductor having an input end adjacent the input end of said housing and an output end adjacent said printed circuit board, the conductor having a hollow interior at its input end, the input end being surrounded by and tightly fitted in the insulator member, the elastomeric sealing member being in compressed engagement with the surrounding female connector to provide a moisture seal against the surrounding female connector.

22. An electronic filter comprising:

a conductive housing having input and output ends, said housing having a body portion and a cylindrical female connector, said female connector being located at the input end of said housing and having a diameter that is less than the diameter of the body portion,

a printed circuit board within the body portion; and

a collet assembly within the female connector to receive electrical signals and conduct them to said printed circuit board, said collet assembly including

a single insulator member within the female connector,

a conductor extending through the insulator member, the conductor having an input end and an output end, the input end being adjacent the input end of said housing, the conductor having a hollow interior at its input end, the input end of the conductor being surrounded by and in close contact with the insulator member, and

an elastomeric sealing member surrounding the insulator member in compressed engagement with the insulator member and the surrounding female connector to provide a moisture seal between the insulator member and the female connector.

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