

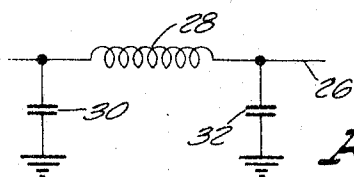
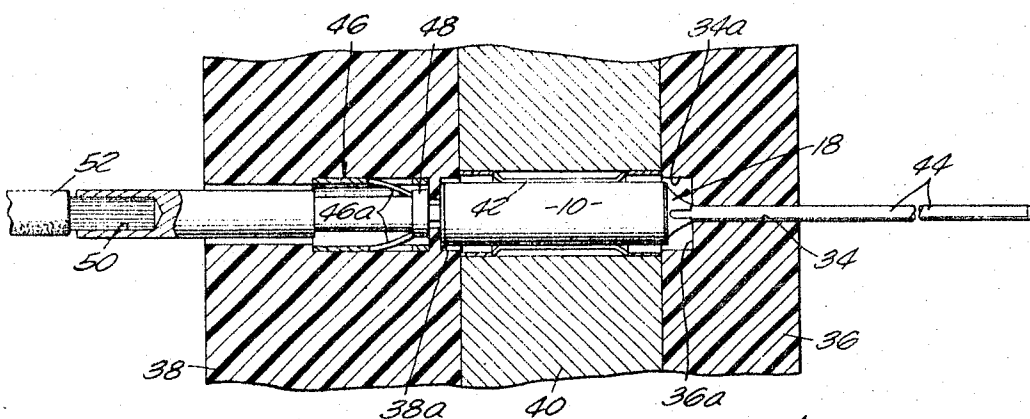
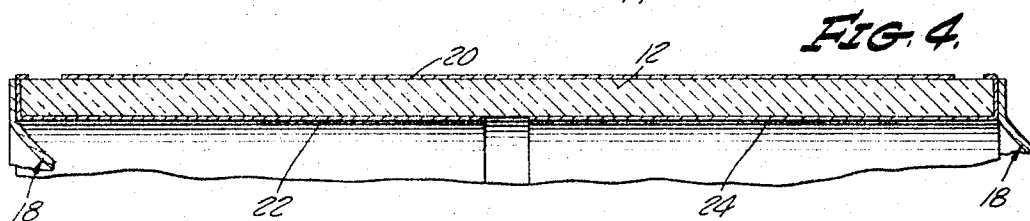
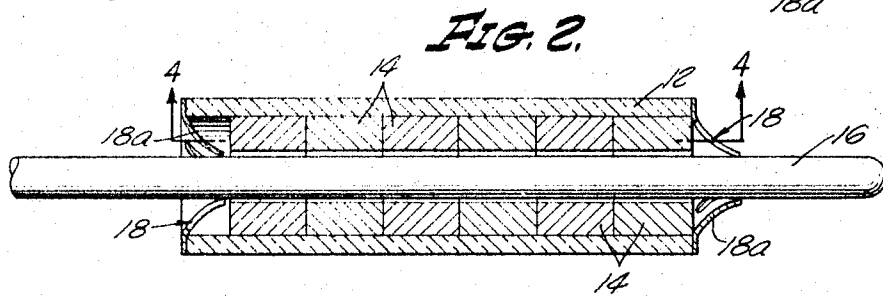
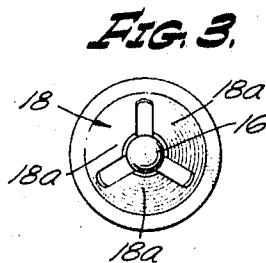
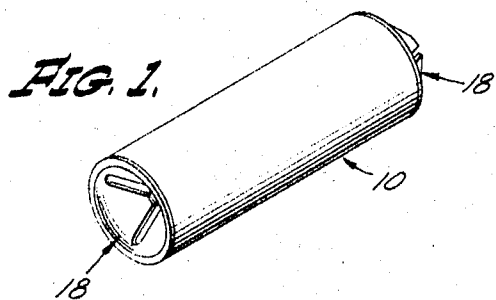
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REMOVABLE ELECTRICAL CONNECTOR FILTER ASSEMBLY

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REMOVABLE ELECTRICAL CONNECTOR FILTER ASSEMBLY

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6 Claims

ABSTRACT OF THE DISCLOSURE

A filter assembly comprises capacitor means including a tube made of dielectric material and an electrically conductive coating on the exterior of the tube. Preferably, one or more electrically conductive coatings are formed in the interior of the tube in spaced relation to each other. Inductor means are positioned within the tube having a central aperture for receiving a connector terminal. The inductor means are confined within the tube by conductive means closing the ends of the tube and having flexible fingers defining a central opening slightly smaller than the aperture in the inductor means. Hence, the fingers are adapted to receive and frictionally grip the terminal. The end closing means are spaced from the outer coating on the tube and connected to the inner coatings. Such a simple and unique construction can be easily slipped onto and removed from a terminal pin and the unit is very easy to assemble.

The present invention relates to electrical connectors wherein one or more contact terminals are mounted in one connector member and complementary contact terminals are mounted in another connector member, the contact terminals mating to provide one or more electrical circuits upon interengagement of the two connector members. The invention relates more particularly to such an electrical connector wherein one or more RF filter assemblies comprising a capacitor and an inductor, are electrically coupled with contact terminals of one of the connector members so as to attenuate or ground out unwanted RF signals which might otherwise pass through the connector.

In many circuits it is necessary or desirable to include an RF filter which may include one or more capacitors, and which preferably also includes at least one inductor, and it is frequently particularly desirable to embody such RF filter components in an electrical connector so that the circuit is not interrupted by the filter at any point. The embodying of RF filter components in one or more electrical connectors eliminates the necessity for a large amount of expensive shielding which would otherwise be required in certain applications.

While the prior art RF filters have usually performed satisfactorily from a functional standpoint, they have in general been somewhat expensive to assemble and mount on the connector terminal. Also, many filter constructions have been permanently mounted to a terminal and hence; if either the terminal or the filter requires replacement the entire combination is discarded. Moreover, permanent connections require the stocking of a great number of components in that a given terminal might be useable with or without a filter and a given filter might be useable on several terminals of varying length having the same diameter. Permanent connections also introduce additional problems during the operation of joining a lead wire to the filter terminal.

In view of these and other problems in the art, it is a primary object of this invention to provide an improved low cost RF filter assembly for use with an electric con-

ductor for preventing interfering signals from entering or leaving equipment to which the connector is attached.

It is a further object of this invention to provide such a filter assembly which is simply and removably attached to a connector terminal.

It is another object of the invention to provide such a filter assembly which can be secured within a connector body to receive a connector terminal and hence minimize the problems associated with joining such terminal to a connector lead wire.

In accordance with one aspect of this invention, the filter assembly comprises capacitor means including a tube made of dielectric material and an electrically conductive coating on the exterior of the tube. Preferably, one or more electrically conductive coatings are formed in the interior of the tube in spaced relation to each other. Inductor means are positioned within the tube having a central aperture for receiving a connector terminal. The inductor means are confined within the tube by conductive means closing the ends of the tube and having flexible fingers defining a central opening slightly smaller than the aperture in the inductor means. Hence, the fingers are adapted to receive and frictionally grip the terminal. The end closing means are spaced from the outer coating on the tube and connected to the inner coatings. Such a simple and unique construction can be easily slipped onto and removed from a terminal pin and the unit is very easy to assemble.

Further features, objects and attendant advantages will become apparent with reference to the following specification and drawing in which:

FIG. 1 is a perspective view of a filter assembly constructed in accordance with the teachings of this invention;

FIG. 2 is an elevational sectionalized view of the assembly of FIG. 1 when mounted on a terminal;

FIG. 3 is an end view of the unit of FIG. 1;

FIG. 4 is a sectionalized view on line 4—4 of FIG. 2;

FIG. 5 is a showing of the filter assembly when mounted in a connector; and

FIG. 6 is a schematic diagram of the filter circuitry.

Referring now to FIGS. 1—3, there is shown a filter assembly 10 comprising a thin-walled tube 12 made of high dielectric material such as ceramic. A plurality of annular cores 14 made of ferromagnetic material are positioned within the tube 12. Each core is formed with an aperture for receiving a terminal 16 which forms a component of an electrical connector.

In accordance with the invention, the ends of the tube are closed by a pair of eyelets 18 which uniquely serve several different functions.

First, the eyelets provide a simple means for confining the cores 14 within the tube 12. Secondly, each eyelet is formed with inwardly extending flexible fingers 18a which frictionally engage terminal 16 to provide good electrical connection between the terminal and the eyelets and to retain the filter assembly on the terminal. Note that the eyelets are axially tapered to provide the necessary flexibility for the fingers 18a. The eyelets may face in either direction, but are preferably arranged as illustrated to facilitate assembly of the filter onto the terminal.

As seen in FIG. 4, an electrically conductive coating 20 is formed on the outer surface of tube 12 to form one plate of a capacitor. This coating is adapted to engage a suitable ground connection when the assembly is installed within a connector body. On the inner surface of tube 12 there is formed a pair of axially spaced conductive coatings 22 and 24, which form capacitive plates in cooperation with coating 20. The outer ends of coatings 22 and 24 are electrically connected to eyelets 18 and hence extend onto the ends of the tube 12 and slightly onto the outer surface adjacent the ends. The eyelets are prefer-

ably soldered to the coated ends of tube 12 to insure good mechanical and electrical connection.

The RF filter assembly 10 provides a circuit arrangement like that illustrated diagrammatically in FIG. 6, which is a so-called pi-section filter. In the diagram, conductor 26 represents terminal 16 and inductor 28 has the electrical effect of inductor cores 14 mounted on terminal 16. The capacitors 30 and 32 are formed by inner conductive coatings 22 and 24 separated from outer coating 20 by dielectric tube 12. Eyelets 18 form the electrical connections between the terminal 16 and the capacitors while the outer coating 20 is connected to ground in operation.

While the construction of the invention illustrated includes a pair of capacitors, it should be understood that more or less may be employed. Also, to obtain the desired filtering action the capacitance across each capacitor 30 and 32 can, of course, be varied by varying the type of dielectric material employed, width of the dielectric gap and the area of the conductive coatings. It should also be noted, that theoretically, some capacitance can be attained between the outer coating 20 and terminal 16 if proper design parameters are employed; however, this would be rather insignificant in most designs.

Similarly, with respect to inductance, it should be understood that the amount of inductance obtained may be varied by varying the composition of the ferromagnetic material employed in the cores 14, and by varying the size and configuration of the cores.

From the foregoing, it can be seen that the filter construction disclosed is very simple and easy to assemble as a unit and to assemble and remove from a terminal. Also, the construction is quite versatile in that it can be easily manufactured in the size desired.

While the filter assembly may be conveniently slipped onto a terminal and then the combined terminal and filter installed in a connector body, the filter assembly also lends itself to being permanently installed in a connector body to permit the terminals to be removably inserted therein. Such an arrangement is shown in FIG. 5 wherein a filter assembly 10 is illustrated in an enlarged portion 34a of a bore 34 extending through a connector body formed of a front insulator 36, a rear insulator 38 and a ground plane 40. The outer conductive coating on filter assembly 10 is electrically connected to ground plane 40 by a grounding spring 42. As can be seen, the filter assembly 10 is confined in the connector body by the inner shoulders 38a and 36a.

A connector terminal 44 is conveniently inserted into filter assembly 10 as guided by the eyelets 18 and retained in the connector body by suitable means such as a retaining clip 46 having inwardly extending fingers 46a which engage the rear face of shoulder 48 formed on terminal 44. The terminal may be removed by inserting a suitable tool (not shown) around the terminal to depress the fingers 46a. The rear of the terminal 44 is formed with a socket 50 for connection to a conductor wire 52.

One of the advantages of the construction shown in FIG. 5 is that the slip-on type filter permits the terminal 44 to be removed from the insulator body to permit the conductor wire 52 to be secured conveniently to terminal 44. This is a great advantage when it is realized that the terminals and the filters are miniature components and a large number of such components are commonly employed in a single connector. For example, in one type of connector, more than 50 filter contact terminals are concentrated in a circle less than one inch in diameter. The task of soldering lead wires to contacts so close together requires extreme care and is frequently tedious and slow. Excess solder on a terminal can lead to short circuits or incipient shorts which can be very troublesome.

A preferred method of attaching a lead wire to a terminal is to use a crimping process wherein the wire 52 is inserted into socket or crimp cavity 50 and a crimping tool is used to squeeze the socket walls around the wire

to provide good electrical and mechanical connection. When the contacts are as close together as in the above described example, it is impossible to use a crimp tool since there is insufficient space to allow entry of the clamping jaws. With non-filter type connectors, it is common practice to remove a terminal from its connector body and attach a wire in this fashion. However, while this method is possible with filter type terminals having the filters permanently secured thereto, there are numerous disadvantages to this approach.

For example, the terminal retaining mechanism in the connector must accommodate passage of the filter assembly as well as the terminal. Rubbing the retaining elements, such as fingers 46a in FIG. 5, over the ceramic gap on the outer surface of the filter tube increases the leakage resistance between the terminal and the ground plane. Further, the additional handling of filter terminals causes increased likelihood of damage to the delicate filter element, such as the thin-walled ceramic tube. Moreover, if a crimped terminal is damaged, it is only necessary to replace the terminal and not the entire filter and terminal assembly.

The improved slip-on filter of the invention permits the crimping operation and obviates the foregoing enumerated disadvantages as well as providing further advantages such as lower cost, better reliability and requiring less skill and care in handling.

While a particular embodiment of the invention has been described, it should be understood that various modifications will now be apparent, and it is intended that all such modifications that fall within the true spirit and scope of the invention be included in the appended claims.

What is claimed is:

1. An electrical filter assembly comprising:

capacitor means including a tube made of dielectric material and an electrically conductive coating on the outer surface of said tube adapted to be connected to a suitable ground;

an electrically conductive terminal;

inductor means positioned within said tube having a central aperture receiving said electrically conductive terminal therein; and

means made of electrically conductive material closing the ends of said tube retaining said inductor means within the tube and having flexible means defining a central opening slightly smaller than said aperture receiving and frictionally gripping said terminal, said filter being removably attached to said terminal, said end closing means being spaced from said electrically conductive coating.

2. The invention of claim 1 in which said end closing means comprises a pair of eyelets each secured to a respective end of the tube and having a plurality of flexible fingers which extend toward said electrically conductive terminal.

3. The invention of claim 1 in which said capacitor means includes a pair of electrically conductive coatings formed on the inner surface of said tube, said inner coatings being axially spaced from each other and each being electrically connected to said end closing means.

4. The invention of claim 1 wherein said inductor means includes a plurality of annular cores made of ferromagnetic material.

5. An electrical connector and filter assembly comprising:

a connector insulator body having a bore therethrough;

a tubular filter assembly secured within said bore;

a connector terminal extending into said bore and through said filter assembly;

means mounted in said body for releasably securing said terminal in said body; and

said filter assembly including capacitor means connected to a ground within said body, inductor means, and means made of electrically conductive material defining an aperture receiving and frictionally gripping

5

said terminal, said filter assembly being removably attached to said terminal.

6. The invention of claim 5 wherein said capacitor means includes:

a tube made of dielectric material, an electrically conductive coating on the outer surface of said tube; 5
said inductor means comprises a plurality of ferromagnetic core positioned within said tube to surround said terminal; and

said means gripping said terminal includes a pair of eyelets each secured to an end of said tube and each 10
having flexible fingers extending toward said terminal for engaging said terminal.

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