

United States Patent

[11] 3,588,758

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| [21] | Appl. No. | 819,692 |
| [22] | Filed | Apr. 28, 1969 |
| [45] | Patented | June 28, 1971 |
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- [54] ELECTRICAL CONNECTOR FILTER HAVING
DIELECTRIC AND FERROMAGNETIC TUBES
BONDED TOGETHER WITH CONDUCTIVE
ELECTRODE LAYERS AND HAVING
NONINTEGRAL CONNECTING SPRING
1 Claim, 4 Drawing Figs.**

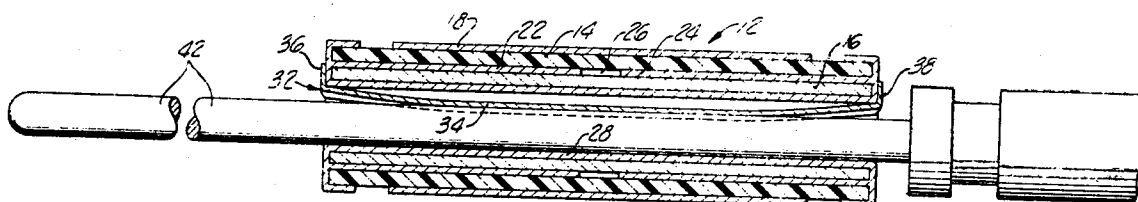
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| [52] | U.S. Cl. | 333/79,
317/242 |
| [51] | Int. Cl. | H03h 7/04 |
| [50] | Field of Search | 333/79, 81,
70: 317/242 |

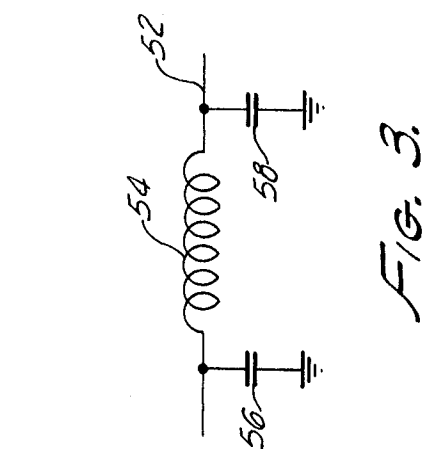
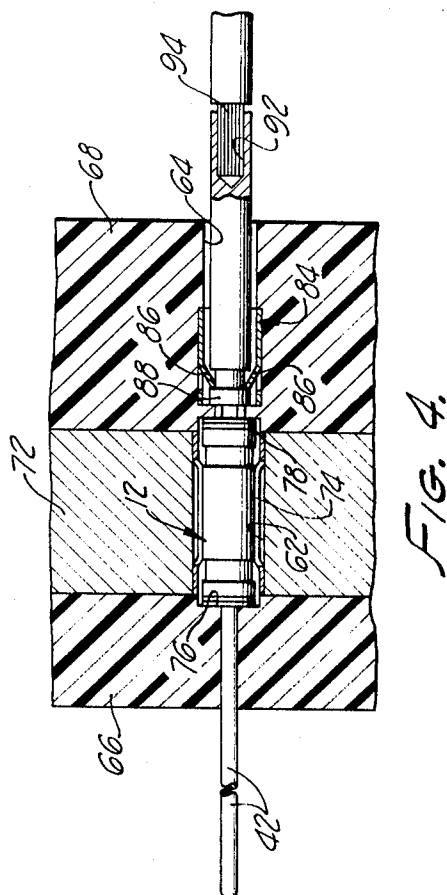
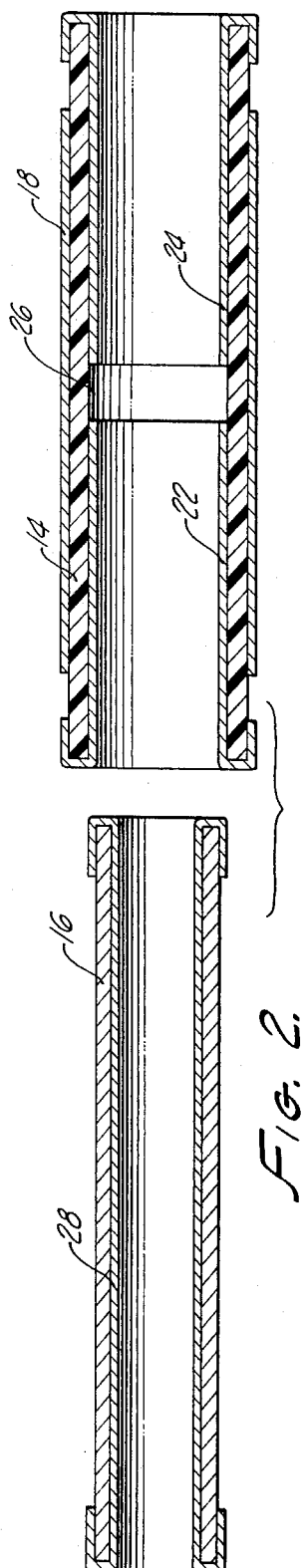
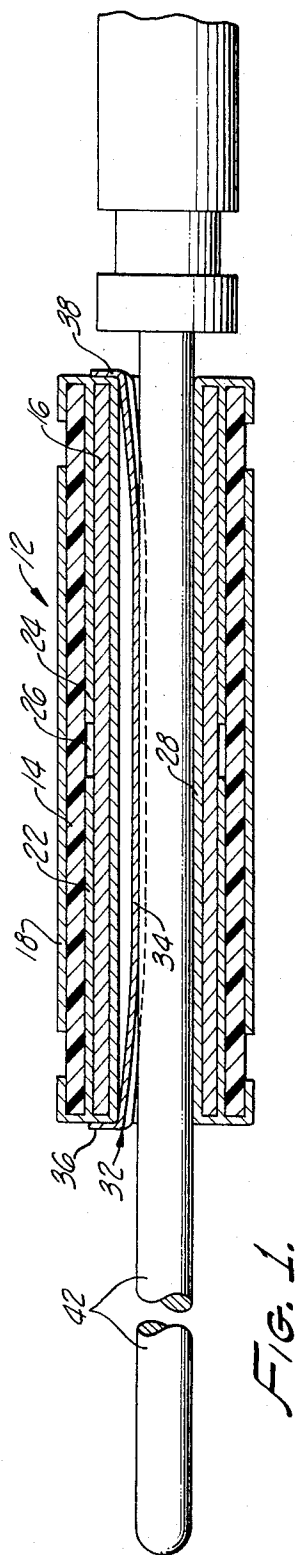
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ABSTRACT: The disclosure relates to an electrical connector filter assembly formed of a first tubular member made of a high dielectric constant material such as barium-titanate. The tubular member is conductively coated by means of a silver frit such as silver particles together with microscopic glass beads, which is readily applied to the dielectric tubular member. Further, a second tubular member, made of ferromagnetic material is also coated by means of a silver frit on its inner surface and around its ends. The ferromagnetic member is inserted in the dielectric member and the entire assembly fired to form a single complete assembly. A spring pin may be placed between a terminal pin and the silver surface inside the ferromagnetic member to aid the terminal pin in contacting the silvered surface. The filter may be readily removed from the terminal pin and replaced with a different filter when desired.





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ELECTRICAL CONNECTOR FILTER HAVING DIELECTRIC AND FERROMAGNETIC TUBES BONDED TOGETHER WITH CONDUCTIVE ELECTRODE LAYERS AND HAVING NONINTEGRAL CONNECTING SPRING

ELECTRICAL CONNECTOR FILTER

The invention relates in general to electrical connector filters, and, more particularly, to removable filter elements for use in coaxial lines.

BACKGROUND OF THE INVENTION

The use of RF (radio frequency) filter elements which are removable in coaxial lines wherein the filter assembly does not require soldering of the attached accessories to the filter has reached proportions such that large quantities of these filters must be mass-produced. In one type of arrangement, described in U.S. Pat. Application Ser. No. 793,264, filed Jan. 23, 1969, the electrical filter comprises a tubular element having a central aperture therethrough and an electrical conductive coating on the outer surface of the element which is adapted to be connected to a suitable ground. A conductive tube is slidably inserted in the aperture and the ends of the tube are bent to form flanges at the ends of the tubular element with spring members disposed between the flanges and the tubular element to make good electrical contact therebetween. Further, the tube may contain engaging tines adapted to engage a terminal pin insertable through the tube. The tubular element is normally formed of an outer cylindrical core of dielectric material which contains coated layers of conductive material thereon and is secured to an inner cylindrical core made of ferromagnetic material. Normally, the two cores are soldered together after coating. In such an arrangement, the manufacturing process requires the additional steps of, in addition to coating the conductive layer on the surface of the tubular element, the soldering of the dielectric core and ferromagnetic cores together and forming of the conductive tube around the tubular element to form flanges. Moreover, electrical contact between the end of the flanges and the tubular element is dependent upon the intermediary spring member. In an alternative arrangement, eyelets are soldered at the end of the filter assembly. Such an arrangement, however, requires an additional soldering step, that is, after the filter has been assembled, the eyelets must be soldered to the filter. Such an arrangement is shown in U.S. Pat. Application Ser. No. 55,398, filed.

In order to overcome the attendant disadvantages of prior art removable filters, the present invention allows a relatively simple manufacture of the filter which requires no soldering steps. Further, a simple and inexpensive device may be used for directly attaching the filter to the contact pin. Moreover, the use of only a silver coating for the tubular element allows the filter to be subjected to higher temperatures than soldered filter elements.

The advantages of this invention, both as to its construction and mode of operation will be readily appreciated as the same become better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like referenced numerals designate like parts throughout the FIGS.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 depicts a completed filter assembly for mounting in a connector assembly;

FIG. 2 depicts the filter assembly of FIG. 1, disassembled prior to firing of the tubes which form the filter assembly;

FIG. 3 is a schematic diagram of the filter circuitry; and

FIG. 4 depicts the filter assembly mounted in a connector assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is shown in FIG. 1, an electrical connector filter assembly 12 in accordance with the

invention. The assembly comprises an outer ceramic tubular member 14 made of a high dielectric constant material such as barium titanate and an inner tubular member 16, made of ferromagnetic material. The outer tubular member contains a conductive layer 18 which covers the outer cylindrical portion of the member 14. The inner portion of the member 14 contains a pair of coated layers 22—24 which are separated from each other to form an air gap 26 at the center thereof. The layers 22 and 24 extend around the ends of the core 14 and cover the outer end portion thereof, but are separated from the central outer layer 18 by means of a gap. The ferrite member 16 is secured along its outer surface to the layers 22 and 24 and contains a silver coated layer 28 along its inner surface. Further, layer 28 surrounds the ends of the member 16 and is contiguous with the layers 22 and 24. An eyelash spring 32 contains a central portion 34 which bows at the center of the filter assembly and has a pair of end sections 36—38 which contact the ends of the tubular member to prevent the spring 32 from moving axially. The central portion 34 is used to insure that the layer 28 positively contacts a terminal member 42 inserted through the center of the assembly.

Referring now to FIG. 2, there is shown the dielectric member 14 and the ferrite member 16 prior to assembly. The dielectric member 14 is coated by means of layers 18, 22 and 24, formed of a mixture of silver particles and microscopic glass beads bound together by a conventional carrier agent. The ferrite member 16 is also silver coated along the inner surface thereof and at its outer ends by layer 28 which extends around the ends of the outer surface of the member 16. Then, the ferrite member is inserted in the dielectric member and the combined unit fired in a furnace at approximately 1310° Fahrenheit for about 10 minutes. The silver particles float in the glass beads and become a vitreous mass. The resultant structure, upon cooling, is shown in FIG. 1. Thus, the two tubular members 14 and 16 are secured to each other, eliminating soldering of the members 14 and 16. Further, with the elimination of solder joints, the filter assembly can be subjected to higher temperatures.

The layers 18, 22, 24 and 28 have been exaggerated in the drawing for the purpose of clarity. These layers are normally one-fifth to one-tenth the thickness of the tubular members 14 and 16. When the tubular member 16 is inserted into the tubular member 14, there may be a slight airgap between the tubular member 16 and the layers 22 and 24. Also, the layers 22 and 24 may be fired on the tubular member 14 and the layer 28 fired on the tubular member 16, respectively. Then the tubular member 16 is inserted into the tubular member 14 and the device again fired.

The electrical connector filter assembly 12 provides a pi-section filter arrangement which is shown in FIG. 3. The conductor 52 represents the terminal member 42 and the inductor 54 has the electrical effect of the ferrite core 16. The capacitors 56 and 58 are formed by conductive coatings 22 and 24 separated from the conductive coating 18, by the dielectric member 14. The eyelash spring 32 forms the electrical connection between the terminal 42 and the capacitors 56, 58, while the outer conductive coating 18 is connected to ground in normal operation. It should be pointed out, however, that the device of FIGS. 1 and 2 are only an approximation of the circuit of FIG. 3, and not an exact duplication thereof.

The construction of the invention depicted herein includes a pair of capacitors, although it should be understood, of course, that more or less may be employed. Further, the value of capacitors can be varied by varying the type of dielectric material employed, the width of the dielectric gap, and area of the conductive coating. Moreover, 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 core 16, and by varying the size and configuration of the core. The filter assembly, as depicted in FIGS. 1 and 2 can be conveniently slipped onto the terminal 42 and then the combined terminal and filter installed in a connector body. Further, the filter assembly also

lends itself to being installed into a connector body to permit the terminal to be removably inserted therein.

As shown in FIG. 4, the filter assembly 12 is illustrated in an enlarged portion 62 of a bore 64, extending through a connector body formed of a front insulator 66, a rear insulator 68, and a ground plane 72. The outer conductive coating 18 on the filter assembly 12 is electrically connected to the ground plane 72 by a grounding spring 74. The filter assembly 12 is confined within the connector body by an inner shoulder 76 formed in the front insulator 66 and an inner shoulder 78 formed in the rear insulator 68.

The connector terminal 42 is inserted in the filter assembly 12 between the central portion 34 of the eyelash spring 32, and the inner coated surface 28 of the ferrite core 16, and is retained in the connector body by means of a retaining clip 84 having inwardly extending fingers 86 which engage the rear surface of a shoulder 88 formed on the terminal 42. The terminal 42 may be removed by inserting a suitable tool around the terminal to cause the fingers 86 to extend outwardly, as is conventional in rear-releasable connectors. The rear of the terminal 42 may be formed of a socket 92 for connection to a conductor wire 94.

Further, while the tubular element has been described for use as a removable filter, it should be understood, of course, that the tubular element could also be used as a nonremovable filter, or as a crimp-removable filter.

I claim:

1. An electrical filter assembly comprising: a filter element formed of an outer ceramic tubular member and an inner ferromagnetic tubular member said ferromagnetic tubular member having an axial opening therethrough whose surface is conductively coated, the outer ceramic tubular member having at least a portion of its outer surface conductively coated and a portion of its inner surface conductively coated and integral with the coating on the outer surface of said ferromagnetic tubular member, and a removable eyelash spring insertable through said opening in said ferromagnetic tubular member for causing a terminal pin to electrically connect said conductive coating on the opening in said ferromagnetic tubular member, said eyelash spring containing means for preventing axial movement of said spring with respect to said tubular members.

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