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(54) **CONNECTOR AND CONNECTOR ASSEMBLY**

VERBINDER UND VERBINDERBAUGRUPPE

CONNECTEUR ET ENSEMBLE CONNECTEUR

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Description**FIELD OF THE INVENTION**

[0001] The invention relates to connectors, connector assemblies, electrical circuits comprising such connectors, and methods of manufacturing such connectors.

BACKGROUND OF THE INVENTION

[0002] In particular, the instant invention is related to a connector suitable for mating with a complementary connector comprising:

- an insulating housing comprising a first face for connection to wires for providing an electrical signal (either DC or AC) to the complementary connector through said connector, and a second face for mating with the complementary connector,
- two terminals disposed inside the housing and extending each from a first end for connection to a second end for connection to the complementary connector,
- a filter element inside said housing for filtering of said electrical signal.

[0003] In an automotive environment, Safety Restraint Systems such as air bags or seat belt pretensioner systems have become widespread safety systems. They are often triggered by ignition. Electrical connectors used for commanding the ignition of such system require to be protected against electro-magnetic interference, in order to avoid such interference to cause an unwanted triggering of the safety system. To this aim, a filtering circuit is used, such as in US 2001/006860. This particular filtering circuit comprises capacitor elements. Even though this connector is satisfactory, the applicant wanted to develop connectors that can be differently manufactured.

SUMMARY OF THE INVENTION

[0004] To this aim, a connector is provided wherein the filtering function is essentially provided by the terminal configuration itself, i.e. the configuration of the terminals or the wires inside the connector provides for a filter element, though it may remain possible to optionally incorporate in the connector an additional filter.

[0005] With these features, there is no need for an outer filtering circuit since the connector itself will integrate the filtering ability. The electrical response of the whole connector will be taken into account when designing the connector for a given application. Further, the obtained connector remains suitable for incorporating any externally-provided filtering circuit. This connector therefore provides added flexibility and increased functionality.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Other characteristics and advantages of the invention will readily appear from the following description of four of its embodiments, provided as non-limitative examples, and of the accompanying drawings.

[0007] On the drawings:

- Fig. 1 is a schematic view of an electrical circuit according to the prior art,
- Fig. 2 is a schematic view of a connector according to a second embodiment,
- Fig. 3 is a perspective exploded view of a filter element according to a third embodiment, and
- Fig. 4 is a schematic view of a filter element according to a fourth embodiment.

[0008] On the different figures, the same references signs designate like or similar elements.

DETAILED DESCRIPTION

[0009] Fig. 1 is a schematic view of an electrical circuit according to the prior art comprising a connector 1 comprising a front face 2 for mating with a complementary connector 3, such as a counterpart connector of an SRS device, and a back face 4 connected to an input circuit 5.

[0010] The connector 1 comprises a housing 6 typically made of an electrically insulating material, and comprising mating apertures 7a, 7b in the front face 2 and back apertures 8a, 8b in the back face 4.

[0011] Inside the housing 1, a first terminal 9a and second terminal 9b are arranged and extend each from a respective back aperture 8a, 8b to a mating aperture 7a, 7b. At the back apertures, each first and second terminal is electrically connected, for example, by soldering or crimping, to a respective wire 10 which extends to the input circuit 5.

[0012] At the mating apertures, each first and second terminal is designed to be connected with a complementary terminal 11 of a complementary connector 3.

[0013] For example, the complementary connector 3 is a triggering element for triggering the ignition of an air bag in an automotive environment. The input circuit 5 is, for example upon detection that a car crash is occurring, adapted to emit a triggering electrical signal to the complementary connector 3, through the connector 1, for triggering the air bag.

[0014] In order to make sure that no electromagnetic interference will trigger an unwanted deployment of the air bag, the connector 1 will comprise a filtering circuit 12 which will filter out from the signal on terminals 9a and 9b the signals due to these typical types of interference.

[0015] According to the electrical circuit as shown on Fig. 1, the filtering circuit 12 will comprise a filtering element 13 and optionally an additional filtering element 14. As visible on Fig. 1, the filtering element 13 is formed by the specific shape and arrangement of the first and sec-

ond like a thin flat metallic portion 13b extending sensibly parallel to the first portion, and spaced therefrom so as to form a capacitor.

[0016] For example, the two flat portions 13a and 13b are fixed together and isolated by a dielectric solid material 15 which is for example a 20 μm thick PET film (not on scale on Fig. 1).

[0017] In this first example, an optional additional filter element 14 is a ferrite element comprising a ferrite body 16 surrounding a first and a second hole 17a, 17b through which extend, respectively, the first terminal 9a and the second terminal 9b.

[0018] A sample was performed according to Fig. 1, the capacitor having a capacity of 30 Picofahrad (pF), with a D35 ferrite. Another sample was performed without the ferrite. A reference sample was also prepared, without any filtering circuit. A Vector Network Analyser was used to measure the S-parameters of the samples. From these parameters, the terminated power loss for a two-ohms load was calculated.

[0019] For the reference sample without any filter, the terminated power loss in Decibels (dB) was calculated to be lower than 10 dB over the frequency range from 0 to 1500 megahertz (MHz).

[0020] For the sample without the ferrite, the terminated power loss was calculated over 19.5 dB, in the frequency range between 700-1500 MHz.

[0021] For the sample according to Fig. 1, the terminated power loss was over 19.5 dB in the frequency range between 450 and 1500 MHz.

[0022] It is expected that optimization of the shape and arrangement of the flat portions 13a, 13b and of the dielectric film 15 would improve even further the filtering abilities of the connector according to the embodiment of Fig. 1. For example, insulating paint with a selective deposit could be used as the dielectric film 15.

[0023] According to a second embodiment, as shown on Fig. 2, the first and second terminals 9a, 9b will criss-cross on their respective way from the back face aperture 8a, 8b to the front face aperture 7a, 7b. The filtering element 14 comprises a ferrite 16 which is made of a ferrite body which surrounds a common hole 18 through which the central portion of both terminals 9a, 9b extend juxtaposed. When compared to a conventional connector, the position of the front apertures 7a, 7b are exchanged, so that the electrical current, in operation of the connector, will flow, in the first and second terminals, inside the common hole 18, in the same direction, when the connector receives an electrical signal from the input circuit 5. Due to this crossing configuration, the ferrite 16 will provide common mode filtering, whereas, from the application side of view, the input excitation and output are still in differential mode.

[0024] Experiments show that the embodiment of Fig. 2 will provide enhanced filtering ability, with less ferrite material, when compared to a connector with a conventional ferrite element, wherein the ferrite body surrounds two separate holes 17a, 17b, each receiving a single ter-

minal.

[0025] A specimen of the embodiment of Fig. 2 was performed. Further, as a reference, a connector was performed with a ferrite 16 having two holes, only one of the terminals extending through each of the holes. The tests, as described before in relation to Fig. 1, showed that the terminated power loss of the embodiment of Fig. 2 was over the terminated power loss for the reference embodiment between 20 and 600 MHz. Further, the embodiment of Fig. 2 used half the ferrite volume of the reference embodiment.

[0026] An improvement of the second embodiment of Fig. 2 is described as a third embodiment in relation to Fig. 3. According to this embodiment, the ferrite body 16 comprises two parts and defines a common hole 18, and two separated holes 17a, 17b which each extends from the common hole 18, and are separated from each other. In this portion of the connector, the first and second terminals 9a, 9b are each provided as a flat metallic sheet portion. They both extend juxtaposed in the common hole 18 of the ferrite element 16, and each of them extends, respectively, in one of the separated holes. Again, the connector is connected so that, in operation, the current will flow in the same direction in the part of the terminals which extend into the common hole 18, so that the ferrite effect occurs on common mode for these terminals at that common hole.

[0027] Further, the portions of the first and second terminals 9a, 9b which extend in the common hole 18 are bonded together with a thin dielectric film, so as to perform a capacitor according to the teaching of Fig. 1.

[0028] As shown on Fig. 4, according to a fourth embodiment, the ferrite 16 will comprise a first common hole 18 such as in the embodiment of Fig. 2, and a second common hole 19, similar to the first common hole, so as to provide with double criss-crossing configuration of the terminals 9a and 9b. This fourth embodiment offers the advantage that its connection scheme to the mating connector and to the input circuit will not be changed, since the complementary terminal 11a and 11b will still be facing respectively the terminals 9a and 9b upon usual connection of the connector (whereas, since front apertures 7a and 7b are exchanged in the embodiments of Fig. 2 and 3, the terminals in the mating connector also have to be exchanged for these embodiments). Possibly, in one or each of the common holes, flat portions of the terminals will be formed and assembled to define a capacitor.

Claims

1. A connector suitable for mating with a complementary connector comprising:

- an insulating housing (6) comprising a first face (4) for connection to wires for providing an electrical signal to the complementary connector

through said connector, and a second face (2) for mating with the complementary connector,
 - two terminals (9a, 9b) disposed inside the housing and extending each from a first end for connection to a respective wire to a second end for connection to the complementary connector,
 - a filter element inside said housing for filtering part of said electrical signal,

wherein the filter element comprises a ferrite (16) which is made of a ferrite body,
characterized in that the ferrite body surrounds a common hole (18) and a central portion of both terminals (9a, 9b) extend juxtaposed through said common hole (18) of the ferrite body, so that the electrical current, in operation of the connector, will flow in the first and second terminals inside the common hole (18) in the same direction, when the connector receives an electrical signal from an input circuit (5).

2. A connector according to claim 1, wherein each of said terminals comprises an enlarged flat portion (13a, 13b), the enlarged flat portions of said terminals being shaped and arranged in relation to one another so as to form an additional filter element.
3. A connector according to claim 2, wherein the enlarged flat portions form a part of a capacitor.
4. A connector according to claim 2 or 3 wherein the additional filter element comprises a dielectric solid film (15) bonding the two flat portions together.
5. A connector according to claim 1 wherein flat portions of both terminals extend into said one hole (18), so that, in operation, the ferrite works, at said one hole, in common mode for the flat portions of the terminals.
6. A connector according to any of the preceding claims, wherein wires or terminals are criss-crossed in at least one hole of the ferrite.
7. A connector according to claim 5 or 6, wherein the ferrite comprises two holes (18, 19), both terminals (9a, 9b) or wires are criss-crossed in each of said holes.
8. A connector assembly comprising a connector according to any of claims 1 to 7, and a mating connector (3) for commanding an SRS system.

Patentansprüche

1. Ein Verbinder, der geeignet ist zum Verbinden mit einem komplementären Verbinder, aufweisend:

- ein isolierendes Gehäuse (6), das eine erste Seite (4) zur Verbindung mit Leitungen zum Vorsehen eines elektrischen Signals an den komplementären Verbinder durch den Verbinder und eine zweite Seite (2) zur Verbindung mit dem komplementären Verbinder aufweist,
 - zwei Anschlüsse (9a, 9b), die innerhalb des Gehäuses angeordnet sind und sich jeweils von einem ersten Ende zur Verbindung mit einer entsprechenden Leitung zu einem zweiten Ende zur Verbindung mit dem komplementären Verbinder erstrecken,
 - ein Filterelement innerhalb des Gehäuses zum Filtern eines Teils des elektrischen Signals,

wobei das Filterelement einen Ferrit (16) aufweist, der aus einem Ferritkörper besteht,

dadurch gekennzeichnet, dass der Ferritkörper ein gemeinsames Loch (18) umgibt und sich ein zentraler Teil von beiden Anschlüssen (9a, 9b) nebeneinanderliegend durch das gemeinsame Loch (18) des Ferritkörpers erstreckt, so dass der elektrische Strom, bei Betrieb des Verbinders, in den ersten und zweiten Anschlüssen innerhalb des gemeinsamen Lochs (18) in dieselbe Richtung fließt, wenn der Verbinder ein elektrisches Signal von einer Eingangsschaltung (5) empfängt.

2. Ein Verbinder gemäß Anspruch 1, wobei jeder der Anschlüsse einen vergrößerten flachen Teil (13a, 13b) aufweist, wobei die vergrößerten flachen Teile der Anschlüsse in Bezug zueinander derart geformt und angeordnet sind, um ein zusätzliches Filterelement zu bilden.
3. Ein Verbinder gemäß Anspruch 2, wobei die vergrößerten flachen Teile einen Teil eines Kondensators bilden.
4. Ein Verbinder gemäß Anspruch 2 oder 3, wobei das zusätzliche Filterelement einen dielektrischen festen Film (15) zum miteinander Verbinden der zwei flachen Teile aufweist.
5. Ein Verbinder gemäß Anspruch 1, wobei sich flache Teile von beiden Anschlüssen in das eine Loch (18) erstrecken, so dass in Betrieb der Ferrit an dem einen Loch in einem Gleichtakt für die flachen Teile der Anschlüsse arbeitet.
6. Ein Verbinder gemäß einem der vorhergehenden Ansprüche, wobei sich Leitungen oder Anschlüsse in zumindest einem Loch des Ferrits kreuzen.
7. Ein Verbinder gemäß Anspruch 5 oder 6, wobei der Ferrit zwei Löcher (18, 19) aufweist, wobei sich beide Anschlüsse (9a, 9b) oder Leitungen in jedem der Löcher kreuzen.

8. Eine Verbinderanordnung, die einen Verbinder gemäß einem der Ansprüche 1 bis 7 und einen passenden Verbinder (3) zum Anweisen eines SRS-Systems aufweist.

Revendications

1. Connecteur approprié pour s'accoupler avec un connecteur complémentaire, comprenant :

- un boîtier isolant (6) comprenant une première face (4) pour la connexion à des fils pour fournir un signal électrique au connecteur complémentaire via ledit connecteur, et une seconde face (2) pour s'accoupler avec le connecteur complémentaire,
- deux bornes (9a, 9b) disposées à l'intérieur du boîtier et s'étendant chacune depuis une première extrémité pour la connexion à un fil respectif jusqu'à une seconde extrémité pour la connexion au connecteur complémentaire,
- un élément de filtre à l'intérieur dudit boîtier pour filtrer une partie dudit signal électrique,

dans lequel l'élément de filtre comprend une ferrite (16) qui est constituée d'un corps en ferrite,

caractérisé en ce que le corps en ferrite entoure un trou commun (18), et une portion centrale des deux bornes (9a, 9b) s'étend de manière juxtaposée à travers ledit trou commun (18) du corps en ferrite, de sorte que le courant électrique, en fonctionnement du connecteur, va s'écouler dans la première et dans la seconde borne à l'intérieur du trou commun (18) dans la même direction quand le connecteur reçoit un signal électrique depuis un circuit d'entrée (5).

2. Connecteur selon la revendication 1, dans lequel chacune desdites bornes comprend une portion plate élargie (13a, 13b), les portions plates élargies desdites bornes ayant une forme et un agencement en relation l'une par rapport à l'autre de manière à former un élément de filtre additionnel.

3. Connecteur selon la revendication 2, dans lequel les portions planes élargies forment une partie d'une capacité.

4. Connecteur selon la revendication 2 ou 3, dans lequel l'élément de filtre additionnel comprend un film solide en diélectrique (15) qui colle les deux portions planes ensemble.

5. Connecteur selon la revendication 1, dans lequel les portions planes des deux bornes s'étendent jusque dans ledit trou (18), de sorte qu'en fonctionnement la ferrite fonctionne, au niveau dudit trou, en mode commun pour les portions planes des bornes.

6. Connecteur selon l'une quelconque des revendications précédentes, dans lequel les fils ou les bornes sont croisé(e)s dans au moins un trou de la ferrite.

7. Connecteur selon la revendication 5 ou 6, dans lequel la ferrite comprend deux trous (18, 19), les deux bornes (9a, 9b) ou fils étant croisé(e)s dans chacun desdits trous.

8. Ensemble formant connecteur comprenant un connecteur selon l'une quelconque des revendications 1 à 7, et un connecteur accouplé (3) pour commander un système SRS.

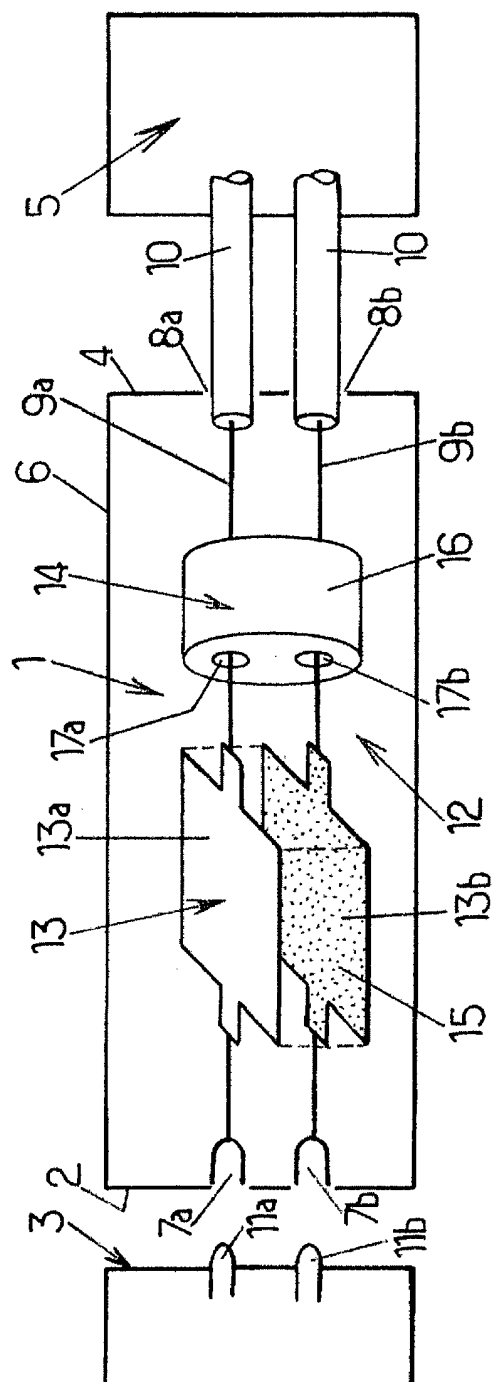


FIG. 1.

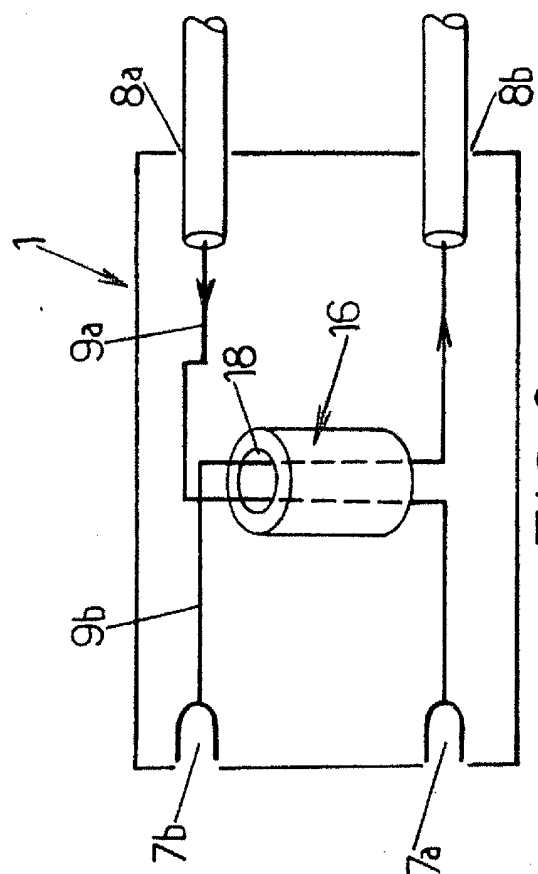


FIG. 2.

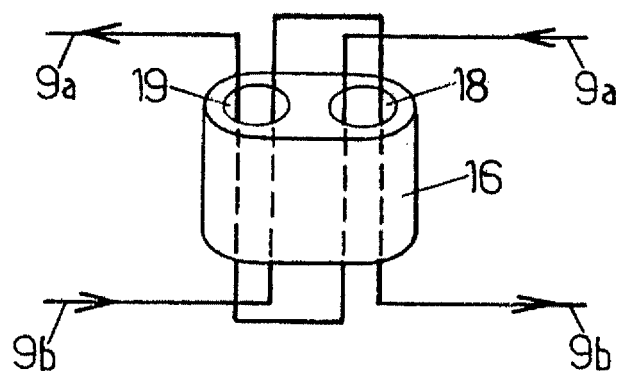
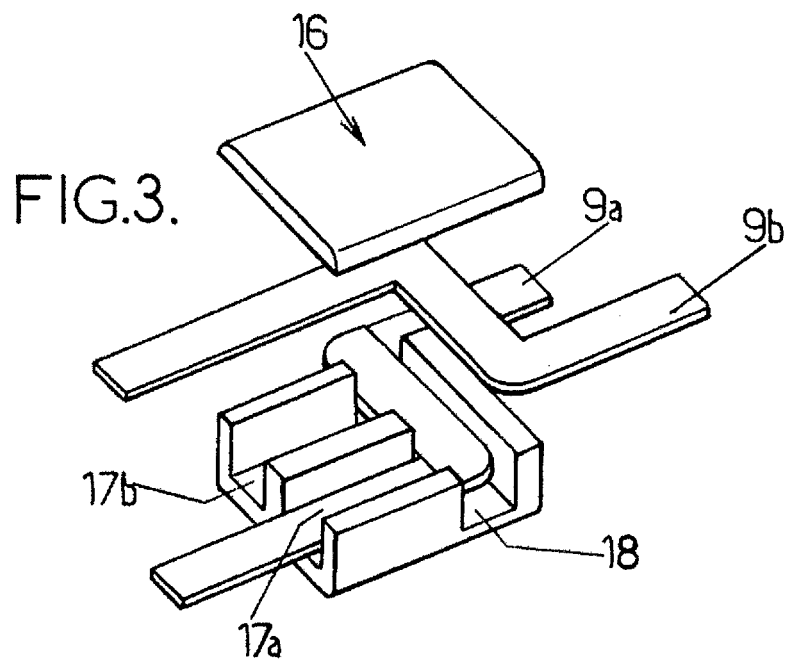


FIG.4.

REFERENCES CITED IN THE DESCRIPTION

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