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ELECTROMAGNETIC SHIELDING GASKET AND METHOD

STATEMENT OF THE GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for Governmental purposes without the payment of any royalties thereon or therefore.

BACKGROUND OF THE INVENTION

(1) Field of the Invention

The present invention relates generally to EMI shielding devices and, more specifically, to an EMI shielding gasket that may also provide repeated mechanical latching and magnetic shielding.

(2) Description of the Prior Art

Most electrical and electronic equipment is capable of generating radio frequency and/or electromagnetic radiation, which, if not properly shielded, can interfere with other electronic equipment. For instance, office equipment such as

electronic typewriters and printers, household appliances such as washing machines and vacuum cleaners, automobile electronic control systems, and the like may generate significant electromagnetic radiation. This can include electromagnetic energy of wavelengths along the various points of the spectrum such as radio frequency interference. As used herein, the term electromagnetic interference pertains to interfering electromagnetic energy of any wavelength.

An electromagnetic interference (EMI) gasket is a gasket formed of a material, or a combination of materials, which conducts electricity and which is used to ensure a continuous low-impedance contact between two surfaces which conduct electromagnetic energy. Among the known devices are gaskets having a resilient core surrounded by a deformable wire-mesh gasket material. Suitable wire-mesh materials include but are not limited to tin-plated phosphor bronze, tin-coated copper-clad steel, silver-plated brass, monel, beryllium copper and aluminum. EMI gaskets are generally used to shield conventional computer or other electronic equipment by compressing the gasket around an openable access panel, door, or the like.

Shielding of access panels and doors in the housing of equipment presents a significant problem. This is because the seams between the access panels or doors and the housing body

provide escape and entry routes for electromagnetic interference. Gaps present conductivity discontinuities which are conducive to electromagnetic radiation. Moreover, latches and locks that are used with such access panels and doors may present electromagnetic radiation problems even if the seams between the panels and doors are otherwise sealed for electromagnetic radiation. In some cases, magnetic sources may cause considerable damage to magnetically sensitive components even though the cabinets are sealed for electromagnetic radiation.

In recent years, enclosures for equipment which is susceptible to electromagnetic interference such as airplane instruments, computers, and the like are designed to use various types of shielding gaskets. However, due to vibration, cracks formed by fasteners, problems that develop with repeated opening and closing, and the like, an improved gasket is desirable. Moreover, it would be desirable to eliminate the need for special fasteners used with access panels while still providing a secure electromagnetic shield and mechanical seal between conductive housing members.

The following patents disclose efforts to produce an effective electromagnetic shielding gasket:

U. S. Patent No. 5,115,104, issued May 19, 1992, to Michael A. Bunyan, discloses a shielding gasket, comprising a conductive

or non-conductive resilient core, the surface of which is rendered electrically conductive by flocking with conductive fibers. The gasket is inexpensive, lightweight and allows a low closure force. The invention further provides a method of rendering selected areas of the surface of a core conductive by selectively flocking with conductive fibers. The gasket is inexpensive, lightweight and allows a low closure force. The invention further provides a method of rendering selected areas of the surface of a core conductive by selectively flocking with conductive fibers.

U. S. Patent No. 5,142,101, issued August 25, 1992, to Toru Matsuzaki et al, discloses an electromagnetic-shielding gasket which shields electronic components from electromagnetic waves by covering a surface of a resilient core with metal mesh and inserting the core into a joint of a conductive housing which contains electronic components. The core comprises an installing portion which is fixed to the joint of the conductive housing. A segregating portion or area separates the metal mesh from the surface of the core in the corner portions so that when the core elastically deforms greatly during insertion or use of the gasket, the metal mesh does not break as the core presses and pulls the metal mesh.

U. S. Patent No. 5,202,536, issued April 13, 1993, to Samuel S. Buonanno, discloses a seal for blocking propagation of electromagnetic energy through a gap between bodies having conductive surfaces at least adjacent the gap including an elongated core element defining a resiliently compressible cross section which can be molded, extruded or otherwise formed. At least one elongated conductive sheath portion is attached to the core element at a surface of the core element exposed to the conductive surfaces of the bodies. The conductive sheath portion extends only part way around said cross section and defines ends which are spaced on the core element and are non-over-lapping. Preferably, at least one additional sheath portion is attached to the core element and extends between the ends of the conductive sheath portions. The conductive sheath can include metal fibers or metallized resin fibers, woven or nonwoven. Preferably, the conductive sheath portion is a metallized fabric and the additional sheath portion is a nonconductive resin suitable for making an environmental seal. The cost of the seal is reduced as compared to a fully conductive enclosed seal, with the added benefit of improved environmental sealing.

U. S. Patent No. 5,522,602, issued June 4, 1996, to Joseph J. Kaplo et al, discloses one embodiment of a gasket for shielding electromagnetic interference passing through a seam

between first and second electrically conductive bodies including a base for securing the gasket to the first, electrically conductive body and a multiplicity of discrete, elongate, metallized filaments projecting substantially perpendicularly from the base so that a substantial amount of the filaments contacts the second, electrically conductive body when electromagnetic interference passing through a seam between the bodies is to be shielded. The gasket further includes structure, arranged with the base, for providing an electrically conductive path for conducting electric current between the filaments and the first, electrically conductive body. In this manner, energy absorbed in or by the shielding member as a result of the shielding of passing electromagnetic interference can be dissipated to ground through the first, electrically conductive body. The gasket is particularly useful for shielding electromagnetic energy passing through seams between electrical apparatus housings and door or access panels in such housings.

U. S. Patent No. 5,889,229, issued March 30, 1999, to Anthony Michael Sosnowski, discloses a knitted metalized yarn gasket fashioned from a core, a first tubular layer formed from a hot melt yarn around the core, and a second tubular structure knitted from a conductive yarn and disposed over at least a portion of the first tubular layer and core assembly. The hot

melt yarn forming the first tubular layer adheres the second tubular structure to the core such that fraying of the knit gasket is substantially prevented.

In summary, while the prior art shows various gaskets for shielding electromagnetic interference, the above does not show a gasket that prevents electromagnetic radiation leakage around the locking mechanism or that may be used to eliminate the locking mechanism. Consequently, there remains a need for a gasket that provides a locking mechanism, that may be used to shield magnetic fields, and that may be used to provide a gripping interconnection to thereby more effectively shield electromagnetic radiation. Those skilled in the art will appreciate the present invention that addresses the above and other problems.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an improved method for electromagnetic shielding.

It is yet another object of the present invention to provide a gasket that provides an improved electrical connection between the conductive surfaces of a door or cover or the like of a housing that may house electrical and/or electronic equipment.

It is yet another object of the present invention to avoid the electromagnetic radiation that may be associated with latches and the like.

These and other objects, features, and advantages of the present invention will become apparent from the drawings, the descriptions given herein, and the appended claims.

Therefore, an EMI shielding gasket is disclosed that comprises a first half of the shielding gasket formed of electrically conductive material where the electrically conductive material may be formed into a plurality of loops. A second half of the shielding gasket is also formed of electrically conductive material where the electrically conductive material may be formed into a plurality of hooks. The first half and the second half may be connectable to form a physical interconnection whereby respective of the plurality of hooks extend into respective of the plurality of loops upon application of pressure.

The shielding gasket may be comprised of magnetic material to effect magnetic shielding. The plurality of hoops preferably form a plurality of interconnected rows and the plurality of hooks may be arranged into a plurality of rows. A conductive adhesive is preferably used for attachment of the shielding gasket to a conductive surface such as a door, opening, or the

like of an enclosure or housing that is to be shielded from electromagnetic interference that may arise between a first conductive surface and a second conductive surface of the housing. The first portion of the gasket may be secured to the first conductive surface and the second portion of the gasket may be secured to the second conductive surface by means of the conductive adhesive. Other connection means could be used whereby the gasket is electrically connected to the conductive surfaces. Preferably a ground is connected to the housing such that the first portion of the gasket and the second portion of the gasket are grounded when the first portion of the gasket is interconnected with the second portion of the gasket.

In one embodiment, the housing has no other latch between the first conductive surface and the second conductive surface except for the interconnection of the first portion of the gasket and the second portion of the gasket. Thus, the gasket of the present invention can be used to replace a latch for a door or panel opening.

In operation, a first half of the gasket is secured to the first conductive surface, and the second half of the gasket is secured to a second conductive surface, the first and second halves of the gasket may be comprised of conductive material. Thereafter, applying pressure to the first conductive surface and

to the second conductive surface engages and affixes the first half of the gasket to the second half of the gasket thereby affixing the first conductive surface to the second conductive surface. Likewise, the first and second conductive surfaces can be separated by applying sufficient pressure to pull the first and second conductive surfaces apart.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the invention and many of the attendant advantages thereto will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings wherein corresponding reference characters indicate corresponding parts throughout the several views of the drawings and wherein:

FIG. 1 is a schematic representation of a single hook and loop in accord with the present invention;

FIG. 2A is a schematic of one half of an EMI gasket in accord with the present invention formed of a plurality of the loops of FIG. 1;

FIG. 2B is a schematic of a complementary second half of an EMI gasket in accord with the present invention formed of a plurality of the hooks of FIG. 1; and

FIG. 3 is a schematic of an EMI gasket in accord with the present invention in place on an instrument cabinet.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings and, more particularly, to FIG. 1 there is shown a schematic of a latch 10 that illustrates the basic element of construction of gasket 12 of the present invention with complementary halves 12A and 12B as shown in FIG. 2A and FIG.2B, respectively. Gasket 12 includes a plurality of hooks, such as hook 14, and a plurality of loops, such as loop 16. The principle of operation is clearly shown in FIG. 1 where end 18 extends through loop 16 to thereby provide a gripping action. The operation of hook and loop fasteners is well known but this function has never been used before for electromagnetic field and magnetic field shielding purposes. The electromagnetic interference (EMI) gasket 12 of the present invention is preferably formed of one material, or a combination of materials, that conducts electricity. In this way, gasket 12 may be used to ensure a continuous low-impedance contact between two surfaces which conduct electromagnetic energy. Several different materials have been listed above that have been successfully used for making EMI gaskets. Any conducting material would provide EMI protection from electric fields, but something that was also

magnetic would provide shielding from magnetic fields. A composite material may be used to provide all desired features.

Gasket 12 is preferably comprised of two sections such as gasket 12A and gasket 12B. In FIG. 2A an array of loops 16 are shown that form one half of gasket 12. In this embodiment, a plurality of loops 16 are organized into rows such as rows 19, 20, and 22. Rows 19, 20, and 22 are parallel with each other and attached to each other along seams 24 and 26. There may be overlap between the rows of loops. Other configurations or arrangement of loops 16 may be used as desired.

In FIG. 2B is shown an array of hooks 14 that form the other half of gasket 12. Hooks 14 may arranged in rows such as rows 28, 30, 32, 34, and 36. Moreover, hooks 14 may be arranged in rows such as rows 38, 40, 42 and the like. Preferably hooks 14 are arranged to be mated with loops 16.

Thus, gasket 12 consists of top and bottom complementary pieces such as 12A and 12B of FIG 2A and FIG. 2B, respectively. For installation to an instrument cabinet such as instrument housing 44, a conducting adhesive 46 is attached or applied to the underside of each half of gasket 12 and/or to the instrument cover such as instrument cover 48 and mating enclosure 50. The first half of gasket 12 is affixed, such as by conducting adhesive 46 to instrument cover 48 or enclosure 50. The second

half of gasket 12 is likewise affixed to the remaining mating surface. Preferably instrument housing 44 is comprised of low conductivity material and is preferably magnetic. A ground 52 may preferably be electrically connected to instrument housing 44 to maintain the housing at a ground potential. Although adhesive is the presently preferred method of affixing each half of gasket 12 to the conductive surface of a cover, door, or the like, other method such as staples, screws, rivets, and the like may be in addition or by themselves while taking care to establish a good electrical connection between the conductive surface and the gasket.

Once installed on cover 48 and mating enclosure 50, then cover 48 is assembled on enclosure 50 by applying pressure. Cover 48 may be removed by pulling to separate the joining parts. Therefore, gasket 12 of the present invention may be used to replace latches that otherwise may leak or radiated electromagnetic waves. Gasket 12 of the present invention provides large numbers of electrical interconnections and physical connections thereby ensuring a good EMI shield. If gasket 12 is made of magnetic materials, then magnetic shielding is also provided.

In summary, gasket 12 of the present invention provides increased shielding effectiveness over typical gasket

construction because of the mechanical interlocking compression/deflection properties guaranteeing improved transfer impedance. Because of the mechanical strength, fasteners on covers are no longer required allowing for ease of removal and reinstallation.

It will be understood that many additional changes in the details, materials, steps and arrangement of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention.

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ELECTROMAGNETIC SHIELDING GASKET AND METHOD

ABSTRACT OF THE DISCLOSURE

An electromagnetic interference (EMI) shield gasket method is disclosed for shielding electromagnetic waves that may leak or be radiated from cracks and latches of an electronic housing. The gasket of the present invention comprises an interlocking first half that mates to a second half. Preferably a plurality of hooks are used on the first half and a plurality of loops are provided on the second half. The hooks and loops of the gasket are comprised of a material with low conductivity thereby providing an improved transfer impedance. The first half of the gasket is affixed, such as by conductive adhesive, to the conductive surface of a door or the like in the electronic housing. The second half of the gasket is likewise affixed to the mating surface of the door. The door can now be affixed in position and removed without latches while providing good mechanical connection and improved electromagnetic shielding.

FIG. 1

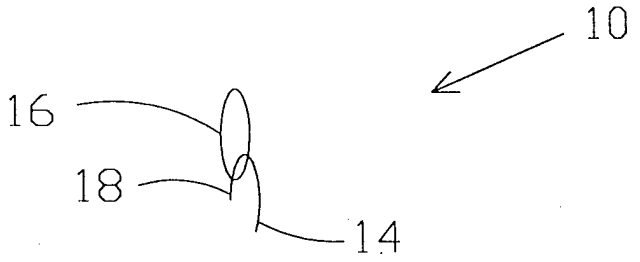

FIG. 2A

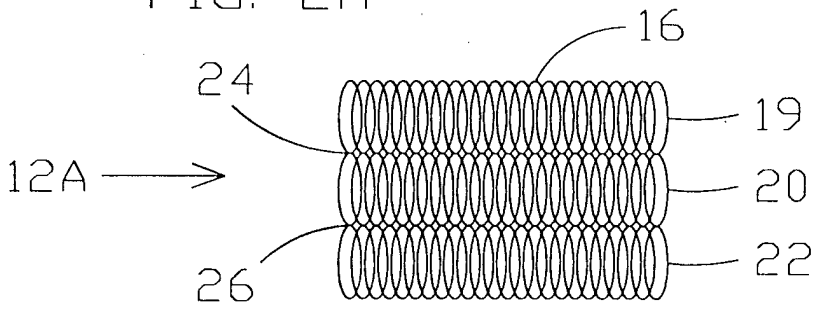

FIG. 2B

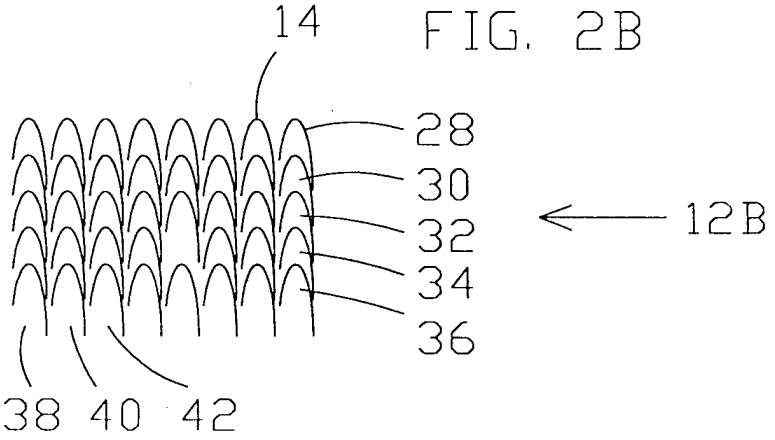

FIG. 3