

DUAL ELASTOMER GASKET SHIELD
FOR ELECTRONIC EQUIPMENT

Field of the Invention

The present invention relates to the shielding of electronic equipment and, more particularly, to gaskets for cabinet enclosures, which cabinets are adapted to receive electronic equipment, the gaskets serving to shield the electronic equipment from damage due to exterior electromagnetic radiation.

Background of the Invention

Producers of commercial electronic equipment, not to mention defense applications, are being forced to improve the performance of shielding devices to counter-act electromagnetic interference complicated by the ever higher frequencies of energy generation in and beyond the megahertz range. Openings in cabinet enclosures for access doors, hinges, etc. must be so protected by the use of suitable shielding.

This has been an ongoing problem and various solutions have been proposed, these prior solutions however being unsatisfactory from one or more points of view. Thus, the prior devices have been insufficient from point of view of at least one or more of the following requirements:

1. Attenuation of internal and external interference using gasketing with resistive values within the range of 0.1 to 0.001 ohm-cm and selectable attenuation from 30 to 90 dB.

2. Low compression set of the gasket so long term mechanical sealing is maintained.

3. Superior physical properties of the gasket to prevent failure due to tearing forces.

4. Resistance to reduced electromagnetic shielding due to oxidation.

5. Ease of cleanliness maintenance.

6. Freedom from free metal chips as occurs with the initial fitting and subsequent deterioration of metallic meshes and metal assemblies.

7. A neat appearance of the shield.

8. Ease of installation and replacement.

9. Low cost relative to alternate designs.

There are presently available four different types of cabinet shielding means which suffer one or more defects. These are as follows:

<u>Product</u>	<u>Principal Inadequacy</u>
1. Carbon Filled Elastomers	Shielding ability falls off in the higher frequency range
2. Metal Filled Elastomers	Poor physical properties (compression set, tear, etc.)
3. Metal Mesh with Elastomeric Core	Hard to cut cleanly for corners; chips of free metal
4. Metallic Seals (Spring-like fingers)	Difficult to keep clean, oxidation

Summary of the Invention

It is therefore an object of the present invention to overcome deficiencies in the prior art such as indicated above.

It is another object to provide an improved gasket shielding material for electronic equipment.

It is yet another object of the present invention to provide dual elastomer gasket shielding for counteracting electromagnetic interference.

The present invention provides a flexible gasket element for counteracting electromagnetic interference, said element comprising a relatively thick elastomeric inner layer integral with a relatively thin elastomeric outer layer, said outer layer being of an elastomer which is metal filled for attenuation of electrical energy, and substantially the entire area of said outer layer being supported by the inner layer.

In such an element, the inner layer can provide high strength and good elasticity, while the outer layer can be efficient at counteracting or attenuating electromagnetic radiation.

The inner layer may be conductive, formed for example of carbon filled rubber, and in particular formed of carbon-black and fumed silica reinforced silicone rubber.

The elastomer of the outer layer may be rubber.

The inner layer may have between 5 and 20 times the thickness of said outer layer, and is preferably about 10 times as thick. The outer layer may be between 2 and 8 mils thick.

The inner and outer layers may be chemically bonded together, for example by being co-extruded.

The element may be secured to a metallic substrate, preferably chemically locked to said substrate such as by co-extrusion onto the substrate.

The nature and advantages of the present invention will be more apparent from the following detailed description of certain specimen embodiments thereof, taken in conjunction with the drawing, wherein:

Brief Description of the Drawings

Fig. 1 is a perspective view of an EMI gasket according to the present invention, showing one general configuration;

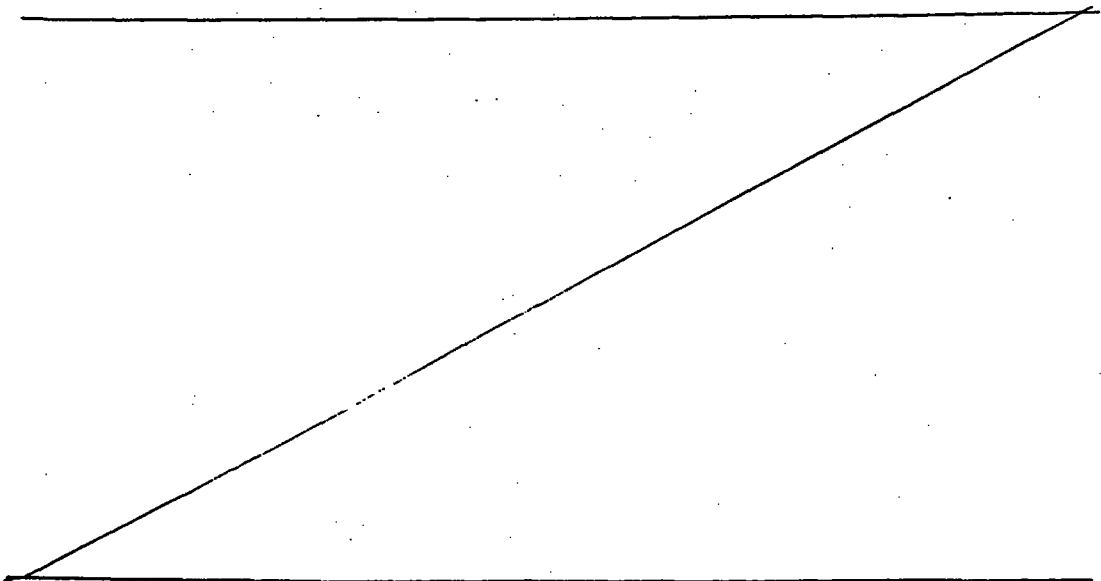
Figs. 2a - 2f are end views of other possible configurations, Fig. 2d being somewhat similar to the embodiment of Fig. 1; and

Fig. 3 is an enlarged partial cross-sectional view of the gasket of Fig. 1.

Detailed Description of the Embodiments

Fig. 1 shows one typical general configuration of an EMI gasket 10 according to the present invention, having a metal clip part 12 and a rubber gasket part 14 adhered together. Figs. 2a - 2f show various other typical forms which may be used.

The gasket part 14 is formed of an elastomeric inner portion 16 which is preferably, but not necessarily, conductive. To this portion 16 is permanently bonded, preferably by co-extrusion within the die, a relatively thin outer sheathing or covering of metal filled



elastomer. From the embodiment of Figs. 1, 3, 2a, 2b, and 2d-2f, it will be understood that such a gasket may be co-extruded and bonded during extrusion onto metallic and conductive non-metallic shapes for convenient assembly to cabinets. From Fig. 2c, it will be understood that the gasket material can be provided in other shapes which can be subsequently attached to a suitable substrate. In general, the extrusions are made in continuous length, shaped to any desired uniform cross-section.

The product can be formed onto a metallic carrier, for example a flat metal strip (see Figs. 2a, 2e and 2b) or a roll-formed shape (Figs. 2d and 2f) by passing the metal substrate through the co-extrusion tooling in a continuous process. The inner portion 16 is chemically locked to the metallic layer thus ensuring transmission of electrical energy un-impeded between the co-elastomer and the metallic carrier.

The inner layer 16 is constructed of a strong elastomeric material which has good physical properties, including high tear resistance, as well as the ability to recover shape after deformation, i.e. good elasticity. This material is desirably carbon filled rubber.

The metal filled exterior covering 18 provides a higher degree of attenuation of electrical energy than presently available non-metal filled elastomeric shielding. On the other hand, such metal filled elastomer used alone as a shielding material suffers from poor physical properties, including low tearing resistance, and its recovery of shape after deformation is poor.

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The metal filler does not reinforce the elastomer and acts as a diluent. Furthermore, as the cost of the metal, usually silver, is relatively high, it is desirable to minimize the quantity of the material used.

By chemically bonding a metal-filled elastomer 18 to a carbon-filled elastomer substrate 16, the amount of expensive metal filler used is minimized and the tear resistance and compression recovery of the gasket 14 substantially improved. In addition, the shielding effectiveness is substantially improved over the use of carbon-filled rubber alone. The product is easily cleaned to maintain shielding effectiveness and presents a neat appearance.

When the two elastomers 16 and 18 are simultaneously bonded under the pressure of co-extrusion, the unity of the resultant gasket is assured and electrical and physical results are optimum.

It will be understood that both layers 16 and 18 are conductive, except that the outer layer 18 is considerably more conductive while the inner layer 16 is less conductive but much stronger and with better physical properties. They are bonded by co-extrusion in a molecular sharing way, and thus provide a superior electrical shield over either one used alone.

The inner layer 16 is substantially thicker than the outer coating, preferably on the order of 5 - 20 times as thick when such layer 16 is hollow as preferred, preferably at a thickness ratio of 10:1, the outer coating 18 desirably being 2-8 mils thick and the inner support layer 16 being 5-160 mils thick, preferably 20-80 mils thick.

The inner support layer may be formed of a variety of elastomers, but preferably it comprises an elastomeric silicone polymer containing fumed silica and carbon black as reinforcers, plus a suitable cross-linking agent. Alternatively, the inner layer 16 may be composed of a non-conductive silicone elastomer, such as

one comprising silicone gum, fumed silica and a cross-linking agent. The covering layer 18 is suitably formed of an elastomeric silicone polymer filled with glass or copper beads coated with silver.

The following Example is offered illustratively.

EXAMPLE

Suitable materials from which to form the inner and outer cores are set forth below in Table 1, and the properties of the resultant gasket according to the present invention are set forth in Table 2 below.

Table 1

	<u>INNER CORE</u>	<u>OUTER CORE</u>
Silicone Polymer	100 parts by weight	100 parts by weight
Fumed Synthetic Silica	30 parts by weight	0
Carbon Black,		
Ketjen E300	20 parts by weight	0
Silver Coated Copper	0	70 parts by weight
DiCumyl Peroxide Curative,		
90% Active	2 parts by weight	2 parts by weight
Colorant		Selectable
Metal Bonding Agent	as applicable	0

Table 2

<u>Typical Combined Properties of Silicone & Carbon With Silver-Silicone Co-Extrusion Cover</u>	
Volume Resistivity, ASTM D-91	0.02 ohm-cm
Shielding Effectiveness, dB at 10 GHz Plane Wave	85 Minimum
Specific Gravity, combined	1.25
Tensile Strength, psi	700
Elongation, %	165
Tear Strength, lb/inch	67
Durometer Hardness, Shore A	60
Compression Set, Method B-22Hrs. @ 212°F	24%

CLAIMS

1. A flexible gasket element for counteracting electromagnetic interference, said element comprising a relatively thick elastomeric inner layer integral with a relatively thin elastomeric outer layer, said outer layer being of an elastomer which is metal filled for attenuation of electrical energy, and substantially the entire area of said outer layer being supported by the inner layer.

2. A gasket element according to claim 1 wherein said inner layer is conductive.

3. A gasket element according to claim 1 or claim 2 wherein said inner layer is formed of carbon filled rubber.

4. A gasket element according to claim 3 wherein the inner layer comprises a conductive, carbon-black and fumed silica reinforced silicone rubber.

5. A gasket element according to any preceding claim wherein the elastomer of said outer layer is rubber.

6. A gasket element according to any preceding claim wherein said inner layer has between 5 and 20 times the thickness of said outer layer.

7. A gasket element according to claim 6 wherein said inner layer has of the order of 10 times the thickness of said outer layer.

8. A gasket element according to any preceding claim wherein said outer layer is between 2 and 8 mils thick.



9. A gasket element according to any preceding claim wherein said inner and outer layers are chemically bonded together.

5 10. A gasket element according to any preceding claim wherein said inner and outer layers are co-extruded.

10 11. A gasket shield comprising a gasket element according to any preceding claim, and a metallic substrate to which the element is secured.

12. A shield according to claim 11 wherein the element is chemically locked to said substrate.

15 13. A gasket shield substantially as hereinbefore described with reference to the accompanying drawing.

