



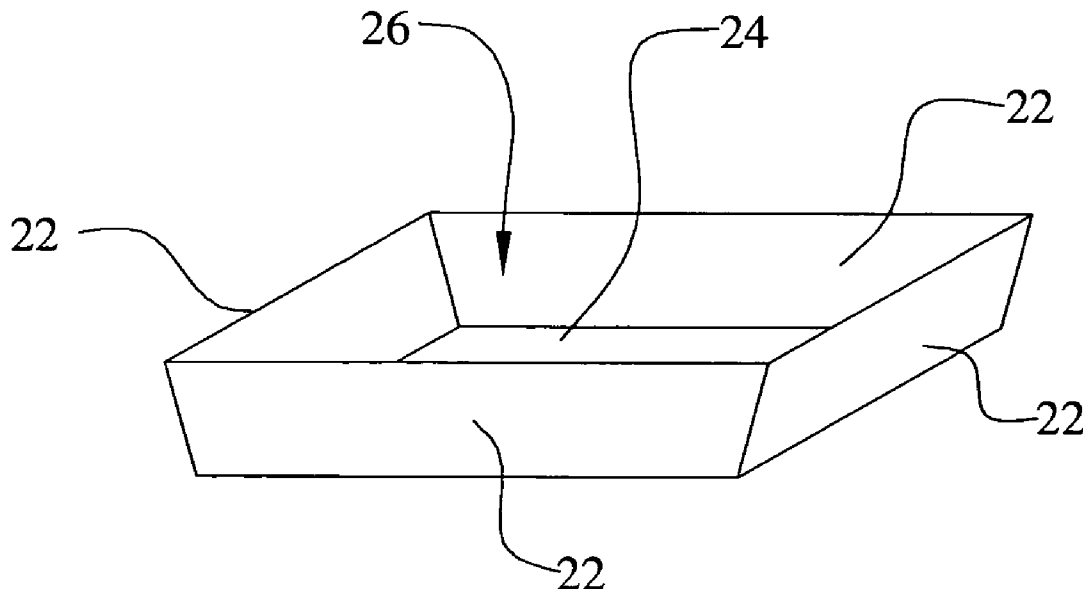
US 20050025919A1

(19) **United States**(12) **Patent Application Publication****Aisenbrey**(10) **Pub. No.: US 2005/0025919 A1**(43) **Pub. Date: Feb. 3, 2005**(54) **LOW COST CONDUCTIVE CONTAINERS
MANUFACTURED FROM CONDUCTIVE
LOADED RESIN-BASED MATERIALS**414, filed on Feb. 16, 2001. Provisional application
No. 60/317,808, filed on Sep. 7, 2001.(75) Inventor: **Thomas Aisenbrey, Littleton, CO (US)**

Correspondence Address:

STEPHEN B. ACKERMAN**28 DAVIS AVENUE****POUGHKEEPSIE, NY 12603 (US)**(73) Assignee: **Integral Technologies, Inc.**(21) Appl. No.: **10/929,299**(22) Filed: **Aug. 30, 2004****Related U.S. Application Data**(63) Continuation-in-part of application No. 10/309,429,
filed on Dec. 4, 2002, which is a continuation-in-part
of application No. 10/075,778, filed on Feb. 14, 2002,
now Pat. No. 6,741,221.(60) Provisional application No. 60/499,449, filed on Sep.
2, 2003. Provisional application No. 60/268,822, filed
on Feb. 15, 2001. Provisional application No. 60/269,**Publication Classification**(51) **Int. Cl.⁷ B65D 1/00**(52) **U.S. Cl. 428/35.2**(57) **ABSTRACT**

Conductive containers useful for anti-static devices are formed of a conductive loaded resin-based material. The conductive loaded resin-based material comprises micron conductive powder(s), conductive fiber(s), or a combination of conductive powder and conductive fibers in a base resin host. The percentage by weight of the conductive powder(s), conductive fiber(s), or a combination thereof is between about 20% and 50% of the weight of the conductive loaded resin-based material. The micron conductive powders are formed from non-metals, such as carbon, graphite, that may also be metallic plated, or the like, or from metals such as stainless steel, nickel, copper, silver, that may also be metallic plated, or the like, or from a combination of non-metal, plated, or in combination with, metal powders. The micron conductor fibers preferably are of nickel plated carbon fiber, stainless steel fiber, copper fiber, silver fiber, or the like.



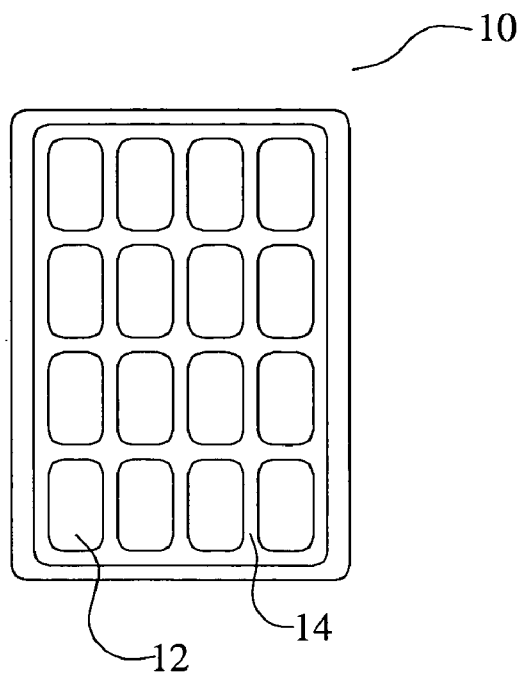


FIG. 1a

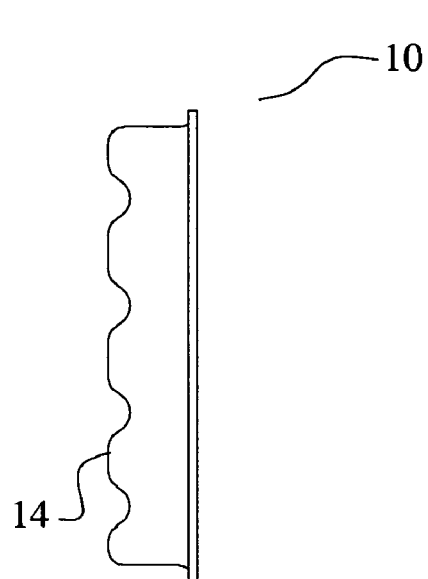


FIG. 1b

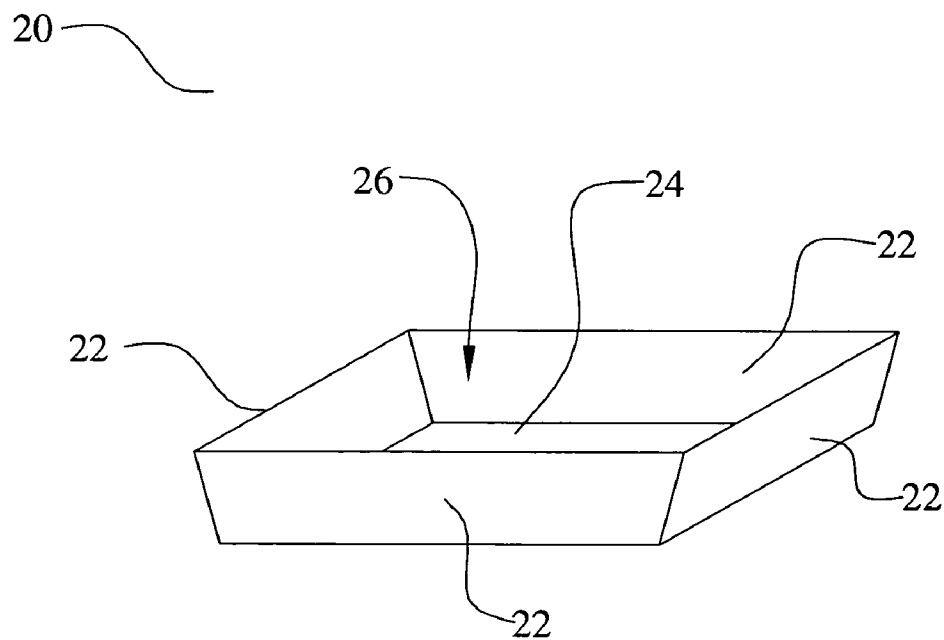


FIG. 1c

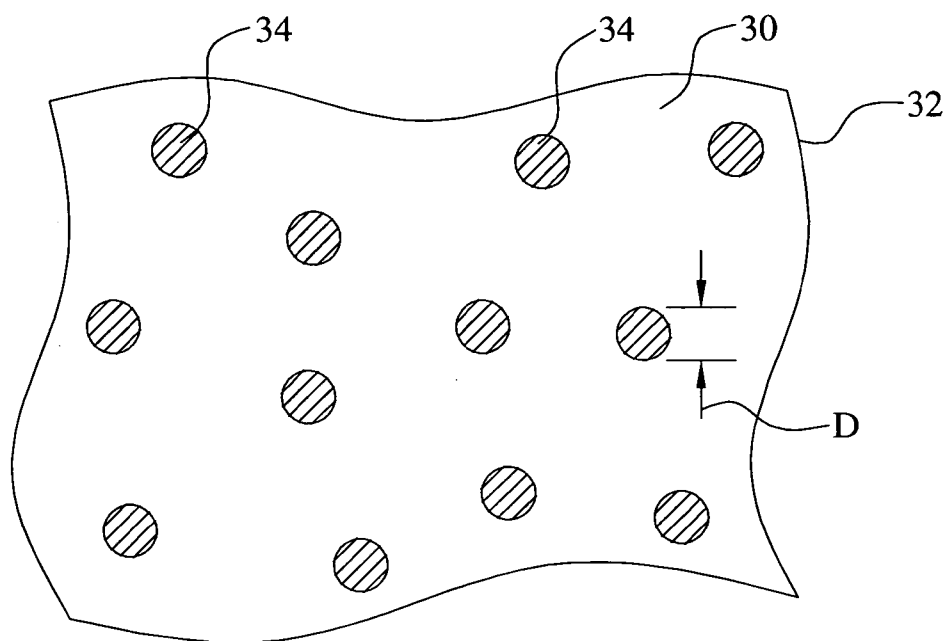


FIG. 2

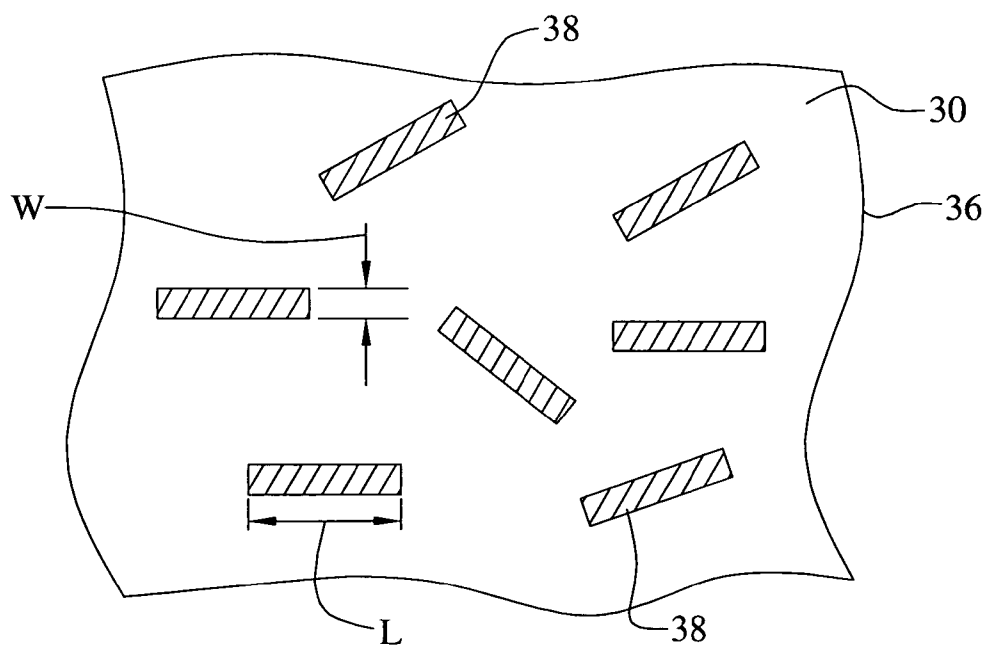


FIG. 3

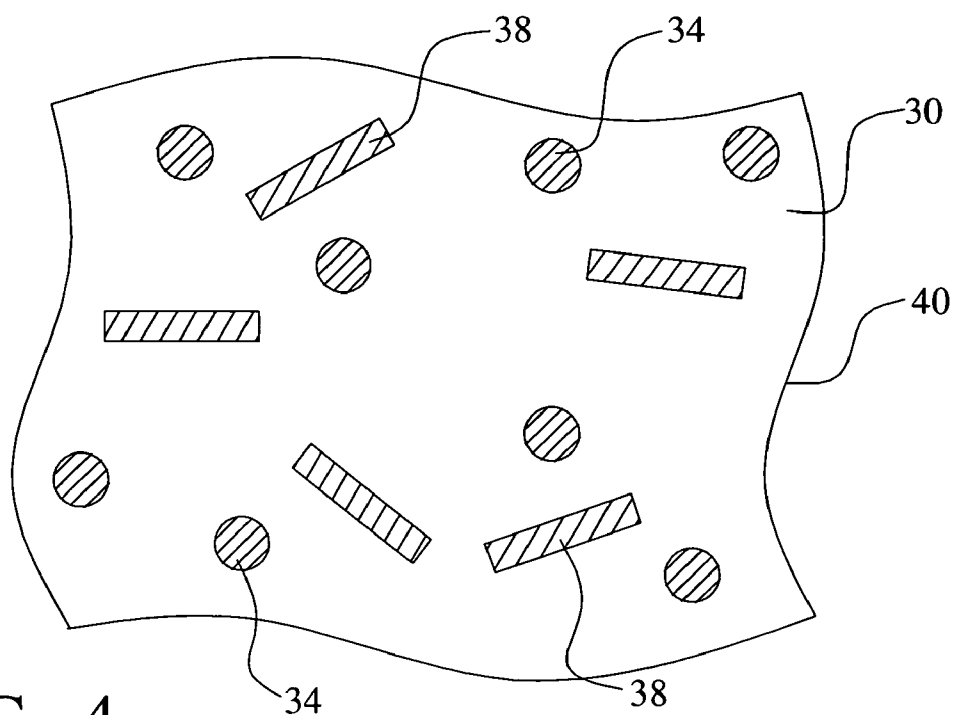


FIG. 4

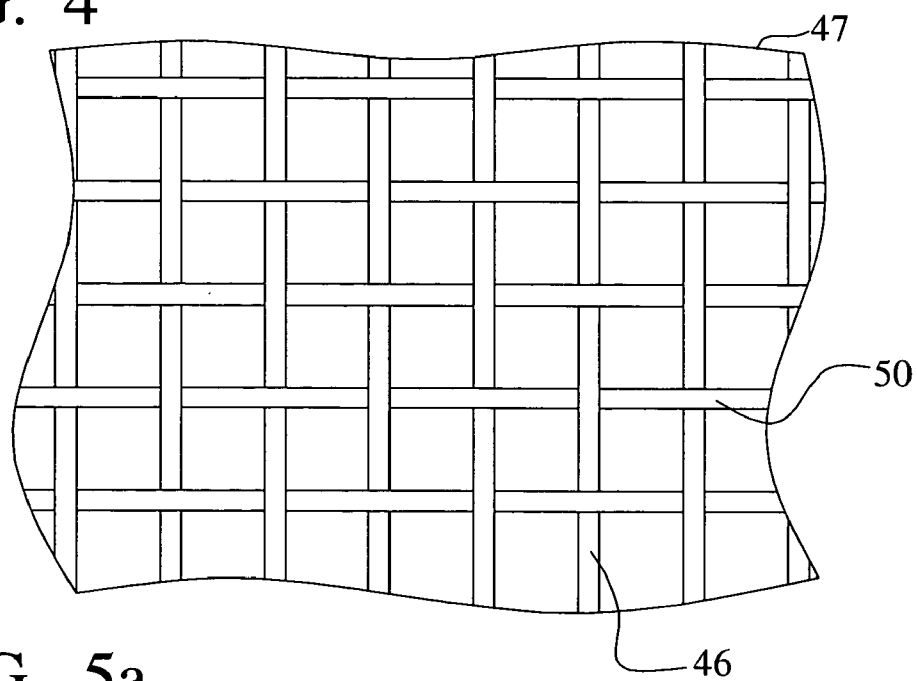


FIG. 5a

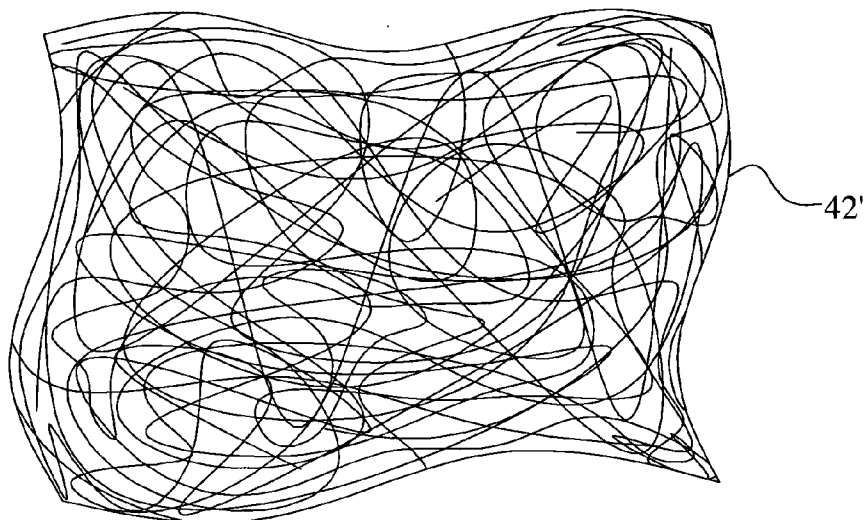


FIG. 5b

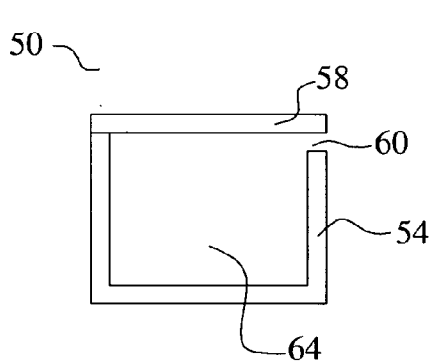


FIG. 6a

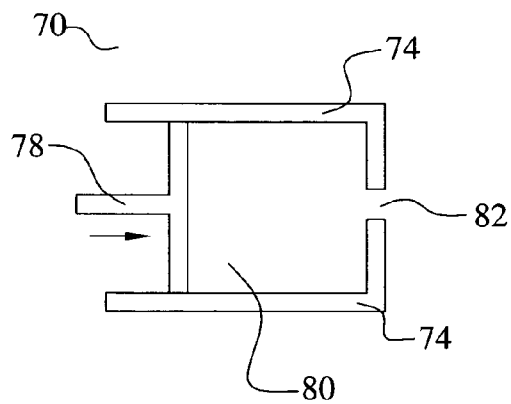


FIG. 6b

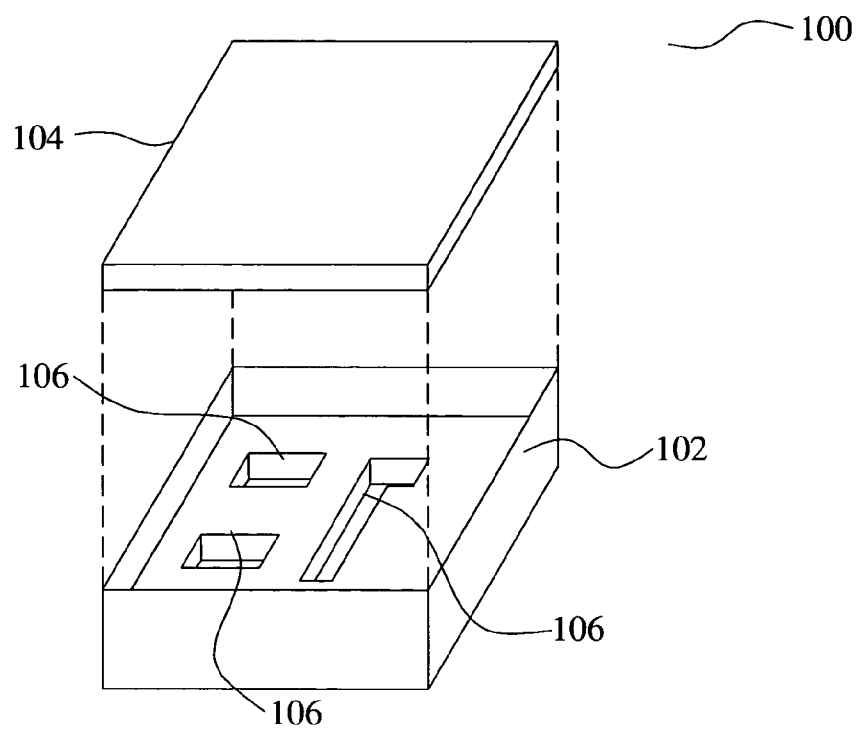


FIG. 7

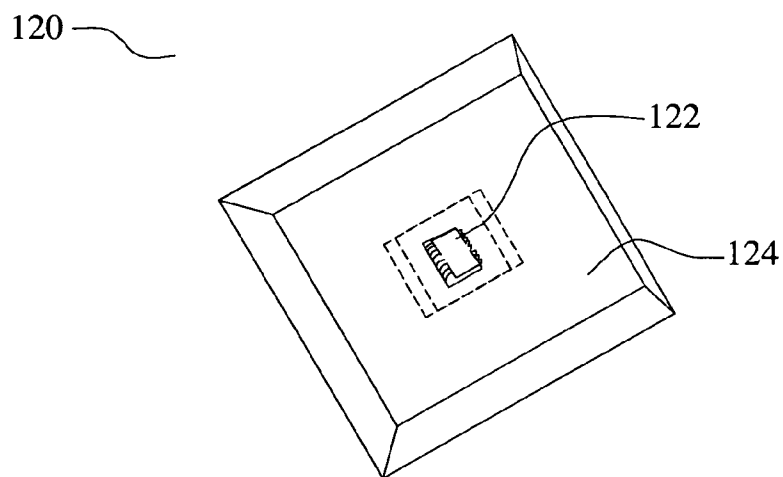


FIG. 8

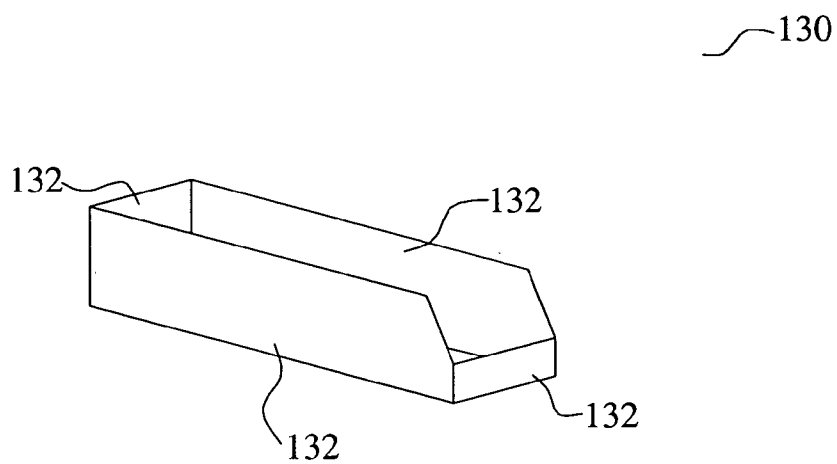


FIG. 9

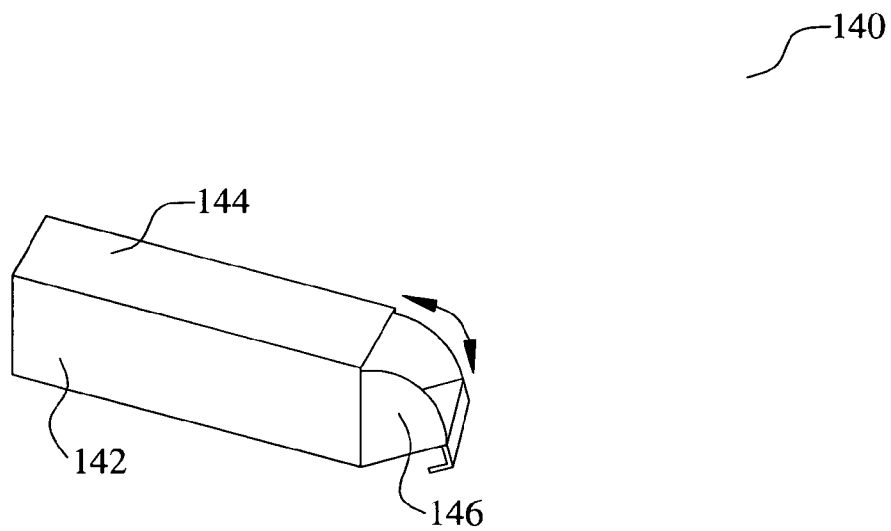


FIG. 10

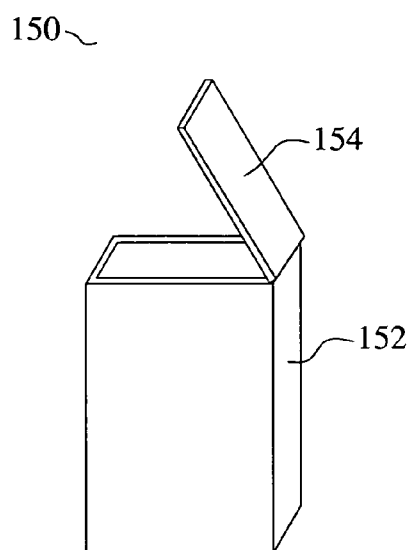


FIG. 11a

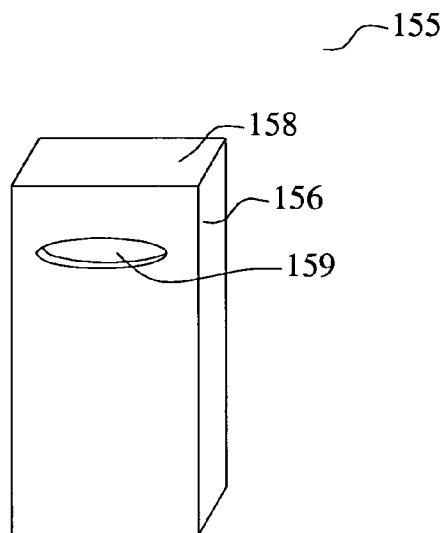


FIG. 11b

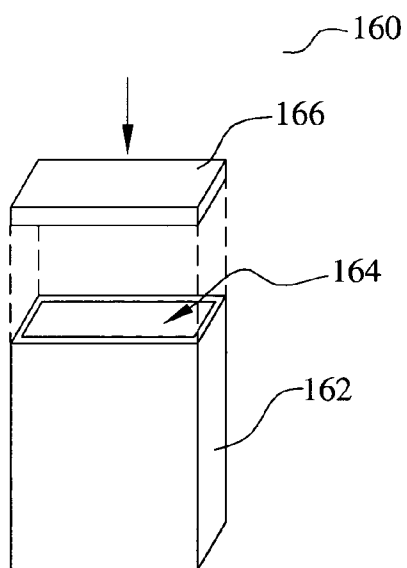


FIG. 11c

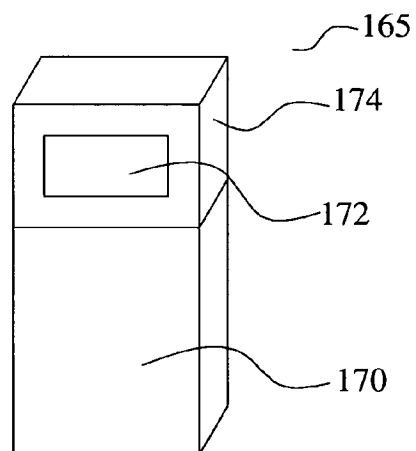


FIG. 11d

180

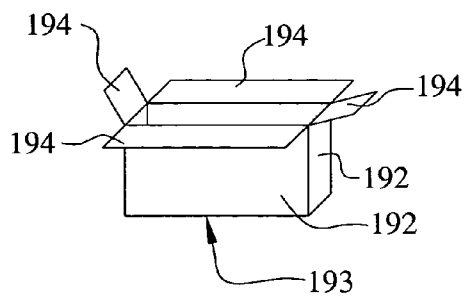


FIG. 12a

181

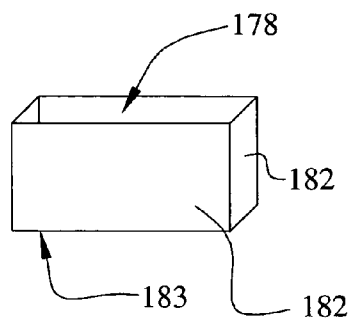


FIG. 12b

185

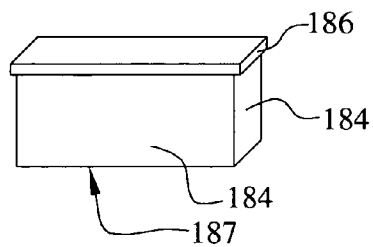


FIG. 12c

191

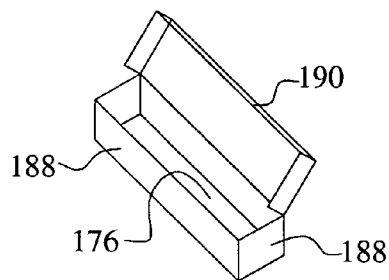


FIG. 12d

200

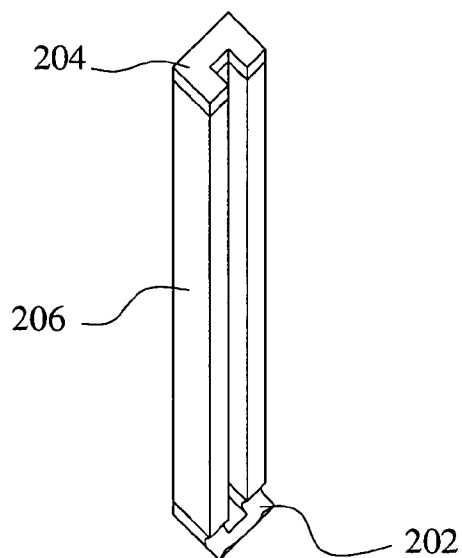


FIG. 13

210

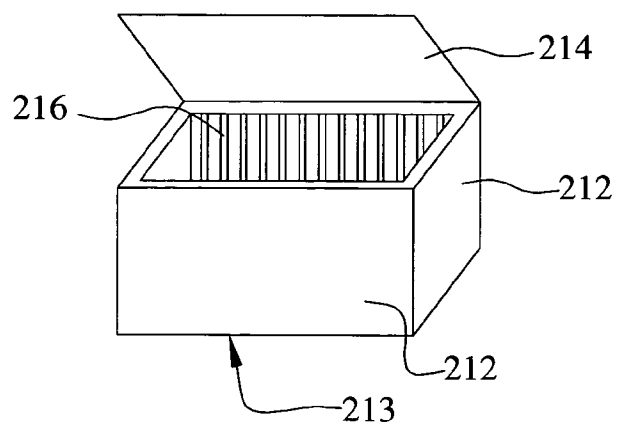


FIG. 14

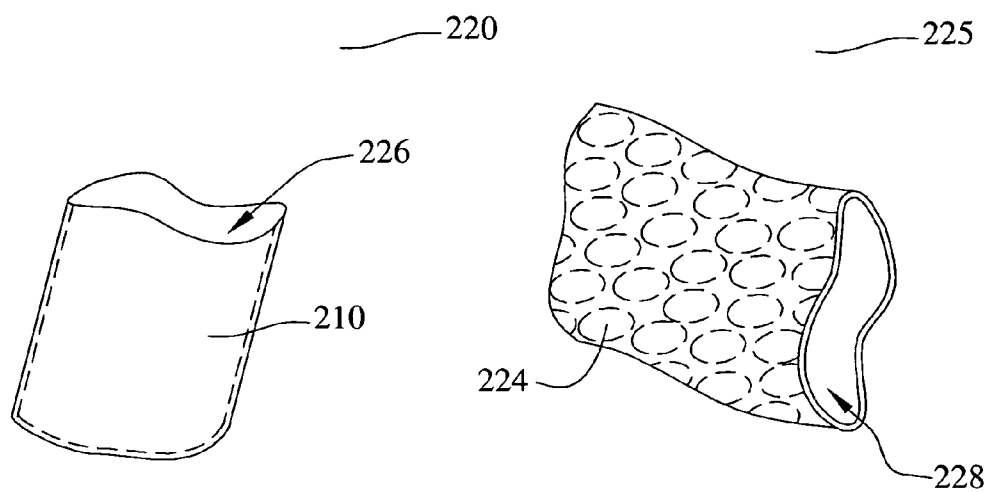


FIG. 15a

FIG. 15b

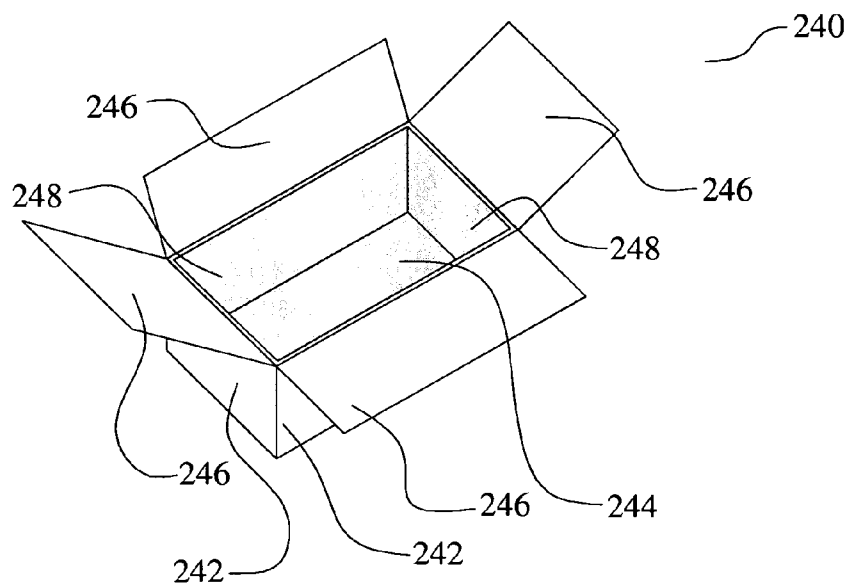


FIG. 16

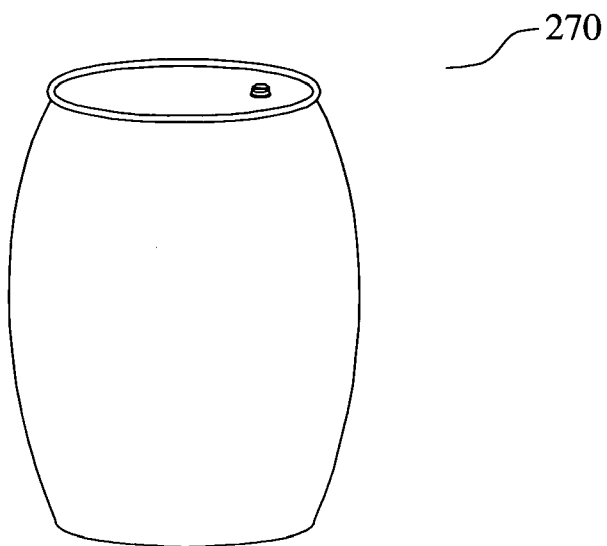


FIG. 17

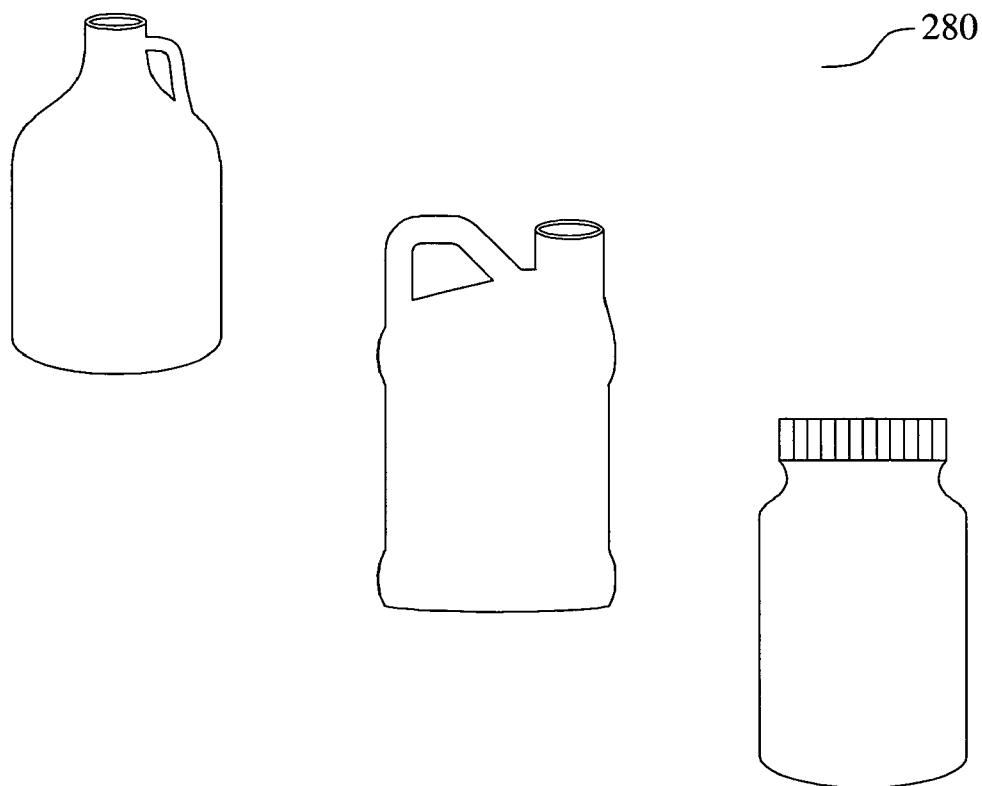


FIG. 18

LOW COST CONDUCTIVE CONTAINERS MANUFACTURED FROM CONDUCTIVE LOADED RESIN-BASED MATERIALS

[0001] This Patent Application claims priority to the U.S. Provisional Patent Application 60/499,449, filed on Sep. 2, 2003, which is herein incorporated by reference in its entirety.

[0002] This Patent Application is a Continuation-in-Part of INT01-002CIP, filed as U.S. patent application Ser. No. 10/309,429, filed on Dec. 4, 2002, also incorporated by reference in its entirety, which is a Continuation-in-Part application of docket number INT01-002, filed as U.S. patent application Ser. No. 10/075,778, filed on Feb. 14, 2002, which claimed priority to U.S. Provisional Patent Applications Ser. No. 60/317,808, filed on Sep. 7, 2001, Ser. No. 60/269,414, filed on Feb. 16, 2001, and Ser. No. 60/268,822, filed on Feb. 15, 2001.

BACKGROUND OF THE INVENTION

[0003] (1) Field of the Invention

[0004] This invention relates to conductive, or anti-static, containers and, more particularly, to trays, bins, boxes, dispensers, barrels, bags and the like, molded of conductive loaded resin-based materials comprising micron conductive powders, micron conductive fibers, or a combination thereof, homogenized within a base resin when molded. This manufacturing process yields a conductive part or material usable within the EMF or electronic spectrum(s).

[0005] (2) Description of the Prior Art

[0006] Many electronic devices, also known as electronic components, such as integrated circuits (ICs), are sensitive to electrostatic discharge (ESD). ESD is caused by the build-up of static charge resulting in voltage potentials of many thousands of volts. When a discharge event, such as merely handling a component, occurs, then a very short but intense pulse of energy is released. Although most electronic components are designed to provide discharge paths for this energy, it is highly preferred to avoid exposing the components to this energy pulse.

[0007] Therefore, throughout the fabrication, transportation, storage, and dispensing of electronic components, it is critical that electronic components be protected from experiencing ESD. If these electronic devices are subjected to ESD, they may become damaged and unusable in their intended application. Containers are widely used to accommodate the transportation, storage, and dispensing of electronic components sensitive to ESD. It is important that electronic component containers dissipate electrostatic charge and thereby prevent the accumulation of potentially damaging static charges.

[0008] In addition to the containment of electronic components themselves, it is also important that containers of certain other items be electrically conductive. For example, barrels, jugs, canisters, and other containers used to house hazardous/flammable materials should be constructed of a conductive material to prevent ignition due to static discharge.

[0009] Several prior art inventions relate to conductive, or anti-static, containers. U.S. Pat. No. 4,404,615 to Dep teaches an anti-static container for electronic circuit boards

and the like. More specifically, Dep teaches a generally rectangular box having an open top into which a liner formed of an anti-static substance is inserted. The liner is formed to include slots for supporting a plurality of circuit boards on edge in upwardly extending fashion. Dep further teaches the use of conductive rivets or lugs extending through the bottom portion of the box to connect the liner with an external ground plane, so that static charges cannot accumulate or be imparted to the circuit boards within the box.

[0010] U.S. Pat. No. 5,906,281 to Fujikawa et al teaches a box formed of corrugated cardboard having metallic foil adhered to the inner sidewalls of the box. A closed path is formed along the internal circumference of the packing box-thereby short-circuiting or shielding charged static electricity from the ESD sensitive devices contained therein.

[0011] U.S. Pat. No. 4,593,339 to Robinson teaches an anti-static carrying case for electrostatic sensitive circuit boards. U.S. Pat. No. 4,333,565 to Woods teaches an anti-static package for storage, transportation and field use of microcircuit devices which inhibits electrostatic charge buildup on the devices. U.S. patent application Publication U.S. 2002/0066692 A1 to Smith et al teaches a support structure for supporting a reticle or silicon wafer. In addition to retaining a wafer, the invention also creates a discharge path to remove electrostatic charges from the wafer. U.S. Pat. No. 5,518,120 to Ahlm et al teaches an anti-static package for protecting sensitive electronic components from electrostatic charges. U.S. Pat. No. 6,685,989 B2 to Bhat-tacharjee et al teaches anti-static cleanroom products having a coating of conductive polymeric particulates which decreases the surface resistivity of the products. U.S. Pat. No. 4,421,233 to Burnett teaches an anti-static tray for holding semi-conductor devices and components. The tray is formed of flat sheet metal with a layer of electrically conducting foam material on one side. U.S. patent application Publication U.S. 2003/0107195 A1 to Zambanini et al teaches an injection molded mobile maintenance cart made of electrostatic dissipative material comprising structural foam plastic.

SUMMARY OF THE INVENTION

[0012] A principal object of the present invention is to provide an effective conductive container.

[0013] A further object of the present invention is to provide a method to form a conductive container.

[0014] A further object of the present invention is to provide a conductive container molded of conductive loaded resin-based materials.

[0015] A yet further object of the present invention is to provide a conductive container molded of conductive loaded resin-based materials wherein the conductive loaded resin-based material provides a means of preventing and/or dissipating electrostatic charge.

[0016] A yet further object of the present invention is to provide a conductive container molded of conductive loaded resin-based material where the electrical characteristics can be altered or the visual characteristics can be altered by forming a metal layer over the conductive loaded resin-based material.

[0017] A yet further object of the present invention is to provide methods to fabricate a conductive container from a conductive loaded resin-based material incorporating various forms of the material.

[0018] A yet further object of the present invention is to provide a method to fabricate a conductive container from a conductive loaded resin-based material where the material is in the form of a fabric.

[0019] In accordance with the objects of this invention, a conductive container device is achieved. The device comprises a conductive loaded, resin-based material comprising conductive materials in a base resin host. The container device is capable of physically supporting an object during transport and is capable of conducting electrical charge or current.

[0020] Also in accordance with the objects of this invention, a conductive container device is achieved. The device comprises a conductive loaded, resin-based material comprising conductive materials in a base resin-host. The container device is capable of physically supporting an object during transport and is capable of conducting electrical charge or current. The percent by weight of the conductive materials is between about 20% and about 50% of the total weight of the conductive loaded resin-based material.

[0021] Also in accordance with the objects of this invention, a method to form a conductive container device is achieved. The method comprises providing a conductive loaded, resin-based material comprising conductive materials in a resin-based host. The conductive loaded, resin-based material is molded into a conductive container device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] In the accompanying drawings forming a material part of this description, there is shown:

[0023] FIGS. 1a and 1b illustrate a first preferred embodiment of the present invention showing a conductive tray comprising a conductive loaded resin-based material.

[0024] FIG. 1c illustrates another preferred embodiment of the present invention showing a conductive tray comprising a conductive loaded resin-based material.

[0025] FIG. 2 illustrates a first preferred embodiment of a conductive loaded resin-based material wherein the conductive materials comprise a powder.

[0026] FIG. 3 illustrates a second preferred embodiment of a conductive loaded resin-based material wherein the conductive materials comprise micron conductive fibers.

[0027] FIG. 4 illustrates a third preferred embodiment of a conductive loaded resin-based material wherein the conductive materials comprise both conductive powder and micron conductive fibers.

[0028] FIGS. 5a and 5b illustrate a fourth preferred embodiment wherein conductive fabric-like materials are formed from the conductive loaded resin-based material.

[0029] FIGS. 6a and 6b illustrate, in simplified schematic form, an injection molding apparatus and an extrusion molding apparatus that may be used to mold anti-static containers of a conductive loaded resin-based material.

[0030] FIG. 7 illustrates a multi-chambered conductive container comprising conductive loaded resin-based material.

[0031] FIG. 8 illustrates a transparent conductive container comprising conductive loaded resin-based material.

[0032] FIG. 9 illustrates a conductive shelf bin comprising conductive loaded resin-based material.

[0033] FIG. 10 illustrates a conductive storage bin comprising conductive loaded resin-based material.

[0034] FIGS. 11a, 11b, 11c, and 11d illustrate conductive trash bins comprising conductive loaded resin-based material.

[0035] FIGS. 12a, 12b, 12c, and 12d illustrate conductive shipping boxes comprising conductive loaded resin-based material.

[0036] FIG. 13 illustrates a conductive container used to dispense ICs. This container comprises conductive loaded resin-based material.

[0037] FIG. 14 illustrates a conductive carrying case comprising conductive loaded resin-based material.

[0038] FIGS. 15a and 15b illustrate conductive bags comprising conductive loaded resin-based material.

[0039] FIG. 16 illustrates a box containing a conductive liner comprising conductive loaded resin-based material.

[0040] FIG. 17 illustrates a conductive barrel comprising conductive loaded resin-based material.

[0041] FIG. 18 illustrates additional embodiments of jugs and canisters comprising conductive loaded resin-based material according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0042] This invention relates to anti-static containers molded of conductive loaded resin-based materials comprising micron conductive powders, micron conductive fibers, or a combination thereof, homogenized within a base resin when molded.

[0043] The conductive loaded resin-based materials of the invention are base resins loaded with conductive materials, which then makes any base resin a conductor rather than an insulator. The resins provide the structural integrity to the molded part. The micron conductive fibers, micron conductive powders, or a combination thereof, are homogenized within the resin during the molding process, providing the electrical continuity.

[0044] The conductive loaded resin-based materials can be molded, extruded or the like to provide almost any desired shape or size. The molded conductive loaded resin-based materials can also be cut, stamped, or vacuumed formed from an injection molded or extruded sheet or bar stock, over-molded, laminated, milled or the like to provide the desired shape and size. The thermal or electrical conductivity characteristics of anti-static containers fabricated using conductive loaded resin-based materials depend on the composition of the conductive loaded resin-based materials, of which the loading or doping parameters can be adjusted, to aid in achieving the desired structural, electrical or other

physical characteristics of the material. The selected materials used to fabricate the anti-static container devices are homogenized together using molding techniques and or methods such as injection molding, over-molding, insert molding, thermo-set, protrusion, extrusion or the like. Characteristics related to 2D, 3D, 4D, and 5D designs, molding and electrical characteristics, include the physical and electrical advantages that can be achieved during the molding process of the actual parts and the polymer physics associated within the conductive networks within the molded part(s) or formed material(s).

[0045] The use of conductive loaded resin-based materials in the fabrication of conductive containers significantly lowers the cost of materials and the design and manufacturing processes used to hold ease of close tolerances, by forming these materials into desired shapes and sizes. The containers can be manufactured into infinite shapes and sizes using conventional forming methods such as injection molding, over-molding, vacuum-forming, or extrusion or the like. The conductive loaded resin-based materials, when molded, typically but not exclusively produce a desirable usable range of resistivity from between about 5 and 25 ohms per square, but other resistivities can be achieved by varying the doping parameters and/or resin selection(s).

[0046] The conductive loaded resin-based materials comprise micron conductive powders, micron conductive fibers, or any combination thereof, which are homogenized together within the base resin, during the molding process, yielding an easy to produce low cost, electrically conductive, close tolerance manufactured part or circuit. The micron conductive powders can be of carbons, graphites, amines or the like, and/or of metal powders such as nickel, copper, silver, or plated or the like. The use of carbons or other forms of powders such as graphite(s) etc. can create additional low level electron exchange and, when used in combination with micron conductive fibers, creates a micron filler element within the micron conductive network of fiber(s) producing further electrical conductivity as well as acting as a lubricant for the molding equipment. The micron conductive fibers can be nickel plated carbon fiber, stainless steel fiber, copper fiber, silver fiber, or the like, or combinations thereof. The structural material is a material such as any polymer resin. Structural material can be, here given as examples and not as an exhaustive list, polymer resins produced by GE PLASTICS, Pittsfield, Mass., a range of other plastics produced by GE PLASTICS, Pittsfield, Mass., a range of other plastics produced by other manufacturers, silicones produced by GE SILICONES, Waterford, N.Y., or other flexible resin-based rubber compounds produced by other manufacturers.

[0047] The resin-based structural material loaded with micron conductive powders, micron conductive fibers, or in combination thereof can be molded, using conventional molding methods such as injection molding or over-molding, vacuum-forming, or extrusion to create desired shapes and sizes. The molded conductive loaded resin-based materials can also be stamped, cut or milled as desired to form create the desired shape form factor(s) of the conductive container. The doping composition and directionality associated with the micron conductors within the loaded base resins can affect the electrical and structural characteristics of the anti-static container, and can be precisely controlled by mold designs, gating and/or protrusion design(s) and/or

during the molding process itself. In addition, the resin base can be selected to obtain the desired thermal characteristics such as very high melting point or specific thermal conductivity.

[0048] A resin-based sandwich laminate could also be fabricated with random or continuous webbed micron stainless steel fibers or other conductive fibers, forming a cloth like material. The webbed conductive fiber can be laminated or the like to materials such as Teflon, Polyesters, or any resin-based flexible or solid material(s), which when discretely designed in fiber content(s), orientation(s) and shape(s), will produce a very highly conductive flexible cloth-like material. Such a cloth-like material could also be used in forming anti-static containers or liners as well as other resin materials such as rubber(s) or plastic(s). When using conductive fibers as a webbed conductor as part of a laminate or cloth-like material, the fibers may have diameters of between about 3 and 12 microns, typically between about 8 and 12 microns or in the range of about 10 microns, with length(s) that can be seamless or overlapping.

[0049] The conductive loaded resin-based material of the present invention can be made resistant to corrosion and/or metal electrolysis by selecting micron conductive fiber and/or micron conductive powder and base resin that are resistant to corrosion and/or metal electrolysis. For example, if a corrosion/electrolysis resistant base resin is combined with stainless steel fiber and carbon fiber/powder, then a corrosion and/or metal electrolysis resistant conductive loaded resin-based material is achieved. Another additional and important feature of the present invention is that the conductive loaded resin-based material of the present invention may be made flame retardant. Selection of a flame-retardant (FR) base resin material allows the resulting product to exhibit flame retardant capability. This is especially important in anti-static container applications as described herein.

[0050] The homogeneous mixing of micron conductive fiber and/or micron conductive powder and base resin described in the present invention may also be described as doping. That is, the homogeneous mixing converts the typically non-conductive base resin material into a conductive material. This process is analogous to the doping process whereby a semiconductor material, such as silicon, can be converted into a conductive material through the introduction of donor/acceptor ions as is well known in the art of semiconductor devices. Therefore, the present invention uses the term doping to mean converting a typically non-conductive base resin material into a conductive material through the homogeneous mixing of micron conductive fiber and/or micron conductive powder into a base resin.

[0051] As an additional and important feature of the present invention, the molded conductive loaded resin-based material exhibits excellent thermal dissipation characteristics. Therefore, containers manufactured from the molded conductive loaded resin-based material can provide added thermal dissipation capabilities to the application. For example, heat can be dissipated from electrical devices physically and/or electrically connected to a container of the present invention.

[0052] As a significant advantage of the present invention, conductive containers constructed of the conductive loaded resin-based material can be easily interfaced to an electrical circuit or, more importantly, grounded. In one embodiment,

a wire can be attached to a conductive loaded resin-based container via a screw that is fastened to a ground plane. For example, a simple sheet-metal type, self tapping screw, when fastened to the material, can achieve excellent electrical connectivity via the conductive matrix of the conductive loaded resin-based material. To facilitate this approach a boss may be molded into the conductive loaded resin-based material to accommodate such a screw. Alternatively, if a solderable screw material, such as copper, is used, then a wire can be soldered to the screw that is embedded into the conductive loaded resin-based material. In another embodiment, the conductive loaded resin-based material is partly or completely plated with a metal layer. The metal layer forms excellent electrical conductivity with the conductive matrix. A connection of this metal layer to another circuit or to ground is then made. For example, if the metal layer is solderable, then a soldered connection may be made between the conductive container and a grounding wire.

[0053] The conductive loaded resin-based material can be contacted in any of several ways. In one embodiment, a pin is embedded into the conductive loaded resin-based material by insert molding, ultrasonic welding, pressing, or other means. A connection with a metal wire can easily be made to this pin and results in excellent contact to the conductive loaded resin-based material. In another embodiment, a hole is formed in to the conductive loaded resin-based material either during the molding process or by a subsequent process step such as drilling, punching, or the like. A pin is then placed into the hole and is then ultrasonically welded to form a permanent mechanical and electrical contact. In yet another embodiment, a pin or a wire is soldered to the conductive loaded resin-based material. In this case, a hole is formed in the conductive loaded resin-based material either during the molding operation or by drilling, stamping, punching, or the like. A solderable layer is then formed in the hole. The solderable layer is preferably formed by metal plating. A conductor is placed into the hole and then mechanically and electrically bonded by point, wave, or reflow soldering. The contacting methods described herein are particularly useful for conductive containers of the present invention. For example, any of the embodiments described hereinafter can utilize these contacting methods in order to connect the anti-static container to a desired ground plane. In this manner, electrostatic charges are safely dissipated to ground without damage to ESD sensitive devices stored within the anti-static containers of the present invention.

[0054] Referring now to **FIGS. 1a** and **1b**, a first preferred embodiment of the present invention is illustrated. Several important features of the present invention are shown and discussed below. A multi-chambered conductive container or tray **10** is illustrated. **FIG. 1a** shows a top view of the tray **10**. **FIG. 1b** illustrates a side view of the same tray **10**. The tray **10** comprises a plurality of individual slots, or recessed chambers **12**, designed to temporarily house and/or transport electronic devices such as packaged ICs and the like. The individual recessed chambers **12** are separated by, for example, protruding ridges **14** which essentially surround the perimeter of each recessed chamber **12**. This tray **10** comprises conductive loaded resin-based material of the present invention.

[0055] The conductive loaded resin-based material provides an electrically conductive tray **10** which protects the

electronic devices stored thereupon from potential ESD damage. The conductive loaded resin-based material is highly conductive and is capable of high frequency response to provide an excellent energy dissipation path. The tray **10** of the present invention is superior to conventional plastic trays in that conventional plastic trays are unable to provide ESD protection. The tray **10** is superior to a conductive metal tray in that the conductive loaded resin-based material tray **10** is less costly to manufacture and is lower weight. The conductive loaded resin-based material of the present invention is uniquely formulated so as to provide a finished conductive container wherein the percent by weight of conductive materials is between about 20% and about 50% of the total weight of the conductive loaded resin-based material. This results in a superior balance between the characteristics of electrical conductivity, weight, manufacturability and cost. The particular dimensions of the tray **10**, recessed chambers **12**, and protruding ridges **14**, are established based on the size, weight, shape and logistic requirements of the devices to be stored and/or transported. Conductive loaded resin-based material of the present invention can be shaped into essentially any size and shape that is desired for a given application. The tray **10** is preferably formed by vacuum-forming, a process well known in the art of plastics fabrication. Alternately, the tray **10** is formed by other means such as injection molding or the like.

[0056] Referring now to **FIG. 1c**, an additional conductive tray **20** is shown. This anti-static capable tray **20** comprises conductive loaded resin-based material of the present invention. A single chamber **26** is formed in the conductive loaded resin-based material tray **20**. Walls **22** surround the single chamber **26**. These walls **22** and the floor or bottom of the tray **24** serve to contain ESD sensitive devices. The tray **20** is used to store and/or transport ESD-sensitive devices. The thickness, length, height, and width of the tray **20** are defined according to the total weight, size, shape, and other characteristics of the devices intended to be stored and/or transported within the tray **20**. Conductive loaded resin-based material of the present invention can be formed into anti-static trays of essentially any size and shape that is desired for a given application. The tray **20** is preferably formed by injection molding, a process well known in the art of plastics fabrication. Alternately, the tray **20** is formed by other means such as vacuum-forming, extrusion, heat pressing, or the like.

[0057] Referring now to **FIG. 7**, another preferred embodiment of the present invention is illustrated. **FIG. 7** illustrates another example of one of the many forms which multi-chambered conductive containers may take. The multi-chambered container **100** comprises conductive loaded resin-based material of the present invention. This container **100** comprises a base container **102** and a cover **104**. The base container **102** comprises one or more individual chambers **106** wherein ICs or other electronic devices are contained. These individual chambers **106** are formed in any shape and size necessary to house the desired devices. In an alternate embodiment, the cover **104** is omitted.

[0058] **FIG. 8** illustrates an exemplary transparent conductive container assembly **120**. This container is unique in that the electronic assembly **122** is visible through the transparent container body **124**. The transparent container body **124** comprises conductive loaded resin-based material of the present invention. The transparent characteristic is

achieved by selecting a base resin host which is transparent. The conductive loaded resin-based material container is formed into any shape that is beneficial for the application.

[0059] Referring now to **FIG. 9**, an exemplary conductive shelf bin **130** is illustrated. The shelf bin **130** comprises conductive loaded resin-based material of the present invention. The shelf bin **130** is used to contain ESD sensitive components. As with all of the anti-static containers of the present invention, the conductive loaded resin-based material provides an electrically conductive path to safely dissipate electrostatic charges so that the contained devices are protected against ESD. The walls **132** and floor or bottom, not shown, of the shelf bin **130** serve to contain ESD sensitive components.

[0060] Referring now to **FIG. 10**, a conductive storage bin **140** is illustrated. This anti-static storage bin **140** is formed with conductive loaded resin-based material sides **142**, top surface **144** and, for example, a pivoting door **146** also comprising conductive loaded resin-based material. The anti-static storage bin **140** is used to store ESD sensitive components. As with all of the anti-static containers presented in the present invention, the exact size, shape, wall thickness, host resin, and micron conductive particles are selected based on the needs of the particular application.

[0061] Referring now to **FIGS. 11a, 11b, 11c, 11d**, conductive, or anti-static, trash bins **150, 155, 160, and 165** comprising conductive loaded resin-based material are illustrated. Typical nonconductive trash bins found in the art tend to generate electrostatic buildup particularly when trash or a trash bag is added or removed from the trash bin. Anti-static trash bins **150, 155, 160, and 165** are beneficial in areas where the electrostatic buildup associated with typical nonconductive trash bins is a detriment to ESD sensitive devices located nearby. This is a particular concern in semiconductor manufacturing facilities where every precaution is taken to eliminate ESD. The anti-static trash bin **150** of **FIG. 11a** comprises an anti-static trash storage container **152** with an attached anti-static lid **154**. In an alternate embodiment **165** of **FIG. 11d**, an anti-static swinging door **172** is located on the side of the trash bin **165** to serve as a passageway through which trash is added and/or removed. In yet another preferred embodiment, this trash bin **165** comprises an anti-static upper portion **174** which is removable for the purpose of removing trash from the anti-static container **170**. The anti-static trash bin **155** of **FIG. 11b** represents a trash storage container **156** comprising a lid **158** and an open slot **159** where trash is inserted. The anti-static lid **158** is removable so that trash may be removed through the lid opening. The anti-static trash bin **160** of **FIG. 11c** represents an anti-static trash storage container **162** comprising an anti-static lid **166** which, when removed, exposes the open interior chamber **164** of the trash container. The trash bins illustrated in **FIGS. 11a, 11b, 11c, and 11d** represent only four of the many configurations conductive loaded resin-based material may be formed into to create anti-static trash containers in accordance with the present invention. For example, in another preferred embodiment not shown, conductive loaded resin-based material trash bins are formed of generally cylindrical shape having generally circular cross-section.

[0062] Referring now to **FIGS. 12a, 12b, 12c, and 12d**, conductive, or anti-static, boxes **180, 181, 185, and 191** are

shown. These boxes are used for shipping and/or storing ESD sensitive devices. The boxes comprise conductive loaded resin-based material of the present invention. The anti-static box **181** of **FIG. 12b** comprises anti-static sidewalls **182**, an anti-static floor or bottom portion **183** and an open top area **178**. The anti-static box **185** of **FIG. 12c** comprises anti-static sidewalls **184**, an anti-static floor or bottom portion **187**, an open top area, and an anti-static lid **186**. The anti-static box **191** of **FIG. 12d** comprises anti-static sidewalls **188**, an anti-static floor or bottom portion **176**, an open top area, in addition to the attached anti-static lid **190**. The anti-static box **180** of **FIG. 12a** comprises anti-static sidewalls **192**, an anti-static floor or bottom portion **193**, and one or more affixed anti-static flap(s) **194** which can be maneuvered into position to form a cover for the box of **FIG. 12a**.

[0063] Referring now to **FIG. 13**, a conductive, or anti-static, container **200** used for transporting and/or dispensing ICs is illustrated. The anti-static container **200** comprises conductive loaded resin-based material of the present invention. The anti-static container **200** further comprises an anti-static main storage sleeve **206**, an anti-static dispensing end cap **202**, and an anti-static lid **204**. This conductive loaded resin-based material container **200** is used in locations such as an electronic module assembly plant wherein the packaged ICs are dispensed and subsequently added to the electronic module as the module is being assembled. The size and shape of the anti-static container **200** are established so as to provide storage and dispensing for the particular ICs used in the application. The container **200** is further designed to hold and dispense only one unique IC or one family of ICs where non-universal keying is desired. In an alternate embodiment, the container **200** is designed to hold and dispense a broad range of ICs where universality is desired.

[0064] Referring now to **FIG. 14**, a conductive case **210** is illustrated. The case **210** is used for carrying ESD sensitive components or assemblies such as printed circuit boards. The carrying case **210** comprises conductive loaded resin-based material of the present invention. The case **210** further comprises anti-static sidewalls **212**, an anti-static floor or bottom **213**, an anti-static lid **214**, and anti-static slots **216**. The slots **216** serve to position the components or assemblies such as printed circuit boards within the case **210**. The slots **216** are formed as an integral portion of one or more of the sidewalls **212**. In an alternate embodiment, the slots **216** comprise a separate fixture that is inserted into the case **210**.

[0065] Referring now to **FIGS. 15a and 15b**, conductive bags **220 and 225** comprising conductive loaded resin-based material **210 and 224** are shown. The bags **220 and 225** are fabricated from relatively thin, flexible conductive loaded resin-based material of the present invention. The anti-static bag **220** of **FIG. 15a** is formed with one or more opening(s) **226** where ESD sensitive device(s) are inserted into the bag **220** for protection during storage and/or shipping or the like. The anti-static bag **225** of **FIG. 15b** is similar to the first bag **220** except that this bag **225** contains sealed air pockets or "bubbles" within the thickness of the bag material. The conductive loaded resin-based material of the present invention provides safe dissipation of electrostatic charges so that such charges cannot buildup and subsequently discharge in a manner harmful to the ESD sensitive devices contained therein. The bags **220 and 225** are each formed with at least

one opening where ESD sensitive devices may be inserted. After any such devices are contained therein, the opening(s) 226 and 228 are sealed, or alternately, the opening(s) 226 and 228 remain open.

[0066] Referring now to FIG. 16, a conductive box 240 is illustrated. The box 240 comprises a cardboard exterior 242 similar to cardboard boxes well known in the art. The unique feature of this anti-static box 240 is that the interior side-walls 248 and interior floor 244 comprise conductive loaded resin-based material of the present invention. The conductive loaded resin-based material serves to line the interior of the box 240 thus providing anti-static surfaces for ESD sensitive devices to contact while housed within the box. In an alternate embodiment, only the interior floor 244 comprises conductive loaded resin-based material. In yet another alternate embodiment, only the interior sidewalls 248 comprise conductive loaded resin-based material. In yet another embodiment, the interior of the cover flaps 246 comprise conductive loaded resin-based material of the present invention.

[0067] Referring now to FIG. 17, an electrically conductive barrel, or drum, 270 is shown. The barrel 270 is formed of conductive loaded resin-based material of the present invention. This barrel 270 is used to store, transport, and/or dispense a wide range of items. Such items include, but are not limited to, hazardous materials and flammable liquids. These hazardous and/or flammable materials benefit from the use of conductive loaded resin-based material barrels because this barrel material does not allow the buildup of electrostatic charges which might cause the contents to ignite. As previously stated, the conductive loaded resin-based material of the present invention is formed using many different combinations of conductive materials and host resin. The specific materials selected to fabricate the barrel 270 are selected from those which provide a clean, chemically inert environment for the hazardous and/or flammable liquids contained therein. In an exemplary embodiment, high density polyethylene serves as the host resin and is combined with micron fiber conductor. In another embodiment, the barrel 270 further comprises a lid. The barrel and lid are preferably constructed to mechanically fasten together either using a threaded connection, as in a screw-on lid, or some type latching connection as is well known in the art. In yet another exemplary embodiment, the barrel 270 contains spouts or spickets. The spouts are used for dispensing liquid from the barrel 270. The spouts comprise conductive loaded resin-based material of the present invention. Alternately, the spouts comprise other materials.

[0068] Referring now to FIG. 18, additional embodiments of jugs, canisters, and other containers 280 are shown. In each case, the canister 280 comprises the conductive loaded resin-based material of the present invention and provides excellent conductivity to prevent electrostatic discharge. Further, lids are constructed of the conductive loaded resin-based material. The jugs, canisters, and other containers 280 are constructed in various sizes and are particularly useful for containing hazardous/flammable materials.

[0069] Referring again to FIGS. 1a, 1b, and FIGS. 7 through 18, any of the conductive containers illustrated therein may also be configured so as to be grounded to an external ground plane as previously described.

[0070] If a metal layer, not shown, is used on any of the conductive containers, or anti-static, containers presented

herein, the metal layer may be formed by plating or by coating. If the method of formation is metal plating, then the resin-based structural material of the conductive loaded, resin-based material is one that can be metal plated. There are many of the polymer resins that can be plated with metal layers. For example, GE Plastics, SUPEC, VALOX, ULTEM, CYCOLAC, UGIKRAL, STYRON, CYCOLOY are a few resin-based materials that can be metal plated. The metal layer may be formed by, for example, electroplating or physical vapor deposition.

[0071] The conductive loaded resin-based material of the present invention typically comprises a micron powder(s) of conductor particles and/or in combination of micron fiber(s) homogenized within a base resin host. FIG. 2 shows cross section view of an example of conductor loaded resin-based material 32 having powder of conductor particles 34 in a base resin host 30. In this example the diameter D of the conductor particles 34 in the powder is between about 3 and 12 microns.

[0072] FIG. 3 shows a cross section view of an example of conductor loaded resin-based material 36 having conductor fibers 38 in a base resin host 30. The conductor fibers 38 have a diameter of between about 3 and 12 microns, typically in the range of 10 microns or between about 8 and 12 microns, and a length of between about 2 and 14 millimeters. The conductors used for these conductor particles 34 or conductor fibers 38 can be stainless steel, nickel, copper, silver, or other suitable metals or conductive fibers, or combinations thereof. These conductor particles and or fibers are homogenized within a base resin. As previously mentioned, the conductive loaded resin-based materials have a sheet resistance between about 5 and 25 ohms per square, though other values can be achieved by varying the doping parameters and/or resin selection. To realize this sheet resistance the weight of the conductor material comprises between about 20% and about 50% of the total weight of the conductive loaded resin-based material. More preferably, the weight of the conductive material comprises between about 20% and about 40% of the total weight of the conductive loaded resin-based material. More preferably yet, the weight of the conductive material comprises between about 25% and about 35% of the total weight of the conductive loaded resin-based material. Still more preferably yet, the weight of the conductive material comprises about 30% of the total weight of the conductive loaded resin-based material. Stainless Steel Fiber of 8-11 micron in diameter and lengths of 4-6 mm and comprising, by weight, about 30% of the total weight of the conductive loaded resin-based material will produce a very highly conductive parameter, efficient within any EMF spectrum. Referring now to FIG. 4, another preferred embodiment of the present invention is illustrated where the conductive materials comprise a combination of both conductive powders 34 and micron conductive fibers 38 homogenized together within the resin base 30 during a molding process.

[0073] Referring now to FIGS. 5a and 5b, a preferred composition of the conductive loaded, resin-based material is illustrated. The conductive loaded resin-based material can be formed into fibers or textiles that are then woven or webbed into a conductive fabric. The conductive loaded resin-based material is formed in strands that can be woven as shown. FIG. 5a shows a conductive fabric 42 where the fibers are woven together in a two-dimensional weave 46

and 50 of fibers or textiles. **FIG. 5b** shows a conductive fabric 42' where the fibers are formed in a webbed arrangement. In the webbed arrangement, one or more continuous strands of the conductive fiber are nested in a random fashion. The resulting conductive fabrics or textiles 42, see **FIG. 5a**, and 42', see **FIG. 5b**, can be made very thin, thick, rigid, flexible or in solid form(s).

[0074] Similarly, a conductive, but cloth-like, material can be formed using woven or webbed micron stainless steel fibers, or other micron conductive fibers. These woven or webbed conductive cloths could also be sandwich laminated to one or more layers of materials such as Polyester(s), Teflon(s), Kevlar(s) or any other desired resin-based material(s). This conductive fabric may then be cut into desired shapes and sizes.

[0075] Anti-static containers formed from conductive loaded resin-based materials can be formed or molded in a number of different ways including injection molding, extrusion or chemically induced molding or forming. **FIG. 6a** shows a simplified schematic diagram of an injection mold showing a lower portion 54 and upper portion 58 of the mold 50. Conductive loaded blended resin-based material is injected into the mold cavity 64 through an injection opening 60 and then the homogenized conductive material cures by thermal reaction. The upper portion 58 and lower portion 54 of the mold are then separated or parted and the anti-static containers are removed.

[0076] **FIG. 6b** shows a simplified schematic diagram of an extruder 70 for forming anti-static containers using extrusion. Conductive loaded resin-based material(s) is placed in the hopper 80 of the extrusion unit 74. A piston, screw, press or other means 78 is then used to force the thermally molten or a chemically induced curing conductive loaded resin-based material through an extrusion opening 82 which shapes the thermally molten curing or chemically induced cured conductive loaded resin-based material to the desired shape. The conductive loaded resin-based material is then fully cured by chemical reaction or thermal reaction to a hardened or pliable state and is ready for use. Thermoplastic or thermosetting resin-based materials and associated processes may be used in molding the conductive loaded resin-based articles of the present invention.

[0077] The advantages of the present invention may now be summarized. An effective conductive container is achieved. A method to form this conductive container is also achieved. The conductive container is molded of conductive loaded resin-based materials. The conductive loaded resin-based material provides a means of preventing and/or dissipating electrostatic charge such that electronic devices in contact with the container are protected against ESD. The conductive container is molded of conductive loaded resin-based material where the electrical characteristics can be altered or the visual characteristics can be altered by forming a metal layer over the conductive loaded resin-based material. Methods to fabricate a conductive container from a conductive loaded resin-based material incorporating various forms of the material including in the form of a fabric.

[0078] As shown in the preferred embodiments, the novel methods and devices of the present invention provide an effective and manufacturable alternative to the prior art.

[0079] While the invention has been particularly shown and described with reference to the preferred embodiments

thereof, it will be understood by those skilled in the art that various changes in form and details may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. A conductive container device comprising a conductive loaded, resin-based material comprising conductive materials in a base resin host wherein said container device is capable of physically supporting an object during transport and is capable of conducting electrical charge or current.

2. The device according to claim 1 wherein the percent by weight of said conductive materials is between about 20% and about 50% of the total weight of said conductive loaded resin-based material.

3. The device according to claim 1 wherein the percent by weight of said conductive materials is between about 20% and about 40% of the total weight of said conductive loaded resin-based material.

4. The device according to claim 1 wherein the percent by weight of said conductive materials is between about 25% and about 35% of the total weight of said conductive loaded resin-based material.

5. The device according to claim 1 wherein said conductive materials comprise metal powder.

6. The device according to claim 5 wherein said metal powder is nickel, copper, or silver.

7. The device according to claim 5 wherein said metal powder is a non-conductive material with a metal plating.

8. The device according to claim 7 wherein said metal plating is nickel, copper, silver, or alloys thereof.

9. The device according to claim 5 wherein said metal powder comprises a diameter of between about 3 μm and about 12 μm .

10. The device according to claim 1 wherein said conductive materials comprise non-metal powder.

11. The device according to claim 10 wherein said non-metal powder is carbon, graphite, or an amine-based material.

12. The device according to claim 1 wherein said conductive materials comprise a combination of metal powder and non-metal powder.

13. The device according to claim 1 wherein said conductive materials comprise micron conductive fiber.

14. The device according to claim 13 wherein said micron conductive fiber is nickel plated carbon fiber, or stainless steel fiber, or copper fiber, or silver fiber or combinations thereof.

15. The device according to claim 13 wherein said micron conductive fiber has a diameter of between about 3 μm and about 12 μm and a length of between about 2 mm and about 14 mm.

16. The device according to claim 13 wherein the percent by weight of said micron conductive fiber is between about 20% and about 40% of the total weight of said conductive loaded resin-based material.

17. The device according to claim 13 wherein said micron conductive fiber is stainless steel and wherein the percent by weight of said stainless steel fiber is between about 20% and about 40% of the total weight of said conductive loaded resin-based material.

18. The device according to claim 17 wherein said stainless steel fiber has a diameter of between about 3 μm and about 12 μm and a length of between about 2 mm and about 14 mm.

19. The device according to claim 1 wherein said conductive materials comprise a combination of conductive powder and conductive fiber.

20. The device according to claim 19 wherein said conductive fiber is stainless steel.

21. The device according to claim 1 wherein said base resin and said conductive materials comprise flame-retardant materials.

22. The device according to claim 1 further comprising a metal layer overlying said conductive loaded resin-based material.

23. The device according to claim 1 further comprising slots, chambers, or pockets of said conductive loaded resin-based material to support multiple said objects.

24. The device according to claim 1 further comprising a lid of said conductive loaded resin-based material.

25. The device according to claim 1 wherein said conductive loaded resin-based material is transparent.

26. The device according to claim 1 further comprising an electronic device that is encapsulated by said container device.

27. The device according to claim 1 further comprising side walls and a bottom of said conductive loaded resin-based material.

28. The device according to claim 27 wherein one side wall is of reduced height or is tilted to allow side access to said object in said container device.

29. The device according to claim 27 wherein said device comprises a trash receptacle.

30. The device according to claim 1 wherein said device comprises a flexible bag of said conductive loaded resin-based material.

31. The device according to claim 30 wherein said flexible bag comprises bubble wrapping.

32. The device according to claim 1 wherein said device is a jug, canister, drum or barrel.

33. A conductive container device comprising a conductive loaded, resin-based material comprising conductive materials in a base resin host wherein said container device is capable of physically supporting an object during transport and is capable of conducting electrical charge or current wherein the percent by weight of said conductive materials is between about 20% and about 50% of the total weight of said conductive loaded resin-based material.

34. The device according to claim 33 wherein the percent by weight of said conductive materials is between about 20% and about 40% of the total weight of said conductive loaded resin-based material.

35. The device according to claim 33 wherein the percent by weight of said conductive materials is between about 25% and about 35% of the total weight of said conductive loaded resin-based material.

36. The device according to claim 33 wherein said conductive materials comprise metal powder.

37. The device according to claim 36 wherein said metal powder is a non-conductive material with a metal plating.

38. The device according to claim 33 wherein said conductive materials comprise non-metal powder.

39. The device according to claim 33 wherein said conductive materials comprise a combination of metal powder and non-metal powder.

40. The device according to claim 33 wherein said conductive materials comprise micron conductive fiber.

41. The device according to claim 40 wherein the percent by weight of said micron conductive fiber is between about 20% and about 40% of the total weight of said conductive loaded resin-based material.

42. The device according to claim 40 wherein said micron conductive fiber is stainless steel and wherein the percent by weight of said stainless steel fiber is between about 20% and about 40% of the total weight of said conductive loaded resin-based material.

43. The device according to claim 33 wherein said conductive materials comprise a combination of conductive powder and conductive fiber.

44. The device according to claim 43 wherein said conductive fiber is stainless steel.

45. The device according to claim 33 further comprising a metal layer overlying said conductive loaded resin-based material.

46. The device according to claim 33 further comprising slots, chambers, or pockets of said conductive loaded resin-based material to support multiple said objects.

47. The device according to claim 33 further comprising a lid of said conductive loaded resin-based material.

48. The device according to claim 33 wherein said conductive loaded resin-based material is transparent.

49. The device according to claim 33 further comprising an electronic device that is encapsulated by said container device.

50. The device according to claim 33 further comprising side walls and a bottom of said conductive loaded resin-based material.

51. The device according to claim 50 wherein one side wall is of reduced height or is tilted to allow side access to said object in said container device.

52. The device according to claim 50 wherein said device comprises a trash receptacle.

53. The device according to claim 33 wherein said device comprises a flexible bag of said conductive loaded resin-based material.

54. The device according to claim 53 wherein said flexible bag comprises bubble wrapping.

55. The device according to claim 33 wherein said device is a jug, canister, drum or barrel.

56. A method to form a conductive container device, said method comprising:

providing a conductive loaded, resin-based material comprising conductive materials in a resin-based host; and

molding said conductive loaded, resin-based material into said conductive container device.

57. The method according to claim 56 wherein the percent by weight of said conductive materials is between about 20% and about 40% of the total weight of said conductive loaded resin-based material.

58. The method according to claim 56 wherein said conductive materials comprise micron conductive fiber.

59. The method according to claim 58 wherein said micron conductive fiber is nickel plated carbon fiber, or stainless steel fiber, or copper fiber, or silver fiber or combinations thereof.

60. The method according to claim 58 wherein said micron conductive fiber has a diameter of between about 3 μm and about 12 μm and a length of between about 2 mm and about 14 mm.

61. The method according to claim 58 wherein the percent by weight of said micron conductive fiber is between about 20% and about 40% of the total weight of said conductive loaded resin-based material.

62. The method according to claim 58 wherein said micron conductive fiber is stainless steel and wherein the percent by weight of said stainless steel fiber is between about 20% and about 40% of the total weight of said conductive loaded resin-based material.

63. The method according to claim 62 wherein said stainless steel fiber has a diameter of between about 3 μm and about 12 μm and a length of between about 2 mm and about 14 mm.

64. The method according to claim 56 wherein said conductive materials comprise conductive powder.

65. The method according to claim 56 wherein said conductive materials comprise a combination of conductive powder and conductive fiber.

66. The method according to claim 56 wherein said molding comprises:

injecting-said conductive loaded, resin-based material into a mold;

curing said conductive loaded, resin-based material; and
removing said conductive container device from said mold.

67. The method according to claim 56 wherein said molding comprises:

loading said conductive loaded, resin-based material into a chamber;

extruding said conductive loaded, resin-based material out of said chamber through a shaping outlet; and

curing said conductive loaded, resin-based material to form said conductive container device.

68. The method according to claim 56 further comprising subsequent mechanical processing of said molded conductive loaded, resin-based material.

69. The method according to claim 56 further comprising overlying a layer of metal on said molded conductive loaded, resin-based material.

70. The method according to claim 56 wherein said molding comprises:

loading said conductive loaded, resin-based material into a chamber;

vacuum forming said conductive loaded, resin-based material; and

removing said conductive container device from said mold.

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