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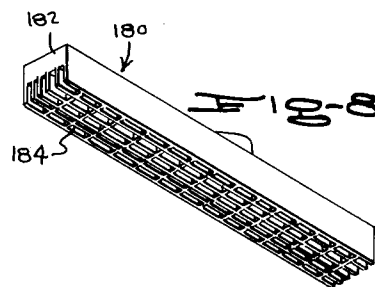
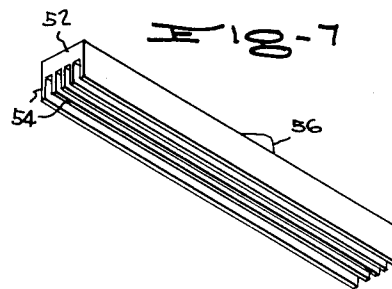
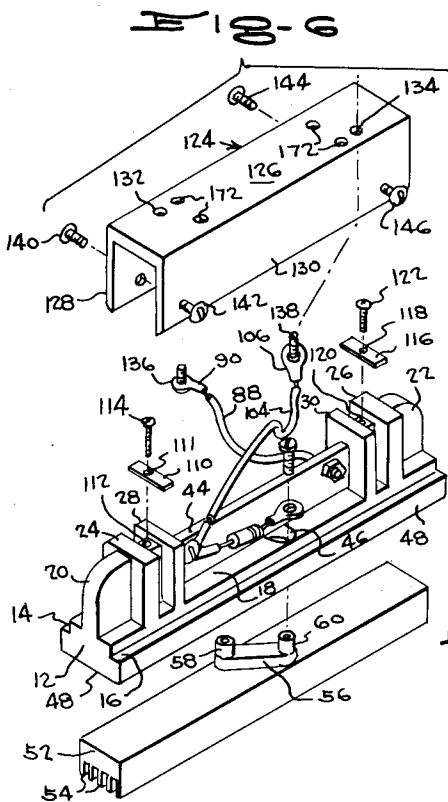
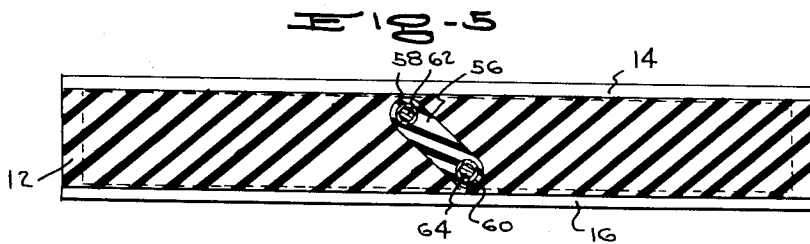
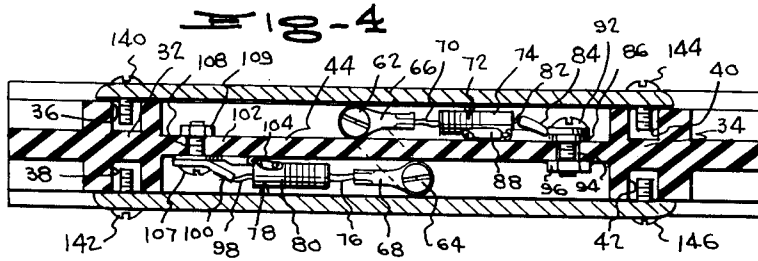
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2,985,798

ELECTROSTATIC DISCHARGE APPARATUS

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2 Sheets-Sheet 2



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ELECTROSTATIC DISCHARGE APPARATUS

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3 Claims. (Cl. 317—2)

This invention relates to electrostatic discharge devices and, more specifically, the invention pertains to especially designed means for connection with furniture utilized in hospital operating rooms or in other areas wherein inflammable gases, dust mixtures, etc., are present, the means effectively electrically grounding the furniture to prevent explosion of the inflammable gas or dust mixtures by an electrically generated spark.

For understandable reasons, the public is seldom informed of explosions which occur in hospital operating rooms. However, such explosions are not infrequent and are of sufficient violence to not only do serious bodily harm to the occupants of the operating room but also, in some cases, causes fatalities.

Investigation and study of fires and explosions which have occurred in hospital operating rooms have resulted in the conclusion that approximately ninety percent of them have been caused by electrostatic sparks. As a result of these conclusions, the National Fire Protection Association has enumerated a considerable number of precautionary recommendations in its pamphlet No. 56, dated July, 1956, to which further reference will be made below. The safety code set forth in this pamphlet has been adapted by a large number of governmental agencies, Federal, State and municipal. The association will be hereinafter referred to by the letters "NFPA."

From studies made by governmental agencies and private organizations, it has also been determined that human beings are generally unable to feel an electrical current flow if it is less than 1.0 milliamperes. As a result of this determination, various types of floors and floor coverings incorporating sufficient resistance to prevent electrical current to flow in excess of this value have been developed. These floors and floor coverings range from vitrified tile to plastic and rubber, all incorporating acetylene carbon in order to increase their conductivity. Some of these meet the recommendations of code 56 but it must be pointed out that the plastic and rubber types tend to lose their conductivity with age after an installation ranging from four to five years. The terazzo grid floors fail to meet the recommendations of code 56 because they present a short circuit to the metal strips, resulting in excessive current flow, and until recently there has been no satisfactory means of connecting the furniture and personnel to the floor. The availability of satisfactory devices to accomplish this has, of course, had a restraining influence on the recommendations made by the NFPA. This is evidenced by the NFPA recommendations in code 56 that the conductive casters and leg tips of conductive rubber be used as being the best available means, at the time of the recommendations, to provide a positive electrical path to ground. It is now generally conceded, however, that these devices are not satisfactory due to the fact that they lose their conductivity in a relatively short period of time. In addition to this, any variations in the conductivity of the flooring at dif-

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ferent points is not compensated for and can, in some cases, permit current flow in excess of safe limits.

To point up and to stress the seriousness of the electrostatic hazard in operating rooms, certain sections of the NFPA code No. 56 are quoted below:

SECTION 6

Reduction of electrostatic hazard

6-1. GENERAL

The requirements of this section have been formulated for the purpose of reducing the possibility of electrostatic spark discharges and, hence, of the ignition of flammable gases by the energy liberated thereby, and shall be complied with in storage rooms for combustible anesthetic agents located in the surgical suite and anesthetizing locations (see sections 2—1, 2—2), in corridors immediately serving the anesthetizing locations and in rooms such as sterilizing rooms, directly communicating with anesthetizing locations. (See also section 13—2.)

6-2. CONDUCTIVE FLOORING

(a) Resistance. (See also appendix A-6-2.)

(1) To prevent the accumulation of dangerous electrostatic charges, the surface of the floor in the locations specified by section 6-1 shall provide a path of moderate electrical conductivity between all persons and equipment making contact with the floor. No point on a non-conductive element in the surface of the floor shall be more than ¼ inch from a conductive element of the surface.

NOTE.—It is not necessary to provide a special floor-to-ground connection unless required by the authority having jurisdiction.

(2) The resistance of the conductive floor shall be less than 1,000,000 ohms as measured between two electrodes placed three feet apart at any points on the floor.

(3) For additional protection against electric shock, the resistance of the floor shall be more than 25,000 ohms, as measured between a ground connection and an electrode placed at any point on the floor, and also as measured between two electrodes placed 3 feet apart at any points on the floor.

6-3. FURNITURE

(a) All furniture shall be constructed of metal or of other electrically conductive material to provide an electrically conductive path to the floor. Surfaces on which movable objects may be placed should be without paint, lacquer, or other insulating finish. Casters, tires or leg tips shall be of metal or conductive rubber, or equivalent conducting material, with a floor contact surface having one dimension of at least ⅝ inch.

(b) If conductive casters, tires, or leg tips are used, the resistance between the metallic frame of the furniture and a metallic plate placed under one supporting member but insulated from the floor shall not exceed 250,000 ohms, measured with an ohmmeter of the type described in section 6-2(b).

(c) Approved equivalent means of making electrical contact between the piece of furniture and the floor are acceptable provided the contact device is firmly bonded to the piece of furniture, is made of a material which does not oxidize under conditions of normal use to decrease the conductivity of the circuit, and the contact with the floor is at least ⅝ inch in one dimension.

SECTION 13

Electrostatic hazards

13-1. REDUCTION OF ELECTROSTATIC HAZARD

Part II, section 6 of these recommendations deals with the elements required to be incorporated into the structure

to reduce the possibility of electrostatic spark charges which are a frequent source of the ignition of combustible anesthetic agents.

13-2. GENERAL

The elimination of static charges is dependent on the vigilance of administrative activities in materials purchase, supervision and periodical inspection. It cannot be too strongly emphasized that a partial chain of precautions will generally increase the electrostatic hazard. For example: Conductive flooring (section 6-2) may be ineffective unless all personnel wear conductive shoes and unless all objects in the room are electrically continuous with the floor.

13-5. PERSONNEL

(e) Conductive footwear and other personnel-to-floor connective devices should be tested on the wearer each time they are worn. An approved resistance measuring device having a short-circuit current not exceeding 0.5 milliampere shall be used. The reading may be taken between two insulated, non-oxidizing, metal plates so located that the wearer can stand in a normal manner with a foot on each, in which case the indicated resistance must not exceed 1,000,000 ohms (1 megohm).

13-10. TESTING AND MAINTENANCE

(b) To be effective conductive floors must not be insulated by a film of oil or wax. Any waxes, polishes or dressings used for floor maintenance of conductive floors should not adversely affect the resistance of the floor.

A-6-2. CONDUCTIVE FLOORING

A conductive floor need not be provided with a special grounding connection to prevent the accumulation of charges due to the motion of objects or persons resting on it. To be effective it is necessary only that it be conductive and that the persons and objects be electrically connected to it. Considerable conductivity to ground is generally attained in the usual construction, often because of the proximity of grounded conduits and water pipes. This incidental conductivity to ground and the large area, and therefore capacitance of the floor, make any hazard due to the entry of charged persons or objects into the protected zone negligible, provided such persons and objects have proper conductivity to the floor. Grounded objects within the room, such as portable electrical equipment, will be electrically connected to the floor by the requirements of section 6, and will thus ground the floor, so that such objects do not increase this electrostatic hazard. Therefore, a special grounding connection need not be incorporated in the floor for electrostatic protection, unless desired or otherwise required.

A-13-5. PERSONNEL

One method for electrically connecting all persons to conductive floors is through the wearing of shoes conforming to the following specifications:

Each shoe having a sole and heel of conductive rubber, conductive leather, or equivalent material, should be so fabricated that the resistance between a metal electrode placed inside the shoe and making contact with the inner sole equivalent in pressure and area to normal contact with the foot, and a metal plate making contact with the bottom of the shoe, equivalent in pressure and area to normal contact with the floor, shall be not more than 250,000 ohms.

The ohmmeter described in section 6-2(b)-2 may be used for testing personnel, if a one-megohm resistor is introduced into the measuring circuit. The "one-megohm" mark on the ohmmeter scale then becomes the "zero" reference point for personnel resistance measurements.

To the end that electrostatically produced fires and explosions in hospital operating rooms may be completely eliminated or materially reduced, it is one of the primary objects of this invention to provide a grounding device for utilization with hospital operating room furniture,

the device being mechanically constructed so as to insure a positive electrical ground.

Another object of this invention is to provide a grounding device or, as it is known in the trade, a bonding device for interconnecting operating room equipment with terazzo floors having metal divider strips spaced not more than 6 inches apart in either direction.

A further object of this invention is to provide a bonding device of the type generally referred to above, wherein the grounding terminal includes a plurality of strips of conductive rubber secured to the equipment in a floating mounting.

Still another object of this invention is to provide a bonding device which may be secured to the hospital equipment in such a manner that it does not protrude beyond the edges of the equipment, and the normal movement of the equipment is not hampered by or interfered with the use of the device.

This invention contemplates, as a still further object thereof, the provision of a bonding device of the type referred to supra, which is self-cleaning.

A still further object of this invention is to provide a bonding device of the type described which is non-complex in construction and assembly, inexpensive to manufacture, and which is durable in use.

Other and further objects and advantages of the instant invention will become more evident from a consideration of the following specification when read in conjunction with the annexed drawings, in which:

Figure 1 is a perspective view of a bonding device constructed in accordance with the present invention, the bonding device being illustrated in an operative installation;

Figure 2 is an enlarged detail cross-sectional view of the bonding device illustrated in Figure 1, Figure 2 being taken substantially on the vertical plane of line 2-2 of Figure 1, looking in the direction of the arrows;

Figure 3 is an enlarged detail cross-sectional view taken substantially on the vertical plane of line 3-3 of Figure 2, looking in the direction of the arrows;

Figure 4 is an enlarged detail cross-sectional view taken substantially on the horizontal plane of line 4-4 of Figure 3, looking in the direction of the arrows;

Figure 5 is an enlarged detail cross-sectional view taken substantially on the horizontal plane of line 5-5 of Figure 3, looking in the direction of the arrows;

Figure 6 is an exploded perspective view of the bonding device illustrated in Figure 1;

Figure 7 is a perspective view of one embodiment of the conductive rubber strips utilized in the bonding device;

Figure 8 is a perspective view of a second form of the conductive rubber element; and,

Figure 9 illustrates a modified form of the construction of one of the resistance elements.

Referring now more specifically to the drawings, reference numeral 10 designates, in general, a bonding device constructed in accordance with the teachings of the present invention. The device 10 is seen to comprise an elongated substantially rectangular main body portion 12 having opposed laterally spaced grooves 14, 16 extending inwardly from each of it longitudinally extending marginal edges and forming a platform 18. Substantially rectangular abutments 20, 22 arise from the ends, respectively, of the platform 18 and are integral therewith. The inner ends of the abutments 20, 22 terminate in a pair of integral laterally extending substantially rectangular flanges 24, 26, respectively, which are also integrally connected with the platform 18. A pair of substantially rectangular longitudinally spaced and confronting flanges 28, 30 arise from and are integrally connected to the platform 18. As is seen in the drawings, the pairs of flanges 24, 28 and 26, 30, respectively, are disposed in confronting relation relative to each other and are integrally connected to each other and to the

platform 18 by a pair of spacer members 32, 34 to form a pair of channels 36, 38 and 40, 42 adjacent the respective ends of the main body 12. Integral with the main body portion 12 and projecting upwardly therefrom is a centrally located, longitudinally extending substantially rectangular rib 44, the opposed ends of which are integrally connected with the flanges 28, 30. To serve a function to be described, a diagonally extending, substantially rectangular slot 46 extends through the main body portion 12 and the platform 18 intermediate their respective opposed ends. To also serve a purpose to be described is a continuous peripheral flange 48 which depends from the longitudinally extending sides and ends of the main body portion 12 to define a cavity or pocket 50 in the underside thereof.

The main body portion 12 and the above described elements associated therewith are molded or otherwise constructed of a dielectric such as, for example, rubber or of any other suitable materials normally employed as dielectric insulators and having substantially the same physical characteristics.

Reference numeral 52 denotes an elongated substantially rectangular element formed of electrically conductive rubber and from a side of which depend a plurality of laterally spaced, longitudinally extending and parallel rectangular flanges 54. The element 52 constitutes an insert receivable within the cavity or pocket 50 in which it is fixedly secured by conventional means. The opposite side of the element 52 carries a laterally projecting upright plug 56 which is adapted to be received within the slot 46, the plug 56 having disposed in the opposite ends thereof a pair of internally threaded metallic sleeves 58, 60 it being observed that the sleeves 58, 60 are disposed on opposite sides of the rib 44. The sleeves 58, 60 receive, respectively, screws 62, 64 between which are clamped one of the ends of a pair of metallic lugs 66, 68. The other end of the lug 66 connects through a lead 70 with one side of an electrical resistor 72 encased in a plastic casing 74 and disposed on one side of the rib 44. In a similar manner, the other end of the lug 68 connects through the lead 76 with one side of an electrical resistor 78 also encased within a plastic casing 80. Each of the resistors 72, 78 have a value in the range of 270,000 ohms.

The other side of the resistor 72 connects through a lead 82 with one end of a lug 84, and the latter is juxtaposed against one end of a lug 86 which is connected to one end of a wire 88. The other end of the wire 88 is electrically connected to one end of a lug 90 to which further reference will be made. The juxtaposed lugs 84, 86 are electrically connected together on one side of the rib 44 by means of a screw 92 that extends therethrough and through an aperture 94 formed in the rib 44. Displacement of the screw 92 is prevented by a nut 96 threaded thereon on the opposite side of the rib 44.

In a similar manner, the other side of the resistor 78 connects through a lead 98 with one end of a lug 100, and the latter is juxtaposed against one end of a lug 102 which is, in turn, connected to one end of a wire 104. The other end of the wire 104 is electrically connected to one end of a lug 106 to which further reference will be made. The juxtaposed lugs 100, 102 are electrically connected together on the other side of the rib 44 by means of a screw 107 which extends therethrough and through an aperture 108 formed in the rib 44. Displacement of the screw 92 is prevented by a nut 109.

Reference numeral 110 connotes an elongated substantially rectangular metallic abutment having a central opening 111. The abutment 110 engages across the upper end of the spacer member 32 with the opening 111 disposed in alignment with an opening 112 formed therein and with the opposed ends of the spacer member 32 projecting laterally across the upper ends of the channels 36, 38 and substantially closing the same. A screw 114 extends through the aperture 111 and is threadedly re-

ceived within the opening 112 to maintain the above described relation between the abutment member 110 and the channels 36, 38.

Reference numeral 116 indicates a second elongated substantially rectangular metallic abutment having a central opening 118, the abutment 116 extending across the upper end of the spacer member 40 with the opening 118 disposed in alignment with an opening 120 formed in the spacer member 34 and with the opposed ends of the abutment member 116 projecting laterally across the open upper ends of the channels 40, 42 and substantially closing the same. A screw 122 extends through the aperture 118 and is threadedly received within the opening 120 to maintain the above described relation between the abutment member 116 and the channels 40, 42.

An inverted substantially U-shaped metallic casing is designated at 124 and comprises an elongated substantially rectangular bight portion 126 from the longitudinally extending sides of which depend a pair of laterally spaced, longitudinally extending, substantially rectangular side walls 128, 130.

The casing 124 embraces the platform 18, the flanges 24, 26, 28 and 30, the spacer members 32, 34, the rib 44, the resistors 72, 78 and the electrical elements associated therewith as described above, the lower ends of the side arms 128, 130 engaging within the grooves 14, 16.

Threaded apertures 132, 134 disposed adjacent the opposed respective ends of the bight 126 receive screws 136, 138, respectively, to electrically connect the lugs 90 and 106 thereto.

Screws 140, 142 are threaded through the side arms 128, 130 proximate a pair of their respective adjacent ends and are received for reciprocation within the channels 36, 38, respectively. A similar pair of screws 144, 146 are threaded through the side arms 128, 130 proximate the other pair of adjacent ends thereof, the screws 144, 146 being received for reciprocation within the channels 40, 42, respectively.

Reference numeral 148 indicates an elongated substantially rectangular metallic bar of appropriate length for extension between a pair of metallic tubular legs 150, 152 of a given piece of hospital operating room furniture, the floor engaging ends of which are encased in tubular members 153 formed of a dielectric material. A split clamping member 154 including the separable clamping jaws 156, 158 surrounds the legs 150, 152, the jaws 158 each including laterally projecting tongues 160 fixedly secured to the opposed ends, respectively, of the bar 148 by means of screws 162. As is seen in the drawings, the jaws 160 are each provided with a pair of laterally spaced tubular extensions 164 through which project a pair of screws 166 which are threadedly engaged within tapped sockets 168 at each lateral side of the clamping jaws 156. The bar 148, intermediate the ends thereof, is provided with a plurality of apertures 168 and receive therethrough screws 170 which are threaded into the tapped openings 172 formed in the bight portion 126 of the casing 124, thereby electrically connecting the casing 124 to the bar 148.

The side arms 128, 130 of the casing 124 span the adjacent pairs of flanges 24, 28 and 26, 30, so that the channels 36, 38 and 40, 42 are substantially closed at all times to prevent the accumulation of debris or other foreign matter from accumulating therein, and it should be here noted that the bar 148 is properly adjusted in such a manner so that when the lower ends of the flanges 54 rest on the conductive floor 174 (which may optionally have intersecting grids 176 formed therein), the screws 140, 142, 144 and 146 are positioned substantially midway between the platform 18 and the abutment members 110, 116. It is also of importance to note that the screws 140, 142, 144 and 146 are laterally spaced from the immediate adjacent pairs of flanges

24, 28 and 26, 30. With this spacing a floating mounting is provided whereby contact of the flanges 54 with the floor 174 is constantly insured and the casing will automatically raise, lower or tilt vertically to compensate for irregularities. In connection with this floating mounting it should be noted that no portion of the weight of the article to which it is connected bears on the flanges 54.

As has been stated above, the flanges 54 are of the self-cleaning type, and the sharp lower squared ends thereof maintain a positive electrical contact with the floor 174.

It will be obvious to those skilled in this art that from the mechanical construction of the bonding device 10 as set forth above, the resistors 72, 78 are electrically connected in a parallel circuit between the casing 124 and the flanges 54. This too is an important feature of the invention inasmuch as should one resistor fail, the other one thereof will remain in the circuit between the flanges 54 and the casing 124.

A modified insert is illustrated in Figure 8 and is generally designated at 180. As shown therein, the insert 180 comprises an elongated substantially rectangular element 182 formed of electrically conductive rubber and from a side of which depends a grid 184 also formed of conductive rubber. The element 180 may be substituted for the insert 52, if desired and functions in exactly the same manner as described above.

Also, the resistors 72, 78 may be molded in a rubber casing 186 as is illustrated in Figure 9 of the drawings.

Having described and illustrated a plurality of the embodiments of this invention, it is to be understood that the same have been offered merely by way of example, and that this invention is to be limited only by the scope of the appended claims.

What is claimed is:

1. A bonding device for electrically grounding a metallic article of furniture or the like to an electrically conductive floor comprising a first elongated block of electrically conductive material, a plurality of integral longitudinally extending flanges projecting downwardly from said first block to support said first block upon such a floor, a second elongated block of dielectric material overlying said first block and fixedly mounted thereupon, a metallic casing adapted to be electrically and mechanically connected to such an article of furni-

ture or the like, said casing having a downwardly opening recess therein slideably receiving said second block, cooperating means on said casing and said second block defining spaced limits of relative movement between said casing and said second block, a plurality of electrical resistors mounted on said second block, and means electrically connecting said resistors in parallel between said casing and said first block.

2. A bonding device as defined in claim 1 wherein said cooperating means comprises a plurality of abutment members projecting inwardly from said side walls of said casing, and means on said second block defining a plurality of vertically elongated recesses, each of said recesses being located to loosely receive one of said abutment members.

3. A bonding device for electrically grounding a metallic article of furniture to an electrically conductive floor comprising a first elongated block of electrically conductive material, a plurality of integral longitudinally extending flanges projecting downwardly from first said block to support said first block upon such a floor, a second elongated block of dielectric material overlying said block and fixedly mounted thereupon, said second block comprising a main body portion having a recess in its lower surface receiving said first block, a longitudinally extending central rib projecting upwardly from said main body portion of said second block, an elongated metallic casing of inverted U-shaped transverse cross-section having opposed longitudinally extending side walls in sliding engagement with side surfaces on said main body portion of said second block and in spaced relationship with said central rib, said casing being adapted to be electrically and mechanically connected to such an article of furniture or the like, an electrical resistor mounted in said second block on each side of said central rib, and means electrically connecting each of said resistors in parallel between said first block and said casing.

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