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(54) **TERMINAL COVER STRIP**

(76) Inventor: **Steven E. Silvers**, Lawrence, KS (US)

Correspondence Address:
Law Offices of Louis Woo
1901 North Fort Myer Drive, Suite 501
Arlington, VA 22209 (US)

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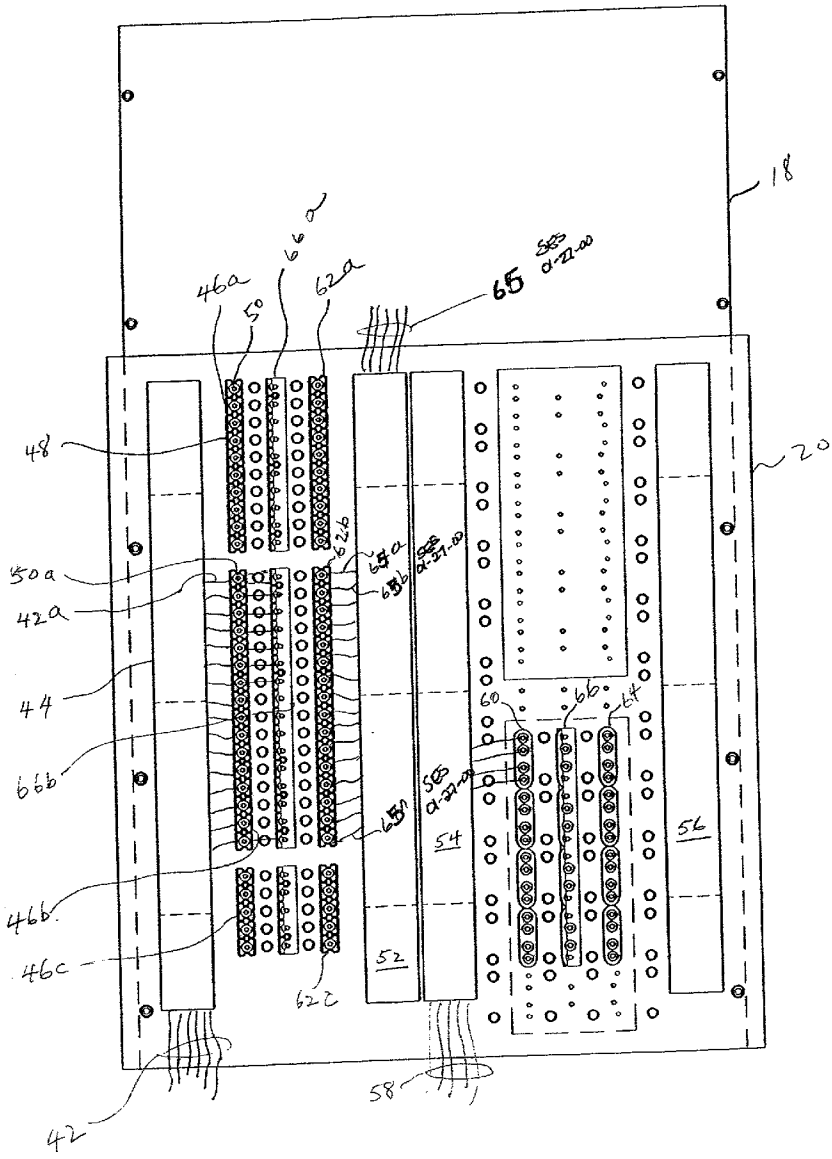
(57) **ABSTRACT**

To prevent lightning from destroying equipment in a housing structure, a shield structure is built within the housing structure for enclosing electrical conductors that may allow surge currents to be routed into the housing structure. The shielding structure is constructed of ferrous or non-ferrous metal and preferably of the same material as that of the ground plane of the housing structure to which the electrical conductors are mounted. A terminal cover strip for enhancing efficient grounding is also disclosed.



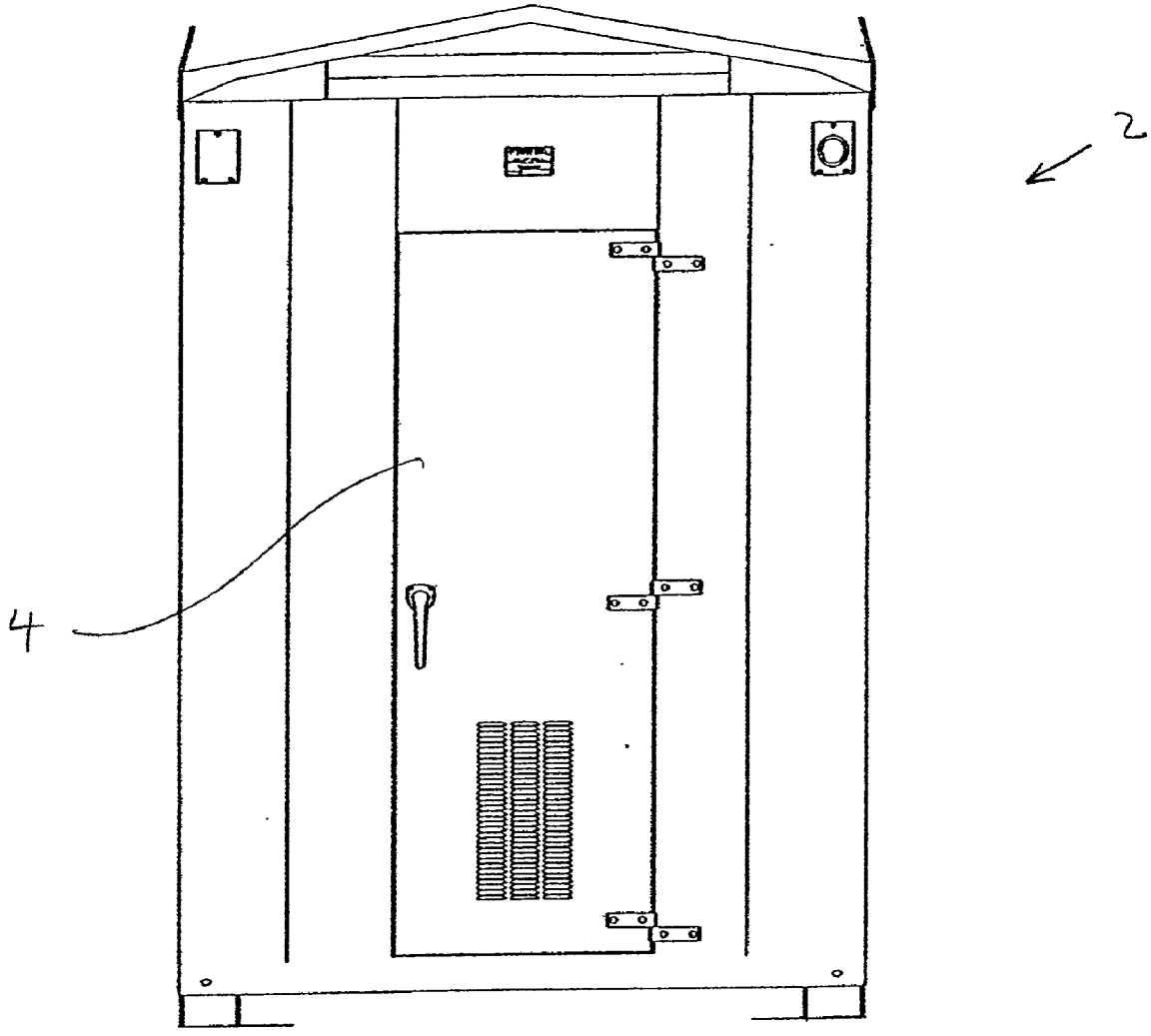


Fig 1

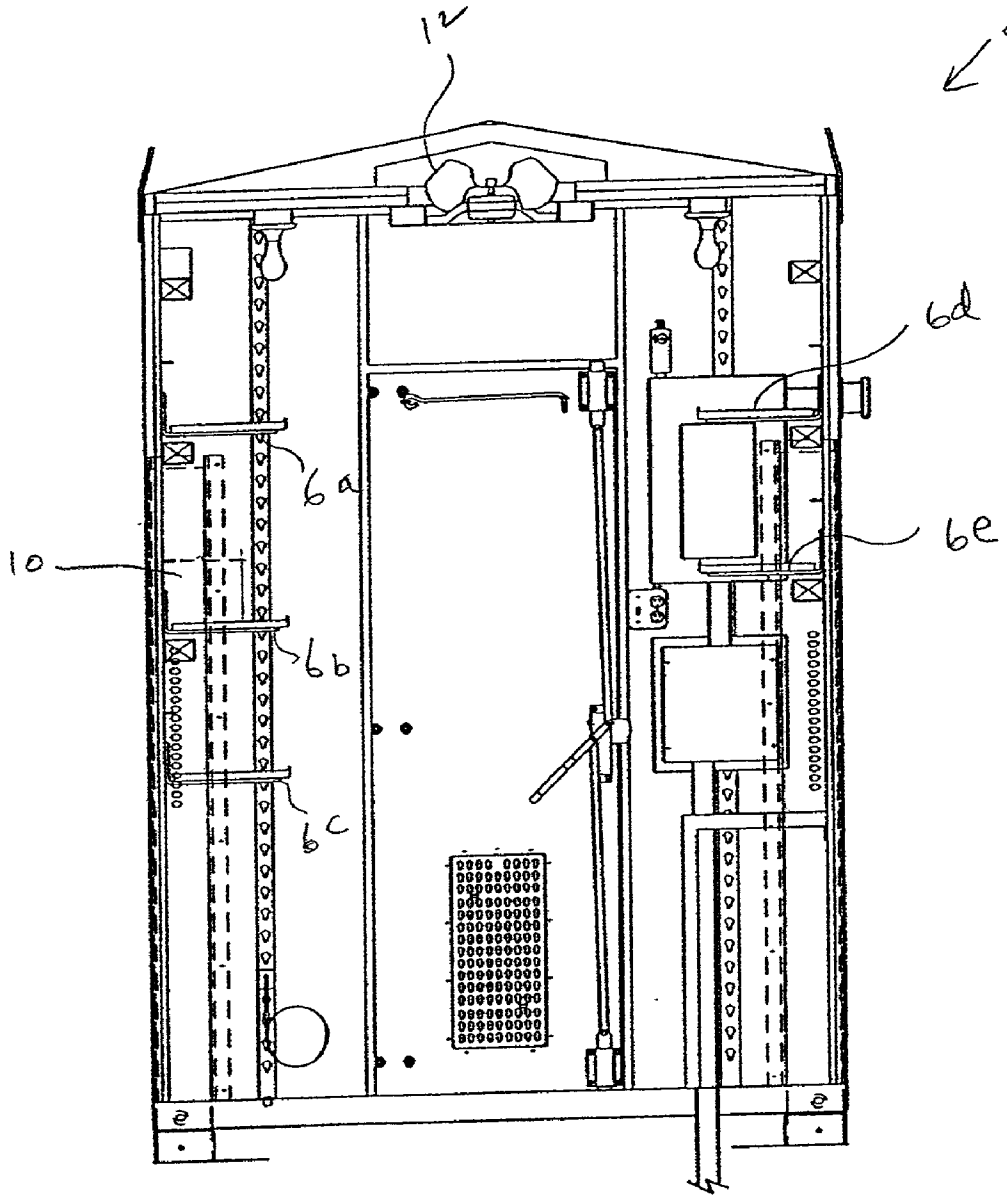


Fig 2

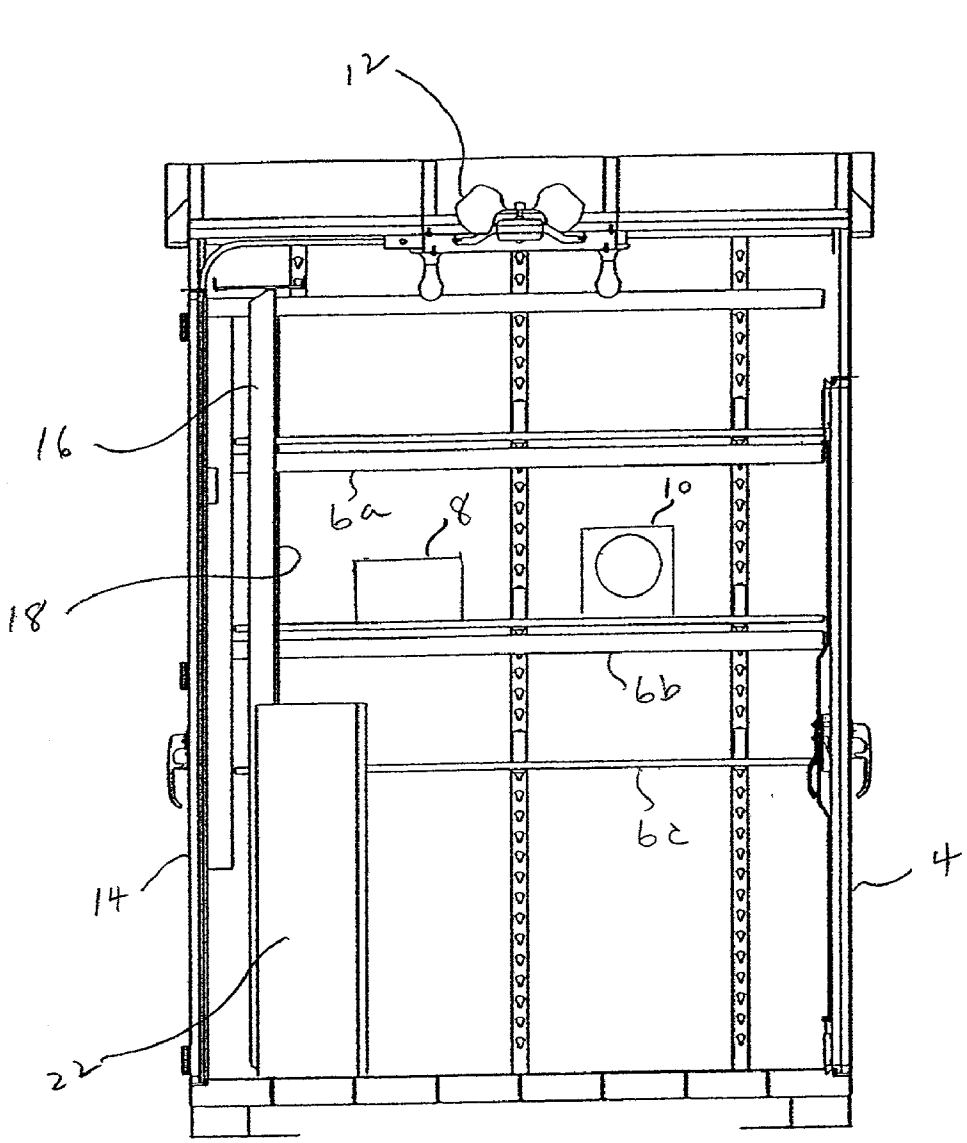


Fig 3

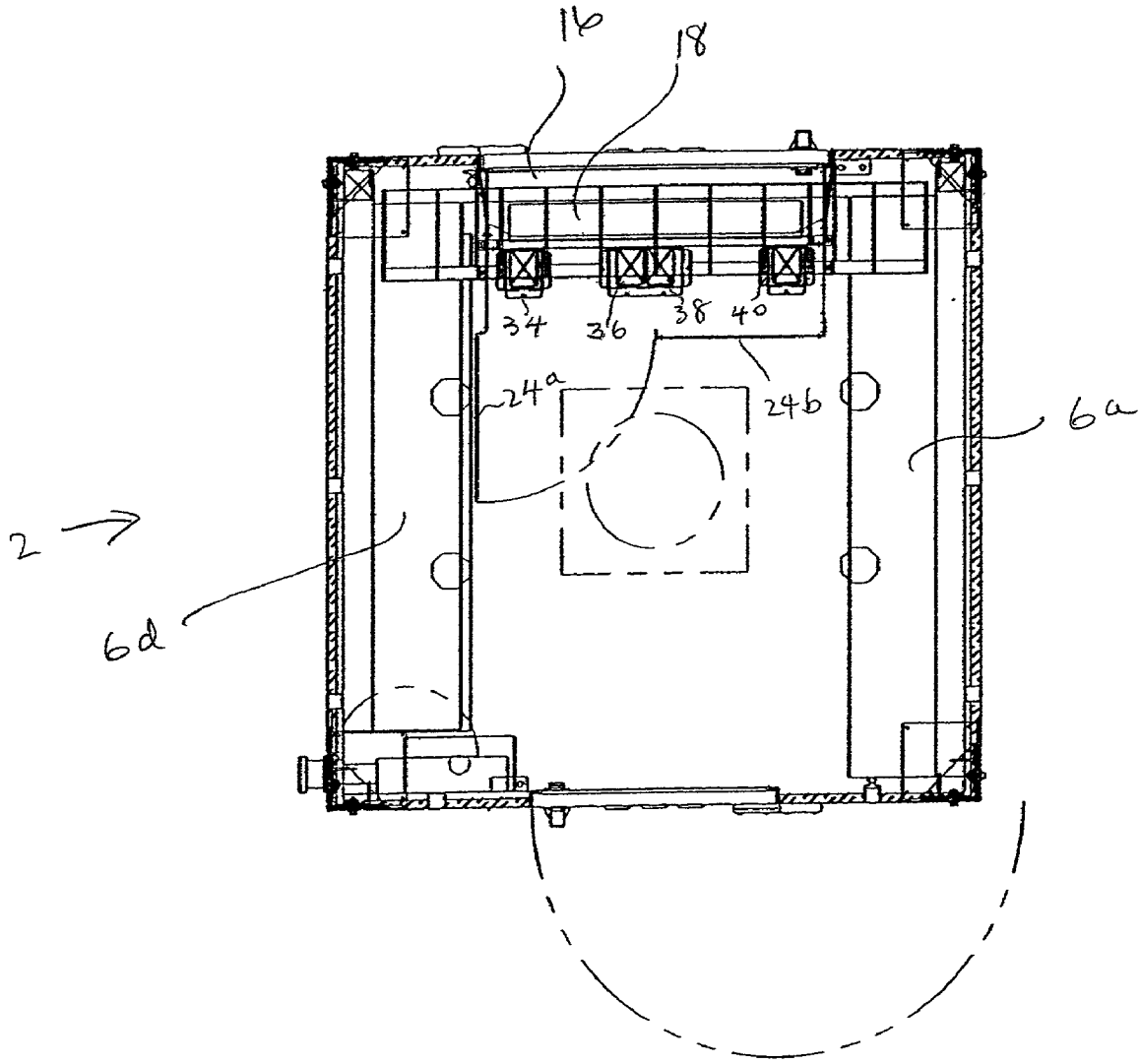


Fig 4

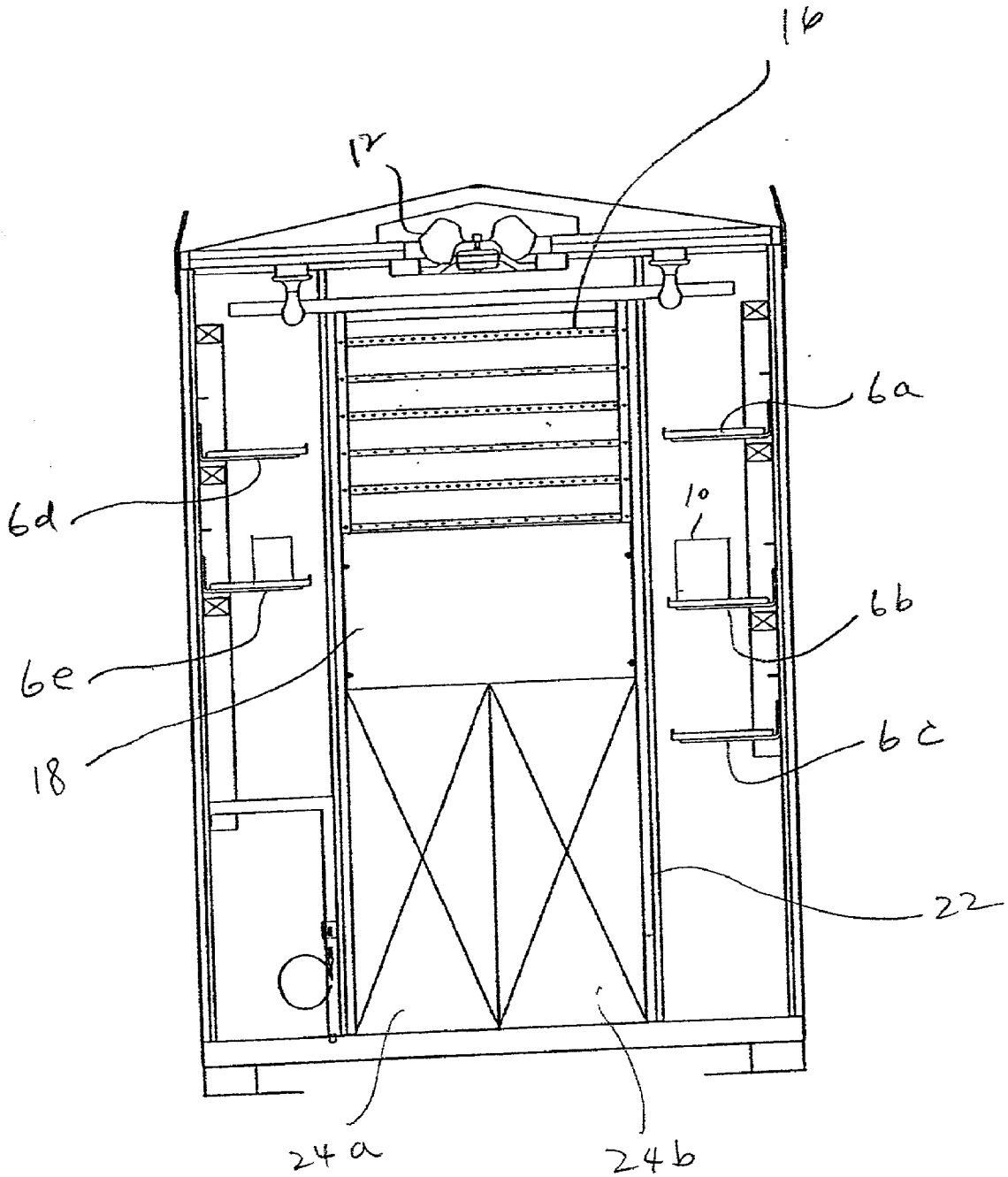


Fig 5

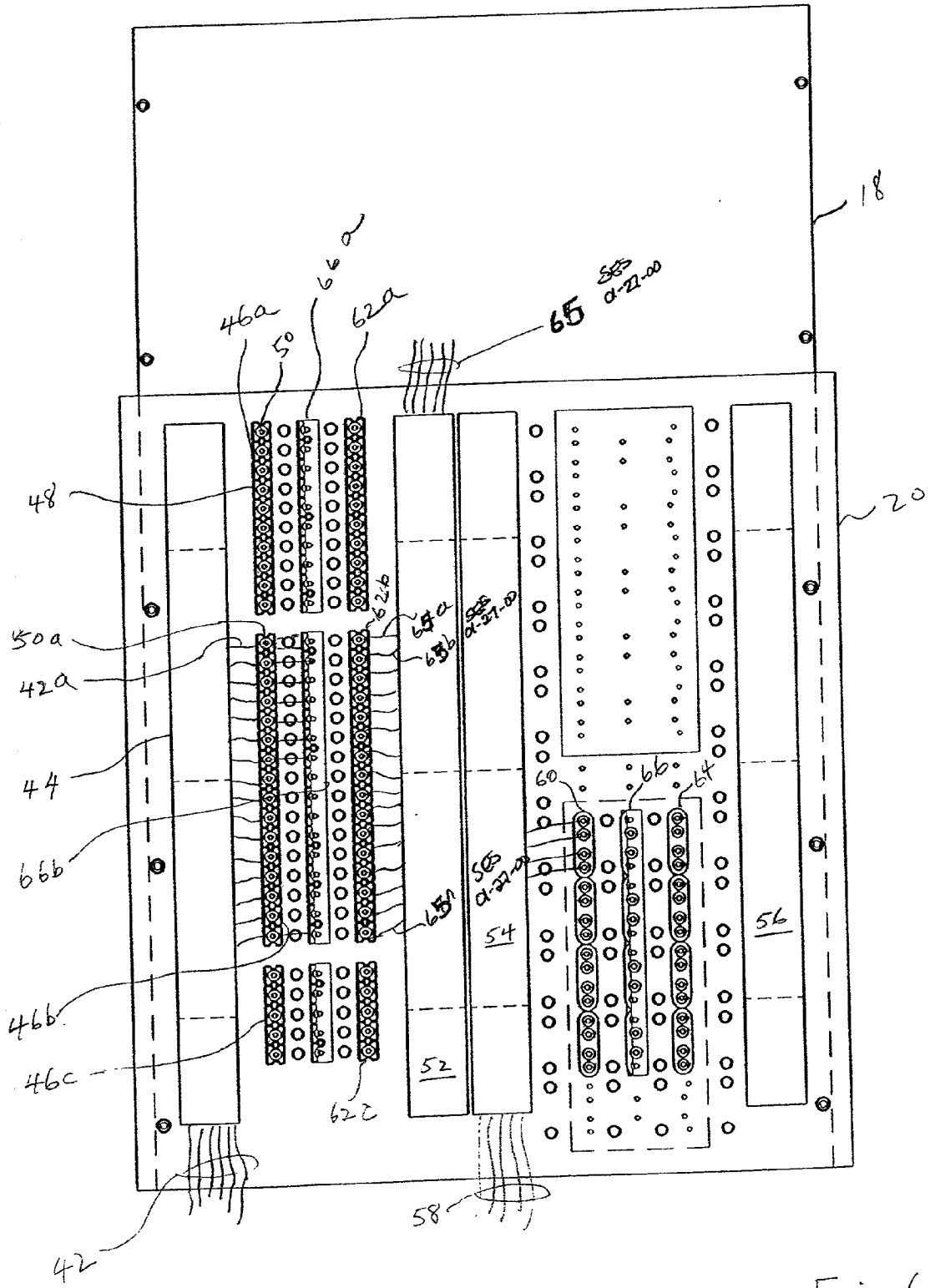

18
46a
50
60
62a
65
48
20
50a
42a
44
66b
46b
46c
62b
65a
65b
54
52
56
60
66
64
62c
58
42

Fig 6

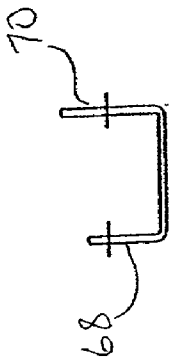


Fig. 7B

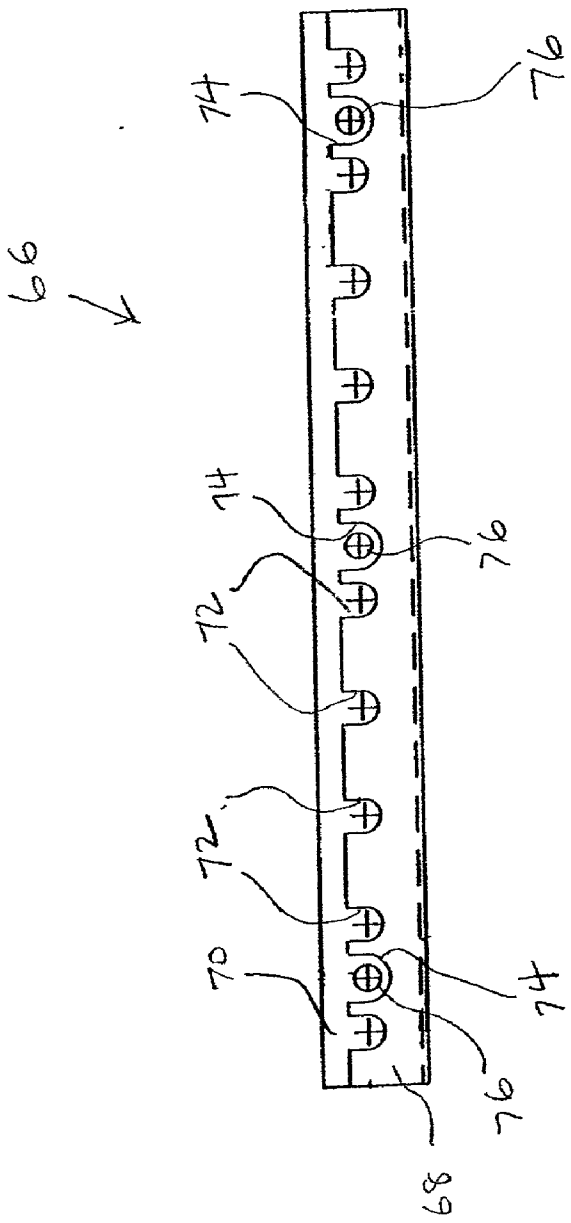


Fig. 7A

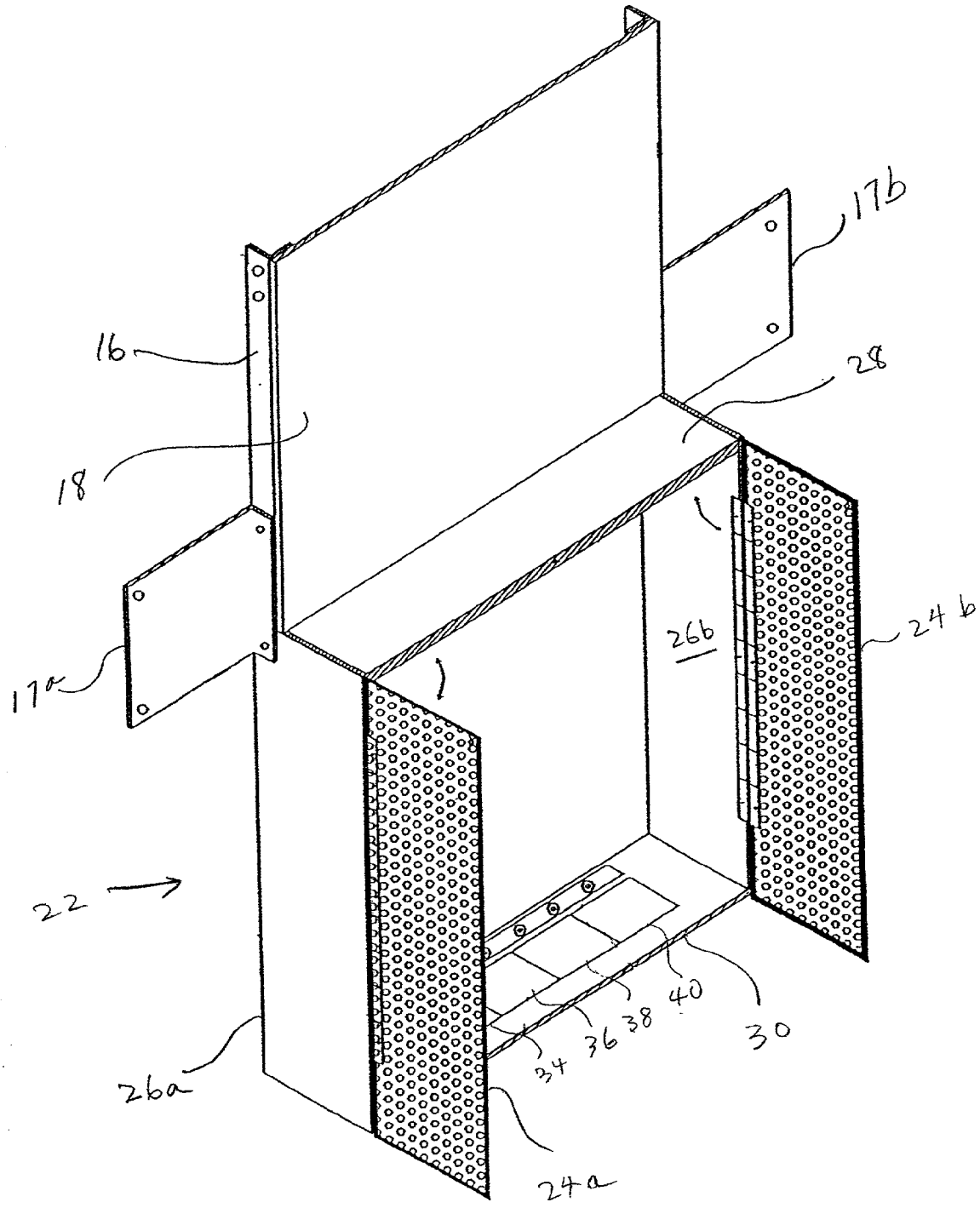
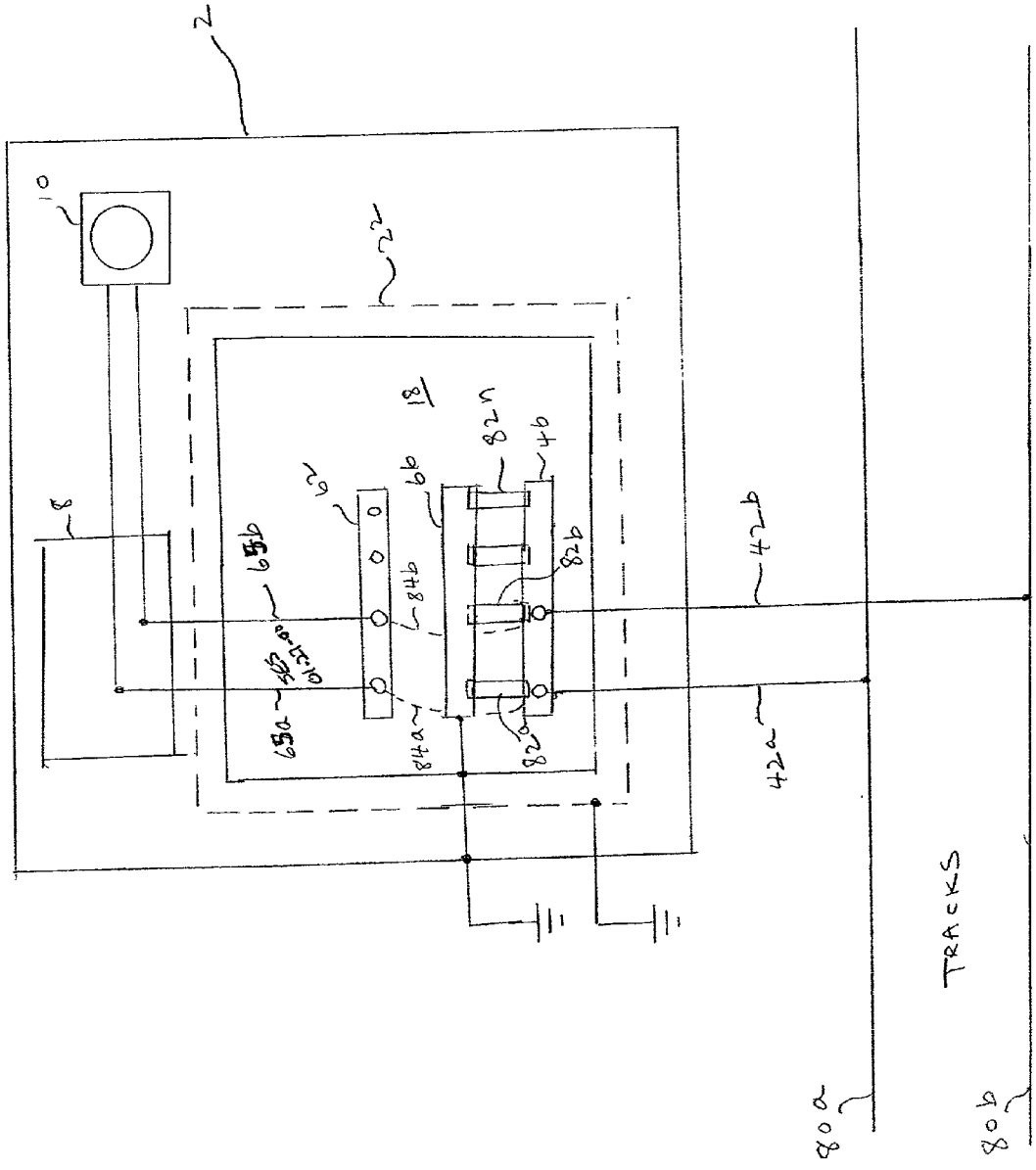


Fig 8

Fig 9



TERMINAL COVER STRIP

CROSS REFERENCE TO RELATED APPLICATION

[0001] This is a divisional application of U.S. application Ser. No. 09/373,504 filed Aug. 13, 1999.

FIELD OF THE INVENTION

[0002] The present invention relates to a housing structure that is equipped with a lightning protective system, and particularly the equipping of a railroad switch house with a lightning protection system for maintaining the integrity of the electrical or electronic equipment stored therein.

BACKGROUND OF THE INVENTION

[0003] Signal switch houses for railroads have been around for a long time. Such houses usually have stored therein electrical and/or electronic equipment and other electronic components such as for example relays for monitoring and regulating the operation of trains along railroad tracks to which such houses are adjacently located. Such switch houses are usually spaced anywhere from ¾to ½miles all along the length of the railroad tracks. In essence, the equipment stored in the houses would provide wayside signals to the train, as for example red, yellow and green lights, so that the train engineer has some indication of the condition of the tracks down the line. Moreover, a switch house is usually located at each railroad crossing for providing warnings to traffic crossing the railroad tracks if a train is approaching.

[0004] The equipment stored inside each of these switch houses may vary, depending on the kinds of signals that are to be monitored and regulated. However, each of the equipment stored in each of the switch houses tend to be electrical or electronic in nature, and accordingly could be effected by power surges resulting from transients from the power line or lightning that strikes either the railroad tracks adjacent to the house or the house directly. And when the equipment malfunctions, the signals for regulating the movement of trains along the railroad tracks are disrupted.

[0005] It has been estimated that it costs a single railroad company thousands of dollars for each unscheduled train stop as the stoppage of one train tends to have a domino effect on all other trains along the same tracks. This is due to the fact when a train is stopped unexpectedly, the tracks would act as a shunt to prevent a proceed signal from being transmitted along the tracks to other switch houses. With the absence of the proceed signal, the equipment in the switch houses downstream or upstream of where the stopped train is would provide a caution yellow light or a stop red light to the train engineers at the other trains to warn them either to slow down or stop.

[0006] Prior to the instant invention, there has not been any reliable protection against power surges that may affect the performance of the electrical or electronic equipment in the switch houses. Thus, excessive lightning damage has been sustained by the train control equipment. Such damage not only means that the equipment has to be replaced, but more importantly it affects the operation of the trains along the tracks and therefore causes both inconvenience and a loss of money for the railroad companies.

SUMMARY OF THE INVENTION

[0007] The housing structure or house of the instant invention has secured to one of its interior walls a terminal board. Coupled to the terminal board are a number of terminal blocks or strips to which wires may be mounted. A number of openings are provided on the floor of the house for enabling wires external to the house to be inserted into the house. These outside wires are mounted to one of the terminal blocks on the terminal board. The equipment that are inside the house are placed on shelves which are secured to the house. The signal leads or wires that are provided to and from the equipment are also mounted to the terminal board, preferably at another terminal block or strip coupled to the terminal board. There is also coupled to the terminal board at least one conductive terminal strip that is electrically grounded. The wires from outside which are mounted to the terminal block on the terminal board each in turn are connected to the grounding strip by way of a current or lightning arrester. At least one ground plane is provided also on the terminal board so as to enable any power surges that may reach the terminal board to be readily routed to ground.

[0008] To confine any power surges that enter the house which most likely first reach the terminal board, a shield structure in the form of interconnected panels are placed over the terminal board so as to enclose at least the portion of the terminal board whereat both the wires from the outside and the wires that are connected to the equipment are located. The panels may be in the form of grids or solid sheets that are made of ferrous or non-ferrous metals. The panels furthermore are connected to ground. Thus, power surges that enter the house and wind up at the terminal board, even if they were to jump over the arresters that connect the outside wires to the terminal grounding strip, nonetheless are prevented by the shield structure from entering into the rest of the house. The power surges are therefore prevented from doing damage to the equipment stored in the house. The shield structure may be in the form of a Faraday cage.

[0009] To enhance grounding, in place of conventional grounding strips or terminals, the house of the instant invention utilizes a grounding strip that comprises a longitudinal U shaped member, with a longer side and a shorter side respectively up bending along the length of the member. Multiple holes are provided in the longer up-bent portion for enabling the grounding strip to be mounted to the terminal board. Notches or semicircular cut-outs are formed at the shorter up-bent side to enable the mounting thereto of the respective wires from the terminal block on the terminal board where the outside wires are mounted.

[0010] It is therefore an objective of the present invention to equip a house with lightening protection features.

[0011] It is another objective of the present invention to provide a Faraday cage inside a housing structure for confining power surges that may enter the structure.

[0012] It is still another objective of the present invention to protect equipment in a housing structure from lightning or power surges that may enter the structure.

[0013] It is yet a further objective of the present invention to provide to the terminal board of the house of the instant invention an inventive unitary grounding strip adaptable to be connected by a plurality of wires from the outside the house.

BRIEF DESCRIPTION OF THE FIGURES

[0014] The above-mentioned objectives and advantages of the present invention will become apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

[0015] **FIG. 1** is a front view of an exemplar house of the instant invention;

[0016] **FIG. 2** is an inside view of the front wall of the house of the instant invention;

[0017] **FIG. 3** is a cut away side view of the house of the instant invention;

[0018] **FIG. 4** is a plan view of the house of the instant invention;

[0019] **FIG. 5** is an inside view of the back of the house of the instant invention;

[0020] **FIG. 6** illustrates the terminal board secured to the house of the instant invention;

[0021] **FIG. 7***a* is a front view of an inventive terminal cover strip coupled to the terminal board of the instant invention;

[0022] **FIG. 7***b* is a side view of the terminal cover strip of **FIG. 7***a;*

[0023] **FIG. 8** is a perspective view of a shield structure placed over the terminal board of the house of the instant invention; and

[0024] **FIG. 9** is a schematic illustrating the interconnections between exemplar railroad tracks, the wires connected from the tracks to the house of the instant invention and the inside wires that route the signals from the railroad tracks to the equipment inside the house.

DETAILED DESCRIPTION OF THE INVENTION

[0025] **FIG. 1** is a view of the front of an exemplar house **2** of the instant invention. House **2** in this instance may be a switch house used in a train environment in which the house is located adjacent the railroad tracks of a railroad system. A number of such houses are spaced anywhere from ¾miles to 1½miles along the length of the tracks. Moreover, such switch house is placed at railroad crossing for controlling the lowering or raising of gates to prevent traffic from crossing the railroad tracks when a train is about to pass that crossing. As shown, house **2** has an entrance door **4**.

[0026] As shown in **FIGS. 2 and 3**, the interior of house **2** has secured thereto a number of shelves **6***a* to **6***c*. These shelves are used for storing electrical or electronic equipment such as for example **8** and **10** shown stored onto shelves **6***b*. The air inside house **2** is circulated by means of an exhaust fan **12**. As best shown in **FIG. 3**, in addition to front door **4**, a back door **14** is provided to the back wall of house **2** so as to allow a technician to access the back of a frame **16** to which a terminal board **18**, which may be made of plywood, is mounted. Overlaying terminal board **18** is a ground plane **20**, best shown in **FIG. 6**. Ground plane **20** is conductive and may be made of ferrous or non-ferrous metal.

[0027] A cage **22**, a perspective view of which is shown in **FIG. 8**, covers a portion of terminal board **18**. As shown in **FIGS. 5 and 8**, cage **22** has two front doors **24***a* and **24***b* each hingedly mounted to a side panel such as for example panels **26***a* and **26***b*, respectively. Cage **22** also has a top panel **28**. Note that although doors **24***a* and **24***b* each are shown as a grid, in practice, doors **24***a* and **24***b* may be solid panels or sheets. In essence, cage **22** is made up of a number of interconnected panels, or sheets which together, provide a shield enclosure or structure for shielding at least a portion of terminal board **18**.

[0028] As best shown in **FIGS. 4 and 8**, on the floor of housing **2** positioned in front of terminal board **16** are a number of openings **34**, **36**, **38** and **40** on floor **30**. At least one of these openings provides an inlet or port for electrical connections such as wires external of house **2** to be fed into the interior of house **2**. Such external wires, designated by **42** in **FIG. 6**, may be referred to as outside wires or "dirty" wires.

[0029] As shown in **FIG. 6**, the outside wires **42** are fed into a panduit **44** at terminal board **18**, and then separated and routed to a number of terminal blocks **46***a*, **46***b* and **46***c*. Each of the terminal blocks **46** has an insulating base **48** and a number of posts **50**. Thus, outside wire **42***a* output from panduit **44** is shown to be connected to post **50***a* at terminal block **46***b*. Similarly, other wires from outside of house **2** are connected to terminal blocks **46**. See for example the many wires **42** connected to their respective posts **50** at terminal block **46***b*.

[0030] Further with reference to **FIG. 6**, it can be seen that terminal board **18**, and specifically the ground plane **20** superposed thereover, has a number of panduits, including panduits **52**, **54** and **56**. Note that each one of panduits **52**, **54**, **56**, as well as panduit **44**, can have bundled therein a plurality of wires, such as for example outside wires **42** in panduit **44** and another set of wires **58** shown bundled within panduit **54**. Note that wires **58**, for the embodiment being discussed, could also be wires that are led into house **2** from the outside. In fact, outside wires **58** may be led into house **2** by way of inlet opening **38**, as shown in **FIGS. 4 and 8**. Outside wires **58** are in turn connected to a terminal block **60**.

[0031] In addition to terminal blocks **46** and **60**, there are also shown a number of other terminal blocks such as for example **62***a*, **62***b*, **62***c* and **64**, coupled to terminal board **18**. Like terminal block **46**, each of terminal blocks **62** and **64** has an insulating base section and a plurality of posts integrated thereto.

[0032] There are a number of wires **65** each connected to a corresponding post at terminal **62***b*, as shown in the exemplar terminal board **18** of **FIG. 6**. These wires **65** may be referred to as inside or "clean" wires that are electrically connected to the equipment inside house **2**. Each of the inside wires is connected to a corresponding outside wire at the back of terminal board **18**. Thus, signals can traverse between the equipment in house **2** and any instruments or sensors that are situated outside of house **2**, as for example sensors or switches mounted to the railroad tracks that are shunted when passed over by the axles of a train.

[0033] Further with respect to **FIG. 6**, also shown to be coupled to terminal board **18** are a number of terminal cover

strips **66**. As best shown in **FIGS. 7***a* and **7***b*, terminal cover strip **66** is an elongated member having a shorter end **68** and a longer end **70** up bending along the longitudinal axis of member **66** to thereby form a U-shaped member as shown in **FIG. 7***b*. Up-bent portion **68** has cut thereinto a number of semi-circular notches **72** and a number of bigger notches **74**. Notches **72** are openings whereat connections may be made by means of screws and nuts of electrical conductors of adjacent posts, for example the wires extending from posts **50** of terminal block **46**. Instead of electrical conductors, a lightning or surge arrester could be connected from one of the notches **72** to a corresponding post at terminal block **46**.

[**0034**] On the longer up-bent portion **70** of cover strip **66** there are provided a number of holes **76** for enabling the coupling of strip **66** to terminal board **18**, by means of screws or bolts, as shown in **FIG. 6**. Note that although the exemplar terminal strip shown in **FIG. 7***a* shows a strip that corresponds to strip **66***a* shown in **FIG. 6**, in actuality, a cover strip of any length, such as for example strip **66***b* shown in **FIG. 6**, may be produced. In other words, it is not the length of strip **66** that matters, but rather that strip **66** is formed as a U-shaped member that has the appropriate notches and openings to enable it to be mounted to a terminal board and be connected to ground via the conductive ground plane overlying the terminal board. Prior to the instant inventive terminal strip, a plurality of distinct ground terminals are required for providing electrical connection to a plurality of wires, such as for example the dirty wires **42** from outside of house **2**. Note that another cover strip **66** is provided between terminal blocks **60** and **64**.

[**0035**] With reference to **FIG. 8**, it can be seen that terminal board **18** is mounted to frame **16**, which in turn is secured to house **2** by means of brackets **17***a* and **17***b*. Further with respect to **FIG. 8**, note that panels **24**, **26**, **28** and **30** which together make up shield structure **22**, like ground plane **20**, are made of ferrous or non-ferrous metals such as for example aluminum or stainless steel. Furthermore, other types of conductive materials, be they ferrous or non-ferrous, may be used. They include a woven metallic material that can easily be shaped or a wire grid such as for example doors **24***a* and **24***b* shown in **FIG. 8**.

[**0036**] **FIG. 9** is a simplified diagram for illustrating the principle of the instant invention. In particular, house **2** is shown to be located adjacent, or proximate, to a path, represented by rails **80***a* and **80***b*, of a plurality of railroad tracks whereon trains traverse. Although not shown, it should be appreciated that in addition to sensors and switches provided on the railroad tracks such as for example rails **80**, the equipment in house **2** may also be communicating with at least one central control center that oversees the respective operations of the various trains.

[**0037**] In any event, as shown in **FIG. 9**, switches or sensors provided on rails **80** are routed to house **2** by means of outside wires **42***a* and **42***b*. These outside wires, as described hereinabove, are fed into house **2** at terminal board **18**, and specifically connected to respective posts at a terminal block, such as for example terminal block **46**. These outside wires each in turn are connected by a corresponding lightning or surge arrester **82** to a terminal strip that is connected to ground. Outside wires **42** are shown to be connected, by means of dotted lines **84**, to inside wires **65**, which are connected to terminal block **62**. The inside wires **65** in turn are connected to an electronic equipment such as for example a Harmons Vital Logic Controller (VHLC) that controls the communication between house **2** and the tracks. To enable a worker to monitor the goings on of the trains, the signals may be routed from the VHLC to another equipment, such as for example oscilloscope **10**.

[**0038**] To protect equipment such as for example **8** and **10** inside house **2** from power surges that may get inside house **2**, a shielding structure **22**, such as for example the Faraday cage shown in **FIG. 8**, is placed around terminal board **18**, or at least the portion thereof to which both the outside wires **42** and inside wires **65** are mounted. Structure **22** is electrically connected to ground. Likewise, terminal plane **20** that superposes over or overlies terminal board **18**, the ground terminal strip **66**, as well as house **2** itself, are all connected to ground.

[**0039**] In most instances, power surges would enter into railroad switch houses as a result of lightning striking either the house directly or the railroad tracks. In the case of the railroad tracks being struck by lightning, the power surges resulting from the lightning are fed by outside wires **42** into house **2** and routed to terminal board **18**. Before the instant invention, the lightning, instead of or inspite of being partially routed by lightning arresters **82** to ground, would oftentimes jump over the lightning arresters into the rest of the house, so as to cause damage to the electronic or electrical equipment inside house **2**.

[**0040**] By incorporating a Faraday case **22** around terminal board **18**, the power surges that otherwise would have destroyed the equipment inside house **2** are prevented from doing so insofar as the conductive panels of structure **22** would confine the power surges within structure **22**, so that the power surges are routed to ground. Thus, cage **22** acts as a means to isolate the equipment in house **2** from the surge currents that are routed to terminal board **18** of house **2**. To enhance performance, shield structure **22** should preferably be made of the same conductive material as ground plane **20**. Also, if house **2** is made of either aluminum or stainless steel, shield structure **22** likewise should preferably be made of either aluminum or stainless steel, respectively.

[**0041**] Inasmuch as the present invention is subject to many variations, modifications and changes in detail, it is intended that all matters described throughout this specification and shown in the accompanying drawings be interpreted as illustrative only and not in a limiting sense. For example, even though the discussion above pertains to railroads switch houses, it should be appreciated that the same shield structure may be used in other housing structures that may contain electrical or electronic components that could be exposed to surge currents resulting from lightnings or transient power surges from power lines. Accordingly, it is intended that the invention be limited only the spirit and scope of the hereto appended claims.

1. A grounding strip, comprising:

an elongated body having a base and two upbent sides extending substantially perpendicularly from said base along the longitudinal length of said body for effecting a U-shaped member; and

a plurality of mounting spaces formed on one of said two upbent sides to enable a multiple number of conductors

to be coupled to said one upbent side, the other of said two upbent sides being connected to ground.

2. Grounding strip of claim 1, wherein said upbent sides of said body each extend a respective given length from said body.

3. Grounding strip of claim 1, wherein said grounding strip is coupled to a terminal board whereupon multiple electrical conductors are connected; and

wherein said terminal board has an electrically conductive ground plane superposed thereover whereto said grounding strip makes contact for establishing the grounding for said strip.

4. Grounding strip of claim 1, further comprising:

a plurality of holes formed on said one upbent side, said plurality of holes being of at least two different sizes spaced at predetermined intervals along said one upbent side of said strip.

5. Grounding strip of claim 1, wherein said other upbent side of said body has formed thereon a plurality of holes spaced therealong, said grounding strip being mounted to an electrically grounding plane to establish grounding by coupling said other upbent side to said grounding plane by means of connecting means extending through at least one of said holes.

6. Grounding strip of claim 4, wherein said conductors are connected to said strip via said plurality of holes at said one upbent side for establishing an electrical path to remove aberrant power surges carried by said conductors to ground.

7. In a housing structure provisioned to protect against power surges and lightning strikes, a terminal board in said structure providing a junction whereto wires from inside and outside of said structure are mounted, a terminal cover strip in said housing structure comprising:

an electrically conductive elongated member mounted to said terminal board, said elongated member having a plurality of mounting spaces to which a multiple number of said wires are connected, said member being electrically grounded so that all wires connected to said member are also electrically grounded.

8. Terminal cover strip of claim 7, wherein said elongated member further comprises:

a base and two upbent sides extending substantially perpendicularly from said base along the longitudinal length of said member for effecting a U-shaped member, one of said two upbent sides being shorter than the other of said two upbent sides.

9. Terminal cover strip of claim 7, wherein said elongated member mounts to said terminal board via a ground plane of ferrous or non-ferrous material sandwiched between said elongated member and said terminal board, said ground plane electrically grounding any device making contact therewith.

10. Terminal cover strip of claim 7, further comprising:

first plurality of holes formed along said one side of said strip for said wires to be coupled to said one side, said first plurality of holes being of at least two different sizes; and

second plurality of holes formed along said other side of said strip for enabling said strip to be mounted to a ground plane on said terminal board by connecting means via said holes;

wherein said cover strip effects an electrical path whereby aberrant power surges carried by said wires are routed to ground.

11. In a structure provisioned to protect against power surges and lightning strikes, a terminal board in said structure providing a junction whereto wires from inside and outside of said structure are mounted, a method of efficiently grounding said wires comprising the steps of:

forming an elongated terminal strip from an electrically conductive material; and

mounting said strip to said terminal board, said strip having a plurality of mounting spaces to which a multiple number of said wires are connected, said strip being electrically grounded so that all wires connected to said strip are also electrically grounded.

12. Method of claim 11, wherein said forming step further comprises the steps of:

extending two upbent sides substantially perpendicularly from the base of said strip along the longitudinal length of said strip for effecting a U-shaped member; and

forming one of said two upbent sides shorter than the other of said two upbent sides.

13. Method of claim 11, further comprising the step of:

superposing a ground plane over said terminal board to provide an electrical ground whereupon said strip is mounted.

14. Method of claim 12, wherein said mounting step further comprises the steps of:

forming first plurality of holes along said one side of said strip for said wires to be coupled to said one side, said first plurality of holes being of at least two different sizes;

forming second plurality of holes along said other side of said strip for enabling said strip to be mounted to a ground plane on said terminal board; and

coupling said other side of said cover strip to said ground plane using said holes so that, once coupled to said ground plane, said cover strip effects an electrical path to route aberrant power surges carried by said wires to ground.

* * * * *