

HAZARD MITIGATION CABINET

Field of the Invention

- 5 This invention relates to a hazard mitigation cabinet. In various embodiments the invention allows for the internal partitioning of this cabinet while also reducing heat transfers between adjacent partitions.

Background of the Invention

- 10 Dangerous goods cabinets have been developed to secure flammable, toxic or explosive materials, usually in work places or similar industrial settings. These cabinets are commonly provided with a robust sheet metal construction which seal and potentially lock these materials within a secured
15 internal volume.

- These cabinets can act to contain a fire fuelled by flammable materials for a minimum period of time, allowing persons nearby to flee the area or undertake firefighting activities. In the case of explosive materials the robust
20 construction of the cabinet can act to contain a blast and the pressure wave it generates, capturing and containing materials which would otherwise form shrapnel. Dangerous goods cabinets are usually required to meet government regulations aiming to protect the health and safety of a workforce which uses dangerous consumable materials.

- 25 These prior art cabinets have a simple internal structure, generally providing an interior volume for the storage of dangerous materials. Prior art cabinets can include simple sheet metal shelves to increase the carrying case capacity of the cabinet. This arrangement means that any combustion or explosion
30 will engulf all materials stored in the cabinet.

- Electrical devices and machines powered by rechargeable battery systems have experienced a significant growth in popularity in recent years. In particular Lithium Ion batteries are now commonly provided with cordless
35 electrically powered tools.

These battery packs frequently need to be recharged over the lifespan of the related tool or appliance, with the charging process presenting some risks as the battery pack ages or experiences impact damage with normal wear and tear. The application of a charging current to a degraded battery pack can
5 result in catastrophic failure of the containment of the individual cells of the battery. These failures can result in significant heat and noxious fumes being generated. Presently there is a low level of awareness of the risks posed by the charging of degraded battery packs – with most users simply finding a convenient power point to supply their recharging system.

10 Battery pack charging systems therefore present a new hazard to be addressed by users. The failure of a battery pack under charge does not generally result in combustion or explosive effects, but rather significant increases in the temperature of the battery. The large amounts of heat
15 produced can potentially contribute to the failure of nearby batteries under charge, or combustion and/or explosion events for nearby flammable or explosive materials.

It would be of advantage to have improvements in the field of hazard
20 mitigation cabinets which allowed for the internal partitioning of the cabinet while reducing heat transfers between adjacent partitions. In particular, improvements which allowed separate thermally isolated partitions to be deployed within a hazard mitigation cabinet would be of advantage. It would therefore be of advantage to have improvements in the field of
25 hazard mitigation cabinets which could address any or all of the above problems, or at least provide the public with an alternative choice.

Disclosure of the Invention

30 According to one aspect of the present invention there is provided a hazard mitigation cabinet which defines a base, a roof, at least one side wall or walls extending between the base and the roof, and an access door located by at least one side wall or walls,
the at least one side wall, door, base, and roof enclosing a secured volume
35 with the door providing access to the secured volume,

the cabinet including at least one partition shelf extending between one or more side walls and the access door to divide the secured volume into two or more thermally isolated horizontal partitions.

- 5 The invention provides a hazard mitigation cabinet used to secure and contained hazardous elements or materials. In various regions of the world these types of storage systems can also be referred to as dangerous goods cabinets. Such cabinets are used to manage the storage of materials which can present a health and safety risk for people working or present near to
10 these materials. Commonly materials which are toxic, explosive, carcinogenic or highly flammable can be stored within such cabinets.

In preferred embodiments the hazard mitigation cabinet provided may also be used to contain materials, tools, or similar components which are capable
15 of producing large amounts of heat, or which can present a risk of becoming an ignition source. For example, in various preferred embodiments the invention may be used to contain electrical batteries and their associated charging circuits or stations. As will be appreciated by those skilled in the art, the charging of damaged or degraded batteries can result in the battery
20 failing and generating heat in the order of several hundred degrees Celsius. Although the failed battery does not necessarily combust or explode, it can form a combustion or detonation source for nearby explosive or flammable materials. Furthermore the heat generated by such failed batteries can also degrade other nearby batteries under charge, resulting in a cascade of heat
25 related battery failures.

A hazard mitigation cabinet provided by the invention includes a base, roof and at least one side walls extending between the base and roof structures. An access door is also provided in association with the one or more side
30 walls to enclose a secured internal volume defined by the cabinet. This internal volume can therefore be used to secure and store hazardous materials, with the door being used to access or deposit materials.

The volume secured by the cabinet can therefore be closed to contain stored
35 hazardous materials, and also to prevent people nearby from being exposed to toxic, explosive or fire based hazards. In various embodiments the construction of the cabinet may give people nearby people the opportunity

to flee a fire before it spreads from the cabinet or can contain shrapnel and pressure waves generated by the detonation of materials inside the cabinet.

5 In a preferred embodiment a hazard mitigation cabinet may include three side walls, forming the rear, left hand and right hand sides of the cabinet. The left and right hand side walls may also form a frame for the cabinet door which forms most of the front face of the cabinet. In such embodiments the cabinet may have a square or substantially rectangular shape.

10 Reference throughout this specification will also be made to the cabinet having three side walls and defining a square or cylindrical shape. However those skilled in the art will also appreciate that cabinets provided by the invention may include a single curve side wall to provide an overall cylindrical shape, or alternatively may define a triangular form with two
15 angle side walls combined with a door. Reference to the provision of three side walls and rectangular form cabinets throughout this specification should in no way be seen as limiting.

In preferred embodiments the hazard mitigation cabinet may also
20 incorporate at least one fan capable of moving air into or out of the secured volume of the cabinet. For example in various embodiments fans may be integrated into the side wall, walls, roof or base of the cabinet.

The operation a fan may be controlled manually in some instances. However
25 in some preferred embodiments the cabinet may include a temperature sensor connected to a microprocessor configured to switch one or more fans on or off based on temperature sensor signals.

In various embodiments a fan or fans integrated into the cabinet can act to
30 reduce interior temperatures while batteries are being charged or stored, and may also acts to reduce temperatures in the cabinet in the event of a battery failing and generating heat.

In various preferred forms of such embodiments a plurality of fans may be
35 provided in the cabinet side wall(s) to service an array of horizontal partitions formed in the interior of the cabinet. In such embodiments a fan

may be provided for each horizontal partition formed in the interior of the cabinet.

5 In some preferred embodiments the hazard mitigation cabinet may define at least one vent in a side wall. Vents can allow for the passive circulation of air through a cabinet, particularly when the interior of the cabinet is warmer than its surrounding environment.

10 In further preferred embodiments the side wall or walls of the cabinet may define a plurality of vents with a vent provided for each horizontal partition of the cabinet. In such embodiments localised heating experienced within a particular horizontal partition may be reduced through the circulation of cooler air delivered from the outside of the cabinet.

15 In various preferred embodiments the hazard mitigation cabinet may include a plurality of power supply outlets engaged with at least one of its side walls. In a further preferred embodiment at least one power supply outlet may be provided within each horizontal partition. The provision of power supply outlets allows the cabinet to be used to recharge batteries from a source of
20 electrical energy connected to the power supply outlet or outlets.

The hazard mitigation cabinet provided includes at least one partition shelf which extends between the interior of the side walls of the cabinet and its door. A partition shelf will therefore divide the secured volume into two
25 horizontal partitions. This partition shelf forms a barrier which acts to thermally isolate the two adjacent horizontal partitions. Materials stored or supported by the upper surface of the shelf in one partition can be shielded from heat or high temperatures present in the adjacent lower horizontal partition.

30 Those skilled in the art will appreciate that references made to the thermal isolation of horizontal partitions will appreciate that heat transfer is still possible but greatly attenuated between adjacent partitions. Partition shelves exposed to high temperatures for long enough time periods will
35 inevitably allow for some heat transfer, while the various embodiments of the invention have a significant impact on how much heat is transferred and how quickly heat is transferred.

As indicated above the invention may find particular utility in the storage and charging of battery systems. High temperatures generated by the failure of a degraded battery under charge in one horizontal partition can be
5 isolated from an adjacent partition.

Preferably a partition shelf may define a width, length or circumference which fits the perimeter of the shelf immediately adjacent to the side wall or walls of the cabinet. This arrangement of the partition shelf mitigates the
10 potential for heat to transfer between adjacent horizontal partitions.

Reference throughout this specification will be made to the perimeter of a partition shelf being dimensioned so as to in contact with or be approximately 1 mm away from interior surfaces of the side walls and door.
15 However those skilled in the art will appreciate that other distances or tolerances may be used in practice in other embodiments if required.

In a preferred embodiment the cabinet may include a plurality of shelves. This array of shelves can divide the entire secured volume into a stack of
20 thermally isolated horizontal partitions.

Reference throughout this specification will be made to the cabinet including three shelves which form a stack of four thermally isolated partitions. However those skilled in the art will appreciate that the invention may only
25 provide a single shelf or only two shelves in other embodiments.

In a preferred embodiment the partition shelves include at least one layer of thermal insulator material, where preferably the mass and the thickness of the thermal insulator impede the transmission of heat through the partition
30 shelf. In a further preferred embodiment the thermal insulator may have a thickness, mass and/or composition which impedes the transmission of heat through the shelf.

In preferred embodiments the thermal insulator may be formed from a material which is not damaged by exposure to temperatures above 500
35 degrees Celsius. In further preferred the thermal insulator may be formed

from a material which is not damaged by exposure to temperatures in the range of 500-1600 degrees Celsius.

5 In some preferred embodiment the thermal insulator may be formed from a ceramic material such as a block of ceramic board or ceramic blanket, and may be dimensioned with approximately the same width depth and height as the shelf to be formed. These ceramic-based thermal insulators can therefore act effectively to prevent heat transfer between adjacent horizontal compartments.

10 In other preferred embodiments the thermal insulator may be formed from a mineral material such as – for example – a mineral wool or fibre material. In further particular embodiments high temperature mineral fibre or wool materials may be used form of thermal insulator, with the materials selected preferably being resistant to temperatures above one thousand degrees Celsius. In various instances of such embodiments the mineral thermal insulator may be formed with approximately the same width depth and height dimensions as the partition shelf.

20 In a preferred embodiment a partition shelf may include at least one exterior skin layer. A skin layer may cover and at least partially enclose at least one side of the thermal insulator. Preferably an exterior skin may form an upper surface for the shelf, or an underside surface for the shelf, or may extend around both.

25 In a preferred embodiment an exterior skin layer may include a sheet of metal. Metal sheets provide robust forms of supporting surfaces for shelves and define a strong platform to support the weight of materials based upon them.

30 In a preferred embodiment a partition shelf may include two exterior skins, the first forming the upper surface of the shelf and the second forming the underside surface of the shelf. Those skilled in the art will however appreciate that in other embodiments the invention may incorporate a single exterior skin, preferably forming the upper surface of the shelf.

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However in other embodiments different arrangements may be used, including the provision of a thermal insulator without any exterior skin layers, and/or a thermal insulator engaged with an exterior skin forming an underside surface for the shelf. Reference made to the provision of two
5 exterior skins sandwiching a thermal insulator should therefore not be seen as limiting.

In a preferred embodiment one or more shelves may be provided with an exterior skin layer which defines one or more edge projections. Such
10 projections may extend towards the opposite face or surface of the shelf to that covered by the skin layer, and in some embodiments may engage with these a further skin layer covering the opposite side of the shelf.

In preferred forms edge projections may extend outward approximately to
15 the same distance as the thickness of the thermal insulator. In such embodiments each projection can therefore define an exterior edge surface for the shelf running perpendicular to its upper and lower surfaces. The provision of one or more edge projections also allows the thermal insulator to be fully enclosed by an exterior skin material.

20 In a further preferred embodiment an edge projection of a skin layer may have an L or C-shaped form, preferably by presenting an additional surface extending from the tip of the edge protection parallel to an adjacent surface of the thermal insulator. In such embodiments the edge projection may form
25 both an edge surface and a strengthening rib which runs along the length or width of the shelf. C or L-shaped bracket profiles can abut the edges of the thermal insulator.

In some embodiments an exterior skin layer or any edge protection
30 projection it defines may extend to engage a side wall of a cabinet. In various preferred embodiments complimentary shaped structures - such as a hook and receiving cavity - can be formed in either edge projections or side walls to securely connect a partition shelf to a side wall of the cabinet. For example in some embodiments an edge projection may define a hook
35 received by a complimentary aperture formed in a side wall - or alternatively may define a receiving cavity for a complimentary hook formed on or by a side wall. Preferably the complimentary connection systems

provided may prevent the shelf from being slid forwards towards the door of the cabinet as a relatively heavy load is removed from it's the surface.

5 The present invention may provide many potential advantages over the prior art.

10 The present invention can provide a hazard mitigation cabinet which defines a stack of thermally isolated horizontal partitions. The partition shelves used to achieve this can impede the transmission of heat from an adjacent cell to its neighbour, preventing an ignition source in one partition degrading, igniting or detonating the contents of another partition.

15 In various embodiments the partition shelf provided has a relatively lightweight form with high structural strength. In additional embodiments a partition shelf can be firmly fixed to and engaged with the side walls of the cabinet to prevent it being withdrawn from the cabinet accidentally.

20 In various preferred embodiments the form taken by edge covering projections can define strengthening beams which improve the weight carrying and strength characteristics of a partition shelf.

Brief description of the drawings

25 Additional and further aspects of the present invention will be apparent to the reader from the following description of embodiments, given in by way of example only, with reference to the accompanying drawings in which:

- Figure 1 shows a perspective view of a hazard mitigation cabinet as provided in accordance with a preferred embodiment,
- Figure 2 shows a perspective view of a portion of a partition shelf as provide in an alternative embodiment, and
- Figure 3 shows a perspective exploded view of parts of a partition shelf provided in accordance with another embodiment.

35 Further aspects of the invention will become apparent from the following description of the invention which is given by way of example only of particular embodiments.

Best modes for carrying out the invention

Figure 1 shows a perspective view of a hazard mitigation cabinet as provided in accordance with a preferred embodiment. As can be seen from this figure the cabinet 1 includes a roof 2 base 3 left and right side walls 4 and a rear wall 5. The secured volume defined by the cabinet is fully enclosed when the two front doors 6 are pivoted to a closed position As can be seen from figure 1 the left interior side wall also provides a number of power supply ports 7.

In the embodiment shown the cabinet includes four partition shelves 8, dividing the secured volume into a stack of five thermally isolated horizontal partitions 9.

Projecting hooks 10 formed on the left and right side walls engage the shelves 8 at desired heights within the cabinet. An array of projecting hooks provide flexibility in where shelves can be located within the secured volume.

In the embodiment illustrated by figure 1 each of the shelves 8 may preferably be used to support the weight of battery systems and their charging circuits. These charging circuits can be supplied from one of the power supply ports 7 available adjacent to each shelf 8. The construction of each partition shelf, as discussed further below thermally isolates each horizontal partition from its neighbours, thereby preventing the failure of batteries under charge from causing an ignition, degradation or detonation effect in an adjacent partition.

Figure 2 shows a perspective view of a portion of a partition shelf as provide one embodiment. In the embodiment shown the partition shelf is formed from a layer of thermal insulator 11, provided in this embodiment by thermally insulating ceramic board. The upper surface 12 of the shelf is provided by a thin steel sheet pop riveted 13 into the upper surface of the thermal insulator 11.

The upper skin 12 defines an edge projection 14 extending perpendicular to the edge of the thermal insulator 11, defining an exterior edge surface 15

for the sheet. The same edge projection also defines a connection system 16 for the side walls of a hazard mitigation cabinet. The connection projection showing defines a pair of cavities which receive hooks formed on the side wall of the cabinet.

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Figure 3 shows a perspective exploded view of parts of a partition shelf provided in accordance with another embodiment. This embodiment differs from that shown by figure 2 by providing two separate exterior skin layers 112, 117. The upper surface skin 112 can be engaged with the lower surface skin 117 using pop rivets 113. Similarly with the embodiment shown in figure 2 the lowest skin can also defines projections 114 covering the edge of the shelf and connector systems 116 to engage with the side walls of the cabinet.

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15 The upper skin 112 also defines a pair of edge projections 118 with each of these forming a C-shaped bracket running the length of the shelf edge. This type of edge projection substantially increases the overall structural integrity and strength of the shelf.

20 In the preceding description and the following claims the word "comprise" or equivalent variations thereof is used in an inclusive sense to specify the presence of the stated feature or features. This term does not preclude the presence or addition of further features in various embodiments.

25 It is to be understood that the present invention is not limited to the embodiments described herein and further and additional embodiments within the spirit and scope of the invention will be apparent to the skilled reader from the examples illustrated with reference to the drawings. In particular, the invention may reside in any combination of features described herein, or may reside in alternative embodiments or combinations of these features with known equivalents to given features. Modifications and variations of the example embodiments of the invention discussed above will be apparent to those skilled in the art and may be made without departure of the scope of the invention as defined in the appended claims.

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What we claim is:

1. A hazard mitigation cabinet which defines a base, a roof, at least one side wall or walls extending between the base and the roof, and an access door located by at least one side wall or walls,
5 the at least one side wall, door, base, and roof enclosing a secured volume with the door providing access to the secured volume, the cabinet including at least one partition shelf extending between one or more side walls and the access door to divide the secured
10 volume into two or more thermally isolated horizontal partitions.
2. The hazard mitigation cabinet of claim 1 wherein the partition shelf or shelves include at least one layer of thermal insulator material.
- 15 3. The hazard mitigation cabinet of claim 2 wherein the mass and the thickness of the thermal insulator impedes the transmission of heat through the partition shelf.
- 20 4. The hazard mitigation cabinet of claim 2 wherein the thermal insulator is formed from a material which is not damaged by exposure to temperatures in the range of 500-1600 degrees Celsius.
- 25 5. The hazard mitigation cabinet of claim 2 wherein the thermal insulator is formed from a mineral or ceramic material with approximately the same width depth and height dimensions as the partition shelf.
- 30 6. The hazard mitigation cabinet of claim 1 wherein a partition shelf defines a width, depth or circumference dimension which fits the perimeter of the shelf immediately adjacent to the side wall or walls and door.
- 35 7. The hazard mitigation cabinet of claim 6 wherein the partition shelf is in contact with or is approximately 1 mm away from the side wall or walls and door.
8. The hazard mitigation cabinet of claim 1 wherein the shelf includes at least one exterior skin layer.

9. The hazard mitigation cabinet of claim 8 wherein an exterior skin layer is formed with a sheet of metal.
- 5 10. The hazard mitigation cabinet of claim 8 or claim 9 wherein a partition shelf includes a first exterior skin forming the upper surface of the shelf and a second exterior skin forming the underside of the shelf.
- 10 11. The hazard mitigation cabinet of claim 1 which includes at least one fan capable of moving air into or out of the secured volume of the cabinet.
- 15 12. The hazard mitigation cabinet of claim 11 which includes a temperature sensor connected to a microprocessor configured to switch the at least one fan on and off based on temperature signals provided by the temperature sensor.
- 20 13. The hazard mitigation cabinet of claim 11 or claim 12 which includes a plurality of fans provided in the side wall or walls with a fan provided for each horizontal partition formed in the interior of the cabinet.
14. The hazard mitigation cabinet of claim 1 which defines at least one vent in a side wall.
- 25 15. The hazard mitigation cabinet of claim 14 which includes a plurality of vents formed in the side wall or walls with a vent provided for each horizontal partition formed in the secured volume of the cabinet.
- 30 16. The hazard mitigation cabinet of claim 1 which includes a plurality of power supply outlets engaged with at least one side wall.
17. The hazard mitigation cabinet of claim 16 wherein at least one power supply outlet is provided within each horizontal partition.
- 35 18. The hazard mitigation cabinet of claim 8 or claim 9 wherein an exterior skin layer defines one or more edge projections configured to engage with a side wall.

19. The hazard mitigation cabinet of claim 18 wherein the edge projection or projections form both an edge surface and a strengthening rib which runs along the length or width of the shelf.
20. The hazard mitigation cabinet of claim 18 wherein the edge projection or projections form a complimentary connection system.

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