US007795837B1

(12) **United States Patent**
Haun et al.

(10) **Patent No.: US 7,795,837 B1**
(45) **Date of Patent: Sep. 14, 2010**

(54) **PORTABLE SOLAR POWER SUPPLY TRAILER WITH A SECURITY CONTAINMENT AREA AND MULTIPLE POWER INTERFACES**

(75) Inventors: **Darrell N. Haun**, Sugar Land, TX (US); **Donald N. Haun**, Stafford, TX (US)

(73) Assignee: **Solarcraft, Inc.**, Stafford, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/606,409**

(22) Filed: **Oct. 27, 2009**

(51) **Int. Cl.**
H01M 10/44 (2006.01)
H01L 31/042 (2006.01)

(52) **U.S. Cl.** **320/101**; 136/244

(58) **Field of Classification Search** 320/101
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,261,329 A * 4/1981 Walsh et al. 126/569
5,969,501 A * 10/1999 Glidden et al. 320/101
6,041,242 A * 3/2000 Coulthard 455/575.1
6,396,239 B1 * 5/2002 Benn et al. 320/101
7,388,348 B2 * 6/2008 Mattichak 320/101
2009/0026842 A1 * 1/2009 Hunter et al. 307/66
2009/0079161 A1 * 3/2009 Muchow et al. 280/400
2009/0288698 A1 * 11/2009 Chen 136/244

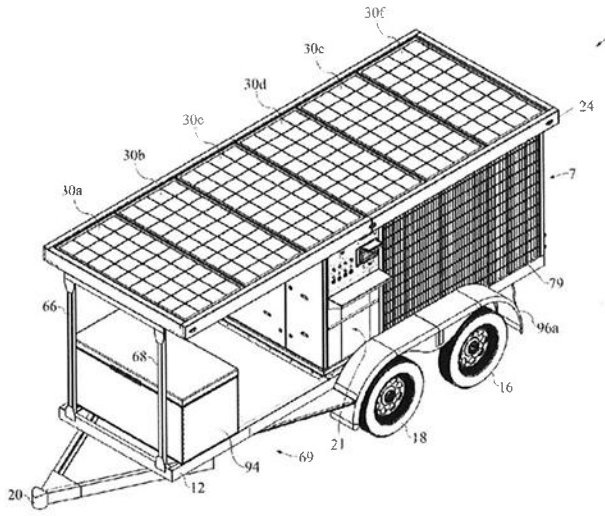
* cited by examiner

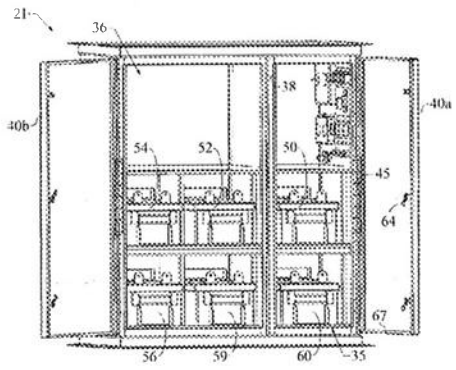
Primary Examiner—Patrick J Assouad
Assistant Examiner—M'Baye Diao
(74) *Attorney, Agent, or Firm*—Buskop Law Group, PC; Wendy Buskop

(57) **ABSTRACT**

A portable solar power supply trailer with a security containment area and multiple power interfaces, wherein the trailer has a trailer frame with wheels on axels and a support hitch. An enclosure on the trailer frame covers about 25 percent of the trailer frame and a solar array frame is disposed on the enclosure, and wherein the solar array frame covers the entire trailer frame and the enclosure, and the solar array frame has at least one photovoltaic cell. The enclosure has plurality of power interfaces for access by a user external to the enclosure, a plurality of batteries, a solar controller, a power interface timer in the enclosures for providing power to the power interfaces, and two posts and two supports for supporting the solar array frame.

20 Claims, 8 Drawing Sheets





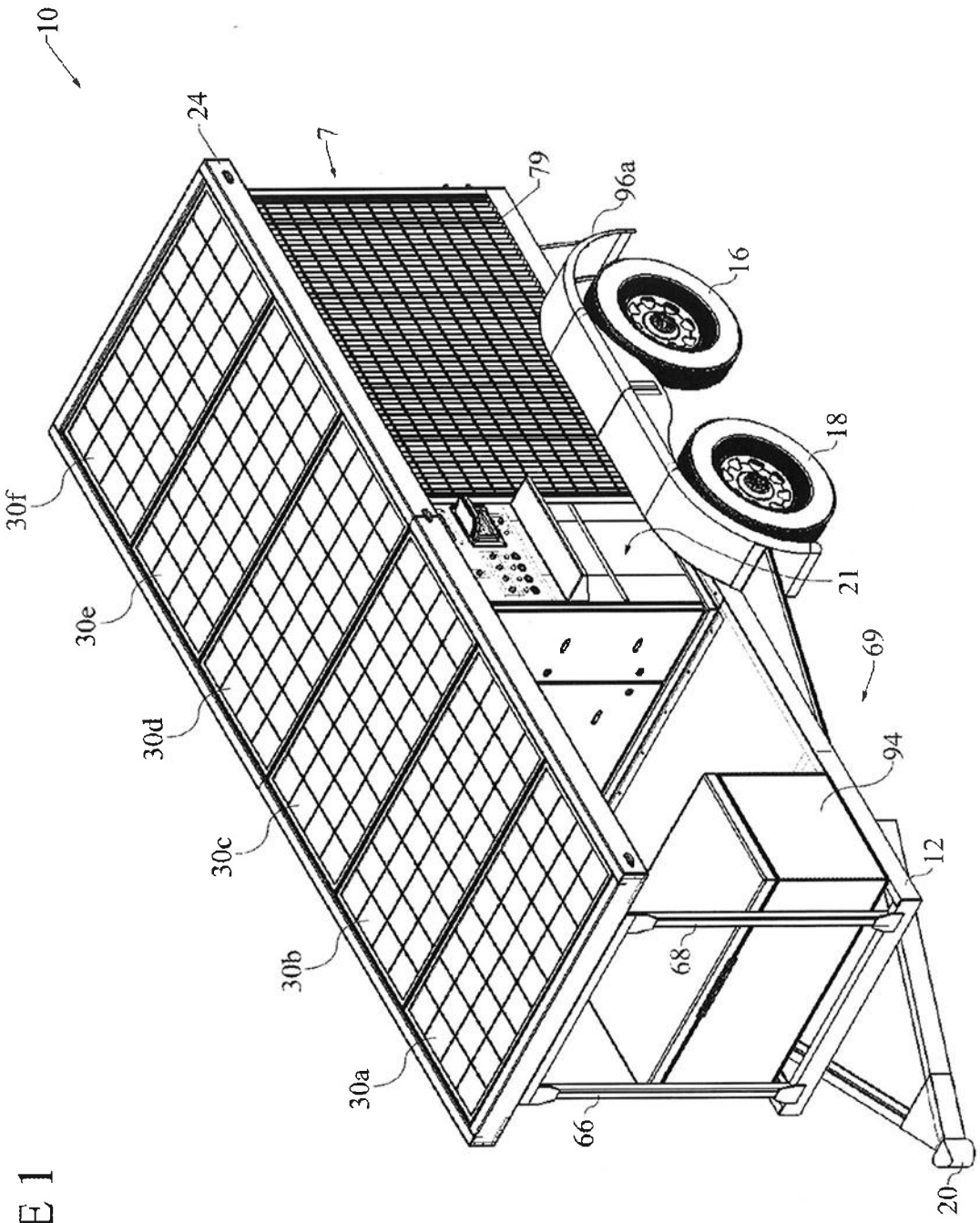


FIGURE 1

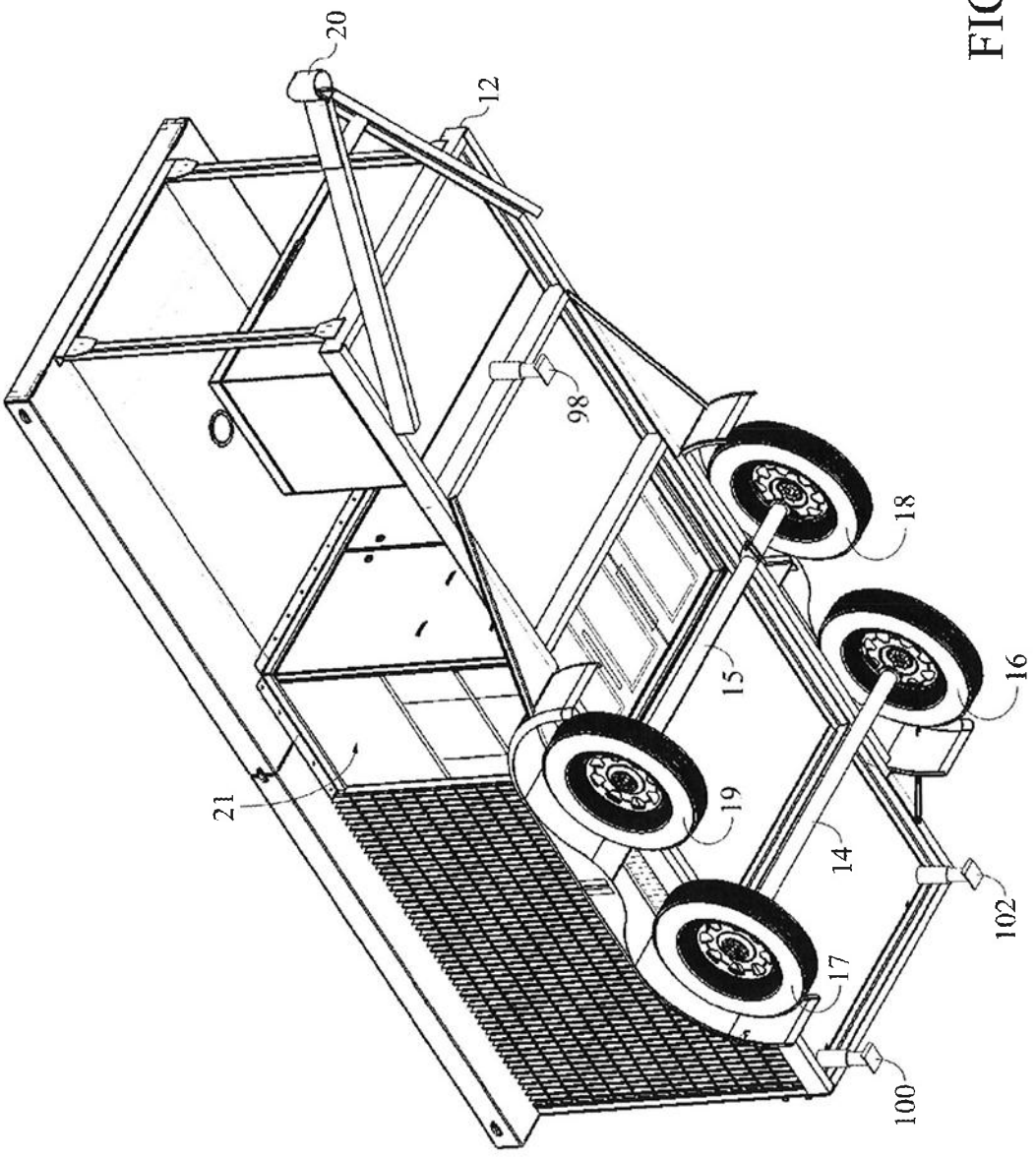


FIGURE 2

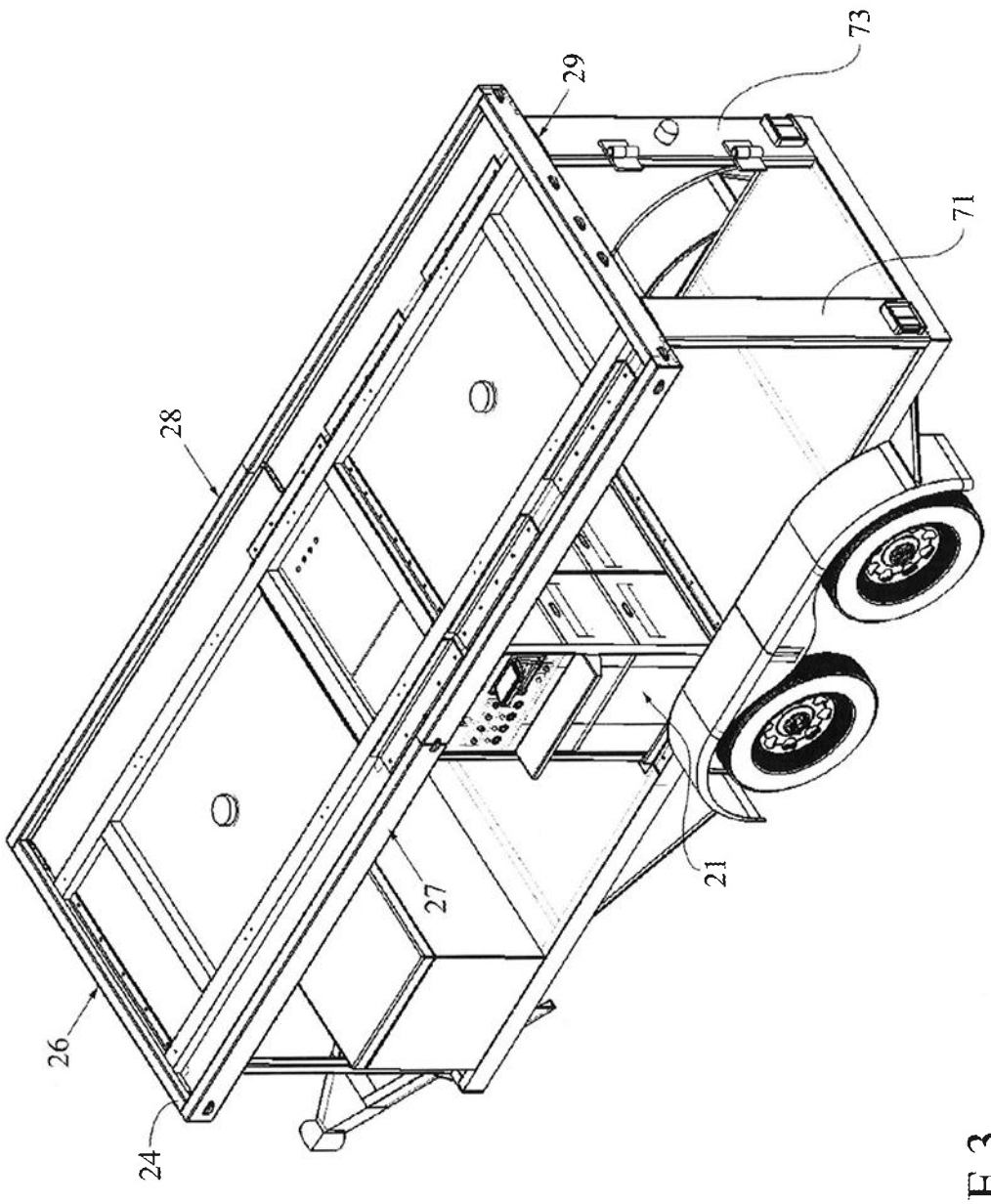


FIGURE 3

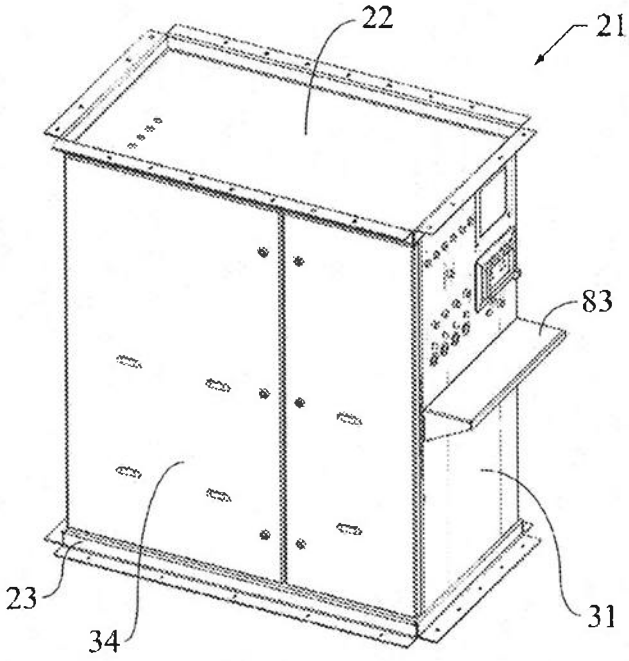
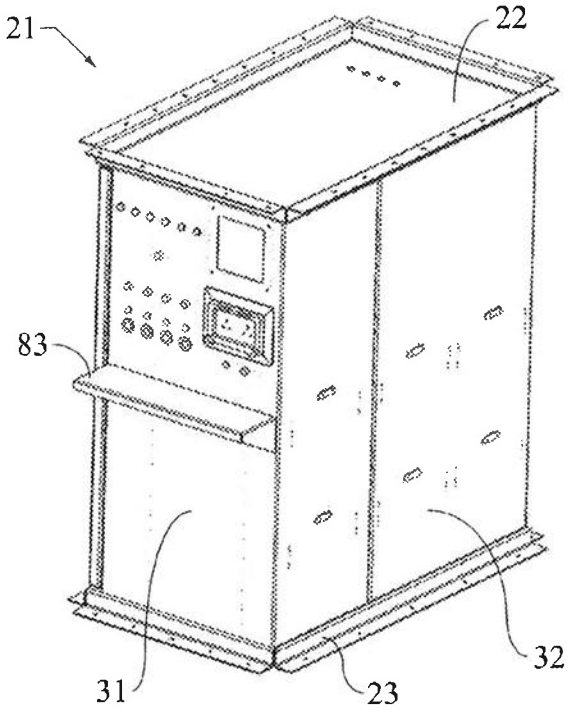


FIGURE 4A

FIGURE 4B



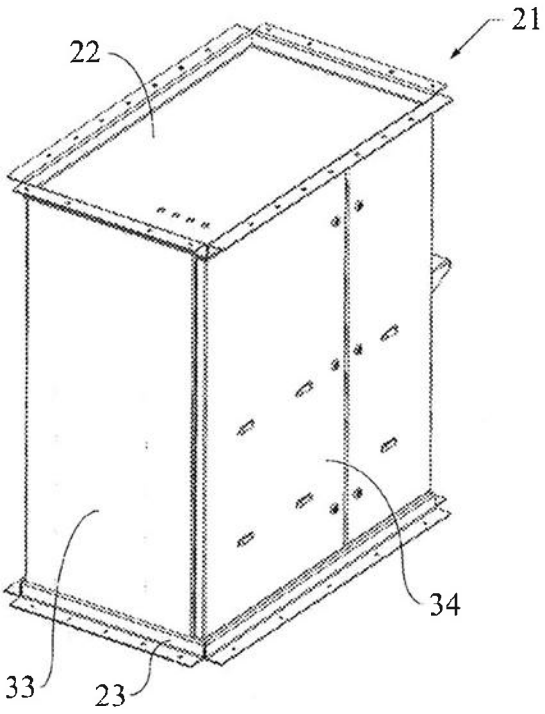
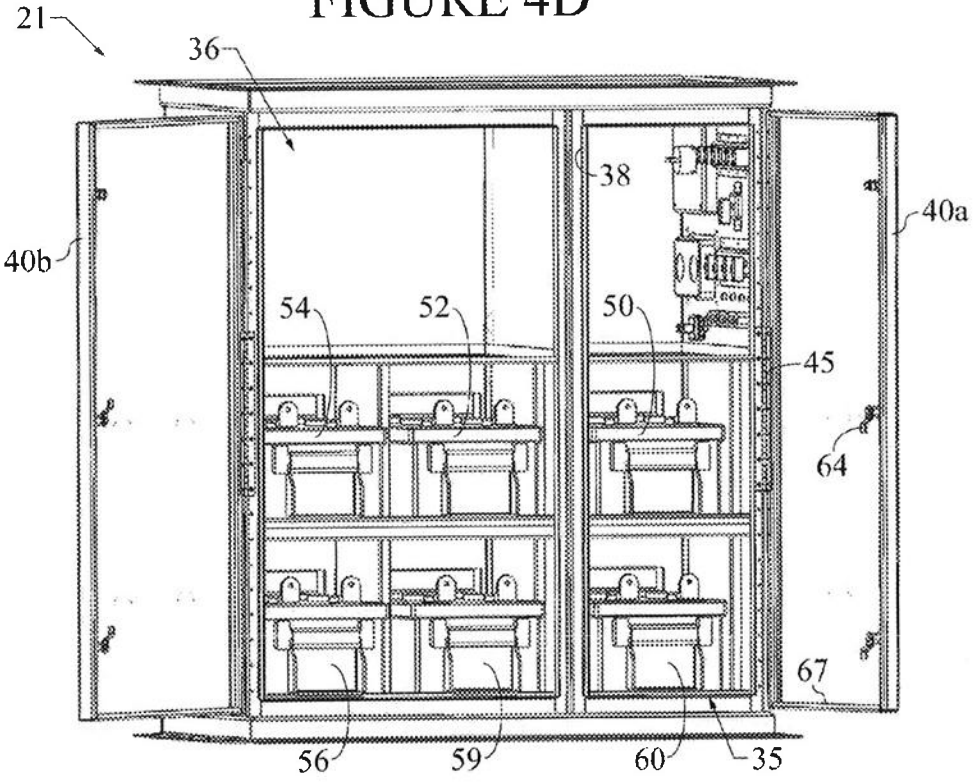


FIGURE 4C

FIGURE 4D



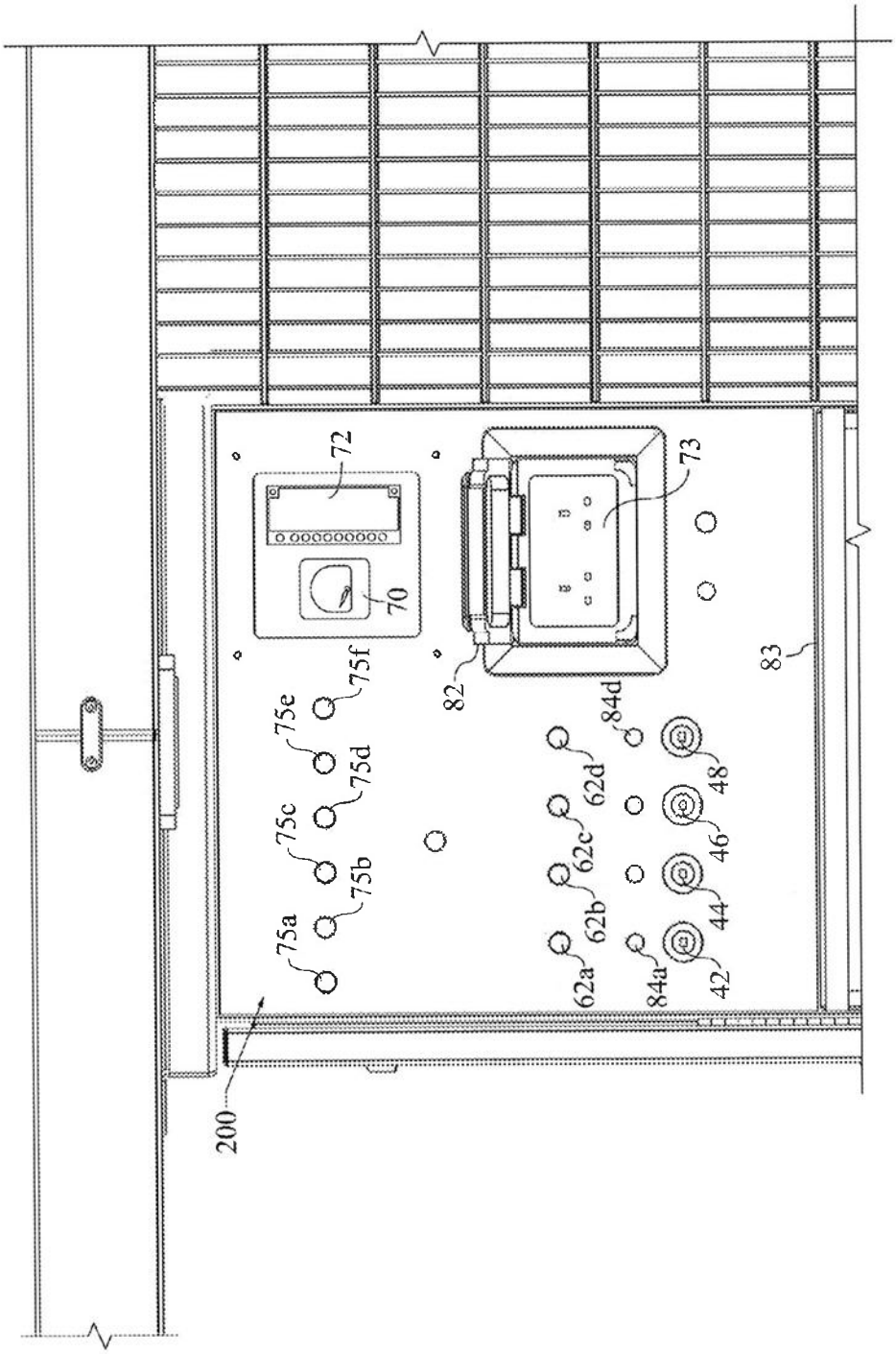

72
70
73
75f
75e
75d
75c
75b
75a
82
84d
62d
62c
62b
62a
84a
48
46
44
42
83
200

FIGURE 5

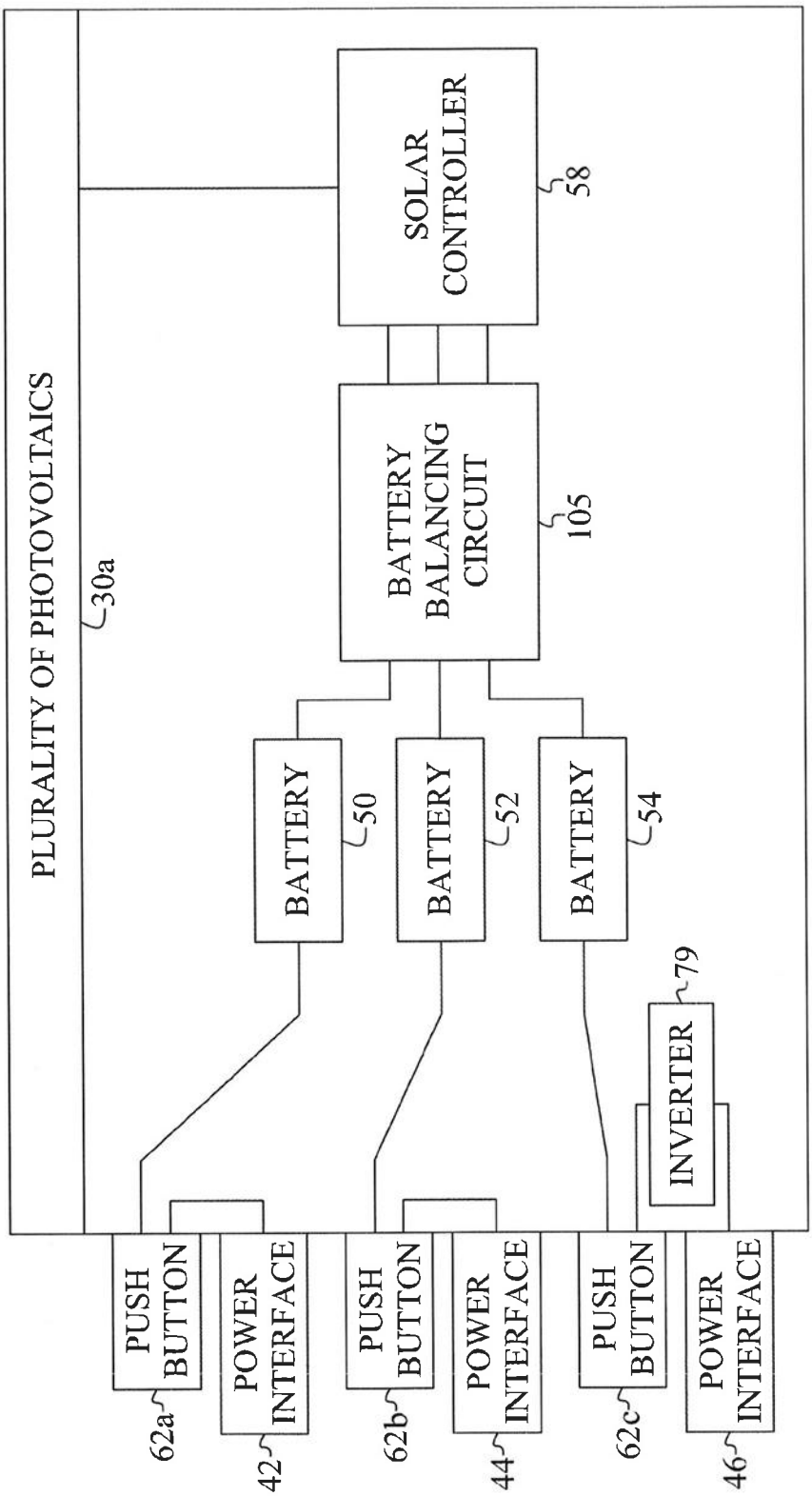

PLURALITY OF PHOTOVOLTAICS
30a
SOLAR CONTROLLER
58
BATTERY BALANCING CIRCUIT
105
BATTERY
50
BATTERY
52
BATTERY
54
INVERTER
79
PUSH BUTTON
62a
POWER INTERFACE
42
PUSH BUTTON
62b
POWER INTERFACE
44
PUSH BUTTON
62c
POWER INTERFACE
46

FIGURE 6

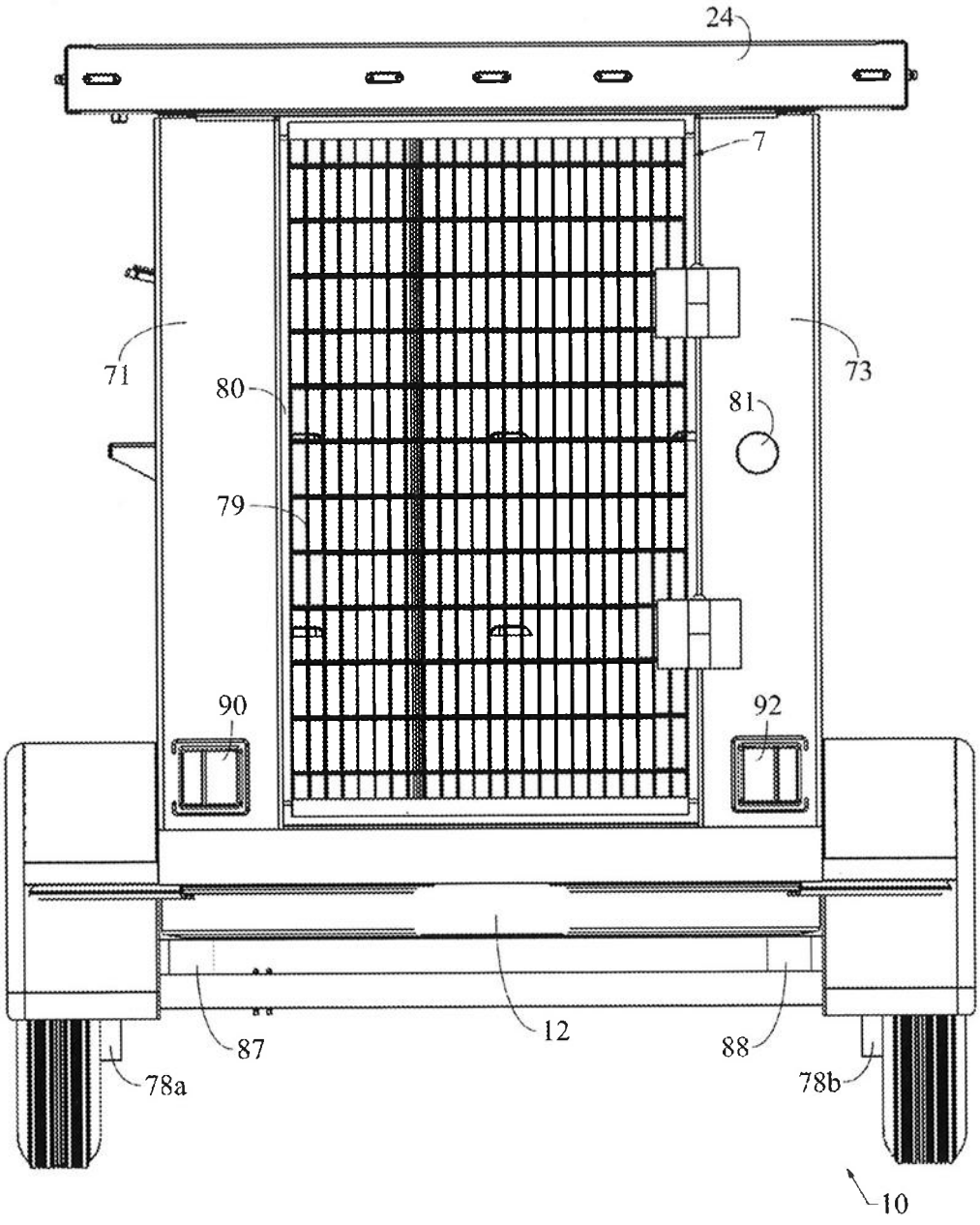


FIGURE 7

PORTABLE SOLAR POWER SUPPLY TRAILER WITH A SECURITY CONTAINMENT AREA AND MULTIPLE POWER INTERFACES

FIELD

The present embodiments generally relate to portable solar power supply trailer using at least one photovoltaics, which can be attached to a car or truck and towed into the desert or other remote areas to charge portable handheld electronics like cell phones, laptops, and portable global positioning system "GPS" devices.

BACKGROUND

A need exists for a portable solar power supply trailer with security containment area and multiple power interfaces.

A need has existed for a power supply trailer having a trailer frame with wheels on axels and a support hitch that can be used in remote areas.

A need has existed for a power supply trailer having an enclosure on the trailer frame covering no more than 25 percent of the trailer frame for providing outlets of power to users to recharge portable electronics in the field.

A need has existed for a portable solar power supply trailer with a solar array frame disposed on and enclosure for providing portable power, using a solar array frame that covers the entire trailer frame and the enclosure and contains at least one photovoltaic cell.

The present embodiments meet these needs.

BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description will be better understood in conjunction with the accompanying drawings as follows:

FIG. **1** is a front perspective view of a portable solar power supply trailer

FIG. **2** is a bottom perspective view of the portable solar power supply trailer of FIG. **1**.

FIG. **3** is a rear perspective view of solar array frame without photovoltaics used in the portable solar power supply trailer of FIG. **1**.

FIG. **4**A-**4**D shows different embodiments of the enclosure.

FIG. **5** is a detailed view of the power interface portion of the enclosure usable on the portable solar power supply trailer.

FIG. **6** is a diagram of the charging and power supply wiring of the portable solar power supply trailer.

FIG. **7** is a back view of the power supply trailer with an on-board security containment area.

The present embodiments are detailed below with reference to the listed Figures.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Before explaining the present apparatus in detail, it is to be understood that the apparatus is not limited to the particular embodiments and that it can be practiced or carried out in various ways.

The present embodiments relate to a portable solar power supply trailer with security containment area and multiple power interfaces.

The trailer can be made up of a trailer frame, which can be powder coated steel and attached to the frame can have at least

one axel. A wheel can be secured to opposite sides of each axel along with brakes and springs.

A support hitch can be connected to the trailer frame to attaching to a car, truck, pickup or another trailer.

In an embodiment, an enclosure, which can be a 6 sided closable box can be disposed on the trailer frame.

The enclosure can have an enclosure top, an enclosure bottom, and four sides. A first enclosure side can be integral with a second enclosure side, a third enclosure side can be integral with the second enclosure side and a fourth enclosure side. The enclosure bottom can be fastened to the trailer frame. The enclosure covers no more than 25 percent of the trailer frame and provides an openable box for installing various electronics.

A solar array frame with four sides can be disposed on the enclosure. The solar array frame covers the entire trailer frame and sits on top of the enclosure top.

The solar array frame can be supported by two poles at the front of the trailer frame and two supports at the back, enabling the solar array frame to be secured on top of the enclosure. The design enables the photovoltaics that are contained in the solar array frame, such as at least one solar panels, such as those made by Kyocera to be horizontal and flat and usable in areas near the equator.

The photovoltaic cell provides power to at least one solar controller that facilitates charging at least one battery that can also be contained within the enclosure.

The enclosure has a design that is rugged and generally water proof for outdoor use. The enclosure can be made from powder coated steel.

The enclosure can have the aforementioned fours sides, a top and a bottom. Around the top and bottom perimeters can be a 1 inch to 2 inch flange, which can enable lifting of the enclosure onto the trailer frame to be allow for easy construction of the solar powered power supply trailer.

In addition to the top and bottom flanges, which can be made from powder coated steel, and can further contain at least 1 lifting hole. A flange can surround the perimeter of an opening formed in the fourth side of the enclosure, which can further have a, which can be hingedly attached. This projecting flange enables the door to further support a rubber or synthetic flexible gasket which enables the door to have an insulated seal with the fourth side flange.

In the interior space of the enclosure, which is formed by the enclosure sides, is contained at least one battery, and up 12 batteries, which can be lead based chargeable car or marine batteries, or a similar rechargeable DC battery.

The batteries can be contained in the space using Styrofoam™ or other closed cell phone insulation, and each can be held into the enclosure with a removable bar that can click into brackets, enabling the batteries to be held securely during transit without bumping or crashing about in the enclosure.

The solar controller in the enclosure can be adapted to receive a charge from the photovoltaics contained in the solar array through an electrical conduit that runs from the solar array frame into the top of the box.

The power from the solar array, which can be volts, 9 volts, 12 volts and up to 52 volts, or any voltage in between, can be used to charge the batteries either in series, in parallel or in parallel and in series.

A battery balancing circuit can be placed between the batteries to ensure that the charging continues when the batteries are in a quiescent mode, a charging mode, or experience a load. The battery balancing circuit is a unique feature that provides a long lasting power supply in a remote environ-

ment, by ensuring that all batteries are usable instantly, that is, all batteries will be able to support a load, which is very important for military uses.

Connected to the batteries and nested in one or more sides of the enclosure are a plurality of power interfaces. The power interfaces can provided mixed currents, that is a first power interface can be a 6 volt interface, 12 volt, 24 volt or some other DC voltage between about 6 volts to about 54 volts allowing the plug in of a charging cable from a user electronic device, like a cell phone into the power interface, which can be a "cigarette lighter" power plug what communicates to the batteries. For example, it could be a power interface used to charge cellular phones, iPods™, or emergency medical equipment, such as heart monitors.

Additional power interfaces can be AC power interfaces providing current from the batteries between about 110 volts to about 230 volts for use with portable gas analyzers, portable seismic equipment, portable radio equipment or other equipment that would need recharging in the field, or need to be plugged into a 110 power supply or 220 power supply in order to work, such as a mini-refrigerator, a small fan, and various types of lighting devices, such as lights usable for landing helicopters or airplanes in a remote location.

The power interfaces of the solar power supply trailers can be used to assist in running field hospital equipment in the event of a natural disaster, such as flooding in an area, or a hurricane affected zone.

The power interfaces can be provided on at least one of the enclosure sides for access by a user external to the enclosure side. All the interfaces can be on one side or on different sides.

In an embodiment, all power interfaces can be identical. In another embodiment the power interfaces can be mixed and on the same trailer.

The rechargeable user device for engaging at least one power interface can be an air compression, for inflating flat tires, a weather station for detecting tornadoes with Doppler™ radar and other detection devices, a flow meter for use in drilling a well, or a similar device.

In the enclosure can be a solar controller fastened into in the interior space and connected to the photovoltaic cells of the solar array frame. The solar controller can further connect to the batteries.

The solar controller can be used to monitor and control charging of at least one of the plurality of batteries from the photovoltaics. A usable solar controller can be one made by Morningstar.

The enclosure can further have a power interface timer connected to the solar controller and a push button for actuating one or more of the power interfaces for a predefined period of time such as 15 minutes, 30 minutes or a similar amount of time. The predefined period of time can be adjusted by a user that has access to the inside space of the enclosure, so that the trailer can have a factory preset time of 10 minutes to charge, but a user in the field can change that length of time to 50 minutes, or 1.2 hours or some other length of time depending on the needs of the user with access to the side space of the enclosure.

In an embodiment, the door of the enclosure can be a locking door or similar controlled access door, such as one using a battery operated biometric lock, that reads fingerprints and is powered from at least one of the on board batteries of the enclosure.

The door of the enclosure can be secured over the opening of the fourth side using at least one fastener, which can be a locking rotatable fastener, a locking knob, or another type of fastener.

A first post and a second post, which can be made of the same material as the trailer frame can connect a front end of the solar array frame to the trailer frame. These first and second posts can be hollow, but strong enough to support the solar array frame non-deformably above the trailer frame during winds what can gust up to about 100 mph. In an embodiment the first and second posts can be welded to the trailer frame.

A first support and a second support can connect to a back end of the solar array frame for supporting the solar array frame non-deformably above the trailer frame as well. These supports can be solid metal channel bars or can be made from another solid metal plate that extends from the solar array frame to the trailer frame.

Between these first and second supports can be a cage material, what can be welded or bolted, that is a combination of horizontal and vertical bars, or plates with perforations, or similar open design, such as the type of material used by zoos to transport wild animals. The cage which can have cage material, or bars, can withstand pressure of at least about 200 pounds of pressure without deforming, and can store various materials.

A door with a frame and similar cage material secured within the frame can be used to created an openable, locking secure enclosure for storing equipment or other materials and for transporting materials while transporting the trailer, such as spare wheels, additional jacks, additional lights, wires, tools and similar materials.

In an embodiment, a steel grating can be used as the cage material and a bumper made from a material similar to automobile tires, or a slide on bumper polymer can be used to prevent the door from smashing a human hand or body part that accidently gets in the way of the door swinging open. The door of the trailer can have this safety feature of the bumper.

In an embodiment, an inverter can be used in the enclosure, disposed in the interior space for taking AC power and forming a DC current, enabling greater versatility in use of the trailer.

A first systems charge gauge can be mounted into one of the enclosure sides and connected electrically to one or more of the photovolatics enabling continuous and simultaneous monitoring of current from the photovolatics while charging one or more user devices.

A second systems charge gauge can be mounted into one of the enclosure sides, near the first systems charge gauge and connected electrically to one or more of the batteries in the enclosure enabling continuous and simultaneous monitoring of current from the batteries while charging one or more user devices.

A gasket can be placed around the door opposite the projecting flange and used to provide a water tight connection between the door and the flange.

One or more covered vents can be formed in one of the side of the enclosure allowing excess heat to escape from the enclosure to prevent damage to the electronics inside the enclosure.

It can be noted that the cage material within the supports with locking door can form a security containment area.

In an embodiment, trailer brakes can be secured to the trailer frame and trailer lights can be used when the trailer is transported and hooked up to another vehicle, such as a pick up truck or other propulsion based tow vehicle. In an embodiment the trailer can have no self propulsion means.

In an embodiment, the trailer with all parts but the photovoltaics, can be stacked one on top of the other creating a very small footprint for shipping in a standard shipping container used with container vessels, which are generally about 8 feet

by about 20 feet. In other words, the wheel of one trailer can fit within the solar array frame of another trailer for secure stacking of the units, lowering the cost of transport by sea from a first location to a second location.

In another embodiment, a protective cover can be used to cover the power interfaces to protect them during shipment, or to prevent rapid deterioration from harsh weather conditions, such as the desert or the rainforest with extreme humidity.

In an embodiment, the cover can be hingedly connected to any enclosure side with a power interface. In another embodiment, multiple covers can be used and can be removably disposed over the plurality of power interfaces. In an embodiment, the covers can be rectangular and can be made of a polymer, such as polypropylene.

In an embodiment, one or more shelves or baskets can be used and disposed beneath at least one of the power interfaces for supporting one or more rechargeable user devices or devices needing power from one of the power interfaces.

At least one light can be used on the trailer to provide a lighted work space between a front portion of the trailer and the enclosure, within the cage area, over one or more of the plurality of power interfaces or combinations thereof.

Each light can be connected to a light timer for controlling illumination over the plurality of power interfaces for a preset period of time, such as 8 minutes.

One light timer can control all the lights, or different light timers can be used on each area needing illumination. The light timer can communicate with the solar controller for providing power for illumination from at least one of the batteries, the at least one photovoltaic or combinations thereof. The lights can be "red lights" for military night use, or bright white reading lights, light emitting diodes "LED" lights or halogens, depending on the trailer use that is intended.

The trailer frame can be supported by a first spring supporting the first wheel on the axel and a second spring supporting the second wheel on the axel, providing a cushioned ride.

Two trailer brake lights can be used in an embodiment.

A storage box can be mounted to the trailer frame between a front portion of the trailer frame and the enclosure for providing additional locking and weather tight storage of tools, electrical cables, portable lights, medicines, medical devices, and nonperishable food.

Fenders can be mounted over each wheel and secured to the trailer frame to control and protect the wheels from mud and sand. The fenders can be made from polymer, metal like the trailer frame, composites to lighten the cost of transport in a shipping container or combinations of these material.

Three leveling jacks can be secured to the trailer frame. A first leveling jack can be foldable for the front of the trailer frame, a second leveling jack and a third leveling jack, which can be adjacent each axel or near the back portion of the trailer, or under the cage area.

Turning now to the Figures, FIG. **1** shows a portable solar power supply trailer **10** with a security containment area **7** shown enclosed with steel grating **79**.

The portable solar power supply trailer **10** has a trailer frame **12** with at least one axel secured to the trailer frame, which is shown in later Figures. A first wheel **16** and a third wheel **18** are shown and can be secured to a first axel. Over the wheels are at least one fender **96***a*.

FIG. **1** shows that the solar array frame **24** can contain a plurality of photovoltaics **30***a*, **30***b*, **30***c*, **30***d*, **30***e*, **30***f*, which can also be referred to herein as "solar panels". The plurality of photovoltaics can provide power for batteries, which can be located in the enclosure **21**.

The solar array frame **24** is shown disposed on the enclosure **21**. In an embodiment, the solar array frame can have no back plate to provide a more lightweight less expensive to transport structure.

A first post **66** and a second post **68** support the solar array frame **24** above the trailer frame **12** near the front end **69** of the trailer frame. A storage box **94** is shown mounted to the trailer frame. A support hitch **20** is also shown connected to the trailer frame **12**.

FIG. **2** is a bottom view of the portable solar power supply trailer and depicts the trailer frame **12**.

A first axel **14** with a first wheel **16** and a second wheel **17** is shown secured on the first axel opposite the first wheel. A second axel **15** is shown parallel to the first axel **14**. A third wheel **18** is shown secured on the second axel **15** opposite a fourth wheel **19**.

FIG. **2** also shows the three leveling jacks secured to the trailer frame. A first leveling jack **98**, a second leveling jack **100** and a third leveling jack **102**. The leveling jacks can be foldable and removable.

The support hitch is also shown in this Figure.

FIG. **3** shows a top view of the solar array frame **24** having a first side **26**, second side **27**, a third side **28** and a fourth side **29**. The solar array frame **24** covers the entire trailer frame and the enclosure **21**.

FIG. **3** shows the second post **68** and with the first support **71** and the second support **73** holding the solar array frame above the trailer frame and on top of the enclosure **21**.

FIG. **4**A, **4**B, **4**C, and **4**D show embodiments of the enclosure **21**.

FIG. **4**A shows the enclosure **21** having an enclosure top **22** and an enclosure bottom **23**. The enclosure top can be fastened to the solar array frame **24** and the enclosure bottom can be fastened to the trailer frame. Enclosure first side **31** and enclosure fourth side **34** are also depicted.

In an embodiment, the enclosure can have at least one shelf **83**, which can be used to support at least one rechargeable user device, such as a cell phone or lap top when plugged into one of the plurality of power interfaces.

FIG. **4**B shows the enclosure **21** having an enclosure top **22** and an enclosure bottom **23**. Enclosure first side **31** and enclosure second side **32** are also depicted. At least one shelf **83** is also depicted.

FIG. **4**C shows the enclosure **21** having an enclosure top **22** and an enclosure bottom **23**. Enclosure third side **33** and enclosure fourth side **34** are also depicted.

FIG. **4**D shows the enclosure **21** with doors **40***a*, **40***b* in an open position. Although two doors are shown in this embodiment, one door or multiple doors can be used.

The enclosures fourth side can have a fourth side opening **35** to an interior space **36** within the enclosure sides.

A projecting flange **38** can surround the fourth side opening **35** extending from the fourth side of the enclosure.

Doors **40***a*, **40***b* can be connected to the enclosure with a hinge **45**. A gasket **67** can be disposed around the door to provide a watertight connection.

The door can have at least one fastener **64** for securing the door to the fourth side of the enclosure. The door can be hingedly connected to the enclosure fourth side or otherwise fastenable to the enclosure fourth side.

Batteries **50**, **52**, **54**. **56**, **59**, and **60** are also shown in FIG. **4**D.

FIG. **5** shows a detail of the power supply and monitoring area **200** of the enclosure, with multiple power interfaces **42**, **44**, **46**, **48** depicted on a side of the enclosure.

The multiple power interfaces enable a user to access the power from batteries in the interior space of the enclosure. Each power interface can provide between about 12 DC volts to about 24 DC volts, or between about 110 AC volts to about 230 AC volts of power to at least one rechargeable user device, such as a cell phone.

FIG. **5** further shows push button **62***a* for power interface **42**, push button **62***b* for power interface **44**, push button **62***c* for power interface **46** and push button **62***d* for power interface **48**.

Also shown in FIG. **5** is a first systems charge gauge **70** connected to one of the enclosure sides, wherein the first systems charge gauge monitors charging current from at least one photovoltaic. A second systems charge gauge **72** is shown for monitoring the charge status of at least one of the plurality of batteries in the enclosure.

FIG. **5** shows at least one plug **73** for a user device, which can support two user devices. Additionally, a plurality of circuit breakers **75***a*, **75***b*, **75***c*, **75***d*, **75***e*, **75***f* are also shown.

FIG. **5** also shows a protective cover **82**, which can be removably disposed over the multiple power interfaces **42**, **44**, **46**, **48** as well as at least one shelf **83**. The shelf **83** can be used to support at least one rechargeable user device, such as a cell phone or lap top when plugged into one of the multiple power interfaces.

Two of a plurality of lights **84***a*, **84***b*, are depicted disposed over the plurality of multiple of power interfaces.

FIG. **6** depicts a plurality of batteries **50**, **52**, **54** are shown and each battery can power at least one of the multiple power interfaces **42**, **44**, **46**.

A solar controller **58** can connect to at least one photovoltaic cell of the plurality of photovoltaics **30***a*. The solar controller **58** can monitor and control charging of at least one of the plurality of batteries **50**, **52**, **54**.

A power interface timer for each battery and each power interface can be used, although one is not shown in this Figure, each power interface timer can be connected to the battery. Each power interface timer can connect to a push button **62***a*, **62***b*, **62***c* for actuating at least one of the multiple power interfaces **42**, **44**, **46** for a predefined period of time.

FIG. **6** also shows a battery balancing circuit **105**, which can communicate between each of the batteries and the solar controller. Additionally, an inverter **79** is shown and can be used to convert the DC voltage to AC voltage for at least one of the multiple power interfaces **42**, **44**, **46**.

FIG. **7** shows a back view of the portable solar power supply trailer **10** with trailer brakes **78***a*, **78***b* and the solar array frame **24** disposed horizontally on the frame, which can maximize the absorption of the sun's rays.

This view also shows a first spring **87** supporting the first wheel on the first axel and a second spring **88** supporting the second wheel also on the first axel. A first trailer brake light **90** and a second trailer brake light **92** are shown for enabling the portable solar power supply trailer **10** to be towed on a roadway in the night, complying with federal or state regulatory laws about illuminating the back of a tow vehicle.

In this Figure, the security containment area **7** can be formed between the solar array frame **24**, the trailer frame **12**, the first support **71** and second support **73**. At least one bar can be used with the steel grating **79**. The hinged locking door **80** can be seen, which can further have a bumper **81**.

While these embodiments have been described with emphasis on the embodiments, it should be understood that within the scope of the appended claims, the embodiments might be practiced other than as specifically described herein.

What is claimed is:

1. A portable solar power supply trailer with a security containment area and multiple power interfaces comprising:

a. a trailer with a trailer frame, at least one axel secured to the trailer frame, a first wheel secured to the axel and a second wheel secured to the axel opposite the first wheel, and a support hitch connected to the trailer frame;

b. an enclosure disposed on the trailer frame having an enclosure top and an enclosure bottom, wherein the enclosure bottom is fastened to the trailer frame and the enclosure covers no more than 25 percent of the trailer frame, and further wherein the enclosure comprises:

c. a solar array frame disposed on the enclosure, wherein the solar array frame comprises: a first side, a second side, a third side, and a fourth side, wherein the solar array frame covers the entire trailer frame and the enclosure top, and further wherein solar array frame comprises at least one photovoltaic cell for providing power to the enclosure;

d. the enclosure further comprises:

i. an enclosure first side;

ii. an enclosure second side;

iii. an enclosure third side;

iv. an enclosure fourth side with a fourth side opening;

v. an interior space within the enclosure sides;

vi. a projecting flange surrounding the opening extending from the fourth side of the enclosure; and

vii. at least one door for providing access to the interior space;

viii. a plurality of power interfaces provided on at least one of the enclosure sides for access by a user external to the enclosure side, and wherein each power interface provides between 6 DC volts to 27 DC volts of current, between 110 AC volts to 230 AC volts of current or combinations thereof, to at least one rechargeable user device engaging at least one power interface;

ix. a plurality of batteries in the interior space;

x. a solar controller in the interior space connected to the at least one photovoltaic cell, and to each of the plurality of power interfaces and the plurality of batteries, wherein the solar controller monitors and controls charging of at least one of the plurality of batteries;

xi. a power interface timer connected to the solar controller comprising a push button for actuating at least one of the plurality of power interfaces for a predefined period of time; and

xii. at least one fastener for securing the door to the fourth side;

e. a first post and a second post connected to a front end of the solar array frame for supporting the solar array frame non-deformably above the trailer frame; and

f. a first support and a second support connected to a back end of the solar array frame for supporting the solar array frame non-deformably above the trailer frame.

2. The portable solar power supply trailer of claim **1**, further comprising an inverter disposed in the interior space.

3. The portable solar power supply trailer of claim **1**, further comprising a first systems charge gauge connected to one of the enclosure sides, wherein the first systems charge gauge monitors charging current from at least one photovoltaic.

4. The portable solar power supply trailer of claim **3**, further comprising a second systems charge gauge for monitoring the charge status of at least one of the plurality of batteries in the enclosure.

5. The portable solar power supply trailer of claim 1, further comprising a gasket disposed between the door and the projecting flange for providing a watertight connection.

6. The portable solar power supply trailer of claim 1, wherein the predefined period of time can be adjusted after accessing the interior space.

7. The portable solar power supply trailer of claim 1, further comprising a high security containment area formed between the solar array frame, the trailer frame, the enclosure, the first support and the second support.

8. The portable solar power supply trailer of claim 7, wherein the high security containment area comprises bars.

9. The portable solar power supply trailer of claim 7, wherein the high security containment area comprises a steel grating with a hinged locking door.

10. The portable solar power supply trailer of claim 9, wherein the hinged locking door has a bumper.

11. The portable solar power supply trailer of claim 1, wherein the trailer has brakes.

12. The portable solar power supply trailer of claim 1, wherein the enclosure has a protective cover removably disposed over the plurality of power interfaces.

13. The portable solar power supply trailer of claim 1 further comprising a shelf for supporting at least one rechargeable user device when plugged into one of the plurality of power interfaces.

14. The portable solar power supply trailer of claim 1, further comprising at least one light disposed over the plurality of power interfaces, wherein the at least one light is connected to a light timer for controlling illumination over the plurality of power interfaces for a preset period of time, and further wherein the light timer communicates with the solar controller for providing power for illumination from at least one of the batteries, the at least one photovoltaic or combinations thereof.

15. The portable solar power supply trailer of claim 1, further comprising a first spring supporting the first wheel on the axel and a second spring supporting the second wheel on the axel.

16. The portable solar power supply trailer of claim 1, further comprising a first trailer brake light and a second trailer brake light.

17. The portable solar power supply trailer of claim 1, further comprising a storage box mounted to the trailer frame.

18. The portable solar power supply trailer of claim 1, further comprises at least one fender mounted over each wheel and secured to the trailer frame.

19. The portable solar power supply trailer of claim 1, further comprising at least three leveling jacks secured to the trailer frame.

20. The portable solar power supply trailer of claim 1, further comprising a battery balancing circuit communicating between each of the batteries and the solar controller.

* * * * *

US007832253B1

(12) **United States Patent**
Haun et al.

(10) **Patent No.: US 7,832,253 B1**
(45) **Date of Patent: Nov. 16, 2010**

(54) **PORTABLE WEATHER RESISTANT GAS CHROMATOGRAPH SYSTEM**

(75) Inventors: **Darrell N. Haun**, Sugar Land, TX (US); **Donald N. Haun**, Stafford, TX (US)

(73) Assignee: **Solarcraft, Inc.**, Stafford, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 92 days.

(21) Appl. No.: **12/397,010**

(22) Filed: **Mar. 3, 2009**

(51) **Int. Cl.**
G01N 30/00 (2006.01)

(52) **U.S. Cl.** **73/23.22**; 73/23.35; 73/23.41; 73/23.42; 73/431; 95/82: 96/101; 96/102; 96/106; 422/89; 422/104

(58) **Field of Classification Search** 73/23.22, 73/23.35, 23.41, 23.42, 431; 95/82; 96/101, 96/102, 106
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,060,301 A * 10/1962 Rondle 219/400
4,553,985 A * 11/1985 Dahlgren et al. 95/26
5,123,276 A * 6/1992 Hartman et al. 73/23.41
5,361,626 A * 11/1994 Colligan et al. 73/40.7
5,559,283 A * 9/1996 Kaji et al. 73/61.56
5,591,406 A * 1/1997 Hirai et al. 422/80
5,711,916 A * 1/1998 Riggs et al. 422/83
2003/0085714 A1 * 5/2003 Keyes et al. 324/464
2010/0032600 A1 * 2/2010 Doe et al. 251/129.15

OTHER PUBLICATIONS

Fast Online Gas Chromatograph Analysis for LPG Distillation, Yokogawa, 2007, pp. 1-3.*
Process Gas Chromatograph PGC 9000 VC, RMG Messtechnik Gmbh, Nov. 2008, pp. 1-8.*

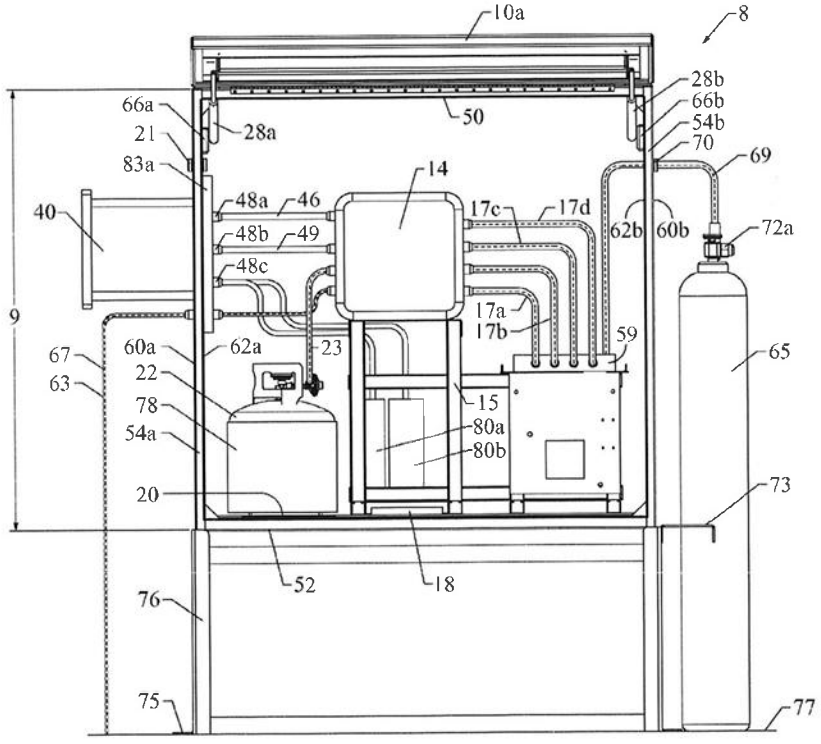
* cited by examiner

Primary Examiner—Daniel S Larkin
(74) *Attorney, Agent, or Firm*—Buskop Law Group, PC; Wendy Buskop

(57) **ABSTRACT**

A portable weather resistant gas chromatograph system with a gas chromatograph enclosure having a body and a movable door and a seal, a gas chromatograph with a frame assembly removably secured in the enclosure, a plurality of exhaust gas lines connected to the gas chromatograph, an explosion proof terminal box with circuit breakers and terminals mounted to the enclosure, a communication conduit and armored power cable between the explosion proof terminal box and the gas chromatograph, a purge gas conduit port for the gas chromatograph, a pedestal for the enclosure, and at least two lifting eyes connected to the enclosure.

19 Claims, 4 Drawing Sheets



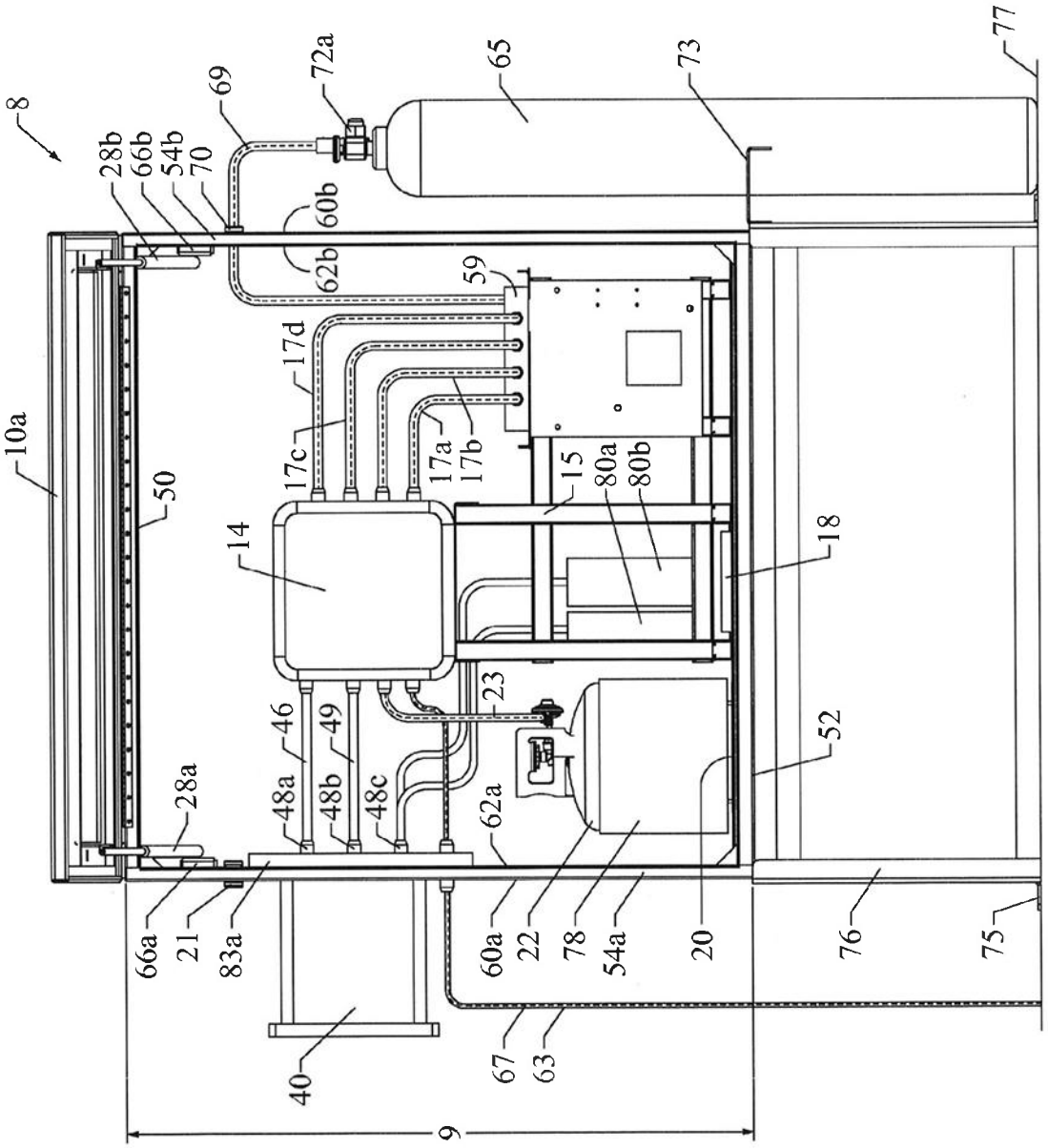

8
28b
66b
54b
70
69
72a
65
73
77
60b
62b
59
17d
17c
17a
17b
15
80a
80b
10a
50
14
18
23
46
49
48a
48b
48c
62a
52
28a
66a
21
83a
60a
22
78
54a
20
76
75
67
63
40
9

FIGURE 1

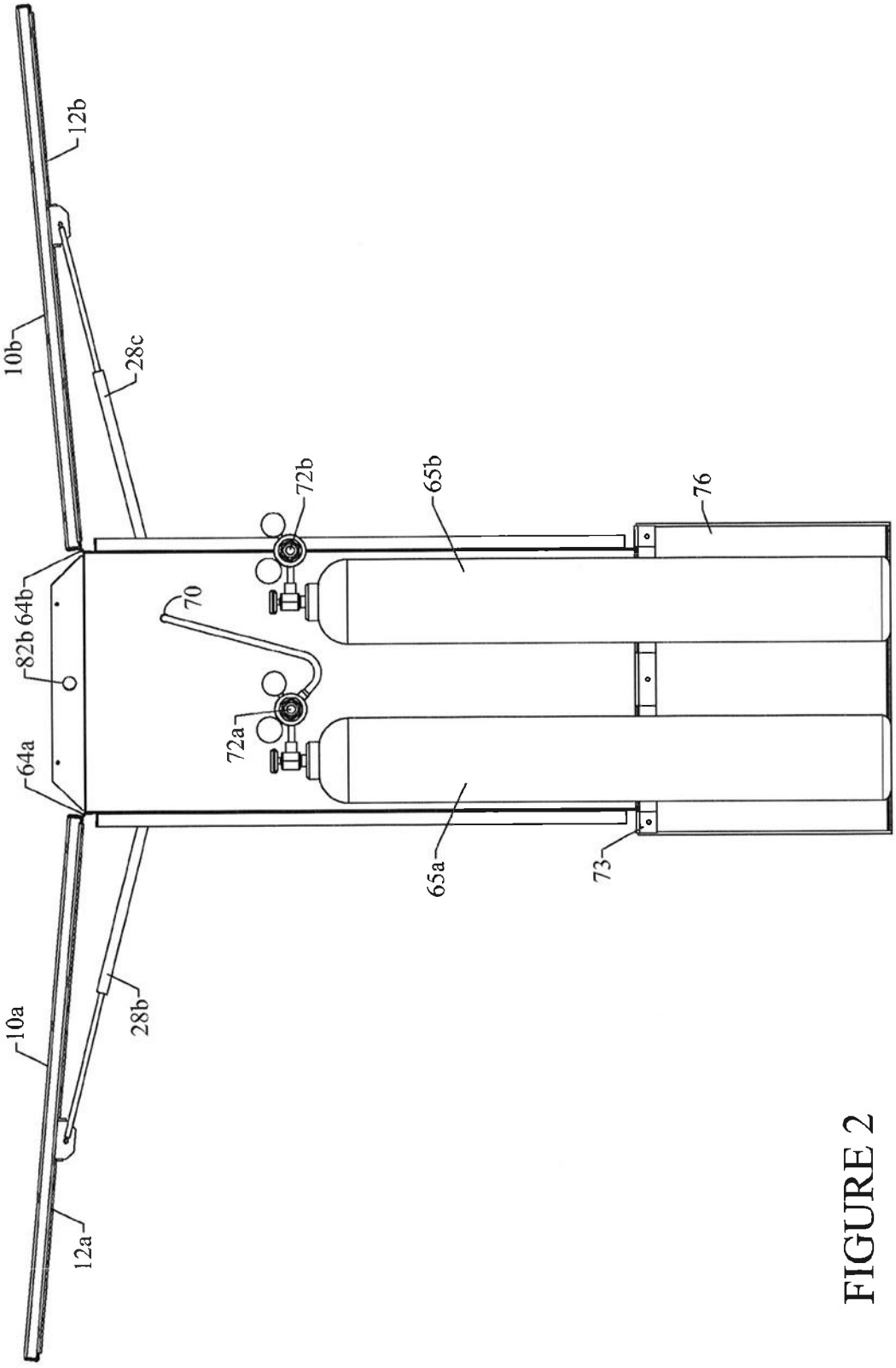


FIGURE 2

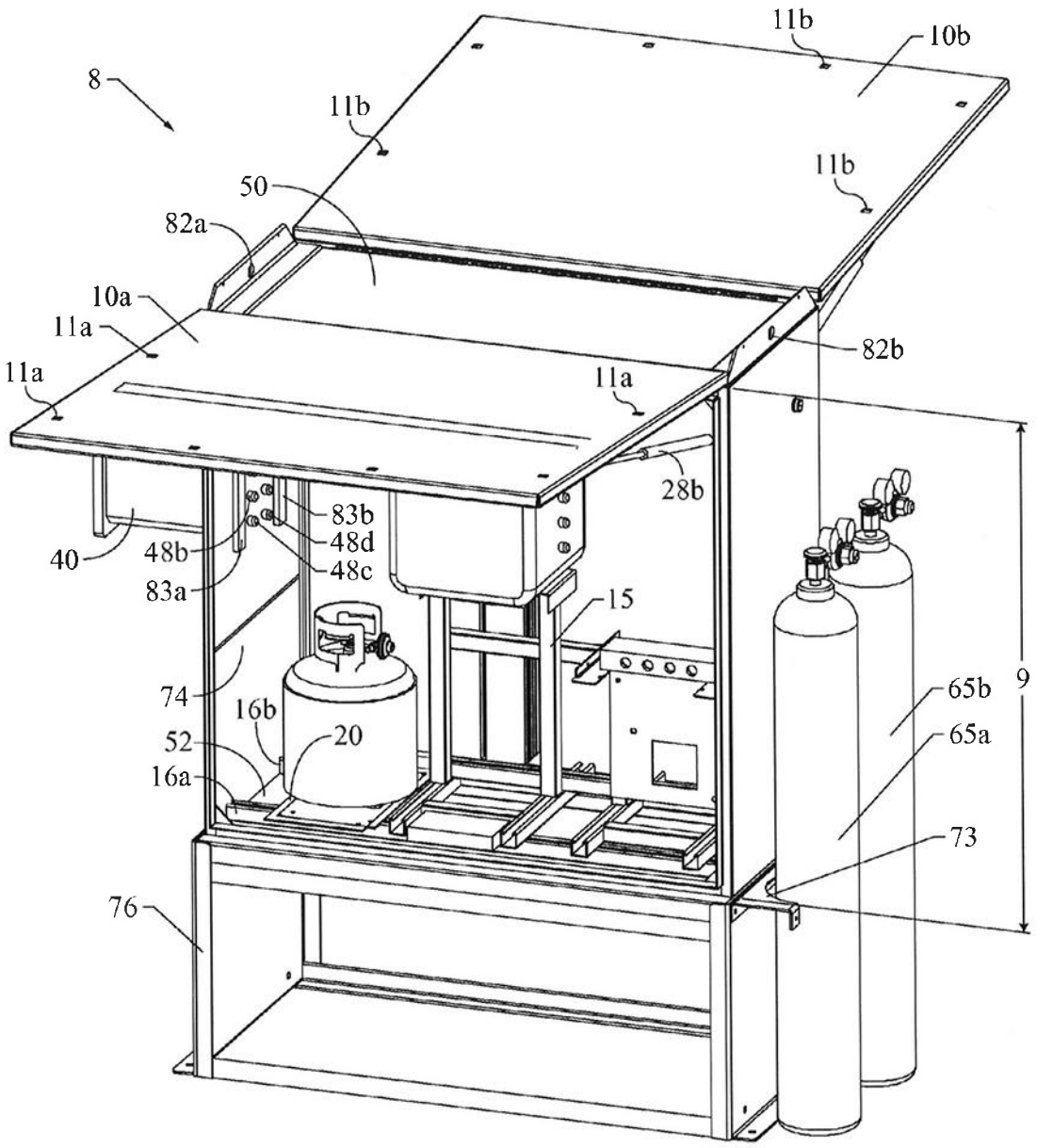

8
11b
10b
11b
11b
50
82a
10a
11a
11a
11a
82b
28b
83b
48d
48c
40
48b
83a
15
74
16b
52
20
16a
65b
65a
73
9
76

FIGURE 3

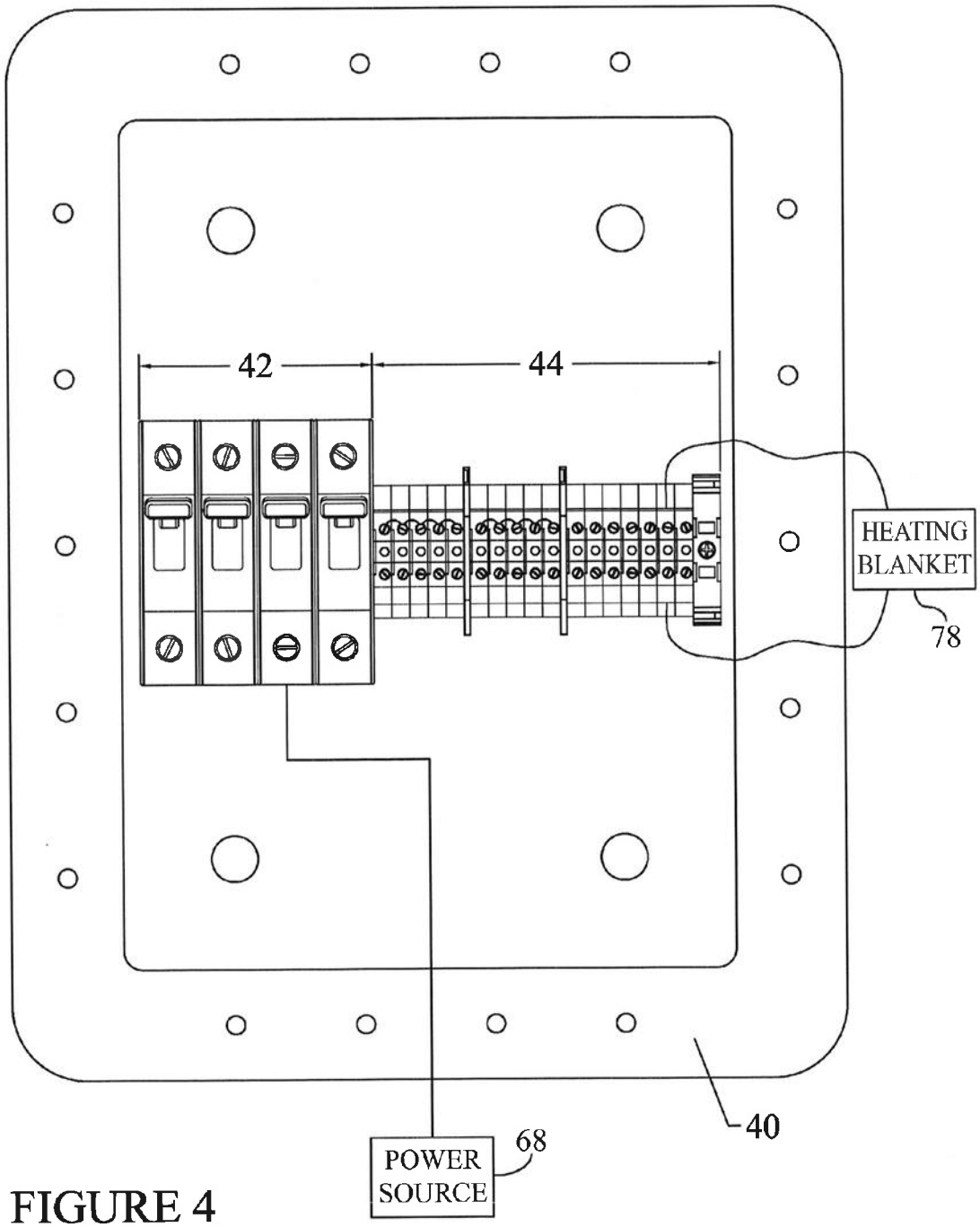


FIGURE 4

PORTABLE WEATHER RESISTANT GAS CHROMATOGRAPH SYSTEM

FIELD

The present embodiments generally relate to a gas chromatograph system that is tough, weather resistant and liftable without deformation for use in the field, particularly in harsh environments, such as the Arctic or Saudi Arabia.

BACKGROUND

A need exists for a sturdy prefabricated enclosure to house a gas chromatograph system. Generally, in order to perform gas chromatography a facility or a building is required for housing the required equipment.

A further need exists for a portable, self contained and self powered gas chromatograph which can be delivered to remote locations within a sturdy enclosure.

A further need exists for a non-deformable portable enclosure for a gas chromatograph. Gas chromatographs require gas lines for purge gases, calibration gases, and sample gases and therefore a need exists for a portable enclosure which will not deform and stress or rupture any gas lines and their connections during transport.

The present embodiments meet these needs.

BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description will be better understood in conjunction with the accompanying drawings as follows:

FIG. **1** illustrates a front view of an enclosure containing a gas chromatograph in accordance with one embodiment of the present invention.

FIG. **2** illustrates a side view of an enclosure containing a gas chromatograph in accordance with one embodiment of the present invention.

FIG. **3** illustrates a perspective view of an enclosure containing a gas chromatograph in accordance with one embodiment of the present invention.

FIG. **4** illustrates a power source connected to a circuit breaker of one embodiment of the present invention.

The present embodiments are detailed below with reference to the listed Figures.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Before explaining the present system in detail, it is to be understood that the system is not limited to the particular embodiments and that it can be practiced or carried out in various ways.

The present embodiments relate to a portable weather resistant gas chromatograph system.

The system includes a gas chromatograph enclosure which can be made from powder coated metal.

The gas chromatograph enclosure can have a body and a movable door that can be adapted to engage the body. The body can be generally a rectangular box with the movable door hinged to the body overlapping the walls of the rectangular box. The movable door can, in another embodiment be removable from the body and attachable to the body with a plurality of fasteners, such as two fasteners, for two opposing walls.

The body can be square or rectangular and have five walls each having an outer side and an inner side forming a chamber

with an opening. The body can also include four sides proving openings in two opposite sides. In either embodiment, one of the walls can form a base.

The body can further be oval or circular in shape, then only two or three walls would be used with one wall being for the bottom or base.

In an embodiment, at least one movable door fastener can be used to secure each wall to the movable door.

In an embodiment the body can be about fifty-four inches high, about fifty-four inches wide, and about twenty-eight inches deep. The body can be made from a power powdered coated aluminum having a aluminum thickness of between about 1/16 inches to about 3/8 inches.

The movable door can be the same height and width as the body, but can have an overhanging lip of up to several inches enabling the movable door to cover the open portion of the body and cover part of any wall that forms the portions of the body engaging the movable door. The movable door can be powder coated aluminum with an aluminum thickness of about 1/16 to about 3/8 inches.

A seal, such as a rubber gasket, can be about two inches wide and about 1/4 inches to about 1/2 inches thick. The seal can be fastened to the movable door to provide a weather tight sealing engagement with the body, so that no water, steam, sand or other undesirable materials get inside the enclosure.

A gas chromatograph can be positioned within the body. An example of a gas chromatograph can be a unit available from Daniels™ of Houston, Tex. or from those made available by Fisher Scientific.

The gas chromatograph can be positioned on a frame assembly and can further be secured to the frame assembly with fasteners such as bolts. Parts of the gas chromatograph can be removed from the frame assembly for repair or replacement if needed.

The frame assembly can be constructed from a metal alloy or other rigid material. In an embodiment, the frame assembly can be contemplated to be movably secured to a support that in turn can be secured to an inside wall of the body. The support can be two parallel bars of channel steel spaced apart. The support can be made of other metals and other rigid materials for the purpose of providing additional support to the enclosure.

At least two exhaust gas lines to about four exhaust gas lines can be fluidly connected between the gas chromatograph and the body. More exhaust gas lines can be contemplated for use with this invention, for example eight exhaust lines can be used with certain embodiments of the present invention. These exhaust lines can be made from metal conduits for carrying pressurized sample gas, inert gas and pressurized purge gas. These sample lines can further be contemplated to sustain pressures between about 0 PSI to about 1000 PSI and can withstand exposure to corrosive and harsh gases without degradation for several years. The exhaust gas can include a sample gas, a purge gas, an inert gas and another gas. A manifold can be used in fluid communication between the plurality of exhaust gas lines for venting exhaust gas out of the body.

An explosion proof terminal box with a height of about ten inches, a width of about ten inches and a depth of about six inches, which can be made from metal with an appropriate plate thickness, can be mounted to an outside portion of one of the walls of the body.

The explosion proof terminal box can be in communication with the gas chromatograph through the wall on which the explosion proof terminal box can be mounted.

The explosion proof terminal box can have at least one circuit breaker and can have at least two terminals, but

can have between one and six circuit breakers and up to about twenty-four terminals. The explosion proof terminal box can also be lockable.

A conduit can be used to provide communication between the explosion proof terminal box and the gas chromatograph. The conduit can be insulated with a sleeve.

At least one armored power cable can provide power between the explosion proof terminal box and the gas chromatograph. This power cable can provide AC current of between about 110 volts to about 220 volts. The explosion proof terminal can receive power from a power station, a solar array, or from another power source. The circuit breaker contained within the explosion proof terminal box can serve to distribute power to each element within the body requiring power in the enclosure.

A purge gas conduit port can be placed in one of the walls of the body for accepting purge gas to be used for the gas chromatograph. The purge gas can come from a purge gas source outside of the body.

A pedestal can be used for maintaining the gas chromatograph enclosure above a surface such as the ground, in case of flooding so none of the tanks or equipment are exposed to drifting sands, flood waters or wildlife.

A first lifting eye can be riveted, welded or bolted to a first wall of the body and a second lifting eye can be similarly connected to a second wall opposite the first lifting eye. This design enables a crane, such as a pedestal crane to lift the portable weather resistant gas chromatograph system with all the equipment mounted it in without deforming the gas chromatograph enclosure. Non-deforming lifting of such heavy and calibrated equipment without damage is an amazing feat and is needed in the field.

In an embodiment, the support can be two parallel stiff non-deformable bars fixedly secured to an inner side of one of the walls. These supports can be welded, bolted or riveted on an inner side of a wall to reinforce the support of explosion proof terminal box mounting on the outer side of that same wall. The non-deformable bars can be constructed from aluminum, steel, other metals, or other rigid materials.

In another embodiment, a flange can be welded to one of the walls. The flange can encircle the walls, like a small frame assembly on top of the body. The flange can be used to support the first and second lifting eyes. The flange can also have lifting holes drilled in it for lifting of the portable weather resistant gas chromatograph system without the lifting eyes.

An embodiment contemplates that the system can include at least one heater, which can be thermostatically controlled, contained in the body. Two heaters can be used in an embodiment. The heaters can be connected to the explosion proof terminal box in order to receive the power they require to operate.

A calibration gas tank can be used in an embodiment of the system. In the calibration gas tank can be a calibration gas for calibrating the gas chromatograph. The calibration gas tank with calibration gas can be in fluid connection with the gas chromatograph.

In an embodiment, the calibration gas tank can be contained within the pedestal, while in another embodiment the calibration gas tank can be located externally to the body.

One or more tank fastening systems can be mounted to an outer side of one of the walls of the body. The tank fastening system can include a frame assembly and chain, a frame assembly and nylon strap or a hinged and locking frame assembly for holding one or more tanks of purge gas, such as helium. The tank fastening systems can secure the calibration gas tank as well.

A heating blanket can be used around the calibration gas tank. The heating blanket can receive power from the explosion proof terminal box.

Insulation, such as sheets of insulating material or coatings of insulating material can be secured or applied to the inside of each of the walls of the body. Depending on the material used, the insulation coating can range from relatively thin to about an inch thick. The overall size of the interior insulation can match the dimensions of the inner side of the walls of the body. The insulation can cover all or part of the walls, but covering at least about fifty percent can be contemplated as useful to reduce water build up inside the body.

A purge gas regulator, which can be fluidly connected between the purge gas conduit port and the purge gas source, can be used for reducing pressure of purge gas prior to flowing the purge gas to the gas chromatograph.

The conduit between the gas chromatograph and the explosion proof terminal box can be contemplated to have at least two sealing fittings in the conduit. The conduit can have a sealing fitting on the inner side of the wall through which the conduit extends and on the outer side of the wall through which the conduit extends.

One embodiment can include a foldable tray between about ten inches to about sixteen inches in length, about six inches to about ten inches in width and a thickness suitable for supporting a portable device. The foldable tray can be mounted to the frame assembly for supporting a computer, a laptop, or other computing device. The foldable tray can fold out from the frame assembly providing unique space saving.

A calibration gas frame assembly can be made of metal or another suitable material and can be dimensioned for supporting the calibration gas tank. The calibration gas tank assembly can be connected to the bottom of the body for supporting the calibration gas tank above the bottom of the body.

In an embodiment, the air around the gas chromatograph in the body can be temperature and pressure controlled using a temperature control, a pressure control or combinations thereof.

The movable door can be controlled using two pneumatic shocks. One pneumatic shock can be connected on an inner side of a first wall, and the other pneumatic shock can be connected to a second wall on the inner side opposite the first wall. Channel bars can be used to add strength to the walls and reinforce the power of the pneumatic shocks when used with the movable door. The channel bars can be welded or bolted to the walls and the shocks can be bolted or attached to the channel bar.

A thermostat can be used in the body and can be connected to one or more of the heaters and a terminal in the explosion proof junction box, for temperature regulation.

Turning now to the Figures, FIG. **1** depicts a gas chromatograph enclosure **8** including a body **9** resting on a pedestal **76**. The body **9** is illustrated with a plurality of walls, including a top **50**, a bottom **52** and at least two sides **54***a*, **54***b*. One of the walls **54***a* is illustrated with an inner side **62***a* and an outer side **60***a* and another wall **54***b* is illustrated on the opposite side with an inner side **62***b* and an outer side **60***b*. The bottom **52** can rest in the pedestal **76**. Pedestal flanges **75** on the bottom of the pedestal **76** can provide a secure means for resting flush with a surface **77** and for fastening the pedestal **76** to the surface **77**. The modular design of the gas chromatograph enclosure **8** allows a crane to move and position the system, and the pedestal flanges **75** permit securing the system at a single location.

FIG. **1** illustrates a movable door **10***a* in an open position providing access to the components contained within the body **9**. The movable door **10***a* can be controlled using two

pneumatic shocks **28***a*, **28***b*. One pneumatic shock **28***a* can be connected on an inner side **62***a* of a first wall **54***a* through a channel bracket **66***a*, and one pneumatic shock **28***b* the can be connected to a second wall **54***b* on the inner side **62***b* of the opposite wall **54***b* through a channel bracket **66***b*. In one embodiment, a single pneumatic shock or multiple pneumatic shocks can operate a movable door. The pneumatic shocks can also be mounted directly on the walls **54***a*, **54***b*.

A gas chromatograph **14** can be secured within the body **9** on a frame assembly **15**. The frame assembly **15** can be connected to the bottom **52** of the body **9**. The gas chromatograph **14** can be a unit available from Daniels™ of Houston, Tex. or a unit available from Fisher Scientific.

A sample gas line **63** can provide a sample gas **67** for analysis by the gas chromatograph **14**. The sample gas line **63** can be connected to an external source, such as a pipe line.

A calibration gas frame assembly **20** can support a calibration gas tank **22**, which can be connected to the gas chromatograph **14** for supplying calibration gas **23**. The calibration gas tank **22** is illustrated with a heating blanket **78** for regulating the temperature of the calibration gas **23**.

FIG. **1** also illustrates a purge gas conduit port **70**, which can be placed in one of the walls **54***b* of the body **9** for accepting purge gas **69** to be used for the gas chromatograph **14**. The purge gas **69** can come from a purge gas source **65** illustrated as a tank outside the body **9** in this Figure. A purge gas regulator **72***a* can be located between the purge gas source **65** and the purge gas conduit port **70** and can regulate the purge gas **69** into the body **9** and into the gas chromatograph **14**.

The gas chromatograph enclosure **8** can have at least one exhaust gas line **17***a*, **17***b*, **17***c*, **17***d*, which can fluidly connect between the gas chromatograph **14** and the body. A manifold **59** can further be in fluid communication with at least one exhaust gas line **17***a*, **17***b*, **17***c*, **17***d* for venting exhaust gas from the body **9**.

Attached to the exterior of the body **9** can be an explosion proof terminal box **40** which can enclose terminal **44** and a circuit breaker **42** for communication with a power source **68**, shown in more detail in FIG. **4**.

In FIG. **1**, the explosion proof terminal box **40** can communicate with the gas chromatograph **14** through a conduit **46**. The conduit **46** can be connected through the wall **54***a* of the body **9** with sealing fitting **48***a* for preventing fluid and gases from passing in and out of the body **9**. Additional sealing fittings **48***a*, **48***b*, **48***c* are also depicted in this Figure.

The conduit can be a power cable, a fiber optic cable or communication cables around a power cable, contained or not contained in a housing, such as a flexible plastic tube.

The gas chromatograph **14** can be supplied with power through an armored power cable **49**, which can further be connected to the circuit breaker **42**, which is shown in FIG. **4**.

A parallel stiff non-deformable bar **83***a* is illustrated on the inner side **62***a* of wall **54***a*. While one parallel stiff non-deformable bar **83***a* is visible in this figure, a second parallel stiff non-deformable bar can be mounted behind the first, and a plurality of parallel stiff non-deformable bars can be mounted in a row. One or more of the parallel stiff non-deformable bars can be used as braces for mounting the explosion proof terminal box **40** on the exterior of the body **9**.

Heaters **80***a*, **80***b* can provide a thermostatic control for regulating the temperature range within the body **9**. Each heater **80***a*, **80***b* can receive power from the explosion proof terminal box **40**. The heaters **80***a*, **80***b* can be located near the support assembly **15**, but those of ordinary skill in the art can appreciated the heaters **80***a*, **80***b* can be located anywhere within the body **9**.

Pressure relief valve **21** can regulate the internal pressure of the body **9** and can further provide an outlet for releasing pressure.

The exterior of the body **9** can also include a tank fastening system **73** for securing the purge gas source **65**, which is illustrated as a tank to the exterior or the body **9**.

A foldable tray **18** can be mounted on the bottom **52** of body **9**. The foldable tray can be affixed with hinges in order to pivot between two positions. The foldable tray is shown in an fully stowed storage position, but can pivot roughly about one hundred and eighty degrees providing a flat surface for laptops or other portable devices.

Turning now to FIG. **2**, a side view of the gas chromatograph enclosure **8**, which shows two movable doors **10***a*, **10***b*, which can be pivotally mounted to the body **9** by hinges **64***a*, **64***b*. Pneumatic shocks **28***b*, **28***c* are illustrated holding each movable door **10***a*, **10***b* in an open position.

In an embodiment pneumatic shocks **28***a*, **28***d* are not visible in FIG. **2**, but can be located opposite pneumatic shocks **28***b*, **28***c*, while in another embodiment each door can require a single pneumatic shock or multiple pneumatic shocks can be used. Seals **12***a*, **12***b* can be seen on the inner surface of the movable doors **10***a*, **10***b* for forming a sealing engagement between movable doors **10***a*, **10***b*, and the body **9**. The seals **12***a*, **12***b* can prevent rain, dirt and other elements from reaching the interior of the body **9**.

Purge gas tanks **65***a*, **65***b* are shown with purge gas regulators **72***a*, **72***b* on the side of the body held in place with a tank fastening system **73**. The tank fastening system **73** can be secured to the pedestal **76**, but can also be secured to the body **9**. Purge gas conduit port **70** can be seen on the side of the body **9**. Lifting eye **82***b* is seen in a flange which can be welded to the top of the body **9**. A second flange on the opposite side of the body cannot be seen in this Figure, but can provide a balanced system for lifting and moving the gas chromatograph enclosure **8**.

FIG. **3** illustrates a perspective view of the gas chromatograph enclosure **8** including a body **9** supported on a pedestal **76**. Each of the movable doors **10***a*, **10***b* are illustrated in the open position. Movable door **10***a* can have at least one fastener **11***a*, in additional embodiments, additional fasteners can be used. Movable door **10***b* can have at least one fastener **11***b*, in an additional embodiment, additional fasteners can be used.

The body **9** can also include supports **16***a*, **16***b*. The supports **16***a*, **16***b* can be constructed from steel or another rigid material. The support **16***a* can provide the body **9** with extra rigidness, helping prevent the body **9** from deforming even when the entire gas chromatograph enclosure **8** is lifted or moved. The supports **16***a*, **16***b* can also serve as a place for mounting the support assembly **15** and the calibration gas assembly **20**.

The parallel stiff non-deformable bars **83***a*, **83***b* are illustrated opposite the explosion proof terminal box **40**, and can be used for mounting the explosion proof terminal box **40** to the wall.

The gas chromatograph **14** can be supported by the support assembly **15** generally in the center of the body **9**.

The lifting eyes **82***a*, **82***b* can be parallel to each other on opposite sides of the body. These lifting eyes **82***a*, **82***b* can provide a balanced means for lifting and moving the entire enclosure. In an embodiment, additional lifting eyes can be used.

FIG. **3** further illustrates purge gas sources **65***a*, **65***b*, which can be supported by the tank fastening system **73**.

FIG. **4** illustrates a power source **68** used in conjunction with certain embodiments of the gas chromatograph enclo-

sure **8**. The power source **68** can be connected to a circuit breaker **42** and a terminal **44**. The power source **68** can be located within or connected to the explosion proof terminal box **40**. The explosion proof terminal box **40** can be electrically connected to the heating blanket (**78**).

FIG. **4** illustrates a power source **68** used in conjunction with certain embodiments of the gas chromatograph enclosure **8**. The power source **68** can be connected to a circuit breaker **42** and a terminal **44**. The power source **68** can be located within or connected to the explosion proof terminal box **40**.

While these embodiments have been described with emphasis on the embodiments, it should be understood that within the scope of the appended claims, the embodiments might be practiced other than as specifically described herein.

What is claimed is:

1. A portable weather resistant gas chromatograph system with a gas chromatograph enclosure comprising:

a. a body comprising a top, a bottom, and at least two walls, connected to each top and bottom, and further wherein each wall has an outer side and an inner side;

b. at least one movable door mounted to the body;

c. at least one movable door fastener for securing the at least one movable door to the body;

d. at least one seal disposed on each movable door for providing a weather tight sealing engagement with the body;

e. a gas chromatograph with a frame assembly secured to the bottom of the body wherein the gas chromatograph is adapted to receive sample gas, purge gas, and calibration gas during operation of the gas chromatograph;

f. at least one exhaust gas line fluidly connected between the gas chromatograph and the body;

g. an explosion proof terminal box mounted to an outer side of one of the walls, and wherein the explosion proof terminal box is in communication with the gas chromatograph through the wall and wherein the explosion proof terminal box comprises at least one circuit breaker and at least one terminal wherein the terminal can engage a power source;

h. a conduit for providing communication between the explosion proof terminal box and the gas chromatograph;

i. at least one armored power cable providing power between the explosion proof terminal box and the gas chromatograph;

j. at least one purge gas conduit port penetrating one of the walls for receiving purge gas for the gas chromatograph from at least one purge gas source;

k. a pedestal for maintaining the gas chromatograph enclosure above a surface; and

l. at least one lifting eye connected to the body enabling lifting of the portable weather resistant gas chromatograph system without deforming the body.

2. The system of claim **1**, wherein a support comprises at least two parallel stiff non-deformable bars secured to the inner side of the wall perpendicular to a plane of the bottom for supporting the explosion proof terminal box.

3. The system of claim **1**, further comprising at least one heater within the body.

4. The system of claim **1**, further comprising a calibration gas tank with calibration gas **23** in communication with the gas chromatograph.

5. The system of claim **4**, further comprising at least one heating blanket disposed around the calibration gas tank and wherein the at least one heating blanket receives power from the explosion proof terminal box.

6. The system of claim **1**, further comprising at least one tank fastening system removably mounted to an outer side of one of the walls.

7. The system of claim **1**, further comprising insulation disposed on at least a portion of the inner sides of the walls.

8. The system of claim **1**, further comprising a purge gas regulator fluidly connected between the at least one purge gas port and the at least one purge gas source for reducing pressure of purge gas prior to flowing the purge gas to the gas chromatograph.

9. The system of claim **1**, wherein the at least one exhaust gas line can be selected from the group consisting of: a sample gas, a purge gas, an inert gas, and another gas.

10. The system of claim **1**, wherein the conduit comprises a plurality of sealing fittings.

11. The system of claim **1**, further comprising between one circuit breaker and six circuit breakers and between six terminals and twenty-four terminals in the explosion proof terminal box.

12. The system of claim **1**, further comprising at least one hinge for connecting each movable door to the body.

13. The system of claim **1**, further comprising a manifold in fluid communication with the at least one exhaust gas line for venting exhaust gas from the body.

14. The system of claim **1**, further comprising a foldable tray disposed adjacent to the frame assembly for supporting a computer.

15. The system of claim **1**, further comprising at least one pressure relief valve disposed in at least one of the walls.

16. The system of claim **1**, further comprising at least one pneumatic shock end secured on an inner side of one of the walls of the body and the other end secured on the at least one movable door.

17. The system of claim **16**, further comprising at least one channel bracket disposed between the at least one pneumatic shock end and one of the walls.

18. The system of claim **1**, further comprising at least one support secured to the frame assembly between the inner sides of the walls.

19. The system of claim **1**, wherein the pedestal further comprises at least one pedestal flange for mounting the gas chromatograph system.

* * * * *

US007843163B1

(12) **United States Patent**
Haun et al.

(10) **Patent No.: US 7,843,163 B1**
(45) **Date of Patent: Nov. 30, 2010**

(54) **PORTABLE WEATHER RESISTANT ENCLOSURE**

(75) Inventors: **Darrell N. Haun**, Sugar Land, TX (US); **Donald N. Haun**, Stafford, TX (US)

(73) Assignee: **Solarcraft, Inc.**, Stafford, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 155 days.

(21) Appl. No.: **12/396,955**

(22) Filed: **Mar. 3, 2009**

(51) **Int. Cl.**

H01M 10/44	(2006.01)
H02J 7/00	(2006.01)
H02J 9/00	(2006.01)
H01L 31/042	(2006.01)

(52) **U.S. Cl.** **320/101**; 320/138; 320/139; 307/64; 307/66; 136/244; 323/906; 220/826; 220/827; 220/849; 220/212

(58) **Field of Classification Search** 320/101
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,056,142	A *	5/2000	Elliott	220/278
7,578,414	B2 *	8/2009	Sellars et al.	221/65
2006/0266759	A1 *	11/2006	Tramontina et al.	221/33
2008/0067227	A1 *	3/2008	Poss et al.	232/17

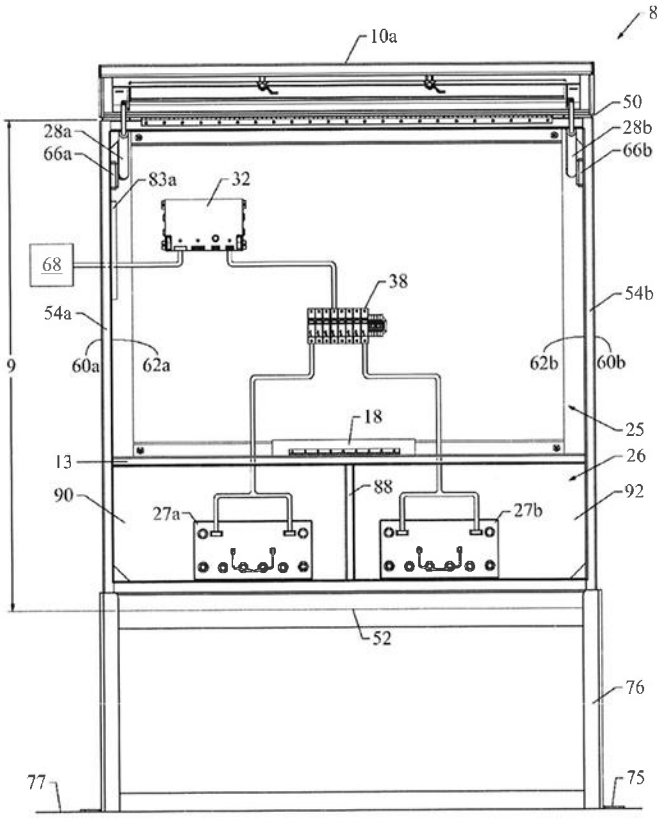
* cited by examiner

Primary Examiner—Edward Tso
Assistant Examiner—Yalkew Fantu
(74) *Attorney, Agent, or Firm*—Buskop Law Group, PC; Wendy Buskop

(57) **ABSTRACT**

A portable weather resistant enclosure for supporting electronics in the field, having a body in sealable engagement with a door. a pedestal for elevating the enclosure above a surface, at least two lifting eyes for transporting the enclosure, the portable weather resistant enclosure being constructed to resist deformation during transport.

16 Claims, 4 Drawing Sheets



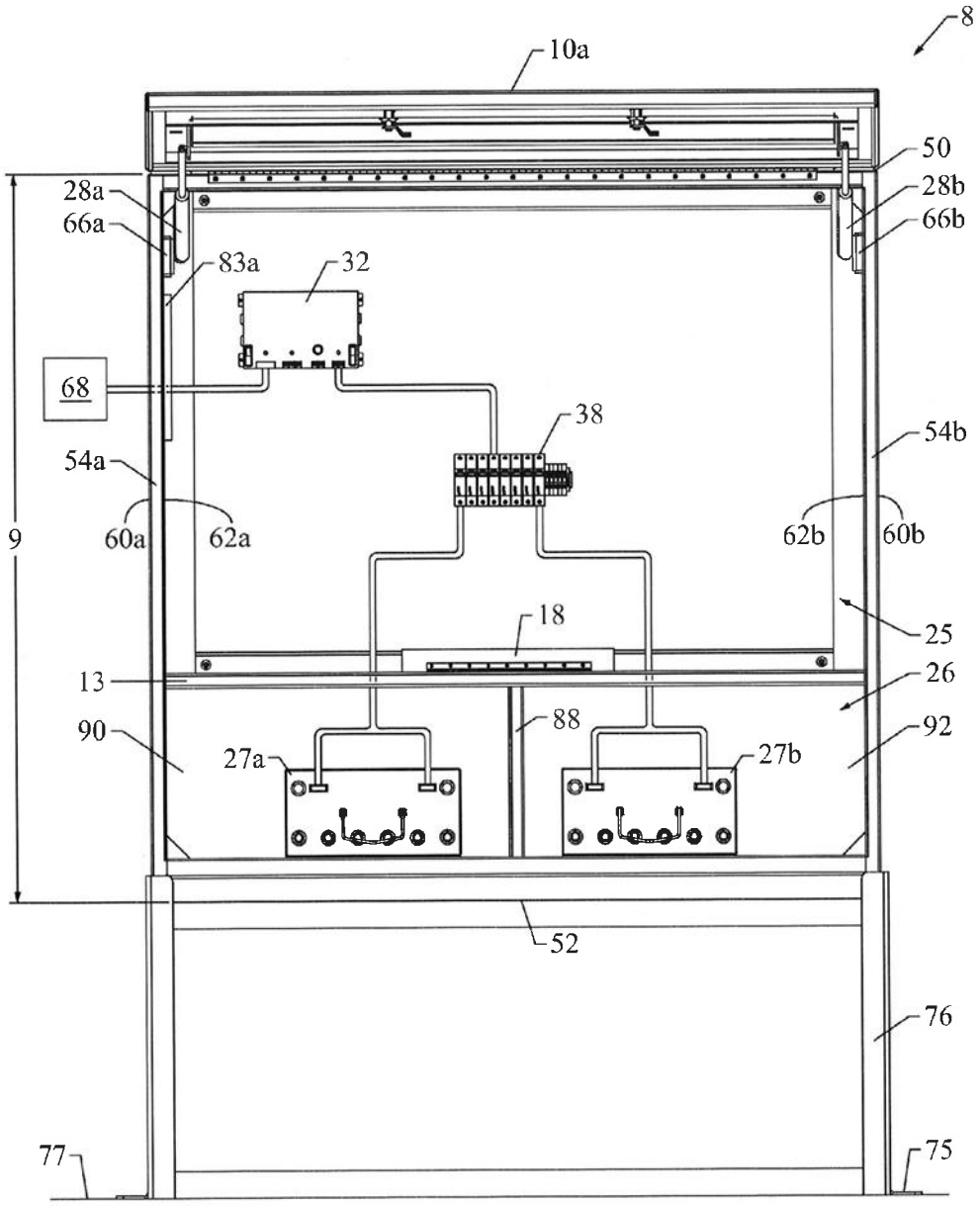

8
10a
50
28a
28b
66a
66b
83a
32
68
38
54a
54b
9
60a
62a
62b
60b
18
25
13
26
90
88
92
27a
27b
52
76
77
75

FIGURE 1

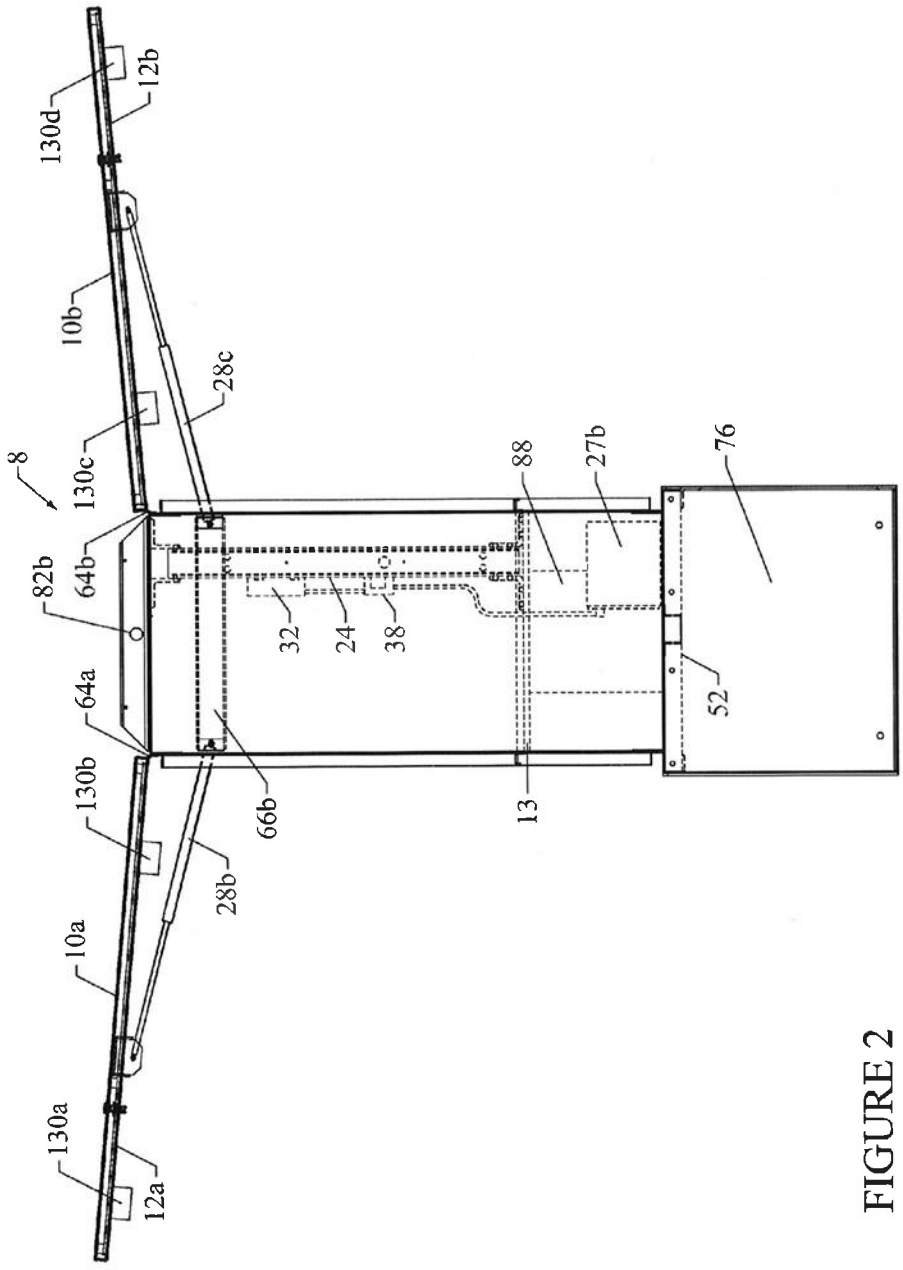

130d
12b
10b
28c
8
130c
82b
64b
64a
130b
10a
130a
12a
28b
66b
32
24
38
88
27b
76
52
13

FIGURE 2

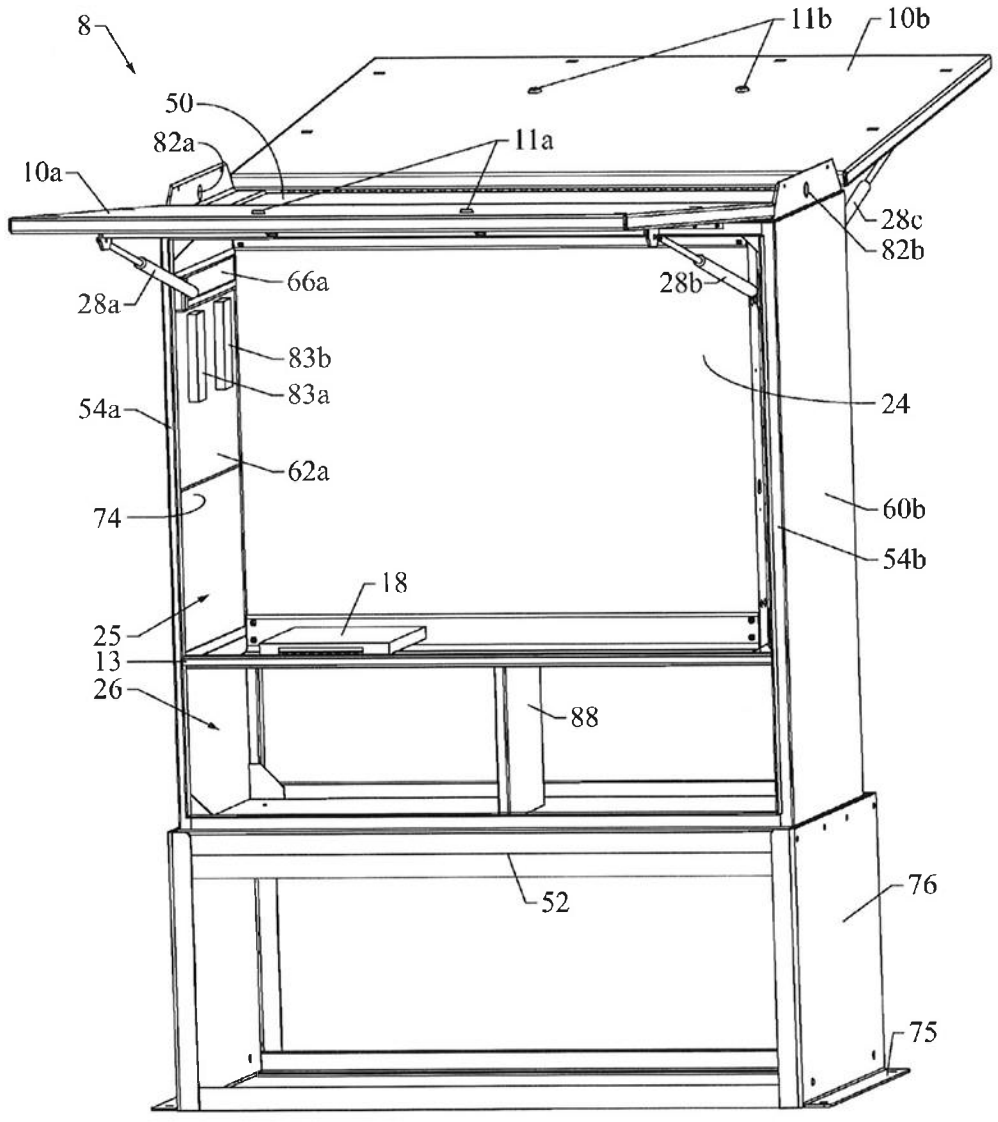

8
11b
10b
50
82a
11a
10a
28c
82b
28a
66a
28b
83b
83a
24
54a
62a
74
60b
54b
18
25
13
26
88
52
76
75

FIGURE 3

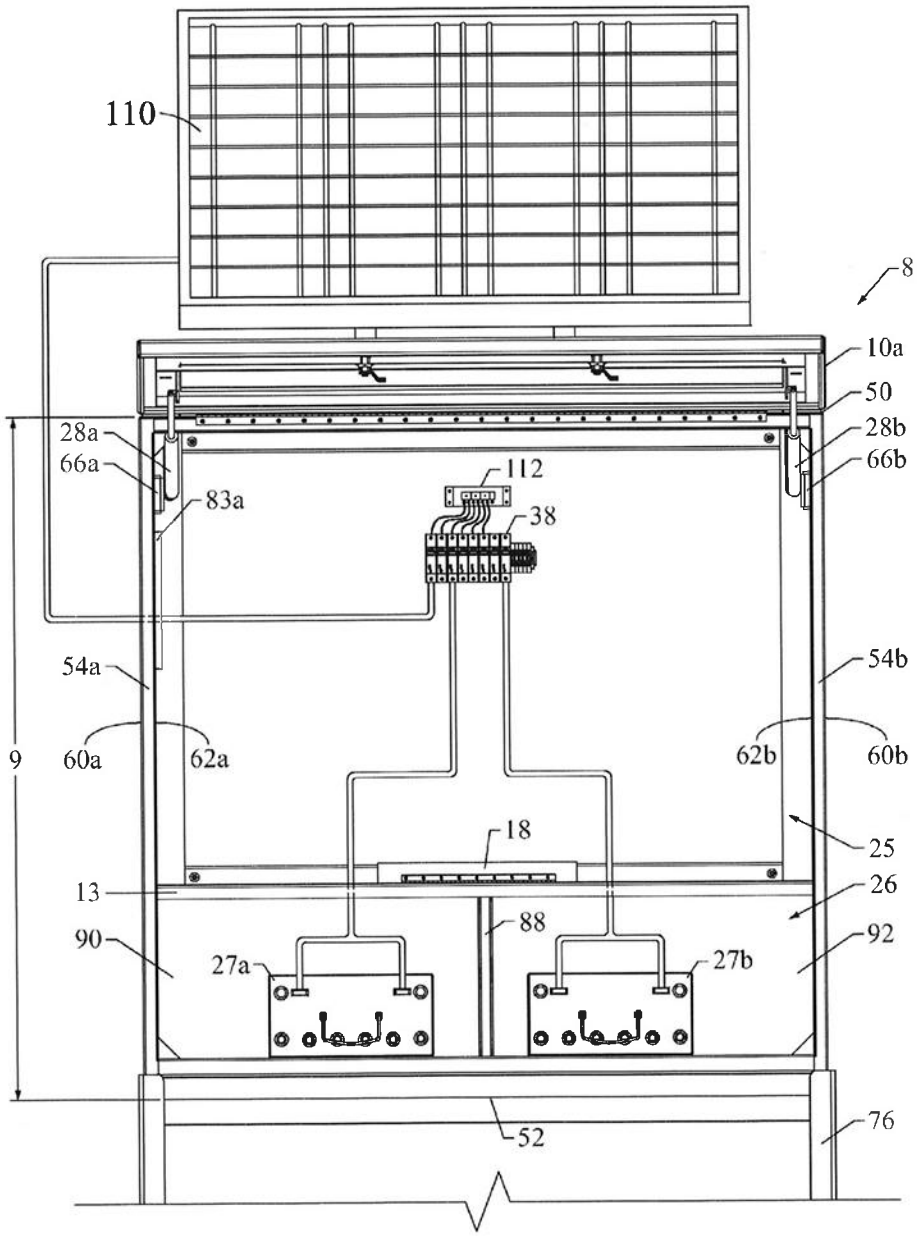

110
8
10a
50
28a
66a
28b
66b
112
83a
38
54a
54b
9
60a
62a
62b
60b
18
25
13
26
88
90
92
27a
27b
52
76

FIGURE 4

PORTABLE WEATHER RESISTANT ENCLOSURE

FIELD

The present embodiment generally relate to a tough resistant electronics supporting enclosure that is tough, weather resistant and liftable without deformation for use in the field, particularly in harsh environments such as the Arctic or Saudi Arabia.

BACKGROUND

A need exists for a sturdy enclosure for use with supporting solar arrays and with holding electronics in a weather resistant manner.

A further need exists for liftable enclosure that can be lifted by a crane to a barge or flatbed full loaded with electronics that will not deform or twist or subject the electronics to weather.

The present embodiments meet these needs.

BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description will be better understood in conjunction with the accompanying drawings as follows:

FIG. **1** illustrates a front view of one embodiment of an enclosure.

FIG. **2** illustrates a side view of one embodiment of an enclosure.

FIG. **3** illustrates a perspective view of one embodiment of an enclosure.

FIG. **4** illustrates an embodiment of an enclosure connected to a solar array.

The present embodiments are detailed below with reference to the listed Figures.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Before explaining the present apparatus in detail, it is to be understood that the apparatus is not limited to the particular embodiments and that it can be practiced or carried out in various ways.

The present embodiments relate to a portable weather resistant enclosure for supporting electronics which can include solar controllers, power chargers and battery systems.

The enclosure can be made from powder coated metal, such as aluminum that can be between about 1/16 inches to about 3/8 inches thick.

The enclosure can have a body and a movable door adapted to engage the body. The body can be generally a rectangular box with at least one movable door hinged to the body, and the movable door can overlap the walls of the box. The movable door, in one embodiment, can be removable from the body and can be attachable to the body with a plurality of fasteners, such as two fasteners. The fasteners can be attached to the body to hold the movable door.

In an embodiment, the body can be square or rectangular in shape. The body can have five walls, with each wall having an outer side and an inner side. One of the walls can form a base parallel to a surface on which the body can rest.

The body can be oval or circular in shape for a particular body. If oval or circular in shape, then only two or three walls would be used with one wall being the bottom or base.

In one embodiment, the body can be about 54 inches high, about 54 inches wide and about 28 inches deep. Various

embodiments are envisioned for smaller or larger sizes depending on the equipment to be stored within the body.

The movable door, like the body, can be made of power coated aluminum having an aluminum thickness of between about 1/16 inches to about 3/8 inches.

The movable door can be the same height and width as the body, but can have an overhanging lip of up to several inches enabling the movable door to cover the open portion of the body and cover part of any wall that forms the portions of the body engaging the movable door.

A first seal, such as a rubber gasket can have a width of about 1 inch and a thickness of about 1/4 inches can be fastened such as with an adhesive, to the movable door to provide a weather tight sealing engagement with the body. The first seal can prevent water, steam, sand and other undesirable materials from getting inside the enclosure.

Various types of electronics can be positioned within the body either on a frame, or on a back plane which can be welded or secured to the base or secured to the interior of the body.

The electronics can include measurement equipment, telemetry equipment, flow control equipment, other equipment and combinations thereof.

In an embodiment, the electronics can be removably attached to the back plane. In an additional embodiment, the electronics can be removably attached to the frame. The enclosure can be designed so that parts of the electronics can be removed from the back plane or frame for repair if needed.

If a frame is used, the frame can be secured to the interior of the body, such as the bottom of the body or to a bulk head.

In another embodiment, a flange can be welded to one of the walls. The flange can encircle the walls, like a small frame on top of the body. The flange can be used to support first and second lifting eyes. The flange can also have lifting holes drilled in it for lifting of the portable weather resistant enclosure without the lifting eyes.

Insulation, such as an insulating material or insulating coating can be secured to the inside of each of the walls of the body or portions of some walls in the body. The overall size of the interior insulation can match the dimensions of the inner side of the walls of the body. The insulation can cover all or part of the walls, but at least about 50 percent can be contemplated as useful to reduce water build up inside the body.

A foldable tray having a size between about 10 inches to about 16 inches in length, about 6 inches to about 10 inches in width and a thickness suitable for supporting a portable device can be secured within the enclosure. The foldable tray can be mounted to a frame assembly, to a bulkhead, or to the bottom for supporting a computer, a lap top, or other computing device. The foldable tray can fold out from the frame assembly providing unique space saving and a place for resting a computer that can be used to run diagnostics and perform other functions on electronic components.

The movable door can be controlled using two pneumatic shocks, one, which can be connected on an inner side of a first wall, and the other, which can be connected to a second wall on the inner side opposite the first wall. Channel bars can be used to add strength to the walls and reinforce the power of the pneumatic shocks when used with the movable door. The channel bars can be welded or bolted to the walls and the shocks can be bolted or attached to the channel bars or directly to the interior of the walls.

Turning now to the figures, FIG. **1** shows an enclosure **8** including a body **9** resting on a pedestal **76**. The body **9** is illustrated with a plurality of walls, including a top **50**, a bottom **52** and side walls **54***a*, **54***b*. One of the walls **54***a* is illustrated with an inner side **62***a* and an outer side **60***a* and a

second wall **54***b* is illustrated on the opposite side with an inner side **62***b* and an outer side **60***b*. Pedestal flanges **75** on the bottom of the pedestal **76** can provide a secure means for resting flush with a surface **77** and can be used to fasten the pedestal **76** to the surface **77**. The modular design of the enclosure **8** can allow a crane to move and position the apparatus, and the pedestal flanges **75** can permit securing the apparatus at a single location.

FIG. **1** further illustrates a movable door **10***a* in an open position providing access to the components contained within the body **9**. The movable door **10***a* can be controlled using two pneumatic shocks **28***a*, **28***b*. One pneumatic shock **28***a* can be connected on an inner side **62***a* of a first wall **54***a* through a channel bracket **66***a*, and one pneumatic shock **28***b* can be connected on an inner side **62***b* to a second wall **54***b* through a channel bracket **66***b*. In one embodiment, a single pneumatic shock can operate the movable door. The pneumatic shocks can also be mounted directly with the walls **54***a*, **54***b*.

A parallel stiff non-deformable bar **83***a*, can be seen in FIG. **1**, which can provide structural support to the body **9**, with at least a second parallel stiff non-deformable bar **83***b*, which is obstructed from view by the first parallel non-deformable bar **83***a*.

A bulkhead **13** can be disposed in the body **9** forming a top compartment **25** and a bottom compartment **26**. A bulkhead support **88** can further divide the bottom compartment into a right compartment **90** and a left compartment **92**.

A foldable tray **18** is illustrated mounted with the bulkhead **13**. The foldable tray can be affixed by hinges in order to pivot between two positions. The foldable tray is illustrated in a storage position, but can pivot providing a flat surface for computers, lap tops or other portable devices.

A power charger can be contained within the body **9** for receiving an outside source of power. The power charger can be an uninterrupted power supply adapted to receive an AC current. The power charger can also be a solar controller for receiving power from a solar array. In either case, the power charger can receive power from a power source for the purpose of charging batteries **27***a*, **27***b* which can be located in the bottom compartment **26** below the bulkhead **13**.

FIG. **1** further illustrates the power charger as an uninterruptable power supply **32** connected to a power source **68**, which can be an external AC power source. The uninterruptable power supply can be connected to the batteries **27***a*, **27***b* through a low voltage distribution block **38**.

FIG. **2** depicts a side view of the enclosure **8** which can have two movable doors **10***a*, **10***b* pivotally mounted the body **9** by hinges **64***a*, **64***b*. Pneumatic shocks **28***b*, **28***c* are illustrated holding each movable door **10***a*, **10***b* in an open position. In one embodiment pneumatic shocks **28***a*, **28***d*, which are not visible in FIG. **2**, can be located opposite pneumatic shocks **28***b*, **28***c* while in another embodiment each movable door can require a single pneumatic shock or multiple pneumatic shocks.

Seals **12***a*, **12***b* can be seen on the inner surface of the movable doors **10***a*, **10***b* for forming a sealing engagement between movable doors **10***a*. **10***b* and the body **9**. The seals **12***a*, **12***b* can prevent rain, dirt and other elements from reaching the interior of the body **9**. The elevated position on the body **9** on the pedestal **76** can further prevent debris and water for entering the body.

The movable doors **10***a*, **10***b* can also include lights **130***a*, **130***b*, **130***c*, **130***d*. The lights **130***a*, **130***b*, **130***c*, **130***d* can be configured within each movable door **10***a*, **10***b* to point generally downward, or to be slightly tilted towards the interior of the body **9**. In this way the equipment stored in or operating in the enclosure **8** can be illuminated, improving a workers ability to work on the equipment or take readings from the equipment.

The lights **130***a*, **130***b*, **130***c*, **130***d* can be connected to the batteries **27***a*, **27***b* or to the uninterruptable power supply **32**.

The pneumatic shocks **28***b*, **28***c* are illustrated connected to the body **9** through a channel bracket **66***b*. The channel bracket **66***b* can add support to the enclosure **8** and can further provide a mounting position for the pneumatic shocks.

Lifting eye **82***b* is illustrated and can be secured through flanges welded on the near side of the body **9**.

The bulkhead support **88** can be seen and can be attached between the bottom **52** of the body **9** and the bulkhead **13**, just above the pedestal **76**.

The back plane **24** can be seen mounted to the bulkhead **13**, and can support a power charger such as an uninterruptable power supply **32** for supplying power through a low voltage distribution block **38**. The uninterruptable power supply **32** can be connected to the batteries **27***a*, **27***b* and other electronics equipment in the body **9**.

FIG. **3** illustrates a perspective view of the enclosure **8** including a body **9**, which can be secured to a pedestal **76**. Movable door fasteners **11***a*, **11***b* can be used for securing the movable door to the body. Both movable doors **10***a*, **10***b* are illustrated in the open position. The body **9** and movable doors **10***a*, **10***b* illustrated in FIG. **3** can include each of parts of the body previously illustrated in FIG. **1** and FIG. **2**, but the power charger has been omitted from this view.

Parallel stiff non-deformable bars **83***a*, **83***b* can be seen in the view of FIG. **2**, which can further provide structural support to the body **9**. The parallel stiff non-deformable bars **83***a*, **83***b* can also be used as supports for mounting objects to the exterior of the body.

The foldable tray **18** can be seen secured to the bulkhead **13** within the body **9**. The bulkhead support **88** can be seen attached between the bottom **52** of the body **9** and the bulkhead **13**.

Insulation **74** can be seen cut way from the interior of the body **9**. The interior of the body **9** can be completely or partially covered with insulation **74**, including the interior side of each movable door **10***a*, **10***b*.

From this perspective view each of the lifting eyes **82***a*, **82***b* can be seen on generally opposite sides of the body providing a balanced means for lifting the enclosure.

FIG. **4** illustrates another embodiment, wherein the body **9** and movable doors **10***a*, **10***b* can contain the same parts as FIG. **1** and FIG. **2**, but can further include a solar controller **112** which can be connected to a solar array **110** for power.

A solar controller **112** can be in communication with a low voltage distribution block **38**, which can be mounted to the back plane **24**. The low voltage distribution block **38** can receive power from a solar array **110** and can distribute power to the batteries **27***a*, **27***b*.

While these embodiments have been described with emphasis on the embodiments, it should be understood that within the scope of the appended claims, the embodiments might be practiced other than as specifically described herein.

What is claimed is:

1. A portable weather resistant enclosure comprising:

a. a body comprising plurality of walls each wall having an outer side and an inner side;

b. a movable door connected to the body;

c. at least one movable door fastener for securing the movable door to the body;

d. a seal disposed on the movable door for providing a weather tight sealing engagement with the body;

e. a back plane removably secured to the body;

f. a bulkhead disposed between at least two walls forming a top compartment and a bottom compartment;

g. at least one battery disposed in the bottom compartment;

h. at least one power charger connected to a back plane in the top compartment;

i. a pedestal for maintaining the body above a surface;

j. a first lifting eye connected to one of the walls and a second lifting eye connected to one of the walls opposite the first lifting eye, wherein the lifting eyes enable a crane to lift the portable weather resistant enclosure without affecting the electronics or deforming the enclosure.

2. The enclosure of claim **1**, wherein the support comprises two parallel stiff non-deformable bars fixedly secured to an inner side of one of the walls.

3. The enclosure of claim **1**, further comprising insulation disposed on at least a portion of the inner sides of all the walls.

4. The enclosure of claim **1**, further comprising a hinge for connecting the movable door to the body.

5. The enclosure of claim **1**, further comprising a foldable tray mounted to at least one wall, wherein the foldable tray can be folded out for supporting a computer, a lap top, a portable device or combinations thereof.

6. The enclosure of claim **1**, further comprising at least one pneumatic shock secured on a first end to a first wall of the body and on a second end to the movable door.

7. The enclosure of claim **6**, further comprising at least one channel bracket disposed between the at least one pneumatic shock first end and the one of the walls, and at least a second channel bracket disposed between a second pneumatic shock first end and the second wall.

8. The enclosure of claim **1**, further comprising lights mounted on the interior of the movable door.

9. A portable weather resistant enclosure comprising:

a. a body comprising plurality of walls each wall having an outer side and an inner side;

b. a movable door connected to the body;

c. at least one movable door fastener for securing the movable door to the body;

d. a seal disposed on the movable door for providing a weather tight sealing engagement with the body;

e. a back plane removably secured to the body;

f. a bulkhead disposed between at least two walls forming a top compartment and a bottom compartment;

g. at least one battery disposed in the bottom compartment;

h. at least one power charger connected to a back plane in the top compartment in communication with the at least one battery;

i. a solar array in communication with the power charger;

j. a pedestal for maintaining the body above a surface;

k. a first lifting eye connected to one of the walls and a second lifting eye connected to one of the walls opposite the first lifting eye, wherein the lifting eyes enable a crane to lift the portable weather resistant enclosure without affecting the electronics or deforming the enclosure.

10. The enclosure of claim **9**, wherein the support comprises two parallel stiff non-deformable bars fixedly secured to an inner side of one of the walls.

11. The enclosure of claim **9**, further comprising insulation disposed on at least a portion of the inner sides of all the walls.

12. The enclosure of claim **9**, further comprising a hinge for connecting the movable door to one of the body.

13. The enclosure of claim **9**, further comprising a foldable tray mounted to the at least one wall, wherein the foldable tray can be folded out for supporting a computer, a lap top, a portable device or combinations thereof.

14. The enclosure of claim **9**, further comprising at least one pneumatic shock secured on a first end to a first wall of the body and on a second end to the movable door.

15. The enclosure of claim **14**, further comprising at least one channel bracket disposed between the at least one pneumatic shock first end and the one of the walls, and at least a second channel bracket disposed between a second pneumatic shock first end and the second wall.

16. The enclosure of claim **9**, further comprising lights mounted on the interior of the movable door.

* * * * *

US007880333B1

(12) **United States Patent**
Haun et al.

(10) **Patent No.: US 7,880,333 B1**
(45) **Date of Patent: *Feb. 1, 2011**

(54) **METHOD FOR WEATHER RESISTANT PORTABLE FLOW METERING**

(75) Inventors: **Darrell N. Haun**, Sugar Land, TX (US); **Donald N. Haun**, Stafford, TX (US)

(73) Assignee: **Solarcraft, Inc.**, Stafford, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/727,823**

(22) Filed: **Mar. 19, 2010**

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/396,984, filed on Mar. 3, 2009, now Pat. No. 7,750,502.

(51) **Int. Cl.**
H02J 9/00 (2006.01)

(52) **U.S. Cl.** **307/64**; 307/66

(58) **Field of Classification Search** 307/64, 307/66

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,335,730	A	8/1994	Cotham, III	
5,757,283	A	5/1998	Janoska	
7,750,502	B1 *	7/2010	Haun et al.	307/64
2003/0192675	A1	10/2003	Cosley et al.	
2006/0239777	A1	10/2006	Martin	
2007/0010916	A1	1/2007	Rodgers et al.	
2007/0171888	A1	7/2007	Adams	

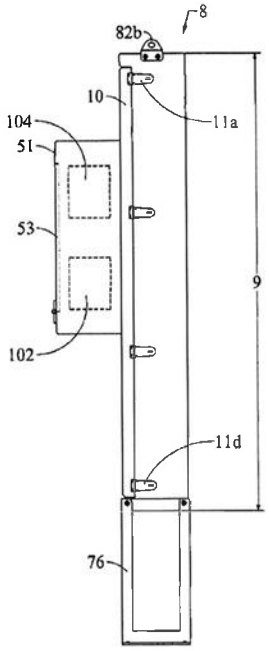
* cited by examiner

Primary Examiner—Fritz M Fleming
(74) *Attorney, Agent, or Firm*—Buskop Law Group, PC; Wendy Buskop

(57) **ABSTRACT**

A method for low voltage flow control, which includes creating an enclosure with a body and a movable door. The enclosure can include a bulkhead forming a top compartment and a bottom compartment, a back plane for supporting electronic equipment, and lifting eyes secured to the enclosure. The method can include disposing batteries in the bottom compartment. A wireless communication unit and a remote terminal unit can be installed on the back plane and can be connected to the batteries. An uninterruptable power supply, an A/C terminal low voltage distribution, and a DC-DC converter can be installed on the back plane. A flow controller can also be installed on the back plane and can be in communication with the A/C terminal, the remote terminal unit, and the wireless communication unit for monitoring and regulating flow control through the enclosure.

12 Claims, 4 Drawing Sheets



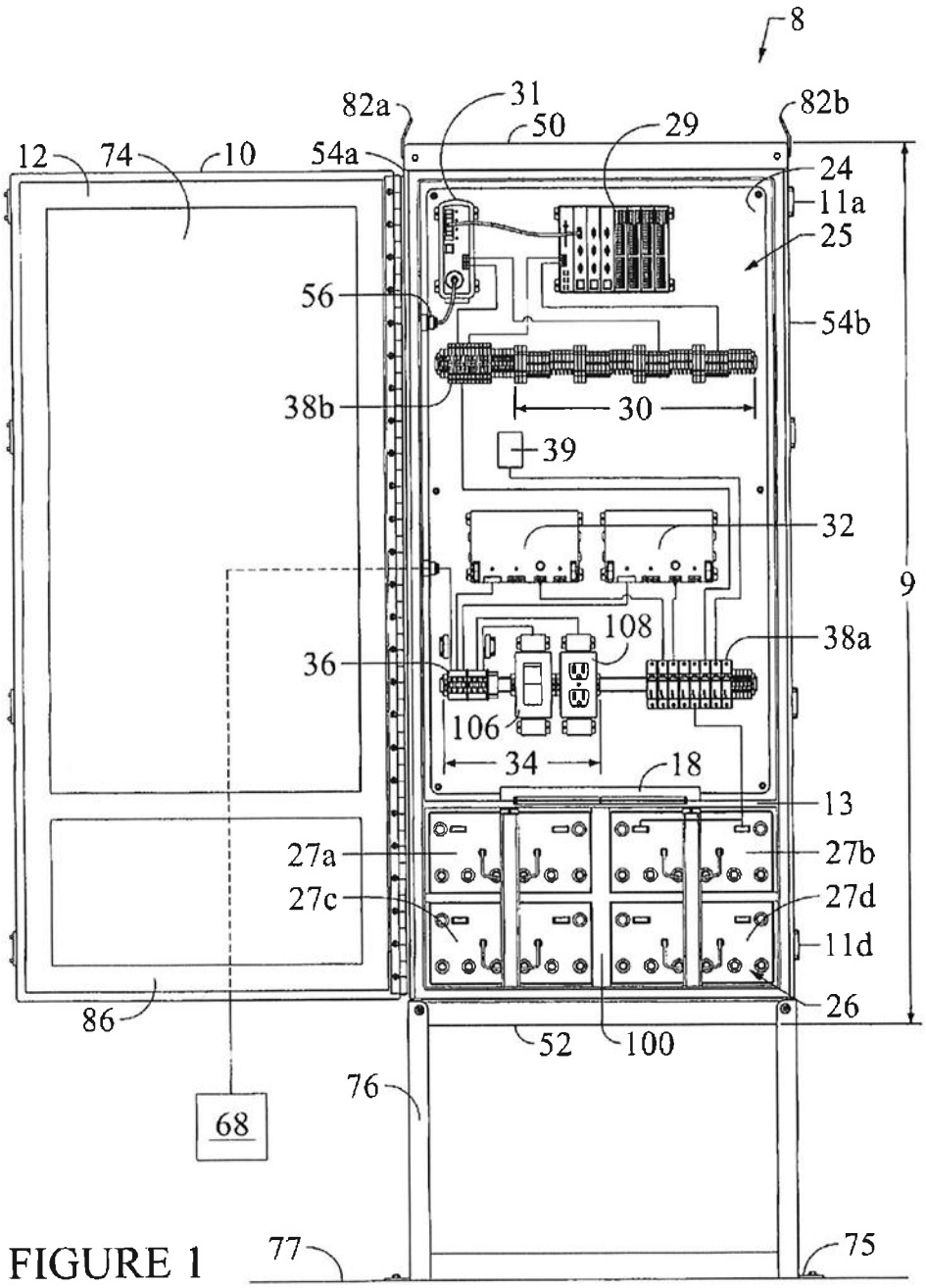

8
82a
31
50
29
82b
12
74
10
54a
24
11a
25
56
54b
38b
30
39
32
9
108
38a
36
106
34
18
13
27a
27b
27c
27d
11d
26
86
52
100
76
68
77
75

FIGURE 1

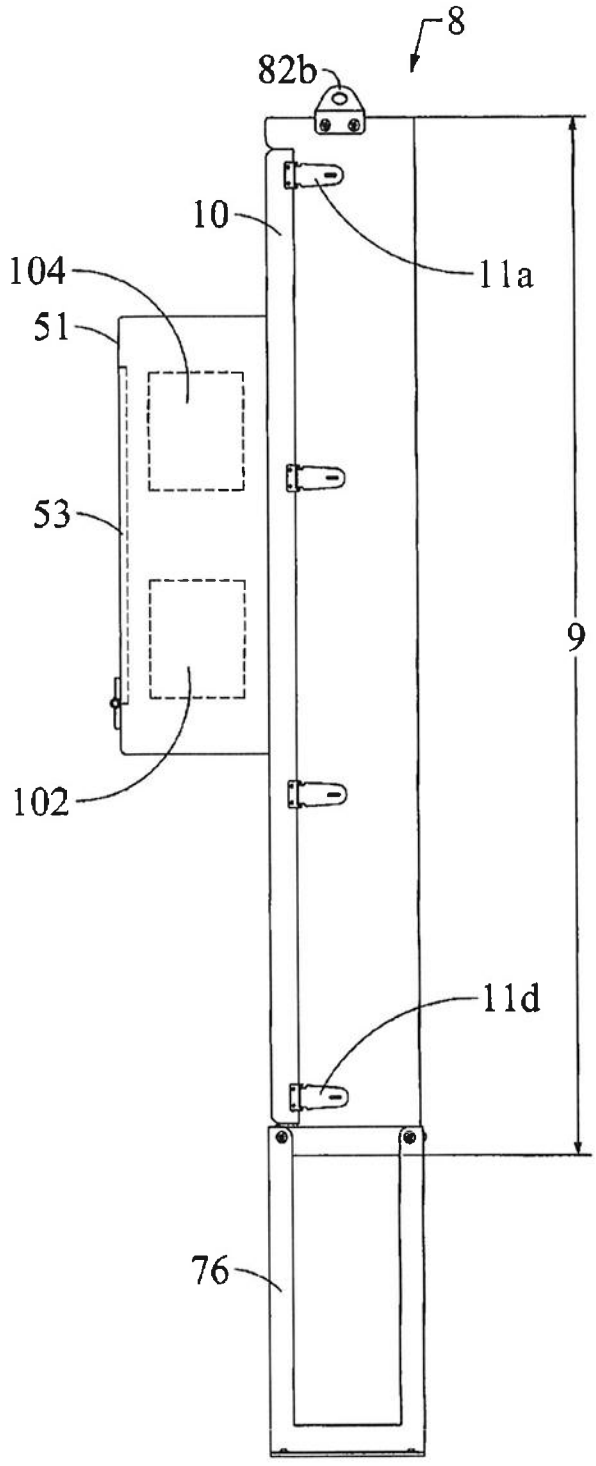


FIGURE 2

FIGURE 3

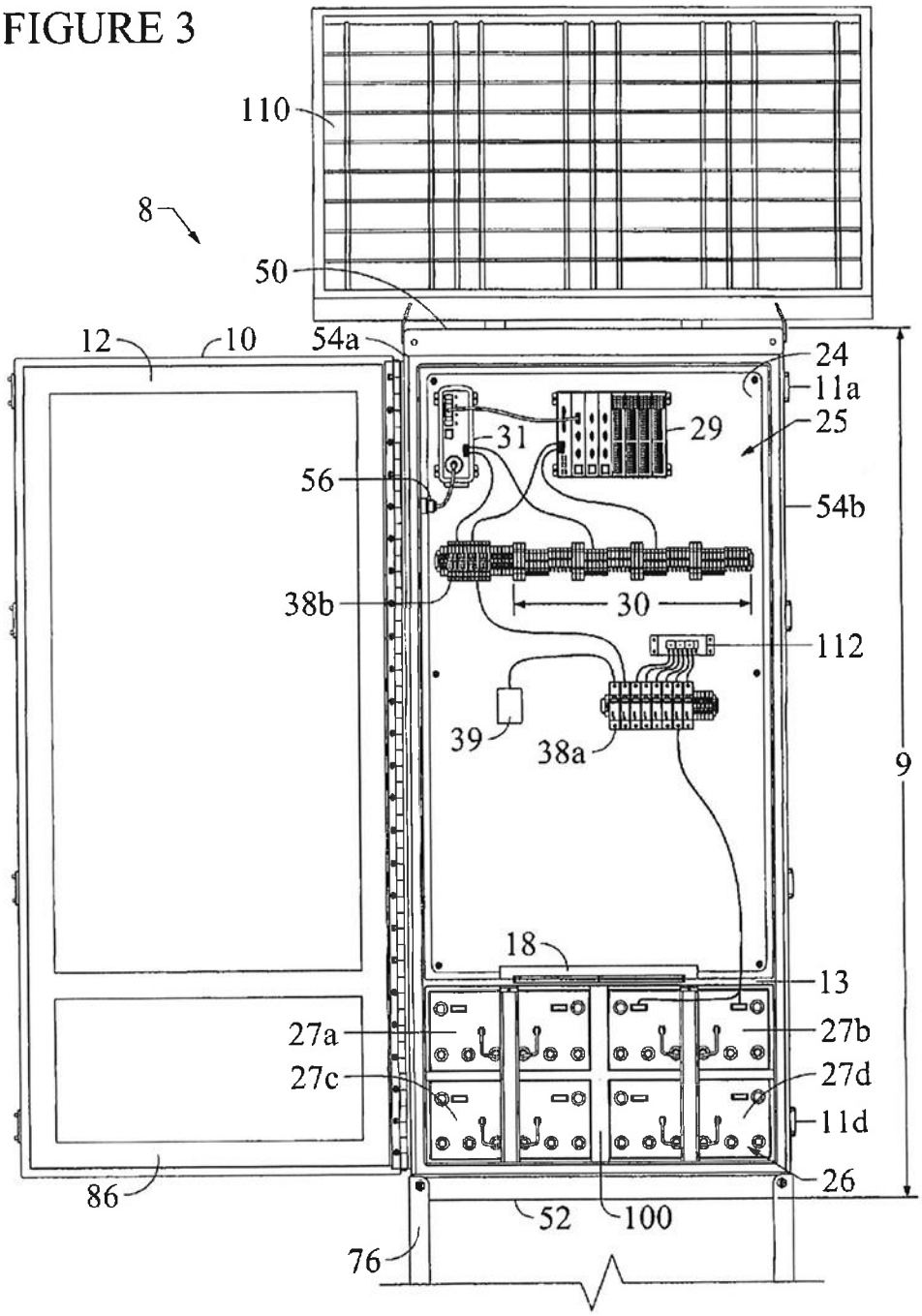
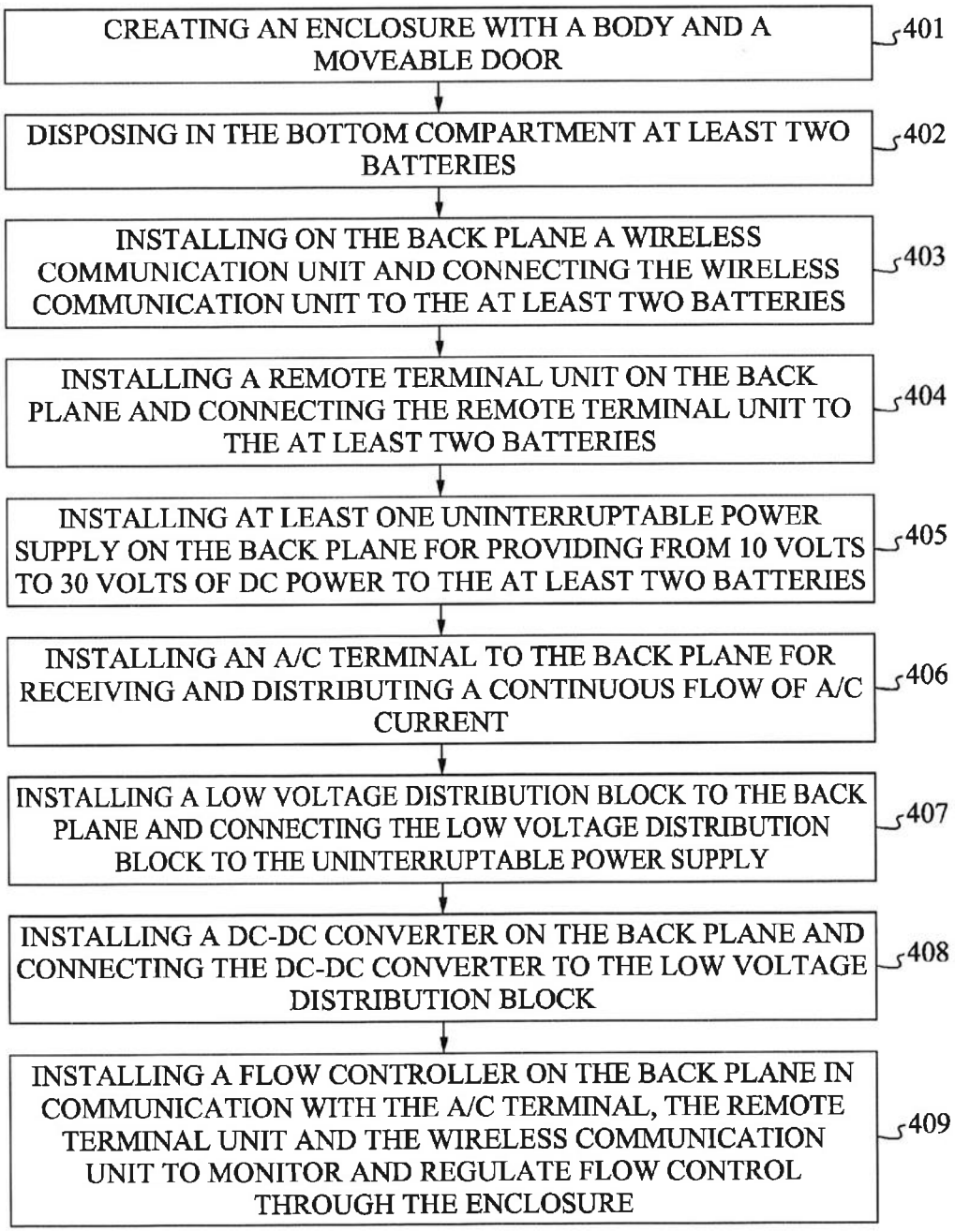

110
8
50
12
10
54a
24
11a
25
29
31
56
54b
38b
30
112
39
38a
9
18
13
27a
27b
27c
27d
11d
26
86
52
100
76

FIGURE 4


CREATING AN ENCLOSURE WITH A BODY AND A MOVEABLE DOOR
401
DISPOSING IN THE BOTTOM COMPARTMENT AT LEAST TWO BATTERIES
402
INSTALLING ON THE BACK PLANE A WIRELESS COMMUNICATION UNIT AND CONNECTING THE WIRELESS COMMUNICATION UNIT TO THE AT LEAST TWO BATTERIES
403
INSTALLING A REMOTE TERMINAL UNIT ON THE BACK PLANE AND CONNECTING THE REMOTE TERMINAL UNIT TO THE AT LEAST TWO BATTERIES
404
INSTALLING AT LEAST ONE UNINTERRUPTABLE POWER SUPPLY ON THE BACK PLANE FOR PROVIDING FROM 10 VOLTS TO 30 VOLTS OF DC POWER TO THE AT LEAST TWO BATTERIES
405
INSTALLING AN A/C TERMINAL TO THE BACK PLANE FOR RECEIVING AND DISTRIBUTING A CONTINUOUS FLOW OF A/C CURRENT
406
INSTALLING A LOW VOLTAGE DISTRIBUTION BLOCK TO THE BACK PLANE AND CONNECTING THE LOW VOLTAGE DISTRIBUTION BLOCK TO THE UNINTERRUPTABLE POWER SUPPLY
407
INSTALLING A DC-DC CONVERTER ON THE BACK PLANE AND CONNECTING THE DC-DC CONVERTER TO THE LOW VOLTAGE DISTRIBUTION BLOCK
408
INSTALLING A FLOW CONTROLLER ON THE BACK PLANE IN COMMUNICATION WITH THE A/C TERMINAL, THE REMOTE TERMINAL UNIT AND THE WIRELESS COMMUNICATION UNIT TO MONITOR AND REGULATE FLOW CONTROL THROUGH THE ENCLOSURE
409

METHOD FOR WEATHER RESISTANT PORTABLE FLOW METERING

CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a Continuation in Part of co-pending U.S. patent application Ser. No. 12/396,984 filed on Mar. 3, 2009, entitled "Portable Weather Resistant Flow Meter System". This reference is hereby incorporated in its entirety.

FIELD

The present embodiments generally relate to a method for providing flow metering that can use a flow meter system that is tough, weather-resistant and liftable without deformation for use in the field, particularly in harsh environments.

BACKGROUND

A need exists for a method that can use a sturdy flow meter which can communicate wirelessly to a network and can be used instantly in the field.

A further need exists for a highly reliable flow metering method using a remote terminal unit that can be easy and fast and can be implemented without requiring a large technical support crew in a hazardous environment.

The present embodiments meet these needs.

BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description will be better understood in conjunction with the accompanying drawings as follows:

FIG. **1** illustrates a front view of a flow meter enclosure with a door open usable in performing the method.

FIG. **2** illustrates a view of the door including a door extension in accordance with certain embodiments usable in the method.

FIG. **3** illustrates a front view of an embodiment of equipment usable with the method including a solar array as a source of power.

FIG. **4** depicts a flow diagram of an embodiment of the method.

The present embodiments are detailed below with reference to the listed Figures.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Before explaining the present method in detail, it is to be understood that the method is not limited to the particular embodiments and that it can be practiced or carried out in various ways.

The present embodiments relate to a portable weather resistant flow control method which can be charged using a solar array.

The method for flow metering can use a flow control enclosure, which can be made from powder coated metal.

The flow control enclosure can have a body and a movable door that can be adapted to engage the body. The body can generally be a rectangular box with the movable door hinged to the body and overlapping the walls of the rectangular box. The movable door can be removable from the body and can be attachable to the body with a plurality of fasteners. For example, two fasteners can be used for two opposing walls.

The body, which can be square or rectangular, can have five walls. Each wall can have an outer side and an inner side. One of the walls can form a base.

In one or more embodiments, the body can be oval or circular in shape and can include two or three walls, with one wall being the bottom or base.

In embodiments at least one movable door fastener can be used to secure each wall to the movable door.

In embodiments, the body can be about 54 inches high, about 54 inches wide, and about 28 inches deep. The body can be made from a powder coated aluminum, which can have a thickness of aluminum of from about ⅛ of an inch to about ⅜ of an inch.

In one or more embodiments, the movable door can be the same height and width as the body, and can have an overhanging lip of up to several inches, enabling the movable door to cover an open portion of the body and to cover part of any wall that forms the portions of the body engaging the movable door. The movable door can be formed at least partially of powder coated aluminum with a thickness of aluminum of from about ⅛ of an inch to about 3/16 of an inch.

The movable door can include a door extension for providing access to some components within the enclosure without requiring the movable door to be unlatched, therefore without requiring exposure of every element to a potentially harsh environment.

A seal, such as a rubber gasket, can be fastened to the movable door to provide a weather-tight sealing engagement with the body, such that no water, steam, sand, or other undesirable materials can penetrate or otherwise get inside of the enclosure. The seal can have a width of about 1 inch and a thickness of about 0.25 inches.

A flow controller can be positioned within the door extension or can be disposed within the body.

Examples flow controllers for flow metering according to the method can include a unit available from Daniels™ of Houston, Tex. or a unit available from Fisher Scientific.

A remote terminal unit "RTU" monitoring controller can also be disposed in the door extension and can be in communication with the flow meter.

In one or more embodiments the RTU monitoring controller can include a voltmeter for determining the voltage generated by a solar array.

In embodiments of the method, the flow controller can be positioned on a back plane and bolted to the back plane. Parts of the flow controller can be easily removed from the back plane for repair or maintenance if needed.

The back plane can be removably secured to the body of the enclosure and can be secured to the back of the enclosure within the body.

A pedestal can be used for maintaining the flow control enclosure above a surface, such as the ground, in case of flooding, such that none of the tanks or other equipment are exposed to drifting sands, flood waters, or other elements including wildlife.

A first lifting eye can be riveted, welded, bolted, or otherwise fastened or connected to a first wall of the body. A second lifting eye can be similarly connected to a second wall opposite the first lifting eye. This configuration can enable a crane, such as a pedestal crane, to lift the portable weather-resistant flow control system with all of the equipment mounted within it without deforming the flow control enclosure.

Non-deforming lifting of such heavy and calibrated equipment without damage is needed in the field. The present embodiments teach a method that is more reliable than other

flow control systems with less protection, while simultaneously providing portability in the field with significant protection.

In embodiments, a flange can be riveted, welded, bolted, or otherwise fastened or connected to one of the walls. The flange can encircle the walls, like a small frame on top of the body. The flange can also be used to support the first and second lifting eyes. The flange can have lifting holes, which can be drilled into it, for lifting of the portable weather resistant flow control system without using the lifting eyes. The flange can prevent deformation of the enclosure by providing extra support. The flange, when attached to the bottom of the enclosure, can keep the enclosure off of the ground, thereby preventing contamination from leaking ground water or mud.

A foldable tray, or foldable computer tray, can be mounted to the body on the inside for supporting a computer. The foldable computer tray can be sized to accommodate portable computing devices such as laptops. The foldable computer tray can fold out from the body, thereby providing a unique space-saving feature.

The method is unique in-part because, with a solar array attached to the enclosure for charging the batteries, the method provides continuous low voltage power to other field sources from an A/C power source while simultaneously providing flow metering. If the A/C power source fails, the method provides continuous operation using the batteries for at least about 48 hours.

The method for low voltage flow control can include creating an enclosure with a body and a movable door. The enclosure can have a bulkhead disposed in the body, forming a top compartment and a bottom compartment, a back plane mounted to the bulkhead within the top compartment for supporting electronic equipment, and at least two lifting eyes secured to the enclosure.

The method can include disposing in the bottom compartment at least two batteries, such as two car batteries.

The method can include installing a wireless communication unit on the back plane and connecting the wireless communication unit to the at least two batteries.

After the wireless communication unit is installed, a remote terminal unit can be installed on the back plane and connected to the at least two batteries.

Next, at least one uninterruptable power supply can be installed on the back plane for providing between 10 volts and 30 volts of D/C power to the at least two batteries.

An A/C terminal can be installed to the back plane for receiving and distributing a continuous flow of A/C current. A low voltage distribution block can be installed to the back plane and can be connected to the power supply, which can be an uninterruptable power supply.

After the A/C terminal is installed, a DC-DC converter can be attached on the back plane and can be connected to the low voltage distribution block.

A flow controller can be connected on the back plane and can be in communication with the A/C terminal, the remote terminal unit, and the wireless communication unit to monitor and regulate flow control through the enclosure.

Additional method steps can include sealing electronic equipment in the top compartment, using up to eight batteries in the enclosure body, and using a fastener to secure the movable door to the enclosure.

One or more embodiments can include additionally using a door extension to house the remote terminal unit and the flow controller in communication with the A/C terminal assembly and at least one piece of field equipment. A viewing port can be formed in the door extension that can be in communication with the A/C terminal assembly and the power supply.

A switch can be used between the power supply and the A/C terminal assembly.

In embodiments of the method utilizing a solar array, the solar array can be attached to the enclosure for receiving and distributing a continuous flow of electric current to the remote terminal unit and to the flow controller. At least one voltmeter can be used for tracking voltage produced by the solar array. At least one indicator can be used for illuminating the areas in the enclosure when the solar array is charging.

The method can include using a surge protector mounted on the back plane for protecting the A/C terminal assembly from power surges from the A/C power source.

An input/output (I/O) termination assembly can be mounted to the back plane. The I/O termination assembly can provide connections for at last one piece of field equipment to the remote terminal unit.

The method can include forming an outlet plug between the A/C terminal assembly and the uninterruptable power supply to allow field equipment to charge in a remote location while flow control monitoring. Field equipment can include a cell phone, a video monitor for security purposes, and other similar devices that allow remote monitoring of the enclosure with flow meter from a position of safety. For example, remote monitoring can be beneficial if the enclosure with the flow meter is installed in a war zone, such as Iraq, where flow metering is greatly needed and where contractors need to be protected from being targets of war zone dangers.

The flow meter can connect or be in communication with the internet with a satellite network for continuous 24 hours a day, 7 days a week monitoring from the portable unit and can be mounted to a trailer with wheels or skid mounted.

Turning now to the figures, FIG. **1** depicts a portable self contained weather resistant low voltage flow control system having a flow control enclosure **8** including a body **9** with a movable door **10** mounted atop a pedestal **76**.

The pedestal **76** can include a pedestal flange **75** for mounting the flow control enclosure on a surface **77**.

The movable door **10** is illustrated in the open position, but can be closed and secured with movable door fasteners **11***a* and **11***d*.

A seal **12** can be located on the inner side of the movable door **10**, which can provide a means for keeping elements such as sand and rainwater out of the interior of the flow control enclosure **8**.

The body **9** can include a top **50**, a bottom **52**, and sides **54***a* and **54***b*, which can each be covered completely or partially with insulation **74**.

A bulkhead **13** can be disposed in the body **9**, forming a top compartment **25** and a bottom compartment **26**.

Batteries **27***a*, **27***b*, **27***c*, and **27***d* are shown stored in the bottom compartment **26** and can fit into respective spaces formed by separator **100**. The bottom compartment **26** can be sealed by bottom seal **86** on the movable door **10**.

A back plane **24** can be mounted to at least the bulkhead **13** within the top compartment **25** for supporting electronics equipment.

One or more embodiments of the flow control method that uses this enclosure can provide from about 12 volts to about 24 volts of power continuously to the remote terminal unit **29** and to the wireless communication unit **31** while providing continuous communication for at least intermittent monitoring of field equipment.

An input/output (I/O) termination assembly **30** can be mounted to the back plane **24**. The I/O termination assembly **30** can provide connections for at least one piece of field equipment to the remote terminal unit **29**. The connected piece of field equipment can provide measurements or data

for storage on the remote terminal unit **29** and transmission by the wireless communications unit **31**.

The wireless communications unit **31** can be mounted to the back plane **24** and can be connected to the wireless communication unit **31**. The wireless communication unit **31** can take data from the remote terminal unit **29** and can transmit that data, via radio frequencies, to receivers located remotely from the flow control enclosure **8**.

An A/C terminal assembly **34** can be connected to an external A/C power source **68** through a surge protector **36** in order to protect the A/C terminal assembly **34** from power surges. The A/C terminal assembly **34** can further be mounted to the back plane **24** for receiving and distributing a continuous flow of A/C current from the A/C power source **68** to at least one uninterruptable power supply **32** (DC-UPS).

The at least one uninterruptable power supply **32** can be mounted to the back plane **24** for providing from about 10 volts to about 30 volts of D/C power to the batteries **27***a*-**27***d*. The uninterruptable power supply **32** can be connected to the batteries through a low voltage distribution block **38***a*.

The low voltage distribution block **38***a* can be mounted to the back plane **24** and can be in communication with a second low voltage distribution block **38***b*. The second low voltage distribution **38***b* block can provide power to the wireless communications unit **31** and the remote terminal unit **29**.

A DC-DC converter **39** can be mounted to the back plane **24** and can also communicate with the low voltage distribution block **38***a*.

At least two removable lifting eyes **82***a* and **82***b* can be secured to the enclosure for lifting of the flow control enclosure **8** by a crane.

A foldable computer tray **18** can be located in the upper compartment **25** and can provide a means for supporting a portable computer such as a laptop.

Also shown is a switch **106**, which can be in communication with the AC terminal assembly **34** and the uninterruptable power supply **32** (DC-UPS).

An outlet **108** is illustrated in communication with the AC terminal assembly **34**. The outlet can be from about a 110 volt outlet to about a 220 volt outlet.

In one or more embodiments, the wireless communication unit **31**, remote terminal unit **29**, I/O termination assembly **30**, uninterruptable power supply **32**, A/C terminal assembly **34**, surge protector **36**, low voltage distribution block **38***a*, and converter **39** can be disposed on the back plane **24** and can be in a sealed watertight, water resistant top compartment.

One or more embodiments can include a ground fault interrupter **56** that can be disposed between the A/C terminal assembly **34** and the uninterruptable power supply **32** (DC-UPS).

FIG. **2** illustrates a side view of a usable flow control enclosure **8** with the body **9**.

The movable door **10** is depicted in a closed position mounted on the pedestal **76**.

In the embodiment depicted, a door extension **51** is shown in the movable door **10**. The door extension **51** can include a viewing port **53**. The viewing port **53** can further include a hinged surface which can provide access to the interior of the door extension.

The door extension **51** can be adapted to house a remote terminal unit monitoring controller **102**, such as one made by Bristol, which can be in communication with the remote terminal unit **29**.

The door extension **51** can also house a flow controller **104**, such as Daniel 2358A or one made by Omni Products, Inc., which can be in communication with the A/C terminal assembly **34** and at least one piece of field equipment.

The remote terminal unit monitoring controller **102** can further comprise a voltmeter for tracking voltage produced by the solar array. An example of a voltmeter can be a Morningstar Sunsaver 10 solar controller ss-10L-24 volt.

Also shown is the second lifting eye **82***b*, which can provide a balanced means for lifting and moving the flow control enclosure **8**.

The movable door **10** is shown attached to the body **9** of the flow control enclosure **8** with fasteners **11***a* and **11***d*.

FIG. **3** illustrates another embodiment of the present method utilizing solar power to keep the batteries continuously charged. A solar array **110** is illustrated in communication with the flow control enclosure **8**.

A body **9** can be mounted on a pedestal **76**. The body **9** can have a top **50**, a bottom **52**, and walls **54***a* and **54***b*. The body **9** can be enclosed by a movable mounted door **10**. The movable door **10** can include a seal **12** and a bottom seal **86** for providing a weather tight seal with the body **9**. The movable door **10** can be securely shut with movable door fasteners **11***a* and **11***d*.

A bulkhead **13** can separate a top compartment **25** and a bottom compartment **26**, with batteries **27***a*, **27***b*, **27***c*, and **27***d* stored in the bottom compartment **26**. The batteries are shown fit into respective spaces formed by the separator **100**, which can form up to about 8 spaces for about 8 batteries. The bottom compartment **26** can be sealed by bottom seal **86** on the movable door **10**.

The top compartment **25** can include a back plane **24**, which can be mounted to at least the bulkhead **13** within the top compartment **25** for supporting electronic equipment.

A wireless communication unit **31** can be mounted to the back plane **24**. The wireless communication unit **31** can be connected with the batteries **27***a*-**27***d*.

The remote terminal unit **29**, the wireless communication unit **31**, and the input/output (I/O) termination assembly **30** can work in much the same way as described with respect to FIG. **1**, such as for storing and transmitting data received from pieces of equipment in the field.

The remote terminal unit **29** can be mounted to the back plane **24** and can be in communication with the wireless communication unit **31** and the batteries. The remote terminal unit can communicate data to the wireless communication unit for transmission via radio frequency.

The I/O termination assembly **30** can be mounted to the back plane **24** and can provide connections for at least one piece of field equipment to the remote terminal unit **29**.

A solar controller **112** can be in communication with a low voltage distribution block **38***a*, which can be mounted to the back plane **24**. The low voltage distribution block **38***a* can receive power from the solar array **110** and can distribute power to a DC-DC converter **39**, to the batteries **27***a*, **27***b*, **27***c*, **27***d*, and to a second low voltage distribution block **38***b*. The second low voltage distribution block **38***b* can power the remote terminal unit **29**, the wireless communications unit **31**, and the batteries **27***a*, **27***b*, **27***c*, **27***d*.

The DC-DC converter **39** can be mounted to the back plane **24** and can be connected to the low voltage distribution block **38***a*.

The ground fault interrupter **56** can be in communication with the wireless communication unit **31**.

The method can be operated using a solar array.

In one or more embodiments, the solar array **110** can supply from about 10 volts to about 30 volts of power using photovoltaics. Photovoltaics are generally known as the field of technology and research related to the application of solar cells for energy by converting sunlight directly into electricity.

Solar power can be extremely beneficial for this method due to the growing demand for clean sources of energy. The manufacture of solar cells and photovoltaic arrays has expanded dramatically in recent years

One or more embodiments provide a method for flow metering using a durable flow control enclosure, which can further have an advantage in that no external source of power is necessarily required. The solar array can generate enough power to operate the system that can be used to implement the method.

In embodiments, the remote terminal unit monitoring controller can have an indicator, which can be an illuminating indicator.

In embodiments, the indicator can provide illuminations, sounds, visuals, or other means of providing an indication when the solar array is charging, when a load is disconnected, or combinations thereof.

FIG. **4** depicts a flow chart of steps of an embodiment of a method for low voltage flow control.

Step **401** can include creating an enclosure with a body and a movable door.

Step **402** can include disposing in the bottom compartment at least two batteries.

Step **403** can include installing on the back plane a wireless communication unit and connecting the wireless communication unit to the at least two batteries.

Step **404** can include installing a remote terminal unit on the back plane and connecting the remote terminal unit to the at least two batteries.

Step **405** can include installing at least one uninterruptable power supply on the back plane for providing from 10 volts to 30 volts of DC power to the at least two batteries.

Step **406** can include installing an A/C terminal to the back plane for receiving and distributing a continuous flow of AC current.

Step **407** can include installing a low voltage distribution block to the back plane and connecting the low voltage distribution block to the uninterruptable power supply.

Step **408** can include installing a DC-DC converter on the back plane and connecting the DC-DC converter to the low voltage distribution block.

Step **409** can include installing a flow controller on the back plane in communication with the A/C terminal, the remote terminal unit and the wireless communication unit to monitor and regulate flow control through the enclosure.

While these embodiments have been described with emphasis on the embodiments, it should be understood that within the scope of the appended claims, the embodiments might be practiced other than as specifically described herein.

What is claimed is:

1. A method for low voltage flow control comprising:

a. creating an enclosure with a body and a movable door, wherein the enclosure further comprises:

i. a bulkhead disposed in the body forming a top compartment and a bottom compartment;

ii. a back plane mounted to the bulkhead within the top compartment for supporting electronic equipment; and

iii. at least two lifting eyes secured to the enclosure;

b. disposing in the bottom compartment at least two batteries;

c. installing on the back plane a wireless communication unit and connecting the wireless communication unit to the at least two batteries;

d. installing a remote terminal unit on the back plane and connecting the remote terminal unit to the at least two batteries;

e. installing at least one uninterruptable power supply on the back plane for providing from ten volts to thirty volts of DC power to the at least two batteries;

f. installing an A/C terminal to the back plane for receiving and distributing a continuous flow of A/C current;

g. installing a low voltage distribution block to the back plane and connecting the low voltage distribution block to the uninterruptable power supply;

h. installing a DC-DC converter on the back plane and connecting the DC-DC converter to the low voltage distribution block; and

i. using a door extension to house a remote terminal unit monitoring controller and a flow controller in communication with the A/C terminal and at least one piece of field equipment, wherein the flow controller is in communication with the remote terminal unit and the wireless communication unit to monitor and regulate flow control through the enclosure.

2. The method of claim **1**, further comprising sealing the electronic equipment in the top compartment.

3. The method of claim **1**, further comprising using up to eight batteries in the body.

4. The method of claim **1**, further comprising using a fastener to secure the movable door to the body.

5. The method of claim **1**, further comprising using a viewing port in communication with the A/C terminal and the uninterruptable power supply.

6. The method of claim **5**, further comprising using a switch between the uninterruptable power supply and the A/C terminal.

7. The method of claim **1**, further comprising using a solar array attached to the enclosure for receiving and distributing a continuous flow of electric current to the remote terminal unit and the flow controller.

8. The method of claim **7**, further comprising using at least one voltmeter for tracking voltage produced by the solar array.

9. The method of claim **8**, further comprising using an indicator for illuminating when the solar array is charging, when the flow controller is disconnected, or combinations thereof.

10. The method of claim **1**, further comprising using a surge protector mounted on the back plane for protecting the A/C terminal from power surges from an A/C power supply.

11. The method of claim **1**, further comprising using an input/output termination assembly mounted to the back plane, wherein the input/output termination assembly provides connections for the at least one piece of field equipment to the remote terminal unit.

12. The method of claim **1**, further comprising using an outlet plug disposed between the A/C terminal and the uninterruptable power supply.

* * * * *