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(54) **Title:** POTENTIAL VOLTAGE AND HAZARD STOP SYSTEM

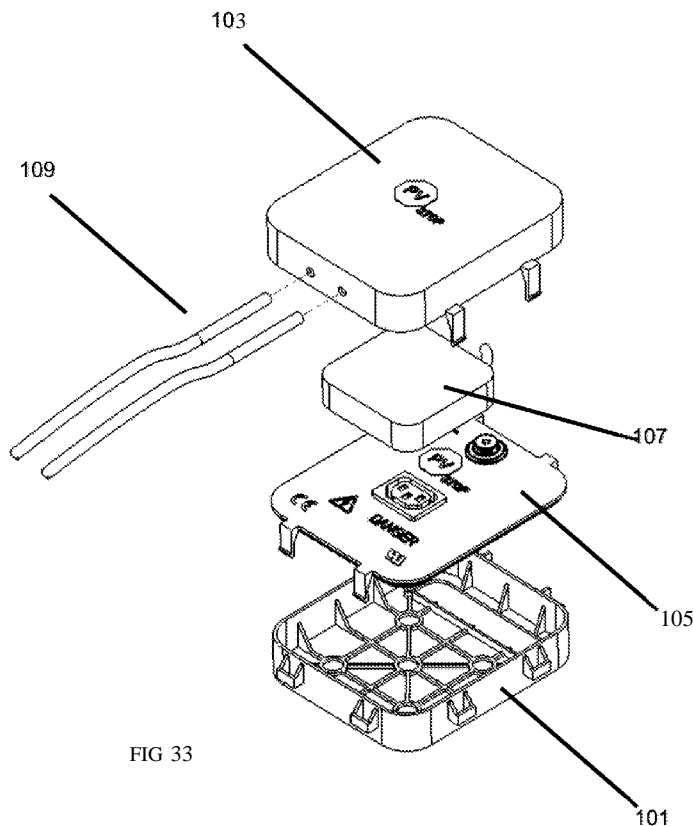


FIG 33

(57) **Abstract:** A system to interrupt the line or supply side power or charged system of any building, appliance, process, and the like, so as to render the system without charge or current output outside of the junction box/enclosure or equipment load supply connection so that emergency first responders or solar/any technician, authorized personnel in any field, system maintenance crew may avoid electrocution, chemical or machine/appliance hazard in the presence of fire, explosion, structural failure/compromise, moisture, flammables, caustics, hazmat, water stream, mist, fogging, physical damage or servicing of the system. The system can be engaged for any anticipated disaster such as fire, hurricane, tornado, earthquake, flood, and the like.

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POTENTIAL VOLTAGE AND HAZARD STOP SYSTEMCROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to and the benefit of the filing of U.S. Patent Application Serial No. 14/829,589 entitled "PV Stax - Multi-Function Junction Mf/J System" filed on August 18, 2015, and of the filing of U.S. Provisional Patent Application Serial No. 62/220,252 entitled "PV Stor Universal Energy Storage And Management System" filed on September 18, 2015, and the specifications and claims thereof are incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR
DEVELOPMENT

[0002] Not Applicable.

INCORPORATION BY REFERENCE OF MATERIAL SUBMITTED ON COMPACT
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[0003] Not Applicable.

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BACKGROUND OF THE INVENTION

Field of the Invention (Technical Field)

[0005] The present invention relates to devices and methods for manually or automatically shutting down supply of power, liquids or gases to buildings or facilities in the cases of emergencies, and for manual or automated shutdown of supplies in other situations. The invention also relates to devices and methods for manually or automatically controlling assemblies of devices through electronic and electro-mechanical means, to shut down, restart, modify input /output, invert, rectify, optimize, enhance safety, provide format matching of device interlocking and connection interfaces for electro-mechanical function, water proofing, electrical connection junctions, coupling of devices, coupling of industry standard devices by existing and future add-on equipment/devices, rapid plug/unplug (plug and play) devices in field installations and factory parts/device assemblies of power, liquids, or gases to buildings or facilities in case of emergencies, for adding or removing ganged assemblies and equipment, reconfiguration, maintenance and service and for manual or automated control in other situations. The invention further relates to devices and methods for self-contained enclosure(s) and rapid installation system for varied energy input, storage and varied output energy management system manually or automatically controlling assemblies of devices through electronic and electro-mechanical means, enclosed in one or more nesting or separate, Mil-Std or other industrial case of any shape or material, enclosures assembled for ease of shipping and installation with handles or grips or other handling configurations on one or more surfaces, to enclose energy storage systems such as batteries or storage system of any type, inverters, energy management systems, charge controllers, Rapid Shutdown systems, to shut down, restart, modify input /output, invert, rectify, optimize, enhance safety, provide format matching of device interlocking and connection interfaces for electro-mechanical function, water proofing, electrical connection junctions, coupling of devices, coupling of industry standard devices

by existing and future add-on equipment/devices, rapid plug/unplug (plug and play) devices in field installations and factory parts/device assemblies of power, liquids, materials, processes, or gases to buildings or facilities in case of emergencies, for adding or removing ganged assemblies and equipment, reconfiguration, maintenance and service and for manual or automated control in other situations..

Background Art

[0006] The present invention relates to the Solar PV Panel, Solar electricity industry, Electrical contracting, First Responder Fire/EMS services, Solar PV service technicians and electrical and fire safety, manufacturing, automation, robotic, conveyor system, public or private utility, wind turbine, mechanical contracting, gas, fuel, process piping of air, gas, chemical, any material or any system requiring complete or partial shutdown control for the purpose of mitigating or eliminating any hazard to animal/human/environment health, safety or property. Historically and as renewable energy systems such as wind and solar power become more prevalent, increasingly dangerous conditions exist for first responders to fire and other emergencies. First responders face possibility of electrocution, explosions, hazardous toxic exposure and other threats when responding to emergencies. In the case of solar PV modules on or near a structure, solar panels are electrically energized when exposed to sunlight, any light source including even moonlight. This presents electrocution hazard when fire responders introduce water to attack a fire. An examination of the hazards presenting to first responders and technicians concerning emergencies and repairs it became evident that PV Stop™, the present invention, could mitigate or eliminate many of these hazards presented by solar PV and other charged equipment or systems.

BRIEF SUMMARY OF THE INVENTION

[0007] Objects, advantages and novel features, and further scope of applicability of the present invention will be set forth in part in the detailed description to follow, taken in conjunction with the accompanying drawings, and in part will become apparent to those skilled in the art upon examination of the following, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

[0008] The present invention provides a system to interrupt the line or supply side power or charged system of any building, appliance, utilization equipment, fuel burning, process piping system, hazmat, conveyor, robotic, automation, vehicle, material handling, backup battery system, backup generator, moving machine parts hazard, wind generator, or power output of a solar PV or any other solar electrical or heat producing device so as to render the system without charge or current output outside of the junction box/enclosure or equipment load supply connection so that emergency first responders or solar/any technician, authorized personnel in any field, system maintenance crew may avoid electrocution, chemical or machine/appliance hazard in the presence of fire, explosion, structural failure/compromise, moisture, flammables, caustics, hazmat, water stream, mist, fogging, physical damage or servicing of the system. The system can be engaged for any anticipated disaster such as fire, hurricane, tornado, earthquake, flood, etc.

[0009] The inventive device comprises a control panel, containing a multiplicity of devices, located and properly marked, presumably in building code approved or fire marshal approved location, or any other appropriate location, in readily recognized area such as at the utility service entrance to premises or a substation area within a facility or any other location to communicate commands to any PV Stop controlled equipment.

[0010] In the case of a solar PV or solar concentrating system a Wireless Control Personality Module containing receiver/transceiver switch/relay inside, adjacent, near or in proximity to the junction box/enclosure or immediately at the output leads from any solar PV energy source which is activated from a remote or on-site location relative to the solar electrical producing device through a combination of any transmitter/transceiver and any receiver/transceiver, through command protocols generated by Arduino, Raspberry Pi or other similarly capable micro controller platform, wired, wireless, Bluetooth, RF, IR, WiFi, voice command, WAN, LAN, smart phone, GSM, CMDA, tablet, computer or any other signal, direct signal or electrical connection which either locks the switch on or off, connected through or directly to the PV STOP POTENTIAL VOLTAGE AND HAZARD STOP SYSTEM main control panel. A visible and/or audible indicator allows for the first responder or system maintenance crew to have definitive feedback at the PV Stop main control panel, as to the off or on status or power output of the controlled system. In the off position the relay/switch renders the load side leads or electrical wiring from the solar electrical device or any other device controlled by PV STOP, dead or un-charged. A Lockout code sequence and/or mechanical lockout device mechanism is required to re-energize any potential hazard controlled by the PV Stop system subsequent to remedy of the hazard event conditions.

[0011] The present invention also provides a system of stackable self-registering, water proof J-box sleeves covers and MF/J boxes to stack or add on a multiplicity of devices and enclosures to an electrical junction box or a MF/J box as described and claimed in the invention.

[0012] The inventive device or system provides a means to add into the MF/J box enclosures, any number of electrical, electro-mechanical or other control devices to provide for modularity or plug and play rapid installation or removal/replacement, upgrading, assembly and disassembly of stacked MF/J boxes and the enclosed devices.

[0013] The inventive device or system provides for a multiplicity of connectors, contacts, leads, wiring harnesses, and varying configurations of electro-mechanical devices.

[0014] The inventive device or system provides for the control of the devices within the MF/J boxes through a central control panel such as PV Stop, Fire, and Alarm or other control and command generating systems for electrical and mechanical devices.

[0015] The present invention also provides an energy storage and management system of stackable self-registering cases/enclosures, water proof J-box sleeves covers and MF/J boxes to stack or add on a multiplicity of devices and enclosures to an electrical junction box or a MF/J box as described and claimed in the invention.

[0016] The inventive device or system provides a mean to add into the system's cases/enclosures MF/J box enclosures, any number of electrical, electro-mechanical or other control devices to provide for modularity or plug and play rapid installation or removal/replacement, upgrading, assembly and disassembly of stacked components, MF/J boxes and the enclosed devices.

[0017] The inventive device or system provides for a multiplicity of connectors, contacts, leads, wiring harnesses, and varying configurations of electro-mechanical devices.

[0018] The inventive device or system provides for the control of the devices within the MF/J boxes or enclosures through a central control panel such as PV Stop, Fire, and Alarm, diagnostics, data logging, monitoring, reporting or other control and command of generating systems for electrical and mechanical devices and any other utilization equipment.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0019] The accompanying drawings Figures 1 - 40 in the attachment, which are incorporated into and form a part of the specification, illustrate one or more embodiments of the present invention and, together with the description, serve to explain the principles of the invention. The drawings are only for the purpose of illustrating one or more preferred embodiments of the invention and are not to be construed as limiting the invention. In the drawings:

1. Terminal Block in solar junction box
2. Antennae
3. Receiver / Transceiver
4. Single Throw - Double Pole Relay/Switch (or multiplicity of poles and/or throw) either normally open or normally closed.
5. Solar PV MF Junction Box (MF - Multi Function) Panel or Enclosure
6. Junction Box Leads
7. Conductors to next PV unit or to Inverter
8. Relay Coil
9. Solar PV BusBar Tabs
10. Speaker/Annunciator
11. Red LED Indicator Light
12. Green LED Indicator Light for Utility Grid or any line supply voltage
13. OFF Switch
14. On Switch
15. LCD LED or other Voltage Status Display Panel (Readout)
16. Printed Circuit Board w/ Arduino, Raspberry Pi or similar platform
17. Backup Battery
18. Remote Transmitter
19. Remote Signal (RF)
20. On Button

21. Off Button
22. Indicator Light
23. 110 v (or any voltage) Power In to Power Supply and to Charge Backup Battery
24. PV STOP Weather Proof Enclosure Controller Panel
25. Transformer
26. 12 VDC Power Supply
27. 6 Pole Single Throw Switch (or any number poles or throw or relay)
28. Main Printed Board (with Arduino, Raspberry Pi, terminals etc.)
29. 12 Volt Regulator (or any voltage)
30. Wireless Transmitter/Transceiver to Gas and/or Liquid and/or Material
31. Wireless Transmitter/Transceiver to PV Module and/or Any Power Supply or Source
32. Wireless Transmitter/Transceiver to Utility/Grid and/or any Power Supply or source for breaker interrupt of any load usage on any utilization equipment or building load.
33. LED indicator light for Gas and/or Liquid and/or Material
34. Hard wire power to Gas and/or Liquid and/or Material
35. Inputs/Outputs to Communicator RJ1 1, RJ45, Coaxial, Fiber Optics etc. or any other means
36. Still and/or Video Camera - Local or off site streaming via POE or any power source
37. PV module On Indicator light
38. Communication Module Incoming or outgoing fire, status, internet, broadband fiber optic, coaxial, any hard wire or any wireless signal.
39. Retro-Fit WP MF J-Box Enclosure Panel
40. PV Module
41. Manufacturer Factory Lead Spool
42. Y- Connector
43. Power from PV Stop Device
44. Gas and/or Liquid and/or Material Supply Source

45. To Gas and/or Liquid and/or Material Utilization Equipment
46. Seismic Actuated Valve
47. Solenoid Valve or other Actuated Valve w/ mechanical lock out
48. WP Enclosure for Remote Valve/Power Equipment Controls
49. Seismic Simulator (Vibrator)
50. Circuit Breaker (Remote Controlled Multi-Pole Breaker as required)
51. From Power Source (Utility Grid or any Source)
52. Power Load To Meter or Utilization Equipment
53. Power/Grid On Indicator Light
54. 12 VDC Power Supply
55. Transformer
56. Lead Connectors
57. Mini (or any sized for load) Solar PV Module Power Supply for Remote Receiver/Transceiver and Battery Power Supply
58. Standard Solar PV Module or any solar PV module w/ Retrofit J-Box
59. Flexible Leads w/ terminals for solar bus tabs
60. Snap in or friction projection and detent retention or equivalent fastener clip system
61. J-Box Cover
62. Retrofit MF J-Box Enclosure Sleeve extension
63. Seal
64. Logo - in this depiction for PV Stop trademark
65. Liquid tight Vapor transport, 2 way liquid moisture exclusion device
66. Wireless Control Personality Module
67. Diodes Only Personality Module
68. Pressure Clips or Tab Terminals
69. MF J-Box Adapter Plate
70. Diodes
71. BusBar Tabs to Solar PV MF Junction Box (MF - Multi Function) Panel or Enclosure to Leads Circuit
72. MF J-Box Printed Circuit Board

73. Relay
 74. MCU - Micro Controller
 75. Transceiver
 76. Peripherals Module - relays, switches, sensors, keypad/input
 77. USB Storage
 78. Auxiliary Input/Output (I/O)
 79. Fire Alarm System
 80. Shutdown Relay Contact
 81. Solar Module Outside range of 24 Control Panel
 82. Range for Wireless Communication with Remote Devices
 83. Signal from Control Panel 24
 84. Signal from In-Range Transmitter/Transceiver to Out of Range Equipment or PV Module 8 1
 85. Keypad/Touch Screen or other similarly capable input device to key in commands, communications, programming, security codes.
 86. Wind Turbine
 87. Backup Battery or Battery System
 88. Backup or Auxiliary Generator
 89. Materials Conveyor
 90. Motorized Equipment
 91. Material Handling (or any) Vehicle
 92. Process Piping (liquid or gas)
-
- 101 . PV Stax Multi-Function/Junction Base
 102. Locking Female Clip Receiver for Male clip (4)
 103. PV Stax Multi-Function/Junction Cover
 104. Locking Male Clip
 105. PV Stax Multi-Function/Junction Cover with Outlet Receptacle
 106. PV Stax Multi-Function/Junction Outlet Receptacle
 107. PV Stax Multi-Function/Junction Micro-Inverter or DC to DC Converter

108. PV Stax Multi-Function/Junction Micro-Inverter AC Leads
109. DC Leads
110. PV Stax Multi-Function/Junction Micro-Inverter or DC to DC Converter Male Plug
201. PV Stor System Interior Case/Enclosure Base
202. Battery Bank w/ Battery Management System
203. DC Disconnect
204. DC Input Leads
205. Inverter
206. MF/J Box / Enclosure
207. PV Stop or Rapid Shutdown Controller
208. Manual or Automatic Transfer Switch
209. Utility Feeder
210. Load Feeder
211. PV Stor System Case/Enclosure Base
212. Wheel
213. Exterior Case/Enclosure Cover
214. Positive or Passive Ventilation
215. Digital or Analog Line Voltage Meter
216. Inverter Display
217. Fold-Out Wheel Assembly
218. PV Stop - PV Stax Components

[0020] Figure 1 is a schematic drawing of a solar PV MF junction box 5 containing a receiver/transceiver 3, receiving signal through antenna 2 connected to the solar busbar tabs terminal block and a single throw double pole relay 4 and powered by a relay coil 8 to operate the relay 4 through the power produced by the solar PV module, to effect positive disconnect of the junction box leads 6.

- [0021] Figure 2 is an interface panel within a weather proof enclosure control panel 24 containing a speaker/annunciator 10, on and off (green and red) indicator lights 11 12, on and off manual switches (green and red) 13 14, a keyboard interface 85 and an LCD display panel 15.
- [0022] Figure 3 is a side view 24 cutaway section of Figure 2.
- [0023] Figure 4 is a remote transmitter 18, in this case an RF transmitter with indicator light 22, green on button 20 and red off button 21, sending signal 19 to the equipment controlled by the PV Stop System.
- [0024] Figure 5 is a schematic of printed circuit board 16 depicting 2 switches 13 14, antennae 2, speaker/ annunciator 10, backup battery 17, LED indicator lights 11 12, input interface keypad/touchscreen 85, display 15, power feed from Line In 23, and connected to the switched conductors 7.
- [0025] Figure 6 is a schematic of a remote controlled valve or shutoff device 47, within a weather proof enclosure 48, depicting a power feed 43 of any voltage, in this case 12 VDC, supplying a receiver/transceiver 3, interrupted via relay 4, when actuated, shuts off the valve or shutoff device 47 and indicator light 33, providing shutoff control between the supply 44 and the building or utilization equipment delivery 45.
- [0026] Figure 7 is a schematic similar to Figure 6 with the additional capability of being affixed to a seismic valve or shutoff device 46, between the supply 44 and the building or utilization equipment delivery 45, within a weather proof enclosure 48, whereby the relay 4, actuates the Seismic Simulator 49, to simulate earthquake. Power is supplied by a backup battery 17, which is charged through voltage regulator 29 by a solar PV panel 57, sized for the load required. Signal is received by antenna 2, in receiver/transceiver 3, receiving in this case RF signal 19 from main control panel 24. The transmitter/transceiver 3 can transmit valve status back to any device in PV STOP base unit 24.

[0027] Figure 8 is a schematic similar to Figure 6 with wireless actuation capability, receiver/transceiver 3 affixed with antenna 2, receiving in this case RF signal 19, within a weather proof enclosure 48, whereby the relay 4, actuates the Valve or shutoff device 47. Power is supplied by a backup battery 17, which is charged by a solar PV panel 57 through voltage regulator 29, sized for the load required. The transmitter/transceiver 3 can transmit valve status back to any device in PV STOP base unit 24.

[0028] Figure 9 is a schematic of a shutoff device depicting the capability of interrupting any power source of any voltage or phase configuration. Figure 9 depicts a single phase system supplied by source 51, configured with circuit breaker 50, which can be actuated by remote signal received by antenna 2, on receiver/transceiver 3 from control Panel 24 depicted in Figure 11. The device depicted in Figure 9 receives power from line voltage 51, conditioned by transformer 55, to a power supply 54 depicted here as 12 VDC, supplying power to remote receiver/transceiver 3, receiving in this case RF signal 19 to activate relay switch 4. A power indicator light 53 is located on the load side of the circuit breaker 50 to indicate power on or off status to persons in need of positive system status feedback.

[0029] Figure 10 is a schematic of a remote shut off device containing a multiplicity of electronic devices and connectors enclosed in a waterproof enclosure 39 that fits over a standard PV solar module MF J-box or enclosure 5, in a standard, non-standard or any Solar PV module 58, providing a lead spool 41, allowing for factory Module leads 6 to be wound up and gathered with the ends terminating in a Y connector 42, feeding power to terminal block 1 and receiver/transceiver 3, receiving in this embodiment RF signal 19 through antenna 2 to activate relay switch 4. Power under normal conditions is fed from Relay 4 to lead connectors 56 into standard manufacturer leads 7 to next module in array or to inverter. Waterproof Retrofit Enclosure 39 is fitted with a water tight access cover (not shown).

[0030] Figure 11 is a schematic of an embodiment expanding the capabilities depicted in Figures 1-5 of the main PV STOP - POTENTIAL VOLTAGE AND HAZARD STOP SYSTEM panel enclosure 24 with a multiplicity of electronic devices, connectors, communication modules, transmitters, receivers/transceivers, and mechanical devices. Power for the system 23, with connected power indicator light 12, feeds transformer 25, supplying conditioned power to power supply 26, thus feeding power to transmitters/transceivers 30 31 32, or more not shown, and supplying power to Main Printed Board 28, communication module 38, PV module voltage status display readout 15, and/or a multiplicity of voltage displays 15 (not shown). The main controller PB 28 is equipped with a mechanical or electronic switch 27 of any number of poles, (in this depiction six pole) which actuates all of the connected transmitters/transceivers 30 31 32, and direct transmitted connection to relay 4, an embodiment of remote personality module (or more not shown). Main PB controller 28 is equipped with a speaker 10 or other sound communication for positive system status feedback. Remote Receiver/transceiver 3 signals relay 4 in remote enclosure 48 and connected to indicator light 33 for positive status feedback on any system/equipment/appliance controlled by transmitter/transceiver 30 or relay 4 on load line 34. Each transmitter/transceiver 30 31 32 or more is fitted with its own individual switch 13 14 for isolated control of remote Personality modules from the rest of the system. Communication module 38 is fitted with input/output to fire alarm systems, keypad/touchscreen input 85, hard wired 35 or through any wireless signal through antenna 2, to equipment manufacturers/monitoring, owner, any need-to-know personnel, first responder, still/video camera 36 either/or archived (remote or local) and/or streaming live, and capable of two way communication to and from main system controller PB 28 to actuate any transmitter/transceiver, switch, relay, signal communication embodied within PV STOP, POTENTIAL VOLTAGE AND HAZARD STOP SYSTEM panel enclosure 24. Voltage regulator 29 is fitted with PV Module Status light 37 either wired as shown or wireless, for positive system voltage status feedback. Multiple PV STOP, POTENTIAL VOLTAGE AND

HAZARD STOP SYSTEMS embodied within Enclosure 24 can be installed at multiple locations on site and daisy-chained via hard wire or wireless signal through communication modules 38 thereby providing safety protection and scene control for large expansive facilities with no distance or layout configuration limitations. A transmitter/transceiver 3 can communicate to any remote wireless control device location such as depicted in Figure 7 and can transmit status back to any device in via transceiver/receiver 30 31 32 in PV STOP base unit 24.

- [0031] Figure 12 is a schematic embodiment of a PV module MF J-Box or enclosure 5 where by the PV solar busbar tabs 9, are severed and reconnected through Flexible Leads w/ terminals 59, connected to receiver/transceiver 3, receiving signal through antenna 2 to be switched by relay 4, fitted with flexible leads w/ terminals 59, connected to remaining downstream busbar tabs 9 into PV j-box terminal bar 1, feeding j-box leads 6. Power to receiver/transceiver 3 and relay 4 is provided by power from PV solar busbars 9. Relay 4 is operated through relay coil 8.
- [0032] Figure 13 is an exploded view of a factory J-box or enclosure 5 with factory leads 6. The factory J-box or enclosure cover 61 is removed from j-box enclosure 5. A Retrofit MF J-Box or Enclosure Sleeve extension 62, configured with seal 63 and Snap in or friction projection and detent retention clip system 60, is positioned to snap onto j-box or enclosure 5 and provides space for receiver/transceiver 3, Relay switch 4, antenna 2, relay coil 8, and the PV solar busbar tabs 9 and flexible leads 59 which all comprise what is depicted in Figure 25 and as a Wireless Control Personality Module 66 in Figure 19. Cover 61 is then fitted to closure on Sleeve Extension 62.
- [0033] Figure 14 is a side elevation view of Fig 13, depicting J-box or enclosure 5 with leads 6, fitted with Retrofit J-Box/Enclosure Sleeve extension 62 and j-box enclosure cover 61.

- [0034] Figure 15 is an assembled view of Fig 13 and 14, showing J-box or enclosure 5 with j-box leads 6, Retrofit MF J-Box Sleeve extension 62, and fitted with j-box/enclosure cover 61.
- [0035] Figure 16 is a top view of a preferred embodiment of PV Stop J-box or enclosure assembly depicting j-box/enclosure cover 61, Snap in or friction projection and detent retention clip system 60, Liquid tight Vapor transport, 2 way liquid moisture exclusion device 65, and j-box leads 6.
- [0036] Figure 17 is an side elevation view of Fig 16 depicting J-box or enclosure 5, J-box leads 6, Snap in or friction projection and detent retention clip system 60, j-box/enclosure cover 61, and j-box leads 6.
- [0037] Figure 18 is a 3-d perspective view of Fig 16 and 17 depicting the assembly of a PV Stop J-box or enclosure 5, with PV Stop logo 64, Liquid tight Vapor transport, 2 way liquid moisture exclusion device 65, Snap in or friction projection and detent retention clip system 60, j-box/enclosure cover 61, and j-box leads 6.
- [0038] Figure 19 is an exploded view of a preferred embodiment of the PV Stop MF J-box or enclosure 5 with J-box leads 6, assembly depicting Snap in or friction projection and detent retention clip system 60, j-box/enclosure cover 61, Seal 63, PV Stop Logo 64, Liquid tight Vapor transport, 2 way liquid moisture exclusion device 65, Wireless Control Personality Module 66 (interchangeable with Diodes Only Personality Module 67 not shown), and Pressure Clips or Tab Terminals 68.
- [0039] Figure 20 is a top view of Fig 19 J-box or enclosure 5 assembly showing j-box leads 6, Snap in or friction projection and detent retention clip system 60, and Liquid tight Vapor transport, 2 way liquid moisture exclusion device 65.
- [0040] Figure 21 is a top view of a possible embodiment for a retrofit J-box or enclosure sleeve 62 assembly providing a space and location for a personality module to snap over an existing manufacturers j-box or enclosure 5 as shown in

the exploded view Fig 22 thus enabling PV Stop upgrades to existing manufacturers PV module's J-box or enclosure.

[0041] Figure 22 is an exploded 3-d view of a possible embodiment for a retrofit J-box or enclosure sleeve 62 assembly providing a space and location for a personality module 66 or 67 (not shown) to snap over an existing manufacturers j-box or enclosure 5, fitted with a j-box/enclosure cover 61, and J-Box or enclosure Adapter Plate 69.

[0042] Figure 23 is a 3-d view of a possible embodiment for a retrofit J-box or enclosure sleeve 62 assembly providing a space and location for a personality module 66 or 67 (not shown) to snap over an existing manufacturers j-box or enclosure 5, fitted with a j-box/enclosure cover 61, and J-Box/enclosure Adapter Plate 69.

[0043] Figure 24 is an elevation view of assembly depicted in Fig 23 showing Snap in or friction projection and detent retention clip system 60, a j-box/enclosure cover 61, a retrofit J-box or enclosure sleeve 62, and J-Box/enclosure Adapter Plate 69.

[0044] Figure 25 is a schematic preferred embodiment of a Wireless Control Personality Module 66, within a PV j-box or enclosure 5, depicting the possible arrangement of solar PV busbar tabs 9, connecting to terminals 68, diodes 70, circuit 71, connected to j-box leads 6, on a printed circuit board 72 fitted with antenna 2, having located upon circuit board 72, a Relay 73, MCU - Micro Controller 74 and Transceiver 75.

[0045] Figure 26 is a schematic preferred embodiment of a Diodes Only Personality Module 67, within a PV j-box or enclosure 5, depicting the possible arrangement of solar PV busbar tabs 9, connecting to terminals 68, diodes 70, circuit 71, on PCB 72, connected to j-box leads 6, functionally providing a simple jumper module between PV busbars 9, through diodes 70, and circuit 71, to the PV j-box leads 6.

- [0046] Figure 27 is a preferred embodiment schematic block diagram depicting an LCD display 15, connected to a main control Printed Circuit Board (or processor board) 28, with an external peripherals module 76, a USB storage module 77, a keypad/touchscreen input device 85, and a Communications Module 38 and Aux I/O 78.
- [0047] Figure 28 is a schematic block diagram showing relationship between Fire Alarm System 79 with Shutdown Relay Contact 80, and the Main PV Stop Control Panel 24, fitted with antenna 2 and Aux I/O 78.
- [0048] Figure 29 is a schematic block diagram showing a relationship in terms of range 82, from the Main PV Stop Control Panel 24 with antenna 2, sending signal 83 to (receiver/transceiver 3 not shown), in J-box or enclosure 5 fitted with antenna 2 on PV module 40, which then sends signal 84 to Out of Range PV module 81 demonstrative of a daisy chain capability of the PV Stop System.
- [0049] Figure 30 is a schematic block diagram showing a relationship to demonstrate the capability of the PV Stop system to communicate between Main Control Panel 24, either directly or through Junction/Enclosure 5 fitted with Antenna 2, containing a wireless or wired personality module, to control via wireless signal, the on/off status of Wind Turbine 86, Backup Battery or Battery System 87, Backup or Auxiliary Generator 88, Materials Conveyor 89, Motorized Equipment 90, Material Handling (or any) Vehicle 91, Process Piping (liquid or gas) 92, or any other potential hazard connected via wired or wireless communication with the PV Stop System.
- [0050] Figure 31 is a schematic drawing of a PV Stax Multi-Function/Junction Base depicting the MF/J base box 1, configured with Locking Female Clip Receiver 2.
- [0051] Figure 32 is a schematic drawing of PV Stax Multi-Function/Junction Cover 3, configured with Locking Male Clip 4.

[0052] Figure 33 is a schematic drawing of an exploded assembly of multiple possible configurations of PV Stax Multi-Function/Junction MF/J System Components depicting a PV Stax Multi-Function/Junction Cover 3, with DC Leads 9, MF/J Micro inverter or DC to DC Converter 7, a PV Stax Multi-Function/Junction Cover 5, with MF/J Outlet Receptacle 6, and a MF/J Base 1.

[0053] Figure 34 is a schematic drawing depicting a PV Stax Multi-Function/Junction MF/J Cover 5, with a MF/J Outlet Receptacle 6.

[0054] Figure 35 is a schematic drawing depicting a PV Stax Multi-Function/Junction Micro-Inverter 7, with AC Leads 8, and MF/J Male Plug 10.

[0055] Figure 36 is a schematic drawing of a PV Stor System Enclosure with batteries and battery management system 2, DC Disconnect 3, Inverter 5, Transfer Switches 8, Rapid Shutdown Controller 7, MF/J Junction Box 6.

[0056] Figure 37 is a schematic drawing of PV Stor System Side View depicting base 11, cover 13 and wheels 12.

[0057] Figure 38 is a schematic drawing of the PV Stor System cover face 13, depicting transfer switches 8, line voltage meter 15, rapid shutdown control interface 7, inverter display 16 and ventilation 14.

[0058] Figure 39 is a schematic drawing depicting a side view of PV Stor System case/enclosure base 11, cover 13, with base wheels 12 and fold out wheels 17.

[0059] Figure 40 is a schematic drawing depicting PV Stor System PV Stop and PV Stax multiple energy input/output equipment and components.

DETAILED DESCRIPTION OF THE INVENTION

[0060] As depicted in Figure 1-30, power from the solar PV module(s) or other source comes into the junction box/enclosure 5, connects to terminal block 1, then feeds the receiver 3, which operates relay 4 to feed or interrupt power to junction box leads 6, power then conducted to next PV module or the inverter, and also feeding the printed circuit board/microprocessor board in Main Control Panel enclosure 24. The preferred embodiment would be the devices contained within a Wireless Controlled Personality Module within junction box/enclosure 5 as depicted in Figure 19 to be installed on each and every solar PV power source (panel) in the system. The objective is to positively shut off all power emanating from the junction box/enclosure 5 into the junction box leads 6 so that first responders, emergency and solar maintenance workers can be safe from electric shock or electrocution. This switching/relay system could be utilized for any power source, back up generation, co-generation, electric utility system, wind generator, etc.

[0061] While the preferred embodiment of the invention includes application directed to the Solar PV industry and trades, the invention is designed to interrupt any power, energy, gas, fuel, chemical or material source for the safety of workers and emergency first responders including but not limited to any electrically powered tool or system, backup power generation, co-generation systems, wind turbine systems, process piping system, hazmat material delivery system, conveyor of any type, material handling, vehicle, stored energy system, moving machine parts, robotics, automation or any other potential mechanical, electrical, chemical, gas or fuel delivery system, to provide a definitive and fail safe complete shutdown of all electrically charged parts in an electric power system and/or remove any potential supply or machine/appliance hazard controlled by the PV STOP system, as described herein, or of any sort, with verifiable visual and/or audible system status feedback.

[0062] As depicted in Figures 31 - 35, the invention is also of a system to provide a multi-function connection capability to contain and provide for stacking, mounting self-registering Multi-Function Junction (MF/J) boxes that contain a multiplicity of control electronics and can be stacked, removed, replaced, and/or upgraded with a minimal of steps or connection processes in order to simplify methods and conserve on or add value, capabilities to materials and electrical/mechanical equipment. The system can be engaged or utilized by any EMS/First Responded Service Technician, authorized personnel in any field, Contractor, manufacturer, BOS integrator and any assembler of systems that require a multiplicity of interfacing devices to be in proximity, connection or contact to each other, including Standard Electrical Boxes and enclosures, DC to DC Converters, Micro-Inverters, Module Level Control Electronics, Safety Systems, Monitoring Systems, Rapid Shutdown Systems, Micro Processors and power Semi Conductors.

[0063] As depicted in Figures 36 - 40, the invention is further of a UNIVERSAL ENERGY STORAGE and MANAGEMENT system to provide a multi-function connection capability to contain and provide for OFF-Grid or Grid Tied Power systems for stacking, mounting self-registering varying equipment and Multi-Function Junction (MF/J) boxes that contain a multiplicity of control electronics and can be stacked, removed, replaced, and/or upgraded with a minimum of steps or connection processes in order to simplify methods and conserve on time or add value and capabilities to materials and electrical/mechanical equipment. The system can be engaged or utilized by any EMS/First Responded Service Technician, authorized personnel in any field, Contractor, manufacturer, Utility Industry, BOS integrator and any assembler of systems that require a multiplicity of interfacing devices to be in proximity, connection or contact to each other, including Battery or other storage, Standard Electrical Boxes and enclosures, DC to DC Converters, DC Inverters, Micro-Inverters, Module Level Control Electronics, Safety Systems, Monitoring Systems, Rapid Shutdown Systems, Micro Processors and power Semi Conductors.

Industrial, Residential and Commercial Applicability :

[0064] The invention is further illustrated by the following non-limiting examples.

EXAMPLE 1

[0065] This PV STOP - POTENTIAL VOLTAGE AND HAZARD STOP SYSTEM can be used to control a single PV power source, multiple PV module power sources, a backup generator system, a battery backup power system, a wind turbine power generator, and an electrical energy source of any type to render the entire system off for the safety of workers and emergency first responders. A mock up was made to disable and re-energize a single PV panel with a backup battery system and it was 100% effective in completely interrupting all power output from the PV electric power source rendering all downstream devices, receptacles, outputs, usb, 12 v 110 v and all other electrically connected parts off or disabled. It was then able to reconnect all simultaneously.

EXAMPLE 2

[0066] As depicted in Figure 1-30, the PV STOP - Potential Voltage and Hazard Stop System incorporating a multiplicity Micro Processor Control Boards, Switches, Relays, Transmitters, Transceivers, Receivers, Batteries, circuits, Transformers, Communicators, Displays, Annunciators, Indicator Lights, Voltage Regulators, Relays, Antennas, can be used to control any Electrical Power Source, any Hazardous Material Delivery system, any gas or liquid fuel delivery system, any process piping or delivery system, or any other charged system supplying any utilization equipment/machinery including but not limited to conveyor systems, vehicles, robotics, automated production lines, fuel burning appliances/equipment, or any other system or equipment, to render all in a safe state of shutdown for the purpose of allowing first responders, emergency workers and authorized personnel to take complete control of all potential

hazards that could escalate or contribute to the dangers of the scene and remove the necessity for other personnel (who may be absent, injured or otherwise unavailable), or those with specific site/equipment knowledge to be called to action. First responders need not know the locations or any safety stop, lock out or any other switching, relays, controllers or valves on site. They need only to actuate the one or more shut-off mechanism in PV STOP Main Controller Panel device to render all or some systems off, either by physical switch, relay, remote call in, computer access online, wirelessly, via Bluetooth, smart phone, RF, WIFI, or any other means of communication to the PV and Hazard Stop Device. PV Stop Potential Voltage and Hazard Stop System includes capability to shut off the Electric Utility Supply to the premises at the point of service drop, drip loop, on utility pole, on ground at transformer, at service entrance or anywhere on site. PV Stop Potential Voltage and Hazard Stop System Devices can be utilized to shut off any backup generator, wind turbine, Battery Backup, Gas or Fuel valve and/or delivery system charged with any electric, air, gas, fuel, material conveyance, process piping of hazardous materials/chemicals etc. Vehicles/forklifts/cranes and other material handling equipment can be outfitted with receivers to shut down so that operator does not inadvertently enter a hazardous area where first responders are on scene and have actuated the PV and Hazard Stop System to effect scene safety. The Main Control Panel includes capability to disconnect all, some, or a sequence of PV Stop controlled equipment. Fire, first responder or technician personnel having the complete control of any potential hazard controlled by PV Stop. Security for preventing unauthorized access to the PV Stop system is accomplished through command sets generating secure codes, rolling codes, or otherwise encrypted signals to the PV Stop controlled equipment. This security provision also prevents unauthorized regeneration in any disabled equipment or system controlled by PV Stop until inspection/verification that equipment and system integrity is assured.

EXAMPLE 3

[0067] The PV STOP, POTENTIAL VOLTAGE AND HAZARD STOP SYSTEMS embodied in the figures 1 - 30 are capable, either singly or in multiples, of controlling any electric, mechanical, pipe flow, gas flow, chemical flow, material flow, any powered machine, any combustion machine or vehicle, any electrical vehicle, any valve of any type, or any array of similar or dissimilar utilization equipment , over any distance in any size or configuration of residence, business, industrial or manufacturing facility, power plant, co-generation plant, process plant or venue. Through a series of "Daisy Chained" Wireless (or wired) Controlled Personality Modules, any range limitations of signal can be overcome. In a number of tests, indoors and outside, distances up to 200 feet of effective control of equipment and PV Modules was confirmed. The range of signal can be modified by frequency, signal strength, differing transmitter/transceiver/receiver equipment and antenna modification to accommodate longer range as well.

[0068] Standard PV J box or MF/J Base box mounted on a PV Module fitted with a MF/J box, containing Diodes, with stackable add on that contains Module Level Control Electronics.

EXAMPLE 4

[0069] Standard MF/J Module Base J box mounted on a PV Module fitted with a MF/J box add on that contains a DC to DC converter.

EXAMPLE 5

[0070] Standard MF/J Module J box mounted on a PV Module fitted with a MF/J box add on that contains a Micro Inverter.

EXAMPLE 6

[0071] Standard MF/J Module Base J box mounted on a PV Module fitted with a MF/J box add on fitted with connections, Diodes and DC leads.

EXAMPLE 7

[0072] Standard MF/J Module Base J box mounted on an electrical enclosure or utility box of any standard fitted with a MF/J box add on fitted with connections, Diodes and DC leads or AC leads.

EXAMPLE 8

[0073] A UNIVERSAL ENERGY STORAGE and MANAGEMENT SYSTEM in one or more enclosures containing a multiplicity of standard and custom electrical components, electro mechanical devices, inverter(s), batteries, Rapid Shutdown system, battery charge controllers and battery management systems configured to interface and connect to a Standard PV J box or MF/J Base box mounted on one or more PV Module(s) fitted with a MF/J box, containing Diodes, with stackable add on that contains Module Level Control Electronics.

EXAMPLE 9

[0074] A UNIVERSAL ENERGY STORAGE and MANAGEMENT SYSTEM in an enclosure containing batteries, Inverter(s) and Grid Tie equipment configured to interface and connect to a Standard MF/J Module Base J box mounted on one or more PV Module(s) fitted with a MF/J box add on that contains a DC to DC converter

EXAMPLE 10

[0075] A UNIVERSAL ENERGY STORAGE and MANAGEMENT SYSTEM in one or more enclosures containing manual and/or automatic transfer switch(es) configured to interface and connect with any power circuitry through any standard electrical junction box or Standard MF/J Module J box mounted on one or more PV Module(s) fitted with a MF/J box add on that contains a Micro Inverter.

EXAMPLE 11

[0076] A UNIVERSAL ENERGY STORAGE and MANAGEMENT SYSTEM in one or more enclosures containing PV Stop Potential Voltage and Hazard Stop system or other rapid shutdown controllers interfacing with battery system, power input and power output in AC or DC current configured to interface and connect with an Industry standard PV J-Box or Standard MF/J Module Base J box mounted on one or more PV Module(s) fitted with a MF/J box add on fitted with connections, Diodes and, receiver or transceiver and AC or DC leads.

EXAMPLE 12

[0077] A UNIVERSAL ENERGY STORAGE and MANAGEMENT SYSTEM in one or more enclosures containing monitoring and reporting systems to manage and control all aspects of energy input, storage and output consumption or utilization equipment.

EXAMPLE 13

[0078] A UNIVERSAL ENERGY STORAGE and MANAGEMENT SYSTEM in one or more enclosures containing automatic or manual transfer switch(es), PV Stax Multifunction Junction module systems or other industry standard connection methods and equipment configured with Standard or MF/J Module Base J box mounted on an electrical enclosure or utility box of any standard fitted with a MF/J box add on fitted with connections for any energy generator or utilization equipment including Diodes and DC leads or AC leads.

[0079] The preceding examples can be repeated with similar success by substituting the generically or specifically described reactants and/or operating conditions of this invention for those used in the preceding examples.

[0080] Note that in the specification and claims, "about" or "approximately" means within twenty percent (20%) of the numerical amount cited.

[0081] Although the invention has been described in detail with particular reference to these preferred embodiments, other embodiments can achieve the same results. Variations and modifications of the present invention will be obvious to those skilled in the art and it is intended to cover all such modifications and equivalents. The entire disclosures of all references, applications, patents, and publications cited above and/or in the attachments, and of the corresponding application(s), are hereby incorporated by reference.

What is claimed is:

1. A system for personnel at readily accessible locations comprising one or more electrical, mechanical, transmitting and receiving devices, microprocessors and controllers that relay and/or switch on and off the source or line supply of all potentially hazardous equipment or energized/charged systems in a facility and report the status of the system to first responders, any need to know personnel, and equipment/Solar PV module/equipment, machine, tool maintenance technicians via audible and/or visual annunciators and display readouts.
2. The system of claim 1 comprising a modular main control panel enclosure containing a communications module used to transmit and receive data to/from junction boxes/enclosures that are paired to it, and a processor board handling all front panel peripherals, displays, devices, and interaction, interfacing the main control box to external devices, supporting protocols for remote operation and telemetry, data logging for performance and forensic applications, and interaction with security and/or fire systems.
3. The system of claim 2 wherein said main control panel enclosure monitors contact closures that are interfaced as needed to existing or future devices to allow these devices to request a shutdown of a PV module or modules.
4. The system of claim 1 additionally comprising a power interrupting/reconnecting and status notification system for Solar PV or other Solar energy/heating power system or other electrical power source.
5. The system of claim 4 additionally comprising components for power interrupting/reconnecting on individual, multiple strings, or entire arrays of solar energy producing systems.
6. A system to provide for rapid connect and disconnect of devices to a PV module or junction box comprising a Multi-Function/Junction box (MF/J), enclosure allowing for rapid change out, removal and replacement, and customization, for one or more electrical, mechanical, transmitting and receiving devices,

microprocessors and controllers that relay and/or switch on and off the source or line supply of all potential hazardous equipment or energized parts or conveyances, or to connect inverters, rectifiers, electrical controls, DC - DC converters, GPS systems, line conditioners and to reduce the install/connection time, number of box fastenings, number of cable connections for solar PV technicians/installers, electrical and mechanical authorized personnel and provide a plug and receptacle connection or any other type of rapid connect/disconnect for modular assemblies or individual devices configured for stackable mounting or matching on any junction box or enclosure, secured by configuration and fasteners of any type to provide proper registration and water proofing and to prevent unintended disconnect, misalignment, or dismount.

7. The system of claim 6 additionally comprising module level control electronics to bypass one or more PV modules in a string or array and to provide output, power or flow data for a multiplicity of uses and applications.
8. The system of claim 6 additionally comprising a MF/J box mounted on a base MF/J box that contains a DC to DC inverter with Maximum Power Point Tracking electronics.
9. The system of claim 6 additionally comprising a MF/J box mounted on a base MF/J box that contains micro inverter electronics inverting and/or conditioning power and converting any DC voltage from one or more PV Modules per Micro-Inverter, with leads out to AC cabling.
10. An energy storage and management system within one or more enclosures to provide rapid connect and disconnect of devices to an energy source or sources, comprising an industry standard junction box/enclosure or a Multi-Function/Junction box (MF/J) enclosure permitting rapid change out, removal and replacement, and customization for one or more electrical, mechanical, inverter, grid tie, load panel, transmitting and receiving, microprocessor, and control devices that relay and/or switch on and off the source or line supply of all potential hazardous equipment or energized parts or conveyances, and to

connect inverters, rectifiers, electrical controls, DC - DC converters, GPS systems, line conditioners and to reduce the install/connection time, number of box fastenings, number of cable connections for energy technicians/installers, electrical and mechanical authorized personnel and provide plug and receptacle connections or any other type of rapid connect/disconnect for modular assemblies or individual devices configured for stackable mounting or matching on any junction box or enclosure, secured by configuration and fasteners of any type to provide proper registration and water proofing and to prevent unintended disconnect, misalignment, or dismount.

11. The system of claim 10 additionally comprising module level control electronics to bypass one or more PV modules in a string or array and to provide output, power or flow data.
12. The system of claim 10 additionally comprising a J-box or MF/J box mounted on a base MF/J box, which contains a DC to DC inverter with Maximum Power Point Tracking electronics.
13. The system of claim 10 additionally comprising a J-box or MF/J box mounted on a base MF/J box that contains micro inverter or string inverter electronics capable of inverting/conditioning power, and converting any DC voltage from one or more PV Modules per Micro-Inverter, with leads out to AC cabling.
14. The system of claim 10 additionally comprising a MF/J box with connection or receptacle to receive connection or plug, both with any number or shape or configuration of plugs and receptacles, both with or without grounding conductor, from another MF/J box to be stacked.
15. The system of claim 10 additionally comprising scene safety devices for control of hazards to protect inhabitants, firefighters, EMS first responders, and/or electrical technicians.

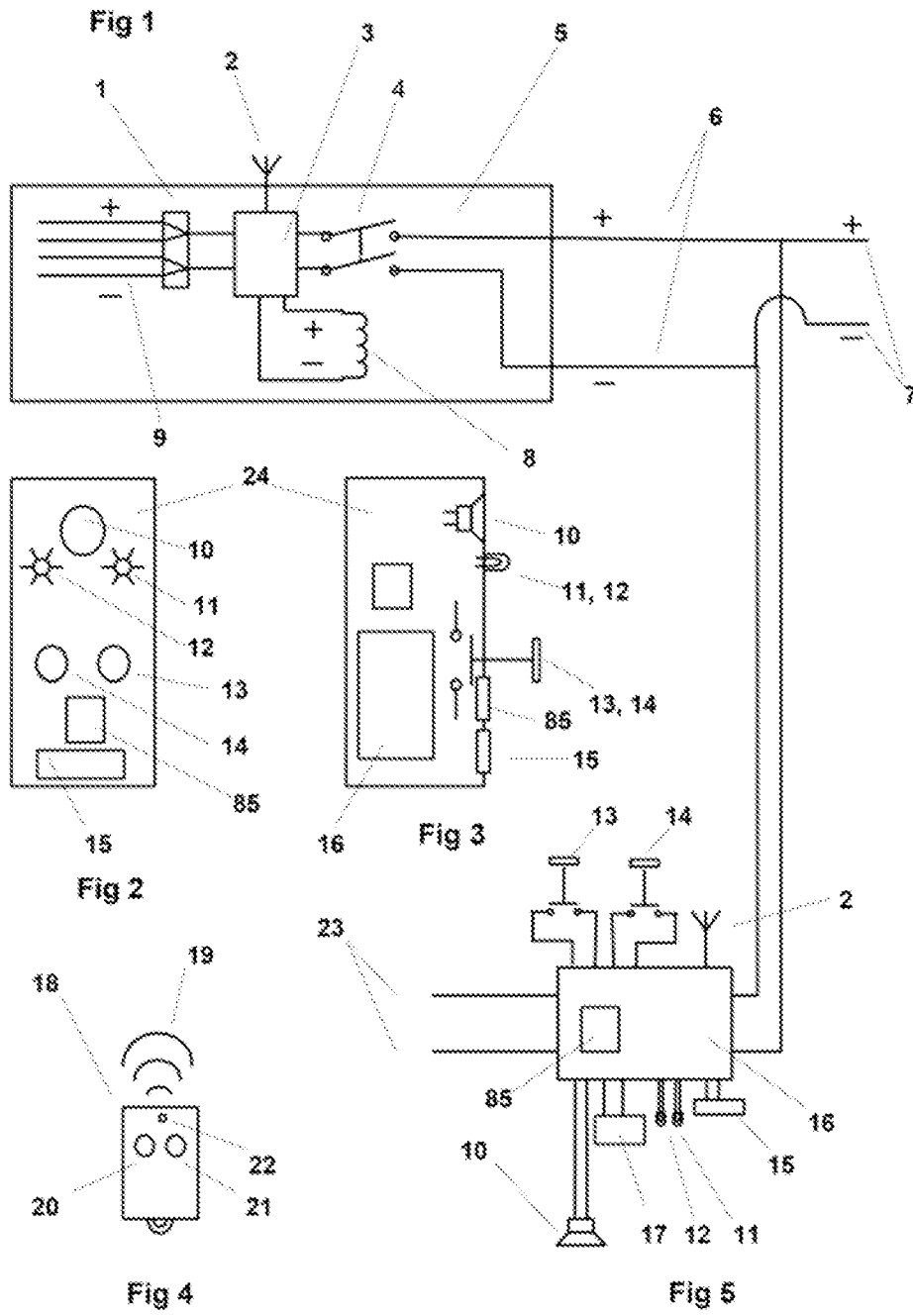


Fig 6

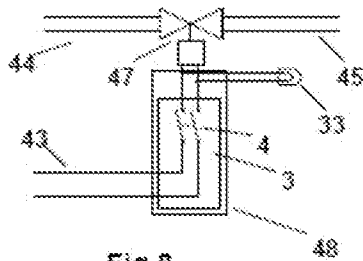


Fig 7

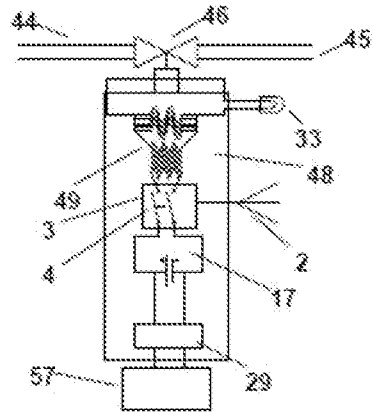


Fig 8

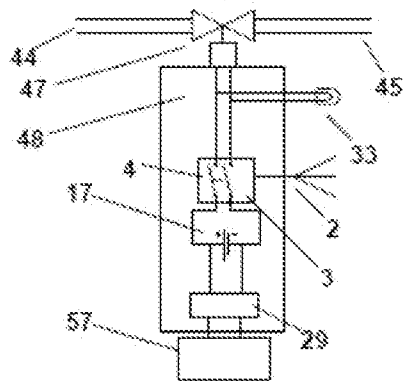


Fig 10

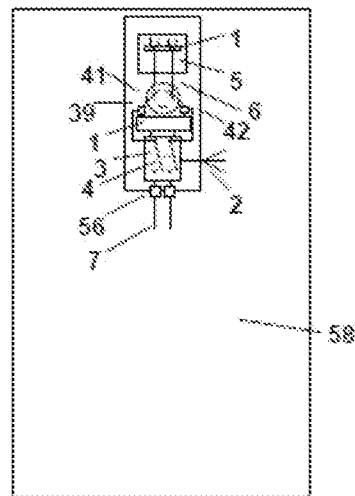
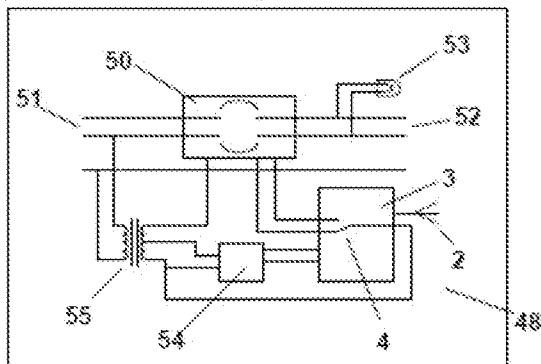
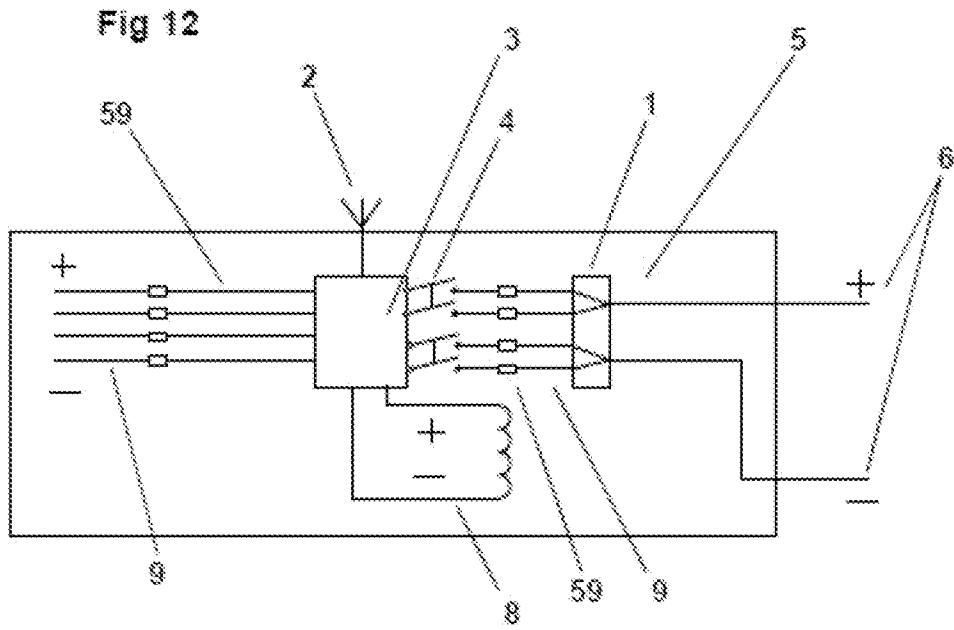
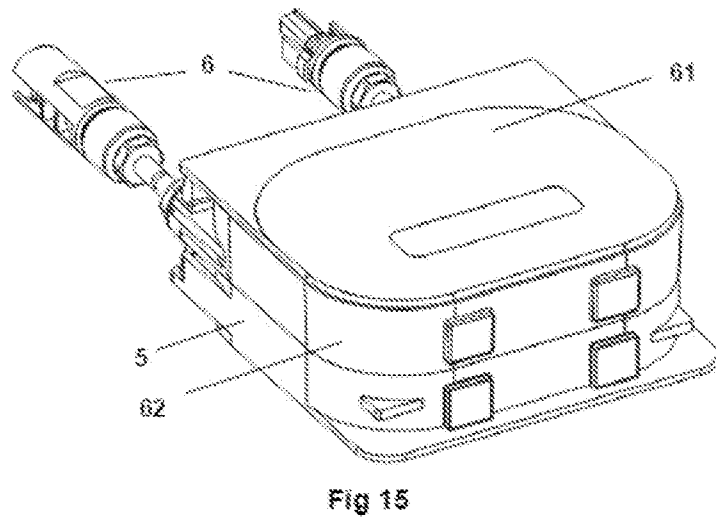
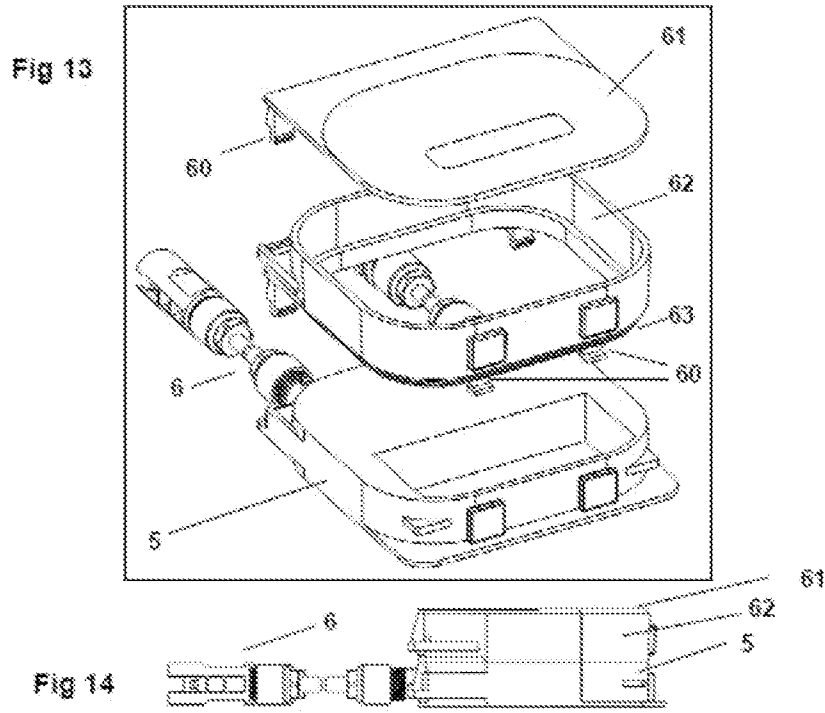


Fig 9







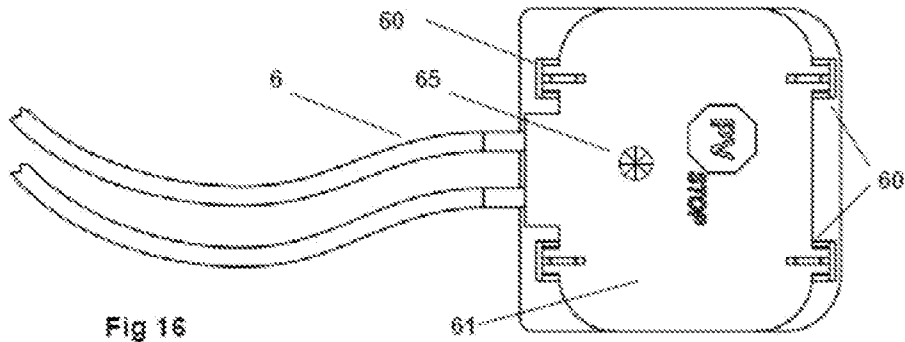


Fig 16

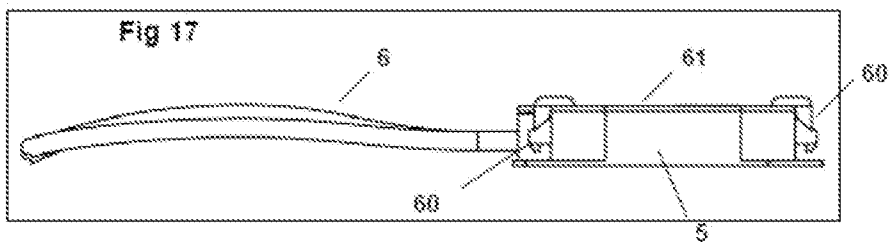


Fig 17

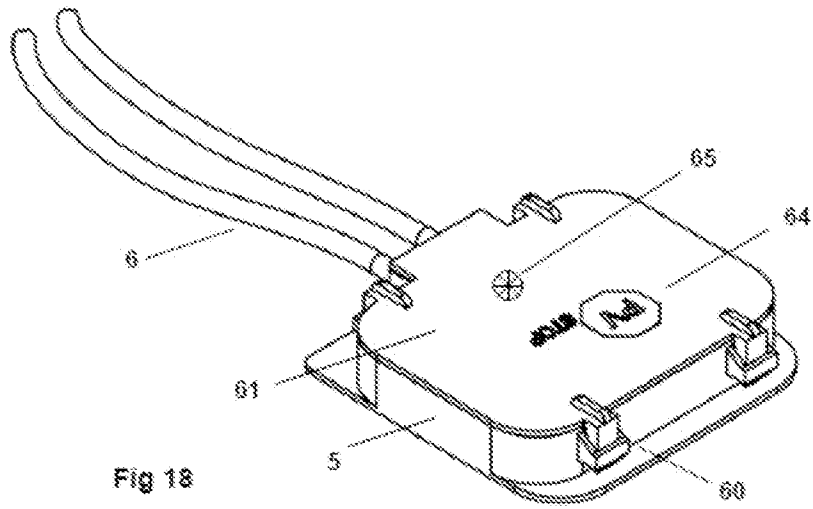
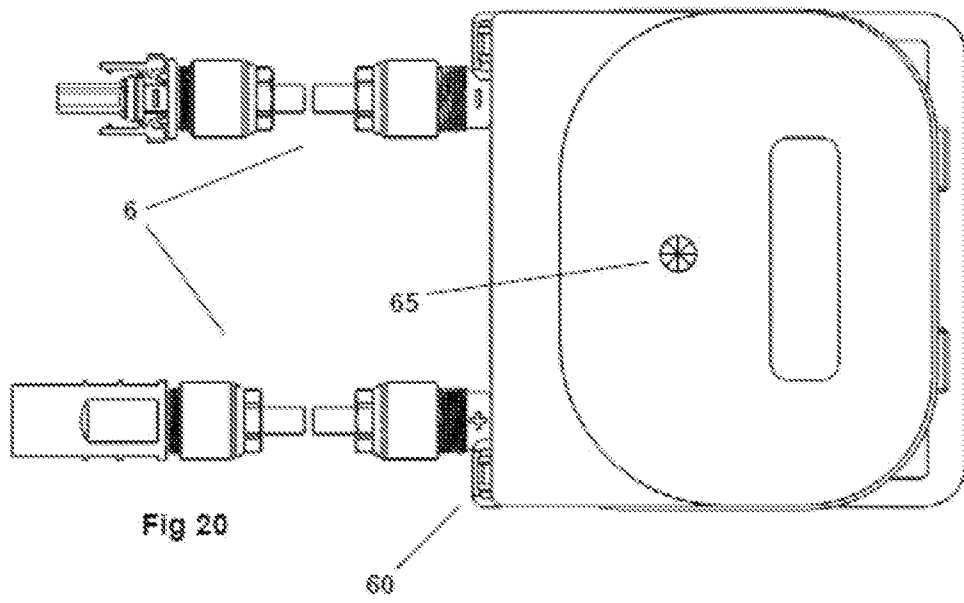
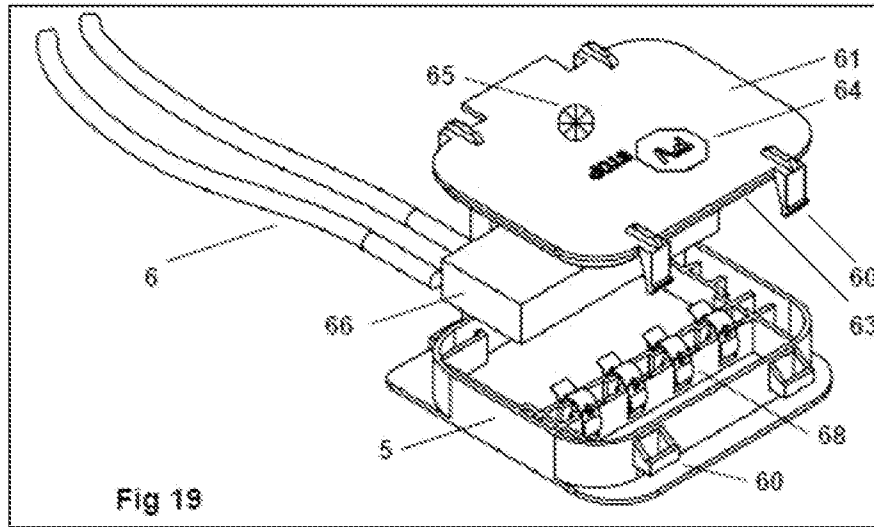


Fig 18



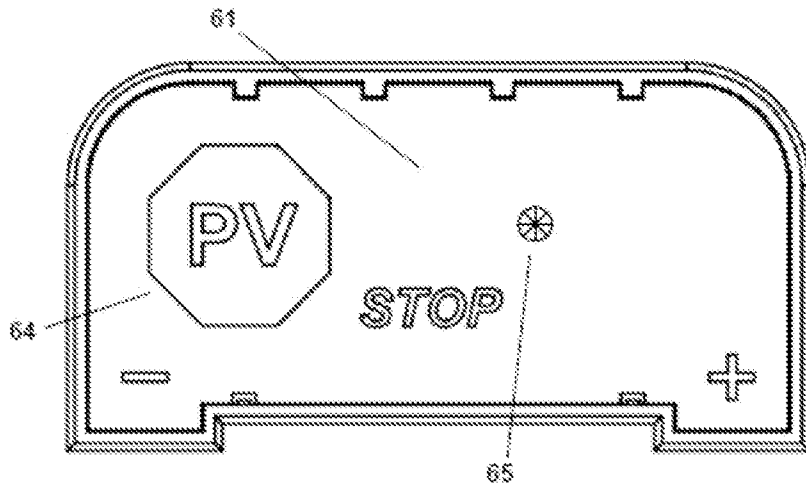


Fig 21

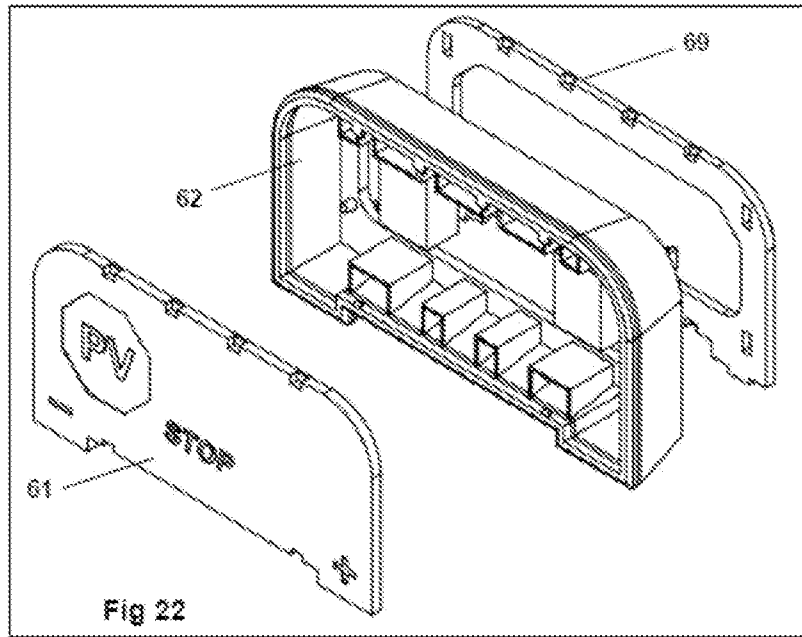


Fig 22

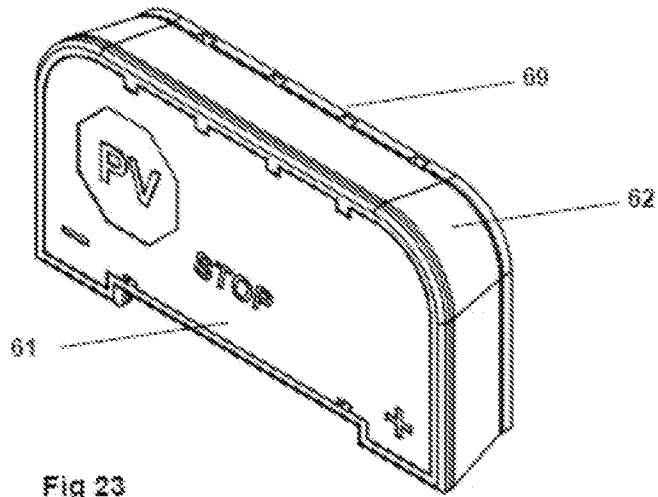


Fig 23

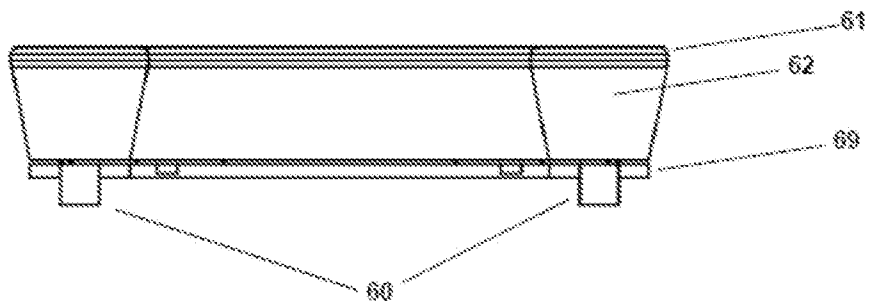
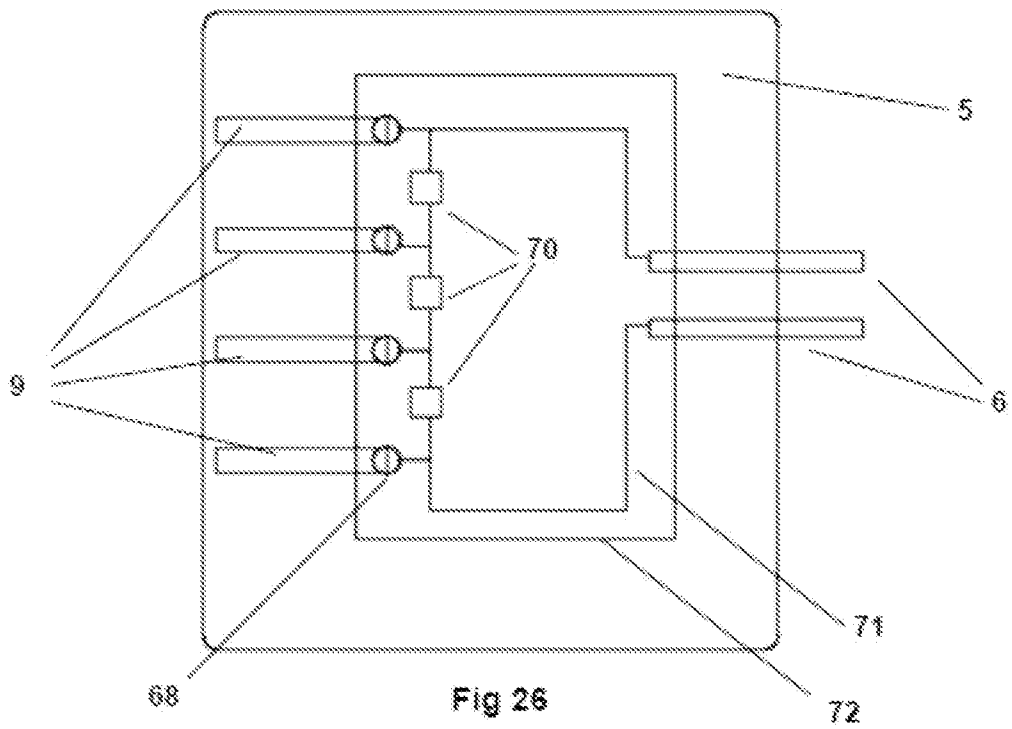
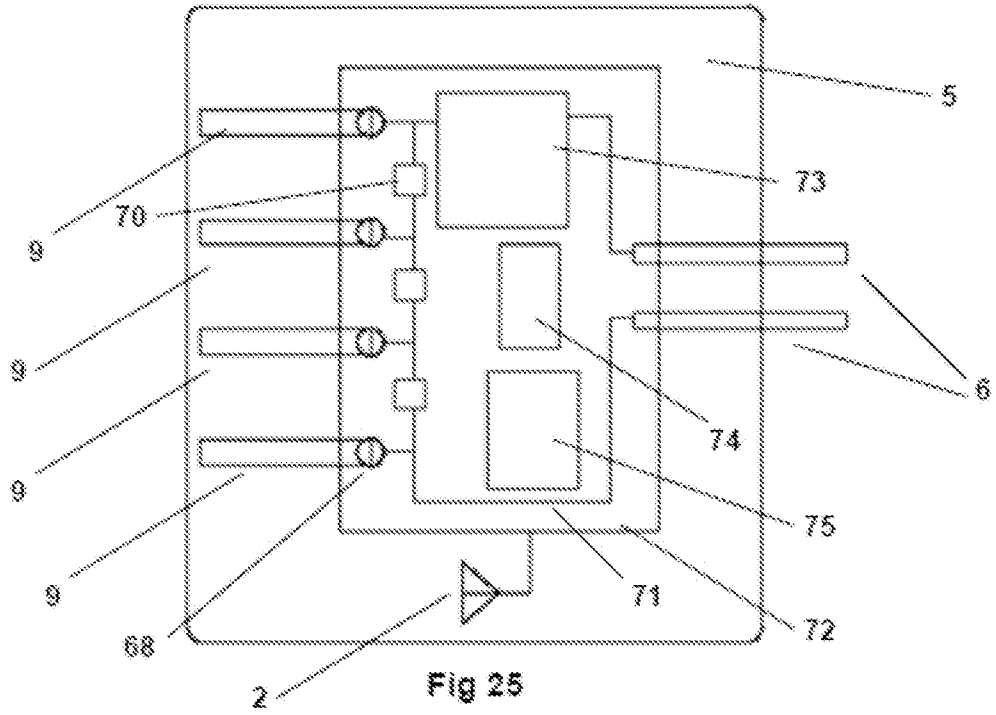
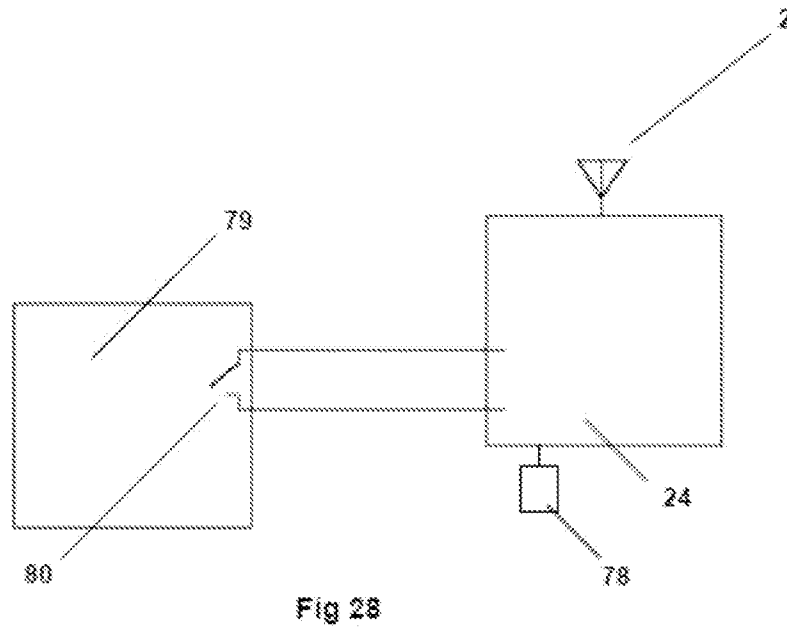
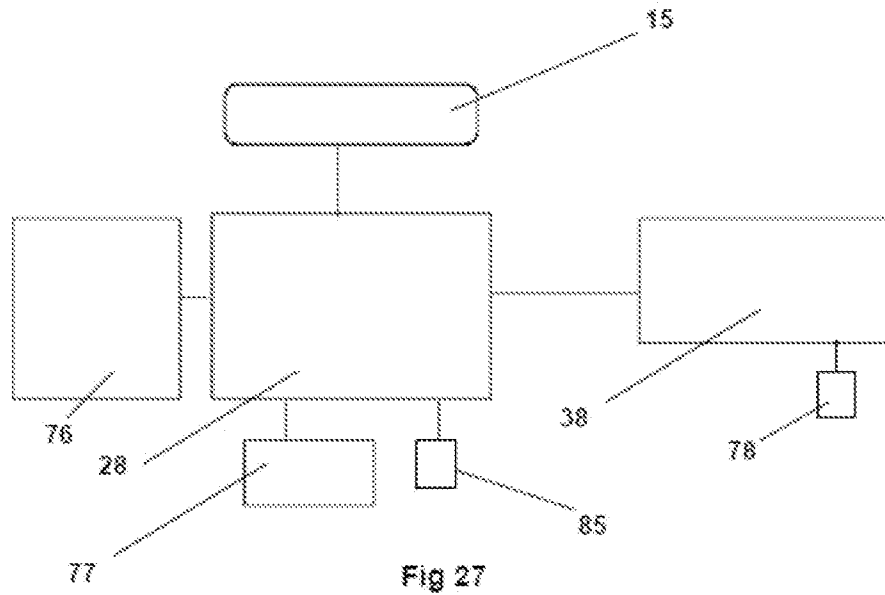


Fig 24





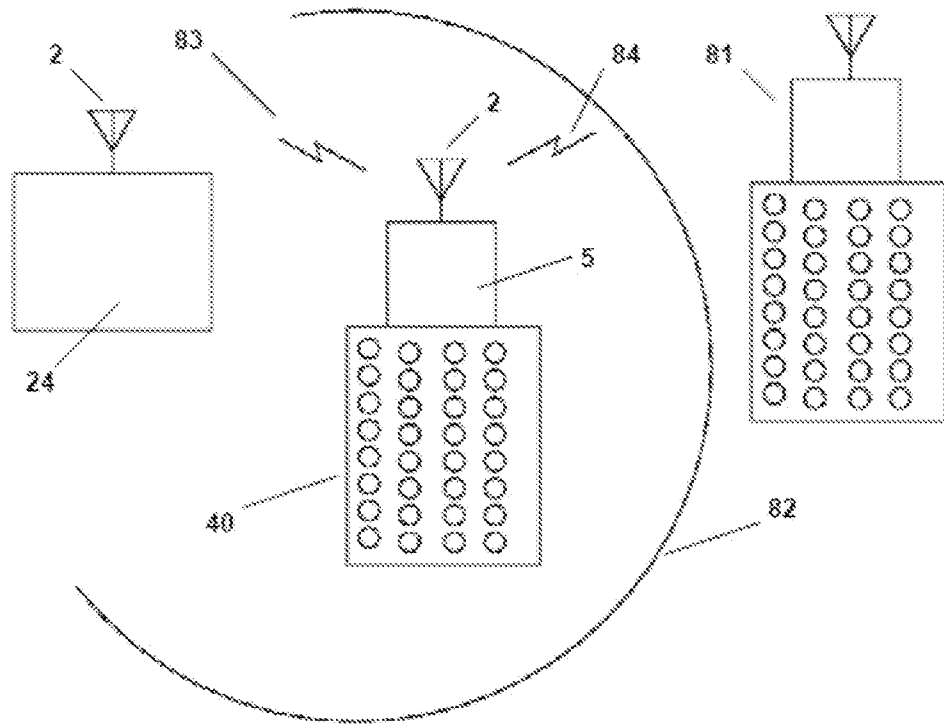


Fig 29

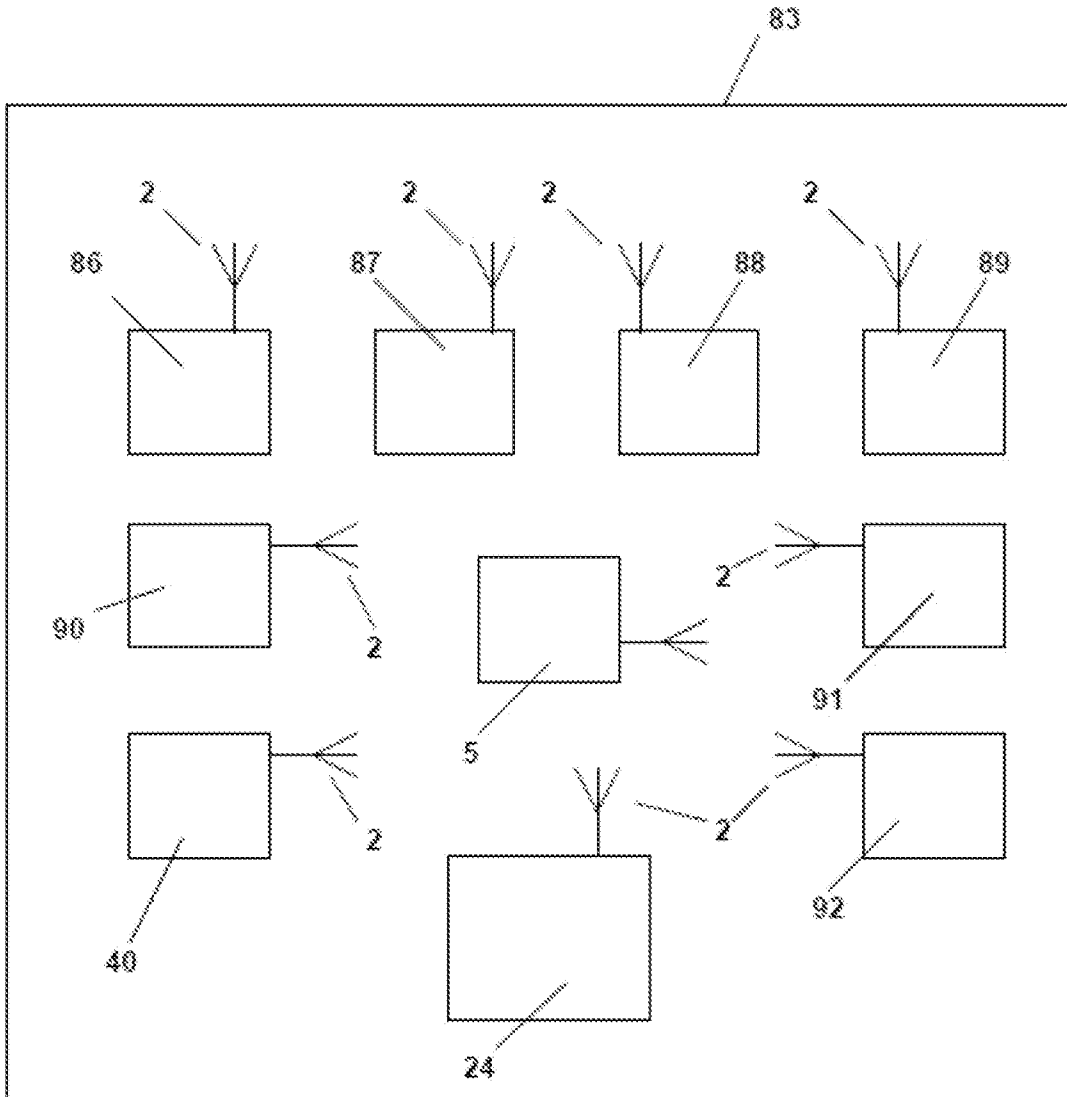


Fig 30

FIG 31

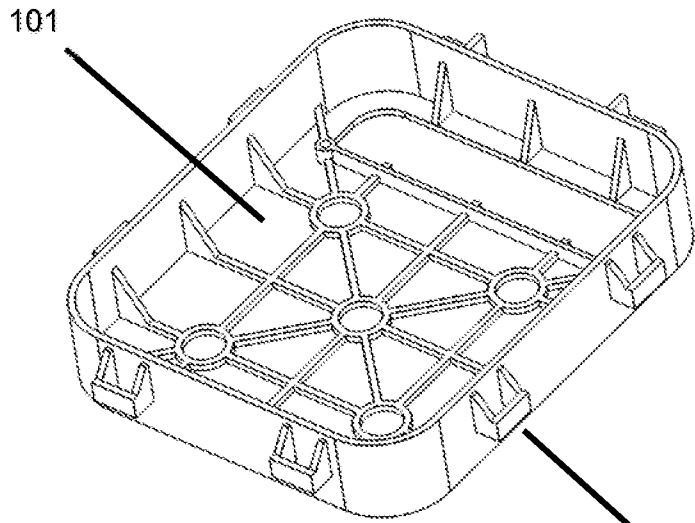


FIG 32

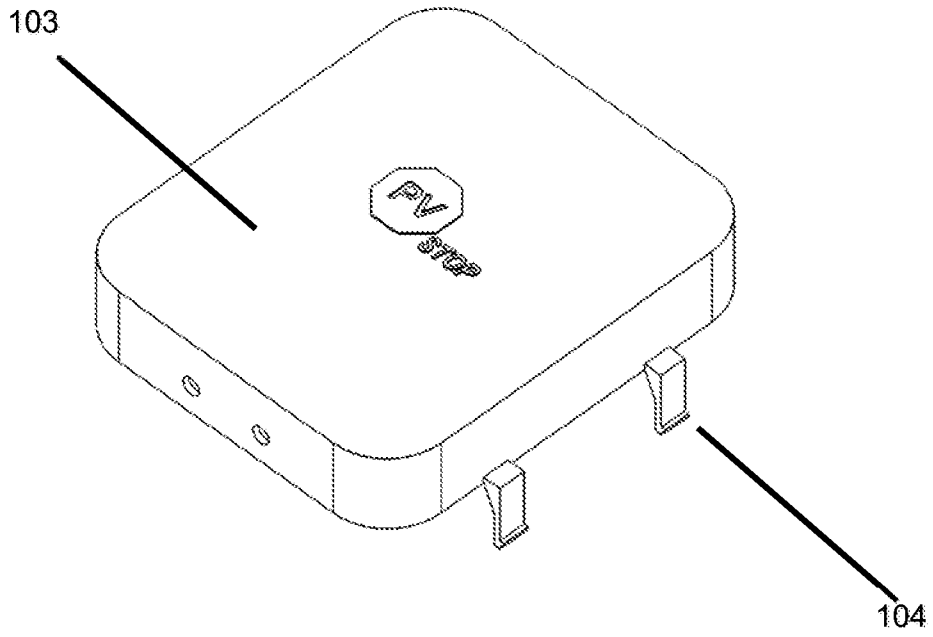


FIG 33

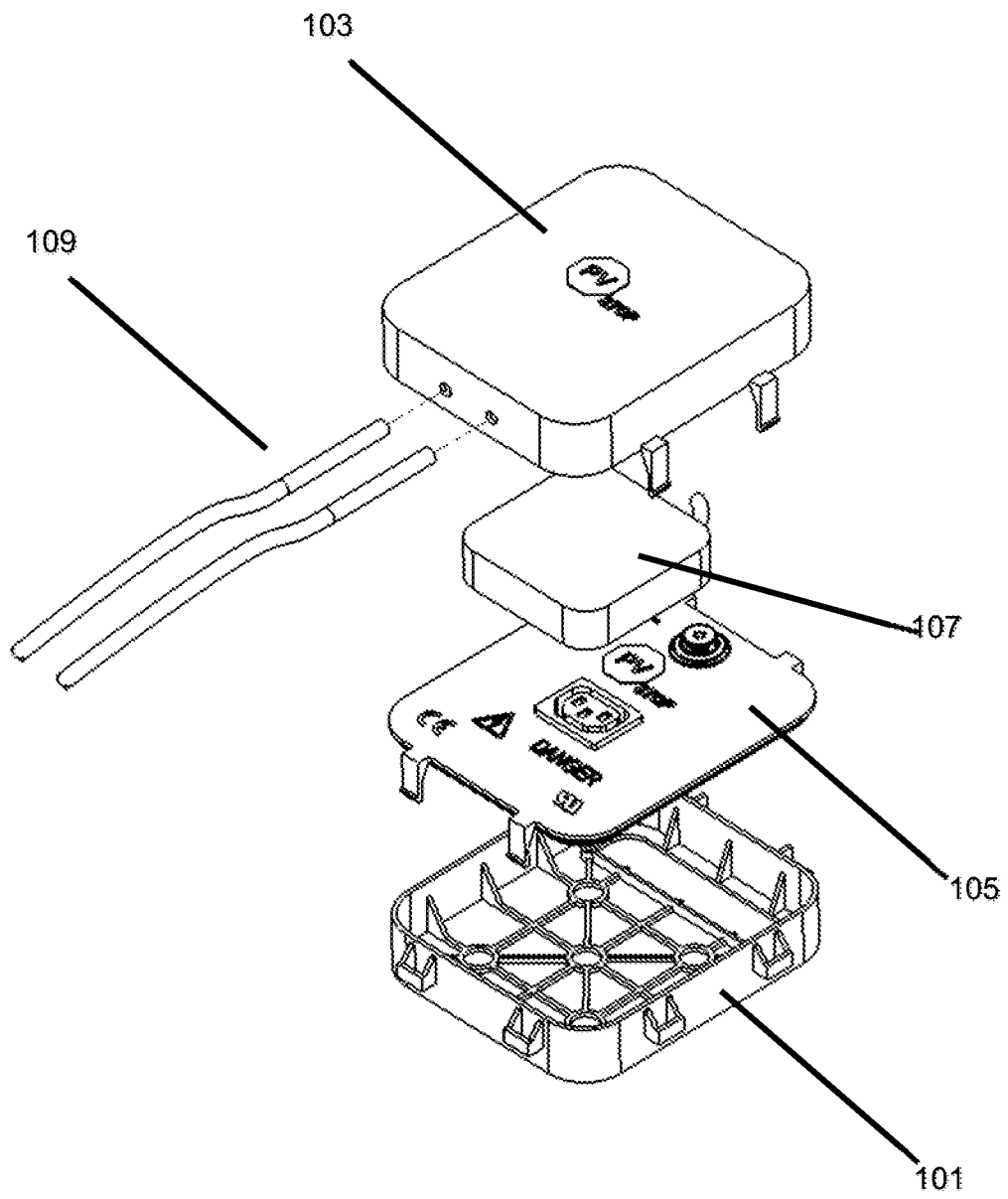
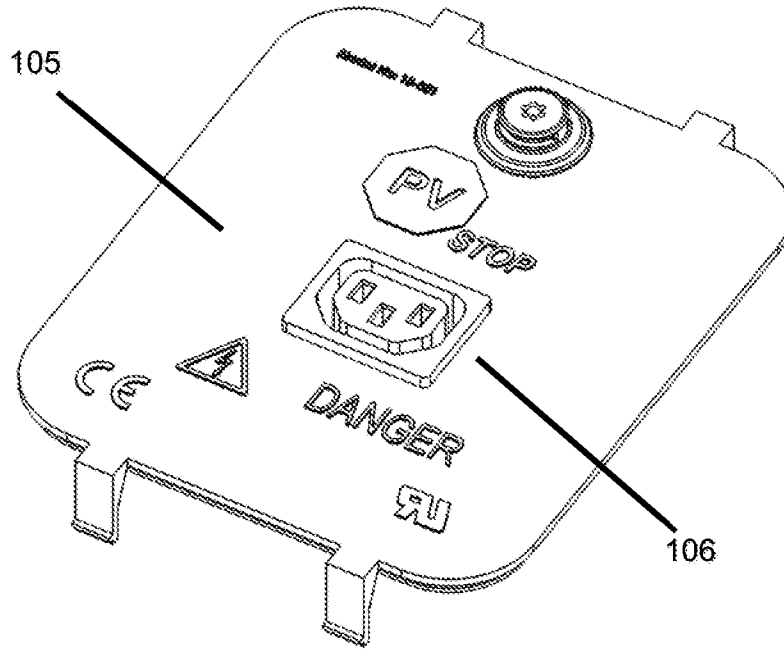


FIG 34



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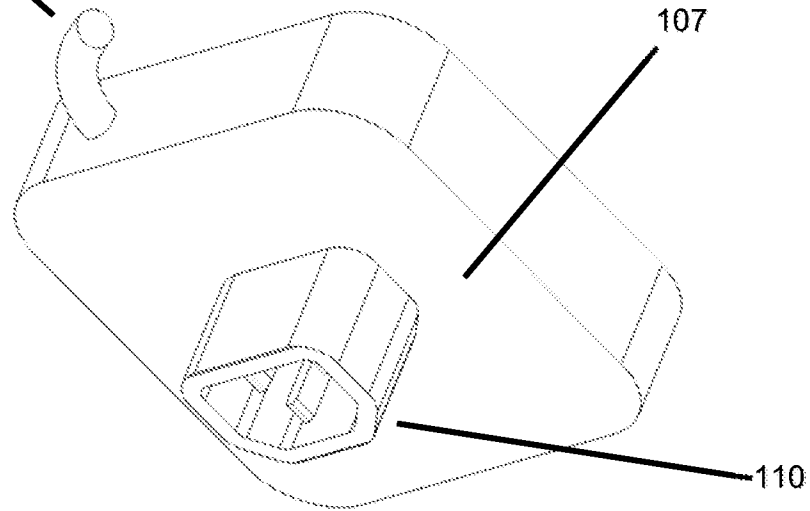


FIG 35

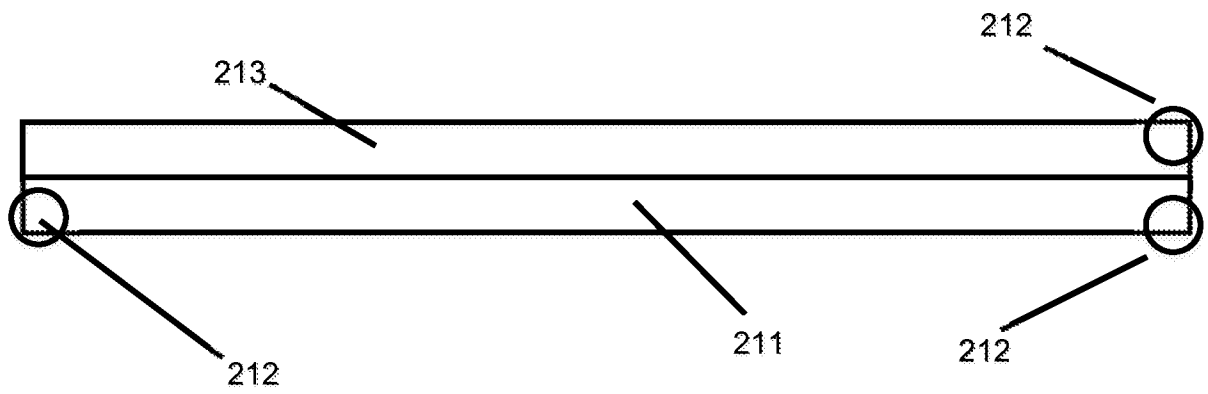
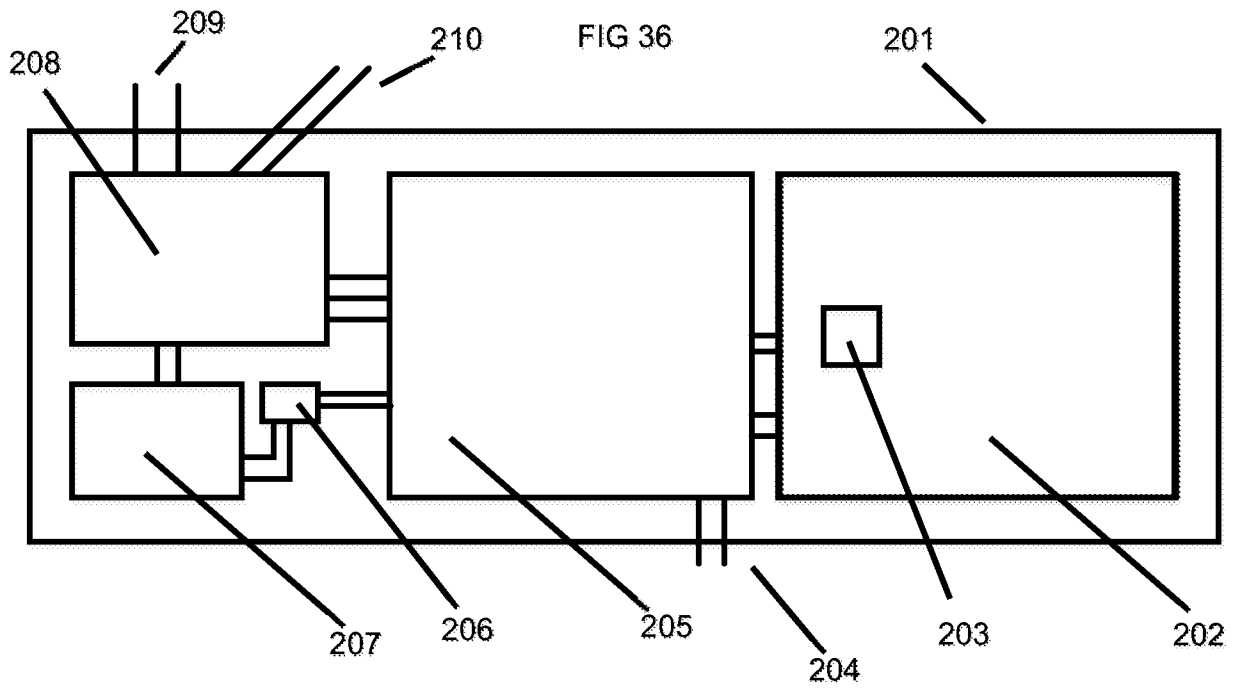


FIG 38

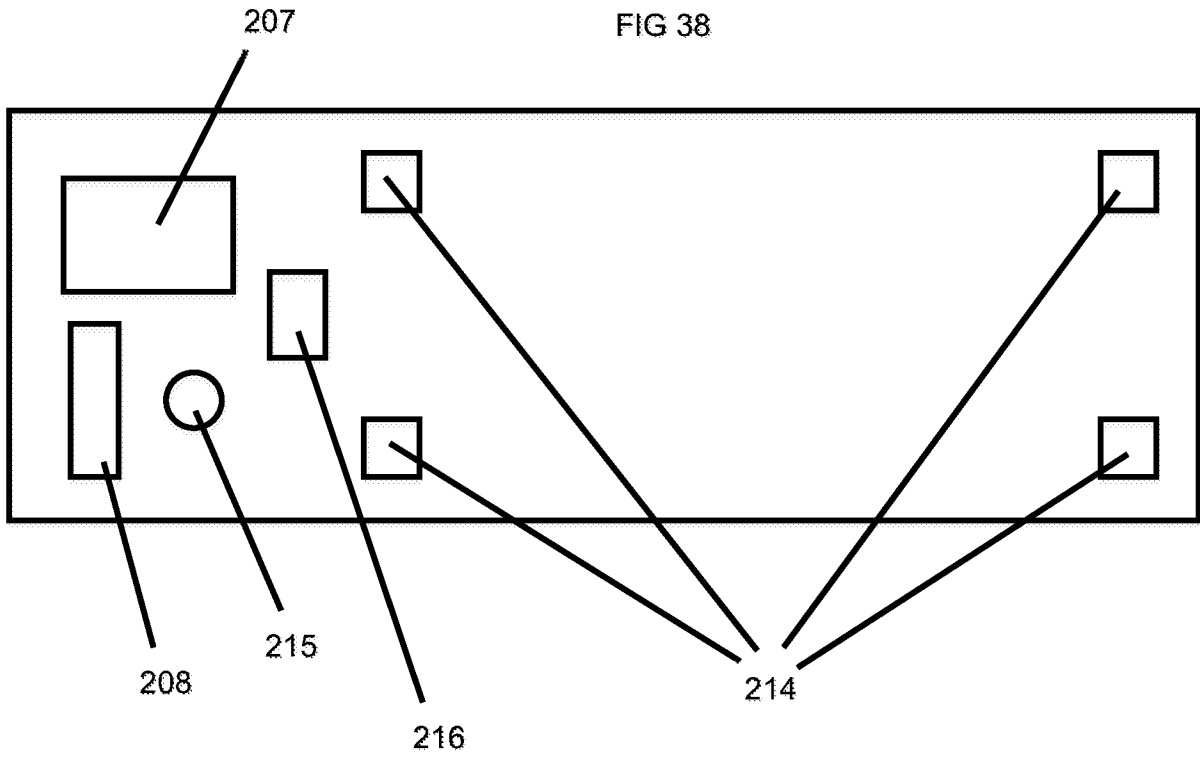


FIG 39

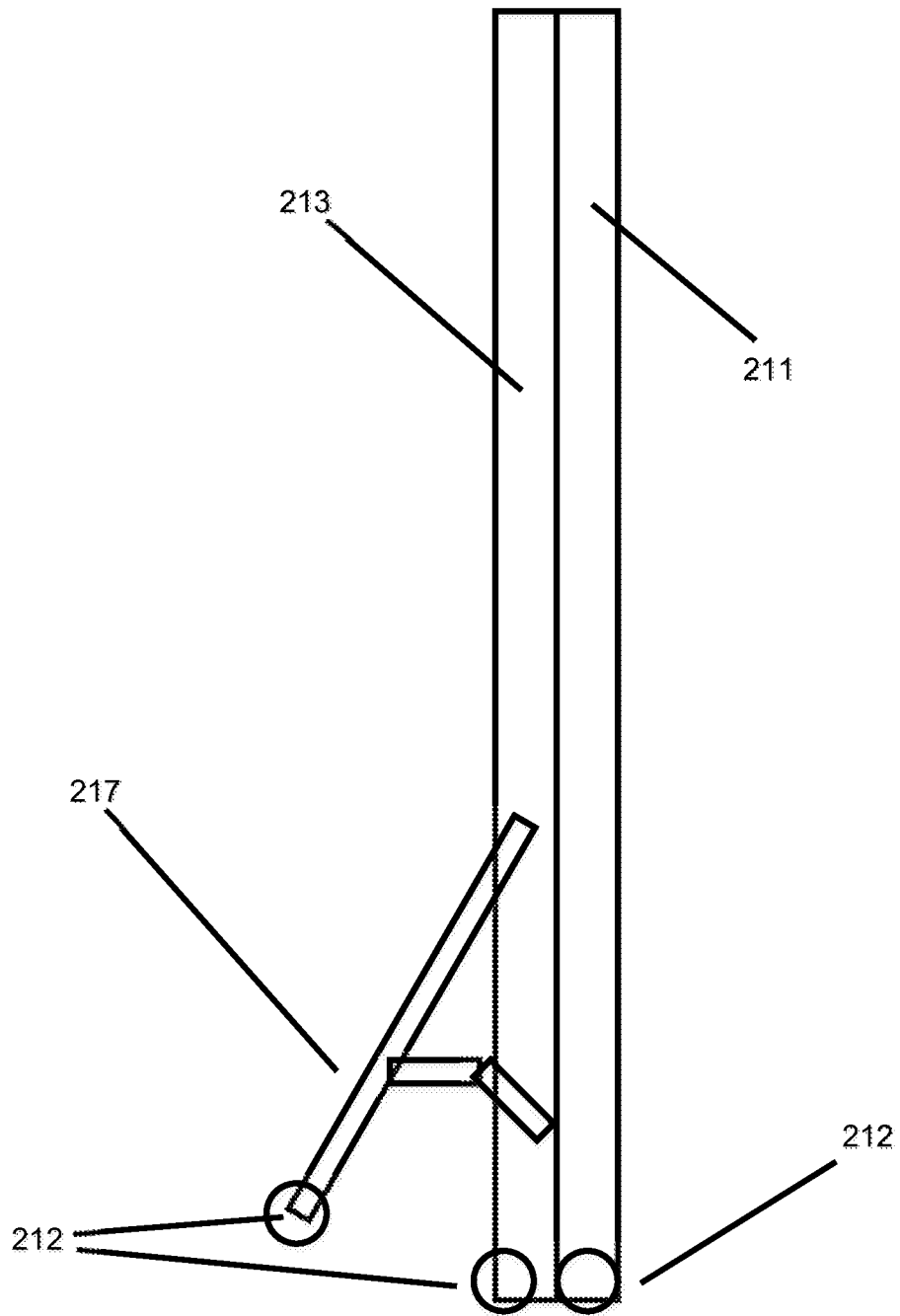
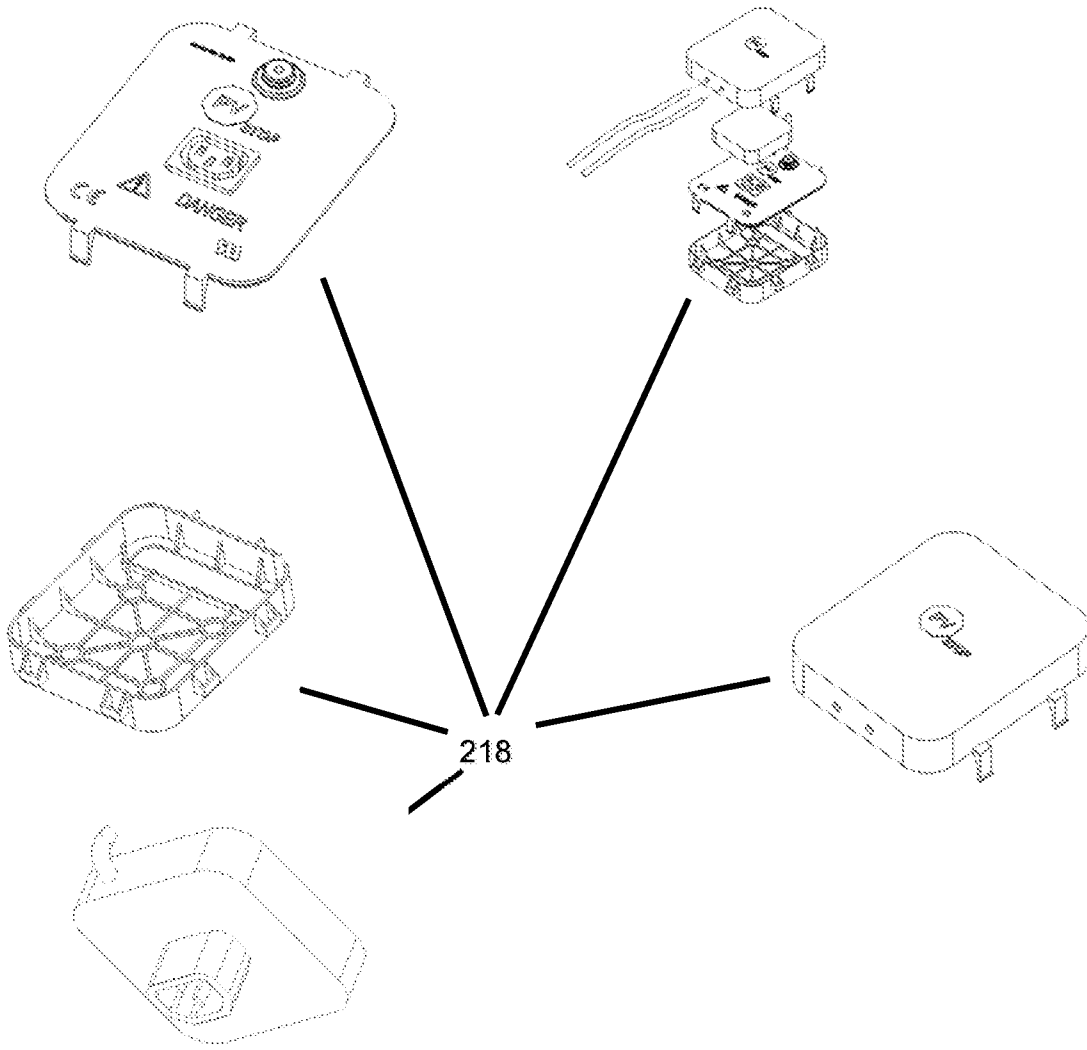


FIG 40



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/54072

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - G05B 11/01, 23/02; G06F 11/07 (2016.01)

CPC - G05B 9/02; G06F 11/0736, 11/0757

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8): G05B 11/01, 23/02; G06F 11/07; H01L 31/02, 31/042 (2016.01)

CPC: G05B 9/02; G06F 11/0736, 11/0757, 11/0793; H02J 3/385; H04L 63/0823

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSeer (US, EP, WO, JP, DE, GB, CN, FP>, KR, ES, AU, IN, CA, INPADOC Data) Google Scholar, Ebsco, IEEE

KEYWORDS: solar-panel photovoltaic-panel, solar-power-panel, power, energy, electricity, voltage, control, manipulate, configure, manage, first-responder, fireman, technician, report, inform, notify, hazard, disaster, emergency, fire

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	McCune, C "PV Stoptm -Potential Voltage and Hazard Stop System for Licensing & distribution under the Trademark mccune works inc" June 14, 2013 [retrieved from the internet December 2, 2015] <URL: http://solarprofessional.com/resources/press/mccune-works-inc/pv-stoptm-potential-voltage-and-hazard-stop-system-for-licensing >; paragraphs 3 & 4	1-5 & 10-16
A	US 2009/0084426 A1 (FORNAGE, M et al.) April 02, 2009; figures 1 & 2, paragraphs [0013], [0015], [0017]-[0019], [0024]-[0025]	6-15
A	US 2012/0316802 A1 to (PRESHER, G et al.) December 13, 2012; figures 3, 5 paragraphs [0063], [0069], [0071]	1-10
A	US 8,854,193 B2 to (MAKHOTA, M et al.) October 07, 2014; column 4, lines 64-67, column 6, lines 10-15	1-15
A	US 4,628,306 A (ROOT, R) December 09, 1986, figures 1-4; column 3, line 60 - column 4, line 64 and column 5, lines 31-46	1-15

Further documents are listed in the continuation of Box C.

See patent family annex.

<ul style="list-style-type: none"> • Special categories of cited documents: 	<ul style="list-style-type: none"> "I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
<ul style="list-style-type: none"> "A" document defining the general state of the art which is not considered to be of particular relevance 	<ul style="list-style-type: none"> "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
<ul style="list-style-type: none"> "E" earlier application or patent but published on or after the international filing date 	<ul style="list-style-type: none"> "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
<ul style="list-style-type: none"> "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) 	<ul style="list-style-type: none"> "&" document member of the same patent family
<ul style="list-style-type: none"> "O" document referring to an oral disclosure, use, exhibition or other means 	
<ul style="list-style-type: none"> "P" document published prior to the international filing date but later than the priority date claimed 	

Date of the actual completion of the international search
21 January 2016 (21.01.2016)

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01 MAR 2016

Name and mailing address of the ISA/
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/54072

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule (5.4(a).

Box No. II¹ Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See supplemental page.

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US 15/54072

---Continued from Box No. III Observations where unity of invention is lacking---

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1-5 are directed toward a system for personnel at readily accessible locations comprising reporting the status of the system to first responders, any need to know personnel, and equipment/Solar PV module/equipment, machine, tool maintenance technicians via audible and/or visual annunciators and display readouts.

Group II: Claims 6-15 are directed toward a system to provide for rapid connect and disconnect of devices to a PV module or junction box comprising a Multi-Function/Junction box (MF/J), enclosure allowing for rapid change out, removal and replacement, and customization, or to connect inverters, rectifiers, electrical controls, DC-DC converters, GPS systems, line conditioners and to reduce the install/connection time, number of box fastenings, number of cable connections for solar PV technicians/installers, electrical and mechanical authorized personnel and provide a plug and receptacle connection or any other type of rapid connect/disconnect for modular assemblies or individual devices configured for stackable mounting or matching on any junction box or enclosure, secured by configuration and fasteners of any type to provide proper registration and water proofing and to prevent unintended disconnect, misalignment, or dismount.

The inventions listed as Groups I and II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features. Group I has at least reporting the status of the system to first responders, any need to know personnel, and equipment/Solar PV module/equipment, machine, tool maintenance technicians via audible and/or visual annunciators and display readouts that Group II does not have. Group II has at least a Multi-Function/Junction box (MF/J), enclosure allowing for rapid change out, removal and replacement, and customization to connect inverters, rectifiers, electrical controls, DC-DC converters, GPS systems, line conditioners and to reduce the install/connection time, number of box fastenings, number of cable connections for solar PV technicians/installers, electrical and mechanical authorized personnel and provide a plug and receptacle connection or any other type of rapid connect/disconnect for modular assemblies or individual devices configured for stackable mounting or matching on any junction box or enclosure, secured by configuration and fasteners of any type to provide proper registration and water proofing and to prevent unintended disconnect, misalignment, or dismount.

The common technical features of Groups I and II are at least one or more electrical, mechanical, transmitting and receiving devices, microprocessors and controllers that relay and/or switch on and off the source or line supply of all potentially hazardous equipment or energized/charged systems. These common features are disclosed by US 4,628,306 A to ROOT, R (hereinafter 'Root'). Root discloses at least one or more electrical, mechanical, transmitting and receiving devices, microprocessors and controllers (control system having a power supply lines 40 and 41 (electrical), push-button (mechanical) switches 18 and 19, transmitter 12 (transmitting device), radio receiver 50 (receiving device), control unit 30 (microprocessors and controllers), figures 1-4; column 3, line 60 - column 4, line 64 and column 5, lines 31-46) that relay and/or switch on and off the source or line supply of all potentially hazardous equipment or energized/charged systems (relays 52 and 55 (relay and/or switch) that provide a hard stop, soft stop, and cycle hold that connects and disconnects power (on and off the source or line supply) to the various drive functions for automated equipment capable of detecting potentially dangerous conditions (potentially hazardous equipment or energized/charged systems), column 1, lines 12-15; column 5, line 31 - column 6, line 24).

Since the common technical feature is previously disclosed by the Root reference, these common features are not special and so Groups I and II lack unity.