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GB 2493631 A
EP 0667666 A1
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(54) Title of the Invention: **Power system**
Abstract Title: **On Demand Power System**

(57) A power system for providing on demand power to one or more electrical devices, the power system comprising a primary electricity producing means 5, one or more batteries and a control means, which comprises an inverter 9, wherein the control means, in a first mode of operation, is configured to switch on the primary electricity producing means upon start-up of the power system and to switch on the inverter only after a first pre-determined period of time from start-up of the power system has elapsed, the primary electricity producing means running continually during the first predetermined period. The primary electricity producing means may comprise a fossil fuel powered generator or a fuel cell. The system may further comprise a secondary electricity producing means using a renewable energy source, for example solar panels. The power system may form part of a welfare unit or self contained cabin.

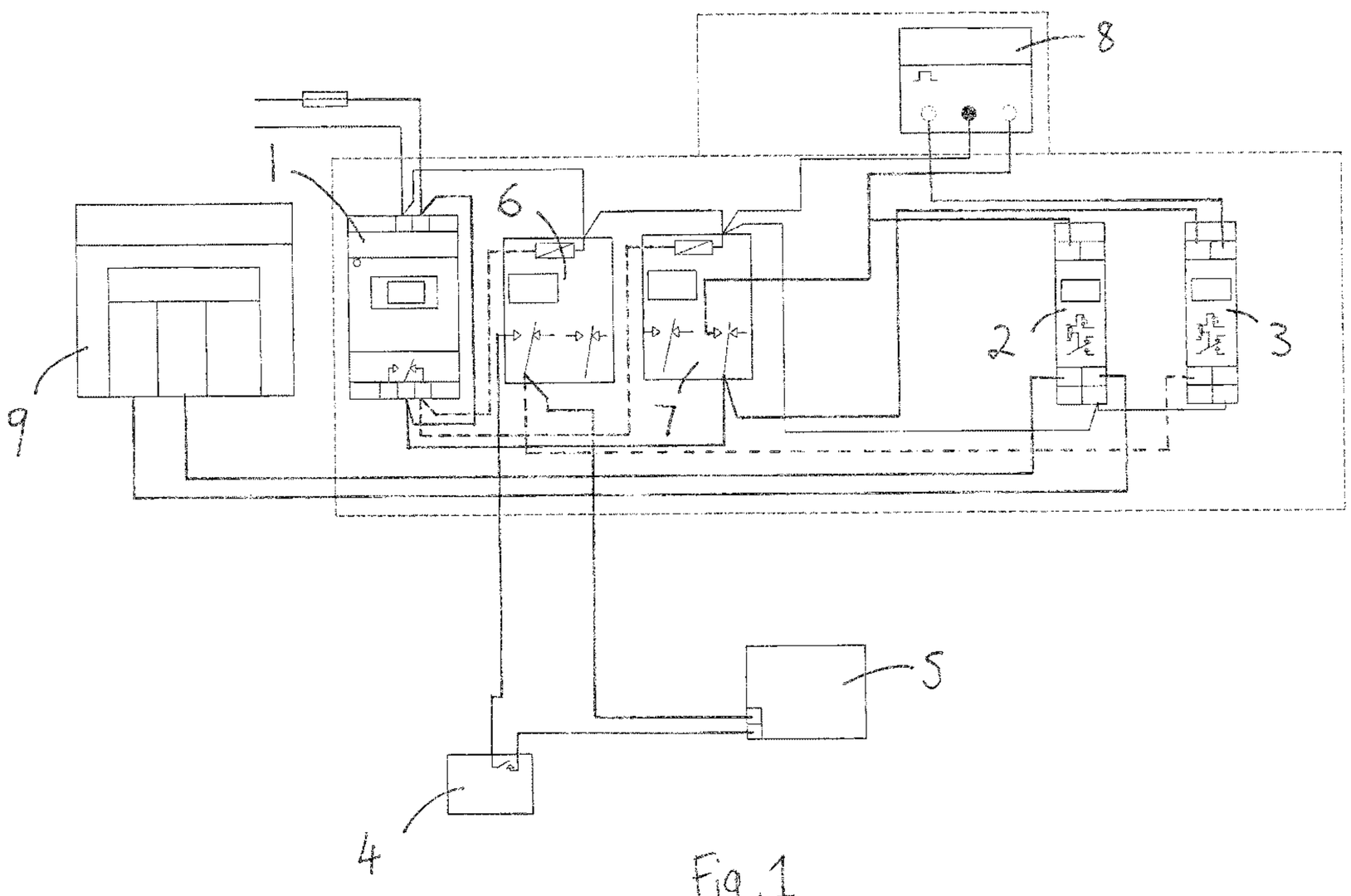

Fig. 1

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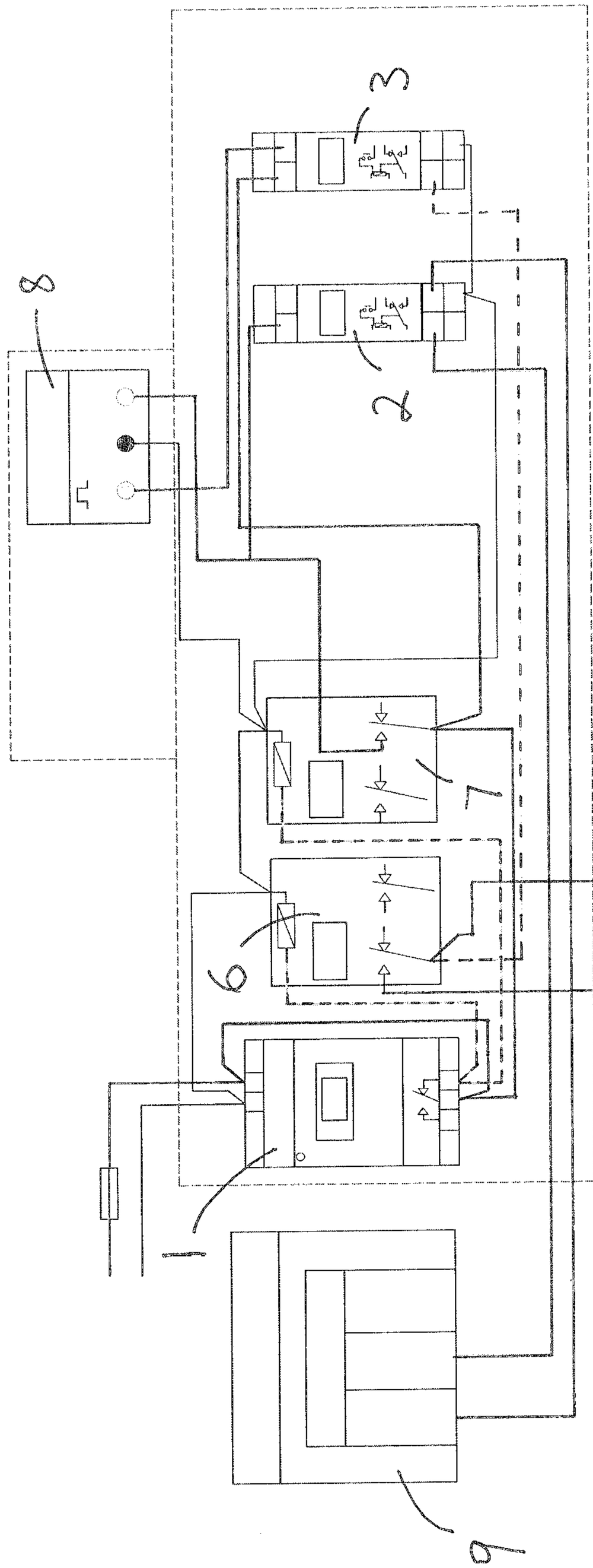

Fig. 1

Intellectual Property Office

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The following terms are registered trade marks and should be read as such wherever they occur in this document:

Victron Energy

Power System

The present disclosure relates to a power system and to a welfare unit or off-grid power supply unit comprising the same.

Welfare units are movable enclosures, typically in the form of self-contained cabins, providing temporary accommodation and welfare facilities, such as basic sanitary and kitchen facilities, to site personnel at work locations, such as building sites or similar, where no other accommodation or welfare facilities may be provided. With recent changes to health and safety legislation, virtually all outside work sites will have to provide temporary accommodation and welfare facilities for site personnel.

Welfare units are commonly powered using generators that are powered by non-renewable energy sources, such as diesel generators. The generators are housed within the welfare units themselves. Such generators, whilst offering a reliable source of power, tend to be noisy and pollute the environment. To limit the runtime of generators it is common to provide one or more batteries for powering devices in the welfare unit, which batteries are charged by the generator and/or by a secondary electricity producing means, such as one or more solar panels. An inverter is provided.

It is common that power systems that comprise the generators and batteries further comprise timers for automatically switching the power systems on/off. Such timers are used, for example to switch off the power systems at night, to save power, and to switch on the power systems in the morning, in advance of the working day, to bring the welfare units into a usable condition for workers on their arrival at the start of the working day, for example, by switching on a heater or water boiler, or similar.

A problem arises in prior art systems, wherein the systems start-up on the timers and the inverters are immediately overloaded by a sudden power draw of a number of electrical devices that are switched on simultaneously. In such a situation

the system goes into shut down and must be reset. This is frustrating and time consuming.

The present invention arose in a bid to provide an improved power system, offering reliable power with a reduced impact on the environment but obviating the problems with the prior art arrangements.

According to the present invention in a first aspect, there is provided a power system as recited by Claim 1.

According to the present invention in a further aspect, there is provided a welfare unit comprising the power system of the first aspect.

Further, preferred, features are presented in the dependent claims.

The present invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows an exemplary layout for a power system according to a first embodiment.

In accordance with a first embodiment there is provided a power system for providing on-demand power to one or more electrical devices. The power system comprises a primary electricity producing means, one or more batteries and a control means, which comprises an inverter. The control means, in a first mode of operation, is configured to switch on the primary electricity producing means upon start-up of the power system and to switch on the inverter only after a first pre-determined period of time from start-up of the power system has elapsed. The primary electricity producing means runs continually during the first predetermined period.

The control means is preferably arranged to switch off the primary electricity producing means after a second pre-determined period of time has elapsed. The second pre-determined period of time runs from the time the inverter is switched on.

The inverter and the primary electricity producing means are both switched on for the duration of the second pre-determined period of time.

More preferably, however, the control means is arranged to maintain the primary electricity producing means running until at least the second pre-determined period of time has elapsed with the control means monitoring the electrical load on the power system and switching off the primary electricity producing means only once the second pre-determined period of time has elapsed and it is determined that the electrical load is below a predetermined threshold level.

The arrangement is such that the primary electricity producing means can provide sufficient power at system start-up. The inverter is not overloaded and does not "fall over" to cause the power system to shut down, as could potentially happen with a heavy load on the power system at start-up.

Start-up of the system may be manual or automatic. It is preferable that the control means comprises a timer for automatically switching on and off the power system. For example, the timer may be set to switch off the power system at night, to save power, and to switch on the power system in the morning, in advance of the working day, to bring a welfare unit or otherwise that comprises the power system into a usable condition for workers on their arrival at the start of the working day, for example, by switching on one or more of a heater, a water boiler, etc.

The first and second predetermined periods are preferably each at least 3 minutes. The first and second predetermined periods may be 5 minutes or more. The first and second predetermined periods may be of the same length or of different lengths.

The power system may find application in numerous situations and environments, particularly where mains power is not available and a reliable source of power is required. In one primary, but non-limiting, example there may be provided a welfare unit, which comprises the power system for providing on demand electrical power to electrical devices within a self-contained cabin of the welfare unit.

In an alternative example, there may be provided an off-grid power supply unit comprising a housing, which comprises a base and a plurality faces, wherein a first of the faces is arranged at an oblique angle to the base and is substantially entirely covered by solar panels, the solar panels comprising a secondary electricity producing means, and the housing containing the power system for controlling the off-grid power supply unit.

The non-limiting example of a welfare unit comprising the power system will be described in greater detail below. The features of the power system described in the context of this example are not to be limited to the example.

The welfare unit may be of any conventional structure and the present invention is not to be limited in this regard. The welfare unit is not specifically depicted. The welfare unit may be used on building sites, or the like, in particular where lavatory facilities are not otherwise available. The welfare unit may comprise a self-contained cabin that is free standing and transportable. It may be formed as a trailer and provided with its own wheels. It may otherwise be arranged to be transported using a flat-bed vehicle. It could, less preferably, be arranged to be permanently located (by the connection to services, such as plumbing). The welfare unit preferably comprises a typical rectangular box shape.

It may be equipped, as will be readily appreciated by those skilled in the art, in accordance with any conventional welfare unit. It may, for example, be provided with one or more toilets and/or showers. It may comprise kitchen facilities. It may be configured as an office or as living accommodation. The present invention is not to be limited to any specific configuration. Numerous conventional layouts and provided facilities will be possible and readily conceived by those skilled in the art. Irrespective of the layout/facilities, the welfare unit will feature at least one electrical device connected to the power circuit for receiving on demand power therefrom. There will most likely be a plurality of connected electrical devices and a plurality of plug sockets. Electrical devices may be hard wired to the electric circuit or connected via plug sockets, and may include, for example, any combination of electric lighting, proximity sensors, a water boiler, an air conditioning unit, a heater,

or otherwise. A sensor may be provided for detecting entry of a user into the cabin. The sensor may automatically activate an electric light within the cabin when a user enters the cabin and deactivate the light when the cabin is vacated. Such an arrangement will further enhance the energy efficiency of the welfare unit.

The one or more batteries and the primary electricity producing means are connected to the electric circuit for providing power to the one or more electrical devices.

The primary electricity producing means may comprise a fossil fuel powered generator, such as a diesel generator. It may alternatively comprise a fuel cell, such as a hydrogen fuel cell. The primary electricity producing means provides a reliable source of power.

There is preferably further provided a secondary electricity producing means, which uses a renewable energy source. The secondary electricity producing means is also connected to the electric circuit for providing power to the one or more electrical devices. The electricity producing means preferably comprises a plurality of solar panels made up of a plurality of photovoltaic cells. The solar panels are preferably located on the roof of the cabin. They could be provided in addition or alternatively on the sides of the cabin, or elsewhere. It is possible that a single solar panel is provided in place of the plurality. It should be noted that whilst the use of one or more solar panels is preferred, the invention is not to be limited as such. The electricity producing means may be arranged to use any alternative renewable energy source. For example, the electricity producing means could comprise a wind turbine connected to a dynamo, or otherwise, as will be appreciated by those skilled in the art.

The one or more batteries are connected to the power system for storing electrical energy generated by the primary electricity generating means and/or the secondary electricity producing means, in order to supply electrical power on demand to devices within the cabin through the power system. In the present arrangement both the primary electricity generating means and the secondary

electricity producing means provide electrical energy to the battery to charge it. Arrangements are, however, possible where only the secondary electricity producing means provides power to charge the battery with the primary electricity producing means providing power to electrical devices directly through the electric circuit only, rather than also via the one or more batteries. There is preferably a battery bank provided that comprises a plurality of batteries. A plurality of batteries may be provided in any conventional array/configuration.

It must be appreciated that arrangements are possible that exclude the secondary electricity producing means, in which case the primary electricity producing means will comprise the only source of electrical power for providing power to the power system (and one or more batteries).

Figure 1 shows an exemplary layout for the power system for the welfare unit. The power system comprises an electrical circuit for providing on demand power to the one or more electrical devices. The power system comprises the control means, which comprises a timer 1, an inverter control 2, a primary electricity producing means (generator) control 3 and a smart controller 4, the primary electricity producing means 5, which is a diesel generator in the depicted arrangement, first and second relays 6, 7, a one shot pulse module 8 and the inverter 9.

The inverter 9 may, for example, comprise a Quattro from Victron Energy, which includes a charger for the one or more batteries (not shown in Figure 1). The inverter 9 may receive inputs from both the primary electricity producing means 4 and the secondary electricity producing means, when present. The smart controller 4 may, for example, comprise a Venus GX from Victron Energy.

Numerous alternative circuit layouts will be readily appreciated by those skilled in the art. The present invention is not to be limited in this regard.

The control means is arranged to monitor the charge level of the one or more batteries for controlling the supply of power from the primary electricity producing

means. In preferred arrangements that comprise both the primary and secondary electricity producing means, the control means may be arranged to switch on the fuel cell automatically when the charge level of the at least one battery has dropped to below a predetermined threshold value. The control means may be arranged to switch on the primary electricity producing means automatically when the charge level of the one or more batteries has dropped to below a predetermined threshold value and real-time power demand from the power system is above a predetermined threshold value.

It must be appreciated that features of the power system described in the context of the non-limiting example of a welfare unit will be applicable to any alternative arrangements, including but not limited to an arrangement that comprises an off-grid power supply unit of the form mentioned above, or otherwise. The specific example is not to be taken as limiting.

Numerous modifications and alterations will be readily appreciated by those skilled in the art, within the scope of the claims that follow.

Claims

1. A power system for providing on demand power to one or more electrical devices, the power system comprising a primary electricity producing means, one or more batteries and a control means, which comprises an inverter, wherein the control means, in a first mode of operation, is configured to switch on the primary electricity producing means upon start-up of the power system and to switch on the inverter only after a first pre-determined period of time from start-up of the power system has elapsed, the primary electricity producing means running continually during the first predetermined period.

2. A power system as claimed in Claim 1, wherein the control means is arranged to switch off the primary electricity producing means after a second pre-determined period of time has elapsed, the second pre-determined period of time running from the time the inverter is switched on, the inverter and the primary electricity producing means both being switched on for the duration of the second pre-determined period of time.

3. A power system as claimed in Claim 1, wherein the control means is arranged to maintain the primary electricity producing means running until at least a second pre-determined period of time has elapsed, the second pre-determined period of time running from the time the inverter is switched on, the inverter and the primary electricity producing means both being switched on for the duration of the second pre-determined period of time, and wherein the control means is arranged to monitor the electrical load on the power system and to switch off the primary electricity producing means once the second pre-determined period of time has elapsed and it is determined that the electrical load is below a predetermined threshold level.

4. A power system as claimed in any preceding claim, wherein the first and second predetermined periods are each at least 3 minutes.

5. A power system as claimed in any preceding claim, wherein the first and second predetermined periods are at least 5 minutes.

6. A power system as claimed in any preceding claim, wherein the control means comprises a timer for automatically switching on the power system.

7. A power system as claimed in any preceding claim, wherein the power system is arranged to charge the one or more batteries using the primary electricity producing means.

8. A power system as claimed in any preceding claim, wherein the primary electricity producing means comprises a fossil fuel powered generator or a fuel cell.

9. A power system as claimed in any preceding claim, wherein the power system further comprises a secondary electricity producing means, which uses a renewable energy source.

10. A power system as claimed in Claim 9, wherein the electricity producing means comprises one or more solar panels made up of a plurality of photovoltaic cells.

11. A power system as claimed in Claim 9 or 10, wherein the power system is arranged to charge the one or more batteries using the secondary electricity producing means.

12. A power system as claimed in any preceding claim further comprising at least one electrical device connected to the power system.

13. A power system as claimed in Claim 12, wherein the power system is arranged such that the primary electricity producing means can provide power directly to the at least one electrical device and can provide power to the at least one electrical device via the one or more batteries.

14. A power system as claimed in any preceding claim, wherein the control means is arranged to monitor the charge level of the one or more batteries for controlling the supply of power from the primary electricity producing means.

15. A power system as claimed in Claim 14, wherein the control means is arranged to switch on the primary electricity producing means automatically when the charge level of the at least one battery has dropped to below a predetermined threshold value.

16. A power system as claimed in Claim 14, wherein the control means is arranged to switch on the primary electricity producing means automatically when the charge level of the one or more batteries has dropped to below a predetermined threshold value and real-time power demand from the power system is above a predetermined threshold value.

17. A welfare unit comprising a self-contained cabin and a power system as claimed in any preceding claim.

18. A welfare unit as claimed in any preceding claim, wherein a sensor is provided for detecting entry of a user into the cabin.

19. A welfare unit as claimed in Claim 18, wherein the sensor automatically activates an electric light within the cabin when a user enters the cabin and deactivates the light when the cabin is vacated.

20. An off-grid power supply unit comprising the power system as claimed in Claim 9 or any claim dependent thereon, the off-grid power supply unit comprising a housing, which comprises a base and a plurality faces, wherein a first of the faces is arranged at an oblique angle to the base and is substantially entirely covered by solar panels, which comprise the secondary electricity producing means, and the housing containing the power system.

Intellectual Property Office

Application No:	GB1903117.8	**Examiner:**	Jonathan Huws
Claims searched:	1-20	**Date of search:**	3 September 2019

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-20	US2010/0045107 A1 COHEN et al See figure 2A, abstract, paragraphs 19 and 20
X	1-20	WO2012/033254 A1 SAMSUNG SDI CO LTD See figure 1, abstract, paragraphs 28-50
X	1-20	EP0667666 A1 PHILIPS ELECTRONICS NV See figures, abstract, column 4 line 31-column 5 line 55
X	1-20	GB2493631 A BAE SYS CONTROLS INC See figures 1 and 2, abstract, paragraphs 10-23
X	1-20	EP3226373 A1 KYOCERA CORP See figure 1, abstract, paragraphs 15-29

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

H02H; H02J; H02M

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

Intellectual Property Office

International Classification:

Subclass	Subgroup	Valid From
H02J	0007/34	01/01/2006
H02H	0009/00	01/01/2006