(12) UK Patent Application (19) GB (11) 2503944 (13) A

(43) Date of A Publication 15.01.2014

(21) Application No: 1212559.7

(22) Date of Filing: 13.07.2012

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(51) INT CL:
G05D 3/10 (2006.01) ***F24J 2/40*** (2006.01)
F24J 2/54 (2006.01)

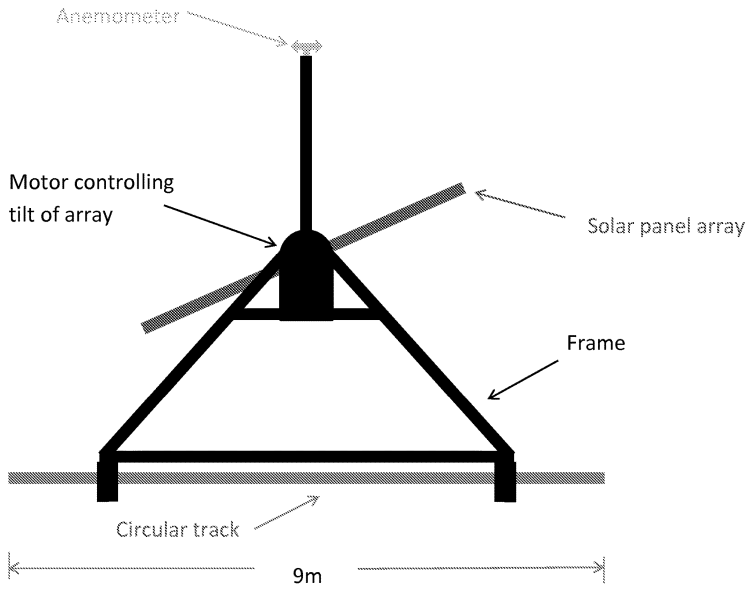
(56) Documents Cited:
WO 2011/043757 A1 **ES 002301430 A1**
US 4209231 A **US 4129360 A**
US 20030151505 A1

(58) Field of Search:
INT CL **F24J, G05D**
Other: **EPODOC; WPI.**

(54) Title of the Invention: **The SUNPhlOWER mobile solar panel array**
Abstract Title: **A sun Tracking Solar Panel Array**

(57) A solar panel array comprising a chassis which can turn on a circular track (ground or flat roof mounted) which itself supports a tilting frame holding solar panels. Light sensors and an anemometer provide information, via a control unit, to two electric motors which twist and tilt the frames so that the panels point at the brightest part of the sky, and to a safe position in high winds or snow. The control system is capable of moving the panel, at night, to face east in preparation for the next dawn.

View facing tilt control motor with array at an angle



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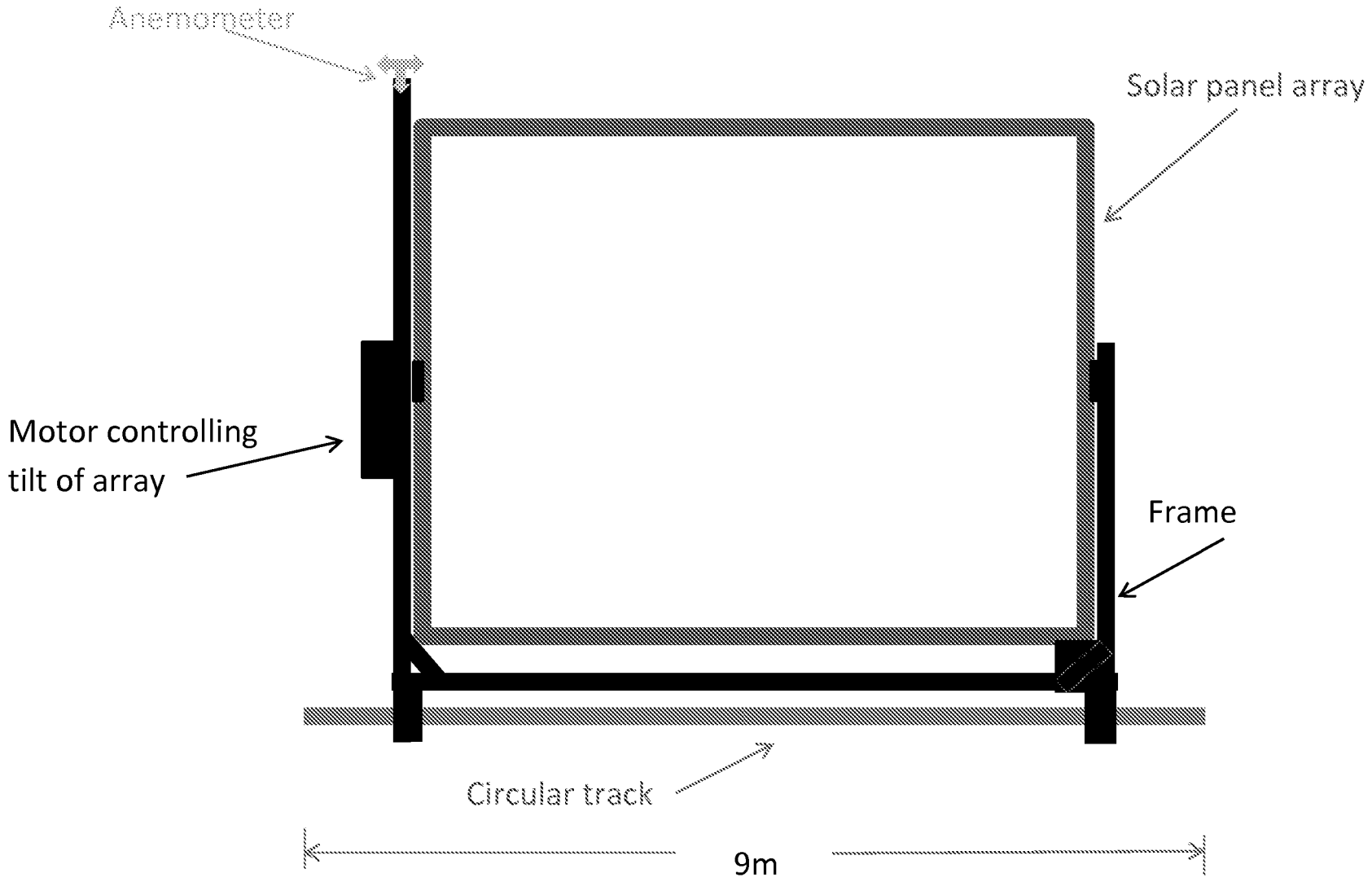
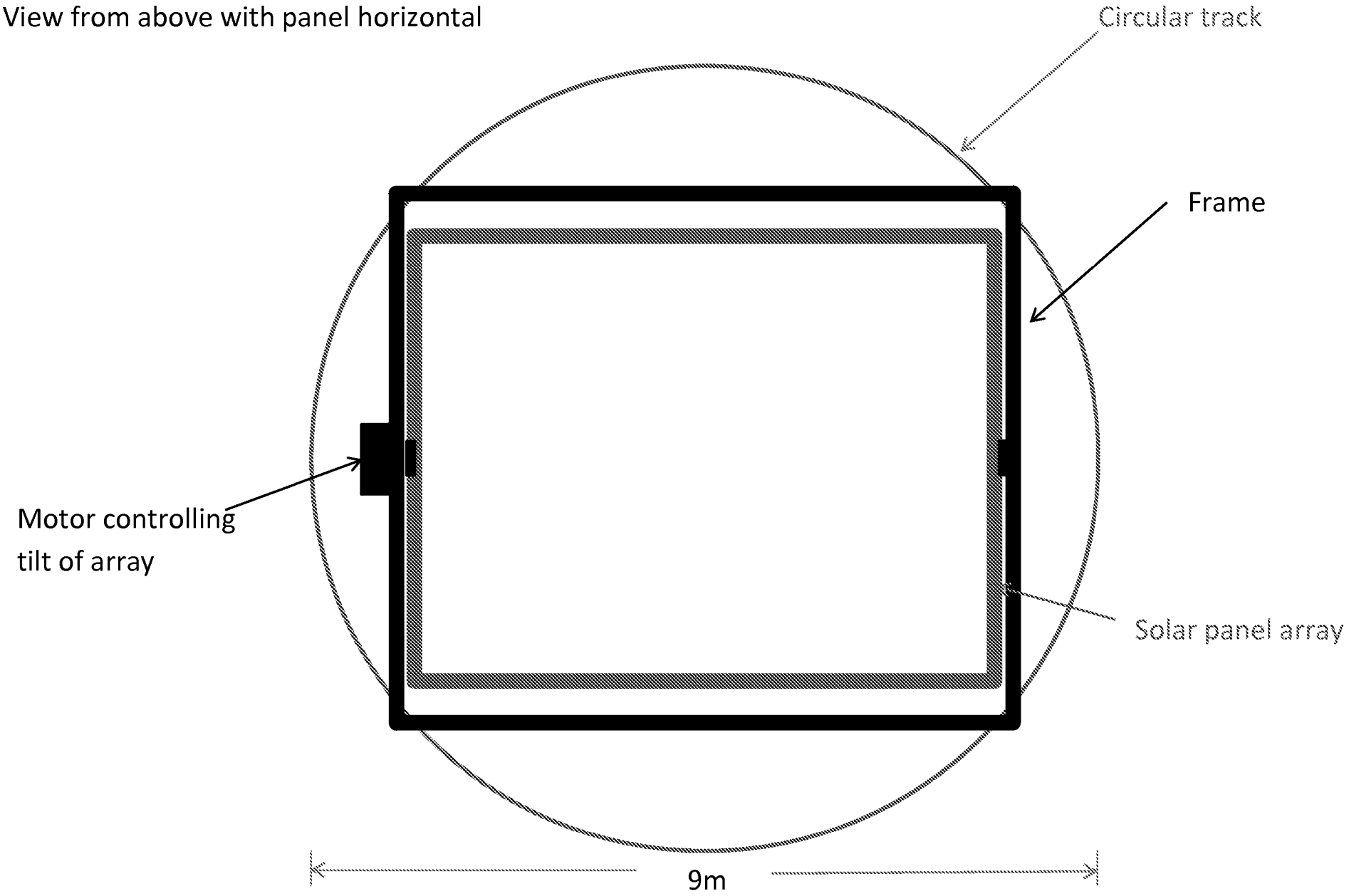
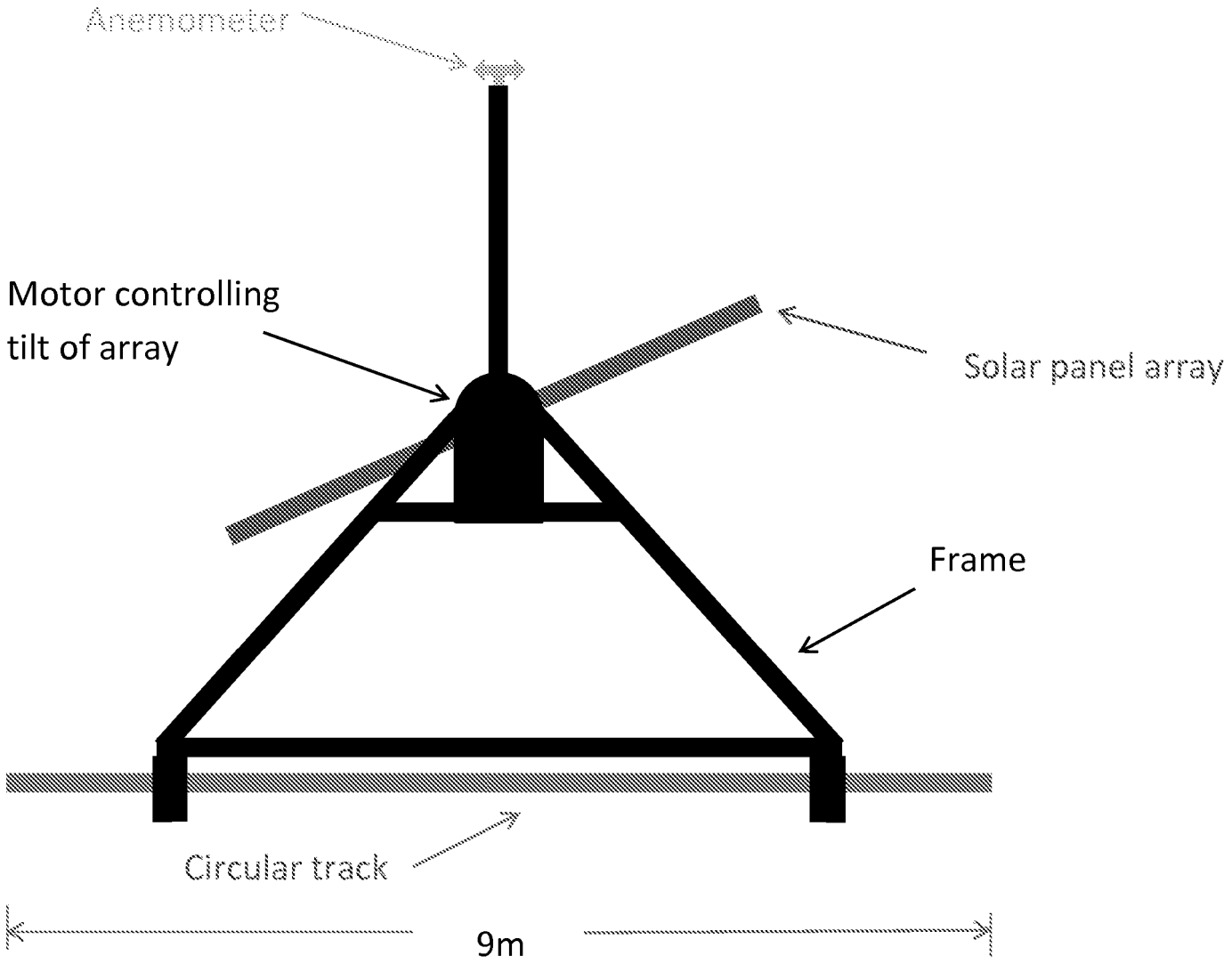
View facing vertical solar panel array



View from above with panel horizontal



View facing tilt control motor with array at an angle



The SUNPhlOWER Mobile Solar Panel Array

Introduction:

Solar panels generating electricity for export to the grid, and for domestic use, can be seen throughout Britain. They are on flat roofs, pitched roofs, and on stands in open spaces.

The best direction in which to point a fixed solar panel array to generate the greatest electrical energy in Britain is a south facing array tilted at between 35 and 40 degrees from the horizontal. This compromise position maximises electrical energy generation (a function of power and time) during the daylight hours of the year. However, it is only at midday in late March and late September that even this configuration will actually be pointed directly at the sun, required to generate maximum power. Every day it will be pointed too far to the left or right of the sun for maximum power, except at midday. In winter it will be too horizontal, and in summer too vertical to be pointed at the sun for maximum power. In late June it will be in shadow for the first two and a half hours after dawn, and the last two and a half hours before sunset. The commonest size of domestic solar panel array is less than 27 square metres in area, capable of producing a maximum of four kilowatts, if lucky enough to be pointing directly at the sun when the sun is shining in a clear sky. When the sun is shining, but the panels are in shadow, the panels can generate less than 100 watts.

When the sky is cloudy, light arrives from the sky from all direction, but very little is reflected off the ground, so it is likely that the maximum power in cloudy conditions will be generated by solar panels facing vertically upwards. Even in the south of England, the sun does not shine for more than about 1200 hours of the 4380 hours the sun is above the horizon each year. Therefore, for 70% of daylight hours, more electricity will be generated by a solar panel facing vertically upwards than one on a pitched roof.

The description of my invention which follows is for a four kilowatt mobile solar panel array, capable of generating near maximum power for the weather conditions, throughout the hours of daylight, thereby generating considerably more electrical energy than a fixed array. The device could be scaled up for larger arrays.

Concept:

A solar panel array that can always point at the sun when shining, or at the brightest part of the sky when it is cloudy, will generate more electrical energy, almost all day, almost every day, than a fixed array, without ever exceeding a certain power level determined by the size of the array.

Previous inventions:

The concept of a mobile array has been considered before, using an equatorially mounted system similar to that used by astronomical telescopes, so that by gradually rotating once every 24 hours on a fixed axis parallel to the axis between the north and south poles of the earth, it can remain pointed at a fixed point in the sky during the day and night. Because the sun appears to change its position throughout the year, over the equator at midday in March and September, and over the tropics of Cancer and Capricorn in June and December respectively, another mechanism is then required to tilt the array at right angles to that fixed “polar” axis, either gradually or episodically, throughout the

year, to take account of the height of the sun above the horizon with the varying seasons. An equatorially mounted solar array will always point to where the sun is, but clouds may mean that that direction is not necessarily the brightest part of the sky, nor can it take account of severe weather conditions which might risk the integrity of the device and the safety of others.

Description:

My invention is an array which can tilt and rotate automatically, so that at all times during the day, when it is safe to do so, it is pointing at the brightest part of the sky. When the sun is shining, it will be pointing directly at the sun. When the sun sets, it will rotate to face east to be ready for the next dawn. When the wind is too strong for it to be pointed towards the brightest part of the sky, or face east at night ready for the next dawn, it will tilt to a horizontal position to minimise the risk of damage to the structure or danger to others. It will revert to the default position of facing east at night, or the brightest part of the sky when light, when the strong wind has abated. If covered with snow during the day it would automatically tilt to the vertical, believing it to be night time, tipping the snow off.

Three schematic drawings show the device viewed from directly above, face on to a vertically tilted frame carrying the solar panels, and end on to the tilted frame carrying the solar panels.

The chassis is mounted on a circular monorail track which is about 9 metres in diameter. The track is just above ground level supported by struts attached horizontally to the inside of the track. The track allows wheels to run on the upper and lower edges. It can be sited on fairly level ground on a concrete ring sunk into the ground, or on the fairly flat roof of a building. A four kilowatt array of sixteen, 1 metre by 1.6 metres, 250 watt panels is mounted on a flat frame about four metres high and 6.4 metres wide. The frame is arranged such that it can tilt on a horizontal axis through the middle of the frame. A geared 12 volt motor attached to the chassis, under automatic control, tilts the frame to the position determined by the control unit. The chassis holding the horizontal axle consists of two vertical triangular constructs, one on each side of the horizontal axis of the frame. One of these constructs carries the geared motor controlling the tilt of the frame. It also carries, at a level above the top of a vertically tilted frame, an anemometer. The two triangular constructs are linked together at the bottom with two horizontal struts, thus forming an oblong. This oblong is mounted on the circular track at its corners, with wheels above and below the track in a similar way to the attachment of a roller-coaster to its track, so that it cannot lift off, and is therefore able to withstand reasonable cross winds. A geared 12 volt motor is attached to one of the wheels so that the chassis can be rotated on the circular track to a position determined by the control unit.

The 12 volt supply to the movement motors comes from a 12 volt “car” battery, which is charged during daylight hours by a trickle charger attached to the inverter supplying the grid with 240 volts at 50 Hz. This battery could also be used to power an electric fence if it is necessary to keep farm animals or pets away from an array mounted on open ground.

Two small directional light receptor units are mounted at right angles to each other on the frame for the solar panels, one mounted to determine the inclination of the brightest part of the sky, and one the horizontal direction of the brightest part of the sky.

A small unit controls the two 12 volt motors with input from the two light receptors monitoring the direction of the brightest part of the sky, the anemometer, and information about the output from the inverter, so that it knows when it is too dark to export power to the 240 volt grid, and too windy to be other than horizontal.

Electrical connections for the power generated by the panels are similar to those for a fixed array, currently used for domestic installations.

It will be of particular interest to those in rural areas. It is rather more likely that a flat area of ground without significant shading from surrounding structures can be found to site the SUNPhlOWER. It is somewhat less likely to upset the local planning office in rural areas. Agricultural buildings with low pitched roofs could be used for the SUNPhlOWER. While the Feed in Tariff is set at reduced rates for larger arrays, in general it is more cost effective and therefore more profitable if the array is close to the maximum size for a particular band of tariff. However, the very properties with land around them suitable for a SUNPhlOWER are also those most likely to be served by a small substation, incapable of accepting to the grid more than a limited wattage. I was limited to system with a maximum output of four kilowatts for this very reason.

The significant increase in electricity generation with this device will more than offset the cost of the system, maximizing income from the Feed in Tariff, and contribute greatly to the efforts of the government to realise its goal of increasing the proportion of sustainable electricity generation. It could become the standard system to replace fixed arrays on the ground, or on flat roofs. As it will usually be ground or flat roof mounted, it will be less difficult for do-it-yourself enthusiasts to contribute significantly to the installation, thereby reducing the capital outlay involved.

The SUNPhlOWER Mobile Solar Panel Array

Claims:

The chassis of the array is mounted on a circular track.

The circular track can be mounted on open ground or a fairly flat roof.

The chassis is mounted on wheels which grip the circular track both above and below the track.

The chassis supports a flat frame covered in solar panels which can be tilted around a horizontal axis.

The array has two sensors at right angles to each other on the tilting frame supporting the solar panels, which determine the horizontal direction and inclination of the brightest part of the sky.

The array is fitted with an anemometer.

A control unit monitors information from the anemometer, the light sensors, and the power output of the solar panels.

The control unit regulates the motors turning the chassis of the array on the circular track, and tilting the frame holding the solar panels.

The array automatically points towards the brightest part of the sky, by rotating on the circular track, and tilting, when the wind is not too strong, and there is enough light to generate sufficient electricity.

A 12 volt battery is recharged daily during daylight hours automatically by a trickle charger.

The motors which adjust the position of the array are powered by a 12 volt battery.

In strong winds (measured by an anemometer) the array automatically tilts to a horizontal position to reduce windage, thereby preventing damage.

When there is insufficient light to generate electricity for export to the national grid, the array tilts to a vertical position when the wind is not too strong, and turns to face east ready for the next dawn.

When the wind speed drops from a dangerous speed, the array automatically resumes the ideal position for electricity generation, or adopts the default night time position.

The array automatically maximises power output to the grid by pointing towards the brightest part of the sky.

I addition to powering the motors, the battery can power a standard electric fence to keep animals away from the array.

Application No:	GB1212559.7	**Examiner:**	Mr Tyrone Moore
Claims searched:	all	**Date of search:**	30 October 2012

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	claims	WO 2011/43757 A1 (KOZICKI JOSEPH) see whole document particularly pages 16 and 17.
X	claims	US 4209231 A (SAYRE ROBERT K) see whole document particularly figure 1.
X	claims	US 4129360 A (DEFLANDRE JEAN et al.) see whole document particularly figure 1 and column 2 at lines 3-5.
X	claims	US 2003/151505 A1 (HAYDEN HERBERT T) see whole document particularly figure 2. An example of when a sensor loop controls the movement of solar collectors into wind stow positions when high wind conditions occur.
X	claims	ES 2301430 A1 (SAIMA TALDEA S L) See EPODOC and WPI abstracts and figures.

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

F24J; G05D

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

EPODOC; WPI.

International Classification:

Subclass	Subgroup	Valid From
G05D	0003/10	01/01/2006
F24J	0002/40	01/01/2006
F24J	0002/54	01/01/2006