(12) UK Patent Application (19) GB (11) 2488198 (13) A

(43) Date of A Publication 22.08.2012

(21) Application No: 1201119.3

(22) Date of Filing: 23.01.2012

(30) Priority Data:

(31) 1102649	(32) 15.02.2011	(33) GB
(31) 1105709	(32) 04.04.2011	(33) GB
(31) 1113423	(32) 03.08.2011	(33) GB
(31) 1117755	(32) 13.10.2011	(33) GB
(31) 1122507	(32) 29.12.2011	(33) GB

(51) INT CL:
C02F 3/20 (2006.01) *F04F 99/00* (2009.01)

(56) Documents Cited:

GB 2472679 A	GB 2456333 A
GB 2366526 A	WO 1987/001690 A1
JP 560065987 A	JP 2008072922 A
JP 2004183637 A	JP 2003155971 A
JP 2000308897 A	US 4767938 A
US 4084375 A	
KR 20020079292 A	

(58) Field of Search:
INT CL **C02F, F03B**
Other: **WPI, EPODOC**

(71) Applicant(s):
Harold Birkett
182 Alfred Street, BURY, Lancs, BL9 9EG, United Kingdom

(72) Inventor(s):
Harold Birkett

(74) Agent and/or Address for Service:
Harold Birkett
182 Alfred Street, BURY, Lancs, BL9 9EG, United Kingdom

(54) Title of the Invention: **CO^2 removal with gas and electric generation**
Abstract Title: **Oceanic pump for removal of carbon dioxide from the atmosphere**

(57) An oceanic biological pumping unit accelerates the photosynthesis in picophytoplankton and other microorganisms and thereby increases the amount of carbon dioxide absorbed into the sea. The unit also comprises electrolysis means which can separate seawater into hydrogen, oxygen and chlorine and smaller quantities of other gases. Gas bubbles produced by electrolysis can be injected into a flexible pipe 9 to induce an upward flow. One or more electric power generators 8 are preferably installed along the flexible pipe to extract energy from the upward flow. The flexible pipe may increase in diameter going upwards and may branch into several pipes to release aerated water and bacteria over a wider area. The unit may be operated in inland waterways by adding brine to the electrolysis unit. The brine can be added by a remotely operated control system. A mesh filter may be placed around the unit to protect against the ingress of unwanted debris.

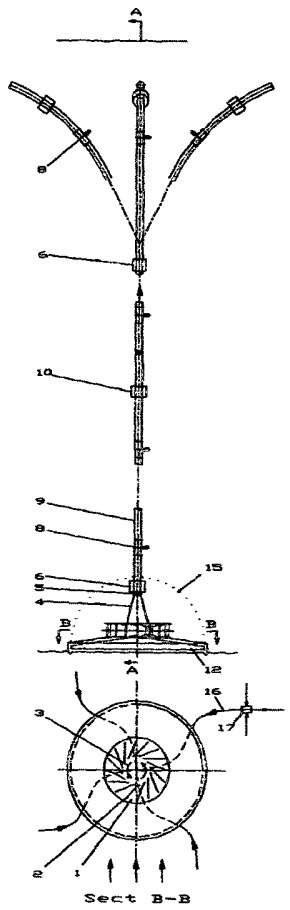


Figure 1

GB 2488198 A

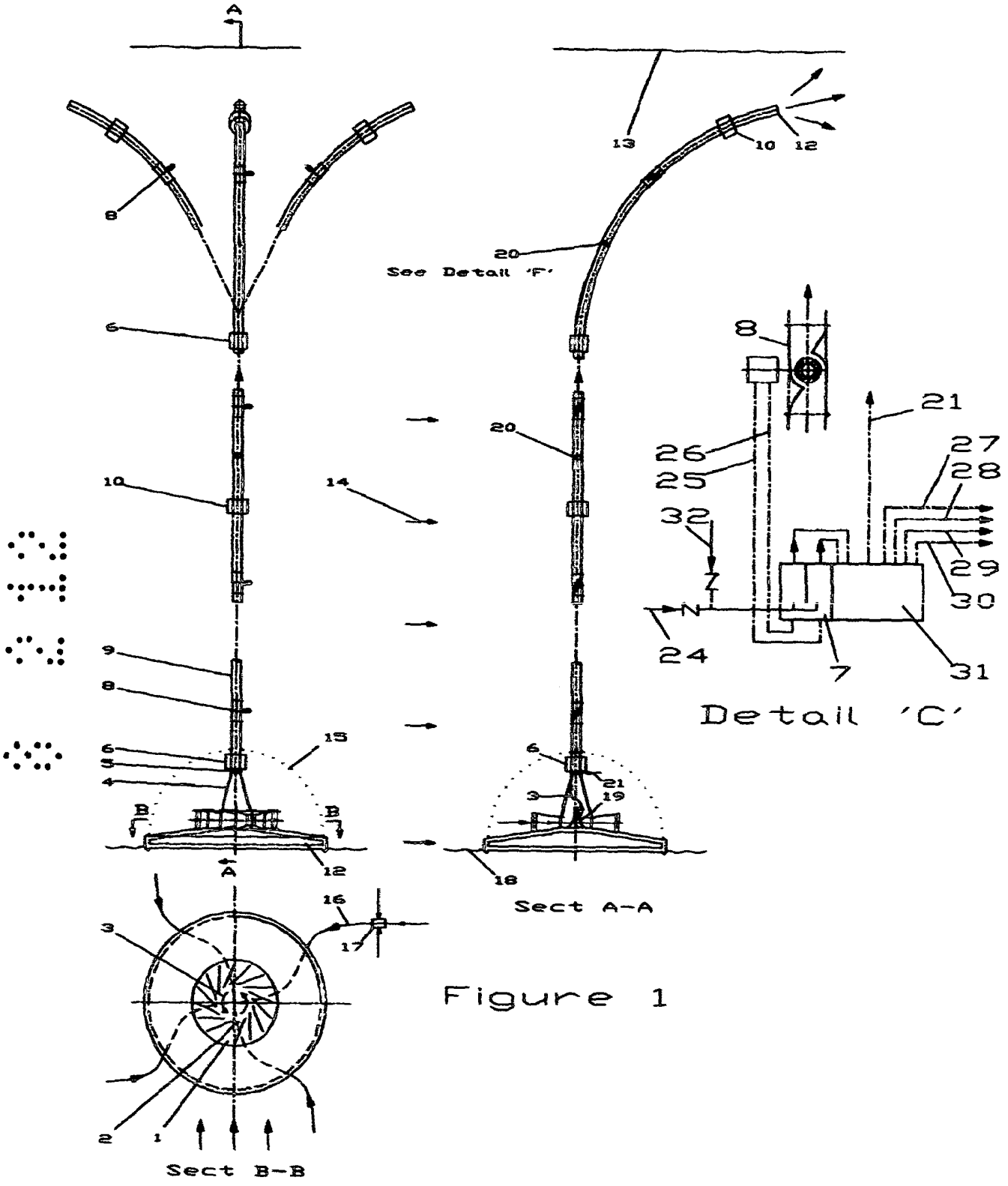
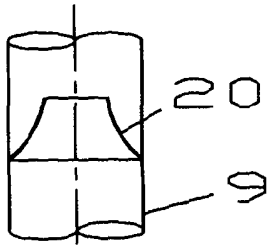
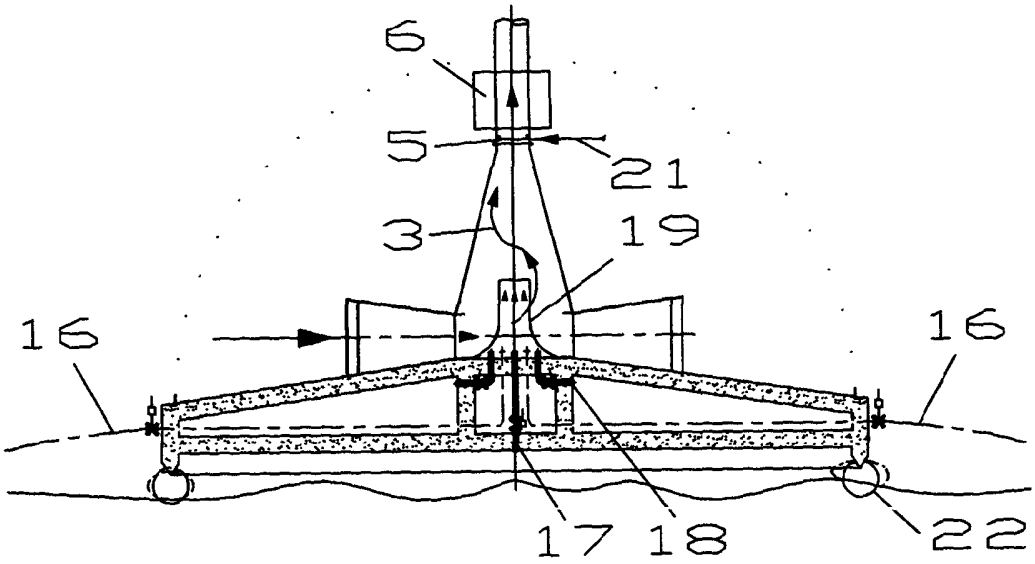

A
8
6
10
14
9
8
6
5
4
15
B
B
A
12
16
17
3
2
1
Sect B-B
13
10
12
20
See Detail 'F'
20
6
21
3
19
18
Sect A-A
8
21
26
25
27
28
32
29
30
N
24
7
31
Detail 'C'

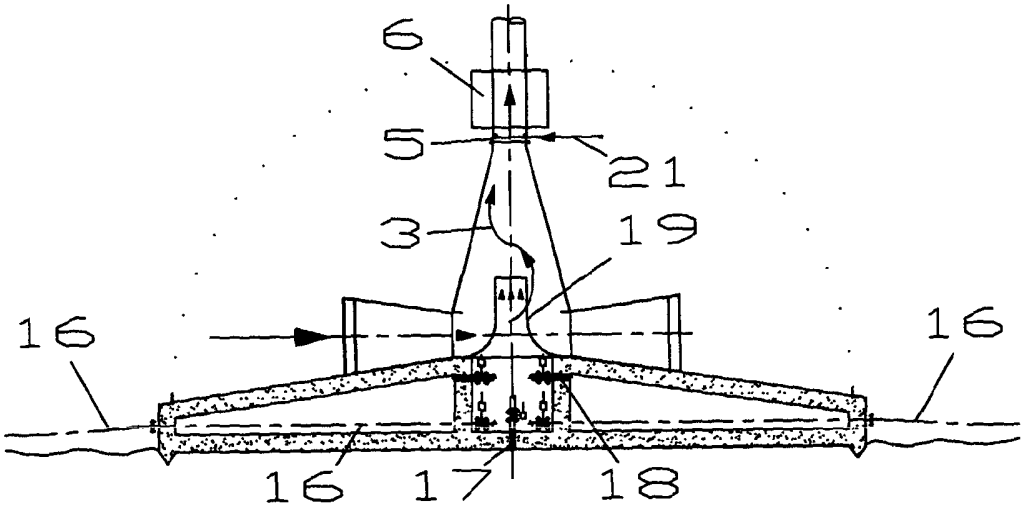
Figure 1



Detail 'F'



Detail 'E'



Detail 'D'

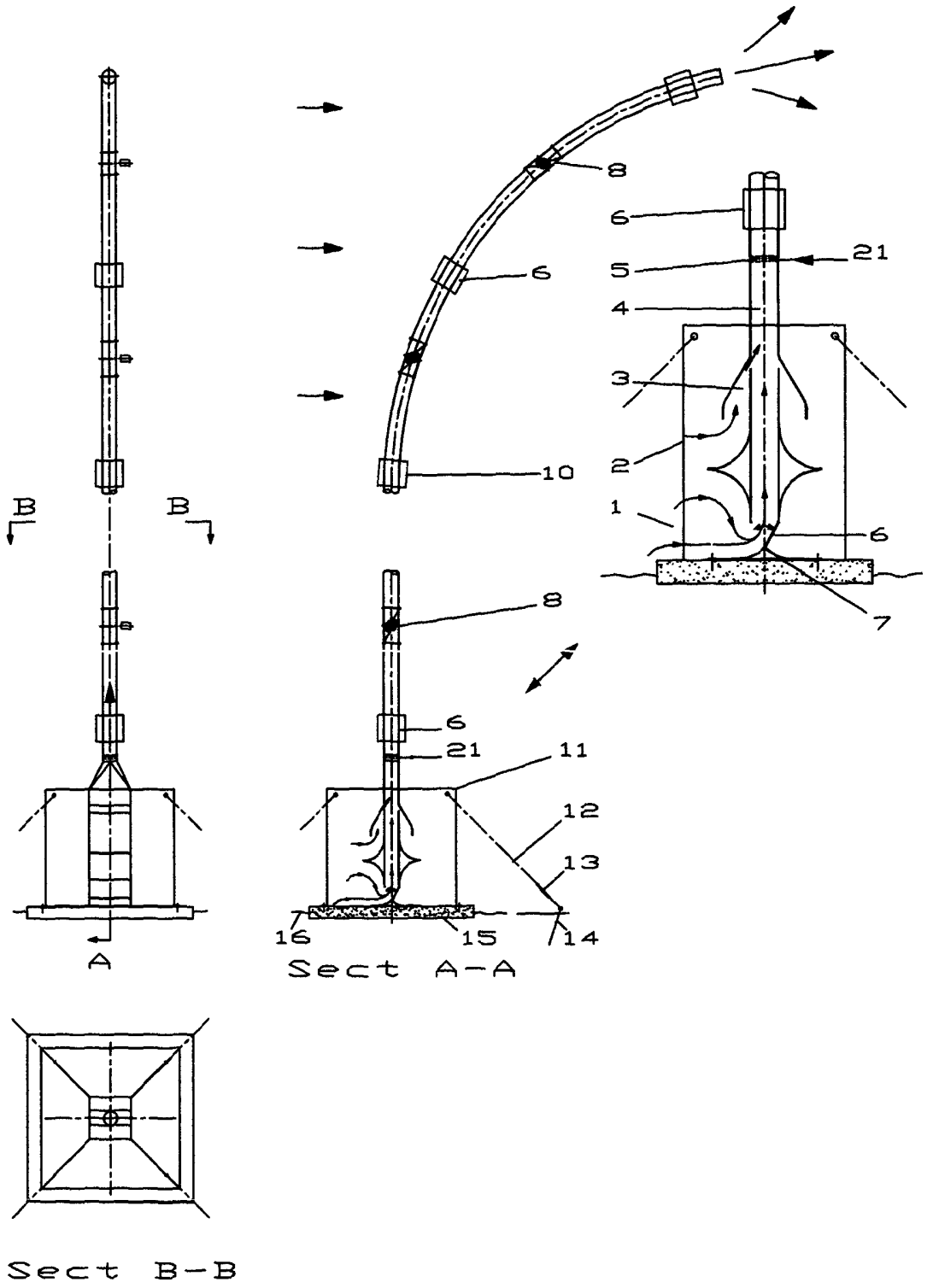


Figure 2

CO_2 removal with gas and electric generation.

This invention relates to an eco-friendly unit which acts as an oceanic biological pump which accelerates and increases the biological process of photosynthesis on picophytoplankton and other micro-organisms which converts carbonic gas CO_2 into carbohydrates by chemical process and which releases oxygen into the sea which results in an increasing amount of carbon-dioxide absorbed into the surface of the sea and also the amount of oxygen combined with cloud forming water put back into the atmosphere the chemical process will also increase the fish stock together with other marine life which feed on the resulting increased quantity of plankton in the marine food chain all of which would improve the environment in the sea and on the land.
The unit described uses the propelling force of an upwards stream of expanding gas bubbles created by electrolysis means whilst the direct electric current required for its operation is supplied from at least one of the state of the art eco-friendly water powered direct current electric generator means to the electrolysis unit which separates the sea water into its component parts of hydrogen, oxygen, and chlorine together with smaller quantities of other gases whilst using only oxygen and those gasses which are bacteria and plankton friendly for the process described above which are injected into and mixed with the upwards stream of the bacteria carrying tidal current which flows from the bottom of the ocean into the unit then into the bottom of a flexible pipe and is propelled upwards by a combination of forces derived from the tidal energy and the rising stream of bubbles of gas contained in the homogeneous mixture which expands as it rises due to the decreasing ambient pressure together with the resulting decreasing specific gravity and increasing pressure and velocity of the homogeneous mixture as it ascends which creates a chimney like effect through the flexible pressurised pipe and water powered generators with the mixture being expelled at an optimum depth beneath the surface of the sea where the bacteria and remaining propellant gas in the mixture feeds the plankton and other organisms which increases the biological process as previously described. The measured quantity of bacteria and plankton friendly gasses injected and mixed into the sea water and bacteria mixture at the bottom of the flexible pipe, will be proportionate to and govern the volume, velocity and pressure of the mixture as it travels upwards when either the diameter of the flexible pipe will have to be increased and reinforced to accommodate these increases or the stream divided up into a number of other pipes in a tree like manner which will also distribute the mixture over a wider area. The required number of eco-friendly state of the art water powered direct current electric generator means together with buoyancy/ballast, dynamic non-return control and homogeneous mixing means number as required are empirically spaced and installed along the flexible pipes
Due to the converging tidal inlets of the unit on the sea bed being positioned in a circle around its central axis will result in the accelerated flow of water into the unit being in a spiral upwards direction inside the unit which will create a negative pressure zone around the central area which if sufficient in suction power could be used to suck in additional sea water containing bacteria through an optimum number of root like flexible pipes extending outwards along the sea bed if this is desirable, required or practical.

The circular tidal inlets configuration of the unit has the advantage of making its orientation relative to the directions of the tidal currents irrelevant when the unit assembly is lowered into position from a ship.
Due to the increase in pressure head with depth (approx.440lbs/squ.inch per 1000 feet) may require dependent upon the depth a state of the art high pressure electrolysis separation unit together with a secondary unit in which each compressed gas of hydrogen, oxygen, chlorine and small quantities of other gasses are separated, their quantities measured, then piped away as required to their destination. Dependent upon size the electrolysis and gas separation and metering unit may be integrated into the main pumping unit when required.
It may be that the production of compressed gasses such as hydrogen is required with multiple units on the sea bed creating a forest like array of tree like structures which would also create a much larger environmentally friendly area.

In order that the unit operates in an inland fresh water or sea environment a brine feed line is added to provide the required salt which is controlled by a remote operated control system between the brine feed line and the electrolysis unit which monitors and controls the level of salt for optimum operation of the electrolysis unit for this and all other requirements.

Due to there being a drop in pressure as the tide, oxygen and bacteria mixture are ejected under pressure from the flexible pipe beneath the surface of the sea which is at a reduced ambient pressure and temperature means that the temperature will be reduced in accordance with 'Charles Law' which means that a self operating system would be created whereby the tide and bacteria taken from the sea bed and injected oxygen would be conveyed to near the surface where due to the sea being cold it will sink again to the bed of the ocean as previously described. It would require groups of units to be distributed over the sea bed in order that a sufficient area of the sea is cold enough to capture a sufficient quantity of carbon dioxide. A single flexible pipe per unit would suffice for distributing the contents of each pipe into the sea if groups of units are installed.

Each unit would be fitted with required off-site manufactured items on board the vessel above prior to the unit being lowered to required location.

Protection against damage caused by corrosion, weather or static electricity may be by means of sacrificial anodes, flexibility, state of the art materials and means to earth any electrical charges, respectively, also an open mesh electrical charged metal filter assembly around the unit may be required which would be tidal self cleaning and whose mesh protects against the ingress of unwanted debris which would keep the system eco-friendly.

It should be noted that all drawings are diagrammatic only and are not to scale together with the various profiles and are for descriptive purposes only.

All control valves will be radio controlled together with their required electric supply and components.

The concept of using the expanding compressed gas bubbles contained within a homogeneous mixture can also be used to assist the transfer of other liquids or slurries from the ocean bed to the surface above or other destination. The specific embodiments of the invention will now be described by way of examples with reference to accompanying drawings in which:-

Figure 1 shows a circular shaped tidal powered biological pumping unit with multiple converging inlets 1, equi-spaced in a circle around the centre of the unit which is attached to a reinforced concrete base 12, which sits on the sea bed 18, which is able to cater for the tidal flow of the sea 14, in any lateral direction with converging inlet vanes 2, profiled to accelerate the flow of water through each inlet and also act as dynamic non-return means to the cyclonic flow of water 3, created inside the central area with the current also travelling in an upwards spiral direction through conical profiled ducting 4, and top outlet through state of the arts eco friendly gas injection unit 5, and liquid/gas mixing units 6, (as required),and electric power generators 8, at least one of which supplies the direct electric current required, for the electrolysis separation of the sea water inside the electrolysis separation and gas separation assembly 7, which separates the hydrogen, oxygen, chlorine and other gasses in less amounts from the sea water and piped into state of the art gas separation and metering means 31, from which measured quantities of the gas or gasses which are bacteria/plankton friendly and best suited are separated and piped to injector means 5, which is located at a suitable lower position in the upwards flow of sea water and bacteria mixture which travels through flexible pipes 9, where the bubbles of compressed gasses expand inside the homogeneous mixture as it flows upwards through and drives an empiric number of electric generators 8, and finally through outlets 12, which are located and supported at an optimum depth by controlled buoyancy/ballast means 10, where the bacteria and plankton friendly gasses feed the plankton at the required depth beneath the surface of the sea 13.
The other compressed gasses from gas separation and metering unit 31, are each piped away to their required destination possibly along the sea bed together with insulated cables carrying electric power from the generators when required . The tidal flow 14, into the unit will be through a mesh 15, shown with a spherical profile but can be conical or other shape to suit supported by a structure (not shown), with mesh openings of such a size to suit requirements as previously described.
The cyclonic current of water 3, into the assembly will create a zone of reduced pressure in the central area which if sufficient in suction power, is practical and desirable can be used to suck in more bacteria carrying sea water through root like flexible pipes 16, resting on the ocean bed 18, which are fitted with flap type non-return valves 17, through which the sea water carrying bacteria will flow .

Detail 'C' shows an outline diagram of a state of the art as required electrolysis separation of sea water unit 7, with positive 25, and negative 26,

currents from water powered electric generator(s) 8, passing into assembly 7, with the electrolysis separation producing oxygen, hydrogen and chlorine and other gasses in small quantities from the sea water and bacteria 24, which then flows into the gas separation and metering means unit 31, from which a measured quantity of bacteria and plankton friendly gasses 21, are used as a propellant gas whilst the remaining gasses are piped away separately through pipes 27, 28, 29 and 30, to their required destination. Brine is added when required to achieve an optimum mixture by means of a remote operated control system.
The size, capacity and location of the electrolysis unit(s) 7, and separator/metering unit(s) 31,will be of course dependent upon requirements. .

Detail 'D' shows a section through reinforced concrete base with central nozzle 19, attached to the base of the unit and profiled to maximise the suction created by the cyclonic and upwards flow of water 3, to the unit outlet.
If the suction is of sufficient strength then it may be used if required to create suction over the bottom area of the concrete base 12, via at least one pipe 17, fitted with radio controlled inlet valve and may also be used to suck in further bacteria carrying sea water through flexible pipes 16, which are spread out on the sea bed with inlets through flap type non-return valves 17, ballast and buoyancy control through required number of lines 18, via radio controlled valves, bacteria and plankton friendly gas through lines 21, into state of the art injector means 5, and mixing means 6.

Detail 'E' shows a section through a different arrangement which is one of several arrangements which may be used but which also has continuous, flexible, porous tube(s) containing a grouting paste 22, attached as required to the concrete base so that where the paste is displaced due to the pressures exerted when on an uneven sea-bed together with the grout being squeezed out through the porous walls will thus improve support on the sea bed when the grout solidifies.

Detail 'F' shows dynamic flow controllers 20, which are installed as required inside the flexible pipe 9, and used to restrict the back pressure and flow back down the pipe.

Figure 2, shows a unit of a different configuration with tidal inlets which are require to be orientated at right angles to the tidal currents which is shown flowing from left to right then dividing into two streams with stream 1, flowing into the bottom inlet via flap valve 6, which pivots about 7, up through ducting 4, and flexible tube 9, whilst stream 2, flows through 3, and is ejected at an increased velocity into the upwards flow. All other processes are as previously described for Figure 1.
The unit is supported on a concrete base 15, located on the sea bed 16, and is laterally supported as required by high tensile ties 12,, with adjustment means 13, attached to unit body 11, and to anchor points 14, fixed into the sea bed.16.
When the tide changes direction and flows from right to left then the flap valve 6, rotates to the left about pivot 7, and the process described above is repeated.

Claims

1. An eco-friendly unit which acts as an oceanic biological pump which accelerates and increases the biological process of photosynthesis on picophytoplankton and other micro-organisms which converts carbonic gas CO_2 into carbohydrates by the chemical process of $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ which releases oxygen (O_2) into the sea resulting in an increasing amounts of carbon-dioxide absorbed into the surface of the sea and also the amount of oxygen combined with cloud forming water put back into the atmosphere which will increase the rainfall increases fish stock together with other marine life which feed on the plankton in the marine food chain all of which would improve the environment in the sea and on the land.

2. A unit according to claim 1, where the unit described uses the propelling force of an upwards stream of expanding gas bubbles created by electrolysis means whilst the direct electric current required for its operation is supplied from at least one of the state of the art eco-friendly water powered direct current electric generator means to the electrolysis unit which separates the sea water into its component parts of hydrogen, oxygen, and chlorine together with smaller quantities of other gases whilst using only those gasses which are bacteria and plankton friendly for the process described above are injected into and mixed with the upwards stream of the bacteria carrying tidal current which flows from the bottom of the ocean into the unit then into the bottom of a flexible pipe and is propelled upwards.

3. A unit according to claim 1, and 2, where by a combination of forces derived from the tidal energy and the rising stream of bubbles of gas contained in the homogeneous mixture which expands as it rises due to the decreasing ambient pressure together with the resulting decreasing specific gravity and increasing pressure and velocity of the homogeneous mixture as it ascends creates a chimney like effect through the flexible pressurised pipe and water powered generators with the mixture being expelled at an optimum depth beneath the surface of the sea where the bacteria and remaining propellant gas in the mixture feeds the plankton and other organisms which increases the biological process as previously described.

4. A unit according to claims 1, 2, and 3, where the measured quantity of bacteria and plankton friendly gasses injected and mixed into the sea water and bacteria mixture at the bottom of the flexible pipe will be proportionate to and govern the volume, velocity and pressure of the mixture as it travels upwards when either the diameter of the flexible pipe will have to be increased and reinforced to accommodate these increases or the stream divided up into a number of other pipes in a tree like manner which will also distribute the mixture over a wider area.

5. A unit according to claims 1, 2 and 3, where the required number of eco-friendly state of the art water powered direct current electric generator means together with buoyancy/ballast means, dynamic non-return valves means and mixing means are empirically spaced and installed along the flexible pipes .

6. A unit according to previous claims where due to the converging tidal inlets of the unit being positioned in a circle around its central axis will result in the accelerated flow of water into the unit being in a spiral upwards direction inside the unit which will create a negative pressure zone around the central area which if sufficient in suction power could be used to suck in additional sea water containing bacteria through an optimum number of root like flexible pipes extending outwards along the sea bed if this is required or practical.

7. A unit according to previous claims which due to the circular tidal inlets configuration of the unit has the advantage of making its orientation relative to the directions of the tidal currents irrelevant when the unit assembly is lowered into position from a ship.

8. A unit according to previous claims where due to the increase in pressure head with depth (approx.440lbs/squ.inch per 1000 feet) will require dependent upon the depth a state of the art high pressure electrolysis separation unit together with a high pressure secondary unit in which each compressed gas of hydrogen, oxygen, chlorine and other smaller quantities of other gasses are separated, their quantities measured, then piped away to their required destination.

9. A unit according to previous claims where dependent upon size the electrolysis and gas separation and metering unit may be integrated into the main pumping unit when required

10. A unit according to previous claims where the production of compressed gasses is a major requirement with multiple units on the sea bed creating a forest like array of tree like structures which would create a much larger environmentally friendly area as previously described

11. A unit according to previous claims where protection against damage caused by corrosion, weather or static electricity is by means of sacrificial anodes, flexibility, state of the art materials and means to earth electrical charges..

12. A unit according to previous claims with an open mesh filter assembly around the unit which is tidal self cleaning and whose mesh protects against the ingress of unwanted debris and keeps the system eco-friendly and which allows only creatures small enough to pass harmlessly through the entire system.

13. A unit according to previous claims of a different configuration with tidal inlets which require to be orientated at right angles to the tidal currents which flow from left to right then in the opposite direction with the current being diverted with a pivoted flap valve.

15. A unit according to previous claims which has continuous, flexible, porous tubes attached to the concrete base containing grouting paste and which when the paste is displaced due to the pressures exerted when on an uneven sea-bed together with the grout being squeezed out through the porous walls provide a seal when the grout solidifies

16. A unit according to previous claims which can operate in inland waterways by adding brine to the electrolysis unit.

17, A unit according to previous claims with reference to Figures 1, and 2, together with the details on the accompanying drawings.

Application No:	GB1201119.3	**Examiner:**	Mr Alun Owen
Claims searched:	1-17	**Date of search:**	26 April 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,P	1-17	GB 2472679 A (BIRKETT) See whole document
X	1-16	GB 2456333 A (HATCHWELL) See especially the Figures and abstract
X	1-16	KR 20020079292 A (NOH) See especially the Figures, the EPODOC Abstract and WPI Abstract Accession Number 2003-686115 [65]
X	1-16	WO 87/01690 A1 (NOGLER) See especially the Figures, the EPODOC Abstract and WPI Abstract Accession Number 1987-093758 [13]
X	1-16	JP 2004183637 A (TAKAHASHI) See especially the Figures, the EPODOC Abstract and WPI Abstract Accession Number 2004-535914 [52]
X	1-16	JP 2003155971 A (HOKURIKU) See especially the Figures, the EPODOC Abstract and WPI Abstract Accession Number 2003-735984 [70]
X	1-16	JP 2008072922 A (INAI) See especially the Figures, the EPODOC Abstract and WPI Abstract Accession Number 2008-E57320 [31]
X	1-16	JP 2000308897 A (HATANAKA) See especially the Figures, the EPODOC Abstract and WPI Abstract Accession Number 2001-095278 [11]
X	1-16	GB 2366526 A (TSAI) See especially the Figures and abstract
X	1-16	US 4767938 A (BERVIG) See especially the Figures and abstract
X	1-16	JP 56065987 A (MANO) See especially the Figure and EPODOC Abstract

X	1-16	US 4084375 A (HORVATH) See whole document

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

C02F; F03B

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

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
C02F	0003/20	01/01/2006
F04F	0099/00	01/01/2009