A power generating system using bubble buoyancy is disclosed. The system generates the bubbles in water charged in a sealed housing and operates a rotational force generating unit using the bubble buoyancy to generate the rotational force. The housing may be partitioned into several chambers by means of vertical partitions and provided with at least one rotational force generating unit in each of the chambers. The air, after being used in the first chamber, is reused for generating the bubbles in the second chamber. The rotational force generating units may be vertically arranged in a line in the housing and the bubbles are generated under the lowest unit. The bubble bucket sizes are different from each other in accordance with unit's positions in the water so that the buckets more reliably capture the bubbles which gradually expand due to water pressure difference according to the depth.
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POWER GENERATING SYSTEM USING BUOYANCY

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates in general to power generating systems for generating power by the conversion of various forms of energy into mechanical force and motion and, more particularly, to a power generating system using buoyancy for generating rotational force by instantaneously collecting bubbles into a floater and buoying up the floater in water due to buoyancy of the bubbles and causing the continuous rotation of a rotor.

Description of the Prior Art

As well known to those skilled in the art, power generating systems, for example, prime movers, are used for generating power by the conversion of various forms of energy into mechanical force and motion. The various forms of energy used in the systems include heat energy, hydraulic energy, wind energy, atomic energy, wave energy and solar energy.

However, neither a power generating system nor its related technique using buoyancy of bubbles in water has been proposed.

Of course, this applicant knows that a system using the buoyancy is used for decoration of aquaria or goldfish
bowls. That is, a bubble generator is immersed in water of, for example, an aquarium and supplied with outside air or oxygen to generate bubbles. In addition, a small rotator, for example, a miniaturized water mill is supported by columns such that it is placed above the bubble generator. The bubbles of the bubble generator are buoyed up in the water and rotates the water mill. However, this system is not used for generating power but used for decoration.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a power generating system which generates bubbles in water charged in a sealed housing and operates a rotational force generating unit, placed in the water, using the bubble buoyancy to generate the rotational force to be applied to do work.

It is another object of the present invention to provide a power generating system which comprises a plurality of rotational force generating units placed in chambers of the housing partitioned into several chambers by means of vertical partitions and generates the bubbles in the water charged in the chambers and operates the units using the bubble buoyancy and reuses the air, after being used in the first chamber, for generating the bubbles in the second chamber and thereby generating the
rotational force more efficiently.

It is a further object of the present invention to provide a power generating system which comprises a plurality of rotational force generating units vertically arranged in a line in the housing and generates the bubbles under the lowermost unit and operates the units using the bubble buoyancy and whose bubble buckets are different from each other in their sizes in accordance with unit's positions in the housing and thereby more reliably capturing the bubbles which gradually expand due to water pressure difference according to the depth when the bubbles are buoyed up in the water and generating the rotational force more efficiently.

It is still another object of the present invention to provide a power generating system in which the housing is partitioned into several chambers and the plurality of rotational force generating units are vertically arranged in a line in each of the chambers and which generates the bubbles under the lowermost unit and operates the units using the bubble buoyancy and whose bubble buckets are different from each other in their sizes in accordance with unit's positions in the chamber and thereby more reliably capturing the bubbles which gradually expand due to water pressure difference according to the depth when the bubbles are buoyed up in the water and generating the rotational force more efficiently.

In order to accomplish the above objects, the present
invention provides a power generating system using bubble buoyancy comprising: a housing charged with water such that a top space remains in the housing; at least one rotational force generating unit placed in a housing charged with water, the unit having: top and bottom rotating shafts horizontally extending in the housing, opposed ends of each of the shafts being rotatably held by the side walls of the housing and having their sprockets inside the housing; a power transmission chain wrapped about each of the sprockets of the top shaft and about an associated sprocket of the bottom shaft; a plurality of bubble buckets mounted to the power transmission chains, opposed ends of each of the buckets being fixedly mounted to the chains respectively such that the buckets are spaced out at regular intervals; means for generating bubbles, the bubble generating means having an air pipe and a bubble outlet formed in a bottom end of the air pipe, the bubble outlet being disposed under about the bottom side of the rotational force generating unit such that the bubbles coming out of the bubble outlet are captured by the bubble buckets and continuously buoying up the buckets in the water due to buoyancy and thereby rotating the sprockets along with the rotating shafts and causing the shafts to generate the rotational force.
BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a sectional view of a power generating system in accordance with a primary embodiment of the invention;

Fig. 2 is a sectional view of the system taken along the section line A-A of Fig. 1;

Fig. 3 is a sectional view of a power generating system in accordance with a second embodiment of the invention;

Fig. 4 is a partially enlarged sectional view of the system of Fig. 3; and

Fig. 5 is a sectional view of a power generating system in accordance with a third embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to Figs. 1 and 2, there is shown a power generating system in accordance with a primary embodiment of the invention. The system has a plurality of rotational force generating units 3 vertically placed in a housing 1. In this embodiment, the interior of the
housing 1 is partitioned into several chambers by vertical partitions 20 and 30 and the units 3 are vertically placed in the chambers respectively. A plurality of bubble generators 5 are arranged in the chambers respectively such that their bubble outlets 23 are disposed under their associated units 3. To rotatably support the units 3 in the housing 1, a pair of rotating shafts, that is, top and bottom shafts 7 and 9, horizontally extend in each chamber of the housing 1. The top shaft 7 is provided with a pair of first chain sprockets 15 while the bottom shaft 9 is provided with a pair of bottom chain sprockets 17. A first endless chain 11 is wrapped about both one of the first chain sprockets 15 and an associated second chain sprocket 17. In the same manner, a second endless chain 13 is wrapped about both the other first chain sprocket 15 and the other second chain sprocket 17. Each unit 3 also includes a plurality of bubble buckets 19 spaced out at regular intervals. The opposed ends of each bucket 19 are held by the opposed chains 11 and 13 respectively.

The bubble generator 5 comprises an air supply pipe 21 vertically extending in each chamber of the housing 1. The bottom end of the pipe 21 has the bubble outlet 23. This outlet 23 is disposed under the unit 3 such that the bubbles coming out of the outlet 23 are captured by a bubble bucket 19 in the lower side position during rotation of the bubble buckets 19 as shown in Fig. 2.

Water 27 is charged in the housing 1 such that a top
space 25 remains in the housing 1. A blower 29 supplies the outside air for the bubble generator 5 so that bubbles come out of the bubble outlets 23 to be captured by the bubble buckets 19 in the lower side position. Due to the bubble buoyancy, the buckets 19 with the bubbles are continuously buoyed up in the water and thereby rotating the chain sprockets 15 and 17. The units 3 thus generate the rotational force which will be applied to do work.

In the invention, each bubble bucket 19 is preferred to have a sharpened top and an open bottom. Such a shape of each bucket 19 is profitable in view of both bubble capturing effect and reduction of water resistance. That is, the open bottoms of the buckets 19 in the ascending motion reliably capture the bubbles coming out of the bubble outlets 23. The sharpened tops of the buckets 19 reduce the water resistance during the descending motion of the buckets 19.

It is also preferred to charge the water 27 in the chambers of the housing 1 such that buckets 19 in the uppermost position are slightly exposed to the outside of the water surface 31 as shown in Figs. 1 and 2. When the interior of the housing 1 is partitioned into several chambers by the partitions 20 and 30, the top space 25 of the housing 1 is also divided into several parts 25a, 25b and 25c. In this case, the parts 25a, 25b and 25c can be used as a space for keeping the compression air.

In the drawings, the reference numeral 10 denotes a
side wall of the housing 1.

As described above, the housing 1 includes the vertical partitions 20 and 30 for partitioning the interior of the housing 1 into the several chambers for installing the units 3. The chambers are also provided with their bubble generators 5, 5a and 5b. The air supply pipes 21 of the second and third bubble generators 5a and 5b extend from the upper portions of the partitions 20 and 30. Due to the pipes 21, the first chamber for the first unit 3 communicates with the second chamber for the second unit and the second chamber communicates with the third chambers for the third unit 3.

In the above system, the top spaces 25a, 25b and 25c of the chambers are airtightly sealed and separated from each other. The top space 25c of the last chamber does not keep the compression air but exhausts the compression air to the atmosphere.

Turning to Figs. 3 and 4, there is shown a power generating system in accordance with a second embodiment of the invention. In the same manner as described for the primary embodiment, the system of this second embodiment has the plurality of rotational force generating units 3 placed in the housing 1. However, the housing 1 of this embodiment has a higher height but a narrower width as the units 3 are vertically arranged in a line in the housing 1 as best seen in Fig. 3. The bubble generator 5, having the blower 29 outside the housing 1, vertically extends
down to the interior bottom of the housing 1. The bubble outlet 23 of the generator 5 is disposed under the lowermost unit 3 such that the bubbles coming out of the outlet 23 are captured by a bubble bucket in the lower side position during rotation of the bubble buckets 19 (19a, 19b and 19c) as shown in Fig. 4. The units 3 are connected to and cooperates with each other by means of power transmission means installed outside the housing 1. Alternately, the power transmission means may be installed inside the housing 1.

The power transmission means provided between, for example, the uppermost unit 3 and the neighboring unit 3 may be achieved using a gear transmission mechanism. That is, a first spur gear 33 is mounted to the outside end of the bottom shaft 9 of the uppermost unit 3, while a second spur gear 37 is mounted to the outside end of the top shaft 7 of the neighboring unit 3 as shown in Fig. 3. The gears 33 and 37 engage with each other by means of a middle gear 35 which gears into both gears 33 and 37 and forms a gear train. In this gear transmission mechanism, the first and second gears 33 and 37 rotate in the same direction as they gear into the common gear 35. Of course, it should be understood that the power transmission means may be achieved using a chain transmission mechanism. When using the chain transmission mechanism as the power transmission means, a first sprocket is mounted to the outside end of the bottom shaft
9 of the uppermost unit 3 and a second sprocket is mounted to the outside end of the top shaft 7 of the neighboring unit 3. The sprockets are connected to each other by means of a chain wrapped about the sprockets. In the same manner as described for the gear transmission mechanism, the sprockets rotate in the same direction.

In the second embodiment, it is preferred to make the bubble bucket sizes of the units 3 be different from each other in accordance with unit's positions in the housing 1. That is, the bucket sizes are preferably varied in such a manner the buckets 19c of the uppermost unit 3 have the largest size but the buckets 19a of the lowermost unit 3 have the smallest size. Such a size enlargement of the buckets 19c is due to the fact that the bubbles coming out of the bubble outlet 23 placed on the interior bottom of the housing 1 gradually expand due to water pressure difference according to the depth when the bubbles are buoyed up in the water 27. The large buckets 19c of the uppermost unit 3 will more reliably capture the expanded bubbles.

Fig. 5 shows a power generating system in accordance with a third embodiment of the invention. If briefly described, the system of the third embodiment is produced by combination of the systems of the primary and second embodiments. In this system, the slender housing 1 having side walls is partitioned into two chambers by a vertical partition in the same manner as described for the system.
of the primary embodiment. A plurality of units 3 are vertically arranged in a line in each chamber of the housing 1 as described for the system of the second embodiment. The bubble generators 5 vertically extend down to the interior bottoms of the chambers of the housing 1. The bubble outlet 23 of each generator 5 is disposed under the lowermost unit 3 in each chamber such that the bubbles coming out of the outlet 23 are captured by a bubble bucket in the lower side position during rotation of the bubble buckets 19 (19a, 19b and 19c). The units 3 are connected to and cooperates with each other by means of power transmission means installed outside the housing 1. Of course, it should be understood that the power transmission means may be installed inside the housing 1.

The operational effect of the power generating system of the invention will be given hereinbelow.

In operation of the system having one chamber of the invention, the outside air is supplied to the chamber, defined by the side walls 10 of the housing 1 and charged with the water 27, by the blower 29. In this case, the outside air, after passing the air pipe 21, is discharged from the bubble outlet 23, thus to form bubbles in the water 27. The bubbles coming out of the bubble outlet 23 of the bubble generator 5 are captured by a bubble bucket 19 located above the bubble outlet 23 at that time. The bubble bucket 19 capturing the bubbles is thus lifted up
in the water 27 due to bubble buoyancy. After the bubble bucket 19 is lifted up due to the bubble buoyancy, another bubble bucket 19 is newly located above the bubble outlet 23 and captures the new bubbles coming out of the outlet 23 so that this bubble bucket 19 is also lifted up in the water 27 due to bubble buoyancy. Such a continuous lifting motion of the bubble buckets 19 is accompanied with turning motion of the chains 11 and 13 wrapped about the sprockets 15 and 17. The continuous turning motion of the chains 11 and 13 rotates the sprockets 15 and 17 along with the shafts 7 and 9 and thereby generating the rotational force of the shafts 7 and 9 to be applied to do work.

When the bubble buckets 19 reach the water surface 31, each bucket 19 lies to open its open bottom to the top space 25 in the chamber as shown in Fig. 2. The bubbles captured in the bucket 19 are thus escaped from the bucket 19 into the space 25. When the bubble buckets 19 descend in the water, the sharpened tops of the buckets 19 are directed to the bottom of the chamber but the open bottoms of the buckets 19 are directed to the water surface 31 so that the buckets 19 during descending in the water 27 are charged with water and reduce the water resistance.

In operation of the system having several units 3 provided in their associated chambers partitioned by the vertical partitions 20 and 30 in accordance with the primary embodiment (Figs. 1 and 2) of this invention, the
outside air is supplied to the first chamber, defined by a side wall 10 of the housing 1 and the first partition 20 and charged with the water 27, by the blower 29 of the first bubble generator 5. In this case, the outside air discharged from the bubble outlet 23 forms bubbles in the water 27. The bubbles coming out of the bubble outlet 23 are captured by the bubble buckets 19 to lift up the buckets 19 in the water 27 and collected in the top space 25a of the first chamber in the same manner as described above. The air pressure in the first top space 25a is gradually increased so that the air of the top space 25a flows into the second chamber through the second bubble generator 5a extending from the upper portion of the first partition 20. In the second chamber, the air is discharged from the bubble outlet 23 of the second bubble generator, thus to form bubbles in the water 27 in the second chamber. The top space 25b of the second chamber is continuously charged with the air so that the air pressure in the space 25b is increased. Therefore, the air of the second top space 25b flows into the third chamber through the third bubble generator 5b extending from the upper portion of the second partition 30 and forms the bubbles in the water 27 of the third chamber.

In the system of the primary embodiment, the bubbles coming out of the bubble outlets 23 of the bubble generators 5, 5a and 5b are captured by the bubble buckets 19, located above the bubble outlets 23 respectively at
that time, and lift up the bubble buckets 19 in the water 27 of the first to third chambers. The lifting motion of the bubble buckets 19 in the chambers is accompanied with turning motion of the chains 11 and 13 of the units 3. Due to the turning motion of the chains 11 and 13 in each chamber, the sprockets 15 and 17 along with the shafts 7 and 9 of each unit 3 are rotated and generate the rotational force to be applied to do work.

The system of the primary embodiment has an advantage in that the air, after being used in the first chamber, is supplied to the second chamber for generating the bubbles in the water of the second chamber. In the same manner, the air, after being used in the second chamber, is supplied to the third chamber for generating the bubbles in the water of the third chamber. Therefore, this system improves the efficiency in use of outside air for generating the bubbles in the chambers and increases the rotational force generated by the system. Of course, the number of the partitions for partitioning the interior of the housing 1 into the chambers may be changed as desired.

In operation of the system having several units 3 which are vertically arranged in a line in the housing 1 and connected to each other by means of power transmission means outside the housing 1 in accordance with the second embodiment (Figs. 3 and 4) of this invention, the outside air is supplied to the lowermost unit 3 in the housing 1.
by the blower 29 of the bubble generator 5. The bubbles coming out of the bubble outlet 23 are captured by the bubble buckets 19a of the lowermost unit 3 to lift up the buckets 19a in the water 27. Therefore, the chains 11 and 13 of this unit 3 are turned and rotate the sprockets 15 and 17 along with the shafts 7 and 9 and thereby generating the rotational force. When the buckets 19a reach about the top shaft 7 of the lowermost unit 3, the bubbles of the buckets 19a are escaped from the buckets 19a into the water 27. However, the bubbles are captured by the buckets 19b of the middle unit 3 to lift up the buckets 19b. Therefore, the chains 11 and 13 of this middle unit 3 are turned and rotate the sprockets 15 and 17 along with the shafts 7 and 9 and thereby generating the rotational force. When the buckets 19b reach about the top shaft 7 of the middle unit 3, the bubbles of the buckets 19b are escaped from the buckets 19b into the water 27. However, the bubbles are captured by the buckets 19c of the uppermost unit 3 to lift up the buckets 19a. Therefore, the chains 11 and 13 of this uppermost unit 3 are turned and rotate the sprockets 15 and 17 along with the shafts 7 and 9 and thereby generating the rotational force. The units 3 are connected to and communicate with each other by means of the gear transmission mechanism comprising the gears 33, 35 and 37 installed outside the housing 1. In addition, the bubble bucket sizes of the units 3 are different from each other.
in such a manner the buckets 19c of the uppermost unit 3 have the largest size but the buckets 19a of the lowermost unit 3 have the smallest size. The different size buckets 19a, 19b and 19c reliably capture the bubbles which gradually expand due to water pressure difference according to the depth when the bubbles are buoyed up in the water 27. Therefore, the system of this embodiment achieves the reliable rotating operation of the units 3 more efficiently.

The system of the third embodiment (Fig. 5) will achieve the operational effect resulting from combination of the operational effects of the primary and second embodiments as the construction of the third embodiment results from combination of the constructions of the primary and second embodiments. That is, the bubble bucket sizes of the units 3 vertically arranged in a line in each chamber are different from each other in the same manner as described for the second embodiment. The different size buckets 19a, 19b and 19c reliably capture the bubbles which gradually expand due to water pressure difference according to the depth when the bubbles are buoyed up in the water 27. In addition, the housing 1 is partitioned into several chambers by means of the partitions. The air, after being used in the first chamber, is supplied to the second chamber for generating the bubbles in the water 27 of the second chamber. Therefore, this system improves the efficiency in use of
outside air for generating the bubbles in the chambers and increases the rotational force generated by the system.

In the present invention, several types of liquid such as sea water having a higher specific weight may be substituted for the water 27 in the housing 1. In addition, several types of gas having lower specific weight such as nitrogen, oxygen and helium may be substituted for the air supplied to the water 27 by the blower 29. When using the gas having lower specific weight, the bubbles coming out of the bubble outlet 23 of the bubble generator 5 have higher buoyancy. Therefore, use of the lower specific weight gas reduces the system size.

As described above, the present invention provides a power generating system which generates bubbles in water charged in a sealed housing and operates a rotational force generating unit, placed in the water, by the bubble buoyancy and thereby generating the rotational force to be applied to do work. The housing may be partitioned into several chambers by means of a plurality of vertical partitions. In this case, the rotational force generating unit is placed in each of the partitioned chambers. Alternatively, the housing may have a higher height and a narrow width and two or more rotational force generating units are vertically arranged in a line in the housing. As a further alternative, the housing may have a higher height and be partitioned into several chambers by means
of a plurality of vertical partitions. In this case, two or more rotational force generating units are vertically arranged in a line in each of the chambers. The air, after being used in the first chamber, is supplied to the second chamber for generating the bubbles in the water of the second chamber. Therefore, the system improves the efficiency in use of outside air for generating the bubbles in the chambers and increases the rotational force generated by the system.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.
WHAT IS CLAIMED IS:

1. A power generating system using bubble buoyancy comprising:
   a housing charged with water such that a top space remains in the housing;
   at least one rotational force generating unit placed in a housing charged with water, said unit having:
   top and bottom rotating shafts horizontally extending in the housing, opposed ends of each of said shafts being rotatably held by the side walls of the housing and having their sprockets inside the housing;
   a power transmission chain wrapped about each of the sprockets of the top shaft and about an associated sprocket of the bottom shaft;
   a plurality of bubble buckets mounted to the power transmission chains, opposed ends of each of said buckets being fixedly mounted to the chains respectively such that the buckets are spaced out at regular intervals;
   means for generating bubbles, said bubble generating means having an air pipe and a bubble outlet formed in a bottom end of the air pipe, said bubble outlet being disposed under about the bottom side of the rotational force generating unit such that the bubbles coming out of the bubble outlet are captured by the bubble buckets and continuously buoying up the buckets in the water due to buoyancy and thereby rotating the sprockets along with the
rotating shafts and causing the shafts to generate the rotational force.

2. The power generating system according to claim 1, wherein the interior of the housing is partitioned into a plurality of chambers by means of a plurality of vertical partitions, and both the rotational force generating unit and the bubble generating means are provided in each of said chambers, the air pipes of the bubble generating means provided in the chambers except for the first chamber extending from the top portions of the partitions such that the chambers communicate with each other.

3. The power generating system according to claim 1, wherein two or more rotational force generating units are vertically arranged in a line in the housing, and the air pipe of said bubble generating means vertically extends down to the interior bottom of the housing such that the bubble outlet is disposed under the lowermost unit, said rotational force generating units being connected to and cooperating with each other by means of power transmission means installed outside the housing.

4. The power generating system according to claim 3, wherein the bubble bucket sizes of the rotational force generating units are different from each other in
accordance with the unit's positions in the housing.

5. The power generating system according to claim 1, wherein the interior of the housing is partitioned into a plurality of chambers by means of a plurality of vertical partitions, and two or more rotational force generating units are vertically arranged in a line in each of said chambers of the housing, and the air pipe of said bubble generating means vertically extends down to the interior bottom of each of said chambers such that the bubble outlet is disposed under the lowermost unit provided in each of the chambers, said rotational force generating units being connected to and cooperating with each other by means of power transmission means installed outside the housing, and the air pipes of the bubble generating means provided in the chambers except for the first chamber extending from the top portions of the partitions such that the chambers communicate with each other.

6. The power generating system according to any one of claims 1, 3 and 4, wherein each of said bubble buckets has a sharpened top and an open bottom.
**INTERNATIONAL SEARCH REPORT**

**INTERNATIONAL APPLICATION NO.**

**PCT/KR 95/00071**

**A. CLASSIFICATION OF SUBJECT MATTER**

**IPC:** F 03 B 17/02

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:** F 03 B 17/02, 9/00

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

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

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Further documents are listed in the continuation of Box C.

See patent family annex.

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Date of the actual completion of the international search: 19 January 1996 (19.01.96)

Date of mailing of the international search report: 25 January 1996 (25.01.96)

Name and mailing address of the ISA/AT

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