A rotary gravity compressor with a rotating shaft held between two support walls is driven by a drive gear mechanism, which may be a hydraulic system, and multiple cylinders are affixed to and juxtaposed about the rotating shaft at different angles relative to its rotation. Each cylinder has two bases at its opposite ends, each of which has an intake valve and an outtake valve for controlling flow of gas into and out of the cylinder, respectively, and a piston moves downward between the two bases as a result of gravity due to rotation of the shaft so that the piston compresses air within the cylinder until it is released through the bottom outtake valve when the piston has reached full compression while uncompressed air is introduced through the top intake valve as the piston moves downwardly. Bearings are located on the piston to lessen friction, a seal (e.g., an o-ring) is used to assist in compression of gas as the piston moves downwardly, shock absorbing devices are used to lessen shock as the piston reaches maximum compression and locking devices are used to hold the piston in place until it is released. The rotary gravity compressor is used in a system or method for generating power in which compressed air is used to generate work in an air turbine or power in a generator or is stored in an air tank that is then used to power an air turbine or a generator or a pneumatic tool.
Fig. 2
COMPRESSED AIR POWER GENERATING SYSTEMS USING A ROTARY GRAVITY COMPRESSOR

FIELD OF THE INVENTION

[0001] This invention is in the field of electric power generating systems that use compressed gas and, more particularly, to systems using a rotary gravity compressor to compress air.

BACKGROUND OF THE INVENTION

[0002] Electrical power is generated by a number of different processes throughout the United States and the world. For example, coal, natural gas or oil can be burned, or nuclear power can be used, to generate steam to drive a steam turbine to drive an electrical generator to produce electricity. These types of plants are well known, and vary in design details, but they all involve the use of a depletable fuel and raise environmental concerns because of byproducts that such plants generate that pollute the environment.

[0003] Because of concerns over depletion of natural resources, as well as environmental concerns, efforts have been made to generate electricity through cleaner (or “greener”) processes using alternative power sources or power generating schemes that do not deplete limited natural resources or create harmful byproducts. For example, efforts have been made to generate electricity through solar and wind power and hydroelectric power has been used for some time when conditions are right for its use.

[0004] Other efforts have been directed to ways that power can be generated during off-peak times and stored for use during peak demand conditions, thus minimizing the need for new power plants and increased capital spending.

[0005] As energy consumption increases throughout the world, especially with developing countries like China consuming more and more energy, and with concerns about pollution and limited natural resources becoming more and more of a concern, there is a need for new and improved methods of generating electrical power that do not deplete limited natural resources, that do not pollute or at least are more environmentally friendly, and that are still economical. It is this need to which the present invention is directed.

SUMMARY OF THE INVENTION

[0006] The present invention is generally directed to a rotary gravity compressor with a rotating shaft held between two support walls that is driven by a drive gear mechanism (which may be a hydraulic system). Multiple cylinders are affixed to and juxtaposed about the rotating shaft at different angles relative to rotation of the shaft. Each of the cylinders has two bases at its opposite ends, each of which has an intake valve and an outtake valve for controlling flow of gas into and out of the cylinder, respectively, and the outtake valves are connected to an air outtake pipe with multiple air connections. A piston is movable within each cylinder between the two bases as a result of gravity due to rotation of the shaft and movement of the piston in a downward direction creates compressed air within the cylinder which is released from the cylinder through a bottom outtake valve when the piston has reached full compression while uncompressed air is introduced into the cylinder through a top intake valve as the piston moves toward the bottom base.

[0007] In a first, separate group of aspects of the present invention, bearings are located on the pistons to lessen friction, a compression seal is used to assist in compression of gas as the piston moves downwardly, shock absorbing devices are used to lessen shock as the piston reaches maximum compression and locking devices are used to hold the piston in place until it is released.

[0008] In a second, separate group of aspects of the present invention, a rotary gravity compressor is used in a system or method for generating power in which compressed air from the air outtake pipe is used to generate work or power an air turbine or a generator or is stored in an air tank that is then used to power an air turbine or a generator or a pneumatic tool.

[0009] Accordingly, it is a primary object of the present invention to provide improved compressed air power generating systems using a rotary gravity compressor.

[0010] This and further objects and advantages will be apparent to those skilled in the art in connection with the drawings and the detailed description of the invention set forth below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 is a side view of a rotary gravity compressor according to a preferred embodiment of the present invention.

[0012] FIG. 2 is a partial cut-away end view of the rotary gravity compressor of FIG. 1.

[0013] FIG. 3 is another partial cut-away end view as shown in FIG. 2 with the addition of a support wall and diagrammatic representation of a drive gear mechanism.

[0014] FIG. 4 is a representation of a cylinder used in a rotary gravity compressor as shown in FIG. 1 with a representation of air flow.

[0015] FIG. 5 is a partial cutaway and blow up of one end of the cylinder shown in FIG. 4.

[0016] FIG. 6 is a partial cutaway of a cylinder and piston used in the rotary gravity compressor of FIG. 1.

[0017] FIG. 7 is a top planar view taken along line 7-7 of FIG. 6.

[0018] FIG. 8 a partial cutaway of one end of a cylinder used in the rotary gravity compressor of FIG. 1 with the piston close to, but not in, locking engagement with, the base of the end of the cylinder.

[0019] FIG. 9 is a top planar view taken along line 9-9 of FIG. 8.

[0020] FIG. 10 is a partial cutaway of a cross section of one end of the cylinder shown in FIG. 1.

[0021] FIG. 11 is a partial cutaway of a cross section of one end of the cylinder shown in FIG. 1 in which the rotating shaft has been rotated ninety degrees from its position shown in FIG. 10.

[0022] FIG. 12 is a diagrammatic view of a rotary gravity compressor according to a preferred embodiment of the present invention used in connection with a turbine.
FIG. 13 is a diagrammatic view of a rotary gravity compressor according to a preferred embodiment of the present invention used to pressurize an air tank for use with an air turbine or other system using compressed gas.

FIG. 14 is a diagrammatic view of a rotary gravity compressor according to a preferred embodiment of the present invention used to pressurize an air tank for use with a pneumatic tool.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is generally directed to a rotary gravity compressor that has multiple cylinders that are rotated in a circular motion about an axis of a shaft. A piston is raised to a vertical raised position and then released, compressing air in its cylinder in a one-step process. The compressed air is then removed, and the multiple piston/shaft structure is rotated so that a second piston is now in a vertical free fall position. This second piston now falls due to gravity, compresses air in its second cylinder, and then that compressed air is removed. The structure then rotates to a third piston/cylinder and the process is repeated. So, there are multiple piston/cylinders that operate sequentially in series on a continuous basis to compress air. The movement of the cylinders between positions can take place continuously or in a step-wise fashion.

The present invention will now be discussed in connection with a detailed description of one preferred embodiment shown in FIGS. 1-14. The drawings are not drawn to engineering scale and the actual scale of a device will depend upon need and the application in which it is used.

In the Figures and the following more detailed description, numerals indicate various features of the invention, with like numerals referring to like features throughout both the drawings and the description. Although the Figures are described in greater detail below, the following is a glossary of the elements identified in the Figures:

1. rotary gravity compressor
2. support wall
3. rotating shaft
4. air outtake pipe
4a. air outtake pipe air opening
5. cylinder
6. air outtake cylinder pipe
7. rotating pipe coupling valve
8. drive gear mechanism
11. first cylinder base
12. first cylinder base intake valve
13. first cylinder base outtake valve
14. air intake pipe
14a. air intake pipe air opening
15. one-way valve
16. air intake cylinder pipe
21. second cylinder base
22. second cylinder base intake valve
23. second cylinder base outtake valve
31. piston
32. wheel
33. compression seal
34. shock absorbing device
35. locking device
35a. male locking device
35b. female locking device
41. cylinder base
42. cylinder intake valve
43. cylinder outtake valve
51. air turbine
52. transmission
53. generator
54. air tank
70-91. positions of cylinder 5 during rotation

FIG. 1 is a side view of a rotary gravity compressor 1 with eleven cylinders 5 connected or affixed to rotating shaft 3. Rotating shaft 3 is held above the ground by two support walls 2 and is rotated by a suitable drive gear mechanism, generally designated and diagrammatically represented as 8 (see also FIG. 3). In view of the size and weight of rotary gravity compressor 1, it is especially preferred that gear mechanism 8 be designed with a gearing system that will minimize torque and utilize a hydraulics system connected to the gears. The hydraulic system will be run by an electric motor that will be getting its power from an electrical grid or, in case there is no grid available, the electric motor can run using a diesel generator as a startup device and later on once the device is ready and workable the electric motor will draw electricity from the local grid that is made by using the rotary gravity compressor. In this regard, for a very large scale rotary gravity compressor, where each piston might weigh a ton or more, there will be a number of engineering issues related to torque and rotation; however, the details of such a gearing system should be within the skill of a person of ordinary skill in the art when coupled with the present disclosure, especially if such person studies the engineering details associated with the Falkirk Wheel which is a rotating boatlift used to connect the Forth & Clyde and Union canals in central Scotland. An introductory description of the Falkirk Wheel can be found in the pages of Global Design News, in an article published May 20, 2002 by Norman Bartlett, the disclosure of which is incorporated herein by reference.

Although cylinders 5 are connected or affixed to rotating shaft 3 in an especially preferred embodiment, it is conceivable that such cylinders could be incorporated into or made part of a rotation mechanism itself, accordingly, for purposes of the present invention, a “rotating shaft” shall be defined as any device or mechanism, or group of devices or mechanisms, whether it includes a “shaft” or not, by which
multiple cylinders are aligned in a preselected orientation and rotated together in accordance with the teachings of the present invention.

[0064] As shown in FIGS. 1, 7 and 11, compressed air exits rotary gravity compressor 1 through air outtake pipe 4 which is coupled to a non-rotating pipe by rotating pipe coupling valve 7. Rotating pipe coupling valve 7 can also include ball bearings (not shown) to reduce friction, and the design of such a valve is within the skill of one of ordinary skill in the art aided with the present disclosure. Air outtake pipe 4 proceeds from rotating pipe coupling valve 7 through support wall 2 and into one end of rotating shaft 3 whereupon it exits at two air outtake pipe air openings 4a and is then connected to a series of air outtake cylinder pipes 6 which have air flow regulated throughout by a series of one-way valves 15. Air outtake pipe 4 and air openings 4a, when they are inside of a solid rotating shaft 3, can be formed by boring the structures out of the solid shaft. Each cylinder 5 has two air outtake cylinder pipes that run along or offset from the outside of the outer cylinder wall to the ends of the cylinder where they are connected through a cylinder outtake valve 43 (see FIG. 5) to the outside of a cylinder base 41. The series of air outtake cylinder pipes 6 and one-way valves 15 feed compressed air from the cylinders 5 into air outtake pipe 4, as will be described in greater detail later.

[0065] It is especially preferred, in certain applications, to provide a treated stream of feed air to cylinders 5 (e.g., when the air might need to be dried). To accomplish this purpose, a second system of pipes and one-way valves, similar to that for the outtake system, can be included in rotary gravity compressor 1, as is shown in FIG. 1, although such a system might be omitted in certain applications. An intake system of piping can be designed so that it enters rotary gravity compressor 1 at either of its two ends, although FIG. 1 shows an especially preferred embodiment in which the intake piping system enters rotary gravity compressor 1 at the end opposite of air outtake pipe 4. In such a system, air intake pipe 4a would be coupled by a rotating pipe coupling valve (not shown) similar to rotating pipe coupling valve 7, and could proceed in mirror image fashion to the air outtake piping system so that air intake pipe 14 proceeds from its rotating pipe coupling valve through support wall 2 and into the other end of rotating shaft 3 whereupon it exits at two air intake pipe air openings 14a and is then connected to a series of air intake cylinder pipes 16. Each cylinder 5 has two air intake cylinder pipes that run along or offset from the outside of the outer cylinder wall to the ends of the cylinder where they are connected through a cylinder intake valve 42 (see FIG. 5) to the outside of a cylinder base 41. Thus, the series of air intake cylinder pipes 16 feed air into cylinders 5 from air intake pipe 14. The piping system utilized in the preferred embodiment is exemplary but not the only way that a suitable piping system can be designed and implemented.

[0066] FIG. 1 provides a perspective of the orientation of cylinders 5 as to one another along rotating shaft 3. As shaft 3 rotates, the angle of the various cylinders 5 relative to the ground varies as the shaft goes through a complete 360 degree rotation. The orientation of cylinders 5 relative to one another will depend upon how many cylinders are used in a particular application; however, it is generally desirable that the cylinders be spaced apart at symmetric angles for a more continuous compressed air feed unless the sizing of the cylinders is adjusted to accomplish the same purpose.

[0067] Rotary gravity compressor 1 can be designed for use in high or low pressure applications and the particular application may dictate changes in how pistons 31 move within cylinders 5 to compress air. FIG. 4 is a representation of one cylinder 5 used in rotary gravity compressor 1 with a representation of air flow into and out of cylinder 5. As shown in FIG. 4, cylinder 5 is in a vertically upright position in which piston 31 is at or near the top base of cylinder 5 which is designated as first cylinder base 11 which also has first cylinder base intake valve 12 and first cylinder base outtake valve 13. Piston 31 is preferably solid, so as to increase its weight and thereby increase the degree to which it can compress air within cylinder 5 beneath it as it moves toward the lower base of cylinder 5 which is designated as second cylinder base 21 which also has second cylinder base intake valve 22 and second cylinder base outtake valve 23. It is especially preferred that piston 31 be made of stainless steel material because such metal is abundant and because of its high density which makes it easier and more effective for rotary gravity compressor 1 to use the effects of gravity to generate its compressed air.

[0068] In general, when piston 31 moves downwardly (due to gravity) from first base 11 toward second base 21, the volume of air (or gas) held within cylinder 5 will decrease while its pressure will increase according to Boyle’s Law which may be simplified as pressure times volume is equal to a constant (PV = C) for a given mass at a constant temperature. To obtain increased pressure of air or another gas held within cylinder 5 as piston 31 moves, the volume of space occupied by the gas must decrease. The size of cylinder 5 will affect the volume of gas and piston 31 size and weight will affect the pressure. Also, if high pressure outtake gas is desired, it is especially preferred that piston 31 be dropped from its highest practical height and be allowed to compress trapped gas in a rapid action.

[0069] Seals 33, at each end of piston 31, help prevent leakage around the outside circumference of piston 31. It is especially preferred that compression seals 33 be an oversize compression o-ring that can withstand high pressure and seal tight for minimum loss of air pressure, but such seals must not be so complete that they unduly limit or restrict movement of piston 31 within cylinder 5, and, in an especially preferred embodiment, such seals can be made of metal in an oval shape that can be snapped into a groove formed in piston 31 and then secured in place by securing piston heads to the ends of piston 31 to thereby retain the seals.

[0070] To assist movement of piston 31 within cylinder 5, especially in low pressure applications where it might gradually move from one base to the other as shaft 3 rotates through 180 degrees, piston 31 is fitted with bearings to help minimize friction, and it is especially preferred that four such bearings be located ninety degrees apart from each other at both ends of piston 31 near compression seals 33 (see FIGS. 6 and 7), although other configurations with more bearings will also work. In the preferred embodiment depicted in the drawings, the bearings are shown as wheels 31, although other types of bearings can also be used. In addition, cylinder 5 may need to have a lubricant in order not to overheat and cylinder 5 may also need to have a double wall (not shown) to allow a liquid, such as water, to cool the cylinder.
In low pressure applications (where compressed gas leaving cylinder 5 through cylinder outtake valve 43 is approximately 100 psi or less), piston 31 can be allowed to roll down cylinder 5 from one base to its other base until it reaches maximum compression when cylinder 5 is perpendicular to the ground. Such movement occurs as shaft 3 rotates so that as an upper end of a cylinder rotates from roughly position 87 shown in FIG. 2 until a position between positions 70 and 71, assuming a counterclockwise rotation of shaft 3 shown in FIG. 2. Once piston 31 has reached its maximum compression location, cylinder outtake valve 43 can be opened to allow the pressurized gas to enter air outtake cylinder pipe 6 from the bottom of the cylinder which would be in a position between positions 81 and 82. After this point, cylinder outtake valve 43 would be closed and then cylinder intake valve 42 would eventually be opened to allow gas into cylinder 5 so as to avoid creating a vacuum that would restrict movement of piston 5 toward the opposite base of cylinder 5 during further rotation. Cylinder intake and outtake valves 42 and 43 (which include first and second cylinder base intake and outtake valves 12, 22, 13 and 23, respectively), are all one-way valves whose timing is configured so that compressed gas is withdrawn from cylinder 5 from a lower base at an appropriate time, depending upon the application. When rotary gravity compressor 1 is being used to send compressed gas to an air tank, the outtake valves in the lower base may remain open during substantially all of the time that such valves would be in the lower 180 degrees of rotation of their cylinder, whereas such valves might remain closed during a substantial portion of such bottom rotation when rotary gravity compressor 1 is being used to feed compressed air to an air turbine.

In high pressure applications, piston 31 can be released when it is at or near its maximum height from the ground, such as when the upper base of cylinder 5 is between positions 70 and 71 shown in FIG. 2. In such an application, a locking device 35 is needed at both the first and second cylinder bases 11 and 21, and one such locking device is shown in FIGS. 8 and 9 where male locking member 35a is affixed to a base end of piston 31 and then couples with female locking device 35b affixed to cylinder base 41. In such an embodiment it is also desirable to include a shock absorbing device 34 at each cylinder base 41.

In high pressure applications it may also be desirable to vary the volume of one or more cylinders 5, or the diameter of air outtake cylinder pipes 6, to take into account distances of cylinders 5 from air outtake pipe air opening 42.

One or more rotary gravity compressors 1 according to the present invention can be used in a single application, but it may be advantageous to use multiple compressors that can be synchronized to provide a more constant rate of pressurized gas where such a constant rate is desired. The pressurized gas can be used directly with an air turbine, stored in an air tank 54 (see FIG. 13) or the like (such as a cave) or be used in any other application utilizing compressed air. (For example, pressurized gas could be used in a power generating system such as disclosed in U.S. Pat. No. 4,208,592.) Once the pressurized gas has been stored, the stored gas can be released when it is needed to an air turbine (e.g., during high demand peaks for energy) or in connection with pneumatic tools (see FIG. 14) or in any other application utilizing compressed air.

While the invention has been described herein with reference to an especially preferred embodiment, this embodiment has been presented by way of example only, and not to limit the scope of the invention. Additional embodiments thereof will be obvious to those skilled in the art having the benefit of this detailed description, especially to meet specific requirements or conditions. Further modifications are also possible in alternative embodiments without departing from the inventive concept.

Accordingly, it will be apparent to those skilled in the art that still further changes and modifications in the actual concepts described herein can readily be made without departing from the spirit and scope of the disclosed inventions as defined by the following claims.

What is claimed is:

1. A rotary gravity compressor, comprising:
   a first support wall;
   a second support wall;
   a rotating shaft held between the first and the second walls;
   an air outtake pipe with a plurality of air connections;
   a plurality of cylinders affixed to and juxtaposed about the rotating shaft at a plurality of different angles relative to rotation of the shaft, each of the plurality of cylinders further comprising:
   a first base having a first intake valve and a first outtake valve for controlling flow of gas into and out of the cylinder, respectively, wherein the first outtake valve is connected to the air outtake pipe;
   a second base having a second intake valve and a second outtake valve for controlling flow of gas into and out of the cylinder, respectively, wherein the second outtake valve is connected to the air outtake pipe, the second base being located at the opposite end of the cylinder from the first base; and
   a piston movable within the cylinder;
   wherein the piston moves between the first base and the second base as a result of gravity due to rotation of the shaft and creates compressed air within the cylinder in a downward direction of the piston; and
   wherein compressed air is released from the cylinder through the first outtake valve when the piston is in a first base compressed state and through the second outtake valve when the piston is in a second base compressed state; and
   a drive gear mechanism for causing rotation of the rotation shaft.

2. A rotary gravity compressor as recited in claim 1, wherein each of the plurality of cylinders is further comprised of:
a device to lessen friction between an inner wall of the cylinder and the piston as the piston moves between the first base and the second base.

3. A rotary gravity compressor as recited in claim 2, wherein the device is a plurality of bearings.

4. A rotary gravity compressor as recited in claim 2, wherein each of the plurality of cylinders is further comprised of:

a seal to assist in compression of gas as the piston moves between the first base and the second base.

5. A rotary gravity compressor as recited in claim 4, wherein the seal is comprised of at least one compression seal.

6. A rotary gravity compressor as recited in claim 1, wherein each of the plurality of cylinders is further comprised of:

a first shock absorbing device to lessen shock as the piston approaches the first base compressed state; and

a second shock absorbing device to lessen shock as the piston approaches the second base compressed state.

7. A rotary gravity compressor as recited in claim 1, wherein each of the plurality of cylinders is further comprised of:

a first locking device to hold the piston in the same position as the first base compressed state until the first locking device is released; and

a second locking device to hold the piston in the same position as the second base compressed state until the second locking device is released.

8. A rotary gravity compressor as recited in claim 7, wherein the rotary gravity compressor is used to produce compressed air having a pressure of less than approximately 100 psi.

9. A rotary gravity compressor as recited in claim 1, wherein the drive mechanism is a hydraulic system.

10. A rotary gravity compressor as recited in claim 1, wherein compressed air from the air outtake pipe is used to power an air turbine.

11. A rotary gravity compressor as recited in claim 1, wherein compressed air from the air outtake pipe is stored in an air tank that is used to power a pneumatic tool.

12. A system for generating power, comprising:

a rotary gravity compressor, comprising:

a rotating shaft having an air outtake pipe with a plurality of air connections;

a plurality of cylinders affixed to and juxtaposed about the rotating shaft at a plurality of different angles relative to rotation of the shaft, each of the plurality of cylinders further comprising:

a first base having a first intake valve and a first outtake valve for controlling flow of gas into and out of the cylinder, respectively, wherein the first outtake valve is connected to the air outtake pipe;

a second base having a second intake valve and a second outtake valve for controlling flow of gas into and out of the cylinder, respectively, wherein the second outtake valve is connected to the air outtake pipe, the second base being located at the opposite end of the cylinder from the first base; and

a piston movable within the cylinder;

wherein the piston moves between the first base and the second base as a result of gravity due to rotation of the shaft and creates compressed air within the cylinder in a downward direction of the piston; and

wherein compressed air is released from the cylinder through the first outtake valve when the piston is in a first base compressed state and through the second outtake valve when the piston is in a second base compressed state; and

wherein uncompressed air is introduced into the cylinder through the second intake valve as the piston moves between the second base compressed state and the first base compressed state and through the first intake valve as the piston moves between the first base compressed state and first base compressed state;

a drive gear mechanism for causing rotation of the rotation shaft; and

a generator for generating power that is powered by use of compressed air from the air outtake pipe.

13. The system of claim 12, further comprising:

an air tank located between the air outtake pipe and the generator.

14. The system of claim 12, further comprising:

an air turbine located between the generator and the air outtake pipe.

15. The system of claim 14, further comprising:

a transmission located between the air turbine and the generator.

16. The system of claim 14, wherein the air turbine is operated using outtake gas from the rotary gravity compressor with a pressure of less than about 100 psi.

17. A method for generating work from compressed air, comprising the steps of:

(1) generating compressed air through use of a rotary gravity compressor having a rotating shaft with an air outtake pipe with a plurality of air connections connected to a plurality of cylinders affixed to and juxtaposed about the rotating shaft at a plurality of different angles relative to rotation of the shaft, each of the plurality of cylinders comprising:

a first base having a first intake valve and a first outtake valve for controlling flow of gas into and out of the cylinder, respectively, wherein the first outtake valve is connected to the air outtake pipe;

a second base having a second intake valve and a second outtake valve for controlling flow of gas into and out of the cylinder, respectively, wherein the second outtake valve is connected to the air outtake pipe, the second base being located at the opposite end of the cylinder from the first base; and

a piston movable within the cylinder;
wherein the piston moves between the first base and the second base as a result of gravity due to rotation of the shaft and creates compressed air within the cylinder in a downward direction of the piston; and

wherein compressed air is released from the cylinder through the first outtake valve when the piston is in a first base compressed state and through the second outtake valve when the piston is in a second base compressed state; and

wherein uncompressed air is introduced into the cylinder through the second intake valve as the piston moves between the second base compressed state and the first base compressed state and through the first intake valve as the piston moves between the first base compressed state and second base compressed state; and

a drive gear mechanism for causing rotation of the rotation shaft;

(2) using the compressed air to generate work.

18. The method of claim 17, wherein the compressed air is first stored in an air tank before it is used to generate work.

19. The method of claim 18, wherein the air tank is used to power a pneumatic tool.

20. The method of claim 17, wherein the compressed air is used to power an air turbine that is used to drive an electrical generator.

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