



(51) International Patent Classification:

F03D 9/00 (2006.01) *F03D 3/02* (2006.01)
F03D 9/02 (2006.01) *F03D 11/00* (2006.01)

(21) International Application Number:

PCT/US2009/039481

(22) International Filing Date:

3 April 2009 (03.04.2009)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/123,287 7 April 2008 (07.04.2008) US

(71) Applicant and

(72) Inventor: **OHLE, Ernest, L.** [US/US]; 6960 Mikado Lane, Colorado Springs, CO 80919 (US).

(74) Agents: **DETWEILER, Sean, D.** et al.; Lahive & Cockfield, Llp, One Post Office Square, Boston, MA 02109-2127 (US).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) Title: BUILDING-BASED WIND CYLINDER INSTALLATION

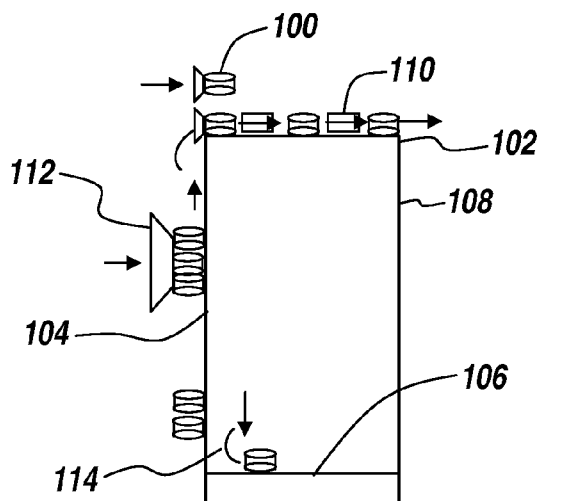


Fig. 1A

(57) Abstract: An energy generating system includes a plurality of wind cylinders configured for converting wind energy to mechanical energy. The system uses wind cylinders positioned on and/or around a building. At least one electrical generator converting the mechanical energy supplied by the plurality of wind cylinders to the electrical energy is coupled with the wind cylinders. The energy generating system further includes a distribution mechanism to distribute electrical energy generated by the at least one electrical generator. The energy generating system also includes a plurality of energy storage devices used to collect energy generated by the wind cylinders and supply energy back to the wind cylinders to contribute energy to the rotational motion of the wind cylinders.

BUILDING-BASED WIND CYLINDER INSTALLATION**RELATED APPLICATION**

This application claims the benefit of U.S. Patent Application Serial No. 61/123,287 filed April 7, 2008, the contents of which are hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention relates to energy generated from wind energy, and more particularly relates to utilization of a plurality of wind cylinders arranged in a predetermined grid or matrix arrangement on polygonal structures, including buildings.

BACKGROUND INFORMATION

Rising electricity prices are becoming a global problem as more countries are modernizing. Traditional electricity-producing sources and/or non-renewable resources are quickly depleting and not always accessible.

Renewable resources provide an alternative for the production of electricity. The availability of the renewable resources can and has been exploited in almost every location around the world. Renewable energy resources are available from many sources. These sources include but are not limited to wind, hydro, solar, and bio fuels. Some of these sources have been exploited for centuries, although their original use was not to produce electricity.

The present application is generally directed to using wind power as a source to produce electricity. As will be explained below, mechanical devices such as wind turbines or wind cylinders may be used to convert the wind power to electricity. These mechanical devices include spinning blades that rotates with wind power. In terms of the technical conversion of wind power to electricity, the formula relating power generation to wind properties and machine properties is expressed as:

$\frac{1}{2} \times \text{Air Density} \times \text{Wind Speed}^3 \times \text{Area of the blades} \times \text{Roughness of area.}$

This formula only gives the potential wind power in watts per blade area. Albert Betz's seminal study on flow through and around objects recognizes that the maximum conversion rate of a wind turbine converting wind to electricity is 59%. While the wind, in part due to location, may be inconsistent and variable, the height of the wind turbine towers today generally minimizes this variability. Even then, adding in all of the other possible production losses, most commercial megawatt wind turbines are efficient around 30 to 40% of their potential.

Wind energy conversion machines have been of two primary styles. Both styles are designed around a spinning blade connected to a tall pole. One style is the horizontal axis wind turbine (HAWT) that spins one or more blades around a horizontal shaft. The other style is a vertical axis wind turbine (VAWT) that spins several blades around a vertical shaft. The HAWT is placed at the top of a pole or structure in either an up-wind or down-wind position. The VAWT is connected at the top and bottom of the pole and spins around it in either an oval or 'H' shape.

The HAWT design has been more successful as a commercial application. While the VAWT has some unique characteristics that give it more potential, these features have produced additional problems - such as issues with the stress on the bottom connection when the wind is not blowing. Both the HAWT and the VAWT technical implementations have various operational constraints that are addressed by this invention.

One significant operational constraint for the commercial wind turbine comes directly from its technical success in producing electricity. To remain commercially competitive, the wind turbine must be built to larger standards. This means that the turbine tower, which is a single use structure, must be built taller to support a bigger wind conversion system. Currently the largest towers exceed 100 + meters in height. The blades have a diameter of 100 + meters. Behind the rotor is the nacelle that houses a 1, 2, or 3 + megawatt electricity generator. Together the complete structure may weight over 200 tons.

The base to support these giant structures may exceed 50 tons and require several acres of construction depending upon the bedrock depth and integrity of the ground.

A second operational constraint originates with the type of wind needed to operate a wind turbine. The wind must be smooth in its flow pattern, relatively unidirectional, and must have an average annual wind speed of 6 to 9 meters per second, for conventional wind turbine installations. Most rural wind turbine sites and those situated off-shore in shallow water have these characteristics. Non-smooth wind, such as that represented by frequent changes of direction, frequent changes of speed, and swirling wind (i.e., turbulent wind) create lost energy conversion opportunities, which is a concern for urban areas.

A third operational constraint originates with the need to have smooth wind flow. Wind turbines that are placed in a farm environment for efficiency of operation require substantial spacing between machines. This can be at least on the order of 20 to 40 acres. Assuming 3 rotor diameters horizontal and 5 rotor diameters vertical to the primary wind direction, an 80 meter diameter rotor has a 23 acre space requirement, approximately 4 x 6 acres. This is calculated by $(3 \times 80 \text{ m}) \times (5 \times 80 \text{ m}) \times .000247105 \text{ acre/m}^2$. Similarly, a 100 meter diameter rotor has a 37 acre space requirement, approximately 5 x 7.5 acres. This is calculated by $(3 \times 100 \text{ m}) \times (5 \times 100 \text{ m}) \times .000247105 \text{ acre/m}^2$.

To support an economically-viable wind farm, the amount of required land becomes fairly substantial and the access to the sites requires special equipment and construction techniques. The result is that wind farms are situated at great distances from the user.

This leads to a fourth operational constraint. The electricity grid needed to reach the user needs to be extensive. This adds to the initial cost of the wind farm. In addition, with the variability of the wind, the wind farm will produce its maximum electricity load only around 30% of the time. The grid needs to be built for this 30% load factor.

A fifth constraint is that the electricity generator size must be selected from predetermined configurations that do not accommodate variations in generation rates very well. Many are identified in the sales literature as 1.5 Megawatt, 2.0 Megawatt, and larger.

The difficulty is that when the wind reaches a speed where the rotor converts the wind at the nameplate electricity amount, i.e. usually at winds that are 12 meters per second, the electricity generator reaches its capacity. That means from 12 meters per second to the cut-out wind speed, the electricity generator will discard the excess energy.

A corresponding problem, a sixth operational constraint, is one where the wind flows too fast, above a threshold, i.e. the cut-out speed. That is generally around 25 meters per second. For safety purposes, the wind turbine is shut down, producing no electricity at all.

In addressing the above constraints, a seventh operational constraint is encountered. Extensive braking systems, both mechanical and electrical must be deployed on the blades and nacelle to a) shift the rotor and blades out of a perpendicular direction to the wind, b) deflect the wind from the effective attack angle, c) use air brakes on the tips of the blades to slow the blades, d) use mechanical brakes on the shaft, or e) reverse the electrical energy flow to slow the rotation of the blades. Most of these braking systems do not recapture the energy to generate additional electricity. Thus, efficiency further suffers.

An additional issue is an environmental one. The wind turbine's blade diameter and rotational speed can create acoustic and visual pollution, as well as potential bird killings.

Moving a wind turbine to an urban environment poses certain limitations. The three urban building constraints stem from wind quality and direction. First, building designs alter the winds around the building creating swirling winds. Second, the wind striking a building perpendicular to the building creates an upwind that forces the horizontal wind across the building's roof to vector upward based on their relative speeds. Third, the wind on the leeward side of a wind turbine creates its own turbulent wind reducing the number of wind turbines that could be supported by a building.

Thus, there is a need for a system and a method of using the wind power to generate electrical energy, while avoiding the above-identified constraints and issues. The present invention provides novel combinations of wind-driven, vertical axis, building-based wind

cylinders arrayed in patterns that optimize the harvest of available wind, and with improved designs further increase efficiency of operation.

SUMMARY

The present invention comprises a system and a method of using wind power to generate electrical energy. Novel combinations of wind-driven, vertical axis, building-based wind cylinders arrayed in patterns that optimize the harvest of available wind, with improved designs that further increase efficiency of operation, are disclosed. The present invention reduces the large wind generator blade areas and harnesses the energy contained in non-smooth wind flows represented by frequent changes of direction, frequent changes of speed, and swirling wind. The present invention also reduces the inter-generator spacing required for generator farms to allow the efficient use of space on large buildings in urban areas. The present invention allows placement of wind-generator farms in urban areas, substantially reducing the need for expensive, purpose-built transmission lines from the wind-generator locus to the site where the energy is needed and will be used. A wind generator design that can use winds with speeds in excess of those conventionally allowable with conventional generator designs is disclosed. As such, generator braking and control systems may be eliminated. The wind generator design disclosed herein allows energy generation from higher wind velocities than currently possible.

In accordance with aspects of the present invention, an energy generating system includes a plurality of wind cylinders formed of a first group of wind cylinders, a second group of wind cylinders or both. The wind cylinders are configured for converting wind energy to mechanical energy. The first group of wind cylinders is positioned on a polygonal structure at a first elevation and configured to convert wind energy to mechanical energy. The second group of wind cylinders is positioned on the polygonal structure at a second elevation and configured to convert wind energy to mechanical energy. The first elevation is greater than the second elevation. A subset of the plurality of wind cylinders is contemporaneously positioned at a corner of the polygonal structure. At least one electrical generator is coupled with the plurality of wind cylinders and adapted for conversion of the mechanical energy supplied by the plurality of wind cylinders to the electrical energy. The

energy generating system further includes a distribution mechanism coupled with the at least one electrical generator adapted to distribute electrical energy generated by the at least one electrical generator. The energy generating system also includes a plurality of energy storage devices bi-directionally coupled with the plurality of wind cylinders. The plurality of energy storage devices both collect energy generated by the first and second groups of wind cylinders and supply energy back to the first and second groups of wind cylinders to contribute energy to the rotational motion of the wind cylinders.

In accordance with various aspects of the present invention, an electrical energy generating system using wind power includes a plurality of wind cylinders formed of a first group of wind cylinders, a second group of wind cylinders or both. The wind cylinders are configured for converting wind energy to mechanical energy. The first group of wind cylinders is positioned at a roof of a building. The second group of wind cylinders is positioned at one or more corners of the building. Each wind cylinder of the plurality of wind cylinders comprises a plurality of blades and a plurality of magnets mounted on a surface of the wind cylinder and on a surface of the blades. The plurality of magnets produces a push-pull effect on the plurality of blades. The electrical energy generating system further includes a plurality of electrical generators coupled with the plurality of wind cylinders converting the mechanical energy supplied by the plurality of wind cylinders to electrical energy. A distribution mechanism coupled with the plurality of electrical generators is provided. A plurality of energy storage devices bi-directionally coupled with the plurality of wind cylinders are configured to store energy produced by the plurality of wind cylinders and supply energy to perpetuate the rotational motion of the plurality of wind cylinders. A wind cylinder of the plurality of wind cylinders is coupled with at least one electrical generator and one storage device.

In accordance with various aspects of the present invention, an energy generating system includes a plurality of wind cylinders formed of a first group of wind cylinders, a second group of wind cylinders or both. The wind cylinders are configured for converting wind energy to mechanical energy. The first group of wind cylinders positioned at a roof of a building. The second group of wind cylinders positioned at one or more corners of the building. Each wind cylinder of the plurality of wind cylinders comprises a plurality of

blades and a plurality of mobile weights move between the plurality of blades to increase a torque created by the plurality of blades. The energy generating system further includes a plurality of electrical generators coupled with the plurality of wind cylinders converting the mechanical energy supplied by the plurality of wind cylinders to the electrical energy. A distribution mechanism coupled with the plurality of electrical generators is provided. A plurality of energy storage devices bi-directionally coupled with the plurality of wind cylinders are configured to store energy produced by the plurality of wind cylinders and supply energy to perpetuate the rotational motion of the plurality of wind cylinders. A wind cylinder of the plurality of wind cylinders is coupled with at least one electrical generator and one storage device.

In accordance with various aspects of the present invention, a method of positioning a plurality of wind cylinders on a building to convert wind energy to mechanical energy is provided. The method includes positioning a plurality of wind cylinders formed of a first group of wind cylinders, a second group of wind cylinders or both, and configured for converting wind energy to mechanical energy on or around a building. A first group of wind cylinders is positioned on a roof of the building. A second group of wind cylinders is positioned on a plurality of corners of the building at a first elevation above ground. A third group is positioned above a canopy of the building at a second elevation above ground. The first elevation is greater than the second elevation. The method further includes connecting each wind cylinder to at least two power generators. A first power generator converts a mechanical energy generated by the plurality of wind cylinders to electrical energy and a second power generator stores a portion of the wind energy as compressed air. The method also includes supplying the electrical energy to at least the building.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become better understood with reference to the following description and accompanying drawings, wherein:

FIG. 1A illustrates a system of a plurality of wind cylinders positioned on a building according to one exemplary embodiment of the present invention;

FIG. 1B illustrates a wind cylinder placed on a side of the building according to one exemplary embodiment of the present invention;

FIG. 2A illustrates a top view of a wind cylinder according to one exemplary embodiment of the present invention;

FIG. 2B illustrates a side view of a wind cylinder according to one exemplary embodiment of the present invention;

FIG. 3A illustrates a wind cylinder with magnets placed on a wall and blades of the wind cylinder according to one exemplary embodiment of the present invention;

FIG. 3B illustrates a wind cylinder with weights placed on the blades of the wind cylinder according to one exemplary embodiment of the present invention;

FIG. 3C illustrates a wind cylinder with wings placed on the blades of the wind cylinder according to one exemplary embodiment of the present invention;

FIG. 4A illustrates a front view of side forms provided around the wind cylinder according to one exemplary embodiment of the present invention;

FIG. 4B illustrates a side view of side forms provided around the wind cylinder according to one exemplary embodiment of the present invention;

FIG. 4C illustrates a top view of side forms provided around the wind cylinder according to one exemplary embodiment of the present invention;

FIG. 5A illustrates a side view of middle forms provided around the wind cylinder according to one exemplary embodiment of the present invention;

FIG. 5B illustrates a top view of middle forms provided around the wind cylinder according to one exemplary embodiment of the present invention; and

FIG. 5C illustrates a side view of middle forms provided around a plurality of stacked wind cylinder according to one exemplary embodiment of the present invention.

DETAILED DESCRIPTION

The present invention is generally directed to a plurality of wind cylinders arranged in a grid or matrix, on and/or around a building. By providing such grid or matrix of wind cylinders on and/or around the building, it is possible to generate electricity, in an amount sufficient to power that building, relying on wind power as the source. Such an arrangement can also eliminate the need to connect the wind cylinders to a larger power grid, or can

alternatively enable net metering to occur with the wind power generating electricity to supply the grid. It is also possible to store energy that is not immediately consumed by the building. The stored energy may be utilized to contribute to rotation of the wind cylinders when the wind power is not consistent enough to keep the wind cylinders rotating.

According to aspects of the present invention, a plurality of wind-driven wind cylinders 100 are situated on one or more building roofs 102, at heights which take advantage of ambient wind flow, as well as at vertical corners 104, and, in some embodiments, above the canopy 106 that may be situated directly above the external walkways of the building 108, as illustrated in **FIG. 1A**. The placement of the wind cylinders 100 is configured to make use of the highly agitated winds around the building 108 to drive the 3 to 6 - 7.5 meter area blades of the wind cylinders 100. The blades are set, among other configurations, in a pattern spaced apart by either 120° or 60°. This arrangement of the blades optimizes harvest of available wind. In one exemplary configuration, each wind cylinder 100 has a footprint of 3 meters high by 6 square meters.

In contrast with conventional practice, roof-top cylinders may be stacked in accordance with embodiments of the present invention. Since the cylinder 100 is not as affected by turbulent wind streams, the residual leeward wind may be re-directed through an original design of a y-shaped form 110 combining two leeward cylinders into a single joint cylinder. This configuration may be used across the roof surface 102 until it reaches the building's leeward side. Wind from the opposite direction is processed in reverse. As the wind cylinders 100 are fixed in place on the building 108, each building side 104 is engineered to have wind cylinders 100 placed along the length of that side of the building 108. Wind cylinders may be stacked down a vertical length of each corner of the building 108 with wind forms 112 that increase the wind capture input space up to 27 square meters per wind cylinder 100. The position of the wind form 112, when extended out from the outer corner of the wind cylinder 100, creates a 3 meter high, and up to a 9 meter wide, wind entrance. Wind cylinders 100 above the canopy 106 use vertical forms 114 to direct the wind down and across the blades.

FIG. 1B illustrates, in accordance with one example embodiment of the present invention, a bird's-eye view of a plurality of wind cylinders 100 stacked on the corners 104 of the building 108. In segments spaced at 10 meters each along the corners of a building 108, three stacked wind cylinders 100 are placed starting at, for example, 30 meters above the ground. A 200 meter building 108 will therefore have 50 positions available for wind cylinders 100 at each corner. The forms 112 that direct the wind into these wind cylinders 100 create a consolidation input area of up to 27 square meters into a blade area of 7.5 square meters. The forms 112 may be moveable by computer control to adjust to the wind conditions. The struts that hold the wind cylinder forms 112 in place are attached to the building 108 as opposed to the wind cylinders 100.

In addition to the roof-top 102 and corner 104 cylinders, canopy top 106 cylinders may be placed around the building 108, for example about one floor up from ground level. The forms 114 that guide the downward wind into the cylinder's blade area curve at 90⁰ to maintain the vertical positioning of the wind cylinder 100 at the canopy top 106. In this configuration, ten wind cylinders 100 are placed per building side.

FIG. 2A illustrates a top view of the wind cylinder 100 and **FIG. 2B** illustrates a side view of the wind cylinder 100. According to one exemplary embodiment of the present invention, the dimensions of the wind cylinder 100 may be 3 meters high by 6 square meters. These dimensions are for illustrative purposes only and should not be construed as limiting of the invention. The wind cylinders may be built of different dimensions to accomplish the functions described herein. A core unit 202 of the wind cylinder can be identical in each placement location – roof top, corners, or above the canopy. Each wind cylinder 100 contains an electrical generator 206 and an air compressor 208 in the core unit 202.

Each wind cylinder 100 connects with two generators, i.e. the electrical generator 206 and the air compressor 208. The generators 206 and 208 may be provided within the core 202 of the wind cylinder 100. The electricity conversion device, i.e. the electrical generator 206, may support a maximum of 15 kilowatt per hour output in accordance with the exemplary embodiment of the present invention. The second conversion device 208

connected to each wind cylinder 100 is a mechanically-operated air compressor that creates a supply of stored energy during winds above the 15 kilowatt per hour generation periods when the generator 206 is unable to operate due to speed limitations. The unique design of this dual conversion solution enables the wind cylinder 100 to operate both above the current name-plate electricity generator's production limit, and above the nominal 'cut-out' speed designed into most wind turbine operational constraints. The compressed air stored by the air compressor 208 may be used to drive the electricity generator 206 during low wind periods.

The 15 kWh nameplate electricity generator 206 can be modified to fit inside the 1 meter core 202 of the wind cylinder 100. The air compressor 208 is an original mechanical compression and compressed air holding device provided at the base of the core 202 of the wind cylinder 100. The electricity generator 206 is a modified standard generator attached to the inside frame in the core 202 of the wind cylinder 100. The electricity generator 206 creates a maximum of 15 kilowatt hours of electricity. The air compressor 208 is a mechanical device that runs above the 15 kWh level of the electricity generator 206. The air compressor 208 converts air into a compressed form and moves the compressed air to a storage location near the wind cylinder 100. Using the wind rose to determine historical wind speeds during a year, the compressor 208 is optimized to supplement low wind speeds with the reserve of compressed air.

The exemplary wind cylinder 100 also has a plurality of blades 204. In keeping with the unique design of the blades 204, there are three enhancements to create a positive energy extraction increase above the standard formulaic amount for a 7.5 square meters wind cylinder. These include a) magnets, b) weights, and c) wings.

FIG.3A illustrates an exemplary use of a plurality of magnets provided on a blade 204 and a wall 210 of the wind cylinder 100 in a configuration producing a push-pull effect on the blade 204. Two magnets 304 and 306 situated on a wall 210 of the wind cylinder 100 have opposite charges and are separated by a shield. The forward magnet 306 has a positive (+) charge and the rear magnet 304 has a negative (-) charge. Forward is defined as the direction of the motion of the blade 204. A negatively (-) charged magnet 302 is provided

on the tip of the blade 204. When the blade 204 is centered between the two wall magnets 304 and 306, their charges are enhanced by an electricity flow of $1/18^{\text{th}}$ the amount of that produced by the spinning wind cylinder blades 204. The magnets will also provide a reduced friction for the rotating blades by creating a repulsion force during start up.

FIG. 3B illustrates an exemplary use of weights 308 that allow the wind cylinder 100 to dramatically change the weight proportion of the wind cylinder 100 in a manner not available to the horizontal-axis wind turbine. The weights 308 are provided in a plurality of tubes 310 that are 0.15 meters in diameter in the exemplary illustrative embodiment described herein. The tubes 310 extend from the inside of the core 202 of the cylinder out to the external support structure 312 of the spinning cylinder 100. Each tube 310 may contain five balls, i.e. weights; the outer ball is 1 kilogram, the second ball is increased to a weight of, for example 2 kilograms, the third ball is 3 kilograms, the fourth ball is 4 kilograms, and finally the fifth ball is 5 kilograms and is located nearest the core 202. As the wind cylinder 100 spins faster, the balls, i.e. the weights 308, move out along the tube 310 to the outer end. The weights 308 increase the torque and minimize a spin rate of the wind cylinder 100 during high winds (thus both storing mechanical energy and providing a rotational speed control for wind cylinder 100). The tube 310 starts with a vertical down portion just inside the core 202 where the balls are positioned at the bottom with the weight of the 5 kilogram and 4 kilogram balls slightly to the inside of the inner core 202. The tube 310 bends 120° toward the external support structure 312. As it comes closer to the external support structure 312, the pipe 310 bends more sharply upward until it is at a perpendicular angle to the surface. Both ends of the pipe 310 are sealed with a small hole at the inner seal for air removal and a larger hole at the outer seal for faster air removal. Each end of the pipe will hold a spring board to slow the speed of the balls. Each tube 310 is designed with two grooves set 180° apart and of .02 meters in depth to provide free wind flow during the ball movement. There may be three to six tubes 310 that center between and match up to the three to six blades 204.

FIG. 3C illustrates exemplary blades 204 or wings 314 designed to increase the aerodynamic properties that generally escape a 'push' design of wind cylinder 100. The enhancements may include 1) one or more vertical wings 314 on the outside section of each

blade 204; 2) horizontal wings 314 along the center of each blade 204; 3) off-center cams at the end of each wing 314 that adjust the wings 314 to the proper 'angle of attack' for any wind speed on the wind intake side of the cylinder 100 and make the wing 314 parallel to the spin direction on the back side of the cylinder 100; and/or 4) off-center cams inside the wings 314 that rotate to full width on the wind intake side. A wing curvature is created on the wind intake side of the cylinder 100. This increases the leeward side air pressure and increases the spin rate of the wind cylinder 100. The center cam moves to its least width to create a flat wing 314 on the back side of the cylinder 100 where minimum air contact is preferable.

In one exemplary configuration, the wind is guided into the wind cylinder 100 using forms, i.e. wind deflectors, which divert the wind from an 18 square meters entrance into a 7.5 square meters entrance. The forms are not secured to the wind cylinder structure 100. Rather, the forms are attached directly to the building 108 to simplify the physical structure of both the wind cylinder 100 and the forms. The wind cylinder 100 experiences less stress and fewer electricity production failures by attaching the forms to the building 108. The forms are designed to allow wind to pass through the forms when the wind flows directly into the wind cylinder 100. The forms are further designed to guide the wind from disparate directions (up to 60° from a front facing location) into the wind cylinder 100.

Depending upon the location of the wind cylinder 100, the appropriate form is placed before or after it. The forms include a) three unique forms on the roof, b) 1 pair on the corners, and c) 1 form above the canopy. All forms are secured to the building 108 rather than to the wind cylinder 100 or the support structure of the wind cylinder 100. Eliminating the need to use the support for the wind turbine as the support for its non-productive components reduces machine failure. Each form is able to withstand winds equal to the maximum destructive force of 200 kilometers per hour of the building 108. A wind rose of the building's annual wind pattern determines the best angle to place the forms.

As the wind can come from multiple different directions of the compass, a set of forms is created to face outward from the edge of the building. Because the wind has fairly consistent dominant flow patterns due to the existence of the building structure, it is

preferable to set the forms so that they attempt to face the oncoming wind in a best intake position. This may be accomplished by placing a curved, bolted or welded cap on the outer edge to bend the wind into the wind cylinder from the predominant directions. As different seasons and even different times of day create different predominant wind directions, and because the wind cylinders along the roof and on the corners will be fixed, the first generation of the forms may have a limited directional change to capture their wind energy from the most dominant directions. The cap section may be automated to bend toward the wind based on real time external wind vane readings. Within the 90 degree range, the moveable form caps would be able to capture more wind energy than fixed caps would.

FIGs. 4A-4C illustrate two example types of forms 402 and 404, i.e. wind deflectors, fronting each wind cylinder 100 along the parapet. The first form is referred to as down form 402. The down form 402 extends outward 3 to 4 meters from the building 108 and curves downward in a 90° arc for 3 meters. The cylinder side of the down form 402 extends 1 meter up the entrance into the wind cylinder 100. The down form 402 directs wind from an 18 square meters area into an area of 2.5 square meters. The second form, referred to as the side form 404, is located on either side of the wind cylinder 100. The side forms 404 shadow the width of the wind cylinder's 6 meter length and extend up to the top of the wind cylinder 100. Because multiple wind cylinders 100 are stacked, the base cylinder, i.e. the lowest wind cylinder, has an 18 square meters entrance into the 5 square meters cylinder's opening.

As illustrated in **FIG. 4C**, the side forms 404 have a curvature on the inside allowing wind not directly entering the cylinder's opening, to be directed, up to an angle of 60° into the cylinder's opening. This curved form's exact shape is determined by the wind rose of the building 108. Each higher stacked cylinder 100 has identical side forms 404 still directing wind from an 18 square meters area into a larger entrance area of 6.25 square meters. The lower form 402 extends out 3 to 4 meters but only extends down 0.5 meters. This results in an 18 square meters entrance into a 1.25 square meters area. Both wind cylinders 100 and the forms 402 and 404 are locked in place on the roof 102, or for stacked cylinders 100, onto the frame of the base form that is locked in place on the roof 102.

Multiple wind cylinder 100 pairings group four wind cylinders 100 on the windward side with two wind cylinders 100 in the middle and one wind cylinder 100 on the leeward side.

FIG. 5A illustrates exemplar internal forms 500 provided between the windward, parapet-based wind cylinders 502 and the middle cylinders 506, and then the middle cylinders 506 and leeward parapet-based wind cylinders 504. The forms 500 are enclosed. The forms 500 have a 'Y' shape between the two cylinders on the windward side of each connection. The forms 500 also have a safety leg from a third wind cylinder on the windward side into the connection of the 'Y's legs. This leg is normally blocked by an internal moveable plate but during maintenance it can be opened. As the wind has the ability to blow from many directions, the 'Y' shape of the vents is typically designed for a primary entrance from all four sides of a rectangular building and skewed for a circular or oval building. Vent openings and blockage can be controlled by computer.

FIGs. 5B-5C illustrate a paired stack of cylinders 510 and 516 in accordance with one example embodiment of the present invention. The top of the pair cylinders 512 and 518 mirror the bottom of the pair of cylinders 514 and 520. Between each pair, a step up / step down or vent door, also called a diversion door 522, is provided. The diversion door 522 redirects the wind to the operating pair's middle cylinder during maintenance downtime. Since there are multiple paired stacks on the roof, the form structures continue a paired mirror arrangement from the rooftop on up.

A software application may be provided to control the wind cylinder system discussed above. The software application that controls the system may be designed to maximize the electricity output to the building at a pre-set amount. The software application may control external form positions and internal wind flow for all of the wind cylinder's forms. The software application may position the wing angle in the wind cylinder to maximize the lift efficiency during operation. The software application may further maximize the effect of the magnets. The air compressor's operation may be controlled with the software application during high and low wind cycles. The software application may also control the electricity generator's operation at its maximum output using the air

compressor to control the output at 15 kilowatt hours. Using the software application, the electricity output may be synchronized with the building's electricity usage.

Illustrative Examples:

Three illustrative examples of the above system are provided below. The examples are based on generalized assumptions that may not reflect actual electricity purchase or usage.

Assumptions:

The building is at least 200 meters high and contains square corners. Only three of four corners with wind cylinders would operate at any one time. The base electricity use for the building is 64 watts per square meter. The roof surface is flat. Average natural wind speed is assumed to be 12 meters per second when the anemometer height of 10 meters has a wind speed of 4.4 meters per second for an urban environment. Roughness is 0.3 for an urban environment. The wind cylinder is assumed to operate at 80 percent of the time annually.

For the roof system, the wind conversion is assumed to be at 25% of available wind energy. A secondary system behind the first system would combine the residual wind of two windward wind cylinders with the same wind conversion rate. The same configuration follows to the leeward wall. Wind in the opposite direction is processed in an identical manner using the same forms. Average electricity generation per wind cylinder would be 12 kilowatts per hour.

For the corner system, there are sets of 3 wind cylinder units from the 100 meter height to the roof edge. The wind cylinders are spaced as needed. The forms before and after the wind cylinders have limited adjustment to wind direction.

Example 1:

A first example building has a height of 218 meters. It uses about 6 watts per square foot which converts into 64 watts per square meter. The building houses around 120,000 square meters of space on 56 floors. Its base need for electricity is 7,680 kilowatts per hour.

The estimated average electricity supplied by a wind cylinder designed to produce 15 kilowatts per hour of electricity would normally be around 12 kilowatt hours due to wind direction, speed, season, and other electrical and mechanical deficiencies. A 70% annual operation rate (10.5 kilowatts per hour) is lower than the expected 80% operation rate due to the higher altitude (1610 meters above sea level.) The primary location of the wind cylinders would be on the corners. In this configuration, 120 wind cylinders are installed. At any one time, 90 wind cylinders are operational. 30 wind cylinders per corner from the 100 meter height to the 200 meter height produce 945 kilowatts of electricity per hour. A small roof area can house 48 wind cylinders (40 operational at any one time). That produces another 420 kilowatt hours. As such, the building can produce 18 percent of its electricity on site using the wind cylinder system of the present invention.

Example 2:

The example building contains 418,064 square meters of enclosed space. Base electricity usage for the building equals 26,750 kilowatt hours, at 64 watts per square meter. The number of corner wind cylinders averages 50 units per corner for up to 8 of the building's corners. At this rate, the output for the 200 meters above sea level building equals 80 percent per unit. With 400 units (300 operating at any one time), the building's wind cylinder corner solution generates 3,600 kilowatts per hour. On the roof tops, approximately 200 wind cylinder units (140 operating at any one time) are stacked to take advantage of the prevailing winds. These units generate 1,680 additional kilowatt hours of electricity.

Example 3:

This example building is a 241 meter, 60 story building. This 160,000 square meters building, with its 241 meter height, has the potential to generate more electricity from all of

the attachable areas for wind cylinders. Estimated electricity usage at 64 watts per square meter equals 10,240 kilowatts per hour. On the corners, 40 wind cylinders per corner (120 of the 160 operating at any one time) generate 1440 kilowatts per hour. Not only with its height, the location of the building at sea level and with notoriously cold blustery winter winds, the density of the air creates additional positive energy conversion potential. In addition to the 1440 kilowatt hours generated on the corners, the roof structure is used to house an additional 240 units in layers of 40 (180 operating at any one time). The amount of electricity these units create is 2,160 kilowatt hours.

With many wind cylinders designed in accordance with this disclosure and situated on top of a building in a manner described in this disclosure, on the corners of the building, and above the canopy covering the walkway, all current wind turbine constraints and issues discussed above are addressed and most are completely eliminated. The three building wind turbine operational constraints are also eliminated. The electricity that the wind cylinder produces can be used on site or can be directed into the attached power grid. The number of wind cylinders needed to produce the electricity used by a building or structure can be calculated from wind conversion electricity generation formulas and the current electricity usage of the building, as would be understood by those of ordinary skill in the art. When the wind cylinders are located on site where the electricity user is situated, with the addition of a non-electricity secondary generator that produces compressed air, the wind cylinder will be able to produce the maximum electricity, e.g., 15 kilowatts per hour, up to 100% of the time.

The design and location of the wind cylinder on a building does not require extensions of the pole to support larger blades and more powerful electricity generators. The cumulative number of building wind cylinders target the electricity output needs of the building. Because the number of units per building can be selected to meet specific electricity power needs, the building wind cylinder does not need to be physically as big as the conventional leading-edge wind turbines. The small size and vertical axis of individual wind cylinders allows each wind cylinder to operate in the high blustery winds that are created by the building's design. An optimal size for a wind cylinder in accordance with one exemplary embodiment of the present invention is 3 meters high by 6 meters wide and 6 meters deep. While the cumulative weight of all of the building's wind cylinders might

equal a single wind turbine's rotor, blades, base, and nacelle, the many positions of the wind cylinder on a building distribute the cumulative weight around the building structure.

New buildings can be designed *de novo* to accommodate this system of wind-driven power generation. The novel configuration of the present invention can also be retrofitted onto existing building structures by re-engineering them to support the connection of the forms and the wind cylinder. In buildings designed *de novo* to incorporate such wind cylinder devices, the weight of the power generators may usefully offset the weight requirements for devices to minimize building sway in high winds. Two additional benefits to using a building for wind generator placement in place of the traditional wind turbines' base and tower include: 1) The building exists for other purposes and is not a single purpose cost; and 2) The building's height can be up to 2 to 3 times higher than the current wind turbine's tallest tower providing significantly greater wind potential.

The high wind speed that can be destructive to the conventional wind turbine (forcing a shut down of the rotor) is actually a significant contributor to a wind cylinder's economically efficient operation. The smaller blade surface of the wind cylinders and the multi-point structural connections of the wind cylinders provide a machine that can operate in all winds. Furthermore, in accordance with the embodiments of the present invention, there is no operational cutoff resulting in electricity production loss for the nameplate electricity generator. The electricity generator can run in any winds at any speed when the excess energy is mechanically converted into compressed air, or some other form of storage.

The design of the present invention enables the wind cylinders to be placed close together. In fact, the close proximity enables additional energy extraction from the leeward wind. The channeling of leeward wind recognizes Betz's theory of wind conversion restriction and restates it as a positive law of residual energy re-usage.

In addition, most of the braking techniques that are designed to slow a wind turbine when it passes the nameplate generating speed, or halt the wind turbine when it reaches a wind speed of 25 meters per second are not necessary with the present invention. The only braking system will be the closure of the windward forms when maintenance is needed.

Wind through the leeward forms will be diverted to operational wind cylinders. Non-working cylinders will be in a stopped state because no wind will cross the blades.

Likewise, in the urban environment with a mesh screen at the intake, birds are kept out of the blade system. With the cylinders in dispersed locations, noise and visual pollution are reduced. With solid connections between the wind cylinder and the building and properly positioned dampeners, vibrations should be negligible.

In accordance with aspects of the present invention, the wind cylinder's attributes match up to the urban wind forces. 1) Angular wind is straightened using forms to re-direct the upwind along the face of the building. 2) Blustery wind is harnessed by allowing its free flow into smaller sturdier structures. 3) The exhaust wind from one cylinder is channeled with a peer wind cylinder into a following wind cylinder for additional wind reprocessing.

The various embodiments described above can be used to enhance usage of wind power by creating electricity generators that can resist powerful winds, deflecting wind to concentrate its power, changing the blade structure of the wind cylinders with weights to store excess energy and control blade speed, and using magnetic push/pull force to create additional blade force.

The present invention combines the natural resource of the wind power with the location of the electricity user. The wind is faster at higher locations. Its energy potential grows rapidly at higher speeds. By placing the wind cylinders on and around a building, the natural qualities of the wind can be converted to easily accessible electricity. The small footprint of the wind cylinders help to profit from the powerful characteristics of the wind that may be destructive for conventional systems producing electricity using wind power.

CLAIMS

What is claimed is:

1. An energy generating system, comprising:
 - a plurality of wind cylinders formed of a first group of wind cylinders, a second group of wind cylinders or both, the plurality of wind cylinders configured to convert wind energy to mechanical energy;
 - the first group of wind cylinders positioned on a polygonal structure at a first elevation in such a way that converts wind energy to mechanical energy;
 - the second group of wind cylinders positioned on the polygonal structure at a second elevation in such a way that converts wind energy to mechanical energy, the first elevation being greater than the second elevation;
 - a subset of the plurality of wind cylinders being contemporaneously positioned at a corner of the polygonal structure;
 - at least one electrical generator coupled with the plurality of wind cylinders and configured to convert the mechanical energy supplied by the plurality of wind cylinders to the electrical energy;
 - a distribution mechanism coupled with the at least one electrical generator adapted to distribute electrical energy generated by the at least one electrical generator; and
 - a plurality energy storage devices bi-directionally coupled with the plurality of wind cylinders;

wherein the plurality of energy storage devices both collect energy generated by the first and second groups of wind cylinders and supply energy back to the first and second groups of wind cylinders to contribute energy to the rotational motion of the wind cylinders.
2. The system of claim 1, wherein the polygonal structure comprises a building.
3. The system of claim 2, wherein the first group of wind cylinders is located on a roof of the building.
4. The system of claim 1, further comprising:

a plurality of wind deflectors mounted in such a way that diverts wind toward the plurality of wind cylinders to increase an amount of wind captured by the plurality of wind cylinders, wherein the plurality of wind deflectors are attached to the polygonal structure.

5. The system of claim 2, wherein a position of the plurality of wind deflectors is variable and is computer-controlled.
6. The system of claim 5, wherein the position of each of the plurality of wind deflectors is adjusted in response to a change in wind direction, wind speed, or both.
7. The system of claim 1, wherein first group of wind cylinders and the second group of wind cylinders are vertically stacked relative to each other.
8. The system of claim 1, further comprising:
a third group of wind cylinders provided at a third elevation, wherein the third elevation is less than the second elevation.
9. The system of claim 1, wherein each of the plurality of wind cylinders comprises a plurality of blades, an angle between two consecutive blades being 60 degrees or 120 degrees.
10. The system of claim 1, wherein a storage device of the plurality of storage devices comprises a mechanically operated air compressor.
11. The system of claim 1, wherein the distribution mechanism is coupled with a power grid.
12. The system of claim 1, wherein each of the plurality of wind cylinders has a vertical axis of rotation.
13. The system of claim 1, wherein each of the plurality of wind cylinders is coupled with an electric generator and a storage device.

14. The system of claim 1, wherein an electrical generator and a storage device are provided inside at least one wind cylinder of the plurality of wind cylinders.
15. The system of claim 1, wherein the system is controlled by a computer.
16. An electrical energy generating system using wind power, the system comprising:
a plurality of wind cylinders formed of a first group of wind cylinders, a second group of wind cylinders, or both, the plurality of wind cylinders configured to convert wind energy to mechanical energy;
the first group of wind cylinders positioned at a roof of a building;
the second group of wind cylinders positioned at corners of the building;
each wind cylinder of the plurality of wind cylinders comprises a plurality of blades and a plurality of magnets mounted on a surface of the wind cylinder and on a surface of the blades, wherein the plurality of magnets produce a push-pull effect on the plurality of blades;
a plurality of electrical generators coupled with the plurality of wind cylinders converting the mechanical energy supplied by the plurality of wind cylinders to electrical energy;
a distribution mechanism coupled with the plurality of electrical generators; and
a plurality of energy storage devices bi-directionally coupled with the plurality of wind cylinders and configured to store energy produced by the plurality of wind cylinders and supply energy to perpetuate the rotational motion of the plurality of wind cylinders;
wherein a wind cylinder of the plurality of wind cylinders is coupled with at least one electrical generator and one storage device.
17. An energy generating system, comprising:
a plurality of wind cylinders formed of a first group of wind cylinders, a second group of wind cylinders, or both, and the plurality of wind cylinders configured to convert wind energy to mechanical energy;
a first group of wind cylinders positioned at a roof of a building;
a second group of wind cylinders positioned at corners of the building;

each wind cylinder of the plurality of wind cylinders comprises a plurality of blades and a plurality of mobile weights move between the plurality of blades to increase a torque created by the plurality of blades;

a plurality of electrical generators coupled with the plurality of wind cylinders converting the mechanical energy supplied by the plurality of wind cylinders to the electrical energy;

a distribution mechanism coupled with the plurality of electrical generators; and

a plurality of energy storage devices bi-directionally coupled with the plurality of wind cylinders and configured to store energy produced by the plurality of wind cylinders and supply energy to perpetuate the rotational motion of the plurality of wind cylinders;

wherein a wind cylinder of the plurality of wind cylinders is coupled with at least one electrical generator and one storage device.

18. A method of positioning a plurality of wind cylinders on a building to convert wind energy to mechanical energy, the method comprising:

positioning a plurality of wind cylinders formed of a first group of wind cylinders, a second group of wind cylinders, or both, and the plurality of wind cylinders configured to convert wind energy to mechanical energy on or around a building;

positioning a first group of wind cylinders on a roof of the building,

positioning a second group of wind cylinders on a plurality of corners of the building at a first elevation above ground;

positioning a third group above a canopy of the building at a second elevation above ground, wherein the first elevation is greater than the second elevation; and

connecting each wind cylinder to at least two power generators, wherein a first power generator converts a mechanical energy generated by the plurality of wind cylinders to electrical energy and a second power generator stores a portion of the wind energy as compressed air;

wherein the resulting plurality of wind cylinders supply electrical energy to at least the building.

19. The method of claim 18, wherein the first, second or third group of wind cylinders comprises vertically stacked wind cylinders.

20. The method of claim 18, wherein the first group of wind cylinders comprises a first row of wind cylinders, a second row of wind cylinders and a third row of wind cylinders, wherein each row is formed of a plurality of wind cylinders aligned relative to each other and a plurality of wind cylinders vertically stacked relative to each other.

21. The method of claim 20, wherein the first row of wind cylinders are windward wind cylinders and the third row of wind cylinders are leeward wind cylinders.

22. The method of claim 20, wherein a number of wind cylinders forming a width of the second row are less than a number of wind cylinders forming a width of the first and third rows.

23. The method of claim 20, wherein the wind cylinders of the second row are positioned across from the wind cylinders positioned in middle of the first row and the wind cylinders positioned in middle of the second row.

24. The method of claim 18, further comprising:
providing a plurality of wind deflectors mounted to divert wind toward the plurality of wind cylinders to increase an amount of wind captured by the plurality of wind cylinders;
and
controlling a position of the wind deflectors by a computer.

25. The method of claim 24, wherein the plurality of wind deflectors comprises a plurality of side wind deflectors located at either side of a wind cylinder and a plurality of down wind deflectors.

1/7

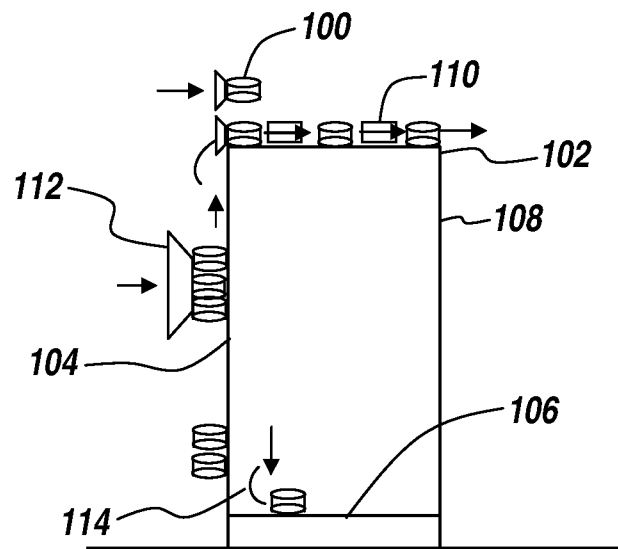


Fig. 1A

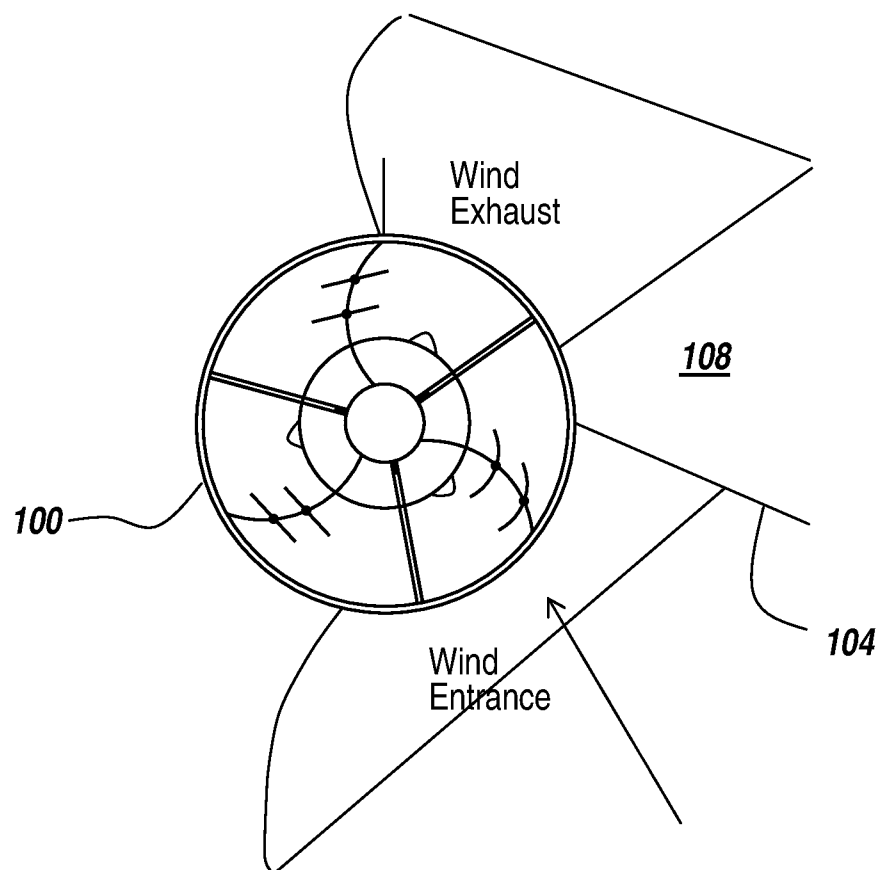


Fig. 1B

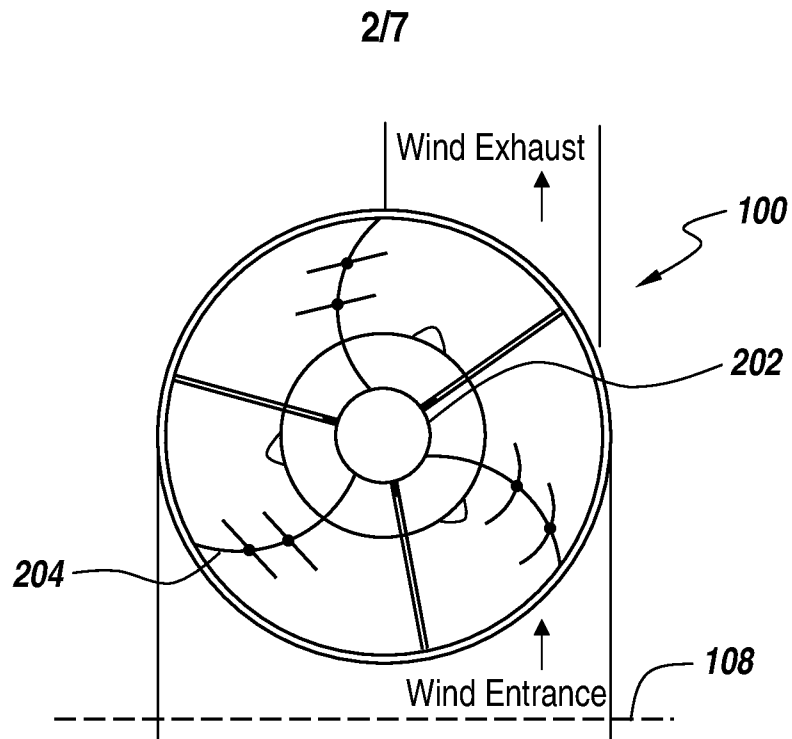


Fig. 2A

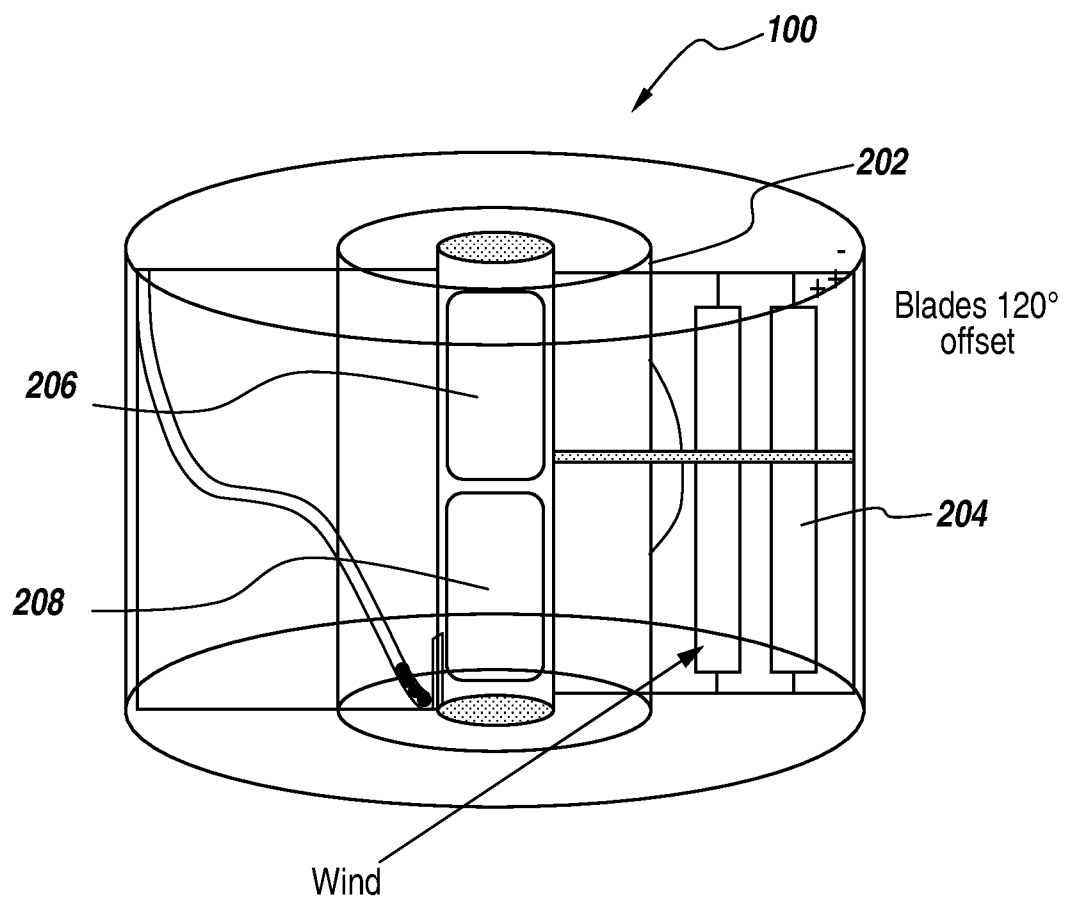


Fig. 2B

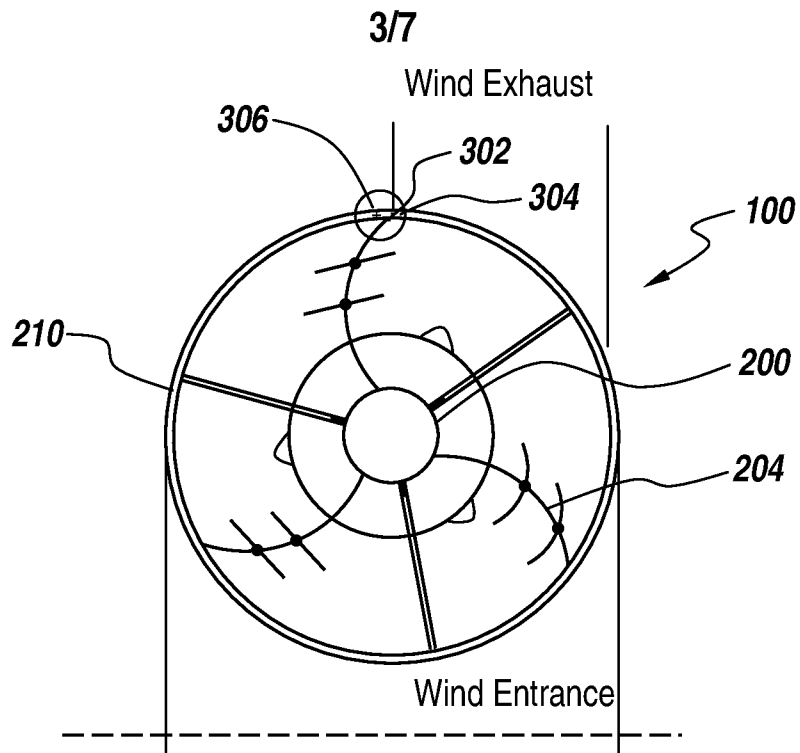


Fig. 3A

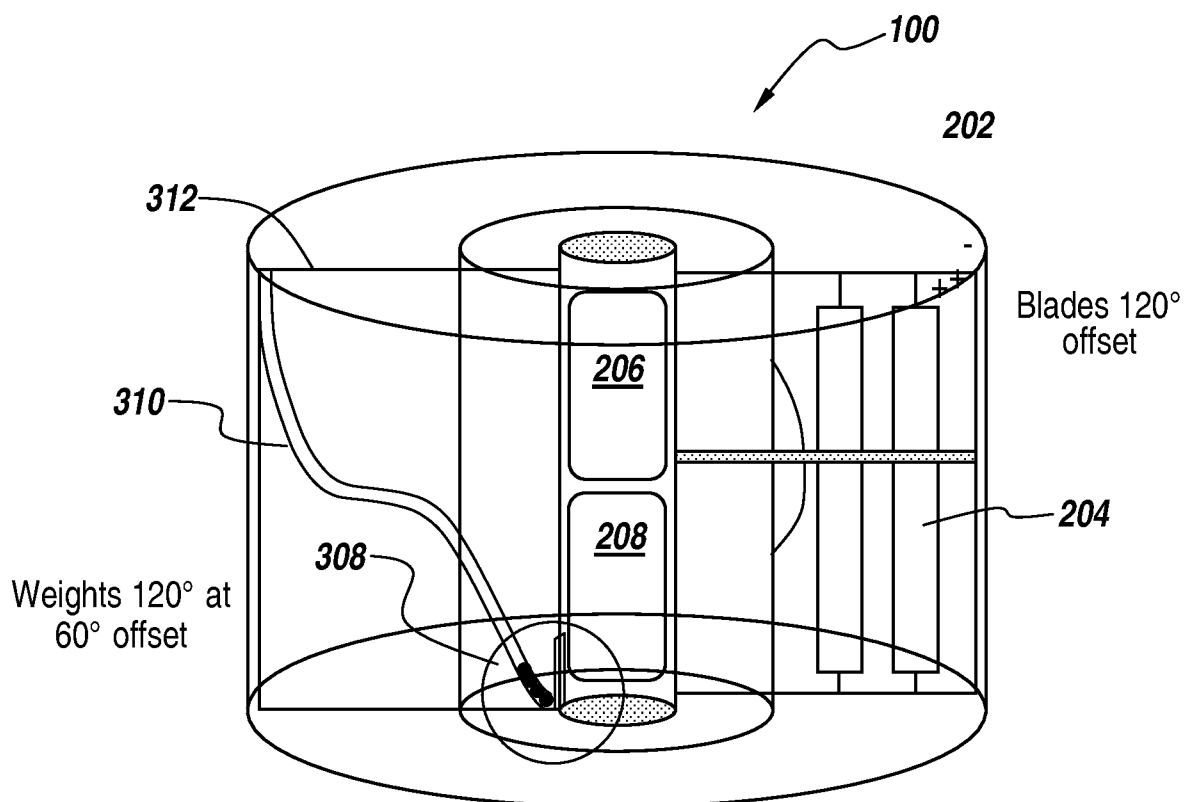


Fig. 3B

4/7

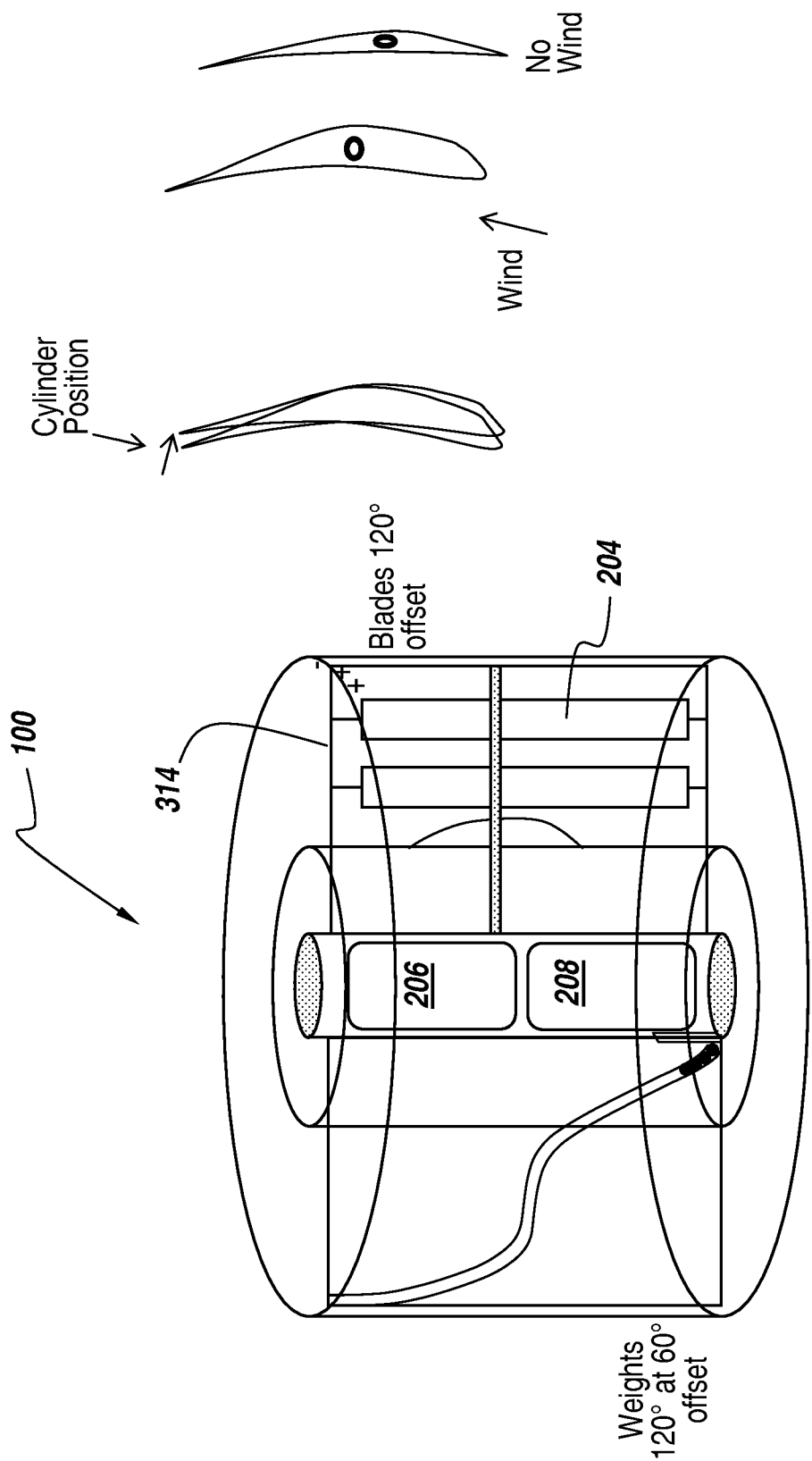


Fig. 3C

5/7

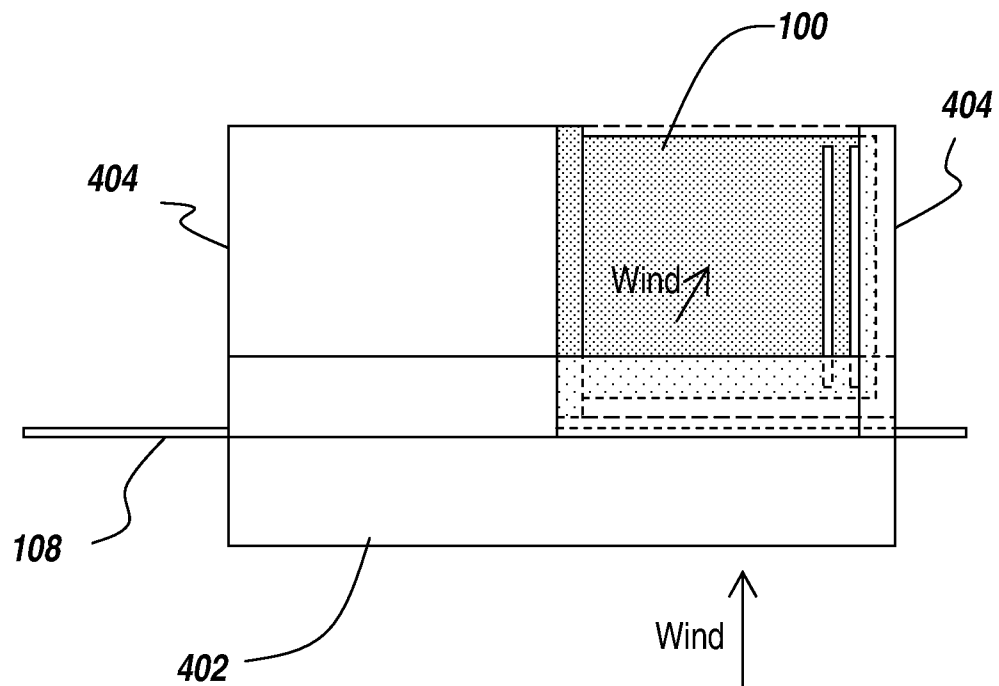


Fig. 4A

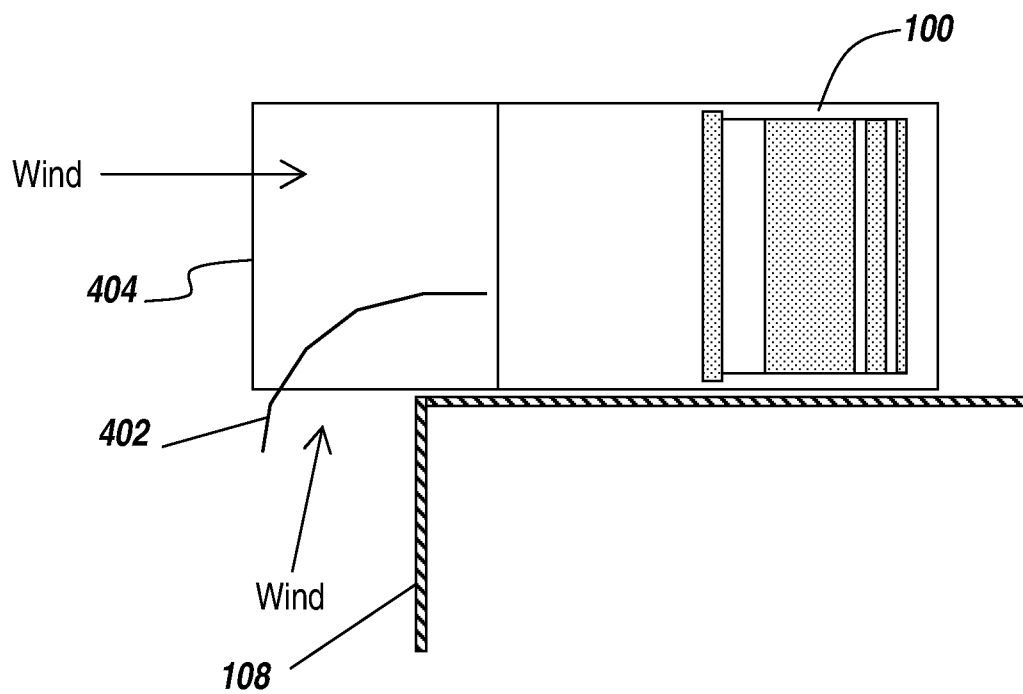


Fig. 4B

6/7

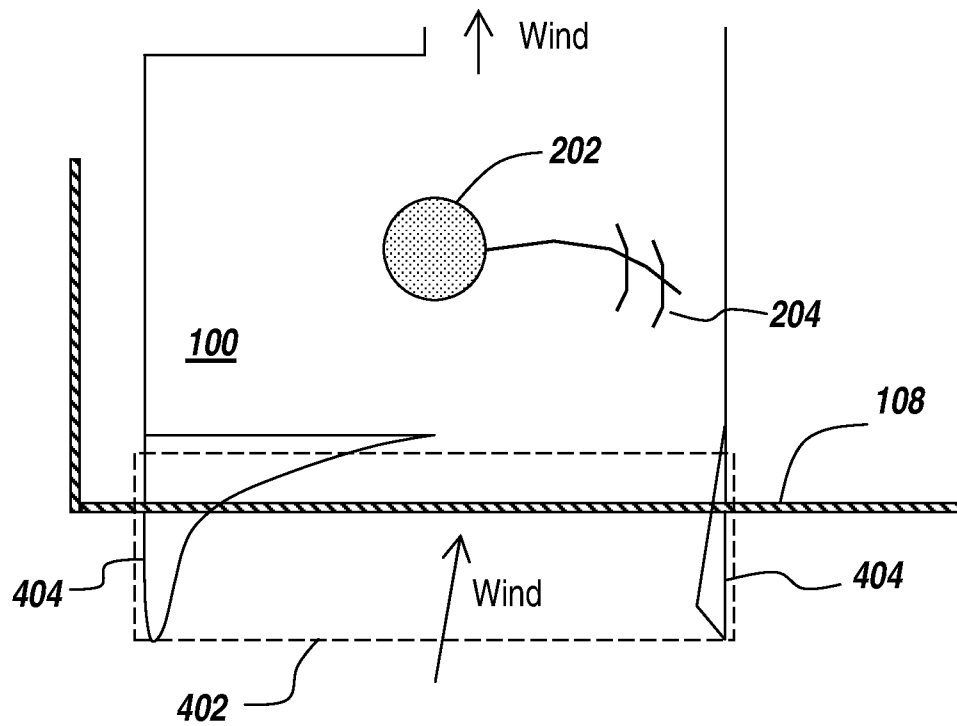


Fig. 4C

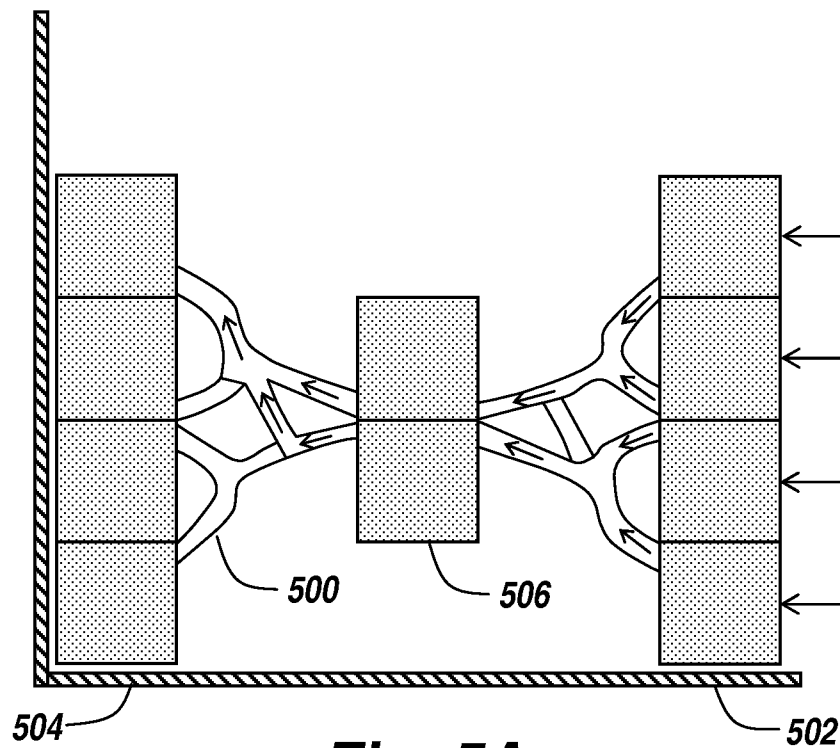


Fig. 5A

7/7

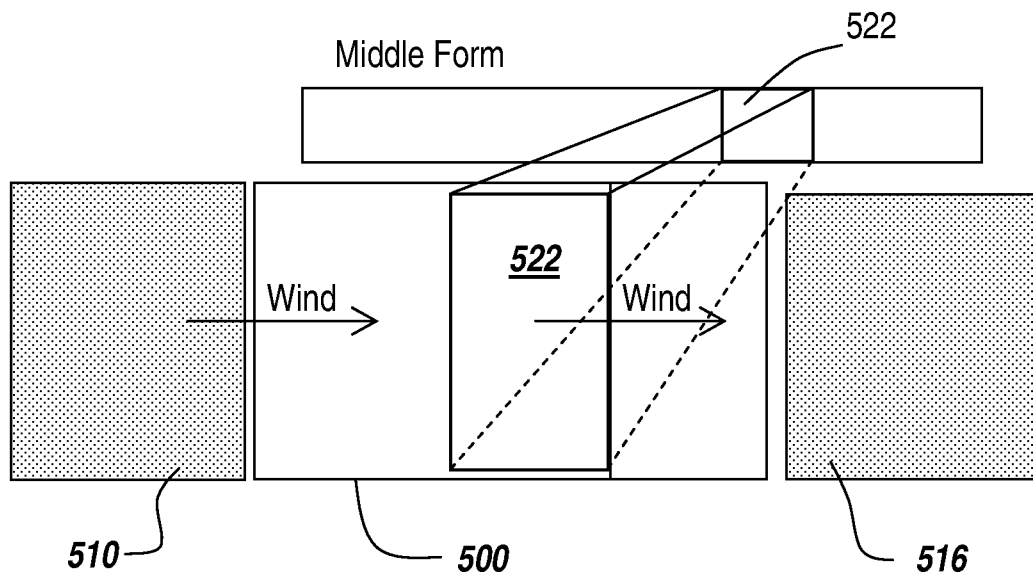


Fig. 5B

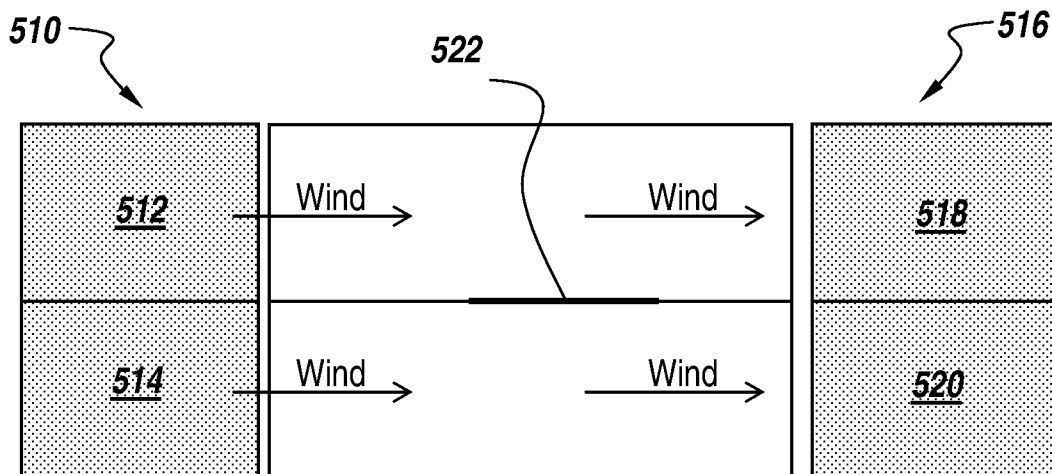


Fig. 5C