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(54) **TUBULAR TURBINE SYSTEMS AND METHODS**

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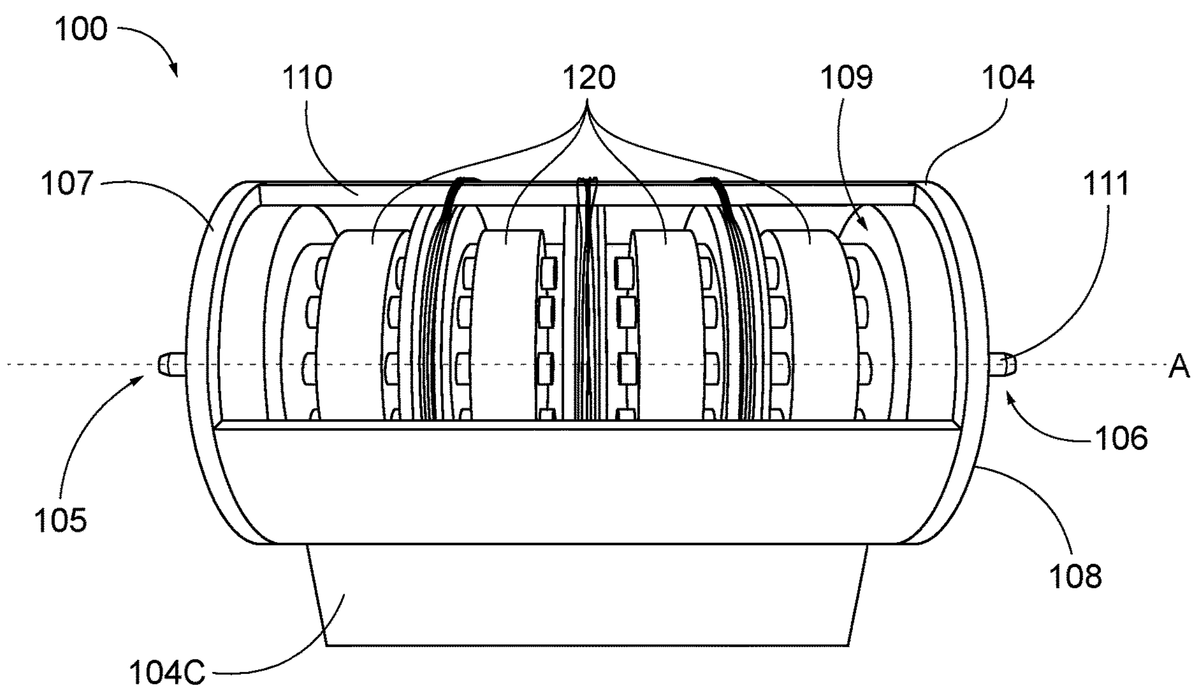
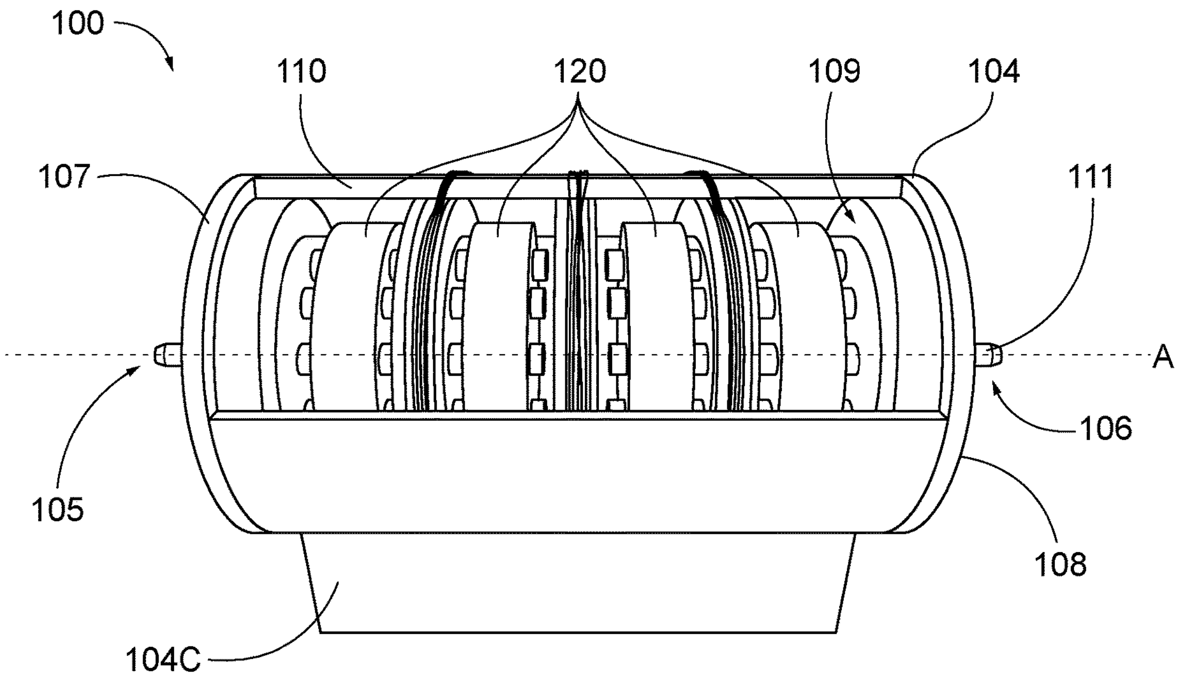
(57) **ABSTRACT**

A turbine system configured to convert fluid energy into electrical power is disclosed. The turbine system includes a tubular frame, a shaft disposed in the tubular frame, a fan coupled to the shaft, and at least one turbine that utilizes rotation of adjacent copper coil discs and magnetic discs to generates energy when a fluid impinges the fan. This configuration allows for a smaller turbine system that may be placed in various compact spaces and that provides a localized, efficient source of electrical energy

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110
120
109
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107
111
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105
108
104C

FIG. 1

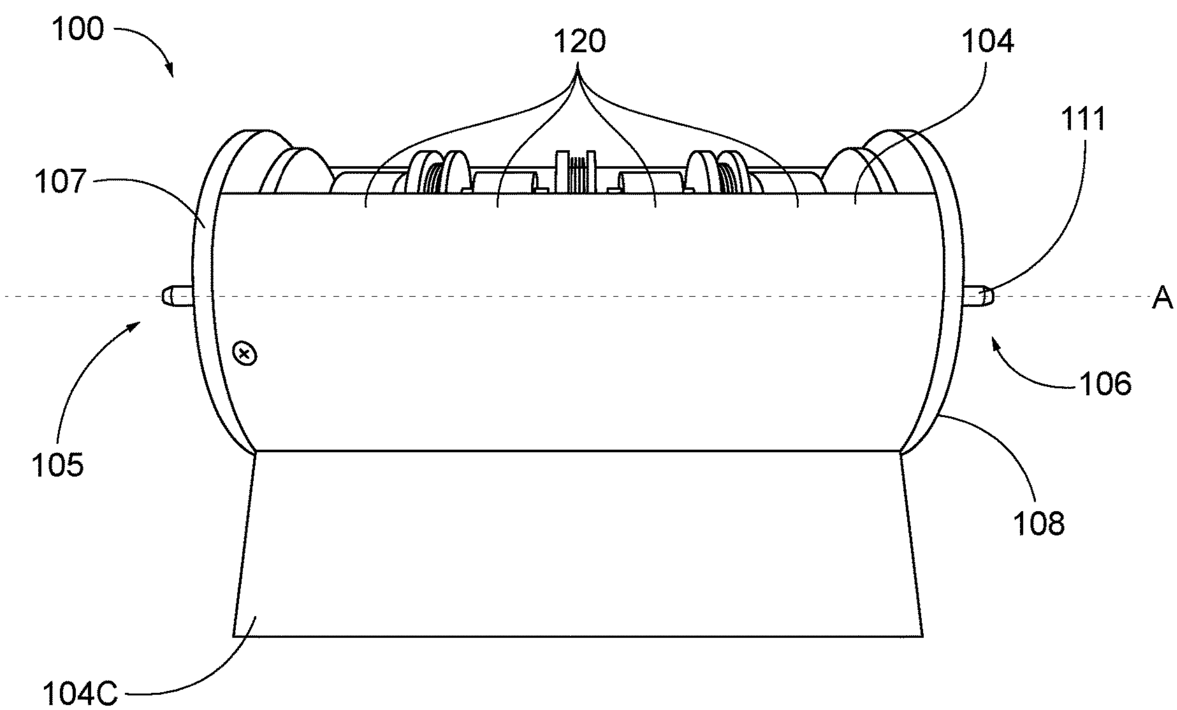
100
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FIG. 2

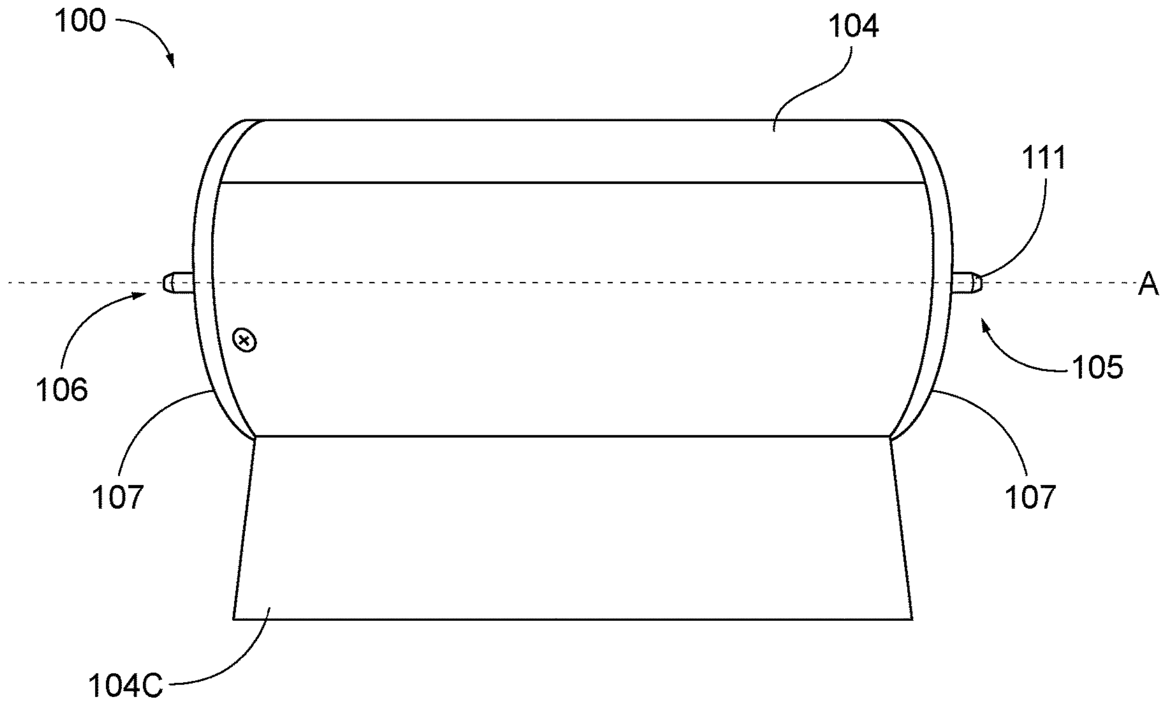



FIG. 3

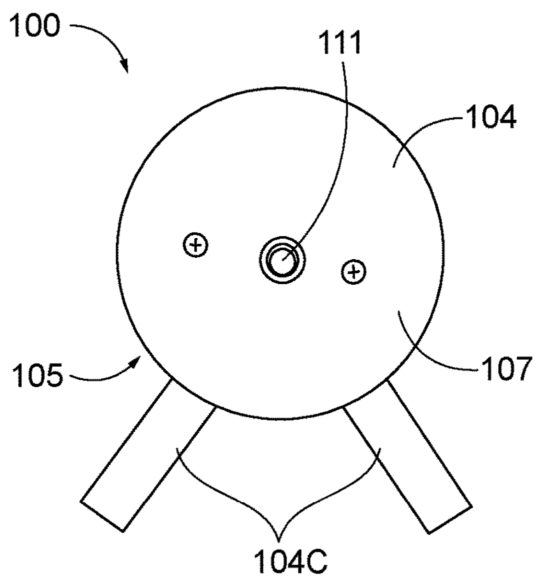



FIG. 4

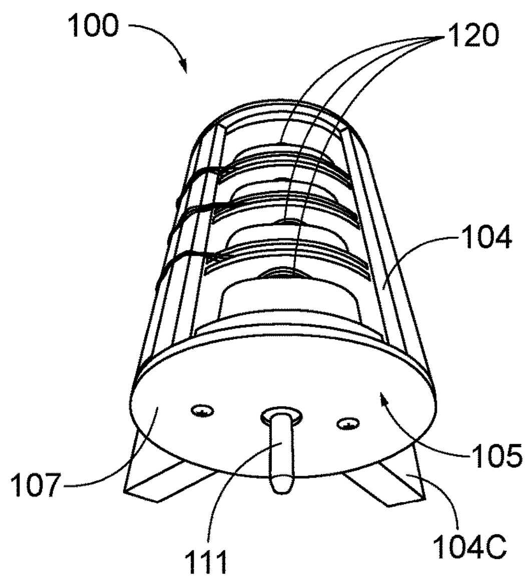



FIG. 5

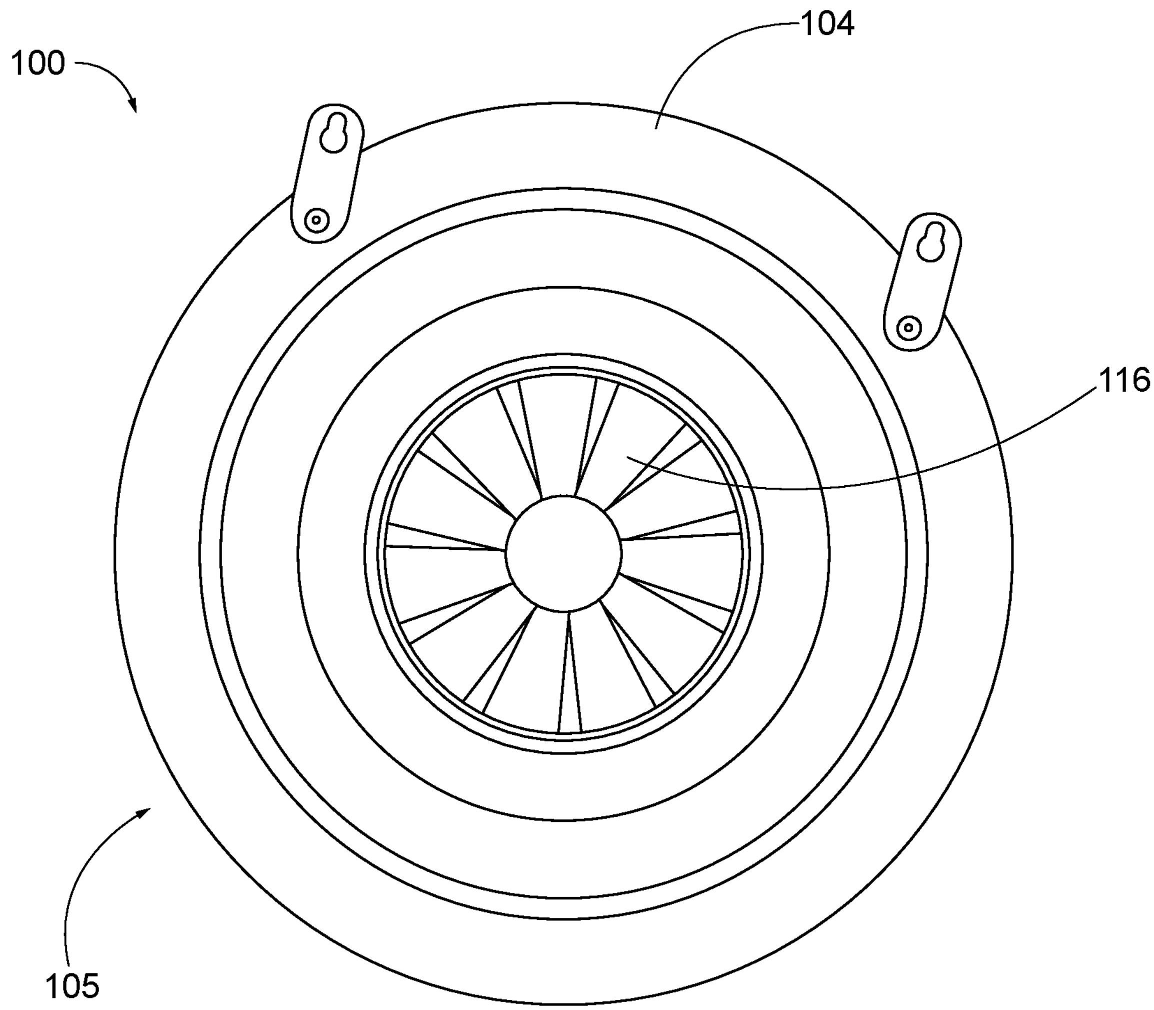



FIG. 6

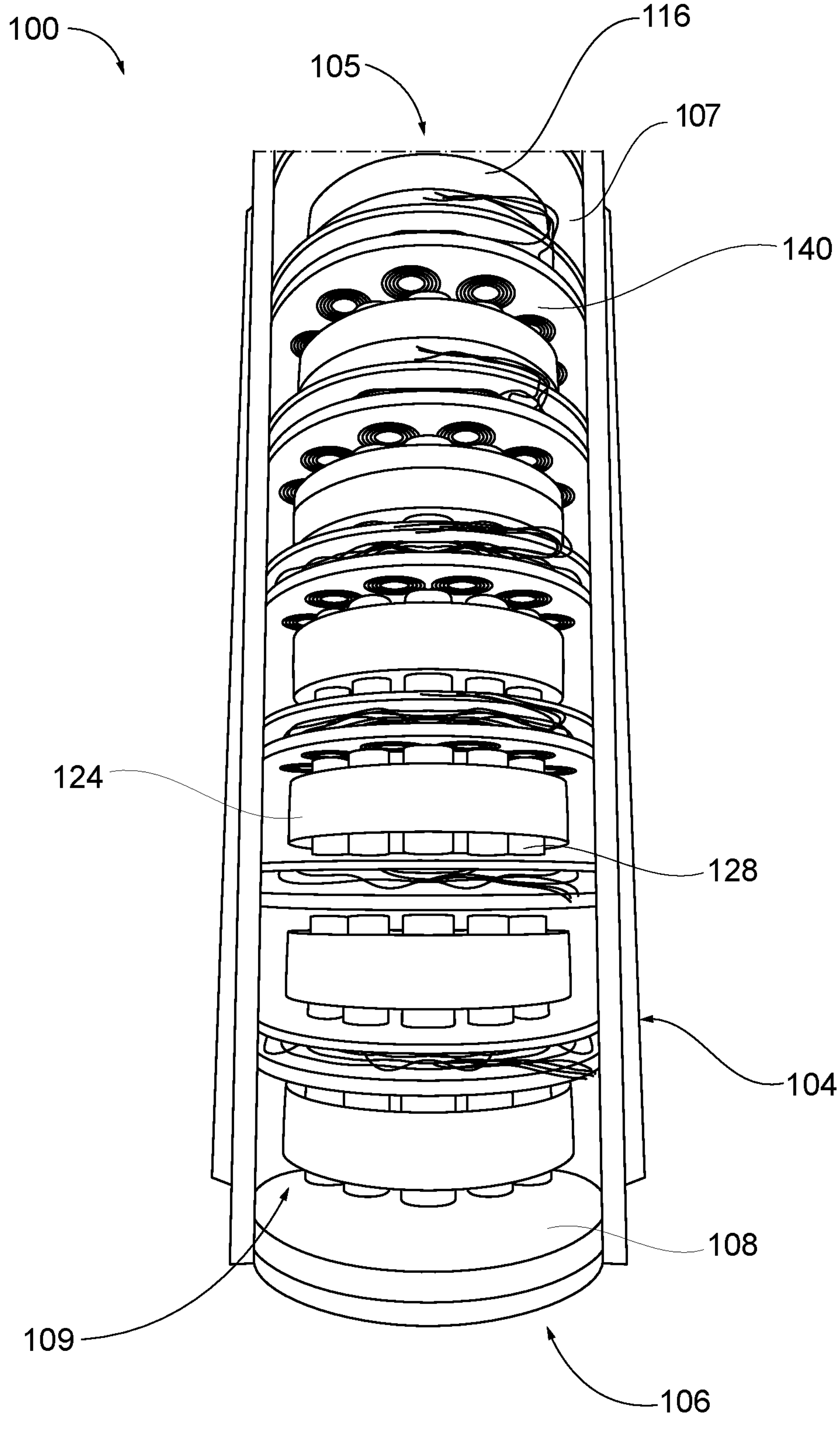
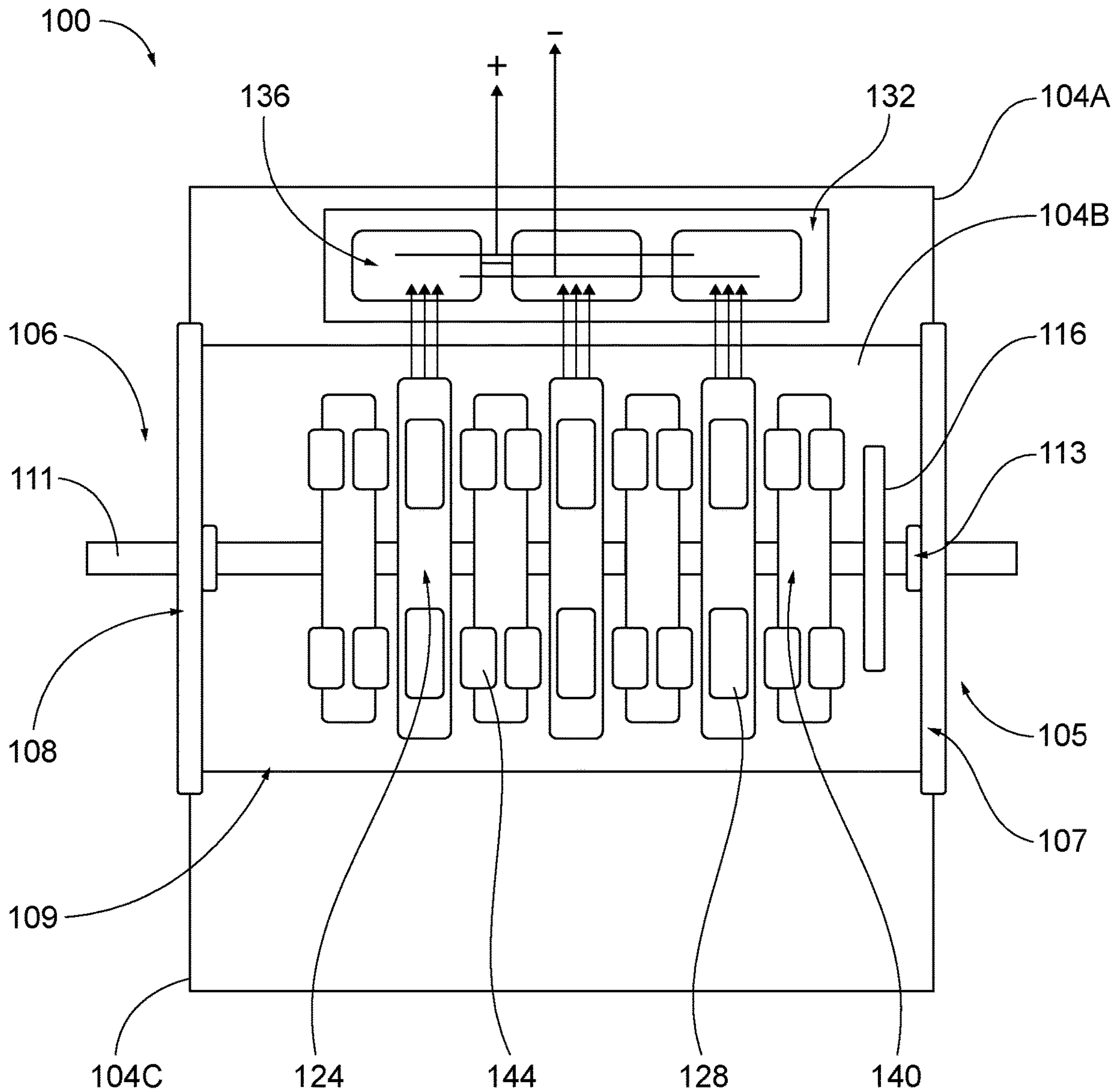



FIG. 7A


100
+
−
136
132
104A
104B
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116
111
113
108
105
107
109
104C
124
144
128
140

FIG. 7B

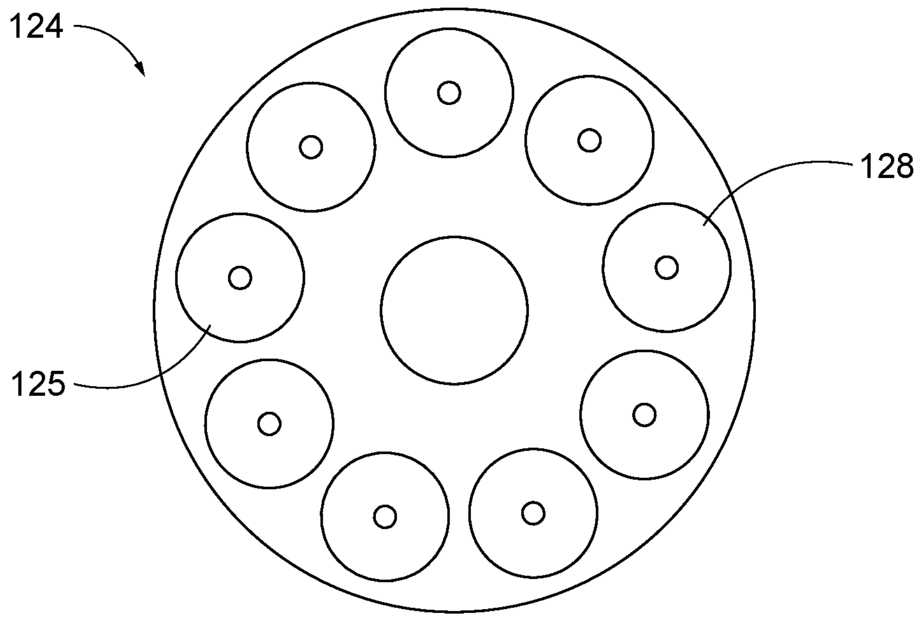



FIG. 8

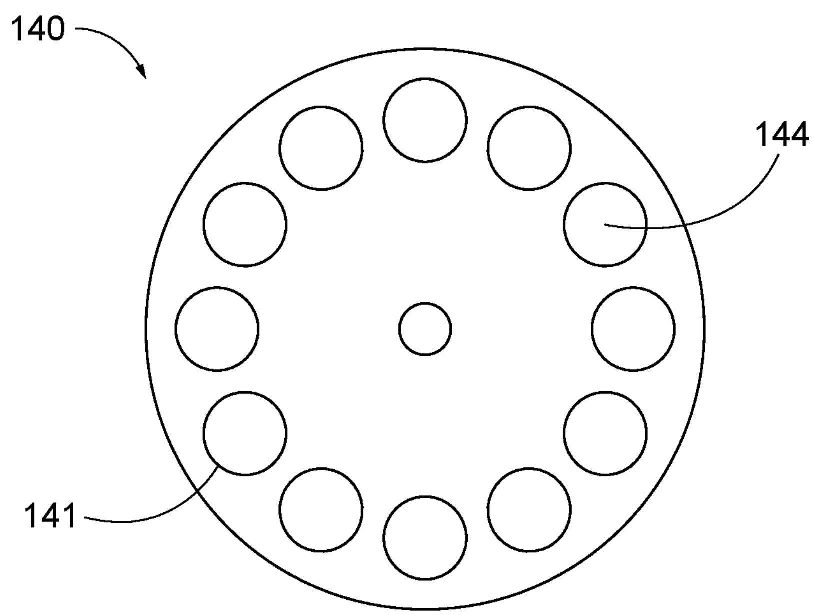



FIG. 9

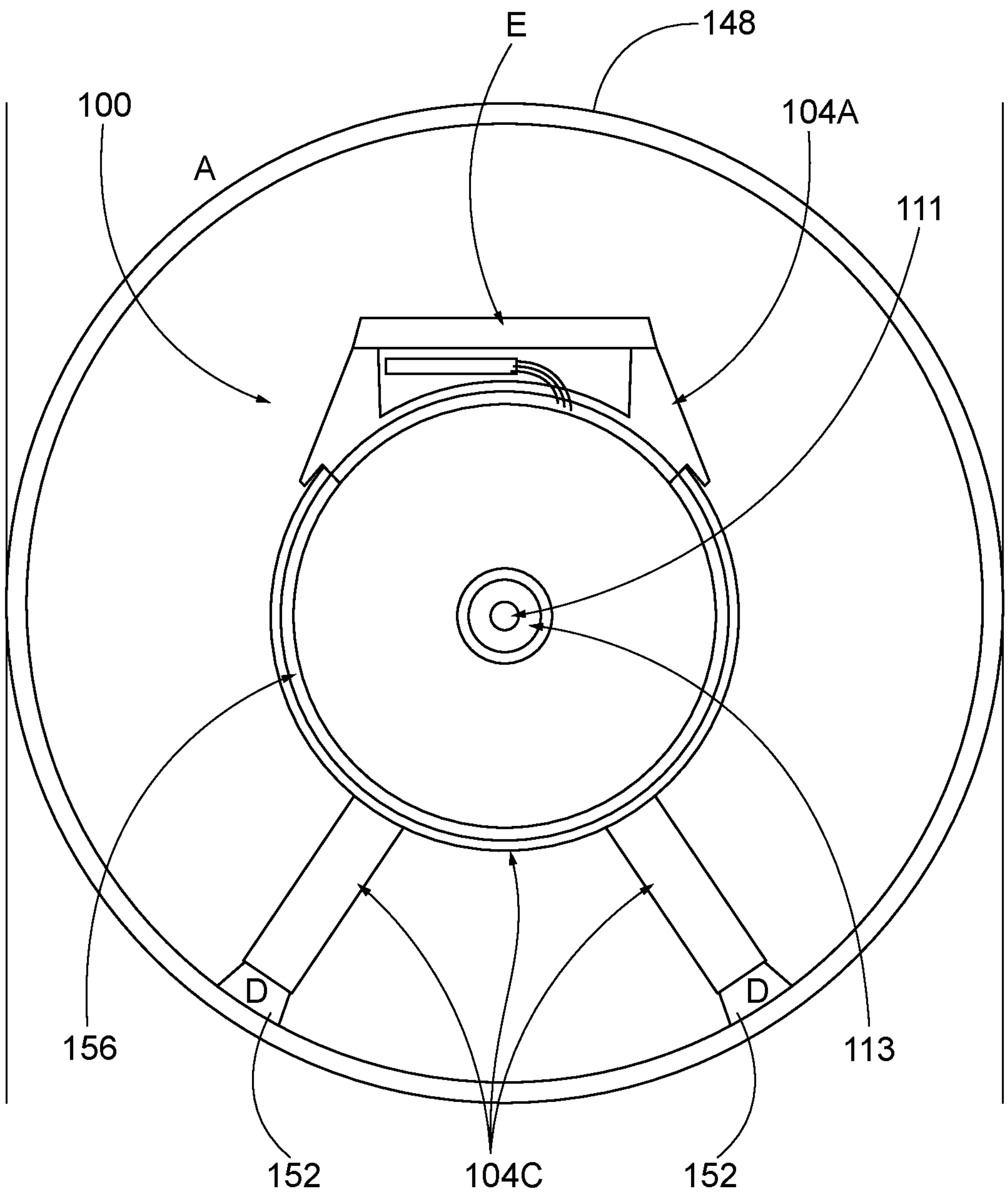



FIG. 10

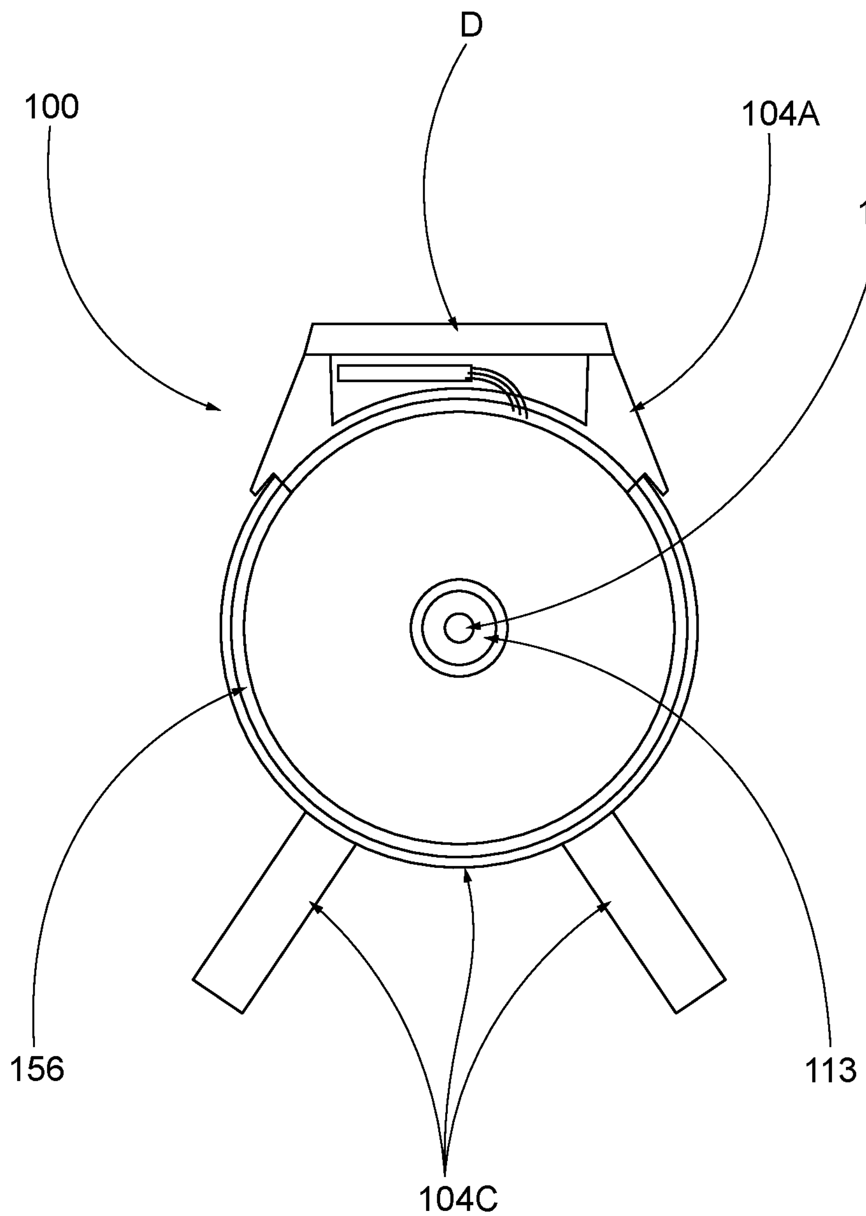



FIG. 11

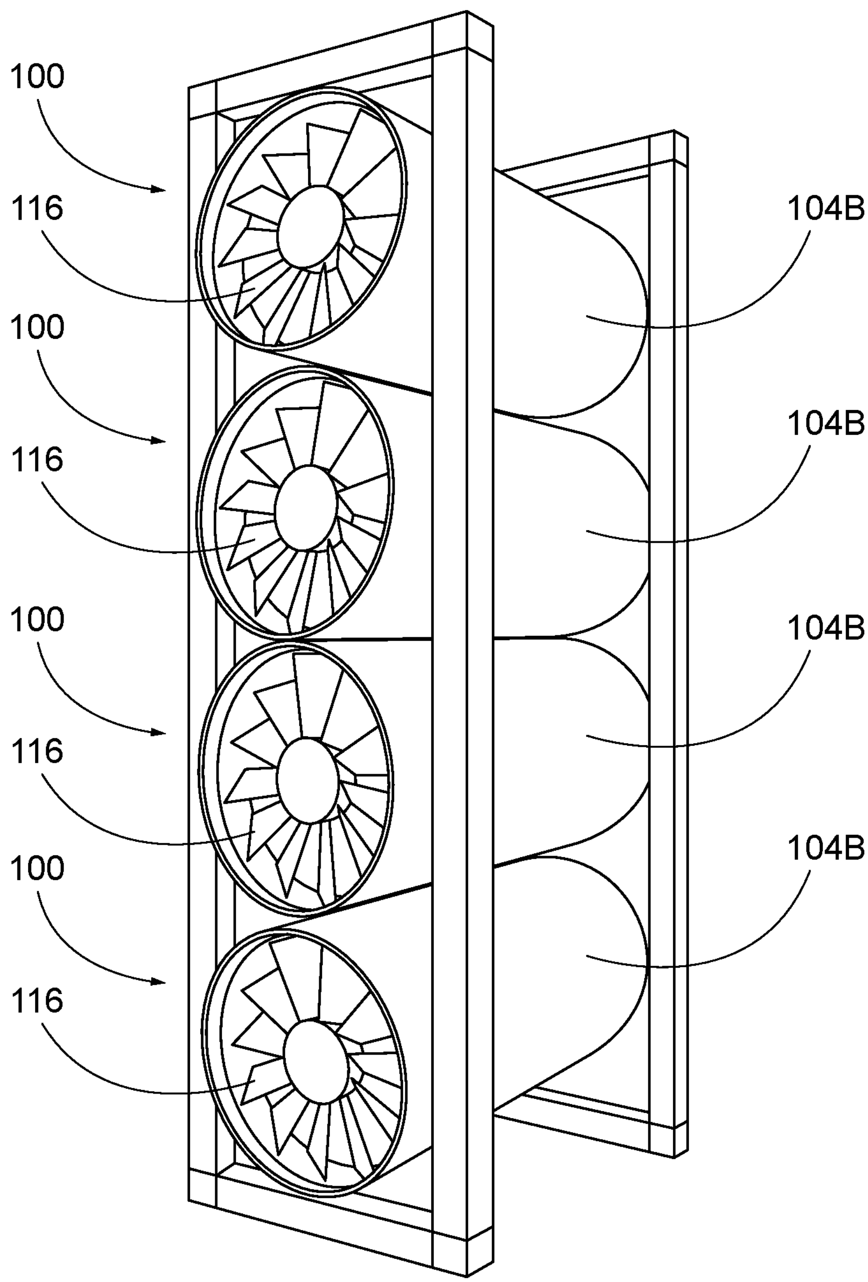



FIG. 12

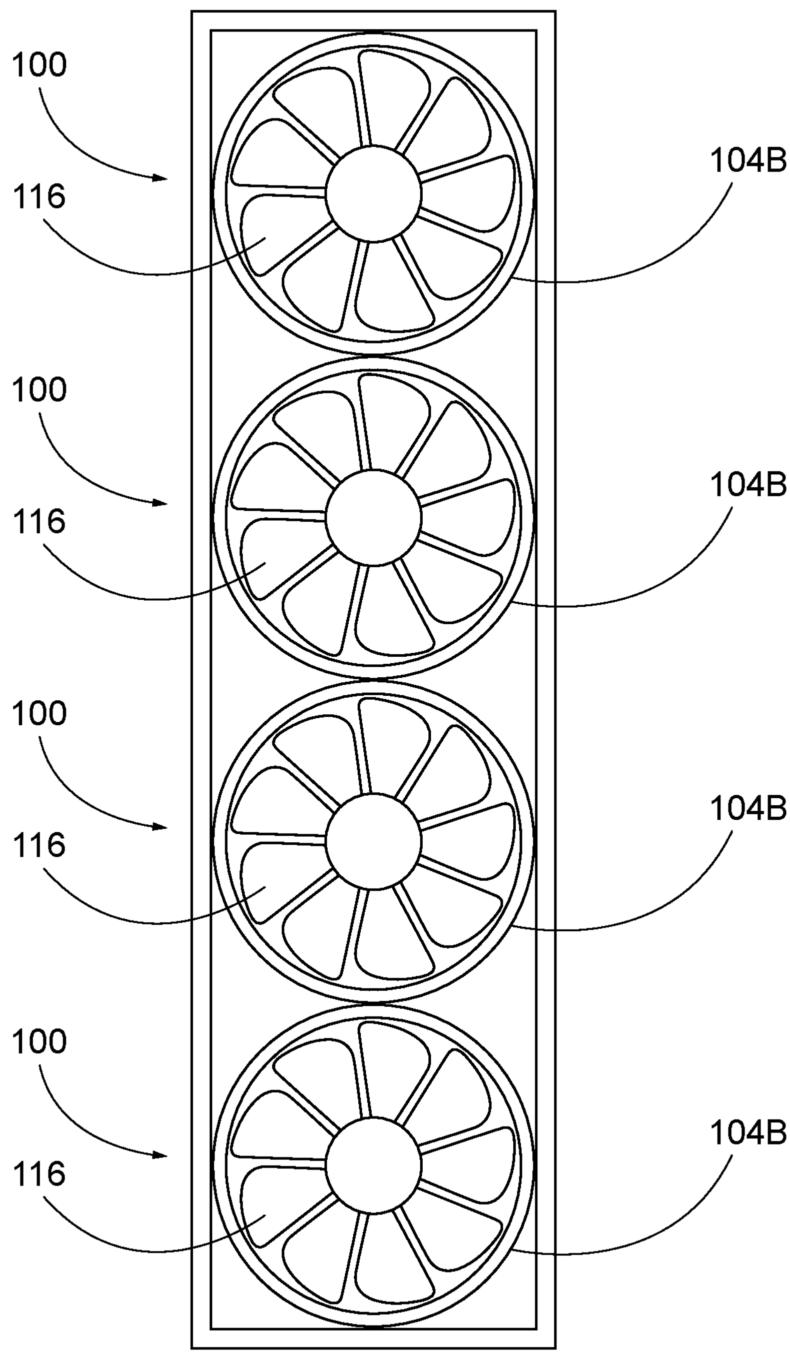
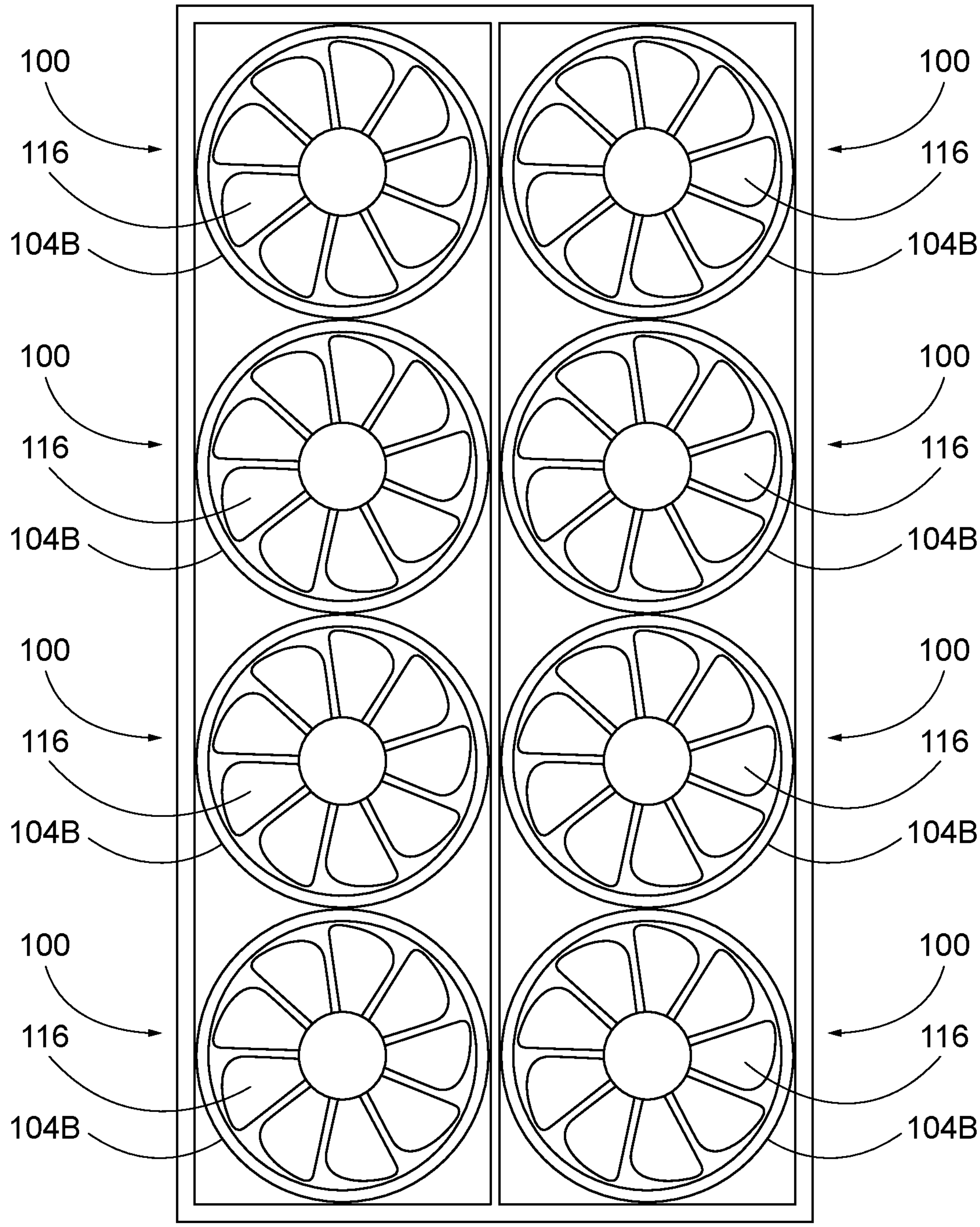



FIG. 13


100
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104B
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104B
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100
116
104B

FIG. 14

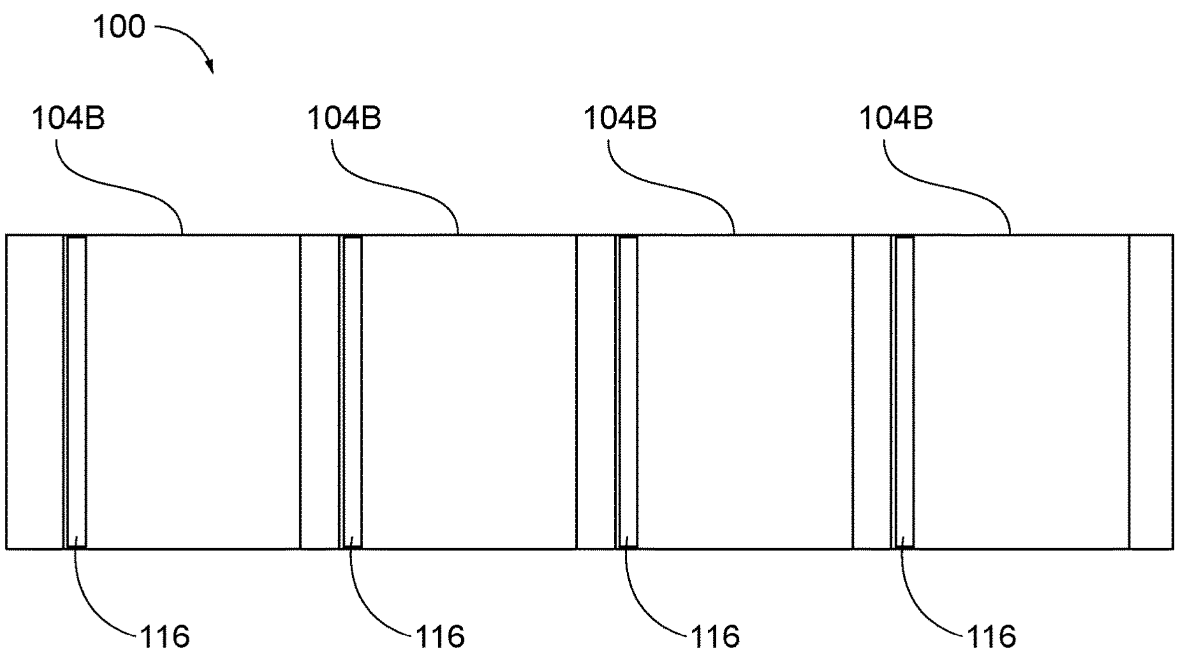


FIG. 15

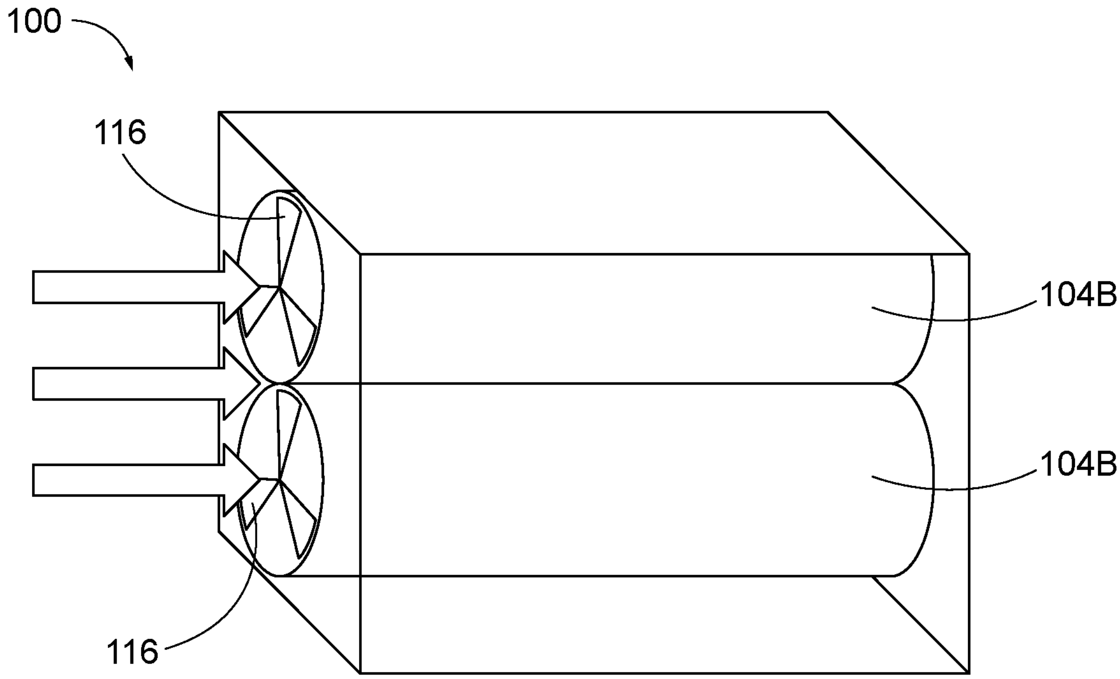


FIG. 16

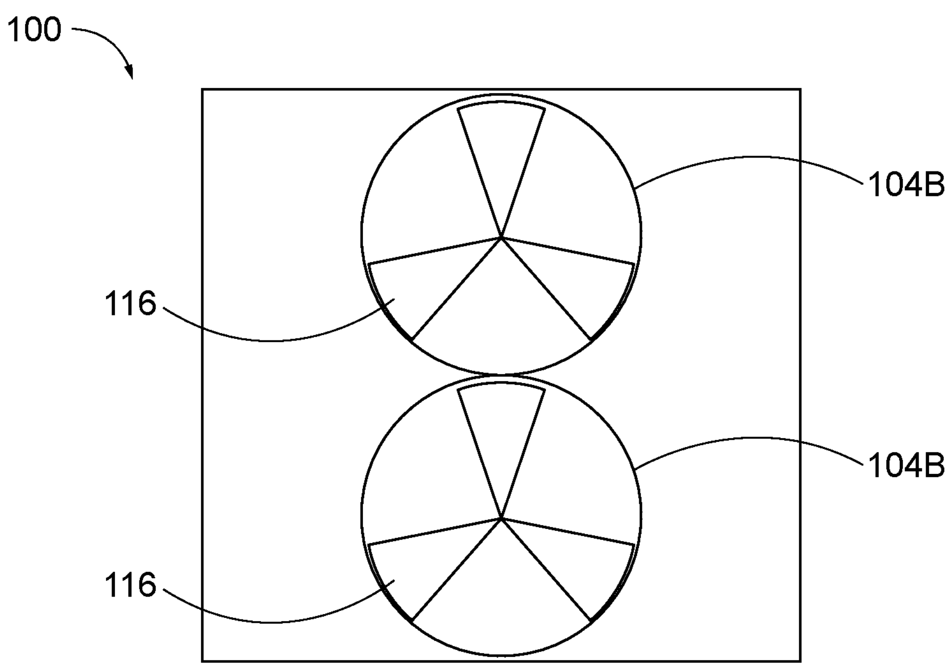


FIG. 17

# TUBULAR TURBINE SYSTEMS AND METHODS

## TECHNICAL FIELD

**[0001]** The present disclosure relates generally to a turbine system and related methods.

## BACKGROUND

**[0002]** Energy generation from renewable sources is becoming increasingly important due to environmental concerns and the need for sustainable power generation. Buildings account for 40% of all CO2 emissions around the world. A common method to reduce CO2 emissions is by reducing electricity use and producing clean energy in order to lower carbon footprint. Turbines are commonly used to harness energy, including wind or solar turbines. However, these turbines may be expensive to build and maintain, may have limited efficacy, and are ultimately not sustainable. Thus, there is a need for a smaller turbine system that may be placed in various compact spaces and that provides a localized, efficient source of electrical energy.

## SUMMARY

**[0003]** An embodiment of the present disclosure includes a system a tubular frame having an internal space. The system further includes a shaft in the tubular frame. The system further includes a fan coupled to the shaft and configured to rotate the shaft when a fluid impinges the fan. The system further includes at least one turbine coupled to the shaft and housed in the internal space of the tubular frame. The at least one turbine has a copper containing disc including a plurality of copper coils mounted in the copper containing disc. The at least one turbine further includes an electronics board electronically coupled to the copper coils in the copper containing disc. The at least one turbine further includes a magnet containing disc mounted on the shaft and arranged adjacent to the copper containing disc. The copper containing disc has a plurality of magnets mounted in the magnet containing disc. The magnet containing disc is configured to rotate with the shaft in response to fluid impinging on the fan. The turbine is configured to generate energy in response rotation of the magnet containing disc.

**[0004]** Another embodiment of the present disclosure includes a method. The method includes positioning at least one tubular turbine in a shaft of an HVAC or airway system in a building. The method further includes causing air flow to impinge a fan of the at least one turbine. The method further includes, in response to air flow impinging the fan, causing a set of magnet containing discs to rotate relative to a set of copper containing discs.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0005]** The foregoing summary, as well as the following detailed description of exemplary embodiments of the present application, are better understood when read in conjunction with the appended drawings. For the purposes of illustrating the present application, there is shown in the drawings, exemplary embodiments of the disclosure. It should be understood, however, that the application is not limited to the precise arrangements and instrumentalities shown. In the drawings:

**[0006]** FIG. **1** is a top view of a turbine system in accordance with an exemplary embodiment of the present disclosure;

**[0007]** FIG. **2** is a front view of the turbine system shown in FIG. **1**;

**[0008]** FIG. **3** is a back view of the turbine system shown in FIGS. **1-2**;

**[0009]** FIG. **4** is a side view of the turbine system shown in FIGS. **1-3**;

**[0010]** FIG. **5** is a perspective side view of the turbine system shown in FIGS. **1-4**;

**[0011]** FIG. **6** is a side view of the turbine system shown in FIGS. **1-5** with the front plate and casings removed;

**[0012]** FIG. **7**A is a top view of the turbine system shown in FIGS. **1-6** with the moveable panel removed;

**[0013]** FIG. **7**B is a cross-sectional diagram of the turbine system shown in FIGS. **1-6**;

**[0014]** FIG. **8** is a top view of a magnet disc of the turbine shown in FIGS. **1-7**;

**[0015]** FIG. **9** is top view of a copper disc of the turbine shown in FIGS. **1-7**;

**[0016]** FIG. **10** is a side view of an enclosure of the turbine system in accordance with an embodiment of the present disclosure;

**[0017]** FIG. **11** is a side view of an enclosure of the turbine system in accordance with an embodiment of the present disclosure;

**[0018]** FIG. **12** is a perspective view of the turbine system shown in FIGS. **1-9** having a stacked turbine configuration in accordance with an embodiment of the present disclosure;

**[0019]** FIG. **13** is a side view of the turbine system shown in FIG. **12**;

**[0020]** FIG. **14** is a side view of the turbine system shown in FIGS. **1-9** having a stacked turbine configuration in series in accordance with an embodiment of the present disclosure;

**[0021]** FIG. **15** is a perspective view of the turbine system shown in FIGS. **1-9** having an end to end configuration in accordance with an embodiment of the present disclosure;

**[0022]** FIG. **16** is a perspective view of the turbine system in an HVAC system, with side and front parts of the HVAC system cut away, in accordance with an embodiment of the present disclosure; and

**[0023]** FIG. **17** is a side view of the turbine system shown in FIG. **15**, with the front part of the HVAC system cut away.

## DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

**[0024]** Turbine systems as described are configured for converting fluid energy into electrical power. Referring to FIGS. **1-6**, there is shown an exemplary embodiment of a turbine system **100**. The turbine system **100** comprises various components configured to harness and transform fluid energy into a usable electrical form. The turbine system **100** may be utilized in an HVAC system. In alternative embodiments, the turbine system **100** may be utilized in circulating fan frames and other applications including, but not limited to, power generation. The turbine system **100** includes a tubular frame **104**, a shaft disposed in the tubular frame **111**, a fan **116** coupled to the shaft **111**, and at least one turbine **120** that generates energy in response to a fluid impinging the fan **116**. A fluid generally means an air; however, other fluids could be used. For instance, the system **100** is generally designed to be inserted in the ductwork and HVAC systems in existing or new buildings. Thus air flow through these systems, when the system **100** is installed, can be used to generate power. The system **100** may also be used in exhaust lines of such systems so that exit flow rotates the fan to generate power, thereby reclaiming energy used to operate the HVAC system.

**[0025]** The tubular frame **104** serves as the structural backbone for housing and supporting components of the turbine system **100**. The tubular frame includes an upper casing **104**A, a main casing **104**B, and a lower casing **104**C. The main casing **104**B includes a first end **105** and a second end **106** opposite the first end **105** along a longitudinal axis A. The main casing **104**B further includes a removable first plate **107** disposed at the first end **105** and a removable second plate **108** disposed at the second end **106**. The main casing **104**B defines an internal space **109** that accommodates various components of the system **100**. It should be noted that the main casing **104**B is not limited to specific dimensions, but in various embodiments, the main casing **104**B is cylindrical and possesses a diameter of at least 9 inches and a length of at least 14 inches. The lower casing **104**C extends from the main casing **104**B and is configured to mount the tubular frame **104** to a surface, such as a ductwork or HVAC system surface. The tubular frame **104** may be constructed from a polymer material to provide structural integrity and lightweight properties. In alternative embodiments, the tubular frame **104** may be made from other known materials, such as metals, alloys, and the like.

**[0026]** Thee tubular frame **104** includes a movable panel **110** located at a top portion of the main casing **104**B. This construction allows the panel **110** to pivot about the shaft **111**. The ability of the panel **110** to open allows easy access to the system components for maintenance and inspection purposes.

**[0027]** The shaft **111** is configured to serve as a rotational axis for the turbine system **100**. As shown, the shaft **111** is disposed within the internal space **109** of the tubular frame **104** and extends through the first end **105** and the second end **106** along the longitudinal axis A. The shaft **111** includes a forward end **110** at the first end **105** and a rearward end **112** at the second end **106**. The shaft **111** may have as a diameter of preferably about 8.0 mm. The shaft **111** may have a length of preferably about 16.0 inches. A set of bearings **113** may be disposed on the shaft **108** and movably coupled to the first plate **107** and the second plate **108**.

**[0028]** Referring to FIGS. **6** and **7**, the fan **116** is fixed to the shaft **111**. The fan **116** is uniquely configured to rotate the shaft **111** when exposed to fluid flow, such as air impinging on the fan **116**. As the fan **116** rotates, it imparts motion to the shaft **111**, thereby initiating the energy conversion process from fluid energy into electrical energy. Specifically, as fluid impinges the fan **116**, the fan **116** rotates the shaft **111**. This rotation, as explained in further detail below, generates an electric field that is harnessed by the turbine **120** for use as needed. This configuration allows the shaft **111** to withstand the rigors of continuous rotation, ensuring durability and resistance of the tubular turbine **100**.

**[0029]** Referring to FIGS. **7** and **8**, the turbine **120** is configured to enable energy generation using a combination of copper containing discs **124** and magnet containing discs **140**. This configuration maximizes efficiency and power output. The copper containing discs **124** are cylindrical bodies with a thickness that is substantially less than their respective diameter. Each disc **124** may have a diameter between 3 inches and 6 inches, preferably at least 4 inches. The discs **112** include multiple through-holes or recesses **125**, which contain a plurality of circular copper coils **128**, respectively. In alternative embodiments, the diameter of the copper-containing discs **124** and the number of copper coils **128** in each disc vary. In one example the turbine **120** includes at least three copper-containing discs **124**. In another example, the turbine **120** may include fewer than three copper-containing discs **124**. In another example, the turbine **120** may include a maximum of 8 copper containing discs **124** and 10 magnet containing discs **140**.

**[0030]** The copper coils **128** are used in generation of electrical energy within the system. The copper coils **128** are circular in cross-sectional shape and are mounted within the copper-containing discs **124** within the recesses. In the illustrated embodiment, nine separate copper coils **128** are incorporated into each disc **124**. In one embodiment, each disc **124** includes 24-gauge wire coils. In another embodiment, each disc **124** includes 23-gauge wire coils.

**[0031]** The turbine **120** further includes an electronics board **132** that may be used to carry various electronic components. As shown, the electronics board is contained in the upper casing **104**A of the tubular frame **104**. However the electronics board could be located in other areas of the system **100** as needed. The electronics board **132** is electronically coupled to the copper coils **128**. The electronics board **132** includes two or more rectifiers **136** configured to convert alternating current generated by the copper coils **128**, via rotation of the shaft, into direct current. The rectifiers **136** thus make the energy output compatible with various applications. In the illustrated embodiment, the electronics board **132** includes three rectifiers, each of which are electronically coupled to individual copper-containing discs **124**. In the illustrated embodiment, the electronics board **132** is in the form of a circuit board.

**[0032]** Continuing with FIGS. **7-9**, the turbine **120** further includes a plurality of magnet-containing discs **140**. The magnet containing discs **140** have a cylindrical body with a plurality of through-holes or recesses **141** within which magnets are mounted. Each disc **140** has a diameter of at least 3.5 inches and a width of at least 0.625 inches. In alternative embodiments, the diameter of the magnet-containing discs **140** and the number of magnets in each disc vary. In the illustrated embodiment, the turbine **120** includes between three and eight magnet containing discs, preferably at least four magnet-containing discs **140**. In alternative embodiments, the turbine **120** may include fewer than four magnet-containing discs **140**. The magnet-containing discs **140** are coaxially mounted to the shaft **111**. The magnet-containing discs **140** are further disposed on either side of the copper-containing discs **124** such that the copper-containing discs **124** and the magnet-containing discs **140** alternate in series along the shaft **111** in the turbine **120**.

**[0033]** Referring to FIG. **9**, each of the plurality of magnet-containing discs **140** is equipped with a plurality of circular magnets **144**. In the illustrated embodiment, twelve round magnets are incorporated into each disc **140**. The magnets **144** are positioned relative to the copper coils so that rotation of the copper containing discs **124** relative to the magnet containing discs **140** creates a relative velocity between the copper coils **128** of the copper containing discs **124** and the magnets **144** of the magnet containing discs **140**. Due to this relative velocity, a circulating current is induced inside the copper containing discs **124**, inducing electrical generation as the magnets **144** pass by the copper coils **128**.

In this configuration, the turbine **120** has a relative velocity of approximately 25 miles per hour and generates approximately 120 watts.

**[0034]** As fluid impinges on the fan **116**, causing it to rotate the shaft **111**, the magnet-containing disc **140** rotates relative to the copper-containing disc **124**. This rotational generates energy within the system **100**. Specifically, rotation of the copper coils **128** of the copper containing discs **124** relative to the magnets **144** of the magnet containing disc **140** generates an electric field in the copper coils **128**, which causes an electrical current to flow through the coil wires. In one embodiment, the turbine **100** produces a specific voltage, such as 16 volts per copper-containing disc at a shaft speed of 1,700 rpm. In another embodiment, the turbine **100** produces 380 volts per copper-containing disc at a shaft speed of 2,800 rpm. The energy generated is then made available for various applications, including, but not limited to, power generation, HVAC systems, and circulating fan frames.

**[0035]** Referring to FIGS. **10** and **11**, the system **100** may be configured to fit an enclosure used for turbine slide frames as described in U.S. Pat. No. 11,371,103, the entire contents of which are incorporated herein. In this configuration, the system **100** may be enclosed in an outer shell **148**. The outer shell **148** may be an air tube comprised of PVC. In the illustrated embodiment, the diameter of the outer shell **148** may be 9 inches. In alternative embodiments, the diameter of the outer shell **148** is less than 9 inches. The system **100** may be mounted at the lower casing **104**C via one or more casing mounts **152**. The system **100** further includes a wiring compartment cover **156** configured to surround the shaft **111**.

**[0036]** Referring to FIGS. **12-14**, the system **100** can be configured as a set of turbines arranged in a stacked configuration. Referring to FIG. **15**, in an alternative embodiment, the system **100** can be configured as a series of turbines connected end-to-end to accommodate varying operational requirements and energy generation capacities.

**[0037]** Referring to FIGS. **16-17**, a further embodiment of the present disclosure includes a method generating energy in an HVAC system. The method includes placing a turbine system **100** in ductwork of the HVAC system. At least one tubular turbine system **100** is positioned in the shaft of an HVAC or airway system in a building. The fan **116** is then impinged by air flow. In response to air flow impinging the fan **116**, a set of magnet-containing discs **140** is configured to rotate relative to the set of copper-containing discs **124**.

**[0038]** Wherever possible, the same or like reference numbers are used throughout the drawings to refer to the same or like features. It should be noted that the drawings are in simplified schematic form and are not drawn to precise scale. Certain terminology used in the description is for convenience only and is not limiting. Directional terms such as top, bottom, left, right, above, below and diagonal, are used with respect to the accompanying drawings. The term "distal" shall mean away from the center of a body. The term "proximal" shall mean closer towards the center of a body and/or away from the "distal" end. The words "inwardly" and "outwardly" refer to directions toward and away from, respectively, the geometric center of the identified element and designated parts thereof. Such directional terms used in conjunction with the following description of the drawings should not be construed to limit the scope of the present disclosure in any manner not explicitly set forth. Additionally, the term "a," as used in the specification, means "at least one." The terminology includes the words above specifically mentioned, derivatives thereof, and words of similar import.

**[0039]** "Substantially" as used herein shall mean considerable in extent, largely but not wholly that which is specified, or an appropriate variation therefrom as is acceptable within the field of art. "Exemplary" as used herein shall mean serving as an example.

**[0040]** Furthermore, the described features, advantages and characteristics of exemplary embodiments may be combined in any suitable manner in one or more embodiments. One skilled in the art will recognize, in light of the description herein, that the exemplary embodiments can be practiced without one or more of the specific features or advantages of a particular embodiment. In other instances, additional features and advantages may be recognized in certain embodiments that may not be present in all embodiments of the present disclosure.

**[0041]** While the disclosure is described herein, using a limited number of embodiments, these specific embodiments are not intended to limit the scope of the disclosure as otherwise described and claimed herein. The precise arrangement of various elements and order of the steps of articles and methods described herein are not to be considered limiting. For instance, although the steps of the methods are described with reference to sequential series of reference signs and progression of the blocks in the figures, the method can be implemented in an order as desired.

**1**. A system comprising:
a tubular frame having an internal space;
a shaft in the tubular frame;
a fan coupled to the shaft and configured to rotate the shaft when a fluid impinges the fan;
at least one turbine coupled to the shaft and housed in the internal space of the tubular frame, the at least one turbine having:
a copper containing disc including a plurality of copper coils mounted in the copper containing disc;
an electronics board electronically coupled to the copper coils in the copper containing disc;
a magnet containing disc mounted on the shaft and arranged adjacent to the copper containing disc, the copper containing disc having a plurality of magnets mounted in the magnet containing disc, the magnet containing disc being configured to rotate with the shaft in response to fluid impinging on the fan;
wherein the turbine is configured to generate energy in response rotation of the magnet containing disc.

**2**. The system according to claim **1**, wherein the at least one turbine has three copper containing discs and four magnet containing discs.

**3**. The system according to claim **1**, wherein the at least one turbine has a mounting for attachment to the frame.

**4**. The system according to claim **1**, wherein the tubular frame has a diameter of at least 9 inches.

**5**. The system according to claim **1**, wherein the tubular frame has a length of at least 14 inches.

**6**. The system according to claim **1**, wherein the tubular frame is formed from a polymer material.

**7**. The system according to claim **1**, wherein the electronics board includes two or more rectifiers coupled to at least one of the copper containing disc.

**8**. The system of claim **7**, wherein the mounting board is a circuit board.

**9**. The system of claim **1**, wherein copper coils are circular in cross-sectional shape.

**10**. The system of claim **1**, wherein copper containing disc includes nine separate copper coils.

**11**. The system of claim **1**, wherein the copper containing disc has a diameter of at least 4 inches.

**12**. The system of claim **1**, wherein the magnet containing disc include twelve round magnets.

**13**. The system of claim **1**, wherein the magnet containing disc has a diameter of at least 3.5 inches.

**14**. The system of claim **13**, wherein the shaft is a stainless-steel shaft.

**15**. The system of claim **1**, wherein the turbine produces 16 volts per copper containing? disc at a shaft? speed of 1,700 rpm.

**16**. The system of claim **1**, wherein the turbine produces 380 volts at a shaft speed of 2,800 rpm.

**17**. The system of claim **1**, wherein the tubular frame is configured to be placed in an outer frame.

**18**. The system of claim **17**, wherein the outer frame includes HVAC ductwork.

**19**. The system of claim **17**, wherein the outer frame includes a circulating fan frame.

**20**. The system of claim **1**, wherein the tubular frame has a movable panel that when opened exposes the components of the turbine.

**21**. The system of claim **1**, wherein the at least one turbine is a series of turbines connected end-to-end.

**22**. The system of claim **1**, wherein the at least one turbine is a set of turbines arranged in a stacked configuration.

**23**. A method, comprising:

positioning at least one tubular turbine in a shaft of an HVAC or airway system in a building;

causing air flow to impinge a fan of the at least one turbine;

in response to air flow impinging the fan, causing a set of magnet containing discs to rotate relative to a set of copper containing discs.

* * * * *