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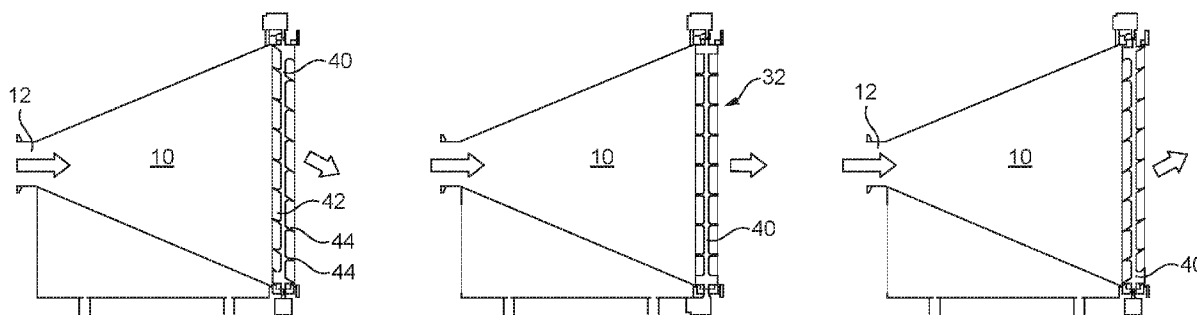


FIG. 2

(57) Abstract: There is provided a vectoring rod in a nozzle's air flow outlet, the vectoring rod comprising an elongate support and a plurality of fins. The elongate support is rotatably mounted so that the fins act to change a direction of air exiting the air flow outlet in dependence of the rotational position of the vectoring rod. Here, each fin is attached to the elongate support so as to extend in a plane bisecting a rotation axis of the elongate support at an oblique angle. Advantageously, the vectoring rod can achieve a wide change in angle of the air flow direction through the nozzle. Moreover, the change in direction can be achieved by a rotation of the vectoring rod and does not require movement of a housing of the nozzle. Consequently, a lower torque motor can be used allowing the change in direction of the air flow to be more rapid. The more rapid change in vectoring direction allows a more natural breeze to be simulated. By providing a second vectoring rod in the nozzle, the air exiting the air flow outlet can form first and second air flows. By controlling the first and second vectoring rods to rotate separately to each other, the direction of the first and second air flows can be changed independently. Thus, advantageously the nozzle can direct air to two targets (for example the head and feet of a user, or two users).

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Improved nozzle for a fan unit

The present disclosure relates to air movement devices, for instance fan units, and in particular, to a nozzle for a fan unit.

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Air movement devices such as fan units are widely known. In some examples of fan units, air is blown through a nozzle in a housing. Typically, the nozzle has a normal direction. That is the nozzle aims the air to be blown in a direction normal to an air flow outlet. Here, it is known to use an oscillating mechanism to enable the air direction to be moved from side-to-side (i.e. a change in horizontal direction) as well as a vectoring mechanism to enable the air direction to be moved upwards and downwards (i.e. a change in vertical direction), both relative to the normal direction. For instance, oscillating the air flow direction can be useful for cooling multiple people, by enlarging the area covered by the air flow. Oscillation can also be used to track a user, as well as being useful for creating a more natural feeling to the air flow (i.e. replicating a natural breeze). Vectoring the air flow allows the air flow from the nozzle to be directed upwards, for instance if the user is positioned above the fan unit, or downwards if the user is positioned below the fan unit. Vectoring also provides the fan unit with a function to help compensate for the temperature dependent buoyancy of the air.

A known oscillation mechanism comprises a cam and linkage powered from a main motor. Using a separate stepper motor allows a separation of the oscillation mechanism from the main motor. However, in both examples, the motor drives the housing to move, which requires a high torque motor. Because the housing is a relatively large and heavy unit, high speed movement is also restricted.

A known vectoring mechanism is configured to pivot the whole housing. However, the range of movement here is generally limited due to the requirement to maintain the stability of the fan unit. Alternatively, adjustable louvres in the nozzle can be used to direct the air. Typically, the louvres are manually operated. Moreover, moving louvers to redirect air flow can cause an audible change in the air flow due to a changing area of the air flow through the nozzle.

The present disclosure has been devised in light of the above considerations. In particular, it is an aim of the present disclosure to provide a nozzle with an improved function for vectoring of the air flow. For example, the improved vectoring may facilitate a quicker change in the direction of the air flow or a larger change in angle of the air flow direction, or a more consistent air flow area through the nozzle. Furthermore, the improved vectoring function may be an improved ability to automate the vectoring or a reduced size of the vectoring mechanism.

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There is provided a vectoring rod mounted in a nozzle's air flow outlet, the vectoring rod comprising an elongate support and a plurality of fins. The elongate support is rotatably mounted so that the fins act to change a direction of air exiting the air flow outlet in dependence on the rotational position of the vectoring rod. Here, each fin is attached to the elongate support so as to extend in a plane bisecting a rotation axis of the elongate support at an oblique angle. Advantageously, the vectoring rod can achieve a wide change in angle of the air flow direction through the nozzle. Moreover, the change in direction can be achieved by a rotation of the vectoring rod, and does not require movement of a housing of the nozzle. Consequently, a lower torque motor can be used, allowing the change in direction of the air flow to be more rapid. The more rapid change in vectoring direction allows a more natural breeze to be simulated.

In the exemplary embodiments, the air flow outlet has a normal direction. Suitably the normal direction has a cross-section defined by a normal plane parallel to the axis of the elongate support in one axis, and parallel to the air flow exit in the other axis. Here, the plane of each fin bisects the elongate support at an oblique angle when arranged perpendicular to the normal plane. That is, the oblique angle is an angle made between the fin across the normal plane and with the elongate support aligned with one of the axes of the normal plane. Because the fin has a plane that bisects the elongate support's rotation axis at an oblique angle, when the fin is aligned to the normal plane, the fin is arranged parallel to the airflow in the airflow direction. That is, at any given cross section through the fin in a plane of the air flow's normal direction, the fin is substantially aligned with the airflow. As the elongate support is rotated, because the plane bisects the elongate support's axis at an oblique angle, the fin becomes angled to the normal air flow direction, acting to divert the air flow from the outlet. Thus, by rotating the elongate support in one direction or the other from a position in which the fins are parallel to the normal air flow direction, the air direction from the air flow outlet can be changed to be angled in one direction (i.e. upwardly) or the other (i.e. downwardly). Because the maximum direction change is achieved when the fin is arranged with the oblique angle aligned with the normal air flow direction (i.e. a rotation of $\pm 90^\circ$), the vectoring can achieve a change in direction of twice the oblique angle.

In a particularly suitable embodiment, a second vectoring rod is provided in the nozzle. This allows the air exiting the air flow outlet to form first and second air flows. By controlling the first and second vectoring rods to rotate separately to each other, the direction of the first and second air flows can be changed independently. Thus, advantageously the nozzle can direct air to two targets (for example the head and feet of a user, or two users). It is envisaged that in some embodiments, further vectoring rods can be included. Herein references to the vectoring rod (i.e. the first vectoring rod) are also references to the second vectoring rod or each further vectoring rod (i.e. the vectoring rod is each vectoring rod as applicable).

In a further exemplary embodiment, the or each vectoring rod can incorporate a heater element. Here, the heater element could suitably be resistive heating wires formed or attached or otherwise fixed to surfaces of the fins. Advantageously, incorporating a heater element into the vectoring rod allows the heater element to be arranged close to the air flow outlet of the nozzle, which can reduce the heat loss as compared to arranging a heater element further upstream in the air flow (i.e. away from the nozzle). Furthermore, it is often necessary to arrange heat resistant plastic around heater elements and boundaries of the air flow guiding the heated air. Thus, by arranging the heater element downstream, towards the outlet, the requirement for heat resistant plastic is reduced.

In a yet further exemplary embodiment, the or each vectoring rod is rotatably mounted adjacent the air flow outlet within a barrel. In embodiments comprising multiple vectoring rods, each vectoring rod can be mounted within a respective separate barrel, or two or more vectoring rods can be arranged within a common barrel, or a combination of both. In these exemplary embodiments, the or each barrel has a longitudinal inlet aperture and a longitudinal exit aperture. The or each barrel is also rotatably mounted, wherein an axis of the barrel and an axis of the vectoring rod are suitably coincident. Here, the air flow from the nozzle can be oscillated by rotating the barrel. That is, the direction of the air flow exiting the nozzle can be oscillated by rotating the barrel and directing an air flow through the barrel from the inlet aperture to the outlet aperture in a different direction. Advantageously, mounting the vectoring rod within the barrel provides a compact mechanism capable of both vectoring and oscillating the air flow direction. Moreover, because the vectoring rod and barrel can be rotated independently, a more realistic, natural air flow can be replicated. Also, users can be targeted more accurately. By combining multiple vectoring rods and multiple oscillating barrels, the nozzle permits greater customisation of air flow, and can allow movement patterns of the air flow directions that create an improved mixing of air in the room to improve a heating effect.

In the exemplary embodiments, the vectoring rod and, where applicable, the barrel are located in a housing. Here, the housing, vectoring rod and optional barrel form the nozzle. Moreover, the housing defines the air flow outlet. The dominant visual of the air flow outlet can therefore be an aperture in the housing. Because the or each vectoring rod and the or each optional barrel rotate relative to the housing and within the housing, the moveable parts are generally concealed by the housing. Thus, the vectoring and optional oscillating of the air flow can be achieved without a user detecting a strong visual movement of components.

In a first aspect, there is provided a nozzle for a fan unit, the nozzle comprising a housing and a vectoring rod. The housing defines an air flow outlet. The vectoring rod is installed in the housing and adjacent the air flow outlet. The vectoring rod comprises an elongate support and a plurality of fins, wherein each fin is fixed to the elongate support so as to extend in a plane bisecting an axis of the elongate support at an oblique angle. Because the vectoring rod is

rotatably mounted in the housing for rotation about the axis of the elongate support, the fins act to change a direction of air exiting the air flow outlet in dependence on the rotational position of the vectoring rod.

In the exemplary embodiments, the housing has an aperture defining the air flow outlet. The aperture is elongate in a direction generally parallel to the axis of the elongate support. A general area of the housing having the aperture is suitably at least partially tubular in a direction generally parallel to the axis of the elongate support. The vectoring rod may be accommodated adjacent the at least partially tubular area. Suitably, the housing accommodates a drive means for driving rotation of the vectoring rod. For instance, the drive means may comprise a stepper motor or the like. Here, the stepper motor may be directly connected to the vectoring rod, or may be indirectly coupled to the vectoring rod as is known in the art. The drive means may be operated by a manual control (via hardware or software), or additionally or alternatively may be programmed to follow predefined vectoring movements to simulate predetermined air flow patterns.

In the exemplary embodiments, the oblique angle at which the plane of each fin bisects the axis of the elongate support is suitably between 10° and 50° . As will be appreciated, here, rotating the vectoring rod so that the oblique angle is arranged in a direction across the air flow outlet, a normal air flow direction is achieved because the fins in the direction through the air flow outlet are not angled. Rotation of the vectoring rod through an angle of 90° in one direction from the normal air flow direction can divert the air flow direction upwardly by the oblique angle. Rotation of the vectoring rod through an angle of 90° in the other direction can divert the air flow direction downwardly by the oblique angle. Thus, a change in vectoring air flow direction of between 20° and 100° can be achieved. In other embodiments, the oblique angle at which the plane of each fin bisects the axis of the elongate support is suitably greater than 20° or greater than 25° or less than 40° or less than 35° . In one embodiment, the oblique angle at which the plane of each fin bisects the axis of the elongate support is around 30° .

In the exemplary embodiments the oblique angle of each fin of the plurality of fins is the same. Advantageously, because the fins are arranged in a parallel arrangement to adjacent fins, the rotation degree of the elongate support does not change the area of the air flow path through the nozzle. Thus, the vectoring of the air flow is achieved with a limited audible sound difference.

It is envisaged that each fin may be non-planar in one direction. For instance, the fin may follow a curve or arc in a plane across the fin. However, in suitable exemplary embodiments, each fin is planar. Optionally, each fin has a substantially constant thickness. As will be appreciated, each fin has a first major surface and an opposed second major surface. Here, the oblique angle at which the plane of each fin bisects the axis of the elongate support is an oblique angle at which a plane of either the first major surface or the second major surface or both the major

surfaces bisect the axis of the elongate support. However, it is also envisaged that the fins may have a profiled cross-section, for instance an aerofoil shape or the like. Here, the plane that bisects the vectoring rod's axis may be a centre between the two major surfaces.

Suitably, each fin of the plurality of fins is elliptical. Thus, the fins have a generally circular profile when viewed along the axis of the elongate support. Advantageously, the fins can be mounted within an at least part tubular portion of the housing, wherein the fins can be rotated within the part tubular portion of the housing. Elliptical fins also allow the angle of the fin relative to the air flow through the outlet to be varied infinitely between the maximum upward and minimum downward directions.

In the embodiments wherein each fin is elliptical, an elliptical centre of each fin of the plurality of fins is suitably arranged to be coincident with the axis of rotation of the elongate support. Here, the housing has an inner surface that is at least partially cylindrical and which has a radius from the axis of rotation of the elongate support.

Optionally, in some embodiments, adjacent fins within the plurality of fins are arranged so that a leading edge of one fin overlaps with the trailing edge of the adjacent fin in a direction orthogonal to the axis of the elongate support. That is, the angle and radial extent of adjacent fins is configured so that a direct air flow through the vectoring unit is prevented by the adjacent fins, when the oblique angle at which the plane of each fin bisects the axis of the elongate support is arranged parallel to the direction of the air flow through nozzle.

In particularly suitable embodiments, the vectoring rod includes a heater element. Thus, the air flowing over the vectoring rod is heated by a heat transfer process and wherein the nozzle provides a room heating function.

In some embodiments, as well as the vectoring rod providing a vectoring of the air flow direction, an oscillating function is provided by mounting the vectoring rod within a barrel.

Suitably, the barrel has a longitudinal inlet aperture and a longitudinal exit aperture, wherein air flows through the barrel and over the fins of the vectoring rod from the inlet aperture to the outlet aperture. Here, the direction determined by the air flow between the inlet aperture and exit aperture directs the air flow exiting the nozzle's outlet. Thus, by rotating the barrel around the vectoring rod, the direction of the air flow can be caused to change in an oscillation direction. Here, the oscillation direction is generally orthogonal to the axis of the elongate support, the vectoring being relative to the axis of the elongate support. Suitably, the barrel is mounted in the housing for rotation about an axis of the barrel so that the longitudinal exit aperture acts to change a second direction of the air exiting the air flow outlet in dependence on the rotational position of the barrel.

Advantageously, in embodiments comprising a barrel, the barrel can be configured to function as a valve to open and close the nozzle, and in particular to open and close the air flow outlet,

or at least a portion of the air flow outlet in which the barrel is mounted. Here, the barrel is able to be arranged in an orientation wherein the longitudinal exit aperture is not in fluid communication with the air flow outlet. For instance, the barrel is rotatable so that the exit aperture is concealed by the housing (i.e. closed by the housing). Suitably a seal or the like can be used to prevent air leakage between the barrel and the housing. Thus, with the barrel arranged with the exit aperture concealed by the housing, air flow from the barrel and out of the air flow outlet is prevented and the portion of the nozzle is closed.

Advantageously, the nozzle can optionally be provided with a second or further vectoring rods. Here, the second vectoring rod comprises a second elongate support and a second plurality of fins, each fin of the second plurality of fins being fixed to the second elongate support so as to extend in a plane bisecting an axis of the second elongate support at an oblique angle. Here, the second vectoring rod is rotatably mounted in the housing for rotation about the axis of the second elongate support so that the second fins act to change a direction of air exiting the air flow outlet in dependence on the rotational position of the second vectoring rod. As will be appreciated, the second vectoring rod can be substantially in accordance with the first vectoring rod. Moreover, it is envisaged that further vectoring rods (i.e. third and fourth vectoring rods) can be included in the nozzle. Here, each further vectoring rod can be substantially similar to the first vectoring rod as herein described.

In embodiments comprising a second vectoring rod, the air flow outlet comprises a first outlet portion and a second outlet portion, the first outlet portion being separated from the second outlet portion. For instance, the first outlet portion can be formed from one aperture in the housing and the second outlet portion can be formed from a second aperture in the housing. Alternatively, the first and second portions can be portions of the same aperture in the housing. Suitably, the first vectoring rod is mounted in the housing adjacent the first outlet portion, and the second vectoring rod is mounted in the housing adjacent the second outlet portion. Optionally, the axes of the first and second elongate supports are coincident (i.e. where the first and second vectoring rods are arranged in the same aperture of the housing). Alternatively, the axes of the first and second elongate supports are parallel and spaced from each other (i.e. where the first and second vectoring units are arranged in separate apertures of the housing).

In embodiments comprising a second vectoring rod, the first vectoring rod may be mounted within a first barrel and the second vectoring rod may be mounted within the same barrel. Here, the barrel is as herein described. Alternatively, the first vectoring rod may be mounted within a first barrel and the second vectoring rod may be mounted in a second barrel. Here, each of the first barrel and the second barrel has a longitudinal inlet aperture and a longitudinal exit aperture. Suitably, the first barrel is mounted in the housing for rotation about an axis of the first barrel so that its longitudinal exit aperture acts to change a second direction of the air exiting the first portion of the air flow outlet in dependence on the rotational position of the first barrel.

Suitably, the second barrel is mounted in the housing for rotation about an axis of the second barrel so that its longitudinal exit aperture acts to change a second direction of the air exiting the second portion of the air flow outlet in dependence on the rotational position of the second barrel. Advantageously, the first vectoring rod, the second vectoring rod, the first barrel and the second barrel are independently driven to rotate by a respective first to fourth drive means. In some embodiments, further vectoring rods are arranged within further barrels. Here, each barrel is substantially as herein described in relation to the first barrel. Moreover, in some variants, two vectoring rods are mounted within a common barrel. Here, conveniently, each vectoring rod may be engaged by the drive means at opposed distal ends of the barrel.

However, where two vectoring rods are arranged to be separately rotated about a common axis (i.e. the vectoring rods are stacked on top of each other), two barrels may also be provided with a common axis so that the oscillating of the air flows generated by the first and second vectoring units can be oscillated separately.

In embodiments including a vectoring rod and a barrel, as well as embodiments including multiple vectoring rods and multiple barrels or combinations thereof, multiple drive units may be employed to rotate one or more of the vectoring rods and one or more of the barrels. Here, the multiple drive units may be operated by a manual control (via hardware or software), or additionally or alternatively may be programmed to follow predefined vectoring movements to simulate determined air flow patterns.

According to a further aspect, there is therefore provided an air movement device including the nozzle of the exemplary embodiments and aspects. For instance, there is provided a fan unit having the exemplary nozzle.

According to a further aspect, there is further provided a method of controlling a fan unit, the method comprising causing air to exit an air flow outlet (e.g. blowing air through a nozzle) and vectoring the air flow direction from the nozzle by rotating a vectoring rod to change a direction of the air exiting the air flow outlet in dependence on the rotational position of the vectoring rod. Suitably, the vectoring rod comprises an elongate support and a plurality of fins, each fin being fixed to the elongate support so as to extend in a plane bisecting an axis of the elongate support at an oblique angle.

Suitably, in exemplary methods, the step of causing air to exit an air flow outlet comprises causing air to exit a first outlet portion and a second outlet portion, and the step of rotating a vectoring rod, comprises rotating a first vectoring rod to change a direction of the air exiting the first outlet portion and independently rotating a second vectoring rod to change a direction of the air exiting the second outlet portion. Here, the first vectoring rod and the second vectoring rod each comprise an elongate support and a plurality of fins, each fin being fixed to the elongate support so as to extend in a plane bisecting an axis of the elongate support at an oblique angle.

Suitably, exemplary methods comprise also oscillating the air flow from the outlet. Here, the method may comprise rotating a barrel having an inlet and an outlet for defining and oscillating direction of the airflow. The vectoring rod being mounted within the barrel as herein described.

Brief Summary of the Figures

5 Embodiments will now be discussed with reference to the accompanying figures in which:

Figure 1 is a perspective view of a manifold having a nozzle according to an exemplary embodiment;

10 Figure 2 is cross-sectional side view through the embodiment of Figure 1, showing the nozzle in a downward vectoring configuration, a normal vectoring configuration, and an upward vectoring configuration;

Figure 3 shows a perspective view of a vectoring rod for use in the exemplary embodiment of Figure 1;

Figure 4 shows a perspective view of a barrel for use in the exemplary embodiment of Figure 1;

15 Figure 5 is a cross-sectional plan view through the embodiment of Figure 1, showing the nozzle in a left oscillation configuration, a normal oscillation configuration, and a right oscillation configuration;

Figure 6 is a cross-sectional plan view through the embodiment of Figure 1, showing the nozzle in an open configuration, and a closed configuration;

Figure 7 shows a cross-sectional perspective view of the manifold of Figure 1;

20 Figure 8 shows the cross-sectional perspective view of the manifold of Figure 7, showing the barrel of Figure 4 and the vectoring rod of Figure 3 installed therein (the barrel and vectoring rod being shown in cross-section along a different plane to the manifold);

Figure 9 shows a fan unit having a manifold with first and second nozzles in a horizontal arrangement; and

25 Figure 10 shows the manifold of figure 9 with the first and second nozzles in a vertical arrangement.

Aspects and embodiments will now be discussed with reference to the accompanying figures. Further aspects and embodiments will be apparent to those skilled in the art.

30 Referring to Figure 1 there is shown a manifold 10, which is representative of an air flow manifold from a fan unit. The manifold 10 channels air blown from the fan unit through the manifold to a nozzle 20. The nozzle comprises a housing 30. The housing is shown as a portion of the manifold 10 in Figure 1. The housing has an aperture 32. Suitably, the aperture

is shown as an elongate aperture 32. That is, the aperture has a width and a height, and the height is greater than the width. For instance, the height may suitably be at least five times greater or at least eight times greater or at least ten times greater than the width. The aperture may therefore have the appearance of a slot.

5 According to the exemplary embodiments, a vectoring rod is arranged within the manifold and adjacent the aperture. As will be explained herein, air is blown through the manifold to exit an air flow outlet defined generally by the aperture in the housing. The manifold guides the blown air generally in a direction through the manifold and out of the air flow outlet. Here, the air flow has a normal direction with a cross-section defined by a normal plane. With the vectoring rod
10 arranged adjacent the air flow outlet, the vectoring rod can be controlled to change a direction of the air flow relative to the elongate direction of the aperture 32. Here, the manifold is shown as being arranged with the elongate aperture in a substantially vertical arrangement. That is, with the elongate aperture upstanding. Thus, the vectoring changes the air flow in an up and down direction. As herein described, it is possible to mount the manifold in an alternative
15 arrangement wherein the elongate aperture is arranged in a substantially horizontal arrangement. That is with the elongate aperture aligned horizontally, in which case the vectoring rod may direct the air flow in a left and right direction (that might be more accurately be described as oscillation). However, for simplicity of terminology, the vectoring rod directing the air flow through the outlet to change in angle relative to the elongate length of the aperture
20 (and as herein described, an axis of the vectoring rod), will be termed vectoring, whether the nozzle is mounted vertically or horizontally.

Referring to Figure 2, the manifold 10 directs air from an inlet 12 to the outlet 32. The air is blown over the vectoring rod 40, which is arranged adjacent the air flow outlet 32. The vectoring rod 40 comprises an elongate support 42 and a plurality of fins 44. Each fin 44 is
25 fixed to the elongate support 42 so as to extend in a plane bisecting an axis of the elongate support at an oblique angle. The fins 44 are formed in a plane in at least one direction. That is, when the fins 44 are arranged aligned with the air flow through the outlet 32, the fins 44 form a plane in a cross-section through the fin in the direction of the air flow. As shown in the middle image of Figure 2, when the vectoring rod is arranged with the fins 44 aligned with the air flow
30 (i.e. with the oblique angle extending from the page), the fins do not direct the air flow to exit the outlet at an angle. Instead, the air is blown over the fins 44 without significant deviance, because surfaces of the fins in the air flow direction do not change. As the vectoring rod is rotated, the fins become angled to the air flow direction through the manifold. Thus, the fins begin to direct the air flow to change direction. When rotated through 90° in one direction (for
35 instance as shown in the left-hand image of Figure 2) the fins 44 become angled to the air flow direction by the oblique angle. For instance, the fins 44 are angled downwardly and the air flow from the outlet 32 is diverted downward from the normal direction generally by the oblique angle. When rotated through 90° in the other direction (for instance as shown in the right-hand

image of Figure 2) the fins 44 become angled to the air flow direction by the oblique angle. For instance, the fins 44 are angled upwardly and the air flow from the outlet 32 is diverted upward from the normal direction generally by the oblique angle.

The vectoring rod 40 is shown in more detail in Figure 3. Here, each fin 44 is shown suitably as an elliptical disc. Each elliptical disc is a planar disc having an elliptical shape. Thus, each fin 44 has a first major surface 45 and a second, opposed major surface 46. The fins 44 are shown as relatively thin discs such that edges of the fins have a small profile. The elongate support is shown as a general rod. The rod defines the rotation axis of the elongate support 42. Each fin 44 is attached to the elongate support 42. For instance, the elongate support 42 may be an integrally formed moulding or the like. Each fin 44 extends in a plane, in this instance, the flat plane of one of the major surfaces 45, 46, or a centre between the major surfaces 45, 46. The fins 44 are attached or formed with the elongate support 42 so that the plane of each fin bisects the axis of the elongate support 42 at an oblique angle. As shown, suitably a centre of each fin 44 is coincident with the rotational axis of the elongate support 42. The oblique angle is shown as being around 30° , which provides a maximum change in vectoring direction of around 60° . However, the oblique angle can be configured for a different range of vectoring, for instance the oblique angle may be between 10° and 50° , giving a range of directional change between 20° and 100° .

In the exemplary embodiment shown in Figure 3, the fins 44 are substantially similar and arranged to be parallel to each adjacent fin. The fins 44 at the distal ends of the vectoring rod may have a first major 45 surface parallel to an opposed major surface 46 of the adjacent fin, but have a non-constant cross-section so that the distal extents of these fins 44 provide a partial rod to limit airflow therethrough.

In optional embodiments, the major surfaces 45, 46 of the fins 44 can include heater elements. For instance, resistive heater wires can be fixed or embedded in the major surfaces 45, 46. Via a heat transfer process with the air flow as it passes over the surfaces, the vectoring rod can therefore act as a heating element. Thus, the nozzle can be used as a room heater or the like.

In optional embodiments, the nozzle is provided with an oscillating function. Here, a barrel 50 is provided. The barrel 50 is shown in Figure 4 as a tube having first and second elongate slots formed along circumferential sides of the tube. When the barrel 50 is arranged adjacent the air flow outlet 32, one of the elongate slots is arranged facing the outlet and the other facing inwards to the manifold. Thus, one of the elongate slots forms an inlet aperture 52 to the barrel 50 and the other elongate slot forms an exit aperture 54 from the barrel. Thus, by rotating the barrel 50 so that the path through the barrel from the inlet aperture 52 to the exit aperture 54 changes angle with respect to the normal airflow direction, the air flow from the outlet 32 can be oscillated.

Referring to Figure 5, the middle image represents the barrel 50 being configured with the path from the inlet aperture 52 to the exit aperture 54 aligned with the airflow direction. The air flow from the outlet 32 of the nozzle is therefore arranged in a normal direction. By rotating the barrel 50, for instance as shown in the lower image in an anti-clockwise direction, the air flow direction can be oscillated to the left. Alternatively, by rotating the barrel, for instance clockwise as shown in the upper image, the air flow direction can be oscillated to the right.

In the exemplary embodiments including the optional barrel 50, the barrel can also be used as a valve to close the nozzle. For instance, as shown in Figure 6, the barrel 50 can be rotated so that the exit aperture 54 of the barrel is closed by the housing of the nozzle. Optionally, in the closed orientation, the inlet aperture 52 may also be closed by the housing. Optionally, the inlet aperture may be formed by a wider slot than the exit aperture 54. Moreover, the housing and barrel may include a sealing arrangement to prevent air from flowing between the barrel 50 and the housing 30.

Referring to Figure 7, the manifold is arranged to channel air blow in through the inlet 12 to the air flow outlet formed generally by the slot aperture 32. The vectoring rod 40 and optional barrel 50 are mounted in a portion of the manifold forming the nozzle housing. The vectoring rod 40 and barrel 50 are both mounted to the housing so as to be rotatable. The vectoring rod 40 is rotatable about the axis of the elongate support 42. The barrel 50 is rotatable about a central axis of the tube. The housing of the nozzle (i.e. the portion of the manifold including the slot aperture and surrounding the vectoring rod and barrel) includes an at least part tubular portion. The at least part tubular portion provides an inner tubular surface 34, within which the vectoring rod 40 and barrel 50 are mounted. The inner tubular surface 34 includes the exit aperture. As shown, in the embodiment including the barrel 50, the vectoring rod 40 is mounted within the barrel 50. Thus, by rotating the barrel 50, the air flow from the outlet 32 can be oscillated whilst simultaneously vectoring the airflow by rotating the vectoring rod 40. Because the vectoring rod 40 is rotatable within the tube, the vectoring and oscillating mechanism is compact. Moreover, the moveable parts (the barrel 50 and vectoring rod 40) are relatively small and light allowing smaller drive means as well as enabling more rapid movements within the constraints of providing a useable device. Conveniently, the drive means may comprise a first stepper motor 62 arranged at one end of the rotational axis of the vectoring rod 40 and for rotating the vectoring rod 40, and a second stepper motor 64 arranged at the other end for rotating the barrel 50.

Figures 9 and 10 show further exemplary embodiments of the nozzle 10. In figure 9, the nozzle 10 is shown assembled to a fan unit 12. The nozzle 10 is shown having a racetrack shape. Here, the outlet 32 of the nozzle is formed from two parallel and spaced outlet portions, generally defined by respective slot apertures 32a and 32b in the housing. Each outlet portion has a respective vectoring rod 40 arranged adjacent the respective outlet portion. As will be

appreciated, each outlet portion may also include an optional barrel 50 as herein described. As shown in Figure 9, the nozzle 10 is arranged with the axis of each vectoring rod 40 arranged in a horizontal direction. Thus, the slot apertures 32a and 32b in the housing are also horizontally aligned. The vectoring of the air as herein described results in a change in angle in the vertical direction. The vectoring rod 40 can therefore be controlled, for instance to direct air upwardly to a user's head, or downwardly to a user's feet. By independently controlling the vectoring rods 40 in the respective outlet portions, the nozzle 10 can be used to direct air from the fan unit simultaneously to the user's head and the user's feet.

In Figure 10, the nozzle is shown with the racetrack orientated with the slot apertures 32a, 32b in the nozzle's housing aligned in the vertical direction. Here, the vectoring rods 40 can be operated to vector the air direction in a horizontal direction.

According to the exemplary embodiments, the vectoring rod 40 is rotatable to provide a convenient and improved vectoring of airflow from the nozzle. For instance, the rotation of the vectoring rod can be controlled to change direction rapidly without requiring a large drive means that liberates space in the nozzle of the fan unit for other components. Moreover, the vectoring can be achieved with a large range of directional change without destabilising the fan unit. Furthermore, because the housing of the nozzle remains stationary, and the slot aperture being the dominant visual of the air flow outlet, the vectoring can be achieved without generating a significant discernible visual movement of the system. Yet further, the vectoring rod is conveniently combined within a barrel for providing additional oscillation of the air flow direction.

The exemplary embodiments set forth above are considered to be illustrative and not limiting. Various changes to the described embodiments may be made without departing from the spirit and scope of the invention.

For the avoidance of any doubt, any theoretical explanations provided herein are provided for the purposes of improving the understanding of a reader. The inventors do not wish to be bound by any of these theoretical explanations.

Any section headings used herein are for organizational purposes only and are not to be construed as limiting the subject matter described.

Throughout this specification, including the claims which follow, unless the context requires otherwise, the word "comprise" and "include", and variations such as "comprises", "comprising", and "including" will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

It must be noted that, as used in the specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise. Ranges may be expressed herein as from "about" one particular value, and/or to "about" another particular value. When such a range is expressed, another embodiment includes from the one

particular value and/or to the other particular value. Similarly, when values are expressed as approximations, by the use of the antecedent “about,” it will be understood that the particular value forms another embodiment. The term “about” in relation to a numerical value is optional and means for example +/- 10%.

Claims:

1. A nozzle for a fan unit, the nozzle comprising a housing and a vectoring rod;
the housing defining an air flow outlet; and
the vectoring rod being installed in the housing and adjacent the air flow outlet; wherein
the vectoring rod comprises an elongate support and a plurality of fins,
each fin being fixed to the elongate support so as to extend in a plane bisecting an axis of the elongate support at an oblique angle; and
the vectoring rod is rotatably mounted in the housing for rotation about the axis of the elongate support so that the fins act to change a direction of air exiting the air flow outlet in dependence on the rotational position of the vectoring rod.
2. The nozzle of Claim 1, wherein the oblique angle is between 10° and 50°.
3. The nozzle of any of Claims 1 or 2, wherein the oblique angle of each fin of the plurality of fins is the same.
4. The nozzle of any of Claims 1 to 3, wherein each fin of the plurality of fins is elliptical.
5. The nozzle of Claim 4, wherein an elliptical centre of each fin of the plurality of fins is coincident with the axis of rotation of the elongate support, the housing has an inner surface that is at least partially cylindrical tubular and which has a radius from the axis of rotation of the elongate support.
6. The nozzle of any of Claims 1 to 5, wherein within the plurality of fins, adjacent fins are arranged so that a leading edge of one fin overlaps with the trailing edge of the other fin in a direction orthogonal to the axis of the elongate support.
7. The nozzle of any of Claims 1 to 6 wherein the vectoring rod includes a heater element.
8. The nozzle of any of Claims 1 to 7, wherein the vectoring rod is mounted within a barrel, the barrel has a longitudinal inlet aperture and a longitudinal exit aperture, wherein
the barrel is mounted in the housing for rotation about an axis of the barrel so that the longitudinal exit aperture acts to change a second direction of the air exiting the air flow outlet in dependence on the rotational position of the barrel.
9. The nozzle of Claim 8, wherein the barrel is able to be arranged in an orientation wherein the longitudinal exit aperture is not in fluid communication with the air flow outlet.
10. The nozzle of any of Claims 1 to 7, having a second vectoring rod comprising a second elongate support and a second plurality of fins,
each fin of the second plurality of fins being fixed to the second elongate support so as to extend in a plane bisecting an axis of the second elongate support at an oblique angle; and

the second vectoring rod is rotatably mounted in the housing for rotation about the axis of the second elongate support so that the second fins act to change a direction of air exiting the air flow outlet in dependence on the rotational position of the second vectoring rod.

11. The nozzle of Claim 10, wherein the air flow outlet comprises a first outlet portion and a second outlet portion, the first outlet portion being separated from the second outlet portion and the first vectoring rod being mounted in the housing adjacent the first outlet portion and the second vectoring rod being mounted in the housing adjacent the second outlet portion.

12. The nozzle of Claim 11, wherein the axes of the first and second elongate supports are parallel and spaced from each other.

13. The nozzle of Claim 12, wherein the first vectoring rod is mounted within a first barrel and the second vectoring rod is mounted within a second barrel, each of the first barrel and the second barrel having a longitudinal inlet aperture and a longitudinal exit aperture, wherein

the first barrel is mounted in the housing for rotation about an axis of the first barrel so that the longitudinal exit aperture acts to change a second direction of the air exiting the first portion of the air flow outlet in dependence on the rotational position of the first barrel;

the second barrel is mounted in the housing for rotation about an axis of the second barrel so that the longitudinal exit aperture acts to change a second direction of the air exiting the second portion of the air flow outlet in dependence on the rotational position of the second barrel; wherein

the first vectoring rod, the second vectoring rod, the first barrel and the second barrel are independently driven to rotate by a respective first to fourth drive means.

14. A fan unit having the nozzle of any of claims 1 to 13.

15. A method of controlling a fan unit, the method comprising:

causing air to exit an air flow outlet;

rotating a vectoring rod to change a direction of the air exiting the air flow outlet in dependence on the rotational position of the vectoring rod, wherein the vectoring rod comprises an elongate support and a plurality of fins, each fin being fixed to the elongate support so as to extend in a plane bisecting an axis of the elongate support at an oblique angle.

16. The method of Claim 15, wherein

the step of causing air to exit an air flow outlet comprises causing air to exit a first outlet portion and a second outlet portion, and

the step of rotating a vectoring rod, comprises rotating a first vectoring rod to change a direction of the air exiting the first outlet portion and independently rotating a second vectoring rod to change a direction of the air exiting the second outlet portion

wherein the first vectoring rod and the second vectoring rod each comprise an elongate support and a plurality of fins, each fin being fixed to the elongate support so as to extend in a plane bisecting an axis of the elongate support at an oblique angle.

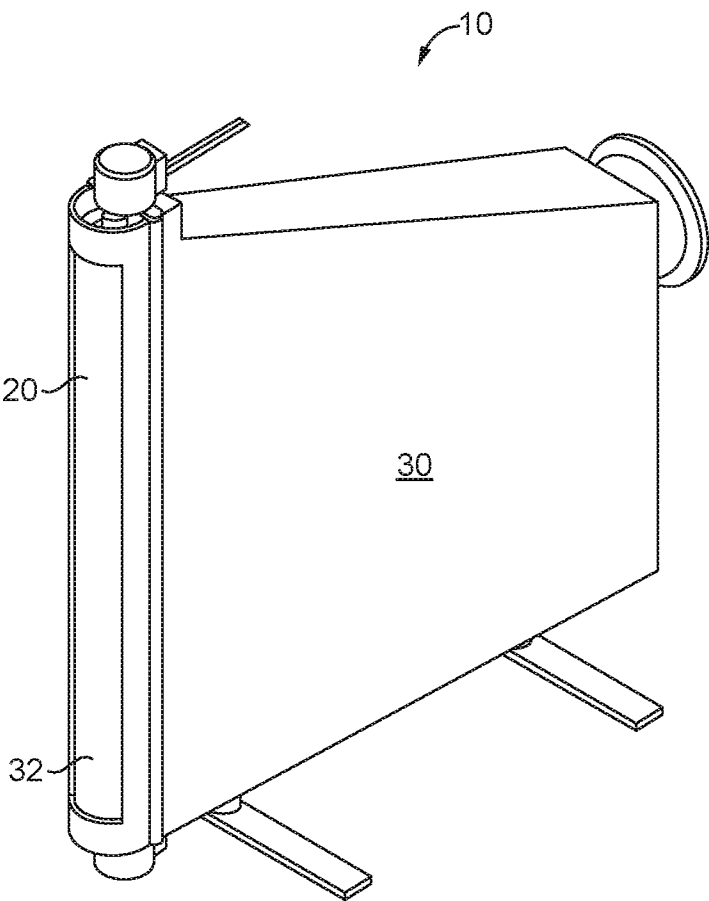


FIG. 1

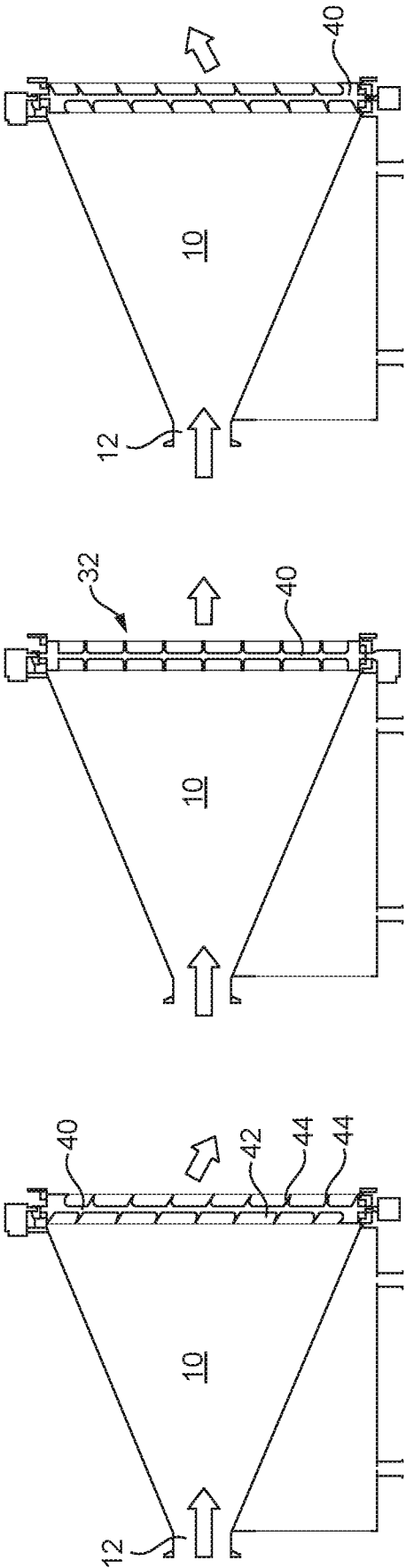


FIG. 2

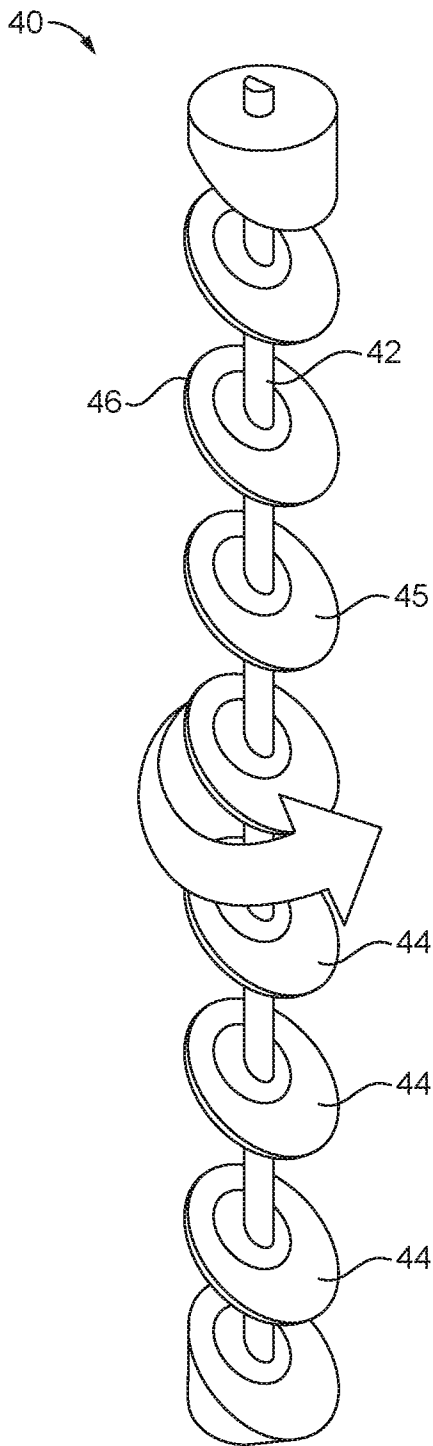


FIG. 3

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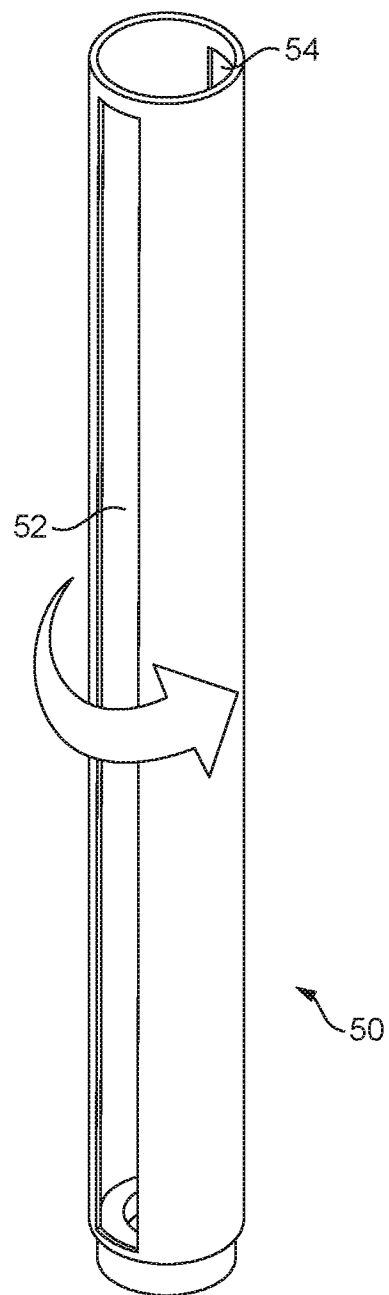


FIG. 4

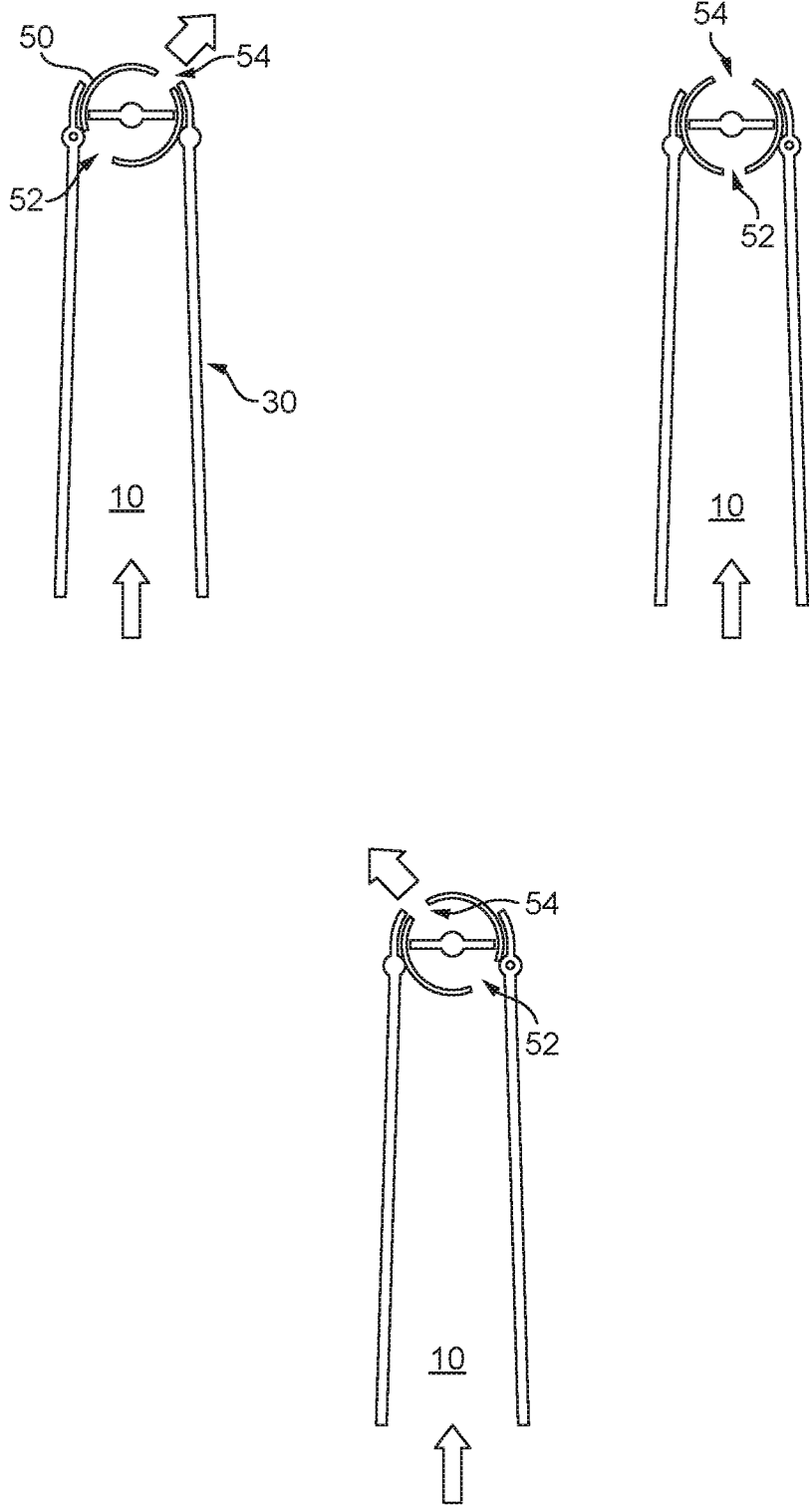


FIG. 5

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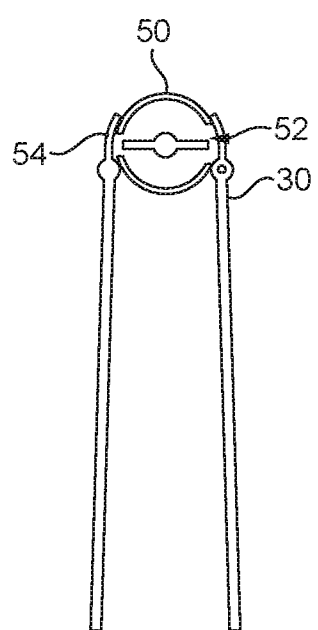
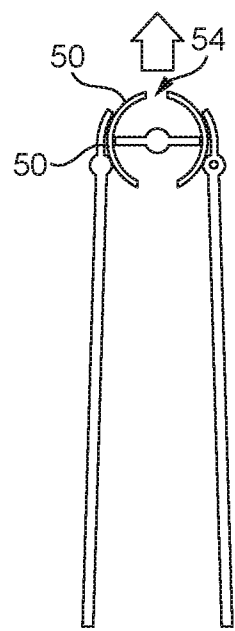


FIG. 6

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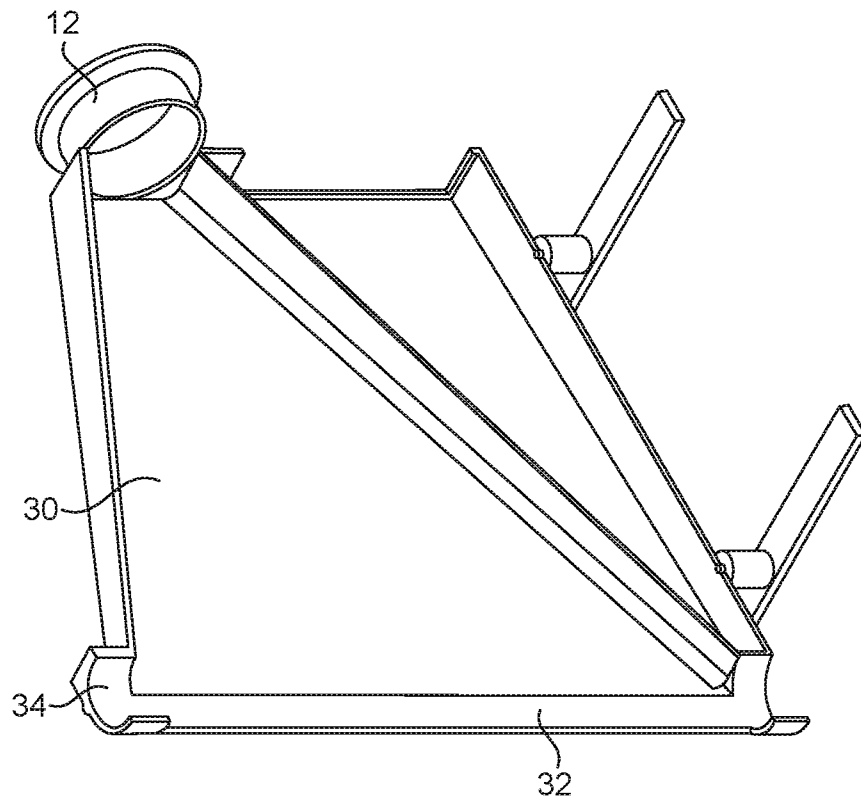


FIG. 7

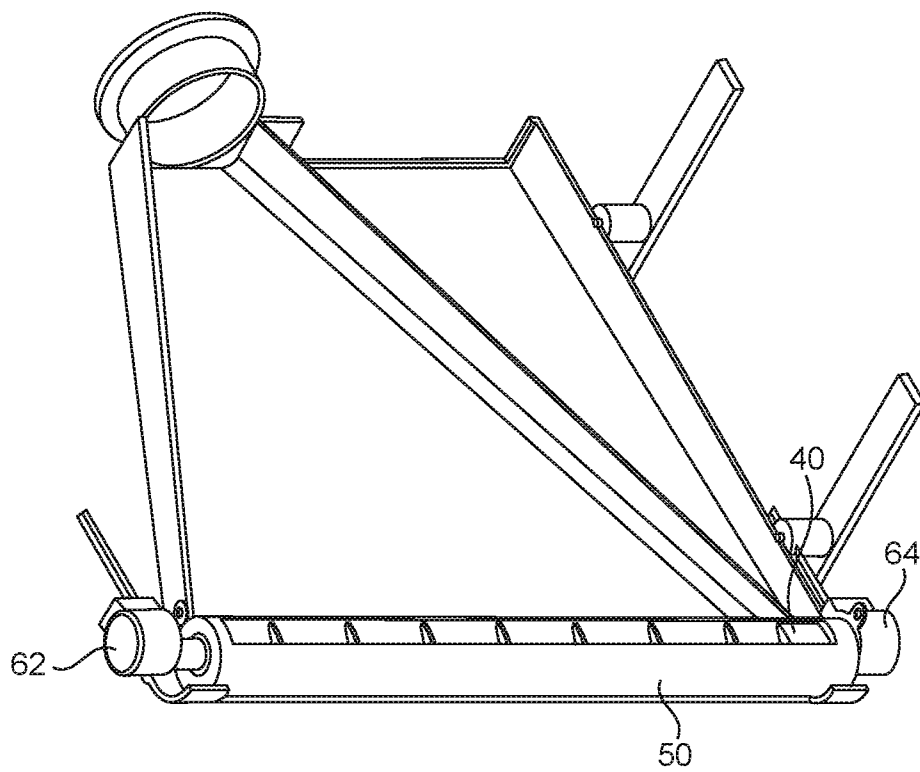


FIG. 8

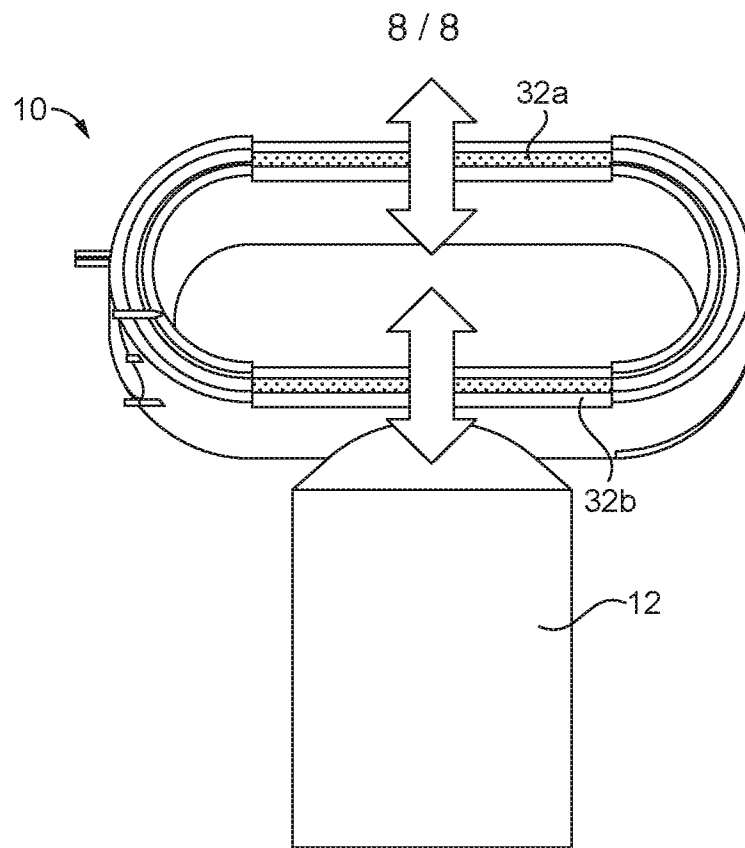


FIG. 9

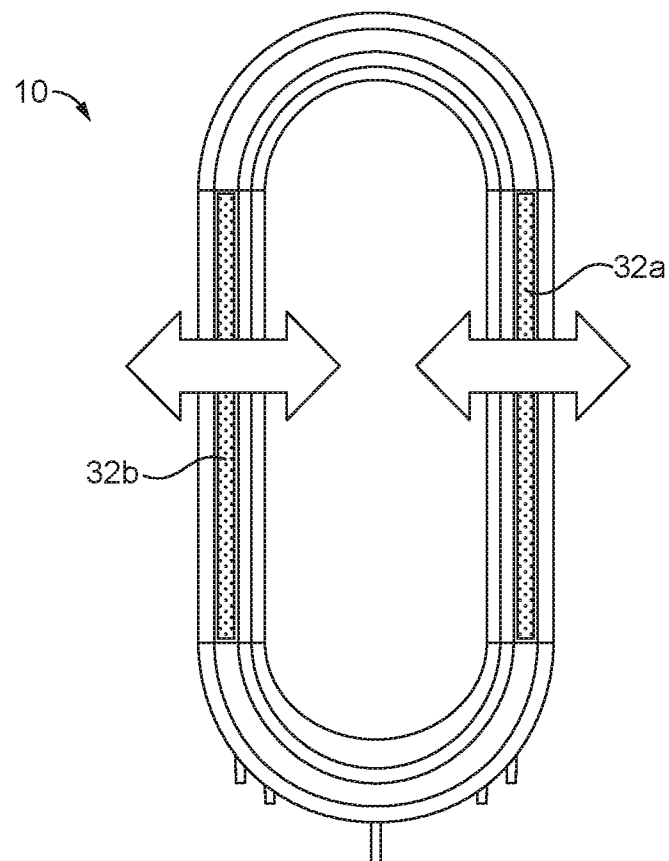


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2023/050482

A. CLASSIFICATION OF SUBJECT MATTER

INV. F04D25/10 F24F13/14

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04D F24F

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2012 145308 A (HINOKI IND CO LTD) 2 August 2012 (2012-08-02)	1-6, 8-16
Y	paragraph [0006] - paragraph [0025] figures -----	4-9, 13
X	WO 2015/115077 A1 (PANASONIC IP MAN CO LTD [JP]) 6 August 2015 (2015-08-06)	1-3, 10-12, 14-16
Y	abstract page 2, paragraph 4 - page 10, paragraph 4 figures -----	4-9, 13
X	JP H10 253141 A (MITSUBISHI HEAVY IND LTD) 25 September 1998 (1998-09-25)	1-3, 6, 7, 10-12, 14-16
Y	paragraph [0005] - paragraph [0031] figures ----- -/--	4, 5, 8, 9, 13



Further documents are listed in the continuation of Box C.



See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

25 May 2023

Date of mailing of the international search report

05/06/2023

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INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2023/050482

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2016 210396 A (HOWA KASEI KK) 15 December 2016 (2016-12-15)	1-6, 10-12, 14-16
Y	paragraph [0054] - paragraph [0199] figures -----	7-9, 13

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2023/050482

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		JP 2016210396 A	15-12-2016