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(54) **FAN ASSISTED PERSONAL HEATER DEVICE**

(57) A personal heater device including an ignition device configured to generate a spark to ignite a fuel; a combustion location where ignited fuel burns in response to the spark; a battery receiving port configured to receive a battery; a controller; and a fan assembly including a motor electrically coupled the battery receiving port and controlled by the controller; a fan coupled to an output shaft of the motor; and a passageway configured to route airflow generated by the fan to a location near the combustion location.

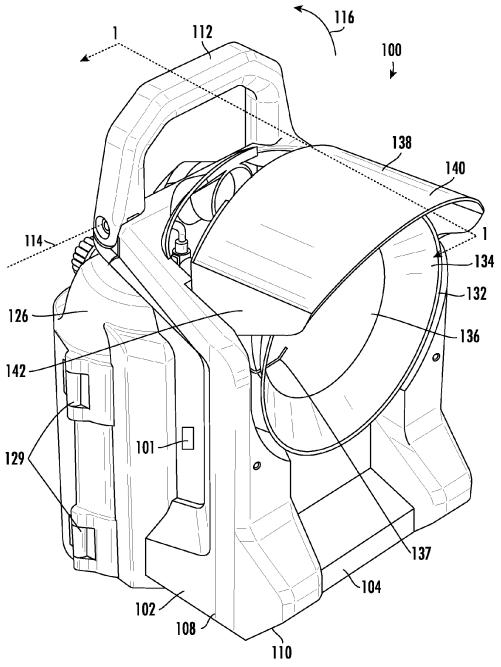

FIG. 1

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Description

FIELD

[0001] The present disclosure generally pertains to personal heater devices, such as portable, personal heater devices.

BACKGROUND

[0002] Heating devices are often used in cold weather to warm environments. Traditional heating devices utilize large ductwork integrated into existing structures to move airflow from a centralized burner to different outlet vents (ducts) disposed within the structure. Personal heater devices are challenged to efficiently generate and distribute heat within large environments while remaining lightweight and portable for a user to carry and freely position.

[0003] A personal heating device that provides improved thermal efficiency would be advantageous and beneficial. In particular, a portable personal heating device that allows a user to quickly and efficiently warm an environment would be desirable.

BRIEF DESCRIPTION

[0004] Aspects and advantages of the invention in accordance with the present disclosure will be set forth in part in the following description, or may be obvious from the description, or may be learned through practice of the technology.

[0005] In accordance with one embodiment, a personal heater device is provided. The personal heater device includes an ignition device configured to generate a spark to ignite a fuel; a combustion location where ignited fuel burns in response to the spark; a battery receiving port configured to receive a battery; a controller; and a fan assembly comprising: a motor electrically coupled the battery receiving port and controlled by the controller; a fan coupled to an output shaft of the motor; and a passageway configured to route airflow generated by the fan to a location near the combustion location.

[0006] In accordance with another embodiment, a method of heating a space is provided. The method includes adjusting a regulator of a personal heater device to permit flow of fuel from a fuel tank coupled to the personal heater device to a combustion area; igniting, with an ignition device, the fuel at the combustion area to create combustion; activating a fan assembly to drive airflow from an air inlet opening to a diffuser defining the combustion area, wherein the fan assembly is powered by a removable battery coupled to the personal heater device.

[0007] In accordance with another embodiment, a personal heater device is provided. The personal heater device includes a frame; a hydrocarbon fuel source removably coupled to the frame and selectively ignitable by an ignition device of the personal heater device; and a fan driven by a motor receiving power from a removable battery electrically coupled to a removable battery port of the personal heater device, wherein the fan drives airflow across a location adjacent to the ignited hydrocarbon fuel source to radiate heated airflow into a nearby environment.

[0008] These and other features, aspects and advantages of the present invention will become better understood with reference to the following description and appended claims. The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the technology and, together with the description, serve to explain the principles of the technology.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures, in which:

FIG. 1 provides a perspective view from a front end of an embodiment of a fan assisted personal heater device in accordance with aspects of the present disclosure;

FIG. 2 provides a perspective view from a rear end of the embodiment of a fan assisted personal heater device in accordance with aspects of the present disclosure;

FIG. 3 provides a perspective view from the front end of internal components of an embodiment of a fan assisted personal heater device in accordance with aspects of the present disclosure;

FIG. 4 provides a perspective view from the rear end of internal components of an embodiment of a fan assisted personal heater device in accordance with aspects of the present disclosure;

FIG. 5 provides a side cross sectional view of an embodiment of a fan assisted personal heater device in accordance with aspects of the present disclosure;

FIG. 6 provides a side cross sectional view of an embodiment of a fan assisted personal heater device schematically depicting fluid flow therethrough in accordance with aspects of the present disclosure;

FIG. 7 provides a side cross sectional view of an embodiment of a fan assisted personal heater device in accordance with aspects of the present disclosure; and

FIG. 8 provides a flow chart of a method of heating an environment in accordance with aspects of the present disclosure.

[0010] Repeat use of reference characters in the present specification and drawings is intended to represent the same or analogous features or elements of the present invention.

DESCRIPTION

[0011] Reference now will be made in detail to embodiments of the invention, one or more examples of which are illustrated in the drawings. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment can be used with another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

[0012] As used herein, the terms "first", "second", and "third" may be used interchangeably to distinguish one component from another and are not intended to signify location or importance of the individual components.

[0013] In general, a personal heater device (referred to hereinafter as "the heater device") can generate heat to warm an environment, such as a living room, a bedroom, an office space, a commercial space, an outdoor area, a campsite, a recreational vehicle (RV), or the like. The heater device can include a fuel tank receiving area for receiving a fuel tank. The fuel tank can store a combustible hydrocarbon fuel, such as a combustible gas and/or a combustible liquid, that is dispensed from the fuel tank and combusted at a combustion area of the heater device. By way of non-limiting example, the combustible hydrocarbon fuel can include liquefied petroleum gas (LPG) such as propane, butane, isobutane, or the like. The fuel tank is coupled to the combustion area by a regulated conduit. The user can prevent the flow of fuel to the combustion area by adjusting a regulator associated with the conduit. To increase combustion, the user opens the regulator. Conversely, to decrease combustion, the user closes the regulator. Through adjusting the regulator, the user is able to control a temperature of the environment proximate to the heater device.

[0014] The heater device can be fan assisted. The heater device includes a fan assembly that biases airflow to move (radiate) heat from the combustion area and the environment proximate to the heater device into the surrounding environment (and potentially to distant areas within the environment). The fan assembly can include a fan and a motor. The motor can be electrically powered, receiving power from an electrical energy source, such as one or more removable and/or rechargeable batteries that are coupled to the heater device. The motor drives the fan to rotate. The fan intakes (draws) atmospheric air from the nearby environment, moves the air towards the combustion area through a passageway, and discharges the air back into the environment. The discharged air passes by or through the combustion area such that the temperature of the air discharged from the heater device is at a higher temperature than atmospheric air at the intake. Over time, the cumulative effect of intaking relatively cooler air and discharging relatively warmer air results in the temperature of the environment increasing (particularly when the space is an enclosed, or partially enclosed, space). Due to use of the fan, the warmer air is more quickly distributed from the combustion area to the surrounding environment, resulting in the formation of a more gradual thermal gradient and increased environmental temperatures at locations remote from the heater device.

[0015] Heater devices described herein can operate at relatively high efficiencies (e.g., fuel consumption rates) and/or better distribute heat within the environment as compared to traditional heat sources. Moreover, the heater device may be self-contained such that the production of heat does not require an external fuel source and/or a power hookup (e.g., an electric cord extending to a wall outlet) during use.

[0016] The heater device is a personal heater device intended for personal use in a desired environment. The heater device is readily movable between different areas of the same environment or even between different environments. The heater device is fully contained and does not require access to external fuel sources and/or electrical power sources during use. Instead, the heater device can be powered using rechargeable and refillable power sources. In this regard, the heater device can be used in areas where traditional heating devices are not suitable (e.g., outdoor camping or jobsites without power) and does not require active input of external electrical power (e.g., using a power cord connected to an external wall outlet) or active input of external fuel source (e.g., a gas line connected to a main supply source). The heater device is lightweight and easy to maneuver. In an embodiment, the heater device weighs less than 100 pounds (lbs) when the fuel source is detached, such as less than 75 lbs when the fuel source is detached, such as less than 50 lbs when the fuel source is detached, such as less than 25 lbs when the fuel source is detached. The heater device includes carrying structure that enables a user to carry the heater device between different environments. The carrying structure can include, for example, a handle. In some implementations, the heater device can include one or more walking elements, such as wheels, treads, or the like, that allow the user to roll the heater device between different locations.

[0017] Referring now to the drawings, FIGS. 1 and 2 illustrate front and rear perspective views of a heater device 100, respectively, in accordance with an example embodiment. The heater device 100 includes a body 102. The body 102 can form an outer surface of the heater device 100. The body 102 can be formed from a plurality of components coupled together, e.g., by one or more threaded or non-threaded fasteners, snap fit, one or more rivets, or the like. Alternatively, the body 102 can be formed from a single-piece (unitary) construction. The body 102 can form an outer faring that protects one or more internal components of the heater device 100

against impact and/or hot temperatures generated during use of the heater device 100.

[0018] The body 102 can generally define a front side 104 and a rear side 106. The front and rear sides 104, 106 are disposed on opposite sides of the body 102. During use, the heater device 100 may be arranged with the front side 104 of the body 102 facing in a direction where heated air is desired. The user can adjust the angle of the heater device 100 to direct heat as desired. Adjusting the angle of the heater device 100 may include adjusting an angle of the entire heater device 100 and not just adjusting an orientation of a directional component such as a louvre or outlet vent, as with traditional environmental heating devices.

[0019] The body 102 further defines a base surface, including, for example, a first base surface 108 and a second base surface 110. The first base surface 108 can form a surface upon which the heater device 100 can be rested during normal use. The second base surface 110 can form a surface upon which the heater device 100 can be rested during certain operations, such as when performing a servicing operation (e.g., when a fuel tank 126 is removed and/or replaced as described below). The first and second base surfaces 108, 110 can be disposed adjacent to one another. In an embodiment, the first and second base surfaces 108, 110 are disposed immediately adjacent to one another. The first and second base surfaces 108, 110 are angularly offset from one another. For example, the first and second base surfaces 108, 110 can each lie along a best fit plane, and the best fit planes of the first and second base surfaces 108, 110 can be angularly offset from one another by at least 5°, such as by at least 10°, such as by at least 15°, such as by at least 20°, such as by at least 25°, such as by at least 30°. Thus, the heater device 100 is swappable between two different orientations based on which of the first and second base surfaces 108, 110 supports the heater device 100. In an embodiment, the second base surface 110 is disposed between the first base surface 108 and the front side 104 of the body 102. In this regard, the front side 104 of the body 102 may point downward when the heater device 100 rests on the second base surface 110 (see, e.g., FIG. 7).

[0020] The heater device 100 can further include a handle 112. The handle 112 can be coupled to the body 102 and extend upward from the body 102. The handle 112 may be movable relative to the body 102. For example, the handle 112 can be rotatably coupled to the body 102 about a rotational axis 114 such that the handle 112 is reconfigurable between two or more different positions. In the depicted embodiment, the handle 112 is shown in an in-use configuration as seen when the handle 112 is used (or ready to be used) by a user to reposition (e.g., lift and carry) the heater device 100. The handle 112 can rotate about the rotational axis 114, e.g., in a direction 116, from the in-use position to a stored position. In the stored position, the handle 112 may cover (hide) one or more user-accessible components of the heater device 100. The one or more user-accessible components of the heater device 100 can include, for example, a regulator 118, an ignition activator 120, a touchscreen (not shown), a status indicator (e.g., LED multi-colored or single colored light(s)), or the like. The handle 112 can restrict access to the one or more user-accessible components when the handle 112 is in the stored position. In some implementations, the handle 112 can form a tactile or audible indication to the user when the handle 112 reaches the stored and/or in-use position(s). For example, the handle 112 can form a tactile and/or audible click when reaching the stored and/or in-use position(s). A detent, or other structure, may restrain further movement of the handle 112 until the user inputs sufficient force to overcome the detent or other similar structure. The body 102 can define further operator-accessible components, such as for example, a power selector 122 (e.g., an on/off component), other buttons and/or actuators, or the like.

[0021] In an embodiment, the heater device 100 is controlled through the one or more user-accessible components without requiring the user to open a portion of the body 102 and/or without requiring the user to access an internal location of the heater device 100. The user-accessible components can be disposed at external locations of the body 102 and be readily adjustable by the user without modifying the body 102. Alternatively, one or more user-accessible components may be accessible only by opening or reaching into the body 102. For example, a secondary (e.g., backup or emergency) regulator may be disposed in the body 102 and accessible only when the body 102 is opened.

[0022] In some implementations, the user may control the heater device 100 using a user device such as a smart device (e.g., a smartphone, a tablet, a personal computer, or the like). For example, the heater device 100 can include a receiver 101 (e.g., an antenna) that communicates with the user device. The user device can run an application that executes a program that allows the user to adjust the heater device 100. For instance, using the user device, the user can select between different run modes (high, low, off, on), different temperatures (high, low, medium, or exact temperatures (e.g., 95 degrees)), different fuel usage rates (eco, boost, etc.), or the like. The user device may also display information to the user, such as a remaining fuel level, an estimated time before refueling, a status of an onboard electrical system or electrical storage device, a current temperature of the heater device and/or environment, an anticipated temperature of the environment, warnings, and other status information. Alternatively, or in addition, the heater device 100 can include an onboard user display that provides information to the user. The onboard user display may be disposed, for example, at the rear side 106 of the body 102, thereby reducing thermal exposure and increasing operating lifespan of the user display.

[0023] The body 102 can define a receiving area 124 configured to receive a fuel tank 126. The fuel tank 126 can include a reservoir (chamber) in which fuel is dis-

posed. For example, the fuel tank 126 can include a bottle, a canister, a closed cylinder, or the like. The receiving area 124 may be disposed at the rear side 106 of the body 102. The receiving area 124 can be configured to hold the fuel tank 126 in a vertical orientation with a fuel outlet at the top of the receiving area 124 when the heater device 100 is resting on the first base surface 108.

[0024] The receiving area 124 can be selectively covered by a door 128. The door 128 can be pivotally coupled to the body 102 by way of an articulating device, such as one or more hinges 129. A handle 130 coupled to the door 128 may allow the user to interact with (engage) the door 128 to move the door 128 between a closed position (as illustrated) and an open position whereby the fuel tank 126 is accessible. The door 128 may lock in the closed position by way of a detent, a lock, a snap fit, or the like. To access the fuel tank 126, the user can reposition the door 128 (e.g., using the handle 130) from the closed position to the open position. In the closed position, the door 128 can protect the fuel tank 126 against impact by external debris and prevent human contact with the fuel tank 126 which may be cold or wet as a result of use. In the open position, the user may interact with the fuel tank 126, allowing the user to remove the fuel tank 126, replace the fuel tank 126, refill the fuel tank 126, or troubleshoot issues associated with the flow of fuel from the fuel tank 126. When the door 128 is closed, the fuel tank 126 may not be visible from outside the body 102.

[0025] The heater device 100 further includes a diffuser 132. The diffuser 132 may be disposed at the front side 104 of the heater device 100. The diffuser 132 can radiate heat generated by combustion of fuel from the fuel tank 126. The radiated heat can be radiated into the environment around the heater device 100. The diffuser 132 can have a shape that directionally dissipates the radiated heat in a desired direction. For example, the diffuser 132 can have a generally frustoconical shape with an outwardly projecting sidewall 134. The sidewall 134 can extend from a base 136. The base 136 may have a generally planar shape, a concave shape, or the like. Heat generated by combustion of the fuel can be radiated outward by the sidewall 134 and base 136 of the diffuser 132.

[0026] In an embodiment, the base 136 can include diffusion holes 129 (FIG. 5) through which fuel from the fuel tank 126 can pass. The diffusion holes 129 can include discrete passageways extending through at least a portion of the base 136. The diffusion holes 129 can also, or alternatively, include porous structure through which the fuel can pass. The diffusion holes 129 may be confined to a specific location within the base 136 (e.g., at a central location) or spread out across the base 136. The diffusion holes 129 can have common or different sizes and/or shapes as compared to one another. Fuel passes through the diffusion holes 129 and is combusted at a location within a volume generally defined by the sidewall 134 of the diffuser 132. An ignition device 137 can be controlled by one or more of the user-accessible components such that the user can generate an ignition of the fuel using the user-accessible component(s). For example, the ignition device 137 can include a spark generator which, when surrounded by fuel, causes the fuel to ignite. Example spark generators include piezo spark generators, electronic ignitors, pilot lights, and the like. Further passage of fuel through the diffusion holes in the diffuser 132 maintains combustion and thus the heating capability of the heater device 100. In other embodiments, the fuel can be routed around the diffuser 132 (e.g., by a fluid conduit extending around the diffuser 132), through a discrete fluid flow path of the diffuser 132 (e.g., via a tube inserted through the diffuser 132), or the like.

[0027] A hood 138 extends over the diffuser 132. The hood 138 can include a top 140 and lateral sidewalls 142 extending downward from the top 140. The hood 138 can direct heat from the diffuser 132 and further directionally bias heat in the desired direction. In an embodiment, the hood 138 is spaced apart from the diffuser 132 and does not contact the diffuser 132. The hood 138 can be coupled with the heater device 100 through one or more mounts, such as flanges 144. The flanges 144 can extend out from the body 102 and the hood 138 can be coupled to the flanges 144 at a location outside of the body 102. The hood 138 may be formed from one or more pieces. In an embodiment, the hood 138 includes a hood opening 146. The hood opening 146 can extend through a portion of the sidewall 142. In an embodiment, the hood opening 146 can extend through the hood 138 in a lateral direction from the rear side 106 to the front side 104 of the body 102. The hood opening 146 can be fully surrounded by portions of the sidewall 142, i.e., the hood opening 146 is not a recess but a fully enclosed opening fully delimited by the sidewall 142. As described below, the hood opening 146 permits airflow to pass over the diffuser 132 to further guide and directionally bias heat in the desired direction.

[0028] Over time, the hood 138 may become hot as a result of combustion at the diffuser 132. To mitigate the risk of the user contacting the hood 138 when maneuvering the heater device 100, the handle 112 can be spaced apart from the hood 138 (e.g., in a lateral direction) and can move to the stored position in a direction generally away from the hood 138 such that in the stored position the handle 112 does not contact the hood 138 and does not receive significant heat transfer from the diffuser 132. In some implementations, the hood 138 can include a material that deflects a majority of the heat from the diffuser 132. The hood 138 can be lined with a thermal barrier, vented, or otherwise constructed to mitigate heat transfer to the handle 112.

[0029] In an embodiment, the heater device 100 may further include one or more electrically powered components (as described below in greater detail). To accommodate electrical power needs of the electrically powered components, the heater device 100 can further include

a power source, such as a removable battery 148. The removable battery 148 can be removably received at a battery receiving port 150. In an embodiment, the battery receiving port 150 can be disposed on the body 102 in a manner such that the battery 148 can be coupled to an outside of the body 102. In the depicted embodiment, the battery receiving port 150 is disposed along a sidewall 152 of the body 102, the sidewall 152 extending between the front and rear sides 104, 106. The battery receiving port 150 is spaced apart from the diffuser 132 such that heat emitted from the diffuser 132 does not readily transfer to the battery receiving port 150 and thus permits longer use of the heater device 100 without the removable battery 148 overheating.

[0030] The removable battery 148 can include a housing and a plurality of battery cells disposed within the housing. The removable battery 148 can further include a plurality of terminals that electrically connect with the battery cells and interface with complementary terminals of the battery receiving port 150. The removable battery 148 may be a universal battery that is configured to power additional devices such as string trimmers, chainsaws, lawn mowers, blowers, motorized pruners, edgers, or the like. The removable battery 148 may thus be used by more devices than just the heater device 100.

[0031] Referring still to FIG. 1, the body 102 can further include an air inlet opening 154. In an embodiment, the air inlet opening 154 is disposed along the rear side 106 of the heater device 100. In another embodiment, the air inlet opening 154 can be disposed at a different location of the heater device 100, such as at a side surface of the heater device 100 between the front side 104 and the rear side 106, along the base surface 108, 110, or the like. In some implementations, the air inlet opening 154 can include a plurality of air inlet openings 154. Each of the plurality of air inlet openings 154 can be disposed at different locations of the body 102. For example, a first air inlet opening can be disposed at the rear side 106 of the body 102 and a second air inlet opening can be disposed at a different side of the body 102. The air inlet opening(s) 154 can be spaced apart from the diffuser 132 such that air passing through the air inlet opening(s) 154 is at a lower temperature than air adjacent the diffuser 132 during use of the heater device 100. The air inlet opening(s) 154 can include a cutout in the body 102. The cutout can have a generally circular shape.

[0032] Referring to FIGS. 3 and 4, an embodiment of the heater device 100 is depicted with the body 102 removed. In particular, FIG. 3 is depicted at the same orientation as FIG. 1 and FIG. 4 is depicted at the same orientation as FIG. 2.

[0033] Referring initially to FIG. 3, a conduit 156 extends from the fuel tank 126 to the diffuser 132. The conduit 156 allows fuel to pass from the fuel tank 126 to the diffuser 132 and combust in response to the ignition device 137 generating a spark. The regulator 118 can regulate the flow (e.g., flowrate) of fuel through the conduit 156 from the fuel tank 126 to the diffuser 132. By way of example, the regulator 118 can include an adjustable valve gate, such as a ball valve, a wedge gate valve, a butterfly valve, a rising stem gate valve, or the like. The regulator 118 can be a manual regulator which is controlled by manual rotation. Alternatively, the regulator 118 can include an electric regulator with a motor for adjusting a position of the valve and thus a fuel flowrate from the fuel tank 126. As depicted, the regulator 118 can be coupled to the conduit 156 such that the regulator 118 remains along the conduit 156 when the body 102 is removed from the heater device 100.

[0034] During use, fuel flows from the fuel tank 126 to the diffuser 132 through the conduit 156 and is combusted to generate heat. Over time, the area surrounding the heater device 100 continues to rise at a rate faster than the rate of the surrounding area. That is, the combustion generates a localized heat gradient from which the environment is gradually heated. Without airflow to dissipate the heat into the environment, the heat remains localized at the heater device 100 and the thermal gradient at the heater device 100 is sharp.

[0035] To mix the heat more evenly into the environment, the heater device 100 includes a fan system 158 that drives the heat away from the heater device 100 and into the environment. The fan system 158 includes a motor 160 (e.g., a variable speed direct current (DC) motor) having an output shaft that is rotatably driven by activation of the motor 160. The motor 160 can be electrically coupled to the battery 148 to draw power therefrom. In an embodiment, the heater device 100 can further include a controller 162 having a processor and memory that control power draw from the battery 148 to the motor 160. For example, the processor can execute instructions stored in the memory that cause the motor 160 to operate at a prescribed operating threshold or condition in response to the user activating the fan system 158. Moreover, the controller 162 can cause the motor 160 to adjust speed in response to the user setting a speed of the fan assembly 158.

[0036] The motor 160 can be coupled to a frame 161 of the heater device 100. The motor 160 is further coupled to a fan 164. The fan 164 can be an axial or radial fan, e.g., an involute fan. In the depicted embodiment, the fan 164 is a radial fan configured to drive airflow in a radial direction in relation to the axis of rotation. The fan 164 can define a plurality of blades 166. The blades 166 can be rotationally staggered about the axis of rotation and curved to generate a desired airflow A in response to activation of the motor 160.

[0037] The fan 164 can be disposed within a cavity 168 defined at least in part by the body 102 or another portion of the heater device 100. The cavity 168 can be shaped to accommodate the fan 164. For instance, the cavity 168 can have a disc shape. The air inlet opening 154 is disposed adjacent to the cavity 168, such as coaxial with the output shaft of the motor 160. A passageway 170 extends from the cavity 168 towards the diffuser 132. The passageway 170 can be defined by a tubular struc-

ture 173 through which airflow A can pass. In an embodiment, the tubular structure 173 has a continuous (non-interrupted) sidewall such that all, or substantially all, of airflow A passes from the cavity 168 to an outlet opening 172. The continuous sidewall is devoid of openings that allow airflow A to escape from the passageway 170. In an embodiment, the tubular structure 173 can be part of, or at least partially defined by, the body 102. For example, an inner portion 174 of the tubular structure 173 (as seen in FIG. 4) can be defined by a non-body portion of the heater device 100, while an outer portion of the tubular structure 173 is formed by the body 102. When the body 102 is coupled to the inner portion 174, the tubular structure 173 becomes continuous (non-interrupted) such that all, or substantially all, of the airflow A passes to the outlet opening 172.

[0038] The tubular structure 173 can extend in a generally linear direction over at least a majority of its length. For example, as depicted, the tubular structure 173 extends vertically from the cavity 168 towards the outlet opening 172. The tubular structure 173 may start to curve towards the front side 104 of the heater device 100 (FIG. 1) at or near the regulator 118 such that the outlet opening 172 is facing the front side 104 (i.e., the direction of airflow A at the outlet opening 172 is perpendicular, or generally perpendicular, to the front side 104).

[0039] In some implementations, the outlet opening 172 can be disposed adjacent to the hood opening 146. In an embodiment, the outlet opening 172 can be disposed immediately adjacent to the hood opening 146. Airflow A can pass through the outlet opening 172 and directly enter the hood opening 146 for circulation through the environment. In another embodiment, the tubular structure 173 and the hood 138 are connected either directly or indirectly, or are integrally formed, such that the airflow A passes from the tubular structure 173 to the hood 138 without any gap therebetween through which the airflow A can escape. In other implementations, the outlet opening 172 can be spaced apart from the hood opening 146 by a gap 176. The gap 176 can separate the tubular structure 173 from the hood 138. In an embodiment, the gap 176 can have a length, as measured between the outlet opening 172 and the hood opening 146, of at least 0.5 inches (12.5 millimeters (mm)), such as at least 1 inch (25 mm), such as at least 2 inches (50 mm), such as at least 3 inches (75 mm). At least some of the airflow A can bridge the gap 176 and enter the hood opening 146. Airflow A can then pass through the hood 138, move against the diffuser 132, and then dissipate into the space in a direction 180. While the airflow A moves from the outlet opening 172 through the hood opening 146 and past the diffuser 132, heat from the combustion at the diffuser 132 is transferred to the airflow A, causing a temperature of the airflow A to increase. Thus, the airflow A is hotter after passing the diffuser 132 in the direction 180 (e.g., at or near a location 182) than when the airflow A enters the cavity 168 through the air inlet opening 154 (e.g., at or near location 184). In an embodiment, the airflow A can be at least 0.1° Fahrenheit (F) hotter at location 182 than location 184 (i.e., a thermal gradient between locations 182 and 184 can be at least 0.1° F), such as at least 0.25° F hotter, such as at least 0.5° F hotter, such as at least 1° F hotter, such as at least 2° F hotter, such as at least 5° F hotter, such as at least 7.5° F hotter, such as at least 10° F hotter. Over prolonged periods of combustion, the diffuser 132 may become hotter, causing the airflow A at location 182 to further increase in temperature as compared to the airflow A at location 184 near the air inlet opening 154.

[0040] In an embodiment, the controller 162 can control the fan assembly 158 in view of (e.g., in response to) the temperature at the diffuser 132 or at another location. For example, as the diffuser 132 gets warmer over prolonged usage, the airflow A can increase in intensity as a result of the thermal mass of the diffuser 132 storing greater amounts of heat. Thus, airflow A can increase in intensity (e.g., volumetric flow rate) as the temperature of the diffuser 132 increases. The controller 162 can receive temperature data (e.g., associated with the diffuser 132 as determined by a thermometer) and adjust the fan assembly 158, e.g., speed of the motor 160, in response thereto. By way of non-limiting example, the controller 162 can include a lookup table saved to memory. The lookup table can include a plurality of motor 160 run speeds each associated with a different temperature. The controller 162 (and more particularly a processor associated with the controller 162) can compare a measured temperature to the lookup table to determine the motor 160 run speed and then control the motor 160 accordingly.

[0041] In an embodiment, the heater device 100 can be configured to enter a startup procedure when the heater device 100 is initiated from a cold startup. In the startup procedure, the rate of airflow A through the tubular structure 173 can be minimal (or even zero) at and immediately following startup. In this regard, the diffuser 132 can begin to warm. As the measured temperature (e.g., of the diffuser 132) reaches a threshold condition, the fan assembly 158 can be activated by the controller 162 to generate airflow A or increased to increase the flow rate of the airflow A. The user can set a maximum rate of airflow A, e.g., using one of the user-accessible components or through a user device that communicates wirelessly or through a wired connection with the controller 162. The user can also change one or more operating parameters of the heater device 100, such as cold startup procedure, lookup table numbers and adjustments, or the like. While the user may be able to change these parameters using the user-accessible components, it may be easier for the user to change the parameters at the user device.

[0042] FIGS. 5 and 6 depict cross-sectional side views of the heater device 100 as seen along Line 1-1 in FIG. 1. In particular, FIG. 5 illustrates the heater device 100 as seen with the motor 160 in the off (non-active) state and FIG. 6 illustrates the heater device 100 as seen with

the motor 160 in the on (active) state to drive airflow A through the heater device 100.

[0043] Referring initially to FIG. 5, the tubular structure 173 is depicted with the body 102 joined to the inner portion 174 to complete the continuous tubular structure 173. The tubular structure 173 is in continuous communication with the cavity 168 and the fan 164 when the motor 160 is on and when the motor 160 is off. The tubular structure 173 extends from the cavity 168 towards the handle 112 and completes a turn to face the front side 104 of the body 102 at a vertical elevation (location in the vertical direction) below the handle 112. Referring to FIG. 6, airflow A leaves the cavity 168 under biasing force generated by the fan 164 and travels through the tubular structure 173 before reaching the outlet opening 172. A portion of the airflow A bridges the gap 176 between the outlet opening 172 and the hood opening 146 and enters a heating volume 186 disposed between the diffuser 132 and the hood 138. The diffuser 132 can restrict (throttle) airflow within the heating volume 186, providing additional time for the airflow A to mix with and absorb heat from the diffuser 132, thus further heating the airflow A. In an embodiment, the sidewall 134 of the diffuser 132 can define an outer surface 135 against which the airflow A passes.

[0044] After passing the heating volume 186, the airflow A is pushed beyond the diffuser 132 in the direction 180 into the environment. Heat from combustion at the diffuser 132 also moves outward away from the heater device 100 as shown by lines 188A, 188B, and 188C. At least some of the heat shown by lines 188A, 188B, or 188C can be absorbed with the airflow A moving in the direction 180. Thus, the airflow A may continue to heat up even after passing the heating volume 186.

[0045] Some airflow A may escape through the gap 176 before being heated by the diffuser 132. In some instances, this escape of airflow through the gap 176 may be advantageous. For example, the airflow A escaping through the gap 176 passes close to the diffuser 132 prior to escaping from the gap 176 and thus may exhibit increased temperatures as compared to the airflow A entering the air inlet opening 154. This may be desirable, for example, in instances where a user wants to heat the space above the heater device 100. In such instances, the airflow A heats both in the direction 180 and in a direction above the heater device 100.

[0046] In other implementations, where the user does not want escape of airflow A at the gap 176, a connective structure 190 can be installed at the gap 176. The connective structure 190 can include a hollow body 192 defining a passageway 194 through which airflow A can pass. The passageway 194 can be shaped to accommodate airflow A exiting the outlet opening 172. For example, the passageway 194 can have the same, or a substantially similar, cross-sectional shape as compared to the passageway 170 of the tubular structure 173. The connective structure 190 can directly connect the outlet opening 172 and the hood opening 146 such that airflow cannot escape, or is substantially prevented from escaping, from the gap 176. The connective structure 190 can be installed, for example, by laterally translating the connective structure 190 into position in the gap 176 and fixing the connective structure 190 in place by way of an attachment device, such as a fastener, an adhesive, a snap fit, an interference fit, or the like. Once in place between the outlet opening 172 and the hood opening 146, the connective structure 190 can bridge the gap 176, forming a tubular passageway for the airflow A to reach the heating volume 186.

[0047] After the fuel tank 126 is exhausted (empty), the user may want to replace the fuel tank 126 or refill the fuel tank 126 to allow further use of the heater device 100. In an embodiment, the user can open the door 128 (FIG. 2) to expose the fuel tank 126. The user can unthread or otherwise detach the fuel tank 126 from the conduit 156 (FIGS. 3 and 4). The user can then remove the fuel tank 126 from the heater device 100 and return a filled fuel tank 126 for further use. In some instances, the user must rotate the heater device 100 to remove the fuel tank 126. For instance, as described above, the base surface can include the first base surface 108 and the second base surface 110. The heater device 100 can be moved from the first base surface 108 onto the second base surface 110 prior to removing the fuel tank 126. With the heater device 100 resting on the second base surface 110 as depicted in FIG. 7, the fuel tank 126 can be slid out of the heater device 100 in the direction 196. Requiring the fuel tank 126 to be removed in the direction 196 (as opposed to direction 198) requires the heater device 100 to be repositioned onto the second base surface 110 prior to removing the fuel tank 126. This prevents the user from accidentally removing the fuel tank 126 while the heater device 100 is on (i.e., actively providing heating).

[0048] FIG. 8 depicts a flow chart of a method 800 of heating an environment in accordance with an example embodiment. In general, the method 800 will be described with reference to a system including the heater device 100 of FIGS. 1 to 7. In addition, although FIG. 8 depicts steps performed in a particular order for purposes of illustration and discussion, the method discussed herein is not limited to any particular order or arrangement. One skilled in the art, using the disclosure provided herein, will appreciate that various steps of the method disclosed herein can be omitted, rearranged, combined, and/or adapted in various ways without deviating from the scope of the present disclosure.

[0049] The method 800 can include adjusting 802 a regulator of a personal heater device to permit flow of a fuel from a fuel tank coupled to the personal heater device to a combustion area. The adjusting 802 can be performed manually or using a computer-controlled actuator (motor). In some implementations, adjusting 802 the regulator can include adjusting a plurality of regulators, such as for example, a primary regulator and a backup (emergency) regulator. Adjusting 802 the regulator can be per-

formed to allow fuel to flow to the combustion area. Prior to adjusting 802 the regulator, fuel may be prevented from flowing to the combustion area. Thus, the user can prevent combustion by maintaining the regulator in a non-adjusted (closed) state. In the closed state, fuel is prevented from flowing to the combustion area.

[0050] The method 800 can further include igniting 804 the fuel at the combustion area to create combustion. Igniting 804 the fuel can be performed with an ignition device. The ignition device can include, for example, a piezoelectric device that generates a spark. In some implementations, igniting 804 the fuel can occur automatically, e.g., in response to adjusting 802 the regulator from a closed state to an open state. For example, the regulator, or the conduit regulated by the regulator, can include a detection device that notifies a controller when fuel is flowing. The controller can initiate activation of the ignition device in response thereto. In other implementations, igniting 804 the fuel can be done manually. For example, the user can activate one of the user-accessible components to cause activation of the ignition device.

[0051] The method 800 can further include activating 806 a fan assembly to drive airflow from an air inlet opening of the personal heater device to a diffuser defining the combustion area. Activating 806 the fan assembly may be performed before igniting 804 the fuel or after igniting 804 the fuel. In some instances, activating 806 the fan can be performed automatically, e.g., in response to igniting 804 the fuel or in response to a particular condition (e.g., the combustion area reaching a prescribed temperature, completion of a timer countdown initiated when the fuel is ignited 804, or the like). The fan assembly includes a fan driven by a motor powered by a removable battery coupled to the personal heater device. In some implementations, activating 806 the fan is not performed when the removable battery is not actively coupled to the personal heater device. In other implementations, activating 806 the fan assembly is not performed when the removable battery is coupled to the personal heater device but a remaining power (charge) of the removable battery is below a prescribed threshold condition (e.g., below a prescribed charge level, such as below 5%).

[0052] In some embodiments, the heater device may be configured to regulate the fan assembly to adjust a speed of the fan. For example, when the heater device initiates cold startup, temperature at the diffuser may be below a critical threshold. After heating for some duration of time, the temperature at the diffuser increases whereupon reaching the critical threshold, the fan assembly is activated 806. The fan may begin rotating at a first speed in response to activation. As the temperature at the diffuser continues to increase, the speed of the fan can increase. For instance, when the temperature reaches a second critical threshold, the fan can rotate at a second speed. Moreover, when the temperature reaches a third critical threshold, the fan can rotate at a third speed. In another embodiment, the speed of the fan can be modulated (changed) in view of the temperature (e.g., proportionally with the temperature). Yet other control protocols are possible without deviating from the disclosure.

[0053] Embodiments of the heater device 100 provided herein may provide improved thermal efficiency. For instance, the fan 164 may be operable by the motor 160 to improve the flow of air through the passageway, such as for heat distribution, allowing for improved heat generation and reception by a user, and improved heat distribution, and improved burning efficiency (e.g., reduced fuel usage).

[0054] Further aspects of the invention are provided by one or more of the following embodiments:

Embodiment 1. A personal heater device comprising: an ignition device configured to generate a spark to ignite a fuel; a combustion location where ignited fuel burns in response to the spark; a battery receiving port configured to receive a battery; a controller; and a fan assembly comprising: a motor electrically coupled the battery receiving port and controlled by the controller; a fan coupled to an output shaft of the motor; and a passageway configured to route airflow generated by the fan to a location near the combustion location.

Embodiment 2. The personal heater device of any one or more of the embodiments, wherein the personal heater device further comprises a diffuser through which the fuel moves prior to reaching the combustion location, and wherein the airflow passes by the diffuser after exiting the passageway.

Embodiment 3. The personal heater device of any one or more of the embodiments, further comprising a hood disposed above the diffuser, wherein the hood comprises a hood opening in fluid communication with an outlet opening of the passageway, and wherein airflow passes from the passageway through the hood opening to enter a heating volume disposed between the hood and the diffuser before moving into a nearby environment.

Embodiment 4. The personal heater device of any one or more of the embodiments, wherein the personal heater device comprises a fuel tank receiving area configured to removably receive a fuel tank storing the fuel, and wherein the fuel tank receiving area is selectively covered by a hinged door.

Embodiment 5. The personal heater device of any one or more of the embodiments, wherein the personal heater device further comprises a body defining a base surface, and wherein the base surface comprises a first base surface and a second base surface angularly offset from the first base surface by at least 10°.

Embodiment 6. The personal heater device of any one or more of the embodiments, wherein the motor is a variable speed motor, and wherein the controller is configured to control a speed of the motor in response to a measured temperature of the heater device.

Embodiment 7. The personal heater device of any one or more of the embodiments, wherein the personal heater device further comprises a handle, the handle rotatable between an in-use position and a stored position.

Embodiment 8. The personal heater device of any one or more of the embodiments, wherein the airflow enters the passageway from a rear side of the personal heater device and exits the passageway from a front side of the personal heater device.

Embodiment 9. A method of heating a space, the method comprising: adjusting a regulator of a personal heater device to permit flow of fuel from a fuel tank coupled to the personal heater device to a combustion area; igniting, with an ignition device, the fuel at the combustion area to create combustion; activating a fan assembly to drive airflow from an air inlet opening to a diffuser defining the combustion area, wherein the fan assembly is powered by a removable battery coupled to the personal heater device.

Embodiment 10. The method of any one or more of the embodiments, wherein activating the fan assembly comprises initiating a motor of the personal heater device to rotate such that a radial fan is driven by the motor and drives airflow to the combustion area.

Embodiment 11. The method of any one or more of the embodiments, wherein the airflow is driven through a heating volume disposed between a hood and the diffuser, and wherein a controller of the personal heater device is configured to regulate airflow through the heating volume based at least partially on a temperature as measured at the personal heater device.

Embodiment 12. The method of any one or more of the embodiments, further comprising: repositioning the heater device from a first base surface on which the personal heater device is supported to a second base surface; and removing the fuel tank from the personal heater device after the heater device is repositioned to the second base surface.

Embodiment 13. The method of any one or more of the embodiments, wherein adjusting the regulator is performed manually.

Embodiment 14. The method of any one or more of the embodiments, further comprising: coupling the removable battery to a removable battery port of the personal heater device; fluidly connecting the fuel tank to a conduit of the personal heater device, the conduit in fluid communication with the combustion area; and moving the personal heater device to a desired area before igniting the fuel, wherein moving the personal heater device comprises moving a single-unit to the desired area.

Embodiment 15. A personal heater device comprising: a frame; a hydrocarbon fuel source removably coupled to the frame and selectively ignitable by an ignition device of the personal heater device; and a fan driven by a motor receiving power from a removable battery electrically coupled to a removable battery port of the personal heater device, wherein the fan drives airflow across a location adjacent to the ignited hydrocarbon fuel source to radiate heated airflow into a nearby environment.

Embodiment 16. The personal heater device of any one or more of the embodiments, wherein the hydrocarbon fuel source comprises a fuel tank storing a hydrocarbon fuel, and wherein the fuel tank is removable from the personal heater device.

Embodiment 17. The personal heater device of any one or more of the embodiments, wherein the personal heater device further comprises a handle, the handle rotatable between an in-use position and a stored position.

Embodiment 18. The personal heater device of any one or more of the embodiments, wherein the personal heater device further comprises a body defining a base surface, and wherein the base surface comprises a first base surface and a second base surface angularly offset from the first base surface by at least 10°.

Embodiment 19. The personal heater device of any one or more of the embodiments, wherein the personal heater device further comprises a diffuser through which the fuel moves prior to reaching a combustion location, and wherein the airflow passes by an outer sidewall of the diffuser.

Embodiment 20. The personal heater device of any one or more of the embodiments, wherein the personal heater device weighs less than 75 pounds.

[0055] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they include structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

Claims

1. A personal heater device comprising:

an ignition device configured to generate a spark to ignite a fuel;
a combustion location where ignited fuel burns in response to the spark;
a battery receiving port configured to receive a battery;
a controller; and

a fan assembly comprising:

a motor electrically connected to the battery receiving port and controlled by the controller;
a fan coupled to an output shaft of the motor; and
a passageway configured to route an airflow generated by the fan to a location near the combustion location.

2. The personal heater device of claim 1, wherein the personal heater device further comprises a diffuser through which the fuel moves prior to reaching the combustion location, and wherein the airflow generated by the fan passes by the diffuser.

3. The personal heater device of claim 2, further comprising a hood disposed adjacent to the diffuser, wherein the hood comprises a hood opening in fluid communication with an outlet opening of the passageway, and wherein airflow passes from the passageway through the hood opening to enter a heating volume disposed between the hood and the diffuser before moving into a nearby environment.

4. The personal heater device of claim 2, wherein the diffuser comprises a base and a sidewall extending from the base, wherein the sidewall defines the combustion location.

5. The personal heater device of claim 2, wherein the diffuser comprises a plurality of holes through which the fuel flows to reach the combustion location.

6. The personal heater device of claim 2, wherein the personal heater device further comprises a hood disposed adjacent to the diffuser, and wherein the airflow generated by the fan assembly moves through a heating volume defined between the hood and an outer surface of the diffuser.

7. The personal heater device of claim 6, wherein the passageway is spaced apart from the hood by a gap.

8. The personal heater device of claim 1, wherein the personal heater device comprises a fuel tank receiving area configured to removably receive a fuel tank storing the fuel, and wherein the fuel tank receiving area is selectively covered by a hinged door.

9. The personal heater device of claim 1, wherein the personal heater device further comprises a body defining a base surface, and wherein the base surface comprises a first base surface and a second base surface angularly offset from the first base surface by at least 10°.

10. The personal heater device of claim 9, wherein the personal heater device is supported by the first base surface during use of the personal heater device, and wherein the personal heater device is supported by the second base surface to removably couple a fuel tank to the personal heater device.

11. The personal heater device of claim 1, wherein the motor is a variable speed motor, and wherein the controller is configured to control a speed of the motor in response to a measured temperature of the heater device.

12. The personal heater device of claim 1, wherein the personal heater device further comprises a handle, the handle rotatable between an in-use position and a stored position.

13. The personal heater device of claim 1, wherein the airflow enters the passageway from a rear side of the personal heater device and exits the personal heater device a front side located opposite the rear side.

14. The personal heater device of claim 1, further comprising a frame to which the motor is coupled, and wherein a body is coupled to the frame and encloses the motor.

15. The personal heater device of claim 1, wherein the personal heater device weighs less than 75 pounds, as measured without the fuel.

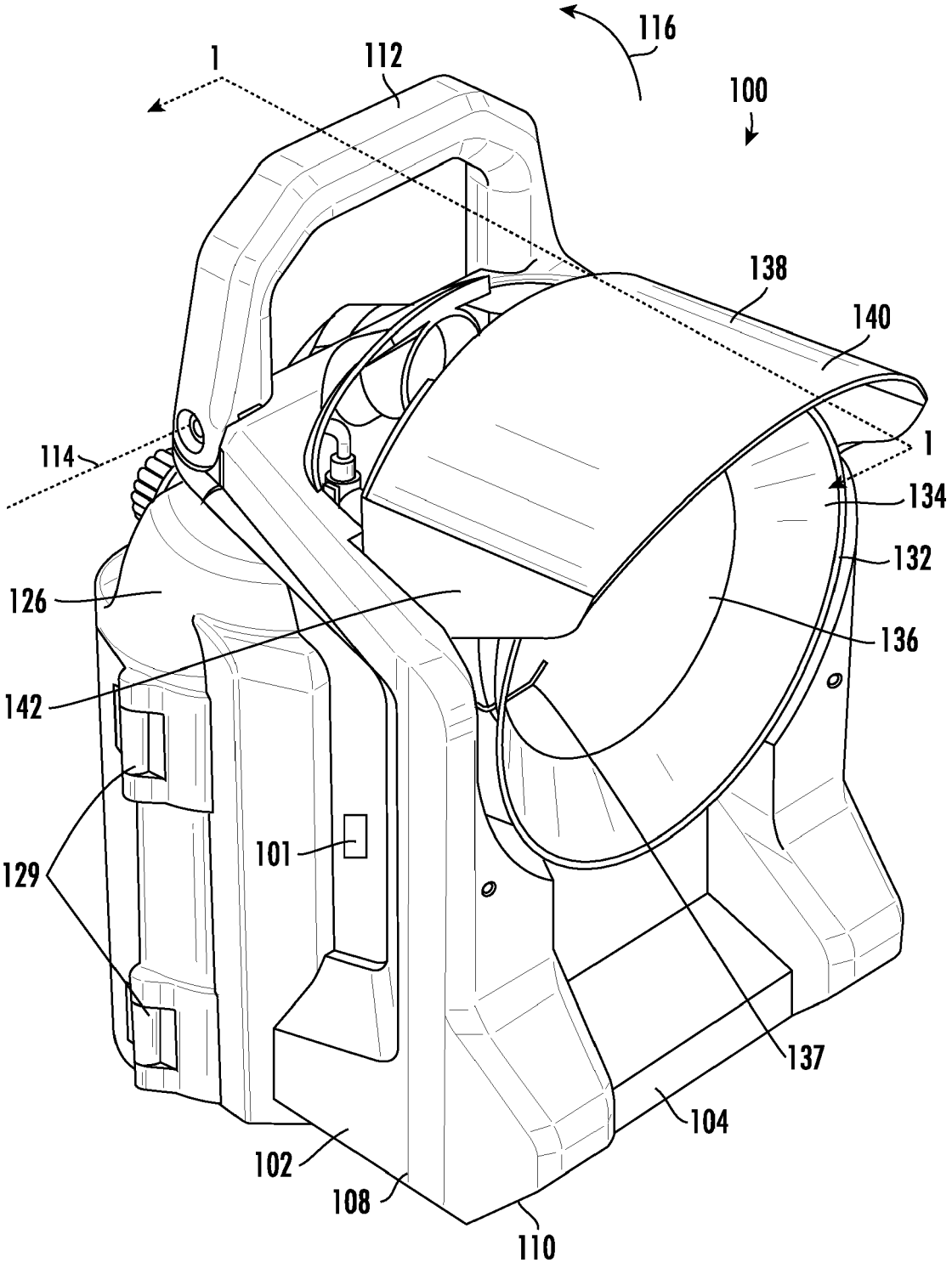
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FIG. 1

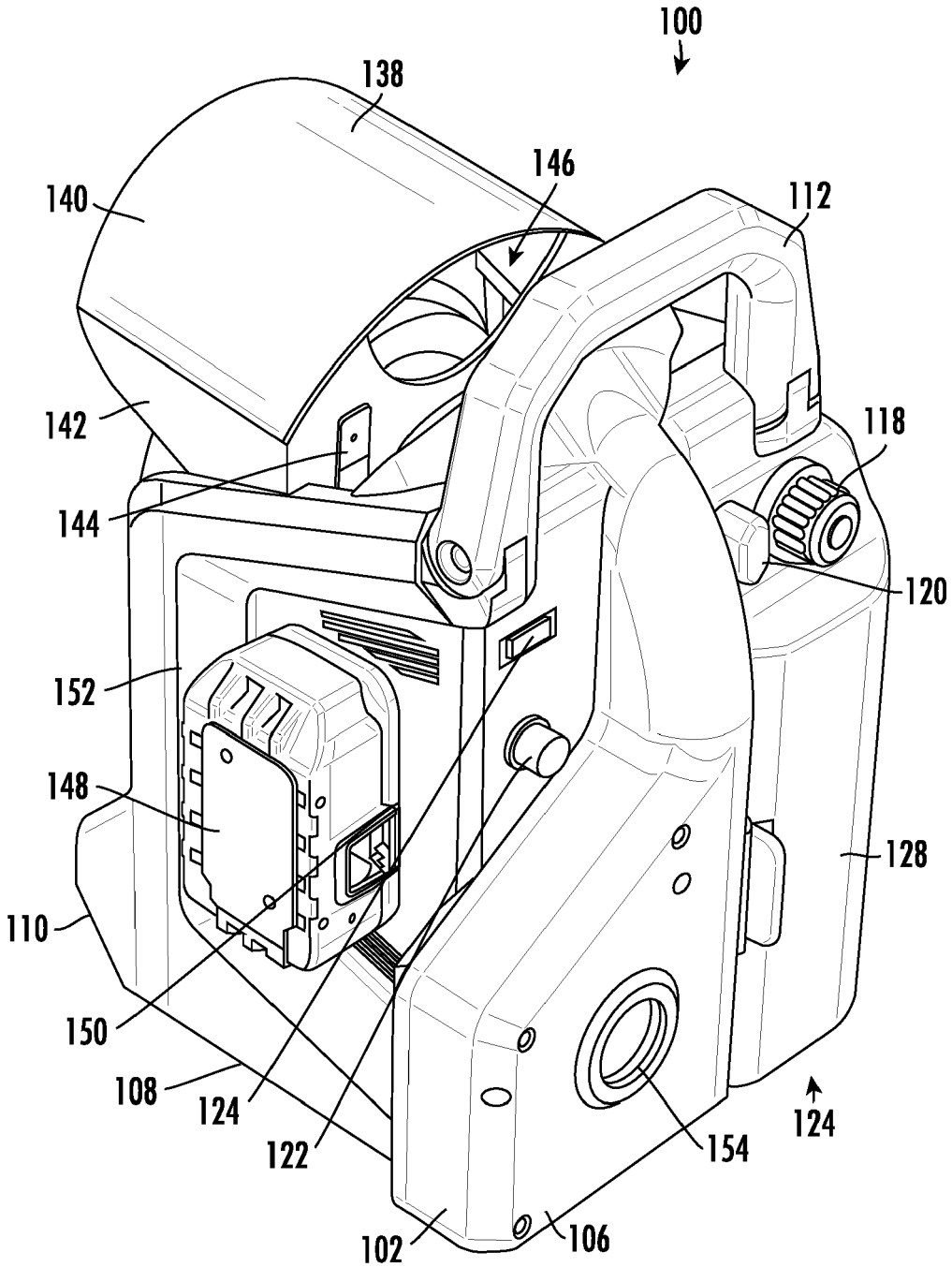
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FIG. 2

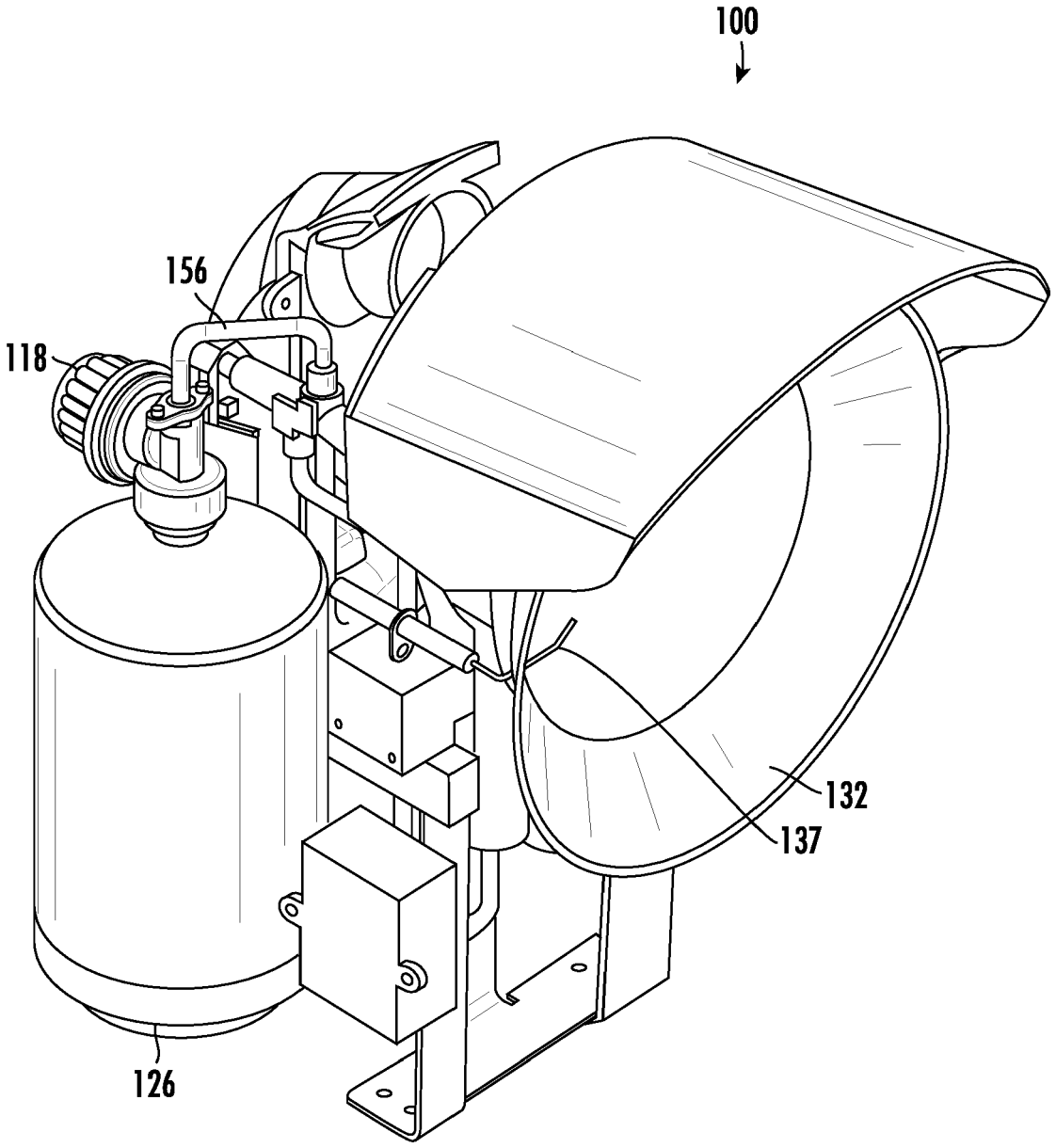
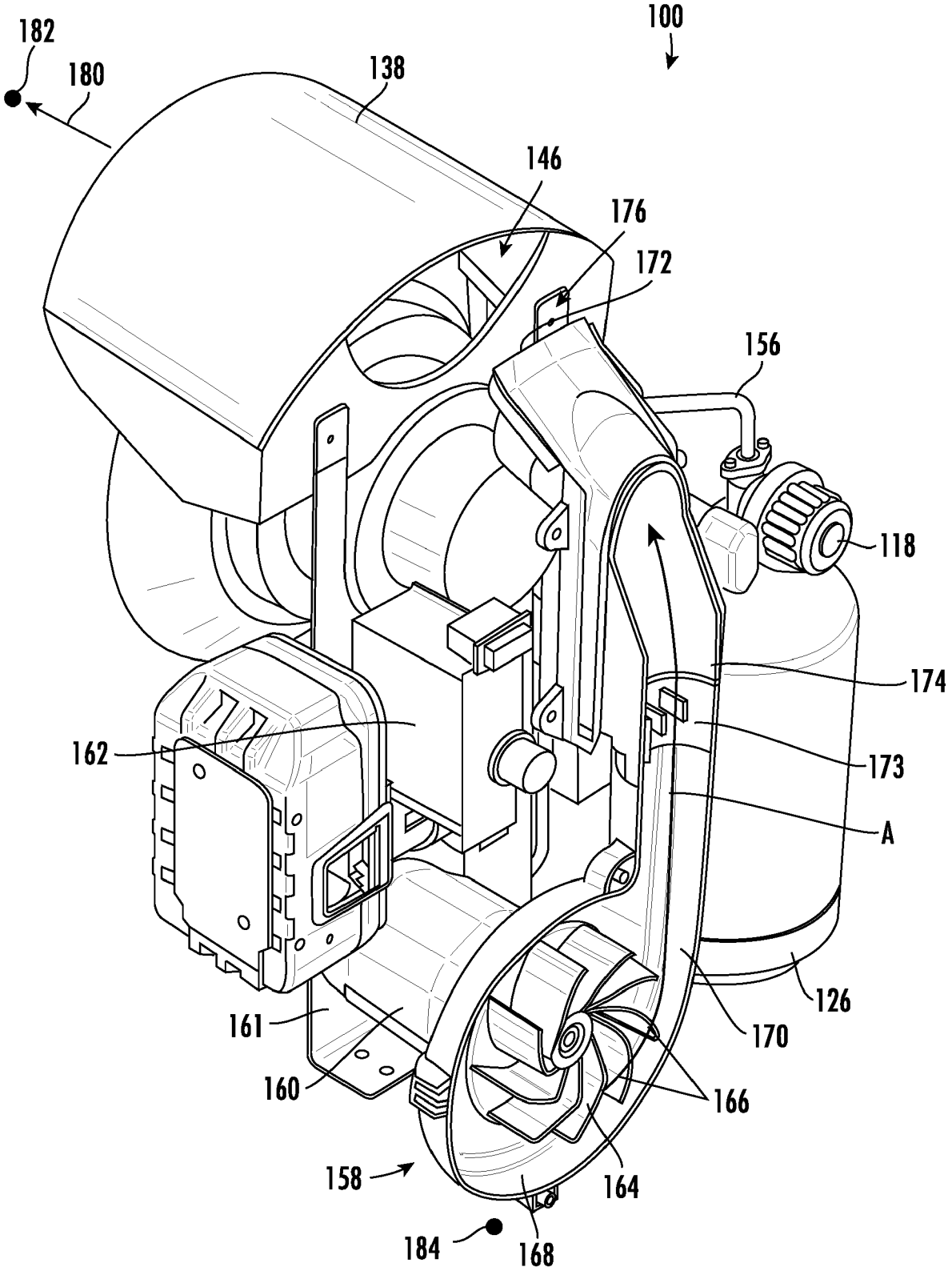


FIG. 3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182
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138
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FIG. 4

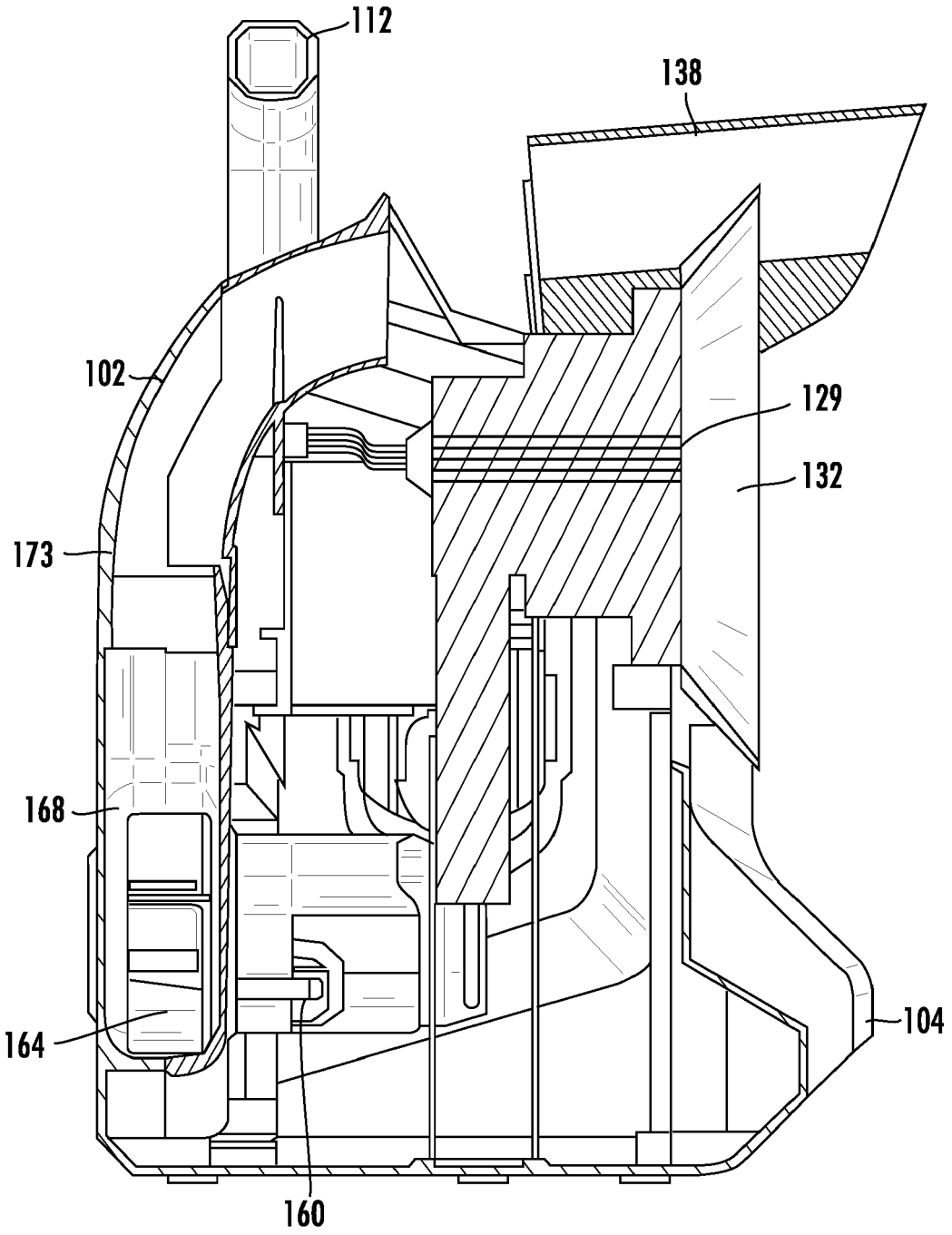
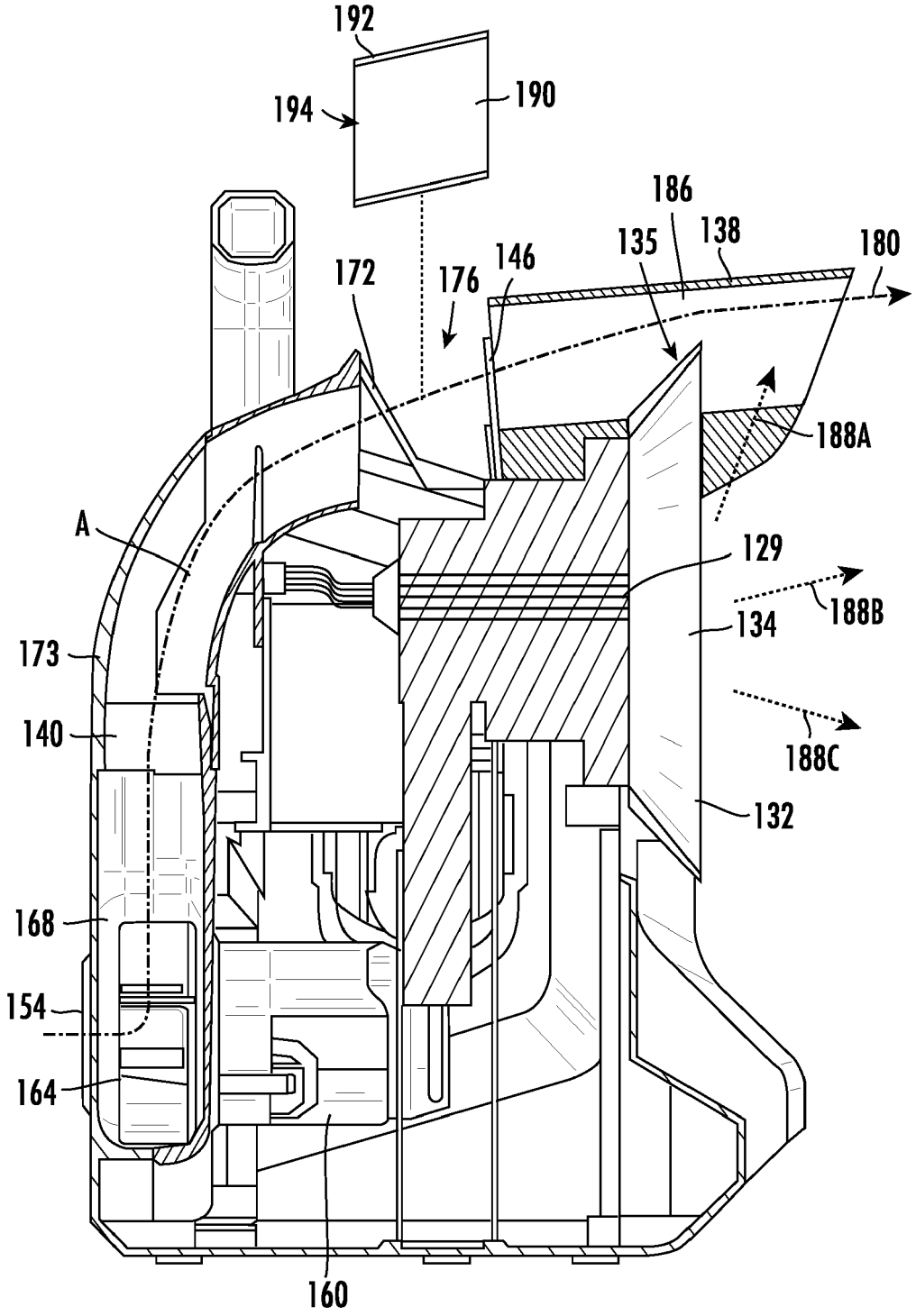


FIG. 5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194
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186
135
138
180
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188A
A
129
188B
134
173
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188C
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168
154
164
160

FIG. 6

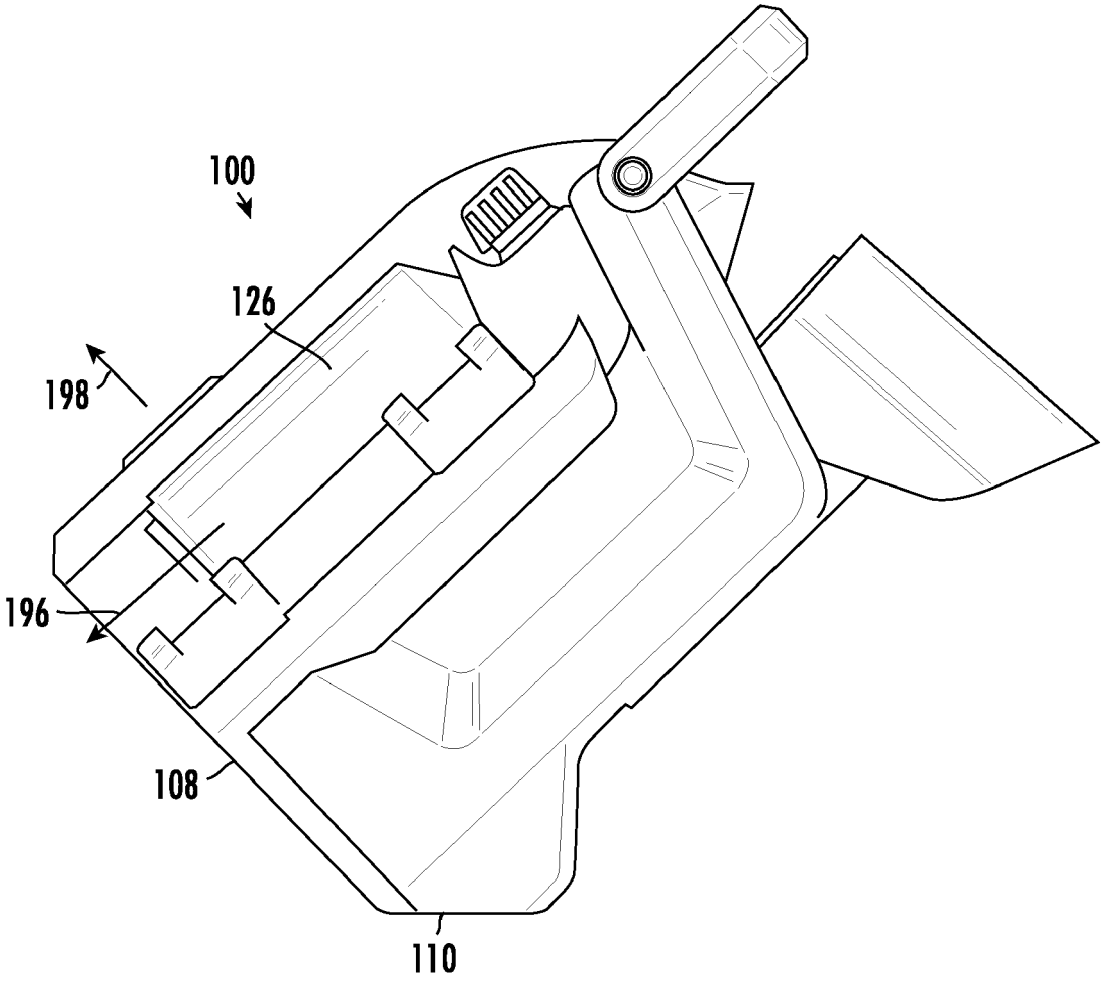

FIG. 7

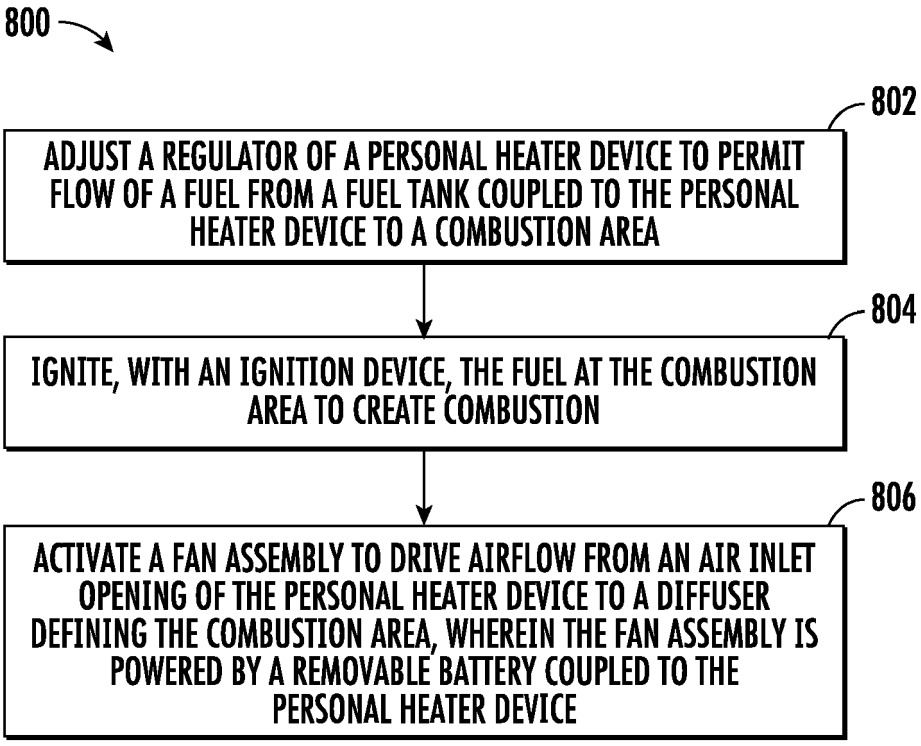
800
802
ADJUST A REGULATOR OF A PERSONAL HEATER DEVICE TO PERMIT FLOW OF A FUEL FROM A FUEL TANK COUPLED TO THE PERSONAL HEATER DEVICE TO A COMBUSTION AREA
804
IGNITE, WITH AN IGNITION DEVICE, THE FUEL AT THE COMBUSTION AREA TO CREATE COMBUSTION
806
ACTIVATE A FAN ASSEMBLY TO DRIVE AIRFLOW FROM AN AIR INLET OPENING OF THE PERSONAL HEATER DEVICE TO A DIFFUSER DEFINING THE COMBUSTION AREA, WHEREIN THE FAN ASSEMBLY IS POWERED BY A REMOVABLE BATTERY COUPLED TO THE PERSONAL HEATER DEVICE

FIG. 8

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 24 18 0431

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2019/041093 A1 (VANDRAK BRIAN S [US] ET AL) 7 February 2019 (2019-02-07) * paragraphs [0005], [0006], [0030], [0040], [0048], [0049], [0056]; figures 1-19 *	1-12,14, 15	INV. F24H3/02 F24H3/04 F24H3/06 F24H9/00 F24H9/20
X	US 2019/145663 A1 (HUGGINS MARK [US] ET AL) 16 May 2019 (2019-05-16) * paragraphs [0022] - [0036]; figures 1-14 *	1-7, 11-15	
A	US 2022/136704 A1 (GOODMAN ALEXANDER J [US]) 5 May 2022 (2022-05-05) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (IPC)
F24H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	27 September 2024	García Moncayo, O

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27-09-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2019041093 A1	07-02-2019	US 2011265779 A1	03-11-2011
		US 2015107573 A1	23-04-2015
		US 2018195761 A1	12-07-2018
		US 2019041093 A1	07-02-2019
		US 2020072500 A1	05-03-2020
US 2019145663 A1	16-05-2019	CA 3023578 A1	10-05-2019
		CN 209639274 U	15-11-2019
		US 2019145663 A1	16-05-2019
US 2022136704 A1	05-05-2022	CN 221036204 U	28-05-2024
		EP 4241024 A1	13-09-2023
		US 2022136704 A1	05-05-2022
		WO 2022098624 A1	12-05-2022

EPO FORM P0459

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