

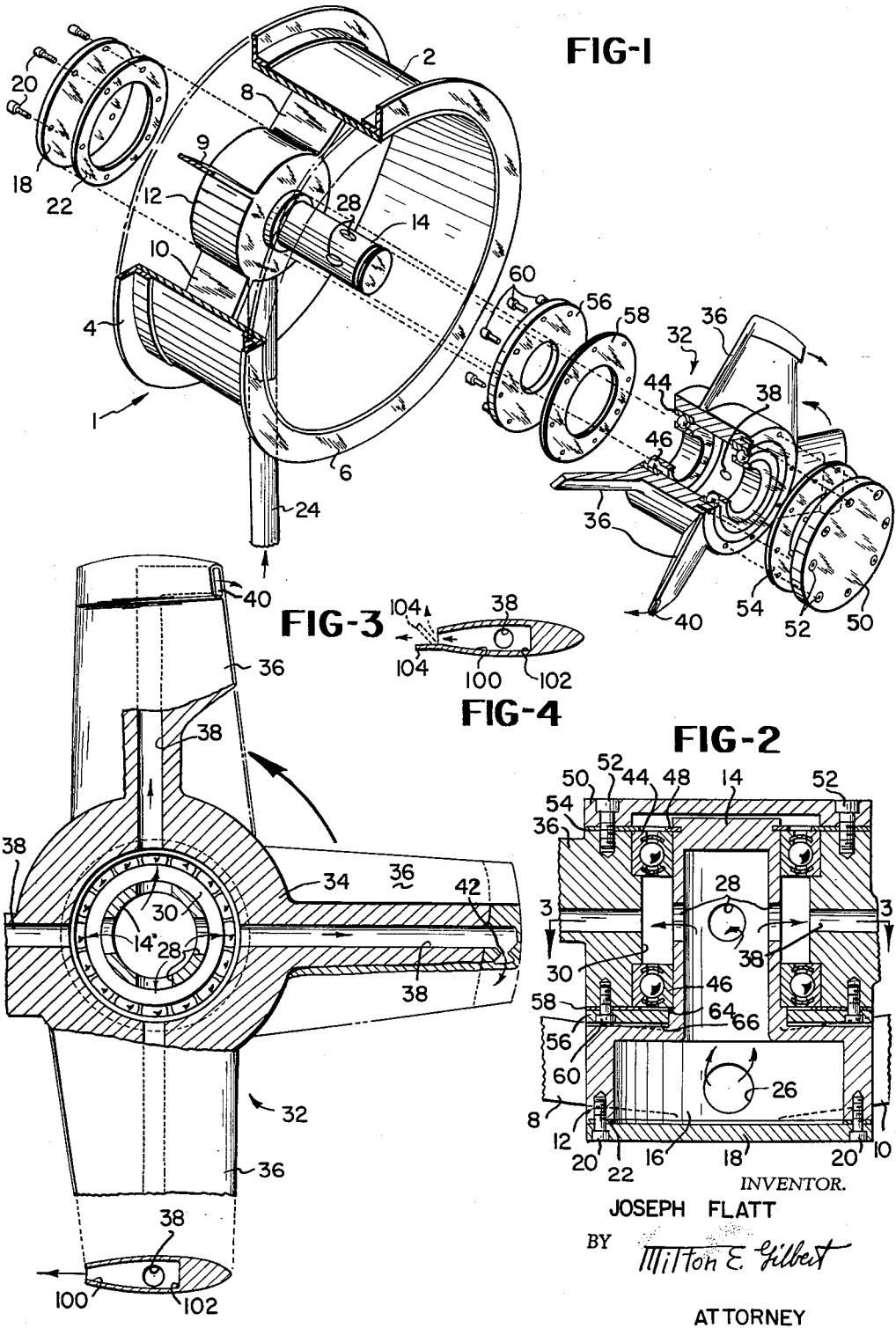
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J. FLATT
FAN DEVICE

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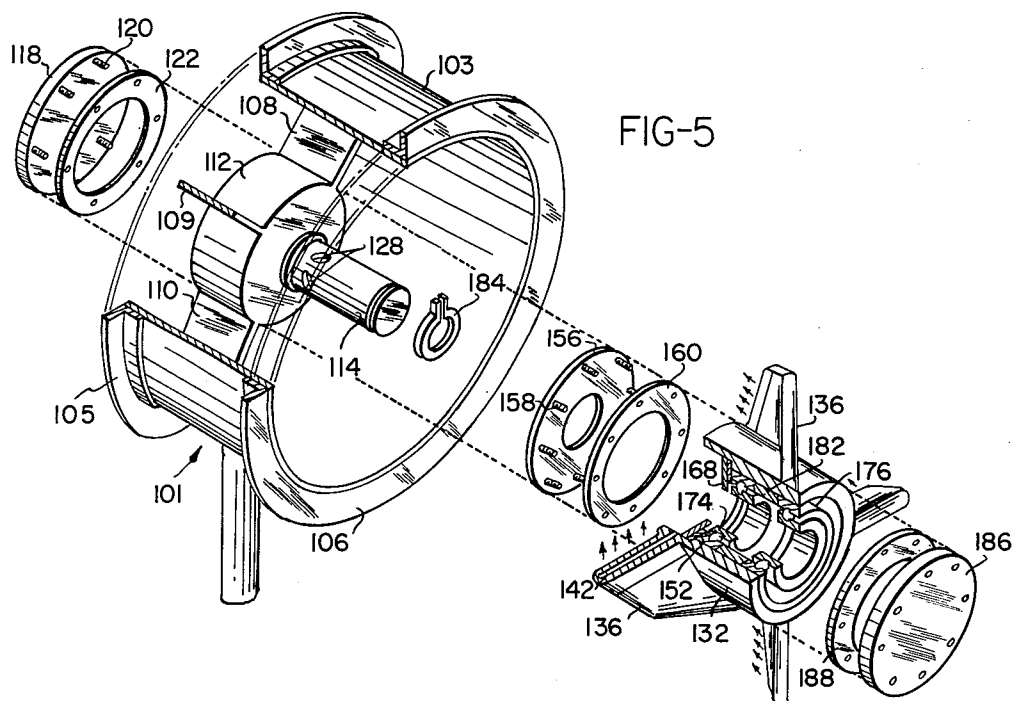


FIG-5

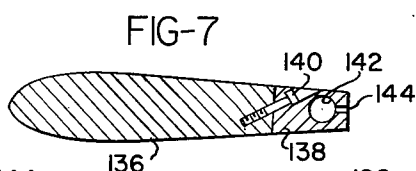


FIG-7

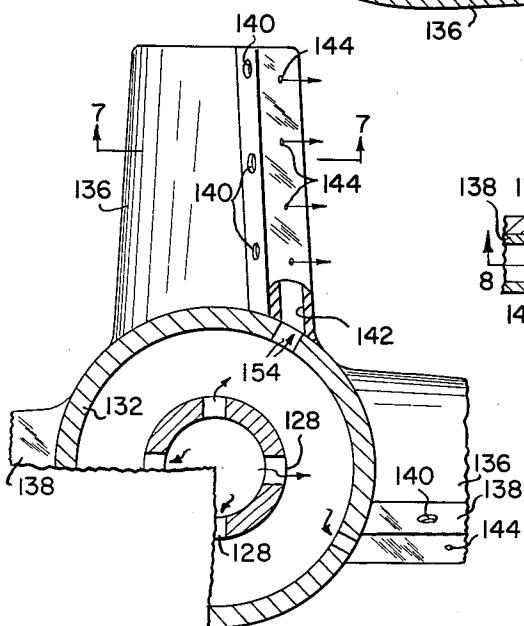


FIG-8

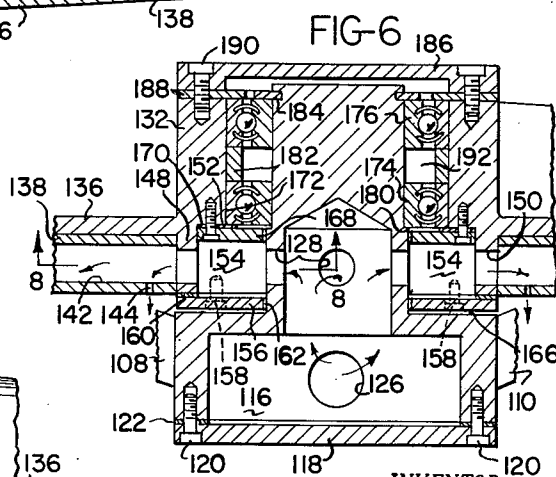


FIG-6

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3,104,803 FAN DEVICE

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This invention relates to a fan and is more particularly concerned with an axial flow fan for moving liquids or gases. The invention is further concerned with the employment of a jet fan in a novel manner as a dust precipitator.

This application is a continuation-in-part of my prior application Serial No. 858,423, filed December 9, 1959, now abandoned.

An object of the invention is to employ the jet reaction principle to operate the fan to produce high thrust and high air flows. Another object of the invention is to provide a fan operating on compressed air as the motive power source, and to thereby eliminate the use of large electric motors for equivalent power outputs. A still further object of the invention is to provide a steam powered dust collecting fan which operates to efficiently and economically remove dust from the air.

These and further objects of the invention will become more readily apparent upon a reading of the description following hereinafter and upon an examination of the drawings, in which:

FIG. 1 is an expanded perspective view of one embodiment of the fan of the invention,

FIG. 2 is a cross-sectional view taken through the hub portion of the fan of the invention,

FIG. 3 is a cross-sectional view taken along line 3—3 of FIG. 2,

FIG. 4 is a cross-sectional view through a rotor blade indicating a modified form thereof,

FIG. 5 is an expanded perspective view of another embodiment of the invention,

FIG. 6 is a cross-section view taken through the hub portion of the embodiment of FIG. 5,

FIG. 7 is a cross-sectional view taken along line 7—7 of FIG. 8, and

FIG. 8 is a cross-sectional view taken along line 8—8 of FIG. 6.

The use of Newton's third law of physics as applied to obtain motive power has been employed in the past in the well known jet aircraft. The instant invention applies such theory to the propulsion of fan blades to obtain air circulation or to create a thrusting force. Also, the fan of the invention is so designed that leakage of air is reduced to a minimum, while eliminating completely any friction existing due to sealing.

As shown in FIGURE 1, the fan 1 comprises an outer shroud or housing 2 which is provided with mounting flanges 4 and 6. The housing 2 is a thin cylinder which is provided at the rear thereof with a series of guide vanes 8, 9, 10, interconnecting the outer shroud portion with an inner hub portion 12. The hub 12 is hollow and is provided with a shaft extension 14. The hollow hub 12 thus encompasses an air chamber 16 which is sealed at one end by a cover plate 18, appropriate fastenings 20, and a gasket 22.

The hub portion 12 is integrally formed with, or has connected thereto, an inlet conduit 24 leading to an opening 26 into the chamber 16. The shaft extension 14 is provided with a series of outlet openings 28. Mounted upon the shaft extension 14 is a rotor 32. The rotor 32 is spaced from the shaft 14 to provide an annular chamber 30. The rotor 32 is also formed to provide a series of blade portions 36, 36. Each of the blades 36 is formed with one or more bores 38 leading from

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the chamber 30. Mounted upon the end of each blade 36, or integrally formed thereon, is a plenum box 40. This plenum box 40 contains a jet nozzle 42 interconnected with the passage 38. The compressed air entering from outlets 28 into chamber 30 flows through the bore 38 in each blade and out through the jet passage 42, thus creating an impelling or rotating force in the direction of the arrow shown in FIGURE 3 (i.e., counter-clockwise).

Devices similar to that thus far described have previously been known, however, all of such devices have been relatively inefficient due to either a large loss of air, because of the clearance that is necessary for rotatable mounting of the rotor, or because of undue friction caused by tightly fitting seals to prevent air leaks. In the device of the invention, effective sealing is obtained by a simple brass ring which is designed to permit a slight amount of leakage, e.g., about one percent of total flow, thereby eliminating all friction due to bearing seals. As shown in FIGURE 2, the rotor 32 is mounted upon the shaft extension 14 by a pair of roller bearings 44, 46. The roller bearing 44 is retained in place by snap ring 48. This end of the assembly is enclosed by a cap 50, bearing seal 54 and a series of fastenings 52. The inner bearing 46 rides on its inner race on a shoulder 64 formed on the shaft 14, and is further held in place by bearing seal 58, ring 56 and a series of fastenings 60. The dimensioning of the parts is such that a slight clearance of perhaps half a thousandth of an inch exists between the inner diameter of ring 56 and the outer diameter of shoulder 64. Also, the dimensioning is such that the ring 56 is spaced from the hub 12 to provide a clearance 66. The diameter of the shoulder 64 is made as small as possible in order to make the circumference of the shoulder 64 as small as possible. The diameter of the shoulder 64 is directly proportional to the leakage that occurs for a fixed amount of clearance between the shoulder 64 and the ring 58. Thus, the only place that air can leak from the conduit leading from the compressed air source out to the jet 42 is between the ring 56, made preferably of brass or a graphited material, and the shoulder 64. The clearance 66 may be in the order of 30 to 50 thousandths of an inch.

As shown in FIGURE 4, a means is provided whereby the amount of thrust can be varied, or the rotational speed of the rotor can be varied, for a given compressed fluid input. Thus, a tab 104 is formed on the trailing edge of the blade adjacent the outlet 100 of the nozzle chamber 102. This tab is thin and positionable (see dotted line position) so as to change the direction of the efflux from chamber 102. By thus changing the direction of efflux, the axial and tangential (with respect to the rotor) components of thrust are changed, resulting in either greater thrust or higher rotational speed.

Units constructed according to this invention, employing a seven inch diameter rotor can deliver 20 pounds of thrust. Comparing such a unit with one normally driven by an electric motor, it is apparent that an 8 to 10 horsepower motor would be required, thus increasing the bulk and size of the unit tremendously. The comparative unit of the invention would weigh only 2 1/4 pounds.

The air moving device of the invention can be used to produce thrust or air flow for ventilation purposes. Instead of a single rotor, stacked rotors can be provided which either rotate counter to one another or in the same direction. Also, the device of the invention can be used with liquids either as a pump, an ejector or a mixer. As a mixer, the device can be used to mix liquid with gas to produce aerosols. Thus, liquid can be used to flow out of the jet nozzles to produce turbulence, etc.

A particularly advantageous use of the device of the invention is as a dust precipitator. Thus, in factories or other areas where a large amount of dust is created, the fan can be powered by a liquid to draw the dust from the air, and mix it with the liquid as it leaves the fan, to form aerosols. The dust laden liquid can then be discharged into a settling tank, or simply dumped on the ground into a pit. The jets may then be formed with the constriction at the trailing edge of the blades (i.e., tapering back the trailing edge of the blade, as viewed in FIGURE 3, until the throat of the jet is exposed).

A more advantageous embodiment of a dust removing device is that shown in FIGURES 5-8. As shown in FIGURE 5, the dust fan 101 comprises an outer shroud or housing 103 which is provided with mounting flanges 195 and 196, for mounting into a ducting or the like. The housing 103 is a thin cylinder which is provided at the rear thereof with a series of guide vanes 108, 109, 110, interconnecting the outer shroud portion with an inner hub portion 112. The hub 112 is hollow and is provided with a shaft extension 114. The hollow hub 112 thus encompasses the air chamber 116, which is sealed at the end by a cover plate 118, appropriate fastenings 120, and a gasket 122.

The hub portion 120 is integrally formed with, or has connected thereto an appropriate fitting for attachment of a lead in line for the steam. The steam lead in fitting is not shown in the drawing, but any number of well-known fittings can be used. The fitting and lead in line conduct steam to an opening 126 into the chamber 116. The shaft extension 114 is provided with a series of outlet openings 128. Mounted upon the shaft extension 114 is a rotor 132. The rotor 132 is formed to provide a series of blade portions 136, 136; or alternatively, the blades 136, 136 may be welded or otherwise affixed to the rotor. The trailing edge of each blade can be made as an extrusion 138, which could be bolted on with bolts 140 (see FIGURE 7). This extrusion 138 has a passage 142 drilled therein, and spaced at intervals are a series of outlet holes or nozzles 144, 144. The extrusion wall containing the nozzles 144 is extended to a lower portion 146 which cooperates with a boss 148 on the lower portion of the rotor hub 132 to form a connecting port 150, leading to the passage 142. The rotor hub 132 is counterbored at 152. An annular chamber 154 is formed within this counterbore 152 by means of the ring 156 which is appropriately fastened to the rotor hub 132, as by fastenings 158. A seal 160 is also provided between the ring 156 and the lower portion 146. The chamber 154, thus formed, provides the connecting passage for a steam flow passageway running from the openings 128 to the nozzles 144. The steam under pressure thus flows into openings 126, through chamber 116, openings 128, chamber 154, openings 150, bore 142 and out through nozzles 144, thus creating an impelling or rotating force in the direction of the arrow shown in FIGURE 5 (i.e. counterclockwise).

Effective sealing is obtained by the ring 156 in the manner accomplished in the embodiment of FIGS. 1 and 2. Thus a slight amount of leakage flow is permitted past this ring 156 due to the slight clearance 162 (shown exaggerated in the drawing), of perhaps half a thousandth of an inch. The dimensioning is also such that the ring 156 is spaced from the hub 112 to provide a clearance 166. This clearance 166 may be in the order of 30 to 50 thousandths of an inch.

A second ring 168 is placed in the lower portion of the counterbore 152, which is provided with a seal 170 and fastened to the rotor hub 132 by a series of fastenings 172. There is thus formed a stuffing box which contains the bearings 174 and 176. The bearing 174 rests against a shoulder 180 on the extension 114, and the bearing 176 is held in place by the spacer 182 and the snap ring 184. The end of the rotor hub 132 is closed off by the cover plate 186 and the seal 188, the plate being affixed by fas-

tenings 190. The space 192 may then be filled with grease.

The fan is powered by steam which issues from the series of small nozzles 144, and thus serves to impel the fan and draw the dust laden air through the duct in which the fan is mounted and past the fan blades. The injection of steam into the air flow provides a uniform distribution of moisture through the system since the steam will condense at a very short distance back of the fan. The moisture picks up the dust particles as they go down the duct, and by gravity, the particles fall in the lower part of the duct, so that clean air comes out of the duct and a sludge or mud lies along the bottom of the duct. The bearing arrangement is thus such that steam is not taken in between two bearings but is separated from the bearings by the plate 168. The life of the bearings is not thereby shortened and the bearing grease is not contaminated. In a device of the type just described, steam pressures of 50 to 60 pounds have been used, with excellent results with regard to the fan action and with regard to providing sufficient moisture to wash the dust from the air.

Although particular embodiments of the invention have been described, it will become readily apparent to those skilled in the art that many modifications can be made to the fan of the invention without departing from the spirit and scope thereof.

What I claim is:

1. A fluid reaction fan comprising a shroud-like housing having a bladed rotor rotatably mounted therein, said rotor comprising a central hub having a plurality of blades mounted thereon, said blades having jet nozzles at the trailing edges thereof communicating with passageways leading to the hub, said hub being provided with a first fluid receiving chamber, the housing further having a fluid distribution member mounted therewithin and affixed thereto, said member having a second fluid distribution chamber and being adapted to receive propelling fluid from an external source, a hollow shaft extending from said member and upon which said rotor is mounted, openings in said shaft permitting communication between the said two fluid chambers, whereby propelling fluid may be transmitted from said fluid distribution chamber in said member to said nozzles, and means including a bearing means for rotatably mounting said rotor on said shaft permitting a metered leakage of propelling fluid through said bearing means out of said rotor fluid receiving chamber and establishing a film of fluid upon which said rotor rides.

2. The fan of claim 1 wherein said mounting means comprises a metering ring fitted to said rotor and so dimensioned as to provide minimum clearance with said shaft to permit slight leakage therebetween.

3. The fan of claim 1 wherein said bearing means comprises roller bearings and said mounting means comprises a metering ring fitted to said rotor and so dimensioned as to provide minimum clearance with said shaft to permit slight leakage therebetween.

4. A fluid reaction fan comprising a shroud-like housing having a bladed rotor rotatably mounted therein, said rotor comprising a central hub having a plurality of blades mounted thereon, said blades having jet nozzles at the tips thereof communicating with passageways leading to the central hub, said hub being provided with a first fluid receiving chamber, the housing further having a fluid distribution member mounted therewithin and affixed thereto, said member having a second fluid distribution chamber and being adapted to receive propelling fluid from an external source, a hollow shaft extending from said member and upon which said rotor is mounted, openings in said shaft permitting communication between the said two fluid chambers, whereby propelling fluid may be transmitted from said fluid distribution chamber in said member to said nozzles, bearing means between said rotor and said shaft, fluid metering means including a ring fitted to said rotor, said shaft being provided with

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a shoulder upon which said ring is rotatably mounted, said shoulder and ring being so dimensioned as to provide minimum clearance to permit slight leakage of propelling fluid therebetween.

5. A fluid reaction fan comprising a shroud-like housing having a bladed rotor rotatably mounted therein, said rotor comprising a central hub having a plurality of blades mounted thereon, said blades having jet nozzles communicating with passageways leading to the central hub, said hub being provided with a first fluid receiving chamber, the housing further having a fluid distribution member mounted therewithin and affixed thereto, said member having a second fluid distribution chamber and being adapted to receive propelling fluid from an external source, a hollow shaft extending from said member and upon which said rotor is mounted, openings in said shaft permitting communication between the said two fluid chambers, whereby propelling fluid may be transmitted from said fluid distribution chamber in said member to said nozzles, said blades having a trailing edge through which said nozzles discharge fluid, means upon said trailing edge adjacent said nozzles for changing the direction of efflux of fluid leaving said nozzles and means including a bearing means for rotatably mounting said rotor on said shaft permitting a metered leakage of propelling fluid through said bearing means out of said rotor fluid receiving chamber and establishing a film of propelling fluid upon which said rotor rides.

6. The fan of claim 5 wherein said means adjacent said nozzles comprise adjustable tabs provided upon said trailing edges and movable into the path of fluid outflow from said nozzles to change the direction of efflux.

7. A steam driven fan for dust removal comprising a shroud-like housing having a bladed rotor rotatably mounted therein, said rotor comprising a central hub having a plurality of blades mounted thereon, said blades having a series of jet nozzles at the trailing edges thereof communicating with passageways leading to the central hub, said hub being provided with a first fluid receiving chamber, the housing further having a fluid distribution member mounted therewithin and affixed thereto, said member having a second fluid distribution chamber and being adapted to receive steam propellant from an external source, a hollow shaft extending from said member and upon which said rotor is mounted, openings in said shaft permitting communication between said two fluid receiving chambers, whereby steam propellant may be transmitted from said fluid distribution chamber in said member to said nozzles, and means for rotatably mounting said rotor on said shaft permitting a metered leakage of steam therebetween out of said first fluid receiving chamber and establishing a film of steam upon which said rotor rides, said means further comprising one wall of said first fluid receiving chamber in the rotor hub, whereby the steam acts as the propelling fluid for the fan and simultaneously as the dust collecting medium.

8. The fan of claim 7 wherein said mounting means comprises a metering ring fitted to said rotor and so dimensioned as to provide minimum clearance with said shaft to permit slight leakage flow of steam therebetween, one face of said ring providing a wall of said first fluid receiving chamber in the rotor hub.

9. The fan of claim 8 wherein a second ring is mounted to form the second wall of said first fluid receiving chamber in the rotor hub, bearing means in said rotor hub separated from said fluid receiving chamber in the rotor hub by said second ring, whereby steam may be

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transmitted to said nozzles through said chamber without impinging upon said bearing means.

10. A fluid reaction fan comprising a housing having a bladed rotor rotatably mounted therein, said rotor comprising a central hub having a plurality of blades mounted thereon, said blades having jet nozzles so arranged as to provide propelling force to said blades upon the passage of fluid therethrough, said nozzles communicating with passageways leading to the hub, said hub being provided with a first fluid receiving chamber, the housing further having a fluid distribution member mounted therewith and affixed thereto, said member having a second fluid distribution chamber and being adapted to receive propelling fluid from an external source, a hollow shaft extending from said member and upon which said rotor is mounted, openings in said shaft permitting communication between the said two fluid chambers, whereby propelling fluid may be transmitted from said fluid distribution chamber in said member to said nozzles, and means including a bearing means for rotatably mounting said rotor on said shaft permitting a metered leakage of propelling fluid through said bearing means out of said rotor fluid receiving chamber and establishing a film of fluid upon which said rotor rides.

11. A steam driven fan for dust removal comprising, in combination:

a housing having a bladed rotor rotatably mounted therein;

said rotor comprising a central hub having a plurality of blades mounted thereon;

said blades having jet nozzles so arranged as to provide propelling force to said blades upon passage of steam therethrough;

said nozzles communicating with passageways leading to the hub;

said hub being provided with a first steam receiving chamber;

the housing further having a steam distribution member mounted therewithin and affixed thereto;

said member having a second steam distribution chamber and being adapted to receive steam from an external source;

a hollow shaft extending from said member and upon which said rotor is mounted, openings in said shaft permitting communication between the said two steam chambers, whereby propelling steam may be transmitted from said steam distribution chamber in said member to said nozzles;

and means including a bearing means for rotatably mounting said rotor on said shaft permitting a metered leakage of propelling steam through said bearing means out of said rotor steam receiving chamber and establishing a film of steam upon which said rotor rides, whereby the steam acts as the propelling fluid for the fan and simultaneously as the dust collecting medium.

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