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2,391,512

BLOWER APPARATUS

Filed Oct. 21, 1943

2 Sheets-Sheet 1

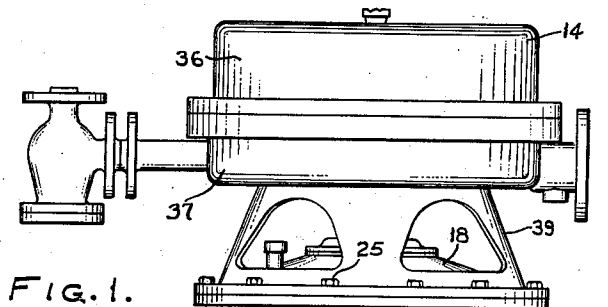


FIG. 1.

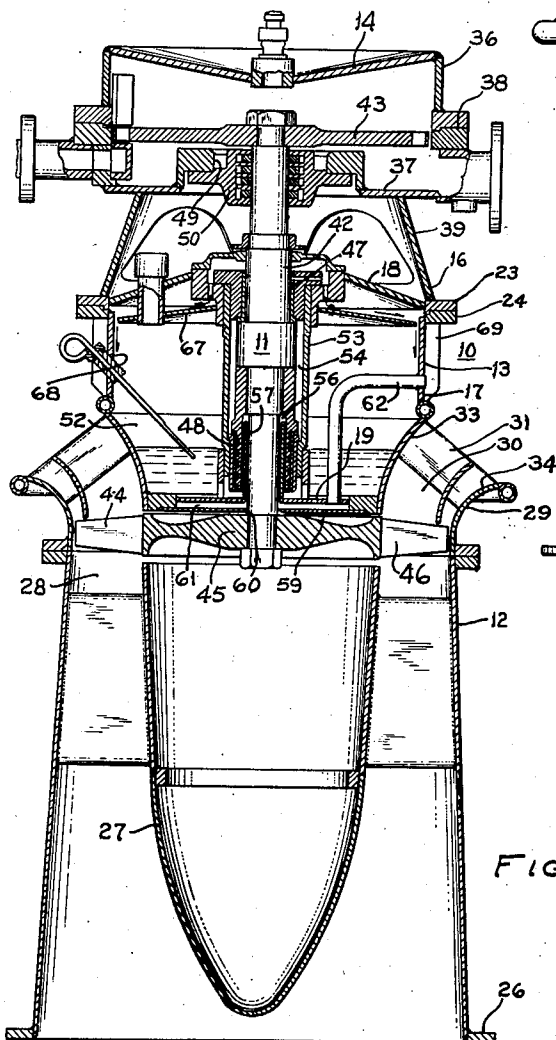


FIG. 2.

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2 Sheets-Sheet 2

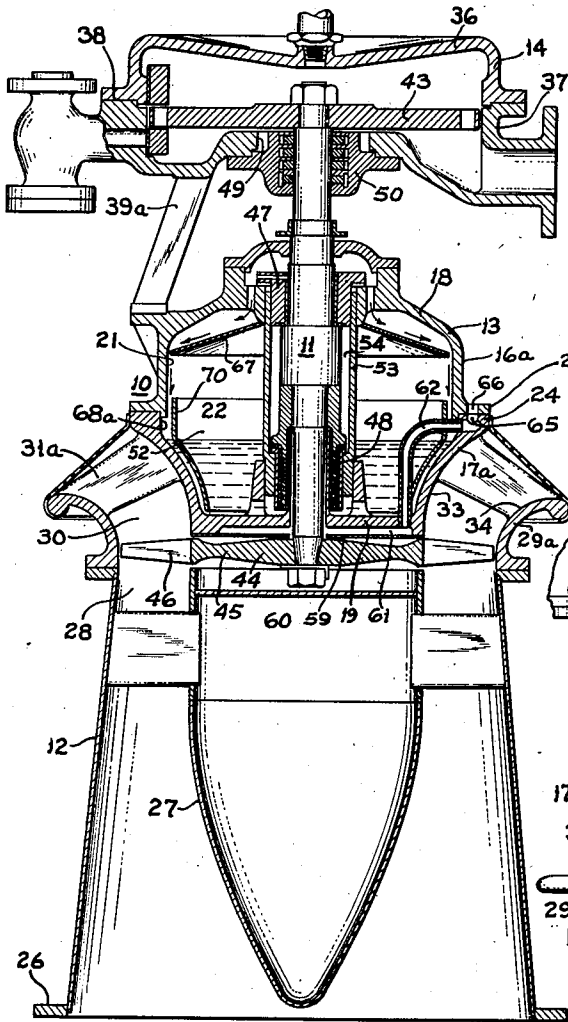


FIG. 4.

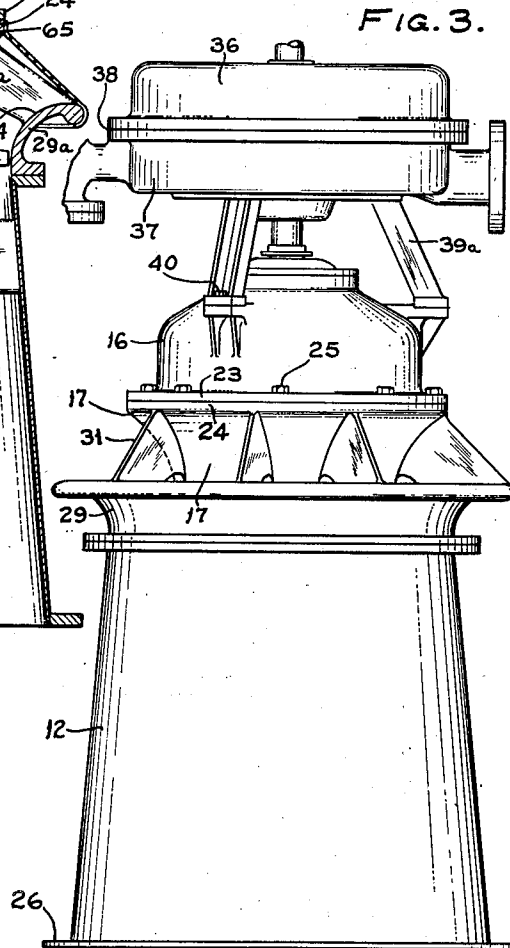


FIG. 3.

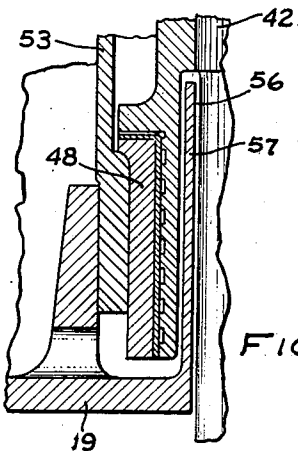


FIG. 5.

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BLOWER APPARATUS

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5 Claims. (Cl. 230-132)

The invention relates to propeller blowers of the type disclosed and claimed in the application of Schmidt, Serial No. 506,155, filed October 14, 1943, and it has for an object to improve such apparatus with respect to features combined to provide a relatively simple and durable construction and one which is economical to produce.

The wider application of propeller blowers, particularly in the marine field, of course, requires simplicity of construction and reduction in the cost of production. To achieve this purpose, I have devised a novel arrangement of stationary or blower housing structure and relationship of the rotary structure thereto. Furthermore, the housing structure devised also involves self-contained features contributing to effective lubrication and lubricant cooling.

Accordingly, a further object of the invention is to provide a self-contained and self-supporting vertical blower, wherein all essential parts and features are incorporated within its structure, without external auxiliaries connected thereto and without compromise of the structure to provide for lubrication and cooling, and wherein the blower is comprised by parts arranged in superposed relation and which carry the rotary structure and provide an annular air passage for the propeller having a properly formed entrance.

The aforementioned objectives are made possible by the particular arrangement of the tubular member providing the blower passage, a body member carrying the rotary structure, and a motor having a rotor forming a part of the rotary structure. The tubular member or casing is arranged as a column structure for supporting the blower and it comprises joined upper and lower parts, the lower part carrying an internal fairing cone for the propeller hub to define the annular passage at the discharge side of the propeller. The upper part of the tubular member telescopes over the body member lower part and it is joined to the latter to provide a unitary structure and an annular entrance portion of the blower passage defined by concavo-conical and convexo-conical surfaces formed on the telescoping parts. The lower body member part is connected by a horizontal joint to the upper body member part and the latter is connected by suitable structure to the lower part of the motor casing, whose upper part is connected to its lower part by a horizontal joint. The body member carries a pair of upper and lower bearings for the rotary structure and it is formed to provide a reservoir for lubricating oil. Oil is forcibly cir-

culated through the lower and upper bearings, the oil escaping from the upper end of the latter returning to the reservoir. As the circulating oil is used both to lubricate the bearings and to dissipate heat, and as the quantity of oil is limited by the capacity of the reservoir, measures must be taken to cool the circulating oil; and, to this end, oil escaping from the upper bearing is constrained to flow outwardly over a baffle to the inner surface of a body member circumferential wall whose exterior is exposed to the atmosphere, whereby full advantage is taken of the capacity of such wall to transfer heat from oil flowing thereagainst at the inside to the atmosphere at the outside. Furthermore, as the drive shaft must pass through an opening formed in the bottom of the reservoir, it is necessary to seal the latter against withdrawal of oil particularly because of the suction effect exerted by the contiguous propeller hub. Therefore, the shaft opening is bounded by a cylindrical dam and a chamber is formed adjacent to the bottom wall and with which communicates the lower end of the shaft opening, the chamber or space communicating with the atmosphere so as to maintain therein a substantially atmospheric pressure condition effective to prevent the suction effect of the propeller being exerted on the lower end of the shaft opening to withdraw oil from the reservoir. As with the lubricating system for the bearings and the means for cooling the circulating oil, the means for furnishing atmospheric air to the sealing space or chamber is also incorporated within the structure of the body member. Therefore, a more particular object of the invention is to provide a self-contained and self-supporting blower comprising parts connected and arranged as specified and wherein the body member carries the rotary structure, provides the reservoir for lubricating oil, has self-contained means for lubricating the bearings and for cooling the circulating oil, and has its lower part provided with conduits arranged internally of the reservoir for placing the sealing space or chamber in communication with the atmosphere.

These and other objects are effected by the invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is an elevational view of the improved blower;

Fig. 2 is a vertical sectional view of the apparatus shown in Fig. 1;

Figs. 3 and 4 are views similar to Figs. 1 and 2,

respectively, but showing a modified form of the invention; and

Fig. 5 is a detail view of structure found in both embodiments.

The stationary or housing structure, at 10, includes a tubular member 12, a body member 13, and a motor casing 14 arranged in vertical superposed relation, with the body member supported by the tubular member and the motor casing supported by the body member.

To facilitate manufacture of the stationary structure, at 10, so far as practicable and at the same time to provide for accessibility of constituent parts, both the body member 13 and the motor casing 14 are comprised by upper and lower parts, so that the lower body member part connected by radial elements to the inlet end portion of the tubular member 12 may be formed as a single structure and so that the lower motor casing part may be formed with supporting structure for attachment to the upper part of the body member (Fig. 3) or which may be joined to the upper part of the body member to constitute a unitary structure (Figs. 1 and 2).

The body member, therefore, includes upper and lower parts 16 and 17 having top and bottom walls 18 and 19 and joint flanges 23 and 24 connected by bolts 25.

As shown, the tubular member 12 is formed with a flange 26 adapted for attachment to any suitable structure, so that the tubular member constitutes a column-like supporting structure for the blower. The tubular member and the fairing member 27, carried thereby, cooperate with the lower part 17 of the body member to provide the blower passage 28 of annular section and which preferably converges and then diverges, as hereinafter pointed out, the passage having its inlet just below the flange 24.

The tubular member 12 includes an annular element 29 telescoping the lower part 17 of the body member to provide the suction portion 30 of the annular passage, and it is connected to the body member lower part by the vane-type radial members 31 in the suction portion of the passage. With this arrangement, not only does the annular element 29 support the body member and all parts carried thereby, but it is practicable to form the lower body part, the connecting elements, and the annular element as a unitary structure, thereby not only contributing to economy of production but also making it possible more readily to provide suitable concavo- and convexo-conical surfaces 33 and 34 properly related to define the converging suction passage portion 30 which gradually changes the flow from a direction which is largely radial at the inlet to one which is largely axial for the propeller.

The motor casing is formed of upper and lower parts 36 and 37 connected by a horizontal joint 38, and the lower part 37 has supporting structure 39 joined in a unitary manner with the upper body part 16, as shown in Figs. 1 and 2, or connected thereto by bolts or screws 40, as shown in Fig. 3.

The rotary structure or aggregate, at 11, includes a vertical drive shaft 42, a motor rotor 43 attached to the upper end of the drive shaft, and a propeller, at 44, including a hub 45 attached to the lower end of the drive shaft and having propeller blades 46 connected thereto.

The rotary structure or aggregate is supported by upper and lower bearings 47 and 48 carried by the body member 13 and located at the upper and lower walls 18 and 19, with the motor rotor 43 and the propeller, at 44, attached to the ends of

the drive shaft overhanging the bearings and the bottom and top walls of the body member. The upper overhanging end portion of the drive shaft extends through an opening 49 provided in the lower motor casing part and a gland construction 50 is attached to the casing and cooperates with the drive shaft to provide a seal for the latter.

The body member 13 provides an interior oil reservoir 52; and, in accordance with the present invention, the upper and lower bearings are connected by a tubular element 53, which encompasses the drive shaft 42 to form with the latter a passage 54 of annular section which receives oil discharging from the lower bearing and furnishes it for passage through the upper bearing. Oil discharging from the upper end of the upper bearing is returned to the reservoir.

As the drive shaft extends through the bottom wall 19 of the reservoir 52, it is necessary to provide means for retaining oil within the latter. Accordingly, therefore, the drive shaft is formed with an upwardly-extending channel 56 of annular section having its lower end open to the reservoir near the bottom wall thereof, and the bottom wall 19 has a dam 57 extending upwardly therefrom, about the shaft opening, above the oil level in the reservoir, and arranged in the channel. Thus, it will be seen that the interior chamber of the body member not only constitutes a reservoir for means supplying oil to the bearings, but it also provides space for oil draining or returning from the bearings.

As the propeller hub 45 is located near to the bottom wall 19, its centrifugal action will exert a suction effect tending to withdraw oil through the channel 56 and over the dam 57. To avoid this, a plate 59 has an opening 60 defining close clearance with the drive shaft and cooperating with the bottom wall to provide a sealing space 61 in open communication with the lower end of the shaft opening formed in the bottom wall and in communication with the atmosphere, whereby, due to the maintenance of pressure substantially at atmospheric in such sealing space or chamber, exertion of the suction effect of the propeller hub on the bottom wall shaft opening is prevented. The bottom sealing structure so far described is disclosed and claimed in the aforesaid application of Schmidt; and, I have improved thereupon in the respect of furnishing air to the sealing space or chamber by structure dictated by the dominant features of construction already described. In accordance with the present invention, the sealing space or chamber 61 is placed in communication with the atmosphere by means of tubes 62 connected unitarily with the lower part of the body member, such tubes being bent, arranged in the reservoir, having their upper ends open to the atmosphere above the blower inlet, and having their lower ends open to the sealing space or chamber 61. As shown in Figs. 3 and 4, the upper tube ends communicate with the atmosphere through registering openings 65 and 66 formed in the flanges 24 and 23.

Self-containment of the blower without auxiliary connections or protruding auxiliary parts, not only makes necessary the complete internal lubrication system already described, but the capacity of the oil reservoir is limited by structure dictated by the over-all design. Besides, it is necessary to circulate oil through the bearings both to lubricate the latter and to cool them. Therefore, fairly rapid oil circulation is required. Hence, it is essential that provision be made for

cooling the circulating oil, and this is done so as not to interfere with the over-all objective of interior containment of all parts.

In Figs. 1 and 2, oil escaping from the upper bearing flows onto an upwardly-dished plate or baffle 67 and drains to the periphery of the latter arranged contiguously to the inner surface of the reservoir wall 68 with the result that the returning oil is constrained to flow down along the interior surface of such wall; and, as the wall is exposed to the ambient atmosphere, it is effective to transfer heat from the oil to the atmosphere. In Figs. 1 and 2, such heat transfer is promoted by providing the wall 68 with external cooling fins 69.

As shown in Figs. 3 and 4, effectiveness of the wall 68a to transfer heat to outside air is improved by provision of a circular baffle 70 within the reservoir, such baffle constraining oil discharging from the peripheral edge of the dished plate or baffle to flow downwardly and contiguously to the inner surface of the wall 68a before joining the main body of oil in the reservoir.

The embodiment of the invention shown in Figs. 3 and 4 differs over that of Figs. 1 and 2 mainly in that many of the component parts are cast with the result that even greater economy of production is possible. In Figs. 3 and 4, the upper part 29a of the tubular member, the radially arranged vane-type members 31a, and the lower part 17a of the body member are cast as a single piece; the upper part 16a of the body member is a cast element, and the same is true with respect to the upper and lower parts of the turbine casing, the lower part of the latter preferably being cast with legs 39a for attachment to the upper body member part. Aside from casting being more conducive to greater uniformity of component parts, it is advantageous because of the great ease and economy in providing complex shapes particularly where double curvatures are involved as with the concavo-conical and convexo-conical surfaces forming the entrance portion of the blower passage.

From the foregoing, it will be apparent that I have devised a self-contained and self-supporting blower wherein the number of main parts is reduced to a minimum and each part is constructed and arranged, with the others, to contribute to the achievement of the principal objective. The tubular member or casing has upper and lower parts and the upper part is connected to the lower part of the body member by vane-like elements to constitute a unitary structure, the upper part of the tubular member and the lower part of the body member being constructed and arranged to provide the convexo-conical and concavo-conical surfaces forming the entrance portion of the blower passage and which functions to gradually change the direction of air from one having a substantially large radial component to one which is substantially axial at the inlet side of the propeller. In addition to the lower part, the body member also includes an upper part connected thereto by a horizontal joint, and the motor comprises a casing including upper and lower parts connected by a horizontal joint with the lower part connected and supported from the upper body member part in a suitable manner. The entire rotary structure is positioned by a pair of bearings carried by the body member. The bearings are lubricated and the lubricating oil is cooled by a complete system arranged within the structure of the body member; and the system is effective to dissipate heat

without involving an externally arranged cooling device, this being made possible mainly because of internal features contributing to the effective action of the body member wall to transfer heat to the atmosphere.

While the invention has been shown in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and it is desired, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What is claimed is:

1. In a vertical propeller blower, a tubular casing; a hollow body member carried by the casing and cooperating with the latter to provide the suction portion of the blower passage; said body member comprising upper and lower walls joined by a circumferential wall; a vertical drive shaft traversing the interior of the body member and having upper and lower portions extending beyond the upper and lower walls; a propeller carried by the lower portion of the drive shaft and arranged adjacent to the lower wall; radial and thrust bearings for the drive shaft and supported radially and axially by the upper and lower walls; said upper and lower radial and thrust bearings each including radial and thrust bearing surfaces, said drive shaft being formed with radial and thrust bearing surfaces cooperating with the bearing surfaces of the bearings, and the thrust bearing surfaces being at the upper end of the lower bearing and at the lower end of the upper bearing; means for lubricating the bearings comprising a seal opposing the escape of oil from the interior of the body member so that the lower portion of the latter may serve as an oil reservoir and means providing for the circulation of oil from the reservoir and through the lower and upper bearings in series and for the return to the reservoir of oil escaping from the upper bearing; said means providing for the circulation of oil including a sleeve member connecting the bearings and encompassing the thrust surfaces and the drive shaft to provide an annular passage for supplying oil discharging from the lower thrust bearing to the upper thrust bearing.
2. Apparatus as claimed in claim 1 with a baffle arranged internally of the body member to constrain oil escaping from the upper bearing to flow contiguously to the body member wall to promote transfer of heat from the oil to the atmosphere to cool the oil.
3. Apparatus as claimed in claim 1 with a tubular baffle arranged internally of the body member and cooperating with the circumferential wall of the latter to provide an annular passage whose upper end is arranged above the normal reservoir oil level and whose lower end is near to the lower wall and means for constraining oil escaping from the upper bearing to enter the upper end of the annular passage, whereby oil heated by the bearings is caused to flow through the passage to the lower portion of the reservoir to promote the transfer of heat from such oil to air in ambient relation with respect to the circumferential wall.
4. Apparatus as claimed in claim 1 with means promoting a transfer of heat from heated oil to air in ambient relation with respect to the circumferential wall comprising an upper baffle constraining oil escaping from the upper bearing to flow outwardly and then downwardly in contact with the upper portion of the circumferential

wall and a tubular baffle cooperating with the circumferential wall to provide an annular passage whose upper end is arranged to receive oil flowing along the upper portion of the circumferential wall and whose lower end is near to said lower wall, whereby oil heated in the bearings, in returning to the reservoir, is constrained to flow in contiguous relation with respect to the circumferential wall.

5. In a vertical propeller blower, a tubular casing; a hollow body member carried by the casing and cooperating with the latter to provide the suction portion of the blower passage; said body member including an upper portion comprised by top and circumferential wall elements, a lower portion comprised by bottom and circumferential wall elements, and a joint connecting adjacent ends of the circumferential wall elements; a vertical drive shaft traversing the interior of the body member and having upper and lower portions extending beyond the top and bottom walls; a propeller attached to said lower portion of the drive shaft and arranged adjacent to the bottom wall; radial and thrust bearings for the drive shaft and supported radially and axially by the top and bottom walls; said upper and lower radial and thrust bearings each including radial and thrust bearing surfaces, said drive shaft being

formed with radial and thrust bearing surfaces cooperating with the bearing surfaces of the bearings, and the thrust bearing surfaces being at the upper end of the lower bearing and at the lower end of the upper bearing; means for lubricating the bearings comprising a seal opposing the escape of oil from the interior of the body member so that the lower portion of such interior bounded by the circumferential wall element of the lower body member portion serves as an oil reservoir and means providing for the circulation of oil from the reservoir and through the lower and upper bearings in series and for the return to the reservoir of oil escaping from the upper bearing; means cooperating with the bottom wall externally of the latter and defining close clearance with respect to the drive shaft to provide an annular air chamber encompassing the latter; and means for maintaining an atmospheric pressure condition in the air chamber comprising one or more pipes carried by the lower body member portion with one end of each pipe attached to the circumferential wall element of such portion and communicating with the atmosphere above the suction end of the blower passage and the other end attached to the bottom wall and communicating with said air chamber.

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