Aug. 10, 1954 A. J. SCHIMPKE 2,685,841

PUMP FOR PUMPING LIQUID

Original Filed April 17, 1947 2 Sheets-Sheet 1

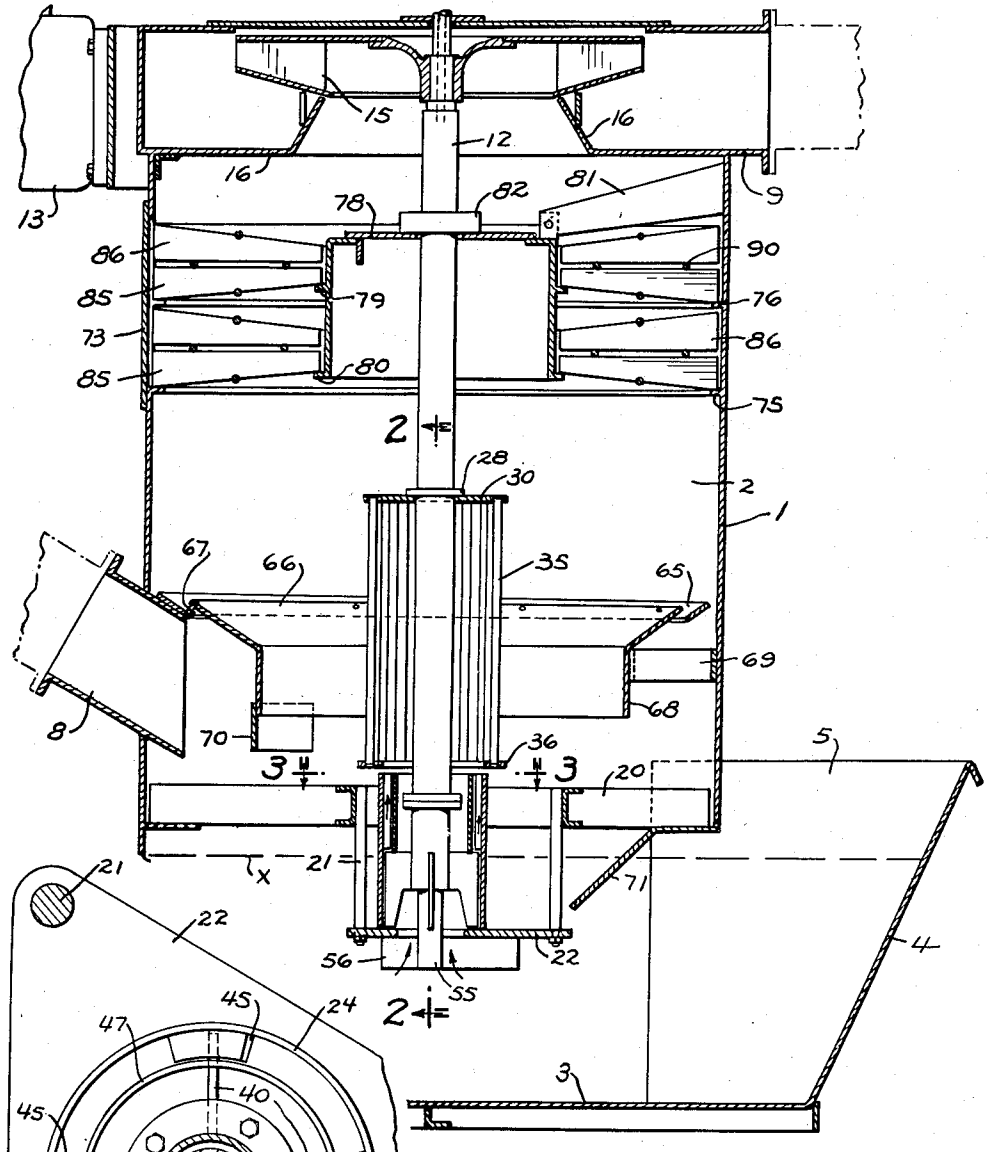


Fig. 1.

Fig. 3.

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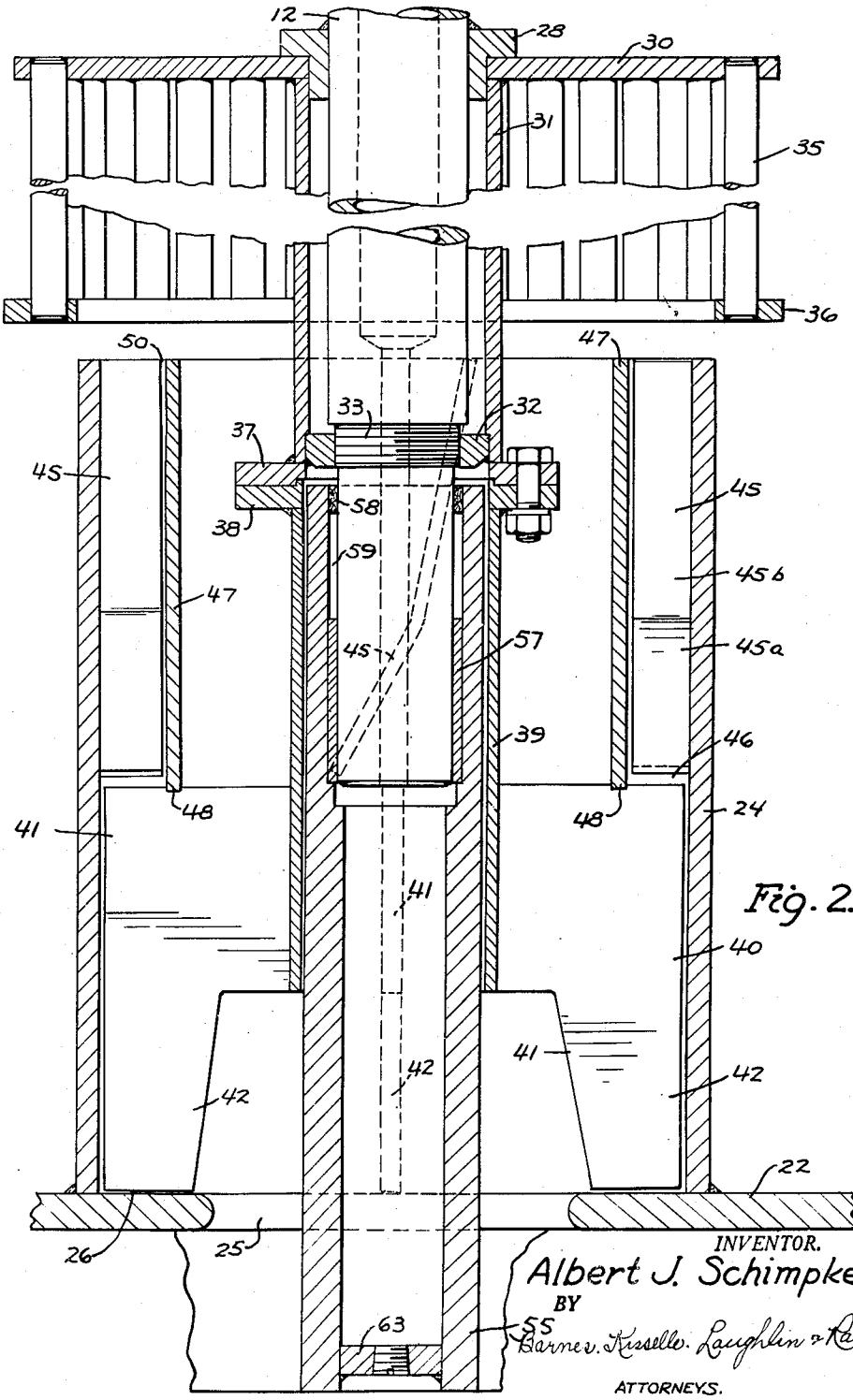


Fig. 2.

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PUMP FOR PUMPING LIQUID

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Original application April 17, 1947, Serial No. 742,163, now Patent No. 2,599,202, dated June 3, 1952. Divided and this application April 10, 1952, Serial No. 281,610

6 Claims. (Cl. 103—103)

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This invention relates to a device or apparatus for pumping liquid and it is concerned particularly with a form of pump useful in pumping water for an air cleaning device.

In a wet type of dust collector, that is to say, a device for cleaning air of a factory or the like, entrained substances and materials in the air are caught by water which is pumped and sprayed and thus caused to be separated or collected.

Such an air cleaner or dust collector may be used under many conditions with many different types of substances and materials which may be in the air, and it is necessary in order to have an apparatus which will work properly over long periods of time, that the structure is such as to prevent the same from being clogged or choked with the material.

One object of the invention is to provide an improved pump system organized and designed as to efficiently pump the liquid with a continuous non-surging action so that the liquid may be spread or sprayed for contact with the air. It is an aim of the invention to provide a pump which will not become clogged with pieces of cloth, thread, string or the like, and which will not otherwise be interfered with with the presence of such substances. It is a further purpose to provide a pump structure which is highly efficient in operation from the standpoint of the volume of water pumped in relation to the power required.

The invention is disclosed in the accompanying drawings and to demonstrate one use of the pump an air cleaner or dust collector is illustrated. It is understood, however, that the pump construction may be employed for pumping water or other liquid for other purposes. This application is a division of application Ser. No. 742,163 filed April 17, 1947, now Patent 2,599,202 issued June 3, 1952.

Fig. 1 is a cross sectional view illustrating the pump of the present invention as it may be incorporated in a dust collecting or air cleaning apparatus.

Fig. 2 is an enlarged cross sectional view taken substantially on line 2—2 of Fig. 1 illustrating features of the pump construction.

Fig. 3 is a detailed view taken substantially on line 3—3 of Fig. 1 showing some of the pump structure and its support.

As illustrated in Fig. 1, the apparatus comprises an exterior shell 1 which provides a chamber 2 therein. The lower portion of the shell at 3 provides a sump for the liquid which may be

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plain water where air is to be cleaned and the sump portion has an extending part 4 with an opening 5 through which the accumulated material may be removed in any suitable manner.

The inlet for air is shown at 8, the same entering the side of the shell 1 and preferably discharging the air slightly above the level of the liquid which is indicated at x. The outlet for the air is at the top of the shell, as shown at 9. Mounted centrally in the shell is a shaft 12 which may be driven by a suitable motor 13 operating through driving means, not shown, and on the upper portion of this shaft is a fan 15 provided with suitable shrouding 16. When the fan is operated the air is drawn in through the inlet 8 and discharged through the outlet 9 with the air moving generally upwardly in the shell 1.

The pump structure is primarily supported by an interior supporting brace structure 20, suspended from which by rods 21 is a supporting plate 22. Attached to the plate 22 is an upwardly extending bowl 24. The plate has an opening 25 which provides an opening in the bottom of the bowl. The opening 25 has a cross dimension less than that of the bowl and thus provides a circumferential ledge 26. The shaft 12 is hollow, as indicated, and as shown in Fig. 2, it has a collar 28 fixedly secured thereto. Mounted on the shaft is the spray element of the unit and this comprises an upper plate or bracket 30 with a tubular center part 31 through which the shaft 12 extends. Secured to the lower end of the tubular member 31, as by means of welding or the like, is a nut 32 arranged to engage the threads 33 on a reduced portion of the shaft. When the sleeve 31 is passed over the shaft and rotated relative thereto, the nut screws onto the thread 33 and draws the collar 28 tightly against the upper plate 30 and, therefore, the spray element is fixedly united in driving relationship with the shaft. Needless to say, the hand of the thread is such that the direction of rotation tends to keep the threaded engagement tight.

Mounted on the upper plate 30 are a plurality of rods 35. These rods extend downwardly from the upper plate and their lower ends are attached to a lower ring or plate 36. Thus, when the shaft revolves, the spray element, which may be considered as being a cage-like element, is rotated with the shaft.

The lower end of the tubular element 31 is provided with a flange 37 which is bolted to a flange 38, in turn united as by means of welding or the like, to a rotary tubular element 39. Mounted as by means of welding on the tube 39,

are a plurality of impeller blades 40. As shown in Fig. 3, there may be four of such impeller blades. These blades extend outwardly and have a running clearance with respect to the interior of the bowl 24. The lower portions of the blades are preferably cut away as at 41 to provide relatively narrow portions 42, the lower edges of which are located immediately above the ledge 26. These blades are preferably vertically positioned.

Positioned above the blades are guide vanes 45. These are preferably welded to the interior of the bowl and have an adequate running clearance as at 46, with respect to the impeller blades. A tubular element 47 is welded to the upper portions of the blades 40, as indicated at 48. This tubular element encases the element 39 and has a running clearance 50 with respect to the guide vanes 45. There may be, and preferably are, four of such guide vanes 45, although this number may be varied, and they are angularly disposed, as illustrated by the dotted lines in Fig. 2. These guides preferably have a bend formation to provide a lower portion 45a at a different angle from an upper portion 45b. The annular space between tubular element 47 and the upwardly extending bowl 24 thus provides a circumferential passage through which the water is pumped upwardly and which is deflected by the guide vanes. No substantial amount of water is pumped through the space inside the tubular element 47.

It will be seen, therefore, that when the shaft 12 is rotated, that the spray element comprising the rods 35 is rotated, the lower end of the spray element being slightly above the bowl, and also the impeller blades 40 are rotated. The level of the liquid, as indicated in Fig. 1, is such that the blades 40 are normally submerged.

In order to provide an adequate bearing for the lower end of the shaft, there is a bearing support of tubular form as at 55, which is supported by brackets 56 welded to the underside of the plate 22 and which extends upwardly in the tube 38. As shown in Fig. 2, this is a relatively strong bearing supporting element and it is provided with a bearing 57 for the lower end of the shaft. At the upper end of the bearing support and positioned between the bearing support and the shaft is a sealing element 58, the same being spaced from the bearing 57 to provide a space 59. As mentioned above, the shaft is hollow and its upper end may be provided with an oil cup 61 and the entire hollow portion of the shaft is filled with oil. It follows that if the hollow bearing support 55 is filled with oil, the lower end being closed by a suitable plug 63, this oil moves upwardly, particularly in the operation of the device, to thus lubricate the bearing 57 and the oil also fills the space 59. As the device operates the space 59 is full of oil, but its escape is checked at least in part by the seal 58. Therefore, if the apparatus stands at rest for any considerable period of time, there is adequate oil present to lubricate the bearing. Moreover, if, due to inadvertence, the oil cup is not kept filled, there is a large supply of oil which will serve to lubricate the bearing for a long period of time.

Surrounding the spray element is a sort of baffle structure, which includes an inclined baffle ring 65 secured in spaced relation to the inside of the shell 1, and another element having a frusto-conical portion 66 which overlies the ring 65 in spaced relationship to provide a pasasgeway 67. The member 66 has a circumferential wall portion 68 which may be supported by a plurality of brackets 69. Adjacent the inlet 8, the wall 68 carries a depending baffle 70. This structure, including the elements 65, 66 and 68 is offset or eccentrically disposed as shown in Fig. 2, so that the air entering through inlet 8 is caused to flow upwardly around the element 35 in substantially uniform manner. A baffle 71 projects into the liquid and thus prevents the air from flowing through the outlet trough 5.

Mounted in the upper portion of the casing is a separator structure, access to the space accommodating the same being made through a door 73. There are two circumferential supporting ledges 75 and 76 and an interior supporting structure 78 having circumferential supporting flanges 79 and 80. The interior structure 78 may be supported by a plurality of brackets 81. The structure 78 may also support a bearing 82 for the shaft 12. The separator structure embodies baffles 85 and 86 carried by the ledges 75 76 79 and 80 and these baffles may be welded to strips 90 to hold them in assembly.

In the operation of the apparatus the dust-laden air passes into the shell through the inlet 8 and then passes upwardly through the shell passing inside the circumferential wall 68 and through the separator plates. The baffle 70 is arranged to deflect the air circumferentially so that the air which passes upwardly inside the wall 68 is quite uniformly distributed throughout the area inside the wall 68. The center of the separator structure is closed by the support 78. The air then passes out through the outlet 9.

When the pump and spray unit are in operation, the blades 40, which are submerged in the water or other cleansing liquid, displaces the water upwardly. This is due to several factors including the head of liquid at the level x, the presence of the ledge 26, and the angularity of the blade. However, the water would be displaced upwardly even if the blades were not angularly disposed. The water passes upwardly through the circumferential passage outside the rotating tubular element or ring 47 and inside the fixed bowl 24 and is guided by the inclined vanes 45 so that the water is forcibly pumped upwardly in the form of a cylinder and into the revolving spray cage. The rotation of the spray cage throws the water outwardly by centrifugal force and thus creates a fine mist inside the casing. As mentioned above, the angularity of the vanes 45 may be varied to attain the desired mist characteristics. If the vanes 45 are fairly steep in angularity, the water will wet the rods 45 all the way to the top plate 30. If the vanes 45 are at a lesser angle, the water will travel up and wet the rods 45 only part of the distance. So, it will be seen that the angularity of the vanes may be selected as desired. Other factors in selecting the angularity are such things as the speed of rotation in the operation of the machine and the height of the spray cage. The action appears to be one where the pumped water strikes and accumulates in a film on the rods 45 and travels upwardly on the same, which water is thrown off centrifugally providing the fine mist or spray.

The air passing through the casing travels through the mist and then through the baffles of the separator. The water carrying the dust and dirt particles collect on the baffle plates of

the separator and form drops of water larger than those of the spray and, therefore, these drops fall by gravity especially along the interior walls of the casing 1. The drops of water carrying the extraneous material thus fall back into the sump. Some of the water strikes the angular ring 65 and flows downwardly through this space 67 thence into the sump and some flows through the space between the wall of the shell and the ring 65.

It has been found in practice that the apparatus is so efficient in cleaning air, in a factory for example, that the air which is discharged through the outlet 9 may be discharged directly back into the factory building. This represents a large saving in fuel for heating the plant inasmuch as the warm air is not necessarily discharged to the outside of the building. The pump construction, as aforesaid, is one which will not be clogged nor will the function thereof be impaired by threads or strings or the like which may pass into the same with the air. There is an adequate running clearance between the blades 40 and the walls of the bowl, between the blades 40 and the vanes 45, and between the ring 47 and the blades 45. Fibrous or stringy particles will not, therefore, catch and collect in masses in these locations of clearance.

The pumping apparatus can be used in the aeration of liquids, as in a sewage disposal application, for cooling water, as in a spray pond, and for cooling air in a cooling tower.

I claim:

1. A pump comprising, a sump for the liquid to be pumped thereby, a bowl having an open lower portion, said lower portion being positioned below the normal level of the liquid, an operating shaft disposed in the bowl, impeller blades secured to the operating shaft extending substantially radially outwardly therefrom and being driven by the operating shaft, said impeller blades being located in the lower portion of the bowl so that at least portions of the impeller blades are normally submerged, guide vanes mounted on the interior surface of the bowl above the impeller blades for guiding the liquid which is pumped upwardly by the blades, and a rotatable tubular element secured to and supported by the upper portions of the impeller blades and having a running clearance with the guide vanes.

2. In liquid pumping means for a machine for washing purposes having a sump for liquid, a vertically disposed driving element, a vertically disposed bowl positioned concentrically about the driving element, said bowl having an opening in its bottom of a cross dimension less than that of the bowl whereby to form a ledge between the side wall of the bowl and said opening, impeller blades attached to the driving element, said blades extending substantially radially outwardly from the driving element and having a running clearance with respect to the inner wall of the bowl, the lower portion of the bowl being disposed within the sump and the major portion of the impeller blades and the corresponding portion of the bowl being normally submerged in the liquid, said bowl extending above the impeller blades, guide vanes mounted on the interior surface of the bowl and positioned above the impeller blades, and a rotatable tubular element secured to and supported by the upper portions of the impeller blades and extending upwardly therefrom with a running clearance with respect to the guide vanes, said tubular element and the upper portion of the bowl cooperating to define a circumferential passage through which the liquid is pumped.

3. In liquid pumping means for a machine for washing purposes having a sump for liquid, a vertically disposed driving element, a vertically disposed bowl positioned concentrically about the driving element, said bowl having an opening in its bottom of a cross dimension less than that of the bowl whereby to form a ledge between the side wall of the bowl and said opening, impeller blades attached to the driving element, said blades extending substantially radially outwardly from the driving element and having a running clearance with respect to the inner wall of the bowl, the lower portion of the bowl being disposed within the sump and the major portion of the impeller blades and the corresponding portion of the bowl being normally submerged in the liquid, said bowl extending above the impeller blades, guide vanes mounted on the interior surface of the bowl and positioned above the impeller blades, and a rotatable tubular element secured to and supported by the upper portions of the impeller blades and extending upwardly therefrom with a running clearance with respect to the guide vanes, said tubular element and the upper portion of the bowl cooperating to define a circumferential passage through which the liquid is pumped, the impeller blades having upper portions with a close running clearance with respect to the bowl and lower portions of relatively narrow width having a substantial clearance with respect to the bowl and having lower edges which project out from the driving element a distance substantially corresponding to the cross dimension of the openings in the bottom of the bowl.

4. A pump comprising a sump for liquid to be pumped thereby, a stationary bowl mounted within the sump and disposed at least partially below the normal level of the liquid, a rotary driving member within and concentric with the bowl, the bowl being open at its lower end, impeller blades on the driving member, said impeller blades being positioned in the lower portion of the bowl and rotatable therein and being at least partially submerged in the liquid, a tubular guide disposed within the upper portion of the bowl and cooperating therewith to define a circumferential outlet passage through which the liquid passes as it is pumped by the blades, the tubular guide being connected to rotate with the driving member, and inclined vanes secured to the bowl and lying in said circumferential outlet passage for deflecting liquid pumped therethrough.

5. A pump comprising, a sump for liquid to be pumped thereby, a stationary bowl mounted within the sump and disposed so that it is at least partially below the normal liquid level, a rotary driving member within the bowl, means partially closing the bottom of the bowl and defining a centrally positioned opening and an inwardly extending circumferential flange, a rotary driving member in the bowl, blades on the driving member positioned in the lower portion of the bowl and having a close clearance with respect to the inner wall of the bowl, said blades extending substantially radially outwardly from said driving member, said blades having the inner and lower portions thereof cut away substantially above the said opening provided by said means, a tubular guide rotatably mounted within the

upper portion of the bowl spaced from the rotary driving member and spaced from the bowl to form, with the bowl, a circumferential outlet passage for liquid pumped by said blades.

6. The pump as substantially described in claim 5 characterized in that there are inclined vanes positioned in said circumferential outlet for deflecting the water pumped therethrough and in that the tubular guide device is secured to and rotatable with the driving member and blades.

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