April 19, 1938. A. E. LANDERHOLM 2,114,884

VACUUM PUMP

Filed Sept. 11, 1936 3 Sheets-Sheet 1

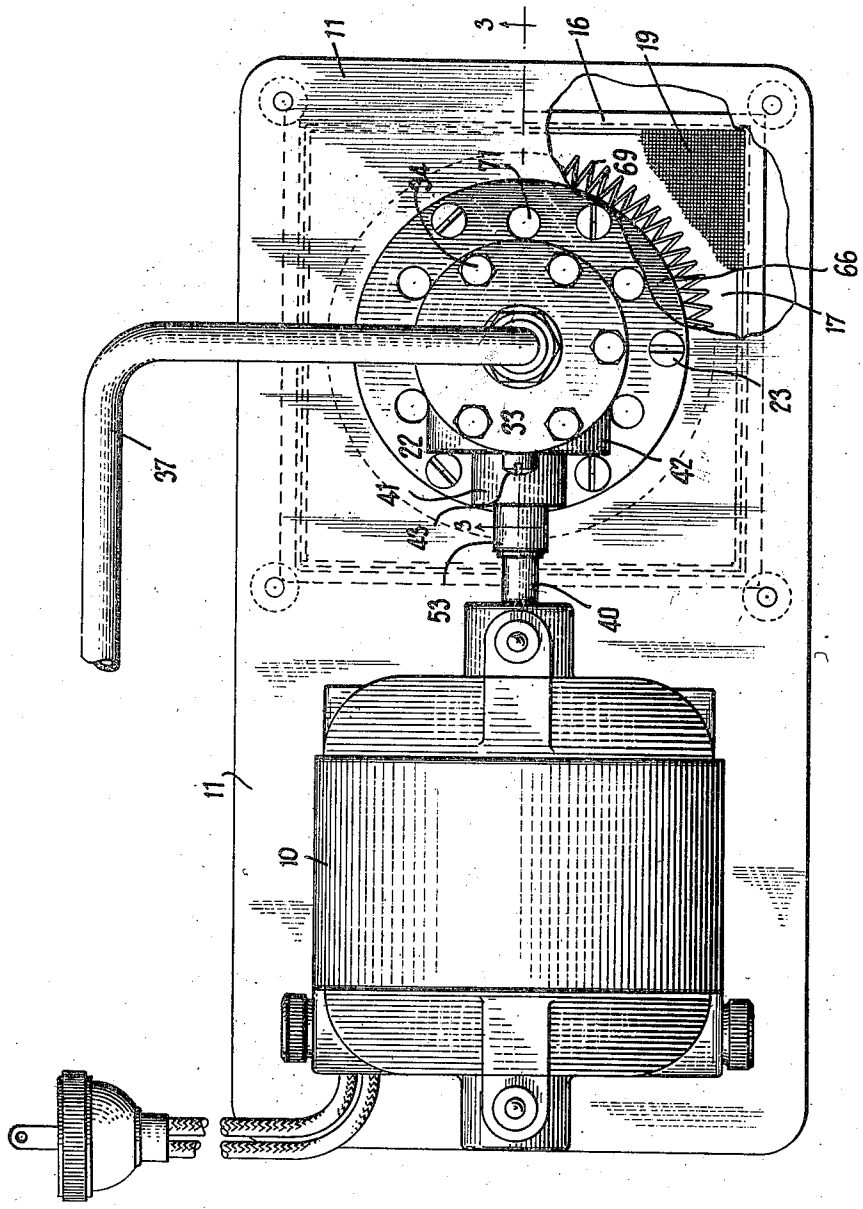

Fig. 1.

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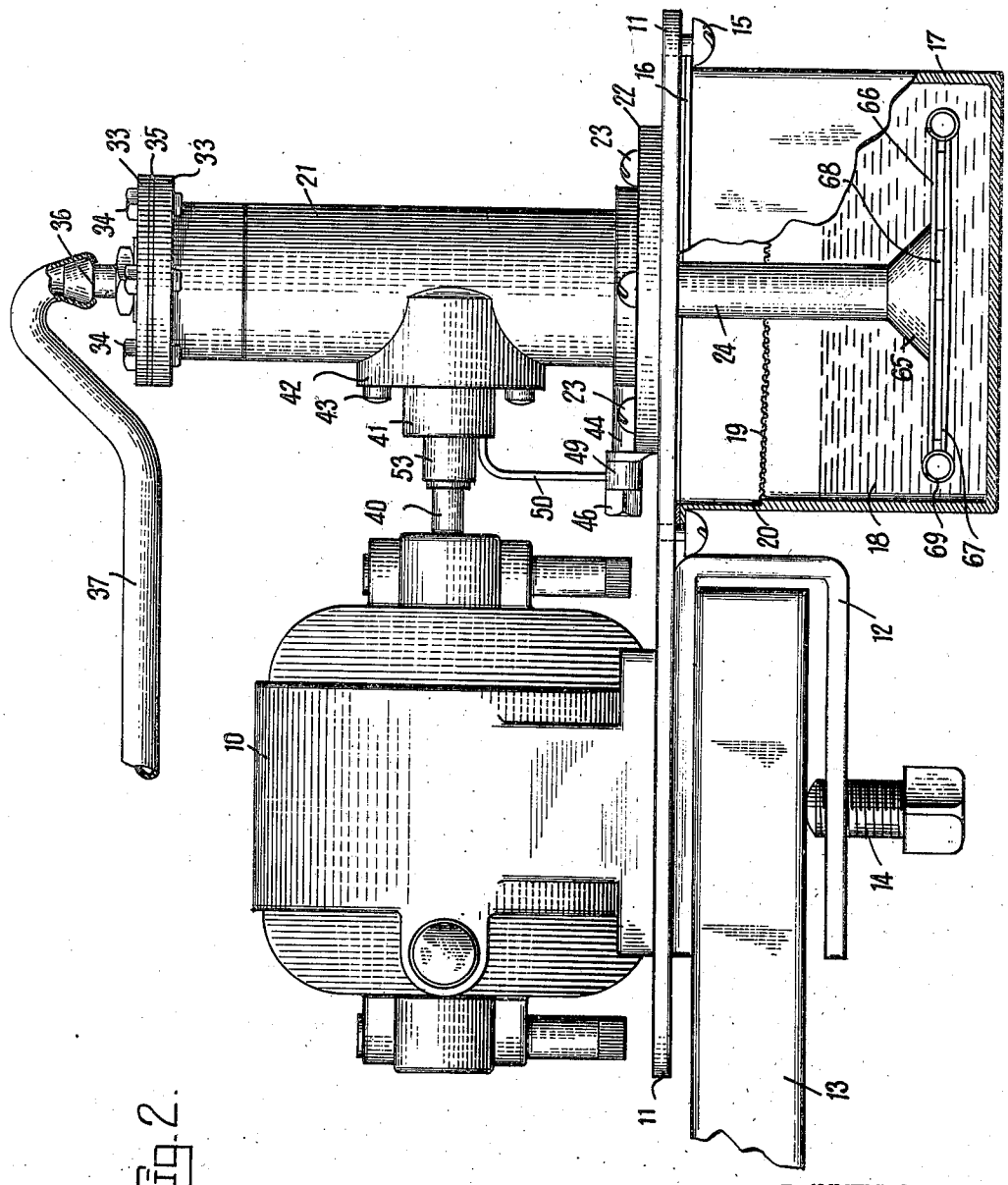

FIG. 2.

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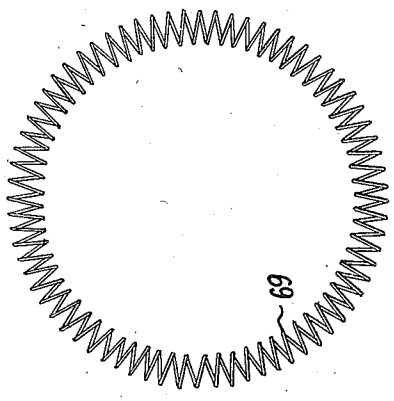

Fig. 4.

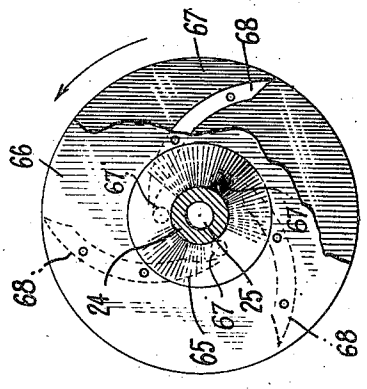

Fig. 5

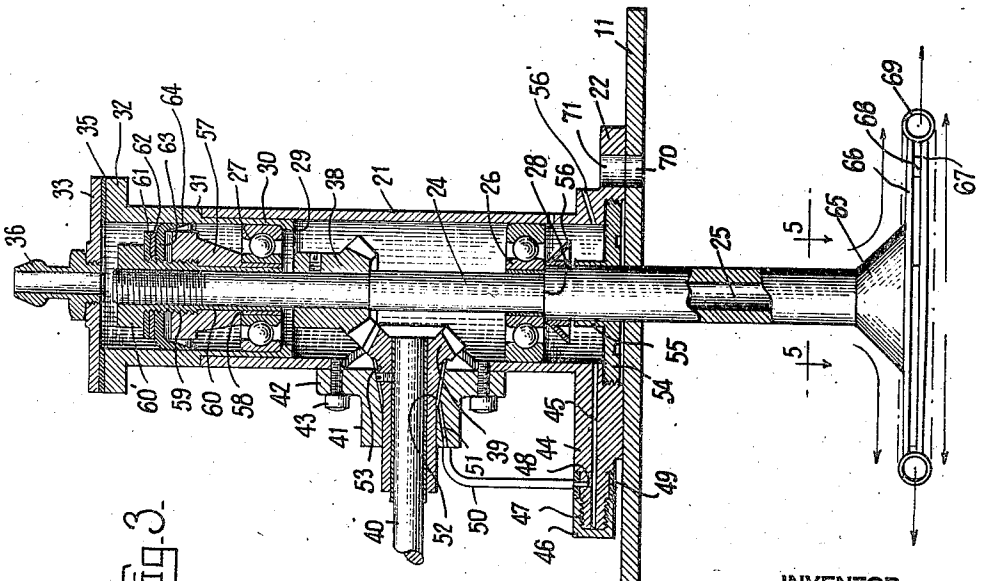

Fig. 3.

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UNITED STATES PATENT OFFICE

2,114,884

VACUUM PUMP

Axel E. Landerholm, New York, N. Y.

Application September 11, 1936, Serial No. 100,260

12 Claims. (Cl. 230—108)

This invention relates to pumps and has particular reference to a new and useful improvement in pumps for evacuating receptacles, and is especially intended to evacuate air and gases from containers.

A main object of the invention is to provide a simple, efficient, high speed pump adapted to remove gases from receptacles containing the same.

A further object is to provide a simple and efficient form of impeller which, when driven at high speed, will remove the gas from the container with speed and efficiency.

A still further object is to provide a simple and efficient device whereby the high-speed parts are kept in quiet working condition through efficient lubrication.

Further and more specific objects, features, and advantages will more clearly appear from a consideration of the specification hereinafter when taken in connection with the accompanying drawings which form part of the specification and which illustrate a present preferred form of the invention.

In considering the invention broadly and briefly, it is to be noted that a hollow high speed shaft is connected at one end to the receptacle to be evacuated and at the other end dips into a container below the level of fluid therein especially when the fluid is a liquid. The shaft is rotated at high speed and on its lower end beneath the surface of the fluid there is disposed a high speed propeller or impeller comprising a rotating chamber preferably circular in form connected to the lower end of the passage in the hollow shaft and having around its periphery a toroidal-shaped element which assists materially in the propulsion of the fluid with respect to the impeller in such a manner that the gas in the system is most effectively drawn out. Preferably in one form the toroidal element is in the form of a helical spring wrapped around the periphery of the rotating suction chamber at the bottom of the shaft. The elements of the toroidal element are disposed each to extend outwardly from the periphery of the chamber in a somewhat radial direction and in one form may be also of ring-like formation and act as wings spaced apart which divide up the stream of fluid into a plurality of separate streams of mixed gas and fluid to more rapidly discharge them through the centrifugal action of the rapidly rotating impeller unit.

The invention also concerns a simple construction whereby the high-speed parts such as gears and bearings are continuously and effectively lubricated and whereby the lubricating fluid is kept in constant and efficient circulation for use over an extended period of time.

The present preferred form of the invention is illustrated in the drawings of which

Fig. 1 is a plan view of the apparatus, partly broken away;

Fig. 2 is a side elevation thereof, partly broken away;

Fig. 3 is a vertical section taken on the line 3—3 of Fig. 1;

Fig. 4 is a plan detail of the fluid propelling means; and,

Fig. 5 is a cross section taken on the line 5—5 of Fig. 3, with a portion broken away.

As shown in the drawings, the present preferred form of the invention includes an electric motor 10 fastened to a base plate 11, which is attached to a curved clamp element 12, enabling the plate 1 to be adjustably fastened to a support such as a table 13 by means of the adjustment of the set screw 14. A portion of the plate 11 extends beyond the end of the support 13, and on its underside has a series of adjustable elements such as screws 15 which can be adjusted to clamp a flange 16 against the lower face of the plate 11. This flange 16 is on the upper face of a receptacle 17 in the form of a glass or other container shown as square in shape altho that may be varied as desired. This container holds a fluid such as water disposed therein up to a predetermined level. Above the fluid level is disposed a screen 19 resting upon a flange or shoulder 20 formed in the inner wall of the container 17 in any desired manner.

On the upper side of the extension of the plate 11 there is disposed a casing 21 having a flange 22 at the bottom which is fastened to the support or plate 11 by means of screws 23. Within this casing or shell 21 there is disposed a vertical shaft 24 having a continuous bore 25 therein from one end to the other. This shaft 24 is journalled at two points in ball bearing units 26 and 27 disposed at spaced points within the casing 21. The lower bearing unit 26 bears against a shoulder 28 on the shaft 24. The upper bearing unit 27 rests on an inturned shoulder 29 at the lower end of sleeve 30 dependent within the upper end of the casing 21. This sleeve 30 has a shoulder 31 resting on the top edge of the casing 21. A flange 32 on the top of the sleeve 30 forms a support for a cap plate 33 which may be fastened in position by means of bolts 34 with a gasket 35 between it and the flange 32. A nipple 36 provides a passage into the top of the casing 21

and may be connected by a flexible pipe 37 to any desired receptacle (not shown) which is to be evacuated.

Keyed to the shaft 24 just below the ball-bearing unit 27 is a bevel gear 38, meshing with a bevel gear 39 keyed to a shaft 40, journalled in a bearing sleeve 41 mounted on a plate 42 fastened by means of screws 43 to the side of the casing 21. Extending laterally from the bottom of the casing 21 is a tubular member 44 having an oil passage 45 connected at one end to the interior of the casing 21 at the bottom thereof. The outer end of this oil tube 44 is closed by a cap 46 which cooperates with screw threads 47 on the end of the tube 44. A lateral passage 48 through the tube 44 and an auxiliary tube 49 connects to a pipe 50, the upper end of which connects to a bore 51 leading to a sloping groove 52 in the sleeve 41 adjacent the flaring surface 53 of the bevel gear 39.

The bottom of the casing 21 is closed by a screw threaded plug disk 54 having a snug fit with the shaft 24 through the integral sleeve 55. Above the sleeve 55 there is tightly fitted on the shaft 24 a metal cap 56 which slopes outwardly and downwardly to prevent oil which runs down to the bottom of the casing 21 from escaping along the shaft 24.

Above the ball-bearing unit 27 there is disposed a plug 57 having a dependent sleeve 58 embraced by the inner member of the bearing unit. This plug engages threads 59 on a nut having a dependent sleeve 60 also embraced by the unit 27. The upper end of the nut has a cap flange 60' below which are disposed washers 61 and 62 and a valve gasket 63 of material such as leather or similar material having an outer end flared downwardly and bearing resiliently against the inner wall of the upper end of the casing 21 to prevent any air from getting from below the valve or gasket 63 to a point above within the casing 21.

The lower end of the shaft 24 is outwardly and downwardly flared as at 65 and to it is connected a circular plate or disk 66. Spaced from and below the plate 66 is another plate 67. The two plates 66 and 67 are connected by means of rivets through the intermediary of curved wing-like elements such as baffles 68 acting as spacers and also, by reason of their curvature, acting as impellers to throw out any fluid which is disposed between the two plates in the operation of the pump. The bore 25 in the shaft 24 opens into the space between these two plates 66 and 67. Around the periphery of the two spaced plates 66 and 67 is disposed a close-coiled helical spring member 69. The disposition of this spring member 69 is such that its elements form a series of outwardly extending wings extending outwardly from the periphery of the plates 66 and 67 in a somewhat radial direction for the purpose of splitting up the flow of fluid outwardly from between the plates 66 and 67 and from the top and bottom of the unit formed by these two plates 66 and 67.

In the operation of the pump the shaft 40 is driven by and connected to the motor 10. This action rotates the gear 39 and the gear 38, turning the shaft 24, and with it the propeller unit at the bottom of the shaft 24 comprising the plates 66 and 67 and the spring member 69. The rotation of the gear 39 due to the tapered or flared shank 53 will cause a centrifugal action on the oil thereon tending to throw the oil upwardly and downwardly from the gear to lubricate the gear 38, the ball-bearing unit 27 and the ball-bearing unit 26. This action will also suck in oil through the pipe 50 from the oil passage 45 into which the oil passes from the oil chamber at the bottom of the casing 21. The cape or apron 56 will allow the oil to pass to the bottom of the casing 21 but will prevent it from escaping along the shaft 24. This apron 56 will rotate with the shaft 24. The casing 21 is provided with an oil vent 56' near the bottom thereof and the outer end of this vent is on a level just below the top of the sleeve 55 so that oil will flow through the vent before it will rise above the top of said sleeve. This vent will also provide means for adding more oil to the system when needed.

At the bottom of the shaft 24 the propelling unit comprising the plates 66 and 67 and the spring 69 will rotate at high speed and the centrifugal action thereby set up will violently throw outward the water of fluid in the receptacle 17. This outward movement of the liquid in the vessel will act as a source of suction on the lower end of the passage 25 in the shaft 24 and will suck the fluid in the passage down to its lower end where it will be violently thrown out by the centrifugal action. This action will thus gradually draw from the vessel being evacuated through the pipe 37 a steady flow of the fluid which it is desired to extract from its interior. The bottom plate 67 is provided with a series of holes 67' therein disposed off center and adapted to improve the flow of the fluid from the bottom of the receptacle up through the holes 67' to the space between the plates 66 and 67 and then outwardly under the centrifugal action above mentioned. This movement of the fluid will enhance the withdrawal of the gas from the pipe 37.

In observing the action of the spring 69 it is well to note, from a consideration of Figs. 2, 3, 4, and 5, that the spring turns act as a series of wing-like elements extending outwardly from the periphery of the rotating plate unit and that they assist in providing separate paths or channels through which the fluid passes in flowing outwardly from the center of the rotating system. It will also be observed that the area between the turn sections at the inner edge of the spring is less than between the same turns at the outer edge of the spring. Therefore the stream of fluid and entrapped gas which is being pumped out enters an expanding channel in which the stream of fluid is moving fastest at the very edge of the plates so as to give there the greatest sucking action. As the fluid and the entrapped gas is thrown off by the rotating unit it enters the body of the fluid in the receptacle 17 and the gas passes upward out of the fluid and passes out of the receptacle 17 through the holes 70 in the plate 11 aligned with similar holes 71 in the flange 22 to allow the escape of the gas. It will also be observed that to some extent that fact that the spring diameter is larger than the width between the plates 66 and 67 will, due to the high speed rotation of the plates 66 and 67, cause some of the fluid at least to have to pass off the plates 66 and 67 by passing over and under the tops and bottoms of the turns of the spring 69 and therefore these two streams at least will present a flaring relation or direction with respect to each other, so as to further enhance the flaring or increasing area of the space between the inner edges of the spring turns and the outer edges of the turns. These various factors are

such as to contribute to an efficient pumping action with a construction of impeller which is exceedingly simple and easily repaired and replaced and removed for adjustment and cleaning.

The high-speed rotating plates 66 and 67 form a sort of rotating suction chamber which by centrifugal action acts as a suction device to draw out the fluid or gas in the hollow shaft and to discharge it most efficiently into the liquid in the vessel 17 through the intermediary of the toroidal member such as the helical spring 69.

While the invention has been described in detail and with respect to a present preferred form thereof, it is not to be limited to such details and forms since many changes and modifications may be made in the invention without departing from the spirit and scope of the invention in its broadest aspects. Hence it is desired to cover any and all forms and modifications of the invention which may come within the language or scope of any one or more of the appended claims.

What I claim is:

1. A pump which includes a hollow rotating shaft, a circular chamber disposed at one end of the shaft and connected to the interior thereof, said chamber having a peripheral slot therein, and means including a series of outwardly extending wing-like elements disposed around the periphery of the chamber to assist in centrifugally discharging fluids from the chamber as it rotates, said elements lying adjacent said peripheral slot.

2. A pump which includes a hollow rotating shaft, a circular chamber disposed at one end of the shaft and connected to the interior thereof, said chamber having a peripheral slot therein, and a helical spring disposed peripherally around the chamber and lying adjacent said slot.

3. A pump which includes a hollow rotating shaft, a chamber disposed at one end of the shaft and connected to the interior thereof, said chamber having a peripheral slot therein, and a helical spring disposed peripherally around the chamber and lying adjacent said slot.

4. A pump which includes a hollow rotating shaft, a pair of plates spaced apart to form a chamber, said chamber connected to the interior of the shaft, said plates supported on and rotating with the shaft, and a helical spring disposed around the periphery of the plates and lying in the space formed between said plates.

5. A pump which includes a hollow rotating shaft, a pair of circular plates spaced apart to form a chamber and supported from and rotating with said shaft, and a helical spring disposed peripherally around the edge of said plates and lying in the space formed between the peripheral edges of said plates.

6. A pump which includes a hollow rotating shaft, a plate fastened to one end of the shaft and at right angles thereto, a second plate disposed parallel to the first plate and spaced slightly therefrom to form a chamber therebetween, means to connect said plates, the chamber between the plates being connected to the interior of the shaft, and a helical spring disposed around the periphery of the plates and lying in the space formed between the plates.

7. A pump which includes a hollow rotating shaft, one end of which is connected to a receptacle from which fluid is to be evacuated, a body of liquid into which the other end of the shaft projects, a chamber mounted on the last named end of the shaft and having peripheral openings therein, and an impeller of toroidal shape disposed around the periphery of the chamber.

8. A pump which includes a rotating chamber element having a peripheral discharge opening and a helical spring disposed in toroidal fashion around and adjacent said opening.

9. A pump which includes a rotating member having an annular discharge opening, and a series of wing-like elements extending outwardly from said opening, said elements disposed around and adjacent said opening.

10. A pump which includes a rotating member having an annular discharge opening, and a series of wing-like, ring-shaped elements extending outwardly from said opening, said elements disposed around and adjacent said opening.

11. In a pump, a pair of rotating parallel spaced plates, a plurality of sector-shaped elements disposed between said plates and connected thereto to hold them in their spaced relation, said elements acting to throw off and out any fluid disposed between the plates, and a helical spring disposed peripherally around the edges of the plates and lying in the space between the edges of the plates.

12. In a pump, a pair of rotating spaced plates, a plurality of sector-shaped elements disposed between said plates and connected thereto to hold them in their spaced relation, said elements acting to throw off and out any fluid disposed between the plates, and a helical spring peripherally disposed around the edges of the plates and lying in the space between the edges of the plates, a shaft connected at right angles to the center of one of the plates, said shaft being hollow, the passage in the shaft being opened to the space between the plates.

AXEL E. LANDERHOLM.