No. 631,469. Patented Aug. 22, 1899.

F. G. LUNDWALL.

CENTRIFUGAL PUMP.

(Application filed Feb. 25, 1899.)

(No Model.)

Fig. 1.

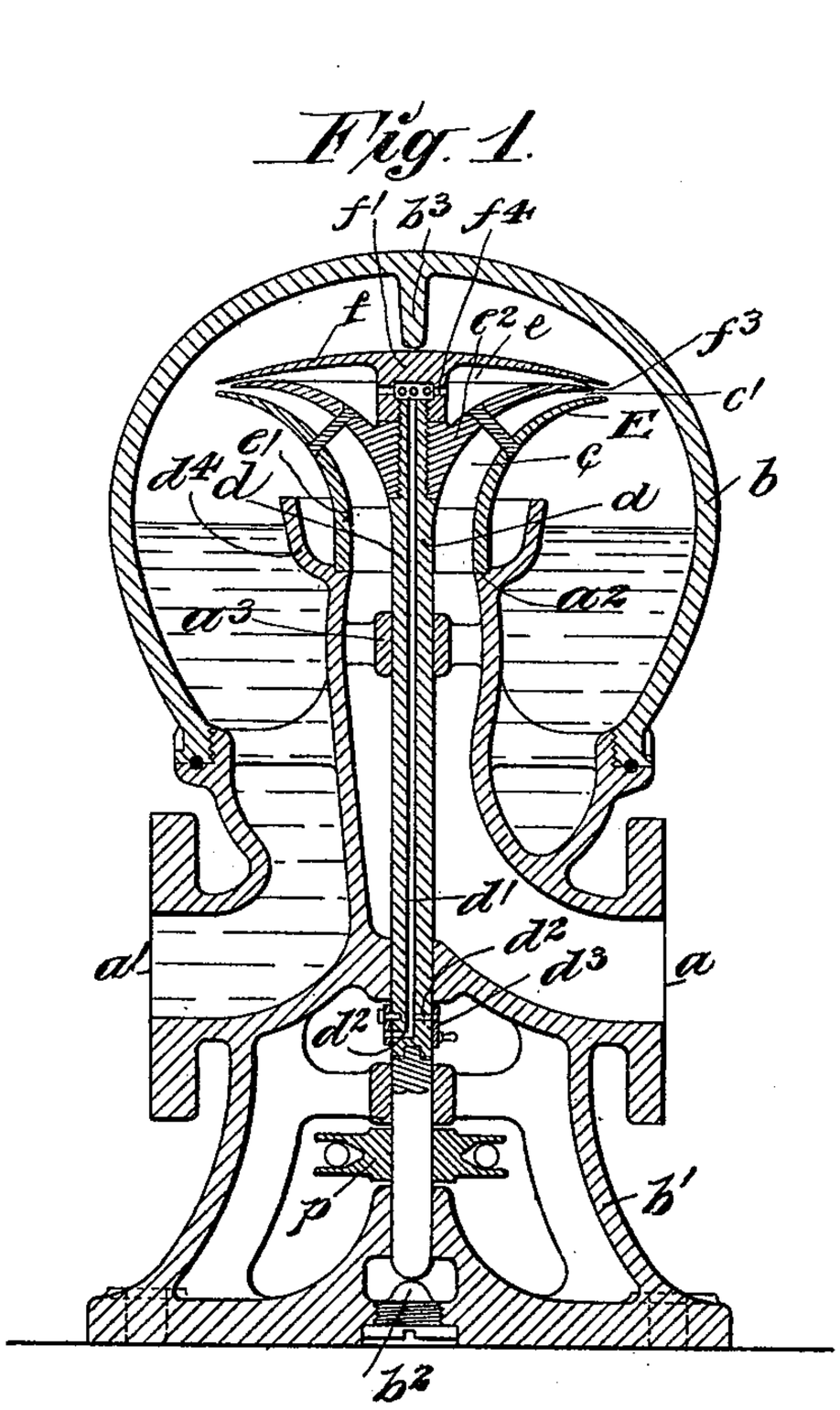
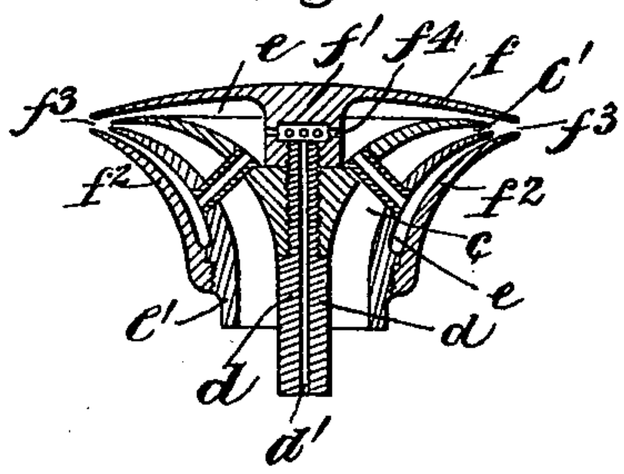


Fig. 2.



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CENTRIFUGAL PUMP.

SPECIFICATION forming part of Letters Patent No. 631,469, dated August 22, 1899.

Application filed February 25, 1899. Serial No. 706,825. (No model.)

To all whom it may concern:

Be it known that I, FRITZ GUSTAF LUNDWALL, engineer, a subject of the King of Sweden and Norway, residing at Helleforsnäs, Sweden, have invented certain new and useful Improvements in Centrifugal Pumps; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

My invention has relation to centrifugal pumps; and it has for its object a construction of pump by which its efficiency is increased and its dimensions or bulk considerably reduced.

In centrifugal pumps, whether of that type in which the pumping-wheel is submerged or in the type in which the said wheel revolves in an air-space in the pump body or chamber, it has been proposed to admit air to said pump-chamber, which by reason of level variations is compressed and caused to act upon the liquid to increase the velocity of its outflow. This principle has more generally been applied to centrifugal pumps in which the pumping-wheel is not submerged in liquid; but in either case it has been found difficult to so regulate the volume of air admitted or drawn into the pump-chamber as to prevent the liquid therein from rising to the pumping-wheel and submerging the same, thereby necessitating an increase of motive power.

This invention is designed to overcome the difficulties referred to, and this I attain by means of a duplex pumping-wheel and the provision of means whereby said wheel may pump different fluids from different points outside of the pump and deliver the same, separately or admixed, into the pump-chamber. By this means the volume of air drawn into the pump by the pumping-wheel is at all times in proportion to the volume of liquid drawn in by the same wheel, and if the relations between the air and liquid pumps are once adjusted the volume of air drawn into the pump-chamber will be uniform and sufficient to prevent the water in said chamber from rising to the wheel whatever the speed of rotation of the latter may be.

In order that the efficiency of the air-pump may be increased to the maximum, I preferably so construct the duplex pumping-wheel as that the liquid discharged therefrom will assist in the suction of the air, and this I accomplish by so constructing and arranging the outlet of the passage for liquid and the outlet of the passage for air as that the former will practically constitute a continuation of the latter or so that the outlet for the liquid will be contained within the outlet for air, whereby the passage for liquid performs the function of an injector, and thereby increases the quantity of air drawn in as the pumping-wheel revolves.

The invention has also for its object a pump provided with a duplex pump-wheel, such as above referred to, which can be adapted to various uses—as, for instance, for pumping fluid generally or as a vacuum-pump, with the pumping-wheel submerged or not, as may be found desirable, and to these ends it is important that means should be provided for regulating the amount of air, for instance, drawn or pumped into the pump-chamber. This I accomplish by providing means for varying the cross-sectional area of the air outlet or nozzle and by regulating the admission of air to the air-pump.

By the means above outlined I am enabled to produce a light, compact, and easily-operated centrifugal pump of great efficiency.

That my invention may be fully understood, I will describe the same in detail, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical axial section of a pump constructed in accordance with my invention, showing the nozzle or outlet for liquid of the duplex pumping-wheel as forming a continuation of the nozzle or outlet for air; and Fig. 2 is a similar section of the duplex pumping-wheel, showing the nozzle or outlet for liquid as contained in the nozzle or outlet for air.

In said drawings I have shown the pump-body as of pear shape, or substantially so, this form being recognized as the most efficient in that it presents no angles to the flow of fluids therethrough, and it is composed of two parts,

the pump-chamber proper, b, and a base b', detachably connected together, and in said base b' are formed the suction and discharge branches a and a', respectively. The suction branch a is extended axially into the pump-chamber b and has in its upper enlarged end an offset, forming a bearing a^2, and near the latter a central bearing-sleeve a^3 for the driving-shaft d, stepped on a step b^2, arranged on the base b'. The driving-shaft d projects above the upper end of the suction-pipe a, and said upper end of the shaft d is for a portion of its length of reduced diameter to form a bearing-shoulder for the duplex pumping-wheel E. The shaft d has an axial passage d' extending from a point below where it passes through a bearing in the suction-pipe to its upper end, the lower end of said passage communicating with the atmosphere through radial passages d^2, adapted to be closed or more or less closed by a sliding sleeve d^3, provided with a handle and having apertures adapted to be moved into and out of register with said radial passages. The driving-shaft d carries a driving-pulley p, driven from any suitable prime mover.

The duplex pumping-wheel E consists of a shell e', having a cylindrical body the walls of which flare outwardly, or, in other words, the shell is trumpet-shaped and is adapted to seat squarely on the bearing a^2 in the upper enlarged end of the suction-pipe a. Within the shell e' is secured a hub e^2 of the same shape as said shell and in such a manner as to form between them a circular passage, the cross-sectional area of which gradually increases from the rim or perimeter of the flaring portion of the two parts and which constitutes the nozzle or outlet c' to the inlet of said passage or approximately to said inlet, which forms a continuation of the bore of the suction-pipe a. The hub e^2 of the wheel E is bored out to receive the upper attenuated portion of the driving-shaft d, to which it may be screwed, as shown, and having bearing on the shoulder formed by the parts of different diameter of said shaft, so that the wheel can be so supported from the shaft as to seat very lightly on the bearing a^2, and as the suction-pipe is enlarged about said bearing a cup d^4 is formed to hold liquid, thus providing a liquid seal for the contacting bearing-faces, the liquid acting at the same time as a lubricant, and in view of the general form of the wheel and of the fact that there is but slight resistance offered to its rotation in the pump-chamber but very little power is required to drive said wheel, as will be readily understood. The shaft d extends through the hub of the wheel E, and owing to the configuration of said hub—namely, its outwardly-flaring portion—there is a cavity e formed in its upper face, which constitutes the air-chamber for the air-pumping portion of the wheel. This cavity is covered by a concavo-convex disk f, the thickness of which is gradually reduced from its hub f' to its outer edge or perimeter. The diameter of the disk f is the same as the greatest diameter of the wheel-shell e', while the greatest diameter of the wheel-hub is slightly less, and said disk f is so secured to the shaft d as to form a narrow annular slot f^3 between it and the rim of the flaring portion of the wheel-hub, which slot constitutes the nozzle or outlet for the air, and so as to form a similar but wider slot c' between its perimeter and that of the flaring portion of the shell e', which slot constitutes the nozzle or outlet for liquid, as shown in Fig. 1. The hub f' of disk f is screwed to the upper end of the shaft d and is chambered in its inner face, said chamber communicating with the air-passage d' in the shaft, and from said chamber lead radial passages f^4, through which the air pumped in passes from the shaft to the air-chamber e of the air-pumping portion of the pumping-wheel, from which it is ejected by centrifugal action through the circular nozzle f^3.

It will readily be seen that when the wheel E is revolved a partial vacuum will be formed both in the suction-pipe a and in the air-passage in shaft d, so that air and liquid are both drawn in and forced into the pump-chamber b, and as the circular nozzle c' lies in advance of the like nozzle f^3 the jet of water materially increases the suction-power of the centrifugal air-pump, so that the quantity of air forced into the pump-chamber is at all times proportioned to the quantity of liquid forced into and flowing out of said chamber, whereby the level of the liquid therein is prevented from rising to such an extent as to flood the sealing-cup d^4.

Inasmuch as the frictional resistance of the shaft in its bearings is comparatively slight, and in view of the fact that the pumping-wheel practically rotates upon a liquid packing or bearing and is entirely free from angular faces, but is, on the contrary, so constructed that the resistance exerted thereon by the air in the pump-chamber b is reduced to a minimum, the pump can be operated with a great economy in power and driven at a very high speed.

It is obvious that by more or less unscrewing the disk f from shaft d the cross-sectional area of the air-nozzle f^3 will be correspondingly increased, and to prevent vertical displacement of the driving-shaft, and hence of the pumping-wheel, relatively to its bearing on the suction-pipe, I provide an abutment b^3, projecting centrally from the pump-chamber b close to the upper face of the disk f.

The injector action of the liquid forcing and ejecting nozzle c' of the pumping-wheel may be considerably increased by inclosing said nozzle within the air forcing and ejecting nozzle f^3, as shown in Fig. 2, in which case the disk f is made of greater diameter than the diameter of the liquid lifting and ejecting nozzle c', and a supplementary flar-

ing shell f^2 is provided and so connected with the pumping-wheel shell e' as to be adjustable toward and from said disk, as by screwing the supplemental shell f^2 to said pumping-wheel shell, as shown. The greatest diameter of the supplemental shell f^2 is the same as the like diameter of the disk f, so that the liquid lifting and ejecting nozzle will be contained within the air lifting and ejecting nozzle, while the air-chamber e will completely encompass the flaring portion of the pumping-wheel shell e', whereby the capacity of said chamber is considerably increased.

I do not of course limit myself to any specific means of connecting the duplex pumping-wheel with the driving-shaft nor to the specific form of pumping-chamber shown and described, as these may be varied in many ways without departing from the nature of my invention.

I have hereinbefore stated, and it will be readily understood from the description of the construction and operation of the pump, that the latter is adapted to the purposes of pumping fluids generally, and this whether the pumping-wheel is submerged or not, and that said pump is also adapted for use as a vacuum-pump, and may therefore be readily used for exhausting electric-lamp bulbs or other bodies in which a substantially perfect vacuum is to be established, especially as there is nothing to prevent in this operation the use of a heavy liquid, such as mercury. It will also be observed that when the duplex pumping-wheel is constructed as described in reference to Fig. 1 there is practically no admixture of the air with the liquid, the two fluids being forced into the pump-chamber in substantially superposed strata, while in the construction shown in Fig. 2 the air becomes more or less mixed with the liquid and is liberated therefrom after the two fluids pass into the pump-chamber.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. In a centrifugal pump, the combination with a suitable pump body or chamber, of a duplex centrifugal pumping-wheel organized to draw different fluids from different sources of supply outside of the pump-chamber and force them into the latter and having separate passages in communication with said sources of supply, said passages terminating in circular concentrically-disposed discharge-nozzles, for the purpose set forth.

2. In a centrifugal pump, the combination with a suitable pump body or chamber having a suction-pipe extending vertically into said chamber, of a duplex centrifugal pumping-wheel revoluble on said suction-pipe and provided with separate passages one of which is in communication with said suction-pipe and the other with the atmosphere, said passages terminating in circular discharge-nozzles, for the purpose set forth.

3. In a centrifugal pump, the combination with a suitable pump body or chamber having a suction-pipe extending vertically and axially thereinto, said pipe having its upper end enlarged and provided with a circular bearing-face at the upper end of its narrower portion, and a driving-shaft extending axially through said suction-pipe and provided with an air-passage in communication with the atmosphere outside the pump-chamber; of a trumpet-shaped duplex pumping-wheel carried by the aforesaid shaft and revoluble in the bearing on the suction-pipe, said wheel having two circular passages, one for liquid and one for air communicating respectively with the suction-pipe and with the axial passage in the driving-shaft, for the purpose set forth.

4. In a centrifugal pump, the combination with a suitable pump body or chamber having a suction-pipe extending vertically and axially thereinto, said pipe having its upper end enlarged and provided with a circular bearing-face at the upper end of its narrower portion, and a driving-shaft extending axially through said suction-pipe and provided with an air-passage in communication with the atmosphere outside the pump-chamber and means for regulating the flow of air through said passage; of a trumpet-shaped duplex pumping-wheel carried by the aforesaid shaft and revoluble in the bearing on the suction-pipe, said wheel having two circular passages one for liquid and one for air communicating respectively with the suction-pipe and with the axial passage in the driving-shaft, for the purpose set forth.

5. A duplex trumpet-shaped pumping-wheel for centrifugal pumps having separate passages for liquid and air terminating in circular discharge-nozzles, for the purpose set forth.

6. A duplex trumpet-shaped pumping-wheel for centrifugal pumps having separate passages for liquid and air terminating in circular concentrically-disposed discharge-nozzles, for the purpose set forth.

7. A duplex trumpet-shaped pumping-wheel for centrifugal pumps having separate passages for liquid and air terminating in circular discharge-nozzles and means for varying the cross-sectional area of the air-discharge nozzle, for the purpose set forth.

8. A duplex pumping-wheel for centrifugal pumps composed of two concentric trumpet-shaped bodies consisting of an outer shell and an inner solid body arranged to form between them a circular through-passage of gradually-increasing cross-sectional area from the perimeter of the flaring portions or outlet of said passage to the inlet thereof, and of a disk arranged above the cavity in the upper face of the inner body so as to form a narrow circular passage f^3 between the upper face of said inner body about the perimeter of the flaring portion thereof and to

form with the perimeter of the flaring portion of the outer shell a similar passage c' in advance or outside of said passage f^3, said inner body provided with a through-passage in communication with the aforesaid cavity in its upper face, for the purpose set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

FRITZ GUSTAF LUNDWALL.

Witnesses:
KONR. DAHLQVIST,
M. GENBERG.