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AIRLIFT PUMPS WITH VALVING BAFFLES

Filed April 22, 1958

Fig-1

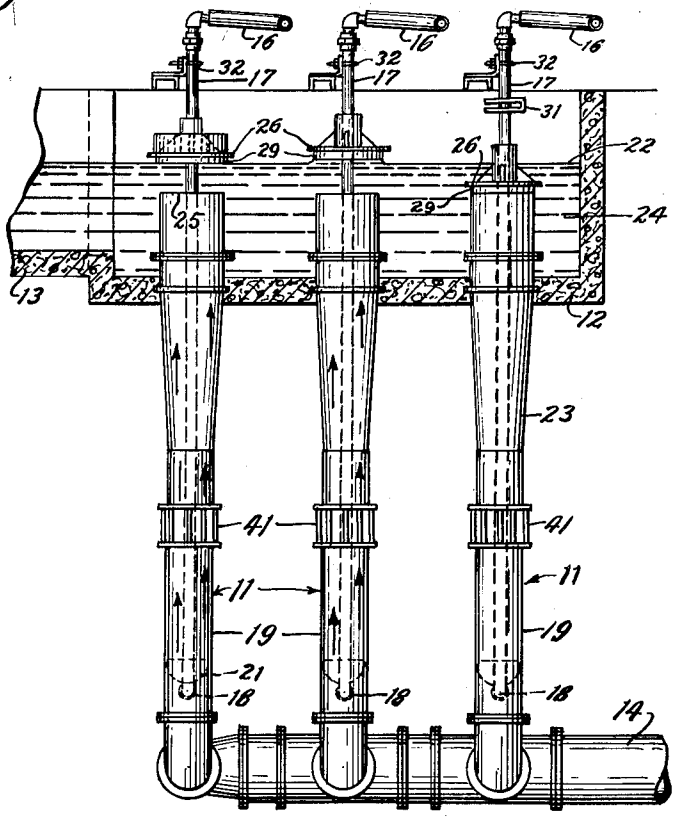


Fig-2

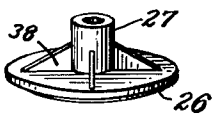


Fig-3

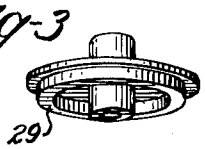
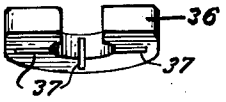


Fig-4



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AIRLIFT PUMPS WITH VALVING BAFFLES

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Airlift pumps have been known for many years and have been recognized as much more desirable for some situations than the more common pump with moving parts. When liquid only needs to be lifted a short distance, it can quite often be pumped most efficiently by an airlift pump.

In a typical airlift pump situation, a vertical updraft tube may extend down perhaps 12 or 13 feet below the level of the liquid to be pumped. Near the bottom of the updraft tube, air is liberated within the tube so that the air can rise up through the tube. The buoyancy of the air causes the water in the tube to be raised with it, the actual raising force of course coming from the pressure of the liquid outside of the tube. There must be enough air in the column of water within the tube at all times so that the denisty within the tube is enough less than the density of the liquid outside of the tube so that even when the water is being raised to the required height the pressure it creates at the bottom of the tube is less than the pressure outside the tube at the same depth. If we consider successively increased heights to which the liquid must be raised, the efficiency becomes lower and lower, unless the tube is correspondingly extended downwardly. Unless nearly seventy percent of the tube is submerged, the efficiency may drop so low as to make this type of pumping undesirable.

When the amount of liquid which needs to be pumped varies from time to time, a special problem arises. A pump of sufficient capacity to handle the maximum volume would not be efficient when continuously operated for a volume of only one quarter of the maximum. Reducing the amount of air supplied to the airlift pump will reduce the amount of which it pumps, but if much reduction is attempted the pumping action will become very unstable or cease altogether.

A plurality of airlift pumps can be provided and it is a very simple matter to shut any pump off at will by discontinuing the air supply. The air supply can be discontinued by turning a manual valve or by an electric valve, and in the latter case the control can be automatic, depending on the volume to be pumped. However, when the air is simply shut off from one of the plurality of pumps, the water raised by the other pumps will flow back through the one shut off unless special steps are taken to prevent this. Of course, the pump discharge openings can be above the level of the water in the receiving basin, but that would require extra lifting by the pump while it is pumping and would therefore result in lower efficiency. Constructing the discharge end of the updraft tube in the form of a vertically sliding sleeve which can be raised and lowered would permit raising the discharge above the water level in the receiving basin when the pumping through a given pump is discontinued. Likewise each pump could deliver to a separate receiving section with a gate that could be closed to prevent backflow into that section. However, such expedients require an extra operation each time a pump is shut off or resumed, and do not lend themselves to simple automatic control.

According to the present invention, the problem is solved by providing a plurality of airlift pumps, each having a simple automatic valving device at its discharge end which prevents backflow of water through the pump

if the air supply to that pump is discontinued. The valving device is preferably a baffle which is raised by the upflowing liquid and is useful in the raised position.

Additional objects and advantages of the invention will be apparent from the following description and from the drawings.

Designation of Figures

FIGURE 1 is a vertical sectional view through a receiving basin showing the side elevation of three airlift pumps incorporating this invention.

FIGURE 2 is a perspective view of a valving baffle shown in FIG. 1.

FIGURE 3 is a perspective view showing the under side of the valving baffle of FIG. 2 to show the gasket thereon.

FIGURE 4 shows a weight which may be applied to the baffle of FIGS. 1, 2 and 3 to give it a slightly greater constricting effect on the flow during pumping, for the purpose of minimizing surges or increasing the speed of lateral flow, or both.

General Description

Although the following disclosure offered for public dissemination is detailed to ensure adequacy and aid understanding, this is not intended to prejudice that purpose of a patent which is to cover each new inventive concept therein no matter how others may later disguise it by variations in form or additions or further improvements. The claims at the end hereof are intended as the chief aid toward this purpose, as it is these that meet the requirement of pointing out the parts, improvements, or combinations in which the inventive concepts are found.

The airlift pumps **11** have been shown in FIG. 1 delivering liquid to a receiving basin **12** from which the liquid flows out through a channel **13**. The liquid being pumped might, for example, be sewage delivered to a plant through an inflow pipe **14**. The airlift pump **11** could also be extending down to a tank from which the liquid is to be raised to the receiving basin **12**.

Air for the airlift pumps is supplied through connection **16** to pipes **17** extending down through the airlift pumps and discharging air through air liberation heads **18**. A desirable way to hold the air liberation heads **18** centered in the main tubes **19** of airlift pumps **11** is to provide fins **21** on air pipes **17**, these fins preferably extending in three directions. Even when no air is supplied to discharge heads **18**, the water should rise within the airlift pumps **11** to a sufficient elevation for the airlift pump to function efficiently. It is preferred that the distance from the discharge heads **18** to the level the liquid seeks be at least seventy percent of the distance from the discharge heads **18** to the surface level **22** in the receiving basin **12**.

Above each of the lower tubes **19** there is preferably a head recovery section **23** which is of gradually enlarging cross sectional area, upwardly. Above each section **23** may be a cylindrical section **24** which preferably has approximately twice the cross sectional area of the main tubes **19**.

The tube sections **19**, **23** and **24** form one continuous tube which is open at its top to form a discharge opening **25** lying in a horizontal plane.

Above each discharge opening is a baffle plate **26**. Such baffle plates are desirable for deflecting the upflowing water to minimize splashing out of receiving basin **12**. Both baffle plates (fixed) and the head recovery feature are credited to Mr. Joseph Cunetta and are not claimed as the invention of the present applicants.

According to the present invention the baffle plates serve an additional function. For this purpose, they

are provided with fairly high collars **27** which have a smooth sliding fit with pipes **17**. Thus the baffles **26** can slide up and down on pipe **17** quite easily. The flow of water up through an airlift pump **11** causes the baffles **26** to rise along pipe **17** to let the water escape through the discharge opening **25**. When the air through any discharge head **18** is discontinued the pumping action of that airlift pump **11** ceases. Its valving baffle **26** drops to close the associated discharge opening **25** so that water will not flow back into this opening.

Each baffle or valve **26** is preferably provided with a gasket **29** on its under face, positioned to engage the rim of discharge opening **25**. Preferably these gaskets are fairly deep and soft so that their compression will compensate for slight departures from true parallelism of the planes of openings **25** and baffles **26**. Foam rubber, preferably with a surface skin, is a suitable material for these gaskets.

Even though the baffles **26** are preferably made of aluminum and are therefore rather light in weight, they have an additional advantage (taught by Joseph Cunetta for fixed baffles) in minimizing surges. During smooth operation they assume a position at which they have little or no retarding effect on the discharge of the pumped liquid. However, their inertia delays them somewhat in rising to a new position in the event of a surge, and therefore the intensity of the surge is slightly diminished. This may increase the average amount of the discharge, since surges are likely to be followed by periods of abnormally low flow.

If desired, the anti-surge effect can be increased by limiting the upward movement of the baffles **26**. Thus on one of the pipes **17** a spring clamp **31**, which can be adjustably positioned after squeezing its free ends to loosen it, has been shown.

The pipes **17** with their heads **18** thereon may be removed for inspection of the heads. Preferably the pipes **17** are normally secured at the proper elevation by a readily releasable clamp **32**.

Some operators may prefer heavier baffles **26**. Accordingly weights **36** may be provided, and they have been illustrated as readily removable. Specifically they are shown as being of **C** shape so that they may be slipped around pipe **17** at a higher level and lowered onto the baffle **26**. Slots **37** in the lower faces of weights **36** are designed to cooperate with stiffening webs **38** on the upper faces of baffles **26** to hold the weights accurately positioned for balance. The weights **36** should be so designed that they will be balanced about the axis of pipe **17** when in place. Under some conditions, particularly when deflection of the upflowing water to a horizontal path increases the speed of flow of water away from the receiving basin **12**, the added weights **36** may improve the overall efficiency in the use of the airlift pumps even aside from reducing surges. Tests may be made at each installation to determine whether efficiency is greatest with or without the weights.

With or without the weights **36** it is apparent that extremely simple, self-valving airlift pumps have been provided so that a plurality of pumps may be provided discharging into a common basin without danger of backflow through one of the pumps if its pumping action is discontinued. Thus the pumping action of each pump may be started and stopped merely by opening and closing its air supply valve. When maximum volume of pumping is required, all three air supply valves can be open and for reduced pumping requirements one or two of the air supply valves may be closed so as to leave only two or only one airlift pump operating.

In the drawings Dresser couplings **41** have been illustrated, the main updraft tubes **19** being in two sections for ease of assembly.

We claim:

1. An airlift pumping assembly including a plurality of airlift pumps, a common receiving basin into which the pumps discharge, each pump including an updraft tube with its upper end open to form a discharge opening lying in a horizontal plane at a level within the receiving basin below an expected or predetermined liquid level therein, means for supplying air within the updraft tubes at a low level in each and a baffle valve for at least one of said airlift tubes of a size to seat on and close the discharge opening thereof and being moveably positioned, and said assembly including means for guiding the baffle valve with respect to the discharge opening of the tube and said baffle valve being biased toward a position in which it closes the discharge opening when the flow of liquid upwardly through that tube ceases, the biasing force being yieldable to upwardly flowing liquid to permit the baffle valve to move to an open position substantially as high as said liquid level, said assembly including means inhibiting upward movement of the baffle valve, causing the baffle valve to stop at a height near said liquid level and substantially nearer to the discharge opening than the height to which the pump would cause the pumped liquid to fountain if unimpeded by the baffle valve, and at which the baffle valve increases the average rate of flow.

2. An airlift pump according to claim 1 in which the baffle-valve is of substantial weight so that its inertia resists surges through the updraft tubes.

3. An airlift pumping assembly including a plurality of airlift pumps, a common receiving basin into which the pumps discharge, each pump including an updraft tube with its upper end open to form a discharge opening lying in a horizontal plane at a level within the receiving basin below an expected or predetermined liquid level therein, means for supplying air within the updraft tubes at a low level in each and a baffle valve for at least one of said airlift tubes of a size to seat on and close the discharge opening thereof and being moveably positioned, and said assembly including means for guiding the baffle valve with respect to the discharge opening of the tube and said baffle valve being biased toward a position in which it closes the discharge opening when the flow of liquid upwardly through that tube ceases, the biasing force being yieldable to upwardly flowing liquid to permit the baffle valve to move to an open position substantially as high as said liquid level, said baffle valve being weighted to inhibit upward movement of the baffle valve causing the baffle valve to stop at a height near said liquid level and substantially nearer to the discharge opening than the height to which the pump would cause the pumped liquid to fountain if unimpeded by the baffle valve, and at which the baffle valve increases the average rate of flow.

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