No. 814,601. PATENTED MAR. 6, 1906.

W. B. HARRIS.

AIR OR GAS LIFT FOR FLUIDS.

APPLICATION FILED SEPT. 23, 1904.

2 SHEETS—SHEET 1.

Fig 2

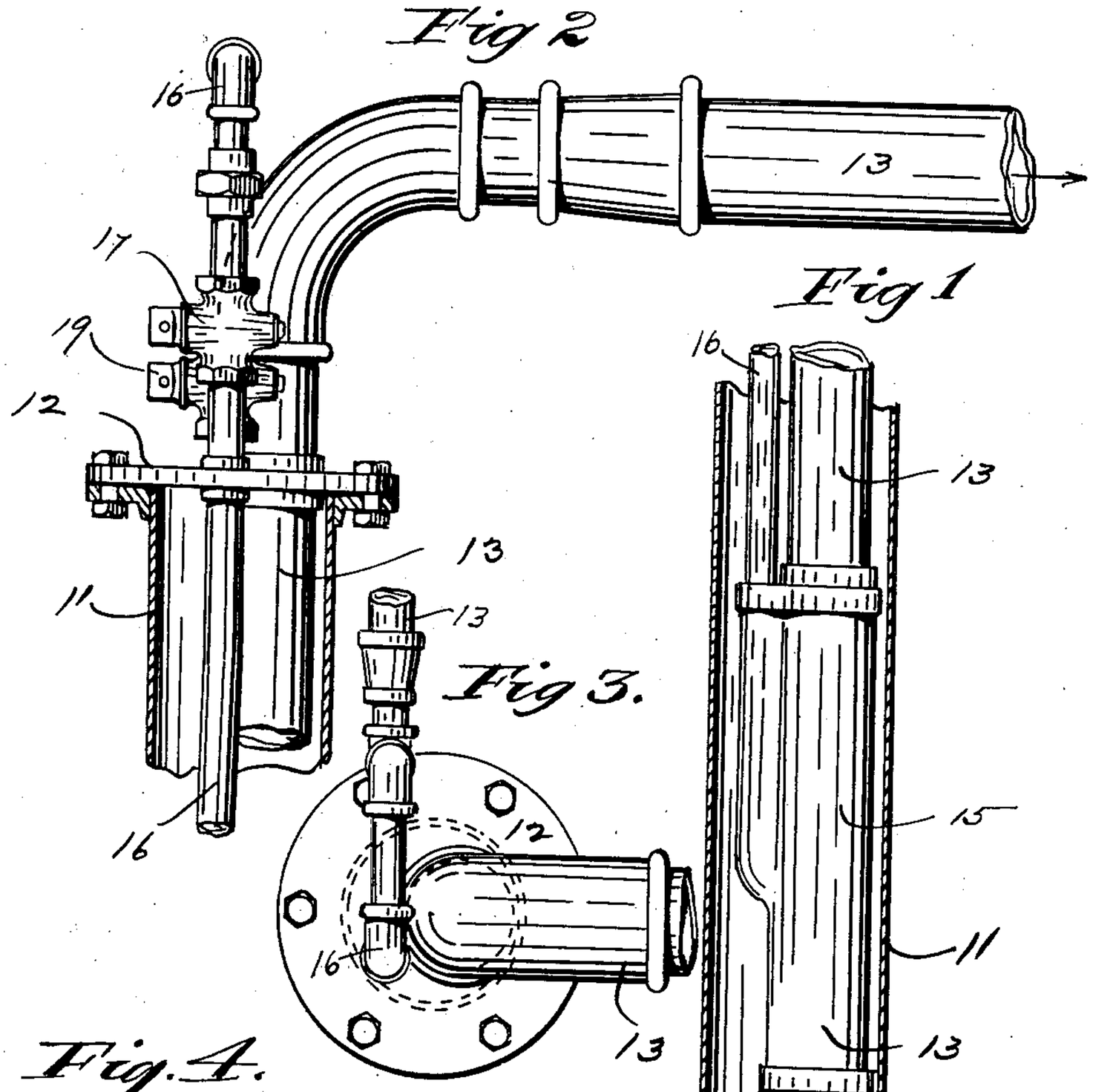

Fig 1

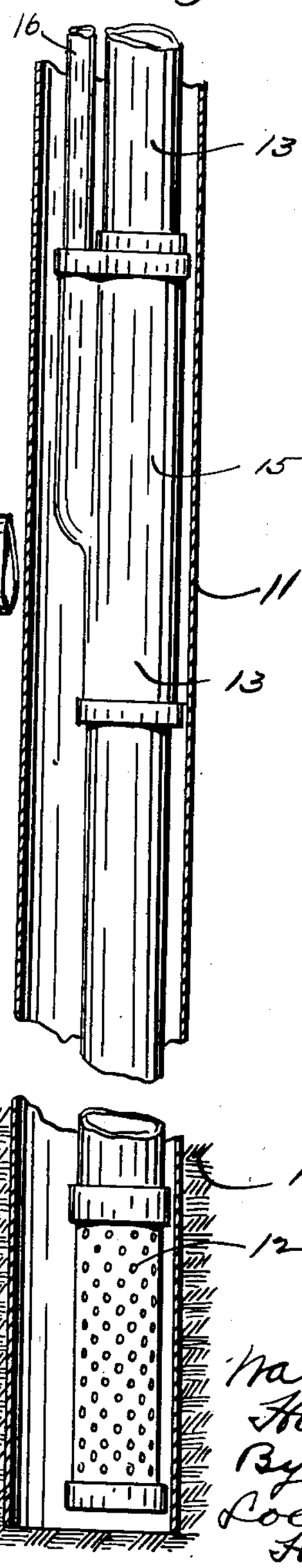

Fig 3.

Fig. 4.

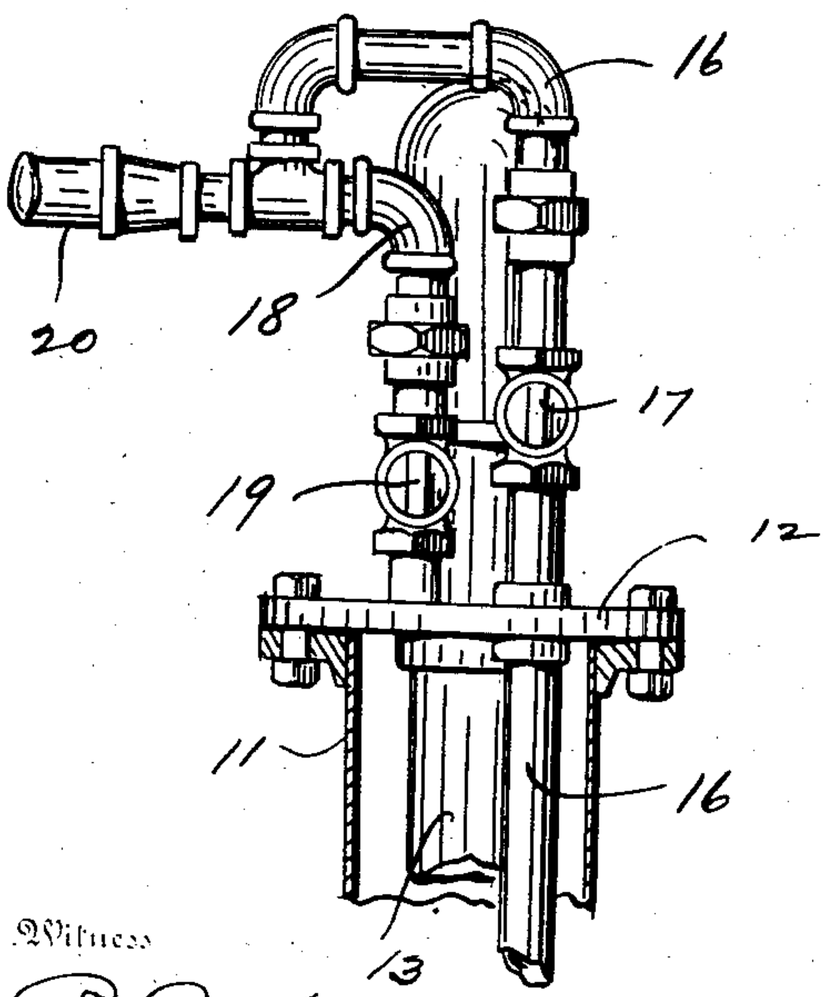

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Fig. 5.

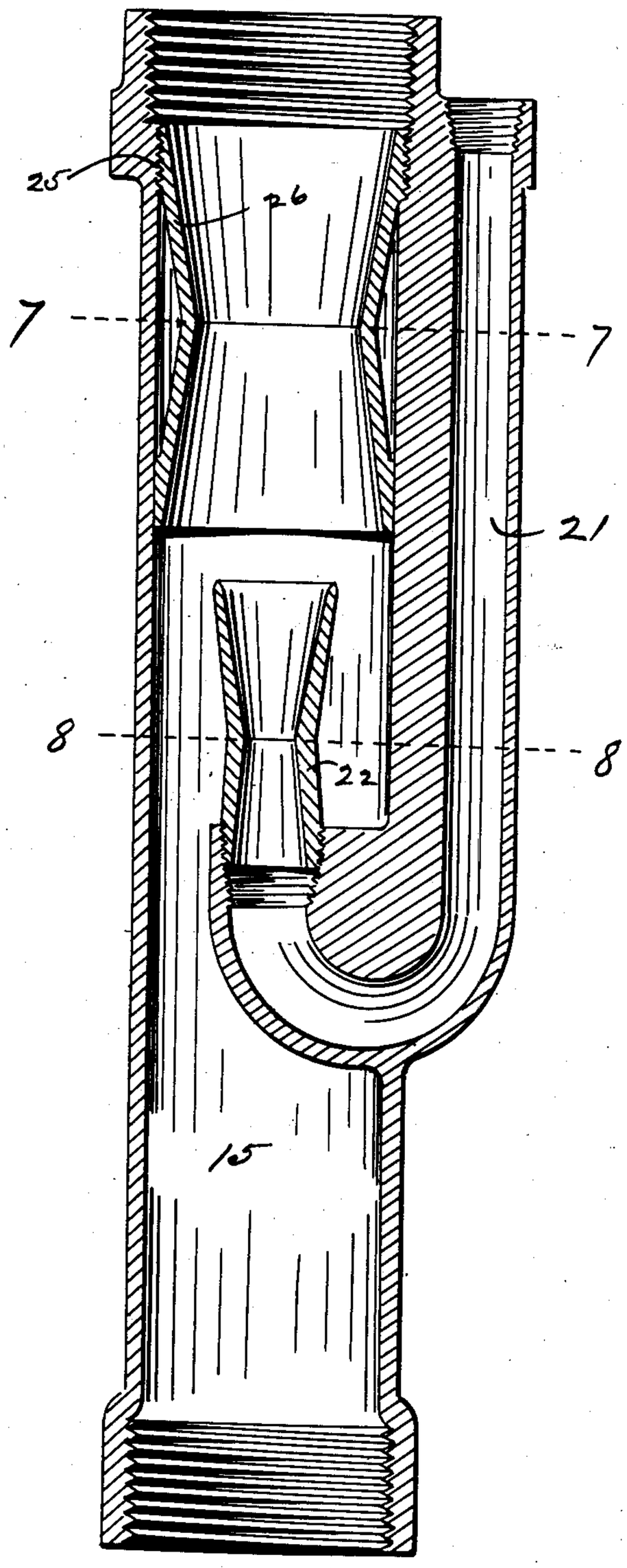


Fig. 6.

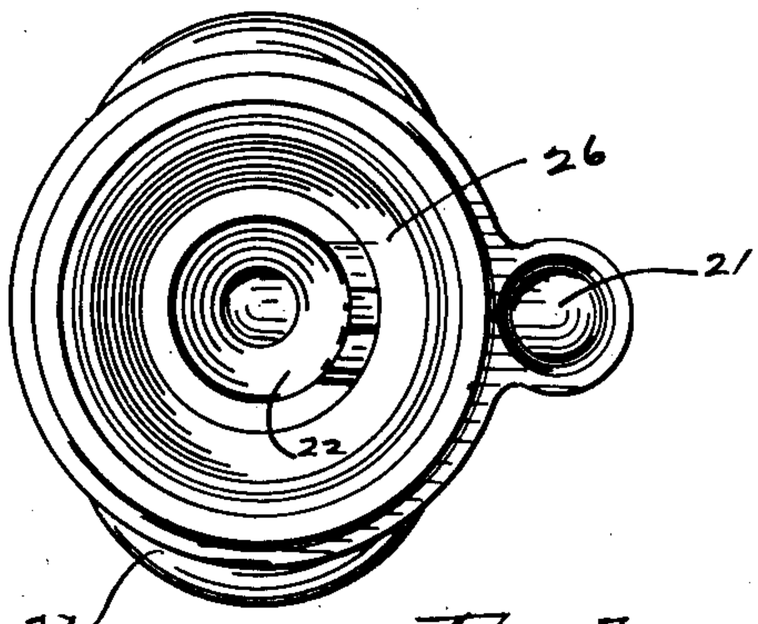


Fig. 7.

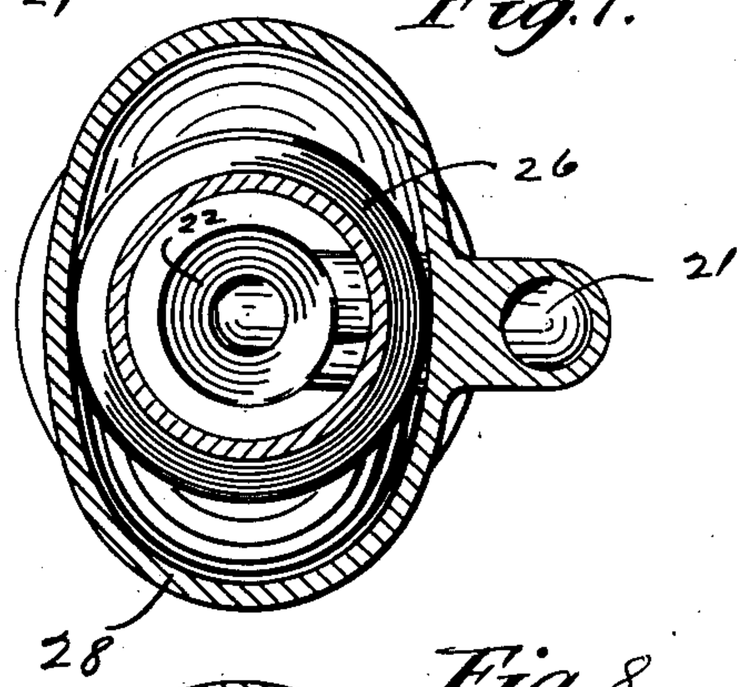
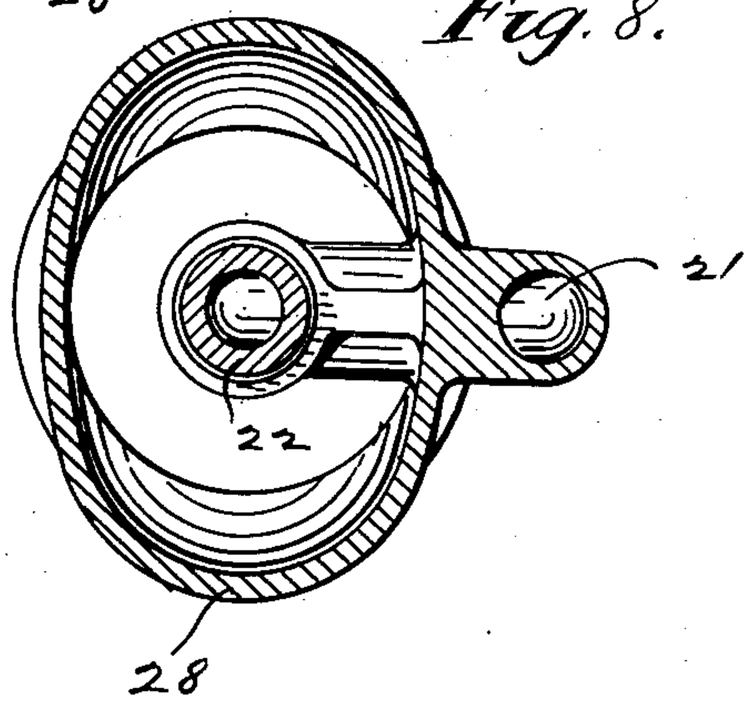


Fig. 8.



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UNITED STATES PATENT OFFICE.

WALTER B. HARRIS, OF INDIANAPOLIS, INDIANA, ASSIGNOR TO HARRIS AIR PUMP COMPANY, OF INDIANAPOLIS, INDIANA, A CORPORATION OF INDIANA.

AIR OR GAS LIFT FOR FLUIDS.

No. 814,601. Specification of Letters Patent. Patented March 6, 1906.

Application filed September 23, 1904. Serial No. 225,721½.

To all whom it may concern:

Be it known that I, WALTER B. HARRIS, of Indianapolis, county of Marion, and State of Indiana, have invented a certain new and useful Air or Gas Lift for Fluids; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which like figures refer to like parts.

This invention relates to improvements on air or gas lifts for fluids shown in patents heretofore granted to me, No. 758,360, dated April 26, 1904; No. 759,100, dated May 3, 1904, and No. 759,706, dated May 10, 1904.

The chief novel features herein lie in the construction of the ejector, the object being to give to the compressed air greater lifting power, so that the water or other fluid will be lifted to a greater height relative to the extent of submergence and the air-pressure employed.

Only one ejector is herein shown and described, although I do not wish to limit myself to the use of one as a number of these ejectors may be used in the manner shown in my previous patents. This particular construction has been employed by me with only one ejector for the purpose of raising water from wells which have a relatively small degree of submergence, and I find that it has an unexpected power of increasing the flow of water from wells as well as increasing the height to which it can be lifted. These features of the invention will be better understood from the accompanying drawings and the following description and claims.

In the drawings, Figure 1 is a central vertical section of the lower part of the well with the lower part of my air or gas lift therein, parts being broken away. Fig. 2 shows the upper part of the same, the upper end of the flow-pipe being in side elevation. Fig. 3 is a plan view of Fig. 2. Fig. 4 is an elevation of what is shown in Fig. 2 looking at the latter from the left-hand side of Fig. 2 and the casing being in vertical section, parts being broken away. Fig. 5 is a central vertical section of the ejector. Fig. 6 is a plan view of the upper end of the ejector. Fig. 7 is a transverse section of the ejector on the line 7 7 of Fig. 5. Fig. 8 is a transverse view of the same on the line 8 8 of Fig. 5.

The drawings show in Fig. 1 the wall 10 at the lower part of a well, with a metal casing 11 inserted therein. A cap 12 is secured over the upper end of said casing in such manner as to render the same air-tight. A flow or outlet pipe 13 is inserted in said casing with the lower end entirely open or provided with a strainer 12. Near the lower end of the flow-pipe and in the lower part of the well the ejector 15 is placed, forming a part of the flow-pipe, the fluid passage-way through the ejector and other sections of the flow-pipe having substantially the same transverse area throughout its length. The upper part of said flow-pipe passes through and is supported by said cap-plate 12. Also a compressed-air pipe 16 extends through the cap-plate 12 down to the ejector for supplying compressed air to said ejector. Said pipe is closed above the well by the valve 17. Another compressed-air pipe 18 extends through the cap-plate 12 into the casing below, the function of this being to supply compressed air to the casing or well for pressing down upon the surface of the water of the well and forcing it up into the flow-pipe 13 through the opening at the bottom of said flow-pipe. A valve 19 is placed in the air-pipe 18. A compressed-air pipe 20 supplies said pipes 16 and 18 with compressed air from any suitable source.

The ejector is constructed as shown in Figs. 5 to 8. An air-tube 21 is cast integral with the body 15 of the ejector, said tube at its upper end being internally threaded to connect with the lower end of the compressed-air pipe 16. Said tube at its lower end enters the passage-way of the ejector and is turned upward in the direction of the movement of the fluid through said ejector to a central point in the passage-way through the ejector, and at its inner end it is internally threaded to receive a nozzle 22, that is externally threaded at its lower end to fit in said air-tube and is contracted between its ends to a diameter smaller than at either end. In the form shown the contracted portion is about midway between the ends of the nozzle, so that the diameter of the contracted portion is less than the diameter of the air-tube 21, and above the contracted portion the nozzle flares to an increased diameter at the vent. Im-

mediately above said nozzle and the vent thereof the flow-pipe passage-way through the ejector is contracted to a diameter or transverse area smaller than the diameter or transverse area of the flow-pipe passage-way at all other points. In other words, the transverse area of this contracted portion of the passage-way through the ejector is less than the transverse area of the passage-way elsewhere through the flow-pipe and ejector. I construct this ejector by internally threading it at 25, near the upper end thereof, and placing within the ejector a tubular sleeve 26, contracted about midway between its ends and flaring from said middle portion in a straight line to each end, as shown in Fig. 5. The upper end of the sleeve is externally threaded to screw into the threads 25. The length of the sleeve 26 is such as to bring the lower end thereof but a very short distance above the vent of the compressed-air nozzle. Below the sleeve 26 the body of the ejector is bulged out laterally at 28, as seen in Figs. 6, 7, and 8, around and to a point below the inner portion of the air-tube 21 and nozzle 22. The purpose of this enlargement of the ejector is to cause the transverse area of the passage-way through the ejector to be substantially the same at all points, both above and below the air-inlet, and also substantially the same as the flow-pipe at all other points. The only point at which the transverse area of the passage-way through this fluid-outlet or flow-pipe is smaller is in the contracted portion of the sleeve 26.

While exact dimensions are not necessary to the proper operation of this invention, still its operation is enhanced by substantially the following proportions: In the device which I have used the flow-pipe is a three-inch pipe, so that the upper and lower ends of the sleeve 26 in the ejector have a diameter of about three inches, while the contracted portion of said sleeve has a diameter of about two and one-eighth inches, being seven-eighths of an inch less than the ends of the sleeve. The compressed-air tube 21, as well as the air-pipe 16, has a diameter of one inch, so that the lower end of the nozzle 22 is about one inch in diameter, the contracted portion about five-eighths of an inch in diameter, while the vent or upper end is about one and one-fourth inches in diameter, being larger than the normal diameter of the air-tube and still larger than the contracted portion of the nozzle. I have also placed the lower end of the sleeve 26 about one-half inch above the upper end of the nozzle 22. With a device of the dimensions just described in a well about sixty-two feet deep with only thirty-six feet of water or submergence I pump constantly and with full volume, say, about one hundred and ninety gallons of water per minute to a tank one hundred and twenty-two feet above the water-level, and therefore over one hundred and fifty feet above the ejector, with a constant air-pressure of sixty pounds.

The dimensions above specified indicate the proportions, so that for lifts of larger capacity the parts should be relatively increased in size.

As explained in the first of my above-mentioned Letters Patent, this sort of air or gas lift for fluids brings into coöperation three influences—namely, the submergence of the lower end of the device below the surface of the water in the well, so that the water will rise to the same level in the flow-pipe 13, and with the introduction of compressed air into the casing or well upon the body of water therein the water will rise still higher within the flow-pipe. The second influence is that caused by compressed air coming in through the air-tube 21 and passing upward through the vent thereof and drawing up the water from below by suction and in coöperation with the compressed-air pressure in the well or the submergence. The third influence is that coming from the introduction in the flow-pipe above the vent of the compressed-air pipe of a volume of air which displaces a corresponding quantity of water and forces the water to a higher level in the flow-pipe.

With the ejector herein set forth the effect of the contracted portion of the passage-way through the ejector that is located immediately above the compressed-air vent is to assist in preventing the return or downward movement of the volume of water above and also to increase the pressure of the air and water coming from below at the contracted portion of the passage-way, so that a much higher or larger body of water can be sustained above such contracted portion of the passage-way at a given compressed-air pressure than if there were no contracted portion of the passage-way in the ejector. As I now believe, this is the chief feature that enables me with relatively low air-pressure and with a shallow well and consequent slight submergence to raise water continuously to an unexpected height. The contraction of the nozzle at the end of the compressed-air tube increases the pressure of air at that point, and the subsequent enlargement of the air-vent causes a relative expansion of the air and an increased suction-power, as I now believe, so that the efficiency of the device in drawing water below is correspondingly increased. In my opinion the latter object is also facilitated by the relative location of the vent and the lower end of the sleeve 26 and the proportion of said adjacent parts and the flaring of the air-vent, so that the air strikes the wall of the lower part of the sleeve 26 near its lower end and creates a powerful suction effect and at the same time all the more tends to support and force upward the body of water above the contracted portion of said sleeve 26.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In an air or gas lift for fluids, a flow-pipe for the fluid with the passage-way therethrough contracted at one point and flaring in both an upward and a downward direction from said contracted portion, and a compressed-air tube entering the flow-pipe and turned in the direction of the flow therein with the vent thereof located immediately below the lower flaring portion of the passage-way through said flow-pipe, the passage-way through said air-tube being contracted near the vent and flaring from the contracted portion of the passage-way through the air-tube to said vent, said flow-pipe being enlarged about the air-tube so that the dimensions of the flow-pipe will be substantially uniform.

2. In an air or gas lift for fluids, a flow-pipe for the fluid having its passage-way contracted at one point, and a compressed-air tube entering the flow-pipe and turned in the direction of the flow therein with its vent located immediately below said contracted portion of the flow-pipe, said air-tube being contracted near its vent, the contraction in the air-tube and flow-pipe being in substantially the same ratio.

3. In an air or gas lift for fluids, a flow-pipe for the fluid with its passage-way contracted at one point and flaring both upward and downward from said point, and a compressed-air tube entering said flow-pipe and turned in the direction of the flow therein with its vent immediately below the lower flaring portion of the passage-way in the flow-pipe, the transverse area of said air-tube at the vent having less than one-half the transverse area of the passage-way through the flow-pipe, the contracted portions of said flow-pipe and air-tube having their transverse areas reduced in substantially the same ratio.

4. In an air or gas lift for fluids, an ejector with a passage-way therethrough for the flow of the fluid that is internally threaded near its upper end, a sleeve externally threaded near its upper end that is adapted to fit sungly into said passage-way and which is contracted between its ends, an air-tube entering said passage-way in the ejector and turned in the direction of the flow of the fluid therein and substantially in the center of the passage-way and internally threaded, and a nozzle adapted to screw into said air-tube with its vent immediately below said sleeve, said nozzle being contracted between its ends, the wall of said ejector being enlarged about the air-tube so that the dimensions of the passage-way through the ejector may be substantially uniform.

5. In an air or gas lift for fluids, an ejector with a passage-way therethrough for the flow of the fluid that is internally threaded near its upper end, a sleeve externally threaded near its upper end that is adapted to fit snugly into said passage-way and which is contracted between its ends, an air-tube entering said passage-way in the ejector and turned in the direction of the flow of the fluid therein and substantially in the center of the passage-way and internally threaded, and a nozzle adapted to screw into said air-tube with its vent immediately below said sleeve, said nozzle being contracted between its ends with the transverse area of the vent greater than the transverse area of the main portion of the air-tube, the wall of said ejector being enlarged about the air-tube so that the dimensions of the passage-way through the ejector may be substantially uniform.

In witness whereof I have hereunto affixed my signature in the presence of the witnesses herein named.

WALTER B. HARRIS.

Witnesses:
N. ALLEMONG,
V. H. LOCKWOOD.