C. W. WHITNEY.

AIR LIFT PUMP.

APPLICATION FILED DEC. 13, 1915.

1,253,115.

Patented Jan. 8, 1918.

2 SHEETS—SHEET 1.

Fig. 2

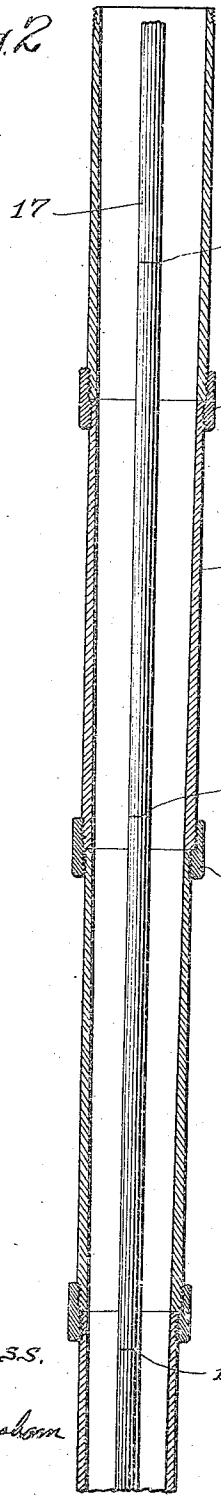


Fig. 1

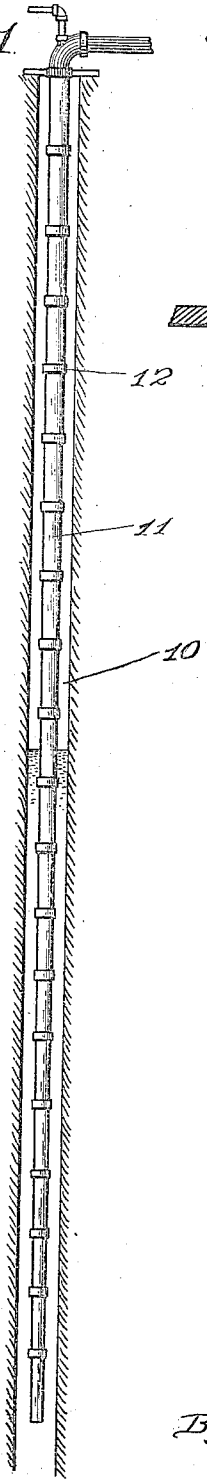
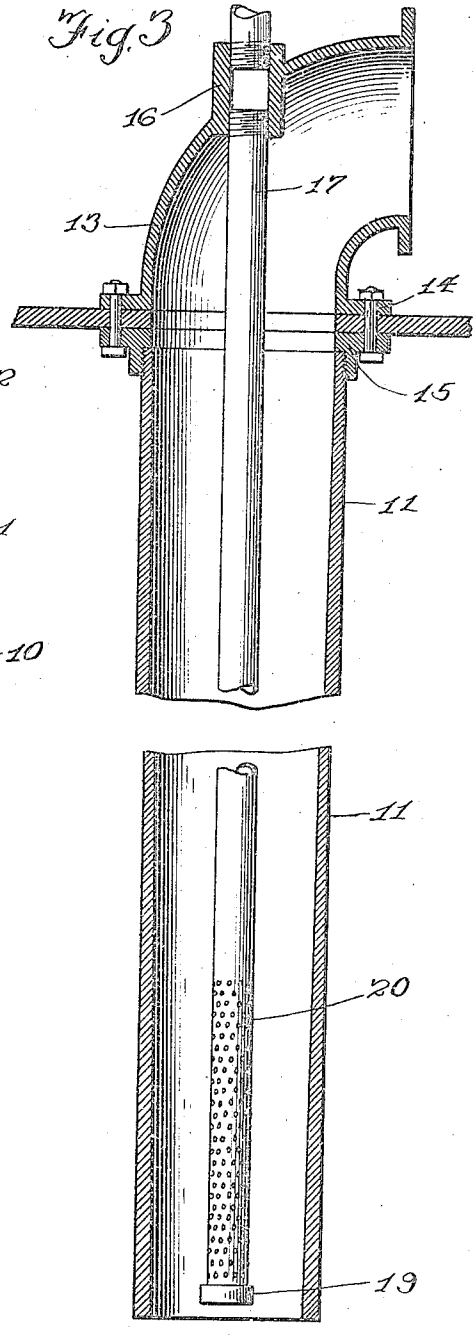


Fig. 3



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2 SHEETS—SHEET 2.

Fig. 4

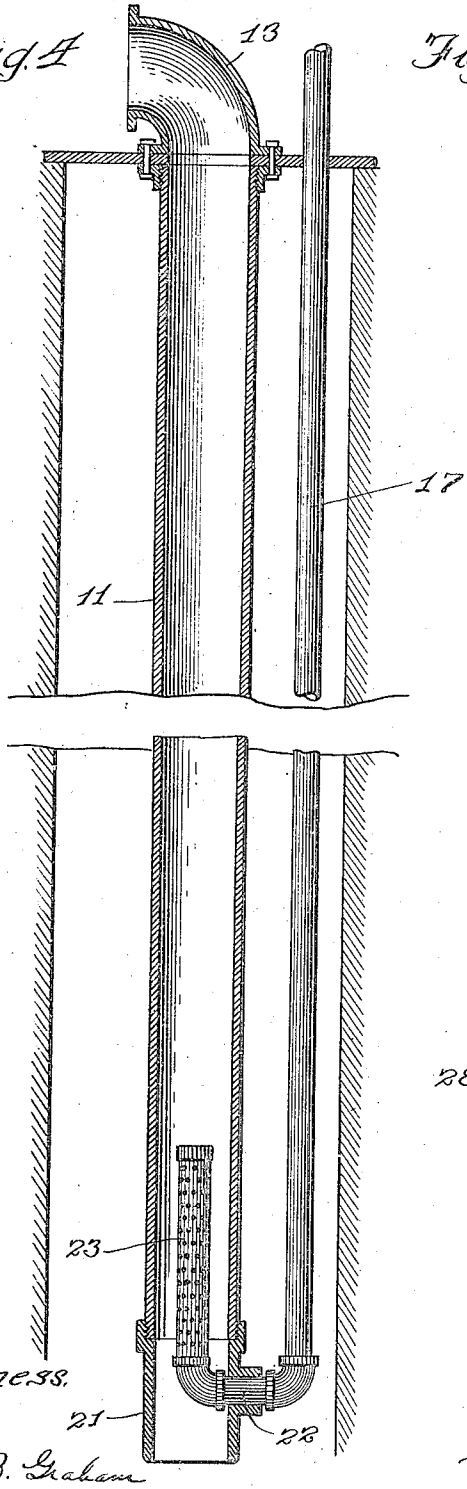
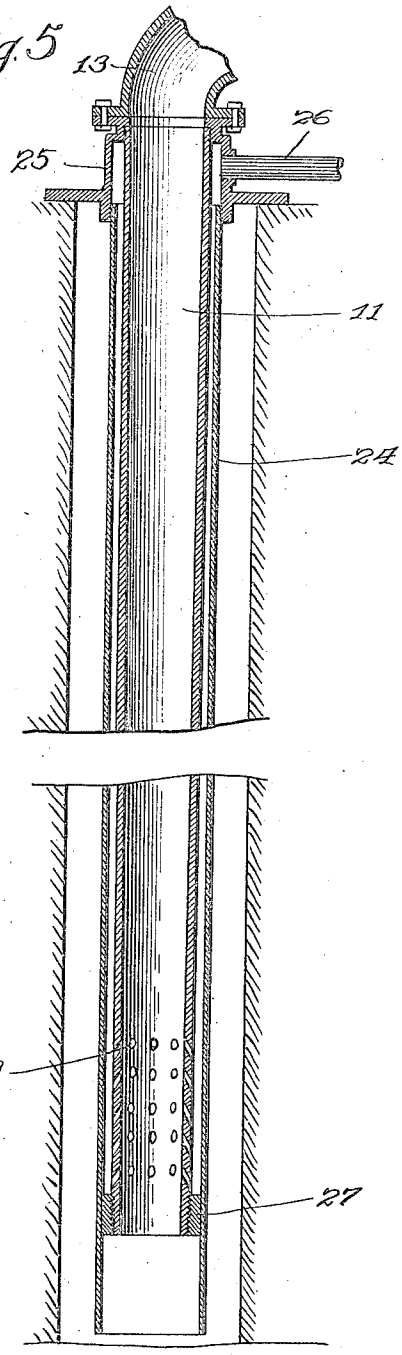


Fig. 5



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UNITED STATES PATENT OFFICE.

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AIR LIFT-PUMP.

1,253,115. Specification of Letters Patent. Patented Jan. 8, 1918.

Application filed December 13, 1915. Serial No. 66,455.

To all whom it may concern:

Be it known that I, CHARLES W. WHITNEY, a citizen of the United States, and resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Air Lift-Pumps, of which the following is a description, reference being had to the accompanying drawings, which form a part of my specification.

My invention relates to air lift pumps, more especially intended for the pumping of water from deep wells by means of compressed air, wherein the eduction pipe is preferably constructed of cast iron, so as to eliminate the difficulties of corrosion and disintegration experienced with eduction pipes constructed of ordinary steel or wrought iron.

The object of my invention is to provide an eduction conduit or pipe having a continuously increasing internal diameter, commensurate with the pressure employed, in order to permit of the gradual expansion of the air within the conduit or pipe as it ascends with the water. By employing a conduit or pipe made in accordance with my invention, the tendency toward increased velocity on the part of the air toward the discharge end of the eduction conduit or pipe will be greatly reduced, with the result that higher efficiency is obtained because of the opportunity afforded for a full and yet gradual expansion of the air during its passage upward through the eduction pipe.

Another object of my invention is to provide an air lift or pneumatic pump wherein the eduction conduit or pipe,—which necessarily must consist of a number of sections where the water is being lifted or pumped from a well of considerable depth,—will present no broken joints on the conduit or pipe interior, and thereby overcome the slippage which results where broken joints are presented, as it has been found in practice that such broken joints cause a disturbed relation between the air and water to take place. With my improved eduction conduit or pipe, an absolutely smooth passage for the air and water is provided, with the result that the slippage of air, past the water in the ascending column, is prevented, and a constant and much more efficient air lift or pneumatic pump provided.

The objects of my invention will be more readily comprehended from the following detailed description of the drawings, wherein:—

Figure 1 illustrates, in side elevation, the installation of my improved eduction conduit or pipe in the bore or shaft of a well.

Fig. 2 is a longitudinal sectional view of a number of the sections of the eduction conduit or pipe and the couplings therefor; the eduction conduit or pipe being provided with a centrally located air tube or pipe.

Fig. 3 is a longitudinal sectional view of a portion of the topmost section and a portion of the lowermost section of the eduction conduit or pipe, provided with the centrally located air tube or pipe, as disclosed in Fig. 2; the air tube or pipe, at the lower end, being shown provided with a series of perforations whereby the air is permitted to escape into the eduction pipe.

Fig. 4 is a partial longitudinal sectional view and partial side elevation of another system, namely wherein the air-line or pipe is located to the outside of the eduction pipe, except for the discharge nozzle or end of the air-line which is centrally located within the lower section of the eduction pipe.

Fig. 5 is a longitudinal sectional view of a third type or system of air lift or pneumatic pump wherein the eduction pipe or conduit is located within the air tube.

In the exemplification of the invention, as disclosed in Fig. 1, the bore of the well is shown at 10, with my improved eduction conduit or pipe, indicated at 11, made up of a series of sections. The various sections are made of suitable length and secured or coupled together by means of the unions or couplings 12. The upper end of the topmost section of eduction conduit or pipe 11 is shown provided with an elbow 13, see Figs. 1 and 3, suitably bolted or secured to the topmost section, as, for example, by means of the bolts 14 which take through the flange on the elbow 13 and the flanged collar 15 which is shown screwed onto the upper end of the topmost section of the eduction conduit or pipe 11.

The elbow 13 is shown provided with an

opening, in its bend, surrounded by the boss 16 which is internally threaded to receive the ends of the air-line or tube 17. The air-line or tube 17 is made up of suitable lengths of piping, such as wrought iron, and the like, and secured together in any suitable manner, preferably with flush point 18, as shown in Fig. 2. The lowermost section of air-line or pipe 17 has its lower end closed by any suitable means as, for example, the cap 19, while the side walls are provided for a suitable distance with perforations 20, which allow the air to escape from line or tube 17 into the eduction pipe 11.

In order to practically eliminate corrosion and disintegration heretofore encountered with ordinary steel and wrought iron pipe, I contemplate constructing my improved eduction conduit or pipe of cast iron.

The respective sections of the eduction pipe or conduit 11 are made with gradually increasing diameter internally from bottom to top, as can very clearly be seen in Fig. 2, so that the upper end of the one section is of internal diameter corresponding with the internal diameter at the lower end of the next adjacent or succeeding section, enabling the ends to abut against each other so as to provide unbroken or smooth joints between the various sections, as shown in Fig. 2.

I prefer to construct the eduction conduit or pipe of cast iron, and by reason of the tapering or increasing internal diameter, the lower ends of the respective sections are shown provided with thicker walls than the upper ends; the external diameter of each section being substantially similar throughout the entire length of the respective section; with the different sections, however, being of increased diameter externally, as can more clearly be seen in Fig. 2, where the upper section is of greater diameter than the bottom section.

By reason of this construction, the unions or couplings 12 are shown with one portion having an internal diameter corresponding with the external diameter of one section, while the other portion is shown provided with an enlarged internal diameter to correspond with the increased external diameter of the adjacent section, see Fig. 2.

The ends of the respective sections of the eduction conduit or pipe are shown threaded, in order to receive the threaded unions or couplings 12, whereby the respective sections are securely clamped or secured together. This method of securing the different sections together, permits the use of cast iron sections and enables the united sections of the eduction conduit or pipe to be lowered into the bore of the well to the desired depth.

In practice, the section of smallest internal diameter is first started into the well to a partial or limited extent until the next succeeding section,—having an internal diameter at its lower end corresponding with the internal diameter at the upper end of the inserted or first mentioned section,—is coupled onto or secured to the partially inserted section. The two sections are then lowered sufficiently to permit a third section of proper dimensions, namely a section having an internal diameter at its lower end corresponding with the internal diameter at the upper end of the second mentioned section, to be coupled in place, and so on successively until a sufficient number of sections of proper registering internal diameters have been lowered and put into place.

It will be understood, of course, that at the same time a sufficient number of air-line sections or pipes are also coupled together and lowered so as to provide an air-line, of proper length, with the upper end of the topmost inserted section of the air-line secured in the threaded boss 16 formed in the elbow 13, which latter is then bolted or secured in place, as shown in Fig. 3.

The internal diameter of the discharge or eduction pipe is of great importance to secure proper efficiency, and must bear a relation not only to the amount of water to be handled, but also to the amount of air employed for the lift.

In the exemplification shown in Fig. 4, I disclose what is known as an outside system, namely wherein the air-line or tube 17 is located outside of the eduction or discharge pipe 11. In the system disclosed in Fig. 4, the eduction pipe, like the eduction pipe shown in the first three figures of the drawings, is composed of a sufficient number of sections having gradually increasing internal diameters from the lower toward the upper ends of the sections, as heretofore described; and the respective sections, like those shown in Fig. 2, are intended to be secured or clamped together by means of the unions or couplings 12, as previously described.

In the system shown in Fig. 4, the lower end of the lowermost section of the eduction pipe or conduit 11 is shown provided with a foot-piece 21 which may be screwed onto the lower end of the lowermost section, as shown; the foot-piece being provided with a lateral connection 22 which connects the air-pipe or line 17 with the air-discharge member 23, centrally located in the lower end of the lowermost section of the eduction conduit 11; the perforations being preferably upwardly disposed so that the air will be discharged in an upwardly sloping manner within the eduction pipe.

The foot-piece 21 is of sufficient internal diameter to permit the water or fluid to rise within the eduction pipe about the discharge member 23. With the system disclosed in this figure, where the air-line or

pipe is located to the side of the eduction pipe, the elbow 13, secured at the top of the upper section of the eduction pipe 11, need not be provided with the threaded boss 16, shown in Fig. 3.

In the exemplification shown in Fig. 5, I illustrate a third system wherein the eduction pipe 11 is located within an outer casing 24, which latter constitutes the air-line or tube. In this construction, the upper end of the casing 24 is shown provided with a suitable member or head 25 having communication with the upper end of the casing 24 secured thereto and arranged to receive the compressed air from a suitable source by means of the pipe 26. The upper end of member or head 25, in this instance, receives the elbow 13. The elbow 13 is arranged to receive the upper end of the eduction conduit 11 so as to convey the lifted water or fluid to the desired point; the connection between the elbow and conduit 11 being such as to provide an air chamber within the head 25 which communicates with the casing 24.

When this system is employed, the space intervening the lower end of the eduction pipe 11 and the casing 24 must be closed by suitable means as, for example, the collar 27, which may be screwed onto the end of the lowermost section of the eduction pipe 11, as shown in Fig. 5, or otherwise secured thereto, so that the air cannot pass down below the open end of the lowermost section of the eduction pipe 11. The lowermost end or section of the eduction pipe 11 is provided with a series of perforations 28, preferably sloping upwardly toward the interior of the eduction pipe, whereby the air, between the eduction pipe 11 and the casing 24, will be discharged into the eduction pipe and exert its expanding energy in lifting the water or other fluid.

The eduction pipe sections in this system, like the eduction pipe sections in the previously described systems, are all made with gradually increasing internal diameters from the lower toward the upper ends of the sections; with the internal diameter at the upper end of one section corresponding with the internal diameter at the lower end of the next adjacent section above, so that the eduction pipe 11 will be provided with a continuously and gradually increasing internal diameter.

The air is introduced by means of the air-line or tube into the lower end of the eduction pipe 11 under pressure, and therefore occupies less space than when it has expanded back to atmospheric pressure. If a perfectly straight pipe, towit, a pipe of equal internal diameter throughout its length, is employed, then the air can only expand in one direction, namely vertically. In effecting this expansion toward the discharge, its velocity is increased. This increased velocity induces increased friction between the liquid or fluid and the walls of the eduction pipe, with the result that the water, being heavier than the air, is retarded in its upward flow by the friction encountered. This condition tends to draw the water back around the bubble or pocket of air which becomes elongated. The result of such condition and action will at times permit the air to slip through and leave the water behind, so that the efficiency of the pneumatic pump or air lift is materially reduced and results in a pulsating or intermittent discharge.

The air lift provided with the ordinary straight pipe—towit, pipe having the same internal diameter throughout its length—starts with a very low velocity at the point at which the air is admitted to the eduction pipe and the velocity gradually increases, resulting in a more or less violent explosion as the air and water reach the surface or discharge end of the eduction pipe, allowing the air to expand back to atmospheric pressure.

With my improved eduction pipe, namely a pipe having a constantly, gradually increasing internal diameter from bottom to top, the expansion of the air will be partially taken care of laterally and the velocity kept at a more normal rate, with the result that the friction encountered by the rising column is materially diminished, and the efficiency of the pump greatly increased. In other words, my improved eduction pipe allows a gradual and constant expansion of the air, both laterally and vertically, as it ascends with the water, thereby producing higher efficiency because of the opportunity afforded for a full expansion of the air without undue increase in velocity as encountered with air lifts or pumps as heretofore employed.

Where ordinary piping is employed, wherein the sections do not abut within the couplings or nipples, the edges of the pipe-sections in the coupling present sharp corners to the ascending water and each joint creates a swell, with the result that a certain amount of air slips by and allows the water it is carrying to drop. This action results in a considerable loss especially where a long string of pipe, towit a pipe composed of a large number of sections, is necessarily used for high lifts.

With my improved manner of securing cast iron pipe-sections together, which not only enables cast iron piping to be employed, but also provides a perfect and smooth conduit, the slippage resulting from the disturbed relation between the air and water encountered with pipes as heretofore employed, will be obviated. Furthermore, the corrosion and disintegration encountered where ordinary steel and wrought iron pipe are employed,

are to a large extent prevented and a longer lived air lift or pump provided.

I have shown and described what I believe to be the simplest and best forms of my invention, which, however, may be modified in certain details without departing from the spirit of the invention.

What I claim is:—

1. An air lift or pump eduction piping composed of a series of cast iron sections coupled together so as to provide a smooth interior, the external diameter of a section being substantially identical throughout its length while the internal diameter is gradually and constantly increased from one end to the other.

2. An air lift or pump having an eduction conduit or pipe composed of a series of cast iron sections, each section being provided with a substantially straight exterior and a constantly increasing or tapering interior, and means whereby the sections are coupled together so as to provide a smooth interior.

3. An air lift or pump having an eduction conduit or piping composed of a series of sections, the exterior diameter of each section being substantially identical throughout the length of the section, while the internal diameter of each section is constantly increased or tapered from end to end, the enlarged internal end of a lower section being adapted to register the smaller internal lower end of the adjacent section above, means whereby the sections are secured together so as to provide smooth internal joints, and means whereby compressed air may be forced into the said eduction conduit adjacent the lower end thereof.

4. An air lift or pump having an eduction conduit or piping composed of a series of cast iron sections having externally threaded ends, the external diameter of each section being substantially identical throughout the length of the section, while the internal diameter of each section is constantly and gradually increased at a ratio commensurate with the pressure, the internal diameter at the upper end of one section being adapted to correspond with the internal diameter at the lower end of the adjacent upper section, and means provided with a varying internal diameter adapted to screw onto the upper and lower ends of adjacent sections so as to form smooth internal joints.

CHARLES W. WHITNEY.

Witnesses:
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F. A. FLORELL.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."