Jan. 7, 1930. H. F. CHILDERS 1,742,579

DEEP WELL PUMPING APPARATUS

Filed June 21, 1928 3 Sheets-Sheet 1

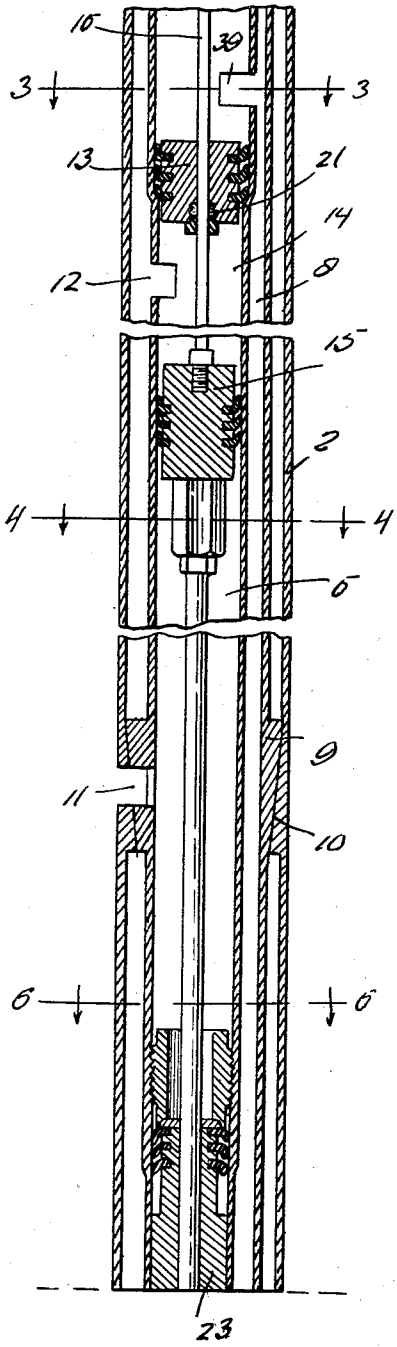


Fig. 1.

Fig. 3.

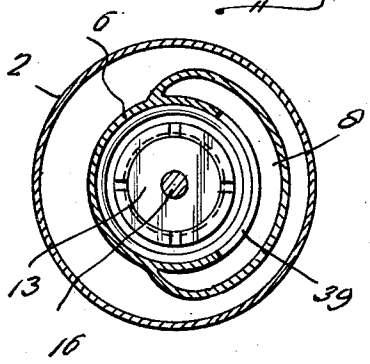
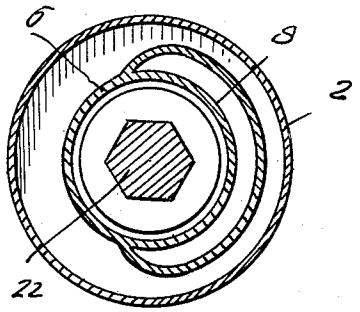


Fig. 4.



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DEEP WELL PUMPING APPARATUS

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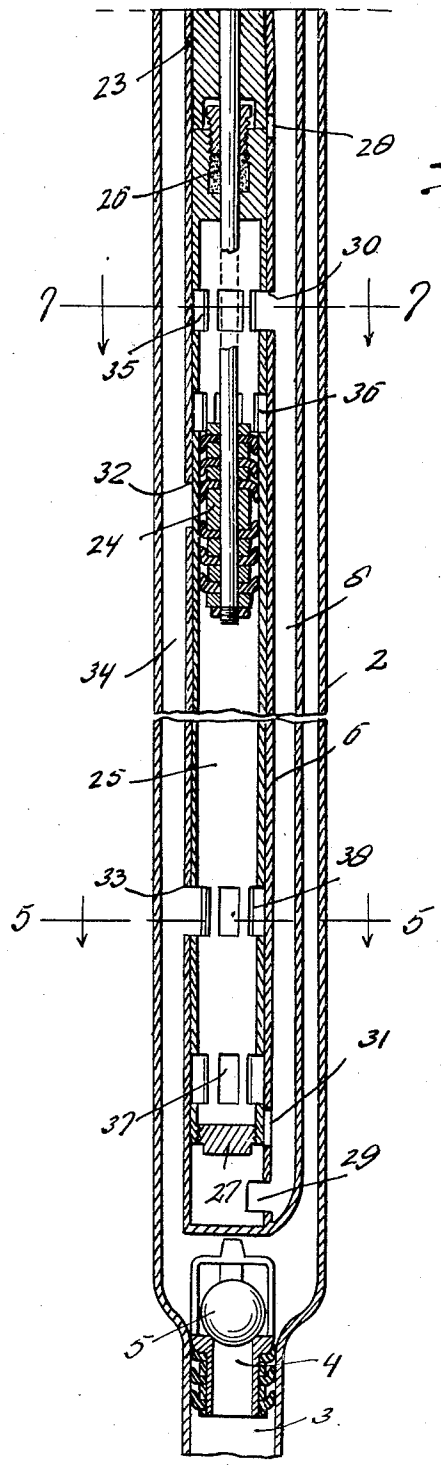


Fig. 2.

Fig. 5.

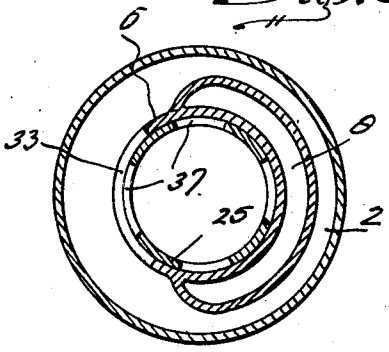
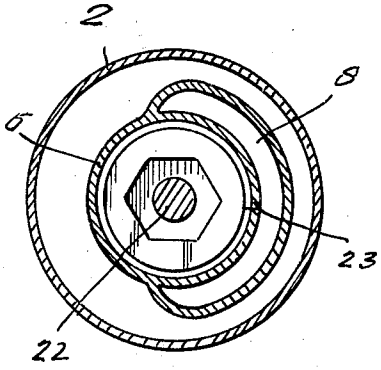


Fig. 6.



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DEEP WELL PUMPING APPARATUS

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Fig. 8.

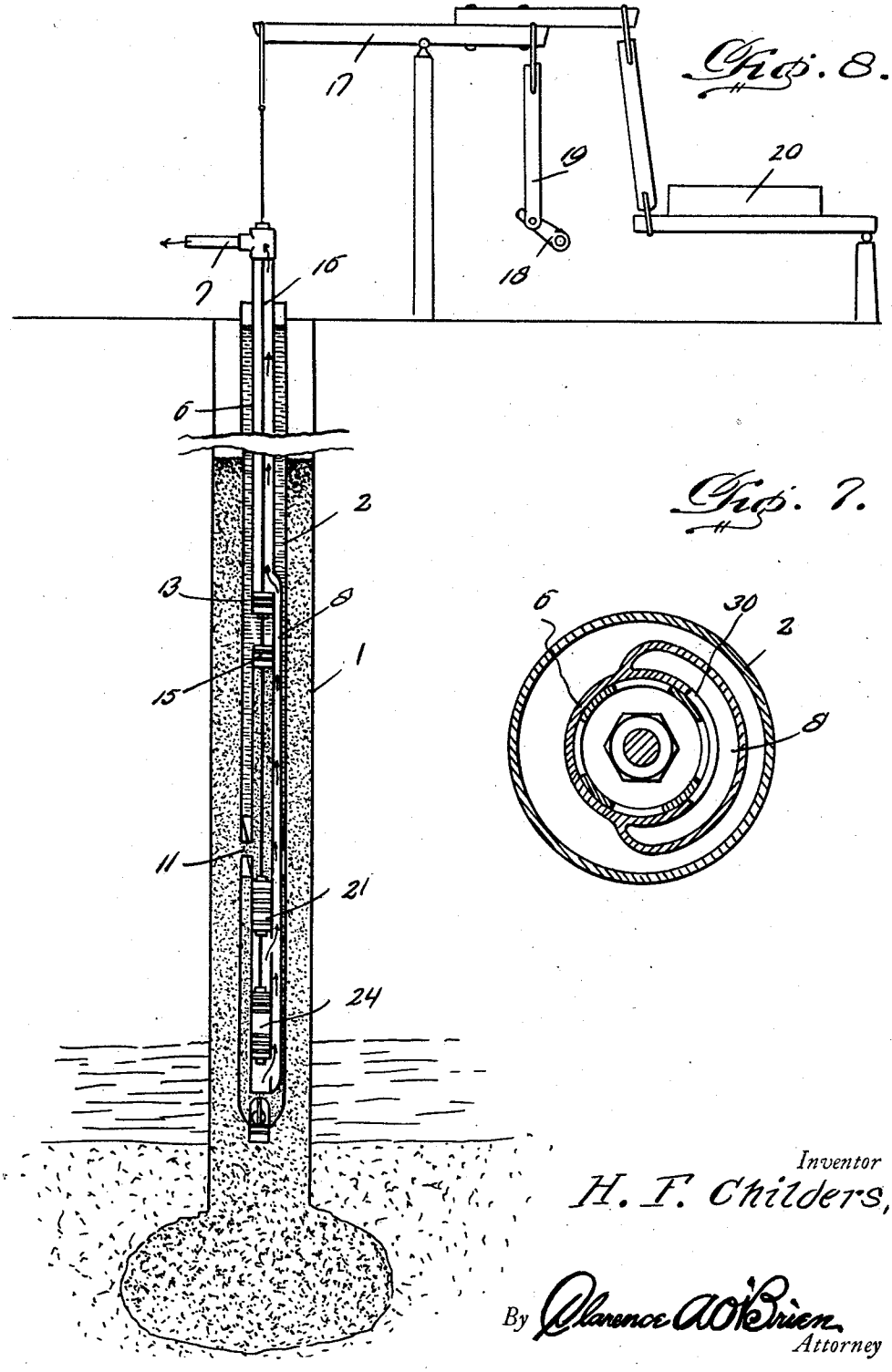


Fig. 7.

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UNITED STATES PATENT OFFICE

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DEEP-WELL PUMPING APPARATUS

Application filed June 21, 1928. Serial No. 287,097.

The present invention relates to improvements in deep well pumps and has for its principal object to provide an apparatus which includes the use of a hydraulic lifting fluid.

One of the important objects of the present invention is to provide a deep well pumping apparatus that includes a double acting piston and valve arrangement for effecting the discharge of the fluid from the well, in a positive and efficient manner.

Another important object of the invention is to provide a deep well pumping apparatus which comprises a particular eduction tube arranged in a cylindrical pipe, a packer being carried by the eduction tube for engagement with the inner wall of said pipe to prevent the admittance of the hydraulic lifting fluid to the lower portion of the pipe and the double acting piston unit operable in the lower portion of said eduction tube.

Still a further object is to provide a deep well pumping apparatus of the above mentioned character which is simple in construction, inexpensive, strong and durable and further well adapted to the purpose for which it is designed.

Other objects of the invention will become apparent as the nature of the invention proceeds and when taken in connection with the accompanying drawings.

In the accompanying drawings, forming a part of this application and wherein like reference characters designate like parts throughout the views:

Figure 1 is a fragmentary vertical sectional view through the intermediate portion of the cylindrical pipe and eduction tube arranged therein showing the hydraulic piston and the piston rod associated therewith arranged in said eduction tube and also illustrating the packer member.

Figure 2 is a similar section through the lower portion of the fluid pipe and eduction tube showing the position of the sliding cylinder and piston in their uppermost positions.

Figure 3 is a cross sectional view taken approximately on the line 3—3 of Figure 1.

Figure 4 is a similar section taken on the line 4—4 of Figure 1,

Figure 5 is a cross sectional view, taken approximately on the line 5—5 of Figure 2.

Figure 6 is a cross sectional view, taken approximately on the line 6—6 of Figure 1.

Figure 7 is a cross sectional view, taken approximately on the line 7—7 of Figure 2, and

Figure 8 is a diagrammatic view of the deep well pumping apparatus, embodying my invention.

In the drawings, wherein for the purpose of illustration is shown the preferred embodiment of my invention, the numeral 1 designates the usual casing that extends downwardly into the well. Arranged within the casing is the pipe 2, the lower end thereof being reduced to provide a fluid inlet 3 and arranged within the reduced portion is the valve cage unit 4, the ball check valve included in this unit being denoted by the reference character 5. Arranged within the casing pipe 2 is the eduction tube 6 that is spaced with respect to the pipe 2, as clearly shown in the drawings. This eduction tube is spaced with respect to the lower end of the pipe 2 and furthermore the lower end of the eduction tube is closed. The upper open end of the eduction tube extends upwardly above the open upper end of the pipe 2, and has communication with a fluid discharge conduit 7, in the manner as clearly illustrated in the diagrammatic view in Figure 8. The eduction tube is formed with a longitudinally extending arcuate shaped fluid by-pass 8, that is also spaced from the pipe 2, as clearly suggested in the cross sectional views in the drawings, and this by-pass extends from the lower end of the eduction tube to a point at a suitable distance below the upper end of the pipe, as suggested in Figure 8.

Formed on the outer wall of the eduction tube 6 is the tapered packer 9, that has snug engagement with the tapered portion 10 formed on the inner wall of the pipe 2 as more clearly illustrated in Figure 1, whereby to seal the upper portion of the pipe 2 with respect to the lower portion of said pipe. The eduction tube 6 has communication with the casing 1, by means of the communicating passages formed in the packer and the

adjacent portion of the pipe, as shown generally at 11, also in Figure 1 of the drawings.

The eduction tube 6 is formed with a hydraulic lifting fluid inlet port 12 and secured in this eduction tube directly above the inlet port 12 is the cup packer shown at 13, in Figure 1, that is wedged into place. The portion of the eduction tube directly below the packer 13 constitutes what I term as a lifting fluid chamber 14, and operable within this portion of the eduction tube is the hydraulic piston 15 that is secured at its upper end to the lower end of an actuating rod 16 that extends upwardly through the cup packer 13 and the eduction tube. The upper end of this rod 16 is operatively connected to the walking beam 17 that constitutes a part of the usual pump power mechanism and included in this power mechanism is the engine crank 18 that is operatively connected with the walking beam 17 by the member 19. A counter-weight 20 is also operatively associated with the pivoted walking beam as illustrated in a diagrammatic manner in Figure 8. The purpose of the counterweight will also be presently described.

A stuffing box 21 is associated with the bottom of the cup packer 13 for cooperation with the sliding rod 16 as indicated in Figure 1.

The hydraulic piston 15 is furthermore operatively connected at its bottom with the upper end of the piston rod 22 that extends downwardly through the eduction tube 6 through the stop forming plug 23 that is threaded in the intermediate portion of the eduction tube as suggested in Figure 1 and the lower end of this suction rod 22 is operatively connected to a double acting piston unit 24, the construction of which is more clearly illustrated in Figure 2.

Arranged for slidable movement within the lower portion of the eduction tube is the cylinder 25, the same being closed at its respective ends and the double acting piston 24 is operable within this cylinder. A stuffing box 26 is associated with the closed upper end of the cylinder through which the piston rod 22 is slidable. Furthermore, the closed upper end of the sliding cylinder 25 is adapted to engage with the bottom of the stop forming plug 23, when the cylinder is at its uppermost position in the eduction tube. The lower end of this cylinder is formed with a threaded opening, in which is removably secured the threaded plug 27.

The eduction tube 6 is formed with the upper and lower air release openings 28 and 29 respectively, where indicated in Figure 2.

The eduction tube is furthermore formed with the fluid outlet ports 30 and 31 respectively that afford communication between the eduction tube and the by-pass 8 as shown in Figure 2.

The eduction tube is furthermore provided with the fluid inlet ports 32 and 33, respectively that are located in the opposite side of the tube and the inlet port 32 is located below the outlet port 30, while the other inlet port 33 is located above the other outlet port 31 as clearly shown in Figure 2. The inlet ports 32 and 33 afford communication between the fluid chamber 34 and the eduction tube.

The sliding cylinder 25 is formed in its upper end portion with the spaced fluid outlet ports 35, that are adapted to have communication with the elongated outlet port 30 formed in the eduction tube 6, when the sleeve is in its uppermost position as shown in Figure 2. The upper portion of the sliding cylinder is formed with an additional series of intake ports 36 located below the outlet ports 35 and these intake ports are adapted for communication with the intake port 32, formed in the eduction pipe 6.

When the outlet ports 35 are in communication with the outlet port 30, the intake ports 32 and 36 will be out of communication as shown in Figure 2.

The lower portion of the sliding cylinder 25 is formed with a series of outlet ports 37 that are adapted to have communication with the outlet port 31 formed in the lower end portion of the eduction tube, when the cylinder is in its lowermost position in said eduction tube. Formed in the lower portion of the sliding cylinder above the outlet ports 37 are the intake ports 38 that cooperate with the intake port 33 and manifestly, when the cylinder 25 is in the position shown in Figure 2, the intake ports 32 and 33 will be in registration while the outlet ports 31 and 37 will be out of registration with each other.

In the cross sectional view, there is clearly illustrated the construction of the various intake and outlet ports.

The improved deep well pumping apparatus may be briefly described as follows: Beginning with the piston 24 at the bottom or lower end of the stroke, the sliding cylinder 25, at the lower end of the shorter stroke with the plug 27 is adapted to rest on the lower end of the eduction tube 6. Further, the discharge port 37 in the lower end of the sliding cylinder will be in registration with the outlet port 31, and the inlet or suction port 38 on the lower end of the cylinder will be out of communication with the inlet port 33.

On the upper end of the sliding cylinder a reverse order takes place, that is to say, the intake port 32, and 36 will communicate and the discharge ports 35 and 30 will be out of communication. This is the position of the sliding cylinder at the lower end of the piston 24 stroke so that the fluid being discharged through the outlet port will be sucked in through the intake port.

The upward movement of the piston 24 in the cylinder 25, will cause the fluid already sucked into the piston to flow back out

through the communicating intake port above but the ball check valve 5 will prevent the discharge of the fluid from the fluid chamber 34 back into the well. The fluid thus prevented from escaping by the action of the piston 24 builds up sufficient pressure against the suction chamber and inside of the sliding cylinder to cause the sliding cylinder to move up until the upper end strikes the plug or stop 23, in which position the discharge ports 30 and 35 will be in registration with each other and the intake ports at the upper end of the cylinder and the adjacent portion of the induction tube will then be closed while on the other end of the cylinder the suction or intake ports will be opened and the discharge ports closed.

In this position, with the continued up stroke of the piston 24, the fluid is discharged through the ports into the by-pass 8 and in the meantime, additional fluid is sucked in after the piston 24 through the communicating intake ports 33 and 38 as well as permitting the flow of fluid to fill the suction chamber 34 through the ball check valve 5.

During the upstroke, the hydraulic lifting fluid between the pipe and the eduction tube 20 will act on the hydraulic piston 15 in the chamber 14 and the same will be counterbalanced by the counter-weight 20 that is operatively associated with the beam of the pump power mechanism. In this manner, only the necessary power is applied to lift the fluid out of the well. Further on the upstroke of the piston 24, fluid is admitted through the port 11 in the side of the hydraulic packer 9 and permitted to follow the hydraulic piston 15.

On the piston 24 reaching the height of its stroke and starting downwardly, the same action takes place as before and the check valve 5 holds the fluid in the suction chamber 34 until the piston 24 builds up sufficient pressure inside of the sliding cylinder to move the same until the plug 27 strikes the lower closed end of the eduction tube, and when in such position, the discharge portion at the upper end of the cylinder and adjacent portion of the pipe or tube will be closed, while intake ports will be opened, the lower discharge port being open and the adjacent intake port being closed.

The piston continues on its downward stroke, discharging the fluid through the by-pass 8 and into the upper portion of the induction tube through the port 39 located above the cup packer 13 and on out of the well through the discharge pipe 7.

In the descent of the piston on the pumping stroke, the hydraulic lifting fluid functions and the counter weight is lifted outside of the well and the fluid between the pipe and induction tube is permitted to act against the hydraulic piston which has a larger area exposed to the hydraulic fluid than that which is exposed to the fluid being forced out of the well by the piston 24. The hydraulic piston 15 in turn actuates the pump and the movement of the piston 24 effects the actuation of the communicating intake and outlet port in the manner as above described. The openings 28 and 29 provide means for releasing the air at the respective ends of the cylinders during the movement in the eduction pipe.

The port 11 acts as a release to the space below the hydraulic piston 15, to allow it to move up and down and if any liquid escapes past the piston 15, it cannot cause any back pressure, but is relieved through the port 11.

It will thus be seen from the foregoing description that I have provided a pumping apparatus that will, at all times, be positive and efficient in its operation and furthermore, the parts are so arranged as to enable the same to be readily assembled, whenever necessary.

While I have shown the preferred embodiment of my invention, it is to be understood that various changes in the size, shape and arrangement of parts may be resorted to, without departing from the spirit of the invention or the scope of the appended claims.

Having thus described the invention, what I claim as new is:—

1. In a deep well pumping apparatus, a well casing, a pipe arranged in said casing, the lower end of said pipe providing a fluid inlet opening, a check valve therefor, an eduction tube arranged within said pipe and spaced therefrom to provide a fluid chamber, a packer carried by the eduction tube and engaging with the inner wall of the pipe to seal off the fluid chamber, the upper portion of the pipe being adapted to contain a piston actuating fluid, a by-pass associated with the eduction tube, said eduction tube being provided with fluid outlet ports that communicate with the by-pass, the eduction tube being formed with fluid inlet ports, a pressure operated cylinder arranged in the eduction tube and provided with inlet and outlet ports for communication with the respective inlet and outlet ports of the eduction tube at predetermined periods, a piston operable within the sliding cylinder, means arranged with the eduction tube for limiting the upward sliding movement of the cylinder, and an additional piston operable within the upper portion of the eduction tube by the fluid in the upper portion of the pipe, said pistons being operatively connected together for simultaneous actuation.

2. In a deep well pumping apparatus, a well casing, a pipe arranged in said casing, the lower end of said pipe providing a fluid inlet opening, a check valve therefor, an eduction tube arranged within said pipe and spaced therefrom to provide a fluid chamber, a packer carried by the eduction tube and engaging with the inner wall of the pipe to seal off the fluid chamber, the upper portion of

the pipe being adapted to contain a piston actuating fluid, a by-pass associated with the eduction tube being formed with fluid outlet and inlet ports, the outlet ports communicating with the by-pass, a pressure operated cylinder arranged in the eduction tube and provided with inlet and outlet ports for communication with the respective inlet and outlet ports of the eduction tube at predetermined periods, a piston operable within the sliding cylinder, means arranged within the eduction tube for limiting the upward sliding movement of the cylinder, an additional piston operable within the upper portion of the eduction tube by the fluid in the upper portion of the pipe, said pistons being operatively connected together for simultaneous actuation, the eduction tube being provided with a lifting fluid intake port, a seal in the eduction tube directly above said intake port, the aforementioned by-pass having communication with the upper end of the eduction tube at a point above said seal.

3. In a deep well pumping apparatus, a well casing, a pipe arranged in the casing, a valved fluid inlet at the lower end thereof, an eduction tube arranged within the pipe and spaced therefrom to provide a fluid chamber, coacting packer forming members carried by the eduction tube and the inner wall of the pipe to seal off the fluid chamber, said packer forming members being provided with registering openings to afford communication between the education tube and the casing, the eduction tube and the pipe being formed with openings registering with the aforementioned openings, the upper portion of the pipe being adapted to contain a piston actuated fluid, a by-pass associated with the eduction tube, said tube being provided with outlet ports that communicate with the by-pass, and fluid inlet ports, a pressure operated cylinder arranged in the eduction tube and provided with inlet and outlet ports for communication with the respective inlet and outlet ports of the eduction tube at predetermined periods, a piston operable within the sliding cylinder, and a stop forming plug arranged in the eduction tube for limiting the upward sliding movement of the cylinder.

In testimony whereof I affix my signature.

HARRY F. CHILDERS.