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MULTISTAGE LIQUID ELEVATOR

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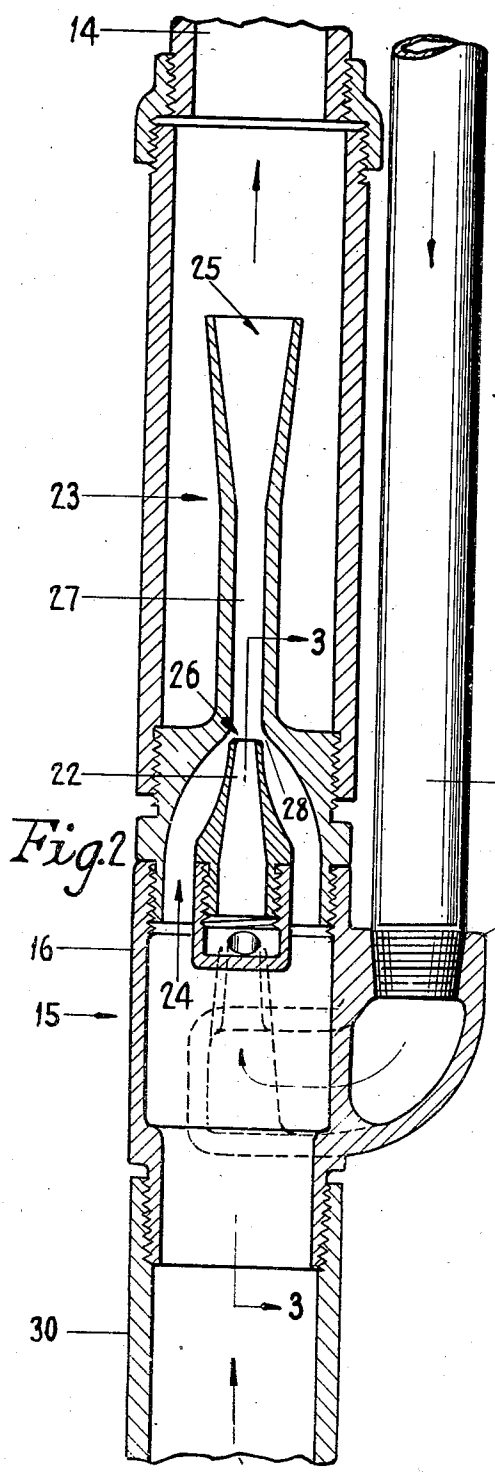


Fig. 2

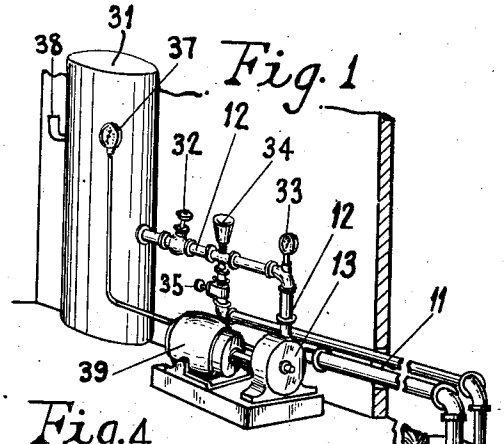


Fig. 1

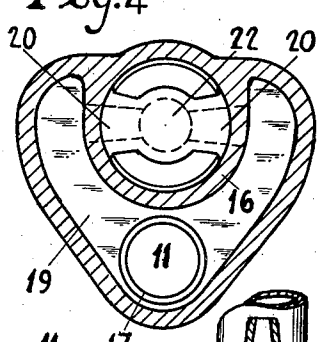


Fig. 4

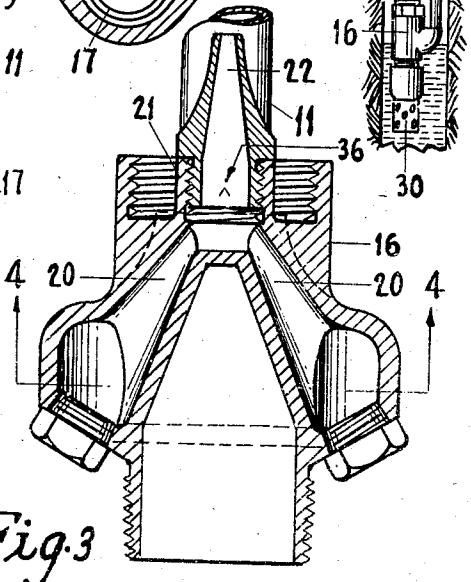


Fig. 3

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MULTISTAGE LIQUID ELEVATOR

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2 Claims. (Cl. 103—5)

This invention relates to an apparatus for increasing the efficiency and range of use of suction pumps for exhausting liquids from deep wells.

An object of this invention is to provide an apparatus whereby a suction pump may be utilized in raising a liquid through an appreciably greater height than the atmospheric lift height for the liquid.

Another object of this invention is to provide a device in which the liquid being lifted from the well is itself utilized as a pumping agent.

Another object of this invention is to provide a device of the character described, which is particularly applicable for use with continuous rotary pumps arranged for effecting a continuous flow.

Another object of this invention resides in the particular arrangement and structural features of the cooperating elements.

It is well known that the maximum suction lift of a pump is below thirty feet, with the result that a suction pump at the ground level is only effective for a shallow well. In the case of deeper wells it is common to dispose the pump below the ground level and within its suction lift distance of the liquid in the well. In accordance with the present invention, a continuous flow pump may be used for drawing from a well considerably exceeding in depth the suction lift limit without necessitating a disposal of the pump below the ground level. Since some of the pumped liquid is itself utilized for effecting the desired injection of water into the suction pipe, the pump is the only part of the device which requires power for its operation and a minimum of pumping equipment is required.

With the above and other objects in view, the invention will be hereinafter more particularly described, and the combination and arrangement of parts will be shown in the accompanying drawing and pointed out in the claims which form part of this specification.

Reference will now be had to the drawing, wherein like numerals of reference designate corresponding parts throughout the several views, in which:

Figure 1 is a view of an installation embodying the invention.

Figure 2 is a vertical cross-sectional view of a portion of the apparatus used.

Figure 3 is a vertical central cross-sectional view through all the nozzles.

Figure 4 is a horizontal cross-sectional view, the section being taken as on line 4—4 in Figure 3.

In the illustrated embodiment of the invention, the numeral 10 indicates a well casing of a deep well in which is a high pressure drive line 11 connected to a pump discharge pipe 12 of a rotary pump 13, preferably of the centrifugal type and having a suction pipe 14. Both the discharge and suction pipes lead downwards into the well and terminate in a water elevator 15.

The water elevator 15 comprises an elongated main body 16 and a pipe connection 17 to which the drive line 11 is connected. The body 16 forms a tubular central portion around which is a circumscribing storage chamber 19. A plurality of nozzles 20 are positioned diametrically of said tubular body 16 and in inverted V-shaped form with the apex 36 of the V coinciding with the axis of the tubular body.

The outlet ends of the nozzles 20 terminate in a threaded socket 21 into which has been threaded a combining nozzle 22. The nozzle 22 has been positioned in alinement with the axis of the tubular body 16 and so that the said apex is positioned within said nozzle.

A Venturi or compound tube 23 has been secured at the upper end of the tubular body 16 and in axial alinement therewith. The Venturi tube has a converging lower portion 24, a diverging upper portion 25, a throat 26 and a cylindrical tubular portion 27.

The nozzles 20 substantially join together at their upper ends and jointly discharge into the combining nozzle 22, the outlet of which terminates closely contiguous to the throat 26 of the Venturi tube 23, leaving an annular gap 28.

The nozzles 20 are of conical converging form so as to increase the velocity of the water entering the combining nozzle 22. The nozzle 22 is also of conical converging form to further increase the velocity of the water passing therethrough.

The combining nozzle 22 is directed axially through the converging passage 24 which passage may be curved and enlarged between its upper and lower ends, as shown, whereby the flow of the incoming liquid about the nozzle is facilitated.

The water elevator 15 extends into the water at the lower elevation of the well and is provided at its bottom end with a suitable foot valve 30 through which the water from the well is drawn into the suction pipe 14. The discharge from the pipe 12 takes place under pressure into a tank 31.

A regulating valve 32 is provided in the discharge line 12 near the tank 31 and a pressure gauge 33 is connected at the upper end of the discharge pipe 12.

When the pump 13 is operating to discharge water into the tank 31 under pressure, a portion of the water passing through the discharge pipe 12 will be diverted into the drive line 11 and through the water elevator 15 and back into the suction pipe 14, the discharge of this re-circulated water from the water elevator is operative independently of and in addition to the suction in the pipe 14, for drawing water through the foot valve 30. The amount of water re-circulated is controlled by regulating the discharge pressure in the discharge line 12 by means of the valve 32.

A cup 34 above the pump discharge pipe 12 serves for priming the system. A valve 35 serves to set the water elevator 15 in or out of operation.

In operation, the liquid is pumped downwardly through the drive line 11 and upwardly through the successive conical converging nozzles 20 and 22. The first stage nozzles 20 and the second stage conical converging nozzle 22 cause the liquid discharge therethrough to be under increased high velocity. The nozzle 22 projects directly into the entrained stream so that the direction of the entrained stream is not changed. The entrained liquid is given an impulse by the water elevator jet in the same direction exactly in which it is flowing. The two streams mix within the Venturi tube 23 where their resultant velocity head is converted into pressure head sufficient to lift the liquid up to the pump 13.

An air volume control 37 controls the air in the tank 31 and a pressure switch 38 mounted on the tank and connected to the motor automatically controls the operation of the motor 39.

It will thus be seen that there has been provided a multi-stage liquid elevator in which a double or compound impulse effect is imparted to the liquid and which functions to repeatedly increase the velocity of the liquid and to create a high suction at the throat 26 of the Venturi tube 23, which suction can entrain and lift the liquid from a deep well.

We claim:

1. In a pumping mechanism for a deep well, comprising a pump, a high pressure drive line connected to the pump discharge, a multi-stage liquid elevator disposed in said well and connected to said drive line, said elevator having an elongated tubular central body portion, a storage chamber circumscribing said tubular body portion, a plurality of conical converging nozzles connected with said chamber and being positioned diametrically of said tubular body and in inverted V-shaped form, the apex of said inverted V coinciding with the axis of said tubular body portion, an upper conical converging and combining nozzle in alinement with the axis of said tubular body portion and with said apex positioned within said nozzle, a Venturi tube positioned at the upper end of said tubular body portion, said upper nozzle being positioned inside the converging portion of said Venturi tube with the outlet of said nozzle terminating closely contiguous to the throat of said Venturi tube, each of said converging nozzles having an elongated linear body and being designed for increasing the velocity of a liquid passing therethrough, whereby the velocity of the liquid is repeatedly increased before entering said Venturi tube and forms a high suction at the throat of said Venturi tube which entrains and lifts the water from the well, and means in circumscribing relation with said Venturi tube for connecting said elevator with the pump suction.

2. A multi-stage liquid elevator of the class described, comprising a tubular body portion, a storage chamber circumscribing said tubular body, a plurality of conical converging nozzles connected with said chamber and being positioned diametrically of said tubular body and in inverted V-shaped form, the apex of said inverted V coinciding with the axis of said tubular body portion, an upper conical converging and combining nozzle in alinement with the axis of said tubular body portion and with said apex positioned within said nozzle, a Venturi tube positioned at the upper end of said tubular body portion, said upper nozzle being positioned inside the converging portion of said Venturi tube with the outlet of said nozzle terminating closely contiguous to the throat of said Venturi tube, all of said nozzles being of conical form, each of said converging nozzles having an elongated linear body and being designed for increasing the velocity of a liquid passing therethrough, means for supplying a liquid to said storage chamber, means in circumscribing coaxial relation with the outlet of said Venturi for discharging the liquid therefrom, the outflowing liquid being in submerged relation in said discharge means.

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