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APPARATUS FOR THE EXTRACTION OF LIQUIDS

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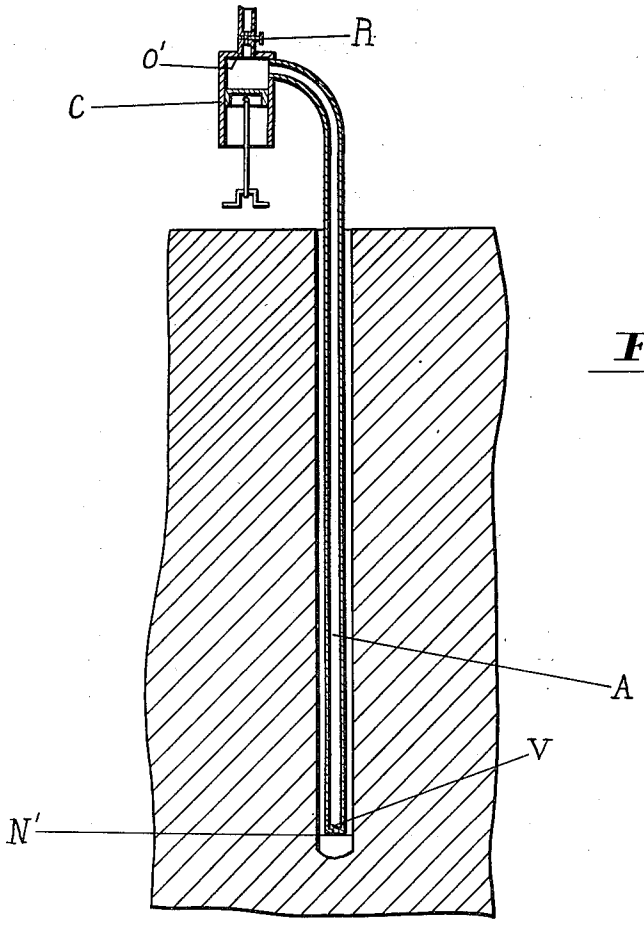


Fig.1.

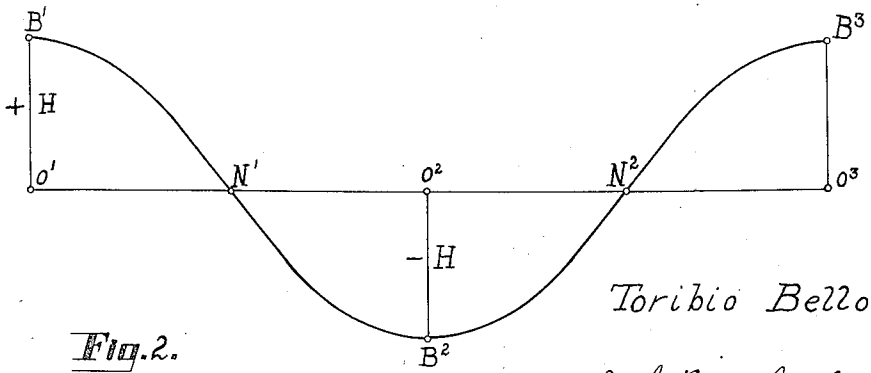


Fig.2.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR THE EXTRACTION OF LIQUIDS

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My invention relates to moving or transporting liquids and especially to extracting or pumping liquids from deep wells or other source of supply in a new manner, its main purpose being directed towards a pumping scheme of very simple and economical construction by which the mechanism at the bottom of the well is reduced to a minimum and the extraction of fluid effected from the ground level substantially irrespective of the depth of the well, and thus when used for water it is not limited to the 25 or 30 foot limit of the usual suction pump for water, and similarly the limits usual with pumps for other liquids do not persist. In order that my present invention may be clearly understood and easily carried into practice, a preferred embodiment thereof has been shown in the appended diagrammatic drawings wherein Figure 1 is a vertical section of a well and apparatus and Fig. 2 is a diagram of the curve of the pressure wave to which reference will be made hereinafter.

In the embodiment shown the device consists of a pipe A through which the liquid is withdrawn. The pipe reaches to the bottom of the well, or to the liquid level therein, and is of a suitable length as will be explained. At the bottom of the pipe is a check or retention valve V. The upper end of the pipe A is connected at or about the ground level with a pump or compressor C preferably making rapid reciprocations with a short stroke. The compressor is a valveless pump and is provided with an outlet controlled by an adjustable cock or the like R, through which the pumped liquid may pass from the system. The cock may be opened at the beginning of the operation but may be adjusted to a desirable point during operation.

Before starting the operation of the compressor care must be taken to completely fill the pipe A and the cylinder of the compressor with liquid, carefully excluding substantially all free air and being sure that the piston of the compressor is in the outermost position.

It is well known that energy may be conducted through a column of liquid by setting up a wave motion therein. The waves so set up are comparable to sound waves or waves of electric energy. In order to set up such waves it is necessary to cause alternate areas of high and low pressure in the medium and this may be effected by any suitable known means. I find it convenient to use for this purpose a reciprocating piston. The piston of the compressor C when rapidly reciprocated sets up waves in the liquid in the pipe A by alternately compressing the liquid in the pipe and releasing the pressure especially when the piston has a short stroke. These waves have a length L equal to $\frac{v}{n}$ in which n is the number of strokes per second of the piston of the compressor C and v is the speed of the wave per second. When operating in water the speed of the wave may be substantially the speed of sound in the water under the operating conditions.

As may be seen from the diagram in Fig. 2 the wave form includes bulges B^1, B^2, B^3 . . . which are associated with corresponding nodes N^1, N^2, N^3 . . . . When the closed end of the pipe is at a distance from the reciprocating piston equal to any number of half waves, that is at O^1, O^2, O^3 . . . or when the pipe is cut off at a distance equal to any odd number of quarter waves, that is at N^1, N^2, N^3 . . . , a stationary wave may be set up in the pipe. For the purpose of the present invention it is preferred to arrange the valve V at the end of the pipe and adjust the apparatus in such a way that the valve will be at an odd quarter wave length such as N^1, or N^2 etc., but the purpose can be accomplished, possibly less efficiently, by other adjustments.

The maximum variation of pressure accompanied by no variation in flow of the liquid occurs at the points O^1, O^2, O^3 . . . whereas at the nodes N^1, N^2, N^3 . . . the variation in pressure is zero with the maximum variation in flow of the liquid. By the preferred arrangement of placing the valve V at the point N^1 or N^2 etc. the liquid may enter continuously. The valve V tends to remain always open but it may open and close from time to time during the operation. On the other hand the liquid will flow more or less intermittently from the cock R when it is adjusted to the proper opening. The required

pressure in the apparatus may be regulated by choosing an appropriate diameter of pipe and by employing a piston of the proper cross-section, stroke and speed. If required or thought desirable or necessary there may be installed a liquid filled bottle or chamber to act as a capacity or condenser in the manner well known in connection with the transmission of energy by means of waves traveling in liquids.

I have found that one specific appropriate apparatus which will illustrate in a concrete way the present invention may consist of a fluid pipe having an internal diameter of one inch. Such a pipe placed in a well having water at a depth of 20 meters may have arranged at its lower end a valve opening 30 millimeters in diameter seated in which is a ball of approximately 38 millimeters in diameter and held in place by the usual cage which may be adjusted so that the ball can rise from its seat about 20 millimeters. On the surface of the earth the pipe may be led into the cylinder of a compressor of 50 millimeter diameter in which is a piston having a stroke of about 36 millimeters. The piston may be reciprocated at a speed of about 360 revolutions per minute by an electric motor. Leading out from the cylinder of the compressor may be a pipe of one half inch internal diameter in which is placed an adjustable cock or valve. The cock will not be closed but is used merely for adjusting the out flow. The piston will be moved to its outermost position and the cylinder and pipe entirely filled with water, the cock being left open. At this time the ball valve will be closed. On starting the electric motor the ball valve will lift from its seat and may remain open throughout the operation when the cock is properly adjusted, but it may vibrate from its seat opening and closing during the operation. Water will begin to flow from the outlet and by an appropriate adjustment of the cock a continuous operation may be effected and an output of 1,000 liters per hour procured.

While the fundamental theory on which the operation is based may be somewhat in doubt, I believe that the rapid reciprocation of the piston working upon the water in the apparatus produces a series of periodic pressure variations with periodic changes of pressure and volume throughout the liquid column due to the elasticity and compressibility of the liquid. The energy waves so set up travel to the valve V at which point they may be reflected and the transmitted energy is sufficient to open the valve V and lift the column of liquid at the same time drawing in liquid from the well itself. In some systems of energy transmission through liquid there is no substantial flow of the main body of liquid for carrying the energy. I have discovered, however, that apparently the transmission of energy may go through a flowing column of liquid and the transmitted energy may be relied upon to keep the liquid in more or less constant flow.

According to the present invention liquids may be extracted from substantially any depth without using any complicated machinery or mechanism in the well and simply by lowering a pipe of the required length and dimensions duly connected to a simple compressor the latter being at or about the ground level. The valve at the lower end of the pipe will be subject to substantially no wear if the valve is substantially always in its open position during the operation of the compressor. On starting this valve is closed and great care must be taken when filling the pipe and cylinder with liquid to see that substantially no free air remains in the system.

The piston may work either with the cylinder horizontal or with the cylinder vertical or inclined. The pipe through which the liquid flows may be either horizontal or vertical or inclined and it may be curved or straight. All of these arrangements may be referred to as pumps and I use the term pumping as including moving, transporting or conveying in vertical or horizontal or inclined direction.

The term liquids is used to include not only simple liquids but also mixtures of liquids and such mixtures of liquids with gases or solids as are capable of being transported through pipes or pumped.

It is obvious that the device has been shown only as a preferred embodiment and that any other may be used for the same purpose. Apparatus for carrying out the invention may be constructed from mechanisms or devices already known and used for other purposes and the invention is not confined to any specific form of valves or compressors or means of operating them.

I claim:

1. An apparatus for pumping liquids comprising a pipe filled with liquid leading to the liquid supply, a check valve in the end of the pipe in the liquid supply, a compressor cylinder at the other end of the pipe, an open outlet from the cylinder, and a piston in the cylinder and means to cause the piston to alternately compress the liquid in the pipe and release the pressure.

2. An apparatus for pumping liquids comprising a pipe leading to the liquid supply and filled with liquid, a check valve in the pipe within the liquid to be moved, an outlet for the pipe open to the air, and means for alternately compressing the liquid in the pipe and releasing the pressure.

3. Apparatus for pumping liquids comprising a check valve in the liquid supply, a compressor adjacent the point of delivery, a pipe filled with liquid leading from the valve to the compressor, an outlet for the liquid, and means for operating the compressor to

alternately compress the liquid in the pipe and release the pressure to operate the check valve and move the liquid.

4. Apparatus for pumping liquids comprising a check valve in the liquid supply, a compressor at the point of delivery including a cylinder and a piston and an outlet, a pipe filled with liquid extending from the valve to the compressor, and means for reciprocating the piston rapidly through a short stroke whereby the compression of the liquid produced by the piston is varied.

5. The method of pumping liquids comprising alternately compressing a confined body of liquid in a pipe and releasing the pressure and causing the pressure variations to move the liquid toward the compressing means and permit new liquid to enter the pipe from a source of supply.

6. The method of pumping liquid comprising placing in the liquid supply a pipe provided with an outlet near one end and carrying at the other end a check valve in the liquid supply, filling the pipe with liquid, and alternately compressing the liquid in the pipe and releasing the pressure to cause the liquid to flow toward the compressing means near the outlet and to cause new liquid from the supply to enter the pipe.

7. The method of pumping liquids in pipes having outlets comprising repeatedly compressing liquid in the pipe and releasing the pressure, and causing the pressure variations to pass through the liquid so as to cause liquid to enter the pipe and pass through it.

8. Apparatus for pumping liquids comprising means for alternately compressing a body of liquid in a pipe and releasing the pressure, and an outlet for the pipe, whereby the variations in compression cause liquid to enter and flow through the pipe.

9. The method of pumping liquid through a pipe provided with an outlet near one end and a check valve at the other end, comprising placing the check valve in the liquid to be pumped, filling the pipe with liquid and alternately compressing and releasing the liquid in the pipe.

In testimony whereof I affix my signature.

TORIBIO BELLOCQ.