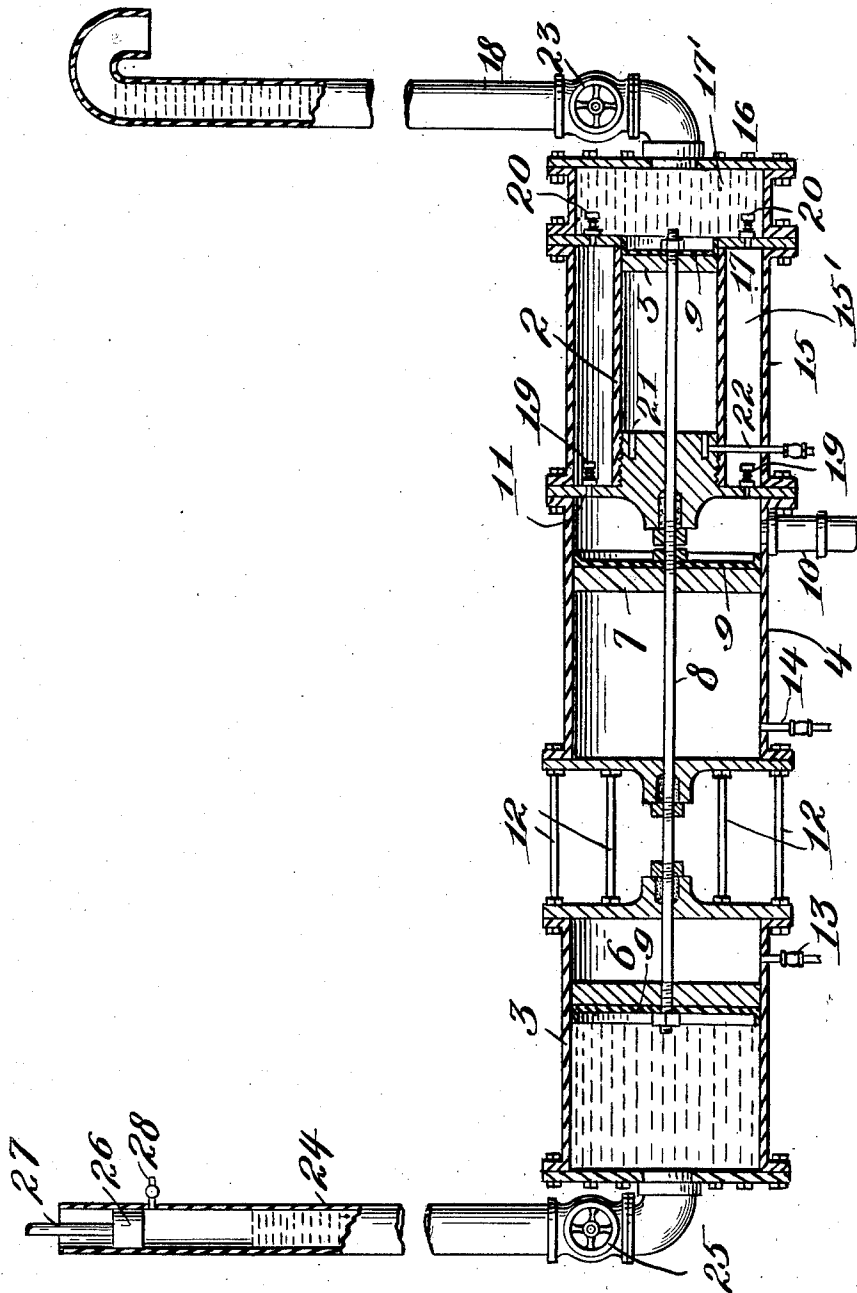


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HYDROSTATIC PUMP.
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HYDROSTATIC PUMP.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, FRANK D. PAGLIUCHI, a subject of the King of Italy, residing at Mantua, Cuba, have invented new and useful Improvements in Hydrostatic Pumps, of which the following is a specification.

This invention relates to hydrostatic pumps.

A pump involving my invention may be put to several advantageous uses, one of which is the elevation of water or other liquid to a considerable height. This result I can obtain in an effective manner by the use of extraneous power which may be either manual or mechanical.

The pump comprises several fundamental relations, one of which is the provision of two pipes each to contain a column of liquid whether the same be water or some equivalent substance, the hydrostatic pressure of one column approximately balancing or equalizing the hydrostatic head or weight of the other column, pump mechanism acted on by the columns of liquid, and means causing an overbalance of hydrostatic pressure alternately in the columns to cause the same to operate the pump mechanism. These several parts may be of any desirable character.

I use a number of terms herein in their broad senses; for instance, when I use the term "pipe" I mean to cover equivalent articles or any means for containing a hydrostatic column, the designation "pipe" simply being used for convenience or as a simple word for covering the article thus familiarly known as well as equivalent devices such as ducts formed in any desirable way.

Another important feature of the invention is in a combination involving a cylinder and its piston, a pipe to contain a hydrostatic column for driving the piston, and a pumping member operable in one direction by the hydrostatic pressure acting on said piston, said pumping member, when moved in the opposite direction, serving to supply liquid pumped thereby to said pipe.

The pumping member to which I have just alluded may be comprised in the pumping mechanism mentioned in the association of parts to which I have first referred. I have indicated that I use the term "pipe" in a generic sense; this statement applies to the element "cylinder," for the cylinder

need not strictly speaking be of the shape thus familiarly known, as it may be of any other suitable form, and such statement applies as well to the piston contained therein. In using the term "column", it will be understood that the pipe or other means for containing the liquid is included.

I have stated generally some of the features of the invention. Reference will be made to others in the following description wherein I set forth in detail that form of embodiment of the invention which I have selected for illustration in the accompanying drawing forming a part of this specification.

The novelty of the invention which resides in certain broad relations, will be embraced in the claims succeeding said description. It will be evident, of course, that I may make certain departures from the particular disclosure made by said drawing and its complementary description. The drawing and description are provided to enable those skilled in the art to practice the invention, and said drawing shows in section said form of embodiment of the pump.

Referring to said drawing, the numerals 2 and 3 designate working cylinders, while the numeral 4 designates a pumping cylinder located between the other cylinders, and these several cylinders form part of the pumping mechanism to which I have referred. The pistons for the respective cylinders are denoted by 5, 6, and 7, respectively, and they are mounted for reciprocatory movement in their coöperating cylinders. In the present instance they are concentric and are shown as connected together by a rod or spindle as 8 fixedly united thereto in any desirable way, by virtue of which one piston may apply its effect to another and vice versa. Those sides of the pistons 5, 6, and 7 which are subjected to the action of water have attached thereto packings each denoted by 9 and which packings may be of leather of approximately cupped-form. The packings prevent passage of water or other liquid from the water spaces of the several cylinders into what might be considered the air spaces thereof.

The piston 7, as will hereinafter appear, constitutes a suitable pumping member, it being adapted on one stroke thereof or, as shown, on the movement to the left, to draw water into the cylinder 4, and, on the opposite or advancing stroke thereof, to expel such water from said cylinder 4. The inlet

for the water may consist of a supply or suction pipe as 10 opening into said cylinder 4 between piston 7 and the forward end of said cylinder. This pipe may lead down into a mine, well, shaft or into any other chamber or cavity containing water to be elevated and may be made of any desirable length. The rear head of the cylinder 2 has an annular flange 11 which, with the said rear head, constitutes the forward head of the cylinder 4 or the dividing wall between said cylinder 4 and the cylinder 2. The cylinder 2 in the construction shown is of less diameter than the cylinders 3 and 4, and the difference in diameter may be as desired to meet certain conditions. The cylinders 3 and 4 are shown in the present instance as completely separated or spaced apart and connected by tie-bolts as 12. Between the piston 6 and the forward head of the cylinder 3 is located a vent as 13, while between the piston 7 and the rear end or head of its cylinder 4 is located a similar vent as 14. By means of the vent 13 air between the piston 6 and the forward head of its cylinder is permitted to escape on the forward stroke of said piston 6, while the same function takes place on the rearward stroke of the piston 7 by virtue of the vent 14, so that there is no back pressure exerted upon said pistons when they are doing work.

The cylinder 2 is illustrated as surrounded by the sectional shell 15 bolted or otherwise suitably fastened in some liquid-tight manner at its rear end to the marginal portion of the annular flange 11. The shell or casing 15 is longer than the cylinder 2, its forward end extending beyond the forward end of said cylinder 2 for a purpose that will hereinafter appear, and being closed by the plate or head 16 bolted or otherwise suitably fastened in place. The forward end of the cylinder 2 is represented as having an external annular flange 17, the marginal portion of which fits between the sections of the shell or casing 15 and is bolted or otherwise suitably fastened to said sections. In fact, all parts when necessary are connected together by water-tight joints. The diameter of the shell or casing 15 is greater than that of the cylinder 2 and in the present case equals substantially that of the two cylinders 3 and 4 respectively. The space 15' between the outside of the cylinder 2 and the inner surface of the shell or casing 15 constitutes a passage for water in its travel from the cylinder 4 toward the discharge pipe 18. The flange or wall 11 is provided with ports controlled by check-valves as 19 which open in the direction of movement of the pumping stroke of the piston or pumping member 7, while the wall or flange 17 is equipped with similar ports controlled by valves as 20. The valves 19 and 20 are normally closed by springs so as to prevent water

flowing into the cylinder 4 from the space or chamber 15'.

It will be seen upon an inspection of the drawing that there is a space or chamber 17' between the wall 17 and the head 16 and that the forward open end of the cylinder opens into this space or chamber 17', and the lower end of the pipe 18 connected with the head 16 opens also into said space or chamber 17'.

The head of the cylinder 2 located at the rear thereof, has in its inner face an annular channel or groove 21 from which a vent pipe 22 leads, said vent pipe extending outwardly from the channel through the cylinder 2 and also through the shell or casing 15. This vent pipe with its valve relieves the cylinder 2 of air pressure between the piston 5 and the head of said cylinder 2, so that there can be no check or retardation of the backward movement of said piston 5.

It will be assumed that there is no water in the apparatus except in the pipe 18 and the space 17' and that the level of the water in the pipe 18 is up to the place indicated and further the valve 23 near the lower end of said pipe 18 is wide open. With this relation the overbalance of hydrostatic pressure of the column of water in the said pipe 18 with respect to that in pipe 24 is sufficient to drive the piston 5 to the extreme left. It follows that as the piston 5 thus moves, the rod 8 and therefore the pistons 6 and 7 are moved in a similar direction. As the piston 7 moves toward the left it draws water up into the cylinder 4 by way of the suction pipe 10. As will hereinafter appear, the pumping stroke of the piston 7 is effected by agents acting upon the piston 6. As the piston 7 moves to the right it expels the water from its cylinder 4 through the ports in the flanges or walls 11 and 17 and up into the pipe 18, causing the column of water in said pipe 18 to rise and to discharge a volume of water substantially equal to the amount displayed by the pump piston 7. All the water, however, is not expelled from said pipe for there is at the moment of discharge a column of water extending as high as the discharge opening, as indicated.

In that form of the invention shown in the accompanying drawing, the discharge pipe or column 18 is constructed of a height sufficiently greater than that of the column or pipe 24 as to permit the liquid in the pipe 18 to rise to a height sufficiently in excess of the column of liquid in the pipe 24 as to act upon its piston 5 and overbalance the force of the liquid in the pipe 24 acting upon its respective piston 9, thereby causing a return stroke of the pumping element as the latter is returned to a position of equilibrium.

The piston 5 acting under the hydrostatic pressure of the column of liquid in pipe 18 imparts, through the intermediate rod 8, a

suction stroke to the piston 7. The return or pumping stroke of said piston 7 is accomplished, as it is believed will be understood, by forces acting against the piston 6, and the same involves a column of water which in itself acts with less power upon the pumping member or element than the column in the pipe 18 but the effect of which is increased by positive means active primarily by hand or by a motor of some kind. Therefore it will be apparent that in the present instance the column of water in the pipe 24 hereinafter described is at a lower level during the return stroke of the pumping element than that in the pipe 18.

To the rear head of the cylinder 3 is shown as connected a pipe 24, the hand-valve 25 near the lower end of which is normally open. This pipe 24 is adapted to contain at all times a column of water which at the commencement of operation is at about the height indicated. The diameter of the piston 6 is preferably considerably greater than that of the pipe 24 so that the pressure applied on top of the column of water in said pipe 24 can act with an increased or multiplied effect upon said piston 6 by virtue of this difference in diameter. The pipe 24 may contain a reciprocatory plunger as 26, the stem 27 of which extends out of said pipe and is operated, as will be obvious, in any desirable way. Upon the lowering of this plunger 26 it acts to drive the water from the pipe 24 so that the hydrostatic effect is such that the piston 6 is moved to the right and in opposition to the hydrostatic pressure of the column of water in the pipe 18. In the present case the piston or plunger 26 does not act directly against the body of water in the pipe 24 and rear portion of the cylinder 3, but there is a body of air or other elastic medium preferably interposed between the said plunger or piston and the upper surface of said body of water. This air, which may enter the pipe 24 by way of the valve-controlled nipple 28, or in any other suitable way, is suddenly compressed by the said plunger or piston on its descending movement, producing an impact or blow which, acting through the column of water, accelerates the working movement of the piston 6 causing a quick discharge of water from the top of pipe 18. The pressure exerted by the piston or plunger 26 is very sudden and greatly in excess of that exerted by the column of water in the pipe 18, in order that it may overcome the hydrostatic pressure thereof and increase the height of the column sufficiently to cause, through co-operating parts, the suction or return stroke of the piston 7. By causing a quick movement of the pumping element by means of the impact just described, the column of liquid in the discharge pipe is instantly

and quickly moved upwardly, relieving the hydrostatic pressure at the bottom of said column and enabling the liquid discharged by the piston 7 to readily enter the column. As the discharge opening in the pipe 18 is at a height greater than that of the pipe 24, the liquid elevated in the discharge pipe will overbalance at the end of the working stroke of the pumping element, the liquid contained in the pipe 24, this overbalance being sufficient to overcome the incidental friction and any suction that may be required to fill the cylinder 4 and also the hydrostatic head of the liquid remaining in the pipe 24, thereby producing the return stroke of the pumping element.

To operate the pump the pipe 18 is first supplied with water substantially to the level indicated, and the valve 23 being open, the hydrostatic pressure of the column of water in said pipe 18 is applied to the piston 5 causing said piston to move backward or toward the left in the present case, to the end of its stroke. As said piston 5 is connected with the pistons 6 and 7 by the rod 8, said pistons 6 and 7 are moved in a corresponding direction and on such movement of said piston 7 it draws water into the cylinder 4 by way of the pipe 10. The pipe 24 is also supplied with water up to a desired height or level and lower than that of the maximum level of the water in the pipe 18. To obtain the working or forward stroke of the three pistons and therefore the discharge of water drawn into the cylinder 4 by the piston 7, the plunger 26 is utilized. The weight of this plunger or the power applied thereto is in excess of the hydrostatic pressure developed by the column of water in the pipe 18. This has the virtual effect of giving the column of water in the pipe 24, in connection with the weight of the said plunger or the power applied thereto, a greater hydrostatic pressure than that in the pipe 18. In other words, the plunger 26 on its descent increases the hydrostatic pressure of the column in the pipe 24 and exerts a force against the piston 6 sufficient to drive the same to the right. As the piston 6 moves to the right the pistons 7 and 5, through the intermediate rod or spindle 8, are correspondingly moved, and during the travel of the piston 7 toward the right, it expels the water drawn into the cylinder 4, into the chamber or space 15', and into the pipe 18 causing a volume of liquid to be discharged from the latter. Owing to an elastic compression exerted at the surface of the water in the pipe 24 a very rapid movement or blow is produced by the plunger 26, and the impact or sudden pressure produced on the liquid in the column 24 is instantly transmitted therethrough to the pumping element, the working movement of the piston 6 being very sudden or accelerated to an

extent sufficient to insure the quick discharge of the water from the cylinder 4 by the piston 7 into the discharge column, the concentration of power produced by the impact enabling the hydrostatic pressure in the discharge column to be readily overcome.

The movement of the pumping element toward the right causes the hydrostatic column in the pipe 18 to rise to the height of its discharge opening, a level higher than the level of the hydrostatic column in the pipe 24, and this increase in height of the column in pipe 18 produces a hydrostatic pressure in the latter pipe sufficiently in excess of that in the opposing column in pipe 24 as to act on the piston 5 with ample force to cause a return movement of the pumping element toward the left, and as the pumping element moves in such direction, the height of the column in pipe 18 falls or decreases until it is in substantial equilibrium or balance with that contained in the pipe 24, the excess of hydrostatic pressure of the column contained in the pipe 18 serving automatically or inherently in the present instance to produce the movement of the pumping element in one direction.

It is generally preferable to arrange one of the hydrostatic columns so as to act on a relatively small piston area on the pumping element, and the other or opposing column so as to act on a relatively larger piston area on such element, in order that a mechanical advantage may be obtained by the pressure producing plunger in one column over the piston area upon which said column acts, and by arranging the discharge column so as to act upon a relatively small piston area to effect the return movement of the pumping element, the column of liquid in the discharge pipe does not fall through any considerable distance. The pump shown in the present instance, as an example, embodies a pumping element having such different effective piston areas, and one of the columns is extended a sufficient distance above the level of the liquid in the opposing column as to produce a sufficient overbalance of hydrostatic pressure to effect the return stroke of the pumping element. It will be understood, however, that the invention is not limited in this respect and that in some cases it may be possible to employ a pumping element having piston surfaces or areas of substantially equal extent upon which the respective hydrostatic columns act. In the present instance, the pipe 18 also extends a distance above the level of the liquid in pipe 24 sufficient to produce the necessary overbalance in hydrostatic pressure by reason of the rising of the column therein, as to effect the return stroke of the piston element. In some cases, however, the two pipes may be of substantially equal height, the necessary overbalance in the hydrostatic pressure of

one column with respect to the other being obtained, if so desired, by making the piston areas of the pumping element of equal size or by mechanically applying pressure to each column alternately.

Hydrostatic apparatus constructed in accordance with my invention is capable of use generally in various connections, and it is especially adapted for use as a pump or liquid elevating apparatus for lifting a liquid through a considerable height, as the hydrostatic column in one of the pipes substantially balances or equalizes the hydrostatic pressure or head in the other pipe, the applied power serving to cause a descending movement of the liquid in one pipe and a corresponding ascending movement in the other pipe, and the return strokes of the pumping element being effected in the present instance by the overbalance of hydrostatic pressure in the discharge column and by reason of the balancing effect of the columns, the pump may be installed so as to elevate liquids from the bottom of mines, wells and in other connections where a considerable vertical lift of the liquid is required.

What I claim is:

1. In a pump, the combination of a pumping element, of a column of liquid being pumped and a column of liquid opposing it between which columns the pumping element will be approximately in equilibrium when in one position and out of equilibrium in another position, and means for alternately applying, by impact through the medium of an elastic body, and removing, power with respect to one of said columns, whereby the pumping element is moved from its position of equilibrium by such application of power and returned to such position by the column of liquid being pumped.

2. Hydrostatic apparatus comprising pipes to contain hydrostatic columns arranged in balancing relation, a pumping element having pistons acted on by the hydrostatic heads of both columns, and means for producing an impact upon one of said columns through the medium of an interposed elastic body to create an overbalance of the hydrostatic head of one column to cause a discharge of liquid therefrom and for causing a displacement of the pumping element, the latter being acted on by the hydrostatic head of the column having the overbalance of hydrostatic pressure to cause a reverse stroke thereof.

3. Hydrostatic apparatus comprising hydrostatic columns, one of said columns having a discharge permanently open to the atmosphere, a pumping element having a pair of pistons acted on by the hydrostatic pressure of both columns, and an impact-producing device acting on one of said columns

through the medium of an elastic body for actuating the pumping element to cause a discharge of liquid from the column communicating with the atmosphere, the atmospheric pressure acting on said column and the overbalance of hydrostatic head thereof causing return movement of the pumping element.

4. Hydrostatic apparatus comprising a pair of hydrostatic columns, a pumping element embodying a piston acted on by the hydrostatic pressure of one column, a piston of relatively larger surface acted upon by the hydrostatic pressure in the other column and also having a liquid discharging piston communicating with one of said columns, and means for increasing by impact and through the medium of an elastic body the hydrostatic pressure of the column which acts upon the relatively larger piston surface.

5. Hydrostatic apparatus comprising a pair of hydrostatic columns of different heights, the longer column having a discharge permanently open to the atmosphere, a pumping element having a relatively small piston area acted on by the hydrostatic pressure in the higher column, having a relatively larger piston area acted on by the hydrostatic pressure in the shorter column and also having a liquid discharging piston communicating with the base of the relatively longer column, and means for overbalancing by impact and through the medium of an elastic body the hydrostatic pressure in the shorter column with reference to that in the longer column.

6. Hydrostatic apparatus comprising a pair of hydrostatic columns, a pumping element having a pair of pistons of different effective areas acted upon by the hydrostatic pressure in the respective columns and also having a liquid discharging piston communicating with the base of the column, the liquid of which acts upon the relatively smaller piston, and an impact producing device acting on one of said columns through an elastic medium to produce a sudden overbalance of hydrostatic pressure in such column to effect a movement of the pumping element.

7. Hydrostatic apparatus comprising hydrostatic columns having a normal tendency to balance, a pumping element acted on by the hydrostatic pressure in said columns, and means acting by impact and through an elastic medium on one column to actuate the pumping element in one direction and produce an overbalance of hydrostatic pressure in the other column, such overbalance of hydrostatic pressure serving to effect a return movement of the pumping element.

8. Hydrostatic apparatus comprising a pair of hydrostatic columns, one of said columns being of greater height than the other and serving as a liquid discharge, a

pumping element having pistons subject to the hydrostatic pressure of both columns and also having a liquid discharging piston communicating with the relatively longer column, and means acting by impact and through an elastic medium on the shorter column to operate said pumping element to overcome the hydrostatic pressure of the discharge column for producing an overbalance of hydrostatic pressure in the longer column to act upon the pumping element to produce a return movement thereof.

9. Hydrostatic apparatus comprising a pair of hydrostatic columns, one of said columns being of greater height than the other and having a liquid discharge, an impact producing device acting through an elastic medium upon the shorter column, and a pumping element having a pair of pistons acted on by the hydrostatic pressure of both columns and also having a liquid discharging piston communicating directly with the base of the higher column, the said pressure device producing an overbalance of hydrostatic pressure in the higher column driving said pumping element in one direction, the said overbalance of hydrostatic pressure serving to produce a return movement of the pumping element.

10. Hydrostatic apparatus comprising pipes to contain hydrostatic columns in balancing relation, a pumping element having piston surfaces of different areas acted on by the hydrostatic pressure of the respective columns and also having an additional liquid discharging piston communicating directly with the base of one of said columns, a plunger communicating with the column acting on the piston surface of larger area and having an area less than that of the said piston surface of the pumping element, and means for maintaining an elastic body between said plunger and the top of the column on which it acts, said plunger acting by impact to increase the hydrostatic pressure of its respective column to actuate the pumping element.

11. Hydrostatic apparatus comprising a pair of hydrostatic columns, one having a discharge, a pumping element having a pair of pistons acted upon by the hydrostatic pressure of both columns and also having an additional liquid discharging piston communicating with the base of one column, and a plunger having a body of air interposed between it and the surface of liquid in one of the columns for producing by impact an accelerating movement of the pumping element with respect to said plunger, and means for admitting air to the space beneath said plunger.

12. Hydrostatic apparatus comprising a pair of pipes adapted to contain columns of liquid, one of said pipes having a discharge, a pumping element having piston sur-

faces acted upon by the hydrostatic pressure of both columns and also having a liquid discharging piston communicating directly with the base of one of said pipes, a plunger having a body of air interposed between it and one of said columns and serving to produce by impact a quick movement of the pumping element, the latter causing a corresponding quick movement of the liquid column in the discharge pipe, and a valve for admitting air to the space beneath said plunger.

13. Hydrostatic apparatus comprising a pair of pipes adapted to contain columns of liquid, one of said columns serving as a power medium, and the pipe containing the other column being of greater height and provided with a discharge, a pumping element having piston surfaces subject to the hydrostatic pressure of both columns and also having a liquid discharging piston communicating directly with the base of one of said pipes, and a plunger mounted in the shorter pipe and having a body of air interposed between it and the surface of the liquid contained therein, said plunger being adapted to produce an impact upon the shorter column which is transmitted to the pumping element causing a quick power stroke thereof which will suddenly lift the liquid contained in the discharge column, the rising liquid in the discharge column causing an overbalance of hydrostatic pressure in such column which will effect the return stroke of the pumping element.

14. A pump having a cylinder, a piston in said cylinder, a shell surrounding said cylinder and extending beyond one end of the same, a second cylinder, a wall for closing communication between the first cylinder and the second cylinder and provided with a check-valve, a head for the said shell, a second wall also provided with a check-valve, between said first cylinder and head, a pipe to contain liquid, communicating with the space between said second wall and head, the liquid from said pipe serving to drive said first piston, a second piston constituting a pumping member in said second cylinder, and adapted to be advanced by the first piston when the latter is moved by said liquid, and means for imparting a pumping or discharge stroke to said second piston.

15. A pump comprising an upright liquid containing pipe, a reciprocatory pumping element embodying a relatively small piston acted upon directly at its forward side only by the hydrostatic pressure of the liquid in said pipe, and a cylinder having a liquid inlet and provided with a piston relatively larger in area than the piston first mentioned, means for conducting liquid from one side of said larger piston to said pipe at the point where said smaller piston

is acted on by the liquid in said pipe and having a valve for preventing return flow of such liquid to the larger piston, the rear side of the smaller piston being out of communication with said pipe and the larger piston, and means for actuating by impact and through an elastic medium the pumping element to discharge liquid from said cylinder into said pipe.

16. A pump comprising a pair of upright liquid containing pipes, a pumping element embodying a piston arranged to be acted on by the hydrostatic column in one of said pipes, and a cylinder having a liquid supply pipe and provided with a piston connected to move with the piston first mentioned, a discharge passage leading from one end of said cylinder and communicating with the pipe at a point where the liquid in which pipe acts on the piston first mentioned, the hydrostatic pressure of the liquid in one of said pipes being prevented from acting on the rear side of one piston and the forward side of the other piston, a valve for permitting discharge of liquid from said cylinder and through said passage and preventing return flow of fluid through such passage, and means to act by impact and through an elastic medium on a column of liquid in one of such pipes for moving the pumping element to discharge liquid from said cylinder through said passage leading therefrom.

17. A pump comprising a pair of end cylinders each containing a piston and connected for simultaneous movement, an intermediate cylinder having an inlet for liquid and a piston to operate therein, a pipe to contain a column of liquid adapted to act hydrostatically on one side only of the piston in one of said end cylinders, a valve controlled passage leading from one side of the piston of the intermediate cylinder to said pipe at a point where the liquid therein acts on the respective end piston, direct communication between the intermediate and end cylinders being prevented, a second pipe to contain a column of liquid to act hydrostatically on the other end cylinder to operate the piston therein, and a suitably operated plunger in the second pipe for increasing through an elastic medium the hydrostatic pressure therein.

18. Hydrostatic apparatus comprising an upright pipe to contain a hydrostatic column and having a liquid discharge in its upper portion, a pumping element having a piston acted on by the hydrostatic pressure of the said column and having a second piston communicating with said pipe at the point where the piston first mentioned is acted on by the hydrostatic pressure of the liquid therein, balancing means acting on said pumping element in opposition to the said column, the column being capable

of moving the pumping element in opposition to said balancing means to draw in a volume of liquid, and means co-acting through an elastic medium with said balancing impact producing means for quickly moving by impact the pumping element to overcome the hydrostatic pressure of said column and discharge a volume of liquid therefrom.

10 19. A hydrostatic pump comprising a reciprocatory pumping element having a plurality of piston surfaces thereon, a column adapted to contain a liquid, and a connection provided with a branch passage which
15 establishes communication between one of said piston surfaces and said column and having a second branch passage which leads from another piston surface on the pump-

ing element into the branch passage first mentioned, a non-return valve for permitting a flow of liquid in one direction only through said second branch passage, and means for operating the pumping element to effect a discharge of liquid thereby comprising a second column adapted to contain
20 a liquid, a plunger and means for maintaining a body of air between the plunger and the liquid in said column.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

FRANK D. PAGLIUCHI.

Witnesses:

HEATH SUTHERLAND,
CHAS. S. HYER.

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