

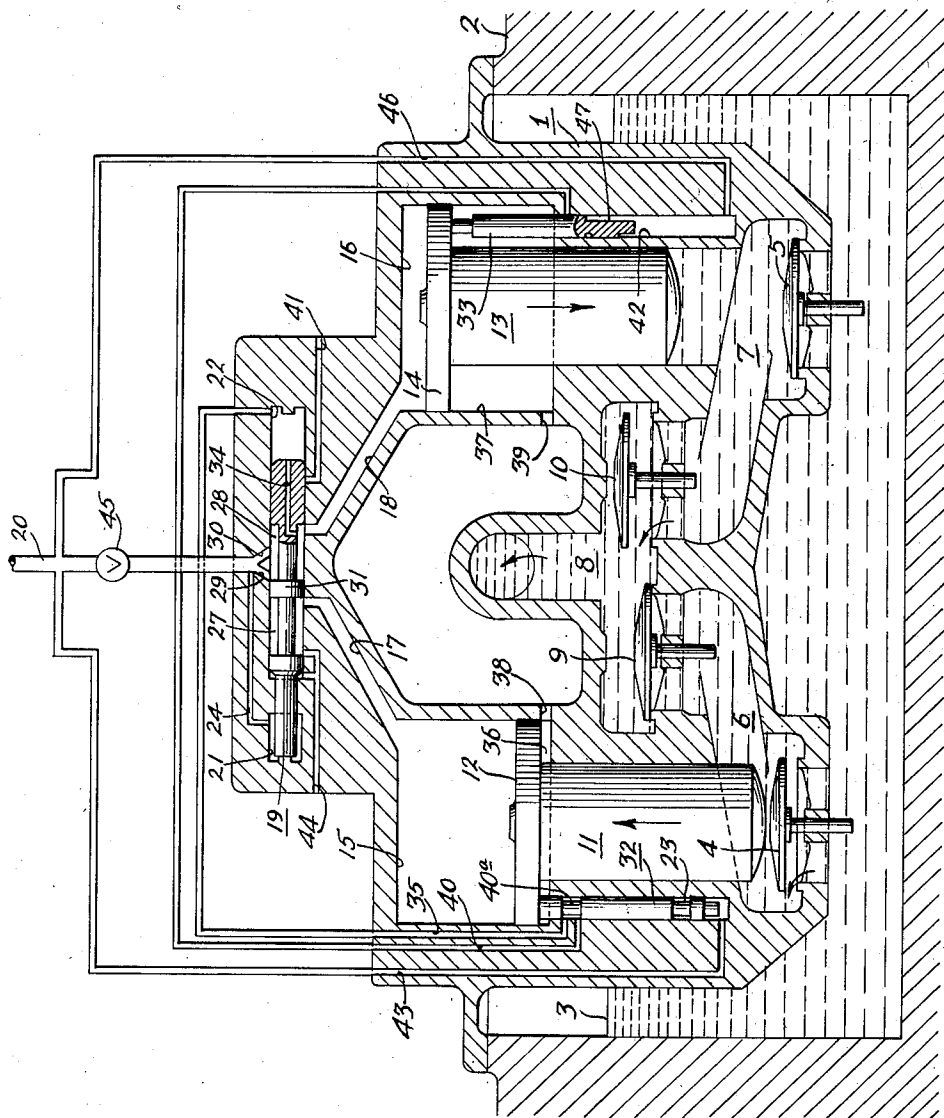
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PNEUMATIC LIQUID PRESSURE PUMP

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PNEUMATIC LIQUID PRESSURE PUMP

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The present invention relates to a liquid pressure pump in which liquid pressure is obtained by permitting air pressure to act alternately on two pistons which each actuate a pump piston in such a manner that pressure liquid is obtained at a constant pressure and temperature and in which the capacity will always adjust itself automatically at each moment in accordance with the consumption of pressure liquid for the time being.

The device according to the invention is provided with a plurality of differential pistons arranged to operate mechanically independent of each other in separate cylinders, the said pistons being subjected at one outer end surface to pressure from a gaseous pressure medium and acting with their other outer end surfaces upon a liquid for example oil.

The purpose of the invention is to provide a device of this kind which operates satisfactorily even when such great quantities of liquid are consumed that the working stroke of the pump takes place during a shorter period than the return stroke. It is characterized mainly thereby that the pistons are governed mechanically independent of each other by a distributing valve or valve system common to all the pistons, the said valve or valve system being in communication with the pistons in such a manner that one of the pistons completes its return stroke before the working piston gives the necessary impulse for movement of the distributing valve and that the first mentioned piston, after beginning its working stroke, creates full pressure in the liquid to be expelled during the next working stroke while pressure is still maintained in the outlet line by the other piston.

The accompanying drawing shows diagrammatically a form of a device according to the invention.

The device comprises a cylinder and valve casing 1 submerged in a liquid container 2 containing a liquid 3 which by way of valves 4 and 5 can flow into two lower chambers 6 and 7 in the valve casing 1.

From the chambers 6 and 7 the liquid can flow to an upper chamber 8 through valves 9 and 10 respectively. The chamber 8 is intended to be connected through one or more pipes, for example to the manoeuvre members which control the movements of the machine parts to be actuated by hydraulic pressure.

The cylinders for the lesser ends of two differential pistons 11—12 and 13—14 are each in direct communication with one of the chambers 6 and 7. The greater ends 12 and 14 of the differential pistons move in cylinders 15 and 16 respectively which are alternately put into communication through channels 17 and 18 with an air pressure line 20 and with the atmosphere by means of a piston valve 19.

Two end chambers 21 and 22 for the piston valve 19, the effective piston area of which is about twice the size in the end chamber 22 as in the end chamber 21, are in communication with the air pressure line 20 and with the atmosphere in such a manner that the piston valve 19 is actuated in a direction towards one of its end positions by the pressure of the air in the opposite end

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chamber. The air pressure line 20 to both valve chambers 27 and 28 of the piston valve divides into two branches 29 and 30 which open into the piston valve at a greater distance from each other than the length of the central portion 31 of the piston valve. For this reason both cylinder chambers 15 and 16 can never be cut off simultaneously from the air pressure line 20.

The differential pistons 11—12 and 13—14 are raised by small auxiliary pistons 32, 33 (of which several, for example three, are provided for each differential piston) actuated by air pressure through channels 43 and 46 as soon as the respective cylinder chambers 15 or 16 are put into communication with the atmosphere by the piston valve 19.

As the piston 14 approaches its lower end position the valve chamber 22 is put into communication with the atmosphere only if the differential piston 11—12 is in one of its end positions or in the immediate vicinity thereof in which position one of two annular channels 40a or 23, connect the channels 35 and 40 with each other. The end chamber 22 will then communicate with the atmosphere through the channel 35, the annular channel 40a or the annular channel 23, the channel 40, the cylinder 37 and the opening 39. The end chamber 21 is in continual communication with the air pressure line 20 through the channel 24 and the piston valve 19 is thus displaced towards the right. The end chamber 22 is hereby also put into communication with the atmosphere through the channel 34, the valve chamber 28 and the channel 41. The cylinders 36 and 37 are in constant communication with the atmosphere through channels 38 and 39. They are therefore always pressureless whereby all risk that air can leak between the pistons 11 and 13 and the cylinder walls is avoided.

The device functions as follows.

In the position in which the piston valve 19 is shown air pressure is communicated from the line 20, the channel 29—30 to the valve chamber 28, through the channel 18 to the cylinder chamber 16 and forces the piston 14 downwards.

The liquid under the piston 13 is thus subjected to a pressure which depends on the pressure of the air and the relationship between the areas of the pistons 13—14. As pressure liquid is withdrawn from the pipes connected to the chamber 8, liquid is forced from the chamber 7 through the valve 10 to the chamber 8. When the differential piston 13—14 has been forced down so far that the upper end of the auxiliary piston 33 opens a channel 40 from the valve chamber 22, the latter will be put into communication with the atmosphere if the differential piston 11—12 is in one of its end positions through the channel 35, the annular channel 40a (or annular channel 23), the channel 40, the cylinder 37 and the opening 39 and will thus be practically pressureless. The piston valve 19 is then displaced to its right hand end position by the air pressure in the end chamber 21 whereby the cylinder 16 will be put in communication with the atmosphere through the channel 18, the valve chamber 28 and a channel 41. The end chamber 22 is thus put into communication with the atmosphere also through the restricted passage 34, the valve chamber 28 and the channel 41 and will remain in communication with the atmosphere even when the channel 40 is closed.

Under the influence of the pressure of the air in the cylinders 42, the differential pistons 13—14 will now be moved upwards by the auxiliary pistons 33 and the valve 10 will close of its own weight. Hereby the valve 5 will be opened, partly by the static pressure of the liquid 3 in the container 2 and partly by the sub-pressure created in the chamber 7 as the piston 13 moves upwards.

During the above described movement towards the

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right of the piston valve 19 the cylinder chamber 15 was put into communication with the air pressure line 20 through the channel 29, valve chamber 27 and the channel 17. Before the channel 30 was closed by the valve body 31, both cylinder chambers 15 and 16 were in communication with the air pressure line 20. Thus a drop in pressure of the liquid in the chamber 8 upon movement of the piston valve 19 from one end position to the other is prevented, even if liquid is simultaneously being withdrawn. Through the action of air pressure in the cylinder chamber 15 the piston 12—11 is forced downwards. The liquid under the piston 11 is then subjected to the same pressure as that already existing in the chamber 8 and, as long as liquid is being withdrawn therefrom to the machine cylinders connected thereto, the differential piston 11—12 will sink, thereby forcing liquid from the valve chamber 6 through the valve 9 to the chamber 8.

The downward movement of the differential piston 11—12 continues until it reaches the immediate vicinity of its lowest position where the annular channel 40a connects the channels 35 and 40 with each other and puts the end chamber 22 into communication with the air pressure line 20 through the channel 46, the cylinder 42, the groove 47, the channel 40, the annular channel 40a and the channel 35. This is under the condition that the differential piston 13—14 has completed its return stroke. Since the effective area in the end chamber 22 is about twice the size of that in the end chamber 21 the piston valve 19 is again displaced towards the left. The connection between the end chamber 22 and the atmosphere through the restricted passage has such small area as compared to the areas of the pressure air inlet that it is of no importance. As soon as the channel 41 has been closed during the movement of the piston valve the communication between the end chamber and the atmosphere will be broken.

If no liquid is being withdrawn from the chamber 8 one of the differential pistons 11—12 or 13—14 will always exert a static pressure on the liquid in the chambers 6 or 7 respectively.

The piston valve has now assumed the position described earlier and the differential piston 13—14 is again on its way downwards or is maintaining the pressure in the chambers 7 and 8.

Through the position of the piston valve 19, the cylinder chamber 15 is in communication with the atmosphere through the channel 17, the valve chamber 27 and the channel 44. The air driven auxiliary pistons 32 force the differential piston 11—12 upwards to its upper end position where it will remain until the differential piston 13—14 has completed its working stroke and the piston valve 19 is thereby moved in the manner described. As long as liquid is being withdrawn from the chamber 8 the device will thus continue to

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function at the speed required to maintain a pressure in the chamber 8 which corresponds to the pressure of the air and the relationship between the areas of the differential pistons. As soon as liquid is no longer being withdrawn from the chamber 8 the device will stop with at least one piston acting upon the contained liquid to maintain the constant pressure for which the device has been adjusted. At each withdrawal from the chamber 8 one of the pistons 13—14 or 11—12 will carry out the corresponding movement. By adjusting a reducing valve 45 in the air pressure line 20 to a pressure corresponding to a certain pressure on the liquid this latter can be adjusted as required.

I claim.

1. A pneumatic liquid pressure pump having a plurality of differential pistons working in separate cylinders the said pistons being subjected at one outer end surface to a gaseous pressure medium, preferably air, from a common source thereof, and acting with their other end surfaces upon a liquid, for example oil, to draw the liquid into a cylinder on the suction stroke and to expel the liquid on the subsequent pressure stroke to a common accumulator, means including a distributing valve common to said cylinders for selectively directing the gaseous medium directly from said source to the cylinders to actuate the pistons mechanically independently of each other, means responsive jointly to the termination of the suction stroke of one of the pistons and to the movement of another of the pistons into the end of its pressure stroke for actuating the distributing valve to reverse the strokes of the two last named pistons, and means in said valve for applying pressure of said gaseous medium from said source to both of the said two pistons simultaneously during the said stroke reversing actuations of the valve until completion of the individual actuation.

2. A pneumatic liquid pressure pump according to claim 1 in which the distributing valve comprises a piston displaceable in a cylinder, means for maintaining one end of the said valve cylinder in continuous communication with a source of pneumatic pressure, means for putting the other end of the valve cylinder alternately into communication with the said pressure source and with the atmosphere, the area of said piston exposed to the fluid pressure in the first named end of the valve cylinder being less than the area of the piston exposed in the said other end of the valve cylinder.

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