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COMPRESSOR UNIT

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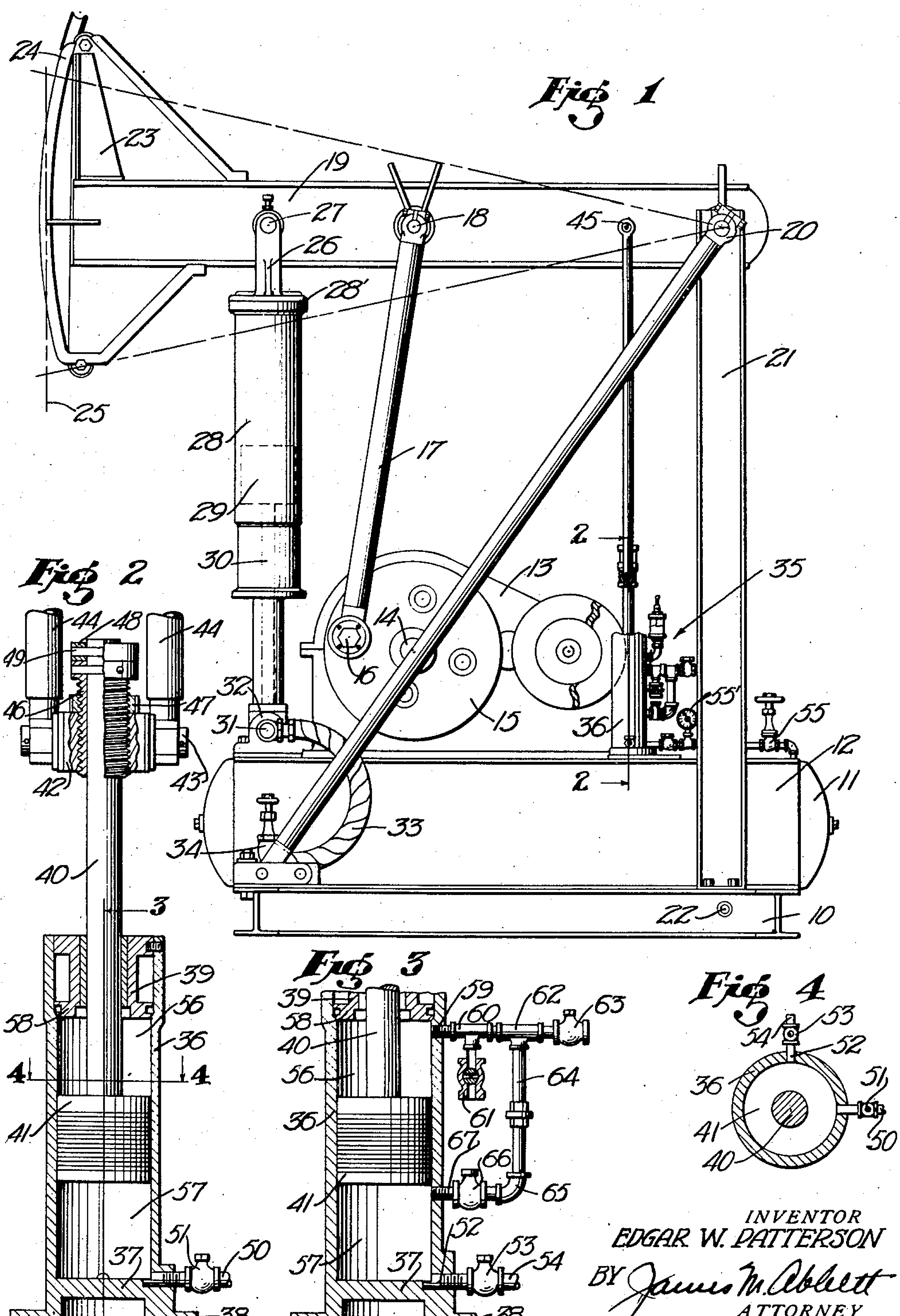

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COMPRESSOR UNIT

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This invention relates to pump structures, and particularly pertains to a compressor unit especially adapted for use in connection with counterbalance mechanism of well pump structures.

In the operation of deep well pumps, and particularly those embodying the use of a fluid counterbalance, as is disclosed in my co-pending application entitled Well pump construction, filed concurrently herewith, it is necessary to provide compressor means which will act to maintain fluid within a receiving tank at a substantially constant pressure. It is desirable to provide a compressor structure of the reciprocating type fitted with adjustable means whereby a predetermined pressure in a receiving tank may be maintained, even though its reciprocating stroke is uniform as to length and piston displacement. It is the principal object of the present invention to provide a compressor of the reciprocating type having a constant length of stroke and which structure may be so adjusted as to insure that a desired fluid pressure will be exerted by the piston to maintain a constant fluid pressure within a receiving tank with which the structure constantly communicates without the use of regulating valves, governors, or other control means for this purpose.

The present invention contemplates the provision of a pump cylinder within which a piston reciprocates, said cylinder being connected with constant reciprocating means whereby the piston will be given a constant stroke within the cylinder, the connecting means being adjustable to vary the volume of the compression space, and said cylinder being fitted with other adjustable means whereby the said pressure of a receiving tank with which the compressor is connected may be maintained constantly at a predetermined pressure.

The invention is illustrated by way of example in the accompanying drawing in which:

Figure 1 is a view in side elevation showing the application of the present invention to a pump structure.

Figure 2 is an enlarged view in vertical section and elevation showing the pump unit as seen on the line 2—2 of Fig. 1, and particularly disclosing the compression space adjusting means.

Fig. 3 is a view through the pump unit as seen on the line 3—3 of Fig. 2 and shows the connections provided between the opposite ends of the pump cylinder whereby the pump may be compounded.

Fig. 4 is a view in transverse section as seen on the line 4—4 of Fig. 2 and shows the relative arrangement of the inlet and outlet connections of the cylinder.

Referring more particularly to the drawing, 10 indicates the sub-frame of a pumping unit of the type with which the present invention may be concerned. Carried by this sub-frame is a base unit which includes a receiving tank 11 and structural frame members 12 rigidly connected therewith. Mounted upon the base unit is a power unit 13 which includes a driving means and gear reduction means through which a shaft 14 may be driven. Secured upon the shaft 14 is a crank disc 15 from the face of which a crank pin 16 projects. Engaging the crank pin is a connecting rod 17, the upper end of which connects to a pivot 18 carried by the cross head of a rocking beam 19. The beam 19 is pivoted for vertical swinging movement upon a fulcrum shaft 20. The fulcrum shaft 20 is carried at the upper end of vertical posts 21 which extend downwardly upon the opposite sides of the base structure and are connected with the sub-frame 10 by bolts 22 which engage an end shoe bolted to the posts 21. The outer free end of the rocking beam 19 carries a "horse head" 23 formed with a segment 24 over which the reins 25 of a pump polish rod are led. Rocking beam cushion and counterbalance means are provided and disposed between the free end of the rocking beam and the connecting rod 17 by which power is applied to the beam. This cushioning and counterbalancing means comprises a bracket 26 pivoted on a shaft 27 carried by the rocking beam. A cylinder 28 is secured to the bracket 26 and depends therefrom. Mounted within the cylinder 28 is a piston 29 which is carried at the upper end of a tubular piston rod 30, said rod extending from the bottom of the cylinder. The lower end of this rod is fitted with a cross shaft 31 carried in bearings 32. The cross shaft is also tubular and is connected to a conduit 33 which leads from the cross shaft to the air receiving tank 11. A valve 34 controls the flow of fluid to and from the container 11 through the conduit 33. Thus the down stroke of the rocking beam 19 as brought about by rotation of the crank disc 15 and the weight of the pump rods in the well will be resisted by compressed fluid between the cylinder head 28' and the piston 29. On the up load stroke the rocking beam will be actuated by the rotation of the crank disc, its crank pin 16, and the connecting rods 17. This force will be augmented by the pressure of the fluid within the receiving tank 11, by reason of its being in unrestricted communication with the compression space in cylinder 28, the piston 29, and the piston rod 30.

In connection with a pumping unit of the type previously described, a compressor unit of the type shown particularly in Figs. 2 and 3, is desirable for the reason that such a structure can act incidental to the operation of the oscillating rocking beam to maintain the pressure of the fluid within the receiver 11 constant. This is accomplished by the compressor unit generally indicated at 35 in the drawing, and shown as mounted upon the base unit. The compressor unit 35 comprises a cylinder 36 which is formed with a closed head 37 at its lower end, the cylinder being secured to the base unit by a footing member 38. The upper end of the cylinder is fitted with a packing gland 39 through which a piston rod 40 reciprocates. Attention is directed to the fact that this gland is of considerable length and acts to prevent the piston rod from being laterally displaced as it reciprocates. Mounted on the lower end of the piston rod 40 is a piston 41. Mounted at the upper end of the piston rod 40 is a cross head 42 fitted with trunnions 43 which are rotatably disposed within bearings at the lower ends of a pair of pitman rods 44. The upper ends of these rods are secured to the rocking beam 19 by pivots 45. The cross head carries an adjustable sleeve 46 which is threaded through the cross head and has a central bore to receive the piston rod 40. A nut 47 is mounted upon the sleeve and adjustably locks the sleeve in a desired position. Lock collars 48 are pinned on the upper end of the piston rod 40 by shear pins 49 which may be sheared in the case of excess strain acting upon the piston 41. It will also be seen that by the adjustment afforded by the sleeve 46 the piston rod may be shifted so that the piston will occupy a different stroke position within the cylinder. This piston and the cylinder forming the compressor act in accordance with the well known isothermol compression formula in which:

$$\frac{V_1 \times P_1}{V_2} = P_2$$

Under this formula the piston when adjusted will act to change the compression ratio, as for example:

$$\frac{V_1 \times P_1}{P_2} = V_2$$

By this arrangement it is possible to adjust the piston within the cylinder to obtain any desired pressure from the compression fluid and to insure that this will be maintained when in constant communication with the air receiver 11 into which the fluid is injected.

As shown in Fig. 2 of the drawing an air inlet 50 communicates with a check valve 51 through which fluid may be drawn into the portion of the cylinder below the piston 41. An air outlet 52 is fitted with a check valve 53 and supplies air through a pipe 54 to the receiving tank 11. A valve 55 is interposed in this line as well as a pressure gauge 55′ said valve 55 being located between the gauge 55′ and tank 11 so that, by closing valve 55, the pressure of air developed by the adjusted air pump will at once appear on the gauge 55′. The piston 41 divides a cylinder 36 into an upper compression space 56 and a lower compression space 57. The lower end of the lower space is defined by the end wall 37. The upper end of the upper space is defined by an end wall 58 of the packing head 39. A pipe 59 extends through the wall of the cylinder 36 adjacent to the end wall 58. As here shown a T connection 60 is attached to the pipe and on a laterally extending leg carries a stop-cock 61. A second T 62 is connected to the first T and in turn carries a check valve 63 through which air may be drawn into the pipe 59, but may not flow in the opposite direction. Connected to the lateraly extending leg of the T 62 is a pipe 64 which is fitted at its lower end with an elbow 65 attached to a check valve 66. The check valve 66 permits the flow of fluid into the cylinder but not in an opposite direction. A pipe connection 67 is attached to the check valve 66 and extends through the wall of the cylinder 36 at a point where it will be covered on the lower portion of the down stroke of the piston and uncovered for a portion of the upstroke of the piston. It is to be understood that the valve 51 connecting with the lower cylinder compartment 57 is a check valve which will allow inflow of the fluid to the cylinder but will prevent an outflow of fluid. The valve 53 is a check valve which at all times allows regulated communication between the compartment 57 of the cylinder and the receiving tank 11. This is of considerable importance in the present device due to the fact that the pressure within the compartment 57 of the cylinder and the receiving tank will be the same, and for the further reason that this arrangement does not cause all of the fluid within the cylinder 36 to be discharged into the receiving tank. Thus there is no tendency to build up heat in the compressor unit, as by this arrangement it will be noted that after the pressure in receiver 11 has reached the pressure at which the compressor is set the same fluid is being compressed and expanded as the piston reciprocates, The valves and the piping which establishes communication from the pipes 59 to 67 make it possible to supercharge the cylinder as the piston 41 makes an upstroke. This, however, may be optionally done by control of the stop cock 61.

In operation of the present invention the required pressure for the receiving tank 11 is determined by the load under which the pumping mechanism is working and by the pressure of fluid necessary within the cylinder 28 to cushion and counterbalance this load and to also aid in lifting the rocking beam 19. The valve 34 may be closed to stop the passage of fluid through conduit 33 and the piston 30 to the cylinder 28 if desired. It will be assumed for example that the fluid pressure required is one hundred pounds. It will then be evident that the compressor unit 35 must be adjusted to maintain the one hundred pounds pressure in the receiving tank 11. Pressure may be determined by operating the compressor and closing the valve 55, and reading the pressure indicated on the gauge 55′. The performance of the compressor may be varied by adjusting the piston rod 40 with relation to the cross head 42 so that the compression space 57 within the cylinder will be such as to produce one hundred pounds pressure as indicated on the gauge 55′. This adjustment is made by regulating the sleeve 46 within the cross head to lengthen or shorten the effective length of the piston rod 40. It will thus be evident that even though the pitman rods 44 maintain a constant stroke and that the piston 41 maintains a constant stroke the compression space 57 will be varied in accordance with the adjustment. Under normal conditions it will be assumed that the piston 41 is to create a compression stroke without a supercharging action, in which event the stop cock 61 is left open. Thus as the piston moves upwardly to its extreme upper position the port of the pipe 67 will be uncovered by the piston 41 and no air will flow into the compression space 57 through the check valve 66 and the pipe 64 by reason of the fact that no compression of air can take place above piston 41 while valve 61 is open. Prior to the time that the port of pipe 67 is uncovered air will be drawn into the compression chamber 57 through the check valve 51 and the pipe 50. On the down stroke of the piston 41 the check valve 51 will be closed and as the piston 41 passes the port of pipe 67 the compression chamber 57 will be closed against the inflow of air and pressure will be imposed upon the entrapped air as it is forced outwardly through the pipe 52 and the valve 53 and then through pipe 54 to the receiving tank 11. Upon the next stroke of the piston 41 the procedure will be repeated and in the event it is desirable to supercharge the fluid within compression space 57 the stop cock 61 is closed. Thus on a down stroke of the piston 41 air will be drawn into the displacement space 56 above the piston 41 through check valve 63, pipe connections 60, and 62, and the pipe 59, since on a portion of the down stroke of the piston 41 the port of pipe 67 is closed so that air may be drawn into the displacement space 56 by suction upon the down stroke of the piston 41. On the upstroke of piston 41 the check valve 63 will be closed and the fluid which has been entrapped within the displacement space 56 will be compressed and forced around through the pipe 64 and the check valve 66 to the pipe 67. When the piston 41 uncovers the port of pipe 67 the compressed fluid from the displacement space 56 will be expelled into the compression space 57 so that the compression space 57 will not only contain a normal volume of air drawn into it through the valve 51 but will also contain the air from the displacement space 56 which is under a predetermined pressure. Upon the down stroke of the piston 41 the air under pressure within the compression space 57 will be further compressed and forced into the receiving tank through the pipe 54. Thus by the arrangement here shown a multi-stage compression may be obtained. It will further be evident that the arrangement also insures that while the compressor is working continuously as an incident to the pumping operation, that it will act to maintain the fluid pressure within the receiving tank at a constant pressure, irrespective of any leakage which might occur in the apparatus.

It will thus be seen that with the counterbalance and cushioning apparatus here shown it is possible to regulate the apparatus to operate at any desired pressure and to maintain the pressure as adjusted and set by simple and effective means.

While I have shown the preferred form of my invention as now known to me it will be understood that various changes might be made in the combination, construction, and arrangement of parts, by those skilled in the art, without departing from the spirit of the invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A compressor structure comprising a cylinder closed at one end, a piston within the cylinder, a piston rod connected therewith and extending from the opposite end of the cylinder, a cylinder head through which said piston reciprocates and by which the opposite end of the cylinder is closed, power means connected with said piston rod and imparting a stroke of constant length thereto, means for adjusting the piston rod with relation to the power means whereby the compression space between the piston and its opposite head may be varied, means for permitting fluid to be drawn into and expelled from the compression spaces of said cylinder, means for bypassing the compressed fluid occurring in one of said compression chambers to the other of said compression chambers before being finally expelled from the cylinder, and means for controlling said bypass means to establish and interrupt the bypass of fluid from one of said compression chambers to the other.

2. A compressor structure, including a piston and piston rod, a cylinder in which said piston reciprocates forming therein compression chambers at opposite sides of the piston, having closed outer ends through one of which the piston rod has a slidable bearing, one of said compression chambers having valved air inlet and outlet connections adjacent its outer end, the said inlet connection opening to the atmosphere, a pressure receiver with which the outlet connection communicates and which, when at a pressure equaling that of said compression chamber, holds the valve of the outlet connection against opening so that the said compression chamber is thus closed and the same air therein alternately compressed and expanded as the piston reciprocates, an external fitting on the cylinder forming an air inlet adjacent to the outer end of the other chamber, a check valve in said fitting opening toward the chamber for the inlet of air thereto and the prevention of out-flow of pressure, a by-pass connection leading from said fitting at a point between said second chamber and said check valve to the first chamber, a check valve in said by-pass immediately adjacent to the first chamber and preventing back-flow from said latter chamber, said by-pass having an outlet to the atmosphere, and a stop valve in said by-pass outlet whereby the by-pass may be manually rendered active and inactive as desired.

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