No. 679,235.

Patented July 23, 1901.

J. PATTEN.

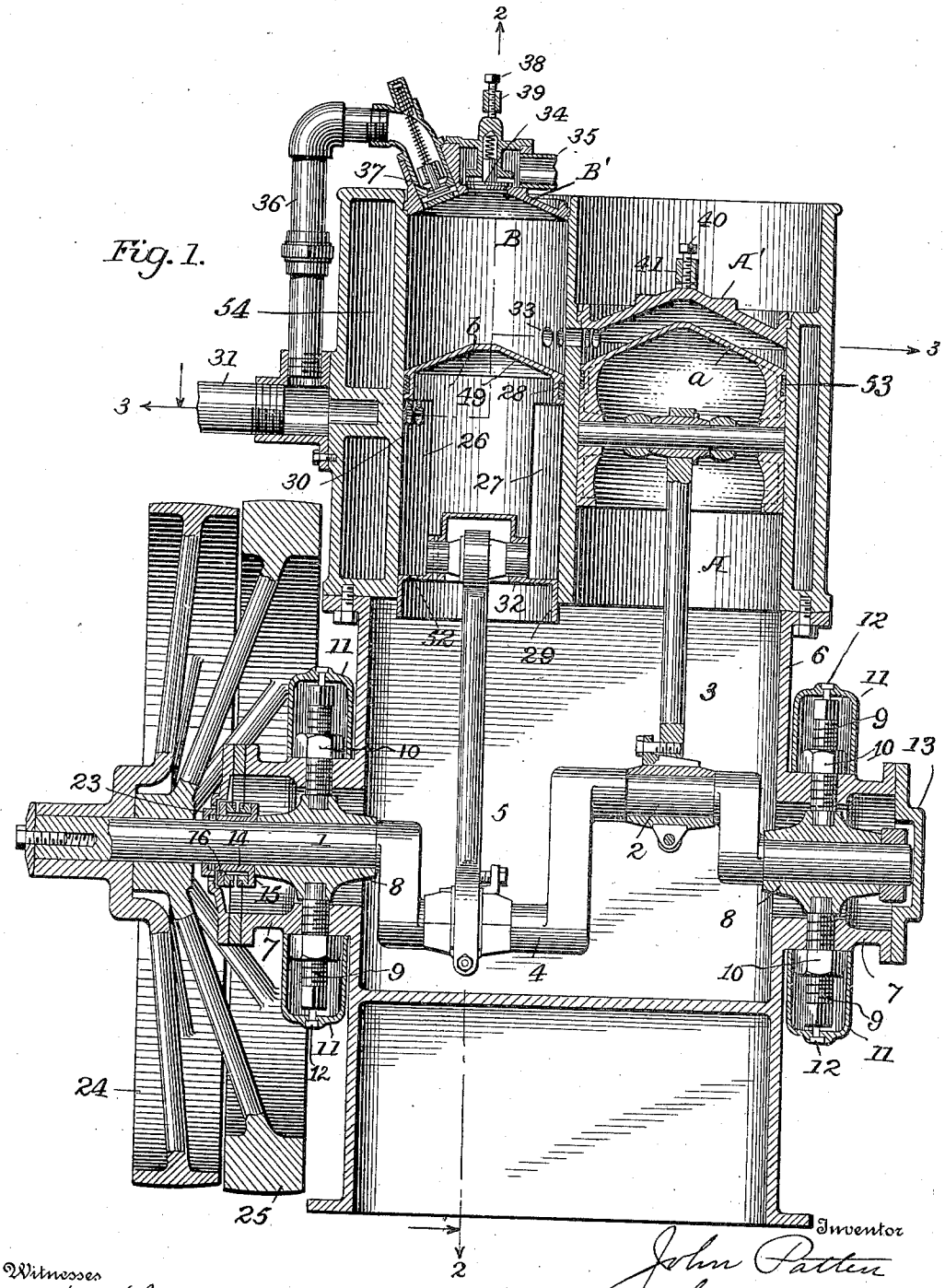
AIR OR GAS PUMP.

(No Model.)

(Application filed June 23, 1900.)

3 Sheets—Sheet 1.

Fig. 1.



Witnesses

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3 Sheets—Sheet 2.

Fig. 2.

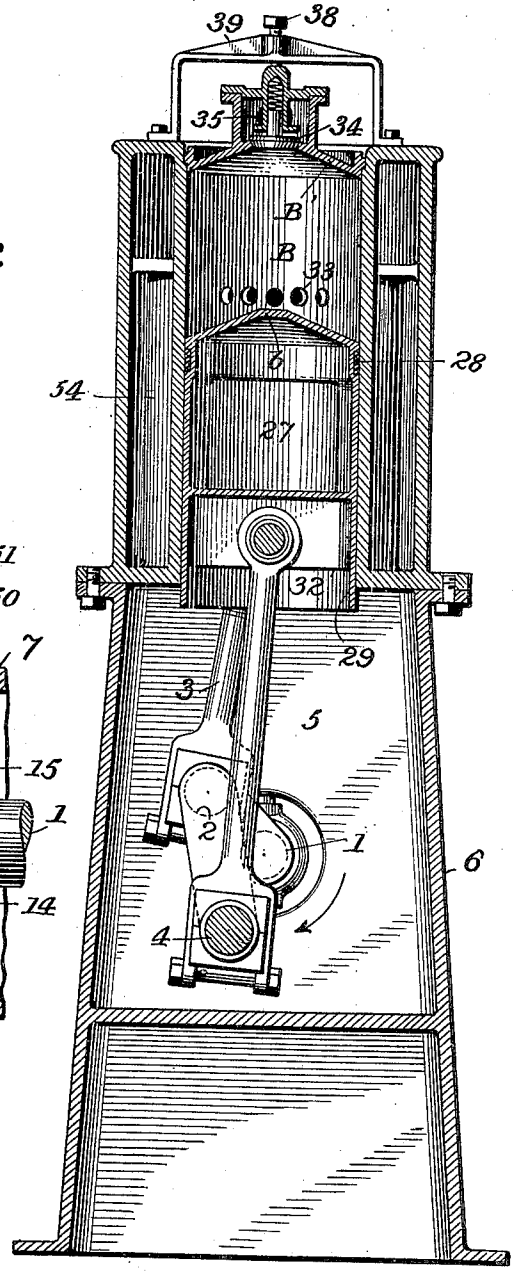
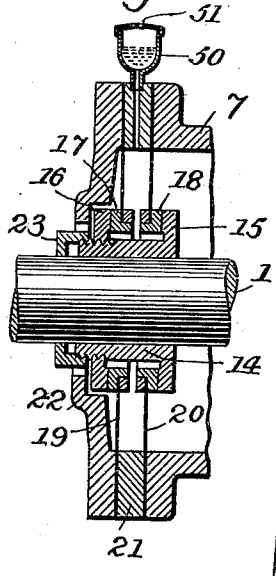


Fig. 6.



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Fig. 3.

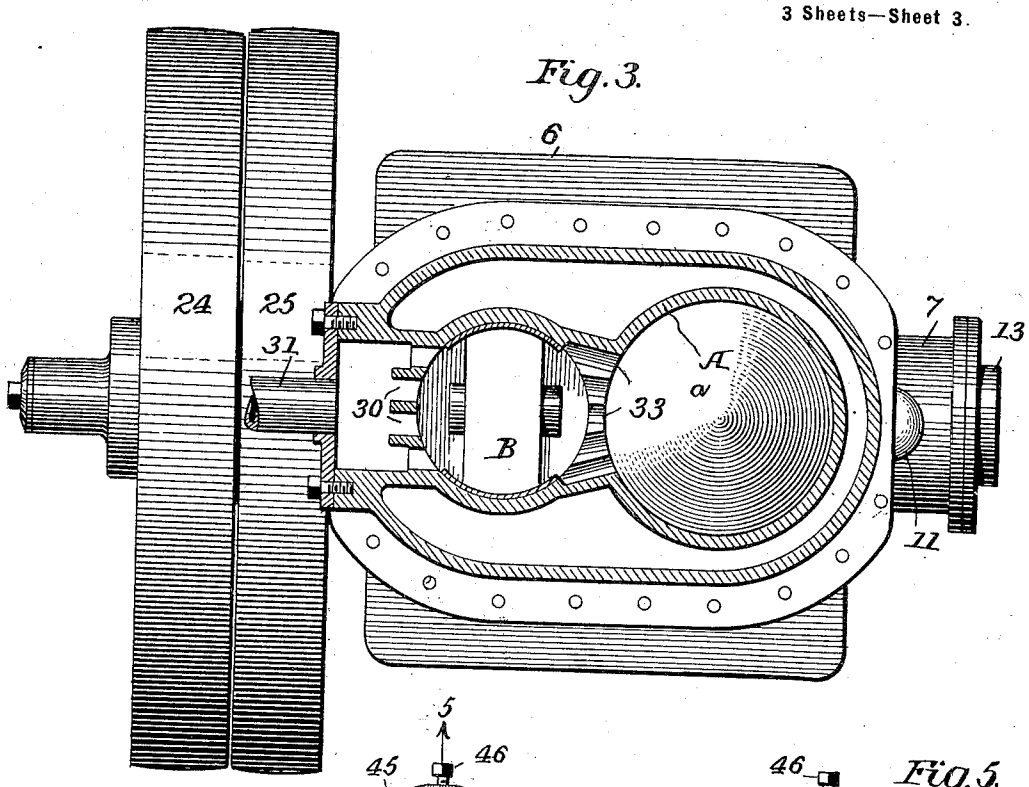


Fig. 4.

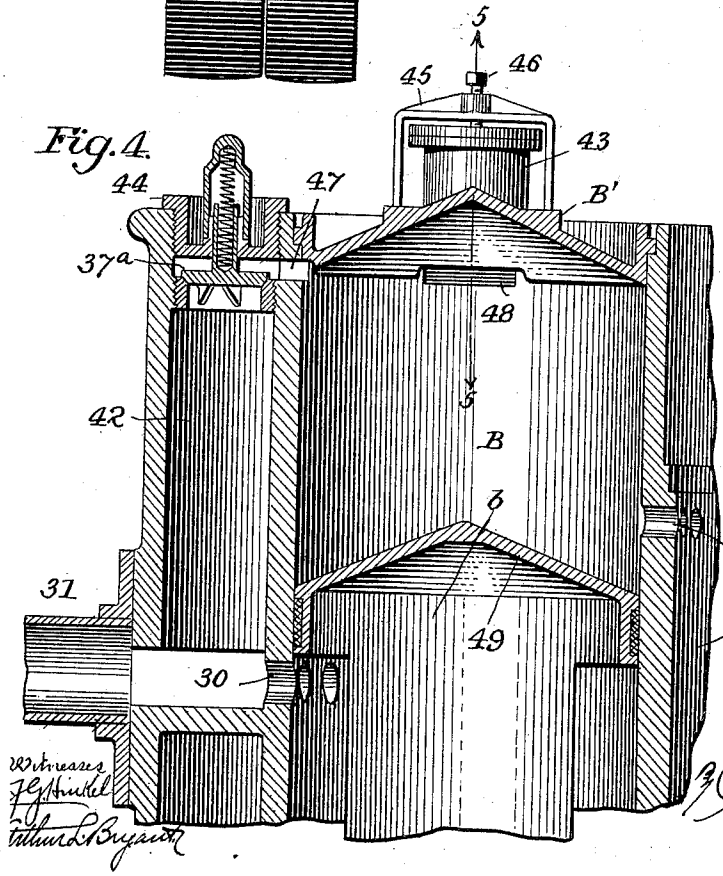
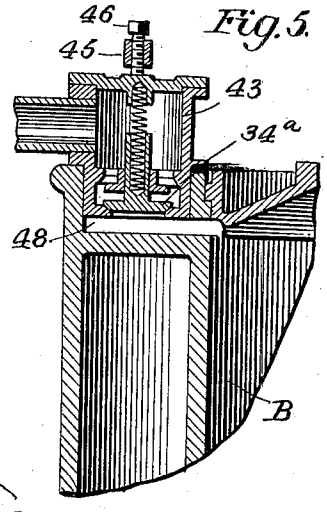


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOHN PATTEN, OF BALTIMORE, MARYLAND, ASSIGNOR TO THE PATTEN VACUUM ICE MACHINE COMPANY, OF SAME PLACE.

AIR OR GAS PUMP.

SPECIFICATION forming part of Letters Patent No. 679,235, dated July 23, 1901.

Application filed June 23, 1900. Serial No. 21,303. (No model.)

To all whom it may concern:

Be it known that I, JOHN PATTEN, a citizen of the United States, residing at Baltimore, State of Maryland, have invented certain new and useful Improvements in Air or Gas Pumps, of which the following is a specification.

The present invention relates to improvements in compound air and gas pumps, and more particularly to pumps used for exhausting air or gases. It is, however, adapted for compressing as well as exhausting gases.

The object of the invention is to simplify the construction and reduce the expense of such pumps and also to render them more efficient. In the present invention two cylinders are used, one of which is preferably larger than the other. The gas first passes into the larger cylinder. It is then forced from the larger cylinder into the smaller cylinder and partially compressed therein, and the piston in the smaller cylinder then further compresses the gas and drives it out into the atmosphere or into a suitable receptacle. The pistons are so arranged and timed that the smaller piston operates as a valve for the ingress and egress of the larger cylinder and also for the ingress of the smaller cylinder. The gas is drawn from the inlet-pipe directly into both cylinders, and during a reciprocation of the pistons the volume of gas discharged from the pump is nearly equal to the total contents of both cylinders at the pressure existing in the inlet-pipe, excepting under certain conditions, as hereinafter explained.

The construction and operation of a pump embodying the invention will now be described, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical central section of a machine constructed according to my invention. Fig. 2 is a section on the line 2 2 of Fig. 1. Fig. 3 is a horizontal section on the line 3 3 of Fig. 1. Fig. 4 is a view corresponding to a portion of Fig. 1, illustrating a different arrangement of valves. Fig. 5 is a section on the line 5 5 of Fig. 4, and Fig. 6 is a detail of part of Fig. 1.

The pump constituting the present invention is adapted for pumping air or gas for the purpose of either exhausting or compressing the same. The pump is especially adapted for producing and maintaining a vacuum in any chamber to which it may be connected, and it is contemplated to use it for exhausting the gases and vapors from the freezing-chamber of a vacuum ice apparatus. It will be understood, however, that protection is desired for various uses and purposes to which the invention is applicable and that the claims are not limited to any particular application of the invention.

In the following specification the term "gas" will for convenience be used in a sense broad enough to include air, vapor, or any other compressible fluid which the pump is adapted to operate upon.

Referring to Figs. 1, 2, and 3 of the drawings, A indicates the larger cylinder of the pump, into which the gas first enters, and B the smaller cylinder, into which the gas passes from the cylinder A. The larger cylinder is provided with a piston *a* and the smaller cylinder with a piston *b*, each of which pistons is adapted to rise almost into contact with the respective cylinder-heads A′ B′ for the purpose of expelling the gas completely from the cylinders at the ends of the strokes of the pistons. Beneath the cylinders is a crank-shaft 1, having a double crank. One of the crank-pins 2 is connected by a pitman 3 with the piston *a*, and the other crank-pin 4 is connected by a pitman 5 with the piston *b*. The shaft is revolved in the direction of the arrow, Fig. 2, and the crank-pin 2 is set at something less than one hundred and eighty degrees in advance of the crank-pin 4, usually about one hundred and five degrees. The cylinders are supported upon a casing 6, and the crank-shaft 1 has its bearings in cylindrical projections 7 of said casing. The casing 6 is designed to be filled with oil to a line above the projections 7, and the bearings are so constructed that no air can enter through them to the interior of the casing and the cylinders. The bearings 8 are adjustably supported by set-screws 9, which are threaded into the upper and lower sides of the extensions 7 and by means of which the bearings may be adjusted laterally to the line of the shaft. The set-screws are provided with lock-nuts 10, and

over the screws and nuts are air-tight cups 11, which are held in place by screws 12. By removing the screws 12 and cups 11 the bearings may be readily adjusted. The extension 7 on the right of the casing has its outer end closed by a cap-plate 13. The extension 7 on the left side of the casing cannot be closed by an ordinary cap-plate, as the power-shaft is required to pass through it. An air-tight stuffing-box for this extension is constructed as follows: Upon the shaft 1 is a collar 14, having an integral flange 15 at its inner end and a ring 16 at its outer end. Between the flange and ring are two rings 17 18, centrally carried by sheet-metal disks 19 20, respectively. The disk 20 fits against the outer end of the extension 7, and the disk 19 fits against a ring 21, the ring 21 being arranged between the margins of the two disks. A flange 22 is arranged against the outer disk, and a packing-ring 23 is arranged on the collar 14 to prevent any leakage between the collar and shaft.

The operation of the parts 14 to 23, inclusive, is as follows: The collar 14 fits closely upon the shaft and turns with it, and to prevent any leakage between the shaft and collar packing is placed under the packing nut or collar 23, which makes a tight joint, which will be permanent, as no friction occurs there, the nut revolving with the collar and shaft. The outer edges of the flexible diaphragms or disks 19 and 20 being tightly clamped between the parts 7, 21, and 23, no leakage can occur around the outer edges. Oil is introduced between the two disks by the oil-cup 50, and the pressure of this oil against the diaphragms forces the ring 18 against the flange 15 and the ring 17 against the flange 16, thereby producing a tight joint, the oil leaking through fast enough to lubricate the wearing-surfaces and render them durable. Usually a partial vacuum is created in the interior of the machine, and the oil between the two diaphragms 19 and 20 being exposed to atmospheric pressure through the vent-hole 51 presses against the disk 19, forcing the ring 18 more firmly against the flange 15, thereby insuring a tight joint, which with this construction will last a very long time, whereby the difficulties of the stuffing-boxes usually used for revolving shafts are avoided.

The oil-cup 50 is preferably made of glass, so that the height of the oil can be easily observed, and sometimes the oil-cup is elevated and connected with the flange 21 by a pipe, thereby producing a greater pressure against the flanges.

The piston *b* is in the form of a barrel, which is cut away on opposite sides at 26 27, as shown in Fig. 1. The upper piston-head of piston *b* is provided with a packing-ring 28, so the piston will not leak, and its upper surface conforms to the shape of the cylinder-head to reduce the clearance to the minimum amount while it is on its upper stroke. The lower piston-head 29 of piston *b* is not packed, and its principal object is to prevent oil placed around the crank-shaft from splashing too freely into the cylinders, thereby getting mixed with the gas, and for the purpose of creating a partial vacuum below this piston a small vent-hole 52 is drilled through the piston-head 29. It is necessary that this vent-hole should be small, because otherwise in starting the pump if a complete vacuum was created too quickly over the surface of the oil the gases previously absorbed would cause it to foam and rise in the cylinders, resulting in a loss of the oil and sometimes a breakage of the machinery; but with a small vent-hole the vacuum rises slowly and the foaming oil cannot pass out rapidly enough to do any damage.

The piston *a* is an ordinary bucket-shaped piston provided with a packing ring or rings 53, and its upper surface is made the shape of the inner surface of cylinder-head A'. The cylinder B is provided with the ingress-port 30, (shown in Figs. 1, 3, and 4,) which is always in free communication with the suction or ingress pipe 31. The cylinder B is also provided with an ingress check-valve 37, Fig. 1, a modification of which is shown in 37^a, Fig. 4. In this case the air must force its way through a valve closed by a spring, and after creating a very high vacuum this valve 37^a ceases to act and all the gas pumped enters through the port 30. There is also a free port 33, communicating between the two cylinders, through which the gases pass first one way and then the other. The upper head of the piston *b* acts as a valve for this port and is so timed that when the piston *a* is ascending, as shown in Fig. 1, the air in the cylinder A is forced through the ports 33 into the cylinder B above the piston *b*, and while the crank operating the piston *a* is on the dead-center or upper stroke the piston *b* sweeps over the ports 33, and while the piston *a* is descending the gases pass through the port 30 through the cut-away sides of the barrel-shaped piston *b* through the ports 33 into the cylinder A. At the same time the piston *b* rises to its upper stroke and forces the gases out through the check-valve 34 into the egress-pipe 35. If the pressure in the suction-pipe 31 is very great, the gases will pass through the check-valve 37 and fill the cylinder B as piston *b* descends; but, as stated above, after a high vacuum has been reached the pressure of the gas will not be great enough to open this valve, and it will lie dormant. After the piston *a* has reached its lower end of the stroke the piston *b* again sweeps over the port 33, and the contents of the cylinder A are again forced into the cylinder B, to be expelled, as before.

For the purpose of lubrication oil is placed in the base of the machine around the crank-shaft up to the journals 8. In order to give the two pistons *a* and *b* their proper relative motion, the crank 2, which operates the pis-

ton *a*, is placed at an angle of about one hundred and five degrees or a little more or less in advance of the crank 4, which operates the piston *b*, as shown in the drawings. By this means the ingress-port to the cylinder A remains open until after the crank has passed its lower center and begun to ascend, thereby insuring a full charge of gas, and the port 33 can be placed much below the center of the cylinder B, where it would have to be if the cranks were set at right angles. I thereby get a greater efficiency in the cylinder B. By this arrangement I not only secure a simple, durable, and efficient machine, but also produce the proper conditions for creating a very high vacuum. I find in this structure I am able to run with the machine much warmer than would be required by the use of pumps of ordinary construction.

The two cylinders working in tandem produce a compound pump, in which the vapors in the first cylinder A are not compressed to such an extent that they condense in the cylinder and then revaporize on the return of the piston, as would be done in a single pump; but the pump is worked at a sufficiently high temperature, so that the vapors introduced in the cylinder A are forced into the cylinder B without condensation. The piston *b* compresses the air, gases, and vapors in the cylinder B up to the pressure of the atmosphere and forces them out through the pipe 37. Some clearance may leave a small quantity of unexpelled gas, and some condensation may take place there; but the unexpelled gas in reëxpanding or the condensed material revaporizing will only fill the cylinder B down to the ports 33 before the pressure is sufficiently reduced to admit the air, gases, and vapors from the cylinder A, thereby producing a machine of high efficiency. However, sometimes when it is necessary to maintain a very high vacuum—for such purposes as making ice in vacuum—I will use one of these pumps, constructed as herein shown, for a vacuum-pump for creating and maintaining a vacuum of from twenty-seven and one-half to twenty-nine and one-half inches, and I will use another pump of like design, but of greater capacity, for working in tandem with the vacuum-pump. This larger pump I call the "vapor-exhauster," which will create and maintain a vacuum within one-tenth or one-twentieth of an inch of mercury of an absolute vacuum and discharge its gases into the vacuum-pump or condensers connected therewith. As the vapor-exhauster does not work under such high pressure, the piston in it will be of light construction.

For maintaining the desired temperature in the cylinders of my vacuum-pump or vapor-exhauster I have provided the jacket 54 around the cylinders, in which steam can be introduced for warming them or through which water can be circulated for the purpose of keeping them cool, according to the purpose for which they are to be used.

The operation of the pump is as follows: As the piston *a* descends the gas passes through ports 30, between the diaphragms *b* and 32, and through the ports 33 into the cylinder A. At this time the piston *b* is above the ports 33, and there is free communication between the inlet-pipe 31 and the cylinder A. As the piston *a* reaches the lowest point in its travel the piston *b* descends until it cuts off communication between pipe 31 and opening 33. The piston *a* then rises and forces the gas in cylinder A into the cylinder B above the piston *b*. During this movement the piston *b* moves to its lowest position and back again to the ports 33, and as the piston *a* stands momentarily at its highest position the piston *b* passes the ports 33, thus entrapping in the cylinder B the gas which has been partially compressed therein by the piston *a*. The piston *b* continues to rise, forcing the gas in B out through valve 34, while piston *a* descends, taking a new charge of gas from the inlet-openings 30 33. After piston *b* reaches its highest point it descends and a vacuum would be formed behind it, which would retard its progress were it not for the valve 37, which permits gas to be drawn directly into the cylinder B from the supply-pipe 31. This cycle of operations is repeated for every revolution of the driving-shaft 1. The crank-pins 2 and 4 are arranged about one hundred and five degrees apart, more or less, as shown in Fig. 1, in order to cause the piston *b* to operate properly as a valve for the cylinder A. It will be seen that at each revolution of the crank-shaft an amount of gas is discharged from the pump practically equal to the capacity of the two cylinders at the pressure existing in the inlet 31, the cylinder B taking its supply through the valve 37 and the cylinder A taking its supply through the ports 30 33.

In Figs. 4 and 5 is shown a modified form in which the valves at the upper end of cylinder B are not carried by the head B′. In this form the inlet-valve 37^a, which controls communication between the inlet-pipe 31 and the upper end of the cylinder B, is located in a tube 42 at the side of the cylinder, which may be cast integral therewith. The outlet-valve 34^a is situated in a casing 43 at one side of the cylinder, thus leaving the cylinder-head B′ free to be removed without disturbing the valves. The valve 37^a may be removed by unscrewing a cap 44. The casing 43, carrying the valve 34^a, is held in place by a removable yoke 45 and set-screw 46, which provide for an easy removal of the valve and all its connected parts. The valves 34^a and 37^a communicate with narrow ports 47 48 in the upper end of the cylinder.

The casing 6, filled with oil, and the devices for excluding air from said casing may be omitted in some cases, as where the pump is used for compressing air. Where it is used as an exhaust-pump, however, the entire structure must be air-tight, and the peculiar

arrangement of bearings and accessories herein described will be found very efficient in accomplishing this object.

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

1. In a compound air and gas pump, the combination of two cylinders, a port leading from one of said cylinders to the other, reciprocating pistons in said cylinders, the piston in one of the cylinders being arranged to reciprocate across said port and thereby form a valve for the other cylinder.

2. In a compound air and gas pump, the combination of two pump-cylinders, A, B, pistons in said cylinders, a port communicating between the end of cylinder A and an intermediate portion of cylinder B, an inlet to the latter cylinder below its piston, and means for reciprocating the pistons, the piston in cylinder B serving as a valve to control the port of cylinder A.

3. In a compound air and gas pump, the combination of two cylinders, A, B, a reciprocating piston in cylinder A, a port leading from the end of cylinder A to an intermediate portion of the cylinder B, a barrel-shaped piston in cylinder B having closed ends and an intermediate transverse passage, and an inlet-port communicating with said passage, the upper end of said barrel being reciprocated across the port of cylinder A whereby said cylinder is alternately placed in communication with cylinder B and the inlet-port, for the purpose set forth.

4. In a compound air and gas pump, the combination of two cylinders A and B, reciprocating pistons in said cylinders, a port communicating between the end of cylinder A and an intermediate portion of cylinder B, and inlet and outlet valves at the end of cylinder B, the piston in cylinder B being adapted to reciprocate across said port and operate as a valve for cylinder A.

5. In a compound air and gas pump, the combination of a cylinder A and a smaller cylinder B, pistons in said cylinders, a port communicating between the upper end of the larger cylinder and an intermediate portion of the smaller cylinder, an inlet-port to the smaller cylinder below the path of its piston, normally-closed inlet and outlet ports at the upper end of the smaller cylinder, and a crank-shaft having two cranks connected to said pistons respectively to reciprocate the same.

6. In a compound air and gas pump, the combination of two cylinders A and B, a port between the upper end of the cylinder A and an intermediate portion of the cylinder B, pistons in said cylinders, the piston in cylinder B serving as a valve for cylinder A, and a double crank-shaft and connecting-rods for operating said pistons, the cranks of said shaft being less than one hundred and eighty degrees apart.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN PATTEN.

Witnesses:

WILLIAM F. HOOFNAGLE,

FELIX R. SULLIVAN.