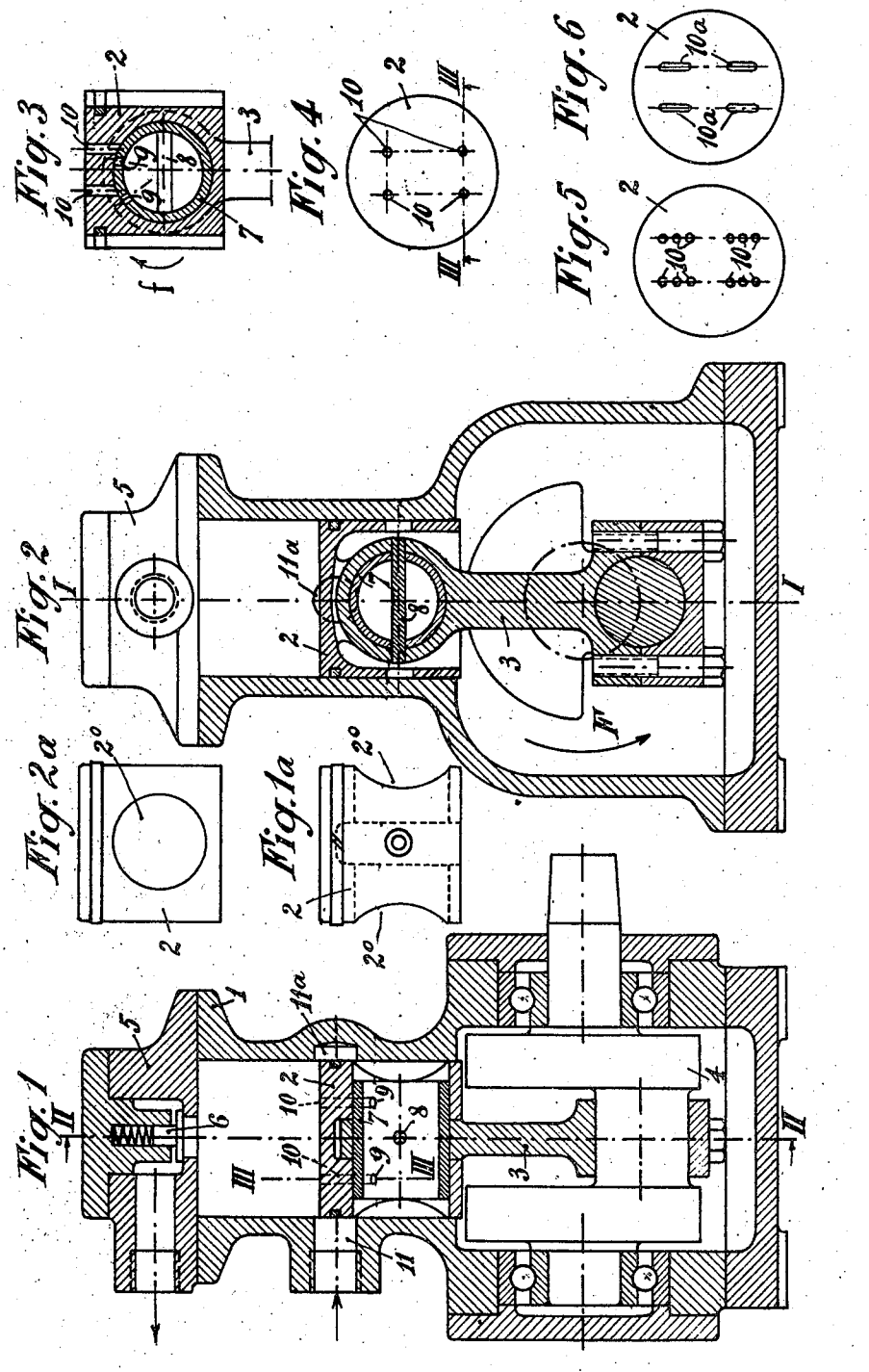
Aug. 6, 1946. P. J. VOREAUX 2,405,475

GAS PUMP

Filed July 17, 1945 2 Sheets-Sheet 1



Paul Jean Voreaux

By Fraser, Myers & Manley

Atty's

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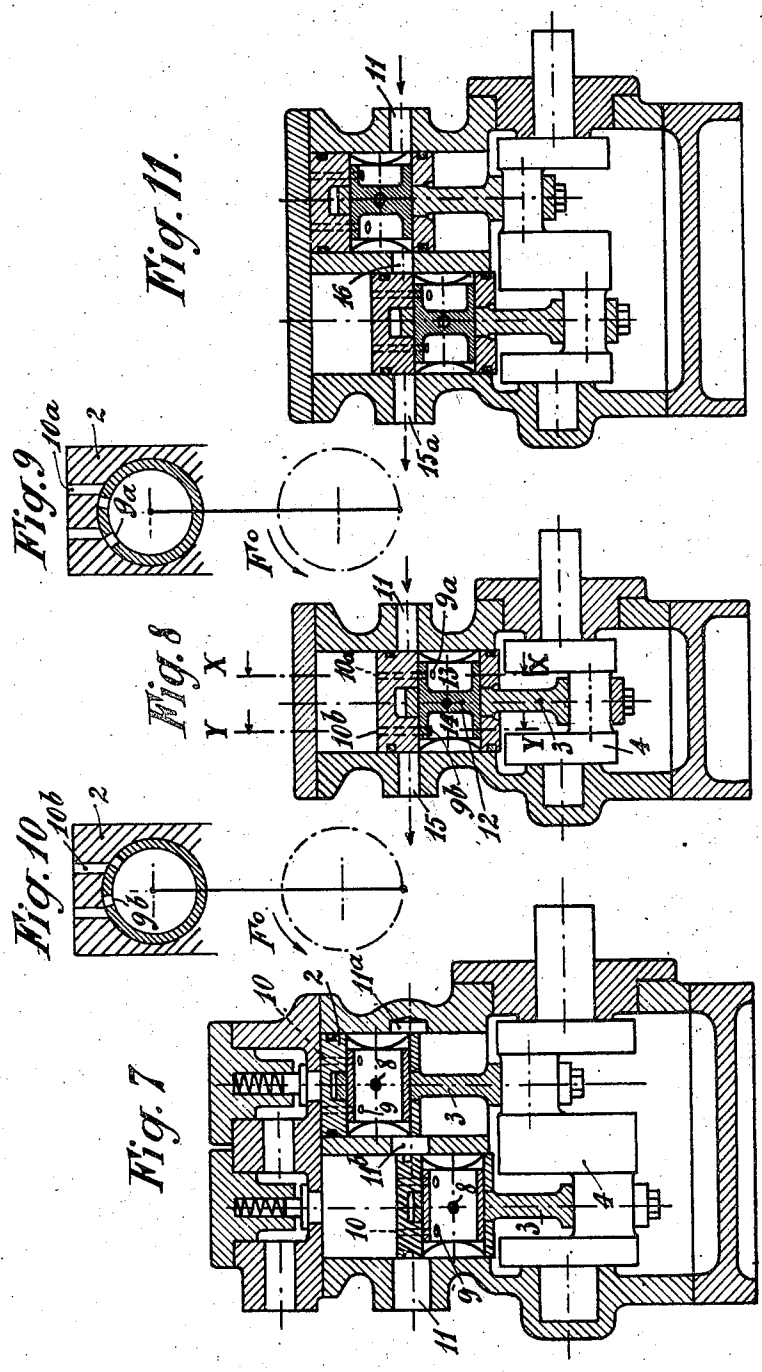

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By Fraser Myers & Manley, Attys

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UNITED STATES PATENT OFFICE

2,405,475

GAS PUMP

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5 Claims. (Cl. 230—190)

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My invention relates to gas pumps of the type comprising a piston reciprocated in a cylinder, and it is a primary object to simplify their construction while improving their operation.

According to this invention, the piston pin is used as a swinging valve and for this purpose, is made as a tube or hollow body through the inner space of which gas to be compressed or forced out is allowed to pass.

Suitable opening or ports are provided through the wall of the tube or hollow body and the piston end wall in order that gas may flow through said piston end wall at proper time; thus either intake valves or intake and outlet valves are dispensed with, while no supplemental members are added.

In the case of a pump with discharge valves, the gas intake duct communicating with the tube or hollow body, used as a piston pin, is uncovered by the upper face of the piston at the end of the stroke.

The intake duct may be a single bore in the cylinder or cylinders, parallel with the distributing piston pin or pins and feeding all cylinders through said piston pins.

In the case of a pump designed to have no valves, the tube or hollow body used as a piston pin is formed with two recesses, provided for instance by an intermediate partition. One of the recesses is in communication with intake, the other one with discharge, and they are successively brought in communication with the cylinder as the piston pin swings.

My invention also comprises a combination of the aforesaid arrangements to obtain a multistage operation.

The following description with reference to the appended drawings given solely by way of example, will show how my invention may be carried out.

Fig. 1 is a longitudinal section of a gas pump with a cylinder having a discharge valve, the section being taken along line I—I on Fig. 2.

Fig. 1*a* shows the piston separately in elevation view.

Fig. 2 is a transverse section taken along line II—II on Fig. 1.

Fig. 2*a* is a detail view corresponding to Fig. 2, the piston being shown alone.

Fig. 3 is a partial section taken along lines III—III on Figs. 1 and 4.

Fig. 4 is a plan view corresponding to Fig. 3.

Figs. 5 and 6 show modifications of Fig. 4.

Fig. 7 shows a modification of Fig. 1 in the case of a two-cylinder pump.

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Fig. 8 shows a further modification of Fig. 1, in the case of a one-cylinder pump without any intake and discharge valves.

Figs. 9 and 10 are diagrammatic sections taken along lines X—X and Y—Y on Fig. 8.

Fig. 11 shows a modification of Fig. 8 in the case of a pump with two compression stages.

The gas pump shown on Figs. 1 and 2 comprises a cylinder 1, a piston 2, a connecting rod 3, a crankshaft 4 revolving for instance in the direction of arrow F (Fig. 2), a head 5 closing cylinder 1 and in which an outlet valve 6 is mounted. The hollow piston pin 7 which has a diameter larger than usual, is secured to an end connecting rod 3 by a transfixing pin 8 or any other suitable means. Pin 7 is provided with ports 9 adapted to register with ports 10 in the end wall of piston 2. Bored in cylinder 1 in parallel relationship with the piston pin 7 is a hole 11 operating as an inlet duct and permanently communicating with the hollow portion of pin 7 through a large opening 2^o in the piston skirt (Figs. 1*a* and 2*a*).

The operation is as follows: as suction stroke is beginning (upper dead centre of piston 2), ports 9 and 10 are positioned as shown on Fig. 3 and do not register. While piston 2 moves down, pin 7 swings in the direction of arrow *f* (Fig. 3) and ports 9 come into register with ports 10, so that gas sucked through duct 11 into hollow piston pin 7 is allowed to pass through ports 9 and 10 into the upper cylinder portion; at the bottom end of down stroke (Fig. 1), duct 11 may advantageously be uncovered by the upper face of piston 2 and thus in direct communication with the cylinder, to complete intake; a port or recess 11*a* may also be provided opposite duct 11 to place the hollow portion of pin 7 in communication with the cylinder, in this dead centre position, so as to complete filling of the cylinder upper chamber. In said bottom dead centre position, ports 9 have resumed their former position shown on Fig. 3, and as piston pin 7 is about to swing in anticlockwise direction when piston 2 moves up to resume said position of Fig. 3 at the end of upwards stroke, it will be realized that throughout the discharge stroke, communication is broken between ports 9 and 10; any gas confined between piston 2 and cylinder head 5 is then forced past outlet valve 6.

Hollow piston pin 7 and the end wall of piston 2 may have two rows of ports, and in each row, there may be two ports (Fig. 4) or more than two (Fig. 5); instead of cylindrical ports, I may also provide parallel slots as illustrated at 10*a*

on Fig. 6. The pump may have two cylinders as shown on Fig. 7; the inlet duct then passes through both cylinders as seen at 11, 11b and 11a; suction of gas into the second cylinder takes place through opening 11b and the hollow pin of the first cylinder, the double cylinder pump operating just as the one cylinder pump above referred to.

I may also construct a pump according to this invention without any inlet and outlet valves as shown on Fig. 8, suction and discharge being controlled by the piston hollow pin. For this purpose, said pin is divided by a partition 12 into two recesses or compartments 13 and 14; recess 13 communicates with intake bore or duct 11 in cylinder 1 while recess 14 communicates with a bore or duct 15 in the opposite wall of said cylinder. Moreover, bores 9a, 10a and 9b, 10b are provided in the wall of the piston pin and the piston end wall respectively; bores 10a may be arranged like bores 10b but bores 9a are shifted to the left (Fig. 9) assuming that the crankshaft revolves in the direction of arrow Fo, while bores 9b are shifted to the right (Fig. 10).

The pump operates as follows:

As the piston moves down, bores 9a in the piston pin register with bores 10a and consequently the upper cylinder chamber is placed in communication with recess 13 and inlet duct 11. While the piston moves up, bores 10a are closed, and bores 10b are placed in communication with recess 14 and discharge duct 15 through bores 9b.

The foregoing arrangement more particularly applicable to vacuum pumps, will advantageously be employed in the first stage of a two-stage pump.

Fig. 11 shows a valveless two-stage pump. Gas is sucked in the first stage cylinder through duct 11 as above described, forced from the first stage cylinder and sucked into the second stage cylinder through a duct 16 providing a communication between said cylinders, then finally discharged from the second stage cylinder through duct 15a.

Ducts 11, 16 and 15a are obtained from one bore through both cylinders.

For constructing a two-stage vacuum pump, it is preferable to use in the first stage an intake and discharge device controlled by piston pin as shown on Fig. 8, and in the second stage a device with intake control by pin and discharge control by automatic valve as shown on Figs. 1 and 2.

What I claim is:

1. A valveless pump which comprises a cylinder having two spaced apart side ducts through its wall; a piston reciprocably movable in the cylinder, having a side bored recess for communication with one of the ducts in the cylinder, and a second side recess for communication with the other duct in the cylinder; a coupling pin borne in the first named recess for swinging motion therein, having a first recess in open communication with said first recess in the piston, and a separate second recess in open communication with the second side recess in the piston; and a

connecting rod fast with said coupling pin, adapted in operation to impart a swinging motion thereto; the piston and pin having each at least two ports therethrough, said ports being so directed and located as to register two by two for predetermined positions of the piston with respect to the cylinder, for placing the inner space of said cylinder in communication either with the first recess in the pin or with the second recess in said pin.

2. The combination of claim 1, the side recesses in the piston forming one bore therethrough, and the ducts in the cylinder being bored in diametrically opposite positions, the recesses in the pin being bored in opposite ends thereof to leave an intermediate partition.

3. In a pump of the type described, the combination of a cylinder having a side intake duct through its wall; a piston reciprocably movable in said cylinder, having a bored side recess so located as to be in open communication with said duct as the piston is reciprocated in said cylinder and to provide between said recess and the upper face of said piston, a piston solid portion of less thickness than the diameter of said duct, whereby said duct communicates both with said cylinder above said piston and with said recess when the piston reaches its lowermost position; a coupling pin having a recess in open communication with the recess in the piston, borne in said bored recess of the piston for swinging motion therein; and a connecting rod fast with said pin, adapted in operation to impart a swinging motion thereto; the piston and the pin having each a port therethrough, said ports being so directed and located as to register for a predetermined position of the piston with respect to the cylinder for placing the inner space of said cylinder in communication with the pin recess.

4. In a pump according to claim 3, characterized in that the cylinder has a recess in its wall, lying opposite, and of the same diameter as the side intake duct.

5. In a pump of the type described, the combination of a cylinder having a side intake duct through its wall; a piston reciprocably movable in said cylinder, having one cross bore therethrough and at least one port extending from the working face of said piston to said bore; an open-ended tubular wrist pin borne in said piston bore for swinging motion therein, said pin having a port through its wall adapted and arranged to register with the port in said piston for a predetermined position of the piston with respect to said cylinder so as to place the inner space of said cylinder in communication with the inside of said wrist pin; a connecting rod fast with said wrist pin; a crank-shaft coupled with said rod; and means fast with said cylinder for revolubly supporting said crank-shaft in such a position that the piston bore is in open communication through an end thereof with said side intake duct.

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