No. 676,266. Patented June 11, 1901.

L. E. MITCHELL.

HYDRAULIC AIR COMPRESSOR.

(No Model.) (Application filed Nov. 9, 1900.)

3 Sheets—Sheet 1.

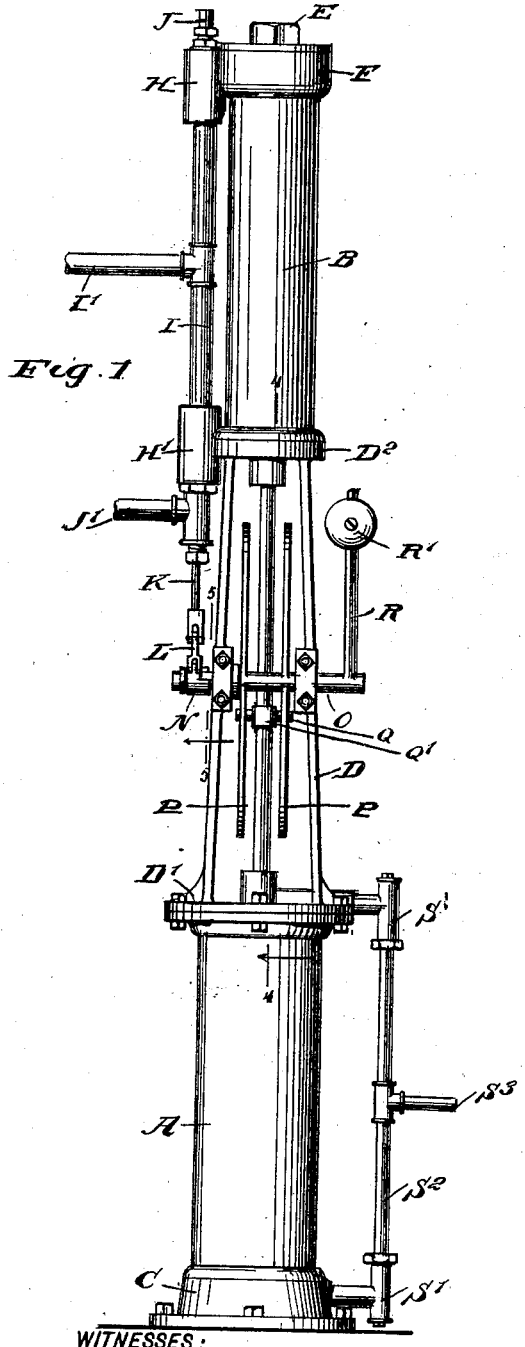

Fig. 1

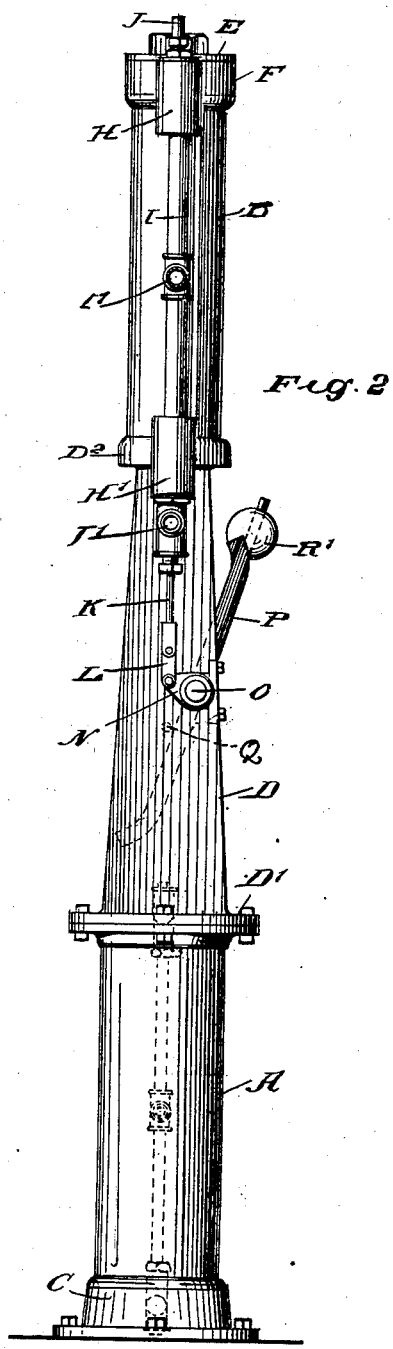

Fig. 2

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(No Model.) 3 Sheets—Sheet 2.

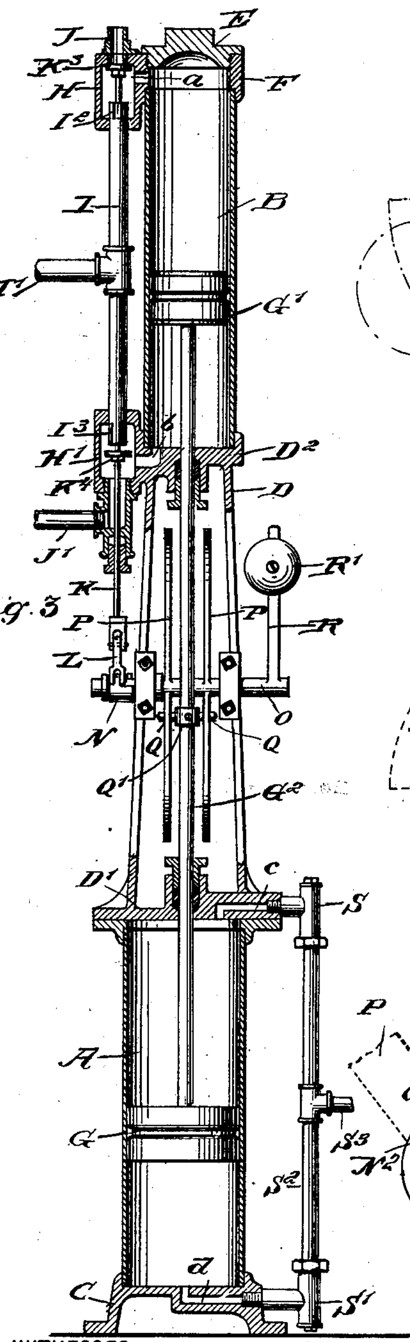

Fig. 3

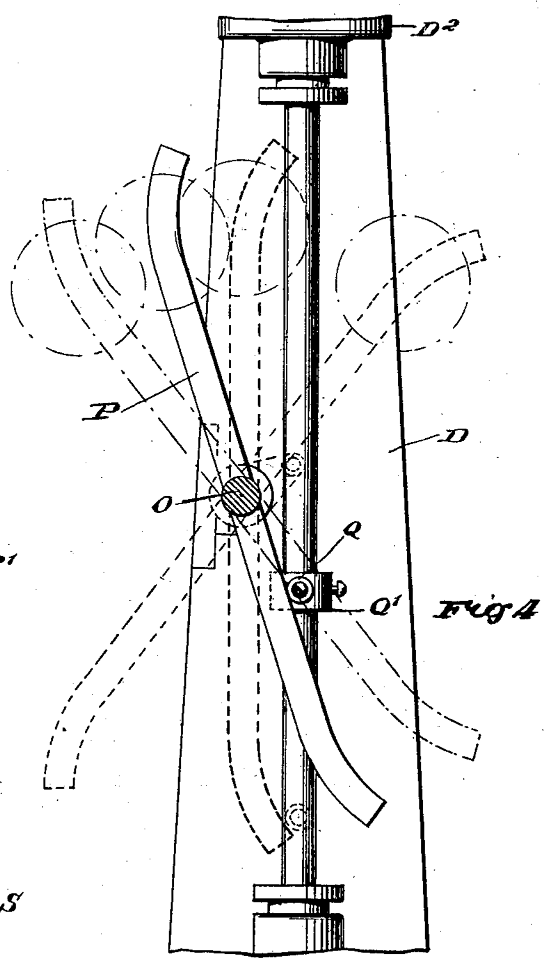

Fig. 4

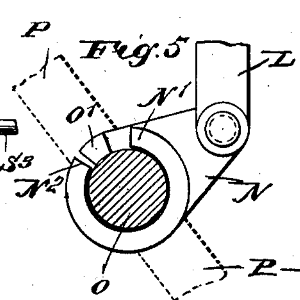

Fig. 5

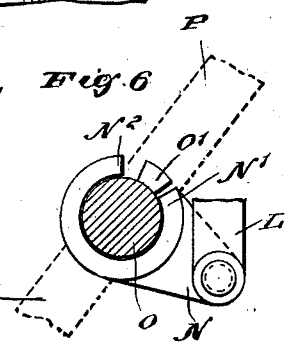

Fig. 6

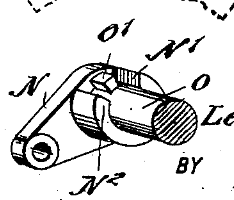

Fig. 7

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(Application filed Nov. 9, 1900.)

(No. Model.) 3 Sheets—Sheet 3.

Fig. 8

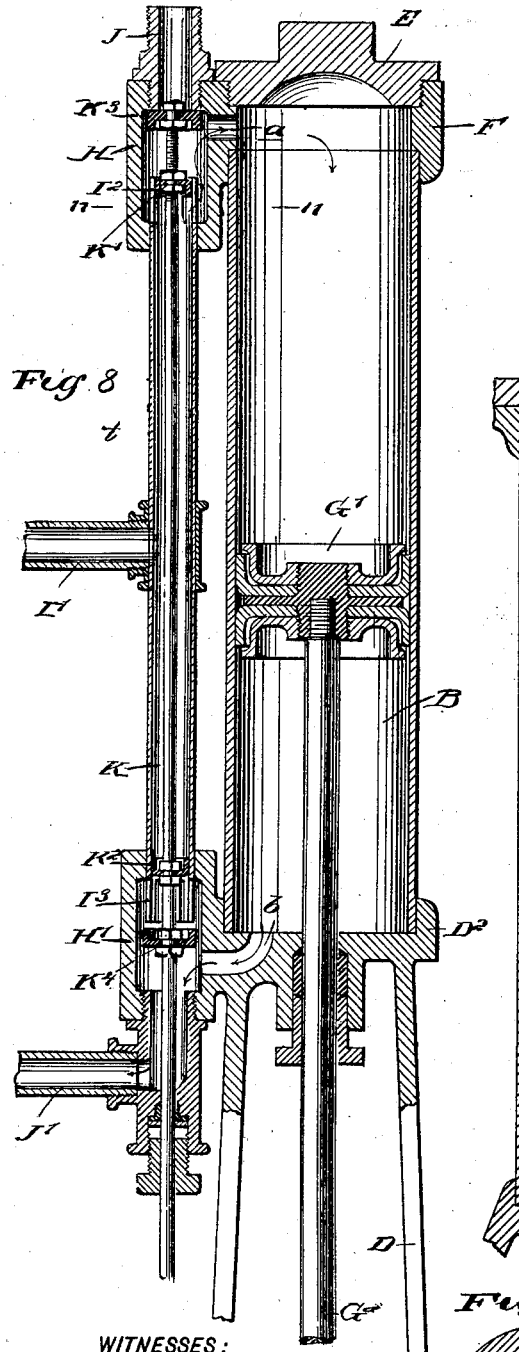


Fig. 10.

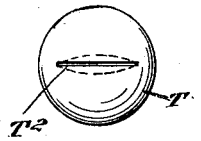


Fig 9

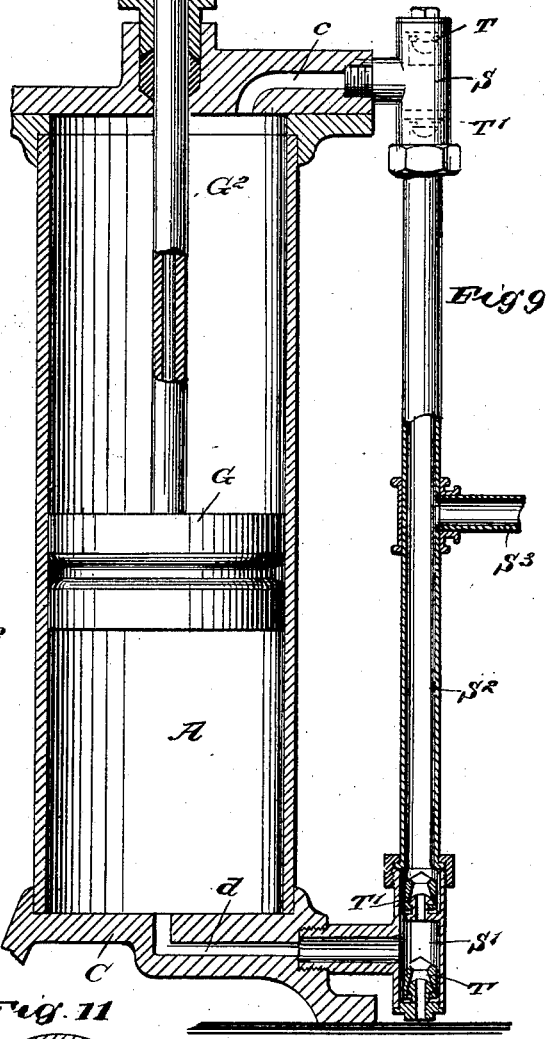
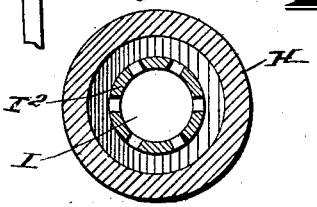


Fig. 11



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UNITED STATES PATENT OFFICE.

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HYDRAULIC AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 676,266, dated June 11, 1901.

Application filed November 9, 1900. Serial No. 35,950. (No model.)

To all whom it may concern:

Be it known that I, LEE EDWARD MITCHELL, a citizen of the United States, and a resident of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and Improved Hydraulic Air-Compressor, of which the following is a full, clear, and exact description.

The invention relates to hydraulic air-compressors such as shown and described in the Letters Patent of the United States No. 641,981, granted to me on January 23, 1900.

The object of the present invention is to provide a new and improved hydraulic air-compressor which is simple and durable in construction, very effective in operation, not liable to get out of order and having the working parts convenient of access for repairs, and arranged to insure reciprocation of the plunger in the hydraulic cylinder until the source of power is shut off by outside means.

The invention consists of novel features and parts and combinations of the same, as will be fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a side elevation of the improvement. Fig. 2 is an edge view of the same. Fig. 3 is a sectional side elevation of the improvement. Fig. 4 is an enlarged cross-section of part of the piston-valve-controlling mechanism, the section being on the line 4 4 in Fig. 1. Fig. 5 is an enlarged cross-section of another part of the piston-valve-controlling mechanism, the section being on the line 5 5 in Fig. 1. Fig. 6 is a similar view of the same with parts in a different position. Fig. 7 is a perspective view of the same. Fig. 8 is an enlarged sectional side elevation of the hydraulic portion of the improvement. Fig. 9 is a like view of the air-compressor. Fig. 10 is an enlarged plan view of one of the air-valves; and Fig. 11 is an enlarged sectional plan view of one of the valve-chests, the section being on the line 11 11 in Fig. 8.

The improved hydraulic air-compressor consists, essentially, of an air-compressor cylinder A and a power-cylinder B, one above the other, the lower end of the cylinder A being mounted on a suitable base C. The cylinders A and B are spaced apart by a frame D, the lower end of which forms a cap or head D' for the upper end of the cylinder A, and the upper end of said frame forms a cap or head D^2 for the lower end of the power-cylinder B. The upper end of the latter is closed by a plug E, screwing in a ring-shaped cap F, screwed or otherwise fastened to the upper end of the cylinder B.

In the cylinders A and B are mounted to reciprocate pistons G G′, respectively, connected with each other by a piston-rod G^2, extending through suitable stuffing-boxes in the heads D' D^2. Valve-chests H H′ connect by ports *a b* with the upper and lower ends of the power-cylinder B, the said valve-chests H H′ being preferably integral parts of the cap F and the head D^2. The interiors of the valve-chests H H′ are connected with each other by a supply connection I, preferably in the form of a tube connected at or near its middle by a pipe I′ with a suitable source of pressure-supply, and the ends I^2 I^3 of said connection I are slotted lengthwise and extend with the slotted portions a suitable distance into the chests H H′, as is plainly indicated in Figs. 3 and 8. The upper end of the chest H is provided with a waste-outlet J, and a similar waste-outlet J′ leads from the lower end of the valve-chest H′.

In the tubular connection I operates a piston-valve comprising a piston-rod K and plungers K' K^2, operating in the slotted ends I^2 I^3 of the connection I, and on said piston-rod are also secured the valves K^3 K^4, adapted to be seated in the valve-chests H H′, respectively, to alternately close and open the waste-outlets J J′. The lower end of the piston-rod K extends through a suitable stuffing-box carried by the waste-outlet J′ to connect at its lower end by a link L with a crank-arm N, mounted to slide loosely on a shaft O, journaled in suitable bearings in the frame D. On the shaft O is secured a lug O′, adapted to alternately engage shoulders N' N^2 on the hub of the crank-arm N, so as to impart a swinging motion to said crank-arm when the shaft O is rocked, as hereinafter more fully explained.

On the shaft O are secured double arms P, slightly curved at their outer ends and adapted to be engaged by antifriction-rollers Q, journaled on a cross-head Q', carried by the piston-rod G^2, connecting the pistons G G' with each other. On the shaft O is also secured an arm R, carrying an adjustable weight R' to move the shaft O into a final position after the arm R has passed the vertical center of the shaft to insure a rapid action of the piston-valve, as hereinafter more fully described.

In the head D' and the base C for the air-compressor cylinder A are arranged ports *c d*, leading to the upper and lower ends of said cylinder A, and the outer ends of said ports *c d* open into valve-chests S S', connected with each other by a pipe S^2, from which leads a pipe S^3 to a reservoir or other device for receiving and storing the compressed air. Each of the valve-chests S S' is provided with a suction-valve T and a discharge-valve T', each being preferably made of rubber and having a slit or slot T^2 in the top thereof, so that the valve opens upon the pressure from within (see dotted lines in Fig. 10) and closes upon pressure from without.

The operation is as follows: When the several parts are in the position shown in the drawings, then water or other fluid under pressure, passing from a suitable source by way of the pipe I' into the connection I, flows through the open slotted end I^2 into the valve-chest H and from the latter through the port *a* into the upper end of the power-cylinder B to move the piston G' therein downward, thereby also moving the piston G in a like direction in the air-compressor cylinder A. As the valve K^3 closes the waste-outlet J, the incoming water cannot pass out through this waste-outlet, and hence must naturally flow into the upper end of the cylinder A to act on the piston G', as above described, and water in the lower end of the cylinder is discharged therefrom by flowing through the port *b* and the valve-chest H' into the waste-outlet J' and to the outside. The fluid under pressure cannot pass into the valve-chest H', as the connection I is closed above the slotted end I^3, and the waste water can readily flow out of the chest H', as the valve K' is in an open position. During the downward movement of the piston-rod G^2 the cross-head Q' is moved in a like direction, and its antifriction-rollers Q impart a swinging motion to the double arms P, so that the latter turn the shaft O and move the lug O' from the shoulder N^2 toward the shoulder N', final contact of the lug O' with the shoulder N' being made at the time the pistons G G' near a lowermost position. When this takes place, the arms P have passed a vertical position, and the weighted arm R now imparts a rapid turning motion to the shaft O, so that the lug O' by abutting against the shoulder N' imparts a swinging motion to the crank-arm N to cause the link L to move the stem K downward and shift the piston-valve so that the valves K' K^4 move into a closed position and the valves K^3 K^2 move into an open position. As soon as this takes place the upper end of the cylinder B is closed to the connection I, but is open to the waste-outlet J, while the waste-outlet J' is closed to the lower end of the cylinder B and the latter is now connected with the supply connection I. Fluid under pressure passes into the lower end of the cylinder B to move the piston G', and consequently the piston G, upward in their respective cylinders B and A. During the upward stroke of the cross-head Q' the antifriction-rollers Q impart a return swinging movement to the arms P, and when the pistons G G' are near the end of their upward stroke then the weighted arm R imparts a quick return rocking motion to the shaft O. When this takes place, a swinging motion is given to the crank-arm N by the lug O' engaging the shoulder N^2, so that the piston-valve is reversed—that is, is moved back to the previous position. (Shown in Figs. 3 and 8.) During the up-and-down stroke of the piston G air is drawn into the cylinder A alternately by the valves T in the valve-chests S S' and compressed air is discharged from the cylinders through the valves T' into the pipes S^2 S^3 to be stored in a suitable reservoir.

From the foregoing it will be seen that the device is very simple and durable in construction and has comparatively few parts, which can be readily repaired whenever necessary.

Although I have shown and described the power device as used in connection with an air-compressor, it is evident that the said hydraulic-power portion may be used for other purposes.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. A power-cylinder, a piston reciprocating in said cylinder, valve-chests opening into the cylinder at the ends thereof and having waste-outlets, a supply connection between the valve-chests, a reciprocating piston-valve in said connection and arranged to alternately open and close the connection to the valve-chests and to alternately close and open the discharge for the waste-outlets from the valve-chests, and means for actuating said piston-valve comprising a shaft mounted to rock and provided with a lug, a crank-arm mounted loosely on said shaft and connected with the valve-stem of the piston-valve, the said crank-arm having spaced shoulders adapted to be alternately engaged by said lug on the shaft, and means for rocking said shaft from the piston-rod of the power-cylinder, as set forth.

2. A hydraulic-power cylinder, a piston reciprocating in said cylinder, valve-chests opening into said cylinder at the ends thereof and having waste-outlets, a tube connecting

the said valve-chests and having its ends slotted lengthwise, the slotted ends extending into said chests at the ends opposite said waste-outlets, the said tube being connected with a pressure-supply pipe, a reciprocating piston-valve comprising a piston-rod arranged in the said tube and having a plurality of plungers operating in said slotted ends of the tube to alternately open and close the same to the chests, and valves on said piston-rod adapted to be seated in the valve-chests for alternately opening and closing said waste-outlets, and means for actuating said piston-valve, as set forth.

3. A power-cylinder, a piston reciprocating therein, valve-chests opening into the cylinder at the ends thereof, a supply connection between the valve-chests, a reciprocating piston-valve in said connection and arranged to alternately open and close the connection to the valve-chests and to alternately close and open the discharge for the waste-outlets from the valve-chests, a shaft mounted to rock, means for rocking said shaft from the piston-rod of the power-cylinder, a crank-arm mounted loosely on the shaft and provided with spaced shoulders adapted to be engaged alternately by a lug on the said shaft, and means for imparting a rapid turning motion to said shaft at the time the lug engages the said shoulders, as set forth.

4. A hydraulic-power cylinder, a piston reciprocating in said cylinder, valve-chests opening into said cylinder at the ends thereof and having waste-outlets, a supply connection between said valve-chests and having slotted ends extending into said chests opposite said waste-outlets, a reciprocating plunger-valve having a plurality of plungers for said slotted ends of the connection, to alternately open and close the same to the chests, valves for alternately opening and closing said waste-outlets, and means for actuating said piston-valve from the piston-rod of said piston, the means comprising a shaft, a crank-arm mounted loosely on the shaft and connected by a link with the valve-stem of said piston-valve, the said crank-arm being provided with shoulders adapted to be alternately engaged by a projection on the said shaft, and means on said shaft adapted to be engaged by a cross-head on the piston-rod to impart a rocking motion to said shaft, as set forth.

5. A hydraulic-power cylinder, a piston reciprocating in said cylinder, valve-chests opening into said cylinder at the ends thereof and having waste-outlets, a supply connection between said valve-chests and having slotted ends extending into said chests opposite said waste-outlets, a reciprocating plunger-valve having a plurality of plungers for said slotted ends of the connection, to alternately open and close the same to the chests, valves for alternately opening and closing said waste-outlets, means for actuating said piston-valve from the piston-rod of said piston, said means comprising a shaft having a lug thereon, a double arm secured on the shaft and engaged by a cross-head on the piston-rod to impart a rocking motion to the said shaft, a crank-arm loose on the shaft and having spaced shoulders adapted to be alternately engaged by said lug, and a link connecting the crank-arm with the valve-stem of the piston-valve, as set forth.

6. A hydraulic-power cylinder, a piston reciprocating in said cylinder, valve-chests opening into said cylinder at the ends thereof and having waste-outlets, a supply connection between said valve-chests and having slotted ends extending into said chests opposite said waste-outlets, a reciprocating plunger-valve having a plurality of plungers for said slotted ends of the connection, to alternately open and close the same to the chests, valves for alternately opening and closing said waste-outlets, means for actuating said piston-valve from the piston-rod of said piston, said means comprising a shaft having a lug thereon, a double arm secured on the shaft and engaged by a cross-head on the piston-rod, to impart a rocking motion to the said shaft, a crank-arm loose on the shaft and having spaced shoulders adapted to be alternately engaged by said lug, a link connecting the crank-arm with the valve-stem of the piston-valve, and a weighted arm on said shaft, as set forth.

7. The combination with a power-cylinder, a rod provided with a piston reciprocating in said cylinder, an air-compressing cylinder into which the piston-rod extends and an air-compressing piston carried by said piston-rod, of valve-chests opening into the power-cylinder at the ends thereof, a supply connection between the valve-chests, a reciprocating piston-valve in said connection and arranged to alternately open and close the connection to the valve-chests, and to alternately close and open the discharge for the waste-outlets from the valve-chests, and means for actuating said piston-valve from the piston-rod of the power-cylinder, the said means comprising a shaft having a lug thereon means carried by said shaft and engaged by a cross-head on the piston-rod to impart a rocking motion to the said shaft, a crank-arm loose on the shaft and having spaced shoulders adapted to be alternately engaged by the said lug and a connection between the crank-arm and the valve-stem of the piston-valve, as set forth.

8. The combination with a power-cylinder, a piston reciprocating therein valve-chests opening into the cylinder, a supply connection between the valve-chests, and a reciprocating piston-valve in said connection, of means for actuating said piston-valve from the piston-rod of said piston, the said means comprising a shaft having a lug thereon, double arms secured to the shaft and curved at their outer ends, a cross-head carried by the piston-rod of the power-cylinder and provided

with rollers for engaging the said arms to impart a rocking motion to the shaft, a weighted arm also carried by the said shaft, a crank-arm loose on the said shaft a link connecting the crank-arm with the valve-stem of the piston-valve, and means for moving the crank-arm from the said shaft as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

LEE EDWARD MITCHELL.

Witnesses:

EDWARD H. NEWCOMB,

WILLIAM S. COOPER.