E. E. MINARD.

FOUR-WAY VALVE.

APPLICATION FILED MAR. 14, 1918.

**1,300,220.**

Patented Apr. 8, 1919.

3 SHEETS—SHEET 1.

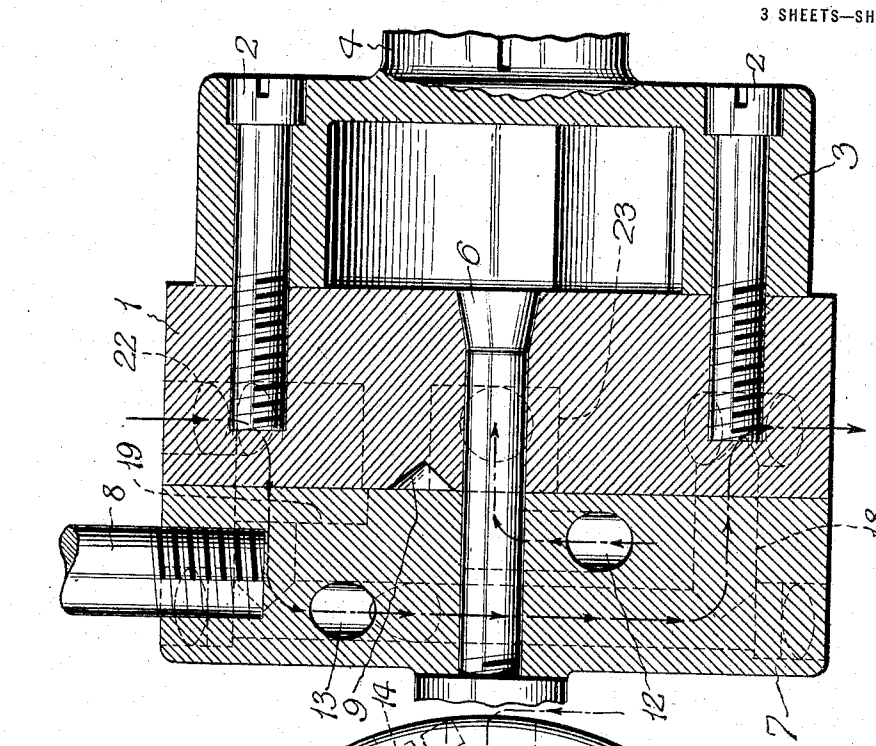


Fig. 2.

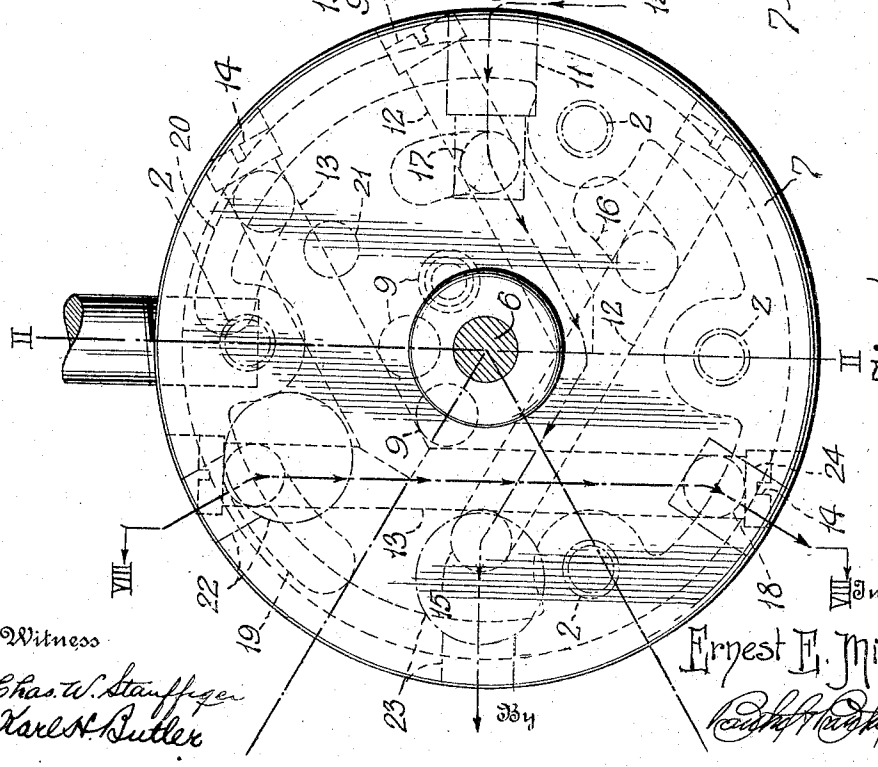


Fig. 1.

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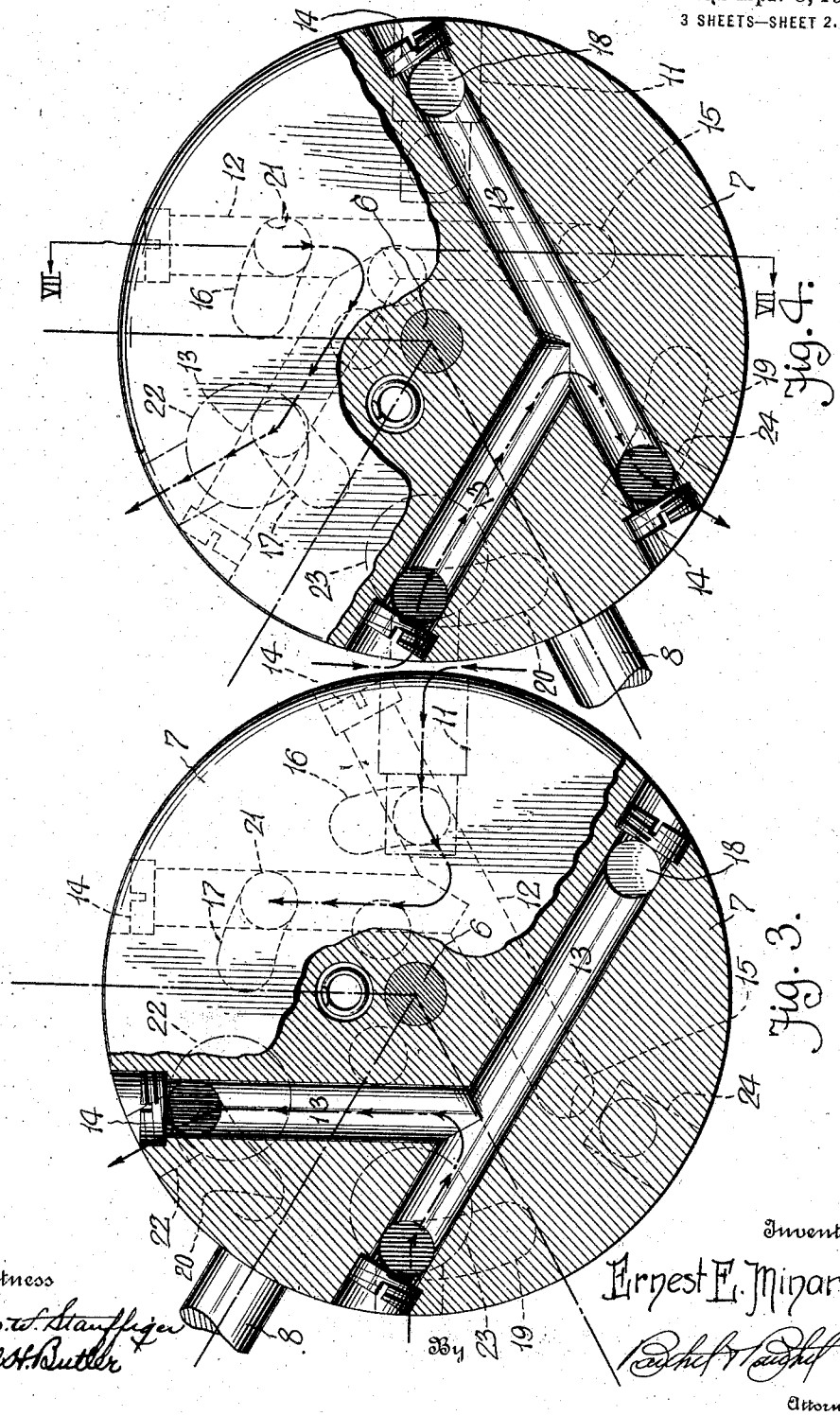



Fig. 4.

Fig. 3.

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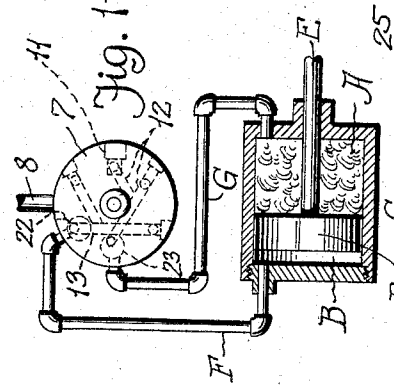


Fig. 11.

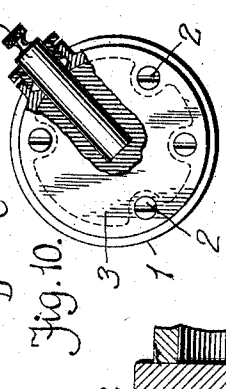


Fig. 10.

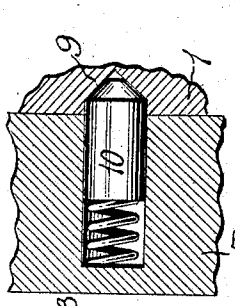


Fig. 9.

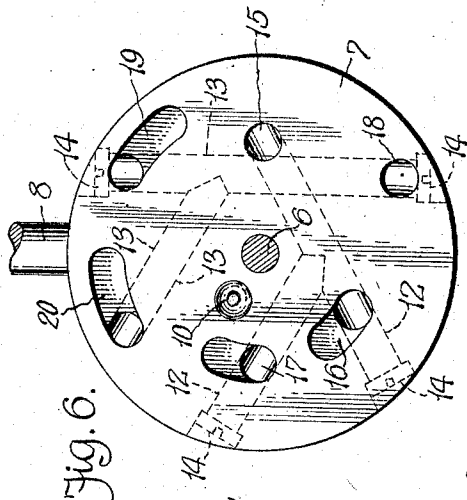


Fig. 6.

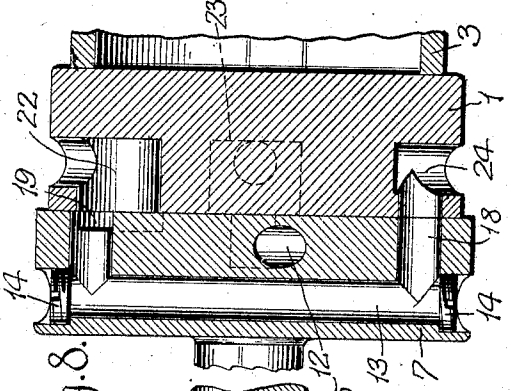


Fig. 8.

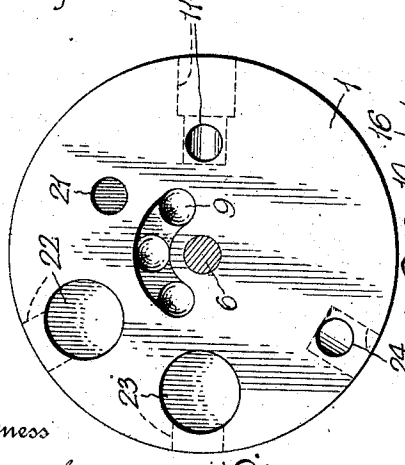


Fig. 5.

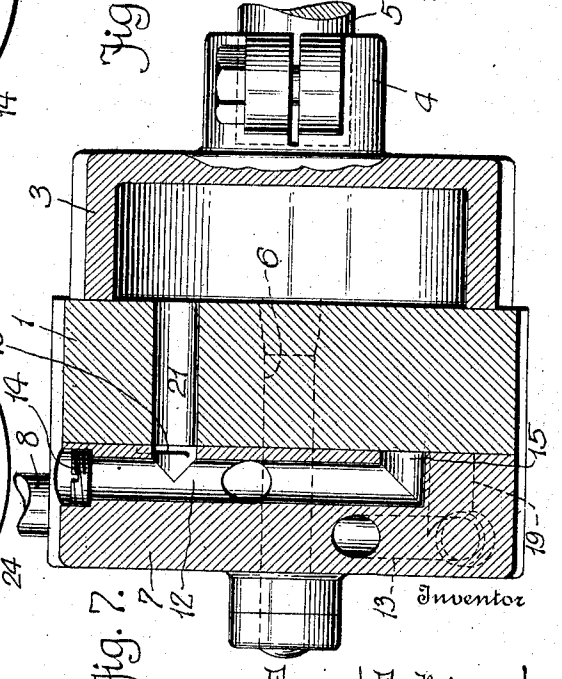


Fig. 7.

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# UNITED STATES PATENT OFFICE.

ERNEST E. MINARD, OF DETROIT, MICHIGAN.

## FOUR-WAY VALVE.

1,300,220. Specification of Letters Patent. Patented Apr. 8, 1919.

Application filed March 14, 1918. Serial No. 222,290.

*To all whom it may concern:*

Be it known that I, ERNEST E. MINARD, a citizen of the United States of America, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Four-Way Valves, of which the following is a specification, reference being had therein to the accompanying drawings.

In utilizing air under pressure as a motive fluid, for producing a reciprocating movement of a piston in a cylinder, it is necessary that a valve be employed to control the desired movement of the piston by permitting the admission and exhaust of the motive fluid to and from the cylinder in proper sequence and direction of flow, and it is desirable that the valve be compact and of such design that there will be a minimum waste of air in producing a predetermined and sometimes varying pressure on the piston in one direction of movement as compared to the pressure in the opposite direction of movement.

My invention aims to provide a pneumatic or four-way valve that may be associated with a work cylinder for positively controlling the use of air or other motive fluid in the cylinder for shifting the jaws of a chuck or other device. The valve is constructed so that when opening or closing the jaws of a chuck, there is an intermediate pressure, particularly when opening the jaws, and this is brought about by equalizing air pressures within the work cylinder, and then unbalance the pressure, thus causing the chuck jaws to open.

My invention further aims to provide a valve of the above type having an auxiliary reservoir and novel means by which the capacity of the reservoir may be increased or decreased at will, thus permitting of the valve being used with a motive fluid under various pressures.

My invention will be hereinafter described and then claimed and reference will now be had to the drawings, wherein—

Figure 1 is a front elevation of a valve, showing the same in a position by which the jaws of a chuck or other device are maintained in a closed or predetermined position by air or a motive fluid, under pressure;

Fig. 2 is a longitudinal sectional view of the valve, showing the valve in the same position as shown in Fig. 1;

Fig. 3 is a front elevation of the valve, partly broken away, and partly in section, showing an intermediate position of the valve whereby the reservoir is charged and a passageway or connection is provided between outlet ports;

Fig. 4 is a similar view showing the third position of the valve, such as with the jaws of a chuck or other device in an open position;

Fig. 5 is a front elevation of the stationary portion of the valve;

Fig. 6 is a rear elevation of the rotary portion of the valve, showing that face of the rotary portion of the valve which confronts the face of the stationary valve as shown in Fig. 5;

Fig. 7 is a longitudinal sectional view of a valve taken on the line VII—VII of Fig. 4;

Fig. 8 is a similar view of a portion of the valve, taken on the line VIII—VIII of Fig. 1;

Fig. 9 is an enlarged detailed sectional view of a portion of the valve, showing a spring pressed detent;

Fig. 10 is a rear elevation of the valve partly broken away and partly in section, showing a capacity regulator for the reservoir of the valve, and

Fig. 11 is a front elevation of the valve associated with a work cylinder, which is shown in section with the piston therein shifted to maintain the jaws of a chuck closed.

As my invention resides in the pneumatic or four-way valve, I have deemed it unnecessary to show a chuck, clutch or other device that has jaws adapted to be shifted by motive fluid, but have shown in Fig. 11, a work cylinder C containing a reciprocable piston D provided with a piston rod E adapted for shifting chuck jaws either to clamp a piece of work or to release the same. The work cylinder is of a conventional form and may be considered as having chambers A and B at each side of the piston D, with said chambers in communication with pipes or other conduits F and G, so that motive fluid, as air may be admitted to and from the chambers of the work cylinder.

The valve comprises a cylindrical stationary body 1 and connected to the rear face of the body by a plurality of screw bolts 2 or other fastening means is a cylindrical reservoir 3 provided with a concentric split sleeve

4 adapted to be clamped on a suitable support 5 adjacent a chuck or convenient to the operator of a lathe or other machine.

Centrally of the body 1 is an outwardly extending bolt 6 and rotatable on the outer end of said bolt and against the front face of the stationary body 1 is a rotary cylindrical valve member 7 provided with a radially disposed handle 8 so that the rotary member may be partially rotated relative to the stationary body 1. The confronting faces of the member 7 and the body 1 are ground for perfect contact and the rotary member is held against the stationary body 1 so that there will be no leak from between the member and the body.

The face of the body 1, as shown in Fig. 5, has a plurality of sockets 9 contiguous to the bolt 6 and, as best shown in Figs. 6 and 9, the rotary member 7 has a spring pressed detent adapted to ride into and out of engagement with the sockets 9 when the rotary member is adjusted relative to the valve body. The detent 10 is employed to hold the rotary member 7 in adjusted position and when adjusting the rotary member by the handle 8, it is easy to determine the three positions of the rotary member. The normal position of the rotary member may be considered as that shown in Figs. 1 and 2, with the handle 8 vertical, and by swinging the handle counterclockwise in an arc of sixty degrees, the intermediate position of the rotary member is reached. Then, by a further counterclockwise movement of the handle for another sixty degrees, the third position of the rotary member is reached. These various positions will be hereinafter referred to after the construction of the valve is better understood.

Again, referring to the valve body 1, the side of said body has an air intake port 11 adapted to communicate with a suitable source of motive fluid, as air, under pressure. The inner end of the port 11 is open at the front face of the valve body, as best shown in Fig. 5, and is adapted to communicate with an angle port 12 in the rotary member 7. The port 12, as well as another angle port 13 in the rotary member 7 are formed in two parallel planes, the angle port 12 being adjacent the inner face of the rotary member and the angle port 13 adjacent the outer face thereof, as best shown in Figs. 2, 7 and 8. To form these ports, the rotary member is provided with bores disposed at an angle to each other, with one of the bores meeting the other bore intermediate its ends. The outer ends of the bores are then closed by plugs 14.

The angle port 12 communicates with ports 15, 16 and 17 in the face of the rotary member 7, and the ports 16 and 17 are somewhat segment shaped, as shown in Fig. 6.

The angle port 13 communicates with ports 18, 19 and 20 in the face of the rotary member, the ports 19 and 20 being somewhat segment shaped.

The stationary valve body 1 has a port 21 communicating with the reservoir 3, and the face of the stationary valve body has ports 22, 23, and 24. The port 22 communicates with the pipe F, the port 23 with the pipe G and the port 24 with the atmosphere.

With the valve in the position shown in Figs. 1 and 2, the supply of air under pressure entering the port 11, passes through the port 17 into the angle port 12, then into the port 23 of the stationary valve body 1, through the pipe G to the chamber A of the work cylinder C; the passage of the air being indicated by arrows in Fig. 1. With the pressure of air shifting the piston D to one end of the cylinder, the chamber B exhausts through the pipe F, port 22, into the angle port 13, and as this port communicates with the port 24, the chamber B can exhaust. The jaws of the chuck are now maintained closed holding a piece of work.

To release the pressure of the jaws of the chuck, the handle 8 is shifted in an arc of sixty degrees, thereby placing the rotary member 7 in the position shown in Fig. 3. The angle port 12 now establishes communication between the supply of air and the reservoir 3, so that said reservoir may be charged through the ports 11, 16, 12, 17 and 21; the passage of air being indicated by arrows in Fig. 3. Simultaneous with this charging of the reservoir, the pressure of air within the chambers A and B of the work cylinder C is equalized by the ports 22 and 23 being placed in communication with each other through the medium of the angle port 13.

To completely open the jaws of the chuck, the handle 8 is swung to a position one hundred and twenty degrees from its original position or sixty degrees from its intermediate position, thus placing the angle ports 12 and 13 in the position shown in Fig. 4. The angle port 12 will establish communication between the reservoir 3 and the pipe F, thereby charging the chamber B of the work cylinder C. The angle port 13 will establish communication between the pipe G and the atmospheric port 24, thereby permitting the chamber A to exhaust. The piston D is reciprocated by the pressure of air within the chamber B and the jaws of the chuck are completely opened.

Reference will now be had to Fig. 10, showing the reservoir 3 provided with an adjustable plug 25 which is operatable from the outside of the reservoir 3 for changing the air capacity of the reservoir, and it is through the medium of this adjustable plug that a desired amount of air may be stored in the reservoir, at the intermediate position of the valve member 7 to be later used for

opening the chuck jaws when the rotary valve member is shifted to the third position.

It will be noted that with the rotary valve member in an intermediate position, that the pressure in the chambers A and B is equalized by the air flowing from the chamber A to the chamber B, consequently there is air within the chamber B to which is added the air of a reservoir 3, when the rotary valve member is shifted to a third position. Now, ordinarily the air in the chamber A would be exhausted to the atmosphere, but instead of this the valve saves the air from the chamber A by releasing it into the chamber B, thereby releasing the pressure of the chuck jaws. While this is taking place the reservoir 3 is receiving the supply of air under the same pressure as the original supply, so that when the valve is swung to the third position there is always a desired quantity of air to overbalance the pressure in the work cylinder, causing the piston D to exhaust the chamber A. As the chamber A had previously exhausted to a certain extent into the chamber B there is very little air in the chamber A to be exhausted when the valve reaches its third position.

It will also be noted that the extreme operations of the valve are limited by the detent 10, thus preventing the valve member from being completely rotated about its axis.

What I claim is:—

1. A valve of the type described, comprising a stationary body adapted to receive air under pressure, a reservoir carried by said body, and a rotary valve member carried by said stationary body, said rotary valve member having ports therein constructed and arranged in one position of said valve member to provide two air passages therethrough, in another position to permit air to simultaneously pass through said valve member, and also to enter said reservoir, and in another position to permit of air simultaneously leaving said reservoir and also passing through said rotary valve member.

2. A valve of the type described, comprising a stationary valve body adapted to communicate with a supply of air under pressure, a reservoir carried by said valve body, and a rotary valve member movable against said stationary valve body, and adapted for three positions relative thereto, said valve body and rotary member having ports therein constructed and arranged so that in one position of said rotary member there are independent air passages therethrough, in another position of said valve member air is permitted to enter said reservoir and also to pass through said rotary member, and in another position the air in said reservoir is permitted to leave through said member and also other air passed therethrough.

3. The combination of a work cylinder, a piston therein dividing said cylinder into chambers, a valve body connected to said cylinder and to a supply of air under pressure, a reservoir carried by said valve body, and adjustable means supported by said valve body adapted in one position to permit of one chamber being charged with air and the other exhausting, in another position to permit of said reservoir being charged and the air equalized in both chambers of said cylinder, and in another position to permit of the reservoir air to enter one chamber of said cylinder and the other chamber thereof to exhaust through said adjustable means.

4. The combination of a work cylinder, a piston therein dividing said cylinder into chambers, a valve body adapted to communicate with the chambers of said cylinder, and with a supply of air under pressure, a reservoir having an open side connected to said valve body and communicating therewith, and a ported valve member carried by said valve body and constructed and arranged so that by adjustment it controls the movement of said piston in said work cylinder by either admitting air to said cylinder direct from the supply or from said reservoir.

5. The combination of a work cylinder, a piston therein dividing said cylinder into chambers, a valve body communicating with the chambers of said cylinder and with a supply of air under pressure, a reservoir having an open side connected to said valve body communicating therewith, and a rotary valve member supported by said valve body and provided with angle ports constructed and arranged for communication with said valve body, said reservoir and the chambers of said cylinder, so that air under pressure may place said piston in two positions in said work cylinder.

6. The combination of a work cylinder, a piston therein dividing said cylinder into chambers, a valve body communicating with the chambers of said cylinder and with a supply of air under pressure, a reservoir communicating with said valve body, means in connection with said reservoir adapted for regulating the capacity thereof, an adjustable valve member carried by said valve body and provided with ports constructed and arranged so that the air under pressure may be used directly in one of the chambers of said cylinder and indirectly through said reservoir in the other chamber of said cylinder, and means between said valve body and said valve member adapted to hold said valve member in an adjusted position.

7. The combination of a work cylinder, a piston therein dividing said cylinder into chambers, a valve body communicating with the chambers of said cylinder and with the supply of air under pressure, a reservoir having an open side connected to said valve

body and communicating therewith, and an adjustable valve member carried by said valve body, said valve member having ports therein constructed and arranged so that air may be admitted directly to one of the chambers of said cylinder, indirectly to the other chamber of said cylinder from said reservoir, and either of said chambers exhaust.

8. The combination of a work cylinder, a piston therein, a valve body communicating with the ends of said work cylinder, and with a main line pressure of air, and an adjustable valve member carried by said valve body and having ports therein constructed and arranged in one position of said valve member to permit air entering one end of said cylinder to shift said piston, and exhaust from the opposite end of said cylinder, in another position to permit of air being stored in a reservoir and equalized at the sides of said piston, and in another position to permit of the stored air entering one end of said cylinder and the opposite end thereof exhausting.

9. The combination set forth in claim 8 and wherein a reservoir chamber carried by the valve body serves as a container for the stored air.

10. The combination of a work cylinder, a piston therein, a valve body communicating with the ends of said work cylinder and with a main line pressure of air, and an adjustable valve member carried by said valve body and having ports therein constructed and arranged in one position of said valve member to permit air entering one end of said cylinder to shift said piston, and exhaust from the opposite end of said cylinder, and in another position to permit of air being admitted to a reservoir chamber and in the same position permitting the pressure of air in the chambers on each side of said piston to be equalized by communication being established between the said chambers of said work cylinder, through said valve body and said ported adjustable valve member, and in another position permit of air stored in the reservoir chamber to enter at one end of said work cylinder and the other end to exhaust.

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

ERNEST E. MINARD.

Witnesses:
KARL H. BUTLER,
ANNA M. DORR.

**Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."**