(No Model.)

F. M. RITES.

FLUID COMPRESSOR.

No. 568,796. Patented Oct. 6, 1896.

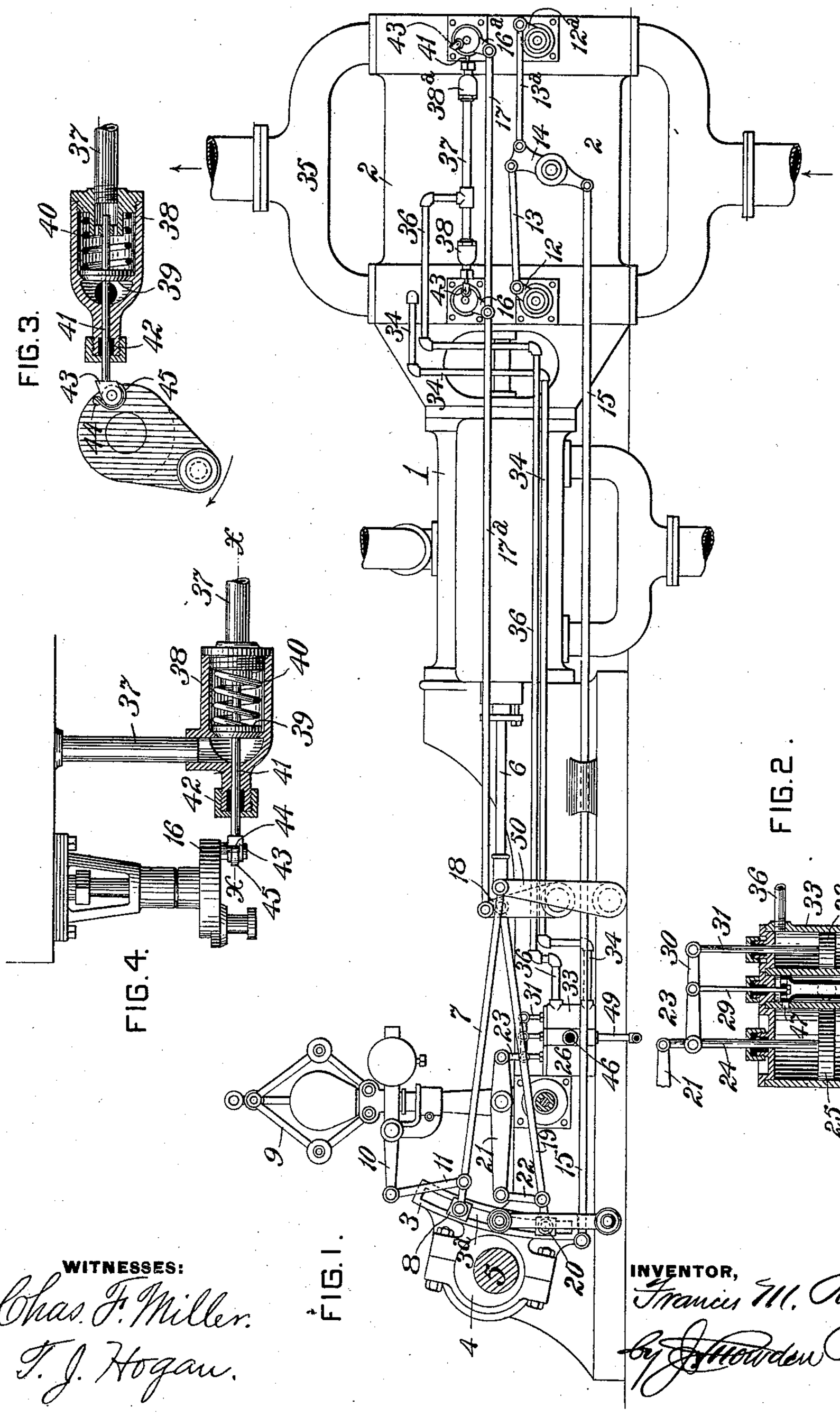

FIG. 1.

FIG. 3.

FIG. 4.

FIG. 2.

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FLUID-COMPRESSOR.

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To all whom it may concern:

Be it known that I, FRANCIS M. RITES, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Fluid-Compressors, of which improvement the following is a specification.

The object of my invention is to provide means for varying the period of operation of the positively-operated valves of a fluid-compressor, the operation of which valves is effected and maintained by the mechanism of the compressor or motor, and to enable the compressor to be run at a high rate of speed without imposing strains on the governing mechanism.

To this end my invention, generally stated, consists in the combination, with a motor-cylinder and a compressor-cylinder, of an adjustable valve-gear and a valve for the compressor-cylinder connected thereto whose operation is effected and maintained by the motor, but whose relative periods of operation are varied by a governor under the influences of pressures within and without the compressor-cylinder.

The improvement claimed is hereinafter fully set forth.

My invention is not limited in application to the specific form of valve-gear herein set forth, but may be employed in connection with any of the usual forms of adjustable valve mechanism or with any form of valve mechanism in which the functions of the valves are adapted to be automatically varied.

In the accompanying drawings, Figure 1 is a side elevation of a compressor, showing an application of my improvement in connection with an Allan valve-gear; Fig. 2, a vertical longitudinal section, on an enlarged scale, through the cylinder and valve of the pressure-governor and through the cylinder of the device which directly effects the variations in the adjustment of the valve-gear of the compressor-cylinder; Fig. 3, a vertical longitudinal section on the line x x of Fig. 4, through a valve device for controlling the admission of fluid from the compressor-cylinder to the cylinder of the pressure-governing device, the means for actuating the admission-valve being shown in elevation; and Fig. 4, a horizontal section of the admission-valve device and a plan view of the actuating mechanism for the admission-valve.

In the practice of my invention as exemplified in the drawings I provide a compressor in which the valve-gear of the steam-cylinder 1 and the valve-gear of the air-compressing cylinder 2 are operated by a single eccentric 4 on the main shaft 5, both valve-gears being connected with an Allan link 3, which is actuated by the eccentric.

The valve-stem 6 of the steam-distribution valve is connected to an oscillating arm 50 and, by means of a rod 7, with a block 8, which is adapted to slide in the link 3. The block 8 is adjusted in position by the centrifugal governor 9, which is connected to the rod 7 by means of the lever 10 and link 11 or which may be connected more directly to the block 8.

The air-compressing cylinder 2 may be provided with oscillating inlet and outlet valves of any of the usual forms.

The arms 12 and 12^a on the stems of the inlet-valves are connected by means of rods 13 and 13^a with an oscillating wrist-plate 14, which is connected with the link 3 by means of the rod 15.

The arms 16 and 16^a on the stems of the outlet-valves are connected together by means of a rod 17, and also connected, by means of a rod 17^a, with an oscillating arm 18, which is mounted on the frame of the engine. The oscillating arm 18 is connected by means of a rod 19 with a block 20, fitted to slide in the slot 3^a of the Allan link 3.

It will be seen that with this construction the inlet and outlet valves of the air-compressing cylinder and the distribution-valve of the steam-cylinder are all actuated by the single eccentric 4 on the main shaft 5. The valve-gear for operating the outlet-valves of the air-compressing cylinder and the valve-gear for operating the distribution-valve of the steam-cylinder are adapted to be adjusted by shifting the sliding blocks 20 and 8, respectively, in the slot 3^a of the link 3. The adjustment of the valve-gear of the steam-cylinder is effected by means of the centrifugal governor 9, which operates automatically to shift the block 8, and the adjustment of the

valve-gear which operates the outlet-valves of the compressing-cylinder is effected by means of my improved governing mechanism, which will now be described.

In the embodiment of my invention shown in the drawings a lever 21, which is shown pivoted to the base or frame of the centrifugal govenor, is connected at one end to the rod 19 by means of a rod 22, and at its other end, by means of a link 23, to the rod 24 of a piston 25, (shown in Fig. 2,) which is fitted to work in a cylinder 26.

If preferred, the rod 22 may connect directly to the block 20, the object of the connection being that the block 20 may be adjusted in position relative to the link 3 by the movement of the lever 21. The movement of the lever 21 for this purpose is effected by the movement of the piston 25, which is actuated by fluid under pressure in the cylinder 26, the admission and release of the fluid to and from opposite sides of the piston 25 being controlled by the valve 27.

The fluid by which the piston 25 is actuated may be obtained from any convenient source of fluid under pressure, but in order to insure a constant supply of fluid under pressure which will always be available independently of the operation of the compressor, and which will be of substantially uniform pressure, I prefer to employ in the construction shown the pressure from a water-main or some other permanent reservoir of pressure, which in this instance is connected with the valve-chamber 28 by means of the passage 46, which opens into the valve-chamber 28 between the ends of the valve 27.

The valve 27 is connected by means of a stem 29 with a floating lever 30, which is connected at one end to the stem 24 of the piston 25 and at its other end to the stem 31 of a piston 32 in the small cylinder 33.

One end of the cylinder 33 is connected by means of a pipe 34 with the outlet-passage 35 of the fluid-compressing cylinder 2 or with the reservoir into which the fluid is compressed, and one side of the piston 32 is thus at all times exposed to the pressure in the outlet or in the reservoir of the fluid-compressor. The other end of the cylinder 33 is connected by means of a pipe 36 with branch pipes 37, leading to opposite ends of the fluid-compressing cylinder 2, through which fluid may be admitted from either end of the compressing-cylinder to one side of the piston 32 in the cylinder 33.

As it is not desirable that either end of the compressing-cylinder should be at all times in communication with the cylinder 33 I employ valves 39 in the casings 38 and 38ª (shown in section in Figs. 3 and 4) for closing communication from each end of the cylinder 2, through the branch pipes 37, to the pipe 36 and cylinder 33, and provide means for opening the valves 39 when it is desired to put the cylinder 33 in communication with either end of the compressing-cylinder 2.

The valves 39 are normally held to their seats by means of springs 40 and are provided with stems 41, which pass through the stuffing-boxes 42 and extend into position to be actuated by the tappets 43, which are pivoted on the arms 16 and 16ª of the outlet-valves.

When the arm 16 is turning in the direction indicated by the arrow in Fig. 3, the tappet 43 is held against the stop 44 by the spring 45, one end of which bears against the tappet and the other end of which is secured to the stop 44, and when the tappet comes in contact with the stem 41 the valve 39 is unseated, so as to admit fluid from the end of the compressing-cylinder 2 to the pipe 36 and cylinder 33. When the arm 16 is moving in the opposite direction and the tappet 43 comes in contact with the stem 41, the spring 45 yields and permits the tappet to pass by the stem without opening the valve. The valves 39 are held closed by the springs 40, except when unseated by the contact of the tappets 43 with the stems 41, and the positions of the tappets 43 on the arms 16 and 16ª are such that each tappet will come in contact with one of the stems 41 and unseat one of the valves 39 just before the outlet-valve at that end of the compressing-cylinder is opened. Communication is thus opened through the pipes 37 and 36 between one end of the compressing-cylinder and the upper end of the cylinder 33 at each stroke of the piston in the compressor-cylinder, and the small piston 32 in the cylinder 33 is exposed on one side to the pressure of the compressed fluid in the compressing-cylinder just before the outlet-valve at the end of the compressing-cylinder opens, and the closing of the valve 39, which is then effected by the spring 40, prevents a reduction of pressure in the cylinder 33 above the piston 32, such as would occur if communication between the compressing-cylinder and the small cylinder 33 remained open after the opening of the outlet-valves of the compressing-cylinder. The closing of the valve 39 also prevents the small piston 32 from being subjected to the variations of pressure which occur at other times in the compressing-cylinder.

It will be understood that each of the casings 38 and 38ª contains a valve device similar to that shown in Figs. 3 and 4; that both of these valves remain closed except during the time that they are momentarily opened by the tappets 43, and that the opening and closing movements of each of the admission-valves 39 always occur just before the opening of the outlet-valve on the same end of the compressor-cylinder. The result of this operation is that the only pressure admitted to the upper end of the small cylinder 33 is the maximum pressure which exists in the compressor-cylinder just before the opening of the outlet-valves.

So long as the pressure in the reservoir or outlet-passage of the compressing-cylinder

and the maximum pressure which exists in the compressing-cylinder just before the opening of the outlet-valves substantially balance one another the opposing pressures on the opposite sides of the small piston 32 will balance one another and there will be no movement of the piston 32, the valve 27 will be held in its middle position, so as to close the ports 47 and 48, the piston 25 will not be moved to change the adjustment of the block 20 in the link 3, and there will be no variation in the time of opening of the outlet-valves.

If the adjustment of the block 20 in the link 3 is such that the outlet-valves are opened before the pressure of the fluid which is being compressed in the compressor-cylinder equals the pressure in the outlet-passage or reservoir of the compressor, or if the adjustment is such that the outlet-valves do not open until the pressure in the compressing-cylinder is considerable in excess of the pressure in the outlet-passage or reservoir, there will be a corresponding difference of pressures acting on the opposite sides of the piston 32, the piston 32 will be moved, so as to shift the valve 27 from its middle position, one of the ports 47 or 48 in the cylinder 26 will be opened to admit fluid under pressure from the passage 46 to one side of the piston 25, and the other port at the opposite end of the cylinder 26 will be opened to permit the escape of fluid from the other side of the piston 25, through the valve 27, to the exhaust-passage 49, and the piston 25 will be moved by the fluid under pressure from the passage 46 to operate the lever 21 and shift the position of the block 20 in the link 3 in direction to effect the desired variation in the time of opening the outlet-valves.

If the pressure of the fluid admitted from the compressor-cylinder to the small cylinder is less than the reservoir-pressure acting on the other side of the small piston, the small piston 32 and the valve 27 will be moved upward, the water main or other independent source of fluid under pressure which is connected to the opening 46 will be put in communication with the upper end of the cylinder 26, the lower end of the cylinder 26 will be put in communication with the exhaust or drain pipe 49, and the piston 25 will be moved downward. The downward movement of the piston 25, acting through the lever 21, will cause an upward movement of the block 20 toward the center of the link 3, and the valve-gear for operating the outlet-valves will thereby be adjusted to effect a later opening of the outlet-valves. In case the pressure of the fluid admitted from the compressor-cylinder to the small cylinder 33 is sufficiently greater than the reservoir-pressure to cause a downward movement of the piston 32, the valve 27 will also be moved downward, the lower end of the cylinder 26 will be put in communication with the main or other independent source of pressure, the upper end of the cylinder 26 will be opened to the exhaust or drain pipe 49, the piston 25 will be moved upward, the lever 21 will be actuated to move the block 20 downward toward the end of the link 3, and the outlet-valve gear will thereby be adjusted to effect an earlier opening of the outlet-valves.

In whatever direction the valve 27 is moved by the small piston 32, the piston 25 will be moved in the opposite direction to effect the proper adjustment of the outlet-valve gear, and the same movement of the piston 25 which effects adjustment of the valve-gear will, by means of the lever 30, move the valve 27 back to its central position, in which position the valve 27 covers both of the ports 47 and 48 at opposite ends of the cylinder 26 and confines the fluid in both ends of the cylinder 26. The confined fluid on opposite sides of the piston 25 will then tend to check or prevent any vertical vibratory movement of the end of the rod 23 or of the rod 19.

After the adjustment of the block 20 to effect the opening of the outlet-valves at the proper time, that is, to effect the opening of the outlet-valves at the time when the pressure in the compressing-cylinder bears the proper relation to the pressure in the outlet passages and reservoir, these two pressures will be approximately equal, and the piston 32 in the small cylinder 33 will be substantially balanced by the pressures on its opposite sides and will be unaffected by any vibrations of the valve mechanism whose adjustment it controls. In the drawings, the area of that side of the piston 32 on which the reservoir-pressure acts is greater than the area of the opposite side, on which the pressure in the compressing-cylinder acts, the difference being equal to the cross-sectional area of the piston-rod 31, and the piston 32 is to that extent a differential piston. This difference in area may be increased or diminished, as found desirable, by enlarging or diminishing the cross-sectional area of the piston or by other means, or an equivalent result may be obtained by the employment of a spring or weight on one side of the piston to offer additional resistance to pressure on the opposite side. I make no claim to any specific construction for this purpose, but merely indicate that the construction and proportions may be varied without departure from my invention.

The diameter of the piston 32 may be very small, as it is only necessary that the area of the piston should be sufficient to permit the difference of pressures on its opposite sides to move the small balanced valve 27. The pipe 36, which connects one end of the small cylinder 33 with the ends of the air-compressing cylinder 2, may be of such small diameter that it will contain but a small volume of fluid, and the volume of the cylinder 33 on one side of the piston 32, together with the volume of the pipe 36, will, when the valve 39 is open, add but very little to the clearance at the ends of the air-compressing cyl-

inder. This is of importance in all fluid-compressors, but it is of special importance in fluid-compressors employed in connection with refrigerating apparatus.

I claim as my invention and desire to secure by Letters Patent—

1. In an elastic fluid-compressor, the combination, of a compressing-cylinder, valve mechanism controlling the valves of said cylinder, and so connected with the motor as to be positively and continuously operated by the motor during the whole of the cycle of operation of the compressor, a pressure-actuated device connected to and acting to vary the operation of said valve mechanism, and connections from the compressor-cylinder and from the outlet passage or reservoir of the compressor to the pressure-actuated governing device, whereby the adjustment of the valve mechanism is effected by the opposing pressures of the fluid in the cylinder and in the outlet passage or reservoir of the compressor, substantially as set forth.

2. In an elastic fluid-compressor, the combination, of a compressor-cylinder, valve mechanism controlling the valves of said cylinder and so connected with the motor as to be positively and continuously operated by the motor during the whole of the cycle of operation of the compressor, a fluid-pressure actuated device for effecting the adjustment of the valve mechanism and means whereby the operation of the fluid-pressure-actuated device is controlled by the opposing pressures of the fluid in the compressor-cylinder and in the outlet passage or reservoir of the compressor, substantially as set forth.

3. In an elastic fluid-compressor, the combination, of a motor, a compressor-cylinder, valve mechanism receiving motion from the motor through an adjustable link connection for directly operating the valves of the compressor-cylinder from the motor, and a fluid-pressure-governing device for effecting the adjustment of the link connection and controlled by the opposing pressure of fluid in the compressor-cylinder and in the outlet passage or reservoir of the compressor, substantially as set forth.

4. In an elastic fluid-compressor, the combination, substantially as set forth, of a compressing-cylinder, positively-operated valve mechanism controlling the outlet-valves of said cylinder, a pressure-actuated governing device connected to and acting to vary the period of operation of said valve mechanism, valve mechanism controlling the admission of pressure from the compressing-cylinder to said pressure-actuated governing device, and connections for actuating said controlling-valve mechanism by the actuating mechanism of the outlet-valves.

5. In an elastic fluid-compressor, the combination, substantially as set forth, of a compressing-cylinder, a motor effecting the function of fluid compression in said cylinder, valve mechanism controlling the outlet-valves of the compressing-cylinder and operated positively by the motor, a pressure-actuated governing device connected to and adapted to vary the position of the member through which the motor operates said valve mechanism, valve mechanism controlling the admission of pressure from the compressing-cylinder to said pressure-actuated governing device, and connections for actuating said controlling-valve mechanism by the actuating mechanism of the outlet-valves.

6. In an elastic fluid-compressor, the combination, substantially as set forth, of a compressing-cylinder, a motor effecting the function of compression in said cylinder, valve mechanism controlling the outlet-valves of the compressing-cylinder, a valve-actuating member operated positively by the motor-shaft and connected with said valve mechanism, a pressure-actuated governing device connected to said valve mechanism and adapted to vary the period of operation imparted to it by the actuating member, valve mechanism controlling the admission of pressure from the compressing-cylinder to the pressure-actuated governing device, and connections for actuating said controlling-valve mechanism by the actuating mechanism of the outlet-valves.

In testimony whereof I have hereunto set my hand.

FRANCIS M. RITES.

Witnesses:
T. J. HOGAN,
F. E. GAITHER.