T. H. SMITH.

VALVE MECHANISM FOR AIR COMPRESSORS.

APPLICATION FILED JAN. 12, 1910.

972,408.

Patented Oct. 11, 1910.

2 SHEETS—SHEET 1.

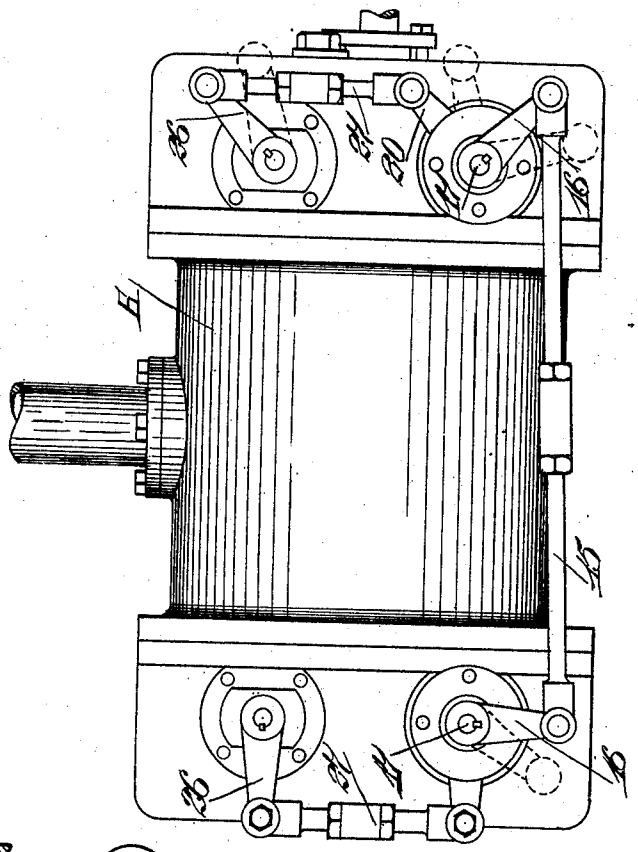

Fig. 1.

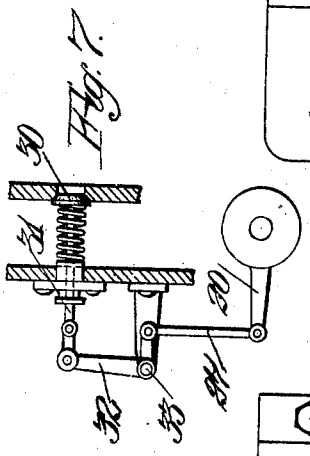

Fig. 3.

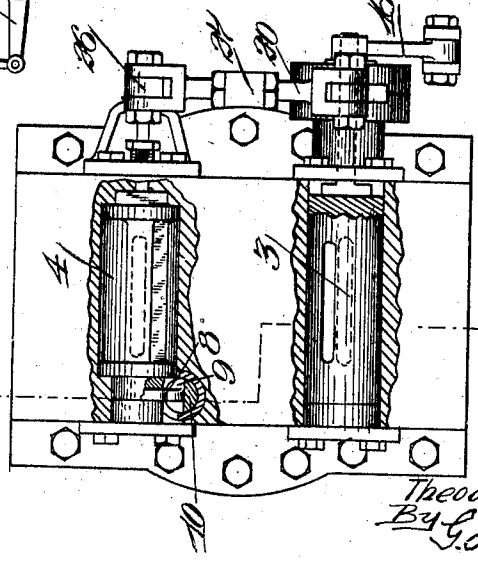

Fig. 2.

Witnesses;
F. E. Maynard.
P. Bosberg

Inventor;
Theodore H. Smith,
By G. B. Strong.
His Atty.

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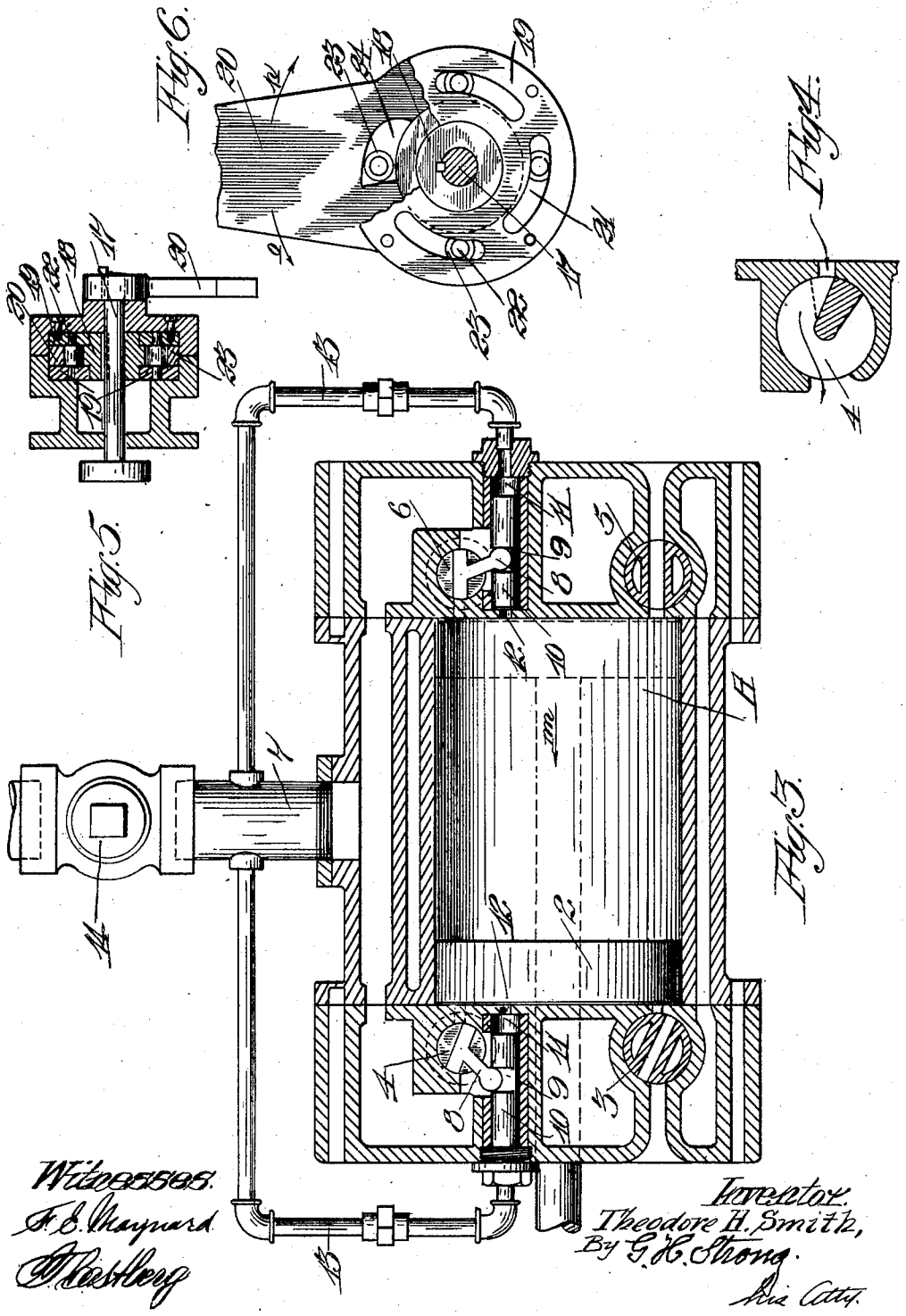

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H. B. Maynard
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Theodore H. Smith,
By G. H. Strong.
His Atty.

UNITED STATES PATENT OFFICE.

THEODORE H. SMITH, OF SAN FRANCISCO, CALIFORNIA.

VALVE MECHANISM FOR AIR-COMPRESSORS.

972,408. Specification of Letters Patent. Patented Oct. 11, 1910.

Application filed January 12, 1910. Serial No. 537,604.

To all whom it may concern:

Be it known that I, THEODORE H. SMITH, a citizen of the United States, residing in the city and county of San Francisco and State of California, have invented new and useful Improvements in Valve Mechanism for Air-Compressors, of which the following is a specification.

My invention relates to a valve mechanism especially designed for air-compressors.

The object of the invention is to provide a simple, practical and reliable valve gear for operating the suction and discharge valves of compressors and the like, and the particular features and advantages of the invention will be apparent hereinafter.

The invention consists of the parts and the construction and combination of parts as hereinafter more fully described and claimed, having reference to the accompanying drawings, in which—

Figure 1 is a side elevation of the compressor. Fig. 2 is an end view in partial section. Fig. 3 is a vertical longitudinal section on line X—X, Fig. 2. Fig. 4 is a sectional detail of an open discharge valve. Fig. 5 is a vertical section of the clutch mechanism. Fig. 6 is a detail view of the clutch. Fig. 7 shows a modified form of valve.

A represents an air-compressor cylinder inclosing the double-acting piston 2.

3 and 4 represent, respectively, the inlet and discharge valves at one end of the compressor, and 5 and 6 are corresponding valves at the opposite end of the cylinder. The inlet valves 3—5 are operated in unison, as will be hereinafter described, so that one opens when the other closes; but the operation of the discharge valves 4—6 is independent of one another, and contingent on the differential pressures in the cylinder and discharge pipe 7. All these various valves are preferably of the Corliss oscillating type, and they, as well as the cylinder, may be suitably water-jacketed.

The discharge valves 4—6 each have a crank-arm 8 at one end engaging in a slot 9, and a piston 10 which operates in a small cylinder 11 in the heads of the compressor cylinder A. The interior of each small cylinder 11 is in constant communication with the interior of the compressor cylinder through a port 12, so that whenever the piston 2 is compressing, the full pressure within the compressor cylinder A is thrown against the inner end of one of the small pistons 10, so as correspondingly to rock one of the discharge valves 4 or 6 according in which direction the compressor piston 2 is moving. The other end of each small cylinder 11 is connected by a pipe 13 with the discharge pipe 7; and beyond the point of union of the pipes 13 and 7, is a suitable check-valve 14.

As seen in Fig. 3, the compressor piston 2 is at its limit of movement to the left, having sucked in a charge of air through the open inlet valve 5 and discharged a compressed charge on the opposite side through the open discharge valve 4; this valve 4 having been opened when piston 2 started its movement to the left by the pressure in cylinder A passing through the small port 12 of the little cylinder 11 in which is the piston 10 controlling the movements of this valve 4. Simultaneous with this movement of the compressor piston 2 to the left, valve 6 was closed, by reason of the back pressure in the discharge pipe 7 passing through the right-hand pipe 13 and acting on the end of the little piston 10 which controls the movement of the discharge valve 6; this back pressure from the discharge pipe throwing the little piston 10 to the left and closing the valve 6, as shown in said Fig. 3. Each time the piston 2 is reversed, the consequent opening of one of the valves 4 or 6 and the closing of the other are effected through the difference in pressures in the discharge pipe 7 and in the cylinder, as readily understood.

The operation of the suction valves 3—5 synchronously with the movements of the discharge valves 4—6 is effected by the following means: The two valves 3—5 operate in unison by means of the connecting rod 15 pivoted to the cranks 16, which latter are fixed to the stems 17 of the valves 3—5. Each valve stem has secured to it, Figs. 4—6, a hub member 18, this hub member being reduced at its ends to accommodate a pair of fixed cam ring plates 19, between which plates works a cam-lever or clutch-lever 20. The ring plates 19 are each provided with eccentric slots 21, Fig. 6, to accommodate the pintles 22 of friction clutch rollers 23. The clutch-lever 20 surrounds the hub 18 and has a set of eccentrically arranged pockets 24 corresponding to the cam slots 21. The outer eccentric walls of these pockets 24 coact with the surface of the hub 18, which is concentric with the stem 17, to grip the roll-

ers 23 and cause the stem to turn when the clutch-lever 20 is rocked in one direction. The clutch-lever 20 is connected with a crank-arm 26 rigid with the stem of valve 6 by suitable means, as the adjustable link 27. It is to be understood that valves 4 and 3 are connected together, just as valves 6 and 5 are connected, which connections are represented in Fig. 1, just described.

The arrangement of the cam slots 21 and pockets 24 is such that when the clutch-lever 20 is moved in one direction, represented by arrow *p*, Fig. 6, the rollers 23 are inactive, so as not to affect the valve stem 17 and its respective valve 5 or 3. When the lever 20, however, is rocked in the opposite direction, the desired binding action first takes place on the rollers to turn the stem 17 and its valve in unison with the lever 20; but before the latter reaches the end of its stroke, the pintles 22 of the rollers are forced to the longer radius of the cam slots 21, thereby lifting the rollers free from the hub 18, as shown in Fig. 6, so that the valve stem 17 with its valve 5 may later turn in the direction of the arrow *o*, Fig. 6, and independently of this particular operating lever 20; this reverse movement of the valve 5 being accomplished by the discharge valve 4 at the opposite end of the cylinder.

In operation, referring to Fig. 3, and assuming piston 2 to be in the dotted line position at the right and moving in the direction of the arrow *m*, the parts are set so that the pressure ahead of the piston 2, acting through the port 12 at the left, will move the corresponding little piston 10 at the left to open valve 4, allowing the compressed charge in the cylinder A, which has previously been drawn in through valve 3, to be forced out through the main 7. Simultaneously the pressure created in the main 7 will react through pipe 13 at the right to shift the right-hand piston 10 to the left, closing valve 6. This closing movement of valve 6 causes its crank-arm 26 to act through the link 27 to rock the clutch-lever 20, thereby causing the rollers 23 to bind and turn the valve 5 to open position. The moment, however, the valve 5 is opened, and before the lever 20 has reached its limit of movement, the pintles 22 of the rollers 23 approach the outer ends of the eccentric slots 21, thereby lifting the rollers from the hub 18 of valve 5. Opening the valve 5 closes valve 3, by reason of the connections between the two valves afforded by the crank-arm 16 and connecting rod 15. Thus it is seen that the opening of the discharge valve 4 preceded the closing of valve 3, these two movements being independent of one another. From this it follows that each inlet valve is closed by the other, but opened by its respective discharge valve; and one discharge valve opens one inlet valve and closes the other inlet valve, but does not affect, except indirectly through the air pressures, the other discharge valve. When the piston 2 reaches its limit at the left of the cylinder, represented in full lines, Fig. 3, the valves are reversed in a similar manner.

In Fig. 7, is shown a form of discharge puppet-valve 30 having a stem 31 projecting through the casing and linked to a bell-crank 32 pivoted at 33. The link 27 connecting the crank 32 and the clutch 20 will actuate the inlet valves in a manner similar to the piston valves 3 and 4.

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

1. In an air-compressor, the combination of a compressor cylinder, an inlet valve and a discharge valve, a discharge pipe connected with said discharge valve, mechanism operable by the differential pressures in the discharge pipe and cylinder for operating the discharge valve, and a clutch mechanism engageable and disengageable with the stem of the inlet valve and operably connected with the discharge valve for operating the inlet valve in one direction.

2. In an air-compressor, the combination of a compressor cylinder, a piston therein, an inlet valve and a discharge valve in each end of the cylinder, a discharge pipe connected with both discharge valves, connections between the inlet valves for opening and closing them in unison, friction clutch connections between each discharge valve and its inlet valve whereby one discharge valve may open one inlet valve and close the other inlet valve independently of the other discharge valve, and means by which the discharge valves are operated independently through the differential pressures in the cylinder and discharge pipe.

3. In an air-compressor, the combination of a compressor cylinder, a piston therein, an inlet valve and a discharge valve in each end of the cylinder, a discharge pipe connected with both discharge valves, connections between the inlet valves for opening and closing them in unison, connections between each discharge valve and its inlet valve whereby one discharge valve may open one inlet valve and close the other inlet valve independently of the other discharge valve, and means by which the discharge valves are operated independently through the differential pressures in the cylinder and discharge pipe, said connections between a discharge valve and its inlet valve including a clutch mechanism engageable and disengageable with the stem of the inlet valve.

4. In an air-compressor, the combination of a compressor cylinder, an inlet valve, a discharge valve, a discharge pipe connected with the discharge valve, means for operating the discharge valve through the differ-

ence in pressures in the discharge pipe and cylinder, an intermittently acting clutch connection between the two valves for operating the inlet valve in one direction by the discharge valve, and independent means for operating the inlet valve in the opposite direction.

5. In an air-compressor, the combination of an inlet valve and a discharge valve, said valves having stems, an arm rigid on one of the stems and a clutch-lever fulcrumed on the other stem, clutch mechanism cooperating with said lever to cause the two valves to turn in unison when the discharge valve moves in one direction, and independent means for operating the inlet valve in the opposite direction.

6. In an air-compressor, the combination of a compressor cylinder, an inlet valve and a discharge valve, means for operating the discharge valve, said valves having stems, a crank on the discharge valve stem, a loose clutch-arm on the inlet valve stem, fixed cam plates between which said loose clutch-arm turns, friction rollers having pintles journaled in eccentric slots in said plates, means by which said loose clutch-arm when rocked in one direction will bind said rollers to the inlet valve stem to rock the latter in one direction, and independent means for rocking the inlet valve in the opposite direction.

7. In an air-compressor, the combination of a compressor cylinder having an inlet valve and an outlet valve, a piston in the cylinder, means for operating the outlet valve on the reciprocation of the piston, said valves having stems, a crank-arm rigid with the outlet valve stem, a clutch-arm normally loose on the inlet valve stem, a friction clutch mechanism operable by said clutch-arm to lock the latter to the inlet valve stem when the outlet valve moves in one direction, and independent means for turning the inlet valve in the opposite direction.

8. In an air-compressor, the combination of a compressor cylinder having inlet and discharge valves, a piston in the cylinder, means for operating the discharge valve on the reciprocation of the piston, said valves having stems, a fixed arm on the discharge valve stem and a loose clutch-arm on the inlet valve stem, fixed ring plates having eccentric cam slots embracing the inlet valve stem, and between which cam plates said clutch-arm is turnable, rollers having pintles journaled in said cam slots and operative by said clutch-arm to grip said stem, the outer ends of said cam slots acting to lift the rollers free from frictional engagement with the inlet valve stem when the rollers are moved to the outer ends of said slots by said clutch-arm, and means independent of the clutch-arm for rocking the inlet valve in the opposite direction.

9. In an air-compressor, the combination of puppet-valves having stems projecting through the compressor walls, inlet valves, stems projecting therefrom, links and levers connecting said stems, a clutch fulcrumed on each inlet valve stem, and connections between the stems of the puppet-valves and said clutches whereby the inlet valves may be actuated.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

THEODORE H. SMITH.

Witnesses:
JOHN W. LEGGETT,
THOMAS TIPPETT.