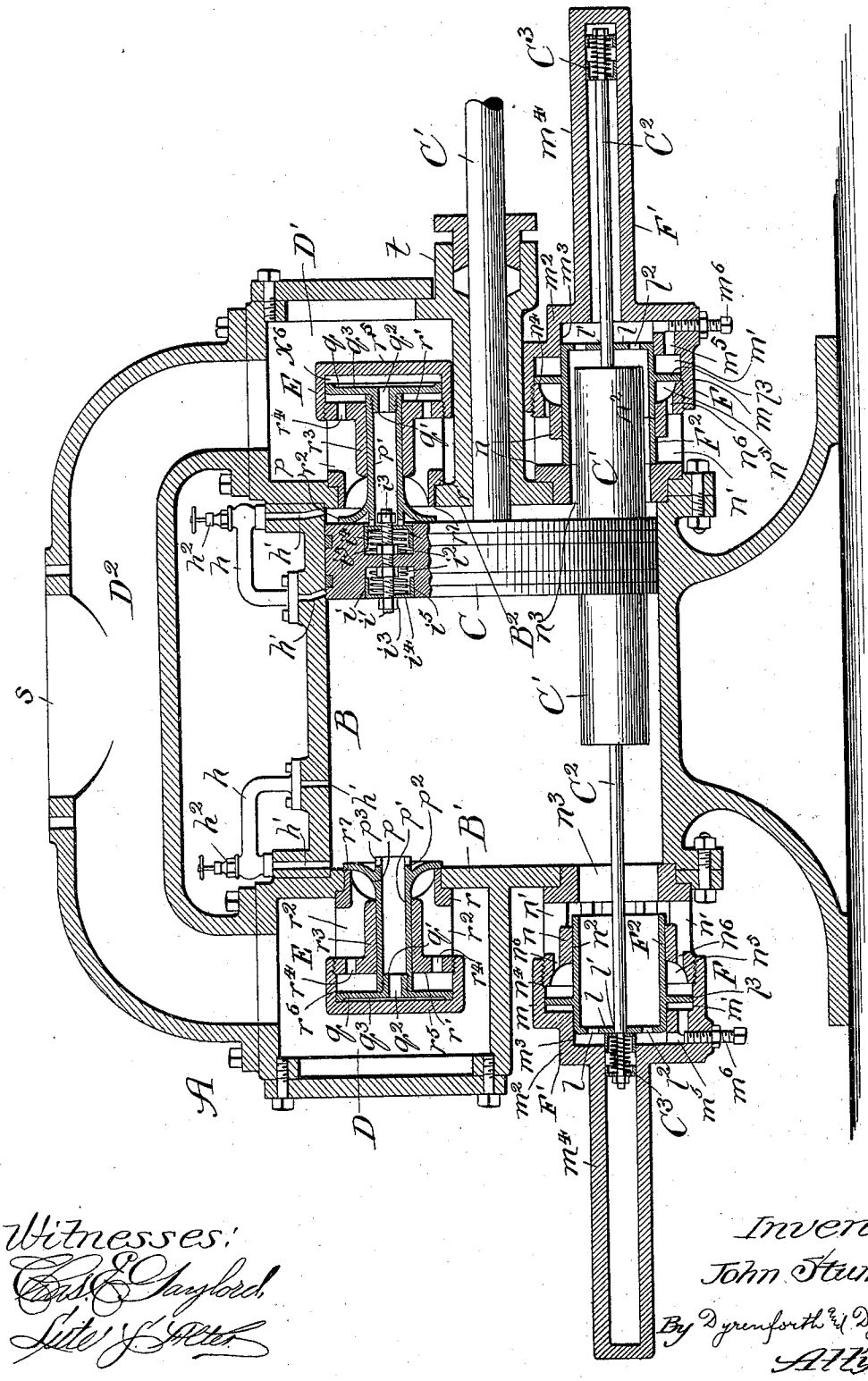
(No Model.)

# J. STUMPF.

## COMPRESSOR.

No. 600,626. Patented Mar. 15, 1898.



Witnesses:
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# UNITED STATES PATENT OFFICE.

JOHN STUMPF, OF CHICAGO, ILLINOIS.

## COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 600,626, dated March 15, 1898.

Application filed November 10, 1896. Serial No. 611,591. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN STUMPF, a subject of the Emperor of Germany, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Compressors, of which the following is a specification.

My invention relates more particularly to improvements in air-compressors, though, generally stated, my improvements are applicable to fluid compressing and forcing pumps generally.

My object is to provide the compressor-cylinder with valves and valve-operating means of an improved construction which renders them particularly quick, smooth, and noiseless in action and capable of a greater lift than the valves hitherto employed in the same connection, all to the end of rendering the compressor more desirable for its purpose.

The drawing shows a view which, in the main, is a vertical longitudinal section of an air-compressor cylinder with my improvements applied.

A is a shell or casing formed of shell members fitted and bolted together. In the shell is a cylindrical piston-chamber B, having end walls or heads $B'$ $B^2$. Working in the chamber B is the piston C on a stem C', which passes through the wall $B^2$ and through a stuffing-box $t$. On the walls $B'$ $B^2$ are eduction-chambers D D', opening into a common passage $D^2$, having an outlet $s$, which in practice will communicate with the air-discharge pipe. In each of the chambers D D' is a plug or valve-shell E, each comprising a hollow body portion $r$, provided in its outer end with a wall $r'$ and with a series of openings $r^2$ around its circumference. The opposite or inner ends of the plugs are open and extend through openings in the walls $B'$ $B^2$, preferably flush with the inner surfaces of the said walls. The wall $r'$ of each plug is provided with a central forward-projecting hollow guide-sleeve $r^3$, and extending through the said wall about the guide-sleeve are one or more openings $r^4$. The outer circumference of the wall $r'$ of each plug is threaded to receive a screw-cap $r^5$, which, with the adjacent wall $r'$, forms a chamber $r^6$. The inner end of each valve-shell or plug E affords a valve-seat $r^7$, preferably flush with the respective wall of the chamber B. In the chamber $r^6$ of each shell or plug E is a piston $q$, having a central boss $q'$ on its inner face, a central opening $q^2$ through it, and a recess $q^3$ in its outer face about the opening $q^2$. A valve $p$ at each shell E is adapted to seat against the seat $r^7$ and has a stem portion $p'$, which works through the guide $r^3$ and is screwed at its outer end upon the boss $q'$ of the piston $q$, which latter thus forms a part of the valve. Extending longitudinally through each valve $p$ and stem $p'$ is a passage opening into the passage $q^2$ of the piston $q$. The arrangement is such that air compressed by the piston C in the chamber B in the direction of one of the valves $p$ will pass through the hollow stem of the latter and the passage $q^2$ into the recessed portion $q^3$ of the piston $q$, and as the said recessed face presents a greater area to the pressure than the front of the valve $p$ the tendency will be to force the piston $q^3$ away from the wall $r^5$ presented by the screw-cap and thus move the valve $p$ from the seat $r^7$. When the piston C is moved in the direction away from one of the valves $p$, the suction of air through the valve-stem and opening $q^2$ will cause the pressure of the air in and surrounding the valve-shell to be exerted through the openings $r^4$ and in the chamber $r^6$ against the piston $q$, pressing the latter to the wall $r^5$ and thus holding the valve $p$ closed. Thus each of the valves $p$ when opened and closed is held in such position by pressure exerted in the direction contrary to the movement of the piston C.

As I prefer to construct the parts described, the piston C as it nears the end of its stroke in the opposite directions strikes a valve $p$ and closes it against the resistance of the air-pressure, the meeting faces of the valve and the stop or portion of the piston C which strikes the valve being sufficiently out of conformity with each other to permit the free escape of air from behind the piston $q$ through the stem of the valve. It will be seen that the lift or degree of opening of the valve $p$ is not affected by the sweep or traverse of the piston C, and the valve may therefore be caused to lift and open the ports at $r^7$ very wide. The air pressed from behind the piston $q$ as the valve $p$ is being closed operates as a cushion and prevents jarring of the valve.

When a valve $p$ is opened under pressure exerted from the piston C, its operation, though quick, is against the back pressure of the air in the chamber $r^6$, which while escaping through the ports $r^4$ produces a cushion against the piston $q$ sufficient to obviate all jar of the valve in opening. The valves $p$, furthermore, when opened or closed are held in either position by air-pressure with comparatively great force, thus obviating the necessity of springs, which are always undesirable. Owing to the fact that in the final movement of the main piston while closing a valve $p$ an increased compression of the fluid between the piston and adjacent end wall is effected, particularly when running above a certain speed, there would be danger of the valve's being opened momentarily by the back pressure in the chamber or recess $q^3$, unless means are provided to prevent it. To obviate this difficulty, I provide each valve $p$ with a forward-projecting part $p^2$, which may be tubular, as shown, and provided with a slot or vent opening $p^3$. In each side of the piston C, I provide a recess $i$, with a bolt or threaded pin $i'$ extending through the piston at the center of the recesses and confined in place by nuts $i^2$. On the outer ends of the pin $i'$ are stops or nuts $i^3$, and surrounding the pin in the recesses are loose disks or cups $i^4$, held normally against the stops and flush with the surfaces of the piston by means of cushioning-springs $i^5$, confined in the recesses. In practice the parts $p^2$ would project, say, one-eighth or one-fourth of an inch beyond the faces of the valves $p$, whereby as the piston approaches one of the valves one of its cushioned disks $i^4$ engages and is compressed by contact with the projection $p^2$ until the piston engages the valve to close the latter. In the initial return movement of the piston the pressure of the cushioning-disk against the valve will tend to hold the same to its seat until the evacuating action of the piston has become sufficient to prevent the valve from jumping or momentarily leaving its seat. As a further precaution against the jumping of the valves, as described, or in lieu of the cushioning devices, I provide at the top of the cylinder toward each end a by-pass $h$, both ports $h'$ of which open to opposite sides of the piston when the latter completes its stroke in that direction. The by-pass effects immediate equalization of pressure on opposite sides of the piston or lowering of pressure in the clearance between the piston and the adjacent wall, so that before the piston moves away from the respective valve $p$ the pressure in the chamber $q^3$ thereat will be reduced below the point where it will cause the valve to jump. I show valves $h^2$ at the by-passes, which may be turned to regulate the sizes thereof or close them altogether, if desired.

F F are induction-valve shells, each comprising a cylindrical plug portion $n$, open at its inner and outer ends and passing at its inner end through the respective wall of the piston-chamber B and extending flush with the inner surface of the wall. In each plug $n$ is a series of circumferential openings $n'$, communicating with the outside air, and the outer end portion is threaded to receive a screw-cap F'. Each plug $n$ presents an inner circumferential guide-surface $n^2$, an outlet $n^3$ to the chamber B, and an annular shoulder or stop $n^4$ at its outer end. In the outer face of each plug $n$ is an annular recess $n^5$, communicating through small passages $n^6$ with the surrounding atmosphere. Each cap F' is formed with an enlarged part $m$, at which it is screwed upon the plug and which affords an inner annular guide-surface $m'$, a somewhat reduced part $m^2$, affording an inner circumferential guide-surface $m^3$, and a central tubular extension $m^4$, closed at its outer end. In each of the shells F is a hollow cylindrical valve $F^2$, sliding in the guide formed by the surfaces $n^2$ $m^3$. Each valve is open at its inner end and closed by a wall $l$ at its outer end. In the wall $l$ of each valve $F^2$ is a central guide-opening $l'$ and one or a series of openings or ports $l^2$. Integral with each valve $F^2$ and extending around its circumference is an annular flange $l^3$, which slides upon the guide-surface $m'$. In each cap portion F', in the position shown, is a passage $m^5$, into which projects a regulating-screw $m^6$, which may be turned to regulate the size of the passage.

On each side of the piston C, in line with the ports $n^3$ and working through the latter, are cylindrical projections C' C', from which extend central stems $C^2$, passing through the guide-openings $l'$ in the valves $F^2$ and provided at their ends beyond said guide-openings with cushioned heads or stops $C^3$, which slide loosely in the guides formed by the tubes $m^4$. The cylindrical projections C' are of a size to cause them to slide loosely through the ports $n^3$ and also loosely into the valves $F^2$.

The view shows the piston C nearly, but not quite, at the limit of its movement toward the wall $B^2$ and the valve $F^2$ at the wall B' open. In the movement of the piston, wherein it closes the valve $p$ at the wall $B^2$, the head $C^3$ on the stem $C^2$ to the left in the figure engages the outer end of the valve $F^2$ and moves it until it seats against the port $n^3$ and crosses and closes the ports $n'$, through which air is supplied to the chamber B. In the reverse movement of the piston C toward the wall B' the air as it is compressed in the direction of said wall exerts pressure through the ports $l^2$ in the valve $F^2$ at said wall and through the port or passage $m^5$ against the flange $l^3$ of the valve, thereby holding the latter to its seat at the shoulder $n^4$ and maintaining the induction-ports $n'$ closed. In the initial movement of the piston C in the direction of the wall B' the cylindrical projection to the right in the figure produces a suction of air through the adjacent ports $l^2$ and passage $m^5$, thereby withdrawing pres-

sure from behind the flange $l^3$ and causing the air under surrounding atmospheric pressure to enter through the ports $n^6$ and move the said valve to the right in the figure to open the respective ports $n'$ and admit air to the chamber B on the side $B^2$ thereof. The valves $F^2$ are held open and closed by fluid-pressure exerted in the direction contrary to the direction of movement of the piston C, and they open, as described, simultaneously with the initial movement of the piston in the direction away from them. As before stated, the valves $F^2$ are held closed by the pressure of air passing through the passages $m^5$, and by means of the screws $m^6$ these passages may be so regulated as to size that while they permit the valves to be closed with all necessary quickness by the yielding stops $C^3$ the closing is effected against a slight back pressure of air, which, acting counter to the yielding stops, prevents jar upon the valves. Thus the valves are closed in a manner so gentle that their operation is practically noiseless. The withdrawal of pressure through the passages $m^5$ from behind the flanges $l^3$ under the suction action of the piston C causes the valves to open with all necessary quickness, but noiselessly and without jar. The induction-valves $F^2$, like the eduction-valves $p$, may have any desired lift, and, being without springs, present comparatively little resistance against opening and are particularly durable and desirable for their purpose.

While I prefer that both the induction and eduction valves shall be closed by the direct engagement therewith of the piston or a part movable with or carried by the piston in the final movement of the piston toward the limit of its traverse, as described, the valves may be closed, if desired, by the fluid-pressure in the initial movement of the piston from the limit of its traverse, so that the valves will be closed as well as maintained closed by the force of fluid-pressure brought about by the compression and suction actions of the piston.

My improvements may be applied with benefit to gas or other pumps or compressors, and they may be modified in the matter of details to meet all requirements without departing from the spirit of my invention as defined by the claims.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a compressor, the combination with the cylinder and piston, of a fluid-passage communicating with the cylinder, a valve at said passage, and means carried by the valve and operated alone by fluid-pressure brought about by the compression and suction action of the piston for moving and holding said valve alternately both in opening and closing positions, the pressure, in each instance, being in the direction contrary to the movement of the piston, substantially as described.

2. In a compressor, the combination with the cylinder and piston, of a fluid-passage communicating with the cylinder and a valve governing said passage in open communication at both its inner and outer sides with the cylinder, the outer face of the valve being of greater area than its inner face, whereby said outer face is acted upon to press the valve to and from its seat under the compression and suction actions of the piston, the pressure, in each instance, being in the direction contrary to the movement of the piston, which brings it about, substantially as described.

3. In a compressor, the combination with the cylinder and piston, of an inwardly-lifting valve governing the cylinder discharge-passage, and means carried by the valve in open communication at its outer side with the cylinder and operated alone by fluid-pressure brought about by the compression and suction action of the piston for moving and holding said valve alternately both in opening and closing positions, the pressure in each instance, being in the direction contrary to the movement of the piston, substantially as described.

4. In a compressor, the combination with the cylinder and piston, of an outwardly-lifting valve governing the cylinder induction-port, and a piston carried by the valve having a greater area than the latter and having open communication at its outer side with the interior of the cylinder and operated alone by fluid-pressure brought about by the compression and suction action of the piston for moving and holding said valve alternately both in opening and closing positions, the pressure, in each instance, being in the direction contrary to the movement of the piston, substantially as described.

5. In a compressor, the combination with the cylinder and piston, of a fluid-passage communicating with said cylinder, and a valve governing said passage in the path of a stop movable with the piston, whereby the valve is closed in the movement of the piston to the end of its traverse, the valve, at its outer side being in open communication with the cylinder and there presenting a greater area to pressure than at its inner side, whereby the valve when closed is maintained closed by fluid-pressure under the action of the piston, substantially as described.

6. In a compressor, the combination with the cylinder and piston, of an induction-passage communicating with the cylinder, and an outwardly-opening valve governing said passage exposed at its outer side to pressure from the cylinder, whereby it is opened under the suction action of the piston, and in the path of a stop movable with the piston, whereby in the movement of the piston to the limit of its traverse away from said passage the valve is closed by the engagement with it of the stop, and in the movement of the piston toward said passage the valve is maintained closed by the fluid-pressure generated by the piston, substantially as described.

7. In a compressor, the combination with

the cylinder and piston, of an eduction-passage extending from said cylinder, and an inwardly-opening valve governing said passage in the path of a stop movable with the piston, and exposed at its outer face to pressure from the cylinder, whereby under the force of fluid-pressure generated by the piston the valve is opened, and in the movement of the piston toward said passage the valve is engaged and closed by said stop, and in the movement of the piston away from said passage the valve is maintained closed by the suction action of the piston, substantially as and for the purpose set forth.

8. In a compressor, the combination with the cylinder and piston, of an eduction-passage extending from said cylinder, an inwardly-opening valve governing said passage in the path of a stop movable with the piston and exposed at its outer face to pressure from the cylinder, whereby under the force of fluid-pressure generated by the piston the valve is opened, and in the movement of the piston toward said passage the valve is engaged and closed by said stop, and in the movement of the piston away from said passage the valve is maintained closed by the suction action of the piston, and a by-pass having ports in the cylinder and affording communication between opposite sides of the piston, to vent the clearance, when the piston nears the end of its stroke, substantially as and for the purpose set forth.

JOHN STUMPF.

In presence of—
M. J. FROST,
J. H. LEE.