No. 674,808. Patented May 21, 1901.

# N. A. CHRISTENSEN.

## AUTOMATIC GOVERNOR FOR FLUID COMPRESSORS.

(No Model.) (Application filed Aug. 21, 1899.)

3 Sheets—Sheet 1.

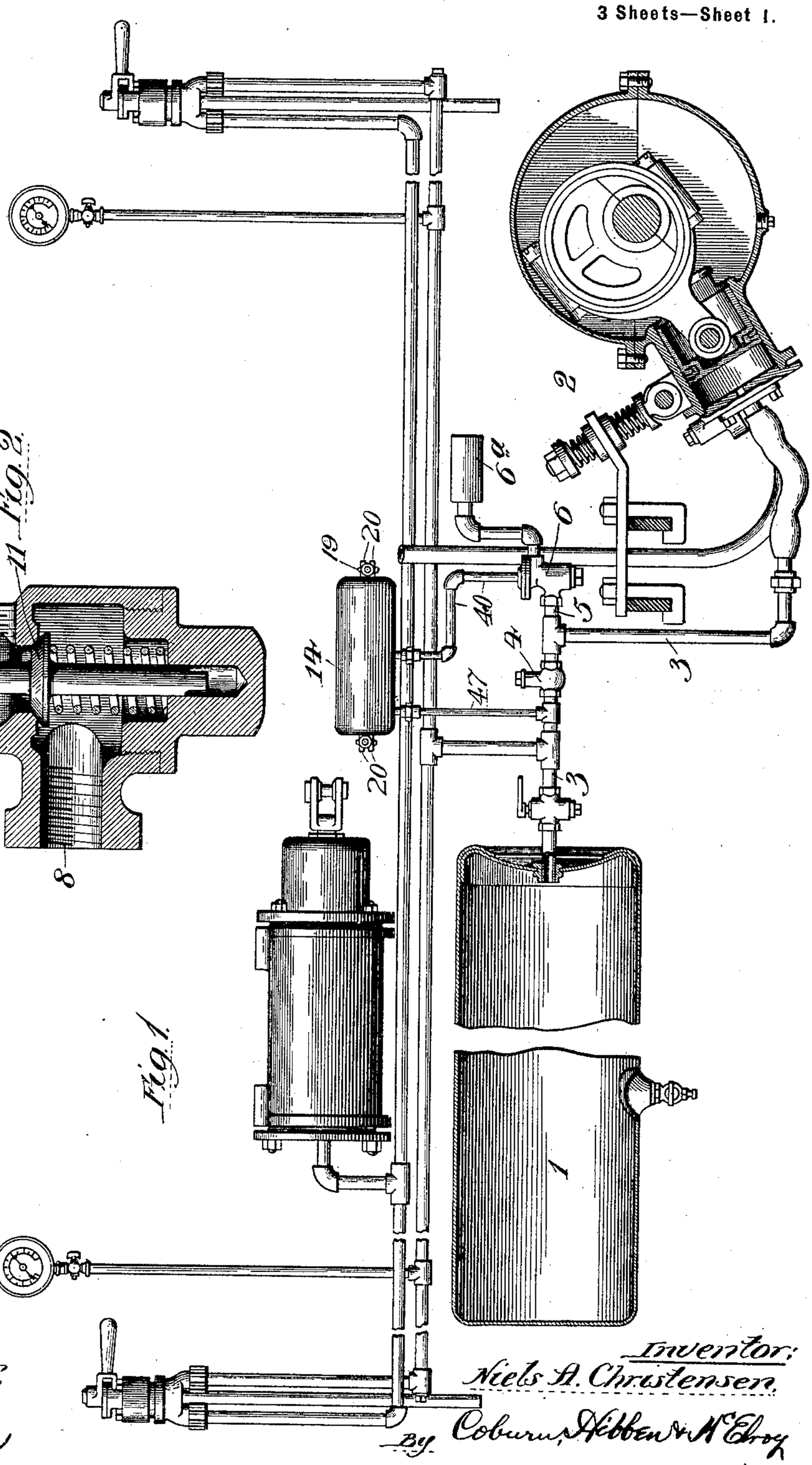


Fig. 1.




Fig. 2.

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R. W. Allen

Inventor:
Niels A. Christensen.
By Coburn, Hibben & McElroy
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3 Sheets—Sheet 2.

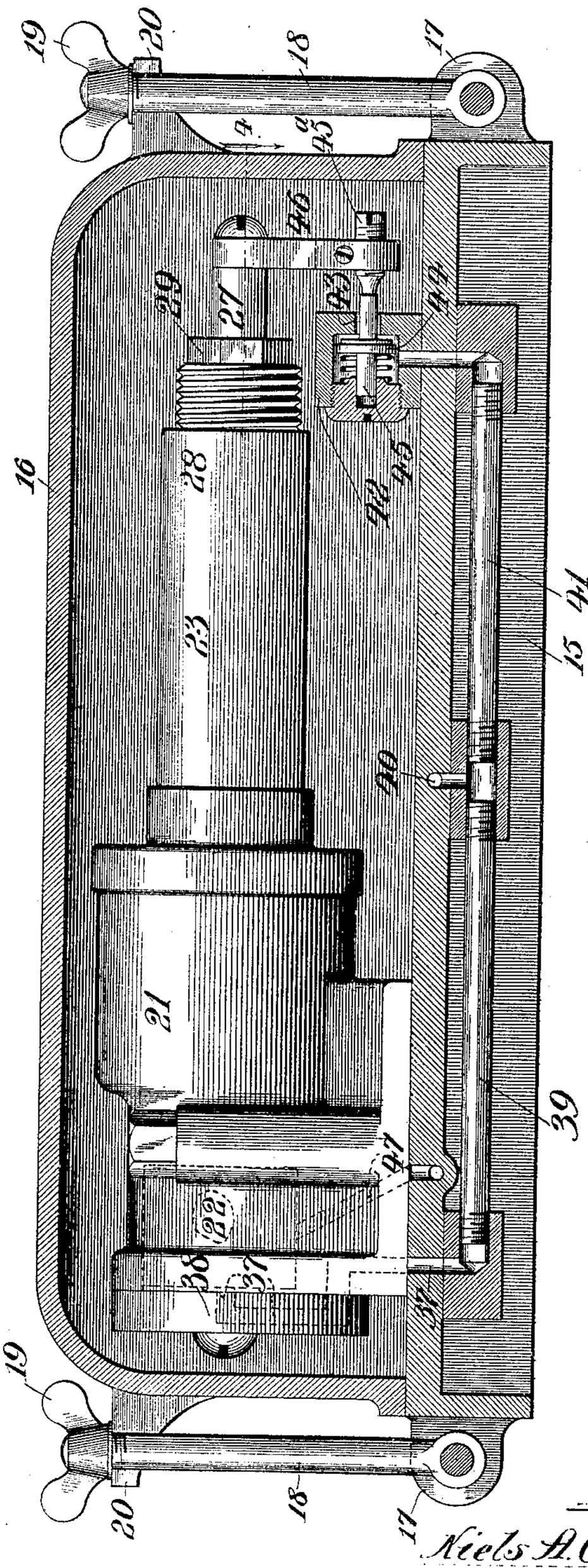


Fig. 3.

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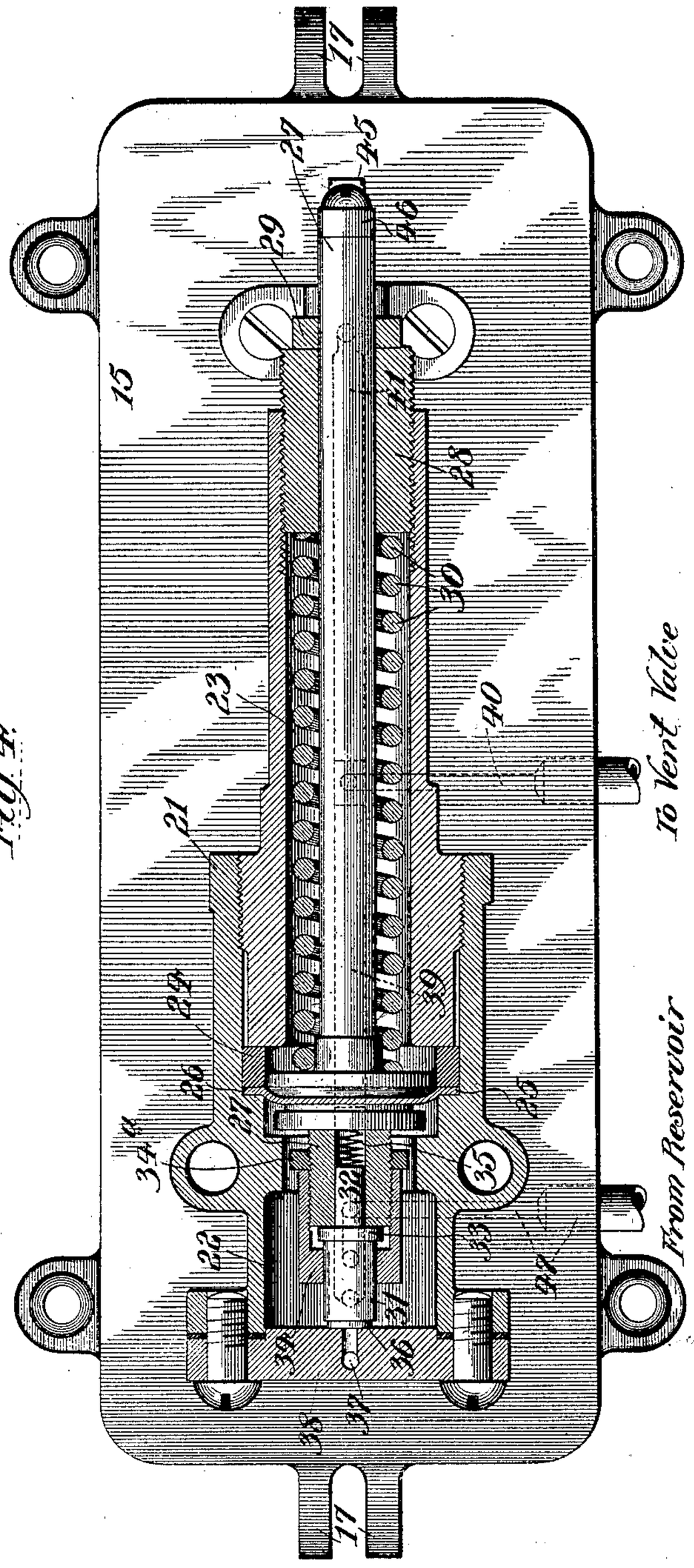


FIG. 4.

Witnesses:

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# UNITED STATES PATENT OFFICE.

NIELS ANTON CHRISTENSEN, OF MILWAUKEE, WISCONSIN.

## AUTOMATIC GOVERNOR FOR FLUID-COMPRESSORS.

SPECIFICATION forming part of Letters Patent No. 674,808, dated May 21, 1901.

Application filed August 21, 1899. Serial No. 727,993. (No model.)

*To all whom it may concern:*

Be it known that I, NIELS ANTON CHRISTENSEN, residing at Milwaukee, Milwaukee county, Wisconsin, have invented a certain new and useful Automatic Governor for Fluid-Compressors, of which the following is a specification.

My invention pertains to fluid-compressors of air-brake systems, more particularly to axle-driven air-compressors for railway-cars, street-cars, and the like; and its object is to provide simple and efficient means whereby the reservoir-pressure may automatically regulate itself between maximum and minimum pressure.

In the drawings, Figure 1 is a diagrammatic view of an air-brake system as applied to a car and showing the arrangement and coöperation of my regulating or governing devices; Fig. 2, a section of the vent-valve; Fig. 3, a sectional elevation of the governor, and Fig. 4 a sectional view of such governor.

An air-brake system embodying my invention is diagrammatically illustrated in Fig. 1. This system comprises the usual reservoir, brake-cylinder, axle-driven compressor, main air-pipe, and engineer's valves, together with the usual connecting pipes and passages. Connecting between the reservoir 1 and the compressor 2 is a reservoir-pipe or supply-pipe 3, in which is arranged a check or non-return valve 4, permitting compressed air to enter the reservoir, but preventing its return. Leading from the reservoir-pipe on the compressor side of the check-valve is a pipe or passage 5, communicating with the automatically-operated vent-valve device 6, which comprises a casing 7, having ports 8, 9, and 10 communicating, respectively, with said reservoir-pipe 5, with the atmosphere through a muffler $6^a$, and with the governor hereinafter described. The discharge-passage between ports 8 and 9 is regulated by a normally-closed spring-pressed valve 11, having a stem 12 connected to and operated by a movable abutment, which, as shown, consists of a diaphragm 13. It is obvious that the admission of pressure through port 10 against the diaphragm will open valve 11 of less area, and the function of the governor is to automatically admit this pressure when the maximum reservoir-pressure is reached, so as to open a vent to the atmosphere, through which the compressor, working continuously and without change or disturbance of its parts or valves, can pump and without exhausting the reservoir.

The preferable form of the governor 14 is illustrated in the drawings, and consists of a base 15 and a suitable cover or housing 16, within which is arranged the actuating mechanism or movable parts. The base and cover may be secured or clamped together as follows: Upon lugs 17 on the base are pivoted swinging bolts 18, having thumb-nuts 19 screwing down against parallel lugs 20 on the cover, the bolts being swung in between the lugs. A casing 21 is secured to the base and contains a chamber 22. A hollow stem 23 screws into one end of the casing and presses against a ring 24, so as to clamp the edges of a diaphragm 25 against the shoulder 26. This diaphragm or movable abutment is clamped between suitable disks on a stem 27, whereby such stem may be reciprocated as the diaphragm is moved. This stem projects on one side of the diaphragm through the hollow stem 23 and reciprocates through an adjusting-nut 28, locked by a nut 29. A coiled spring 30 abuts at one end against the adjusting-nut and at the other end against one of the diaphragm-disks, thereby normally forcing the diaphragm and its stem to the left, Fig. 4. This stem actuates a valve 31, having a reduced portion 32, movable in and guided by a central bore in the end of the stem 27. This valve has a collar or enlargement 33, which has a slight slack or lost motion between the end of the operating-stem and an interior shoulder of a sleeve or end cap 34, screwing on the end of the stem and held in adjusted position by a lock-nut $34^a$. A light spring 35 is preferably provided within said central bore, so as to normally keep the valve 31 seated. This valve 31 may be provided with a seat 36 of suitable material, which governs a port or passage 37 in the end cap 38 of the casing. It will be understood that obvious changes in the shape of this valve and the seat to receive it may be made without departing from the spirit of my invention. The passage 37 leads through the base-plate and through a tube or pipe 39 to a pipe or passage 40, communicating with the

vent-valve through port 10. A similar tube or pipe 41 communicates with a casing 42, preferably located on the base-plate within the cover and adjacent to the governor, which casing has an interior chamber normally in communication with the atmosphere. The exhaust-port 43 of this casing is controlled by a spring-pressed valve 44, whose stem 45 is actuated by an adjustable screw 45ª, carried by an arm 46, connected to and reciprocated by the stem 27. The screw 45ª screws into the arm 46, so that the position of the valve with respect to its operating mechanism may be adjusted and the margin between the operation of valve 31 and valve 44 may be regulated.

The reservoir-pipe 3 communicates with the chamber 22 through the ports and passages 47, and consequently the movable abutment or diaphragm 25 is exposed on one side to reservoir-pressure and on the other to atmospheric pressure. The object of the governor is to control the admission of the reservoir-air to the vent-valve, and the air therefrom is taken, as shown, from the reservoir-pipe 3 on the reservoir side of the check-valve. When the pressure in the reservoir has reached or exceeded the predetermined maximum amount, the reservoir-pressure in the chamber 22 will force the diaphragm and its stem 27 to the right, Fig. 4, against the tension of the spring, and after the slight slack or lost motion is taken up the valve 31 will be unseated, thereby admitting reservoir-air through ports and passages 37, 39, 40, and 10 to the vent-valve, whereupon the diaphragm of such vent-valve will force the valve 11 from its seat, thereby providing a free open passage between the atmosphere and the reservoir-pipe on the compressor side of the check-valve. The compressor operating continuously or at least while the car is running will not compress the air, which will pass to the atmosphere without compression. Upon the first movement of the stem 27 and preceding the opening of the valve 31 the valve 44 will close the exhaust-port 43 in the small valve that vents the pressure from the chamber above the diaphragm in the vent-valve device 6 and the connecting-passages 37, 39, and 40. When the reservoir-pressure has been sufficiently reduced to reach the predetermined minimum amount or lower than such pressure, owing to the application of the brakes, the spring 30 will return the movable parts to the normal position shown, and thereupon close the port 37. As soon as this port is closed the small exhaust-port 43 will be opened and the diaphragm in the vent-valve device will be relieved of pressure, whereupon the spring-pressed valve 11 will be closed and the compressor will again compress air. The proper timing of the opening of the valve 44 and the amount predetermined as the maximum reservoir-pressure may be regulated by the mechanism shown.

The vent-valve is normally held seated by both the spring and the pressure from the delivery-pipe of the compressor and it is opened against such tension and pressure, so that as soon as the reservoir-pressure has been sufficiently reduced and equilibrium occurs between the pressure above the movable abutment of the vent-valve and the pressure below the vent-valve such vent-valve will be positively and emphatically forced to its seat, inasmuch as it opens against the pressure and closes in the direction of the same pressure, there being no friction to be overcome. The relief or vent valve thus does not open directly to the atmosphere, but opens inwardly, so that air is allowed to escape to the atmosphere between the vent-valve and the abutment which operates it. Furthermore, in my construction the pressure which actuated the abutment and which would otherwise be trapped is released in an automatic manner and such abutment is not exposed to any pressure at all above atmospheric pressure while the compressor is discharging air into the reservoir.

While my invention relates more particularly to and is herewith shown and described in connection with axle-driven compressors, it will be understood that I contemplate using the same wherever applicable, and any system embodying the principle of my regulating devices coöperating with any type of compressor will therefore come within the scope and meaning of my invention and claims. While I have shown and described the movable abutment as a diaphragm, it will be understood that its equivalent—a piston—may be employed. Furthermore, it will be obvious that instead of employing the valve device 44 a small leak may be provided in the piston or diaphragm of the vent-valve, whereby the pressure may in time be relieved. This construction would dispense with one working part; but at the same time it has the disadvantage that the small leak exists while the compressor is compressing from minimum to maximum pressures.

Although I have described more or less precise forms and details of construction, I do not intend to be understood as limiting myself thereto, as I contemplate changes in form, the proportion of parts, and the substitution of equivalents as circumstances may suggest or render expedient and without departing from the spirit of my invention.

I claim—

1. An automatic governor for fluid-compressors, comprising, in combination with a compressor, a reservoir, and check-valved reservoir-pipe therebetween; a fluid-pressure-actuated vent-valve device communicating with said reservoir-pipe at a point between the compressor and the check-valve, fluid-pressure mechanism communicating with said reservoir-pipe at a point between the reservoir and the check-valve and adapted to admit reservoir-pressure to the vent-valve device when the reservoir-pressure has reached a

predetermined point, and automatic means for releasing such admitted pressure.

2. An automatic governor for fluid compressors or pumps, comprising, in combination with a compressor, a reservoir and a check-valved connection therebetween, a vent-valve device independent of the compressor and communicating with said connection on the compressor side of the check-valve to form, when operated, a vent for fluid to escape without compression, a movable abutment operating in a chamber which communicates with said connection on the reservoir side of the check-valve, a valve operated by the abutment when the latter is actuated by maximum or excess reservoir-pressure to admit pressure to operate the vent-valve, and automatic means for releasing such admitted pressure.

3. In combination with a pump or compressor, a reservoir and a check-valved connection located therebetween, and having a normally-closed exhaust port or passage on the compressor side of the connection, a fluid-pressure-actuated vent-valve which the pressure from the pump tends to seat and which is independent of the pump and its working parts for governing such port and means controlled by the reservoir-pressure for admitting pressure to vent-valve device and thereby opening the valve controlling the exhaust-port against the pressure from the compressor when the reservoir-pressure reaches maximum.

4. An automatic governing device for fluid-compressors comprising, in combination with a compressor, a reservoir and a check-valved connection or reservoir supply-pipe therebetween, a vent-valve device comprising a casing having a port connecting with the atmosphere, a second port in communication with the said connection on the compressor side of the check-valve and a third port in communication with said connection on the reservoir side of the check-valve, a valve in said casing for governing the communication between the first and second ports and held seated by pressure through said second port, a movable abutment for actuating said valve and exposed to pressure through said third port and a governor interposed in said connection between the vent-valve device and the said supply-pipe and comprising a movable abutment-actuated needle-valve adapted to admit pressure to said movable abutment when the reservoir-pressure has reached maximum, whereby the vent-valve will permit fluid to escape to atmosphere directly from the compressor without compression.

5. An automatic governor for fluid-compressors, comprising, in combination with a compressor, a reservoir and a check-valved reservoir supply-pipe therebetween, a fluid-pressure-actuated vent-valve device communicating with said pipe on the compressor side of the check-valve, a connection between the vent-valve and said pipe on the reservoir side of the check-valve and a governor interposed in said last-mentioned connection for regulating the admission of pressure to actuate the vent-valve when the reservoir-pressure has reached maximum, which governor comprises a casing having a chamber having ports communicating respectively with the supply-pipe and with the vent-valve, a spring-pressed movable abutment in said chamber exposed to reservoir-pressure, and a valve actuated by the abutment to control the port to the vent-valve and having a lost motion with respect to such abutment.

6. In combination with a fluid-compressor, reservoir and a pipe or passage therebetween, a vent-valve device having ports communicating with such passage and with the atmosphere, a fluid-pressure-actuated valve in said device for governing the passage between such ports, a pipe or passage from the reservoir to admit excess reservoir-pressure to actuate said valve, an automatic valve governing said last-named passage to admit or cut off the pressure therethrough, a spring-pressed movable abutment for actuating such automatic valve, the excess reservoir-pressure opening said automatic valve against such spring tension, and automatic means whereby, after the governing-valve is closed, that pressure is exhausted which was admitted by the automatic valve and which actuated the vent-valve.

7. In combination with a fluid-compressor, its reservoir and the reservoir pipe or connection therebetween, a vent-valve device comprising a casing having a port to atmosphere, a second port from said pipe and a third port in normally-interrupted communication with the reservoir, a valve in the casing governing the passage between the first two ports, a movable abutment actuating such valve and exposed to pressure from the third port, an automatically-operating governor-valve in the communication between the reservoir and such third port for admitting reservoir-pressure against the movable abutment and means actuated by the governor-valve for releasing the pressure against the abutment after the governor-valve has closed.

8. An automatic governor for fluid-compressors comprising, in combination with a compressor, a reservoir and a check-valved reservoir supply-pipe therebetween, a fluid-pressure-actuated vent-valve communicating with said pipe on the compressor side of the check-valve, a connection between the vent-valve and said pipe on the reservoir side of the check-valve and a valve for governing the admission of pressure through said last-named connection to operate the vent-valve and a valve actuated by such governing-valve to exhaust the pressure in the connection between the governing-valve and the vent-valve when the governing-valve is closed.

9. In combination with a fluid-compressor, its reservoir and the reservoir-pipe therebetween, a vent-valve device separate from the

compressor and having a casing with ports to the atmosphere and the reservoir-pipe respectively, a valve in the casing for normally closing the connection between the ports, such valve being normally held closed by pressure from the compressor on one side and exposed on its other side to atmospheric pressure a movable abutment in such casing for actuating said valve and means for automatically admitting reservoir-pressure to the casing to actuate said abutment and its valve by moving the same against the pressure in the casing from the compressor when the reservoir-pressure has reached maximum.

10. In combination with a fluid-compressor, its reservoir and the reservoir-pipe therebetween, a vent-valve device communicating through ports with the reservoir-pipe and with the atmosphere, a valve governing said ports, a movable abutment to actuate such valve and a governor for automatically admitting pressure to the movable abutment and comprising a casing having a chamber in always open communication with the reservoir, and having a normally closed port communicating with said movable abutment, a movable abutment in such chamber exposed on one side to reservoir-pressure and on the other to atmospheric pressure, a valve actuated thereby and governing said normally-closed port and a valve actuated by the abutment of the governor for exhausting the pressure admitted to the vent-valve against its abutment.

11. In combination with a fluid-compressor, its reservoir and the reservoir-pipe therebetween, a fluid-pressure-actuated vent device communicating with said pipe, and an automatic governor for controlling fluid-pressure to actuate such vent device and comprising a casing having a chamber communicating respectively with the vent device to admit pressure thereto and with the reservoir, a movable abutment exposed to reservoir-pressure on one side and spring-pressed on the other side, a stem on the abutment having an opening at its free end within the chamber, a valve having a stem extending into such opening and governing the communication to the vent device, and a cap or sleeve adjustably secured to the stem and through the end of which the valve passes, such valve having a slight slack or lost motion between the stem and cap.

12. The governor for controlling the admission of excess reservoir-pressure to a fluid-pressure-actuated vent-valve device for venting the delivery-pipe of the compressor of air-brake systems and comprising a casing having a movable abutment operative in a chamber provided with an inlet-port from the reservoir and an outlet-port to the vent-valve device, a valve actuated by excess reservoir-pressure against the abutment to open the outlet-port to admit such excess reservoir-pressure to the vent-valve device and having a lost motion with respect to the abutment, and means for varying the amount of such lost motion.

13. A governor for controlling the admission of pressure to a fluid-pressure-actuated vent-valve device for the compressor of air-brake systems, and comprising a casing having a movable abutment operative in a chamber provided with an inlet-port from the reservoir and an outlet-port to the vent-valve device through a pipe or passage, an admission-valve actuated by the abutment to govern the outlet-port, and a valve device also actuated by the abutment to control an exhaust-port from said passage and adapted to normally maintain such exhaust-port open when the admission-valve is closed and to close the same when such latter valve is open.

14. A governor for controlling the admission of pressure to a fluid-pressure-actuated vent-valve device for the compressor of air-brake systems and comprising a casing having a movable abutment operative in a chamber provided with an inlet-port from the reservoir and an outlet-port to the vent-valve device through a pipe or passage, an admission-valve actuated by the abutment to govern the outlet-port, a stem actuated by the abutment, a valve device operatively connected with the stem and controlling an exhaust-port from said passage and means for adjusting the valve device with respect to said operating-stem.

15. In combination with a fluid-compressor, a reservoir and a reservoir-pipe therebetween, a vent-valve adjacent to the compressor and governing an exhaust-port from the reservoir-pipe, fluid-pressure-actuated mechanism for operating the vent-valve and a governing-valve controlling fluid-pressure to such mechanism and comprising a casing having a chamber with ports 37 and 47 communicating respectively with the reservoir and the fluid-pressure mechanism, a movable abutment therein having a stem on either side, a valve 31 operated by the stem to govern the port to the fluid-pressure mechanism, a cap or sleeve 34 on the stem and surrounding such valve, a spring 30 on the side of the abutment opposite valve 31, a hollow stem 23 secured in the casing and surrounding the stem on one side of the abutment, an exhaust-valve communicating with port 37 and its connections and comprising a casing 42 having an exhaust-port 43, a valve 44 therein having a stem 45 and an arm 46 connected to the stem of the abutment and actuating stem 45 and its valve.

16. A vent-valve device for a compressor comprising a casing having an abutment-chamber with ports respectively to the atmosphere and to a valve-governed connection with a reservoir, a passage or second chamber with a port to the delivery-pipe of the compressor and communicating with the first chamber through a vent-port, a vent-valve governing such vent-port and exposed on one side to pressure from the compressor

and on the other side to atmospheric pressure and a movable abutment operating in such first chamber to actuate the vent-valve and normally exposed on both sides to atmospheric pressure but actuated by excess reservoir-pressure on one side to open the vent-valve against the pressure from the compressor which tends to hold it seated.

17. A vent-valve device for a compressor comprising a casing having a chamber with ports communicating respectively with the atmosphere, the delivery-pipe of the compressor and a reservoir, a vent-valve governing the second-named port, a movable abutment in the chamber for actuating the vent-valve and operated by excess reservoir-pressure to permit the pressure from the compressor to first enter the chamber and then escape through said port to atmosphere, the vent-valve opening against the pressure from the delivery-pipe, which pressure at all times tends to close such valve, whereby such closing will occur immediately upon a reduction of the reservoir-pressure to the predetermined amount.

18. The combination, with a compressor and its delivery-pipe having a vent to atmosphere, of a vent-valve normally held seated by fluid-pressure to close such vent and fluid-pressure mechanism actuating said valve to open it and exposed to fluid-pressure only when the pressure delivered by the compressor has reached maximum.

19. The combination, with a compressor and its delivery-pipe having a vent to atmosphere, of a valve normally held seated by fluid-pressure to close such vent, fluid-pressure mechanism actuating said valve to open it but normally exerting no influence on the valve and means for admitting pressure to such mechanism when the pressure in the delivery-pipe exceeds a predetermined degree.

20. The combination, with a compressor and its delivery-pipe having a vent to atmosphere, of a vent-valve normally closing such vent, fluid-pressure mechanism controlling said valve, means for admitting pressure to operate such mechanism to open the vent when the pressure delivered by the compressor has reached or exceeded maximum and automatic means for releasing such admitted pressure after the operation of such fluid-pressure mechanism.

21. The combination, with a compressor and its delivery-pipe having a vent to atmosphere, of a vent-valve normally closing such vent, a movable abutment actuating such valve and opening the same when pressure is admitted against the abutment but normally exerting no influence upon the valve, valve mechanism admitting, against such abutment, pressure from the delivery-pipe in excess of a predetermined degree, and means for exhausting such admitted pressure after the movement of the abutment.

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