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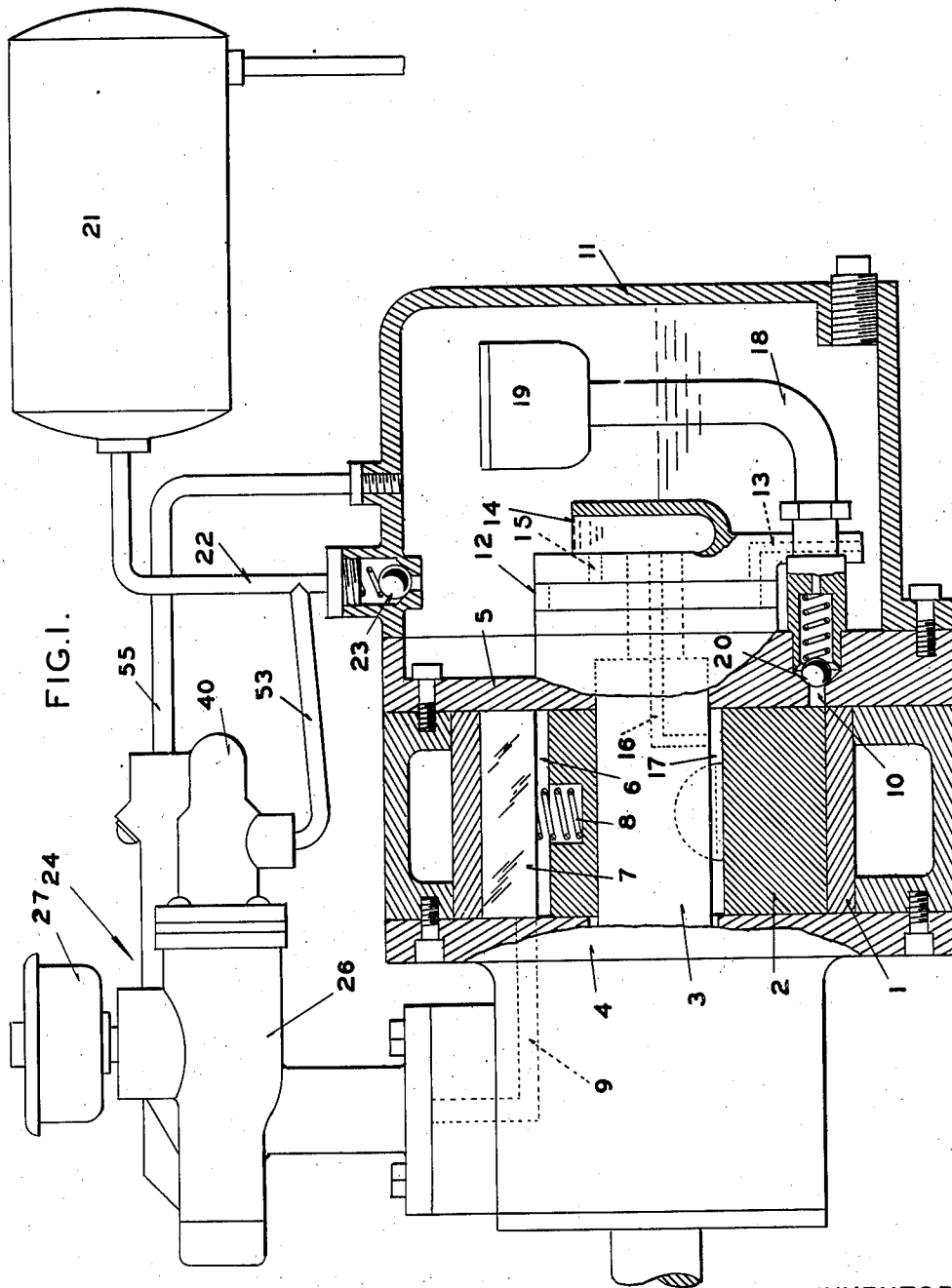
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COMPRESSOR UNLOADING VALVE MECHANISM

Filed Jan. 17, 1940

2 Sheets-Sheet 1



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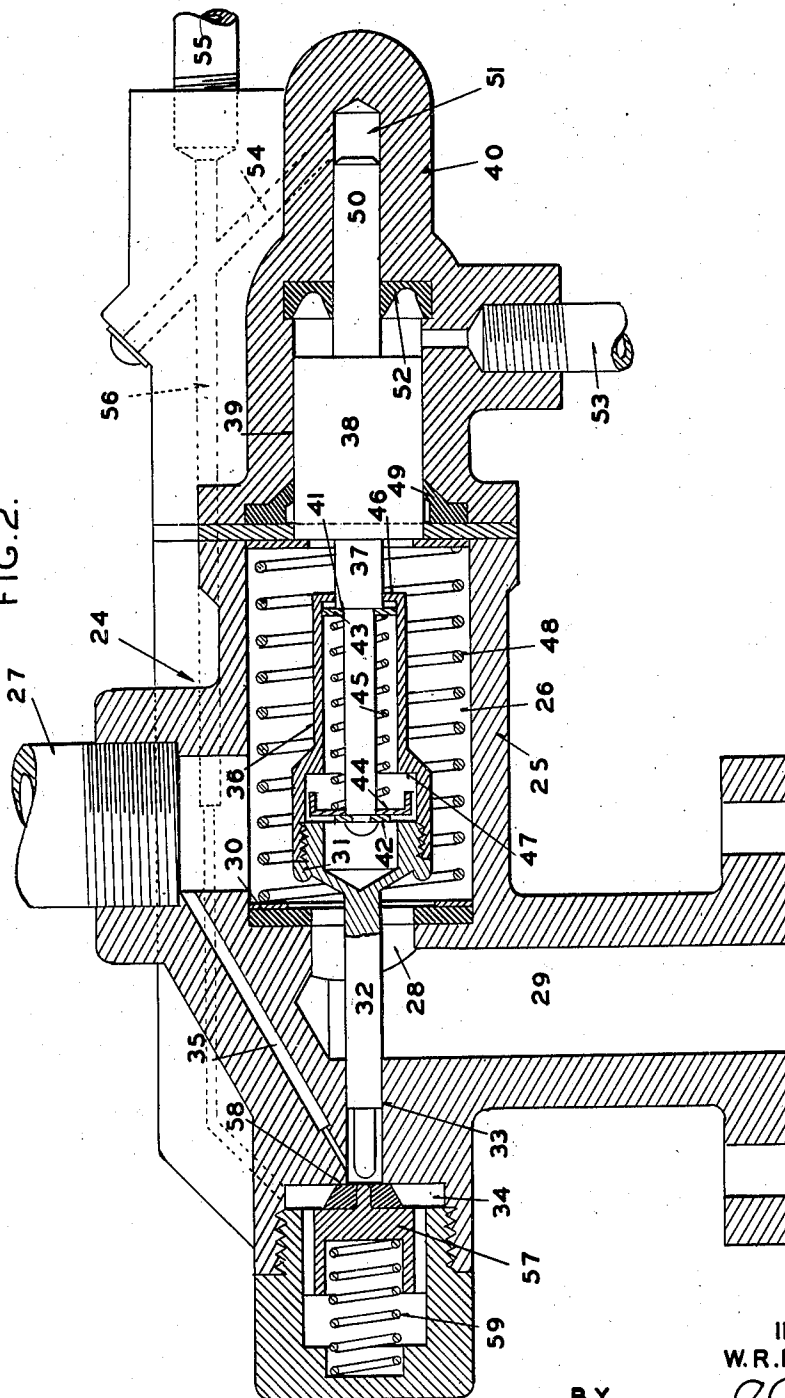
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COMPRESSOR UNLOADING VALVE MECHANISM

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FIG. 2.



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COMPRESSOR UNLOADING VALVE
MECHANISMWalter R. Freeman, University City, Mo., assignor
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a corporation of Delaware

Application January 17, 1940, Serial No. 314,214

12 Claims. (Cl. 230—30)

My invention relates to compressors and more particularly to valve mechanism for unloading the compressor under certain conditions.

One of the objects of my invention is to provide improved valve mechanism for automatically closing the intake port of the compressor and connecting the discharge port to atmosphere when the pressure in the receiver of the compressor is a predetermined value.

A more specific object of my invention is to provide a quick closing and quick opening valve mechanism which is so constructed that the fluid pressure force employed to close the valve will be decreased after the valve is closed thereby permitting the valve to be opened when there has been only a small drop in the fluid pressure which permits the valve to be closed.

Other objects of my invention will become apparent from the following description taken in connection with the accompanying drawings in which Figure 1 is a view, partly in section, showing a rotary compressor, an oil dome therefor and a receiver tank having associated therewith my improved valve mechanism; and Figure 2 is a sectional view showing details of the valve mechanism.

Referring to the drawings in detail, the rotary compressor is of known construction and comprises a stator 1 having eccentrically mounted therein a rotor 2 secured to a drive shaft 3 journaled in the end plates 4 and 5. The rotor 2 is provided with a plurality of spaced slots 6 extending in an axial direction in which are mounted reciprocable blades 7 (one only being shown) biased outwardly into engagement with the inner surface of the stator by springs 8. The end plate 4 is provided with an intake passage 9 and the end plate 5 with an outlet passage 10. Secured to the end plate 5 is an oil reservoir or dome 11 which contains oil for the purpose of lubricating the compressor. In the construction shown the shaft 3 of the compressor drives an oil pump 12 to pump oil from the body of oil through passage 13 and discharge it into a well 14 through the opening 15. The oil in the well is free to flow through the passage 16 in shaft 3 and then into the compressor by way of the keyway 17 to thus provide lubrication for the movable parts of the compressor. In order that the oil may be forced into the compressor under pressure during operation of the compressor, the body of oil in the oil dome is caused to be subject to the fluid under pressure discharged from the compressor. This is accomplished by having the discharge port 10 con-

nected to a pipe 18 which extends above the oil line. An oil separator 19 removes any excess oil which may be discharged from the compressor together with the compressed air. The discharge port 10 has associated therewith a check valve 20 for preventing any of the compressed air from returning to the compressor. The oil dome communicates with the compressed air receiver or tank 21 by a conduit 22 and a check valve 23 prevents return of compressed air to the dome. The compressed air may be used for any purpose desired, as for example, the actuation of vehicle brakes.

In the type of compressor just described the compressor is generally automatically unloaded by shutting off the intake when the receiver for the compressed air discharged by the compressor reaches a predetermined value and again allowed to compress air when the compressed air in the receiver falls to a given pressure below the predetermined value. With such an arrangement, it has been discovered that when the compressor is unloaded an excess amount of oil may be fed to the compressor and cause it to become "choked" because of the compressed air acting upon the oil and forcing it into the compressor. It has also been discovered that the shutting off of the compressor by closing the intake does not cause the compressor to run idle since the compressor still operates to compress the air remaining in the compressor which may be partially discharged into the oil dome against the compressed air already therein or, if this is not accomplished due to insufficient air to compress, recirculated and recompressed continuously. By the compressor being partially under load and performing work, it will continue to generate heat and use power, notwithstanding no additional compressed air is being added to the receiver. All of these undesirable operating features present when the compressor intake is shut off can be eliminated to a large extent by also unloading the oil dome at the same time the intake is shut off. With the air in the oil dome under atmospheric pressure, the oil forced into the compressor will be reduced and the air and oil being circulated in the compressor will be free to be discharged into the oil dome against atmospheric pressure instead of against compressed air. A superior operating compressor results which will require less power to operate when no air is required to be compressed. Also the compressor will operate at a much cooler temperature, less oil will be used, and the life of the compressor extended.

My improved valve mechanism indicated generally by the numeral 24 for closing the intake to the compressor and connecting the oil dome to the atmosphere is mounted on the compressor adjacent the intake passage. The valve mechanism is contained in casing 25 provided with a chamber 26 communicating with the atmosphere through an air cleaner 27. A passage 28 at one end of the chamber places it in communication with a passage 29 leading to the intake passage 9 of the compressor. Associated with passage 28 is a valve seat 30.

Within the chamber is a movable valve member 31 for cooperation with the valve seat to close passage 28 and thus the intake of the compressor. The valve member has a projection 32 extending through the passage 28 and into a guide bore 33 which aids in supporting the valve member. The bore communicates with a chamber 34 and adjacent its end a passage 35 extends to the atmosphere through the air cleaner. The rear of the valve member has threaded thereon a cylindrical element 36 which receives a projection 37 on a piston 38, the latter being mounted in a cylinder 39 of a casing member 40 secured to the end of casing 25 and closing chamber 26.

The projection 37 is provided with spaced shoulders 41 and 42 with which cooperate washers 43 and 44 having interposed therebetween a light spring 45. The washer 43 is adapted to engage a flange 46 on the end of the cylindrical element 36 and the washer 44 is adapted to engage either the valve member 31 or a spaced shoulder 47 on the cylindrical element. The construction is such that there is provided a yieldable lost motion connection between the piston 38 and the valve member in both directions of movement of the piston. If the piston should move toward the left the spring will be compressed prior to the engagement of the end of the projection with the valve member to positively move it. If the piston should move to the right the spring will also be compressed by the washer 44 prior to engaging the shoulder 47 and positively moving the valve member.

The piston 38 is normally held in an inoperative position by a spring 48 and when in this position the valve member 31 is held unseated. The tension of this spring determines the force necessary to move the piston and close the valve member. A packing element 49 seals the piston. The forward end of the piston is provided with a projection which forms a second piston 50 and is reciprocable in a cylinder 51 in the casing member 40. A seal 52 surrounds the projection as shown. The chamber ahead of the piston 38 is connected by a conduit 53 to conduit 22 leading to the receiver or storage tank 21, thus causing the tank pressure to be effective at all times on the exposed surface of the piston. The cylinder 51 ahead of the second piston 50 is connected by a passage 54 and a conduit 55 with the oil dome 11 of the compressor.

The compressor oil dome is also connected by means of the conduit 55 and a passage 56 with the chamber 34 previously referred to. Within this chamber is a valve element 57 biased against a seat 58 by a spring 59. The valve controls communication between passage 56 and the passage 35 leading to the atmosphere through the air cleaner. The valve element 57 is adapted to be engaged and opened against the action of the spring and the force of the fluid pressure of the dome by the reduced end of projection 32 as the

valve member 31 is moved toward its seat 30 to close the intake passage of the compressor.

When the pressure in the receiver or tank is below a selected predetermined value, say for example 100 pounds per square inch, the parts of the valve mechanism are in the positions shown in Figure 2 and under these conditions the compressor will operate to compress air to force it out the discharge port into the top of the oil dome and from there through the check valve 23 into the receiver. Air from the atmosphere will be free to pass into the intake 9 of the compressor since the valve member 31 is disengaged from its seat 30. The air pressure in the dome will be the same as the air pressure in the tank since the check valve 23 only prevents fluid from passing from the tank to the oil dome. The air pressure in the tank will be effective in the chamber ahead of piston 38 and the pressure in the oil dome will be effective in cylinder 51 and act on the second piston 50. The valve element 57 will be seated and thus the oil dome will be sealed.

When the compressor has operated a sufficient time to cause the air pressure in the oil dome and in the tank to approach the value of one hundred pounds per square inch, the forces of the fluid pressures acting on the pistons 38 and 50 will move these pistons to the left and thereby compress spring 48. Since the projection 37 moves to the left with piston 38 it will compress spring 45 since the washer 44 abuts the valve member 31. The valve member 31 will not be moved due to the resistance offered by the valve element 57 which is held seated by spring 59 and also by the fluid pressure in the dome. When the pressure acting on the pistons is such as to cause the end of projection 37 to move sufficiently to engage the valve member 31 and then to unseat the valve element 57 and relieve the fluid pressure acting thereon, the valve member 31 will be quickly forced upon its seat 30 by the action of the compressed spring 45. When the valve member is seated it will be maintained so by the action of suction created by the compressor.

When the valve member 31 is seated and the valve element 57 unseated, the oil dome will be placed in communication with the atmosphere through the conduit 55, passage 56 and passage 35. This will cause the pressure in the oil dome to drop to atmospheric pressure and also eliminate the force acting on the second piston 50. The only force now tending to hold spring 48 compressed so that the valve member 31 will remain seated is that acting on piston 38 by the fluid pressure from the tank. This will permit spring 48 to expand to a degree but not sufficiently to move the piston 38 to such a position to cause the unseating of the valve member 31.

With the valve member 31 seated and the oil dome connected to atmosphere the compressor will be completely unloaded and any air which may be in the compressor or which may leak into the compressor will be readily forced out into the dome at a low pressure since there is no pressure in the dome tending to hold the outlet port check valve 12 seated. With the compressor unloaded it will not perform any work and therefore the power necessary to rotate the rotor will be at a minimum. Furthermore, the temperature of the compressor will drop rapidly due to the fact that the blades are not compressing any fluid. Also with the dome at atmospheric pressure there will be no pressure acting on the

oil in the well 14 to force an excessive amount of oil in the compressor and cause it to become "choked."

When fluid under pressure is used from the tank 21 and the pressure therein drops sufficiently so that spring 48 can move the piston 38 to the right to such an extent that the washer 44 will engage the shoulder 47 on the cylindrical element 36, spring 45 will be compressed and then the valve member 31 positively moved with the piston. The valve member will now be unseated and upon the suction effect being broken, the compressed spring 45 will be effective to quickly move the valve member 31 to an open position and restore the parts to the positions as shown in Figure 2. The movement of the valve member 31 to open position will permit the valve element 57 to again be seated under the action of its spring, thus closing off the oil dome from the atmosphere. Air can now pass to the compressor where it will be compressed and forced out into the oil dome and to the receiver to restore the maximum pressure for the receiver. When this maximum pressure is again reached, the valve member 31 will be again closed and the compressor unloaded in a manner already set forth.

Being aware of the possibility of modifications in the particular structure herein described without departing from the fundamental principles of my invention, I do not intend that its scope be limited except as set forth by the appended claims.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination with a compressor provided with an intake port and a discharge port and having associated therewith receiver means for the compressed fluid developed thereby, of valve means for controlling the intake port, means operable by a predetermined fluid pressure developed by the compressor for closing said valve means, and means operable upon the closing of the valve means for causing a fluid pressure created force of a valve less than that employed to close the valve means to act on said valve means and hold it closed.

2. In combination with a compressor provided with an intake port and a discharge port and having associated therewith receiver means for the compressed fluid developed thereby, of valve means for controlling the intake port, means operable by a predetermined fluid pressure developed by the compressor for closing said valve means, means operable upon the closing of the valve means for causing a fluid pressure created force of a value less than that employed to close the valve means to act on said valve means and hold it closed, and means for opening the valve means when the fluid pressure acting to hold it closed drops below a predetermined value.

3. In combination with a compressor provided with an intake port and a discharge port and having associated therewith two chambers receiving compressed fluid in succession from the discharge port and between which is a check valve, of valve means for controlling the intake port, fluid pressure means operable by a predetermined fluid pressure from both chambers for closing said valve means, and means operable simultaneously with the closing of the valve means for venting the first of said chambers to atmosphere and relieving the fluid pressure force thereof which acted to close the valve means.

4. In combination with a compressor provided with an intake port and a discharge port and having associated therewith two chambers receiving compressed fluid in succession from the discharge port and between which is a check valve, of valve means for controlling the intake port, fluid pressure means operable by predetermined fluid pressure from both chambers for closing said valve means, means operable simultaneously with the closing of the valve means for venting the first of said chambers to atmosphere and relieving the fluid pressure force thereof which acted to close the valve means, and means for opening the valve means when the fluid pressure in the second chamber falls to a predetermined value below the first named predetermined value.

5. In combination with a compressor provided with an intake port and a discharge port and having associated therewith two chambers receiving compressed fluid in succession from the discharge port and between which is a check valve, or valve means for controlling the intake port, two fluid motors having their movable elements connected for simultaneous movement, means for connecting one motor to one of said chambers and the other motor to the other chamber, means for moving said valve means to closed position by the movable elements of the fluid motors when the fluid pressures in the chambers are a predetermined value, and means operable when the valve means is closed for causing the fluid pressure in the first of said chambers and the fluid motor connected thereto to be dissipated to atmosphere.

6. In combination with a compressor provided with an intake port and a discharge port and having associated therewith two chambers receiving compressed fluid in succession from the discharge port and between which is a check valve, of valve means for controlling the intake port, two fluid motors having their movable elements connected for simultaneous movement, means for connecting one motor to one of said chambers and the other motor to the other chamber, means for moving said valve means to closed position by the movable elements of the fluid motors when the fluid pressures in the chambers are a predetermined value, means operable when the valve means is closed for causing the fluid pressure in the first of said chambers and in the fluid motor connected thereto to be dissipated to atmosphere, and spring means for opening the valve means when the fluid pressure in the second chamber falls to a value below the predetermined value.

7. In combination with a compressor provided with an intake port and a discharge port and having associated therewith two chambers receiving compressed fluid in succession from the discharge port and between which is a check valve, of valve means for controlling the intake port, fluid pressure means operable by predetermined fluid pressure from both chambers for closing said valve means, means operable simultaneously with the closing of the valve means for venting the first of said chambers to atmosphere and relieving the fluid pressure force thereof which acted to close the valve means, said means comprising a valve, and means operated by the movable member of the valve means when it is moved toward valve-closed position for opening the valve.

8. In combination with a compressor provided with an intake port and a discharge port and

having associated therewith two chambers receiving compressed fluid in succession from the discharge port and between which is a check valve, of valve means for controlling the intake port, two fluid motors, having their movable elements operatively connected for simultaneous movement, means for connecting one motor to one of said chambers and the other motor to the other chamber, means for moving said valve means to closed position by the movable elements of the fluid motors when the fluid pressures in the chambers are a predetermined value, means operable when the valve means is closed for causing the fluid pressure in the first of said chambers and in the fluid motor connected thereto to be dissipated to atmosphere, said means comprising a second valve means, and an element carried by the movable member of the first named valve means for opening the second valve means simultaneously with the closing of the first valve means.

9. In combination with a compressor provided with an intake port and a discharge port and having associated therewith receiver means for the compressed fluid developed thereby, of valve means for controlling the intake port and comprising a movable valve member, means resisting movement of the valve member to closed position, means including a member operable by predetermined fluid pressure developed by the compressor, a lost motion connection between the valve member and fluid pressure operated member, a spring associated with said members and compressed when the lost motion is taken up whereby when the valve member is moved to overcome the resistance it will be assisted to valve-closed position by the action of the spring.

10. In combination with a compressor provided with an intake port and a discharge port and having associated therewith receiver means for the compressed fluid developed thereby, of valve means for controlling the intake port and comprising a movable valve member, means resisting movement of the valve member to closed position, means including a member operable by predetermined fluid pressure developed by the

compressor, a two-way lost motion connection between the valve member and the fluid pressure operated member permitting movement of the latter in both directions without moving the valve member, a spring associated with the members and compressed by movement of the fluid pressure operated member in either direction of movement prior to taking up the lost motion.

11. In combination with a compressor provided with an intake port and a discharge port and having associated therewith two chambers receiving compressed fluid in succession from the discharge port and between which is a check valve, of valve means including a movable valve member for closing the intake port, means resisting the movement of the valve member toward closed position, fluid pressure means including a piston for closing the valve member when the pressures in the chambers are a predetermined value, a lost motion connection between the piston and valve member, and a spring interposed between the piston and the valve member and adapted to be compressed when the lost motion is taken up.

12. In combination with a compressor provided with an intake port and a discharge port and having associated therewith two chambers receiving compressed fluid in succession from the discharge port and between which is a check valve, of valve means for controlling the intake port, two fluid motors having their movable elements operatively connected for simultaneous movement, means for connecting one motor to one of said chambers and the other motor to the other chamber, a spring biasing the movable elements against the fluid pressures action thereon, a yieldable lost motion connection between the movable elements and the valve means, a spring-closed valve for connecting the first of said chambers and the associated fluid motor with the atmosphere, and means for opening the spring-closed valve when the valve means is closed by the fluid motors, said yieldable lost motion connection assisting in the closing of the valve means after the spring-closed valve has been opened.

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