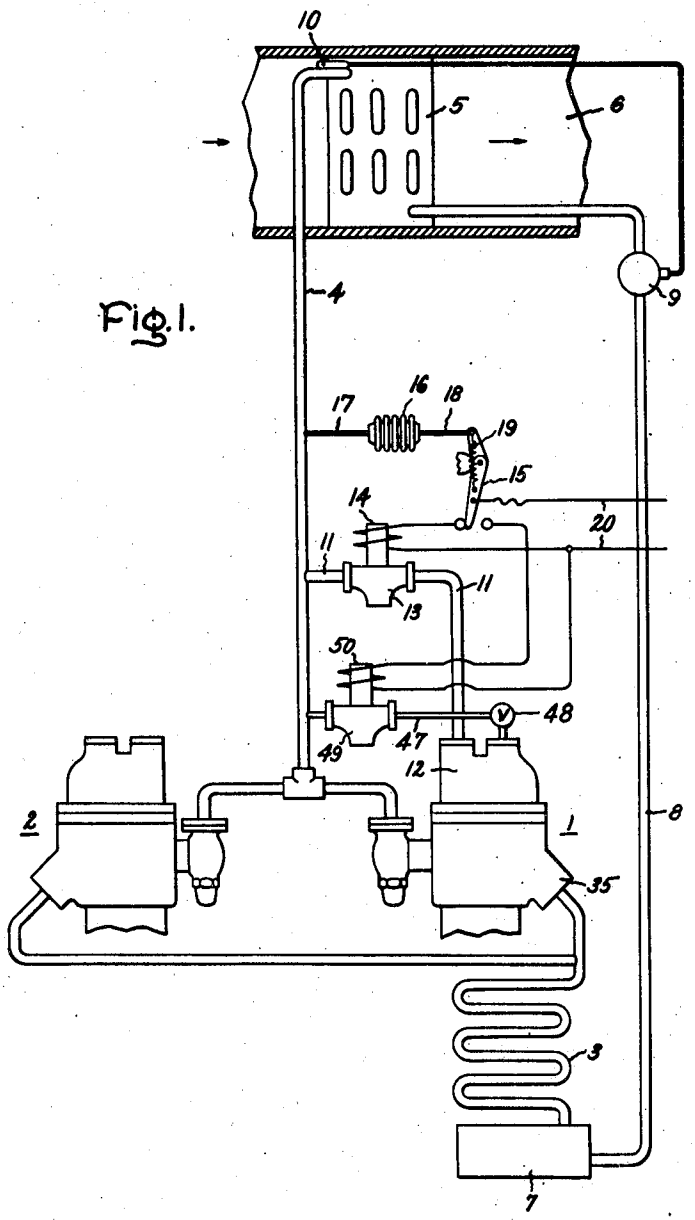
Jan. 11, 1949. W. E. DODSON 2,458,933

UNLOADER FOR RECIPROCATING GAS COMPRESSORS

Filed Dec. 18, 1946 2 Sheets-Sheet 1

Fig. 1.



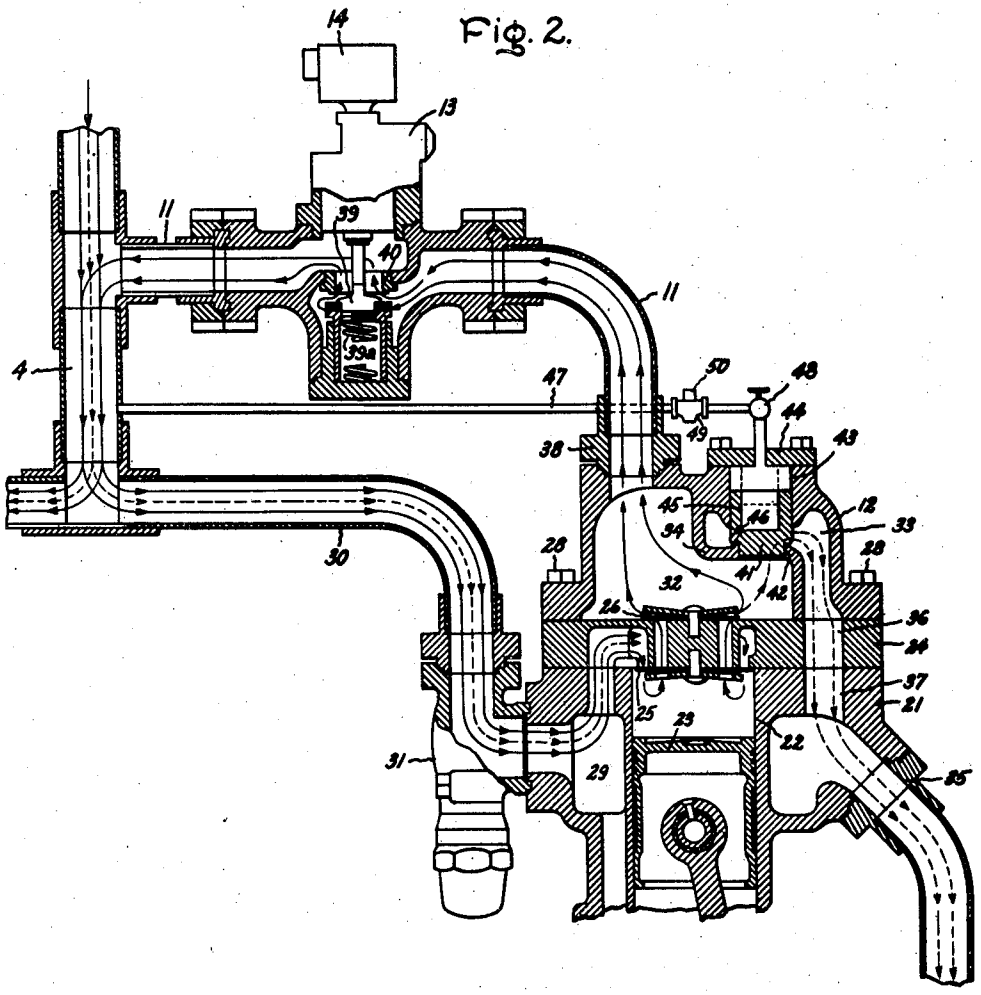
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Fig. 2.



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Patented Jan. 11, 1949 2,458,933

UNITED STATES PATENT OFFICE

2,458,933

UNLOADER FOR RECIPROCATING GAS COMPRESSORS

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Application December 18, 1946, Serial No. 717,002

5 Claims. (Cl. 230—22)

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My invention relates to reciprocating gas compressors and particularly to an improved unloading arrangement for such compressors.

Gas compressors may be unloaded by providing a bypass for the return of compressed gas directly from the discharge to the intake of the compressor. A check valve may be provided to prevent the return of high pressure gas from the system served by the compressor when the bypass is opened. In multiple cylinder reciprocating compressors the load on the compressor may be changed by unloading one or more of the cylinders, and in such compressors a check valve is necessary at each cylinder or group of cylinders to be unloaded so that the compressed gas supplied by the loaded cylinders cannot return through the bypass at the unloaded cylinder or cylinders. The check valves provided for this purpose tend to chatter and produce noise during the normal operation of the compressor under load; such noise is objectionable and, furthermore, the vibration or chattering produces wear and decreases the life of the check valve. Accordingly it is an object of my invention to provide a reciprocating compressor including an improved unloading arrangement utilizing a cylinder bypass and having a check valve for preventing back flow of compressed refrigerant gas during unloaded operation of the compressor.

Further objects and advantages of my invention will become apparent as the following description proceeds, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention reference may be had to the accompanying drawings in which Fig. 1 represents diagrammatically a fluid cooling system provided with a compressor embodying my invention, and Fig. 2 is a detail sectional view of one of the cylinders of the compressor of Fig. 1 including the bypass control.

Referring now to the drawings, the cooling system shown in Fig. 1 comprises a multiple cylinder compressor having cylinders 1 and 2 connected in parallel to deliver refrigerant to a condenser 3 and to withdraw vaporized refrigerant through a suction line 4 from an evaporator 5. In order to simplify the drawing, the driving mechanism for the compressor has been omitted, it being understood that pistons in both cylinders 1 and 2 may be driven from a common crankshaft in the usual manner. The evaporator 5 is arranged in a duct or conduit 6 through which the medium to be cooled is circulated. The condenser 3 is cooled by

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air or other fluid circulated thereover, and the hot compressed refrigerant therein is thus cooled and liquefied and is then delivered to a receiver 7. The liquid refrigerant flows to the evaporator 5 through a liquid line 8 under control of a thermostatic expansion valve 9 having a thermal bulb or feeler 10 secured to the suction line 4 near the outlet of the evaporator.

During the operation of the system illustrated, should the load on the evaporator 5 be greatly reduced it may be desirable to reduce the effective capacity of the compressor, and in order to reduce the capacity without discontinuing operation of the compressor a bypass 11 is provided between the discharge chamber of the cylinder 1 within a head 12 of the cylinder and the suction line 4, the bypass 11 being controlled by a valve 13 actuated by a solenoid 14. The solenoid 14 is arranged to be energized by operation of a snap-acting or over-center switch 15 when the pressure within the suction line 4 falls below a predetermined value and causes a bellows 16 which is in communication with the line 4 through a duct 17 to contract as illustrated and actuate the switch 15 through a rod 18 which pulls a spring 19 over center to snap the switch 15 from its right-hand position, to its left-hand position (as shown) to energize the solenoid 14 by connecting it across supply lines 20. Energization of the solenoid 14 opens the valve 13 so that the cylinder 1 pumps refrigerant gas directly back to the suction line through the conduit 11 and the one cylinder is thus unloaded.

Although the control switch 15 has been illustrated as operated in accordance with suction line pressure, it obviously may be operated manually or by any condition of the system suitable for indicating the requirement for unloading.

The details of construction of the cylinder 1 and the arrangement of the bypass are clearly shown in Fig. 2. The cylinder 1 comprises a block 21 having a cylinder 22 therein and a piston 23 arranged to be reciprocated within the cylinder. A valve plate 24 is mounted on top of the cylinder and on this plate are arranged intake and exhaust valves 25 and 26, respectively. The cylinder head 12 is mounted on top of the plate 24 and it and the valve plate are securely held to the block 21 by suitable bolts 28. An intake passage 29 is formed within the walls of the block 21 laterally of the cylinder 22 and this passage is connected to the suction line 4 through a conduit 30 and an inlet connection 31. The head 12 is formed to provide a discharge chamber or passage 32 above the

valve 26 and a passage 33 separated from the passage 32 by a partition 34; the passage 33 is in communication with a discharge connection 35 through suitable openings 36 and 37 in the valve plate 24 and block 21, respectively. The bypass conduit 11 is secured by a connection 38 in communication with the top of the discharge passage 32 and the passage of gas through the conduit 11 to the suction line 4 is controlled by the valve 13 which includes a movable valve member 39 for controlling a port 40 in the valve body. When the solenoid 14 is energized to move the valve member 39 to its open position against the force of a spring 39a, gas discharged into the chamber 32 is delivered to the suction line 4 through the conduit 11 so that the chamber 32 is connected to the inlet passage 29 through the conduit 11, the suction line 4 and the conduit 30. In order to prevent the return of compressed gas from the connection 35, which is in communication with the condenser 3, a check valve 41 is arranged to close an opening 42 in the partition 34. The check valve 41 comprises a piston mounted in a cylinder 43 at the top of the head 12 and which is closed by a head plate 44. The cylinder 43 and piston 41 are arranged for vertical movement of the piston so that the check valve is biased by gravity to its lower position to close the opening 42. The piston 41 is provided with a cylindrical cavity or chamber 45 which is in communication with the high pressure passage 33 through a duct or bleeder 46. Thus when the valve 41 is in its lower position, high pressure gas enters the cylinder 43 and holds the valve closed. It will thus be evident that when the bypass valve 39 is open, as shown in Fig. 2, the check valve 41 is held in its closed position, the pressure in the chamber 32 being that on the low pressure side of the refrigerating system.

When the valve 39 is closed to load the cylinder 22 of the compressor 21, the gas discharged into the chamber 32 will reach a pressure higher than that in the passage 33 and will lift the check valve 41 allowing the gas to be discharged from the compressor through the connection 35. The operation of the check valve 41 when the compressor is loaded may result in chattering of the valve and consequent noise and wear, which is objectionable. In order to prevent this chattering and wear of the valve, I provide a conduit 47 connected between the suction line 4 and the cylinder 43 under control of a manual valve 48 and a valve 49 actuated by a solenoid 50. As shown in Fig. 1, the solenoid 50 is energized when the switch 15 is in its right-hand position. Thus the switch 15 energizes only one of the solenoids 14 and 50 at a time so that only one of the conduits 11 and 47 can be open at one time. When the valve 49 is opened, the cylinder 43 is in communication with the suction line and the pressure in the cylinder is reduced so that the piston valve 41 is retracted and held in its retracted position during the loaded operation of the compressor. The manual valve 48 may be adjusted to control the bleeding of gaseous refrigerant through the passage 46, cylinder 43 and conduit 47 back to the suction line and in this manner the capacity of the compressor which is lost during loaded operation may be reduced to a negligible amount, only sufficient flow of refrigerant being required to reduce the pressure in the cylinder 43 an amount sufficient to hold the valve 41 in its upper position. When the check valve 41 is in its upper position no chattering or noise will result during the loaded operation of the compressor and wear of the check valve is thereby minimized.

From the foregoing, it is apparent that I have provided a simple and effective arrangement which makes it possible to employ a check valve to prevent return of compressed gas to an unloaded cylinder of a multicylinder compressor without resultant noise or chattering of the check valve during loaded operation of the compressor.

While I have described my invention in connection with a two-cylinder compressor for supplying a refrigerating system, other applications will readily be apparent to those skilled in the art. I do not, therefore, desire my invention to be limited to the specific construction illustrated and described, and I intend by the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A reciprocating gas compressor comprising a cylinder having intake and discharge valves, means providing intake and discharge passages adjacent said intake and discharge valves respectively, an outlet connection communicating with said discharge passage, bypass means providing communication between said discharge and intake passages for unloading said cylinder, means for closing said bypass to load said cylinder, a check valve for preventing return of gas through said outlet connection to said discharge passage upon opening of said bypass, and means rendered effective upon the loading of said cylinder for retaining said check valve in its open position to prevent vibration of said check valve.

2. A reciprocating gas compressor comprising a cylinder having intake and discharge valves, means providing intake and discharge passages adjacent said intake and discharge valves respectively, an outlet connection communicating with said discharge passage, bypass means providing communication between said discharge and intake passages for unloading said cylinder, means for closing said bypass to load said cylinder, a check valve for preventing return of gas through said outlet connection to said discharge passage upon opening of said bypass, and means effective during the loaded operation of said compressor and utilizing the difference in pressure between the inlet an outlet of said compressor for retaining said check valve in its open position.

3. A reciprocating gas compressor comprising a cylinder having intake and discharge valves, means providing intake and discharge passages adjacent said intake and discharge valves respectively, an outlet connection communicating with said discharge passage, bypass means providing communication between said discharge and intake passages for unloading said cylinder, means for closing said bypass to load said cylinder, a check valve for preventing return of gas through said outlet connection to said discharge passage upon opening of said bypass, said check valve including means providing a closed cylinder and a piston arranged therein, said closed cylinder having limited communication with said outlet connection whereby said valve is held closed by the pressure of gas in said closed cylinder, and means effective during the loaded operation of said compressor for reducing the pressure in said closed cylinder to maintain said check valve in its open position when said bypass is closed.

4. A reciprocating gas compressor comprising a cylinder having intake and discharge valves, means providing intake and discharge passages

adjacent said intake and discharge valves respectively, an outlet connection communicating with said discharge passage, bypass means providing communication between said discharge and intake passages for unloading said cylinder, means for closing said bypass to load said cylinder, a check valve for preventing return of gas through said outlet connection to said discharge passage upon opening of said bypass, said check valve including means providing a closed cylinder and a piston arranged therein, said closed cylinder having limited communication with said outlet connection whereby said valve is held closed by the pressure of gas in said closed cylinder, and means actuated upon closing of said bypass for withdrawing gas from said closed cylinder to reduce the pressure therein and retract said check valve to maintain said check valve in its open position when said compressor is loaded.

5. A reciprocating gas compressor comprising a cylinder having intake and discharge valves, means providing intake and discharge passages adjacent said intake and discharge valves respectively, an outlet connection communicating with said discharge passage, bypass means providing communication between said discharge and intake passages for unloading said cylinder, a check valve for preventing return of gas through said outlet connection to said discharge passage upon opening of said bypass, said check

valve including means providing a closed cylinder and a piston arranged therein, said closed cylinder having limited communication with said outlet whereby said valve is held closed when the pressure in said connection is greater than that in said discharge passage, means connecting said closed cylinder with said intake passage to bleed refrigerant from said discharge connection to said intake passage to reduce the pressure in said closed cylinder for retaining said check valve in its open position, a control valve for said connection to said closed cylinder, and means for maintaining each of said control valves in its closed position when the other of said control valves is in its open position whereby said check valve is effective only during the period when said compressor is unloaded.

WAYNE E. DODSON.

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