Dec. 5, 1933. W. B. FLOYD ET AL 1,938,451

COMPRESSING APPARATUS

Filed June 30, 1930 3 Sheets-Sheet 1

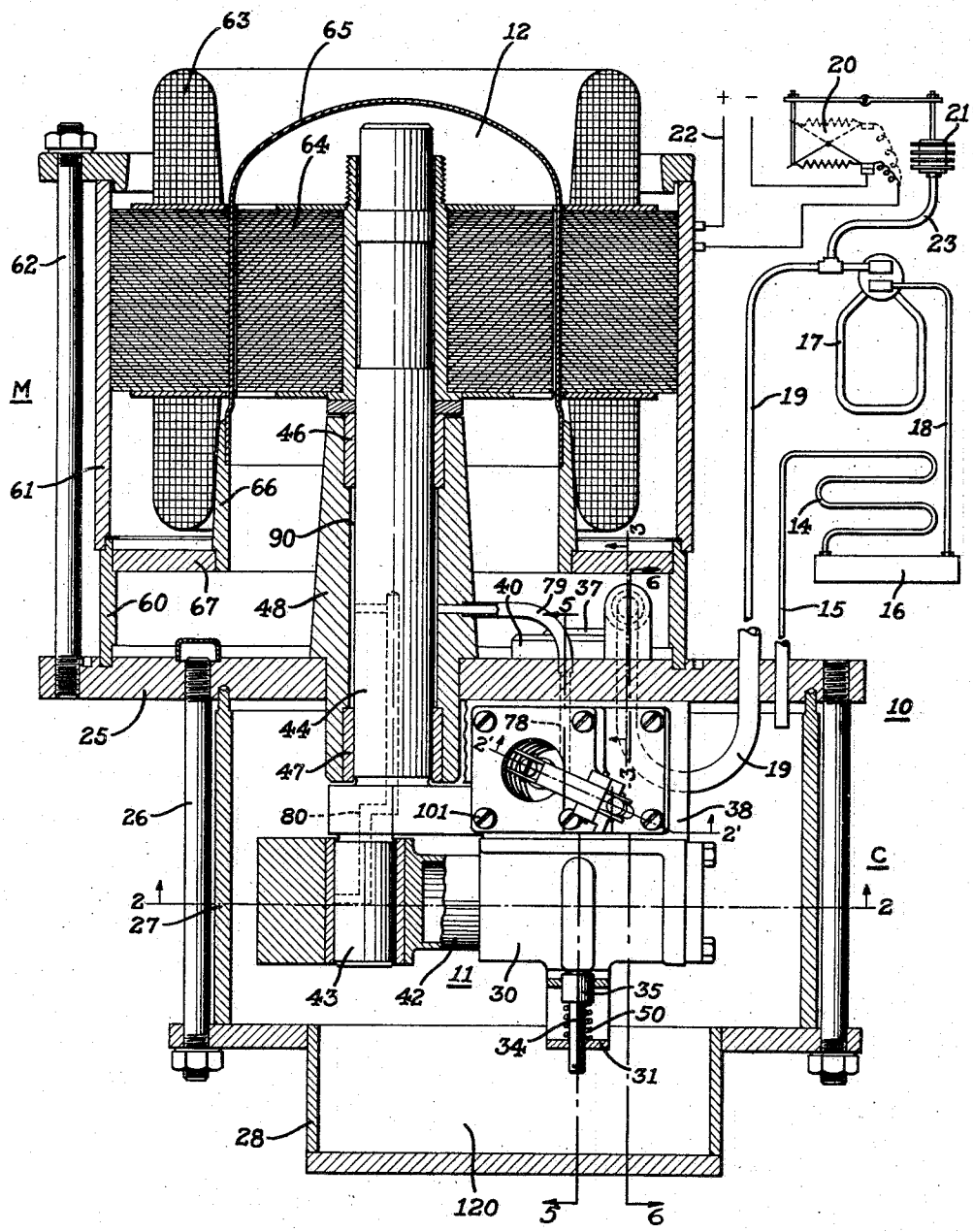

Fig. 1

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COMPRESSING APPARATUS

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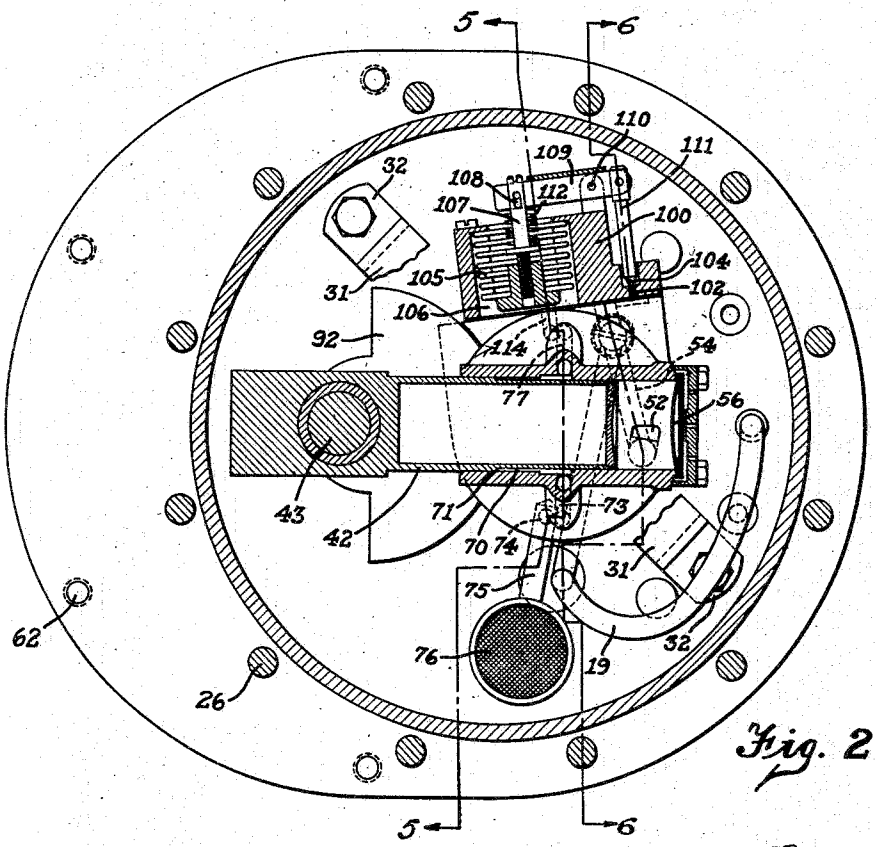

Fig. 2

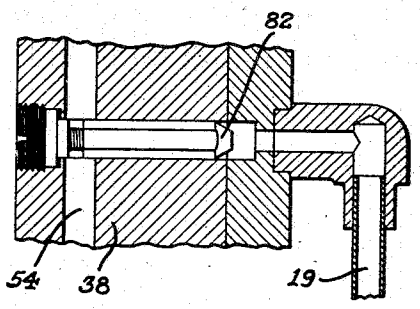

Fig. 3

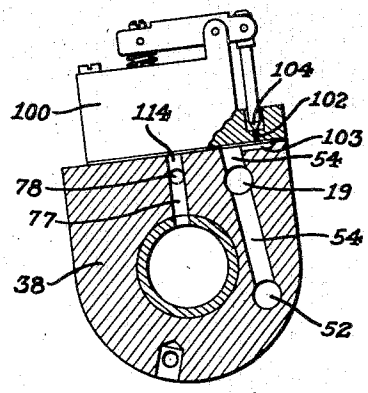

Fig. 4

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COMPRESSING APPARATUS

Filed June 30, 1930 3 Sheets-Sheet 3

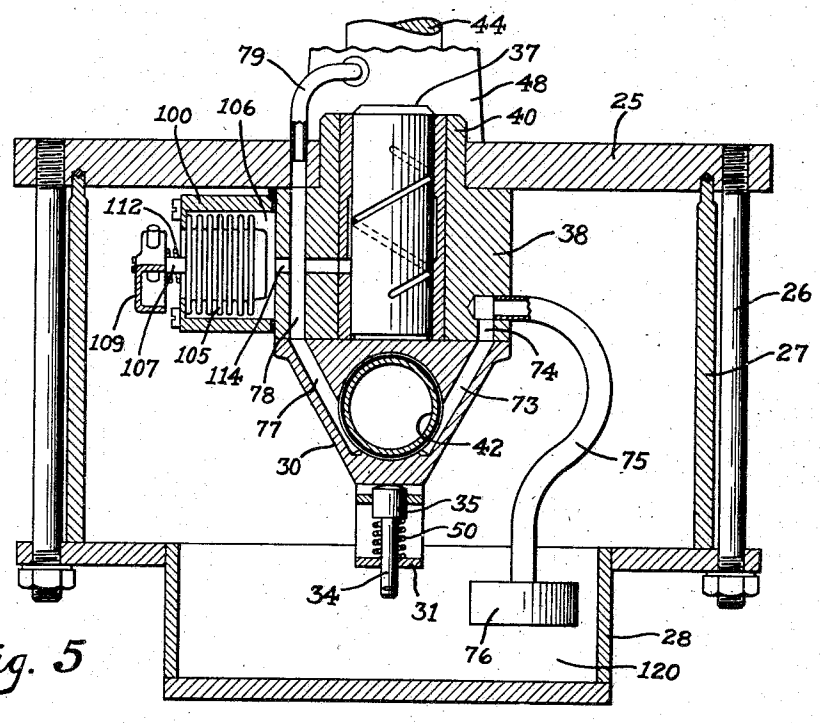

Fig. 5

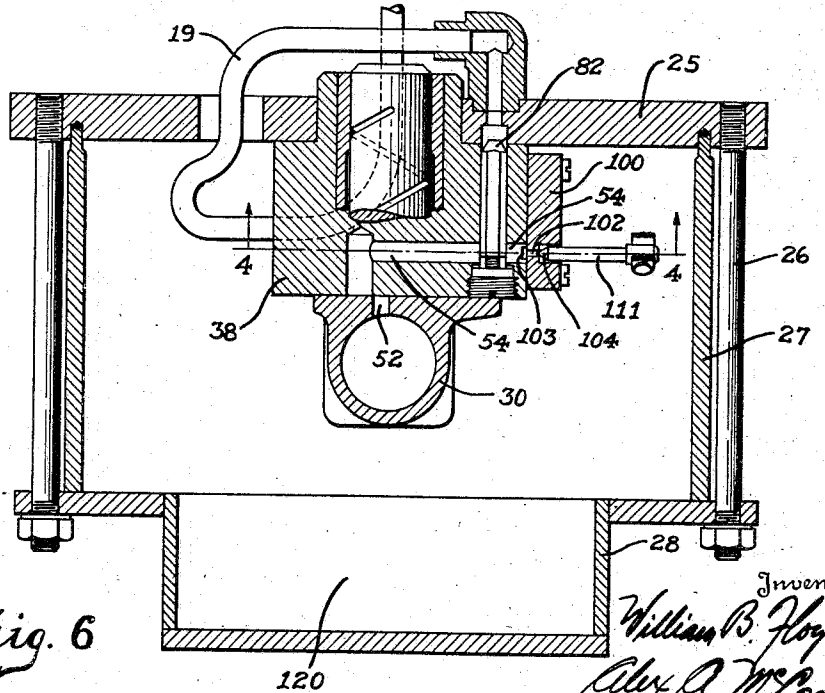

Fig. 6

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Patented Dec. 5, 1933

1,938,451

UNITED STATES PATENT OFFICE

1,938,451

COMPRESSING APPARATUS

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Application June 30, 1930. Serial No. 464,959

2 Claims. (Cl. 230—58)

This invention relates to refrigerating apparatus and more particularly to motor-compressor units for use in refrigerating apparatus of the compression type.

In refrigerating apparatus of the compression type it is customary to provide, among other elements, a compressor having its discharge side connected to a condenser, and its intake side connected to an evaporator, the evaporator being in turn connected to the discharge side of the condenser through some sort of a pressure reducing device. Refrigeration is produced by evaporating a liquid refrigerant under reduced pressure in the evaporator, the vapors being compressed into, and condensed in a condenser at a much higher pressure. In order to maintain a substantially constant or even temperature within the evaporator, or within the refrigerator which, as a general rule, houses the evaporator, it is customary to operate the compressor intermittently. That is to say, it is customary to start the compressor when the temperature within the refrigerator reaches a predetermined high limit, and to stop the compressor when the temperature is reduced to a predetermined low limit.

Since the discharge side of the compressor is at condenser pressure, and since the intake side of the compressor is at evaporator pressure, it is obvious that the compressor will start under a heavy load and consequently a motor having a high starting torque will be required unless some means is provided for allowing the motor to reach a predetermined speed before the compressor becomes heavily loaded.

It is to such apparatus that my invention relates, having for one of its objects means for automatically loading and unloading the compressor whereby when the speed of the driving member reaches a predetermined high limit the compressor is automatically loaded and whereby, when the speed of the compressor or driving member falls below a predetermined limit the compressor will be automatically unloaded. More specifically it is an object of this invention to provide an unloading device which will depend for its operation upon the presence of lubricating fluid within the compressor.

A further object of this invention is to provide an unloading device in the form of a unitary structure capable of being attached to now existing compressors and capable of being constructed and tested as a unit before being applied to a compressor.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatical view of a refrigerating system showing the motor-compressor unit partly in elevation and partly in section.

Fig. 2 is a horizontal section taken on line 2—2 and 2'—2' of Fig. 1.

Fig. 3 is a section taken on the line 3—3 of Fig. 1.

Fig. 4 is a view in section taken through the block shown in Fig. 1.

Fig. 5 is a cross-sectional view taken along the lines 5—5 in Figs. 1 and 2;

Fig. 6 is a cross-sectional view taken along the lines 6—6 of Figs. 1 and 2.

In order to illustrate our invention, we have disclosed diagrammatically a refrigerating system of the compression type having incorporated therein a motor-compressor unit embodying the features of our invention. For instance, we have shown an hermetically sealed motor-compressor unit, generally indicated by the reference character 10, as including a compressor 11, operatively connected to be driven by the motor 12. The compressor is connected to a condenser 14 by means of the conduit 15, and the condenser is in turn connected on its discharge side to a liquid receiver 16. An evaporator 17 is connected on its inlet side to the liquid receiver 16 and on its outlet side to the compressor inlet. Refrigerant may flow through the parts in the order named. For instance refrigerant is compressed in the compressor 11, discharged through the conduit 15 into the condenser 14 where it is liquefied and finally collected in liquid form in the receiver 16. From the liquid receiver 16 the refrigerant, in liquid form, flows through the conduit 18 to the evaporator 17. Herein the liquid refrigerant evaporates under reduced pressure, to produce a cooling effect, and the vapors, passing through the conduit 19, are recompressed in the compressor 11 to be again discharged into the condenser 14. In order to provide means for maintaining the evaporator, or the refrigerator which generally houses the evaporator, at a substantially constant temperature, means are provided for stopping and starting the motor at predetermined low and high temperature limits respectively. For instance, a switch 20 operatively connected to a bellows 21 is located in the motor circuit 22, and the bellows 21 is in open communication through conduit 23, with the suction conduit 18 leading from the evaporator to

the compressor 11. Thus the motor is controlled in response to predetermined high and low pressures within the evaporator 17. In view of the fact that the pressure within the evaporator 17 varies with the temperature therein, the motor is in reality controlled in response to predetermined high and low temperatures within the evaporator.

Referring in detail to the motor-compressor unit generally indicated by the reference character 10, we have shown this unit as comprising a compressor casing, generally indicated by the reference character C, enclosing the compressor 11, and the motor casing, generally indicated by the reference character M, enclosing the motor or part of the motor 12, both of these casings being joined together to form an hermetically sealed unit. The compressor casing C includes the plate member 25 having secured thereto by means of the bolts 26, the annular wall member 27 and the bottom wall member 28. Within the casing C is positioned an oscillating cylinder, reciprocating piston type of compressor 11, the cylinder 30 of which is carried by the plate member 25. To this end, a bracket 31 is secured to the plate member 25 as at 32, the bracket 31 extending downwardly and around the cylinder 30. Beneath the cylinder 30, the bracket 31 is provided with a bearing 34 passing therethrough, the bearing being provided with an enlarged head 35 upon which the cylinder 30 oscillates. In order to provide means to guide the cylinder in its oscillating movement, there is provided a shaft 37 secured to the cylinder 30 and extending upwardly through a block 38 and plate 25, the block 38 being in turn secured to the plate member 25 by means of a reduced portion 40 passing through and welded to the plate member 25.

A piston 42 reciprocates within the cylinder 30, and is connected to an eccentric 43 formed on the drive shaft 44, the drive shaft 44 being journalled in the upper and lower bearings 46 and 47 supported in the sleeve 48, and, the sleeve 48 being in turn carried by the plate 25 and extending upwardly into the motor casing M. A counter balancing weight 92 is also secured to the drive shaft 44.

Rotation of the drive shaft 44 will thus cause the piston 42 to reciprocate within the cylinder 30 and at the same time the cylinder 30 and the shaft 37 will oscillate on the bearing 35 within the limits of eccentricity of the eccentric 43, the cylinder 30 being at the same time urged upwardly against the block 38 by means of a spring 50 surrounding the stem of the bearing 34.

Thus the cylinder 30 oscillates back and forth along the lower side of the block 38, and advantage is taken of this sliding movement to open and close the inlet to the cylinder 30. Thus an inlet valve comprising an opening 52 in the side wall of the cylinder 30 is provided in the upper surface of the cylinder wall, and this opening 52 is adapted to communicate with the passage 54 formed in the block 38 when the piston is at the end of its suction stroke. The passage 54 formed in the block 38 is connected to the conduit 19 leading from the evaporator 17 and a check valve 82 is provided in the passage 19. The cylinder 30 is also provided in its head with an outlet valve 56 of the disc type.

Thus in operation refrigerant is withdrawn from the evaporator 17 through the conduit 19 and passage 54, and is drawn into the cylinder 30 when the inlet opening 52 is in communication with the passage 54. As the piston moves upwardly in the cylinder 30, the opening 52 in the wall of cylinder 30 will move out of communication with the passage 54, due to oscillation of cylinder 30 and the refrigerant within the cylinder 30 will be compressed and discharged through the disc valve into the compressor casing C.

The motor casing also includes the plate 25 to which is secured the vertical walls 60 and 61 by means of the bolts 62. The vertical wall 61 carries the stator 63 of the motor and the rotor 64 is separated therefrom by means of a nonmagnetic high resistance shell 65 hermetically sealed to the wall 66 which in turn is hermetically sealed to the vertical wall 60 by means of the wall 67. Thus the walls 60, 67, 66, and 65 form with the compressor casing C, an hermetically sealed unit enclosing the rotor 64 of the motor, and the compressor 11. The rotor 64 is connected to the drive shaft 44 at the upper end thereof and is adapted to drive the compressor 11 through the drive shaft.

Means are provided for properly lubricating the various moving parts of the apparatus and to this end there is provided a body of lubricating oil in the compressor casing C and an oil pump having its inlet in communication with the body of oil and its outlet discharging to the various bearings of the apparatus. For instance, to form an oil pump, the piston 42 of the compressor 11 is stepped as shown at 70 to provide a piston surface 71 reciprocating within the cylinder 30. This oil pump has its inlet 73 communicating with a passage 74, the passage 74 being in turn connected to the conduit 75 communicating with the body of oil in the compressor casing C through a strainer 76. The oil pump also has its discharge opening 77 communicating with a passage 78, which passage communicates with conduit 79, having its discharge end in communication with a space 90 formed between the drive shaft 44 and the sleeve 48. Passage 80 in open communication with the space 90 is adapted to conduct lubricant from the said space to the eccentric bearing of the drive shaft. Thus as the cylinder oscillates, the oil inlet 73 first communicates with the passage 74 when piston surface 71 is at its innermost position and then the outlet passage 77 communicates with conduit 78 when the piston moves forwardly in the cylinder.

The operation of the apparatus thus far described is substantially as follows. When the compressor is operating, the piston is reciprocating within the cylinder 30, and the cylinder 30 is oscillating on the bearing 37, thereby alternately opening and closing the inlet port 52 as the piston is withdrawn and forced into the cylinder respectively. When the inlet port 52 is uncovered, or on the suction stroke, refrigerant is drawn from the evaporator 17, through conduit 19, past the check valve 82, through the passage 54 in the block 38 into the cylinder 30. On the upstroke of the piston, the cylinder 30 oscillates to cover the port 52 and the refrigerant is compressed and forced through the outlet valve into the compressor casing C from where the refrigerant in gaseous form passes through the conduit 15 to the condenser 14 where the gas is liquefied and collected in the liquid receiver 16. From the liquid receiver 16 the liquid flows into the conduit 18 to the evaporator 17, where it evaporates and again passes in vapor form through the conduit 18 to the compressor. The cycle is thus repeated. At the same time the oscillation of cylinder 30 opens

and closes alternately the inlet and outlet ports of the oil pump, whereby oil is withdrawn from the compressor casing C through the strainer 76 conduit 75 into the inlet passage 73 of the oil pump, from where it is discharged through the passages 77 and 78 and conduit 79 to lubricate the various bearings of the motor and compressor.

In order to provide means whereby the compressor 11 and the motor 12 may attain normal running speed before the compressor picks up its normal or full load, we have provided a device for maintaining the pressure on the inlet and outside of the compressor substantially the same until this predetermined normal speed is attained. For instance, we have provided an unloading device provided with a passage communicating with the high and low pressure sides of the apparatus and with a valve therein adapted to be opened when the compressor is idle and to be closed when the compressor attains a predetermined speed. To this end we have provided a unitary structure comprising a block 100 adapted to be secured to the block or edge 38 of the compressor by means of the screws 101. This block 100 is provided with a passage 102, controlled by valve 104, which passage communicates through a passage 103 formed in block 38 with passage 54 leading to the inlet of the compressor. Thus, it will be seen that when valve 104 is open, high pressure fluid within the compressor casing C will pass through passage 102 to conduit 54 thereby equalizing the pressure on the inlet and outlet sides of the compressor. High pressure fluid in conduit 54 will close check valve 82 thereby preventing the pressure within the evaporator 17 from increasing.

Means are provided for operating the valve 104 to open the valve when the speed of the compressor falls below a predetermined minimum and for closing the valve when the speed of the compressor is increased substantially to normal speed. To this end, a bellows 105 is positioned within a second passage 106 within the block 100. This bellows is provided with a rod 107 secured to the lower face of the bellows, the rod 107 being connected through a lost motion connection 108 to a lever 109 pivoted at 110 and connected at its other end to the stem 111 of valve 104. The lever 109 may be made of sheet metal so that in a view transverse to Fig. 2 it would have an inverted U-shaped cross-section. A spring 112 surrounding rod 107 takes up the lost motion and maintains the lever 109 quiet in operation. Beneath the bellows 105, a passage 114 communicates with the discharge passage 77 of the oil pump whereby oil pumped by said oil pump will pass upwardly against the face of the bellows 105 tending to force the bellows 105 upwardly to close the valve 104.

In operation, the valve 102 will be open when the compressor stops because of the drop in pressure in the lubricant system. If now the switch 20 is thrown to its "on" position due to a predetermined high temperature within the evaporator 17, the motor 12 will start to drive the compressor. During the first few reciprocations of piston 42, the pressure on the inlet side of the compressor will be equal to the pressure on the discharge side. Consequently when the piston moves back to the left as viewed in Fig. 2, it will draw into the cylinder, gas at the same pressure as in the compressor casing C. As the piston moves to the right therefore, it will do no work, except sufficient to overcome the disc valve 56 which will be practically negligible. As the motor and compressor, and consequently the oil pump, speed up, however, the oil forced by the oil pump against the lower face of the bellows 105 will collapse the bellows 105 to close the valve 104. Thereupon the compressor will pick up its load and will operate at full load until such time as the compressor and motor fall below a predetermined speed due to any cause.

Thus we have disclosed a unitary self-contained unloading device, one that may be attached or removed from compressors as a unit; an unloading device that may be tested as a unit before being applied to any of the now existing compressors.

Further, while we have shown the receiver 16 as a separate element, the condenser 14 may discharge into the cavity or depression 120 formed in the lower wall of the compressor casing C.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a compressing unit, a compressor, a casing enclosing said compressor, discharge means for said compressor, intake means for said compressor, one of said means being normally in communication with the interior of said casing, both of said means having passages to the wall of said compressor, a unitary unloading device attached to the wall of said compressor having a valve opening and closing a connection with the means not normally in communication with the interior of the casing, a pressure responsive device for operating said valve, said pressure operable device being actuated at a predetermined speed of the compressor.

2. In a compressing unit, a compressor, a casing enclosing said compressor, discharge means for said compressor, intake means for said compressor, one of said means being normally in communication with the interior of said casing, both of said means having passages to the wall of said compressor, a unitary unloading device attached to the wall of said compressor having a valve opening and closing a connection with the means not normally in communication with the interior of the casing, a pressure responsive device for operating said valve, a lubricating pump operating at the same time with said compressor, the discharge of said lubricating pump being connected to said pressure responsive device.

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