Nov. 3, 1936. D. F. NEWMAN 2,059,894

REFRIGERATOR COMPRESSOR

Filed June 23, 1933

Fig. 1.

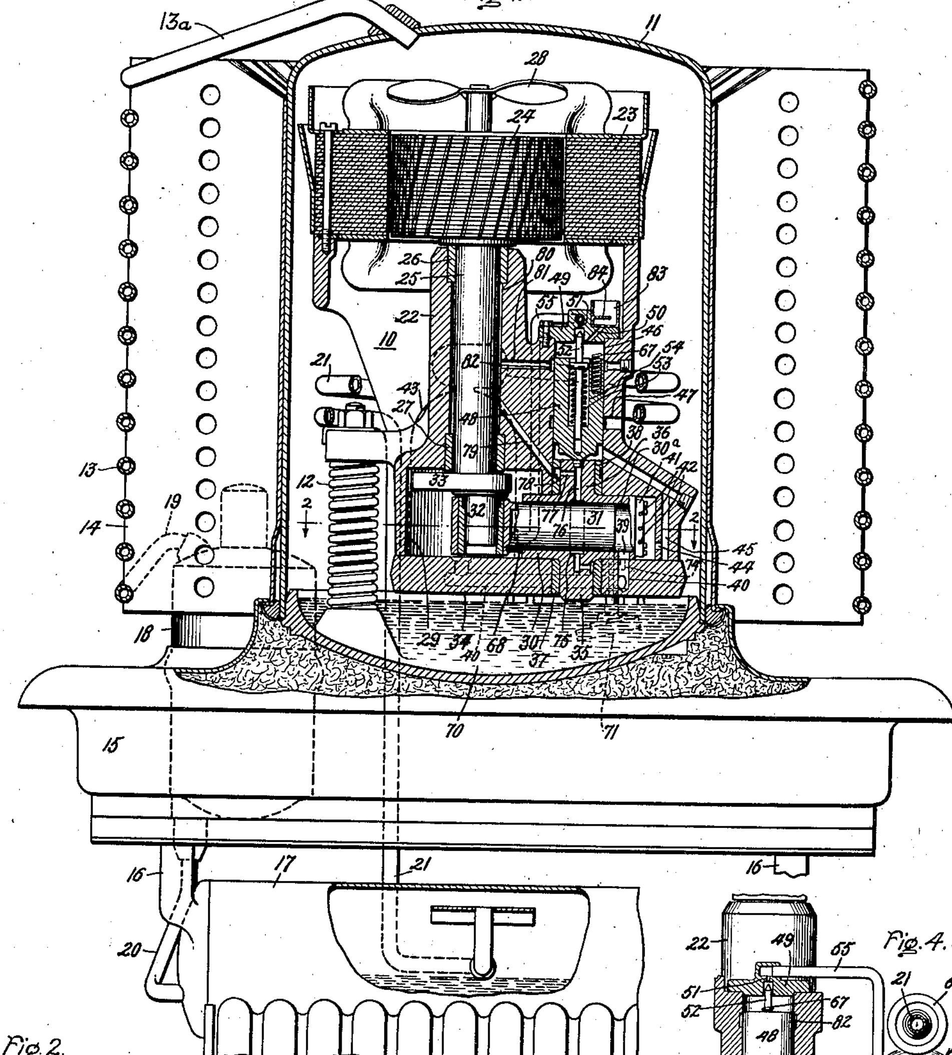


Fig. 2.

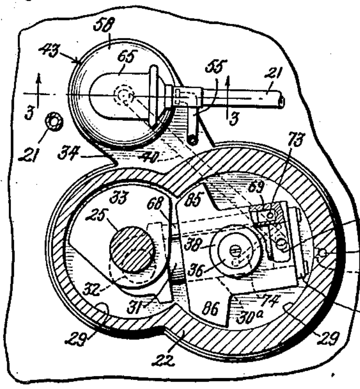


Fig. 3.

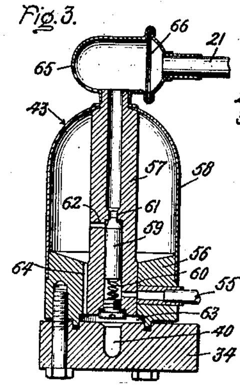
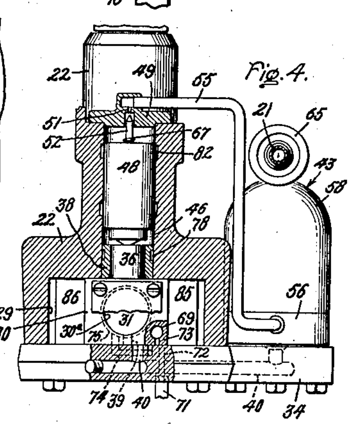


Fig. 4.



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2,059,894

REFRIGERATOR COMPRESSOR

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10 Claims. (Cl. 230—30)

My invention relates to compression refrigerating systems, and particularly to unloaders for the compressors of such systems.

It is an object of my invention to provide a refrigerator compressor having an unloader of improved and rugged construction which is positive and reliable in operation.

Another object of my invention is to provide a refrigerator compressor having an unloader which is operated in response to the pressure at the exhaust side of the compressor and which will not chatter and produce noise during 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 drawing, in which Fig. 1 is a sectional view of a refrigerating machine provided with a compressor embodying my invention; Fig. 2 is a sectional view of the compressor shown in Fig. 1 taken on the line 2—2 thereof; Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2; and Fig. 4 is a side elevation, partly in section, of the compressor, unloader, and check valve with the compressor cylinder in its center position.

Referring to the drawing, in Fig. 1, I have shown a motor and compressor unit **10** arranged within a closed casing **11**, and mounted upon helical springs **12**, only one of which is shown. A helical condenser coil **13** is arranged in spaced relation about the casing and supported on heat radiating fins **14**. The casing **11** and condenser **13** are mounted on a base **15** forming a removable top for a refrigerator cabinet. Below the base or top **15** and suspended therefrom on legs **16** is an evaporator **17** of the flooded type. In order to regulate the flow of condensed liquid refrigerant from the condenser **13** to the evaporator **17**, I provide a float valve **18**, or other suitable flow controlling device, secured in the base **15**, and communicating with the condenser **13** and the evaporator **17** through connections **19** and **20**, respectively. A conduit **21** is provided to convey vaporized refrigerant from the evaporator **17** to the intake port of the compressor, and the conduit **21** is coiled about the motor and compressor unit to provide a resilient connection between the casing and the unit. The motor and compressor unit **10** is provided with a frame **22** upon which is mounted an induction motor stator **23** having suitable windings. A squirrel cage induction motor rotor **24** is secured on a shaft **25** which is journaled in the frame **22** in upper and lower bearings **26** and **27**, respectively. A fan **28** is mounted on top of the rotor **24** to provide circulation of vaporized or gaseous refrigerant about the stator and between the stator and the rotor to cool the motor. The bottom of the frame **22** is provided with a recess or chamber **29** within which is arranged a reciprocating compressor comprising an oscillating cylinder **30** and a piston **31** arranged in a bore **30***a* in the cylinder and driven by the shaft **25** through a crank pin **32**, a counterweight **33** being provided to balance the piston and cylinder. A plate **34** is bolted to the bottom of the frame **22** and the cylinder **30** is provided with trunnions **35** and **36** journaled in bearings **37** and **38** in the plate **34** and the frame **22**, respectively. The cylinder **30** is provided with an intake port **39**, which communicates with a passage **40** in the plate **34** during the intake stroke of the piston **31**, and which is closed by the plate **34** when the cylinder moves toward its exhaust position, it being shown open in Fig. 1, partially closed in Fig. 2, and closed in Fig. 4. Over the end of the cylinder is secured a head **41** provided with a plurality of exhaust ports **42** which discharge compressed refrigerant into the recess **29**. The head **41** is provided with an outwardly opening check valve to prevent flow of compressed gas back into the cylinder through the exhaust ports **42**. Gas is withdrawn by the compressor from the evaporator **17** through tube **21** which communicates with the intake passage **40** through a normally open check valve **43**, which is more clearly shown in Figs. 2, 3 and 4.

In accordance with my invention the compressed refrigerant is utilized to control the loading and unloading of the compressor. In the particular construction illustrated I accomplish this by completely closing the chamber **29** by the plate **34** and providing an outlet port **44** for the chamber, a passage **45** leading to a cylinder bore **46**, and a port **47** for discharging the compressed gas into the casing **11**. I also provide a piston **48** in the bore **46** for closing the port **47** and for admitting compressed refrigerant from the casing to the intake passage **40** of the compressor when the pressure in the passage **45** falls below a predetermined value, to unload the compressor. The bore **46** is arranged vertically in the frame **22** in alignment with the bearing **38** and is closed at the top by a cylinder head **49** having a passage **50** therethrough connecting the cylinder bore **46** and the interior of the casing 11. In the recess at the center of the cylinder head 49, I provide a valve seat 51 which is arranged to be closed by a needle valve 52 resiliently mounted on a spring 53 in a bore 54 in the piston 48. The arrangement of the needle valve 52 and the spring 53 is such that when the piston 48 is raised the needle valve will first close the orifice 51 and on further upward movement of the piston 48 the valve 52 will be pressed against the orifice by the spring 53.

This upward movement of the piston 48 is produced by the pressure of compressed refrigerant discharged from the chamber 29 to the lower portion of the cylinder 46. The orifice 51 provides communication between the upper portion of the cylinder bore 46 and a conduit 55 connecting the bore 46 with the check valve 43. The purpose of the check valve 43 is to prevent the passage of compressed refrigerant into the evaporator 17 through the conduit 21 when compressed refrigerant is admitted to the intake passage 40 for the purpose of unloading the compressor. As shown in Fig. 3, the check valve 43 comprises a base 56 and a central tube 57 secured thereto and an inverted shell 58 providing a chamber surrounding the tube 57. The check valve comprises a plunger 59 retained by a spring 60 toward the bottom of the tube 57. The tube 57 is provided with a restricted portion 61 against which the plunger 59 is seated when in its upper position to cut off communication between the conduit 21 and the passage 40. The surge chamber formed by the shell 58 communicates with the bore of the tube 57 through a small passage 62 in the tube 57 and with a cylindrical chamber 63 at the bottom of the space 56 through a vertical passage 64. Check valve 43 is secured to the plate 34 with the cylindrical recess 63 in communication with the passage 40. On the top of the tube 57 is secured a small chamber 65 provided with a screen 66 and connected to the conduit 21. The screen 66 prevents passage of foreign matter to the intake of the compressor. The conduit 55 affords communication between the bore 46 and the bore of the tube 57 at the bottom thereof, and it will be evident that when compressed gas is admited to the valve 43 through the tube 55 the plunger 59 will be forced upward to seat against the restricted portion 61 of the tube. The plunger 59 remains seated against the restricted portion 61 after the pressure is built up in the chamber 58 as it is retained in this position by the difference in pressure about the plunger and in the bore in the tube above the plunger. The compressed gas will pass around the plunger 59 through the passage 62 into the chamber formed by the shell 58, and thence through the passage 64 and the cylindrical recess 63 to the intake passage 40 of the compressor. When the piston 48 is in the position shown in Fig. 1 compressed gas is free to pass from the casing 11 through the passage 50 in the cylinder head 49 to the cylinder 46 and thence through the orifice 51 and the tube 55 to raise the plunger 59, close the check valve 43, and supply refrigerant at the pressure in the casing 11 to the intake passage 40 of the compressor. It is also evident that with the piston 48 in this position, communication between the casing 11 and the chamber 29 is cut off.

The position of the piston 48, as shown in Fig. 1, is that when the compressor is stopped. If the compressor is now started the gas from the casing 11 will enter the compressor intake and the pressure will gradually be built up in the chamber 29. When this pressure is sufficiently high the piston 48 will be forced toward its upper position in the bore 46, a buffer spring 67 being provided to prevent sudden impacts of the piston 48 against the cylinder head 49. When the piston 48 is in the upper end of the bore 46 the needle valve 52 is seated against the orifice 51 cutting off communication between the casing 11 and the intake port 39 of the compressor and the port 47 is uncovered, providing communication between the chamber 29 and casing 11. When the compressor is again stopped the pressure at the top and at the bottom of the piston 48 will be substantially the same and the piston will drop back to its lower position and will close the port 47 and release the valve 52 to operate the check valve plunger 59. The pressure in the chamber 29 and in the casing 11 will now be the same as the pressure at the intake port of the compressor. The casing formed by the shell 58 of the check valve 43 has a sufficient volume to permit the compressor piston 31 to operate through a number of strokes without the addition of more gas. The admission of gas to the casing is somewhat restricted by the limited clearance around the plunger 59 and this restricted flow gives the motor time to bring the compressor up to substantially full speed before sufficient pressure has been built up in the chamber 29 to operate the piston 48 and apply full load to the compressor.

In order to lubricate the compressor and the associated mechanism, I provide an oil pump comprising a piston 68 operating in a bore 69 parallel to the bore 30*a* in the cylinder 30. A body of oil 70 is maintained in the bottom of the casing 11 and a screened intake 71 of the oil pump opens below the level of this oil and communicates with the bore 69 through passages 72 and 73 on the intake stroke. During the exhaust stroke of the pump, oil is discharged from the bore 69 through a passage 74 into an annular groove 75 around the piston 31 and from there flows through passages 76 and 77 in trunnion 36 to an annular passage 78 in the bearing 38. From the passage 78 the oil flows through a passage 79 to the space 80 around the shaft 25 to lubricate the shaft bearings. In order to lubricate the piston 48, I provide a duct 81 leading from the space 80 around the shaft 25 to an annular passage 82 around the piston 48. During the operation of the compressor, oil will flow around the piston 48 and out of the cylinder 46 through the opening 50 into a cup 83 secured on top of the cylinder head 49 and provided with a baffle 84 to prevent oil from shooting out of the cup. It is evident that when oil passes through the several passages just mentioned, the bearing surfaces of the several moving parts will be lubricated thereby.

When the compressor is in operation the pulsations of the gas as it is discharged from the exhaust port 42 of the compressor cylinder will be muffled to a certain extent due to the fact that the chamber 29, as can be seen in Fig. 2, is divided by balancing wings 85 and 86 on the cylinder 30, there being in effect two chambers connected by restricted passages between the wings 85 and 86 and the walls of the chamber and the gas will flow back and forth in these passages with the pulsations of the compressor.

While this construction serves to muffle the pulsations in the compressor to a certain extent, there may still be pulsations in the gas discharged through the port **44**, into the passage **45**, the cylinder **46** and out through the port **47** into the casing **11**, and for this reason it is desirable to provide some device for damping any motion of the piston **48** which may result from these pulsations. It is for the purpose of damping the movements of the piston **48** that I provide the cup **83**, which is filled with oil which flows thereto from the cylinder **46** through the passage **50** during the operation of the compressor. It will be evident that any movement of the piston **48** will be transmitted to the oil at the top of the cylinder **46** and will produce a flow of the oil through the passage **50**. Since the passage **50** is relatively small, the passage of oil between the cup **83** and the cylinder **46** is restricted, and as a result movement of the piston **48** is damped. The buffer spring **67** is provided in order that the piston **48** may not hit the cylinder head **49** with a sudden impact especially should the oil not have completely filled the upper portion of the cylinder **46** when the piston **48** is forced upward.

In the operation of the refrigerating system shown, assuming the compressor to be stopped and the piston **48** to be in the position shown in Fig. 1, and the plunger **59** in its upper position closing the restricted portion **61** of the tube **57**, when the compressor is started it will begin to pump gas from the casing **58** into the chamber **29**. As the gas in the casing **58** is removed, more gas will flow thereto through the conduit **55** around the plunger **59** and through the passage **62**, the flow of this gas being restricted due to the limited clearance around the plunger **59**. As the pressure is increased in the chamber **29** it will gradually force the piston **48** upwardly in the cylinder **46**, and when sufficient pressure has been attained the needle valve **52** will close the orifice **51**. After the pressure in the casing **58** has been reduced by the compressor, the check valve plunger **59** will be pulled back in the tube **57** by the spring **60** and the compressor will receive gas from the evaporator through the suction tube **21**. The pressure within the chamber **29** will now be further increased and the piston **48** will be forced farther toward its upper position against the springs **53** and **67** and when sufficient pressure has been reached it will uncover the passage **47** and the compressor will thereafter discharge gas directly into the casing **11**. The time consumed in building up the required pressure to load the compressor is sufficient to permit the motor rotor **24** to come up to substantially full speed, and in this way excessive starting current is not required by the motor during starting. While the piston **48** is in its upper position oil will pass out from the annular passage **82** toward the top of cylinder **46** and will fill the bore **46** above the piston **48**. The oil will flow out through the passage **50**, fill the cup **83** and overflow therefrom and return to the body of oil **70** at the bottom of the casing **11**. Any movement of the piston **48** due to the pulsations of the gas discharged from the compressor into the passage **50** will be damped by the oil in the cylinder **46**. The gas compressed in the casing **11** will flow out through the connection **13**a into the condenser **13** where it will be cooled and condensed to a liquid which will flow into the flow controlling device **18**, which is provided with a float or other mechanism for regulating the flow of refrigerant through the conduit **20** and into the evaporator **17**. The condensed refrigerant will be admitted to the evaporator **17** in regulated quantities where it will be evaporated upon absorption of heat from the surrounding medium, such as freezing trays therein and the air in the interior of a refrigerator cabinet. Gas evaporated in the evaporator **17** will flow out therefrom through the conduit **21** and back to the compressor to complete the refrigerating cycle.

It will be apparent from the foregoing that I have provided a refrigerant compressor which may be easily constructed and which is provided with an unloader mechanism which is positive and reliable in operation.

While I have shown and described a specific embodiment of my invention in connection with a compression refrigerating system, I do not desire my invention to be limited to the particular embodiment shown and described and I intend in 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 Unit[illegible] States, is:

1. In a refrigerating machine, a casing, a refrigerant compressor arranged w[illegible]in said casing and having intake and discharge ports, means for providing communication between said intake port and the interior of said casing, means for providing communication between said discharge port and the interior of said casing, and means including a single piston arranged in both of said communicating means and responsive to the pressure of refrigerant discharged from said compressor for controlling the loading and unloading of said compressor.

2. A compressor including an oscillating cylinder having intake and discharge ports, means including a piston arranged in said cylinder for discharging compressed gas from said cylinder, a trunnion on said cylinder, a frame having a bearing supporting said trunnion and a bore in alignment with said bearing, and means including a piston arranged in the bore in said frame and controlled by the pressure of the gas discharged from said cylinder for controlling the unloading of said compressor.

3. A compressor including a cylinder having intake and discharge ports, a casing enclosing said compressor, said discharge port communicating with said casing, means including a valve for subjecting the intake port of said compressor to the pressure within said casing, means responsive to the speed of said compressor for preventing communication between the discharge port of said compressor and said casing, said last named means being actuated by the pressure of the gas discharged from said compressor.

4. A compressor including a frame having a closed chamber therein, a cylinder arranged in said chamber and having a discharge port communicating with said chamber, means for forcing gas into said chamber, means including an intake port for admitting gas to said cylinder, and means preventing the discharge of gas from said compressor and admitting compressed gas to said intake port when said compressor is operating below a predetermined speed for unloading said compressor.

5. A compressor including a frame having a closed chamber therein, a casing enclosing said compressor, a cylinder having intake and discharge ports and arranged in said chamber, said cylinder discharging into said chamber, means for discharging compressed gas from said chamber into said casing, and means responsive to the pressure of the gas in said chamber for establishing communication between said casing and the

intake port of said cylinder and for closing said discharge means to unload said compressor.

6. A compressor including a frame, a cylinder having intake and discharge ports arranged in said frame, a casing enclosing said compressor, a piston in said cylinder, said cylinder discharging into said casing, and means responsive to the pressure of the gas at the discharge port of said cylinder for admitting gas from said casing to the intake port of said cylinder and for preventing the discharge of gas from said cylinder to said casing for unloading said compressor.

7. A compressor including a frame, a cylinder having intake and discharge ports and arranged in said frame, a casing enclosing said compressor, a piston in said cylinder, said cylinder discharging compressed refrigerant into said casing, means including a second piston arranged in said frame and responsive to a predetermined pressure of the refrigerant at the discharge port of said cylinder for substantially equalizing the pressure at the intake and discharge ports of said cylinder to unload said compressor, and means for damping motion of said second piston during operation of said compressor.

8. A compressor including a frame, a cylinder having intake and discharge ports and arranged in said frame, a casing enclosing said compressor, said cylinder discharging refrigerant into said casing, means including a piston responsive to a predetermined pressure of refrigerant at the discharge port of said cylinder for admitting refrigerant from said casing to the intake port of said cylinder and for preventing communication between said casing and the discharge port of said cylinder to unload said compressor, means for supplying lubricant under pressure for lubricating said compressor, and means utilizing lubricant supplied to said compressor for damping motion of said piston.

9. A compressor including a frame, a cylinder having intake and discharge ports and arranged in said frame, a casing enclosing said compressor, said cylinder discharging gas into said casing, means including a piston arranged in said frame and movable between an upper and a lower position for unloading said compressor, means for supplying oil under pressure to said compressor for lubricating said compressor, and means utilizing a portion of the oil supplied to said compressor for damping motion of said piston when said piston is near the upper position thereof.

10. A compressor including a frame, a cylinder having intake and discharge ports and arranged in said frame, a casing enclosing said compressor, said cylinder discharging gas into said casing, means including a second cylinder arranged in said frame and a piston movable between an upper and a lower position in said second cylinder for loading and unloading said compressor, means for supplying oil under pressure to said second cylinder, and means utilizing the oil supplied to said second cylinder for damping motion of said piston.

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