April 10, 1956 C. E. PLOEGER 2,741,424

REFRIGERATION

Filed June 22, 1951

Fig. 1.

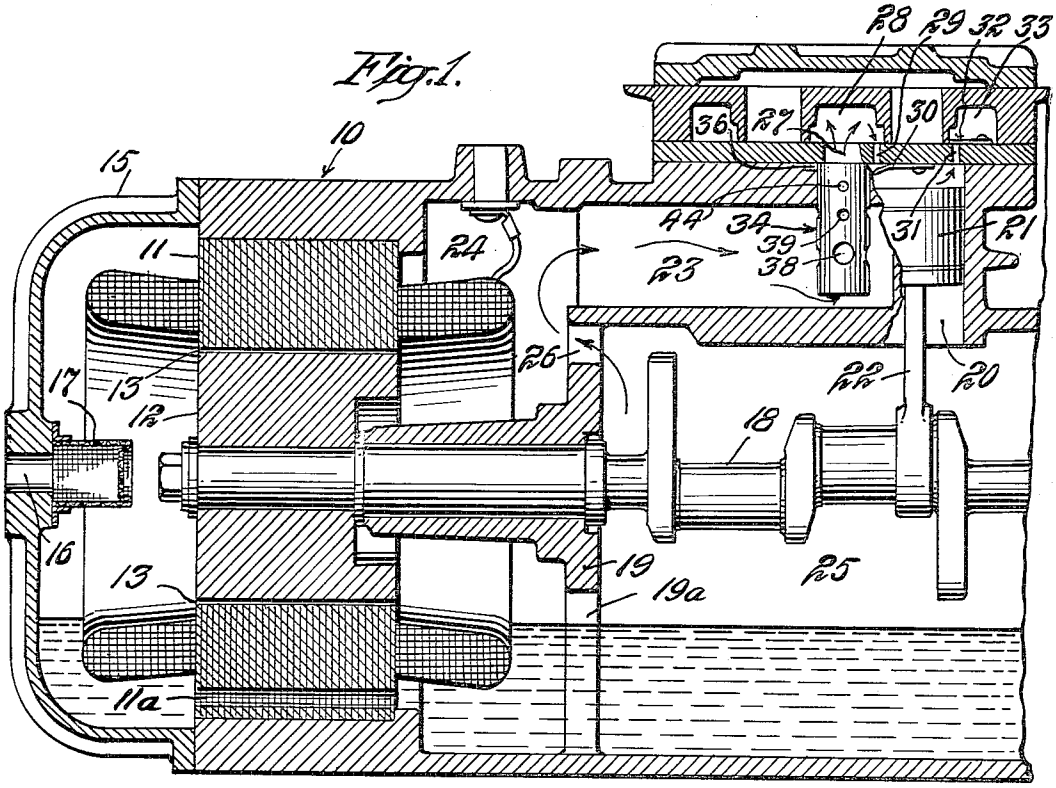


Fig. 2.

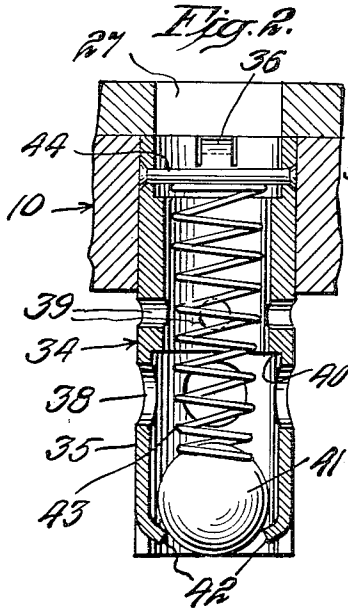
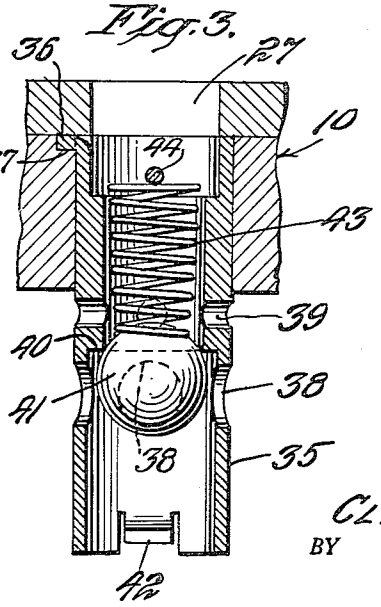


Fig. 3.



INVENTOR.
CLYDE E. PLOEGER
BY
J. L. Kelly
ATTORNEY

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REFRIGERATION

Clyde Edward Ploeger, Evansville, Ind., assignor to Servel, Inc., New York, N. Y., a corporation of Delaware

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3 Claims. (Cl. 230—206)

This invention relates to refrigeration and particularly to means for preventing slugs of oil or liquid refrigerant from entering the cylinders of a refrigerant compressor.

In hermetically sealed motor compressor units, wherein the suction gas enters the compressor through the motor compartment, or wherein the suction gas line is connected to the motor compartment, the problem of oil slugging is one of considerable importance.

In this type of unit, during shutdown periods, refrigerant vapor may condense in the crankcase of the compressor and in the motor compartment, thereby raising the oil level in these parts considerably higher than normally intended. Then, when the compressor is started, the entrained liquid refrigerant may cause violent boiling in the oil. This boiling may be to such an extent that the mixture may even foam up and enter the inlet ports of the cylinder as solid liquid. When this occurs, the cylinder is filled with liquid refrigerant and oil in amounts such that severe hammering occurs which may in turn break the suction valves and the connecting rods, or otherwise damage the compressor; unless steps are taken to throttle the passage of this liquid so that the liquid refrigerant and oil is fed to the cylinders in small amounts.

The present invention contemplates a device for protecting the valves and other moving parts of a refrigerant compressor by throttling the passage of liquid refrigerant and oil to the cylinders each time the compressor is started.

Specifically, I provide a check valve in the suction chamber leading to the intake manifold of the compressor. One end of this suction chamber is in open communication with the crankcase and with the motor compartment. The opposite end of this suction chamber is in communication, through the check valve, with the intake manifold of the compressor. The valve is provided with two sets of ports for parallel flow of refrigerant vapor to the intake manifold and when the compressor is operating normally, that is, when only relatively dry refrigerant vapor is flowing thereto, both sets of ports are open. However, when oil and liquid refrigerant in sufficient concentration try to pass through the ports, this relatively dense oil and vapor mixture causes the valve to close one set of ports, thus restricting the flow to the other set of ports. The amount of oil and vapor mixture that is permitted to pass through the single set of ports is not sufficient to damage the compressor valves or other moving parts. As soon as this liquid refrigerant is removed from the oil in the crankcase by evaporation, the valve resumes its normal position and dry refrigerant gas again flows through both sets of ports to the intake manifold.

The invention, together with the above and other objects and advantages, will be more fully understood by reference to the following description taken in connection with the accompanying drawings, wherein:

Fig. 1 is a longitudinal section of a portion of a motor compressor unit incorporating my invention;

Fig. 2 is a vertical section through my improved check valve, showing the valve in open position; and

Fig. 3 is a section similar to Fig. 2 but taken at an angle of 90° thereto and showing the valve in closed position.

Referring to the drawing, an hermetically sealed casing **10** encloses a motor compressor unit adapted for use in a refrigerating system. Only so much of the unit as is necessary for complete understanding of the invention is illustrated in the drawing. As shown, an electric induction motor comprising a stator **11** and a rotor **12** having an air gap **13** therebetween is arranged within the casing **10**. The stator may be secured within the casing in any suitable manner as by a shrink fit. The casing is provided with a removable head **15** having an opening **16** therein, which opening is connected by a suitable conduit, not shown, to the suction side of the expander or evaporator of the refrigerating system in which the unit is connected. A fine mesh strainer **17** is located at the outlet of the opening **16**.

The compressor includes a crankshaft **18** attached to the rotor **12** and journaled at one end in a support **19**. The opposite end of the crankshaft is supported in a suitable manner, not shown, within the opposite end of the casing **10**. The compressor is of the multiple cylinder type, only one such cylinder, **20**, being shown and described. A piston **21** is arranged within the cylinder **20** and is connected to the crankshaft **18** by a connecting rod **22**. The casing **10** is formed with a suction chamber **23** opening at one end into a motor compartment **24**. The motor compartment is in open communication with a crankcase **25** by means of openings **26** provided in the upper portion of the support **19**. A passageway **27** leads from the suction chamber **23** into an intake manifold **28**. A port **29** provided with a suction valve **30** leads from the intake manifold into the cylinder **20** and an exhaust port **31** provided with an exhaust valve **32** leads from the cylinder **20** to an exhaust manifold **33**. The exhaust manifold is connected by a suitable conduit, not shown, to the condenser of the refrigerating system in which the motor compressor unit is used. So, as to provide for flow of oil and liquid refrigerant between the motor compartment **24** and the crankcase **25**, the stator **11** is provided with an opening **11a** in the lower portion thereof and the support **19** is provided with an opening **19a** in its lower portion. The above described compressor is of a more or less conventional type and is merely one illustration of a type of compressor in which my invention may be incorporated.

In accordance with my invention, the passageway **27** that leads from the suction chamber **23** into the intake manifold **28** is provided with a check valve, indicated generally by reference numeral **34**. This check valve includes a tube **35** provided with a flange **36** adapted to fit within a notch **37** in the casing **10** for holding the tube in position. The tube **35** is provided with two sets of ports or openings **38** and **39**. As shown, the ports **38** are much larger than the ports **39**. Within the tube **35**, and between the ports **38** and **39**, a valve seat **40** is formed. A buoyant check ball **41** is located within the tube **35** and is retained therein by flanged portions **42** at the lower end of the tube. A compression spring **43**, having its lower end in contact with the check ball **41** and its upper end in contact with a retaining pin **44**, urges the check ball away from the valve seat **40** and toward the lower end of the tube **35**.

In operation, assuming that the suction line of a refrigerating system is connected to the inlet opening **16** leading to the motor compartment **24** and that the exhaust manifold **33** is connected to the condenser of such refrigerating system, refrigerant gas is drawn from the suction line into the motor compartment, through the gap **13** between the stator and rotor and into the suction chamber **23**.

Assuming also that the compressor has been running

for a period of time such that the refrigerant gas drawn into the suction chamber **23** is relatively dry, under these conditions of operation, the check ball **41** will be in the lower portion of the tube **35** and refrigerant gas will pass from the suction chamber **23** through both sets of ports **38** and **39**, through the passageway **27** and into the intake manifold **28**. From the intake manifold the refrigerant gas passes through the port **29** and the suction valve **30** into the cylinder **20**, wherein the gas is compressed and discharged through the port **31** and the exhaust valve **32** into the exhaust manifold **33**.

Assuming now that the compressor has been standing idle for a period of time and that refrigerant vapor has condensed and collected in the crankcase **25** and in the motor compartment **24**, under these conditions, when the compressor is later put in operation, the liquid refrigerant collected in the crankcase and in the motor compartment may cause violent boiling in the oil and foam may enter the suction chamber **23** and flow into the valve tube **35**. However, due to the fact that the density of this oil and refrigerant foam is much greater than that of dry refrigerant gas, the check ball **41** will be buoyed or lifted from the lower end of the tube **35** and moved into engagement with the valve seat **40**, thereby cutting off the flow of the mixture of oil and refrigerant vapor through the ports **38**. With the check valve closed, oil and liquid refrigerant, in amounts too small to cause damage to the compressor, will continue to flow through the ports **39**. After a short period of time all of the liquid refrigerant in the crankcase and in the motor compartment will have evaporated, foaming will stop and only relatively dry refrigerant gas will pass from the suction chamber **23**, through the check valve **34** and into the intake manifold **28**. Then the spring **43** will move the check ball **41** away from the valve seat **40** and into the lower part of the tube **35** and the refrigerant gas will again pass from the suction chamber **23** through both sets of ports **38** and **39** into the intake manifold **28**.

Although but one specific form of my invention has been illustrated and described and this specific form has been incorporated in a motor compressor unit of a refrigerating system of the compressor-condenser-expander type, my invention obviously may take other forms and be variously applied. The invention is therefore limited only as defined in the claims.

I claim:

1. A compressor having a crankcase containing a quantity of oil and at times a quantity of liquid refrigerant, said compressor including a cylinder, a piston within said cylinder, means for reciprocating said piston, inlet and outlet valves leading to and from said cylinder, means forming suction and exhaust chambers connected to and leading to and from said cylinder, said suction chamber also being in open communication with said crankcase for flow of refrigerant vapor and entrained oil from the crankcase to said cylinder, and means in said suction chamber operable responsive to the density of the mixture of refrigerant vapor and oil passing therethrough for automatically throttling the flow of such fluid.

2. A compressor having a crankcase containing a quantity of oil and at times containing a quantity of liquid refrigerant, said compressor including a cylinder, a piston within said cylinder, means for reciprocating said piston, inlet and outlet valves leading to and from said cylinder, means forming suction and exhaust chambers connected to and leading to and from said cylinder, said suction chamber also being in open communication with said crankcase for flow of refrigerant vapor and entrained oil from the crankcase to said cylinder, means in said suction chamber providing parallel paths of flow of fluid between said crankcase and said cylinder, and means in at least one of said paths of flow operable responsive to the density of fluid flowing through said suction chamber for throttling the flow of fluid to said cylinder.

3. A compressor having a crankcase containing a quantity of oil and at times containing a quantity of liquid refrigerant, said compressor including a cylinder, a piston within said cylinder, means for reciprocating said piston, inlet and outlet valves leading to and from said cylinder, means forming suction and exhaust chambers connected to and leading to and from said cylinder, said suction chamber also being in open communication with said crankcase for flow of refrigerant vapor and entrained oil from the crankcase to the cylinder, a valve in said suction chamber, said valve having a plurality of ports, and means for closing certain of said ports while leaving others of said ports open, said last named means being operable responsive to the density of fluid passing through said valve.

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