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LUBRICANT SEPARATOR FOR FLUID COMPRESSING AND CONDENSING APPARATUS

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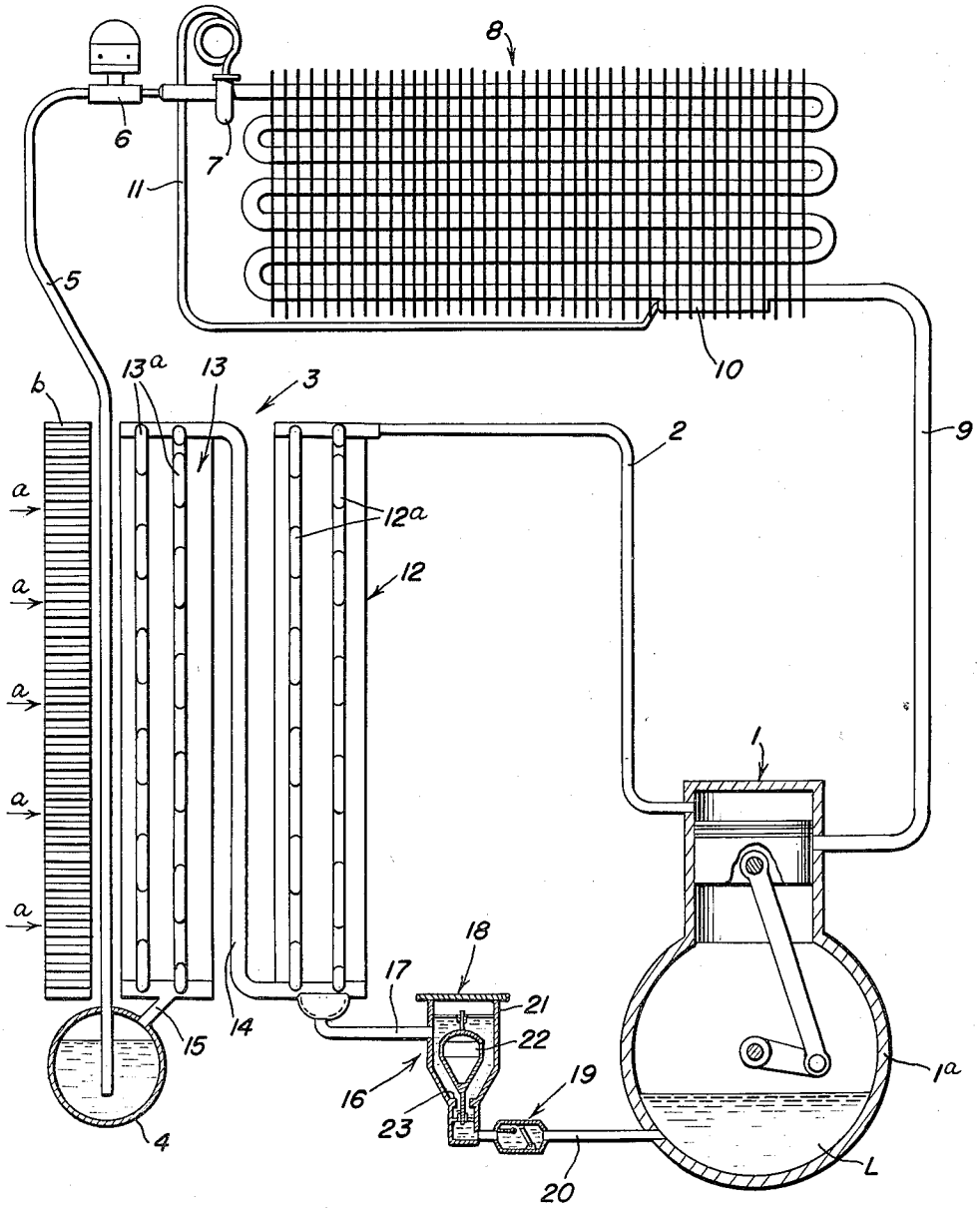

INVENTOR

THOMAS W. CARRAWAY

BY Baldwin & Wight

ATTORNEYS

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LUBRICANT SEPARATOR FOR FLUID COMPRESSING AND CONDENSING APPARATUS

Thomas W. Carraway, Dallas, Tex.

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2 Claims. (Cl. 62—192)

This invention relates to lubricant separators for fluid compressing and condensing apparatus.

Apparatus of this class, for example refrigerant circuit apparatus of the compression-expansion kind, customarily includes mechanically operated compressing means, for example a reciprocating or rotary compressor which, itself, requires lubrication. Almost inevitably, the lubricating oil finds its way into the circulating refrigerating medium and this, in some cases, results in accumulation of oil sludge inside the pipes, valves, and evaporator, in turn lowering the overall operation efficiency. Various efforts have previously been made for overcoming these difficulties, as by separating the lubricating oil from the circulating refrigerant, but these prior efforts have not had complete success.

An object of this invention is to provide an improved fluid compressing and condensing apparatus having lubricant separating means so related to the other parts of the apparatus as to achieve improved lubricant separation.

A further object of the invention is to provide apparatus of the character referred to which also improves the operation of the condenser with resultant increase in thermal efficiency, over and above the advantages of the more effective lubricant separation. Otherwise stated, the invention results in improved and more efficient condensing operation than heretofore was possible.

A preferred embodiment of the invention is illustrated in the drawing, the single figure of which is a schematic view of a fluid compressing and condensing apparatus embodying the invention. But for the means for separating oil or lubricant from compressed fluid and the correlation of the separating means to other parts of the apparatus, the illustrated construction is largely conventional. A compressor generally designated 1 and, in the form shown, being of the reciprocating type and provided with suitable intake and discharge valves, not shown, is arranged to deliver compressed fluid, for example a refrigerating medium, through a condenser intake conduit 2 to a condenser structure 3. Compressed fluid flowing along or through a closed path provided by the condenser structure 3 passes from the condenser outlet to a liquid receiver 4 from which it flows through a conduit 5 to a control valve 6, for example an automatically operable solenoid valve. When the valve 6 is open, liquid refrigerant flows through an expansion valve 7 and into an evaporator 8 in which the liquid is evaporated for effecting desired cooling of the surrounding medium. Evaporated liquid then passes through a compressor intake conduit 9 to the intake side of the compressor 1. The expansion valve 7 may be controlled conventionally, as for example by means including a bulb or the like 10 in heat transferring relation to the evaporator 8 and containing expansible fluid adapted to act through a tube 11 and on the expansion valve 7 for effecting opening and closing of the latter. The compressor 1 includes means, in the form shown a crank

case 1^a, for containing oil indicated at L for lubricating the moving parts of the compressor.

In accordance with the invention, lubricant or oil from the supply of lubricant L in the compressor crank case which finds its way into the refrigerant or compressed fluid circuit is separated from the refrigerant at a particular region in the refrigerant circuit and is returned to the lubricant containing means 1^a in a particularly effective manner. The refrigerant mixed with or entrained in the circulating refrigerant is separated from the latter after it has been cooled in the condenser 3, and preferably is separated at a region intermediate the entrance of the refrigerant to and its exit from the condenser structure. For accomplishing this, the preferred embodiment of the invention has its condenser structure 3 constituted by a primary heat exchanger condenser section 12 and a secondary heat exchanger condenser section 13 communicating with each other in series by an intermediate unobstructed free flow conduit 14 leading from the bottom of the primary condenser section 12 to the top of the secondary condenser section 13. Compressed fluid is delivered initially to the top of the primary condenser 12 and flows downwardly through this section to be partially cooled and condensed, and is then delivered to the top of the secondary condenser 13 and flows downwardly therethrough to be cooled further and condensed and then delivered through a discharge pipe 15 into the liquid receiver 4.

Means, not shown but which may be of any conventional form, are provided for causing a single stream of coolant such as air to flow in the direction of the arrows *a* in the drawing through a filter *b* and then firstly in contact with the secondary condenser coils 13^a and finally in contact with the primary condenser coils 12^a. The arrangement is such that the coolant flows in contact with the secondary and primary condensers 13 and 12 in series, the secondary condenser being upstream relatively to the primary condenser.

By virtue of the condenser sections being positioned adjacent to one another with the secondary section being upstream with respect to the primary section, the primary section serves two important purposes, namely that of initially cooling the compressed liquid delivered through the conduit 2 and also, by such cooling, enhancing the separation of oil from the refrigerant fluid and permitting the separated oil to be collected at the bottom of the primary section to be removed from the refrigerant circuit by apparatus presently to be described. The compressed fluid from which the lubricant has been separated is then passed through the secondary condenser section and, being substantially completely freed of lubricant, is more effectively and economically cooled in flowing through the secondary condenser section 13. In addition to improving the effectiveness and economy of cooling the compressed fluid, the separation of lubricant from the fluid circuit minimizes the formation of oil sludge on the insides of the parts comprising the refrigerant circuit, particularly the valves 6 and 7, the evaporator 8, and the connecting conduits.

Oil or lubricant separated from the compressed fluid by passage through the primary condenser section 12 in the manner stated above, and collected at an intermediate region of the compressed fluid flow path, is returned to the oil containing means 1^a by way of a conduit means generally designated 16 tap connected to the lower part of the conduit 14 so as to extend from the oil accumulation or collection region at the bottom of the primary condenser 12 to the oil containing means 1^a. In most instances, the fluid pressure at the oil collecting region is sufficiently greater than the pressure of the lubricant L in the container 1^a to provide for returning of the

collected lubricant to the container 1a without permitting reverse flow of lubricant from the container 1a back to the condenser structure. Nevertheless, it is preferred to insure that lubricant may flow through the conduit means 16 only from the condenser structure to the lubricant container 1a and never reversely, and it furthermore is desirable to prevent flowing of compressed fluid or refrigerant from the condenser structure through the conduit means 16 to the lubricant containing means 1a. Accordingly, valve means responsive to accumulation of a predetermined quantity of separated lubricant in the collection region between the primary and secondary condensers is interposed in the conduit means 16 for enabling collected separated lubricant to flow to the lubricant containing means 1a, the valve means, however, preventing flow through the conduit means 16 when no separated lubricant or insufficient separated lubricant has been collected. The valve means shown includes a float valve 18 connected to the condenser section 12 by a pipe 17 and a check valve 19 connected to the lubricant container by a pipe 20. The check valve 19 is adapted to permit flow only from the lubricant collection region to the lubricant containing means 1a.

The float valve 18 includes a casing 21 and a movable float valve element 22 cooperable with a seat 23 for closing the conduit means 16 when insufficient separated lubricant has accumulated at the collection region, but which is openable automatically in response to rising of the liquid level in the casing 21 when a predetermined quantity of separated lubricant has accumulated for permitting the separated lubricant to flow to the lubricant containing means 1a.

In the form shown, the lubricant container 1a and the lubricant return conduit means 16 are so related in elevation or level to the collection region at the bottom of the primary condenser 12 that separated lubricant may flow by gravity to the container 1a. It is not, however, necessary that parts be so related as to provide for gravity flow since normally the pressure superimposed upon the collected separated lubricant by the pressure in the condenser structure is sufficient to force the lubricant from the collection region to the container 1a irrespective of the level or elevation of the latter, of course within reasonable limits.

The construction disclosed embodies the invention in a preferred form but it is intended that the disclosure be illustrative rather than definitive, the invention being defined in the claims.

I claim:

1. In a fluid compressing and condensing apparatus, a compressor having means for containing lubricant for the compressor; a condenser structure having an inlet and and outlet and comprising a heat exchanger providing a closed path along which fluid compressed by said compressor may flow and presenting a surface contactable by a single flowing stream of fluid cooling medium; lubricant return conduit means providing communication between said lubricant containing means and said heat exchanger fluid path at a point intermediate the condenser structure inlet and outlet in a region of said path at which compressed fluid has flowed along said path; a float valve in said lubricant return conduit means openable in response to rising of the level at said path region of lubricant separated from said compressed fluid during flowing of the latter along said path for enabling lubricant accumulated at said path region to flow through said return conduit means to said lubricant containing means; and a check valve in said lubricant return conduit means permitting flow of the separated lubricant from said path region to said lubricant containing means and preventing reverse flow through said lubricant return conduit means.

2. In a fluid compressing and condensing apparatus, a compressor having means for containing lubricant for the compressor; a condenser structure comprising a primary condenser section and a secondary condenser section; a condenser intake conduit connecting the discharge side of the compressor to the intake of said primary condenser section; an intermediate conduit connecting the outlet of said primary condenser section to the inlet of said secondary condenser structure, said primary and secondary condenser sections and said intermediate conduit together providing a closed path along which fluid compressed by said compressor may flow and presenting surfaces contactable by a fluid cooling medium; lubricant return conduit means providing communication between said lubricant containing means and said path at a region thereof between said primary and secondary condenser sections; a float valve in said lubricant return conduit means openable in response to rising of the level at said path region of lubricant separated from said compressed fluid during flowing of the latter through said primary condenser section for enabling lubricant accumulated at said path region to flow through said return conduit means to said lubricant containing means; and a check valve in said lubricant return conduit means permitting flow of the separated lubricant from said path region to said lubricant containing means and preventing reverse flow through said lubricant return conduit means.

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