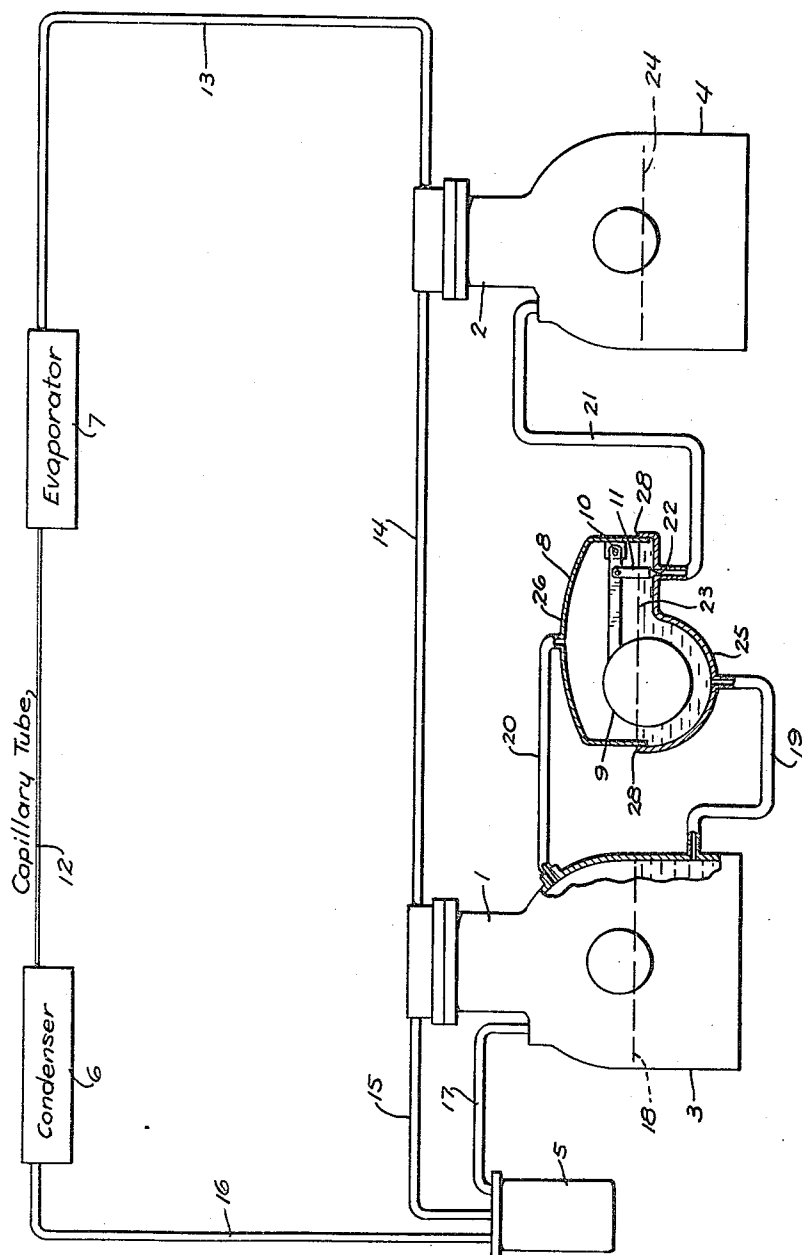


July 21, 1953

E. P. KELLIE  
OIL LEVEL EQUALIZING DEVICE FOR MULTIPLE  
COMPRESSOR ARRANGEMENT  
Filed Nov. 30, 1950

2,646,212



INVENTOR.  
Edward P. Kellie  
BY  
Barnes, Kisselle, Laughlin & Reisch  
Attorneys.

## UNITED STATES PATENT OFFICE

2,646,212

## OIL LEVEL EQUALIZING DEVICE FOR MULTIPLE COMPRESSOR ARRANGEMENT

Edward P. Kellie, Detroit, Mich.

Application November 30, 1950, Serial No. 198,447

5 Claims. (Cl. 230—206)

1

This invention relates to an oil level equalizing device for multiple compressor arrangement.

In a mechanical refrigeration system lubrication of all the mechanical parts is necessary. Lubricating oil is circulated through the compressor and valves. In low temperature refrigeration systems where the refrigerant is compressed in two or more stages, it is an established fact that all the oil will tend to migrate into the crankcase of one compressor.

It is an object of this invention to produce an oil level equalizing device which will tend to maintain equal the oil levels in the crankcases of a multiple compressor system irrespective of whether the compressors are located at the same or different levels and irrespective of whether the gaseous pressure in the crankcases of the compressors are equal or different.

The drawing is a schematic showing of a low temperature multiple compressor refrigerating system provided with the oil level equalizing device, which is the subject of the instant invention.

Referring more particularly to the drawing there is shown a mechanical refrigeration system comprising the following elements: reciprocating piston type compressors 1 and 2 provided with crankcases 3 and 4, oil separator 5, condenser 6, evaporator 7, float valve housing 8, float 9 pivoted as at 10 within housing 8, valve 11, a metering device such as capillary or restrictor tube 12 between condenser 6 and evaporator 7.

The low stage suction line or tube 13 connects the evaporator 7 with the intake port of compressor 4. The low stage compression discharge line or tube 14 connects the outlet port of compressor 4 with the suction or intake port of the high stage compressor 1. High stage compression discharge line 15 connects the exhaust port of compressor 1 with the oil separator 5 wherein the lubricating oil is separated from the compressed refrigerant in a well known manner. The use of oil separator 5 is preferred but optional. Tube or line 16 conducts the highly compressed gaseous refrigerant from the oil separator to the condenser. The oil which is separated from the gaseous refrigerant in separator 5 returns from the separator 5 through pipe line or tube 17 to the crankcase of high stage compressor 1. The oil level in crankcase 3 is indicated by the dotted line 18. The crankcase 3 is connected by tube or pipe line 19 with housing 8. Pipe line 20 connects crankcase 3 with valve housing 8 above the oil levels in crankcase 3 and housing 8. Line 19 communicates with crankcase 3 below oil level

2

18. The use of line 20 is optional but is preferred because it maintains equal the gaseous pressure in crankcase 3 and housing 8. Pipe line or tube 21 connects the crank case 4 with port 22 in housing 8. Port 22 is preferably located in the bottom of housing 8 but in any event below the oil level 23 in housing 8. The oil level in crankcase 4 is indicated by the dotted line 24.

The instant oil level equalizing device is shown incorporated in a multiple stage refrigeration system only for purposes of description and not by way of limitation. The instant oil level equalizing device can be used in any multiple compressor system.

The operation of the multiple stage low temperature refrigeration system is conventional and will only be described briefly. The gas entering compressor 2 through the low stage suction line is compressed and discharged through line 14 into high stage compressor 1 where this refrigerant is compressed to a higher pressure and then discharged through line 15 into oil separator 5 where the oil is separated from the gaseous refrigerant. The compressed gaseous refrigerant passes along line 16 into condenser 6 where it is cooled and condensed to a liquid state. The liquid refrigerant passes through capillary or restrictor tube 12 to evaporator 7 where it evaporates and takes up heat in a well known manner to effect refrigeration.

As shown, compressors 1 and 2 are positioned at the same level but it is understood that either of compressors 1 and 2 can be positioned on a higher level than the other. The entire system is a closed system and the crankcases 3 and 4 and the valve housing 8 are pressure and vacuum tight. The float valve arrangement shown will maintain the oil in the crankcase housings 3 and 4 of the compressors equal or at the same level, 18 and 24, even though the crankcases 3 and 4 are operating at different pressures and even though the compressors are located at different levels.

Valve housing 8 is preferably made in two sections 25 and 26, the upper section 26 being telescoped within section 25. The junction line 23 on the outside of housings 25 and 26 serves as a calibration indicating the level 23 at which float valve 11 will open. If the pressure in crankcase 3 is higher than that in crankcase 4 (irrespective of whether crankcase 3 is positioned at a higher or lower level than crankcase 4), then calibrated opening line 21 should be positioned in the horizontal plane of the correct oil level 18 which it is desired to maintain in crankcase

3

3. If the gaseous pressures in crankcases 3 and 4 are the same but crankcase 4 is positioned at a higher level than crankcase 3, then the calibrated opening point or line 28 should be positioned in the horizontal plane of the oil level of the higher located crankcase 4.

In the operation of the above system any oil returning to compressor 2 with the gaseous refrigerant through line 13 will or may be in part retained in compressor crankcase 4 and in part discharged with the low stage compressed gas through line 14 into compressor 1. If desired, in accord with conventional practice, crankcase 4 will be ported to suction line 13 and maintained at the same pressure as suction line 13 and crankcase 3 will be ported to suction line 14 and maintained at the same pressure as suction line 14. Also any oil removed from the crankcase 4 of compressor 2 will be discharged to compressor 1. The oil discharged from compressor 1 through line 15 will be separated in separator 5 and returned to crankcase 3 through line 17.

The return of oil through line 17 to crankcase 3 tends to raise the oil level 18 in this crankcase. Since the oil in housing 8 and crankcase 3 is under the same pressure, it will flow from crankcase 3 into housing 8 tending to make the oil levels in housing 8 and crankcase 3 equal. As the oil returns to crankcase 3 through line 17 and raises oil level 18 it raises the oil level 23 in housing 8 a like amount until level 23 has raised to the point at which float 9 opens needle valve 11 so that oil can now flow from housing 8 through line 21 into crankcase 4. When the oil ceases to flow from the separator 5 into crankcase 4, the oil level stabilizes at its proper point and the float 9 closes needle valve 11 thereby preventing further flow of oil through line 21 to crankcase 4 and this closing of valve 11 isolates crankcase 4 from crankcase 3. In this way the pressure in crankcase 3 can be maintained at a higher pressure than that in crankcase 4.

From the above it is evident that the instant compressor oil equalizing valve arrangement 3, 9, 10, 11 will prevent the migration of all the oil into one compressor and at the same time permit a difference in pressures in the different crankcases.

In installing the oil level equalizing valve arrangement, which is the subject of this invention, it is only necessary to connect this equalizing valve arrangement into the system as indicated and to mount the valve arrangement so that the opening level indicating line 28 is on the same level as the correct oil level in the crankcase to which the inlet side of the housing 8 is connected by line 19, then the correct amount of oil is poured into each crankcase. Thereafter, during the operation of the compressors, oil leaving any crankcase will be automatically returned in like amount to that crankcase to maintain all the compressor crankcases at their proper level.

I claim:

1. In combination at least two compressors for compressing gas in multiple stages, a fluid conducting line connecting the discharge outlet of the lower stage compressor in series with the intake port of the higher stage compressor so that the fluid compressed in the lower stage compressor is charged into the higher stage compressor, each compressor having a reservoir for liquid lubricant, a housing, a liquid conducting

4

line between said housing and the reservoir of said higher stage compressor, a liquid conducting line between said housing and the reservoir of the low stage compressor, said first mentioned liquid line being open whereby the liquid lubricant levels in the reservoir of the higher stage compressor and the housing will equalize, a valve controlling the flow of liquid lubricant from said housing to the reservoir of the lower stage compressor, and means responsive to the liquid level in said housing for opening said valve when the liquid level in said housing rises above a desired normal liquid level in the reservoir of the higher stage compressor whereby the lubricating liquid flows from said housing into the reservoir of the lower stage compressor and the liquid in said reservoirs is maintained at desired levels.

2. The combination claimed in claim 1 including a separator, a fluid line connecting the discharge port of the higher stage compressor with the separator whereby the liquid lubricant is separated from the compressed gas, and a fluid conducting line connecting said separator with the said reservoir of the higher stage compressor for returning the liquid lubricant from the separator to said last mentioned reservoir.

3. The combination claimed in claim 2 wherein the reservoir of the higher stage compressor is maintained at a pressure higher than the reservoir of the lower stage compressor.

4. In combination at least two compressors for compressing gas in multiple stages, a fluid conducting line connecting the discharge outlet of the lower stage compressor in series with the intake port of the higher stage compressor so that the fluid compressed in the lower stage compressor is charged into the higher stage compressor, each compressor having a reservoir for liquid lubricant, a housing, a liquid conducting line between the lower portion of said housing and the lower portion of the reservoir of said higher stage compressor, a fluid conducting line connecting the upper portion of said housing with the upper portion of the reservoir of said higher stage compressor whereby the gaseous pressures in said housing and reservoir are equalized, a liquid conducting line between said housing and the reservoir of the low stage compressor, said liquid conducting line between said housing and the reservoir of said higher stage compressor being open and said housing being disposed generally at the same level as the reservoir of said higher stage compressor whereby the liquid lubricant levels in said last mentioned reservoir and the housing will equalize, a valve controlling the flow of liquid lubricant from said housing to the reservoir of the lower stage compressor, and means responsive to the liquid level in said housing for opening said valve when the liquid level in said housing rises above a desired normal liquid level in the reservoir of the higher stage compressor whereby the lubricating liquid flows from said housing into said reservoir of the lower stage compressor and the liquid in said reservoirs is maintained at desired levels.

5. In combination, at least two compressors for compressing gas in multiple stages, a fluid conducting line connecting the discharge outlet of the lower stage compressor with the intake port of the higher stage compressor, each compressor having a reservoir for liquid lubricant, the reservoir for the higher stage compressor being maintained at a higher pressure than the reservoir for the lower stage compressor, a housing, a liquid conducting line connecting the lower

5

portion of said housing with the lower portion of the reservoir of said higher stage compressor, a fluid conducting line connecting the upper portion of the housing with the upper portion of the reservoir of the higher stage compressor whereby the gaseous pressures in said housing and said last mentioned reservoir are equalized, said housing being disposed at substantially the same level as said last mentioned reservoir and the liquid conducting line between said housing and said last mentioned reservoir being open whereby the liquid lubricant levels in said housing and said last mentioned reservoir will equalize, a liquid conducting line connecting said housing with the reservoir of the lower stage compressor, a valve for controlling the flow through said last mentioned liquid conducting line, means responsive to the liquid level in said

6

housing for closing said valve when the level of the liquid in the reservoir in the higher stage compressor is at or below a desired normal level, and means in circuit with said higher stage compressor for separating the lubricant in the fluid discharged from said higher stage compressor, said last mentioned means being connected with the reservoir of the higher stage compressor for returning the separated lubricant to the reservoir of the higher stage compressor.

EDWARD P. KELLIE.

## References Cited in the file of this patent

## UNITED STATES PATENTS

| Number    | Name  | Date          |
|-----------|-------|---------------|
| 2,178,100 | Gygax | Oct. 31, 1939 |