

Nov. 23, 1971

R. W. KINNEY

3,621,670

LUBRICATING OIL EQUALIZING SYSTEM

Filed Jan. 12, 1970

4 Sheets-Sheet 1

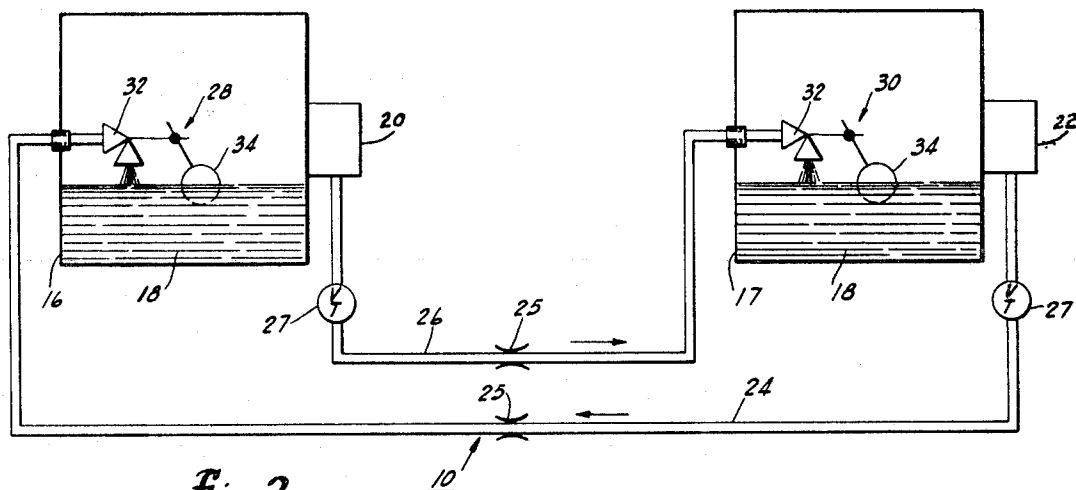


Fig. 2

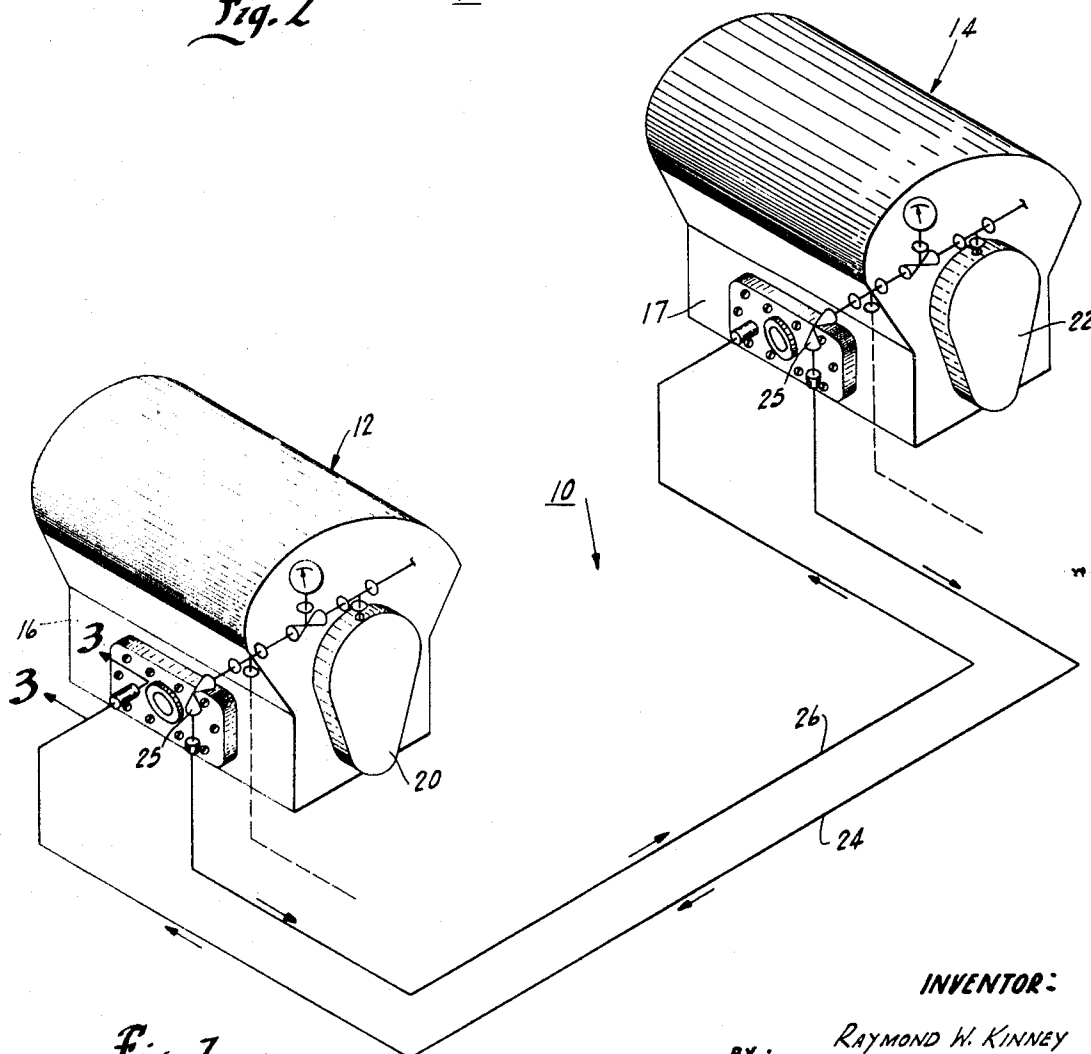


Fig. 1

INVENTOR:

BY: *James E. Nilles*
ATTORNEY

Nov. 23, 1971

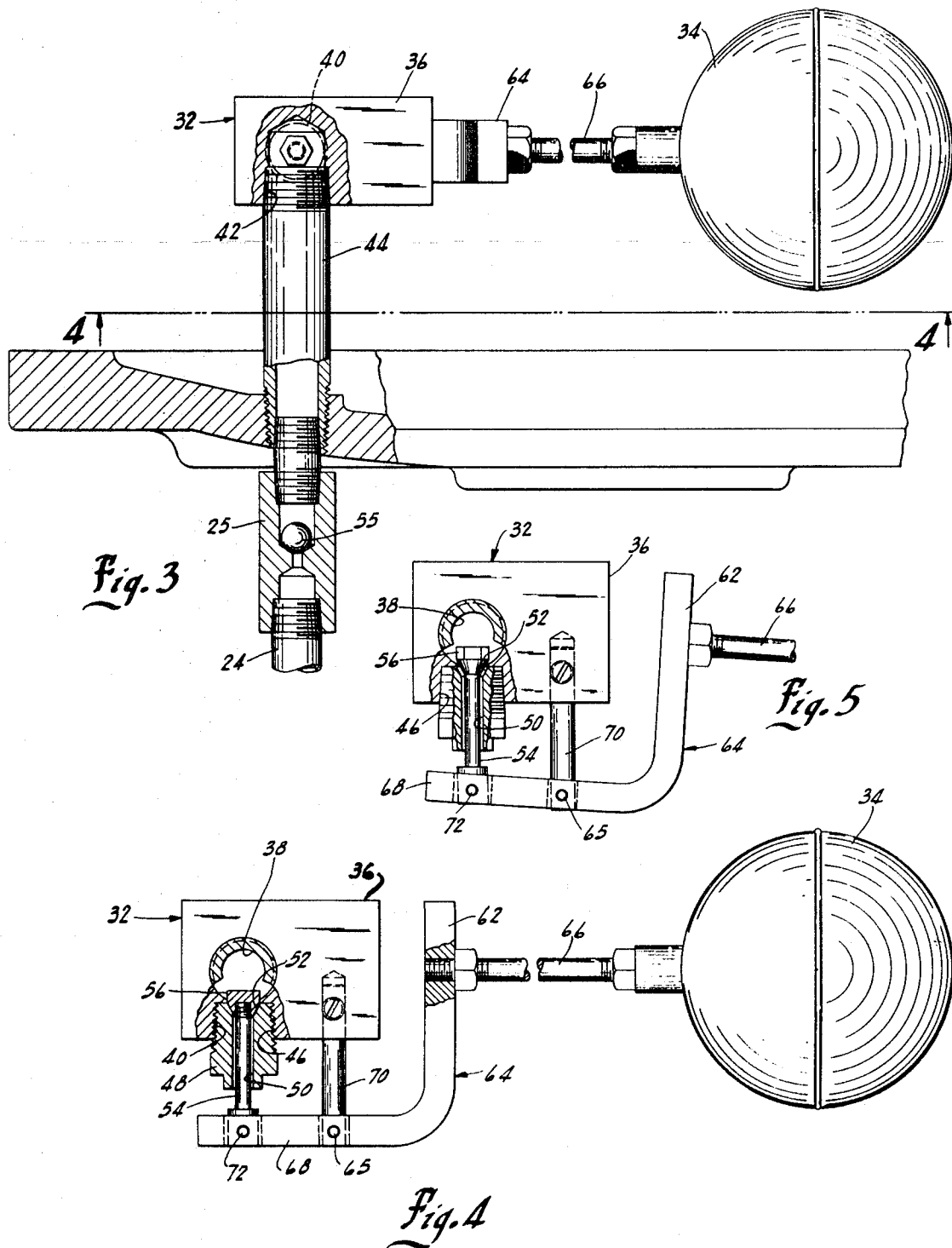
R. W. KINNEY

3,621,670

LUBRICATING OIL EQUALIZING SYSTEM

Filed Jan. 12, 1970

4 Sheets-Sheet 2



INVENTOR:

BY: RAYMOND W. KINNEY

James E. Nilles
ATTORNEY

Nov. 23, 1971

R. W. KINNEY

3,621,670

LUBRICATING OIL EQUALIZING SYSTEM

Filed Jan. 12, 1970

4 Sheets-Sheet 3

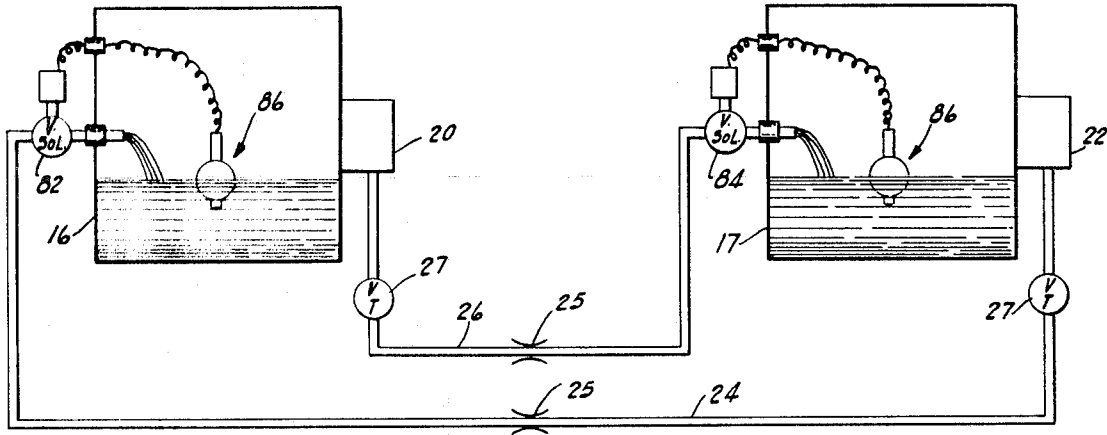


Fig. 6

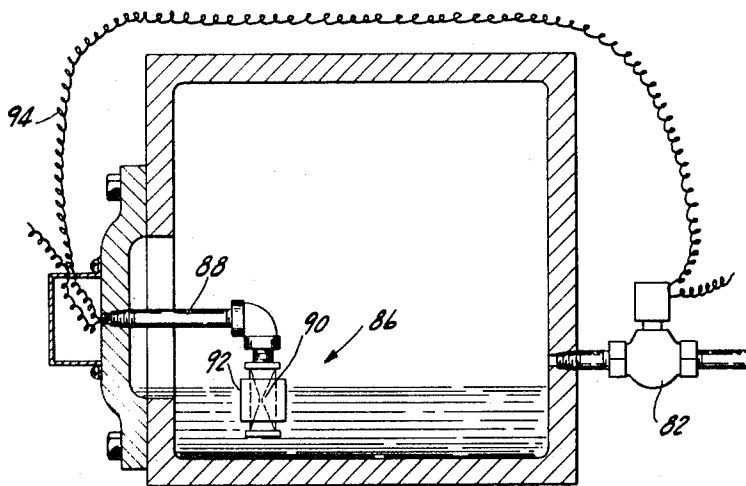


Fig. 7

INVENTOR:

BY: RAYMOND W. KINNEY

James E. Nilles
ATTORNEY

Nov. 23, 1971

R. W. KINNEY

3,621,670

LUBRICATING OIL EQUALIZING SYSTEM

Filed Jan. 12, 1970

4 Sheets-Sheet 4

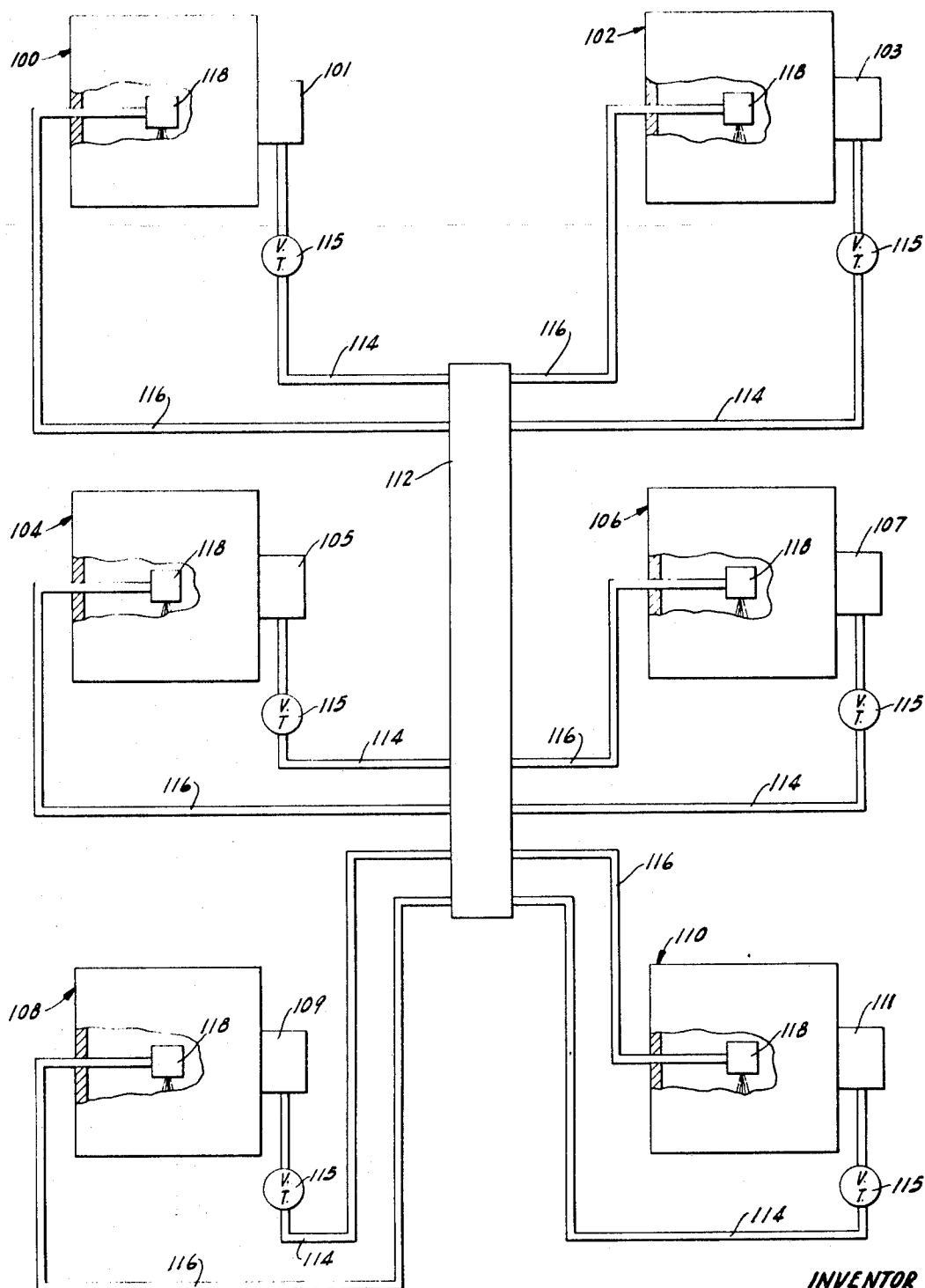


Fig. 8

INVENTOR :

BY : RAYMOND W. KINNEY
James E. Nilles
ATTORNEY

1

3,621,670

LUBRICATING OIL EQUALIZING SYSTEM

Raymond W. Kinney, Milwaukee, Wis., assignor to Vilter Manufacturing Corporation, Milwaukee, Wis.

Filed Jan. 12, 1970, Ser. No. 2,022

Int. Cl. F25b 31/00

U.S. Cl. 62—192

10 Claims

ABSTRACT OF THE DISCLOSURE

An oil level equalizing system interconnecting the compressor crankcases for a multi-compressor refrigeration system to maintain an equal level of oil in the crankcase of each of the compressors. The oil level control system includes a bypass line connecting the outlet of the lubricating pump on each compressor to the crankcase of an adjoining compressor and a liquid level operated valve responsive to the level of oil in the adjoining crankcase to control the admission of oil from the lubricating pump. The liquid level operated valve can be controlled by a float directly connected to open the valve or by a float switch connected to a solenoid valve located in the bypass line.

BACKGROUND OF THE INVENTION

In closed circuit refrigeration systems, multiple compressors connected either in parallel or in series are used to provide various stages of compression for the refrigerant. These compressors are lubricated by oil which is splashed onto the moving parts of the compressor. The lubricating oil intermingles with the refrigerant and is circulated through the refrigerating system and returned to the compressors unequally, reducing the level of oil in some of the compressor crankcases and raising the level of oil in the other compressor crankcases. Substantially all of the lubricating oil is returned to the compressors in the system. However, no control is provided for distributing the returned oil equally to the compressors which results in different levels of oil in the compressors. Many attempts have been made to maintain an equal distribution of the oil in the crankcases, the most commonly used system requiring that the compressors be located on a common level so that lubricating oil can flow freely through the crankcases of the compressors as disclosed in the Miner Pat. 3,360,958 issued Jan. 2, 1968 and the Zercher Pat. 2,076,332, issued Apr. 6, 1937. The former patents operate on an excess oil arrangement which can result in excess valve failure. The latter patent will not operate at different pressures. Where compressors are connected in parallel but at different heights, the oil level and pressure have been equalized through a system such as shown in the Kurtz Pat. 2,663,164, issued Dec. 22, 1953. However, this system is limited to a pair of compressors and requires that all of the suction gas go through both compressors.

SUMMARY OF THE INVENTION

The lubricating oil equalizing system of the present invention maintains an equal level of oil in the crankcases of the compressors in the refrigerating system regardless of the level of the compressors or the pressure within the crankcases. This is accomplished by distributing the excess oil returned to one of the compressors in the system to any adjoining compressor having a deficiency of oil. The oil lubricating pump for each of the compressors is connected to an adjoining compressor through a bypass line and the flow of oil from each of the pumps to the adjoining compressor is controlled by a self-contained, automatic float controlled valve which responds to the level of the oil in the crankcase. A simple float

2

system or an electrically controlled float system can be used to control the flow of oil through the bypass line. The oil can be transferred from one compressor to another regardless of the type of compressor connection, i.e. single or multiple stage or parallel or series connection. This equalizing system can also be used to control the flow of lubricating oil between a plurality of compressors through a common header.

Other objects and advantages will become apparent from the following detailed description when read in connection with the accompanying drawings.

The drawings:

FIG. 1 is a schematic perspective view of a pair of compressors with the lubricating oil equalizing system of this invention interconnecting the crankcases of the compressors;

FIG. 2 is a schematic view of the lubricating oil lines for the compressors;

FIG. 3 is a fragmentary top view partly in section of the float control valve for the lubricating oil system;

FIG. 4 is a view taken on line 4—4 of FIG. 3 partly broken away to show the valve in the closed position;

FIG. 5 is a view similar to FIG. 4 showing the control valve in the open position;

FIG. 6 is a schematic view of a modified system;

FIG. 7 is a view, partly in section, of the liquid level operated valve; and

FIG. 8 is a schematic view of a multi-compressor system connected to a common header.

DETAILED DESCRIPTION OF THE INVENTION

The lubricating oil equalizing system 10 of this invention is embodied in a typical closed cycle refrigerating system wherein a number of compressors are connected in series with a condenser, receiver and evaporator. The compressors can be connected either in series or in parallel, depending on the requirements of the system. The compressors in these systems are conventionally filled with an initial charge of lubricating oil which is then circulated through the system and redistributed to the compressors. However, the oil is not distributed evenly resulting in a deficiency of oil in some compressors and an excess in others.

FIGS. 1 to 5

Referring to FIGS. 1 to 5 of the drawings, two compressors 12 and 14 are shown which are of the well known reciprocating piston type in which lubricating oil is supplied to the crankcases 16 and 17 wherein it is splashed about to lubricate the moving parts of the compressor. The lubricating oil 18 is commonly circulated by lubricating pumps 20 and 22 provided on the compressors 12 and 14, respectively, to dissipate the heat of the oil. It is generally understood that pumps 20 and 22 can be driven directly off of the compressors 12 and 14, respectively, as shown in the drawing, or a separate motor drive can be provided to drive the pumps. The pumps are generally driven whenever the compressors are operating to provide a continuous low pressure flow of oil through the crankcases.

In accordance with the invention, means are provided for maintaining the level of the oil 18 in each of the crankcases 16 and 17 regardless of the level of the compressors or the pressure within the crankcases of the compressors. As seen in FIGS. 1 through 5, such means includes a bypass conduit 24 connecting the outlet of pump 22 to the crankcase 16 in compressor 12 and a bypass conduit 26 connecting the outlet of pump 20 to the crankcase 17 of the compressor 14. Since the pumps 20 and 22 are driven whenever the compressors 12 and 14 are operating a continuous supply of low pressure lubricating oil will be present in the bypass conduits 24 and 26.

3

Means are provided for metering the flow of oil through the bypass conduits to prevent the complete transfer of oil from the pumps 20 and 22 to the adjoining compressor. Such means is in the form of a restricting or metering orifice 25 provided in each of the bypass conduits 24 and 26. If the bypass conduits 24 and 26 are left open, all of the oil from one of the pumps could be transferred to the adjoining compressor with substantially little circulation of oil in the compressor supplied by that pump. A throttling or shut-off valve 27 can be provided in each of the bypass conduits, if desired.

Means are provided for controlling the flow of oil through the bypass conduits 24 and 26 to maintain a substantially constant level of oil in each of the crankcases for the compressors. Such means includes a self-contained liquid level operated valve assembly 28 and 30 provided in each of the crankcases 16 and 17, respectively. Each valve assembly includes a valve 32 operatively connected to a float 34 which is positioned to respond to the level of oil 18 in one of the crankcases 16 and 17. More particularly and referring to FIGS. 3-5, the valve 32 includes a support block 36 having an inlet passage 38, and an outlet passage 40. The inlet passage is threaded at 42 for connection to an inlet pipe 44 provided on the end of bypass conduit 24. The outlet passage 40 is threaded at 46 to receive a plug 48 having a central orifice 50 and a valve seat 52. A valve stem 54 is mounted for reciprocal movement within the orifice 50 and is provided with a head 56 which is positioned to seat on the valve seat 52.

Opening and closing of the valve 32 is controlled by means of the float 34 which is connected to one leg 62 of an L-bracket 64 by means of a rod 66. The other leg 68 of the L-bracket is pivotally connected by a pin 65 to an arm 70 provided in the control block 36 and to the valve stem 54 by means of a pin 72. Whenever the level of the oil in the crankcase reaches the required level, the float 34 will move upward closing the bypass conduit by seating the valve head on the valve seat 52. As the level drops, float 34 will move downward, as seen in FIG. 5, pushing the valve stem 54 upward and opening the valve. Since a constant supply of low pressure oil is provided in the bypass conduits, the oil will flow into the crankcase regardless of the level of the crankcase or the pressure within the crankcase.

Means are provided for preventing the reverse flow of oil through the bypass lines 24 and 26 in the event the bypass lines are disconnected. Such means comprises a ball type check valve 55 provided on one side of the metering orifice 25.

FIGS. 6 and 7

Referring to FIGS. 6 and 7, a modified means for controlling the flow of oil from the pumps 20 and 22 through the bypass conduits 24 and 26 to the crankcases 16 and 17 is shown. Such means includes solenoid valves 82 and 84, one of which is provided in each of the conduits 24 and 26 and a liquid level operated switch assembly 86 provided in each of the crankcases 16 and 17. The assemblies 86 are mounted on the end of a nipple 88 provided in the crankcase with the assemblies being positioned to respond to the level of oil in the crankcases to control the solenoid valves 82 and 84.

In this last regard, the assemblies 86 each include a "reed" type switch 90 and a float 92. Each of the switches 90 is connected directly to one of the solenoid valves through lines 94 which are connected across an electric power source. Whenever the level of the oil is at the required level, the switch 90 will be opened by the float 92 de-energizing the solenoid for the solenoid valve 82 or 84 to close the line. Whenever the level drops below the required level, the float 92 will drop and the switch 90 will close energizing the solenoid valve 82 or 84 to open the bypass conduit and allow oil to enter the crankcase.

4

As disclosed, the compressors 12 and 14 can be connected either in parallel or in series. In the latter instance, the compressors will be operating at different pressures, however the pressure of the oil in the bypass line is high enough to continue to supply oil from the low pressure compressor to the high pressure compressor.

FIG. 8

It is also within the contemplation of this invention to interconnect a plurality of compressors to maintain an equal distribution of oil in all of the compressors. This can be seen in FIG. 8 wherein the outlets for the lubricating oil pumps 101, 103, 105, 107, 109, and 111 for a number of compressors 100, 102, 104, 106, 108, and 110, respectively, are all connected to a common header 112 through bypass lines 114. The rate of flow through the bypass lines is controlled by metering valves 115 provided in each of the bypass lines 114. The header 112 is connected to each of the compressor crankcases by means of return lines 116 which are open or closed by means of float valve assemblies 118 as described above.

Operation

In operation, each compressor supplies a small amount of low pressure lubricating oil to the header 112. Assuming all of the crankcases have the required amount of oil, a stable condition will exist with no flow of oil from the compressors to the header. When the level of oil drops in one of the crankcases, the corresponding valve assembly 118 will open the return line 116 to that compressor. One compressor will then be drawing oil from the header while all six of the compressors will be supplying oil to the header. More than one compressor can be drawing oil from the header at one time since there will always be at least one compressor having an excess of oil as described above. It should be understood, that appropriate controls are provided to indicate if there is a deficiency of oil in the entire system. This arrangement can be used regardless of the type of connection between compressors in the refrigerating system, i.e., parallel or series, or both.

I claim:

1. In a refrigeration system having a number of compressors, each including an oil carrying crankcase and a recirculating lubricating oil pump, and a crankcase oil level control system to maintain a predetermined level of oil in the crankcase of each compressor, said control system comprising:

a bypass line connecting the outlet of each oil pump on each compressor to the crankcase of another compressor, said pump providing positive pressure in said bypass line,

a metering valve in each bypass line, and means responsive to the level of lubricating oil in the crankcase of each compressor for controlling the flow of pressure lubricating oil through said bypass line to said crankcase.

2. The refrigeration system according to claim 1 wherein said controlling means includes a valve in said bypass line and a float operatively connected to control said valve and positioned to respond to the level of oil in the crankcase of the compressor.

3. The refrigeration system according to claim 1 wherein said controlling means includes a solenoid valve in each bypass line, and a float actuated switch assembly electrically connected to control said solenoid valve and positioned to respond to the level of oil in the crankcase of each compressor.

4. The refrigeration system according to claim 3 wherein said switch comprises a reed switch.

5. An oil level control system for a number of compressors connected in a refrigeration system, each compressor having an oil carrying crankcase and a recirculating lubricating oil pump, said system comprising means for connecting the lubricating oil pumps of each compressor

5

sor to supply oil under pressure to the crankcase of an adjoining compressor, and means for controlling the flow of oil from each compressor to the adjoining compressor in response to the level of oil in the crankcase of the adjoining compressor.

6. An oil level control system according to claim 5 wherein said controlling means includes a valve in said bypass line and a float operatively connected to control said valve and positioned to respond to the level of oil in the crankcase of the compressor.

7. The control system according to claim 5 wherein said controlling means includes a solenoid valve in each bypass line and a float actuated switch electrically connected to control each solenoid valve and positioned to respond to the level of oil in each crankcase.

8. An oil level control system for a plurality of compressors connected in a closed cycle refrigeration system, each compressor having an oil carrying crankcase and a recirculating lubricating oil pump, said system comprising:

- a lubricating oil header,
- a bypass line connecting each of the lubricating oil pumps to said header, said pumps maintaining oil under pressure in said header,
- a metering valve in each of said bypass lines,
- a return line connecting said header to each of the compressors,

6

and means connected to each of said return lines for controlling the flow of oil from said header to each of the compressors in response to the level of oil in the compressor.

9. The system according to claim 8 wherein said controlling means includes a float operated valve assembly.

10. The system according to claim 8 wherein said controlling means includes a solenoid valve in each of said return lines and a float actuated switch in each of the compressors responsive to the level of oil in the compressor and connected to the corresponding valve.

References Cited

UNITED STATES PATENTS

15	2,140,415	12/1938	Buehler	62—193
	2,246,244	6/1941	Consley	62—472
	2,253,623	8/1941	Jordan	62—192
	2,418,962	4/1947	Zwickl	62—470
	3,234,749	2/1966	Quick	62—470
20	3,500,962	3/1970	Kocher	62—193

WILLIAM J. WYE, Primary Examiner

U.S. Cl. X.R.

25 184—103, 62—468, 510