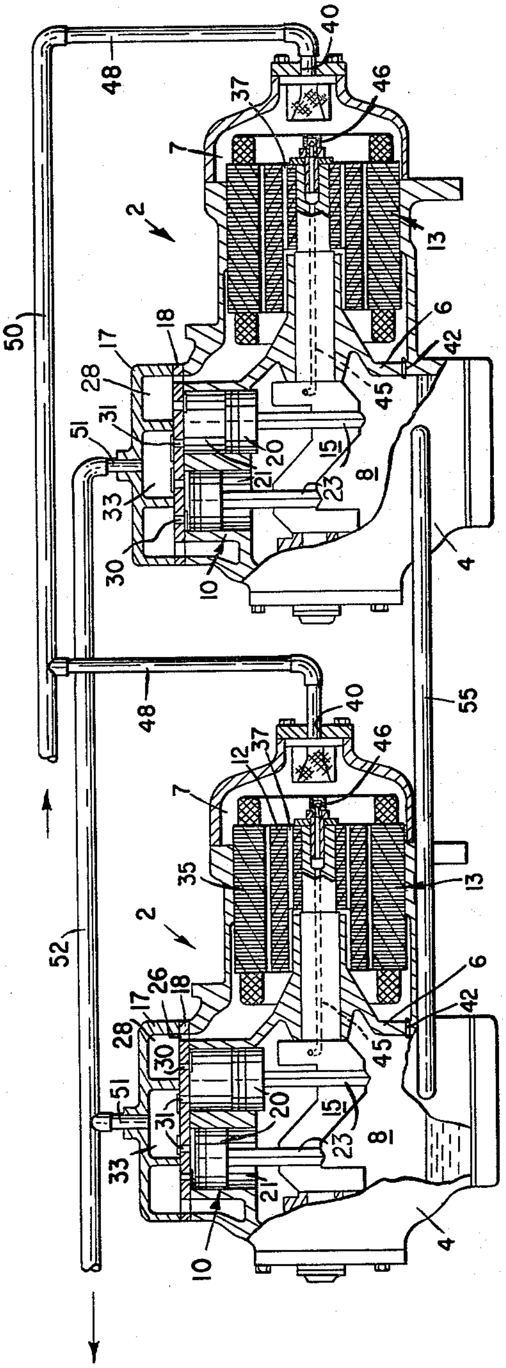
March 29, 1966 D. N. SHAW 3,243,101

COMPRESSOR LUBRICATION SYSTEM

Filed Nov. 25, 1964



INVENTOR.
DAVID N. SHAW.
BY
Frederick E. McMullen
ATTORNEY.

3,243,101

COMPRESSOR LUBRICATION SYSTEM

David N. Shaw, Liverpool, N.Y., assignor to Carrier Corporation, Syracuse, N.Y., a corporation of Delaware

Filed Nov. 25, 1964, Ser. No. 413,942
9 Claims. (Cl. 230—58)

This invention relates to hermetic motor compressors, and more particularly to a lubrication arrangement for hermetic motor compressors adapted for parallel operation in multiple compressor systems.

In systems employing parallel connected compressors, excess lubricant may accumulate in one or more of the compressors at the expense of the remaining compressor or compressors. This phenomenon is particularly evident where one of the compressors has, or by means of unloader mechanism is operated at, a capacity different from that of the remaining compressor or compressors, or where one or more of the compressors is shutdown while the remaining compressor or compressors is used to sustain system operation at reduced capacity. Variations in pressure conditions within the crankcase compartments of the several compressors may override the lubricant balancing function of equalizing lines interconnecting the crankcase compartments of the several compressors resulting in excess lubricant in the crankcase compartment of one compressor to the detriment of the remaining compressor or compressors.

It is a principal object of the present invention to provide a new and improved arrangement for insuring an adequate quantity of lubricant in each compressor of a multiple compressor system.

It is a further object of the present invention to provide a lubrication arrangement for compressors effective to prevent lubricant starvation of one compressor in a system employing multiple compressors interconnected in parallel.

It is an object of the present invention to provide a compressor lubrication arrangement effective to maintain substantially equal quantities of lubricant in the crankcase compartment sump of all compressors of a multiple compressor system during shutdown or reduced capacity operation of one or more of the compressors.

This invention relates to hermetic motor compressors, comprising in combination a housing partitioned into a crankcase compartment having compression means therewithin and a suction compartment adapted to communicate with a source of suction gas, drive means including a crankshaft for the compression means, a gas passage communicating the crankcase compartment with the suction compartment, and gas passage control valve means effective when pressure conditions in the suction compartment of the compressor exceed pressure conditions in the crankcase compartment of the compressor to interrupt the gas passage.

Other objects will be apparent from the ensuing description and drawing in which the figure is a view partly in section and partly in elevation of hermetic compressors incorporating the improved lubrication system connected for parallel operation.

Referring to the drawing, a pair of compressors 2, each incorporating my improved lubrication system, are shown connected for parallel operation. Compressors 2 each comprise a shell or housing 4 separated by a partition 6 into motor compartment 7 and crankcase compartment 8. Crankshaft 15, rotatably journaled in partition 6, operably connects compression means 10 in crankcase compartment 8 with rotor 12 of motor 13 in motor compartment 7. Compression means 10 includes pistons 20 adapted to reciprocate in cylinders 21 and operatively connected to crankshaft 15 by connecting rods 23.

While compressors 2 are illustrated as having plural

cylinders and pistons, it is understood that compression means 10 may comprise a single cooperating piston and cylinder.

Each compressor 2 includes a cylinder head 17 sealingly secured to valve plate 18 opposite cylinders 21. Cylinder head 17 cooperates with valve plate 18 to define suction and discharge manifolds 28, 33 respectively. Openings 26 in valve plate 18 communicate motor compartment 7 with the cylinder head suction manifold 28. Valve plate 18 includes valve controlled suction and discharge openings 30, 31 respectively operatively communicating compression means 10 with suction and discharge manifolds 28, 33 respectively.

Rotor 12 of compressor drive motor 13 has a plurality of longitudinal suction passages 37 therethrough. Suction opening 40 in housing 4 communicates motor compartment 7 with a source of relatively low pressure gas. During operation of compressors 2, relatively low pressure suction gas drawn through opening 40 flows through passages 37 in rotor 12 and in the space between motor rotor 12 and stator 35 through openings 26 into suction manifold 28. Gas in suction manifold 28 passes through valve controlled suction openings 30 in valve plate 18 into cylinders 21 of compression means 10. Relatively high pressure gas from compression means 10 is discharged through valve controlled openings 31 in valve plate 18 into discharge manifold 33.

Crankcase compartments 8 of compressors 2 serve as sumps or reservoirs for lubricant. A pumping mechanism (not shown) forces lubricant drawn from the crankcase compartment sumps to the several points of frictional wear of the compressors.

A relatively small lubricant passage or orifice 42 is provided in the lower portion of partition 6 of each compressor 2. Orifice 42 permits flow of lubricant between motor and crankcase compartments 7, 10 respectively. Passage 45 in crankshaft 15 connects compressor crankcase compartment 8 with motor compartment 7. The dimension of gas passage 45 is substantially greater than the dimension of lubricant orifice 42. Check valve 46 in passage 45 interrupts passage 45 when pressure in motor compartment 7 exceeds pressure in crankcase compartment 8 as will be more fully explained hereinafter. Other types of arrangements for controlling communication between the compressor motor and crankcase compartments via gas passage 45 may be contemplated. For example, a low pressure relief valve may be employed in place of check valve 46.

Suction conduits 48, suitably secured to compressor shells 4 opposite suction openings 40 thereof, operably connect compressors 2 with suction gas header 50. Discharge conduits 51 communicate discharge manifolds 31 of compressors 2 with discharge gas header 52. Suction and discharge gas headers 50, 52 may for example comprise part of a closed system such as a refrigeration system where relatively high pressure refrigerant discharged from compressors 2 through discharge conduits 51 into header 52 is returned as relatively low pressure refrigerant from header 50 through suction conduits 48 to compressors 2.

Compressors 2 are preferably arranged at a substantially common level. An equalizing conduit 55 having a relatively small diameter interconnects the crankcase compartment 8 of each compressor 2. Equalizing conduit 55, suitably joined to shells 4 of compressors 2 at a preselected lubricant level, permits the flow of lubricant from one crankcase compartment 8 to the other. Equalizing conduit 55 is arranged so that a part thereof is above the preselected lubricant level. That portion of conduit 55 above the level of lubricant therewithin permits pressures in the crankcase compartments 8 of compressors 2 to substantially equalize. It is understood that any change in the lubricant level in the compressor crankcases materially affects the ability of the relatively small sized conduit 55 to equalize pressures in the crankcase compartments of the several compressors as will be more apparent hereinafter.

In multiple compressor arrangements of the type described, any excess lubricant in one compressor is distributed by means of the equalizing conduit or conduits to the other compressor or compressors. However, pressure in the motor compartment of one compressor may exceed pressure in the crankcase compartment of that compressor. Higher motor compartment pressures may occur for example where one of the compressors is shutdown or operating at a different capacity than the other compressor. Additionally, higher motor compartment pressures may be due to sizing and disposition of conduits connecting the compressors to each other and to the system associated therewith.

Since crankshaft gas passage 45 communicates the compressor motor compartment with the crankcase compartment, any increased pressure in the motor compartment of one compressor would normally be reflected in the crankcase compartment of that compressor resulting in a pressure differential between crankcase compartments of the several compressors. Due to its relatively small size, equalizing conduit 55 may not be able to dissipate the pressure differential quickly enough to prevent lubricant from being forced from the crankcase compartment of the compressor having the greater crankcase pressure into equalizing conduit 55 and the crankcase compartment of the other compressor or compressors with resultant unbalance in the lubricant levels among the several compressors. And, as equalizing conduit 55 fills with lubricant, the crankcase pressure equalizing ability thereof is further restricted or prevented all together.

Where compressors incorporating applicant's unique lubrication arrangement are joined in multiple compressor arrangements, should a high pressure condition occur in the motor compartment 7 of one of the compressors 2 relative to the crankcase compartment 8 of that compressor, check valve 46 thereof closes to interrupt crankshaft gas passage 45 and forestall the build-up of pressure in the crankcase compartment of that compressor. It may be understood that the small amount of gas which may bleed through lubricant orifice 42 is without substantial effect on pressure conditions prevailing in the compressor crankcase compartment and hence without effect on the level of lubricant therein.

Where lubricant accumulates in the motor compartment of one of the compressors 2 as for example in the off compressor, excess amounts of lubricant may pass through orifice 42 of that compressor into the compressor crankcase compartment 8. It is understood that equalizing line 55 maintains the lubricant levels in the crankcase compartments of compressors 2 substantially balanced.

While paired compressors 2 are illustrated, it is understood that additional compressors may be incorporated in the illustrated arrangement.

Compressors of the type having a check valve controlled orifice for returning lubricant trapped in the motor compartment of the compressor to the crankcase compartment thereof, such as Gerteis Patent No. 2,673,026, issued March 23, 1954, and Cramer et al. application, Serial No. 263,885, filed March 8, 1963 now Patent No. 3,171,589, issued March 2, 1965, may be modified according to the tenets of this invention by the addition of a check valve control to the gas passage communicating the compressor crankcase compartment with the motor compartment. The aforesaid gas passage check valve control, when added to compressors of the type shown in the aforesaid Gerteis and Cramer et al. patents, interrupts the gas passage when pressures on the compressor motor side thereof exceed pressures on the compressor crankcase side thereof as particularly described hereinbefore

in conjunction with compressors 2. It is understood that modification of the compressor construction disclosed in the aforesaid Gerteis and Cramer et al. patents by the incorporation of a check valve control for the gas passage communicating the compressor crankcase compartment with the motor compartment as proposed by applicant, does not interfere with or restrict operation of the crankcase pressure controlling arrangements in the Gerteis and Cramer et al. compressor constructions.

While I have described a preferred embodiment of my invention, it will be understood that my invention is not limited thereto since it may be otherwise embodied within the scope of the following claims.

I claim:

1. In a hermetic motor compressor, the combination of a housing, partition means separating said housing into a crankcase compartment and a suction compartment adapted to communicate with a source of suction gas, compression means in said crankcase compartment, drive means including a crankshaft for said compression means, said compressor having a passage connecting said crankcase compartment with said suction compartment, and valve control means for said passage effective when pressure conditions on the suction side thereof exceed pressure conditions on the crankcase side thereof to close said passage.

2. A hermetic motor compressor according to claim 1 including a second passage connecting said suction compartment with said crankcase compartment, said second passage accommodating flow of lubricant between said suction and crankcase compartments, the dimension of said first passage being substantially greater than the dimension of said second passage.

3. A hermetic motor compressor according to claim 2 including second valve control means for said second passage effective when pressure conditions in said crankcase compartment exceed pressure conditions in said suction compartment to close said second passage.

4. A hermetic motor compressor according to claim 1 in which said gas passage is formed in said compressor crankshaft.

5. In a multiple compressor arrangement wherein each compressor includes a housing partitioned into a crankcase compartment with compression means therewithin and a suction compartment having a drive motor therewithin, and a crankshaft connecting said drive motor to said compression means, the suction compartment of each compressor communicating with a source of suction gas, the combination of a gas and lubricant equalizing conduit interconnecting the crankcase compartments of each compressor, each compressor having a gas passage between the crankcase and the suction compartments, and gas passage control valve means for each compressor effective when pressure conditions in the motor compartment exceed pressure conditions in the crankcase compartment to interrupt said gas passage.

6. A multiple compressor arrangement according to claim 5 in which each compressor includes an orifice connecting the suction compartment with the crankcase compartment, said orifice being disposed at a predetermined crankcase compartment lubricant level.

7. In combination plural hermetically sealed compressors connected in parallel, each of said compressors being partitioned into crankcase and motor compartments, each motor compartment being communicable with a source of suction gas, and means for maintaining substantially equal lubricant levels in the crankcase compartments of each of said compressors under all operating conditions including an equalizing conduit interconnecting the crankcase compartments of all compressors at a selected lubricant level, said equalizing conduit being arranged to permit flow of both lubricant and vapor therethrough so as to maintain pressures in the crankcase compartments of said compressors substantially equal to one another, each of said compressors having a passage connecting the motor com-

partment with the crankcase compartment, and valve control means for said passages, said valve control means being adapted to interrupt the passage associated with one of said compressors at a predetermined high pressure in the motor compartment of said one compressor.

8. The combination recited in claim 7 in which each of said compressors has a second passage connecting the motor compartment with the crankcase compartment, said second passage being adapted to accommodate flow of lubricant between said crankcase and suction compartments and having a dimension substantially less than the first passage.

9. The combination recited in claim 7 including compression means in said crankcase compartment, a drive motor in said motor compartment, a crankshaft operably connecting said drive motor to said compression means, said first passage being formed in said crankshaft.

References Cited by the Examiner

UNITED STATES PATENTS

3,082,937 3/1963 Tucker ------------ 230—207

FOREIGN PATENTS

624,770 1/1936 Germany.

ROBERT M. WALKER, *Primary Examiner.*