March 2, 1965 C. B. CRAMER ETAL 3,171,589

HERMETIC MOTOR COMPRESSOR UNIT

Filed March 8, 1963

FIG. 1

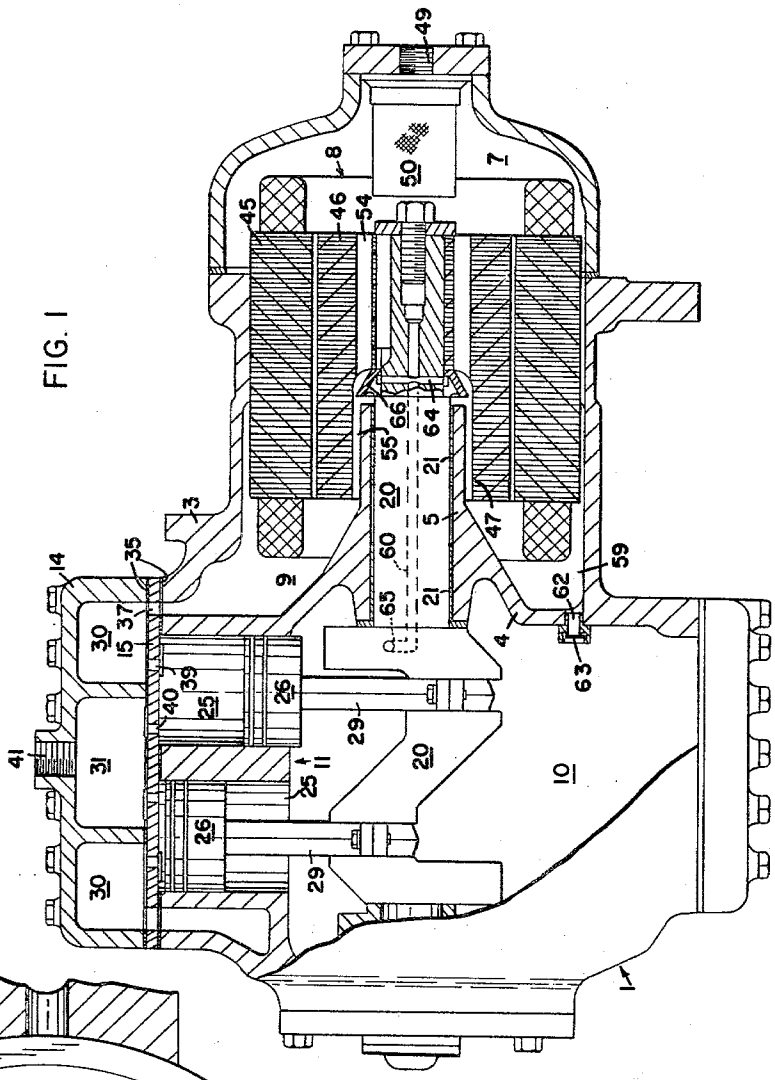
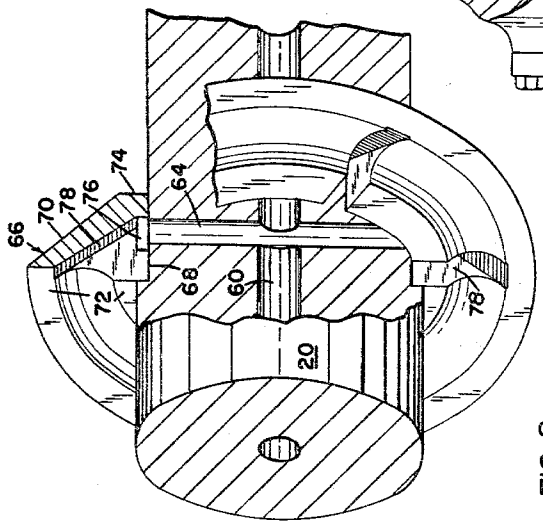


FIG. 2



INVENTORS
CLAYTON B. CRAMER
DAVID N. SHAW.

BY Frederick E. McMullen

ATTORNEY.

United States Patent Office 3,171,589 Patented Mar. 2, 1965

3,171,589

HERMETIC MOTOR COMPRESSOR UNIT

Clayton B. Cramer, Bridgeport, and David N. Shaw, Liverpool, N.Y., assignors to Carrier Corporation, Syracuse, N.Y., a corporation of Delaware

Filed Mar. 8, 1963, Ser. No. 263,885
8 Claims. (Cl. 230—206)

This invention relates to hermetic motor compressor apparatus, and more particularly, to a hermetic motor compressor unit having means to return lubricant in the motor compartment to the compressor crankcase.

In hermetic motor compressor units, the driving motor may be located in a compartment separated from the compressor crankcase. To cool the driving motor, suction gas may be passed through the motor compartment in heat exchange relationship with the motor, the suction gas thereafter passing to a suction manifold for introduction to the compressor. During compressor operation lubricant may accumulate in the motor compartment. To return lubricant in the motor compartment to the compressor crankcase a lubricant return passage between the motor compartment and the compressor crankcase is provided. To retain separation between the motor compartment and the compressor crankcase, the lubricant return passage may be provided with a check valve effective to interrupt the lubricant return passage when crankcase pressure exceeds motor compartment pressure.

Recent hermetic motor compressor design tends to relay on relatively small compressor drive motors. Since less heat transfer surface is available, effective cooling of the small compressor motor requires increase pressure drop in the suction gas flowing through the motor compartment. Mean or average pressure in the compressor crankcase may now be greater than pressure in the motor compartment so that the check valve regulated lubricant return passage is closed preventing the flow of lubricant from the motor compartment to the compressor crankcase with ultimate deleterious effects on the unit.

It is a principal object of the present invention to provide a hermetic motor compressor arrangement effective to remove lubricant from the motor compartment to the compressor crankcase.

It is an additional object of the present invention to provide a unique hermetic motor compressor construction effective to prevent the accumulation of lubricant in the compressor motor compartment.

It is a further object of the present invention to provide, in a compressor of the hermetic type having separate motor and crakcase compartments, apparatus for maintaining crankcase pressure below motor compartment pressure to insure the return of lubricant accumulating in the motor compartment of the crankcase compartment. Other objects of the invention may be readily perceived from the following description.

This invention relates to hermetic motor compressor apparatus comprising in combination a crankcase compartment, a motor compartment, shaft means extending between the crankcase and motor compartments, the shaft means operably connecting the motor to the compressor, means for passing suction gas through the motor compartment to the compressor including passage means through the motor, means adapted to provide a path for lubricant flow from the motor compartment to the crankcase compartment when pressure in the crankcase compartment is less than pressure in the motor compartment, means adapted to reduce crankcase pressure including bleed means communicating the crankcase compartment with the motor passage means, and means for reducing the pressure of the suction gas flowing

through the motor passage means opposite the bleed means.

Other objects and features of the invention will be apparent upon a consideration of the specification and drawing in which:

FIGURE 1 is a view partly in section and partly in elevation of the hermetic motor-compressor unit embodying this invention; and

FIGURE 2 is an enlargment perspective view of the restrictor ring construction with parts broken away.

Referring to FIGURE 1 of the drawing, numeral 1 designates generally a reciporating compressor of the hermetic type embodying the present invention. Compressor 1 includes an outer shell or casing 3 having an inner member 4. Inner member 4 partitions shell 3 into a motor compartment 7, having motor 8 therein, and crankcase 10, having compression means 11 therein. Member 4 cooperates, in a manner to be more fully explained hereinafter, with cylinder head 14 and valve plate 15 to maintain motor compartment 7 substantially sealed from crankcase 10. Crankshaft 20, suitably journalled as by bearing means 21 in bearing support 5 of member 4, operatively interconnects motor 8 with compression means 11. Preferably, a portion of bearing support 5 extends into motor compartment 7. Motor rotor 46 is suitably recessed at 47 for reception of the extended portion of support 5.

Suitable cylinder openings 25 are provided in member 4. Compression means 11 comprises pistons 26 adapted to reciporate in cylinder openings 25 and operatively connected to crankshaft 20 by means of connecting rods 29. While plural cylinder openings and pistons are shown, it may be understood that compression means 11 may comprise a single cooperating piston and cylinder opening.

A valve plate 15 tightly abuts casing 3 and inner member 4 opposite cylinder openings 25. Cylinder head 14, having section and discharge manifolds 30, 31 respectively, tightly abuts valve plate 15. Suitable sealing means 35 may be provided between valve plate 15 and casing 3 and member 4, and between valve plate 15 and cylinder head 14. Passage means 37 in valve plate 15 communicates motor compartment 7 with cylinder head suction manifold 30. Valve plate 15 includes valve controlled suction and discharge openings 39, 40 respectively operatively communicating compression means 11 with the cylinder head suction and discharge manifolds 30, 31 respectively. Discharge manifold 31 includes discharge opening 41 in cylinder head 14.

Motor 8 comprises stator 45 and rotor 46. Stator 45 is suitably fixed within motor compartment 7. Rotor 46 is suitably fixed to crankshaft 20. Rotor recess 47 is in spaced overlapping relationship with the extended portion of bearing support 5 to define suction gas passage 55.

A suction opening 49 communicates motor compartment 7 with a source of relatively low pressure gas. Opening 49 may be provided with suitable filtering means 50. Rotor 46 includes passages 54 therein communicating with the suction gas passage 55. In a manner to be more fully explained relatively low pressure suction gas flows through passages 54 and passage 55, and between the motor stator 45 and rotor 46 to cool motor 8.

During compressor operation relatively low pressure gas passes through opening 49 and filter 50, passages 54, 55 and the space between stator 45 and rotor 46, through passage means 37 to suction manifold 30. Gas in suction manifold 30 flows through inlet openings 39 in valve plate 15 into cylinder openings 25 of compression means 11. Relatively high pressure gas from the compression means 11 passes through outlet openings 40 in valve

plate 15 into discharge manifold 31 for discharge through opening 41.

During compressor operation, pressures in crankcase 10 and in suction manifold 30 and motor compartment 7 are less than in discharge manifold 31. The suction gas passing through passages 54, 55 and the space between stator 45 and rotor 46 of motor 8 undergoes a pressure drop. The pressure of the suction gas entering motor 8 is accordingly greater than the pressure of the suction gas leaving the motor in the motor compartment area 9. The mean or average crankcase pressure, which fluctuates due to movement of compression means 11, is normally greater than the pressure of the suction gas in the motor compartment area 9.

Crankcase 10 serves as a sump for lubricant. A pump mechanism (not shown) forces lubricant drawn from the crankcase sump to various points of frictional wear throughout the compressor including crankshaft bearing means 21. Return lubricant accumulates in the crankcase sump.

A portion of the lubricant directed to bearing means 21 may pass through bearing means 21 into motor compartment 7, the lubricant accumulating in the lower portion 59 thereof. Additionally, a portion of the lubricant directed to the cylinder openings 25 may pass between the walls of cylinder openings 25, and the sides of the pistons 26 reciprocating therein into compressor discharge manifold 31 and through discharge opening 41. If compressor 1 is part of a closed system, as for example, a closed refrigeration system, lubricant borne by the system working medium may pass through the system into motor compartment 7 to accumulate in the lower portion 59 thereof.

To return lubricant in the motor compartment 7 to the crankcase sump, partition member 4 may be provided with a lubricant return passage 62 having a regulating or check valve 63. Check valve 63 closes passage 62 when pressure in crankcase 12 exceeds pressure in the motor compartment area 9 adjacent passage 62.

Applicants' unique hermetic compressor construction includes an axial passage 60 in crankshaft 20 communicating with the compressor crankcase 10 by means of radial passage 65 and with motor compartment 7 by means of radial passage 64. Radial passage 64 opens into motor compartment 7 between passages 54, 55. A restrictor ring 66, fixedly attached to crankshaft 20, is positioned between radial passage 64 and rotor passages 54.

Referring particularly to FIGURE 2 of the drawings, restrictor ring 66 includes an inner mounting surface 68, a sloping outer surface 70, and opposite faces 72, 74 respectively. Inner surface 68, adapted to tightly engage the outer surface of crankshaft 20, includes a circumferential recess 76 adapted, upon positioning of ring 66 on the crankshaft 20 to communicate with radial passage 64. Paired oppositely disposed slots 78 in face 72 of ring 66 are provided. Slots 78 preferably are in axial alignment with radial passage 64. Face 74 of ring 66 is adapted to abut motor rotor 46. As may be appreciated, additional paired oppositely disposed slots 78 may be provided in the face 72 of ring 66 to facilitate axial alignment of a pair of slots 78 with radial passage 64 during assembly. If desired, the restrictor ring 66 may be formed from relatively thin sheet stock as in the form of a washer and mounted on crankshaft 20 between radial passage 64 and rotor suction gas passages 54. The washer is preferably dished to provide a sloping outer face.

Restrictor ring 66, positioned on crankshaft 20 adjacent radial passage 64, restricts the flow of suction gas between passages 54 and 55 thereby increasing suction gas velocity, the maximum increase in suction gas velocity occurring at a point following the restrictor ring. The increase in suction gas velocity is accompanied by a decrease in suction gas static pressure, the maximum static pressure decrease occurring at the point of maximum velocity following the restrictor ring 66. Passage 64, in communication with the crankcase 10 by means of connecting passages 60, 65, communicates with the motor compartment 7 through restrictor ring recess 76 and slots 78 at the point of maximum suction gas static pressure drop closely following the restriction imposed on the flow of suction gas by restrictor ring 66. The communication of crankcase 10 with the motor compartment 7 at the area of relatively low static pressure following restrictor ring 66 reduces mean or average crankcase pressure below the pressure in the motor compartment area 9 adjacent check valve 63. Check valve 63, in response to pressure in crankcase 10 below pressure in motor compartment area 9 opens return passage 62 whereby lubricant in the lower portion 59 of motor compartment 7 may pass into the crankcase sump. By this construction, undesirable accumulation of lubricant in the compressor motor compartment 7 is avoided.

Radial passage 65 in crankshaft 20 serves as a centrifuge to limit the loss of oil from the crankcase when foaming occurs therein, as for example, at compressor startup.

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

We claim:

1. In hermetic motor compressor apparatus, the combination of:

(*a*) a crankcase compartment,

(*b*) a motor compartment,

(*c*) shaft means extending between said crankcase and motor compartments, said shaft means operably connecting a motor to a compressor,

(*d*) means for passing suction gas through said motor compartment to said compressor including passage means in said motor,

(*e*) means adapted to provide a path for lubricant flow from said motor compartment to said crankcase compartment when pressure in said crankcase compartment is less than pressure in said motor compartment, and

(*f*) means adapted to reduce crankcase pressure including bleed means communicating said crankcase compartment with said passage means, and means for reducing the pressure of suction gas flowing through said passage means adjacent said bleed means communicating with said passage means.

2. Hermetic motor compressor apparatus according to claim 1 in which said means for reducing the pressure of said suction gas opposite said bleed passage means comprises a member fixedly attached to said shaft means extending into the stream of suction gas flowing through said passage means to effect partial restriction of said passage means.

3. Hermetic motor compressor apparatus according to claim 2 in which said bleed means is in said shaft means, said bleed means communicating with said passage means closely following said passage means partial restriction.

4. Hermetic motor compressor apparatus according to claim 3 in which said bleed means comprises a substantially longitudinal passage in said shaft means, a first radial passage communicating said longitudinal passage with said crankcase compartment, and a second radial passage communicating said longitudinal passage with said passage means.

5. Hermetic motor compressor apparatus according to claim 4 in which said member comprises a ring-like element fixedly attached to said shaft means opposite said second radial passage having a peripheral part extending into the stream of suction gas flowing through said passage means to effect partial restriction of said passage means, said element including means communicating said second radial passage with said passage means closely following said peripheral part.

6. In hermetic motor compressor apparatus the combination of:

(*a*) a housing,

(*b*) partition means in said housing defining first and second compartments,

(*c*) driving means including a rotatable element in said first compartment,

(*d*) compression means in said second compartment,

(*e*) shaft means rotatably journalled in said partition means between said first and second compartments operably connecting said driving means rotatable element to said compression means,

(*f*) means communicating said first compartment with a source of suction gas,

(*g*) means for passing said suction gas through said driving means to said compression means including passage means in said driving means rotatable element,

(*h*) lubricant passage means in said partition means adapted to communicate said first compartment with said second compartment when pressure in said second compartment is less than pressure in said first compartment, and

(*i*) means for reducing second compartment pressure including orifice means communicating said second compartment with the stream of suction gas passing through said rotatable element passage means, and restriction means in said rotatable element passage means adapted to reduce the pressure of suction gas therein opposite said orifice means, said restriction means being fixedly attached to said shaft means adjacent said orifice means.

7. In hermetic motor compressor apparatus the combination of:

(*a*) a housing having partition means separating said housing into first and second compartments,

(*b*) bearing support means in said partition means including a part extending into said first compartment,

(*c*) shaft means rotatably mounted in said bearing support means,

(*d*) driving means including a rotatable element in said first compartment fixedly attached to said shaft means, a part of said rotatable element having a recess adapted to spacedly receive said bearing support means extended part,

(*e*) compression means in said second compartment operably connected to said shaft means,

(*f*) a check valve in said partition means for returning lubricant from said first compartment to said second compartment,

(*g*) means communicating said first compartment with a source of suction gas,

(*h*) means for passing said suction gas into heat exchange relationship with said driving means including passage means in said rotatable element adapted to pass suction gas through said rotatable element to said recess, said suction gas passing through said recess between said rotatable element part and said bearing support means extended part to said compression means, and

(*i*) means adapted to reduce pressure in said second compartment including orifice means communicating said second compartment with the stream of suction gas flowing through said rotatable element recess, and means adapted to reduce suction gas pressure adjacent said orifice means.

8. Hermetic motor compressor apparatus according to claim 7 in which said orifice means includes an opening in said shaft means between said bearing support means extended part and said driving means rotatable element, said means for reducing suction gas pressure comprising a member fixedly attached to said shaft means between said orifice means opening and said driving means rotatable element extending into the path of suction gas flowing through said recess to restrict the flow of suction gas through said recess.

References Cited by the Examiner

UNITED STATES PATENTS

2,926,840	3/60	Soumerai	230—206
2,963,218	12/60	Tower	230—206

LAURENCE V. EFNER, *Primary Examiner.*