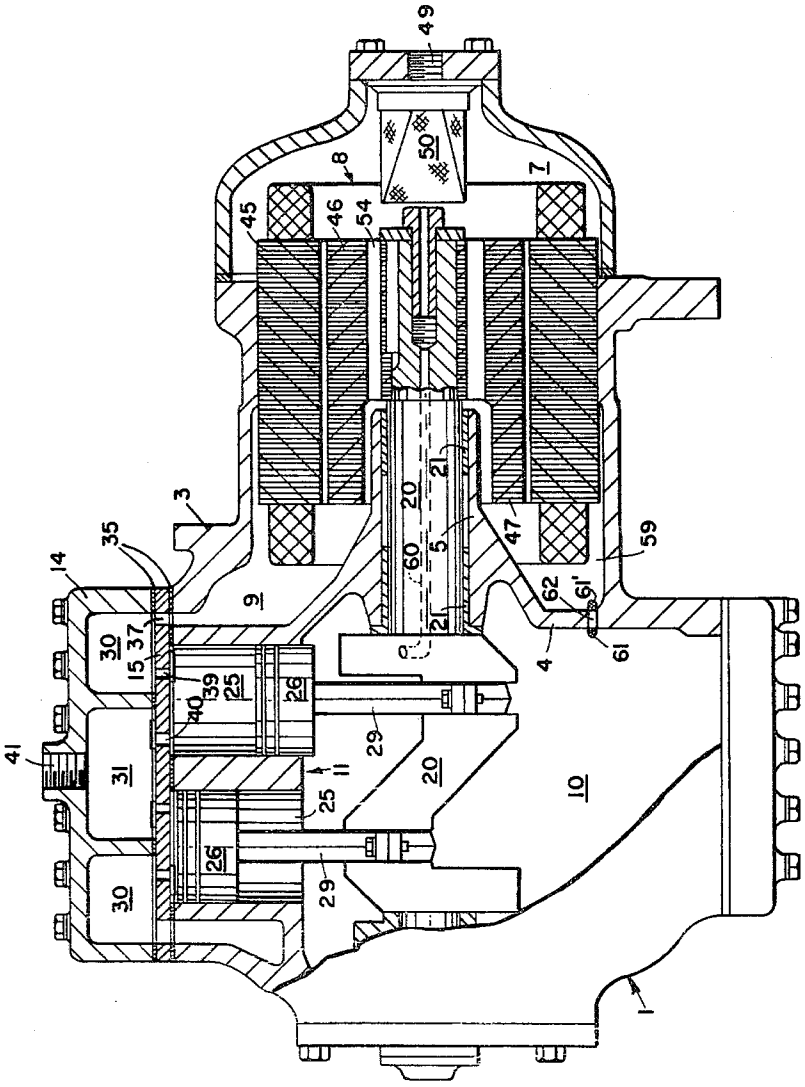
March 1, 1966 D. N. SHAW 3,237,852

HERMETIC MOTOR COMPRESSOR UNIT

Filed July 27, 1964 2 Sheets-Sheet 1

FIG. 1



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HERMETIC MOTOR COMPRESSOR UNIT

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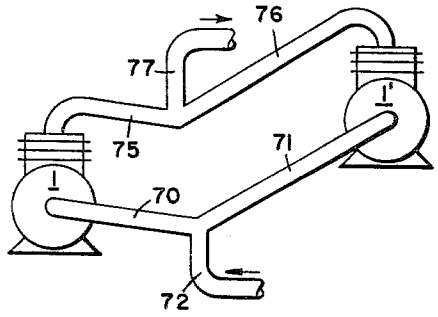


FIG. 2

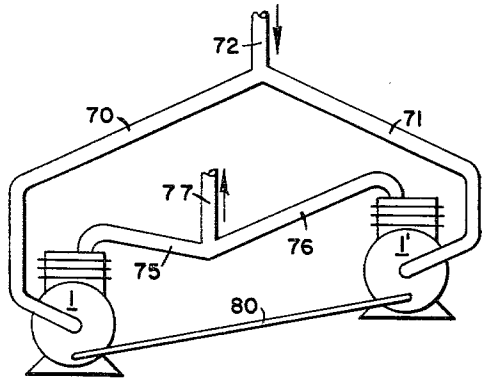


FIG. 3

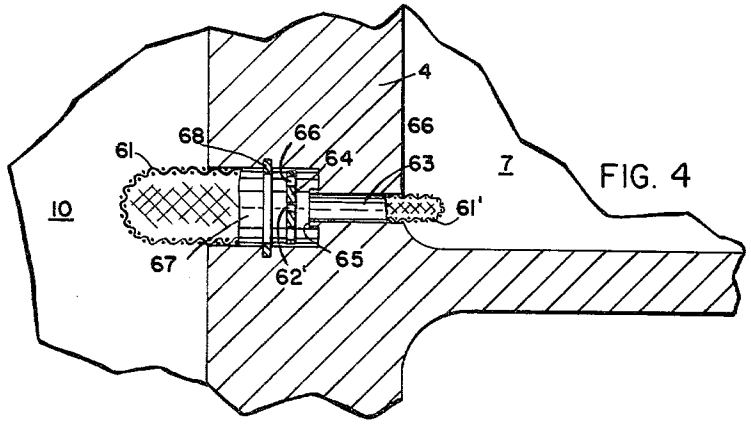


FIG. 4

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HERMETIC MOTOR COMPRESSOR UNIT

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16 Claims. (Cl. 230—206)

This invention relates to hermetic motor compressors, and more particularly, to a lubrication arrangement for hermetic motor compressors.

In hermetic motor compressor units, the compressor drive motor is located in a compartment separated from the compressor crankcase, the lowermost part of which forms a lubricant reservoir or sump. To cool the compressor drive motor, suction gas may be brought through the motor compartment in heat exchange relationship with the drive motor, the suction gas thereafter passing into the suction manifold and the compressor. During compressor operation, lubricant from the working parts of the compressor as well as lubricant carried by the suction gas stream may accumulate in the motor compartment. Where excessive, the accumulated lubricant impairs operation of the compressor drive motor. Lubricant accumulated in the motor compartment is unavailable to the compressor lubrication system.

Heretofore, efforts have been concentrated on returning any lubricant in the motor compartment as expeditiously and effectively as possible to the compressor crankcase sump, usually through the use of a check valve controlled passage between the compressor motor compartment and the crankcase. When pressures in the compressor crankcase compartment are less than the pressures in the motor compartment, the check valve opens and lubricant in the motor compartment drains into the crankcase. To facilitate operation of the check valve control, various arrangements have been proposed to reduce pressures in the compressor crankcase below pressures prevailing in the motor compartment. One such arrangement is shown in Patent No. 2,673,026, issued on March 23, 1954, to Karl M. Gerteis. Other known arrangements utilize fans or ejector mechanisms to establish the pressure differential necessary to insure opening of the check valve to permit lubricant in the compressor motor compartment to drain to the compressor crankcase.

In systems employing multiple compressors, lubricant may accumulate in one or more of the compressors at the expense of the other compressor or compressors. Known systems for maintaining substantially equal amounts of lubricant in each compressor in a multiple compressor system are many and varied; all are involved, expensive, and most require that the compressors be at a common level, the latter often presenting a serious installation problem. One known system, for example, specifies that all compressors be installed at a common level and provides relatively large diameter equalizing lines between each of the several compressor crankcases.

It is a principal object of the present invention to provide a radically new and improved lubrication system for hermetic motor compressors which obviates the deficiencies of prior art constructions.

It is a further object of the present invention to provide a lubrication system for hermetic compressors which dispenses with the usual check valve control of the lubricant return passage between compressor motor and crankcase compartments, and correspondingly with the need for mechanisms for artificially reducing crankcase pressures to insure effective operation of the check valve controlled lubricant return passage.

It is a further object of the present invention to provide a unique compressor lubrication system which removes excess lubricant from the compressor crankcase.

It is an object of the present invention to provide a novel lubricating system for hermetic motor compressors in which compressor crankcase pressures are deliberately maintained greater than motor compartment pressures, the resulting pressure differential forcing excess lubricant from the compressor crankcase into the motor compartment for entrainment in the suction gas stream.

It is an additional object of the present invention to provide a compressor lubrication system which obviates in multiple compressor arrangements the necessity that the several compressors be disposed at equal or predetermined heights relative to one another.

This invention relates to a hermetic motor compressor apparatus comprising in combination a housing partitioned into a first compartment with compression means disposed therewithin and a second compartment communicating the compression means suction side with a source of suction gas, the first compartment forming a reservoir for compression means lubricant, means for controlling the amount of lubricant in the first compartment reservoir, the lubricant controlling means including an overflow passage commuicating the first compartment with the second compartment, and means for establishing a pressure differential between the first and second compartments adjacent the overflow passage to force excess lubricant through the overflow passage into the second compartment.

The invention further relates to a closed system having relatively high and low pressure sides, comprising in combination at least two compressors; each of the compressors including a housing forming a crankcase compartment, with compression means therein, and a suction compartment in communication with the compression means suction side, the crankcase compartment forming a reservoir for lubricant; a first conduit connecting the suction compartment of each of the compressors with the low pressure side of the system; a second conduit connecting the discharge side of each of the compressors with the high pressure side of the system; and means for maintaining substantially equal amounts of lubricant in each of the compressors to prevent lubricant starvation of one compressor including means subjecting the crankcase compartment of each of the compressors to system low side pressure, the housing of each of the compressors having a lubricant overflow passage communicating the crankcase compartment with the suction compartment, and means for reducing pressure in the suction compartment of each of the compressors opposite the lubricant overflow passage to drive excess lubricant through the overflow passage into the compressor suction compartment and the system.

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

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

FIGURE 2 is a schematic view illustrating a multiple compressor arrangement incorporating the lubrication system of the present invention;

FIGURE 3 is an alternate embodiment of a multiple compressor arrangement incorporating the lubrication system of the present invention; and

FIGURE 4 is a fragmentary view of a hermetic motor compressor unit showing a modified form of the lubricant control passage.

Referring to FIGURE 1 of the drawings, numeral 1 designates generally a reciprocating compressor of the hermetic type embodying the present invention. Compressor 1 includes an outer shell or housing 3 partitioned

into a motor compartment 7, having motor 8 therein, and crankcase 10, having compression means 11 therein by partition member 4. 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 journaled 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.

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

A valve plate 15 tightly abuts housing 3 and partition member 4 opposite cylinders 25. Cylinder head 14, separated into suction and discharge manifolds 30, 31, respectively, tightly abuts valve plate 15. Suitable sealing means 35 may be provided between valve plate 15 and housing 3 and partition member 4, and between valve plate 15 and cylinder head 14. Suitable openings 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, suitably fixed to crankshaft 20, overlaps the extended portion of bearing support 5 at 47.

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 therethrough. During compressor operation, relatively low pressure suction gas is drawn through opening 49 and filter 50, through passages 54 and the space between motor stator 45 and rotor 46 into passage means 37 and suction manifold 30. Gas in suction manifold 30 passes through suction openings 39 in valve plate 15 into cylinders 25 of compression means 11. Relatively high pressure gas from compression means 11 discharges through openings 40 in valve plate 15 into discharge manifold 31.

Crankcase 10 serves as a sump or reservoir 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 lubricant overflow orifice or passage 62 is provided in partition member 4 between motor compartment 7 and crankcase compartment 10. Lubricant in crankcase compartment 10 above the level of passage 62 flows through passage 62 into motor compartment 7 for entrainment in the stream of suction gas flowing through motor compartment 7 to compression means 11 as will be more fully explained hereinafter. Suitable filtering means 61, 61′ prevent transfer of foreign matter between crankcase compartment 10 and motor compartment 7. Passage 60 in crankshaft 20 communicates compressor crankcase compartment 10 with motor compartment 7 at suction gas opening 49.

The suction gas flowing through the relatively restricted motor rotor passages 54 and the space between stator 45 and rotor 46 undergoes a drop in pressure. As a result, pressure in motor compartment 7 at suction gas opening 49 is greater than the pressure in motor compartment 7 between motor 45 and suction gas openings 37, designated generally by numeral 9 in FIGURE 1 of the drawings. Crankcase passage 60 maintains pressures in crankcase compartment 10 slightly above the pressure in area 9 of motor compartment 7.

Should the lubricant level in the crankcase compartment 10 rise to the level of overflow passage 62, the pressure differential between crankcase compartment 10 and area 9 of motor compartment 7 causes lubricant to flow through passage 62 into motor compartment 7. A portion of the lubricant in motor compartment 7 is entrained in the stream of suction gas flowing therethrough and passes with the suction gas through openings 37 into suction manifold 30 and cylinders 25.

A part of the entrained lubricant entering compression means 11 with the suction gas stream passes therethrough to the crankcase compartment sump. Applicant believes that lubricant drawn into the cylinders 25 with the suction gas stream deposits on the walls of cylinders 25, the wiping or scraping action of the piston rings returning the lubricant to the crankcase sump. Additionally, blow-by past the piston rings during the compression stroke may carry lubricant in cylinders 25 into the crankcase sump. That lubricant entrained with the relatively high pressure gas discharged from the compressor returns through the system to motor compartment 7 by means of suction gas opening 49 where the compressor 1 is part of a closed system, such as a refrigeration system.

In the construction illustrated in FIGURE 1 of the drawings, excess lubricant flows through passage 62 into motor compartment 7 and entrainment in the stream of suction gas flowing therethrough to suction manifold 30. In the alternative, the excess lubricant may be passed directly to the suction manifold 30 by suitable conduit means between the crankcase compartment 10 and manifold 30. In this alternate arrangement, the passage 62 is dispensed with.

Referring to FIGURE 2 of the drawings wherein like numerals refer to like parts, a multiple compressor arrangement utilizing plural compressors incorporating applicant's new and improved lubrication system is therein shown. Each of the compressors 1, 1′ are connected at the motor end to suction gas header 72 by conduits 70, 71, respectively. Conduits 75, 76 communicate the discharge side of compressors 1, 1′, respectively with discharge gas header 77. To obviate trapping of lubricant in the off-compressor during operation of the other compressor, suction conduits 70, 71 and discharge conduits 75, 76 slope upwardly in the direction of compressors 1, 1′.

Where one of the compressors 1, 1′ is idle, the upwardly rising slope of the suction and discharge conduits thereof effectively prevents lubricant entrained in the suction and discharge gas streams flowing to and from the operating compressor from passing through the suction and discharge conduits associated with the idle compressor into that compressor. While the arrangement of FIGURE 2 utilizes plural compressors 1, 1′, it is understood that additional compressors may be similarly arranged. It may be also understood that the relative height of the several compressors shown in FIGURE 2 of the drawings with respect to one another is unimportant.

In plural compressor arrangements where one or more compressors are idle during operation of the other compressor, pressures in the crankcase compartment of the idle compressor or compressors are normally greater than the pressure in the crankcase compartment of the operating compressor. The multiple compressor arrangement of FIGURE 3 of the drawings wherein like numerals refer to like parts, obviates the requirement that the compressor suction conduits 70, 71 slope upwardly toward the compressor to prevent trapping of lubricant to the idle compressor or compressors as proposed in the embodiment shown in FIGURE 2 of the drawings.

Referring to FIGURE 3 of the drawings, a bleed line 80 is connected between the crankcase compartments 10, 10′ of compressors 1, 1′, respectively. The junction of bleed line 80 with crankcase compartments 10, 10′ of compressors 1, 1′ is preferably at a point slightly above the normal compressor crankcase lubricant level.

Where one of the compressors 1, 1′ is idle, lubricant entrained in the suction and gas streams flowing to the

operating compressor may accumulate in the crankcase compartment of the idle compressor. Should the lubricant level in the crankcase sump of the idle compressor rise to the level of bleed line **80**, the pressure differential between the crankcase compartments of the idle and operating compressors forces the excess lubricant through bleed line **80** to the operating compressor sump. By this arrangement, excess accumulations of lubricant in the idle compressor or compressors of a multiple compressor system at the expense of lubricant in the operating compressor or compressors is obviated. It is understood that additional compressors are similarly connected; and further, that the relative height of the several compressors of the multiple compressor arrangement is immaterial.

Referring to FIGURE 1 of the drawings on shutdown of the compressor **1**, pressure in motor compartment **7** and crankcase compartment **10** tends to equalize. Lubricant accumulated in the motor compartment **7** during compressor operation returns through orifice or passage **62** into crankcase **10**. However, the relatively small diameter of lubricant overflow passage **62** limits the rate of flow of lubricant therethrough. It may be desirable to return lubricant in the motor compartment to the compressor crankcase compartment during the period when the compressor **1** is shut down more rapidly than may be effected by passage **62**.

Referring to FIGURE 4 of the drawings wherein like numerals indicate like parts, an arrangement for increasing the effective size of the lubricant overflow passage between motor compartment **7** and crankcase compartment **10** during periods of compressor shutdown is therein shown. An opening **63** is provided in partition member **4**. The end of opening **63** adjacent motor compartment **10** is enlarged at **67** and check valve **64** having orifice **62'** therethrough movably disposed therewithin. A suitable valve seat **65** is provided between opening **63** and enlarged end **67** thereof. Check valve **64** includes additional openings **66** radially spaced from orifice **62'**. Suitable stop means **68** limit movement of check valve **64** in an opening direction.

During operation of the compressor **1**, the pressure differential established between crankcase compartment **10** and motor compartment **7** maintains check valve **64** in sealing engagement with the valve seat **65**. Crankcase compartment **10** accordingly communicates with suction compartment **7** by means of orifice **62'**. On shutdown of the compressor **1**, pressures in crankcase compartment **10** and motor compartment **7** tend to equalize. Lubricant in motor compartment **7** at the time of compressor shutdown may move check valve **64** in an opening direction to uncover the openings **66** to permit lubricant in motor compartment **7** to drain into crankcase compartment **10** through both openings **66** and orifice **62'**.

Applicant has provided a radically new and unique lubrication arrangement for hermetic motor compressors, an arrangement which dispenses with the check valve controlled lubricant return passage common to the prior art, a lubrication arrangement which eliminates the variety of pipes and valves heretofore employed in multi-compressor installations to prevent lubricant starvation of one or more of the compressors, a lubrication arrangement which obviates the requirement that each compressor in a multi-compressor installation be at the same height as that of the other compressor or compressors.

While I 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.

I claim:

1. In hermetic motor compressor apparatus having a housing partitioned into a first compartment with compression means disposed therewithin and a second compartment adapted to communicate the compression means suction side with a source of suction gas, the first compartment forming a reservoir for compression means lubricant, the combination of means for controlling the amount of lubricant in said first compartment reservoir, said lubricant controlling means including an overflow passage communicating said first compartment with said second compartment, and means for establishing a pressure differential between said first and second compartments adjacent said overflow passage to force excess lubricant through said overflow passage into said second compartment.

2. Hermetic motor compressor apparatus according to claim **1** in which said means for establishing a pressure differential includes means for restricting the flow of suction gas through said second compartment.

3. Hermetic motor compressor apparatus according to claim **2** in which said means for establishing a pressure differential includes a passage communicating said first compartment with said suction gas source.

4. Hermetic motor compressor apparatus according to claim **3**, a drive motor for said compression means in said second compartment, said flow restricting means including passages through said drive motor.

5. Hermetic motor compressor apparatus according to claim **4**, a crankshaft connecting said drive motor with said compression means, said pressure differential means passage being disposed in said crankshaft.

6. Hermetic motor compressor apparatus according to claim **1** in which said lubricant control means includes means for varying the size of said overflow passage in response to a predetermined change in said pressure differential.

7. In hermetic motor compressor apparatus, the combination of a housing partitioned into a suction compartment and a crankcase compartment, compression means in said crankcase compartment, said crankcase compartment forming a lubricant sump, means subjecting said crankcase compartment to suction gas pressure, said housing having a lubricant overflow passage communicating said crankcase compartment with said suction compartment, and means for reducing pressure in said suction compartment adjacent said overflow passage to cause excess lubricant in said crankcase compartment sump to pass through said lubricant overflow passage into said suction compartment.

8. Hermetic motor compressor apparatus according to claim **7**, a drive motor in said suction compartment operably connected to said compression means, said pressure reducing means including passage means in said drive motor.

9. Hermetic motor compressor apparatus according to claim **8** in which said means subjecting the crankcase compartment to suction gas pressure comprises a passage connecting said suction compartment with said crankcase compartment.

10. Hermetic motor compressor apparatus according to claim **9**, a crankshaft connecting said drive motor with said compression means, said suction gas passage being disposed in said crankshaft.

11. In hermetic motor compressor apparatus, the combination of a housing, partition means separating said housing into a crankcase compartment and a suction compartment having an opening therein adapted to communicate with a source of suction gas, said crankcase compartment forming a reservoir for lubricant, said partition means having an opening therein between said crankcase and suction compartments to accommodate the flow of lubricant between said crankcase compartment reservoir and said suction compartment, compression means in said crankcase compartment, a motor disposed in said suction compartment in the stream of suction gas flowing through said suction compartment to said compression means suction side, said motor having passage means to accommodate the flow of suction gas therethrough, a crankshaft journaled in said partition means operably connecting said motor to said compression means, and a passage in said crankshaft connecting

said crankcase compartment with said suction gas compartment adjacent said suction gas opening whereby pressure in said crankcase compartment drives excess lubricant in said crankcase compartment sump through said partition means opening into said suction compartment for entrainment in the stream of suction gas passing therethrough to said compressor suction side.

12. In a closed system having relatively high and low pressure sides, the combination of at least two compressors, each of said compressors including a housing forming a crankcase compartment having compression means therein and a suction compartment in communication with the compression means suction side, the crankcase compartment forming a reservoir for lubricant, a first conduit connecting the suction compartment of each of said compressors with the low pressure side of said system, a second conduit connecting the discharge side of each of said compressors with the high pressure side of said system, and means for maintaining substantially equal amounts of lubricant in each of said compressors to prevent lubricant starvation of one compressor including means subjecting each of said compressor crankcase compartments to system low side pressure, each of said compressor housings having a lubricant overflow passage connecting the crankcase compartment with the suction compartment, and means for reducing pressure in each of said compressor suction compartments adjacent the lubricant overflow passage to force excess lubricant through said overflow passage into the compressor suction compartment and the system.

13. A closed system according to claim 12 in which the junction of said first conduits with said system low pressure side is disposed below the junction of said first conduits with their associated compressor suction compartments.

14. A closed system according to claim 12 in which the junction of said second conduits with said system high pressure side is disposed below the junction of said second conduits with their associated compressor discharge sides.

15. A closed system according to claim 12 including a conduit interconnecting said compressor crankcase compartments, said conduit being connected to said compressor crankcase compartments at a predetermined lubricant reservoir level.

16. A closed system according to claim 12 in which said lubricant maintaining means includes control means operable in response to a predetermined pressure differential between said crankcase and suction compartments to vary the dimension of said lubricant overflow passage.

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ROBERT M. WALKER, *Primary Examiner.*