Oct. 2, 1951 J. E. LANCASTER ET AL 2,570,134

DEGASIFYING MEANS IN THE LUBRICATION SYSTEM OF ELASTIC FLUID COMPRESSORS

Filed June 1, 1949 4 Sheets-Sheet 1

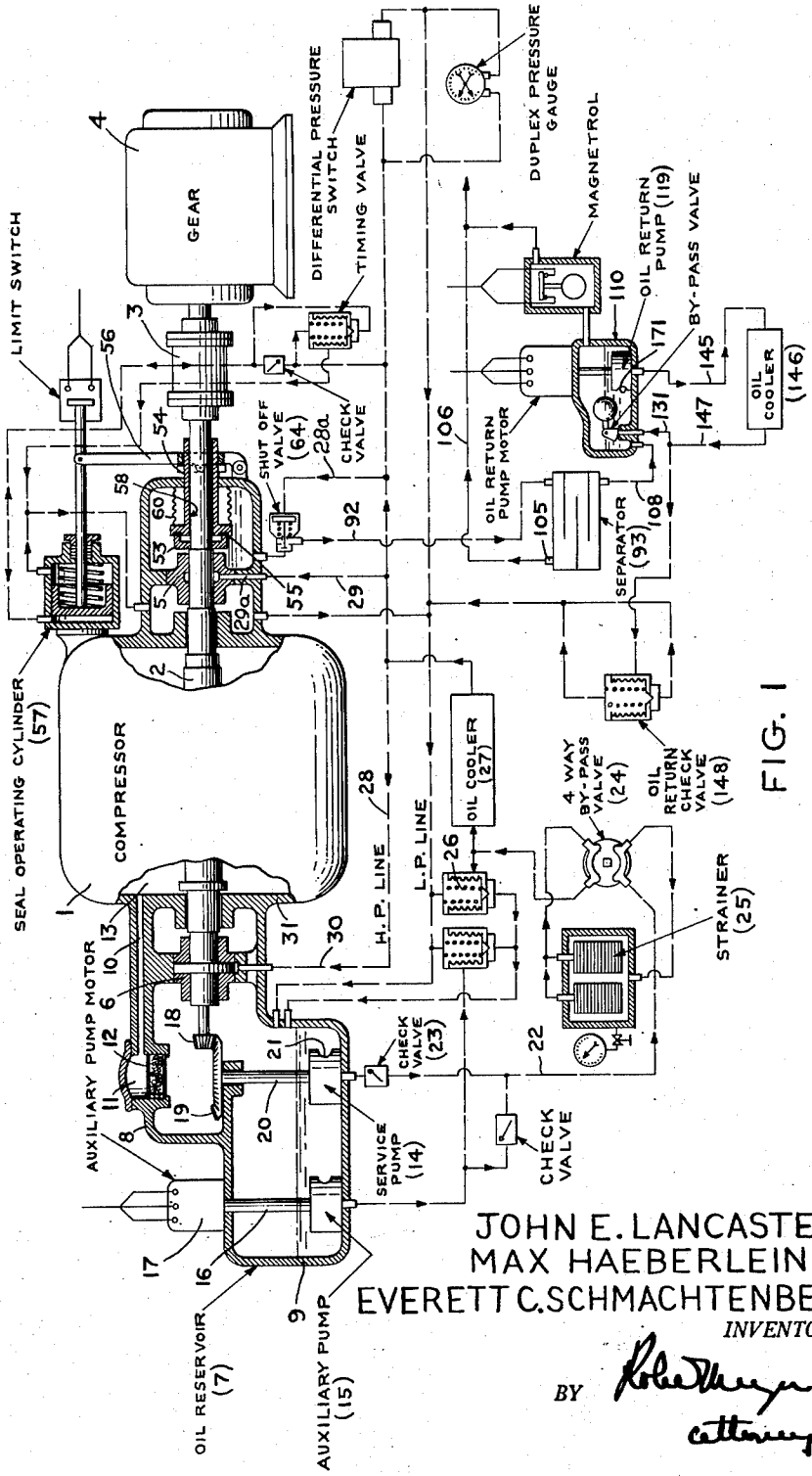


FIG. 1

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DEGASIFYING MEANS IN THE LUBRICATION SYSTEM OF ELASTIC FLUID COMPRESSORS

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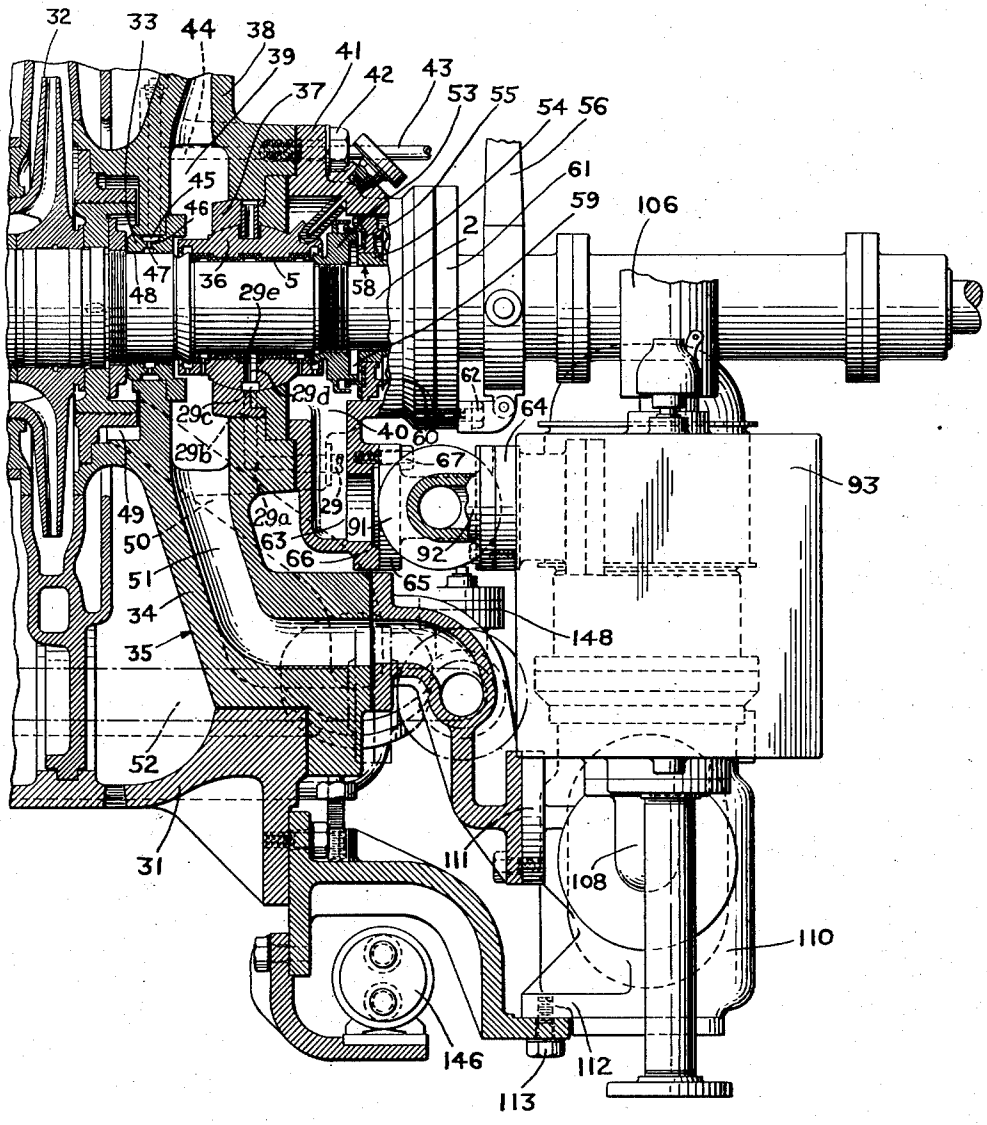


FIG. 2

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DEGASIFYING MEANS IN THE LUBRICATION SYSTEM OF ELASTIC FLUID COMPRESSORS

Filed June 1, 1949 4 Sheets-Sheet 3

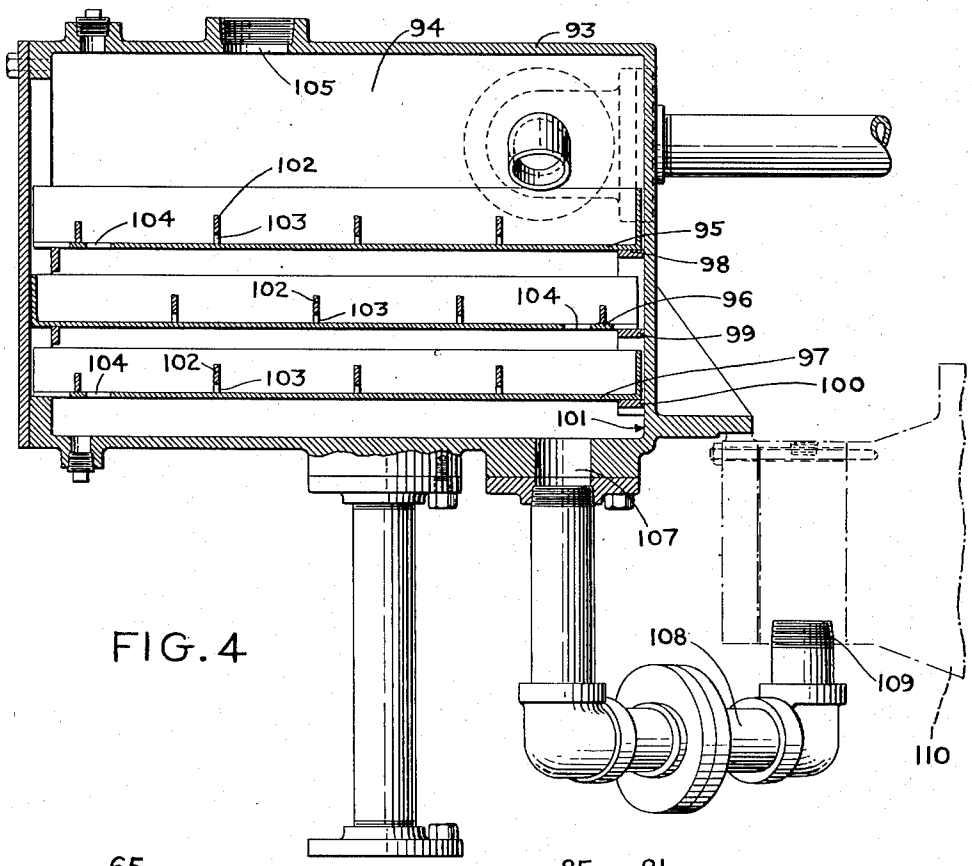


FIG. 4

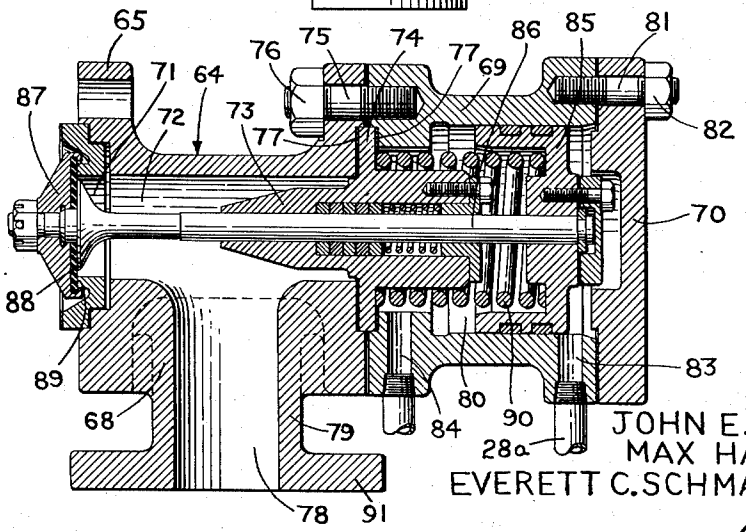


FIG. 3

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DEGASIFYING MEANS IN THE LUBRICATION SYSTEM OF ELASTIC FLUID COMPRESSORS

Filed June 1, 1949 4 Sheets-Sheet 4

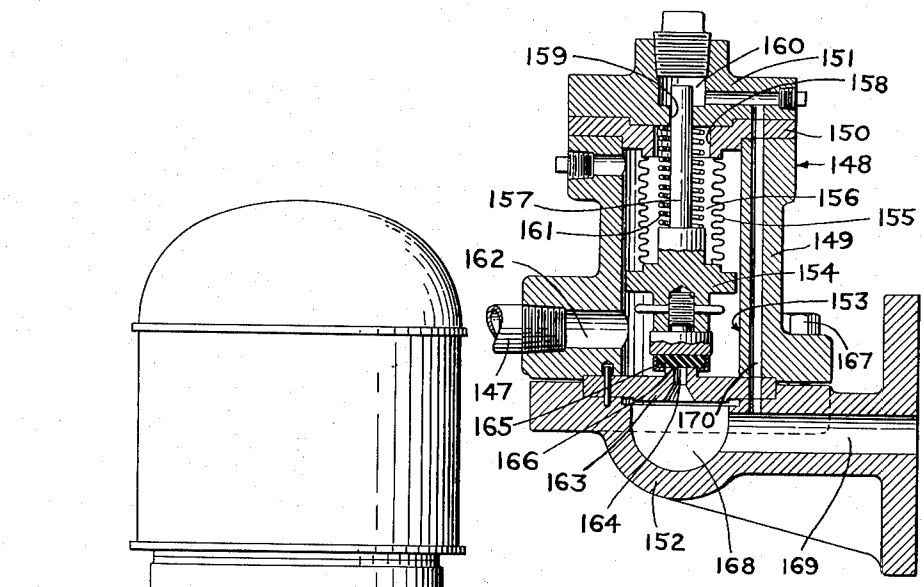


FIG. 6

FIG. 5

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UNITED STATES PATENT OFFICE

2,570,134

DEGASIFYING MEANS IN THE LUBRICATION SYSTEM OF ELASTIC FLUID COMPRESSORS

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Application June 1, 1949, Serial No. 96,438

11 Claims. (Cl. 230—207)

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This invention relates generally to elastic fluid compressors and more particularly to a means for separating absorbed refrigerants from the lubricant circulated in the lubrication system of an elastic fluid compressor.

While it is not intended to so limit the present invention, it is particularly applicable to centrifugal compressors used in refrigerating apparatus for compressing the vapors of volatile liquid refrigerants such for example as trichlorofluoromethane, methylene chloride, etc., wherein the refrigerant vapors are delivered to the suction inlet side of the compressor at pressures above atmospheric pressure.

Centrifugal compressors and elastic fluid compressors so used are provided with a lubrication system which is one of two general types, namely, splash feed or force feed, wherein a suitable lubricant is utilized. Many of these lubrication systems perform additional functions over and above that of lubricating the contacting surfaces such for example as, acting as a cooling medium for the compressor bearings, acting as inner sealing means, and hydraulically operating various controls by the pressure of the lubricant.

In force feed systems, when the lubricant has the additional function of acting as an inner sealing means or for any reason comes into contact with the refrigerant vapor, varying quantities of refrigerant vapor will be absorbed and desorbed by the lubricant under varying conditions of temperature and pressure.

Absorption of refrigerant vapors however adversely affects the physical properties of the lubricant. Accordingly, it is highly desirable to design the compressor whereby the absorption will be minimized or means will be provided to remove the absorbed refrigerant or a combination of both are provided.

Where the system is constructed to minimize the absorption elevated pressures and temperatures may be chosen so that at the equilibrium point for a given temperature and pressure, that is, the point where the refrigerant vapors going into the lubricant will equal the amount of refrigerant vapors escaping from the lubricant, the absorbed refrigerant vapors will not adversely affect the physical properties of the lubricant being used.

However, it has been found that in systems of this type wherein elevated pressures are utilized that small differences in pressure must be maintained in different sections of the lubrication system as any large pressure drops will cause a flashing or effervescing of the lubricant due to the

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escape of absorbed refrigerant vapor. In effect, that produces a lubricant having a whiplike or foamlike consistency and it cannot be pumped through the lubrication system in this condition. Where this occurs in the system the lubricant must be separated from the refrigerant vapor, rehabilitated and thereafter returned for reuse.

Accordingly, it is an object of the present invention to provide a novel arrangement whereby the amount of refrigerant vapor absorbed by the lubricant may be substantially controlled.

It is another object of the present invention to provide a means for degasifying and rehabilitating lubricant which has passed into a reduced pressure zone for reuse in the lubrication system.

It is another object of the present invention to control the pressure in the lubrication system not under reduced pressure so that there will be small differential pressures therein.

With these and other objects in view as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a degasifying means in the lubrication system of elastic fluid compressors of a preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawings:

Figure 1 is a diagrammatic sketch of a typical compressor system.

Figure 2 is a partial section of the inboard end of a compressor showing the invention.

Figure 3 is a cross-section of the shutoff valve.

Figure 4 is a cross-section of the gas separator.

Figure 5 is a partial cross-section through the float housing assembly.

Figure 6 is a cross-section through the oil return check valve.

Referring more particularly to the drawings, Figure 1 shows a diagrammatic sketch of a typical compressor system showing a compressor 1 having a rotor 2 connected by a coupling 3 to step-up gears 4 connected in turn to a prime mover (not shown) which may be of any suitable type for operating the compressor 1. The step-up gears 4 and the coupling 3 may also be of any suitable type easily purchasable on the open market and are therefore generically indicated. The rotor 2 provided for the compressor 1 has a line bearing 5 at the inboard end and a thrust bearing 6 at the outboard end outwardly of the casing 31 to allow for relatively frictionless rotation of the rotor 2. It being understood

that while this type of compressor is shown and described that any typical compressor utilizing a lubrication system where the lubricant will contact the refrigerant resulting in absorption and contamination of the lubricant would suffice to describe this invention.

The lubrication system supplying the lubricant indicated in Figure 1 shows a fully enclosed oil or lubricant reservoir 7 formed by an upper portion 8 and a lower or sump portion 9, mounted on the outboard or thrust bearing end of the compressor 1. A balance line 10 is provided which communicates at one end with a filter chamber 11 having a strainer 12 located in the upper portion 8 of the reservoir 7 and at the other end opens into the suction inlet 13 of the compressor 1 whereby means is provided to balance the pressure in reservoir 7 and to return refrigerant vapor released by the lubricant in the reservoir to the suction side of the compressor to avoid loss thereof. Strainer 12 is provided to prevent the escape of oil vapor which develops in the reservoir 7.

The lower or sump portion 7 carries the service pump 14 and the auxiliary pump 15 utilized for supplying oil or other lubricant therein at high pressure to the lubrication system. Service pump 14 and the auxiliary pump 15 are preferably rotary pumps, although other types of pumps suitable for this purpose may be utilized.

Auxiliary pump 15 is driven by a shaft 16, connected to an electric motor 17 and is utilized to provide lubricant at high pressure to the lubrication system when starting up, shutting down or in case of failure of the service pump 14. An automatic pressure switch (not shown) being provided to start the auxiliary pump motor 17 when the pressure in the service pump 14 falls below a predetermined level.

Figure 1 further shows the rotor 2 having a bevel gear 18 at the end thereof which drives a stepdown bevel gear 19 fixedly connected to a shaft 20 which is in turn connected to the service pump 14. Thus means is provided for driving the service pump 14 for as the rotor 2 turns when the compressor 1 is started up it drives bevel gears 18 and 19 rotating the shaft 20 which in turn drives the service pump 14.

Oil or other lubricant will accordingly be drawn from the lower or sump portion 9 into an opening 21 in the service pump 14 as it rotates. It is discharged from the service pump at high pressure into a conduit 22 having a check valve 23 therein. Thereafter the oil is forced through a four-way by-pass valve 24 into a strainer member 25. It is returned from the strainer member 25 to the four-way by-pass valve 24 and is then passed simultaneously to a pressure control assembly 26 provided to by-pass a quantity of lubricant back to the reservoir to maintain a fixed differential pressure across the bearings of the service pump 14 and to a lubricant or oil cooler 27. It is led from the cooler 27 to the high pressure line 28. High pressure line 28 in turn conducts the lubricant to various portions of the compressor 1 which utilizes the high pressure lubricant such as line bearing 5 and thrust bearing 6, etc., which are supplied by their respective conduits 29 and 30, etc.

The degasifying system may be divided into two portions, one portion of the system lying inwardly of the line bearing 5 and the other portion of the system lying outwardly of the line bearing 5. The first portion of the system operates at elevated pressures and therefore cannot be truly a degasifying system. It operates, however, in conjunction with or as a portion thereof in that it will control the amount of refrigerant vapor absorbed by controlling the equilibrium point. While the second portion of the system corrects the difficulty resulting when the lubricant is passed to a zone of reduced pressure as is hereinafter described.

Line bearing 5 is indicated in Figure 2 and is constructed and arranged to coordinate with these two portions of the system in that it passes the greater portion of the lubricant to the first portion of the system or inwardly of itself.

Figure 2 shows a portion of the inboard end of compressor 1 having a casing 31, and the final stage impeller 32 carried by the rotor 2. Rotor 2 passes outwardly from the casing 31 to the coupling 3 shown in Figure 1 through a distributor or lantern gland 33 mounted in the inner wall 34 of the inboard end cover portion 35 of the casing 31 and through the line bearing 5 mounted in an inner line bearing support 36 and an outer line bearing support 37 supported in turn by the outer wall 38 of the inboard end cover portion 35. A substantially annular first chamber 39 is formed between the inner wall 34 and the outer wall 38 around the rotor 2 passing therethrough.

A second chamber 40 is formed outwardly of the line bearing 5 by a line bearing housing 41 fixedly connected to the outer wall 38 of the inboard end cover portion 35 by suitable means such as bolts 42.

Figure 2 further shows the distributor or lantern gland 33 constructed and arranged to serve the dual purpose of cooling and dissipating the heat of the discharge vapor of the final stage lying inwardly thereof as is more fully shown and described in co-pending application Serial No. 56,946 and of controlling the amount of refrigerant vapor being compressed that is supplied to the first chamber 39 and also of maintaining the first chamber at a pressure above suction inlet pressure to aid returning mixed lubricant and refrigerant vapor therein to the reservoir which is under suction inlet pressure through the connection of the balance line 10. This is accomplished by a conduit 43, a fragment of which is shown in Figure 2 which has its inlet (not shown) at any predetermined point within the compressor casing 31 where the pressure is greater than suction inlet pressure and its outlet connected to passage 44 leading to the distributor or lantern gland 33 all of which is fully shown and described in the co-pending application Serial No. 56,924 now abandoned.

Passage 44 passes through the inboard end cover portion 35 to the distributor or lantern gland 33 which is provided with an annular passage 45 on its outer perimeter into which the refrigerant vapor is delivered. A plurality of radially extending circumferentially spaced openings 46 connect the annular passage 45 with an inner annular lantern gland passage 47. The inner annular lantern gland passage 47 extends about the rotor 2 and if it is desired the inner surface of the gland 33 may be serrated as shown at 48 to facilitate the distribution of the refrigerant vapor delivered thereto along the rotor 2 in both directions.

Inwardly of lantern gland 33 is an annular gas collecting chamber 49 which serves to collect the discharge vapors leaking outwardly along the rotor 2 from the last stage on the compressor stage and inwardly along the rotor 2 from the

lantern gland 33. Connected to the collecting chamber 49 is a vapor return conduit 50 which will return the refrigerant vapors to the suction inlet side of the compressor 1.

Outwardly of the lantern gland 33 is the first chamber 39. Refrigerant vapor will therefore pass outwardly from the lantern gland 33 along the rotor 2 into the first chamber whereby the pressure of the first chamber will be above that of suction inlet pressure to create a small differential pressure to aid in returning lubricant therefrom as hereinafter described.

Figure 2 also shows first chamber 39 having a downwardly extending dashpot 51 connected to one end of a lubricant return conduit 52 which has its outlet connected to the reservoir 7.

Thus, high pressure lubricant is conducted to line bearing 5 by conduit 29 connected to a passage 29a in the outer wall of the inboard end cover 35. Passage 29a passes the lubricant to a radial opening 29b, continues therewith and extending through the outer line bearing support member 37. Radial opening 29b communicates with an annular recess 29c in the inner support member 36, suitable radial passages 29d being provided to pass the lubricant to the inner annular line bearing passage 29e from the annular recess 29c. The pressure of the lubricant passes the fluid along the rotor 2 inwardly and outwardly of line bearing 5. The greater portion passes inwardly to the first chamber 39 where it acts as an inner sealing means to prevent refrigerant vapor from passing outwardly of the first chamber 39. It can be readily seen, however, that while the lubricant acts as inner sealing means in the first chamber 39 it will be in intimate relationship with the refrigerant vapor and will accordingly absorb a portion of the refrigerant vapor which will depend on the temperature and pressure prevailing therein. However, dashpot 51 and return conduit 52 are made sufficiently large so as to provide easy returning means for the mixed lubricant and refrigerant vapor in the first chamber 39 by a combination of gravity flow and the differential pressure which progressively reduces from the pressure in the first chamber 39 to the suction inlet pressure prevailing in the reservoir 7. Desorption of refrigerant vapor will not cause effervescing in this portion of the degasifying system and all released refrigerant vapor passing into the reservoir will be easily passed through the balance line 10 back to the suction inlet side of the compressor. Additional desorption means may be provided in the reservoir 7 in the form of heater elements (not shown) which will help in removing absorbed refrigerant vapor especially when starting up before the lubricant has reached operating temperature.

When the lubricant is forced inwardly along the rotor 2 from the line bearing 5 into the first chamber 39, the pressure change from system pressure to the pressure which prevails in the first chamber 39 will be relatively small. Therefore, little or no effervescing of absorbed refrigerant vapor will occur. However, when the lubricant is forced outwardly along the rotor 2 from the line bearing 5 into the second chamber 40 there is a large difference in pressure as the second chamber 40 is at substantially atmospheric pressure as hereinafter described which causes the absorbed refrigerant to effervesce, giving the lubricant a substantially whip-like consistency. This necessitates the second portion of the degasifying system which separates the refrigerant vapors, rehabilitates the lubricant and returns it for reuse in the system all of which is shown in Figure 2 of the drawings and the component parts of this portion of the system indicated in Figures 3, 4, 5, and 6.

Figure 2 shows second chamber 40 as substantially annular in shape and formed around the rotor 2 which of necessity passes through the line bearing housing 41 to reach the coupling 3.

Where the rotor 2 passes through the line bearing housing 41, it passes to atmospheric pressure. Accordingly a shutdown seal mechanism is provided to prevent the refrigerant vapors from escaping when the compressor is at rest. This mechanism is more fully shown and described in the copending application Serial No. 84,578.

More generally it comprises a sealing collar 53 fixedly connected to the rotor 2 and a sealing sleeve 54 slidably mounted on the rotor 2 inside the line bearing housing 41. A rubber insert 55 is provided on the sealing sleeve 54 for engagement with the sealing collar 53. Sealing sleeve 54 extends outwardly of the line bearing housing 41 along the rotor 2 to contact a lever 56. Lever 56 will be moved inwardly and outwardly by seal operating cylinder 57 in turn actuated by high pressure lubricant fluid when the compressor is in operation. As the lever 56 is moved inwardly and outwardly the sealing sleeve 54 will be moved inwardly and outwardly causing the rubber insert 55 to move into and out of contact with the sealing collar 53 to seal the compressor when it is shut down.

Under normal operation the rubber insert 55 will not be in contact with sealing collar 53 if the compressor is operating. Therefore, a passage 58 will exist between the sealing sleeve 54 and the rotor 2 which will connect the second chamber 40 to atmosphere by a tortuous opening 59 formed when the rubber insert 55 is not in contact with the sealing collar 53.

A Sylphon bellows member 60 is also provided having one end connected to that portion of the sealing sleeve 54 inside the line bearing housing 41 and the other end connected to a back plate 61 forming part of the line bearing housing and fixedly connected thereto by suitable means such as bolts 62 to prevent excessive quantities of refrigerant vapors from escaping to atmosphere from the second chamber 40.

Second chamber 40 is also provided with a downwardly extending dashpot 63. A shutoff valve 64 is provided with a flange 65 which is fixedly connected to the outlet 66 of the dashpot 63 by suitable means such as bolts 67 as is shown in Figure 2 of the drawings. Shutoff valve 64 is shown in Figure 3 of the drawings as substantially cylindrical in shape comprising an upper housing 68, a lower housing 69 and a closure member 70. Upper housing 68 is provided with a valve port 71 at one end thereof which communicates with a bore 72 passing through said upper housing and a valve stem guide 73 closes the other end of said bore 72 by means of a flange 74 held in fluid tight engagement by the lower housing 69 which is fixedly connected to the upper housing by suitable means such as studs 75 and nuts 76. Gaskets 77 being inserted between each of said members to insure said fluid tight engagement. A side outlet passage 78 communicates with the bore 72 and is formed in a side member 79 formed on the upper housing 68.

Lower housing 69 is provided with an annular chamber 80 which is closed at one end by the valve stem guide 73 above described and at the

other end by the closure plate 70 fixedly connected in fluid tight engagement to the lower housing by suitable means such as studs 81 and nuts 82. Chamber 80 is also provided with an inlet port 83 and a return and balancing port 84.

A piston 85 is slidably mounted in the said chamber 80 and is connected to one end of a valve stem 86. Valve stem 86 extends through the valve guide 73 into bore 72 in the upper housing 68 and is fixedly connected at its other end to a valve head 87. Valve head 87 is provided with a rubber-like insert 88 on the under side thereof for air tight engagement with valve seat 89 formed on the flange portion 65 of the shutoff valve. Thus as the piston 85 slides inwardly and outwardly the valve stem 86 and the valve head 87 will move accordingly opening and closing the valve port 71.

A piston returning spring 90 is mounted about the valve guide 73 and abuts the flange 74 at one end and the undersurface of the piston 85 at the other end. It will hold the piston in a closed position when the compressor is not in operation or when the pressure in the lubrication system drops below the tension or force exerted by the return spring 90.

High pressure lubricant is delivered to the shutoff valve by a conduit 28*a* connected to the high pressure line 28 and threadably engaging the inlet port 83 of the chamber 80. Thus high pressure lubricant will enter therein when the lubrication system is put into operation and will expand uniformly against the piston 85, forcing the piston inwardly in the chamber 80 and compressing the piston returning spring 90. This will cause the valve stem 86 and valve head 87 to move inwardly, opening the valve port 71. As long as the pressure in the lubrication system remains higher than the tension or force exerted by the compressed piston returning spring 90 the valve port 71 will remain open. However, when the pressure drops below this predetermined point the valve port 71 will close, airtight closure being effected by the rubber-like insert 88 as it seats against the valve seat 89.

Side member 79 formed on the upper housing 68 is provided with a flange 91 which is connected to a transfer conduit 92 having its outlet connected to a gas separator 93 indicated in Figure 2 but more clearly shown in Figure 4 of the drawings.

Gas separator 93 is substantially block-like in structure and constitutes a chamber 94 having a series of trays 95, 96, and 97 spaced vertically therein and supported by their respective brackets 98, 99, and 100 struck from the inner wall 101 of the chamber 94.

The trays are identical in design and are provided with spaced perpendicular baffles 102 with openings 103 therein. Overflow outlets 104 are provided on each of the trays but the trays are so positioned on their respective brackets that the openings 104 are spaced at opposite ends to provide the longest travel for lubricant to pass through to separate as much gas as possible therefrom before returning it to the lubrication system as hereinafter described.

The upper portion of the gas separator 93 is provided with a first outlet 105 which is connected to a leadoff pipe or venting line 106. Only a fragment of venting line 106 is shown in Figure 2 of the drawings, as the venting line 106 may be led to any suitable location which will allow the released or separated refrigerant vapors to pass harmlessly to atmosphere.

At the lowermost portion of the chamber 94 of the gas separator 93 a second outlet 107 is provided. Threadably connected thereto is a connecting conduit 108 which has its outlet end 109 threadably connected to a float housing 110, all of which is clearly shown in Figure 4 of the drawings.

Float housing 110 is indicated in Figure 2 but shown in more detail in Figure 5 of the drawings. It provides means for returning rehabilitated lubricant to the lubrication system at substantially the system pressure which prevails in the lubrication system.

Float housing 110 is provided with a side flange 111 and a lower flange 112 and is mounted thereby to the compressor 1 by suitable means such as bolts 113 as is clearly shown in Figure 2 of the drawings. In Figure 5 it has a substantially block-like housing 114 having a chamber 115 therein comprising a float section 116 and a pump section 117. The float section 116 is positioned slightly above the pump section 117 and is provided with sloping walls 118 so that any lubricant which will enter the float housing 110 as hereinafter described will tend to settle in the pump section 117 of the chamber 115.

The connecting conduit 108 connected to the float housing 110 has its outlet 109, into the float section 116 of the chamber 115. Rehabilitated lubricant may thus flow by gravity flow from the gas separator 93 into the float section 116 via the connecting conduit 108 and will tend to pass to the pump section 117 of the chamber 115 first due to the sloping walls 118 on the float section 116.

Pump section 117 of the chamber 115 contains a pump 119 therein, and although shown in its preferred form as a rotary pump may be any suitable pump easily purchasable on the open market. Pump 119 is connected to a shaft 120 which is rotated by any suitable prime mover 121 such as an electric motor.

The float section 116 of the chamber 115 contains a float lever mechanism responsive to the level of the lubricant in the float housing which actuates a by-pass valve arrangement formed integrally with the float housing and more fully shown and described in the co-pending application Serial No. 145,559 filed February 21, 1950, now abandoned.

Thus, Figure 5 shows a float 122, of any suitable type easily purchasable on the open market connected to a float arm 123 which is pivotally mounted at 124 to a bracket 125 formed on the by-pass valve assembly 126.

By-pass valve assembly 126 is a substantially flat closure-like piece with a side arm 127 formed integrally therewith. On the underside of said side arm 127 is a valve body 128 and a valve stem guide 129 connected to the side arm 127 by suitable means such as bolts 135. The by-pass valve assembly 126 is provided with a by-pass passage 130 which communicates between a by-pass conduit 131 at one end and a by-pass chamber 132 at the other end, formed in the side arm portion 127 of the by-pass valve assembly. Chamber 132 communicates in turn with a valve chamber 133 by means of a valveport 134 in the valve body 128 lying in the axial line of the chamber 132.

Valve chamber 133 is formed by the valve body 128 having an annular hollowed portion which is engaged and closed by the valve stem guide 129 when both members are assembled and fixedly connected to the side arm 127 by means of bolts 135.

Valve guide 129 is provided with a bore 136 therethrough wherein a valve head 137 is slidably mounted for opening and closing the valve port 134. Valve head 137 is connected to a valve stem 138 which is in turn pivotally connected at 139 to the float arm 123. Thus as the float 123 rises and falls with the level of the lubricant valve stem 138 will be moved upwardly and downwardly moving valve head 137 accordingly which will open the valve port 134 and allow fluid to pass from the by-pass chamber 132 into the valve chamber 133 when the lubricant is too low in the float housing and close to prevent lubricant from by-passing into the valve chamber when the lubricant is high therein.

An overflow opening 140 is provided in the valve chamber 133 threadably connected to an overflow pipe 141 so that any fluid by-passed when the valve port 134 is opened will be returned to the chamber 115 of the float housing.

A filling opening 142 and a filling cap 143 are provided for the float housing 110 to supply lubricant to the float housing when starting up. A sight gauge 144 being utilized to determine the level therein.

The lubricant will be forced out of the float housing 110 at system pressure as is hereinafter described into a conduit 145 which passes the lubricant to a lubricant or oil cooler 146 which may be any suitable type of heat exchanging mechanism easily purchasable on the open market. The lubricant will pass from the cooler 146 to a return conduit 147 provided with an oil return check valve 148 therein.

By-pass conduit 131 is shown in Figure 1 as being connected to conduit 147 between the cooler 146 and the check valve 148. It being understood that it may be connected in conduit 145 without changing the operation of the by-pass valve assembly 126. Fluid discharge from pump 119 will be returned to the float housing 110 via conduit 131 when the valve port 134 is opened pursuant to the rise and fall of the float 122.

Oil return check valve 148 is indicated in Figures 1 and 2 of the drawings but more clearly shown in Figure 6 as being substantially cylindrical in shape having a body member 149, a Sylphon bellows support member 150, an upper closure member 151 and a lower closure member 152.

The body member 149 is substantially tubular having an inner bore 153 provided with a piston type valve head 154 slidably mounted therein. Connected between the valve head 154 and the Sylphon bellows support member 150 is a Sylphon bellows member 155 which forms in the inner bore 153, an inner hollow chamber 156. The inner bore 153 receives the support member 150 and the upper closure member 151 in connecting relationship whereby the support member 150, the upper closure member 151 and the body member 149 are held in fluid tight relationship by suitable means (not shown).

Inside the hollow chamber 153 is a valve stem 157 fixedly connected and movable with the valve head 154 which extends upwardly through the hollow chamber, passing through a first opening 158 in the support member 150 and through a second smaller valve stem guide opening 159 in the upper closure member 151 into an upper chamber 160 which can communicate and pass fluid downwardly to the hollow chamber 156 along the valve stem 157.

Mounted about the valve stem 15 in the hollow chamber is a valve returning spring 161 which

abuts the valve head 154 at one end and the upper closure member at the other end, all of which is clearly shown in Figure 6 of the drawings.

In the inner bore 153 an inlet port 162 is provided which threadably engages return conduit 147 whereby returning lubricant will be passed into the inner bore 153 to act uniformly against the piston-like valve head 154.

At the lower portion of the inner bore a valve plate 163 is provided with a valve port 164 therein in the axial line of the valve head 154. Thus, as the valve head 154 is moved up and down in the inner bore 153, valve port 164 will be opened and closed. To insure air tight or fluid tight engagement between the valve port 164 and the valve head 154, a rubber-like insert 165 is provided on the valve head 154 which engages a valve seat 166 formed as a small annular upwardly extending projection on the valve plate 163.

The lower closure member 152 engages the body member 149 whereby the valve plate 163 is held between these said members which are held in fluid tight engagement with each other by suitable means such as bolts 167.

Lower closure member 152 is provided with a lower returning chamber 168 which communicates with the inner bore 153 through the valve port 164 whereby when the valve port 164 is open fluid will pass from the inner bore 153 to the chamber 168. Chamber 168 is in turn connected to return passage 169 which in turn communicates with the lubricant return conduit 52 described with that portion of the system lying inwardly of the line bearing 5. Thus the rehabilitated lubricant will be returned from this portion of the degasifying system to the lubricant reservoir to be received in the lubrication system.

A balanced or connecting passage 170 is provided in the oil return check valve 148 which opens at one end in the return passage 169 and at the other end with upper chamber 160. Thus, whatever pressure prevails on the reservoir side of the check valve will be distributed via the passage 170 to the upper chamber 160 which passes it downwardly along the valve stem 157 through the opening 159 into the hollow chamber 156 whereby the lubricant may act uniformly against the upper or inner side of the piston valve head 154. Since returning lubricant will enter and act against the lower surface a differential pressure arrangement will be developed such that the pressure from the pump or float housing side of the check valve must always be greater than the reservoir side to allow the fluid to return to the lubrication system.

Thus, as fluid moves outwardly or is forced outwardly along the rotor 2 from the line bearing 5 into the second chamber 40 the lubricant will pass from system pressure to atmospheric pressure. Atmospheric pressure is established by two sources, the passage 58 and opening 59 in the shut down seal system and through the dash pot 63, shut off valve 64 connected between the dash pot and the gas separator 93 which is vented to atmosphere via the first outlet 105 and vent piping 106.

When the pressure is so reduced effervescing will occur giving the lubricant a whip-like consistency. It will not, however, tend to pass through the tortuous opening 59 or the passage 58 but will drop by gravity flow through the dash

pot 63 into the shut off valve 64 which will be automatically open as long as there is pressure in the lubrication system as above described. It will also pass outwardly from the shut off valve 64 through the side member 79 and transfer conduit 92 into the gas separator by gravity flow where it is deposited on the uppermost tray 95 in its voluminous whip-like form. As the lubricant separates from the foam or effervesced portion it will fill the lower portion of the tray 95 passing through the openings 103 in the baffles 102 to the outlet 104 to the lower tray where the process is repeated until it is passed to the outlet 107 in the lowermost portion of the gas separator 93. Connecting conduit 108 then leads the rehabilitated lubricant to the float housing 110.

The refrigerant vapor liberated in the gas separator 93 will be led off to atmosphere through the vent piping 106.

In the float housing 110 the lubricant will tend to settle towards the pump portion 117 and as the pump 119 is rotated by the prime mover 121 and driving shaft 120, the oil will be drawn into the pump through opening 171 shown in Figure 1 and discharged at system pressure or at a pressure sufficient to overcome the differential pressure formed by the return spring 161 and the reservoir pressure acting against the upper side of the valve head 154. Thus, the lubricant will pass through line 145 into oil cooler 146 and then to conduit 147 which will return it to the lubricant return conduit 52 connected to the reservoir 7 of the lubrication system. The lubricant return conduit 52 providing a single returning means for both portions of the degasifying system.

While one form of the invention has been illustrated and described, it is obvious that those skilled in the art may vary the details of construction as well as the precise arrangements of parts without departing from the spirit of the invention and therefore it will be understood that the invention is not to be limited to the specific construction or arrangements of parts shown but may be widely modified within the invention defined by the claims.

What is claimed is:

1. In an elastic fluid compressor having a casing, a rotor shaft extending through openings on either side of said casing, a thrust bearing and a line bearing outwardly of said casing to support the rotor shaft, and a lubrication system including a fully enclosed reservoir about said thrust bearing and mounted to said casing in substantially air tight engagement, a service pump in said reservoir, said service pump connected to and operated by the rotor for delivering lubricant at high pressure to said lubrication system, means connecting said reservoir to the suction side of the compressor, and means for conducting high pressure lubricant to said line bearing, the combination with said lubrication system of, a first chamber between said line bearing and said casing communicating with the fluid being compressed, a second chamber outwardly of said line bearing, said line bearing being constructed and arranged to deliver lubricant fluid to said first and second chambers, means for returning mixed lubricant and fluid being compressed to said reservoir, means for degasifying, rehabilitating and returning lubricant from said second chamber to said reservoir, and means connected between said last mentioned means and said second chamber normally maintained open when lubricant at high pressure is being delivered to said line bearing to collect lubricant from said second chamber and pass it to said last mentioned means.

2. In an elastic fluid compressor having a casing, a rotor shaft extending through openings on either side of said casing, a thrust bearing and a line bearing outwardly of said casing to support the rotor shaft, and a lubrication system including a fully enclosed reservoir about said thrust bearing and mounted to said casing in substantially air tight engagement, a service pump in said reservoir, said service pump connected to and operated by the rotor for delivering lubricant at high pressure to said lubrication system, means connecting said reservoir to the suction side of the compressor, and means for conducting high pressure lubricant to said line bearing, the combination with said lubrication system of, a first chamber between said line bearing and said casing communicating with the fluid being compressed, a second chamber outwardly of said line bearing, said line bearing being constructed and arranged to deliver lubricant fluid to said first and second chambers, means for maintaining said first chamber at a pressure above the suction pressure of the compressor, and said second chamber at substantially atmospheric pressure, means for returning mixed lubricant and fluid being compressed to said reservoir, means for degasifying, rehabilitating and returning lubricant from said second chamber to said reservoir, and means connected between said last mentioned means and said second chamber normally maintained open when lubricant at high pressure is being delivered to said line bearing to collect lubricant from said second chamber and pass it to said last mentioned means.

3. In an elastic fluid compressor having a casing, a rotor shaft extending through openings on either side of said casing, a thrust bearing and a line bearing outwardly of said casing to support the rotor shaft, and a lubrication system including a fully enclosed reservoir about said thrust bearing and mounted to said casing in substantially air tight engagement, a service pump in said reservoir, said service pump connected to and operated by the rotor for delivering lubricant at high pressure to said lubrication system, means connecting said reservoir to the suction side of the compressor, and means for conducting high pressure lubricant to said line bearing, the combination with said lubrication system of, a first chamber between said line bearing and said casing communicating with the fluid being compressed, a second chamber outwardly of said line bearing, said line bearing being constructed and arranged to deliver lubricant fluid to said first and second chambers, means for maintaining said first chamber at a pressure above the suction pressure of the compressor, and said second chamber at substantially atmospheric pressure, a first dash pot connected to said first chamber to collect mixed lubricant and fluid being compressed, a return conduit connected to said first dash pot for returning mixed lubricant and fluid being compressed to said reservoir, a second dash pot connected to and forming part of said second chamber, means for degasifying, rehabilitating and returning lubricant from said second dash pot to said return conduit, and means connected between said second dash pot and said last mentioned means nor-

mally maintained open by lubricant at high pressure from said lubrication system to allow lubricant collected from said second chamber to pass to said last mentioned means.

4. In an elastic fluid compressor as claim in claim 3 wherein said means connected between said second dash pot and said last mentioned means includes, a shut-off valve, and a conduit connecting said shut-off valve to said lubrication system whereby lubricant fluid at high pressure may be delivered to said conduit for normally maintaining said shut-off valve open when the compressor is in operation.

5. In an elastic fluid compressor having a casing, a rotor shaft extending through openings on either side of said casing, a thrust bearing and a line bearing outwardly of said casing to support the rotor shaft, and a lubrication system including a fully enclosed reservoir about said thrust bearing and mounted to said casing in substantially air tight engagement, a service pump in said reservoir, said service pump connected to and operated by the rotor for delivering lubricant at high pressure to said lubrication system, means connecting said reservoir to the suction side of the compressor, and means for conducting high pressure lubricant to said line bearing, the combination with said lubrication system of, a first chamber between said line bearing and said casing communicating with the fluid being compressed, a second chamber outwardly of said line bearing, said line bearing being constructed and arranged to deliver lubricant fluid to said first and second chambers, means for maintaining said first chamber at a pressure above the suction pressure of the compressor, and said second chamber at substantially atmospheric pressure, a first dash pot connected to said first chamber to collect mixed lubricant and fluid being compressed, a return conduit connected to said first dash pot for returning mixed lubricant and fluid being compressed to said reservoir, a second dash pot connected to and forming part of said second chamber, a degasifier including means for separating, rehabilitating and returning lubricant to said return conduit, and a shut-off valve connected between said second dash pot and said degasifier normally maintained open by lubricant at high pressure from said lubrication system when the compressor is in operation to allow lubricant to pass from said second dash pot to said degasifier.

6. In an elastic fluid compressor as claimed in claim 5 wherein said degasifier includes, a gas separator connected to said shut-off valve to receive the mixed lubricant and fluid being compressed from said second dash pot, means in said gas separator for allowing freed fluid to pass harmlessly to atmosphere, a float housing connected to said gas separator for receiving rehabilitated lubricant therein to be returned to said return conduit, a pump in said float housing, a conduit connecting said pump to said return conduit, an oil return check valve adapted to be opened when the pressure in said conduit is raised above the pressure in said return conduit, and means for by-passing lubricant fluid when the level of said lubricant in the float housing drops below a predetermined minimum in said float housing.

7. In an elastic fluid compressor having a casing, a rotor shaft extending through openings on either side of said casing, a thrust bearing and a line bearing outwardly of said casing to support the rotor shaft, and a lubrication system including a fully enclosed reservoir about said thrust bearing and mounted to said casing in substantially air tight engagement, a service pump in said reservoir, said service pump connected to and operated by the rotor for delivering lubricant at high pressure to said lubrication system, means connecting said reservoir to the suction side of the compressor, and means for conducting high pressure lubricant to said line bearing, the combination with said lubrication system of, a first chamber between said line bearing and said casing communicating with the fluid being compressed, a second chamber outwardly of said line bearing, said line bearing being constructed and arranged to deliver lubricant fluid to said first and second chambers, means connected to any discharge stage of said compressor communicating with said first chamber for maintaining said first chamber at a pressure above suction pressure of the compressor, and said second chamber at substantially atmospheric pressure, a first dash pot connected to said first chamber to collect mixed lubricant and fluid being compressed, a return conduit connected to said first dash pot for returning mixed lubricant and fluid being compressed to said reservoir, a second dash pot connected to and forming part of said second chamber, a degasifier including means for separating, rehabilitating and returning lubricant to said return conduit, and a shut-off valve connected between said second dash pot and said degasifier normally maintained open by lubricant at high pressure from said lubrication system when the compressor is in operation to allow lubricant to pass from said second dash pot to said degasifier.

8. A degasifying system for the lubrication system on elastic fluid compressors including a fully enclosed reservoir in said lubrication system connected to the suction side of said compressor, and a line bearing receiving lubricant at high pressure from said lubrication system comprising, a first chamber inwardly of said line bearing communicating with the fluid being compressed, a second chamber outwardly of said line bearing communicating with atmosphere, said first and second chambers so constructed and arranged with respect to said line bearing as to receive lubricant therefrom, means connected to said first chamber for returning lubricant directly to said reservoir in the lubrication system responsive to the differential pressure in said first chamber, a gas separator, means connecting said gas separator to said second chamber normally maintained open by lubricant from said lubrication system delivered thereto at high pressure when the compressor is in operation to allow lubricant received in said second chamber to pass freely to said gas separator for rehabilitation, and means connected to said gas separator to collect rehabilitated lubricant from said separator and return it to the reservoir in said lubrication system.

9. A degasifying system for the lubrication system on elastic fluid compressors including a fully enclosed reservoir in said lubrication system connected to the suction side of said compressor, and a line bearing receiving lubricant at high pressure from said lubrication system comprising, a first chamber inwardly of said line bearing communicating with the fluid being compressed, a second chamber outwardly of said line bearing communicating with atmosphere, said first and second chambers so constructed and arranged with respect to said line bearing as to

receive lubricant therefrom, a first dashpot for said first chamber to receive mixed lubricant and fluid being compressed from said first chamber by gravity flow, a return conduit having one end connected to said dash pot and the other end connected to said reservoir to provide communication between said first chamber and said reservoir, means for maintaining a constant positive differential in said first chamber with respect to said reservoir whereby fluid will be forced from said first chamber to said reservoir, a second dash pot communicating with said second chamber to receive effervesced lubricant and fluid being compressed from said second chamber by gravity flow, a gas separator, means connecting said gas separator and said second dash pot normally maintained open by lubricant at high pressure from said lubrication system when the compressor is in operation to allow the free flow of lubricant from said second chamber to said gas separator, and means connected to said gas separator to collect rehabilitated lubricant from said separator and return it to the reservoir in said lubrication system.

10. A degasifying system as claimed in claim 9 wherein said means for maintaining a constant differential pressure in said first chamber includes a conduit connected between any discharge stage of said compressor and the first chamber to provide communication therebetween.

11. A degasifying system as claimed in claim 9 wherein said means normally maintained open includes, a shut-off valve, and a conduit connected between said shut-off valve and the lubrication system to deliver lubricant under pressure to said shut-off valve when the compressor is in operation for maintaining said shut-off valve open.

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The following references are of record in the file of this patent:

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