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HERMETICALLY SEALED RADIAL COMPRESSOR ASSEMBLY

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3 Sheets-Sheet 1



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3 Sheets-Sheet 2

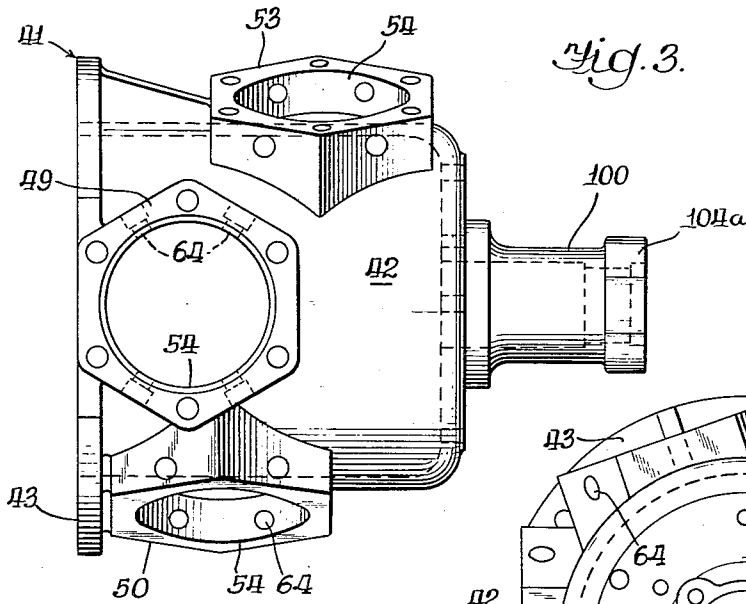


Fig. 3.

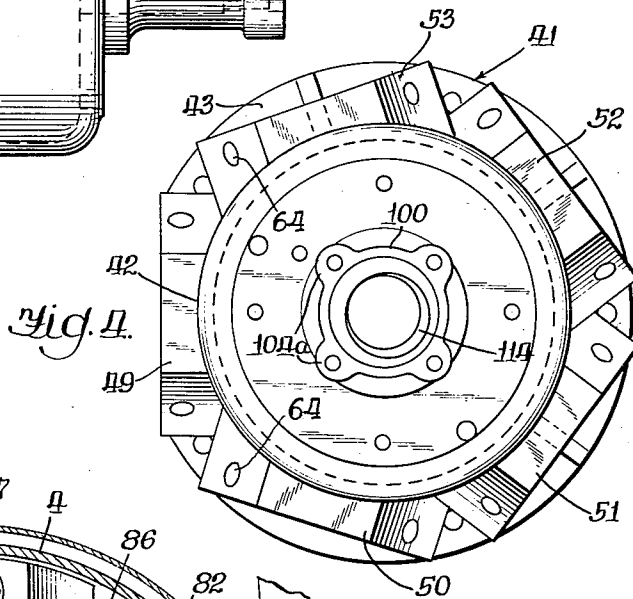


Fig. 4.

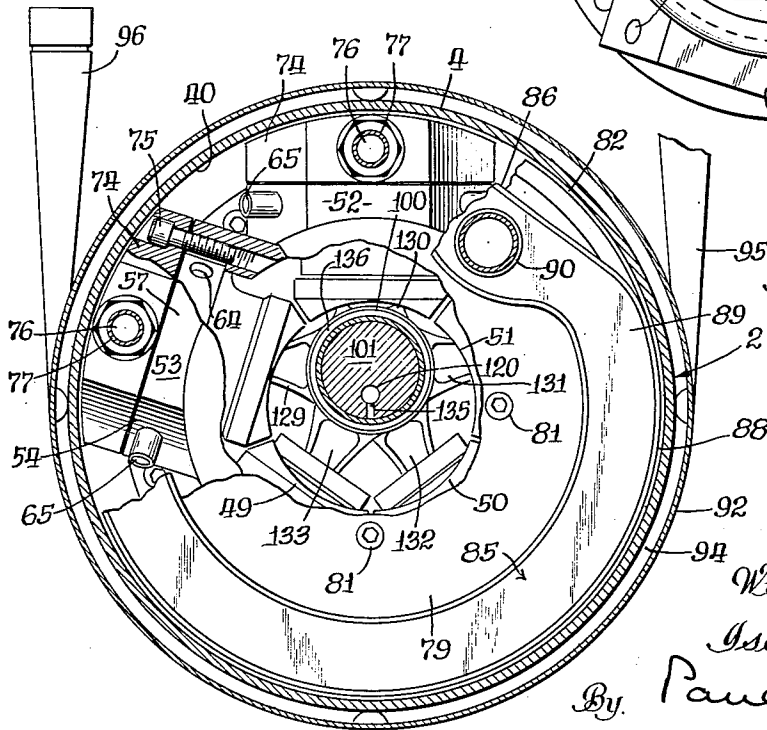


Fig. 2.

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2,752,088

HERMETICALLY SEALED RADIAL COMPRESSOR ASSEMBLY

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Application May 20, 1952, Serial No. 288,846

17 Claims. (Cl. 230—58)

This invention relates to a compressor assembly and more particularly to a novel compressor particularly adapted for use with heat pumps and the like.

A general object of the invention is to devise a compact, light weight compressor assembly wherein the parts are arranged in a unitary structure for relatively easy assembly and disassembly.

Another general object of the invention is to devise a compressor encased within a cylindrical housing and constituted of parts which are arranged to function conjunctively in an improved manner to provide a highly efficient compressor assembly.

A principal object is to develop a high pressure container of simple, inexpensive and compact design and of relatively small diameter and featuring convex end caps secured in advantageous manner to opposite ends of the cylindrical body portion of the container.

A more specific object of the invention is to design a compressor incorporating a generally cylindrical housing hermetically closed at each end, the housing enclosing a compressor and driving motor therefor and the encased assembly having a close fit with the housing intermediate the top and bottom ends thereof and resting on a novel center support in guided engagement with a novel guide cup in the bottom closure end member of the housing or container. These two areas of engagement between the housing and the compressor assembly accommodate ready insertion and withdrawal of the assembly with respect to the housing and further the limited areas of engagement obtain a snug fit between the parts, and the slip mounting of the assembly within the container accommodates expansion and contraction of the compressor and motor unit without wedging the parts together so that they may not be readily separated.

A still further object of the invention is to provide a novel organization of the various components such that the driving motor is at the upper end of the unit, the compressor unit or component is in the intermediate section of the container and the lubricating oil sump is at the bottom end of the container, the sump and the intermediate section being separated by a novel baffle plate arrangement provided with several minute apertures such as will permit an equalization of gas pressures in the intermediate and bottom sections of the container while at the same time preventing froth, which develops from the tendency of gases entrained in the oil to separate therefrom as during initiation of a starting cycle of the compressor, from expanding into the compressor chamber and being carried in the gas therein into the cylinders of the compressor.

A still further object is to dispose the discharge manifold of the compressor within the oil sump for efficient heat transfer thereto, the oil sump, in turn, transferring the heat into the walls of the container which are encased at the intermediate and bottom sections of the container within a preferably copper jacket adapted to have water passed therethrough between the same and the external side of the container encasing the motor and compressor

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unit. Such a novel disposition of parts obtains an efficient heat transfer from desired areas and precludes a deleterious rise in temperature of the upper section of the container whereat the electric drive motor is disposed.

Another object is to provide in the organization last described a discharge manifold of generally circular construction whereby the discharging gases from each cylinder are afforded two paths of discharge and substantially equalized heat dissipation is obtained.

A further object of the invention is to devise a novel compressor assembly featuring a unitary one-piece crank case which affords good thermal characteristics and incorporates a novel distribution of the cylinders arranged along a spiral line developed about the longitudinal axis of the crank case, the arrangement effecting simplification as well as distribution and equalization of thermal stresses about the entire crank case whereby to effect commensurate heat distribution in the housing counter-part.

Another object is to arrange the parts in such manner within the housing so as to divide the housing into a relatively low pressure chamber at the upper end of the housing whereat the driving motor is disposed, the lower end of the low pressure chamber being terminated by a bulkhead member which fits complementally into the housing in relatively tight confinement therewith and providing a bearing mounting for the crank shaft of the compressor, the bulkhead being apertured to provide passages for the gas into a compressor chamber comprising a relatively large area intake manifold defined between the crank case of the compressor and the external housing, the large area of the intake manifold and its separation from the rotating motor parts being conducive to slow down the gases whereby facilitating separation of the oil particles from the gas by deposition upon the extensive surfaces of the housing and the crank case to obviate carrying the oil particles into the cylinders.

A still further object of the invention is to provide in the organization last described a terminus for the lower end of the intake manifold chamber, said terminus being in the form of a baffle plate secured to the bottom end of the crank case and sealed about its outer periphery with the housing to prevent leakage of oil froth therebetween, the baffle plate being provided with few relatively small apertures affording communication between the intake chamber and the oil sump chamber therebelow to obtain equalization of pressures while at the same time resisting the passage of oil froth from the sump into the intake chamber.

A still further object is to provide a novel lubrication system for the compressor component, said system incorporating a pressure pump discharging through a passageway in the crank shaft, the passageway having a series of openings aligned with the bearings of the connecting rods, the openings being arranged to register with squirt holes in these bearings and the squirt holes being selectively disposed to spray the lubricant into the adjacent piston and cylinder assembly therebelow. The system of lubrication further involves depositing the lubricant on the underside of the upper counter-weight member of the crank shaft, the counter-weight functioning in the nature of a slinger phased to throw the oil principally into the uppermost piston and cylinder and to a lesser degree to splash the lubricant over the upper extent or part of the crank case in order to more generally equalize thermal characteristics and thus minimize the development of localized thermal extremes.

These and other objects of the invention will become more apparent from the specification and the drawings, wherein:

Figure 1 is a broken apart vertical sectional view of the novel compressor assembly;

Figure 2 is a transverse sectional view taken substantially on the line 2—2 of Figure 1;

Figure 3 is a side elevational view of the crank case;

Figure 4 is a bottom view of the crank case;

Figure 5 is a side elevational view partly in vertical section of the oil sump baffle plate and discharge manifold assembly;

Figure 6 is a top plan view of the bulkhead member and bearing cage separating the low pressure chamber from the compressor unit;

Figure 7 is a side elevational view of the connecting rod of the uppermost piston assembly;

Figure 8 is an edge view of the rod shown in Figure 7 partly broken away to illustrate the oil passages;

Figure 9 is a side elevational view partially in axial section of the crank shaft; and;

Figure 10 is a sectional view of a piston and cylinder assembly.

Describing the invention in detail the pump unit generally designated 2 comprises a cylindrical or tubular housing or casing 4 closed at its ends by top and bottom caps or end members 6 and 8, the end member 6 being weld-connected about its periphery to the upper edge of the housing as at 10, and the bottom member being weld-connected about its periphery to the bottom edge of the housing as at 12.

The upper end cap 6 supports a terminal assembly 14 connected through a series of leads 16—16 to the usual control unit (not shown). The terminals 14 have their inner ends extended into the upper extremity of the casing 4 beneath the cap 6 and are connected through a series of leads 20—20 to a stator coil or fields 22 of a stator 23 which is arranged in an annular fashion within the low pressure compartment or motor chamber 24 at the upper end of the casing 4.

The outside diameter of the stator 23 substantially approximates the inside diameter of the casing 4 so as to afford an easy fit therewithin. The stator 23 is supported at its lower end upon an inturned flange 25 at the upper end of a combination bulkhead member and bearing cage or partition generally indicated 26. The flange is secured at spaced points as by welding to the lower ends of a series of stud bolts 27 which pass through notches or apertures in the stator laminations, the upper ends of the stud bolts 27 being provided with nuts 28 for securing the stator laminations against the flange 25.

The stator 23 is a circular or annular structure and co-operates with a rotor 29 disposed therewithin, the rotor being suitably keyed to the upper end of a crank shaft 30 for driving the same.

The shaft 30 is journaled at the lower end of the rotor in a bearing 31, entered into the upper end of a support tube 32 which at its lower end is integral with the center of member 26 and at its lower end with the plurality of gussets 34—34. More specifically, the tube 32 adjacent to its lower end, merges into an integral generally circular bulkhead plate 36 which, on its top side, merges with the before mentioned gussets 34—34. The radial plate 36 is joined at its outer periphery with the lower edge of an annulus 37, which, at its upper edge, merges with the before-mentioned inturned annular flange 25. The external side of the annulus 37 is preferably slightly frusto-conical as at 38 and has a snug complementary fit at the bearing area 39^a with the interior of the casing 4, intermediate the top and bottom ends thereof. The plate 36 partitions or forms the lower terminus of the low pressure chamber 24 and is provided with a series of vertical apertures 39—39 along the inner margin of the annulus 37 to afford gas passages from the low pressure chamber 24 to an intake manifold or compressor chamber 40 disposed below the plate 36 and defined between the external side of crank case 41 of the compressor or component and the interior of the opposed intermediate section 42^a of the cylinder 4.

The casing 41 comprises a generally cylindrical body

portion 42 provided with an integral outturned flange 43 at its upper end secured as by stud assemblies 44 to the underside of the plate 36 of the bulkhead member at the step down or depressed portion 45 thereof.

It will be appreciated that the step down portion 45 of the bulkhead plate 36 is adapted to permit complete gravitational drainage of oil which collects on the surfaces thereabove on the stator and the casing walls and particularly as the oil is centrifugally separated when the gases, which are drawn from an intake tube 46 connected to the upper cap member 6 into the low pressure chamber 24, are passed through openings 47—47 in the rotor.

The crank case 41 is provided with five outstanding uniformly spaced cylinder holders designated 49, 50, 51, 52, and 53, these holders 49 through 53 being arranged in a spiral about the longitudinal axis of the crank case 41 with the holder 49 disposed at the uppermost end of the casing and the holder 53 at the lowermost extremity thereof. This arrangement and disposition of the co-operating parts obtains a good running balance so that the unit may be rigidly mounted within the container.

Each holder includes a ring flange 54 which receives a cylinder sleeve assembly generally designated 55 therein. Each cylinder sleeve assembly 55 includes a cylindrical sleeve member 56 with a manifold ring 57 Figure 10 about its outer extremity, the ring 57 being of a larger diameter than the sleeve 56 and complementally fitting within the related ring flange 54 as at 58 and at its inner edge seating as at 59 against a shoulder 60 of the related flange 54. The intake manifold 57 is preferably formed as a separate piece and at its inner edge and internal side seats as at 61 and 62 respectively, snugly against the external shoulder 63 on the sleeve intermediate the ends thereof and against the external side of the related sleeve 56 and connected thereto preferably as by brazing.

Each manifold ring 57 comprises a plurality of radial openings 64—64 therethrough, which, at their radially outer extremities, register with openings 65—65 or pipes (Figures 2 and 10) through the flange ring 54 within which the ring 57 is nested. The radially inner extremities of the ports 64—64 communicate with an annular groove 66 formed within the interior of the manifold ring 57, the groove 66 forming a gas passageway with an opposed frusto-conical surface 67 on the adjacent end of the related sleeve 56, the surface 67 tapering toward the outer extremity of the sleeve 56 and the outer edge of the groove 66 being formed with a rounded edge convex toward the surface 67 and spaced slightly in a radial direction therefrom to provide a relatively narrow annular passage area 68 completely circumscribing the outer extremity of the related cylinder sleeve 56 for communication with the bore 69 thereof within which reciprocates a piston 70 which may be connected through a wrist pin and crosshead 71 to the outer end of a connecting rod which may be journaled on a crank throw forming part of the intermediate section of the crank shaft 30 as hereinafter described.

The connection 71 may be conventional or such as shown in a copending application in the name of John Calling et al. entitled "Connecting Rod and Piston Assemblies," Serial No. 104,526, filed July 13, 1949, now Patent No. 2,694,607.

Each cylinder may be capped by a cylinder head 74 which may be secured to the related ring flange 54 as by studs or bolts 75—75.

The valve arrangement permitting gas to be drawn from the chamber 40 through the pipes or apertures 65, 64 grooves 66, 68 and into the cylinder bore 69 on the intake stroke of the piston and the discharge of the gas on the compression stroke of the piston through the cylinder head port 76 will not be specifically described inasmuch as it forms, per se, no part of the present invention and the same may be substantially as shown and described in Patent No. 2,613,870 entitled "Compressor Cylinder

Head Assembly" issued October 14, 1952, to William F. Borgerd.

Each outlet port 76 may be connected to one end of a discharge means in the form of a pipe 77 as by threaded nipples 77^a. The pipe 77 of each cylinder head extends generally parallel to the casing 4 there alongside through an aperture 78 provided in the baffle disk or partition member 79. Each pipe 76 preferably has a fluid tight connection with the plate 79 about the opening 78, the connection being in the form of silver brazing or a packing gland assembly.

The baffle plate 79 is generally circular and formed preferably of thin flexible sheet metal and has a central dished or depressed portion 80 disposed in cupped relationship with the lower end of the body portion 42 of the crank case. The portion 80 seats on its top side against bottom end of the body portion 42 and is secured thereto as by a series of bolts 81—81.

The outer periphery of the baffle 79 is provided with a gasket 82 in sealing engagement with the internal side of the casing 4. The baffle 79 defines the lower terminus of the chamber 40 and divides the same from the sump chamber 83 located at the lower end of the casing 4. The plate 79 is provided with a series of relatively few small openings 84—84 in the portion 80 thereof and affording communication between the chambers 40 and 83. The location of the openings 84 in the lowermost sections 80 of the plate 79 permits efficient drainage of oils from the chamber 40 to the chamber 83.

The tubes 77—77 of the respective cylinders depend below the plate 79 into the oil sump chamber 83 and at their lower ends are preferably silver brazed to the top wall of a discharge manifold annulus 85 which is inundated within the oil 86 within the sump 83. The circular discharge manifold provides two paths for the gases discharging thereto. The circular discharge manifold 85 has an outer diameter slightly lesser than the inside diameter of the casing 4 whereby the outer wall 86^a thereof is positioned in close proximity to the adjacent portion of the casing 4 without actual physical contact. The close disposition of the wall 86^a with respect to the barrel 4 affords a good heat transfer to the casing and especially through the thin film of oil in the space 88 between the wall 86^a and the casing 4. Furthermore, by disposing the annulus 85 within the oil 86, the oil is heated which effects a ready separation of the gases which may dissolve therein during the stopping cycle of the compressor. The bottom wall 89 of the discharge manifold is connected to a communicating discharge pipe or conduit 90 which may have a connection with the usual condenser not shown. A suitable seal means 91 of a removable nature may be provided between the pipe 90 and the bottom cap 8 through which the pipe passes.

The intermediate and lower portions of the casing 4 may be ensleeved by a jacket 92, which, at its upper end, may have a fluid tight fit with the casing as by a gasket 93, the jacket 92 being preferably formed of thin copper or other good conductible material and may be spaced from the enclosed portions of the container to provide a water chamber 94 for circulation of water therethrough by inlet and outlet pipes 95 and 96, the water in the chamber 94 serving to draw off excess heat.

The lower end of the cap 8 may be provided with mounting members 97—97 which may be connected to mounting studs 98—98 extending through jacket 92 and carrying resilient mounting and sealing blocks 99—99 for mounting the unit on any suitable base or frame in conventional manner.

The lower end of the assembly or motor and compressor structure enclosed within the casing 4 may be carried from the bottom cap through an integral depending sleeve 100 of the crank case 41, the sleeve 100 surrounding the lower end portion 101 of crank shaft 30 and affording a journal therefor through a bearing 102.

The lower extremity of the tubular portion 100 is con-

nected to a combination support and end thrust bearing member generally designated 103, said member 103 including a top relatively thick plate 104 provided with a plurality of ears connected as by bolts to mating ears 104^a at the lower end of the tubular portion 100. The plate 104 provides a smooth flat upper bearing surface 105 against which the lower end of the crank shaft portion 101 bears. The underside of the plate 104 is provided with the central depending boss or support element 106 which at its lower end is formed with a downwardly tapering frusto-conical surface 107 fitting into a complementary surface 108 in a positioning cup or socket 109 depressed downwardly in the center of the bottom cap or end member 8. The boss 106 and cup 109 form the bottom end support and positioning means for the entire assembly disposed within the casing 4 which is maintained centered within the casing by means of the flange 37 which engages at surface 39^a with the casing 4 intermediate the ends thereof.

The lower end of the tubular portion 100 of the crank case as well as the member 103 are received within a cup shaped screen 110 which admits the boss 106 through the bottom thereof, the upper end of the screen being tightly fitted as by a rim member 111 to an enlarged upper end part of the tubular portion 100. The screen 110 is adapted to filter the oil 86 which is adapted to pass through the screen into a pump generally designated 112, the pump including an inlet port 113 through the plate 104, the lower end of the port 113 being open through the lower end of the plate 104 and communicating with the oil sump 83 and at its upper end being open to a pump chamber 114 comprising a bore in the lower extremity of the tubular portion 100 and arranged eccentrically with respect to the axis of rotation of the lower end portion 101 of the crank shaft 30. The chamber 114 is preferably filled by a gravity feed of the oil 86 from the sump 83 through the port 113. The oil is pumped under pressure by means of a vane or blade 115 which is slidably fitted within a complementary transverse slot 116 in the lower end of the crank shaft portion 101, the slot being disposed slightly off center with respect to the axis of rotation of the portion 101. The vane 115 extends at its ends beyond the periphery of the portion 101 and co-operates with the circumscribing surface of the chamber 114 and operating in a wiping fashion over the thrust bearing surface 105 over the intake opening 113 and progressively sweeping the fluid under pressure in the chamber 114 into the outlet passage or port 117 extending downwardly from surface 105 into plate 104. The passage 117 communicates at its upper end with the chamber 114 and at its lower end with a duct 118 which leads to a center passage 119 which at its upper end extends through the top surface 105 of the plate 104 and registers with a main oil passageway 120 bored lengthwise through the crank shaft 30 and extending to a point adjacent to the upper end thereof above bearing 31. The passageway 118 also communicates with a relief valve 121 which in open position uncloses a by-pass passageway 122 in a plate 104 which discharges into the oil sump.

The operation of the pump may be somewhat similar to that shown in U. S. Patent 2,130,862. The crank shaft is provided with branch passageways communicating with the passageway 120 and the bearings 102 and 31 and also a bearing 123 fitted within a portion 124 of the upper tubular support cage 32, the portion 124 extending below the wall 36 immediately above the crank throw 125 of the crank shaft. The crank shaft is provided with upper and lower counter-weights 126 and 127, the counter-weight 127 being removably secured to the crank throw 125 as by a U-strap 128.

A series of five connecting rods 129, 130, 131, 132, and 133, Figure 2, are stacked one above the other, in the order named, on the crank throw 125, the lowermost connecting rod 129 bearing on its bottom side against

the top side of the lower counter-weight 127. The uppermost connecting rod 133 faces at its upper edge against the under side 134 of the throw counter-weight 126. The crank throw portion 125 is provided with branch ports 135 aligned longitudinally of the crank shaft and open through the periphery of the throw portion in alignment with integral one-piece bearing portions 136 of respective connecting rods 129 through 133. The ports 135 communicate with the central passageway 120 and are adapted to conduct oil to respective bearings.

Referring now to Figures 7 and 8, wherein the connecting rod 133 is shown, it will be noted that each of the connecting rods 129 through 133 are substantially identical and comprise the before mentioned integral circular crank shaft bearing portion 136 integrally united with one end of the related connecting rod which at its other end is connected to an integral wrist pin bearing portion 138 connected in the usual manner at 71 (Figure 10) with the related piston assembly 70 as heretofore mentioned. It will be seen that each bearing 136 is provided with a squirt hole 139 adapted to register with the associated port 135 for squirting the oil in the region of the adjacent piston cylinder assembly. It will be noted that the squirt holes 139 are preferably located approximately 63° from the longitudinal center of the rod as indicated at X—X in Figure 7 and that in view of the disposition of the cylinders in a spiral, the squirt hole 139 of each connecting rod is arranged to squirt a stream of lubricant into or in the approximate area of the piston and cylinder assembly therebelow. In view of this distribution of the oil over the entire extent of the interior of the casing thermal characteristics are substantially uniformly distributed about the interior of the casing.

The uppermost connecting rod 133 is substantially identical with the other connecting rods with one exception, and that is that the bearing thereof is provided with an axial passageway 140 which extends from approximately the center of the bearing through the upper edge thereof and opens to the underside 134 of the upper counter-weight 126.

It will be seen from a consideration of Figure 8 that the passageway 140 functions to deliver the oil from the related passageway 135 upwardly against the underside of the lower portion 141 of the upper counter-weight 126 to deposit a squirt of oil against the under surface 134 at a time and in a location whereat the portion 141 will sling the oil into the uppermost piston and cylinder assembly for lubrication thereof. Concomitantly some of the oil will be dispersed along the upper extremity of the casing 42 to afford a balanced thermal distribution as heretofore discussed. It will be seen that the lateral passage 140 is spaced substantially 163° in a counter-clockwise direction (Figure 7) with respect to the squirt hole 139.

It will be appreciated that the above described construction provides a compact unit and that assembly proceeds by inserting the unitary motor and compressor structure into the casing 4 with the boss or lug support 106 entered into the socket 109 and the flange 37 fitted snugly along the area 39. The cap 6 is then sealed to the upper edge of the casing 4 by welding at 10. If desired, cap 6 may be removably connected to casing 4. To disassemble, the weld at 10 is cut, the cap 6 lifted off the upper end of the casing 4, and the entire motor and compressor assembly merely lifted out of the container 4. Thus a novel and simple arrangement is afforded. It will be, of course, understood that for assembly and disassembly the heater 142 projected into the oil sump may be removably connected to the bottom cap 8 and the jacket 92. However, the packing gland assembly 91 about the discharge pipe 90 and engaging the bottom cap and the jacket bottom will, of course, be loosened and upon assembly suitably tightened.

It will be further noted that the novel arrangement of the cylinders, which are oriented in a spiral progression,

accommodates insertion and removal of the crankshaft endwise. To remove, the upper closure means 26 is disconnected and lifted off the upper end of the crankshaft. The crankshaft is rotated to place the lower counterweight circumferentially away from the lowermost cylinder. The lower counterweight is then disconnected and may be moved transversely of the crankshaft in a direction to disconnect its dowel pin therefrom. The disconnection of the lower counterweight may be facilitated by first removing the lowermost cylinder sleeve. This movement of the lower counterweight is permitted in view of the arrangement of the cylinders. The crankshaft is then merely pulled up and the lower arm portion 143 interconnecting the throw 125, which is slightly thicker than arm portion 143, with the first end portion 101 of the crankshaft is worked through each bearing portion 136. To assemble, the procedure is obviously reversed. An alternate method comprises mounting the lower and upper counterweight upon the shaft with all connecting rods and pistons therebetween and the cylinder heads and sleeves removed from the crankcase. This subassembly is lowered and properly rotated to enter the portion 101 of the shaft into the bearing 102. Then each sleeve is inserted in place over its respective piston and fastened with the associated cylinder head.

What is claimed is:

1. In a device of the class described, a casing having closed upper and lower ends, a motor and compressor structure therewithin and comprising a motor component at its upper end, a compressor component intermediate its ends, said structure bearing at its lower end upon the bottom closed end of the casing, an apertured bulkhead between said components dividing said casing into upper and intermediate chambers, said upper chamber containing said motor component and said intermediate chamber containing said compressor component and affording an intake manifold therefor, said structure further including a baffle disposed beneath said compressor component and in fluid tight engagement with said casing, and defining the lower end of the intermediate chamber, a sump chamber containing lubricating oil at the lower end of the casing beneath the baffle, said baffle provided with a few small apertures sufficient to permit gas to pass between said sump chamber and the intermediate chamber but effective to prevent oil froth, developed by dissolved gas separating from the oil under predetermined conditions, from expanding into the intermediate chamber.

2. In a device of the character described, a housing having closed upper and lower ends, a motor and compressor structure encased within the housing, said structure including a bulkhead and a baffle spaced therefrom, and in tight engagement with said housing, and dividing said housing into three axially spaced chambers, a compressor component of said structure located in the intermediate chamber; a lubricating fluid in the bottom chamber, and a motor component of the structure in the upper chamber; said bulkhead and baffle having apertures there-through accommodating communication between said chambers for gas contained in said housing; a gas inlet for the upper chamber, said compressor having an intake charging from said intermediate chamber, discharge means for the compressor extending therefrom downwardly through the baffle in fluid tight association therewith and including a discharge manifold in the lower chamber inundated in the lubricating fluid, and outlet means connected to said discharge manifold, said discharge manifold adapted to conduct heat, developed by compressed gases ported thereto, into the fluid to evaporate gas entrained in the fluid to reduce frothing thereof and thereby substantially preclude entry of the fluid through the baffle apertures into the intermediate chamber, said motor component concomitantly effective to obtain turbulent gas movement in the upper chamber to centrifugally separate atomized fluid particles from the gas; and said bulkhead adapted to pass the gas through

its apertures into said intermediate chamber in a relatively slow moving calm flow whereby effecting substantial settling of fluid remaining in the gas upon surrounding surfaces of the intermediate chamber, prior to the gas in the intermediate chamber being drawn into the intake of said compressor component.

3. In a device of the character described, an upright hermetically sealed housing, a structure including motor and compressor components mounted therein, means delivering gas to the upper end of the housing, a baffle constituting part of said structure and disposed beneath the compressor component of the structure, and in tight engagement with the interior of the housing, an oil sump chamber in the housing below the baffle and containing lubricating oil, gas inlet means associated with the upper extremity of the housing, said baffle being apertured to permit gas passage therethrough into the oil in the sump chamber, said compressor component having intake means adapted to draw surrounding gas into the compressor, the apertures in said baffle being relatively small and few and adapted to accommodate passage of gas from the sump upwardly therethrough and to prevent oil froth developed by gas evaporating out of solution with the oil, from unrestrictedly expanding into the area about the compressor component.

4. In a pump unit, an upright casing having closed ends, a structure therein comprising a motor component and a compressor component therebelow, means expansibly mounting said structure within the casing, a baffle constituting part of said structure disposed beneath the compressor component and in sealed movable engagement about its periphery with the interior of the container, an oil sump at the bottom of the container below said baffle, said compressor component having intake means communicating with the interior of the container above the baffle, discharge means for the compressor component extending below said baffle into the oil sump and including an endless discharge manifold positioned with its outer periphery in close proximity to the interior of the adjacent portion of said casing, oil in said sump inundating said manifold and filling the space between said outer periphery of the manifold and adjacent portion of the casing and providing a heat transfer media between the manifold and the casing, and a water jacket surrounding said casing at least in the area of said adjacent portion thereof.

5. In a compressor apparatus, a closed casing, a structure including a compressor component and motor means therefore expansibly mounted within the casing, said compressor component including a crankcase with a plurality of cylinders, piston assemblies operative within the cylinders, crankshaft means journaled to the crankcase and connected to the motor means and said piston assemblies, each cylinder including an intake manifold circumscribing the same completely thereabout and communicating with the interior of the casing at its inlet and providing an outlet to the associated cylinder extending completely around the inlet end thereof whereby effecting simultaneous substantially uniform distribution of gas across the entire radial extent of the cylinder whereby effecting a substantially uniform thermal condition about the cylinder, said cylinders arranged in a spiral generated about the longitudinal axis of the crankcase and spaced substantially uniformly thereabout to obtain generally equalized thermal characteristics during operation of the piston assemblies therein.

6. A compressor apparatus according to claim 5, and comprising a pair of apertured members spaced longitudinally of the casing and in peripheral tight engagement therewith and defining a relatively quiescent gas chamber therebetween circumscribing said crankcase and communicating with the intake of said cylinder manifolds, said chamber conducive to separation of the gas from oils and the like whereby reducing localized thermal high

stress conditions developing from nonuniform gas constituency entering said cylinders.

7. In an apparatus of the class described, an upright hermetically sealed casing having an upper motor chamber, an intermediate compressor chamber, and a lower lubricant sump chamber, individual partitions between the chambers apertured to provide communication for gas between said chambers, the apertures in the partition being formed and arranged to resist flow of oil froth from the sump chamber to the compressor chamber, a compressor including a one-piece crankcase in the compressor chamber connected to the partition thereabove and having a portion extending through the partition therebelow into said oil sump chamber, oil in the sump chamber inundating said portion of the casing and affording a thermal connection therewith, a crankshaft journaled on said crankcase, cylinders on the crankcase, piston assemblies in the cylinders operatively connected to the crankshaft, and means associated with the crankshaft and including passages therein formed and arranged for discharging oil over substantially the entire interior of the crankcase to substantially equalize the thermal conditions thereabout.

8. In a compressor apparatus of the class described; a compressor including an integral crankcase open at one end and closed at its other end and having a central outwardly projecting tubular extension on the closed end; a crankshaft having coaxial first and second end portions and an intermediate transaxially offset crank throw portion and arm portions interconnecting each end of the throw portion with the related end portion; a series of cylinders carried by the crankcase and arranged in a spiral progression oriented about the longitudinal axis of the casing and extending from one end of the casing to the other; said first end portion journaled within said tubular extension; a counterweight removably connected to the throw portion at the end thereof adjacent said first end portion; a piston in each cylinder; a connecting rod operatively connected to each piston and having an integral one-piece annular bearing portion sleeved over the crank throw portion; said crank throw portion being formed and arranged and the arm portion interconnecting the throw portion with said first end portion being disposed at a predetermined angle with respect to the throw portion and said first end portion and upon disconnection of said counterweight when the counterweight is positioned in an area of the crankcase away from the cylinder next adjacent to said closed end whereby the counterweight is permitted movement transversely of the crankshaft, to accommodate endwise removal and insertion of said crankshaft with respect to said one-piece bearing portions of the connecting rods and said tubular extension of the crankcase.

9. A compressor according to claim 8, and comprising a closure member journaling the second end portion of the crankshaft and removably connected to the crankcase across said open end thereof.

10. In a compressor of the class described, a piston and cylinder arrangement, a crankshaft operatively connected with the piston, means for delivering lubricant through a passage in crankshaft to the connection between the crankshaft and the piston, a counterweight on the crankshaft, a passage adapted to register intermittently with the passage in the crankshaft and open to one side of the counterweight for directing an oil deposit thereon at an area thereof phased to sling the major portion of the deposit into the cylinder pursuant to rotation of the counterweight with the crankshaft.

11. In a compressor as described, a cylinder structure comprising a cylindrical member, an annular intake manifold thereabout, said cylindrical member having a portion with a frusto-conical surface tapering in the direction toward the intake end of the cylinder within said manifold, and said manifold having an annular groove therein facing said surface, the groove face curving toward said

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surface in said direction and providing with said surface a relatively narrow slot completely circumscribing the inlet end of said cylinder member.

12. In a device of the class described, an upstanding tubular casing with top and bottom cap members closing the top and bottom ends of the casing, said bottom cap member having a central dependent cup portion open to the casing, a unitary motor and compressor structure having a motor component at its upper end and a compressor component therebelow and being self-adjustingly slidably fitted within said casing and insertable and removable as a unit endwise thereof, a bottom support for the structure and comprising a central bottom end element on the structure complementally fitting within said cup for centering the structure within the casing, said structure including a bulkhead member disposed intermediate said motor and compressor components and having a peripheral surface in close fitting engagement with the interior of the casing and with said bottom support affording the sole prop for said structure within said casing, said bulkhead member dividing said casing into a relatively turbulent low pressure chamber thereabove and a relatively calm intake manifold chamber therebelow and having said bulkhead member fashioned with a plurality of apertures therethrough affording communication between said chambers and permitting gases to flow from the low pressure chamber to the intake chamber.

13. In a device of the class described, a hermetic housing, a unitary structure mounted therein and comprising interassociated motor and compressor components disposed in axial alignment with the compressor in a lowermost position, an oil sump at the bottom of the housing beneath said compressor component and having a portion of said compressor extending therein, oil in said sump filling the space between said extending compressor portion and adjacent portion of the housing and providing a heat transfer media between said extending compressor portion and the housing, and a readily removable water jacket surrounding said housing in the area adjoining said compressor component and said oil sump.

14. A device according to claim 13 and further characterized by a water jacket that is fashioned to cover the bottom end wall in addition to portions of the side walls of the housing.

15. In a device of the class described, a compressor having a crankcase with a plurality of piston and cylinder components, a driven crankshaft journaled from the crankcase and operatively connected to the pistons of said components, separate discharge means for each component, a common annularly arranged endless manifold

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disposed beneath said components, each of said separate discharge means being fixedly connected in a continuously operable gas conducting relationship to said manifold at circumferentially spaced intervals therealong to provide two paths for the flow of gas discharging therein from each of said separate discharge means, and an outlet for said manifold.

16. In a device of the class described, a compressor having a crankcase with a plurality of piston and cylinder components, a driven crankshaft journaled from the crankcase and operatively connected to the pistons of said components, separate discharge means for each component, a common annularly arranged endless manifold disposed beneath said components, a container encasing said compressor and said discharge manifold, each of said separate discharge means being fixedly connected in a continuously operable gas conducting relationship to said manifold at circumferentially spaced intervals therealong to provide two paths for the flow of gas discharging therein from each of said separate discharge means, heat exchange fluid means in said container completely inundating said manifold, and an outlet for said manifold.

17. In a compressor as described, a cylinder structure comprising a cylindrical member having a cylinder intake end, a manifold member having an annular groove therein, said manifold member being disposed so that the annular groove therein cooperates with said cylindrical member adjoining the intake end thereof to provide an unobstructed and endless intake manifold completely encircling the periphery of said cylindrical member, said manifold member having a portion thereof adjoining the groove therein that is spaced from said cylindrical member to provide an unobstructed annular slot-like passage completely circumscribing the intake end of said cylindrical member and interconnecting said manifold with the intake end of the cylinder whereby gases are passed from the interior of said manifold to the cylinder.

References Cited in the file of this patent

UNITED STATES PATENTS

1,964,415	Van Deventer	June 26, 1934
2,065,162	Trask	Dec. 22, 1936
2,073,547	Berry	Mar. 9, 1937
2,113,691	Heller	Apr. 12, 1938
2,130,276	Hornaday	Sept. 13, 1938
2,286,272	Higham	June 16, 1942
2,555,809	Naab	June 5, 1951
2,673,028	Cornelius et al.	Mar. 23, 1954