

April 2, 1940.

J. B. HAWLEY, JR

2,195,886

ROTARY PUMP

Filed Dec. 11, 1936.

4 Sheets-Sheet 1

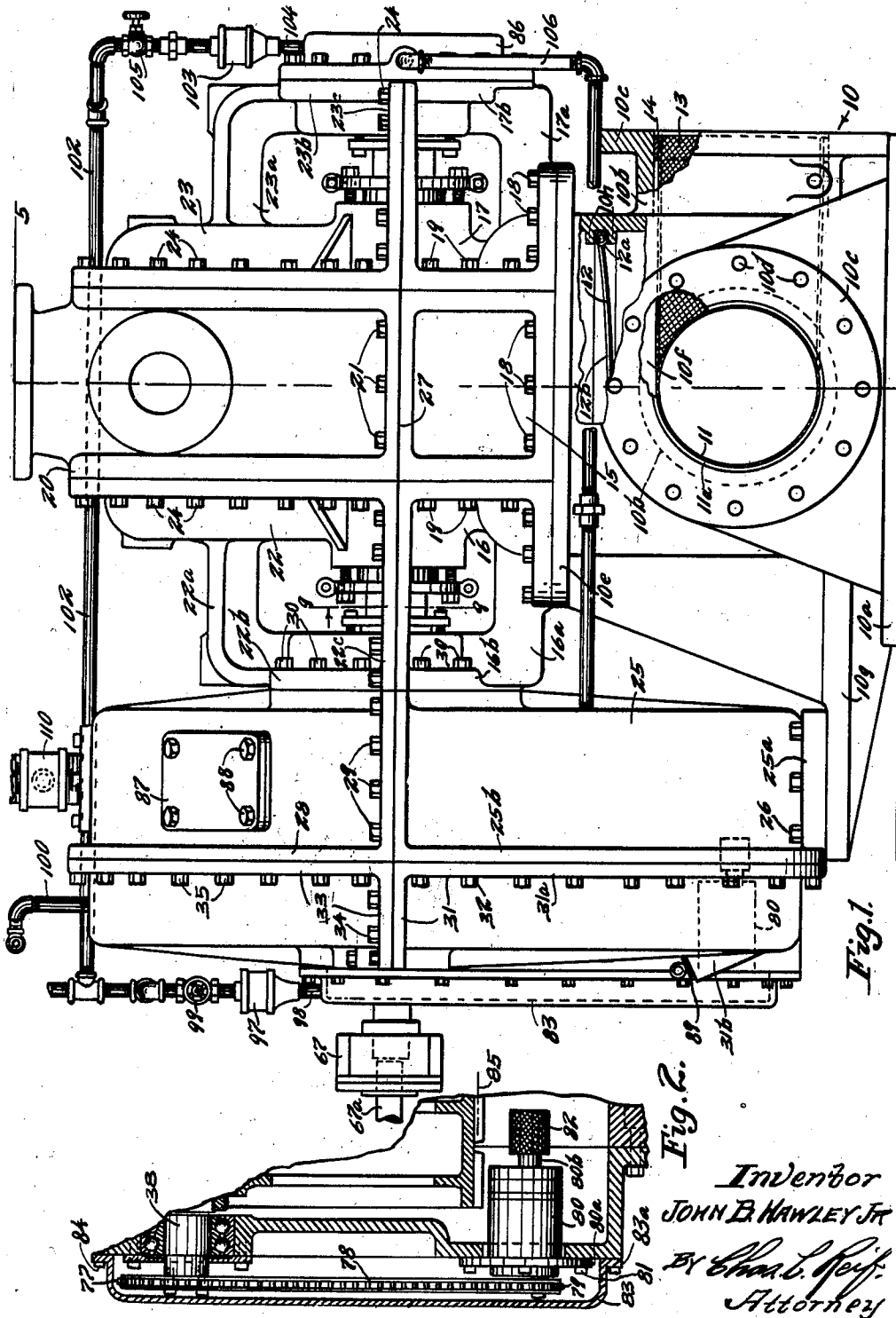


Fig. 2.

Inventor
JOHN B. HAWLEY JR
By *Charles L. Reif*
Attorney

April 2, 1940.

J. B. HAWLEY, JR

2,195,886

ROTARY PUMP

Filed Dec. 11, 1936

4 Sheets-Sheet 2

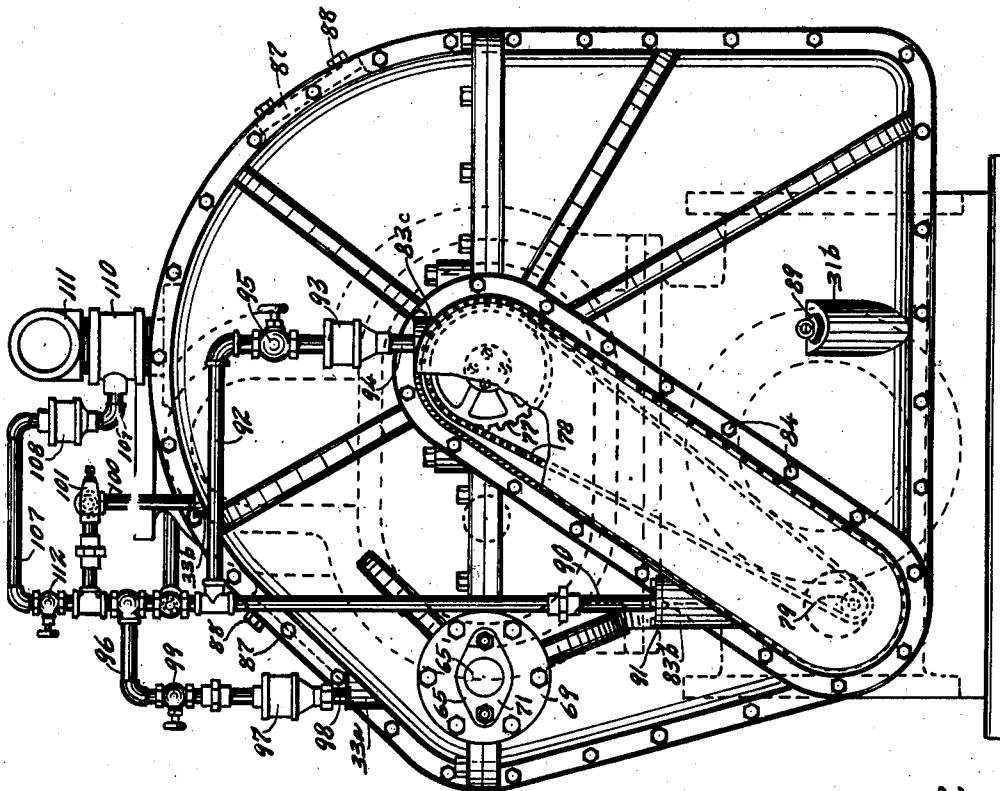


Fig. 3.

Inventor
JOHN B. HAWLEY JR.
By *Chas. C. Reif*
Attorney

April 2, 1940.

J. B. HAWLEY, JR

2,195,886

ROTARY PUMP

Filed Dec. 11, 1936

4 Sheets-Sheet 3

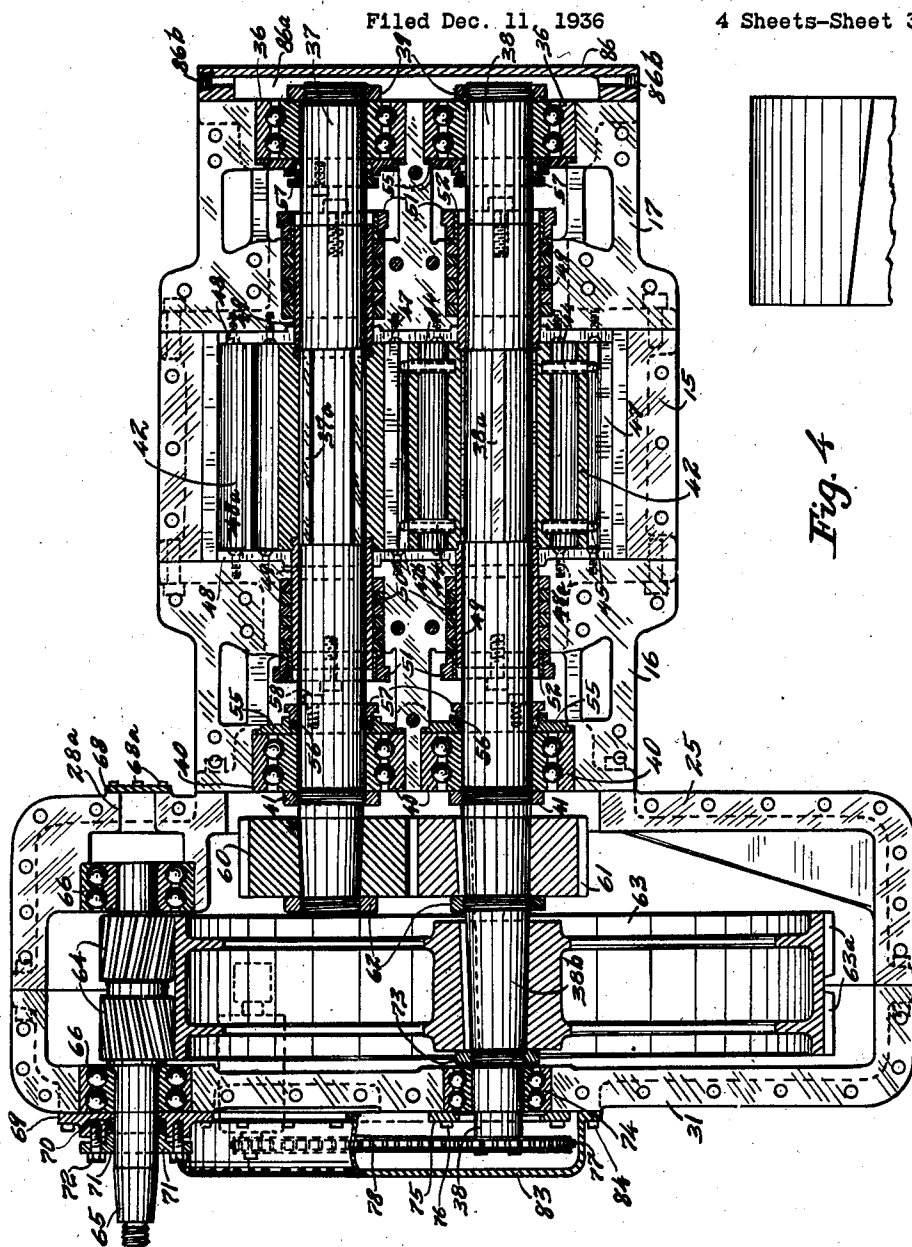


Fig. 4

Fig. 10.

Inventor
JOHN B. HAWLEY JR
By *Chas. C. Rief*
Attorney

April 2, 1940.

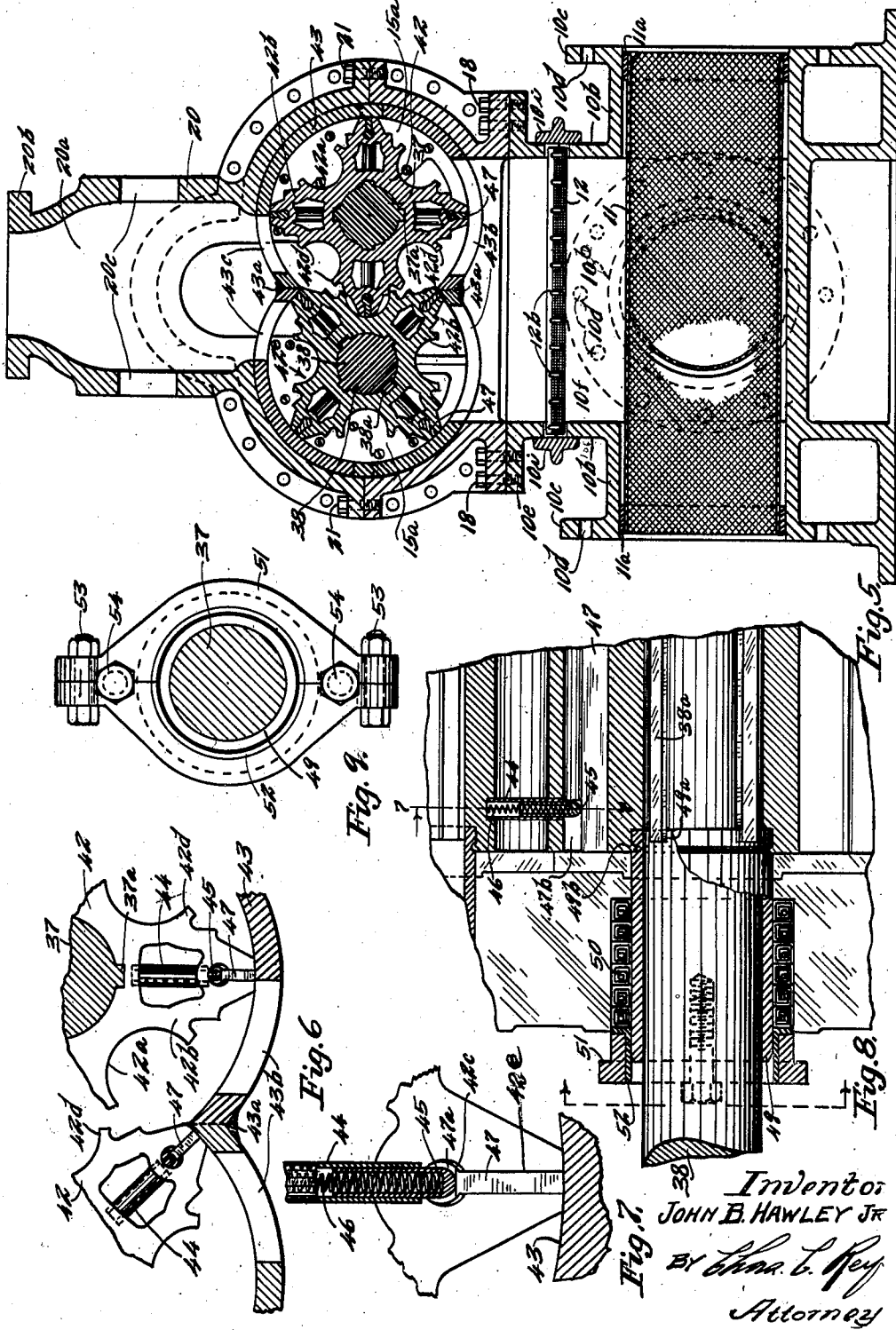
J. B. HAWLEY, JR

2,195,886

ROTARY PUMP

Filed Dec. 11, 1936

4 Sheets-Sheet 4



Inventor
JOHN B. HAWLEY JR
By *John L. Key*
Attorney

UNITED STATES PATENT OFFICE

2,195,886

ROTARY PUMP

John B. Hawley, Jr., Minneapolis, Minn., assignor to Reconstruction Finance Corporation, Minneapolis, Minn., a corporation of the United States

Application December 11, 1936, Serial No. 115,363

22 Claims. (Cl. 103—126)

This invention relates to a pump for pumping liquids, particularly oil and the same is illustrated as one of the type having interacting rotors by means of which said liquid is moved. Said rotors have circumferentially spaced projections with recesses therebetween, the projections of one rotor entering the recesses in the other so that as the rotors are rotated in opposite directions the liquid is moved thereby.

It is an object of this invention to provide such a rotary pump with the rotors thereof, the shafts carrying the same, the bearings for said shafts and the driving means for said shafts being carried in a casing, which casing is divided along a plane passing approximately through the centers of said shafts whereby the discharge side of said casing can be bodily removed from the inlet side.

It is another object of the invention to provide a rotary pump comprising a casing having a shaft journaled therein, a rotor secured to said shaft and rotatable in a chamber in said casing and means for packing said shaft to prevent leakage from said chamber including a sleeve tightly fitting said shaft and having a driving connection therewith at one end.

It is still another object of the invention to provide a rotary pump comprising a casing having connecting chambers therein of semi-cylindrical form, the centers of said chambers being spaced a distance less than the diameter of one of said chambers together with a novel construction of lining for said chambers.

It is another object of the invention to provide a rotary pump comprising a casing, shafts journaled therein, interacting rotors on said shafts, bearings for said shafts carried in said casing, driving gears for said shafts, a driving shaft for said gears, bearings for said driving shaft, an oil pump and means for driving said oil pump from one of said shafts disposed at one end of said casing and an auxiliary casing enclosing said means whereby all parts are enclosed and oil can be distributed thereto.

These and other objects and advantages of the invention will be fully set forth in the following description made in connection with the accompanying drawings, in which like reference characters refer to similar parts throughout the several views and in which—

Fig. 1 is a view in side elevation of said pump, some parts being broken away and others shown in vertical section;

Fig. 2 is a partial view showing a vertical sec-

tion through one end of the casing and illustrating the oil pump and driving means therefor;

Fig. 3 is a view in end elevation of the pump, a small part being broken away and another part shown in vertical section;

Fig. 4 is a view for the most part in central horizontal section through the driving shafts and rotors, the upper half of the casing being removed;

Fig. 5 is a central vertical section taken on line 5—5 of Fig. 1 as indicated by the arrow;

Fig. 6 is a partial view similar to Fig. 5 illustrating the lining for the rotor chamber;

Fig. 7 is a vertical section taken on line 7—7 of Fig. 8 as indicated by the arrow;

Fig. 8 is a partial view similar to Fig. 4 shown on an enlarged scale;

Fig. 9 is a vertical section taken on line 9—9 of Fig. 1 as indicated by the arrow; and

Fig. 10 is a partial view in side elevation of a liner member used.

Referring to the drawings, a pump is shown comprising a casing designated generally as 10. Casing 10 has a base flange 10a which rests upon the floor or supporting surface. Above flange 10a are three cylindrical portions 10b extending in directions at right angles to each other and each having a surrounding and projecting flange 10c to which will be connected the supply members for the liquid to be pumped, which members may be connected to flanges 10c by bolts passing through holes 10d. One of the flanges 10c faces toward one end of the pump and the other two flanges 10c face respectively toward opposite sides of the pump. Frame 10 extends upwardly and has a horizontal flange 10e disposed some distance above the flanges 10c. The frame portion 10 has an interior chamber 10f into which extend the cylindrical passages through portions 10b. A screen member 11 formed of comparatively large wire and of rather coarse mesh has bushings 11a secured to its end portions, which bushings are fitted into the passages in portions 10b. A similar screen 13 has a bushing 14 secured to its end fitted in the other portion 10b, which screen 13 extends to and is connected to screen 11. Another screen 12 of the tray type may be used above screens 11 and 13. Screen 12 is supported in guideways formed by vertically spaced flanges 10g on the inner side of member 10. Said screen comprises side members 12a shown as made of pipes and transverse spaced members 12b shown as wires or rods secured in members 12. A coarse screen is carried by members 12a and

12b. Member 10 is provided with openings through which the screen 12 may be inserted or removed. These openings are closed by cover members or plates 10i. Screens 11, 12 and 13 are preferably made of brass. A frame member 15 is disposed on the top of flange 10e centrally thereof and members 16 and 17 constituting lower frame and bearing bracket members are disposed on flange 10e at each side of member 15. Members 15, 16 and 17 have base flanges which are secured by a large number of bolts, some of which are shown as 18, to flange 10e. Member 15 also has side flanges engaged by side flanges on members 16 and 17 and said flanges are connected by a large number of bolts, some of which are shown as 19. Member 15 has therein the lower portions of semi-cylindrical chambers 15a and said frame member 15 as well as members 16 and 17 have upper flanges, the top surfaces of which are disposed in a horizontal plane passing substantially through the centers of chambers 15a. Members 16 and 17 have outwardly extending side flanges 16a and 17a supporting vertical flanges 16b and 17b, the latter also having horizontal flanges at their tops with top surfaces in the same plane as the top surfaces of the flanges on members 15, 16 and 17. A frame member 20 forming a central top chamber and discharge member rests upon frame member 15 and has a bottom flange connected to the top flange of member 15 by quite a large number of bolts, some of which are shown as 21. Frame member 20 has therein the upper portions of the semi-cylindrical chambers 15a and a discharge chamber or passage 20a extends upwardly from said chambers through member 20. Member 20 has a cylindrical flange 20b at its top with a top horizontal surface to which will be connected the pipes or other members to which the liquid is discharged. Chamber 20a has lateral outlets 20c which may be used as discharge outlets if desired. If not so used they will be closed by cover plates which will be bolted to the finished flat sides of the casing about openings 20c. The openings 20c also constitute inspection openings through which the rotors 42 may be seen and inspected. It is obvious that a lamp can be placed through the opening 20c into chamber 20a so that such inspection can be made. At the opposite sides of frame member 20 are frame members 22 and 23. The frame member 20 has side flanges and members 22 and 23 constituting upper frame and bearing bracket members have flanges engaging said side flanges and connected thereto by quite a large number of bolts, some of which are shown as 24. Members 22 and 23 each have outwardly extending ribbed portions 22a and 23a at the outer ends of which are flanges 22b and 23b. The outer surface of flange 22b is in the same plane as the outer surface of flange 16b and the outer surface of flange 23b is in the same plane as the outer surface of flange 17b. Portions 22a and 23a also have bottom flanges 22c and 23c resting on the flanges at the top of members 16b and 17b and connected thereto by the bolts 24. Another frame member 25 forming the lower main gear casing section has a base flange 25a resting on a flange 10g disposed a short distance above flange 10a. Flange 25a is connected to flange 10g by bolts 26. Member 25 has a top flange, the top surface of which is in the same plane as the top surfaces of the flanges at the tops of members 15, 16 and 17. The plane at the tops of these flanges is indicated in Fig.

1 by the line 27. A frame member 28 forming the upper main gear casing section rests upon frame member 25 and has a bottom flange connected to the top flange of member 25 by the bolts 29. Members 25 and 28 have at one side flat vertical surfaces disposed in the same plane and which are engaged by the flanges 16b and 22b respectively. Flanges 16b and 22b are connected to members 25 and 28 by the bolts 30. Member 25 has a flange 25b at one side having a flat vertical outer surface engaged by the outer surface of a flange 31a of a member 31 forming the lower auxiliary gear casing section and connected thereto by the bolts 32. A frame member 33 forming the upper auxiliary gear casing section has a bottom flange resting upon a top flange of member 31 and connected thereto by bolts 34. These latter flanges meet in a plane which is the same plane as indicated by line 27 in Fig. 1 and in which plane the top surfaces of members 15, 16 and 17 are disposed. Frame member 33 has a flange at one side engaging the vertical surface of a side flange on member 28 and connected thereto by the bolts 35. The various frame members described which are bolted together are carefully and accurately finished and located in position by dowel pins. Members 17 and 23 are bored to receive ball bearings 36 in which are journaled shafts 37 and 38. Said shafts have reduced threaded portions at their ends receiving threaded collars 39 engaging the ends of bearings 36. Members 16 and 22 are bored to receive ball bearings 40 in which shafts 37 and 38 are also journaled. Said shafts have threaded portions adjacent the bearings 40 on which are screwed the collars 41 engaging the ends of bearings 40. Shafts 37 and 38 are thus held from any substantial longitudinal movement. Shafts 37 and 38 have keys 37a and 38a therein shown as four in number and rotor members 42 are bored and splined to receive said shafts and keys and thus be secured to said shafts. Rotors 42 have therein circumferentially spaced substantially semi-cylindrical recesses or pockets 42a between which are the radially extending portions or projections 42b. The outer surfaces of portions 42b are in the surface of a cylinder substantially engaging the inner surfaces of lining members 43 disposed in the chambers 15a. The shafts 37 and 38 have their centers spaced a distance considerably less than the internal diameter of the liner members 43. The liner members 43 are thus of substantially semi-cylindrical shape and the same have surfaces meeting in a vertical plane midway between the axes of shafts 37 and 38. Said liner members are connected so as to form one integral member by being brazed or welded together, some of the brazing or welding metal being shown at 43a. Said liners are also divided on planes adjacent line 27, the divisions as shown in Figs. 5 and 10 extending in a plane making a slight angle with the horizontal. End plates 48 are positioned in the ends of chambers 15a and as shown in Fig. 4 these are disposed within the ends of liners 43 and act to support said liners. Members 48 are secured in place by screws 48a extending therethrough into members 22 and 23. The liner members 43 and members 48 will be made of bronze or some similar comparatively soft metal. The rotors 42 have disposed in portions 42b thereof adjacent each end of the rotor, tubes 44. Tubes 45 having semi-cylindrical closed outer ends are slidable in tubes

44 and a coiled compression spring 46 is disposed in said tubes engaging member 42 at one end and tube 45 at its other end. The projections 42b are provided with central slots 42e at their outer sides, which slots have an inner cylindrical portion 42c. Bars 47 fit in said slots and have inner semi-cylindrical portions 47a disposed in portions 42c but of somewhat smaller diameter than the latter. Bars 47 can thus have some inward and outward movement in said slots. Said bars 47 adjacent their ends are cut away as shown at 47b and the tubes 45 project into the space in the bar thus formed and engage the inner side of the bar as shown in Figs. 7 and 8. Springs 46 thus act to move bars 47 outwardly. The sides of the projections 42b are further provided with teeth 42d. The linings 43 have openings 43c at their upper sides through which the oil or other liquid is discharged into the chamber 20a and said members have openings 43b at their bottoms through which the oil or other liquid pumped passes to the rotors from chamber 10f. Frame members 17 and 23 are provided with bores through which shafts 37 and 38 project from the rotor chambers 15a. Frame members 16 and 22 are also provided with bores through which said shafts extend at the outer sides of the rotor chambers 15a. Shafts 37 and 38 have sleeves 49 thereon. In practice these are made of stainless steel and the inner ends of said sleeves project some distance within the rotor chambers and into bores formed in the ends of the rotors, said sleeves having splines or slots 49a in said inner ends into which extend the keys 37a and 38a formed on said shafts. Sleeves 49 will thus rotate with said shafts and rotors. The inner ends of said sleeves are also provided with small annular slots 49b and the metal of the surrounding rotor is swaged into said slots. The sleeves 49 extend outwardly through the bores in the frame members and are surrounded by rings of packing material 50. A packing gland 51 which is made of steel in order to get the requisite strength and rigidity has a bronze lining 52 throughout its bore and extending across its inner end and said gland extends into the bores of the frame and engages the packing 50. The glands 51 extend at opposite sides of the shafts as shown in Fig. 9, the same being centrally and longitudinally split and having end bosses connected by the headed and nutted bolts 53. Headed screws or bolts 54 extend centrally through the glands within the end lugs and are threaded into the frame for forcing the glands 51 against the packing 50. A tight fit is thus had about the shafts and a seal from the rotor chamber provided. Should any wear occur on the sleeves 49 said sleeves can be removed and replaced without changing the shafts.

Stuffing boxes 55 are disposed in the frame adjacent bearings 40 and 36 and are bored to receive packing material 56 disposed about shafts 37 and 38. Glands 57 extend into boxes 55 and engage packing 56, said glands being forced inward by screws 58 extending through the flanges thereof and into the boxes 55. The glands 57 are also of the centrally split type. Beyond collars 41 shafts 37 and 38 have tapered portions with keys therein and have secured thereto the gears 60 and 61, which gears are of the same size and mesh with each other. Said shafts have threaded portions beyond said gears on which are screwed the collars 62 engaging the outer

sides of gears 60 and 61. Shaft 37 terminates with said threaded portion but shaft 38 is continued therebeyond and has another tapered portion 38b to which is keyed the hub of a gear 63. Gear 63 is of the helical type having spaced tooth portions 63a with which mesh pinions 64 secured to a driving shaft 65. Driving shaft 65 is carried in ball bearings 66 disposed in bores in frame members 28 and 33 respectively. Frame member 28 has a hole or bore 28a provided for construction purposes and which is closed by a plate 68 secured to said frame by bolts 68a. A stuffing box 69 surrounds shaft 65 at the outer side of frame member 33 and is bored to receive packing 70. A gland member 71 extends into the stuffing box 69 engaging packing 70 and is forced therein by the headed bolts 72 threaded into said box. Shaft 65 extends beyond stuffing box 71 and is adapted to be driven by some suitable source of power. In Fig. 1 said shaft is shown as having a coupling 67 secured thereto also secured to a driving shaft 67a which will be driven from some exterior power unit. Shaft 38 is provided with a threaded portion beyond gear 63 on which is screwed a collar 73 engaging the outer side of gear 63. Frame members 31 and 33 are bored to receive ball bearings 74 in which shaft 38 is journaled. A bearing cover plate 75 is bolted to the outer side of frame members 31 and 33 by the bolts 76. Shaft 38 projects beyond frame members 31 and 33 and has secured thereto a sprocket member 77. A chain 78 runs over sprocket member 77 and over a sprocket member 79 secured to the driving shaft of an oil pump 80 having a flange 80a secured to the lower part of frame member 31 by the bolts 81. Pump 80 has an inlet conduit 80b which carries a screen member 82 through which oil must pass going into said pump 80. The outer end of pump 80, the end of shaft 38, sprockets 77 and 79 and chain 78 are enclosed by a casing 83 having a surrounding flange 83a bolted to the end of frame members 31 and 33 by the bolts 84. The chamber in frame members 25, 28, 31 and 33 which contains the gears 60, 61, 63 and 64 is adapted to contain oil to a considerable height substantially to the level indicated by line 85 in Fig. 2. A casing 86 is bolted to the end of the casing or frame opposite that having casing 83 thereon and this casing forms a chamber 86a at said end of the casing. Frame member 28 has inspection holes in opposite sides thereof closed by cover plates 87 secured thereto by the bolts 88. An apertured lug 31b is formed at the lower portion of frame member 31 and has therein a plug 89. This opening is provided for draining the oil chamber by means of a hand pump.

Casing member 83 has a projecting boss 83b through which passes a pipe 90, the top of the boss being tightly sealed around said pipe by a plate 91 bolted to said boss. Pipe 90 has connected thereto another pipe 92 which extends to a sight glass cup 93 having a discharge pipe 94 extending into an apertured boss 83c at the top of casing 83. A hand valve 95 is disposed in the pipe 92. Another pipe 96 extends from pipe 90 to a sight glass cup 97 having a discharge pipe 98 extending into an apertured boss 33a on frame member 33. Pipe 98 delivers oil to bearing 66 and shaft 65 as well as to the gears 64. A hand valve 99 is disposed in the pipe 96. A pipe 100 leads from pipe 90 and delivers oil through a boss 33b in frame member 33 to the other bearing 66. A relief valve 101 is disposed in pipe 100. Another pipe 102 has branches extending to sight

glass cups 103 having discharge pipes 104 extending into the frame member 23 and delivering oil to bearings 36. A hand valve 105 is shown as disposed in pipe 102. Pipes 106 extend from the sides of casing 36 being connected in the outer threaded portions of bores 36b and these pipes extend to and discharge into the chamber in frame member 25. A pipe 107 extends from pipe 90 to a sight glass cup 108 which has a discharge pipe 109 extending into a pipe assembly 110 discharging into the top of casing 28 and onto gears 64 and 63. An elbow member 111 is secured to the top of assembly 110 and has an open end forming a vent. A hand valve 112 is disposed in pipe 107.

In operation of the pump the same will be driven through the coupling member 67 which will drive shaft 65. Gear 63 will be driven by pinion 64 so that shaft 38 is driven. Shaft 37 is driven through gears 60 and 61 so that the rotor members 42 are driven in opposite directions. As the rotor members revolve the bars or blades 47 are held out against the inner surfaces of liners 43 and the oil to be pumped which enters through the screens 11 and 13 and rises in chamber 10f is moved by the projections 42b and carried upwardly past the rotors. The blades 47 enter the recesses 42a and the teeth 42d enter the recesses of the other rotor at the upper sides of said teeth. The oil is thus moved in the well known manner of such pumps. The oil may be discharged under considerable pressure, the pump illustrated in practice being designed to deliver the oil discharged at a pressure of 100 pounds per square inch. The casing for the pump as stated is divided along a horizontal plane passing substantially through the centers of shafts 37 and 38. With this construction the bolts securing the casing together at this plane may be removed and the upper half of the casing lifted bodily from the lower half. This gives access to the shafts, bearings and rotors so that any changes or repairs can be easily and quickly made. It will also be seen that the various sections of the frame can be unbolted and separately removed. Thus members 22 and 23 can be separately removed or the central section 20 can be removed. This is a great advantage as the pumps are used largely in ships such as tankers and are disposed in the hold. It is a very desirable feature that the different frame and bearing members as well as the different parts of the gear casing, such as parts 25, 28, 31 and 33, can be separately removed. By having the split packing glands 51 they can be manipulated in a much smaller space than if the glands had continuous flanges. The portions 51 of the glands are preferably made from stainless steel having a high modulus of elasticity. The bronze bushing 52 forms the bearing and has, as is well known, small frictional resistance. If the whole gland were made of bronze it would not be sufficiently strong and the flange would bend under stress of bolts 54. If enough metal were used to give sufficient strength the gland would have too great dimensions and would be objectionably large necessitating a longer frame and longer rotor shafts. By providing the casings 33 and 36 all parts including the lubricating parts are enclosed and all are contained in an oil chamber. The oil level in the chamber in casing 36 will be maintained at or above the centers of shafts 37 and 38. The lubricating pump 80 pumps oil from the bottom of the chamber in casing portions 25 and 31 and delivers the same to the bearings 36, 40 and 66

as well as the bearings 74. The oil after being delivered to the chamber 86a drains back therefrom into the main oil chamber in casings 25 and 31 through pipes 106. The pump is thus lubricated in all necessary parts by an oil pump enclosed therein and driven by its own parts. The sprockets 77 and 79 and chain 78 are also well lubricated as the lower part of the chain 78 and sprocket 79 are disposed in oil. Attention is called to the fact that should the oil pipe lines communicating with relief valve 101 become clogged so that said valve 101 would operate, oil would be delivered to gears 63 and 64 through pipe 100. This oil would also reach bearings 66. There would thus not be a stoppage of the oil circulation. The construction of the liner members 43 is quite efficient. It is also important to have the liners connected to maintain proper relation thereof to the rotors. The provision of sleeves 49 makes possible an efficient packing method or seal for the rotor chambers and any wear of rotation is taken by the sleeve, which sleeve can be readily replaced. As stated, no change is then necessary in the shaft. The greatest stress on the shafts 37 and 38 occurs just at the ends of the rotors. If the shafts corrode at this point they are apt to fail. In practice two shafts six inches in diameter made of stainless steel became corroded and cracked at the ends of the rotors. By providing the sleeves 49 the corrosion at this point is prevented so that the shaft is protected at the point of greatest stress.

From the above description it will be seen that applicant has provided a very efficient and improved structure of pump. The pump must be very accurately and strongly made. The same has been amply demonstrated in actual practice and found to be very successful and efficient.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the parts, without departing from the scope of applicant's invention, which generally stated, consists in a device capable of carrying out the objects above set forth in the parts and combinations of parts disclosed and defined in the appended claims.

What is claimed is:

1. A rotary pump having in combination, a casing, a pair of parallel shafts disposed in said casing, bearings for each shaft spaced longitudinally thereof and carried by said casing, interacting rotors secured to said shafts, said casing having mating semi-cylindrical chambers for said rotors, gears secured to said shafts and meshing with each other, a driving gear secured to one of said shafts, a pinion meshing with said driving gear, a shaft carrying said pinion, bearings in said casing at each side of said pinion for said latter shaft, said casing having an inlet opening at one side of said rotors and an outlet opening at the opposite side of said rotors, said casing having a chamber in which said gears, driving gear and pinion are disposed, said casing and bearings being divided along a plane passing substantially through the centers of said three shafts to form two units whereby the portion having said discharge outlet therein may be separated as one unit bodily from the portion having said inlet opening therein and means connecting the two portions of said casing together.

2. The structure set forth in claim 1, the upper part of said casing being divided into separately removable parts along vertical spaced planes.

3. A rotary pump having in combination, a

casing, parallel shafts disposed therein one of which constitutes a driving shaft, bearings for each shaft spaced longitudinally thereof and supported in said casing, interacting rotors secured to said shafts respectively, semi-cylindrical chambers in which said rotors are disposed and rotate, an inlet chamber below said chambers communicating therewith and an outlet chamber above said rotors communicating with said first mentioned chambers, gears secured to said shafts and meshing with each other, a driving gear secured to said driving shaft, a pinion meshing with said driving gear, a shaft carrying said pinion, bearings for said first mentioned shafts at each side of said pinion and carried by said casing, said casing having a chamber in which said gears, driving gear and pinion are disposed, an oil pump disposed in the lower part of said casing, means without said casing connected to said driving shaft and oil pump for driving the latter, a casing enclosing said means and secured to said first mentioned casing having a chamber therein communicating with said first mentioned casing, a casing secured to said first mentioned casing at the opposite ends of said shafts and having a chamber therein communicating with said first mentioned casing, oil being maintained in said first mentioned casing and means connected to said oil pump and connected to said first mentioned casing for distributing oil to the bearings therein and to said last mentioned chamber.

4. A rotary pump having in combination, a casing having rotor chambers therein, interacting rotors in said chambers, shafts to which said rotors are secured, gears connecting said shafts, one of said shafts having a large gear connected thereto, a pinion for driving said large gear, a shaft carrying said pinion, said casing having a chamber therein enclosing said gears, said casing being divided about a horizontal plane passing through the centers of said shafts and about a vertical plane passing through said large gear whereby the same is in four parts, said parts being separately removable.

5. A rotary pump having in combination, a casing, a pair of parallel shafts disposed in said casing, bearings for each shaft disposed longitudinally thereof and carried by said casing, interacting rotors secured to said shafts, one of said shafts extending beyond said casing, and driving means connected to said shaft beyond said casing, an oil pump disposed in said casing, a driving shaft for said oil pump extending beyond said casing, a driving element secured to said last mentioned shaft without said casing and driven by said driving means and a second casing secured to said first mentioned casing and enclosing said one shaft and driving means.

6. A rotary pump having in combination, a casing, a pair of parallel shafts disposed in said casing, bearings for each shaft spaced longitudinally thereof and carried by said casing, interacting rotors secured to said shafts, semi-cylindrical chambers for said rotors, gears secured to said shafts and meshing with each other, a driving gear of large diameter secured to one of said shafts, a pinion meshing with said driving gear, said casing having a chamber in which said gears, driving gear and pinion are disposed adapted to contain oil in the lower part thereof, said shaft carrying said driving gear projecting beyond said casing, driving means connected to the projecting portion of said shaft, an oil pump in said last mentioned chamber, a driving shaft for said

oil pump projecting beyond said casing, a driving element for said oil pump secured to said last mentioned shaft and driven by said driving means and a casing enclosing the projecting portion of said shaft and driving means.

7. A lining for a rotary pump having connecting semi-cylindrical chambers adapted to receive rotors, comprising adjacent semi-cylindrical shells having surfaces meeting in a plane midway of said chambers and being rigidly connected at said meeting point, said shells having free edges in planes adjacent a plane passing through the axes of said chambers.

8. A rotary pump having in combination, parallel shafts, coaxing rotors secured to said shafts, semi-cylindrical chambers in which said rotors rotate, the axes of said shafts being spaced a distance smaller than the diameter of said chambers, linings for said chambers meeting in a plane midway between the centers of said chambers, said linings being rigidly connected by metal secured thereto disposed adjacent said plane and being divided along planes adjacent the plane passing through the axes of said rotors whereby said linings may be conveniently assembled and disassembled.

9. In a rotary pump having connecting semi-cylindrical chambers, a lining adapted to receive rotors comprising adjacent semi-cylindrical shells of substantially uniform thickness radially having their axes spaced a lesser distance than the diameter of said shells and having surfaces parallel to their axes meeting in a plane midway of said chambers, said shells being rigidly welded together at said meeting plane whereby the inner surfaces of said lining are parallel to the walls of said chambers, said lining having free edges adjacent the plane passing through the axes of said chambers.

10. A rotary pump having in combination, a driven shaft, a rotor connected to said shaft, a chamber in which said rotor is disposed having an end wall with an opening through which said shaft projects, a sleeve fitting on and secured to said shaft and extending a short distance through said end wall, a cylindrical recess about said sleeve, means for packing said recess, said sleeve having an annular groove within said chamber and said rotor having a portion extending into said groove.

11. A rotary pump having in combination, a rotor member, a semi-cylindrical chamber in which said rotor is disposed, said rotor having circumferentially spaced projections with radial slots extending therein from their outer sides, said slots having enlarged semi-cylindrical inner ends, bars of comparatively soft metal disposed in said slots and having semi-cylindrical inner ends disposed in said semi-cylindrical portions of said slots and of smaller diameter than said portions and resilient means normally urging said bars outwardly.

12. The structure set forth in claim 11, said last mentioned means comprising telescoping tubes and a spring urging one of said tubes against said bar, said bar having a recess adjacent one end into which said tube extends.

13. A rotary pump having in combination, a casing, a pair of parallel shafts disposed in said casing, interacting rotors secured respectively to said shafts, said casing having a chamber in which said rotors are disposed having inlet and outlet passages at opposite sides of said rotors respectively, bearings for said shafts at one side of and outside of said chamber, gears secured to

said shafts meshing with each other, a driving gear secured to one of said shafts, a pinion meshing with said driving gear, said casing having a chamber in which said gears, driving gear, and pinion are disposed, bearings for said shafts adjacent one side of and communicating with said last mentioned chamber so as to be lubricated by oil therein, a bearing for said one of said shafts at the other side of said last mentioned chamber and communicating therewith, said casing being divided along a plane passing through the axes of said shafts to form two rigid units, the upper of said units being bodily removable whereby said shafts with said gears and rotors and bearings may be removed.

14. The structure set forth in claim 13 and a shaft carrying said pinion, spaced bearings for said latter shaft disposed at either side of said last mentioned chamber and communicating therewith.

15. A rotary pump having in combination, a casing, a pair of parallel shafts disposed in said casing, said casing having semi-cylindrical chambers therein, interacting rotors secured to said shafts and disposed in said chambers, gears secured to said shafts and meshing with each other, a driving gear secured to one of said shafts, a pinion meshing with said driving gear, said casing having a chamber in which said gears, driving gear, and pinion are disposed, a shaft carrying said pinion, bearings for said first mentioned shafts at one side of said last mentioned chamber and communicating therewith, and a bearing for said one shaft at the other side of said chamber and communicating therewith, said casing being divided into two rigid units along a plane extending through the axes of said shafts, the upper of said units being bodily removable.

16. The structure set forth in claim 15 and bearings for said last mentioned shaft disposed at either side of said chamber and pinion and communicating with said last mentioned chamber.

17. A rotary pump having in combination, a casing, said casing having mating semi-cylindrical chambers therein, a pair of parallel shafts disposed in said casing to which said rotors are respectively secured, an outlet passage leading from said chambers above said rotors, an inlet passage leading downward from said rotors, said casing having a slot in the side thereof communicating with said inlet passage, a screen extending across said inlet passage and removable through said slot, cylindrical inlet passages at either side of said casing communicating with said first mentioned inlet passage, and a cylindrical screen secured in said cylindrical passages and extending between the same and thus across said first mentioned inlet passage.

18. In a rotary pump having connecting semi-cylindrical chambers, a lining for said chambers having an outer surface fitting against the walls of said chambers and an inner surface parallel to the walls of said chambers, said lining having surfaces meeting in a plane perpendicular to a plane passing through the axes of said chambers and midway of said axes, said lining being formed

as a rigid unit at said meeting surfaces and having free edges in planes adjacent said plane passing through the axes of said chambers and at an angle thereto.

19. A rotary pump having connecting semi-cylindrical chambers, lining members for said chambers each comprising a pair of semi-cylindrical shells having inner and outer surfaces parallel to the walls of said chambers and having edges meeting in a plane extending perpendicular to a plane passing through the axes of said chambers and midway between said axes, said shells being rigidly secured together at said meeting planes, said linings each having free edges at the remote sides of said chambers extending in planes adjacent said plane passing through the axes of said chambers, said chambers having end walls perpendicular to said axes, end lining plates within said first mentioned linings and supporting the same disposed against said end walls and screws securing said end plates to said end walls.

20. A rotary pump having in combination, a casing, said casing having mating semi-cylindrical chambers therein, a pair of parallel shafts disposed in said casing to which said rotors are respectively secured, an outlet passage leading from said chambers above said rotors, an inlet passage leading downward from said rotors, said casing having a slot in the side thereof communicating with said inlet passage, and a screen extending across said inlet passage and removable through said slot, said casing having slots at opposite sides in which said screen is slidable.

21. A rotary pump having in combination, a casing, a pair of parallel shafts disposed in said casing, bearings for each shaft spaced longitudinally thereof and carried by said casing, interacting rotors secured to said shafts, gears secured to said shafts and meshing with each other, a driving gear of large diameter secured to one of said shafts, a pinion meshing with said driving gear, said casing having a chamber adjacent one end and an outer end wall in which chamber said gears, driving gear and pinion are disposed, said chamber being adapted to contain oil, a chamber-forming casing secured to said wall into which said shaft carrying said driving gear projects, an oil pump in said last mentioned chamber having a shaft projecting into said last mentioned casing, a driving means connecting said last mentioned shaft and said shaft carrying said driving gear, said last mentioned casing being adapted to contain oil for lubricating said driving means.

22. A rotary pump having in combination, a driven shaft, a rotor connected to said shaft, a chamber in which said rotor is disposed having an end wall with an opening through which said shaft projects, a sleeve fitting on and secured to said shaft and extending a short distance through said end wall and a short distance into said rotor, a cylindrical recess about said sleeve and means for packing said recess, the metal of said rotor extending into said sleeve.

JOHN B. HAWLEY, JR.