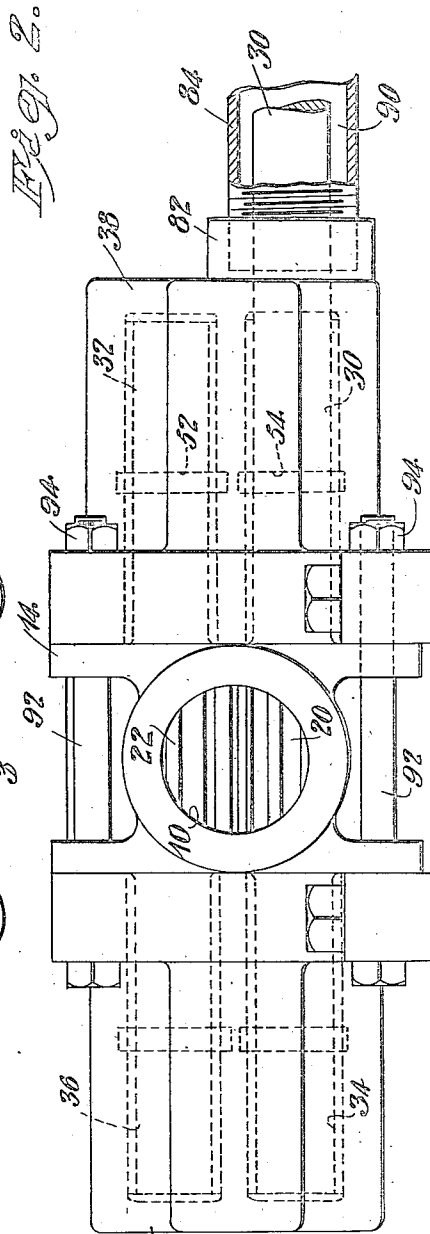
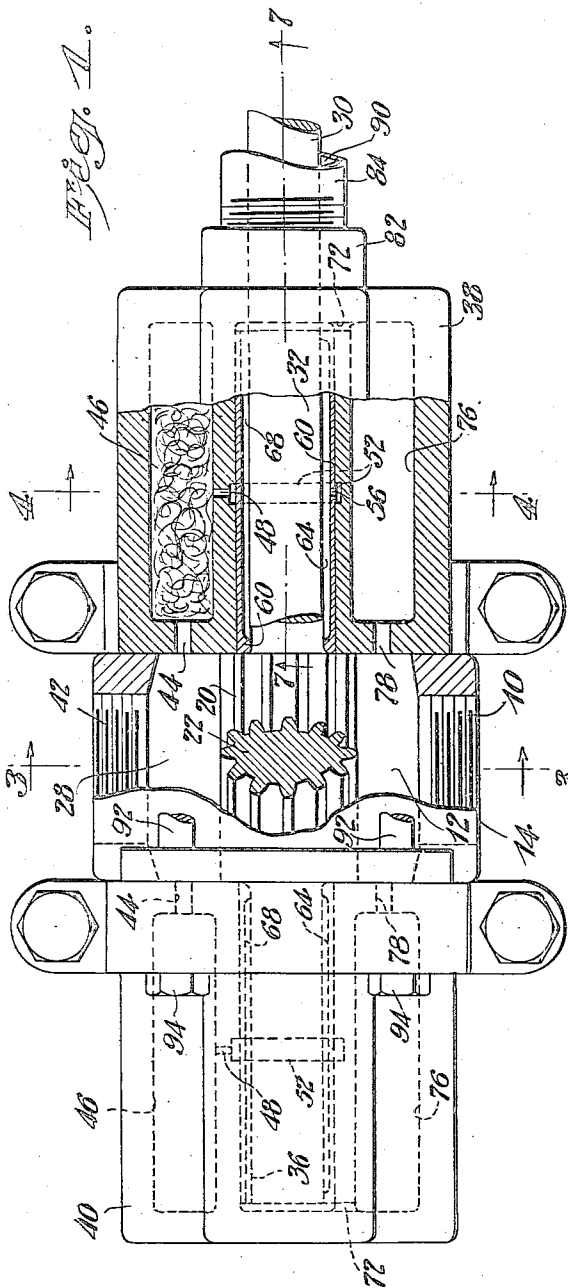


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PUMP.
APPLICATION FILED AUG. 16, 1919.

1,379,587.

Patented May 24, 1921.
2 SHEETS—SHEET 1.



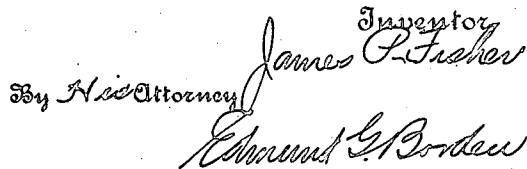
By His Attorney
James P. Fisher
Edmund W. Borden

PUMP.

Patented May 24, 1921.

2 SHEETS—SHEET 2.

1,379,587.



UNITED STATES PATENT OFFICE.

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PUMP.

1,379,587.

Specification of Letters Patent.

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Application filed August 16, 1919. Serial No. 317,352.

To all whom it may concern:

Be it known that I, JAMES P. FISHER, residing at Bartlesville, in the county of Washington, State of Oklahoma, have invented certain new and useful Improvements in Pumps; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to pumps, and more particularly to high speed gear pumps adapted to pump fluids under high pressures, and at high temperatures.

In the refining of mineral oils and in many other industries, there frequently arises the problem of pumping liquids under pressure at high temperatures, the temperature extending in some cases from 500° F. or 600° F. to nearly red heat. The pumps used for pumping liquids at ordinary temperatures are not suitable for working at these higher temperatures, owing to the rapid destruction of the packings and to the melting of the bearing metals. Difficulties in the way of lubrication and in the provision of liquid tight closures are also encountered at high temperatures, which are not met at ordinary temperatures. Consequently, it has been found practically impossible to use any of the ordinary liquid pumps for high temperature operations.

The object of the present invention is to provide a pump which is very efficient for pumping liquids under pressure at high temperatures.

For pumping liquids under high temperature and pressure and especially thick, heavy or sticky liquids, rotary gear pumps are the most suitable, because of their simplicity and the absence of valves and other reciprocating parts, which are liable to fail or to get out of order. Also when pumping easily emulsifiable mixtures of oils or other liquids, gear pumps have the advantage that they cause less disturbance in the condition of the liquid and thus avoid the formation of emulsions. Further, high speed gear pumps give a steady, continuous delivery.

When pumping liquids under high pressure, the gears of a gear pump are exposed to the unbalanced back pressure of the liquid being pumped. As a result, a heavy pressure is thrown on the bearings and sup-

porting shafts causing high friction losses and overheating of the bearings. Under these conditions, it is very difficult to maintain a packing for the gears which will give an efficient pumping action and therefore gear pumps have been limited to a comparatively narrow field of usefulness.

Accordingly, another object of the invention is to provide a high speed gear pump for pumping under pressure by which the unbalanced back pressure on the pumping gears may be effectively overcome.

A further object of the invention is to provide a packed bearing for a high temperature gear pump which is effective and efficient in operation.

With these and other objects in view, the invention consists in the improved gear pump described in the following specification and defined in the claims.

The various features of the invention are illustrated in the accompanying drawing, in which:

Figure 1 is a plan view with parts broken away, of a gear pump embodying the preferred form of the invention.

Fig. 2 is a front elevation of the gear pump shown in Fig. 1.

Fig. 3 is a vertical sectional view of the gear pump taken on the line 3—3 of Fig. 1.

Fig. 4 is a vertical sectional view of the gear pump on the line 4—4 of Fig. 1.

Fig. 5 is a detailed sectional view of a bearing of the gear pump taken on the line 5—5 of Fig. 4.

Fig. 6 is a front elevation of the gear pump together with its driving mechanism.

Fig. 7 is a detailed sectional view of a bearing of the gear pump taken on line 7—7 of Fig. 1.

In the gear pump illustrated in the drawings, the liquid to be pumped enters through an inlet 10 to a suction chamber 12 of the pump 14. The fluid in the chamber 12, enters and fills spaces 16 between gear teeth 18 on gear wheels 20 and 22. By the rotation of the gears 20 and 22 the bodies of liquid contained in the spaces 16 are carried around between the gear wheels 20 and 22 and semi-cylindrical walls 24 and 26 of the pump 14 to a delivery chamber 28. The gear wheels 20 and 22 are rigidly supported on rotatable shafts or trunnions 30, 32, 34 and 36, mounted in bearing castings 38 and 40. The liquid is prevented from passing

from the chamber 28 through the gears 20 and 22 back to the inlet chamber 12 by the intermeshing of the gear teeth 18. From the chamber 28 the liquid is delivered through an outlet opening 42.

In all gear pumps, a part of the liquid carried from the chamber 12 to the chamber 28 by the gears 20 and 22 leaks back to the chamber 12. It has been found that this leakage takes place mostly between the ends of the gears and the walls of the bearing castings 38 and 40 and that there is comparatively little leakage through the gears. In order to cut down this leakage loss, the gears of the present invention are made as long as practicable, in comparison with their diameters, so as to offer the least possible space for leakage of liquid between the ends of the gears and the walls of the pump.

In order to balance the back pressure on the gears, a portion of the liquid which has passed to the delivery side of the gears is led through a duct, or a series of ducts, to the bearing or pressure sides of the gear shafts. The pressure of this delivery side liquid balances the back pressure of the liquid on the gears and tends to force, or float the shafts off from the shaft bearings. The fluid by-passed to the shafts flows slowly around the shafts to the low pressure side of the shafts and escapes through a passageway to the low pressure or inlet side of the pump.

In order to balance the back pressure of the liquid in the chamber 28 on the gears 20 and 22, a small part of this liquid passes through ducts 44, in each of the bearing castings 38 and 40 to filter chambers 46, which are filled with a mass of fibrous, filtering material. The liquid in passing through this filtering material will be freed from particles of grit and solid material which might injure the bearings. From the filter chamber 46, the liquid passes through ducts 48 and 50, (Fig. 4) to annular recesses 52 and 54 respectively, surrounding the bearings of the shafts 30 and 32. The liquid flows through the recesses 52 and 54 to that part of the recesses opposite the ducts 48 and 50 and passes through openings 56 and 58 in bearing collars 60 and 62 surrounding the journals of the shafts 30 and 34 and 32 and 38 respectively. The liquid passing through the openings 56 and 58 enters distributing channels 64 and 66 extending lengthwise nearly the entire length of the bearing collars 60 and 62. The ends of the bearing collars 60 and 62 are made to closely fit the journals of the shafts 30, 32, 34 and 36 and prevent any appreciable amount of liquid from escaping from the distributing channels 64 and 66 between the ends of the collars and the shafts. Throughout the length of the distributing channels 64 and 66, the interior

diameter of the bearing collars 60 and 62 is made slightly larger than the diameter of the shafts 30 and 32 to form a very narrow space between the bearing collars and the shafts, through which the liquid flows under a drop in pressure to collecting channels 68 and 70. The channels 68 and 70 are extended through one end of the bearing collars 60 and 62 and communicate with ducts 72 and 74 connecting the channels 68 and 70 respectively to a collecting chamber 76. The liquid flowing from the distributing channels 64 and 66 around the shafts 30 and 32 to the collecting channels 68 and 70, flows through the open ends of the channels 68 and 70 and thence through the ducts 72 and 74 to the collecting chamber 76. From the collecting chamber 76 the liquid passes through a duct 78 (Fig. 1) to the inlet chamber 12 of the pump.

From the foregoing, it is manifest that the high pressure sides of the journals of the shafts 30, 32, 34 and 36 are those which face toward the low pressure or inlet side of the pumping gears 20 and 22. Conversely, the low pressure sides of the shaft journals face toward the outlet or high pressure sides of the pumping gears.

The extent of the bearing surfaces of the journals of the shafts 30, 32, 34 and 36 is so proportioned with relation to the dimensions of the gears, that the fluid pressure on the shafts will just about balance the back pressures on the gears. To accomplish this, the sum of the projected areas of the shafts is made equal to, or greater than the sum of the maximum projected areas of the gears. In the specification and claims of this application, the words "projected area" are used in the ordinary engineering sense to denote the area of the shadow cast by the respective parts under the action of parallel rays of light upon a plane surface disposed at right angles to the rays of light. Consequently, the maximum projected area of the gears, for example, equals the length of the gears multiplied by the sum of their diameters minus, by reason of the intermeshing of the teeth of the gears, the depth of a tooth on the gears. Inasmuch as the pressure of the oil introduced into the bearing collars 60 and 62 may not be entirely spent in passing from the openings 56 and 58 to the other sides of the shaft journals and may consequently exert some influence tending to move the shafts in the same direction as the back pressure on the gears, the sum of the projected areas of the journals of the shafts is preferably somewhat greater than that of the gears. In the illustrated construction which has been operated with very satisfactory results, the maximum projected area of the gears and the combined projected area of the shaft journals are approximately in the ratio of 3 to 5. It

is manifest that when the pressure of the fluid on the sides of the shafts 30, 32, 34 and 36 facing toward the intake side of the pump chamber counterbalances the back pressure on the pumping gears, the shafts will be, in effect, floated away from the bearing collars 60 and 62, so that they are supported against rearward thrust by a constantly renewed cushion of fluid between their journals and the bearing collars. By thus floating the shafts away from the bearing surfaces, it is possible to dispense with the sheet or layer of bearing metal used for lining the bearings in the common types of gear pumps. The bearing collars 60 and 62 may be made of cast iron or steel or other metals not fusible at relatively high temperatures. The bearing surfaces of the shafts at each end of the gears will of course be made equal, so that the pressures on the gears will be properly balanced.

To provide power for driving the gears, the shaft 30 is extended through the end of the bearing casting 38 and is provided with a driving pulley 80 at its free end. It is difficult if not impossible, to provide a liquid tight stuffing box on the bearing casting 38, because, at the temperatures at which the pump is operated, the stuffing material would rapidly deteriorate. Moreover, at these high temperatures, the liquid has a greater fluidity and has a consequently greater tendency to leak through the stuffing devices. To overcome these difficulties, the bearing casting 38 has an integral collar or projection 82 around the shaft 30. Into this projection or collar is threaded one end of a pipe 84 surrounding the shaft 30. At the outer end of the pipe 84, there is provided a stuffing box 86 and gland 88. Liquid from the ducts 72 and 74 passes into an annular compartment 90, formed between the shaft 30 and the pipe 84 and completely fills said compartment. The oil in the compartment 90 will be cooled by radiation from the walls of the pipe 84 and by the time it reaches the stuffing box 86, its temperature will be low enough so that the packed joint in the stuffing box 86 may be easily prevented from leaking. The oil will not be actively circulated in the chamber 90 and consequently the oil therein will be comparatively cool.

Since the liquid in the chamber 90 is in communication with the low pressure ducts 72 and 74 and through these ducts and the collecting chamber 76 with the low pressure chamber 12 of the pump 14, the pressure tending to force the liquid out of the chamber 90 through the stuffing box 86 will be comparatively small, thereby further reducing the tendency of liquid to leak through the stuffing box 86.

The bearing castings 38 and 40 and the main body of the pump 14 are held together

by four bolts 92. To take the pump apart, for cleaning or repair, nuts 94 on the bolts 92 are removed, whereupon the bearing casting 40 may be removed from the body of the pump 14. The gears 20 and 22 may then be removed through the open end of the pump section 14, leaving every part of the pump accessible for inspection or repair.

While the pump has been described in connection with high temperature operations, it will be understood that it is not limited to use under these conditions, but will be equally advantageous when used at ordinary temperatures.

The preferred form of the invention, having been thus described, what is claimed as new is:

1. A high speed gear pump, which comprises a gear chamber, a pair of intermeshing pumping gears disposed in substantial contact with walls of said chamber, rotatable shafts rigidly fastened to and supporting said gears, means for conducting fluid from the high pressure side of said gears to the sides of said shafts facing toward the low pressure sides of the chamber, and means for withdrawing fluid from the low pressure sides of the shafts.

2. In a high speed gear pump having pumping gears supported on rotatable shafts and bearings for the shafts, the combination of means for introducing fluid under pressure to the bearing surfaces of said shafts adjacent to the low pressure side of the gears, and means for removing fluid from the low pressure sides of said shafts.

3. In a high speed gear pump having a pair of pumping gears rigidly supported on rotatable shafts, the combination of means for conducting fluid under pressure from the high pressure side of said gears to the bearing surfaces of said shafts adjacent to the low pressure side of the gears, and means for withdrawing fluid from the low pressure sides of said shafts to the low pressure side of the pumping gears.

4. In a high speed gear pump having a pair of intermeshing pumping gears rigidly supported on rotatable shafts, the combination of ducts leading from the high pressure side of the pump to the bearing surfaces of the shafts, means for filtering the material passing through the ducts, and ducts leading from the low pressure sides of the shafts to the low pressure sides of the pumping gears.

5. In a high speed gear pump having pumping gears rigidly mounted on rotatable shafts and bearings for the shafts, the combination of ducts leading from the high pressure side of said gears to the portion of the bearing surfaces of the shafts facing toward the low pressure sides of the gears, means for distributing fluid from said ducts throughout the length of the bearing sur-

faces, and means for withdrawing fluid from the low pressure sides of said shafts to the low pressure sides of said gears.

6. In a high speed gear pump, the combination of pumping gears rigidly supported on rotatable shafts, journals for said shafts the projected areas of which are equal to, or greater than, the projected area of the pumping gears, means for conducting fluid under pressure from the high pressure side of said gears to the bearing surfaces of the shafts, and means for withdrawing fluid from the low pressure sides of the shafts.

7. In a high speed gear pump, the combination of a pair of intermeshing pumping gears rigidly supported on rotatable shafts, journals for said shafts, the projected area of which are greater than the projected area of said gears, and means for maintaining a fluid under pressure on the bearing surfaces of the shafts.

8. A high speed gear pump, comprising a pumping chamber, a pair of intermeshing pumping gears dividing said pumping chamber into two sections, shafts for supporting the gears, journals on the shafts, and means for conducting fluid from the high pressure side of the gears to the sides of the journals facing toward the low pressure side of the chamber to cause pressure on the shafts in directions counter to the back pressure on the gears.

9. In a high speed gear pump, the combination of a pair of intermeshing pumping gears rigidly supported on rotatable shafts, and means for supporting said shafts against the back pressure of the fluid being pumped by a cushion of fluid under pressure.

10. A high speed gear pump comprising a pair of intermeshing pumping gears rigidly supported on rotatable shafts within a casing, power means for rotating said shaft fastened to an extension of one of the shafts outside of the casing, a sleeve surrounding said extension and fastened to the wall of said casing, and a stuffing box at the free end of said sleeve.

11. The combination with a high speed gear pump casing of a driving shaft, an air-cooled collar surrounding said shaft and having a liquid-tight connection with said casing, and a stuffing box at the free end of said collar.

12. The combination with a high speed gear pump casing of a driving shaft, an air-cooled collar surrounding said shaft and having a liquid-tight connection with said casing, a stuffing box at the free end of said collar, and means for admitting liquid to said air-cooled collar only from the low pressure side of said pump casing.

13. In a high speed gear pump which comprises a pumping chamber, a pair of intermeshing pumping gears, rotatable shafts

supporting said gears, bearing collars surrounding said shafts, and means for introducing fluid under pressure between the said shafts and said bearing collars in a direction opposite to the direction of back pressure on said gears and withdrawing fluid from the low pressure sides of said shafts.

14. A high speed gear pump, comprising a pumping chamber, a pair of intermeshing pumping gears in said chamber supported on rotatable shafts, bearing collars surrounding said rotatable shafts, means for conducting fluid from the delivery side of said gears and distributing said fluid between the said shafts and said bearing collars on the sides of the shafts facing toward the low pressure or intake side of the pump, and means for withdrawing fluid from the sides of the shafts opposite from the first-mentioned sides to the intake side of the pump.

15. A high speed gear pump, comprising a pumping chamber, a pair of intermeshing pumping gears in said chamber supported on rotatable shafts, bearing collars surrounding said rotatable shafts, means for conducting fluid from the delivery side of said gears and distributing said fluid between the said shafts and said bearing collars at the pressure sides of said shafts, and means for filtering said fluid passing to said shafts.

16. A high speed gear pump which comprises a pumping casing, a pair of intermeshing pumping gears in said casing rigidly supported on rotatable shafts, ducts leading from the high pressure side of said pump to the bearing surfaces of said shafts, ducts leading from the low pressure sides of said shafts to the low pressure side of said pumping gears, power means for rotating said shafts fastened to an extension of one of the shafts outside said casing, a sleeve surrounding said extension and fastened to the wall of said casing, the interior of said sleeve communicating with the duct leading from the low pressure side of said driving shaft, and a stuffing box at the free end of said sleeve.

17. A high speed gear pump which comprises a pumping chamber, a pair of rotatable shafts, intermeshing pumping gears rigidly supported on said rotatable shafts, and journals for said shafts having a combined projected area equal to, or greater than the projected area of the pumping gears.

18. A high speed gear pump comprising a chamber, a pair of intermeshing pumping gears mounted in the chamber, shafts for the gears provided with journals having a combined projected area equal to or greater than the maximum projected area of the gears, bearings for the journals, means for

conducting fluid from the high pressure side of the gears to the portions of the bearing surfaces of the journals facing toward the low pressure side of the pump chamber to counter-balance the back pressure of the fluid on the gears, and means for withdrawing fluid from the opposite sides of the journals.

19. A high speed gear pump comprising a chamber, a pair of intermeshing pumping gears mounted in the chamber, shafts for the gears provided with journals having a combined projected area equal to or greater than the maximum projected area of the gears, bearings for the journals, and means for effecting circulation of fluid from the pump chamber through said bearings of a character such as to exert fluid pressure on the journals of the shafts substantially counterbalancing the back pressure of the fluid on the pumping gears.

20. A high speed gear pump comprising a chamber, a pair of intermeshing pumping gears mounted in the chamber, shafts for

the gears provided with journals having a combined projected area equal to or greater than the maximum projected area of the gears, means for conducting fluid from the high pressure side of the pump chamber to the sides of the journals facing toward the low pressure side of the gears to counter-balance the back pressure of the fluid on the gears, and means for withdrawing fluid from the opposite sides of said journals to the low pressure or intake side of the pump chamber.

21. A method of lubricating a high speed gear pump having intermeshing pumping gears carried on rotatable shafts, which comprises conducting fluid under pressure from the delivery side of the pump to the portion of the bearing surfaces of the shafts facing toward the intake side of the pump, and withdrawing said fluid from the low pressure sides of said shafts to the intake side of the pump.

In testimony whereof I affix my signature.

JAMES P. FISHER.