May 28, 1929. A. P. M. WILKING 1,714,706

PUMP

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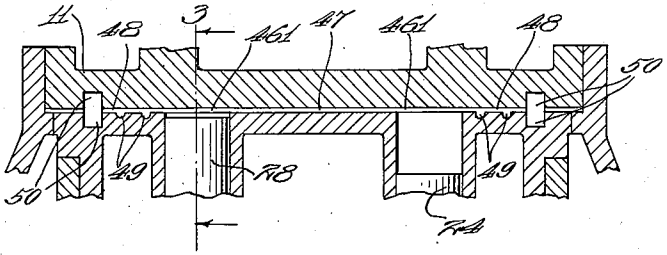


Fig. 3.

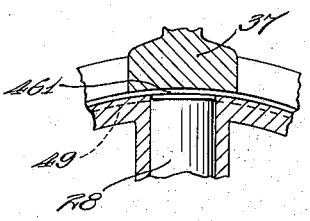


Fig. 3a.

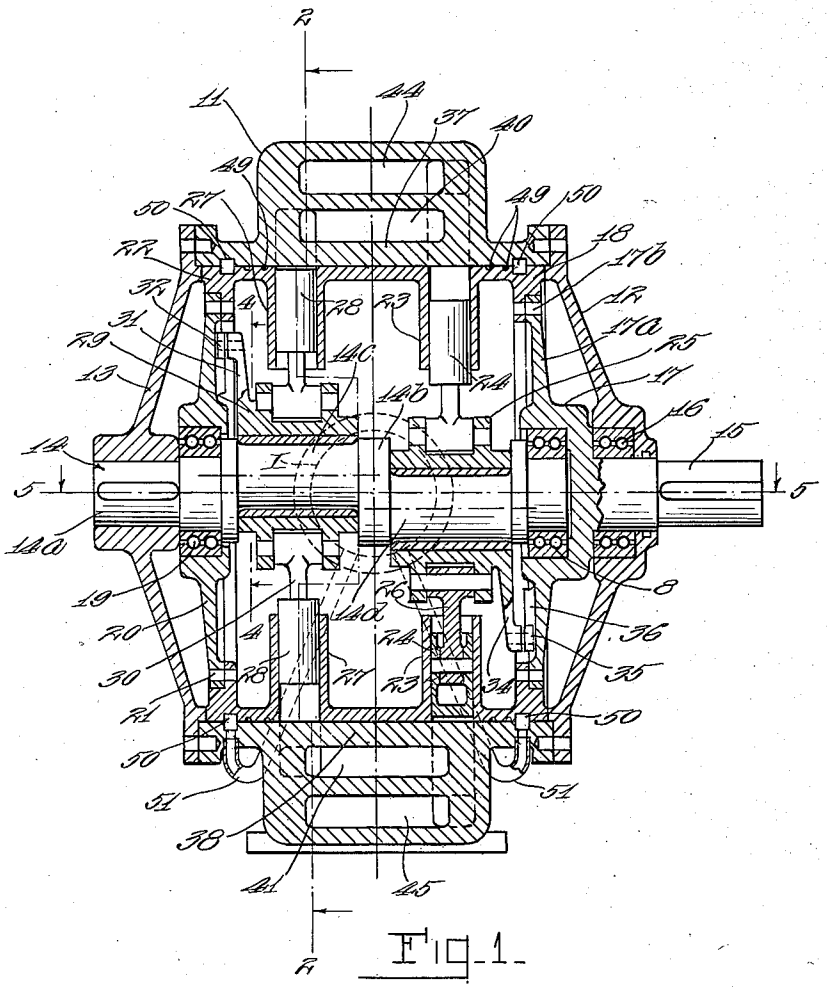


Fig. 1.

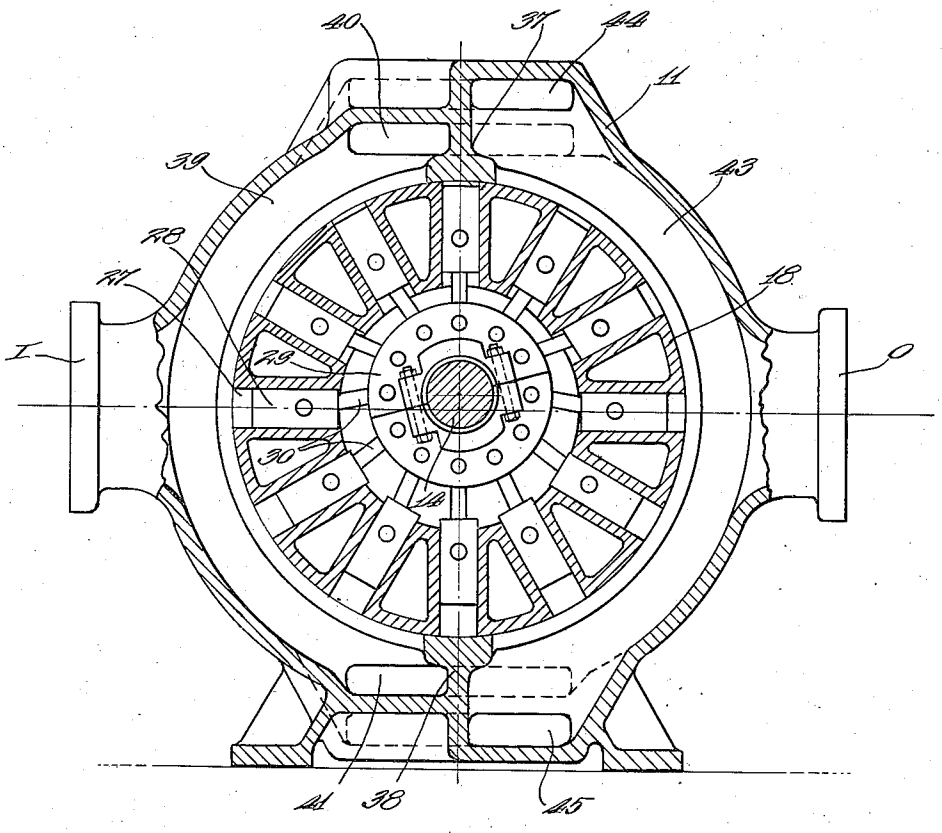
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Fig. 2.



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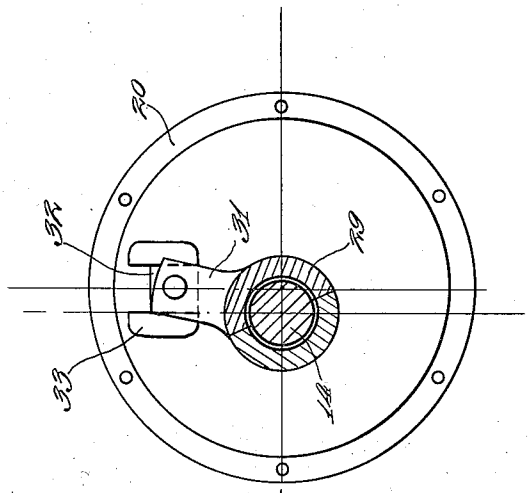


FIG. 4.

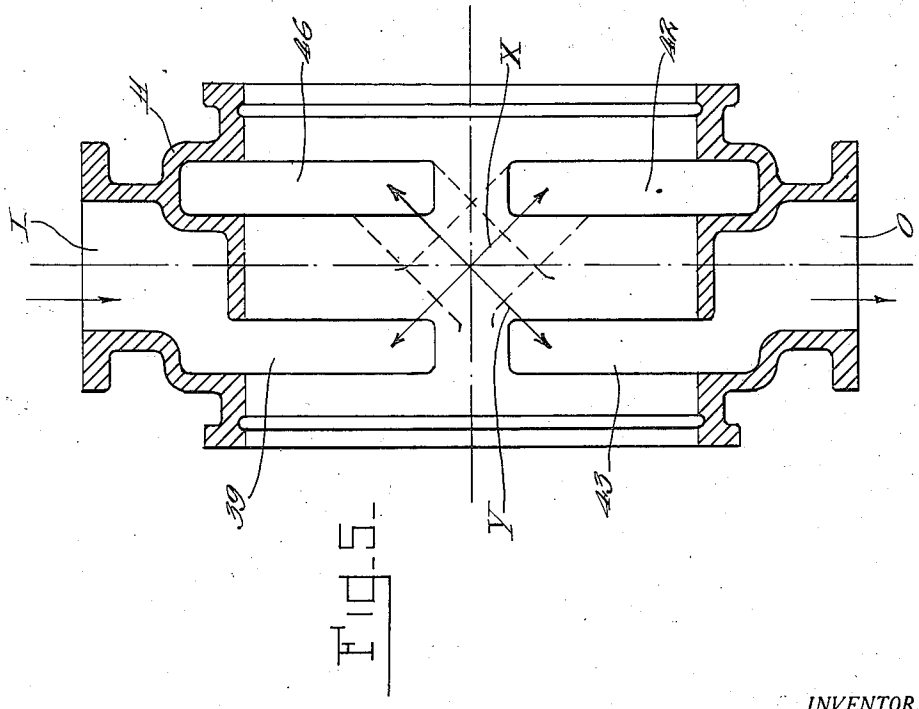


FIG. 5.

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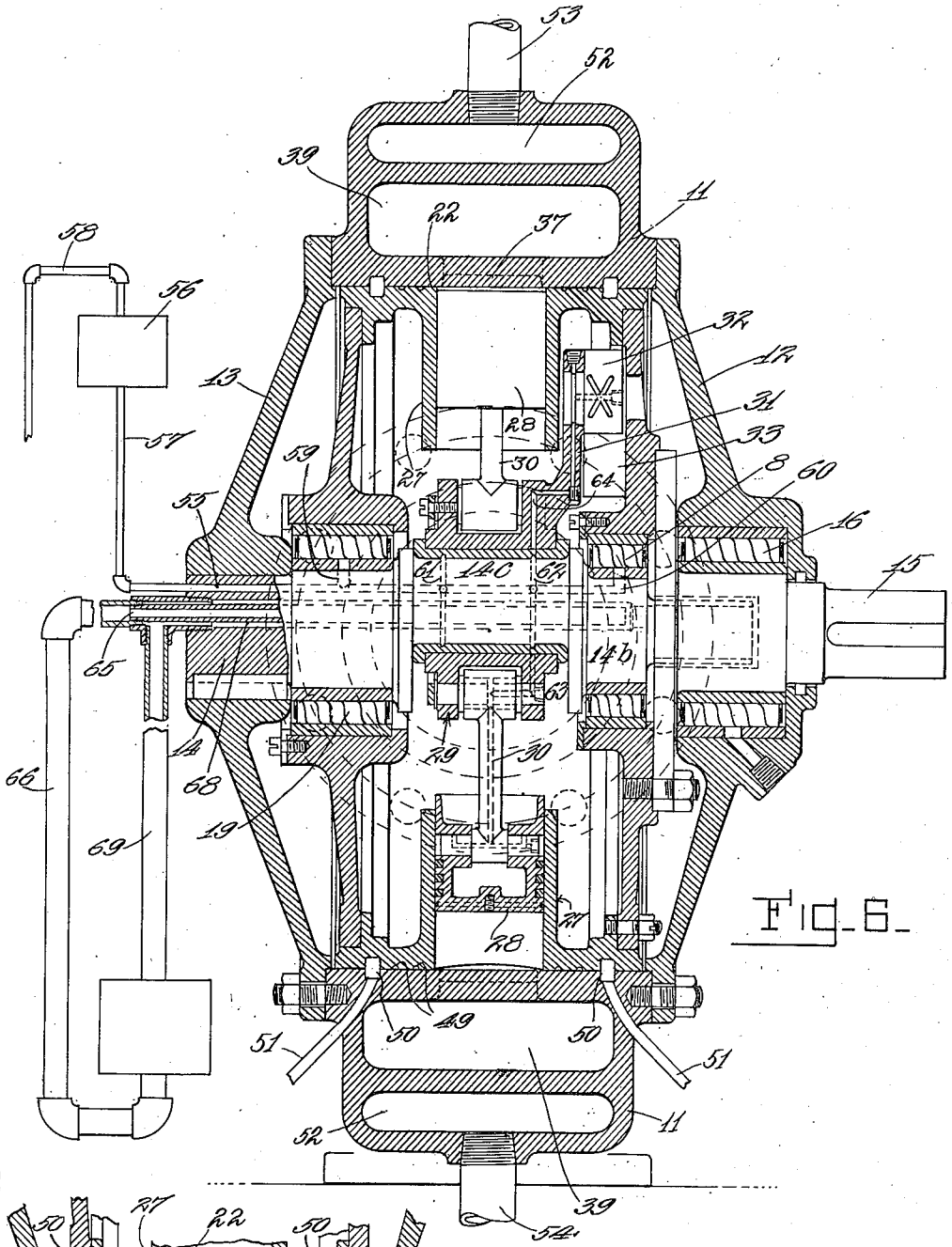


Fig. 6.

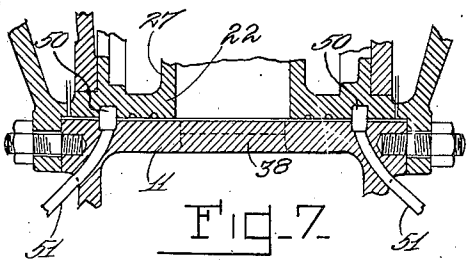


Fig. 7.

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Patented May 28, 1929. 1,714,706

UNITED STATES PATENT OFFICE.

ALPHONSE P. M. WILKING, OF BELMONT, MASSACHUSETTS.

PUMP.

Application filed March 4, 1926. Serial No. 92,274.

This invention relates to pumps and particularly to the rotary type having a circumferential series of radially extending cylinders with pistons operating therein.

An object of this invention is to provide a rotary cylinder pump in which one or more rotors carrying circumferentially arranged cylinders rotate within a casing and wherein a fluid packing is provided between the adjacent relatively moving surfaces or faces of the rotor and casing, so that the exhaust and intake sides are effectually sealed, and the rotor is sealed against leakage of fluid into the casing. Means is also provided whereby the fluid normally escaping between the moving surfaces of the rotor and casing will be returned to the intake of the pump without escaping into the casing. As a result of this construction, the use of valves and stuffing boxes as heretofore, is eliminated, and the rotor carrying the cylinders and pistons forms a self-contained unit sealed from the outside.

A further object of the invention is to provide an improved pump of the foregoing type embodying a plurality of parallel sets or series of radially extending piston carrying cylinders, and wherein the forces or stresses exerted on the supporting shaft by the action of the pistons of the several sets are balanced at all times, thereby preventing any substantial deflection of the shaft.

Another object of this invention is to provide an improved rotary cylinder pump which will be relatively simple in construction and noiseless in operation; wherein the use of valves, stuffing boxes, gears, and restricted fluid passages are eliminated; in which efficient operation without leakage is obtained; and wherein the pump will be balanced in operation and relatively free from vibration.

Other objects of this invention will appear in the following description and claims, reference being had to the accompanying drawings wherein similar reference characters designate corresponding parts.

Fig. 1 is a vertical section through the pump.

Fig. 2 is a sectional view taken substantially on lines 2—2 of Fig. 1 in the direction of the arrow.

Fig. 3 is an enlarged fragmentary section illustrating the fluid seal between the rotor and casing.

Fig. 3ª is a fragmentary section on lines 3—3 of Fig. 3.

Fig. 4 is a detail sectional view taken substantially on lines 4—4 of Fig. 1 and

Fig. 5 is a transverse section through the casing taken on lines 5—5 of Fig. 1.

Fig. 6 is a vertical section illustrating a form of pump having a single circumferential set of pump cylinders.

Fig. 7 is an enlarged fragmentary section illustrating the fluid seal between the rotor and casing of Fig. 6.

Before explaining in detail the present improvement and mode of operation thereof, I desire to have it understood that the invention is not limited to the details of construction and arrangement of parts which are illustrated in the accompanying drawings, since the invention is capable of other embodiments, and that the phraseology which I employ is for the purpose of description and not of limitation.

Referring to Figs. 1 to 5 inclusive of the drawings I have illustrated a form of rotary cylinder pump embodying two parallel cylinder units or sets of radially extending cylinders, but it will be understood that a greater number of units may be provided in accordance with operating requirements. The pump mechanism is enclosed within a cylindrical housing or casing 11. Bolted to the opposite ends of the casing or housing 11 are suitable heads or cover plates 12 and 13. A crank shaft 14 extends centrally through the supporting casing, one end 14^a of the shaft being keyed to the head or end plate 13. The shaft 14 is fixed against rotation and extends centrally through the housing. It is offset at 14^b to provide angularly related portions 14^c and 14^d. A driving shaft 15 extends through the opposite end plate 12 and is journalled in ball bearings 16 carried thereby. Mounted on the inner end of the rotary shaft 15 is a sleeve 17 within which is supported by ball bearings 8 the inner end of the fixed shaft 14. The sleeve 17 is provided with an outwardly extending flange or disk-like portion 17^a to which is secured at 17^b a rotor or rotary element 18. On the opposite end of the fixed shaft 14 is rotatably mounted through ball bearings 19 a similar disk-like sleeve 20, to which is secured at 21 a second rotor or rotary element 22. In the present embodiment, rotors 18 and 22 are integrally

connected together so as to form substantially a single drum or cylinder rotating within the casing or housing 11.

From the foregoing construction it will be seen that one end 14^a of the fixed crank shaft 14 is supported by the rear end head 13 of the casing. The shaft 14 and the rotary driving shaft 15 extend end to end, the driving shaft being supported in ball bearings in the front end head 12. The inner end of the shaft 14 is supported by the inner end of the rotary shaft 15. Thus, the drum or cylinder comprising rotors 18 and 22 is supported entirely through the medium of the endwise extending shafts 14 and 15.

The rotor 18 is provided with a circumferential series of radially extending cylinders 23. These cylinders are equally spaced around the axis of the shaft portion 14^d, and operating within the cylinders is a set of pistons 24. Rotatably mounted on the shaft portion 14^d is a split bearing or hub 25, and the pistons 24 are connected to this hub or bearing by means of connecting rods 26.

The rotor 22 is preferably constructed similar to the rotor 18, and comprises a circumferential series of radially extending cylinders 27, within which operate pistons 28 connected to a two part rotatable hub or bearing 29 on the shaft portion 14^c by means of connecting rods 30.

As shown, especially in Fig. 4, the hub or bearing 29 is connected to the disk 20 for rotation therewith by means of a radially extending arm 31 to the outer end of which is pinned a cross head or guide block 32 slidingly held within a slot in a guide member 33. The bearing or hub 25 of the rotor 18 is connected to the disk 17 in like manner by means of a radially extending arm 34 carrying at its outer end a guide block 35 slidingly held within the guide slot 36.

It will be seen that the axis of the fixed shaft portion 14^c is eccentric and parallel to the axis of the shaft portion 14^d, and both of these shaft sections have the axes thereof eccentric to the longitudinal axis of the rotary or driving shaft 15. In the present construction the shaft section 14^d is offset at an angle of 180° from the shaft section 14^c, as a result of which the intake strokes of the series of pistons 28 will be effected during the exhaust strokes of the series of pistons 24. In other words, the suction strokes of one set of pistons 28 will take place during exhaust strokes of the other sets of pistons, thereby resulting in maintaining a balance of forces on the fixed supporting shaft 14 for the different sets of pistons.

The pump is provided with a common inlet and a common outlet which are identical and is also provided with intake or suction passages from the inlet to the several sets of cylinders as well as exhaust passages to the outlet. The intake and exhaust sides of the pump are preferably identical, as a result of which construction the shaft 15 may be driven in either direction, since the passages in the intake side are interchangeable with the exhaust passages.

For the purposes of the present construction the common inlet of the casing is designated at I and the outlet at O.

The inner annular face of the casing is provided with annular grooves forming an intake passage 39 and an exhaust passage 43, separated at the top and bottom by means of transverse partitions or abutments 37 and 38. Parallel with the passages 39 and 43 the casing is also provided with corresponding annular grooves forming an intake passage 42 and an exhaust passage 46 (see Fig. 5) which are also separated by means of the partitions 37 and 38.

It will be noted that the cylinders of one rotor 18 will exhaust at one side of the partitions 37 and 38 while the cylinders of the other rotor 22 will exhaust at the opposite side of the partitions. As shown in Fig. 2 the cylinders 27 for the rotor 22 communicate by means of the intake passage 39 with the inlet I. This inlet passage for the cylinders 27 communicates by means of diagonally extending top and bottom passages 40 and 41 respectively with the intake passage 42 for the cylinders 23. The diagonal direction of the passages 40 and 41 is indicated by the arrow X in Fig. 5. The cylinders 27 communicate with the exhaust passage 43 (see Fig. 2) which lead to the common outlet O. The passage 43 is connected at its top and bottom by means of diagonal passages 44 and 45 with an exhaust or discharge passage 46 for the set of cylinders 23. The diagonal direction of the connecting passages 44 and 45 is indicated by the arrow Y in Fig. 5.

From the foregoing construction it will be seen that upon rotating the shaft 15 the intake strokes of the pistons 28 in cylinders 27 (see Fig. 2) will take place at one side of the partitions 37 and 38, such as the left hand side in Fig. 2. At the same time the exhaust strokes of the pistons 24 in cylinders 23 will take place during the suction strokes of pistons 28 and at the same side of the partitions 37 and 38. By virtue of the diagonal connecting passages, extending from one side of the partitions to the opposite side all of the exhaust passages for the sets of cylinders will be in communication as well as all of the suction passages.

The construction of the rotors 18 and 22 is such that the outer annular faces thereof will at all times be slightly spaced from and out of contact with the adjacent faces or surfaces of the casing or cylinder 11 and the partitions 37 and 38. As shown in Figs. 3 and 3^a the rotors are separated from

the partition 37 or 38 by a space 461. A similar space 47 is formed intermediate the sets of cylinders between the adjacent relatively moving faces of the rotors and the cylinder. At the outer sides of the cylinder the adjacent faces of the rotors and the cylinder or casing are separated by spaces indicated at 48 in Fig. 3. It will be understood that the size of the spaces shown in Figs. 3 and 3ª is somewhat exaggerated for the purposes of clearly showing the construction. These spaces are such to enable a constant fluid film to be formed between the relatively moving surfaces thereby providing a fluid padding or seal. The fluid seal at 461 between the partition and rotor (see Fig. 3ª) seals the exhaust passage 43 from the intake passage 39, also the exhaust passage 46 from the intake passage 42.

During the exhaust or pressure strokes of the several sets of pistons the pressure will result in a constant movement of the fluid forming the fluid packing or film laterally in the spaces 48 between the relatively moving surfaces of the rotors and casing. The pressure of this fluid film is gradually reduced to normal as the distance is increased from the cylinders, and the reduction in pressure is assisted by means of the annular grooves 49 in the outer faces of the rotors 18 and 22. The adjacent relatively moving faces of the rotors and casing are provided with communicating annular grooves or passages 50 of suitable size, which receive the fluid escaping laterally between the moving surfaces. The fluid which therefore normally escapes under pressure from the cylinders will upon reaching the passages 50 be free from pressure. The passages or ducts 50 are connected by conduits 51 at the bottom of the cylinder with the intake side I of the pump. Thus, the fluid which normally escapes between the surfaces of the rotors and casing is conveyed by suction to the intake side of the pump and does not leak or escape into the casing. In the space 47 intermediate the two sets of cylinders a fluid seal is also formed which separates the exhaust and intake of the cylinders of one set from the other.

Referring to Figs. 6 and 7, a somewhat modified form of pump is illustrated in which the casing 11 is constructed to house a single rotor 22 having a single set of radially extending cylinders 27, provided with reciprocating pistons 28. In this instance where I provide a single set of cylinders, instead of a plurality of parallel sets, the construction differs from that previously described in that the fixed shaft 14 is provided with a single eccentric portion 14ᶜ, upon which is mounted the hub or bearing 29 to which is connected the several piston rods 30 of the pistons 28.

As illustrated in Fig. 7, the rotor 22 is so constructed with relation to the casing of the cylinder 11 that the exterior annular faces thereof will at all times be out of frictional contact with the cylinder and the partitions 37 and 38. As previously described a fluid film or packing is formed between the relatively moving surfaces of the rotor and casing and the fluid under pressure which normally escapes laterally between these surfaces is received in the annular grooves 50 which are connected by conduits 51 with the intake or suction side of the pump.

The pump shown in Fig. 6 is especially adapted for use in connection with certain oil refining processes for pumping oil at high temperatures. The casing 11 is provided with a jacket 52 surrounding the intake and exhaust passages 39 and 43, steam being admitted through a pipe 53 and exhausted through the outlet pipe 54.

In the present instance the various bearings are automatically lubricated and the lubricant is conducted to the bearings and moving surfaces independently of the hot oil which is being pumped and without in any way affecting the temperature thereof. The shaft 14 is drilled longitudinally at 55 to form an oil passage and the oil or lubricant is supplied thereto by a pipe 57 by means of a suitable oil pump 56. This pump is connected to a suitable source of supply by means of a pipe 58. The roller bearings 8 and 19 are lubricated by means of ducts 59 and 60 leading from the oil passage 55. Lubricant is supplied to the hub bearing on the shaft portion 14 by means of oil grooves 61 and 62 communicating with the main oil passage 55. The bearing for each piston rod 30 is lubricated by means of an oil passage 63 which communicates with the oil groove 62, and the relatively moving surfaces between the guide head 32 and its guideway are lubricated by means of the duct 64 communicating with the oil grooves 62 and extending through the arm 31.

The bearings 8, 19 and 29 of the rotor and the pistons on the fixed shaft 14 are cooled by circulating a cooling fluid through longitudinal passages in the shaft 14. This shaft is drilled lengthwise to provide an enlarged bore within which is centered a tube 65. This tube is connected to a pipe 66 and to a suitable water pump, by means of which water is forced through the tube 65. The tube 65 is spaced from the inner walls of the bore thereby providing a return passage 68 for the cooling fluid, which is returned to the pump by means of a pipe 69.

From the foregoing it will be seen that I have provided an improved pump adapted to pump fluid, such as oil at high temperatures. At the same time the normal leakage of the fluid, which heretofore escaped under pressure into the interior of the casing, is

substantially prevented, thereby eliminating the necessity of providing stuffing boxes against the pressure of the pump. In addition, I have provided means for automatically lubricating the bearings of the pump independently of the oil which is being pumped, and the tendency of the various bearings on the shaft of becoming overheated is minimized by automatically conducting a cooling fluid into the shaft and circulating this fluid from end to end of the shaft. Furthermore, it will be noted that the rotor or drum comprises a self-contained unit by virtue of the fluid seal and packing which enables the fluid normally escaping between the relatively moving surfaces to be automatically returned by suction to the intake side of the pump. In addition, it will be seen that where I provide a plurality of sets of radially extending cylinders, the forces exerted by the several sets of pistons on the fixed shaft are balanced, thereby eliminating any substantial deflection of the shaft between its points of support. This not only reduces wear on the bearings, but increases considerably the operating efficiency.

It is to be understood that by describing in detail herein any particular form, structure, or arrangement, it is not intended to limit the invention beyond the terms of the several claims or the requirements of the prior art.

What I claim as my invention is:

1. In a pump, the combination of a casing, a rotor therein, a plurality of radially extending cylinders carried by said rotors, pistons in said cylinders mounted eccentrically to the axis of said rotor, said rotor and casing having their adjacent surfaces, between which there is relative movement, out of contact, and a fluid packing formed therebetween.

2. In a pump the combination of a casing, a rotor therein, a plurality of radially extending cylinders carried by said rotor, pistons in said cylinders mounted eccentrically to the axis of said rotor, said rotor and casing having their adjacent surfaces, between which there is relative movement, free from frictional contact to provide a fluid seal therebetween, and means for preventing substantial leakage of fluid between said surfaces into the interior of the casing.

3. In a pump, the combination of a casing, a rotor therein, a series of radially extending cylinders carried by said rotor, pistons in said cylinders eccentrically mounted with respect to the axis of rotation of said rotor, opposed exhaust and intake passages communicating with said cylinders, and means including a fluid seal for separating said exhaust and intake passages.

4. In a pump, the combination of a casing, a rotor therein, a series of radially extending cylinders carried by said rotor, pistons in said cylinders eccentrically mounted with respect to the axis of rotation of said rotor, opposed exhaust and intake passages communicating with said cylinders, and means including a fluid seal for separating said cylinders at opposite sides thereof from the casing.

5. In a pump, the combination of a casing, a rotor therein having a series of radially extending cylinders, pistons in said cylinders, rotatably mounted eccentrically to the axis of said rotor, exhaust and intake passages communicating with said cylinders, said rotor and casing having the adjacent surfaces out of contact, and an annular passage formed between said surfaces at one side of the cylinders and connected to the intake of the pump.

6. In a pump, the combination of a casing, a rotor therein having a series of radially extending cylinders, pistons in said cylinders rotatably mounted eccentrically to the axis of rotation of said rotor, exhaust and intake passages for the cylinder, and an annular passage formed between the adjacent surfaces of the rotor and casing at either side of the cylinders and connected to the intake of the pump.

7. In a pump, the combination of a casing, a rotor therein having a plurality of parallel sets of radially extending cylinders, a set of pistons in each set of cylinders, means for rotatably mounting the sets of pistons on axes eccentric to each other and to the axis of the rotor, the adjacent surfaces of the rotor and casing being free from frictional contact, and a fluid packing formed therebetween.

8. In a pump, the combination of a casing, a rotor therein having a plurality of parallel sets of radially extending cylinders, a set of pistons in each set of cylinders, means for rotatably mounting the sets of pistons on axes eccentric to each other and eccentric to the axis of the rotor, opposed exhaust and intake passages communicating with each set of cylinders and means including a fluid seal for separating the exhaust and intake passages of each set and also for separating the exhaust passage of one set from the intake passage of the other set.

9. In a pump, the combination of a casing, a driving shaft, a plurality of connected rotors driven therefrom and located in said casing, each of said rotors having circumferential series of radially extending cylinders, a series of pistons for each series of cylinders, means for supporting for rotation one series of pistons eccentrically with relation to another series, said rotors and the casing having their adjacent surfaces, between which there is relative movement, out of frictional contact to provide a fluid seal therebetween.

10. In a pump, the combination of a casing, a fixed shaft supported at one side of the casing and extending therethrough, a rotary shaft having one end supported at the opposite side of the casing, said shafts extending end to end, a rotary drum in the casing and having bearings at opposite sides on said fixed shaft and driven from the rotary shaft, said drum comprising a plurality of parallel sets of radial cylinders, and sets of pistons eccentrically carried by said fixed shaft and operating in said cylinders.

11. In a pump, the combination of a casing, a fixed shaft supported at one side of the casing and extending therethrough, a rotary shaft having one end supported at the opposite side of the casing, said shafts extending end to end, a rotary drum in the casing and having bearings at opposite sides on said fixed shaft and driven from the rotary shaft, said drum comprising at least one set of circumferentially arranged radial cylinders, and a set of pistons adapted to reciprocate in said cylinders and eccentrically mounted on said shaft.

12. In a pump, the combination of a casing, a fixed shaft supported at one side of the casing and extending therethrough, a rotary shaft having one end supported at the opposite side of the casing, said shafts extending end to end, a rotary drum in the casing and having bearings at opposite sides on said fixed shaft and driven from the rotary shaft, said drum comprising at least one set of circumferentially arranged radial cylinders, and a set of pistons adapted to reciprocate in said cylinders and eccentrically mounted on said shaft, and means including a sliding connection for bodily rotating said pistons from said drum.

13. In a pump, the combination of a casing, a fixed shaft extending therein, a rotor within said casing and having bearings on opposite ends of said shaft, a series of radially extending cylinders carried by said rotor, said shaft having an eccentric portion, pistons in said cylinders and having a rotatable bearing on said eccentric portion, and means for conducting a lubricant through said shaft to said bearings.

14. In a pump, the combination of a casing, a shaft carried thereby, a rotor in said casing and having bearings on said shaft, a series of radially extending cylinders carried by said rotor, pistons in said cylinders and having a rotatable bearing on said shaft eccentric to the axis of said rotor, intake and exhaust passages for the cylinders, an annular passage formed between the adjacent surfaces of the rotor and casing and connected to the intake of the pump, and means for conducting lubricant to said bearings during operation.

15. In a pump, the combination of a casing, a shaft carried thereby, a rotor in said casing and having bearings on said shaft, a series of radially extending cylinders carried by said rotor, pistons in said cylinders and having a rotatable bearing on said shaft eccentric to the axis of said rotor, intake and exhaust passages for the cylinders, an annular passage formed between the adjacent surfaces of the rotor and casing and connected to the intake of the pump, means for conducting a lubricant to said bearings during operation, and means for cooling said bearings during operation.

16. In a pump, the combination of a casing, a rotor therein having a series of radially extending cylinders, pistons in said cylinders rotatably mounted eccentrically to the axis of rotation of said rotor, exhaust and inlet passages for the cylinder, a steam jacket surrounding the inlet and outlet passages, and an annular passage formed between the adjacent surfaces of the rotor and casing at either side of the cylinders and connected to the intake of the pump.

In testimony whereof I affix my signature.

ALPHONSE P. M. WILKING.