

July 28, 1936.

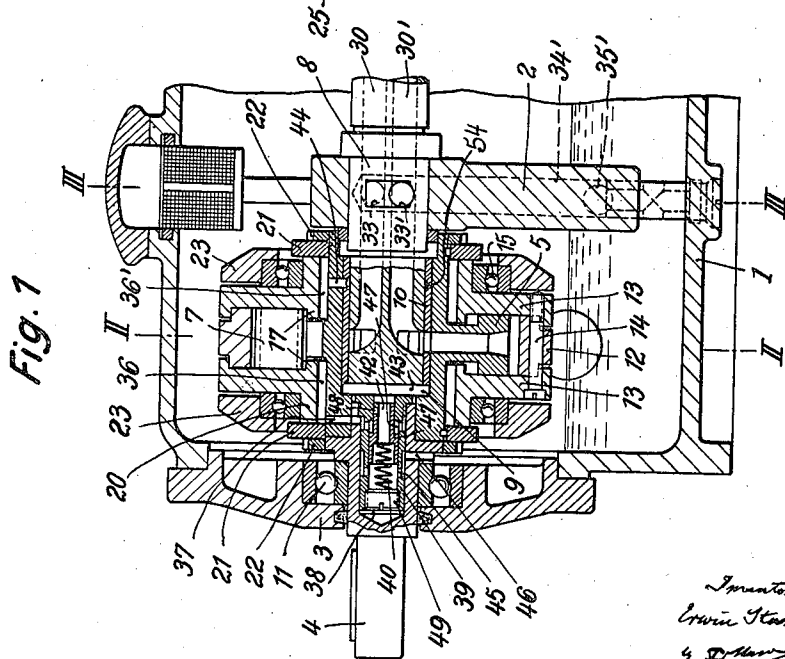
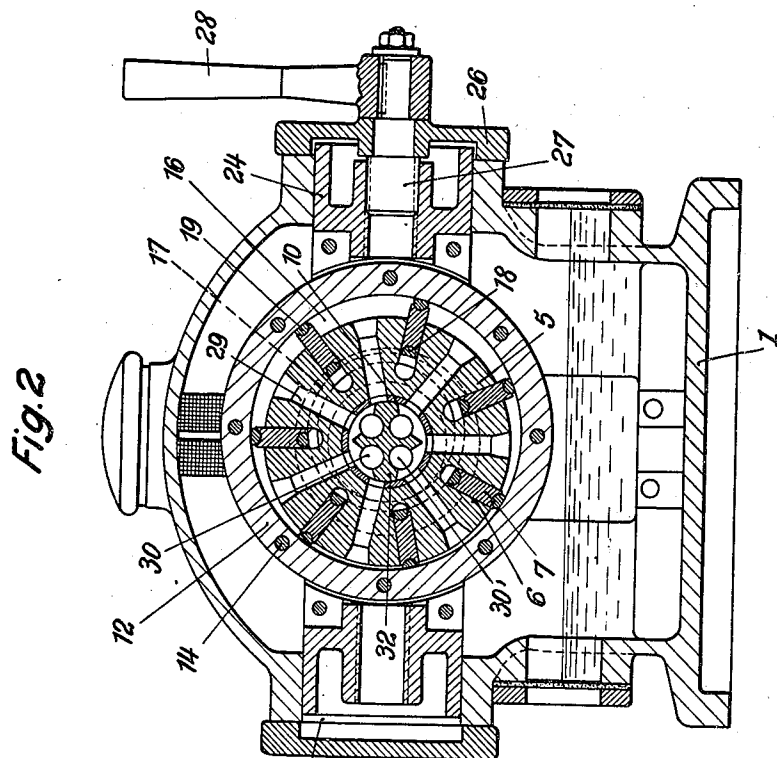
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ROTARY PISTON ENGINE ESPECIALLY FOR FLUID GEARS

Filed April 5, 1935

2 Sheets-Sheet 1



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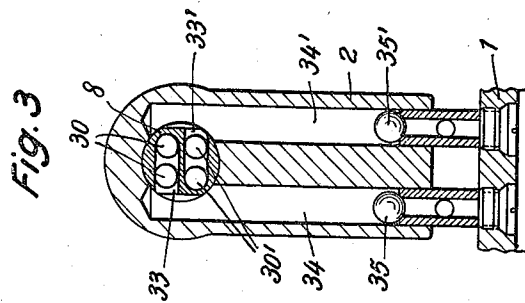
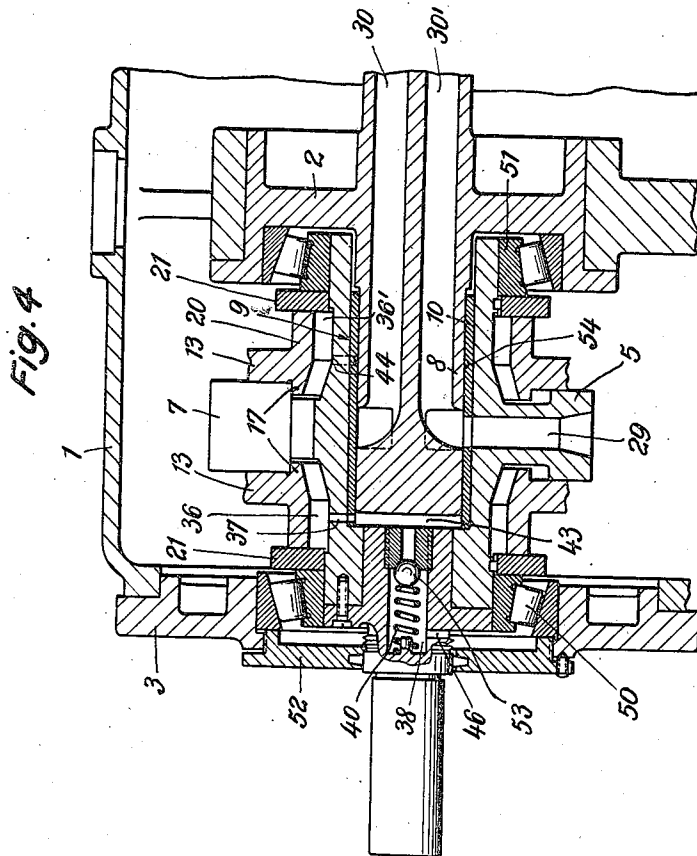
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UNITED STATES PATENT OFFICE

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ROTARY PISTON ENGINE ESPECIALLY
FOR FLUID GEARS

Erwin Sturm, Stuttgart-Botnang, Germany

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3 Claims. (Cl. 103—121)

This invention relates to the special construction of a rotary piston engine with blades or vanes, in which the piston drum rotating about a central journal is surrounded by a rotatable housing forming the boundary wall of the working chamber of the engine. Such rotary piston engines are characterized in that, whilst they are of small dimensions, they supply large delivery quantities and the hydraulic frictional losses are very small because the freely rotatable housing is rotated with the flowing fluid.

As in these engines the rotatable housing rotates in the air space, the drawback arises in the case of high driving medium pressures, that the lateral covers of the rotary housing are pressed slightly away from the end walls of the piston drum in the middle by the high fluid pressure, this, on the one hand, increasing the normal loss due to leakage and, on the other hand, favoring the extremely prejudicial drawing of air into the working chamber.

This invention has for its object, to construct such a rotary piston engine in such a manner that, even in the case of very high driving medium pressures, the covers cannot move away from the end walls of the piston drum and the resulting objectionable phenomena are prevented. This is attained by supporting the covers of the outer housing on the hub by means of rings and by providing at the leakage points chambers in which the leakage oil collects and is, if necessary, maintained at a predetermined pressure. Thus, the leakage points of the engine are sealed by fluid so that air can no longer be drawn into the working chamber. An airtight closure may be attained also by enabling the oil, when the engine is running, to collect and to form an oil ring under the action of the centrifugal force in front of the points to be packed.

Further the oil flowing out of the oil chambers may, according to the invention, be employed at the same time for lubricating the rotating parts of the engine.

Other features of the invention are set forth in the following description of two forms of construction illustrated by way of example in the accompanying drawings in which:—

Fig. 1 shows one half of a fluid gear in longitudinal section.

Fig. 2 is a cross section on line II—II of Fig. 1.

Fig. 3 is a part section on line III—III of Fig. 1.

Fig. 4 shows in longitudinal section another journalling of the piston drum in combination

with a regulator for the leakage oil of modified construction.

The outer housing 1 of a fluid gear constructed as a driving medium container, of which only one half is shown, accommodates the rotary piston engine of the fluid gear acting as a pump and mounted between a partition 2 and one of the covers 3.

The rotary piston engine consists of a piston drum 5 rigidly connected with a driving shaft 4 10 and provided with a plurality of blade pistons 7 slidably mounted in radial slots 6. The piston drum 5 is journaled by a journal 8 of the wall 2 which engages in a central bore 9 in the piston drum. A bush 10 is provided between the piston drum and the journal. The counter bearing for the piston drum is in a ball bearing 11 mounted in the cover 3.

The piston drum 5 is enclosed in a housing formed by a ring 12 and two lateral covers 13. 20 The three parts are rigidly interconnected by bolts 14. This housing is mounted freely rotatable in ball bearings 15. Its cylindrical inner surface encloses with the piston drum 5 a crescent shaped working chamber 16 in which the blade 25 pistons 7 move. These are guided by annular projections 17 on the covers 13 against which the pistons bear by means of a hinge pin or guide bolts 18. The tight bearing of the pistons 7 against the inner surface of the rotary housing 30 is ensured by similar hinge bolts or ring bolts 19 mounted in the blade pistons.

In order to prevent the covers 13 from yielding under the high pressures of the driving medium occurring when the engine is running and the resultant formation of a gap on the end walls of the piston drum, the hubs 20 of the lateral covers 13 bear against annular discs 21 mounted on the neck of the piston drum 5 and rotating therewith. These annular discs are adjusted 40 relative to the hubs by means of screw nuts 22.

The bearings 15 of the rotary housing are fitted in a rigid bearing frame. This frame consists of two transverse bars 23 fixed on piston-like guides 24. These latter are slidably mounted 45 in bores 25 in the outer housing 1. One piston guide carries a screw spindle 27 shiftable in the cover 26 and adapted to be turned by means of a hand lever 28, to displace the bearing frame, thereby changing the eccentricity of the rotary 50 housing relatively to the piston drum and thus altering the shape and position of the working chamber 16.

The working chamber 16 subdivided by the blade pistons 7 communicates with passages 30 55

and 30' in the journal 8 through radial passages 29 arranged between the pistons 7 and slots in the bush 10. Each of these passages 30 and 30' forms a suction or pressure conduit of the rotary piston engine, according to the direction of delivery. The suction and pressure sides are separated by a partition 32 of the journal 8.

The suction and pressure passages also communicate by transverse bores 33, 33' with bores 34, 34' in the partition 2 leading towards the base plate 1. In these bores 34, 34' leading to the oil chamber of the gear check valves 35, 35' are fitted.

If it be supposed that the rotary housing is adjusted towards the right according to Fig. 2, and the piston drum will be driven in clockwise direction, the portion of the working chamber 16 situated above the horizontal central plane then exerts a suction effect and the portion below this plane exerts a pressure effect. Driving fluid is then drawn from the oil chamber through the passages 34, 33, 30 and 29 into the working chamber 16 and in the lower half of the working chamber the driving fluid is forced through the passages 29 into the pressure conduits 30' whence it is conducted to a similarly constructed engine or to some other place of use. Flowing over of the driving fluid into the oil chamber is prevented by the pressure loaded check valve 35'.

If the rotary housing is adjusted so that it is concentric with the piston drum, no delivery takes place.

If, however, it is adjusted towards the left, the delivering direction is reversed in that the driving fluid is drawn in through the passages 34', 33', 30' and 29 and is forced into the conduit 30.

The quantity and direction of delivery can be regulated by adjusting the rotary housing relatively to the piston drum. As this housing is freely rotatable, it is rotated with the driving fluid. The driving fluid therefore flows along the housing only at a very slow speed, so that the fluid losses are as low as possible.

The known rotary piston engines of this type are open to the objection that, especially in the case of high driving fluid pressures, the covers of the rotary housing yield in outward direction, producing gaps at the end walls of the piston drum, thereby increasing the leakage losses. A still greater objection is, that air is drawn in through these gaps and passes into the working chamber.

The yielding of the covers is prevented by the above mentioned annular discs 21. The arrangement of these annular discs 21, however, also enables an arrangement to be produced in which the natural losses due to leakage serve for effecting an airtight closure of the working chamber.

For this purpose annular spaces 36 and 36' are provided one on each side of the piston drum 5 between this drum and the hubs 20 of the covers 13. These spaces intercommunicate through slots 6 and are closed laterally by the annular discs 21. The leakage oil flows off from one of the annular spaces 36 through a passage 37 and is regulated by a control valve arranged in a bore 38 in the stub axle 4. This control valve consists of a bush 39 with a differential piston 41 mounted therein and forming with the bush 39 an annular space 47 in which the passage 37 terminates. The differential piston is acted upon by a spring 40 so that the leakage oil in the spaces 36 and 36' is also maintained under the same pressure. If the oil pressure increases, the

differential piston is shifted towards the left and allows a portion of the oil to flow through a control aperture 48 which now exposes a central bore 42 in the control piston. The oil passes from this bore through discharge aperture 45 in the bush 39 into a return passage 46 leading to the oil chamber.

In this manner a predetermined oil pressure is maintained in the spaces 36 and 36' and an airtight liquid seal is obtained so that no air can pass into the working chamber of the gear.

The height of the pressure can be regulated by changing the tension of the spring 40 by means of an adjusting screw 49.

The pressure produced in the two spaces is utilized at the same time for causing the blade pistons 7 to bear tightly against the housing walls even when the blade pistons are not absolutely accurately fitted. It is thus possible to utilize for guiding the blade pistons annular projections 17 which can be easily provided on the covers 13.

The collecting space 36' arranged on the right hand side of the piston drum also communicates through a passage 44 with an annular groove 54 from which the journal 8, about which the piston drum rotates, receives pressure lubrication. The oil ring in the annular groove 54 serves at the same time for preventing a sucking in of oil at this point.

The lubricating oil flows along journal 8 and 30 collects in a chamber 43 in the end of the journal 8 and partly fills this chamber until it flows off through the central bore 42.

As the outer wall of the chamber 43 rotates, the oil is also rotated and forms, owing to the centrifugal force, an oil ring which likewise prevents the drawing in of air between journal 8 and piston drum 5.

Fig. 4 shows a form of construction of the rotary piston engine in which the piston drum 5 is mounted in conical roller bearings 50, the inner race 51 of which bears against the annular discs 21. The necessary mounting pressure is obtained by a screw cover 52. As the conical roller bearings can take up considerable axial pressure, any desired pressure can also be adjusted in the collecting chambers for the leakage oil without appreciably increasing the friction.

In this form of construction the chamber 36 preferably communicates by the passage 37 directly with the chamber 43 and the pressure in the two chambers is simultaneously regulated by the check valve 53 acted upon by the spring 46 and fitted in the bore 38. Therefore, in this instance, all the leakage points are under liquid seal. The check valve 53 opens when the adjusted maximum pressure is exceeded and allows the leakage oil to flow off through the passage 46. This passage is so arranged that it conducts the oil to the conical roller bearings 50 for the purpose of lubrication.

The rotary piston engine according to the invention enables the employment of much higher driving fluid pressures than were hitherto possible in such engines and, in spite of more simple construction, its dimensions are smaller. Moreover, the losses due to leakage are much lower, and air is positively excluded from the working chamber. Thus, the degree of efficiency of the engine is very favorable.

I claim:—

1. A rotary piston engine, especially for fluid gears, comprising in combination a central jour-

nal having inlet and outlet channels for the driving fluid, a piston drum rotatable about said journal and having alternating radial slots and radial channels, vanes shiftable in said radial slots, a rotatable housing enclosing said piston drum and shiftable relative to said piston drum and forming with the piston drum a sickle-shaped working chamber subdivided by said vanes and communicating by said radial channels with the inlet and outlet chambers of said central journal, covers one on each end of said housing, each cover having an annular chamber, the chambers of both covers communicating by means of said radial slots, rings one on each end of said piston drum and closing said chambers, a chamber at the front end of said journal and an outflow channel in said journal for the leakage oil, and channels extending from all chambers in said covers to said outflow channel, the leaking oil filling all said chambers during the service and effecting by the action of

centrifugal force an air-tight closure of said working chamber.

2. A rotary piston engine as specified in claim 1, comprising in combination with the annular chambers in the covers, a piston valve arranged in the axis of rotation, a spring controlling said piston valve, an axial outflow channel in said piston valve controlling the outflow of the leakage oil from said annular chambers, and channels connecting the pressure space of said piston valve with said annular chambers.

3. A rotary piston engine as specified in claim 1, comprising in combination with the annular chambers between the covers, the rotatable housing and the chamber on the end face of the journal, a channel connecting said annular chambers with said last mentioned chamber, and an axial outflow channel extending from said last mentioned chamber, and a spring controlled valve in said outflow channel.

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