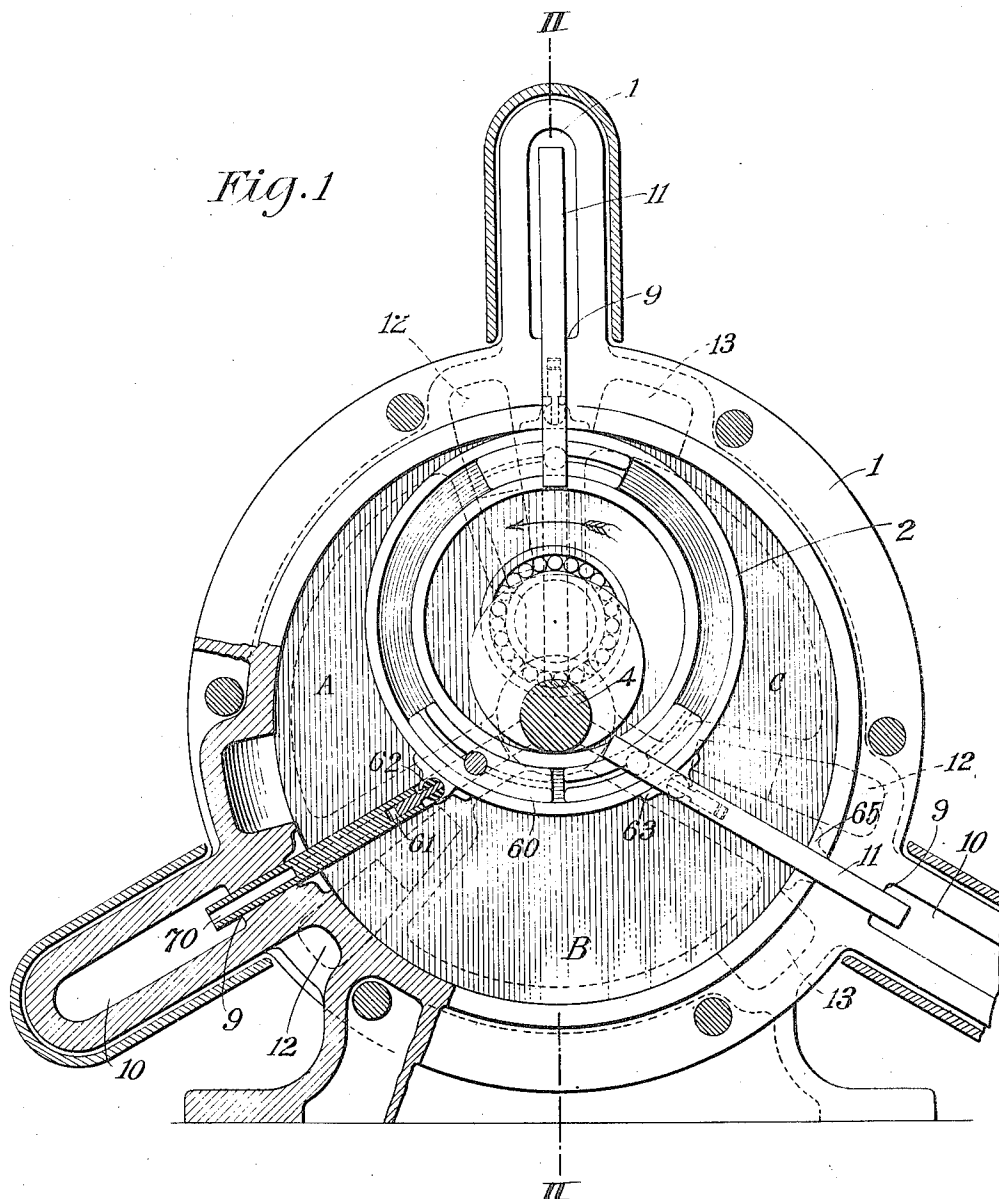


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 ROTARY ENGINE.
 APPLICATION FILED FEB. 11, 1913.

1,158,467.

Patented Nov. 2, 1915.
 4 SHEETS—SHEET 1.



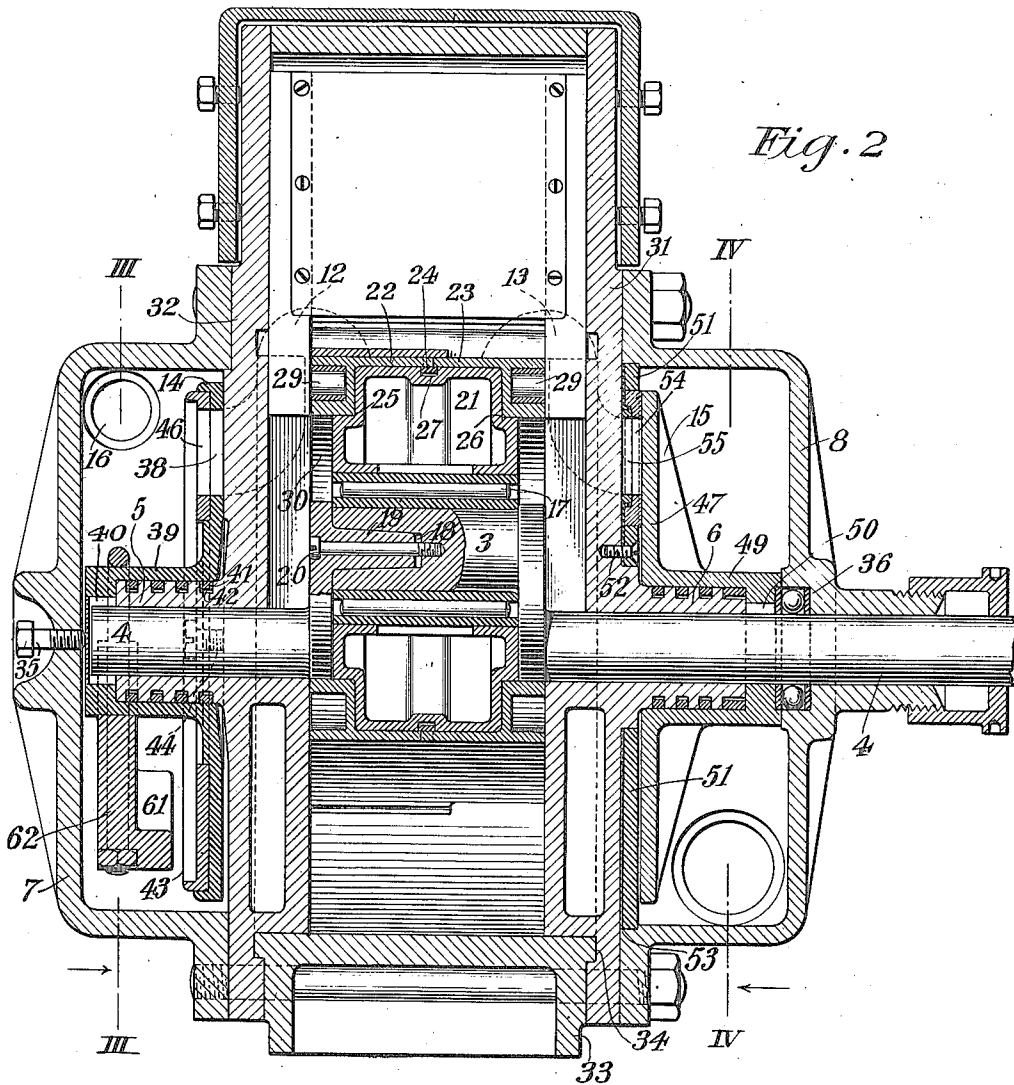
Witnesses:
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4 SHEETS—SHEET 3.

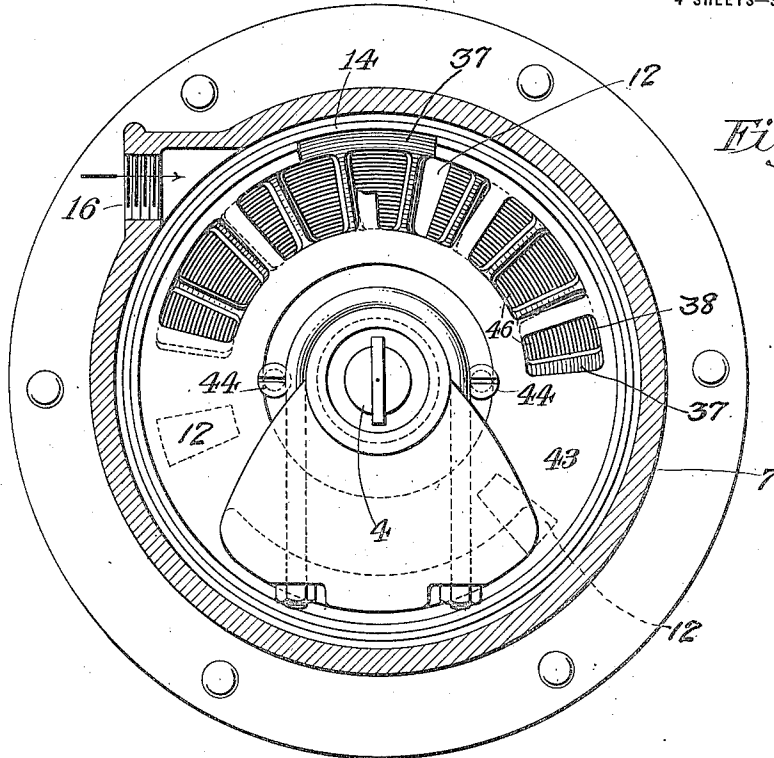


Fig. 3

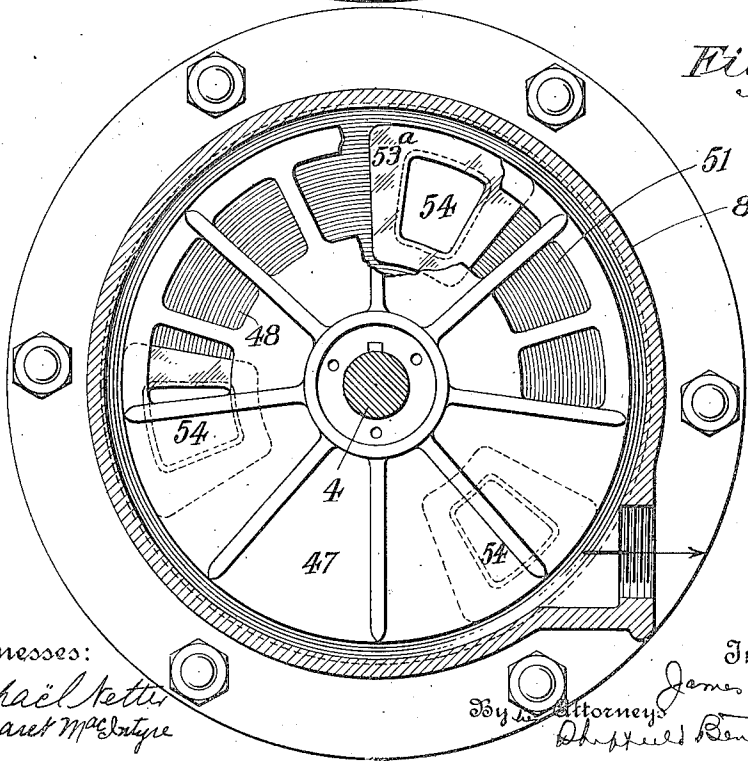


Fig. 4

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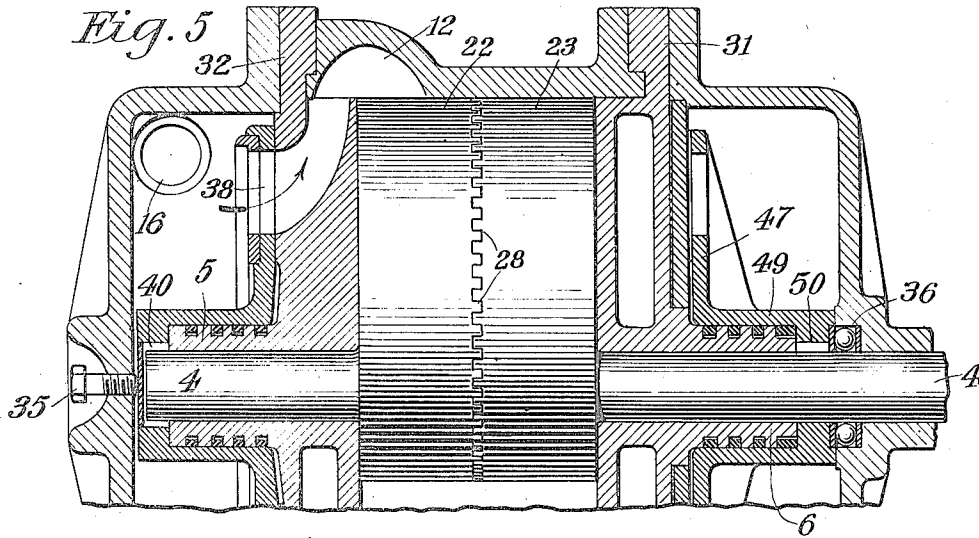
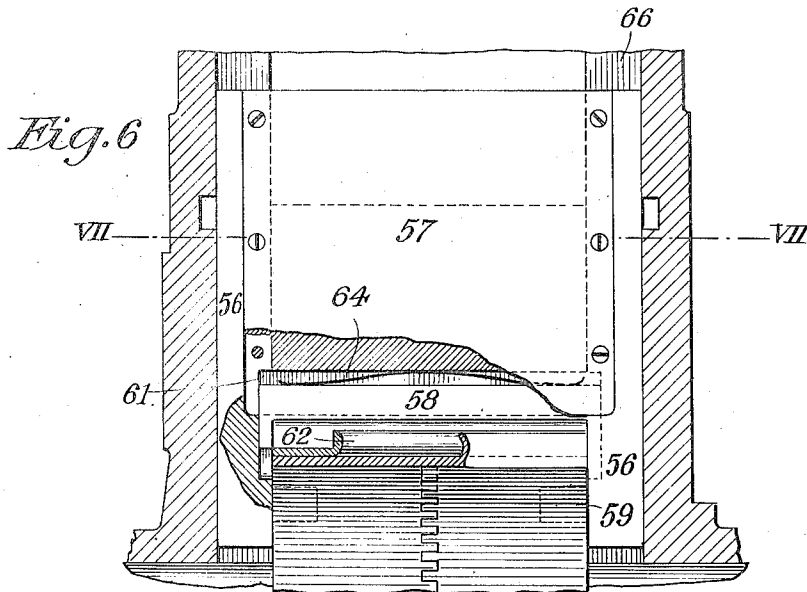
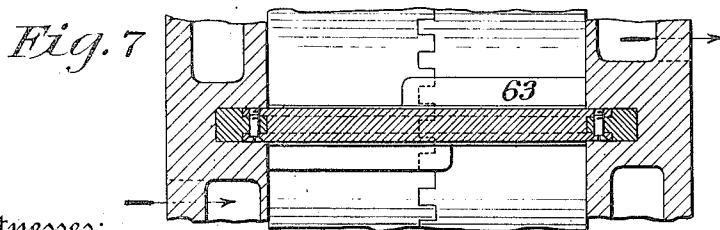
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UNITED STATES PATENT OFFICE.

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ROTARY ENGINE.

1,158,467.

Specification of Letters Patent.

Patented Nov. 2, 1915.

Application filed February 11, 1913. Serial No. 747,619.

To all whom it may concern:

Be it known that I, JAMES M. EVANS, a citizen of the United States, and a resident of the city, county, and State of New York, have invented certain new and useful Improvements in Rotary Engines, of which the following is a description.

My invention relates to the type of rotary engine shown in my Letters Patent No. 656,694 and 659,295, and has for its general object the improvement of the type of engine shown in these Letters Patent, so as to cheapen the cost of its manufacture and insure its more efficient operation.

One of the objects of my invention is to so construct the cylinder, piston and cylinder heads that they may be cheaply manufactured and easily assembled and so that all joints between the various portions of the cylinder and cylinder heads shall be steam tight.

Another object of my invention is to construct the piston so that it will always operate to produce a steam tight joint between itself and the cylinder walls and heads.

Another object of my invention is to construct the dividing partitions and the elements cooperating therewith so that a steam tight joint will be formed between the piston and the dividing partitions, and the dividing partitions will be relieved of pressure at their ends tending to break them or prevent their easy operation.

Another object of my invention is to so arrange the valves that any wear will be compensated for and that a variable cut off of steam at the inlet valve may be effected.

A further object of my invention is to prevent an uneven motion of the piston as it passes over the recesses in the cylinder into which the dividing partitions fit.

The means used to attain the foregoing object tend to the production of an engine of the rotary type which is durable, cheap to construct and smooth and efficient in operation.

The drawings accompanying this specification show my improved rotary engine in detail.

Figure 1 is an end view, partly in section, of my improved engine with the exhaust cover, valve and head removed. Fig. 2 is a longitudinal sectional view of my improved engine taken on the line II—II of Fig. 1. Fig. 3 is a sectional view taken on the line III—III of Fig. 2 looking in the direction

of the arrow and showing the inlet side of my improved engine. Fig. 4 is a corresponding view of the exhaust side of my improved engine taken on the line IV—IV of Fig. 2 looking in the direction of the arrow. Fig. 5 is a view partly in section showing the piston and valves more in detail. Fig. 6 is a detail view partly in section showing one of the dividing partitions and a portion of the piston. Fig. 7 is a detail view in section taken on the line VII—VII of Fig. 6.

Referring to Figs. 1 and 2, it will be seen that my improved engine consists essentially of a cylinder 1, in which is mounted a rotating roller piston 2, mounted upon the crank pin 3 of a crank shaft 4, which crank shaft is journaled in the cylinder head on the inlet side at 5 and in the cylinder head at the exhaust side at 6. Attached to the cylinder head and forming a steam chest at the inlet side is a cover 7, and attached to the cylinder head at the exhaust side is a corresponding cover 8 through which the crank shaft 4 passes. Moving radially in apertures 9 in the cylinder heads and extending into enlarged pockets 10 formed in extensions of the cylinder walls are three dividing partitions 11, which carry shoes at their inner ends which have sliding contact with the surface of the rolling piston, as more fully hereinafter described. These partitions thus divide the cylinder into three equal segmental parts. Communicating with each segmental portion of the cylinder is an inlet passage 12 and an exhaust passage 13, which passages are controlled by rotating inlet and exhaust valves 14 and 15 respectively.

In general the operation of my improved engine is as follows: Steam enters cover 7 through opening 16 and is admitted to one of the divisions of the cylinder, say division A. This admission commences as soon as the piston which is moving in the direction of the arrow has passed the admission port near the top of this compartment and the steam causes a pressure against the piston 2 causing it to roll in the direction of the arrow, thus rotating the crank shaft 4, which carries with it the inlet valves 14 and exhaust 15. This motion continues by reason of the steam in compartment A until the inlet valve has reached such a position that it will admit steam into compartment B, which continues the motion in the direction of the arrow. This engine has a fixed intake and a variable cut off. When operating under

average load and the inlet valves have reached such a position as to admit steam to compartment B, the steam will be cut off from compartment A and will continue to act by expansion against the piston. When the crank shaft has rotated to such an extent that the inlet valve admits steam to compartment C, thus cutting off the compartment B, the exhaust valve will have reached such a position that it will open the exhaust port into compartment A and, the steam in the compartment will be exhausted and the compartment put in proper condition to receive steam through the inlet valve when this valve has again reached the inlet port of the compartment. In the meantime compartments B and C will be going through the same operations as detailed with reference to compartment A. This, therefore, produces a continuous operation, each compartment in turn admitting steam, cutting it off, operating by expansion and exhausting.

I shall now describe my engine more particularly.

The piston.—The piston of my improved engine is mounted upon the crank pin 3 of crank shaft 4, preferably upon roller bearings 17. The crank shaft as described above is journaled in the cylinder heads at 5 and 6 and is made in two parts, one part having a recess 18 into which enters a pin 19, the two parts being held together by means of a screw 20. The piston consists essentially of a core 21, outer members 22 and 23 and a packing ring 24. The core 21 is in the form of a hollow annulus, the inner surface of which bears against the roller bearing 17. The outer surface of core 21 has two annular recesses 25 and 26 formed in it to receive outer members 22 and 23, and a groove in its outer surface 27 to receive packing ring 24. It will be seen from the construction described that the piston may be easily assembled and when assembled forms a rigid and compact whole, which is kept steam tight by its own action. Thus, if the piston were not steam tight, steam would enter the recesses 30 and, passing back of the outer members 22 and 23, would force them outwardly against the walls of the cylinder, thus making the joint tight. The outer members 22 and 23 are complementary and are formed with teeth 28 at their inner edges, which teeth are adapted to interlock and with slots 29 in their outer edges, which slots carry the dividing partitions, as will hereafter be described. Packing ring 24 is a split ring which tends to expand and hold tightly against outer members 22 and 23.

The cylinder.—The cylinder structure consists of two heads 31 and 32 carrying bearings 5 and 6 in which shaft 4 is journaled and a cylinder 33 clamped between the two heads. The heads have annular grooves, as

shown at 34, for the reception of a ring-shaped extension on the cylinder 33. With this structure, the unequal expansion of the heads and cylinder causes these parts to interlock and be held together very strongly, thus making the cylinder absolutely steam tight. Attached to the head of the cylinder are the two covers 7 and 8. The cover 7 forms the inlet steam chest and cover 8 the exhaust. In cover 7 is a screw 35 for holding the steam valve to its seats, as will be described, and in cover 8 is a thrust bearing 36, which serves a similar purpose with respect to the exhaust valve.

The valves.—Both the inlet and exhaust valves 14 and 15 are keyed to the shaft 4 so as to revolve with it, their position with respect to the piston being thus fixed. Inlet valve 14, which is shown more in detail in Fig. 3, consists of a valve disk 37 having a suitable number of apertures or ports 38 arranged in the proper positions so as to give the desired opening to the inlet valve. Inlet valve disk 37 carries a hub 39 which surrounds the bearing through which shaft 4 passes, which hub is keyed to shaft 4 as at 40. A steam tight joint is provided between extension 39 and the outer surface of bearing 5, by means of split rings 41, which are set in grooves 42 upon the outer surface of the bearing and which tend to expand against the inner surface of the extension 39. Attached to the outer surface of valve disk 37 is a cut off disk 43, which rests in a groove in the face of valve disk 37 and is held from movement in a circumferential direction by means of screws 44. This disk is provided with a number of apertures 46, which are adapted to register with the apertures 38 in valve disk 37. Thus, when it is desired to vary the cut off of the steam, the inlet cut off disk 43 is rotated with respect to valve disk 37 and a different valve opening is thus produced. This change of relative position of the two disks 37 and 43 may be accomplished either by means of an automatic governor or by hand through the medium of screws 44 as illustrated. A counter weight 62' is mounted on the hub 39 and is so constructed and disposed as to balance the piston. The counter weight comprises at or near its outer edge an inwardly projecting portion 61', disposed at the side of the valve opposite the intake port. The steam presses this portion of the valve inwardly due to the fact that two of the intake ports are closed and one open and tends to unbalance the valve. This is counteracted and an evenly balanced valve obtained due to the action of centrifugal force on the projection 61 of the counter weight.

The exhaust valve consists of an exhaust valve disk 47, shown more in detail in Fig. 4, having apertures 48 therein, which are adapted to register with corresponding ex-

haust ports. This exhaust valve disk 47 has a hub 49 passing over and about the outer surface of bearing 6 in the same manner as the inlet valve disk, which hub 49 is keyed to shaft 4 as at 50.

In order to take up wear and insure that the joint between the exhaust valve and the outlet ports shall always be tight, I have constructed the exhaust ports in the following manner: Attached to the side of the cylinder wall is a disk 51 having a number of apertures in it of the same general form as the exhaust ports, but of larger size. This disk is held against the cylinder wall by means of screws 52, or any other appropriate method of fastening. Underneath disk 51 and held against the cylinder wall by it is a disk of flexible metal or other suitable material 53. Attached to disk 53 are the rims 53^a of the exhaust ports 54. These rims may be conveniently held in place by clamping the edge of the thin flexible disk 53 under a ring 55 which fits tightly within the rim of the exhaust port 54. It will be seen that the pressure of steam acting against the flexible disk 53 forces it and the exhaust port rims 54 carried by it outwardly against the face of exhaust valve disk 47, thus insuring a perfectly tight joint. In order to resist the tendency to outward movement along the shaft thus produced, the thrust bearing 36 is provided. It is to be understood that a counter weight, such as above described, may also be mounted on the exhaust side and the same arrangement may be employed to balance the exhaust valve if desired.

The dividing partitions.—The dividing partitions, of which there are three as indicated above, consist essentially of two side members 56, a central member 57 and a bearing member 58. Each of side members 56 has attached at its inner end a pin 59, which pin fits in a recess formed in a segmental block 60, which segmental block is adapted to slide in the groove 29 in outer member 22 or 23 of the piston. The piston may thus be rotated with respect to the block and the block may be oscillated with respect to the side members 56. Attached between members 56 and holding them in place is the central member 57, which is formed with a recess 70 at its outer end, and a recess 61 at its inner end. Set into recess 61 is the bearing member 58 which is thus permitted to move relatively to the other portions of the dividing partition. Rearing member 58 has attached to its inner end a slotted rod 62, which fits into a bearing in the shoe 63. This shoe is curved on its inner surface to fit the curvature of the piston and is held against the surface of the piston by means of spring 64, located in recess 61, which tends to force central member 57 of the dividing partition and bearing member 58 apart. Shoe 63 is provided with off-set sides,

as shown in Fig. 7, and similarly shaped apertures 65 are provided in the cylinder walls for the reception of these shoes. Slots 66 within which dividing partitions 11 work are formed in each cylinder head. It is thus apparent that the dividing partitions 11 may move freely in a radial direction, their radial motion being regulated by the position of the rolling piston and that the piston may move freely with respect to the partitions, a steam tight joint being obtained at the same time by means of shoe 63 and block 60, which shoe and block may freely oscillate with respect to the partitions. It will be noted that recess 10 is larger than is necessary to accommodate the dividing partition and that recess 60^a has been provided in the end of the partition. These oppositely disposed recesses prevent the partition becoming broken or deformed by reason of any water which may lodge in the recess 10, as it will be apparent, that whatever the position upon the cylinder of the recesses, a place always remains in which air is trapped, thus permitting free motion of the partition in the recess by merely compressing the air. The air pocket or recess 60^a should, of course, be of such cross-section and depth that it will normally contain a considerable volume of air, and upon movement of the partition into the recess 10 will receive water which may have lodged in said recess. The water so received into the air pocket 60^a acts as a water piston, compressing the air within the air pocket, and thus forming an air cushion within the air pocket. The offset formed shoe 63 is also important since it provides a smooth path of travel for the rolling piston, and at the speeds at which my improved engine is designed to operate, a smooth motion of the piston is very desirable. It will be seen that the transition of the piston from the cylinder to the shoe is gradual.

I am aware that many modifications of my invention may be made without departing from its spirit and I therefore do not intend to confine myself to the exact details shown and described. Also, although I have referred to steam as being the fluid used in operating my engine, it is, of course, obvious that any other expansive fluid, such as air, might be used to operate it. I therefore wish to be understood as including these and similar mediums when I refer to steam. What I claim and desire to secure by Letters Patent is:

1. In a device of the kind described, a dividing partition having an air pocket in its outer end and a recess adapted to be entered by said partition having an enlarged portion at its outer end.

2. In a device of the kind described, a partition adapted to reciprocate into and out of a recess, said partition being provided with

an air pocket of sufficient size to receive water contained in the recess during the movement of the partition thereinto and thereby cushion such movement.

5 3. In a device of the kind described, a valve disk having an opening therethrough and a cut off disk having an opening adapted to register with the opening of the valve disk and means for securing the cut off disk
10 in any desired position relatively to the valve disk.

4. In a device of the kind described, a rotatable valve disk having an aperture therethrough, a cut off disk having an aperture
15 therethrough mounted upon and adapted to rotate with said valve disk and means for changing the angular relation of the valve disk and cut off disk.

5. In a device of the kind described, a rotatable valve, an opening therein, a cylinder having a plurality of ports adapted to register in sequence with said valve opening and a weight mounted on said valve and
20 arranged so that centrifugal force acting on the weight will tend to balance the uneven pressure of fluid on the valve.

6. In a device of the kind described, a rotatable valve disk having a circular slot and an aperture, a cut off disk mounted in said
30 slot and having an aperture adapted to register with the aperture of the valve disk and means for securing the cut off disk in any desired position.

7. In a device of the kind described, a valve, a movable valve seat and means for holding the seat against the valve by the pressure of the fluid behind the valve.

8. In a device of the kind described, a cylinder head having a valve port, a disk
40 of thin flexible material held against the cylinder head and a valve seat attached to the disk.

9. In a device of the kind described, a cylinder head having a valve port, a disk of thin flexible material having an aperture adapted to register with the port, a valve seat mounted upon said disk and having an aperture adapted to register with said port and a clamping disk having an aperture through which the valve seat is adapted to pass.

10. In a device of the kind described, a cylinder head, a disk of thin flexible material having an aperture adapted to register with said port, means for holding said disk
55 against the cylinder wall, a valve seat attached to said disk and having an aperture adapted to register with the port and a rotating valve disk having apertures and adapted to be rotated while in contact with
60 the valve seat.

11. In a device of the kind described, a cylinder head having a valve port, a disk of thin flexible material having an aperture adapted to register with said port, a valve seat having an aperture adapted to register with said port, a ring concentrically mounted within said valve seat and adapted to hold the edges of the thin flexible disk against the valve seat and a valve disk adapted to cooperate with said valve seat.

12. In a device of the kind described, a cylinder head having a port, a rotatable valve disk, a movable valve seat adapted to be pressed against the valve disk by the pressure of the fluid within the cylinder and a thrust bearing adapted to hold the valve disk against the pressure.

13. In a device of the kind described, a cylinder wall having a recess and a shoe in contact with the piston and adapted to enter said recess, said shoe having offset sides.

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