Oct. 9, 1962 F. ROHSMANN 3,057,544

ENGINE OR MACHINE WITH AT LEAST ONE ROTATING PISTON RUNNING IN AN ANNULAR CYLINDER SPACE

Filed April 28, 1959 5 Sheets-Sheet 1

Fig. 1

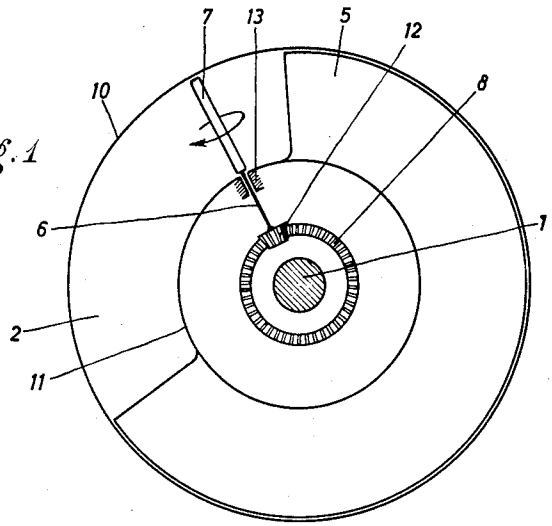
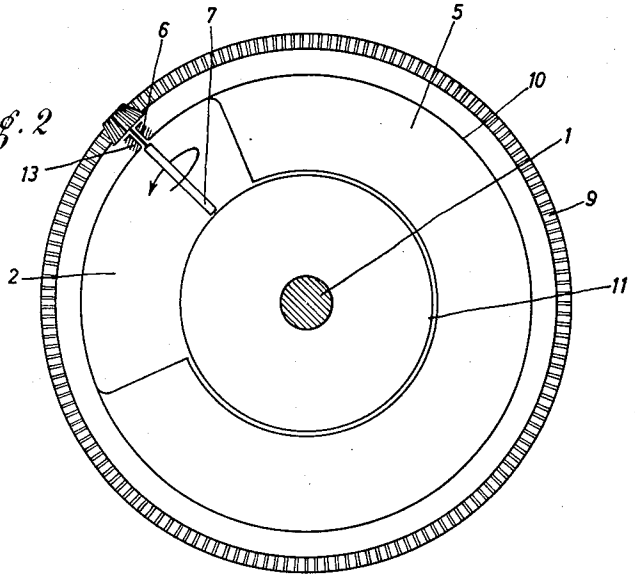


Fig. 2



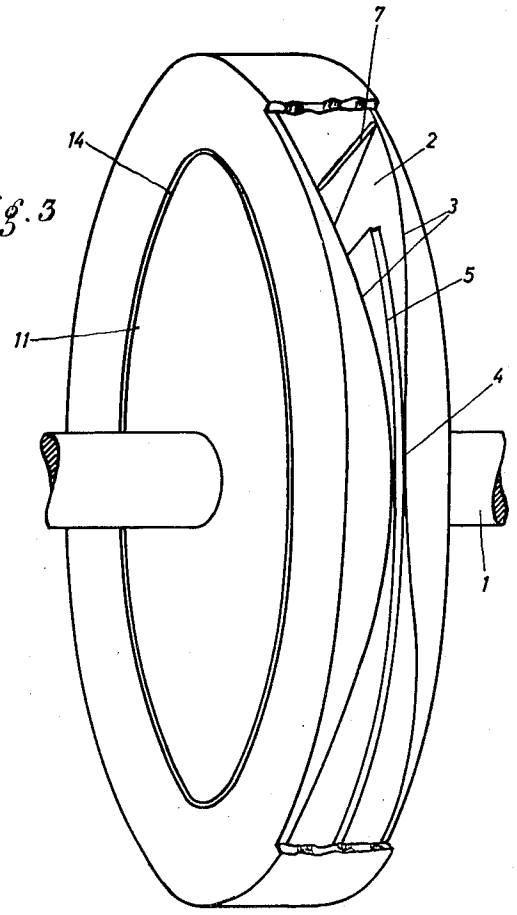
INVENTOR.
FELIX ROHSMANN
BY Leon M. Straus
ATT.

Oct. 9, 1962 F. ROHSMANN 3,057,544

ENGINE OR MACHINE WITH AT LEAST ONE ROTATING PISTON RUNNING IN AN ANNULAR CYLINDER SPACE

Filed April 28, 1959 5 Sheets-Sheet 2

Fig. 3



INVENTOR.
FELIX ROHSMANN
BY Leon M. Strauss
AGT.

Oct. 9, 1962 F. ROHSMANN 3,057,544

ENGINE OR MACHINE WITH AT LEAST ONE ROTATING PISTON RUNNING IN AN ANNULAR CYLINDER SPACE

Filed April 28, 1959 5 Sheets-Sheet 3

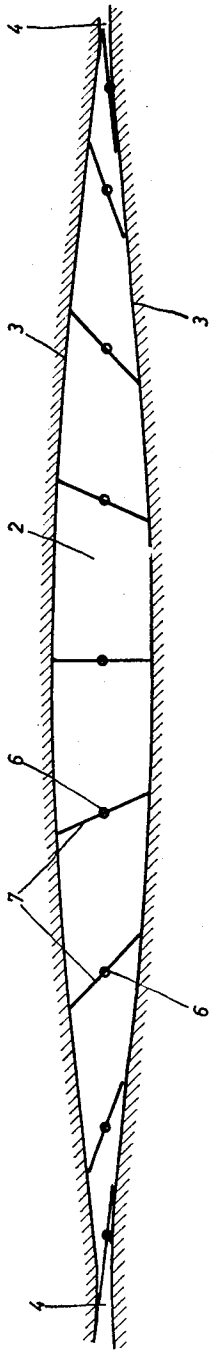


Fig. 4

INVENTOR.
FELIX ROHSMANN

BY Leon M. J. Strauss
Att.

Oct. 9, 1962 F. ROHSMANN 3,057,544

ENGINE OR MACHINE WITH AT LEAST ONE ROTATING PISTON RUNNING IN AN ANNULAR CYLINDER SPACE

Filed April 28, 1959 5 Sheets-Sheet 4

Fig.6

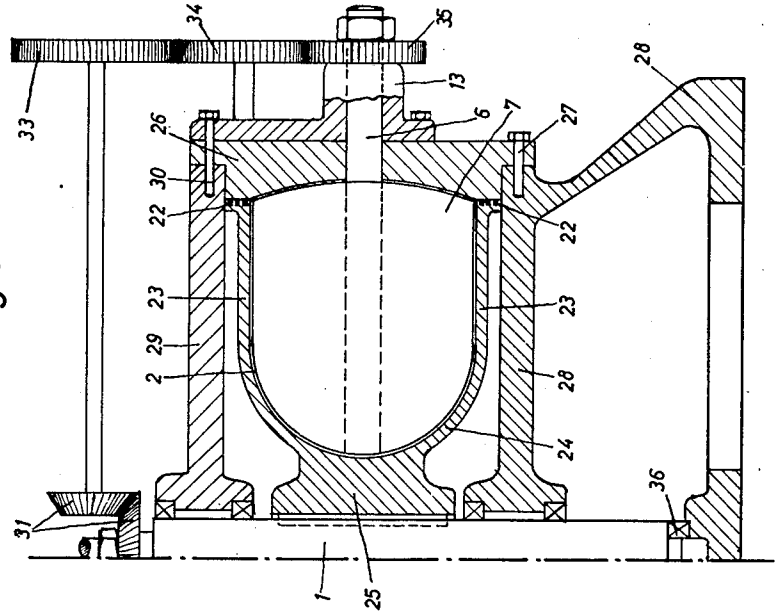
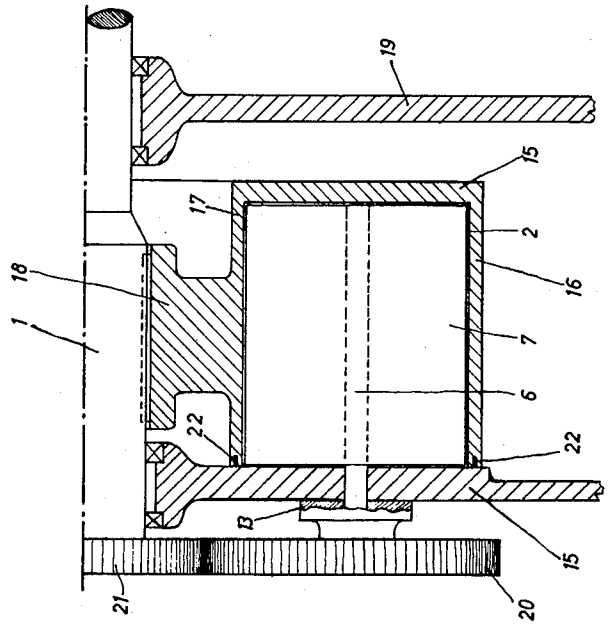


Fig.5



INVENTOR.
FELIX ROHSMANN
BY Leon M. Strauss
ATT.

Oct. 9, 1962 F. ROHSMANN 3,057,544

ENGINE OR MACHINE WITH AT LEAST ONE ROTATING PISTON RUNNING IN AN ANNULAR CYLINDER SPACE

Filed April 28, 1959 5 Sheets-Sheet 5

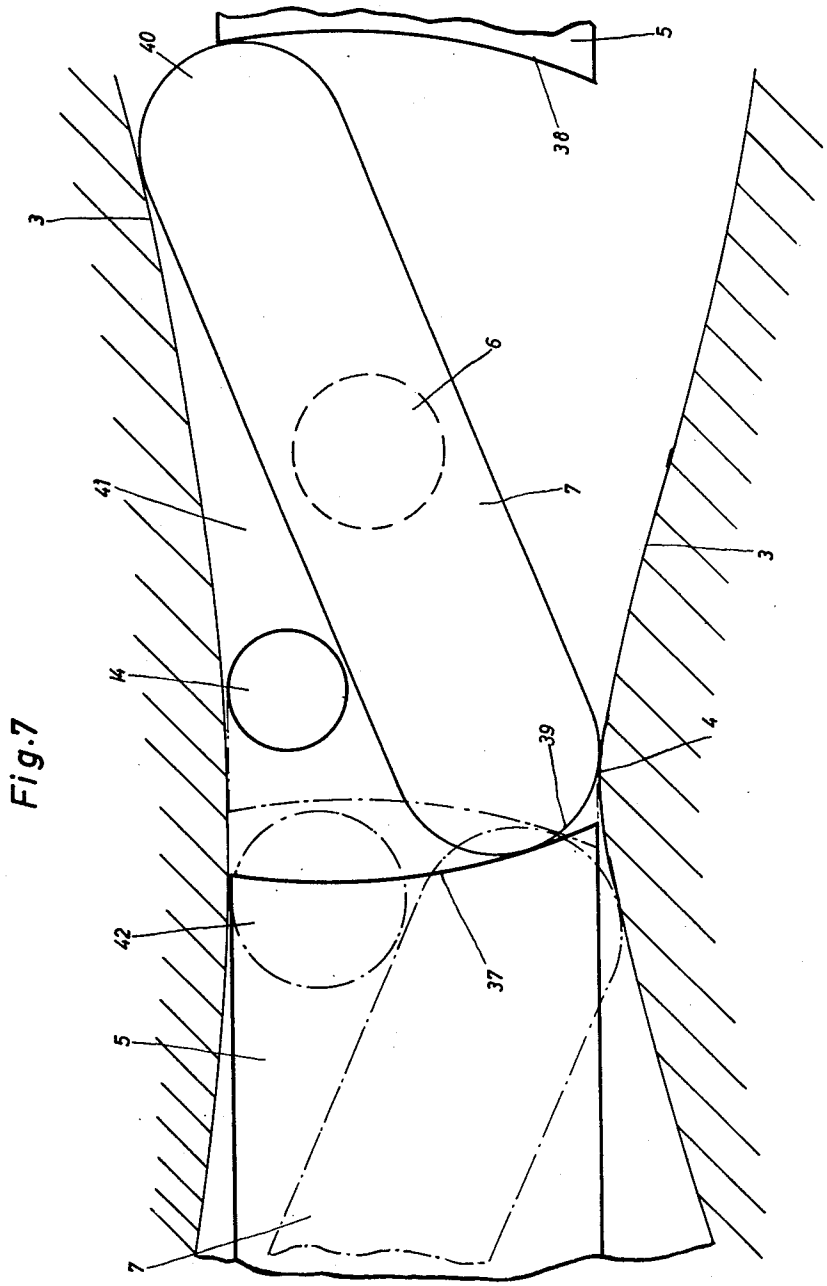


Fig.7

INVENTOR.
FELIX ROHSMANN
BY Leon M. Strauss
AGT.

United States Patent Office

3,057,544
Patented Oct. 9, 1962

3,057,544

ENGINE OR MACHINE WITH AT LEAST ONE ROTATING PISTON RUNNING IN AN ANNULAR CYLINDER SPACE

Felix Rohsmann, 11/11 Milchstrasse, Munich 8, Germany

Filed Apr. 28, 1959, Ser. No. 809,548
Claims priority, application Germany Apr. 28, 1958
11 Claims. (Cl. 230—156)

The present invention relates to an engine or machine with at least one rotating piston running in an annular cylinder space.

Engines as well as machines can be divided basically into rotating machines or engines and into reciprocating machines or engines provided with pistons. In the ranges of smaller performances, smaller transport quantities and higher pressures, the rotating machines or engines are inferior to the reciprocating machines or engines as to their efficiency. On the other hand the rotating machines or engines can be manufactured in these ranges considerably cheaper and they are also more reliable in their function as well as smaller and lighter. Rotating machines operate with less vibrations than reciprocating machines. Finally, in the rotating machines the work medium, e.g. the steam, remains free of lubricating oil and can therefore be used further after having given its output (e.g. for heating purposes).

It has already been proposed to provide an engine, which unites the advantages of the reciprocating engines with those of the rotating engines. In such a known engine with a piston rotating in an annular cylinder space, the closing of the cylinder space behind the piston was to be effected by rotating discs arranged in the annular cylinder space, which were provided with holes for the passing of the piston. The cylinder space was thus closed after the passing of the piston by the rotating disc, so that a work medium, e.g. steam, could be fed into the cylinder space through valves, where it expanded. But with such rotating discs a favourable closing of the cylinder space could not be obtained, so that the efficiency of such an engine is very low. This is the reason why it was not possible up to now to provide an engine or a machine, which unites the advantages of the rotating and the reciprocating engines or machines.

The present invention solves this problem by employing the concept of an engine or machine with at least one piston rotating around its axle and circling in an annular cylinder space.

In carrying out the invention the lateral walls of the annular cylinder space parallel to the axis of the rotating piston are arranged as uniformly curved rolling of surfaces, e.g. cycloides, whereby the apexes of the curvatures are opposed to each other to form at least one narrow spot, the width of which is exactly adapted to the cross section of a massive sealing fin arranged as a ring sector, which is integral in the circling movement with the rotating piston, which besides is moved in a uniform rotation around its axle by means of a suitable gearing arrangement.

In this way a sealed off expansion or compression space is created at all times in the annular cylinder space, without an oscillating movement being necessary; the necessary movements are absolutely uniform, i.e. without any accelerations or retardations.

In this connection the annular cylinder space is closed off for its sealing by an uninterrupted annular wall, which corresponds in its movement with the circling movement of the rotating piston and is provided with sealed-off bearings for the axle of the rotating piston.

It is possible to arrange the annular cylinder space in a stationary manner, while the annular wall with the rotating piston and the sealing fin rotates and the axle of the

rotating piston is provided with a counter gear wheel rolling off on a stationary gear wheel.

A particularly advantageous arrangement of the machine or engine is, however, achieved, if the annular cylinder space rotates together with the main shaft and the sealing fin as well as the rotating piston rotating around its axle are stationary together with the annular wall.

In the case of a stationary cylinder space the rotating drive of the rotating piston is effected in such a way, that on the axle of the rotating piston a gear wheel is arranged, which engages with a stationary gear wheel.

In case of the rotating cylinder space, there is arranged, on the contrary, a gear wheel on the axle of the rotating piston, which is in connection with a gear wheel rotating together with the main shaft.

A particularly simple arrangement of the machine is reached by the fact that the axle of the rotating piston is arranged in parallel to the main shaft and the ring-shaped cylinder space is limited by two flat walls standing perpendicularly to the main shaft and by two cycloid-shaped running walls. As far as, however, a series of such machines or engines are arranged adjacent to each other, the arrangement of the machine or engine must be provided in such a way, that the axle of the rotating piston is arranged perpendicularly to the main shaft and the annular cylinder space is limited by two cycloid-shaped walls perpendicular to the main shaft and by two walls, arranged as ball ring surfaces.

The necessary inlet or outlet openings for the passing of the work medium, e.g. of the steam, can be arranged in the walls which are perpendicular to the axle of the rotating piston.

In the case of the stationary ring-shaped cylinder space it is advantageous, if these necessary inlet and outlet openings for the passage of the work medium are arranged in the stationary wall which is perpendicular to the axle of the rotating piston.

In the case of the rotating annular cylinder space it is, on the contrary, possible, that the necessary inlet and outlet openings for the passage of the work medium, e.g. the steam, are arranged in the stationary ring wall.

In this latter embodiment of the machine or engine a particularly high efficiency is attained, if the sealing fin has a section filling out the narrow spot, while the thickness of the rotating piston is smaller than the inner width of the narrow spot and if furthermore the sealing fin is interrupted only with the length of the rotating piston and the ends of the sealing fin are configurated as sealing surfaces cooperating with the rotating piston ends. It is preferable, that the inlet and outlet openings necessary for the passage of the work medium are arranged beside the radial symmetrical plane of the machine in a wall perpendicular to the axle of the rotating piston.

The invention is to be elucidated further with a reference to the drawings, which illustrates some embodiments of the device according to the invention.

FIG. 1 is a first embodiment of the machine with stationary annular cylinder space diagrammatically in side elevation, the lateral wall being broken away,

FIG. 2 illustrates a further embodiment of the machine with rotating annular cylinder space, likewise diagrammatically in side elevation,

FIG. 3 is a diagrammatic perspective view of the machine of FIG. 1 with parts being broken away to show other parts with greater clarity,

FIG. 4 is a diagram illustrating the ring cylinder space becoming narrower with the rotating piston in the different operational positions,

FIG. 5 is an axial sectional view through the machine according to a third embodiment, in which the axles of the rotating pistons are in parallel with the main shaft and the ring cylinder space rotates around the main shaft,

FIG. 6 is an axial sectional view through the machine according to a further example, in which the axle of the rotational piston is arranged perpendicular to the main shaft and the ring cylinder space rotates, and

FIG. 7 is a view of the narrow spot in the direction longitudinal to the axle of the rotating piston to a greater scale.

The machine is provided with a main shaft **1** and an annular cylinder space **2** which is arranged concentrically to this shaft, is closed, and varies continuously in its section, being limited laterally by cycloid-shaped lateral walls **3** (cf. e.g. FIGS. 3 and 4). The lateral walls **3** approach thus each other and form in this way one or several narrow spots **4**. According to the arrangement of the machine these lateral walls **3** can be flat in radial position or they may be arcuated.

In the cylinder space **2** a sealing fin **5** is arranged, which is shorter or longer according to the number of narrow spots. The thickness of this sealing fin is adapted to the section of the cylinder space **2** (cf. e.g. FIGS. 3 and 7). The sealing fin can either touch the lateral walls **3** in the narrow space **4** or can be separated from them by very narrow slots.

Furthermore, there is arranged in the cylinder space **2** a rotating piston **7**, including a vane rotating round its shaft **6**, which touches the two lateral walls **3** in every work position or is separated from it at the most by a very narrow adjustable slot. As is shown diagrammatically in FIGS. 1 and 2 the rotating piston **7** is rotated by means of gear wheels **8** or **9** from the main shaft **1** in such a way, that the rotating piston executes an absolutely uniform movement round its axle and closes or seals off the variable ring cylinder space in every position, but also passes easily through the narrow spot **4**.

The sealing fin **5** and the rotational piston **7** move thus in common relative to the cylinder space **2** and form together in the course of the rotation of the machine always again a closed off work room, which is limited on the one hand by the cylinder wall **3**, on the other hand by the sealing fin **5** in the narrow spot **4**, and further through the outer limitation surface **10** and the inner limitation surface **11** of the cylinder space **2** and finally by the rotating piston **7**, which by means of its surfaces seals off the lateral and outer and inner limitation surfaces of the annular cylinder space **2**.

FIG. 1 shows a first embodiment of such a machine, in which the cylinder space **2** is arranged stationary, while the sealing fin **5** and the rotating piston **7** rotates together, with the main shaft **1** and the rotation axle **6** of the rotation piston **7** carries a counter gear wheel **12** rolling off on the stationary gear wheel **8**. The inner limitation surface **11** forms the bottom of the cylinder space **2** and is connected integrally with the main shaft **1** and carries besides the bearing **13** for the rotating piston **7** and the sealing fin **5**.

In FIG. 2 a second embodiment of the new machine is represented, which is different from the first in so far, as there the cylinder space **2** rotates with the main shaft **1**, while the sealing fin **5** as well as the rotation piston **7** rotating round its axle **6** are stationary. In the example according to FIG. 1 as well as FIG. 3 with stationary cylinder space **2** a packing **22** is arranged between the stationary walls of the cylinder space and the rotating surface **11**. In the embodiment according to FIG. 2 such a packing is found, on the contrary, between the outer stationary limitation surface **10** and the two lateral walls **3** rotating together with the main shaft. The sealing fin **5** is in this case firmly connected with the outer limitation surface **10** and in the same way this limitation surface **10** carries also the bearing **3** for the rotating piston **1**, the drive of which is shown diagrammatically in FIG. 2.

The second execution according to FIG. 2 has an advantage in so far as there the rotating piston **7** and its bearing are not submitted to any additional rotational

forces. Besides, each formed lateral wall 3 of the cylinder space transfers power and output, while according to the first embodiment the rotational piston **7** is the transmitting means of power and output to the main shaft **1**.

Near the narrow spot **4** there is, according to the type of the machine (engine or machine) seen in the rotational direction in front or behind it in suitable distances, the inlet, respectively, outlet openings **14** (FIG. 7) respectively several such openings, which feed in the gaseous or liquid medium furnishing or absorbing the power, according to whether an engine or a machine is involved. The outlet and inlet openings are arranged, according to the desired degree of expansion or compression nearer or farther away from the narrow spot **4** in the rotational direction or against it. The inlet or outlet openings can be arranged in a shiftable or modifiable manner, whereby also during the operation the relation of expansion and oblique stroke and/or the compression can be varied, respectively, adjusted.

As far as the novel machine works as an engine, the narrow spot **4** is always passed first by the rotational piston **7** and then closed by the sealing fin **2**. If however, the new machine is to be used to execute work, it is always the sealing fin **5** which passes the narrow spot first and then the rotational piston **7** follows in passing each narrow spot **4**.

In the shown embodiments there is illustrated only one narrow spot for simplification purposes. It is, however, possible, that the annular cylinder space **2** can also have several narrow spots **4** as well as several rotation pistons **7** and a corresponding number of sealing fins **5**. It is also favourable in some cases, to arrange several cylinder spaces concentrically straight and/or obliquely laterally one above the other or beside each other, whereby all work on one and the same or several separate shafts in one axis direction. Thereby the cylinder spaces can be used as engines and/or machines or in a mixed manner.

The last named possibility can be made use of if the machine is used as an internal combustion engine, whereby ring channels arranged at the side, above or behind are alternately or in groups used as engines or machines (compressors).

In FIGS. 5 and 6 particularly advantageous embodiments of the novel machine are shown.

The particularity in the embodiment acording to FIG. 5 consists in the fact that the axle **6** of the rotating piston **7** is arranged parallel to the main shaft **1**, whereby not only a particularly simple drive of the axle **6** is obtained of the rotating piston **7**, but also a very simple configuration of the lateral walls **15** of the annular cylinder room **2**. These lateral walls **15** can, it must be said, be arranged in this embodiment in a completely plane manner, while the outer wall **16** and the inner wall **17** of the cylinder space **2** are arranged as rolling off surfaces with regular curvature, i.e. in the manner of cycloid surfaces. In the example according to FIG. 5 the cycloid surfaces **16** and **17** and the plane lateral wall **15** form one integral part, which is keyed on the main shaft **1** by means of the hub **18** and rotates around it. The second lateral side wall **15**, which carries the bearing **13** for the rotating piston axle **6** is stationary, just as the wall **19**, which serves as a bearing for the main shaft **1**. The wall **19** and the stationary lateral wall **15** can be led to a stationary support.

In the embodiment according to FIG. 5 a gear wheel **20** keyed on this axle is sufficient for the rotating of the rotating piston axle **6**, which gear wheel is in engagement with a gear wheel **21** fastened onto the main shaft **1**.

The example according to FIG. 5 can also be varied in such a way, that not only one lateral surface **15** but the two side surfaces **15** are stationary, while the cycloid walls **16** and **17** rotate.

It is besides readily possible to rotate the lateral wall **15** carrying the bearing **13** together with the main shaft **1** and to arrange the cylinder space **2** stationary, which

is formed by the walls 16, 17 and 15. In this case the gear wheel 21 would not be connected with the main shaft 1 but would be arranged in a stationary manner, so that the gear wheel 20 meshes in its circling movement on the stationary gear wheel 21 and rotates thereby the rotating piston 7 in a uniform manner.

It is a feature of the embodiment according to FIG. 6, that the axle of the rotating piston 7 is arranged, it must be said, perpendicular to the main shaft 1, whereby, however, the cylinder space 2 rotates, which is formed by the lateral walls 23 and the inner wall 24, which is arranged as ball ring surface, so that the rotating piston 7 with its corresponding sealing surface cannot lift off during the rotating movement around its axle 6 from the surface 24 in any place. The surface 24 passes over into a hub 25, which is again keyed on the main shaft 1.

The cylinder space 2 is closed off by the outer wall 26, which is configurated in a stationary manner and is connected with the support 28 by means of screws 27. This outer wall 26 has likewise in the inside a sealing surface, which is in the form of a ball ring surface. Between the outer wall 26 and the rotating lateral surfaces 23, which are of cycloid-shaped configuration, packings 22 are arranged. The rotating cylinder space 2 is completely closed in by stationary discs 28 and 29, which serve at the same time as a bearing of main shaft 1. The disc 29 is connected rigidly by means of screws 30 with the outer wall 26. Furthermore the bearing 13 for the rotating piston axle 6 is screwed onto the outer wall 26. The drive of the rotating piston 7 is accomplished done in this embodiment over an angle 31, driven by the main shaft 1 and through a shaft 32, gear wheels 33, 34 and 35, whereby the gear wheel 35 is firmly connected with the axle 6 of the rotating piston. The main shaft 1 arranged in this case vertically is carried in the support 28 by means of an axial bearing 36. It is, however, also possible to modify the embodiment according to FIG. 6 in such a manner, that the main shaft 1 is horizontal and the stationary lateral walls 29 and 28 have an extension arranged at the support.

In the embodiment according to FIG. 7 it is shown in which way a particularly high efficiency of the machine can be reached. In this case the sealing fin 5 is interrupted only in the length of the rotating piston 7. The ends 37 and 38 of the sealing fin 5 are arranged as circular surface and cooperate in a sealing manner with the ends 39 and 40 of the rotating piston 7. The rotating fin 5 is of such a section, that it completely closes the narrow spot 4. In the illustrated position the rotating piston 7, seals with its end 40 at the cycloid lateral wall 3 and with its end 39 on the sealing surface 37 of the sealing fin 5, so that in this way a very small completely sealed off working space 41 is created. If it be assumed that the machine is to be used as a compressor, then there is in this working space 41 arranged in one of the walls perpendicular to the rotating axle 6 of the piston 7 an outlet valve 14 in rotational direction directly before the apex of the narrow spot 4. This valve 14 can e.g. be arranged as a valve in the form of a mushroom, as it is used in the construction of motor vehicles and controlled by means of cams. By the arrangement of this valve 14 laterally from the radially symmetrical line of the machine there is only a very small idle space left in the working space, so that a very high compression can be reached. It must also be taken into consideration in this connection, that in this case the piston 7 is of a smaller thickness than the sealing fin 5.

There is furthermore shown in the embodiment according to FIG. 7 a position of the rotating piston 7 in dotted lines, which is applicable for that case, that the machine is to be used as an engine, e.g. a steam engine. For this case there is, seen in the rotating direction, directly behind the narrow spot 4 an inlet valve 42, which can be constructed and controlled exactly as the cited outlet valve 14.

As far as the machine has to work as a machine, e.g. a compressor, there is arranged in one of the walls of the cylinder space 2 near the narrow spot 4 and opposite to the outlet valve 14 an inlet slot, which can be opened.

As far as the machine works, however, e.g. as a steam engine, there is adjacent to the narrow spot 4 and opposite to the inlet valve 42 an outlet slot, which can likewise be uncontrolled.

Experiments were made in order to find out in which ranges the novel machine works most economically. The results showed that with a relation of the centrifugal speed of the rotating piston to the rotational speed of the rotating piston equal to or greater than eight excellent economic constructions are possible.

No matter whether the novel device serves as an engine or as a machine, it is advantageous in order to reach an economically favourable solution, to provide a cylinder space with several narrow spots and one or more rotating pistons and one or more sealing fins or, still better, the arrangement of cylinder space adjacent to each other, likewise with one or several narrow spots each and one or several rotating pistons and one or several sealing fins.

If it is worked with two or several correspondingly arranged rotating pistons and sealing fins, then it is possible also with one cylinder space with only one single narrow spot and of course also with such spaces with several narrow spots to arrange engines and machines directly behind each other, e.g. in the diesel method the compression is arranged directly before the generating of power. Corresponding off setting of engines and machines are likewise possible.

There is furthermore the possibility in the different constructions, to expand without any difficulty by one step or in several steps creating power or to compress absorbing power, respectively to work in a mixed manner. Thus a steam driven engine constructed in the novel manner can work to several counter pressures with or without condensation, whereby the single expansion relations can be made variable as already described. The same is valid in a similar manner also for the use of the novel device as a machine.

Various changes and modifications may be made without departing from the spirit and scope of the present invention and it is intended that these modifications and changes be embraced by the annexed claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. An apparatus of the type disclosed, comprising a pair of spaced opposed cycloid shaped lateral walls defining therebetween an operating space and defining at least one narrow spot therebetween, a first one of said walls being of relatively small radius of curvature and sharply curved at said narrow spot and a second opposed wall being of relatively large radius of curvature and flatly curved at said narrow spot, a main shaft extending normal to said lateral walls, a sealing fin disposed about said main shaft and located between said lateral walls, and a piston including a piston shaft extending normal to said main shaft and further including a piston vane having opposite end edges engaging said lateral walls during operation, said vane being rotatable about its own axis, said sealing fin having an opening therein, said vane being disposed in said opening and having its axis disposed closer to said second wall than said first wall at a location adjacent said narrow spot, an annular wall closing said operating space, and an inlet and an outlet opening in said annular wall connected into said operating space at spaced locations adjacent said narrow spot.

2. An apparatus of the type disclosed, comprising a pair of spaced cycloid shaped lateral walls defining therebetween an operating space and defining at least one narrow spot therebetween, a first one of said walls being of relatively small radius of curvature and sharply curved and a second opposed wall being of relatively large radius of curvature and flatly curved at said narrow spot, a main

shaft extending normal to said lateral walls, a sealing fin disposed about said main shaft and located between said lateral walls, a piston including a piston shaft extending normal to said main shaft and further including a piston vane having opposite end edges engaging said lateral walls, said sealing fin having an opening therein, said vane being disposed in said opening and being rotatable about its own axis and having its axis disposed closer to said second wall than said first wall at a location adjacent said narrow spot, an annular wall closing said operating space, an inlet and an outlet opening in said annular wall connected into said operating space at spaced locations adjacent said narrow spot, and means connected to said main shaft and said piston shaft for rotating said piston to maintain a positive relationship between said vane and said lateral walls.

3. An apparatus of the type disclosed, comprising a pair of spaced cycloid shaped lateral walls defining therebetween an annular shaped cylinder space having at least one narrow spot, a first one of said walls being of relatively small radius of curvature and sharply curved at said narrow spot and a second opposed wall being of relatively large radius of curvature and flatly curved at said narrow spot, a main shaft extending normal to said lateral walls at the centers thereof, a massive sealing fin disposed about said main shaft and located between said lateral walls, said sealing fin having a thickness substantially the same as the width of said narrow spot, a piston including a piston shaft extending normal to said main shaft and further including a piston vane having opposite end edges engaging said lateral walls, said sealing fin having an opening therein, said vane being disposed in said opening and having its axis disposed closer to said second wall at a location adjacent said narrow spot, an annular wall closing said operating space, an inlet and an outlet opening in said annular wall connected into said operating space at spaced locations adjacent said narrow spot, said vane being rotatable about its own axis with said main shaft, and a gearing arrangement connected to said main shaft and said piston shaft for rotating said piston to maintain a positive relationship between said vane and said lateral walls.

4. An apparatus according to claim 3, wherein the annular cylinder space is arranged to be stationary, while said piston and said sealing fin rotate, said piston shaft being provided with a counter gear wheel forming a part of said gearing arrangement, a stationary gear wheel on one of said lateral walls, said counter gear wheel meshing with said stationary gear wheel.

5. An apparatus according to claim 3, wherein said sealing fin has concave peripheral edges defining said opening, said vane having a thickness less than the width of said narrow spot, said end edges of said vane engaging said concave peripheral edges of said sealing fin when said vane passes through said narrow spot.

6. An apparatus according to claim 5, wherein said annular cylinder space is sealed off by a peripheral annular wall, said gearing arrangement moving said annular

wall to coincide with the circling movement of the rotating vane, said annular wall having a sealed off bearing for the axle of the rotating piston.

7. A fluid working device comprising a main shaft, cylinder wall means adjacent said main shaft including spaced opposing curved walls extending radially outwardly from said shaft defining an operating space therebetween, said walls converging at at least one narrow constricted area, a first one of said curved walls being of relatively large radius of curvature and relatively flat at said constricted area and a second opposed wall being of relatively small radius of curvature and relatively sharply curved at said constricted area, a piston having a vane rotatable about its own axis and about the axis of said shaft and located between said curved walls, the axis of rotation of said piston bearing closer to said first wall than said second wall at said constricted area, said piston having vanes of a thickness less than the distance between said curved walls at said constricted area and having portions in contact with said opposite curved walls during operation, a sealing fin disposed between said walls on each side of said piston, said curved walls and said piston and said sealing fin being operatively connected to said main shaft for relative rotation between said piston and sealing fin on the one hand and said curved walls on the other hand, and fluid access means located at said constricted area including inlet and outlet connections extending radially inwardly into said operating space at circumferentially spaced locations adjacent said constricted area.

8. A fluid working device according to claim 7, wherein said device is a compressor and said piston and said sealing fin are rotated so that said piston approaches said constricted area first during each cycle of operation.

9. A fluid working device according to claim 7, wherein said device is an engine and said piston and said sealing fin are rotated so that said sealing fin approaches said constricted area first during each cycle of operation.

10. A fluid working device according to claim 7, wherein the axis of said piston is substantially perpendicular to said main shaft.

11. A fluid working device according to claim 7, wherein said piston axis is substantially parallel to said main shaft.

References Cited in the file of this patent

UNITED STATES PATENTS

1,101,329	Reaugh	June 23, 1914
1,136,976	Reaugh	Apr. 27, 1915
1,467,944	Mason	Sept. 11, 1923
1,580,808	Borden	Apr. 13, 1926
1,831,263	Ross	Nov. 10, 1931

FOREIGN PATENTS

596,888	France	Aug. 17, 1925
1,149,144	France	July 8, 1957
269,617	Great Britain	Apr. 25, 1927