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Mederer

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[54] **ROTARY PISTON ENGINE**

[76] Inventor: **Gerhard Mederer**, Am Wehr 14, 8501 Allersberg, Germany

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[51] **Int. Cl.**...**F02b 53/00**

[58] **Field of Search** 123/8.47; 418/33, 36, 37

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Primary Examiner—Allan D. Herrmann
Attorney—Kenwood Ross

[57] **ABSTRACT**

A rotary piston engine comprises an annular circular-sectioned cylinder, a working piston and a contra-piston both part annular and circular-sectioned and both mounted for rotation in said cylinder, a chamber defined in said cylinder, between said pistons constituting a working chamber of the engine and undergoing cycle changes in volume during rotation of said pistons.

3 Claims, 5 Drawing Figures

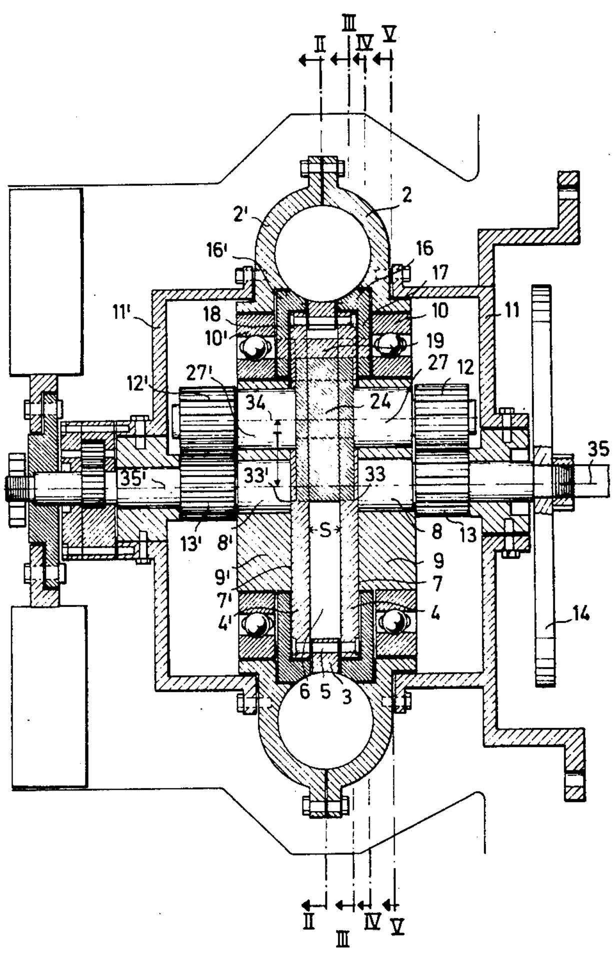
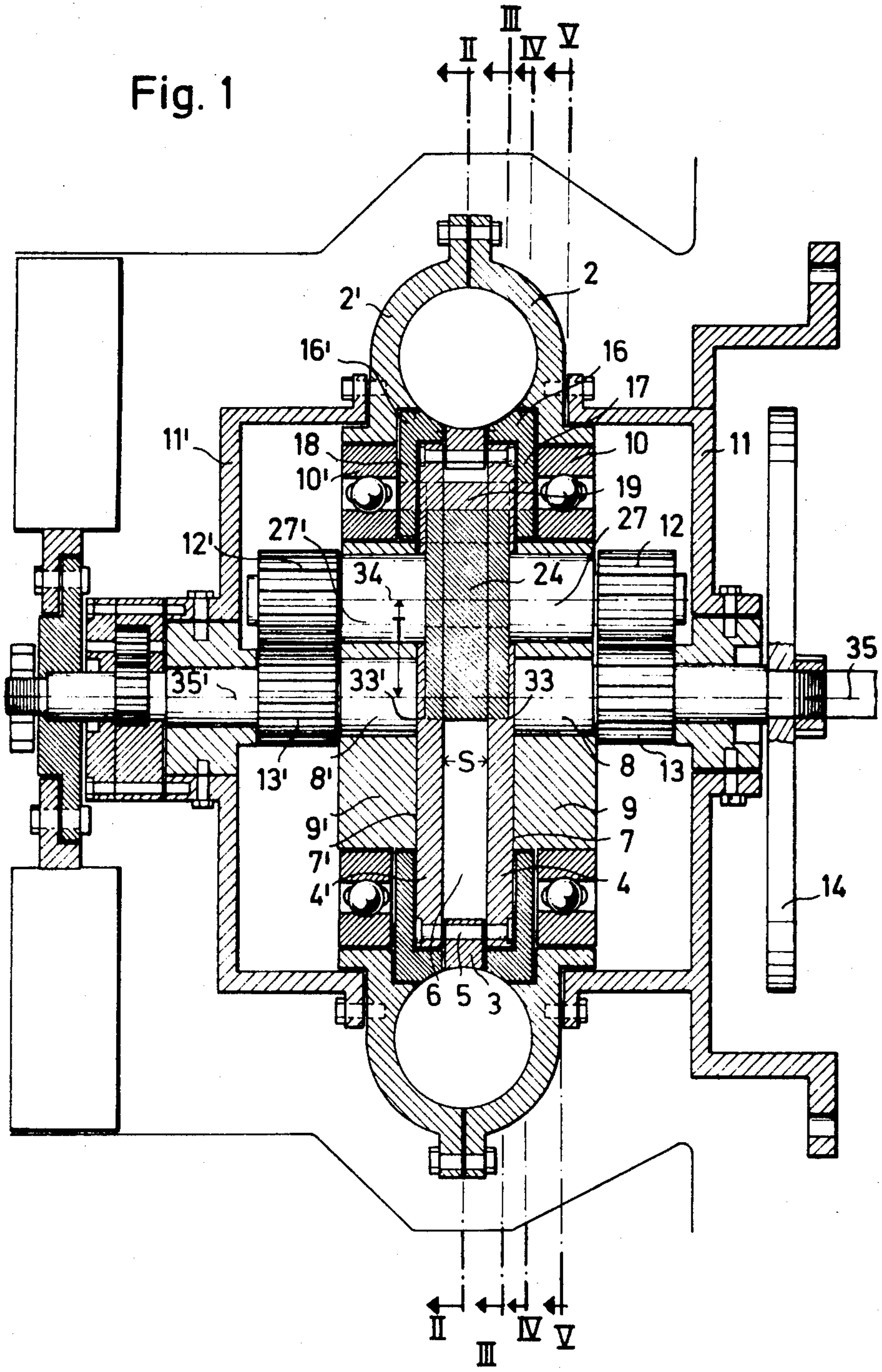


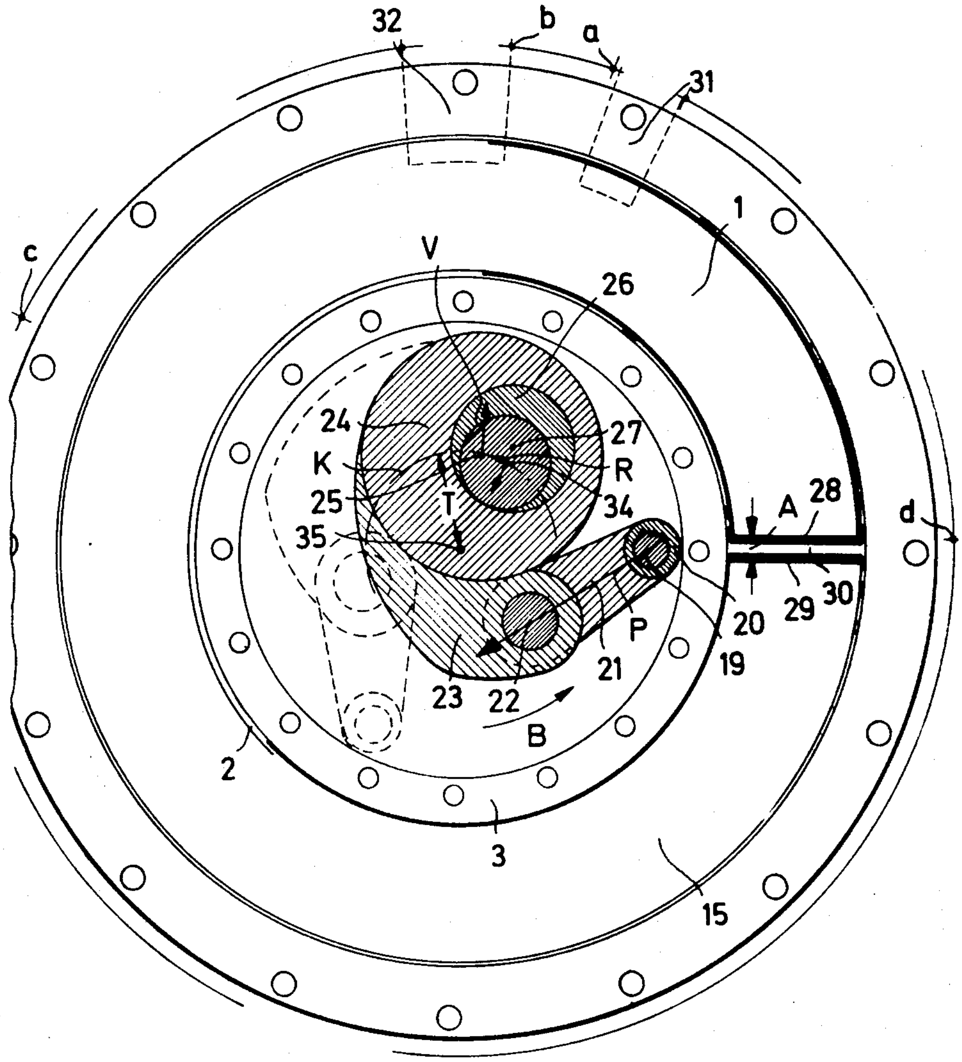
Fig. 1



INVENTOR.
GERHARD MEDERER

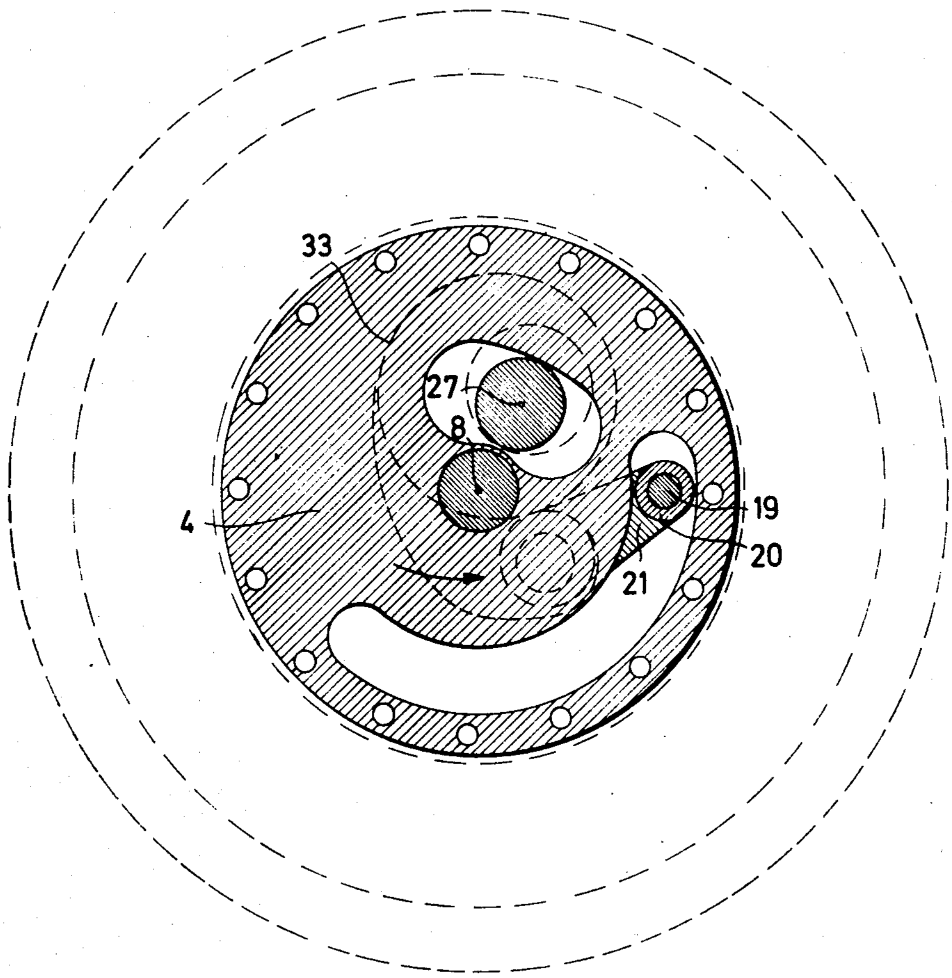
BY Kenwood Ross & Chester E. Flavin
ATTORNEYS.

Fig. 2



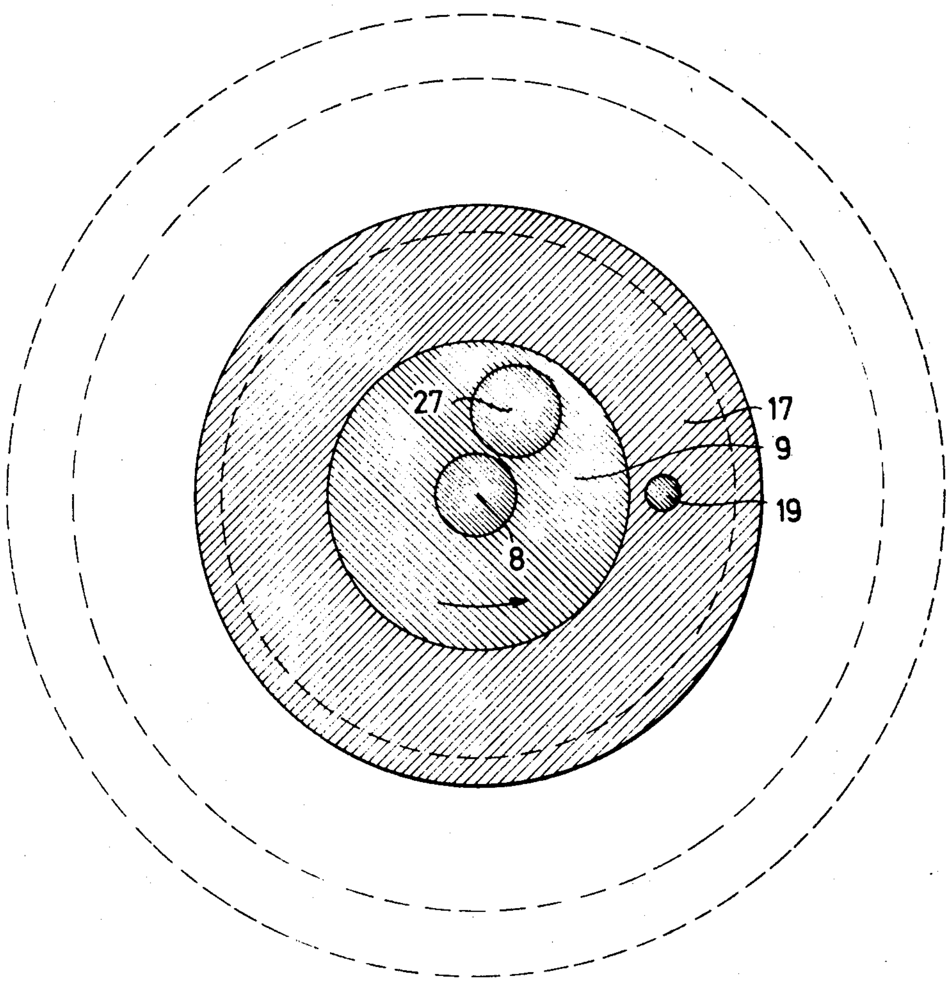
INVENTOR.
GERHARD MEDERER
BY Kenwood Ross & Chester E. Flavin
ATTORNEYS.

Fig. 3



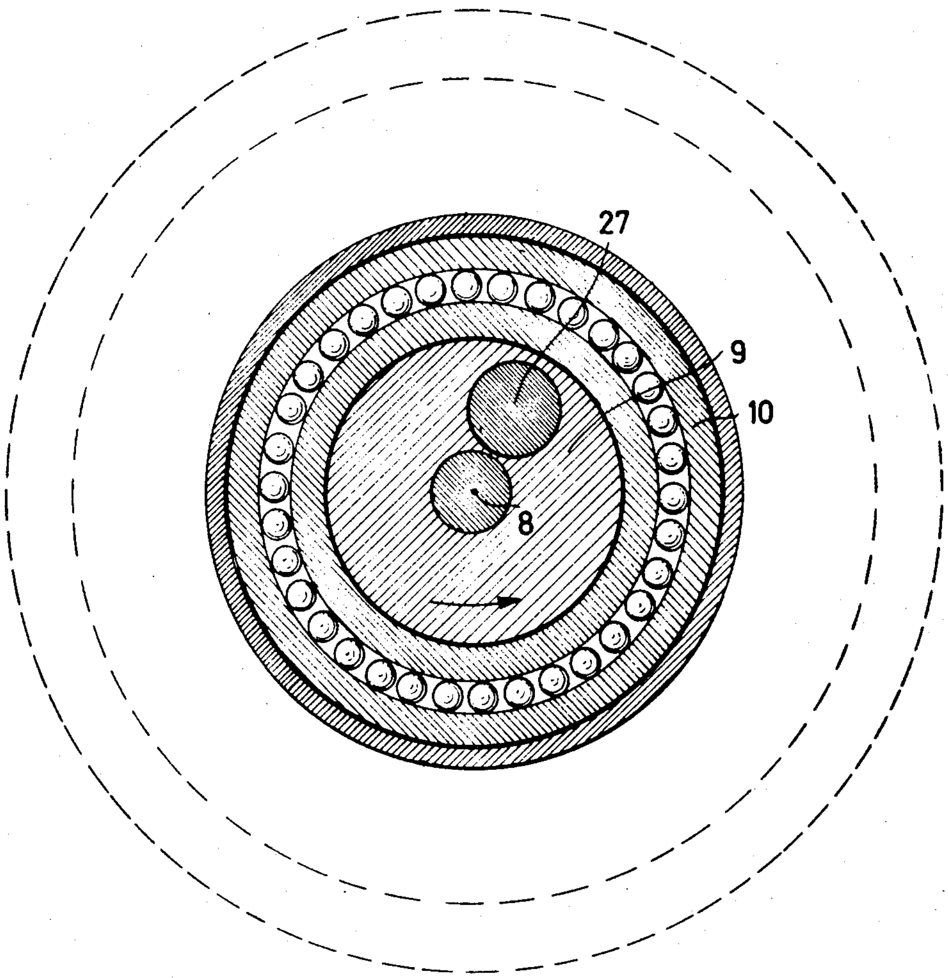
INVENTOR.
GERHARD MEDERER
BY Kenwood Ross & Chester E. Flavin
ATTORNEYS.

Fig. 4



INVENTOR.
GERHARD MEDERER
BY Kenwood Ross & Chester E. Flavin
ATTORNEYS.

Fig. 5



INVENTOR.
GERHARD MEDERER
BY Kenwood Ross &
Chester E. Flavin
ATTORNEYS.

ROTARY PISTON ENGINE

This invention relates to a rotary piston engine. An object of the present invention is to provide a rotary piston internal-combustion engine which is compact and can give high performance and have a high compression ratio.

Accordingly the invention provides a rotary piston engine comprising an annular circular-sectioned cylinder, a part-annular working piston disposed in the cylinder and drivingly connected to an output shaft, a contra-piston also disposed in the cylinder for following the working piston at a distance which varies during working of the engine and automatic device for adjusting the distance between the working piston and the contra-piston being provided, and the chamber defined between the pistons varying during working of the engine so as to constitute a working chamber of the engine which undergoes cycle changes in size during working of the engine.

The annular cylinder and the part-annular working piston and contra-piston, revolving therein, enabling the engine to be of simple construction and simple in operation. Such operation is easy to control and observe or monitor.

During revolving of the working piston and the contra-piston the chambers occassioned by the spacing of the two pistons are constantly shifted circumferentially of the annular cylinder, the device for adjusting the spacing between the pistons effecting a change in the size of the chamber during rotation. The control device is effective to ensure that the chamber is greatest in size for intake of fuel or air and becomes smaller during subsequent compression and has its smallest value at the ignition point. Here at the point of greatest compression is present, the ignition then ensues. Ignition can be effected by a spark plug in the case of a fuel/air mixture or can be be injection of diesel fuel in the case of an engine working on the diesel cycle. The expanding combustion gases bring about an increase in the spacing between the pistons, by the working piston moving in a forward direction away from the contra-piston, the development of a useful torque at an output shaft of the engine. After a short angular movement of the working piston, expulsion of spent combustion gases occurs and, on further movement of the pistons enlargement of the chamber and intake of further fuel/air mixture or air into the chamber for the next working cycle. When the pistons have passed the intake region on their path of movement, the mutual spacing of the pistons is reduced, so that the air or fuel/air mixture is compressed. The mutual piston spacing is at its smallest in the ignition region and so here maximum compression occurs. The working cycle is then repeated.

For transfer of the rotary force from the working piston to the output shaft and for the mounting thereof as well as for incorporation of the piston-spacing control device it is advisable to provide in the space enclosed by the ring cylinder a hollow circular disc, the sides of which are attached, at their centers to the output shaft, the working piston being connected securely to the hollow circular disc and there being provided, outside the hollow space in the circular disc and concentric therewith, bearing discs which are supported for output shaft, the component parts of the control device for adjusting the spacing between the pistons being accommodated in the hollow space of the circular disc. Preferably the hollow circular circular disc is composed of two discs spaced apart by a distance piece connected securely to the working piston and securely to the discs.

In order to mount the contra-piston for movement in the cylinder and for varying of the spacing between the pistons, in a preferred embodiment of the invention, the contra-piston is fastened to a U-section sliding rail, which is pivotally linked to a first lever, which is pivotally connected to a circular disc, which is mounted for rotation on an eccentric of a shaft, which is itself mounted for rotation in the bearing discs and is connected securely to a pinion which meshes with a stationary counter-pinion fixed to the output shaft, the circular disc being guided frontally in circular recesses in the side wall of the hollow circular disc.

If the pinion and counter-pinion have the same number of teeth one ignition ensues for each complete rotation of the working piston and contra-piston. The number of ignitions during one revolution can easily be altered by varying the transmission ratio between the pinion and the counter-pinion.

A high compression ratio, which can be between 1:10 and 1:40, becomes possible because the working piston and the contra-piston have their opposed faces lying in respective radially extending planes.

The invention will be described further, by way of example, with reference to the accompanying drawings wherein:

FIG. 1 is a longitudinal section through a preferred embodiment of rotary piston engine conforming to the invention;

FIG. 2 is a section along the line II—II of FIG. 1;

FIG. 3 is a section along the line III—III of FIG. 1;

FIG. 4 is a section along the line IV—IV of FIG. 1;

FIG. 5 is a section along the line V—V of FIG. 1.

A preferred embodiment of rotary piston engine conforming to the invention comprises a working piston **1** (FIG. **2**) which is part-annular and mounted for rotation in an annular cylinder **2**. The working piston **1** is connected securely to an annular distance piece **3**, which is accommodated in a slot disposed inwardly of the cylinder **2**. Circular discs **4, 4'** are arranged on both sides of the distance piece **3**. These discs **4, 4'** are connected, for example by pins or bolts **5**, to the distance piece **3**. The discs **4, 4'** and the annular distance piece **3** form a circular disc having a hollow interior space **6**.

The discs **4, 4'** are connected, by their outer sides **7, 7'** to two shaft parts **8, 8'** which together form an output shaft of the engine. These shaft parts **8, 8'** are mounted for rotation in bearing discs **9, 9'**, which butt for sliding movement against the outer sides **7, 7'** and are supported by ball bearings **10, 10'** on the cylinder **2**.

The shaft parts **8, 8'** penetrate counter-pinions **13, 13'** which are fastened stationarily to the engine housing and which mesh with pinions **12, 12'**. The counter pinions **13, 13'** are mounted in the housing, and a flywheel **14** is fastened on the shaft part **8** via which the power delivery is effected.

The contra-piston **15** is mounted for rotational movement behind the working piston **1** with a variable spacing A between them in the cylinder **2**. The contra-piston 15 is fastened to a U-section sliding rail 16, whose limbs 17, 18 embrace the hollow disc 3, 4, 4' for sliding movement. The sliding rail 16 is linked via a pivot consisting of a pin 19 and a bush 20 to a lever 21, which is mounted for swinging movement at 22 in a nose 23 fixed to an eccentric 24. The central point of the eccentric 24, which is circular, lies at 25. The eccentric 24 is mounted for rotary movement on a circular shaped eccentric 26, which is mounted fixedly on both sides, to the shaft 27, the shaft 27 being mounted in the bearing discs 9, 9' and securely carrying the pinions 12, 12'.

The opposed surfaces 28, 29, of the pistons 1 and 15 are flat, i.e., they extend as radial planes. The spacing A is at its minimum in the position, shown in FIG. 2, and at this position the volume of the chamber 30 bounded by the pistons 1 and 15 has been brought to its minimum value, fuel/air mixture or air present in this chamber is at its highest degree of compression. The fuel/air mixture can now be ignited by a spark or diesel fuel injected to cause ignition. Upon ignition, the contra-piston 15 remains initially at rest, held by the control device. On the other hand, the working piston 1 is move by the expanding combustion gases in the direction of the arrow B. As soon as the working piston 1 has arrived at *a*, the combustion gases can flow out via outlet orifice 31; they are then completely expelled by the lagging contra-piston 15. As soon as the working piston 1 has arrived at *b*, the suction port 32 is freed, so that a fuel/air mixture, or air is sucked into the now comparatively large chamber. When the working piston 1 has arrived, at *c*, then the contra-piston 15 is moved faster than the working piston, so that the fuel/air mixture or the air is compressed on the path from *c* to *d*. As soon as the pistons are at the level *d*, ignition is effected once again and the working cycle repeated.

The eccentric disc 24 is mounted with a close fit in circular recesses 33, 33' formed in the discs 4, 4' and can move slidingly in these recesses. The nose 23 is kept narrower than the mutual spacing S of the discs 4, 4' and extends into the hollow space 6.

When ignition is effected at the position shown in FIG. 2, a large force is exerted on the opposed piston 15 in a direction opposite to that of the arrow B. Consequently there arises at the pin 19 a force P which leads through the pivot point 22 and which endeavors to rotate the nose 23 and eccentric 24 about the central point 35 of the output shaft 8 which is impossible because the eccentric 26 finds itself off-center in the eccentric 24. There thus arises at the point 34 a force R, effective in the counter direction of rotation to the force P, about the central point 35. From the torsional moments of the forces P and R about the central point 35 there results a residual torque in the direction of the force R about the central point 35. The result of this is that the force, acting in the opposite direction to the arrow B on the contra-piston face 29 upon ignition, does not bring about any effective force reduction. Moreover, a force V arises, which is directed upwardly off-center from the central point 35. This force V endeavors to turn the system anticlockwise. In other words a force V effective in the useful-force direction of rotation also acts when ignition takes place and is obtained from application of force on the contra-piston face 29. Upon ignition the contra-piston 15 initially remains almost at rest, so that the working piston 1 is shifted in the direction of the arrow B and so enlargement of the chamber 30 occurs. On its path of revolution in the direction of the arrow B, the working piston 1 entrains the discs 4, 4' and therewith the eccentric 24 guided in the recesses 33, 33' thereof. Consequently the axis 34 of the shaft 27 is moved on a circular arc K at a spacing T in relation to the axis 35 of the output shaft 8. As this occurs, the pinions 12, 12' rolls on the counter pinions 13, 13', so that the eccentric 26 is rotated and therewith the lever 24 is swung with its nose 23 and the pivot point 22. This effects a change in the spacing A of the pistons 1 and 15, in such a way that the contra-piston runs from the ignition point *d* as far as the point *c*, where the compression begins, slightly more slowly than the working piston, but from *c* as far as *d* it runs more rapidly than the working piston, so that the spacing A of the pistons increases between the ignition point at *d* and the point *c*, but becomes smaller from *c* to *d*.

The number of ignitions upon one rotation of the pistons depends on the transmission ratio of the toothing of pinions 12, 12' and counter pinions 13, 13'. The design can readily be selected in such a way that two or more ignitions are effected on one revolution. A prerequisite for this is that an integral or whole-numbered transmission ratio is selected.

The ejection and intake of air or fuel/air mixture can, if need be, be controlled via valves or slides. In the case of a fuel/air mixture, i.e., a petrol engine or gas engine an ignition plug can be situated in the working piston 1 or adjacent the point *d*. If air is compressed an injection nozzle can be provided in the piston 1 or adjacent point *d* to inject diesel fuel to cause ignition by compression.

In the rotary piston engine of the invention, as in the case of the conventional reciprocating piston engine circular-sectioned pistons are used. The individual strokes of a working cycle are however not effected, as in the case of the reciprocating piston engine, in the same chamber, a chamber instead, in effect, is assigned to each stroke which chamber is formed, on the path of revolution at different points by means of the space in between the working piston and the contra-piston in the cylinder.

With the engine of the invention a high compression ratio can be achieved, which is in addition variable, in that the spacing A can be adjusted. Despite the use of similar pistons as in the case of the reciprocating piston engine, a jamming of working and contra-piston cannot occur in the engine of the invention. The number of revolutions can be selected comparatively high. With small dimensions, a comparatively high performance is achieved. The efficiency of the engine is comparatively high.

The engine can compress a mixture of petrol or gas with air and ignite this mixture, after compression, with a spark, or can compress air and inject diesel fuel to cause ignition by compression. The engine can thus be a petrol or gas engine or a diesel engine. The engine can, of course, also work on the two-stroke principle. If inlet valves and operating mechanisms are provided the engine can be a steam engine or a hot gas engine. Many other variations are, of course, possible.

I claim:

1. A rotary piston engine, comprising an annular circular-sectioned cylinder, a part-annular working piston disposed in the cylinder and drivingly connected to an output shaft, a contra-piston disposed in the cylinder for following the working piston at a variable distance during working of the engine, the chamber defined between the pistons constituting a working chamber which undergoes cyclic changes in size, a hollow circular disc provided centrally of the cylinder with its sides being centrally connected to parts of an output shaft, the working piston being connected securely to the disc, bearing discs supported for rotary movement and supporting the parts of the output shaft, means for controlling the spacing between the pistons, said controlling means comprising the contra-piston being fastened to a slide rail pivotally linked to a lever pivotally connected to an eccentric disc mounted for rotary movement on an eccentric of a shaft mounted for rotary movement in the bearing discs and connected to a pinion meshing with a stationary counter pinion penetrated by the output shaft, the eccentric disc being guided in circular recesses in the side walls of the hollow circular disc.

2. The engine as set forth in claim 1, characterized in that the pinion and counter-pinion have equal numbers of teeth.

3. The engine as set forth in claim 2, characterized in that the number of teeth on the pinion is an integral multiple of the number of teeth on the counter-pinion.

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