May 28, 1968 Z. WINOGRODZKI ET AL 3,385,272

ENGINE OR POWER DRIVEN MACHINE WITH PISTONS ORBITING IN A TOROIDAL CYLINDER

Filed March 6, 1967 4 Sheets-Sheet 1

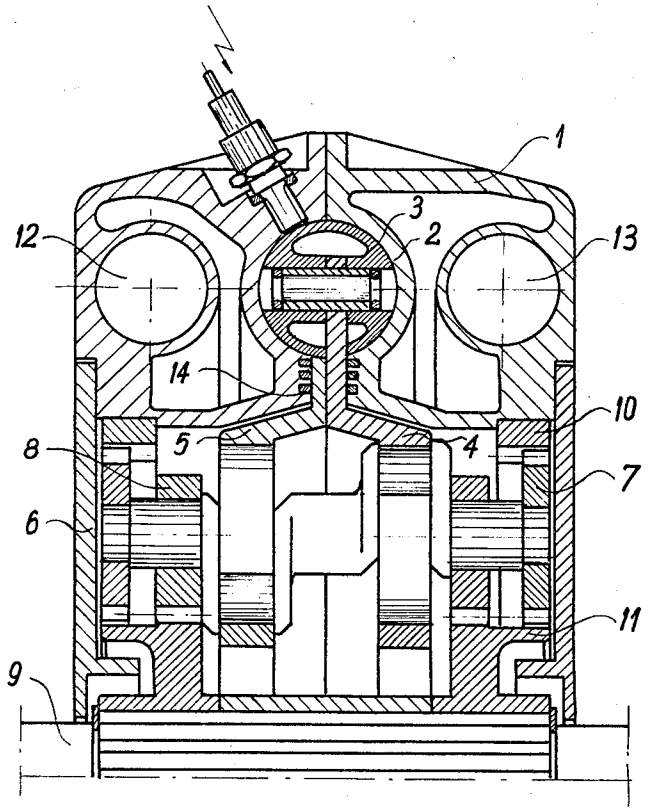


Fig. 1

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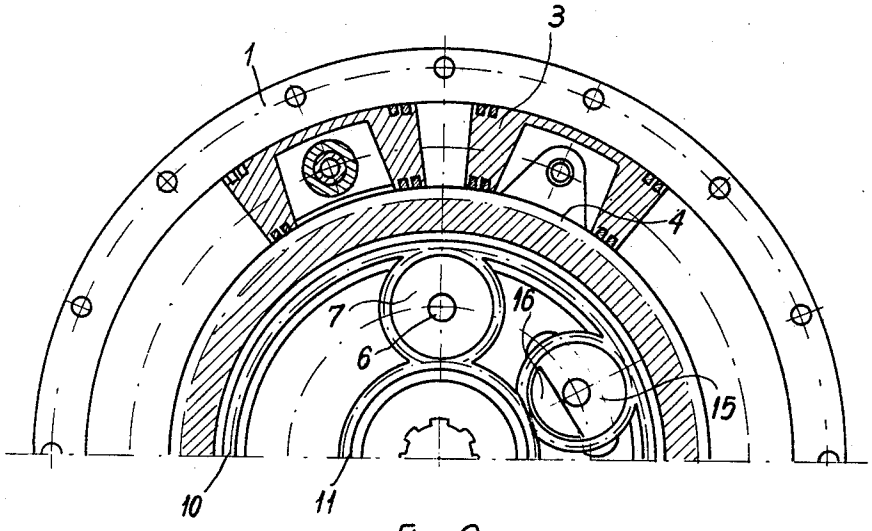


Fig. 2

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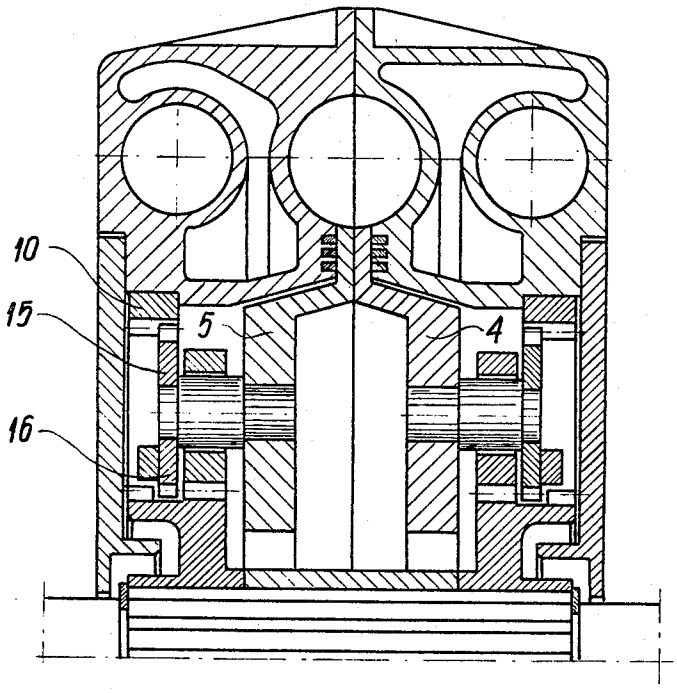


Fig. 3

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ENGINE OR POWER DRIVEN MACHINE WITH PISTONS ORBITING IN A TOROIDAL CYLINDER
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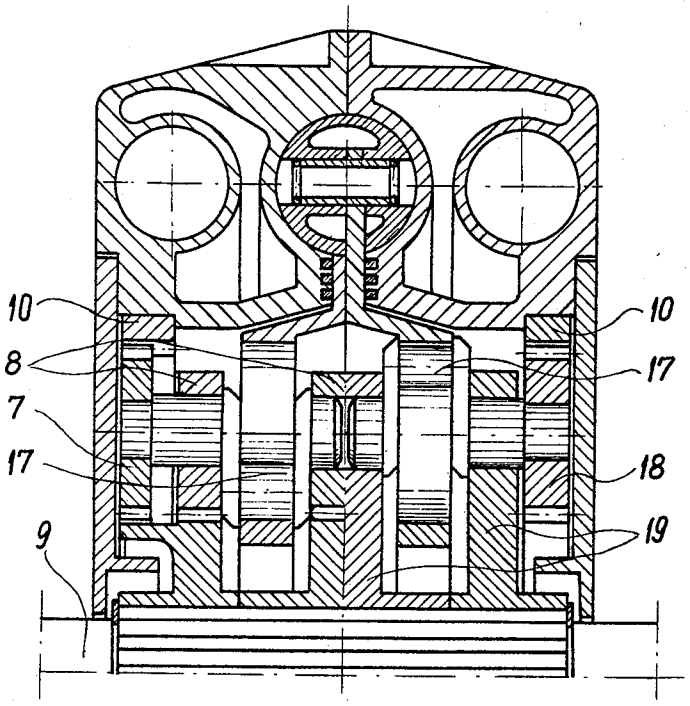


Fig. 4

United States Patent Office 3,385,272 Patented May 28, 1968

3,385,272

ENGINE OR POWER DRIVEN MACHINE WITH PISTONS ORBITING IN A TOROIDAL CYLINDER

Zbigniew Winogrodzki and Jerzy Wardynszkiewicz, Wroclaw, Poland, assignors to Wroclawski Zaklad Przemyslu Maszynowego Lesnictwa, Wroclaw, Poland

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Claims priority, application Poland, Mar. 11, 1966, P 113,435
5 Claims. (Cl. 123—18)

ABSTRACT OF THE DISCLOSURE

An engine or a power driven machine, according to the invention described below, consisting of four pairs of pistons orbiting in a toroidal cylinder. The orbiting of the piston occurs by an angular uniform motion with a simultaneously superimposed oscillating motion, resulting in the formation of working chambers of variable volumes. The admission of the engine is performed by means of suction ducts through intake openings made in the generating surface of the cylinder, and the exhaust is performed through similar exhaust ducts. The ignition is effected by spark elements.

The pistons are fastened alternately to two moving disks by radial incisions provided in the piston to drive the crankshafts through toothed gears mounted thereon. These gears are externally and internally meshed with other gears thus forming a planet gear, which actuates the output shaft. In order to balance the inertial masses of oscillating parts of the engine, there is provided a separate balancing arrangement.

The described engine may, of course, be used as a pump, a compressor etc.

The present patent application is based upon the Polish patent application No. P. 113,435 filed on Mar. 13, 1966, at the Patent Office of the People's Republic of Poland.

This invention relates to an engine or power driven machine with pistons orbiting in a toroidal cylinder.

There are known engines with pistons orbiting in a toroidal cylinder, in which the forces affected by combustion gases are transmitted onto the output shaft by means of complicated beam mechanisms. This causes important vibrations of the engine, an irregular rotation and quick wear and tear of cooperating parts. In order to preserve a suitable durability and rigidity of elements transmitting the power, the driving mechanisms should be extended by enlarging the dimensions and weight of the engine and limiting its application range.

The primary object of the present invention is to remove the above mentioned disadvantages and inconveniences of known designs and provide a structure of an engine which secures high horsepower by simultaneous operation of pairs of pistons and which is substantially without vibration.

This has been achieved through application of four pairs of double-acting pistons, which orbit by uniform motion with simultaneous mutual oscillating motion in a toroidal cylinder. Thus the number of strokes for a single rotation of the output shaft of the engine is diminished to a minimum. A special balance mechanism eliminates the action of the inertial forces of the oscillating parts.

The object of the invention is shown by an exemplary embodiment in the accompanying drawings, where

FIG. 1 shows the cross-section of the engine through

one of the pistons and through the planet gear transmitting the torque onto the output shaft,

FIG. 2 shows the longitudinal section through the dividing line of the body with a view onto the planet gears,

FIG. 3 shows the cross section of the engine through the planet gears with counterweights balancing the rotations of the gears,

FIG. 4 shows the cross section of two alternatives of the embodiment of a power driven machine, through one of the pistons and through the planet gear and the driving mechanism.

In the non-movable case **1** of the engine or of the power driven machine there is situated a toroidal cylinder **2**, in which assemblies of pistons **3** orbit by oscillating motion. These pistons are alternately attached to moving disks **4** and **5** by means of double crankshaft **6** and drive the satellite gears **7** of the planet gear. The crankshaft **6** is fitted in two guiding disks **8** rotatably borne in relation to the output shaft **9**. The torque from the satellite gears **7** is transmitted to the output shaft **9** of the engine through the planet gear, where the internal toothed gear **10** is non-movably mounted in the case of the engine, and the external toothed gear **11** is fixed to the output shaft **9**. The admission of the engine is performed through the suction duct **12**, the exhaust through the exhaust duct **13**, through intake and exhaust openings placed on the generating surface of the toroidal cylinder **2**.

The sealing of the working chambers is provided with known piston rings placed in each piston on both its ends, and by application of peripheral sealings of the moving disks **4** and **5**, schematically shown as **14**.

In order to balance the reciprocating motions of the pistons and of the moving disks a balancing system is applied, shown in FIG. 3. Toothed gears **15**, fitted on the moving disks **4** and **5**, are provided with counterbalancing masses **16** of such dislocation and weight that they completely balance all the inertial forces affected by the oscillating motions of the pistons and of the moving disks.

The mode of operation of the engine, which is the object of the invention, is as follows:

Combutsion of the gaseous mixture in the working chamber closed by the cylinder and heads of two adjacent pistons causes forces pushing the pistons mutually. The pistons, through radial projections on the moving disks **4** and **5** to cause the rotation of the crankshaft **6**, which being rotated together with the satellite gear **7**, actuates the output shaft **9**. Owing to the transmission ratio of the planet gear, the rotational speed of the output shaft is higher than that of the orbiting pistons in the cylinder, whereby this transmission ratio may be defined according to the needs, and in dependence on the principle of operation of the engine (two or four-stroke cycle). The cooling of the engine may be accomplished by one of commonly known means, by using water or air as the cooling medium. By actuating the output shaft **9**, the machine according to the invention may be used as a pump, a compressor or a fan, of constant or variable delivery, whereby two versions of its drive are provided. The left side of FIG. 4 shows the machine with a planet gear as applied in the above-described engine (the satellite gear **7** meshes with the internal toothed gear **10** and with the toothed gear on the output shaft); the right side however, shows a modification of the drive, in which the satellite gear **18** meshes only with the gear **10**. In the first version, the revolutions of the pistons are lower than the rotational speed of the shaft **9** and, in the second case, the rotational speeds of the pistons and of the shaft are equal. In both cases the cranks **17** of the crankshaft **17** are mutually separated, which enables them to shift relatively from 0° up to 180°. This can be performed by means of one of the toothed gears **10**. Such a shifting

causes a continuous variation of the delivery of the machine, which importantly extends the application range of the machine.

What we claim is:

1. An internal combustion engine comprising a casing having a toroidal cylinder therein, a plurality of pairs of pistons mounted in said cylinder, crankshaft means, two disk means, one of each said pair of pistons being attached to each said disk means, both said disk means being mounted on said crankshaft means, planet gear means mounted on said crankshaft means, an internal tooth gearing fixedly mounted on said casing and meshing with said planet gears, a drive shaft having an externally directed gearing meshing with said planetary gears, combustion gas input and exhaust means, and combustion ignition means whereby relative movement of said pairs of pistons is imparted to said drive shaft.

2. An engine according to claim 1 in which guiding disks are fixed to said output shaft, said crankshaft means being mounted on said guiding disks.

3. An engine according to claim 1 in which said planet gears are mounted on individual shafts mutually shiftable in the range of 0° to 180°.

4. An engine according to claim 1 in which said planet gear means includes eccentrically fitted balancing counter-

mass means whereby the reciprocating motions of said pistons can be balanced.

5. An internal combustion engine comprising a casing having a toroidal cylinder therein, a plurality of pairs of pistons mounted for orbital oscillating motion within said cylinder, a pair of disk means, one of each pair of said pistons being attached to each of said pair of disk means, crankshaft means having said disk means mounted thereon, planetary gear means mounted on said crankshaft, inwardly directed gear means fixedly mounted on said casing meshing with said planetary gears, a centrally located output shaft mounted in said casing and having outwardly directing gear teeth meshing with said planetary gears, intake ports and exhaust ports leading to said toroidal cylinder, and ignition means.

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WENDELL E. BURNS, *Primary Examiner.*