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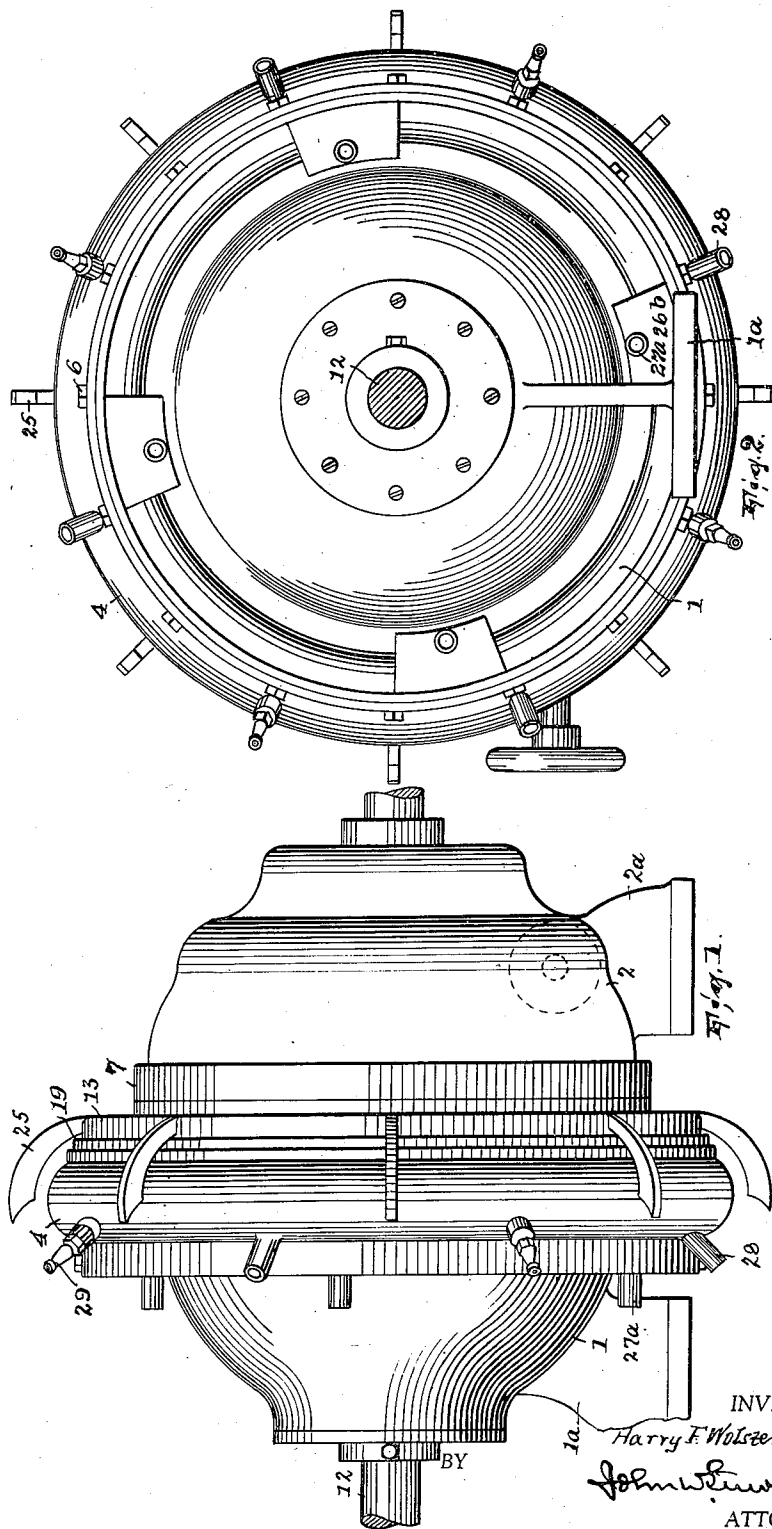
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2,284,186

ROTARY INTERNAL COMBUSTION ENGINE

Filed March 25, 1940

4 Sheets-Sheet 1



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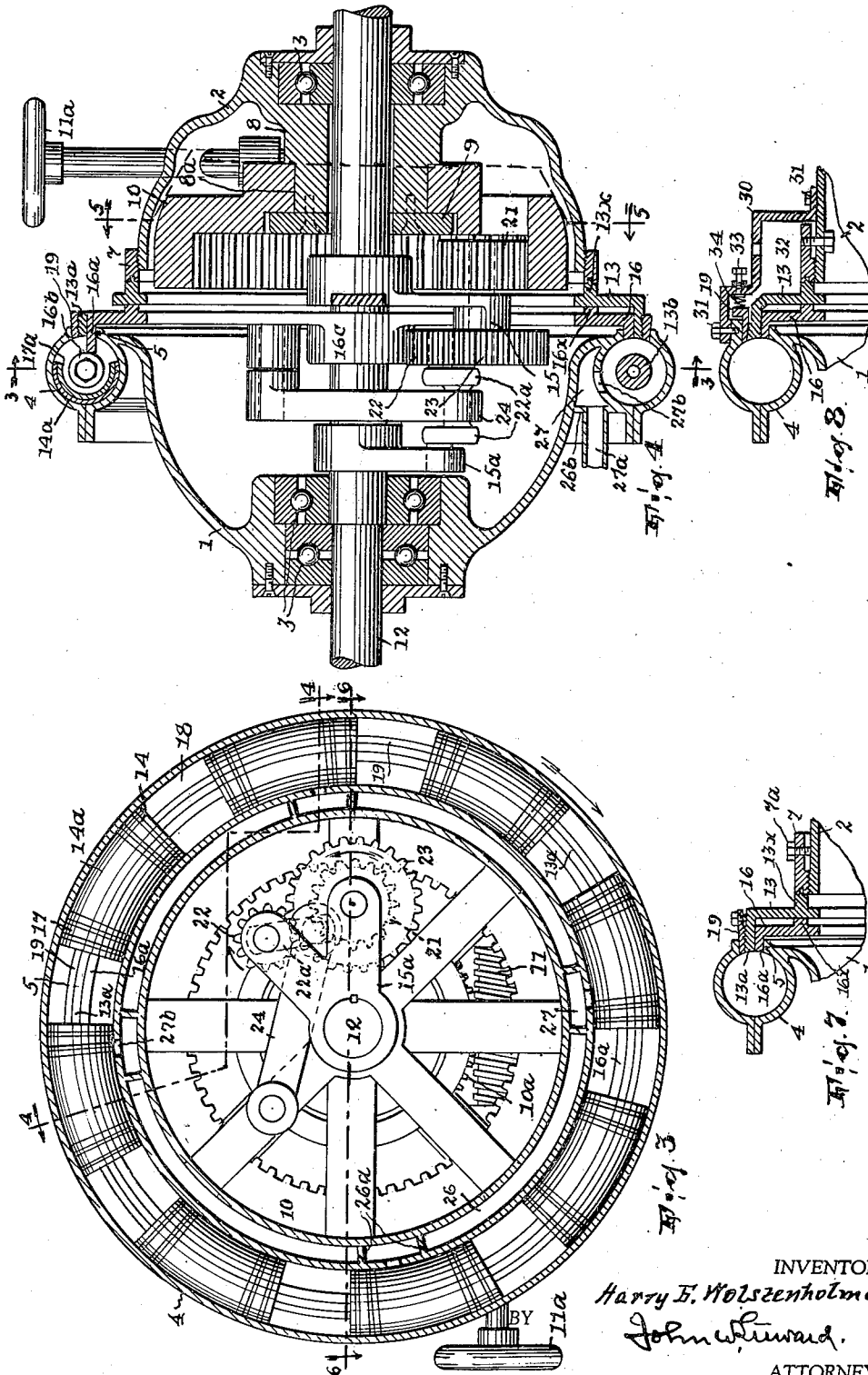
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ROTARY INTERNAL COMBUSTION ENGINE

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4 Sheets-Sheet 2



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ROTARY INTERNAL COMBUSTION ENGINE

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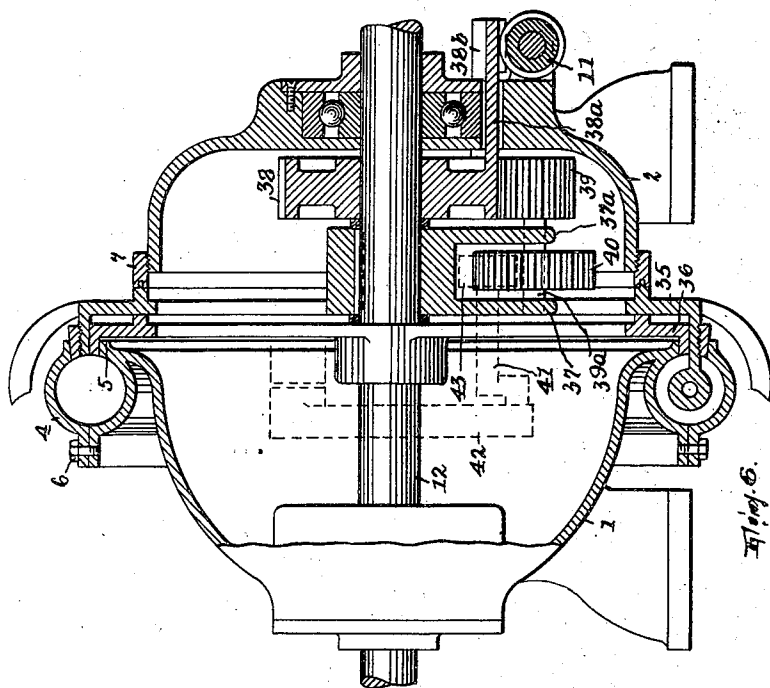


Fig. 6.

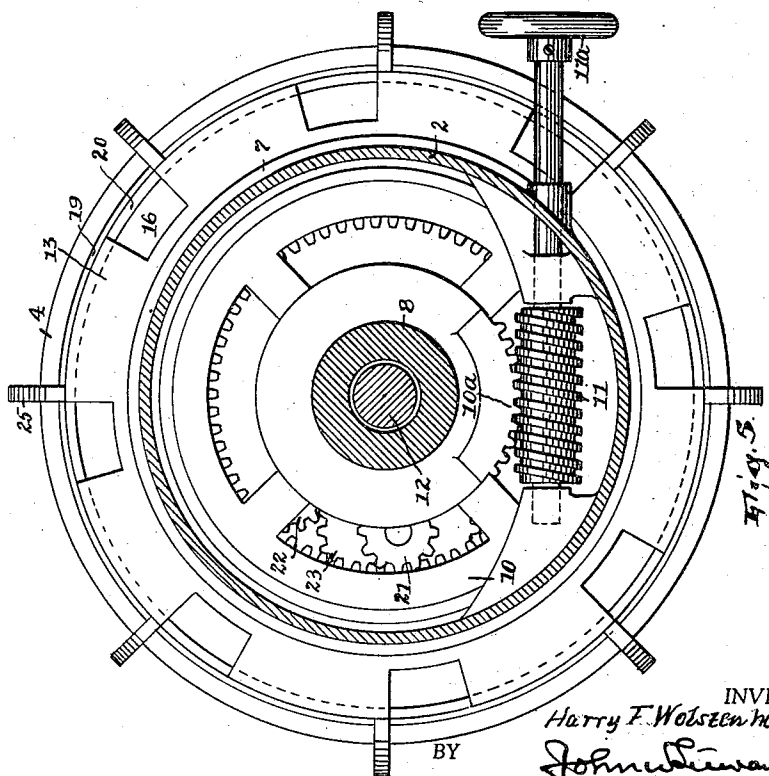


Fig. 5.

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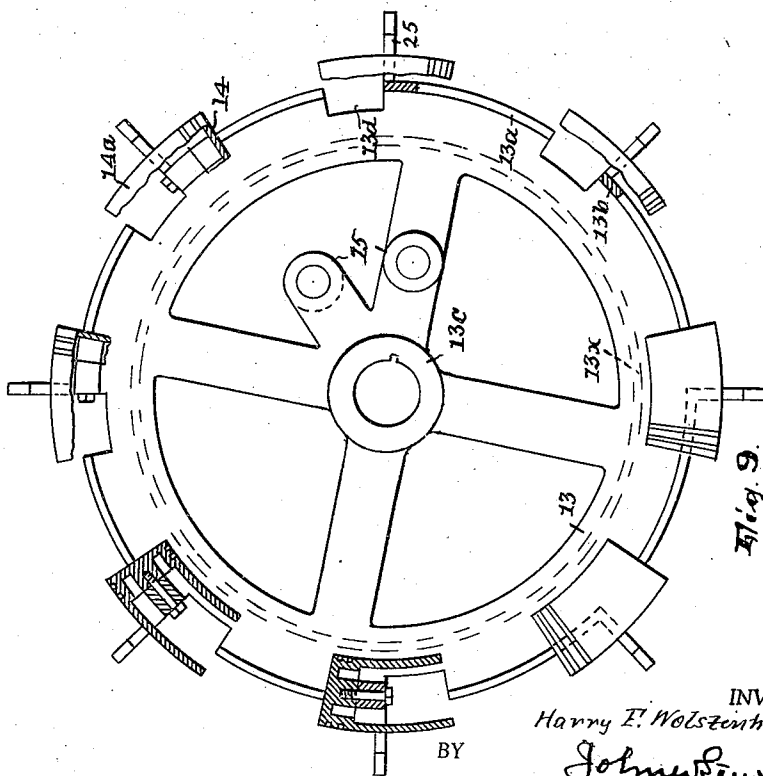
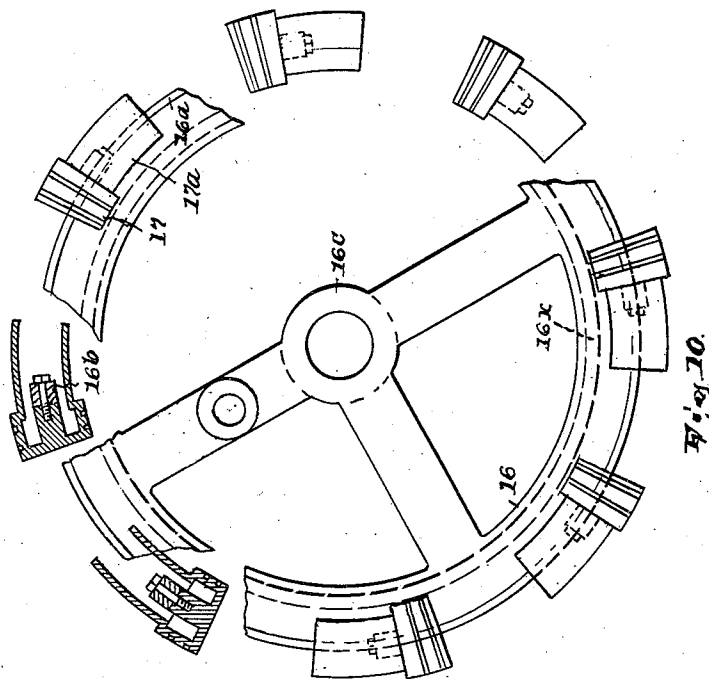
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ROTARY INTERNAL COMBUSTION ENGINE

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4 Sheets-Sheet 4



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## UNITED STATES PATENT OFFICE

2,284,186

## ROTARY INTERNAL COMBUSTION ENGINE

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Application March 25, 1940, Serial No. 325,834

4 Claims. (Cl. 123—11)

In my Patents Nos. 1,796,750; 2,124,327 and 2,142,706, and my pending application Serial No. 265,643, now Patent No. 2,222,133, I have set forth certain improvements in rotary internal-combustion engines of the type characterized by the inclusion of two elements one of which is constantly rotated in one direction and one of which has a cylinder formed annular and with an opening or slot extending continuously thereof around the main axis of the engine and the other of which is coaxial with and has an abutment or abutments in the cylinder; oscillatory means having a piston or pistons in the cylinder; and means, operatively connecting said elements and connected to said oscillatory means, for oscillating the latter.

The present invention contemplates certain improvements in engines of this type among which may be briefly indicated the following:

In these engines the means last referred to above has included a rotary member, as a gear, journaled in the abutment-including element and operatively connected with the oscillatory means to oscillate the same and obtaining its purchase on the other or cylinder-including element, as by being in toothed engagement with the latter. According to this invention the purchase-affording portion of the latter element is rotatively adjustable around the axis of the engine, thus to adjust the timing thereof.

The cylinder-including element has heretofore had the mentioned continuous opening or slot in the cylinder so disposed as to be divided by a plane perpendicular to the axis around which the cylinder is developed to annular form, or to be open radially inwardly of the cylinder. According to the present invention this opening is arranged so as to face laterally or lengthwise of the engine axis. If certain "breathing" of the engine is to be permitted such may be provided for, according to this latter construction, without complication or expensive fashioning of the working parts of the engine such as characterizes the construction when the slot is open radially inwardly of the cylinder.

The invention also contemplates that the engine shall include a novel gearing system by which while the oscillator undergoes a certain over-all progress rotatively it is twice made to undergo a full back-and-forth movement, for affecting intake, compression, explosion and exhaust.

The cylinder-including element (which will usually be the stator) is preferably formed in two hollow sections facing each other and thereby

providing a lubricant-containing housing, and the cylinder is a part of one of these sections. The space of this housing is sealed between the sections by the other of said elements and the oscillatory means or oscillator, which latter also seal off the explosion spaces of the cylinder, preferably with the coaction of a tapered ring adapted to be adjusted into the slot of the cylinder.

The two mentioned sections may be held fast to a suitable base or, as hereinafter shown, rigidly united.

In the drawings,

Fig. 1 is a side elevation of the engine;

Fig. 2 is a left-hand end elevation;

Fig. 3 is a section perpendicular to the main engine axis and on substantially the line 3—3, Fig. 4, parts appearing in elevation;

Fig. 4 is a section on substantially the line 4—4, Fig. 3;

Fig. 5 is a section on line 5—5, Fig. 4;

Fig. 6 is a fragmentary section on line 6—6, Fig. 3, of a modified form and showing certain gearing in elevation;

Fig. 7 is a sectional view of a detail in a plane between pistons of the rotor and oscillator;

Fig. 8 is a similar sectional view of a modified form of such detail; and

Figs. 9 and 10 are left-hand elevations of the rotor and piston structure or oscillator as viewed from the left in Fig. 3, certain parts appearing in section and others broken away.

*The stator.*—1 and 2 designate two semi-bulbous shells to form the mentioned housing and having feet 1a—2a to be fixed to some common base with the open sides of the shells facing each other and the ball-bearings 3 thereof in axial alinement, their axis being the main axis of the engine. These shells form parts of separate sections otherwise formed as follows: The section including shell 1 has an annular cylinder 4 surrounding and arranged adjacent the mouth of the shell and formed with a continuous slot 5 open laterally of the cylinder, i. e., open in one direction in which extends the axis around which the cylinder is formed annular; such cylinder may be formed in two approximate halves, as shown, one of which may be integral with the shell 1 and the other secured thereto by screws 6 (Fig. 2). The section including shell 2 has a ring 7 surrounding and projecting from its mouth portion and screwed thereon so as to be adjustable axially of the engine. (As shown in Fig. 7 this ring may be held to section 2 against turning by screws 7a). This section also has an

axial inwardly projecting hub 8 circumferentially rabbeted at 8a and to the end of which is fast a disk 9 of such diameter that it forms with the rabbet a groove as shown in Fig. 4. Forming a stationary part of this section is an internally toothed sun-gear 10 fitting the groove and having an external toothed segment 10a with which meshes a rotary worm 11 journaled in shell 2 and having an external hand-wheel 11a.

The rotor 12 is the main shaft of the engine journaled in bearings 3 and forming a part of the rotor, the rotor proper of which is thus constructed (Fig. 9): A flat annulus 13 has a lateral peripheral flange 13a from which extend equidistant lugs 13b, the hub 13c for the annulus being keyed to the shaft. Each lug has affixed thereto an abutment or piston 14 which fits cylinder 4 and an anti-clockwise extending half-cylindrical skirt 14a. At the anti-clockwise side of each lug the flanged margin of the annulus is cut away to form an opening 13d. From the hub projects a two-armed crank 15. Keyed to the shaft and spaced from the rotor is another two-armed crank 15a whose arms are in the same radii as those of crank 15.

The oscillator 16 is a flat annulus having a lateral flange 16a (of less extent or depth than flange 13a) from which extend lugs 16b (of the same number as lugs 13b), the hub 16c for the annulus being free to turn on shaft 3. To each lug is affixed an abutment or piston 17 which also fits cylinder 4 and has a half-cylindrical clockwise-extending skirt 17a formed to fit within the skirt 14a of a corresponding abutment 14. (The concave sides of the skirts face as shown in Fig. 4 or toward the slot 5). The diameter of the oscillator thus formed is sufficiently less than that of the rotor so that in the assembled state of the engine flange 13a of the rotor surrounds that of the oscillator, though closely.

As shown by Fig. 4 the rotor and oscillator have their annuli between the sections 1-2 of the stator, they being spaced by a concentric rib 16x of the oscillator, and a similar rib 13x of the rotor providing a tongue-and-groove connection with ring 7. What I term the "explosion spaces" 18, Fig. 3, between the pistons and abutments of the rotor and oscillator are sealed off from the atmosphere by the flanges 13a-16a and a wedgering 19 screwed onto flange 13a. What I term "breathing spaces" are those which alternate with the explosion spaces, or coincide with the telescoped skirts 14a-17a, having access to the atmosphere at the crevices 20 (Fig. 5) which exist between ring 19 and flange 16a of the oscillator in coincidence with the openings 13d of the rotor.

The different parts of the transmission means are as follows: In arms of the cranks 15-15a is journaled a twin intermediate gear whose smaller member 21 is in mesh with the sun-gear. In the other arms of the cranks is journaled a planet-gear 22 which meshes with the larger member 23 of the intermediate gear and which has a crank 22a. This crank is pivotally connected by a link 24 with an eccentric point of the oscillator.

Projecting from the rotor annulus and inverted around the cylinder 4 are radial fan blades 25 for cooling the cylinder.

An endless channel or groove 26 exists between the cylinder 4 and the body part of shell 1 and at each of four equally spaced intervals this is developed, by partitions 26a and an outer wall 26b bridging the partitions, to form a fuel supply space 27 to which the fuel mixture is admitted

from any suitable source via passages 27a and delivered to the cylinder via ports 27b. The rotor rotates as per the arrow in Fig. 3 and suitably aft of each space 27 an exhaust port or exhaust 28 leads from the cylinder. At 29 are the spark-plugs each suitably aft of a space 27 and between it and the corresponding exhaust.

**Operation.**—In the example there is a 1 x 8 ratio between the sun-gear and the planet gear 10, wherefore for each full revolution of the rotor the oscillator completes eight full back-and-forth movements. Of the intakes, spark-plugs and exhausts, there are in this example four each. Therefore as the explosion spaces 18 travel each through 90° of the cylinder they simultaneously undergo two such full back-and-forth movements, first undergoing expansion to draw in fuel from the corresponding fuel-supply space 27, then contraction to compress the fuel, then expansion as an instance of the explosion caused by the corresponding spark-plug and then contraction to discharge the burnt fuel at the corresponding exhaust 28.

As for the breathing spaces between the pistons and coinciding with their skirts, these are always open via the crevices 20 and openings 13d of the rotor, wherefore the suction and pressure otherwise present in said spaces offer no resistance to the oscillations of the oscillator or piston structure.

The necessary accurate timing is attained by rotating the worm 11 and thus the (otherwise fixed) sun gear.

As heretofore described, the two sections 1-2 of the stator are assumed to be held in fixed relation to each other merely by the base or other support to which they are affixed. But as shown in Fig. 8 there may be an annular housing 30, bridging the space between the two sections, to tie them together, such being secured by screws 31 to each of them. Such means will usually be formed annular and concentric with the sections, providing a space 32 with which the breathing spaces communicate via the crevices 20. This view also shows that the ring 19 may be subject to the pressure of a screw 33 screwed into the housing 20 and active on the ring 19 through a spring 34.

In Fig. 6, 35 is the rotor proper and 36 the oscillator both generally the same as before except that their positions are reversed, and the rotor being assumed to have a double crank 37 the same as in Fig. 9. But instead of there being a companion double crank (such as 15a) to the left of crank 37 such companion double crank 37a is at the right of and formed integral with the crank 37. The sun gear 38 is externally toothed and may have a tongue 38a formed with a toothed segment 38b to be engaged by such a worm as 11 already described, except that the worm is here shown in vertical position. Meshing with the sun gear is a pinion 39 having its shaft 39a journaled in two opposed arms of the two double cranks, the sun gear and pinion being in a 4 to 1 ratio. Forming a unit with the pinion and shaft is a gear 40. In the other two arms of the double cranks is journaled a crank shaft 41 having its crank pivoted to a link 42 and thus pivotally connected with the oscillator. The crank has affixed thereto a pinion 43 meshing with the gear 40, 43 and 40 being in a 1 to 2 ratio.

Although usually in practice the element constituted by the two sections 1-2 will be fixed and thus form the stator and the other element rotate and thus form the rotor, I do not wish to be

limited to this condition since either element might rotate and the other remain stationary.

It will be understood that the element here formed by the sections 1—2, together with the rotor and oscillator, form a housing for lubricant for the contained moving parts.

The structure comprising sections 1—2 and the sun gear may be regarded as two distinct units in one of which (1—2) is rotatively adjustable the other around the main engine axis.

Having thus fully described my invention, what I claim is:

1. A rotary internal-combustion engine comprising an element including an annular cylinder and having a slot open laterally and extending continuously of the cylinder around the axis around which the cylinder is developed annular, another element having an annular portion concentric with and projecting through the slot into and terminating in a piston in the cylinder, one such element being rotative around said axis, an oscillator element oscillatory around said axis and having an annular portion also concentric with and projecting through the slot into and terminating in a piston in the cylinder, the second-named element and oscillatory element forming between their pistons an explosion space and together closing the slot in coincidence with such space, means, operatively connecting the first two elements and operatively connected to the oscillatory element, for oscillating the latter, and a sealing ring concentric with said axis and supported by one of the parts which comprise the first-named element and one of the other two elements and projecting into the slot and adjustable in a direction into or out of the slot.

2. A rotary internal-combustion engine including two hollow spaced sections having open sides facing each other and one of them having formed around it an annular cylinder having a slot open continuously of the cylinder in the same direction as the open side of such section faces, a rotor journaled in both sections concentrically with the cylinder, an oscillator oscillatory concentrically with the cylinder, said rotor and oscillator together occupying the space between the sections and each having a portion projecting through the slot and terminating in a piston in

the cylinder, and means, operatively connecting one of said sections and the rotor and operatively connected to the oscillator, for oscillating the latter, said pistons forming between them an explosion space and said engine having means to close said slot in coincidence with said explosion space.

3. A rotary internal-combustion engine including two hollow spaced sections having open sides facing each other and one of them having formed around it an annular cylinder having a slot open continuously of the cylinder in the same direction as the open side of such section faces, a rotor journaled in both sections concentrically with the cylinder, an oscillator oscillatory concentrically with the cylinder, said rotor and oscillator having side-by-side annuli concentric with the cylinder and together occupying the space between the sections and each having a portion projecting through the slot and terminating in a piston in the cylinder, and means, operatively connecting one of said sections and the rotor and operatively connected to the oscillator, for oscillating the latter, said pistons forming between them an explosion space and said annuli being coactive to close said slot in coincidence with said explosion space.

4. A rotary internal-combustion engine comprising an element including an annular cylinder having a slot open laterally and extending continuously of the cylinder around the axis around which the cylinder is developed annular, another element having a portion projecting through the slot into and terminating in a piston in the cylinder, one such element being rotative around said axis, an oscillator element oscillatory around said axis and having a portion also projecting through the slot into and terminating in a piston in the cylinder, the space at one side of one piston being an explosion space and at the other side a breathing space and said portions closing the slot in coincidence with the explosion space but leaving the slot open in coincidence with the breathing space, and means, operatively connecting the first two elements and operatively connected to the oscillatory element, for oscillating the latter.

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