Nov. 18, 1941. R. LAWRENCE, JR 2,263,361

INTERNAL COMBUSTION ENGINE

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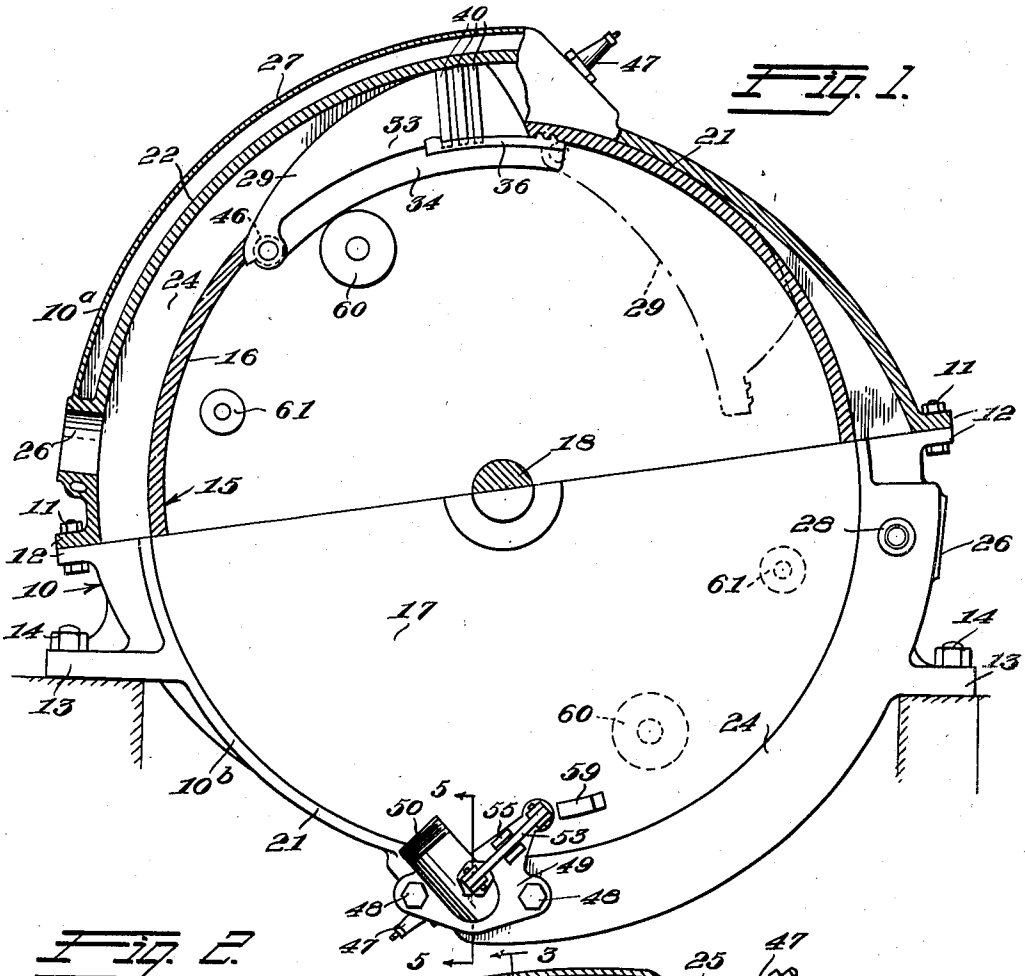


Fig. 1.

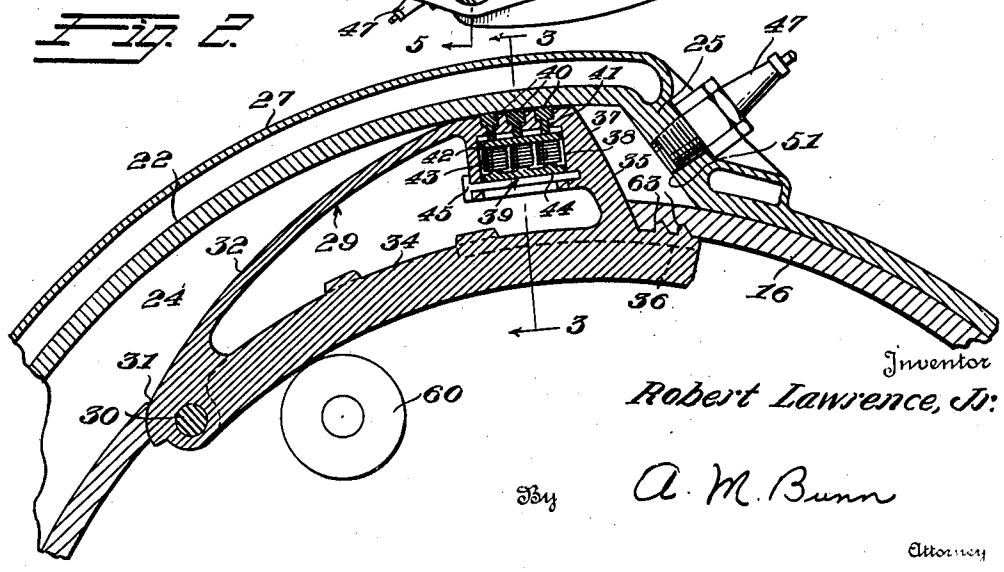


Fig. 2.

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Fig. 3.

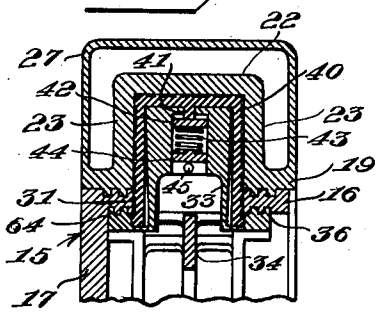


Fig. 4.

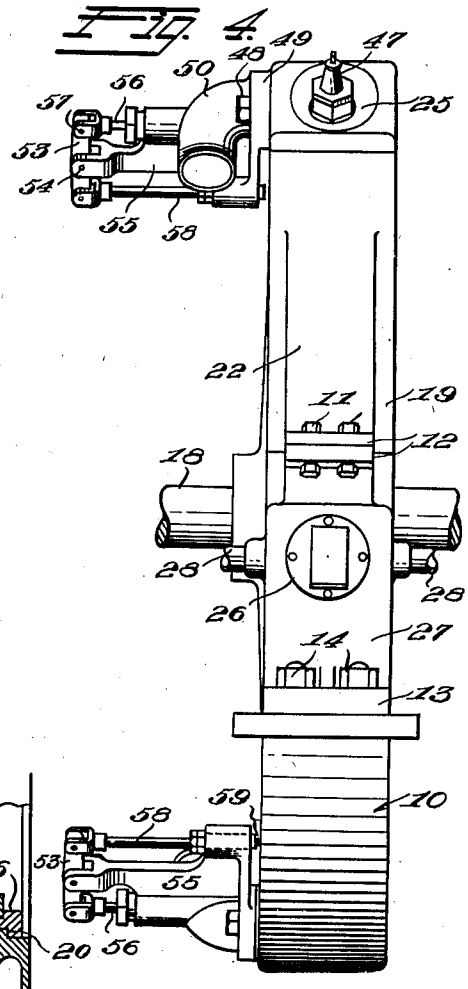
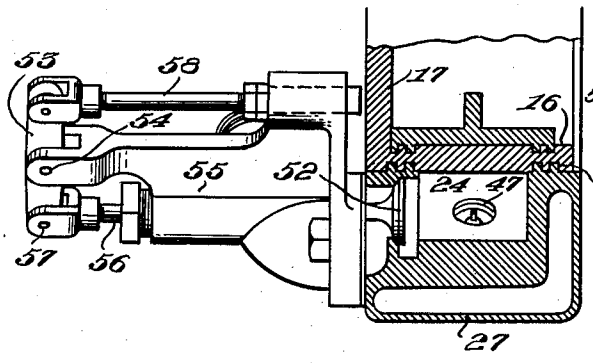


Fig. 5.



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2,263,361

INTERNAL COMBUSTION ENGINE

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Application March 1, 1940, Serial No. 321,763

3 Claims. (Cl. 123—17)

This invention relates to a rotary internal combustion engine.

A primary object of the invention is the provision of a rotary internal combustion engine which is simple in construction, involving a minimum number of parts while at the same time possessing maximum power and efficiency.

Still another aim is the formation of a rotary internal combustion engine in which the heat of combustion and friction is rapidly dissipated and which is of a construction facilitating assembly and disassembly of the cooperating elements composing same.

Yet another purpose of the invention is the production of a rotary internal combustion engine wherein retention of residual gases with attendant dilution of fresh charges is completely eliminated.

A still further object is the provision of a rotary internal combustion engine which provides a more complete expansion cycle with an accompanying lower exhaust temperature and pressure.

For a more complete understanding of the nature and objects of the invention, reference will be had to the following drawings, wherein:

Fig. 1 is a view partially in side elevation and partially in transverse section of the internal combustion engine in accordance with a preferred embodiment of the invention.

Fig. 2 is an enlarged fragmental transverse section disclosing in particular the relation between one of the pistons carried by a rotor and the stationary casing.

Fig. 3 is a section in a plane substantially as represented by the line 3—3 in Fig. 2.

Fig. 4 is an edge elevation of the complete engine.

Fig. 5 is an enlarged view partially in elevation and partially in section in a plane represented by the line 5—5 in Fig. 1.

Referring now in detail to the drawings by the use of reference characters, and wherein like characters designate like parts in the different views, 10 designates a stationary casing and which for the sake of expeditious assembly is preferably constructed of upper and lower sections 10^a and 10^b respectively. The sections 10^a and 10^b have diametrical mating faces outside the pressure zones and are removably connected together in metal to metal contact by means of bolts 11 extending through apertures in mating flanges 12 of the sections. The lower casing section 10^b is provided with opposed flanges 13 for attachment to fixed supports by means of bolts 14.

Rotatably mounted within the casing 10 is a rotor 15 which includes a concentric rim 16 and a side disk 17, the disk being secured to a power shaft 18 rotatably mounted in suitable bearings. The casing 10 includes a cylindrical base portion 19, concentric to shaft 18, which portion and the rotor rim 16 are provided with cooperating circumferential grooves and projections represented at 20 for forming an effective gas seal between the casing and rotor. The base portion 19 of the casing is substantially axially coextensive with the rotor rim 16 and rests directly thereon for a substantial circumferential distance at diametrically opposed locations as indicated at 21 in Fig. 1. From these points the base portion 19 is gradually displaced outwardly for a substantial width thereof to the joining plane of the sections 10^a and 10^b. From such plane the extended base portion in the form of an outer wall 22 extends concentrically and in radially spaced relation to rim 16 together with which and the opposed side walls 23 providing circumferential combustion chambers 24 having end closing walls 25. Each combustion chamber 24 is provided with an exhaust port 26 adjacent the junction of sections 10^a and 10^b and the casing 10 further includes a right angular wall 27 in spaced relation to walls 22 and 23 extending from the exhaust ports 26 to the end walls 25 and providing water cooling jackets for the combustion chambers, the cooling water outlets 28 being shown in Figs. 1 and 4.

A piston segment 29 is carried by the rotor 15 for cooperation with each of the combustion chambers 24. The pistons 29 are diametrically opposed and each is pivotally mounted at one end thereof on a removable pin 30 suitably supported by the rim 16 of rotor 15 adjacent one end of a slot 31 therein.

Each of the pistons 29 includes an outer arcuate wall 32, side walls 33, a base plate 34 intermediate the side walls 33 and concentric with rim 16, a forward sloping wall 35 and lateral flanges 36. It is to be particularly noted that the wall 32 and plate 34 diverge from the pivot pin 30 and that walls 32 and 35 merge into a body portion 37 which is provided with a recess 38 for a sealing ring expansion spring assembly 39. The piston 29 possesses recesses in the top as well as the sides opposed to the body portion 37 and a U-shaped sealing and impact cushioning ring 40 is seated in each of the recesses. Each ring 40 has a centrally depending projection 41 engaged by a bar 42 in recess 38. The bar 42 is yieldingly urged upward by a plurality of coil

springs 43 resting on a plate 44 which is held in the recess by means of a pin 45. The pistons 29 are rotatable with the rotor 15 and are normally urged outwardly about the pivot pins 30 by any suitable means such as coil springs 46 encircling the pivot pins and engaged with the pistons and rotor rim 16. The springs 46 while not sufficiently capable of holding the pistons in position during their explosion movement, do maintain the outer walls of the pistons against the base portion 19 or merging outer walls 22 of the casing during rotation of the rotor 15.

The wall 25 of each combuston chamber 24 is tapped for the reception of a spark plug 47 and secured to one of the side walls of the casing adjacent each wall 25 by means of bolts 48 is a bracket 49 provided with a fuel inlet connection 50 which communicates with the respective chamber 24 immediately within the wall 25, which wall is provided with a sloping inner surface 51 for a purpose later described. The admission of pre-compressed fuel charges into each of the chambers 24 is controlled by a valve 52 which is operated in proper time sequence by means of a rocker arm 53 pivotally connected at 54 to an extension 55 from the bracket 49. A rod 56 is pivotally connected at 57 to one end of the arm 53 and a rod 58 is pivotally connected to the other end of the arm. The rod 58 carries or is suitably connected to the valve 52 and the rod 58 projects into the path of a cam 59 rigid with the side disk 17 of the rotor 15. As the rotor 15 rotates within the casing 10 the pivotally mounted pistons 29 are maintained in engagement with the outer wall of the casing by the springs 46.

As indicated by dotted lines in Fig. 1, each of the pistons moves through the locations 21 with the major portion thereof within the rim of the rotor, that is, the piston is forced by base portion 19 of casing 10 radially inward through the rim slot 31 against the action of the spring 46. Upon reaching the ignition end of the chamber 24 the piston will swing outwardly in the slot 31 into such chamber, sudden impact against the outer wall 22 of the chamber being avoided by the gradual riding upward of the wall 35 of the piston on the inner inclined surface 51 of the wall 25. The rings 40 being normally urged beyond the outer walls of the piston also act to cushion the engagement of the piston with the chamber walls. While the springs 46 urge the pistons outwardly they are insufficient to hold the pistons when subjected to the fuel charge explosions and therefore a pair of rollers 60 and 61 are supported radially inward of each chamber 24 and in such position as to successively engage the plate 34 of the respective pistons and thereby positively maintain the piston within the combustion chamber during the working stroke thereof.

It is to be particularly noted that the plate 34 and flanges 36 are transversely continuous at the front end of each of the pistons, such transversely continuous portion extending beyond the wall 35 and being provided with projections 63 received in corresponding recesses in rim 16 and furthermore the flanges 36 are provided with circumferential projections 64 received in corresponding recesses in the rim 16. These projections and recesses come into engagement as the pistons snap into the combustion chamber 24 and provide a gas seal between the rotor rim and pistons, the rings 40 forming a seal against gas leakage past the walls 32 and 33 of the pistons. The hollow interiors at the pistons 29 between their pivots 30 and the flanges 36 are open on opposite sides of the plate 34 as is indicated in Fig. 3 whereby heat is rapidly dissipated within the rim 16 of the hollow rotor 15. Thus by the provision of the water cooling jackets together with the hollow constructions of the rotor and pistons a highly efficient cooling system is provided.

In operation the fresh charge is drawn into the intake of a simple reciprocating or other positive displacement compressor, from the usual carbureting device and then compressed to a predetermined amount in an intake manifold. The charges enter the chambers 24 between the walls 25 and 35 through the fuel-air intake manifold connections 50 and the corresponding valves 52. This charging begins at the instant the pistons enter the chambers and contact the walls 22. The charging operation is maintained the requisite length of time, governed by the length of the cams 59, and in turn, governed by the predetermined volume of compressed fuel-air mixture required per working impulse. At the time the valves 52 close ignition through plugs 47 takes place, and the pistons are driven through the working impulse until they pass the exhaust ports 26, where the products of combustion escape. This operation produces four working impulses per revolution of the rotor 15, or, in other words, one twin power impulse every 180 degrees at rotor rotation.

The invention, however, is not limited to two pistons as four or more may be provided with a corresponding greater number of working impulses per revolution of the rotor. Residual gases are completely eliminated from the combustion chambers 24 due to the complete occupation at the chambers by the pistons when in working position therein. The improved engine in accordance with this invention provides for a more complete expansion of gases as follows:

The charge is assumed compressed in a compressor having a capacity of six times the volume of the combustion spaces when the pistons have moved through the distance during which the valves 52 are open as governed by the length of the cams 59. From this point to the exhaust ports 26 is the length of expansion which in the specific design illustrated is fourteen times the volume of the compressed charges in the combustion spaces when the valves 52 close and ignition begins. This is equivalent to a compression ratio of six to one and an expansion ratio of fourteen to one. The compression and expansion ratio relationships can be any pre-determined value, and the engine measurements made to suit. The limit to compression is, of course, a point safely below the temperature of compression-ignition of the fuel-air mixture, and the expansion limit is governed by the volume of compressed fuel-air mixture desired and the expansion space available around the periphery of the casing 10.

While I have disclosed but a single specific embodiment of my invention, such is to be considered as illustrative only, and not restrictive, the scope of the invention being defined in the sub-joined claims.

What I claim and desire to secure by Letters Patent is:

1. A rotary internal combustion engine comprising a stationary casing having a cylindrical base portion, spaced circumferentially extending combustion chambers opening through the base

portion, a rotor including a concentric rim in continuous bearing engagement with the base portion and having circumferentially elongated slots corresponding in number to the combustion chambers, pistons pivotally supported at corresponding ends to the rim and successively movable through the slots into and out of the combustion chambers upon rotation of the rotor, the pistons including base plates supported within and concentric with the rim when the pistons are in the combustion chambers, spring means associated with the pivotal connections of the pistons for urging same into the combustion chambers, rollers radially inward of the combustion chambers for engaging the base plates to hold the pistons in the combustion chambers, and cooperating cam surfaces on the pistons and walls of the combustion chambers to urge the pistons out of the chambers against the action of said spring means.

2. A rotary internal combustion engine according to claim 1 together with projections supported by said base plates for entering corresponding recesses in said rim at opposite sides and adjacent the ends of said slots distant from said piston pivotal connections for providing a gas seal between the pistons and rim.

3. A rotary internal combustion engine comprising a stationary casing having a cylindrical base portion, spaced circumferentially extending combustion chambers opening through the base portion, a rotor including a concentric rim and a disc secured at its center to a power shaft, a plurality of pistons corresponding in number to the combustion chambers and pivotally supported by the rim for successive movement into and out of the combustion chambers, a gas inlet at the advance end of each combustion chamber, a bracket secured to the casing adjacent the advance end of each combustion chamber, a rocker arm pivotally connected intermediate its ends to the bracket, a valve for controlling the inlet and having an actuating rod pivotally connected to one end of the rocker arm, a rod slidably supported by the bracket and having one end thereof pivotally connected to the opposite end of the rocker arm and with the free end thereof adjacent the disc and cams supported by the disc for engaging the free ends of the slidably mounted rods upon rotation of the rocker for controlling the admission of gas to the combustion chambers.

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