March 12, 1963 H. J. BERRY 3,080,856

INTERNAL COMBUSTION ENGINE

Filed Feb. 27, 1956 2 Sheets-Sheet 1

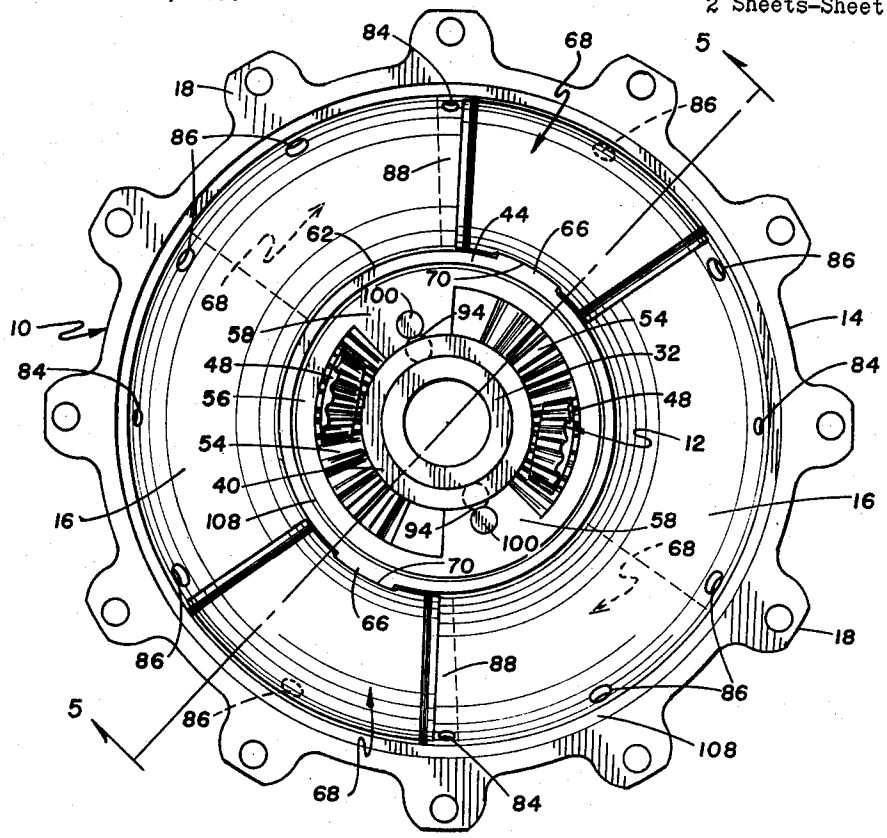


Fig. 1

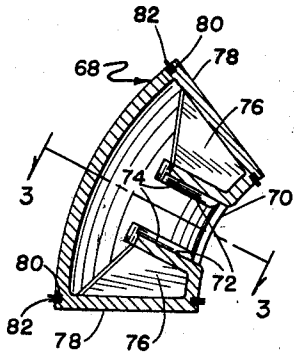


Fig. 2

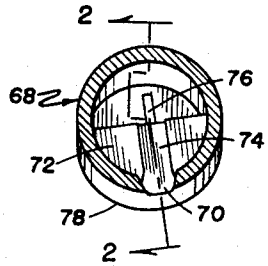


Fig. 3

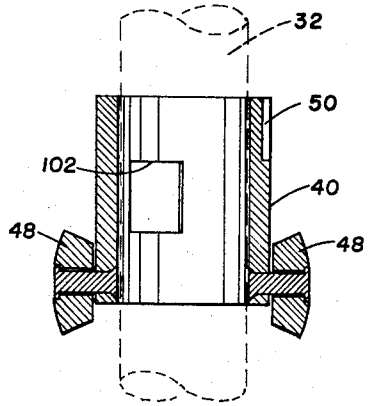


Fig. 4

INVENTOR.
HARRY J. BERRY

BY

Knox & Knox

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INTERNAL COMBUSTION ENGINE

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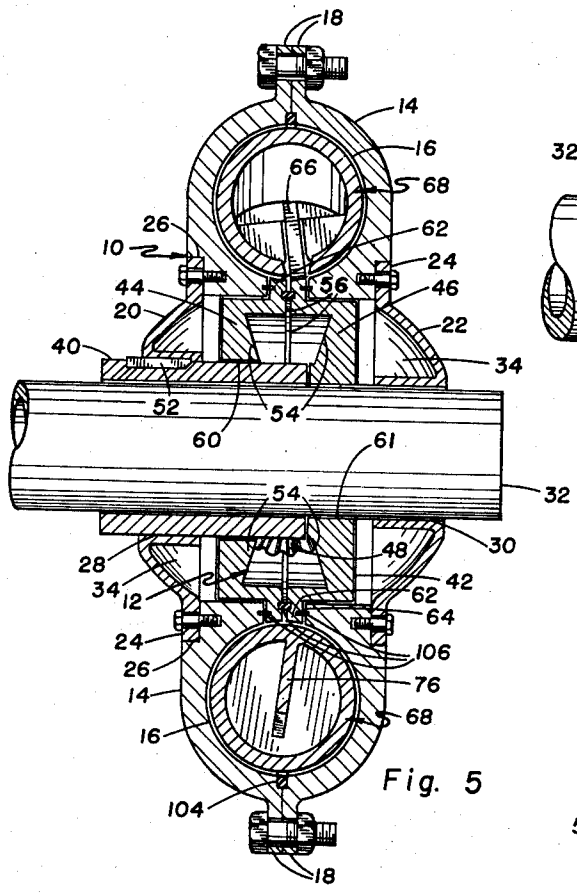


Fig. 5

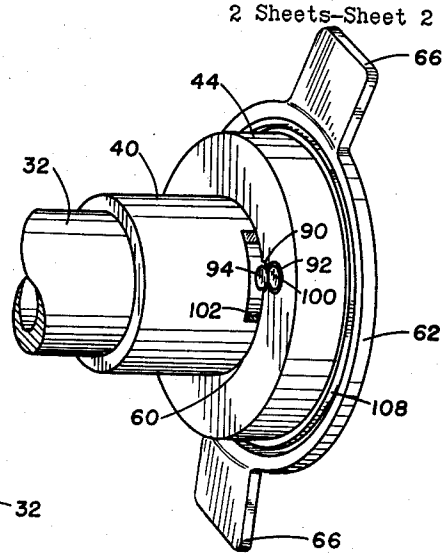


Fig. 6

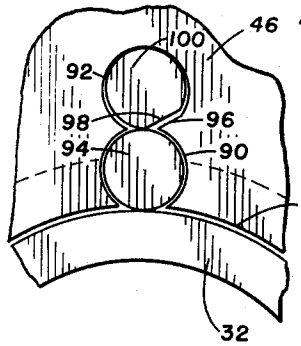


Fig. 7

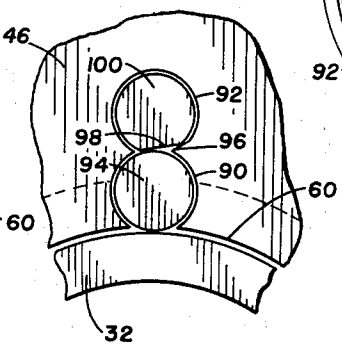


Fig. 8

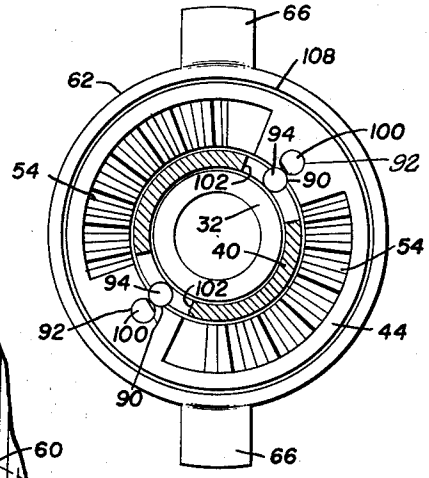


Fig. 9

INVENTOR.
HARRY J. BERRY

BY

Knox & Knox

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INTERNAL COMBUSTION ENGINE

Harry J. Berry, 4511 Hamilton St., San Diego, Calif.

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3 Claims. (Cl. 123—18)

The present invention relates generally to internal combustion engines and more particularly to an engine of the fuel injection type, having arcuate pistons oscillatable in an annular cylinder, and means to convert the oscillatory motion of said pistons into rotary motion of a shaft.

The primary object of this invention is to provide an internal combustion engine of the fuel injection type, having arcuate pistons oscillatable in an annular cylinder, power being transmitted directly to a shaft without the use of a crankshaft.

Another object of this invention is to provide an engine in which means are provided to limit the arcuate travel of the pistons to a predetermined segment of the cylinder.

Another object of this invention is to provide an engine in which the travel limiting means also carries means to convert the oscillatory motion of the pistons to rotary motion of the shaft.

Another object of this invention is to provide an engine of the character described which requires no valves but is simply provided with exhaust ports, opened and closed by the pistons.

Another object of this invention is to provide an engine of the character described in which force of expanding gases in the firing chambers acts on all pistons simultaneously, thereby eliminating the resistive forces met when one piston necessarily motivates one or more temporarily idle pistons, as in conventional engines.

Another object of this invention is to provide an engine which is adapted for fabrication from many different materials, so that the choice of material can be according to the dictates of availability and price considerations, the exact sizes and proportions being matters easily determined to suit particular conditions and needs.

Another object of this invention is to provide an engine which is practicable and inexpensive to manufacture.

Finally, it is an object to provide an engine of the aforementioned character which is simple, safe and convenient to manufacture, operate and maintain and which will give generally efficient and durable service.

With these and other objects definitely in view, this invention consists in the novel construction, combination and arrangement of elements and portions, as will be hereinafter fully described in the specification, particularly pointed out in the claims, and illustrated in the drawings, which form a material part of this disclosure, and in which:

FIGURE 1 is an elevational view of the device with one half of the casing, a ring gear, and two of the pistons being removed for clear representation of internal portions, the removed pistons being indicated only by dash line.

FIGURE 2 is a longitudinal sectional view of one of the pistons taken on the line 2—2 of FIGURE 3.

FIGURE 3 is a view taken on the line 3—3 of FIGURE 2.

FIGURE 4 is a longitudinal sectional view of the sleeve with pinion gears mounted thereon, the driven shaft being indicated only in dash line.

FIGURE 5 is a sectional view taken on the line 5—5 of FIGURE 1.

FIGURE 6 is a perspective view of one ring gear operatively mounted on the sleeve and driven shaft, the shaft being shown fragmentarily.

FIGURE 7 is a fragmentary drawing of a ring gear

and the shaft, drive bearings mounted in said gear contacting the shaft, and shown in driving relationship.

FIGURE 8 is a view similar to FIGURE 7, and showing the drive bearings in coasting relationship.

FIGURE 9 is a detailed view of the ring gear shown in FIGURE 1.

Similar characters of reference indicate similar or identical elements and portions throughout the specification and throughout the views of the drawing.

Referring now to the drawings in detail, the engine is shown as comprising a housing assembly **10** and a drive assembly **12** operatively mounted therein.

The housing assembly **10** comprises an annular member **14** having a toroidal chamber **16** therein. The member **14** is divided into equal halves on a plane normal to the axis thereof, each half being provided with spaced lugs **18** extending radially outward therefrom for bolting the halves rigidly together.

Cover plates **20, 22** having radially extended flanges **24** are fitted into annular seats **26** in the member **14** and bolted thereto, and these cover plates are provided with axial openings, the cover plate **20** having a larger opening to receive a sleeve **40** hereinafter described and the cover plate **22** having a simple bearing for the shaft **32**. Each cover plate **20, 22** is further provided with an annular chamber **34** through which a coolant fluid may be circulated for the dissipation of heat generated during operation of the device.

The drive assembly **12** comprises a sleeve **40** keyed to the cover plate **20**, as at **52**, and extending inwardly, through the opening **28**, into a gear chamber **42** defined by the inwardly disposed surfaces of the member **14** and the cover plates **20, 22**. Two plates constituting interrupted ring gears **44, 46** are mounted coaxially of said shaft and engage pinion gears **48** pivotally mounted in diametrically opposed relationship on the inwardly disposed end of the sleeve **40**.

The teeth **54** of each ring gear **44, 46** are of recessed or internal bevel type and are divided into two segments by diametrically opposed plain faced portions or bearing blocks **58**, which are integral parts of the gears **44, 46** and consist merely of portions raised to approximately flush relationship with the annular, flange-like facing surfaces **56** disposed peripherally of the teeth **54** on each ring gear. Each ring gear **44, 46** is further provided with an axial bore **60, 61**, allowing free rotation about the shaft **32**, the bore **60** in the ring gear **44** being enlarged to accept the sleeve **40**.

A peripheral flange **62** extends radially outward from each ring gear **44, 46** to the chamber **16**, an annular slot **64** being provided in the member **14** therefor, the outwardly disposed edges of the flanges **62** being arcuately bevelled to conform to the curvature of the chamber **16**. Diametrically opposed lugs **66** extending outwardly of the flanges **62** are inclined from true radial disposition and extend into the chamber **16**, to engage their respective pistons **68** therein.

Each piston **68** is arcuate to conform to the curvature of the chamber **16**, and is provided with a slot **70** for engagement with the corresponding lug **66**. Transverse webs **72** extending inwardly of the piston **68** at each end of the slot **70**, are provided with channels **74** which engage the lug **66** and prevent any turning or binding of the piston **68** within the chamber **16**. A reinforcing web **76** extends between each web **72** and the adjacent end wall **73** of the piston. Annular channels **80**, adjacent each end wall **78** of the pistons **68** provide means for retaining conventional pressure rings **82** thereon.

It now becomes clearly evident that the travel of the pistons **68** is limited by the coaction of the ring gears **44, 46** and the pinion gears **48**, since the sleeve **40** on which

the gears 48 are mounted is fixed relative to the member 14, and the bearing blocks 58 serve as stops at either end of a piston stroke. Thus, the arc through which a piston may move is defined by the arc of travel allowed by the gears 44, 46 and the pinion 48. The annular member 14 is provided with four inlet ports 84 spaced 90 degrees apart and positioned so as to be between the adjacent ends of each pair of pistons at the end of their stroke. Also in the annular member 14 are eight exhaust ports 86 spaced intermediate the inlet ports 84 in such manner that the exhaust ports are uncovered beween the widely spaced ends of the separated pistons at the end of their stroke. Fuel is injected into the ports 84 by any suitable injection system, such as that type used in a diesel engine, and the fuel is fired by compression ignition between the approaching pistons. The resultant explosion drives the pistons apart so that the alternate pairs of pistons now approach each other and, as the ends of the pistons pass the exhaust ports 86, the combustion gases are exhausted. Meanwhile two new firing chambers are defined at 90 degrees displacement from those shown, and fuel injection and ignition therein results in return of the pistons to the position as shown in FIGURE 1 and oscillatory motion of the pistons is continued.

If reference now be had to FIGURES 6, 7, and 8, the means by which the oscillatory motion of the pistons is transmitted to the ring gear 44, 46 and converted into rotary motion in the shaft 32 becomes clearly evident. Two intersecting bores 90, 92 having axes co-planar with and parallel to the axis of the shaft 32 are provided in each bearing block 58 of each ring gear 44, 46. The bores 90 adjacent the shaft 32 are positioned so that clutch rollers 94 inserted therein contact the shaft 32. The outwardly positioned bores 92 are provided with a raised, flattened portion 96, adjacent the points of intersection with the bores 90, which coact with a flattened portion 98 of rollers 100 therein to limit the rotation thereof. Thus, as the gear 44 starts to rotate in a clockwise direction, as viewed in FIGURES 7 and 8, the rollers 94 are caused to roll on the surface of the shaft 32 and begin to rotate clockwise, while their frictional contact with the rollers 100 causes the latter to rotate counterclockwise, wedging the bearings 94, 100 between the shaft 32 and the bearing blocks 58, and inducing rotation in the shaft 32.

As the gear 44 begins to rotate counterclockwise, the bearings 94, 100 also reverse rotation, bringing the flattened portion 98 over the bearing 94, allowing free rotation of the latter. Slots 102 provided in the sleeve 40 allow the bearings 94 in the gear 46 to contact the shaft 32. It will be noted that as gear 44 moves counterclockwise, gear 46 moves clockwise, engaging bearings 94, 100 therein with the shaft. Thus, it can now be clearly seen one-half of the pistons are always in driving relation to the shaft and that the oscillatory motion of the pistons is converted into continuous rotary motion of the shaft.

It is noteworthy that a plurality of engines as hereinbefore described may be mounetd on a single shaft without the use of intermediate gearing or transmission connections as presently required. All the engines on the shaft 30 transmit power thereto and, in the event that one engine becomes inoperative, no increased resistance is encountered, since the inoperative engine becomes merely a bearing on the shaft.

Another very important feature of this invention is that an engine may be readily installed on a rotating shaft 32, the bearings 94 in the gear 46 being held in place by any convenient means until contact is made with the shaft 30, then the engine may be moved to the desired location on the shaft 32, and secured to any type of mounting frame desired. After installment is completed, the engine is started and brought up to synchronization with other engines on the shaft 32, thereby adding to the power transmitted to the shaft.

An annular sealing ring 104 and packing rings 106 prevent the escape of presure load from the chambers 88, the member 14, and the gears 44, 46 being provided with channels to receive the said rings 104, 106.

Since no compression stroke is required in the instant invention, no mechanical valves are necessary for the exhaust of gases with in the chambers 88, the exhaust ports 86 being simply located so as to be uncovered behind the pistons 68 slightly before the pistons 68 reach the next injection position, thus allowing the burnt gases to escape.

The operation of this invention will be clearly comprehended from a consideratаion of the foregoing description of the mechanical details thereof, taken in connection with the drawing and the above recited objects. It will be obvious that all said objects are amply achieved by this invention.

Further description would appear to be unnecessary.

It is understood that minor variation from the form of the invention disclosed herein may be made without departure from the spirit and scope of the invention, and that the specification and drawing are to be considered as merely illustrative rather than limiting.

I claim:

1. An internal combustion engine comprising: a housing; a shaft rotatably mounted in said housing; a toroidal cylinder within said housing and encircling said shaft; opposing pairs of arcuate pistons mounted within said cylinder for oscillatory movement; a pair of similar, generally annular members, each engaging one of each pair of pistons to oscillate therewith about said shaft; clutch means providing driving connection between said members and said shaft while the members are individually moving in the direction said shaft is to be driven; said members being in confronting relation and having corresponding ring gear teeth on diametrically opposed portions of the confronting faces thereof; a pair of pinions mounted for free rotation on fixed journals on opposite sides of said shaft and in constant mesh with said teeth and interconnecting said members for equal and opposite movement thereof; and fuel inlets and exhaust outlets for said cylinder adjacent the positions of the ends of the pistons at their limits of travel; and means for injecting fuel between each approaching pair of pistons, such that each oscillation of the pistons includes two firing strokes.

2. An engine according to claim 1 wherein said clutch means comprises a pair of rollers mounted in longitudinally interconnecting bores in each of said members and the confronting portions of structure fixed in relation to said cylinder, one roller of each pair of rollers and the coresponding bore having flats allowing rotation of each roller in one direction only.

3. An engine according to claim 1 and including a sleeve coaxial with said shaft and fixed in relation to said cylinder; said sleeve comprising a journal for one of said members and comprising support means for said journals of the pinions.

References Cited in the file of this patent

UNITED STATES PATENTS

1,094,794	Kemper et al.	Apr. 28, 1914
1,352,127	Henderson	Sept. 7, 1920
1,644,564	Bullington	Oct. 4, 1927
1,917,180	Zwick	July 4, 1933
2,157,764	Langrognet	May 9, 1939

FOREIGN PATENTS

525,354	Germany	May 22, 1931
2,402	Australia	June 2, 1931
619,995	Great Britain	Mar. 17, 1949
455,760	Italy	Mar. 13. 1950