I. B. HUMPHREYS.

ROTARY INTERNAL COMBUSTION ENGINE.

APPLICATION FILED APR. 5, 1915.

1,233,579.

Patented July 17, 1917.

5 SHEETS—SHEET 1.

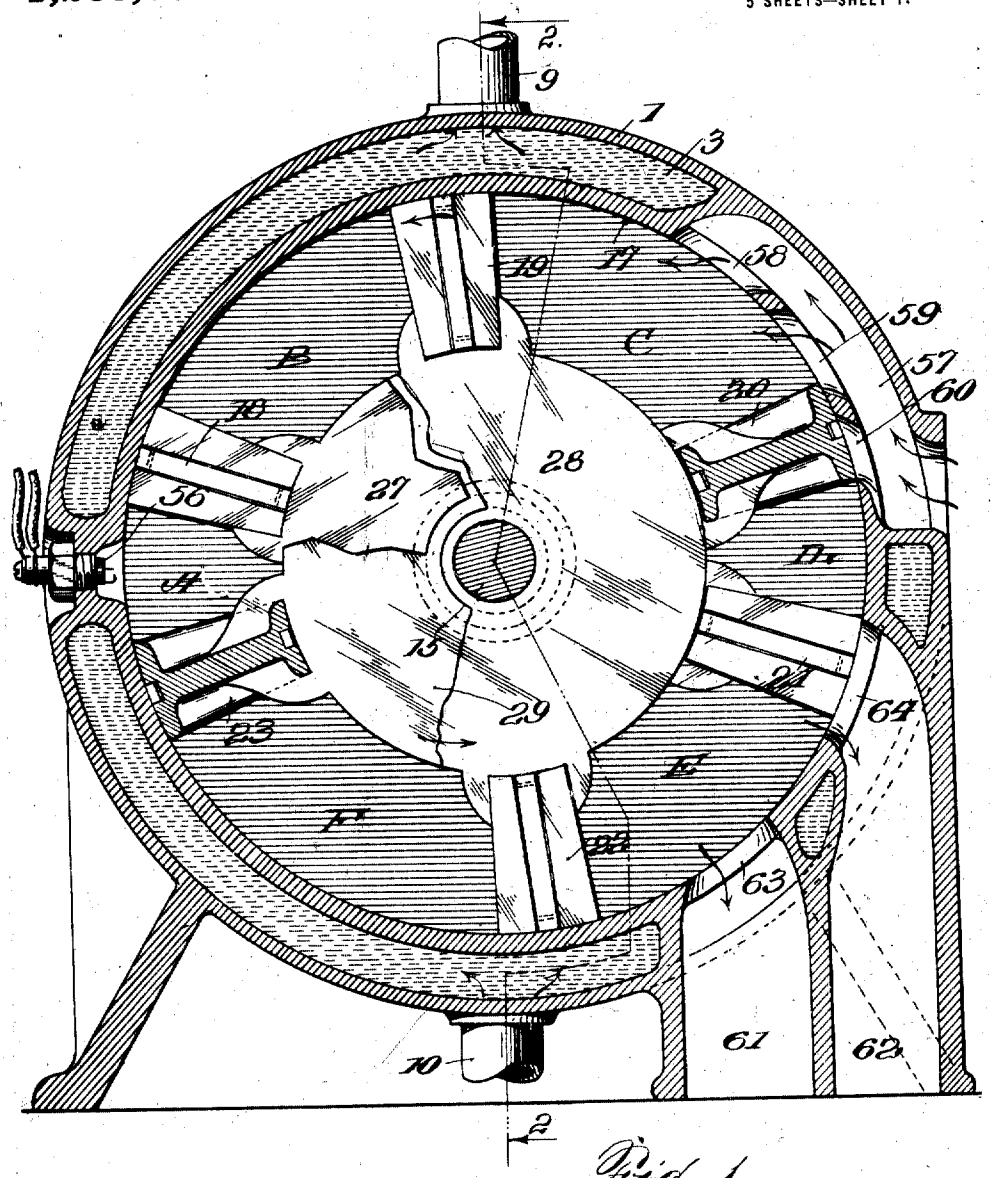


Fig. 1.

Witnesses

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John B. Wade.

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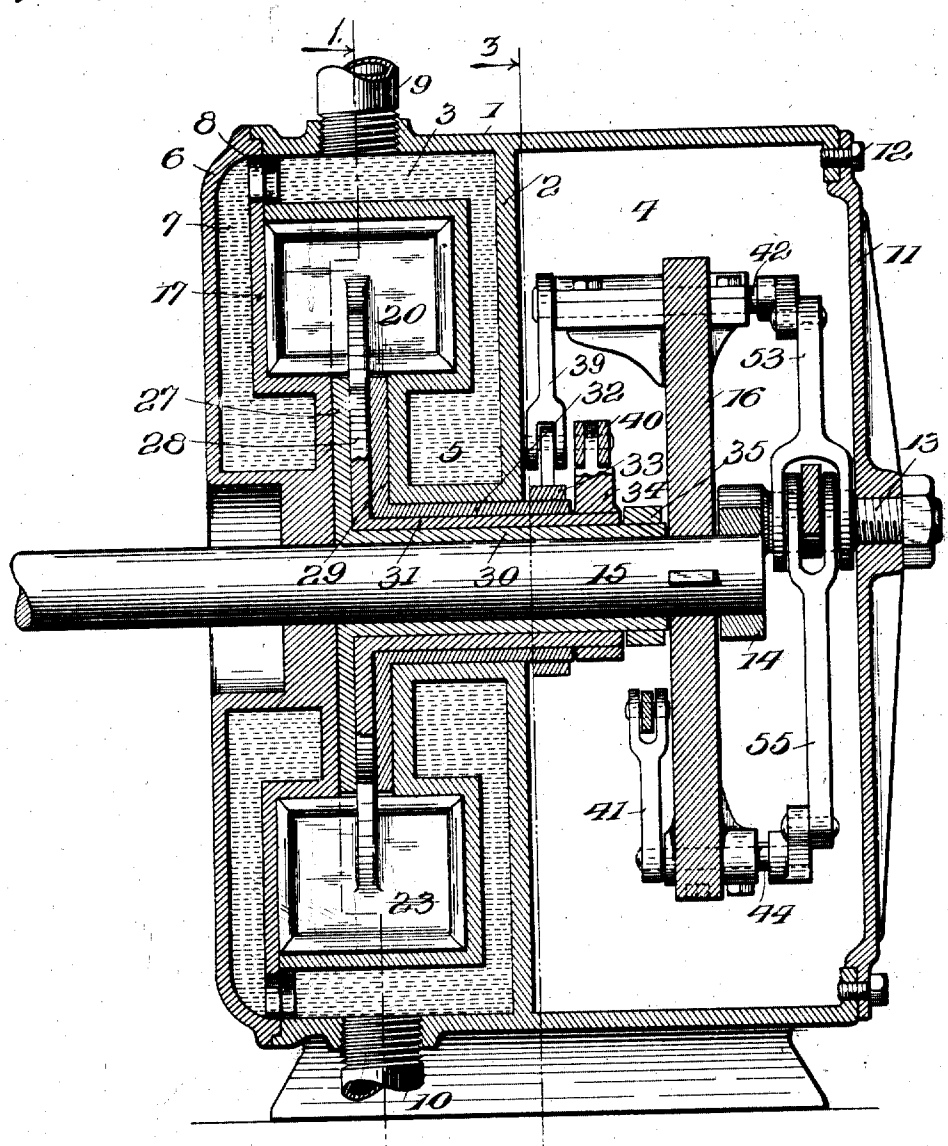


Fig. 2.

Witnesses

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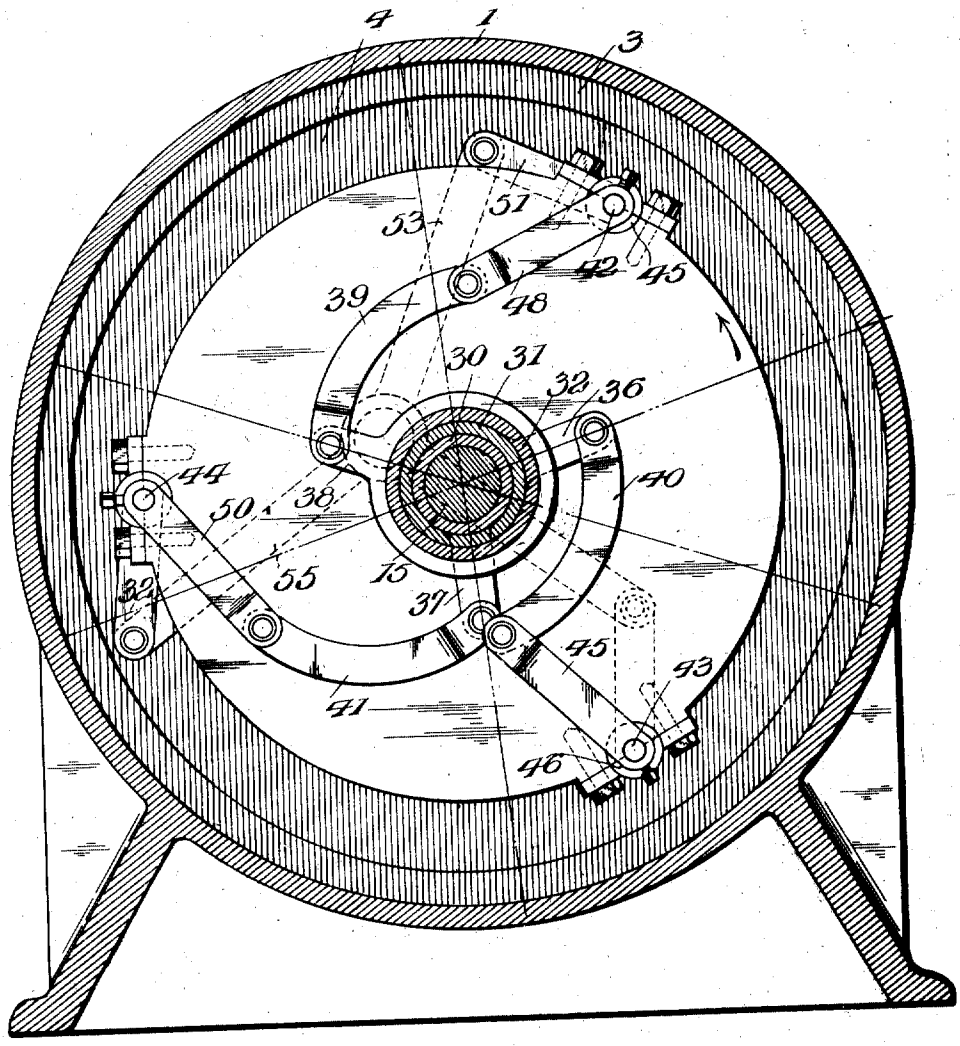


Fig. 3.

Witnesses

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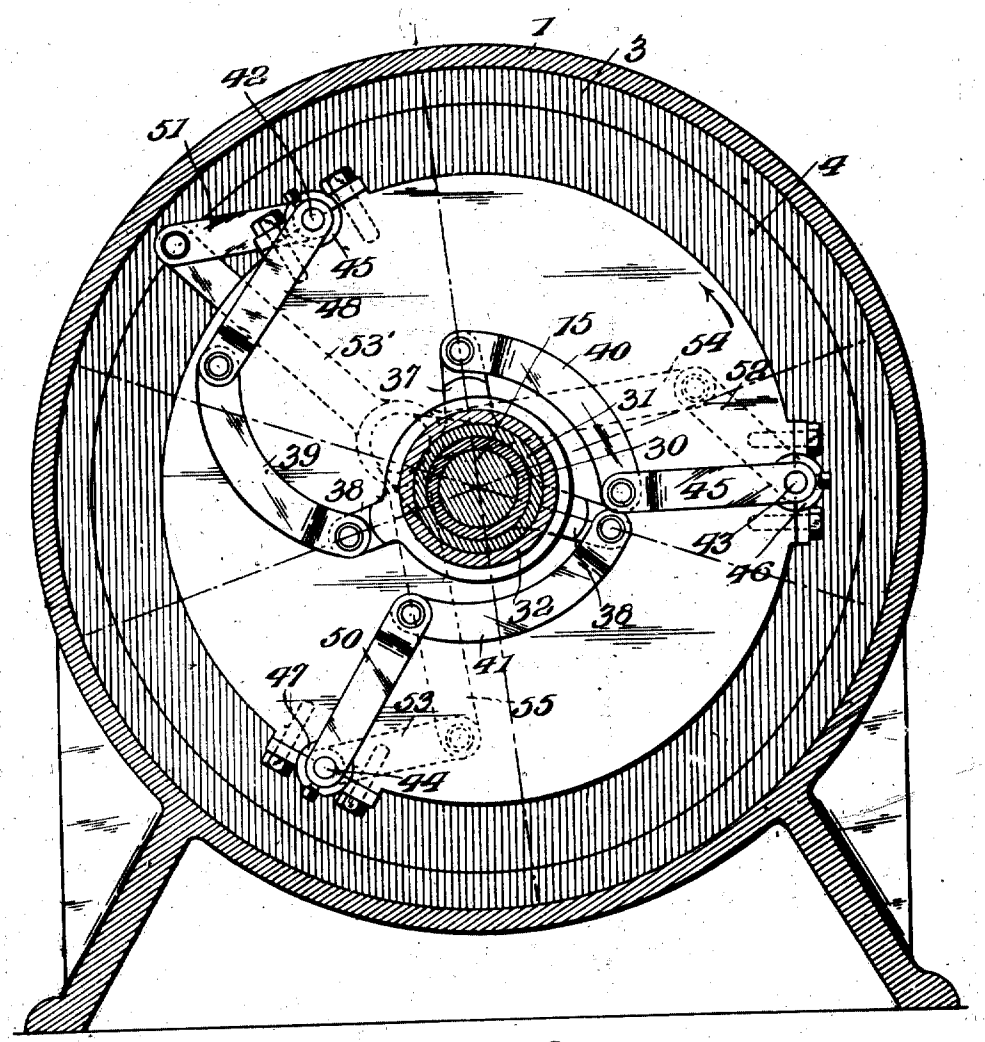


Fig. 4.

Witnesses

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5 SHEETS—SHEET 5.

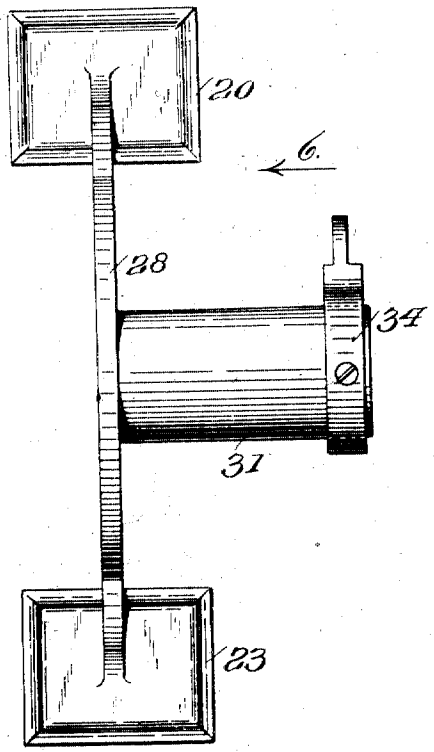


Fig. 5.

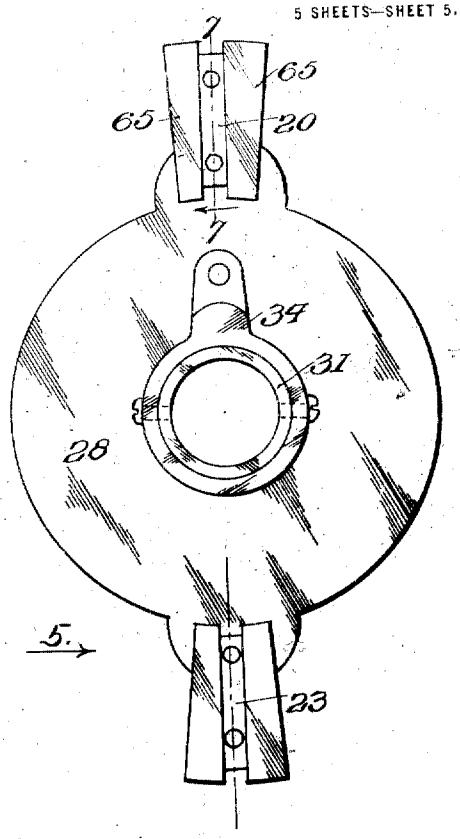


Fig. 6.

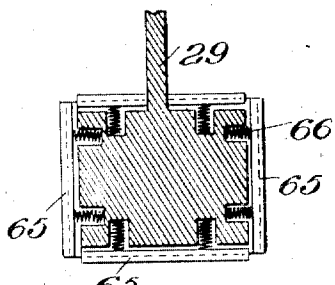


Fig. 7.

Witnesses

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UNITED STATES PATENT OFFICE.

IRA BOYD HUMPHREYS, OF DENVER, COLORADO.

ROTARY INTERNAL-COMBUSTION ENGINE.

1,233,579. Specification of Letters Patent. Patented July 17, 1917.

Application filed April 5, 1915. Serial No. 19,229.

To all whom it may concern:

Be it known that I, IRA B. HUMPHREYS, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Rotary Internal-Combustion Engines, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to improvements in rotary internal combustion engines.

The object of my invention is to provide an engine of this character in which a series of pistons are mounted to travel within an annular cylinder, the pistons being so connected as to vary their speed of travel and with reference to each other, thereby enlarging and contracting the space between them for compressing the charge and firing the same, and whereby the varying speed of the pistons is utilized for producing power.

Another object of my invention is to produce an engine of this character with the highest degree of speed and efficiency by doing away with valves and other reciprocating parts. To that end it consists in connecting a series of pistons to a fly-wheel by means of connecting links eccentrically controlled in respect to the fly-wheel.

Another object of my invention is to provide a simple and effective engine of this character having certain details of structure and combination of parts hereinafter more fully described.

In the accompanying drawings—

Figure 1 is a transverse sectional view taken through the engine cylinder showing the arrangement of the traveling pistons.

Fig. 2 is a longitudinal vertical sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is a transverse sectional view taken on the lines 3—4 of Fig. 2 and looking in the direction of the arrow and showing the arrangement of the levers connecting the pistons with the fly-wheel.

Fig. 4 is a view similar to that shown in Fig. 3, showing the levers in the position they will assume after the fly-wheel has advanced sixty degrees (60°) from the position shown in Fig. 3.

Fig. 5 is a side view of one pair of pistons with the connecting disk and tube looking in the direction of the arrow, Fig. 6.

Fig. 6 is an end view looking in the direction of the arrow Fig. 5.

Fig. 7 is a detail section taken on the line 7—7, Fig. 6, showing the manner of packing the piston head.

Referring now to the drawings, 1 represents the engine cylinder, which as shown, is of an elongated form and sub-divided by means of a partition 2, forming what I will hereafter term the cylinder chamber 3 and the lever chamber 4. The cylinder chamber 3, as fully shown in Figs. 1, 2 and 3 is provided with a water-jacket 5, whereby the engine is kept cool, as is well understood by those skilled in the art. The cylinder chamber 3 has an open outer face which is closed by the head plate 6, which also has a water-jacket 7, and which is provided with openings 8 communicating with the water-jacket 5, whereby the proper circulation of the water through the head plate is attained. Communicating with the upper end of the water-jacket 5 is a water-discharge 9, and at the lower end with a water-supply 10.

The outer face of the lever chamber 4 is provided with a head-plate 11, preferably secured to the chamber 4 by means of the screw-bolts 12, whereby access may be readily had to the lever chamber, as fully shown in Fig. 2 of the drawings. Carried by the head-plate 11 is a stub-pin 13, arranged eccentric to the cylinder and also to the engine shaft, hereinafter more fully described. The stub pin 13 carries at its inner end a bearing 14, for the inner end of the engine or power shaft 15. The said power shaft, as shown, extends through the cylinder chamber and protrudes into the lever chamber 4. Carried by the power or engine shaft 15, some distance from the partition 2, is a fly-wheel 16, through which the power is conveyed to the power or engine shaft 15, which will be later described.

As shown in Figs. 1 and 2 of the drawings, the cylinder chamber 3 and the head plate 7 form an annular passage 17, which is rectangular in cross-section and extends entirely around the cylinder. Within the annular passage 17 are the piston heads 18, 19, 20, 21, 22 and 23, and when in the position shown in Fig. 1 of the drawing, form the compartments A, B, C, D, E and F, which will be later more fully described. Rotatably mounted within the cylinder are disks 27, 28 and 29, and carried by the outer edge of the disk are the piston-heads 18, 19,

20, 21, 22 and 23. These pistons, as shown, are mounted in pairs, the disk 27 carrying the pistons 18 and 21, the disk 28 carrying the pistons 19 and 22 and the disk 29 carrying the pistons 20 and 23. By this arrangement it will be seen that each disk is provided with two pistons arranged on directly opposite sides. The disk 27 is provided with a sleeve 30, which extends outwardly into the lever-chamber 4. The disk 28 likewise has a sleeve 31 extending out into the lever chamber 4, its protruding portion, however, being shorter than that of the sleeve 30. The disk 29 is provided with a sleeve 32 which extends into the lever-chamber 4 and ends a slight distance nearer the partition 2 than does the sleeve 31. By this arrangement it will be seen that the sleeves within the lever chamber are stepped for a purpose later described.

Carried by the outer ends of the sleeves 30, 31 and 32 are collars 33, 34 and 35. These collars are provided with the arms 36, 37 and 38 extending radially and to which are pivotally connected the arms 39, 40 and 41, which extend upwardly toward the periphery of the fly-wheel, as fully shown in Figs. 3 and 4 of the drawings. Carried by the outer periphery of the fly-wheel 16, are three rock-shafts 42, 43 and 44, which are mounted in bearings 45, 46 and 47, and whereby the said shafts are adapted to oscillate. These rock-shafts, as shown, are arranged one-hundred and twenty degrees (120°) apart on the periphery of the fly-wheel. The inner ends of the rock-shafts have rigidly connected thereto the arms 48, 49 and 50, which have their free ends pivotally connected to the outer free ends of the arms 39, 40 and 41, as fully shown in Figs. 4 of the drawings. The outer ends of the rock-shafts 42, 43 and 44 have rigidly secured thereto the arms 51, 52 and 53, which extend downwardly and having pivotally connected thereto the links 53′, 54 and 55, which have their inner ends pivotally mounted on the stub-pin 13, carried by the head 11 of the lever chamber.

The engine cylinder has arranged at one side a spark plug 56, and at the opposite side is provided with a charge admitting passage 57, having three openings 58, 59 and 60, communicating with the annular passage 17, whereby the proper mixture is admitted to the cylinder. Below the passage 57 are two exhaust passages 61 and 62, having openings 63 and 64 communicating with the annular chamber or passage 17, whereby the engine is exhausted, all of which will be later described.

In operation it being assumed that the mechanism is in the position shown in Figs. 1 and 3, it will be seen that the spark-plug 56 is arranged so that it communicates with the chamber A, between the pistons 18 and 23, and in which chamber the charge has been compressed. When the pistons are in this position, the chamber C is being supplied with an explosive charge through the passages 58 and 59. The chamber B, between the pistons 18 and 19, has previosly received its charge and the charge therein is being compressed by the piston 19 moving faster than the piston 18. The chamber F has just been fired and the charge therein is expanding and working on the piston 22 and through its link connection with the fly-wheel it is exerting a pulling action thereon. The piston 22 is traveling faster than the piston 23 and owing to the specific arrangement and position of the link connection with the piston 23 there is a forward pull upon the fly-wheel by the explosion tending to retard its forward movement. The chamber E is exhausting through the openings 63 and 64, while the chamber D is arriving at a position to receive a charge of the explosive mixture. The pistons all travel to the left in the direction of the arrows Figs. 1 and 2, exerting their force of travel through the mechanism heretofore described to the fly-wheel 16 and when the fly-wheel has traveled one-sixth ($\frac{1}{6}$) of a revolution, the several levers will have assumed the position shown in Fig. 4, and each of their connecting pistons will have advanced to the position of its preceding one, viz., the piston 18 will have reached the position of the piston 23; 19 the position of 18; 20 the position of 19; 21 the position of 20; 22 the position of 21 and 23 the position of 22, whereby an explosion will take place between the positions 18 and 19 and the same operation takes place.

It will be seen that the pistons in their travel in the annular cylinder by virtue of their varied speed produce an intake chamber C, a compression chamber B, a compressed mixture and explosion chamber A, an expansion chamber F and an exhaust chamber E, the chamber D being at atmosphere and of small area. It will be readily seen that in this arrangement large intake and exhaust ports may be provided, an important feature where high speed efficiency is desired.

The pistons 18, 19, 20, 21, 22 and 27 are provided on all four sides with spring pressed packing 65 held outwardly by springs 66, whereby a tight joint between the piston and cylinder is formed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A rotary internal combustion engine, comprising a cylinder, a plurality of pistons therein arranged in pairs, a fly-wheel, means connecting the pistons and fly-wheel whereby a rotary movement is given the fly-wheel, and means arranged eccentric to the fly-wheel

and connected with the pistons whereby they move faster throughout a portion of their cycle than they do the remainder of their cycle.

2. A rotary internal combustion engine, comprising a plurality of pistons, a fly-wheel and means connected to the pistons whereby they transmit rotary movement to the fly-wheel, and separate means arranged eccentric to the fly-wheel whereby the pistons move faster throughout a portion of their cycle than they do the remainder of their cycle.

3. A rotary internal combustion engine, comprising a plurality of pistons, a shaft, a fly-wheel thereon, and means mounted on the said shaft and connecting the pistons and fly-wheel whereby they transmit rotary movement to the fly-wheel, and means arranged eccentric to the shaft and connected to the fly-wheel at the point where the pistons are connected thereto whereby the said pistons move faster throughout a portion of their cycle than they do the remainder of their cycle.

4. A rotary internal combustion engine, comprising a cylinder, six pistons therein, a rotary shaft, a fly-wheel carried by the shaft, means connecting the pistons and the fly wheel whereby they transmit a rotary motion to the said shaft, and means arranged eccentric to the fly-wheel whereby the pistons move faster throughout a portion of their cycle than they do the remainder of their cycle.

5. A rotary internal combustion engine comprising a cylinder, six pistons therein, a rotary shaft, a fly-wheel, the said pistons connected in pairs and mounted on the said shaft, means connecting the pistons and the fly-wheel whereby they transmit rotary motion to the shaft, and means arranged eccentric to the fly-wheel whereby the pistons move faster throughout a portion of their cycle than they do the remainder of their cycle.

6. A rotary internal combustion engine, comprising a cylinder, a plurality of pistons therein, a shaft, a fly-wheel mounted thereon, radial and circumferential movable means connecting the pistons and the fly-wheel whereby rotary motion is transmitted to the shaft, and means arranged eccentric to the fly-wheel and connected thereto, whereby the said pistons move faster through a portion of their cycle than they do the remainder of their cycle.

7. A rotary internal combustion engine, comprising a cylinder, a plurality of pistons therein, a shaft, a fly-wheel mounted thereon, means connecting the pistons and one side of the fly-wheel whereby rotary motion is transmitted to the shaft, and means arranged eccentric to the fly-wheel and connected to the other side thereof, whereby the said pistons move faster through a portion of their cycle than they do the remainder of their cycle.

8. A rotary internal combustion engine comprising a cylinder, a plurality of pistons therein, a shaft, a fly-wheel mounted thereon, a stub-shaft arranged eccentric to the said shaft, a bearing for the said shaft carried by one end of the stub-shaft, means connecting the pistons and the fly-wheel for transmitting rotary motion to the shaft, and means carried by the stub-shaft and connected to the fly-wheel, whereby the said pistons move faster through a portion of their cycle than they do through the remainder of their cycle.

9. A rotary internal combustion engine, comprising a cylinder, a plurality of pistons therein, a shaft, a fly-wheel mounted thereon, movable means connecting the pistons and the fly-wheel for transmitting rotary motion to the said shaft, a separate means eccentric to the fly-wheel and connected thereto, whereby the said pistons move faster through a portion of their cycle than they do through the remainder of their cycle.

10. A rotary internal combustion engine comprising a cylinder, a plurality of pistons therein, a shaft, a fly-wheel mounted thereon, connections between the pistons and fly-wheel and rotatable with them, and connections between the fly-wheel and a point eccentric thereto whereby the said pistons move faster through a portion of their cycle than they do through the remainder of their cycle.

11. A rotary internal combustion engine comprising a cylinder, a shaft, a plurality of pistons loosely mounted upon the shaft and between which the explosion takes place, a fly-wheel rigidly carried by the shaft, connections between the pistons and the fly-wheel whereby they transmit rotary motion to the shaft, and connections between the fly-wheel and a point eccentric thereto whereby the said pistons move faster through a portion of their cycle than they do through the remainder of their cycle.

12. A rotary internal combustion engine, comprising a plurality of pistons, a shaft, a fly-wheel mounted thereon, connections between the fly-wheel and the pistons whereby they transmit rotary motion to the said fly-wheel, and connections having one end connected at a point eccentric to the shaft and the other end connected to the pistons where they are connected to the fly-wheel.

13. A rotary internal combustion engine, comprising a cylinder, a plurality of rotary pistons therein, a rotary shaft, a fly-wheel mounted thereon, rock shafts carried by the outer periphery of the fly-wheel, the said pistons connected to the fly-wheel to transmit rotary motion thereto, links connecting

the rock shafts to an eccentric point on the cylinder whereby the pistons move faster through portions of their cycle than they do through the remainder of their cycle.

14. A rotary internal combustion engine, comprising a cylinder, a plurality of rotary pistons therein, a rotary shaft, a fly-wheel mounted thereon, connections between the pistons and the periphery of the fly-wheel for transmitting rotary motion to the shaft, connections between the periphery of the fly-wheel and a point eccentric to the fly-wheel, whereby the pistons move faster through portions of their cycle than they do through the remainder of their cycle.

15. A rotary internal combustion engine comprising a cylinder, a plurality of rotary pistons therein, a rotary shaft, a fly-wheel mounted on the said shaft, connections between the pistons and the periphery of the fly wheel, and connections between the points of connection between the pistons and the fly-wheel and a point eccentric to the fly-wheel whereby the pistons move faster through portions of their cycle than they do through the remainder of their cycle.

16. A rotary internal combustion engine comprising a cylinder, a plurality of rotary pistons therein, a rotary shaft, a fly-wheel mounted thereon, connections between the pistons and the periphery of the fly-wheel, a stub-shaft carried by the cylinder eccentric to the fly-wheel, and connections between the said stub-shaft and the points where the pistons are connected to the fly-wheel, whereby the pistons move faster through portions of their cycle than they do through the remainder of their cycle.

17. A rotary internal combustion engine, comprising a cylinder, a plurality of rotary pistons therein, a rotary shaft, a fly-wheel keyed upon the shaft, rock shafts carried by the outer periphery of the fly-wheel, links connecting one end of the rock shaft to the piston, links connecting the opposite end of the rock-shaft to the cylinder eccentric to the piston, whereby the pistons move faster through two portions of their cycle than they do through the remainder of their cycle, for compressing and firing a charge between two pistons.

18. A rotary internal combustion engine, comprising a cylinder, a plurality of rotary pistons, a rotary shaft, a fly-wheel rigidly carried by the shaft, rock shafts pivotally mounted upon the outer periphery of the fly-wheel, links connecting the inner ends of the rock-shafts with the pistons, links connected to the outer ends of the rock-shafts and to an eccentric point in the cylinder whereby the pistons move faster through two portions of their cycle than they do through the remainder of their cycle.

19. A rotary internal combustion engine comprising a cylinder having an annular passage adjacent its outer periphery, a shaft extending through the cylinder, sleeves loosely mounted upon the shaft and upon one another, disks carried by the sleeves and extending out to the annular passage, two pistons carried by each disk within the annular passage, outwardly extending arms carried by the sleeves, a fly-wheel rigidly carried by the shaft, rock shafts carried by the outer periphery of the fly-wheel, links connecting the arms carried by the sleeves and the inner ends of the rock shafts, links connecting the outer ends of the rock-shafts and a pivot eccentrically carried by the cylinder, whereby the pistons move faster through two portions of their cycle than they do through the remainder of their cycle.

20. A rotary internal combustion engine comprising a cylinder having an annular passage adjacent its outer periphery, a shaft extending through the cylinder, sleeves loosely mounted upon the shaft and upon each other and having their outer ends in stepped form, disks carried by the inner ends of the sleeves and extending out to the annular passage, two pistons carried by the outer edge of each disk within the annular passage and oppositely arranged on the disk, a fly-wheel rigidly carried by the shaft, upwardly extending arms carried by the ends of the sleeves, rock-shafts mounted in the outer periphery of the fly-wheel, a link connecting the inner ends of each rock-shaft and its respective arm carried by the sleeve, links connected to the outer ends of the fly-wheel and having their inner ends connected to a pin carried eccentrically by the cylinder, a bearing carried by the pin for the outer end of the shaft, whereby the pistons move faster through two portions of their cycle than they do through the remainder of their cycle, for the purpose described.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

IRA BOYD HUMPHREYS.

Witnesses:
MAY HAYS,
ROY S. FROTHINGHAM.