April 29, 1924. 1,492,215

C. L. NEDOMA

ENGINE

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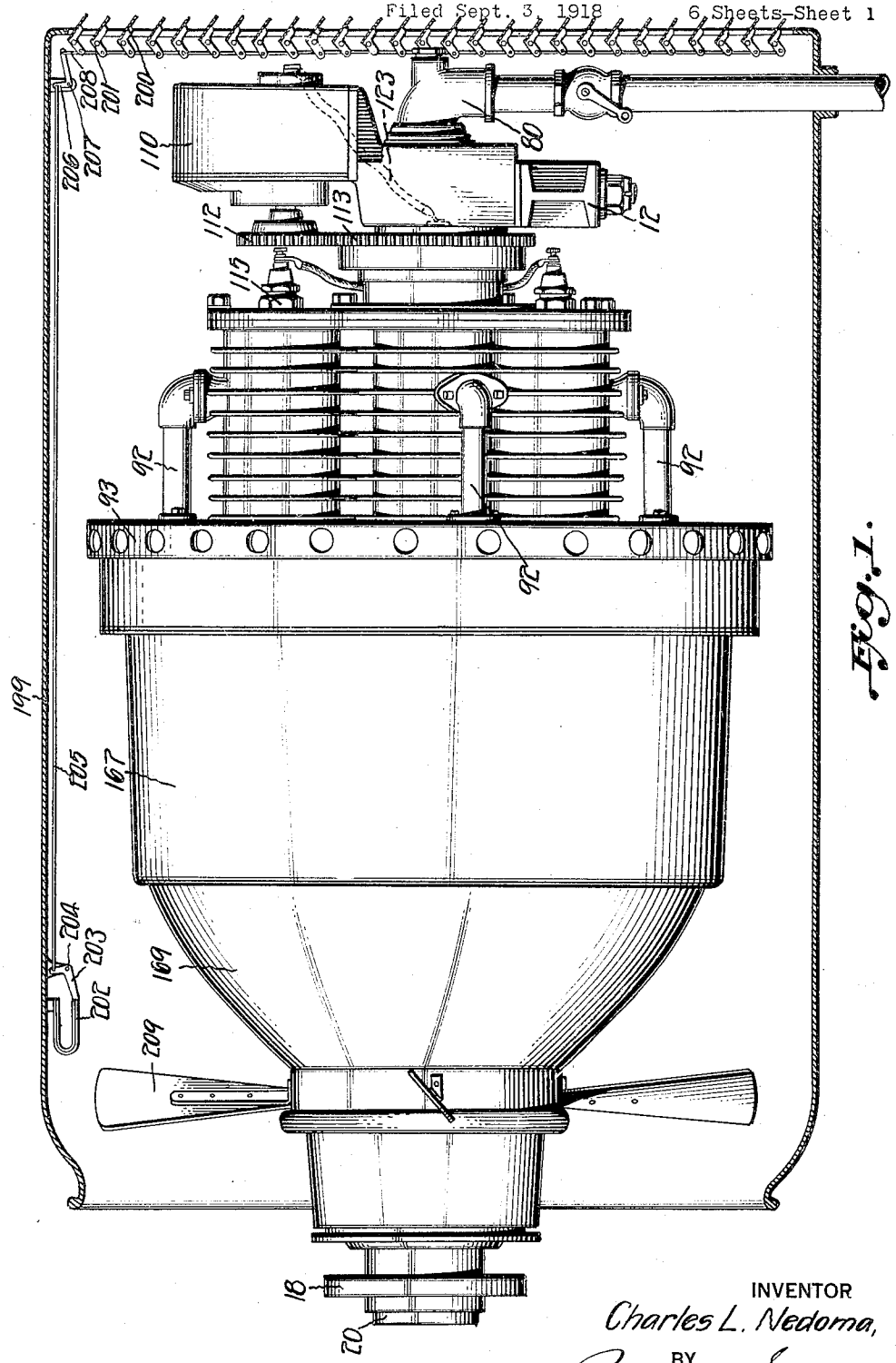


Fig. 1.

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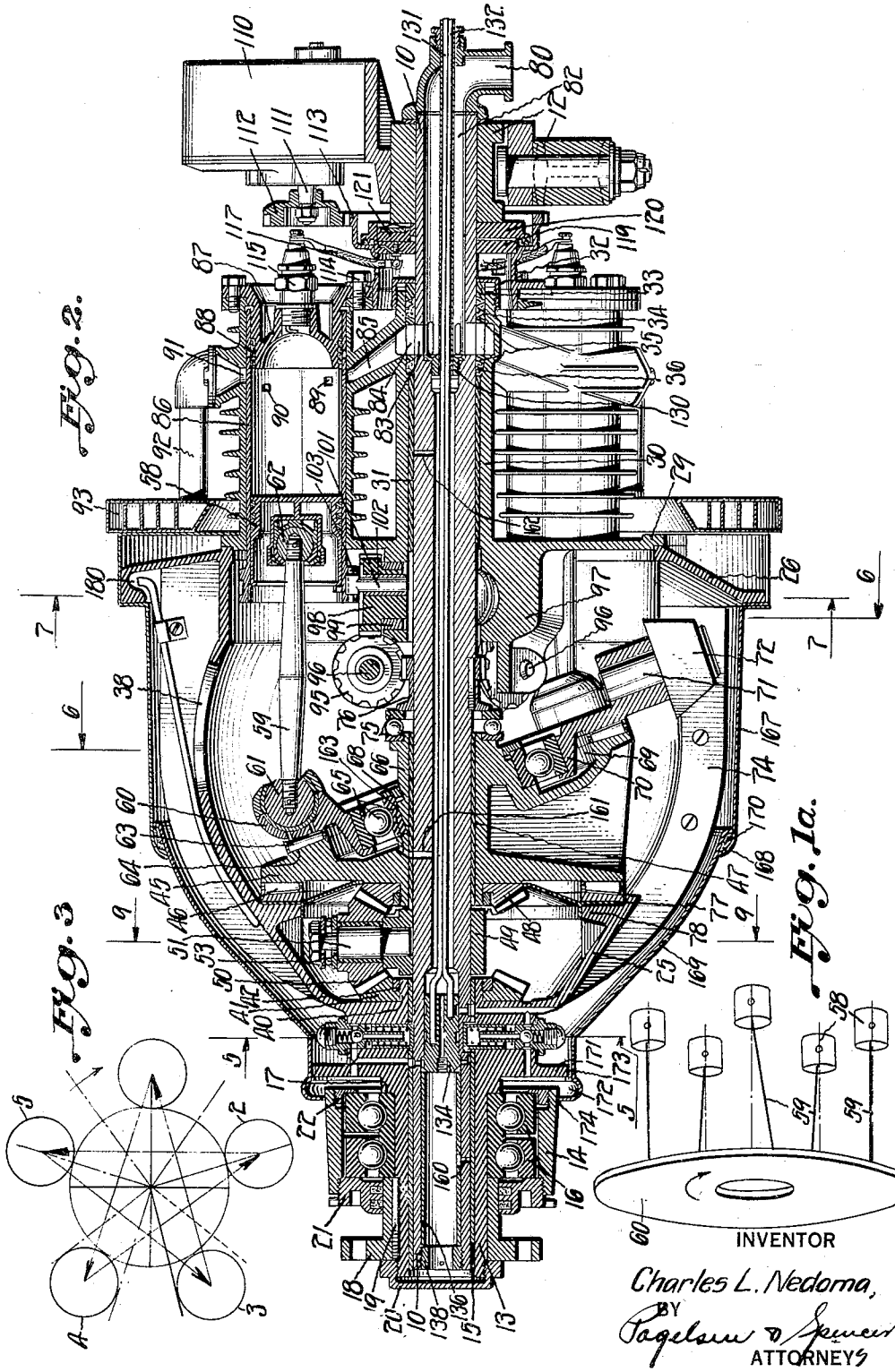


Fig. 2.

Fig. 1a.

Fig. 3

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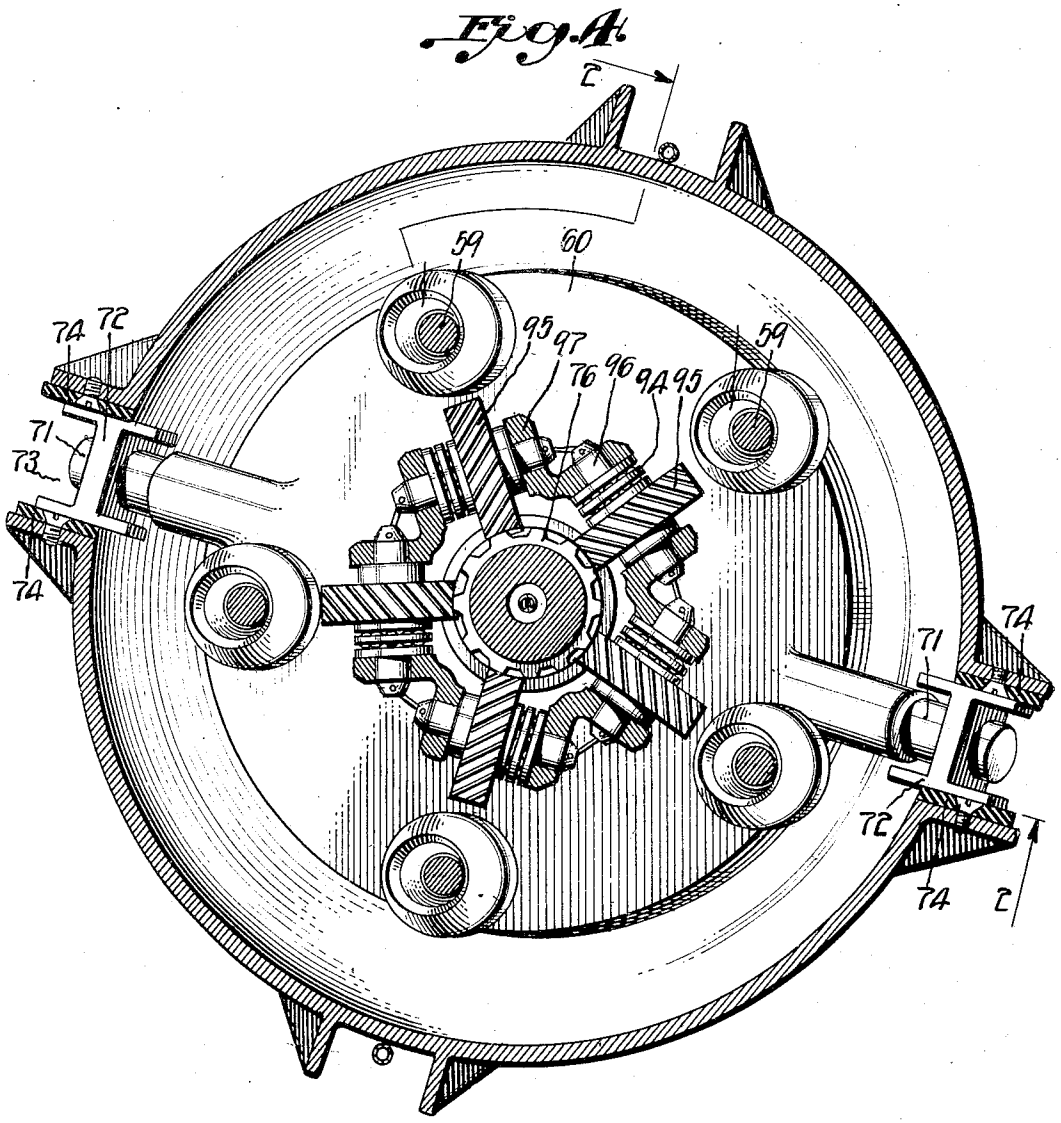
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Fig. 4.



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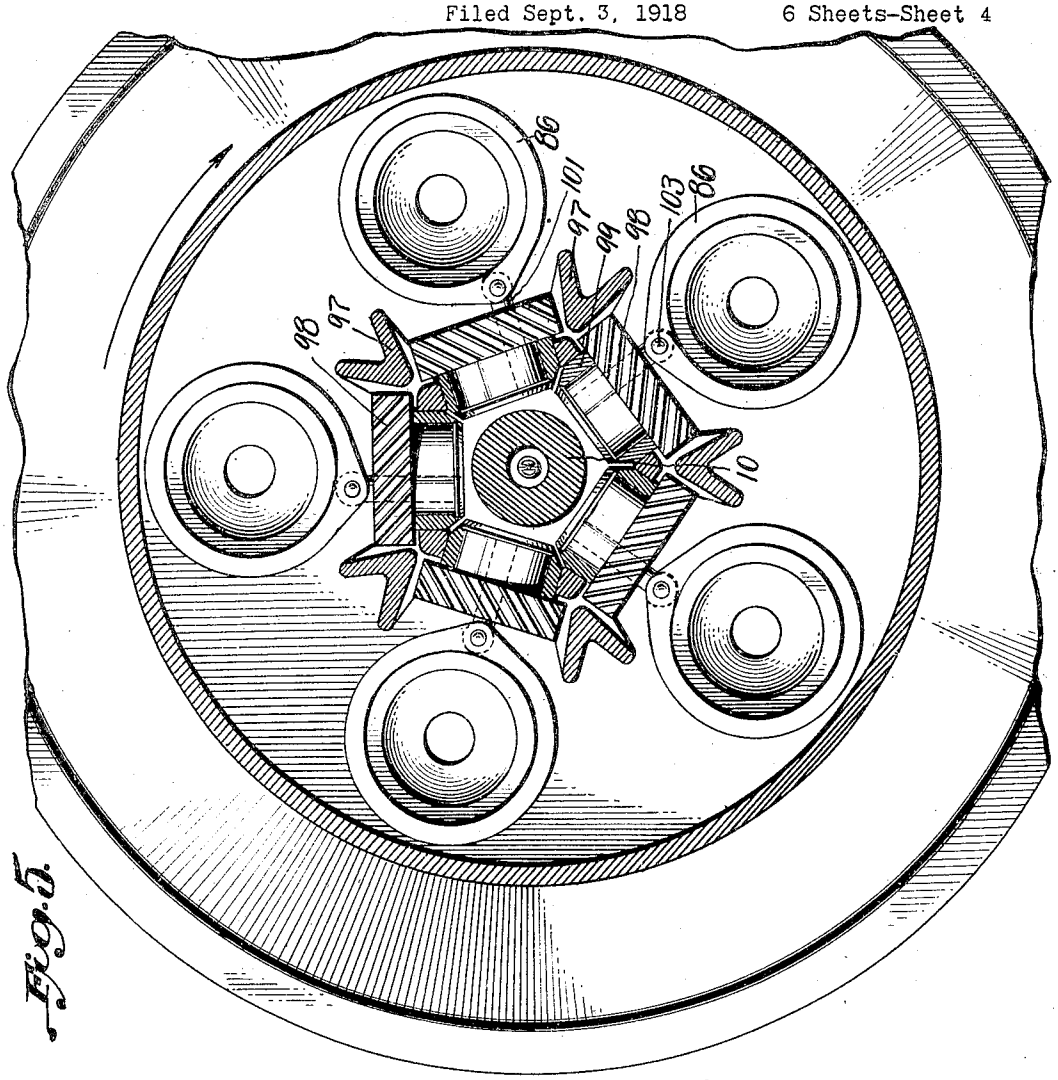


Fig. 5.

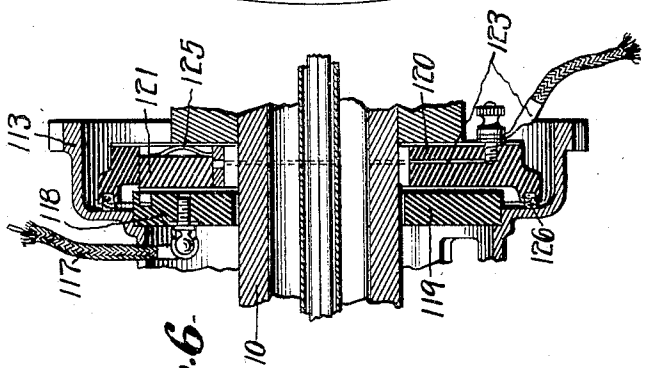


Fig. 6.

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Fig. 7.

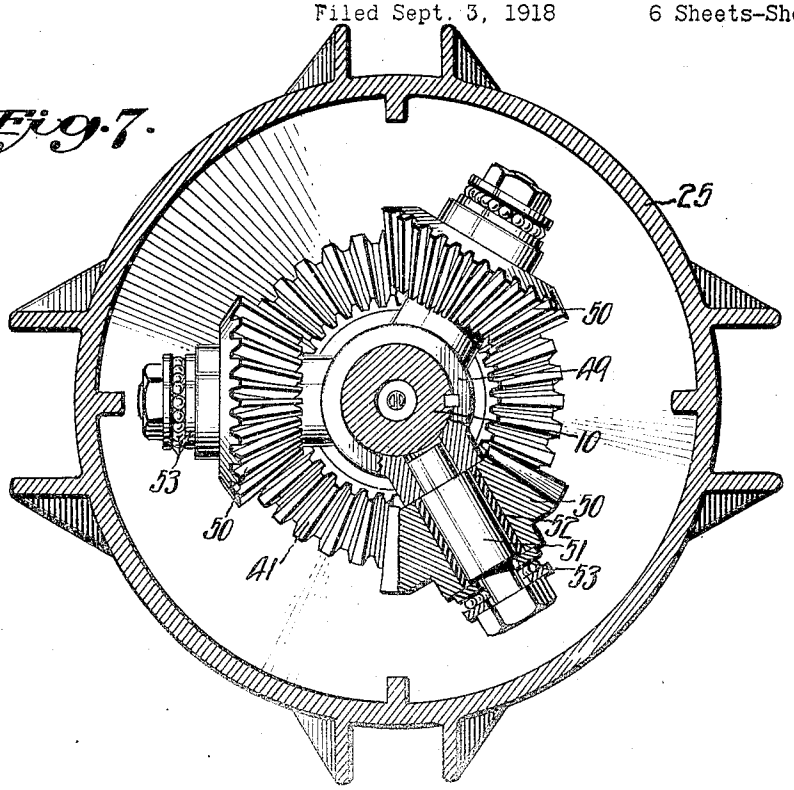
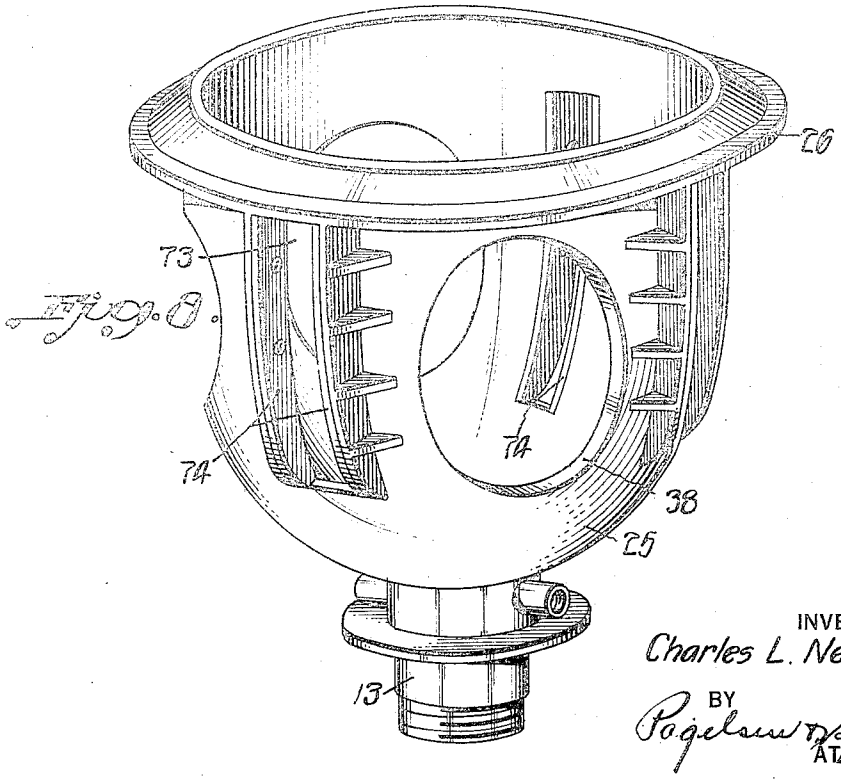


Fig. 8.



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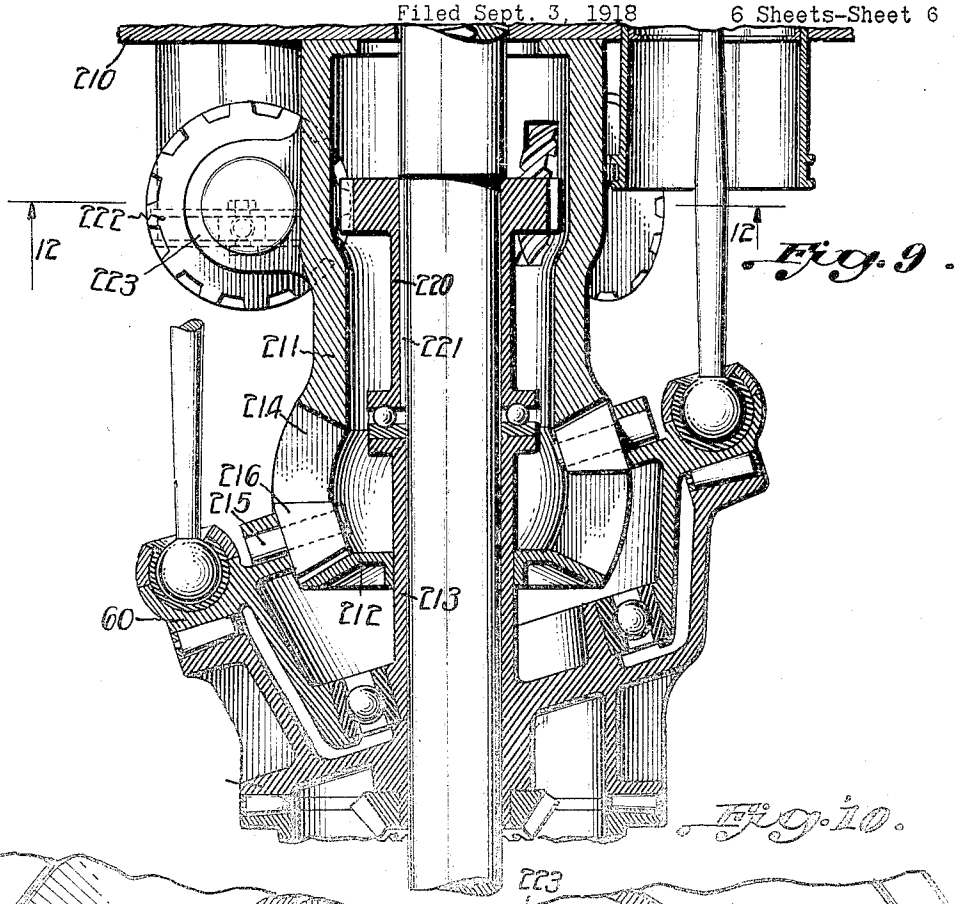
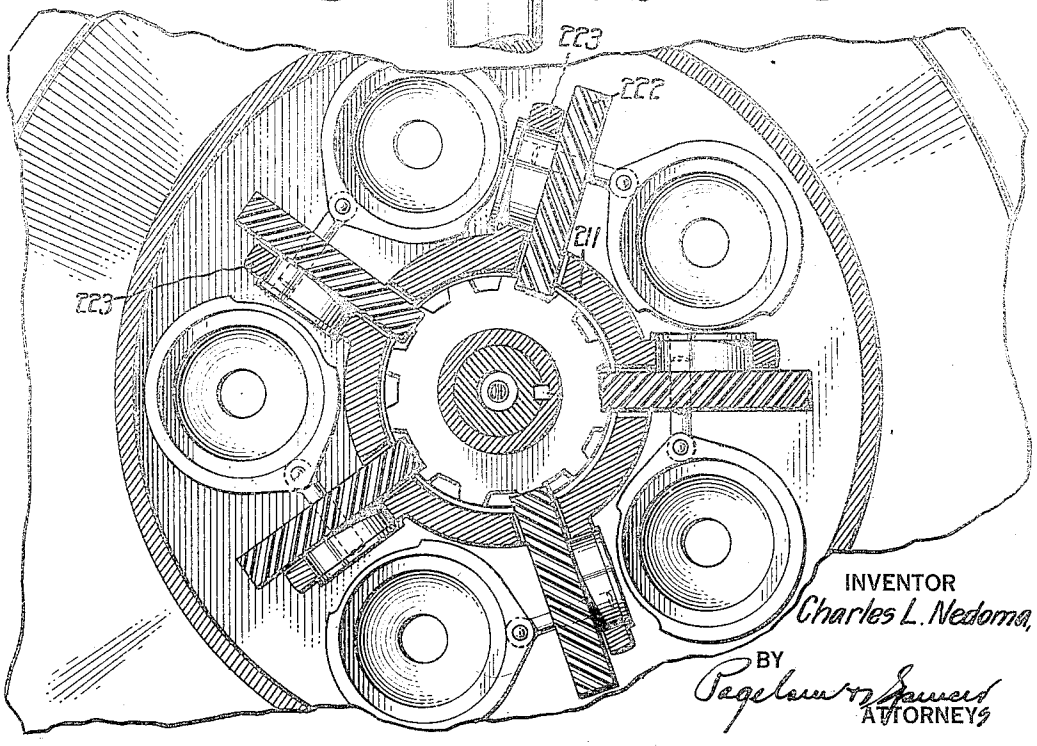


Fig. 9.

Fig. 10.



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UNITED STATES PATENT OFFICE.

CHARLES L. NEDOMA, OF DETROIT, MICHIGAN, ASSIGNOR, BY MESNE ASSIGNMENTS, TO NEDOMA-NAJDER CORPORATION, A CORPORATION OF NEW YORK.

ENGINE.

Application filed September 3, 1918. Serial No. 252,386.

To all whom it may concern:

Be it know that I, CHARLES L. NEDOMA, a citizen of the United States, and residing at Detroit, in the county of Wayne and State of Michigan, have invented a new and Improved Engine, of which the following is a specification.

The invention relates to rotary motors which have cylinders substantially parallel to the axis of the motor, and more particularly to motors of this type wherein the reciprocating movement of the pistons is caused to turn a rotatable driving part through the medium of a rotatable member whose axis is at an acute angle to that of the driving part.

The invention provides means whereby the ratio between the reciprocating movement of the pistons and the angular movement of the motor is such that a full four-cycle movement of the pistons is obtained for each complete revolution of the motor, that is, each piston travels the full length of stroke in one quarter revolution of the motor. Again, the invention very greatly increases the effective leverage of the pistons: this is accomplished by rotating the abutment or support for the inclined rotatable member oppositely to the movement of the member itself.

A further object of the invention is to provide a quiet and efficient valve construction; also to provide an unusually simple valve gear construction.

The invention also relates to an improved casing whereby the connecting rods and associated parts are rendered easily accessible.

The invention further consists in other details of construction shown, described and claimed.

In the drawings, Fig. 1 is a side view of a preferred embodiment of the motor, the casing through which air for cooling is directed being shown in section. Fig 1ª is a diagrammatic side elevation showing the preferred position of the connecting rods relatively to the center lines of the cylinders. Fig. 2 is a longitudinal section of the engine, this section being about on line 2—2 of Fig. 6. Fig. 3 is a firing diagram. Figs. 4 and 5 are sections on the line 6—6 and 7—7 of Fig. 2. Fig. 6 is an enlarged section showing the timing mechanism more clearly. Fig. 7 is a section on the line 9—9 of Fig. 2. Fig. 8 is a perspective view of the barrel. Fig. 9 is a fragmentary longitudinal section showing a modified valve gear. Fig. 10 is a section on line 12—12 of Fig. 9.

Power transmission features.—The stationary shaft 10, preferably hollow, Fig. 2, is carried at one end in a suitable engine support 12 and rests at its opposite end in the rotatable engine hub 13 which is, in turn, carried in a support 14. As shown, a sleeve or bushing 15 is interposed between the shaft and the hub 13, and a double ball bearing 16 is disposed between the hub and the support 14, but other suitable bearings may be used. In the present construction, the hub is shouldered at 17 to form an abutment for the inner race of the bearing and a coupling member or the like 18, keyed to the rotatable hub at 19, serves the double function of holding the inner race properly positioned when the threaded cap 20 is adjusted and of transmitting torque from the hub to a suitable driven element, not shown. Annular elements or caps 21 and 22, threaded into the support 14, position the outer races and retain lubricant.

It will be observed that the hub 13 merges into and forms a part of a barrel 25, Fig. 10, and that the opposite end portion of the latter forms a ring or flange 26 that is bolted and shouldered on a flange 29 on the cylinder block 30. The latter is rotatably supported on the shaft 10 through the medium of the bushing 31, and is provided with the threaded cap 32, follower ring 33, packing 34, spacer 35, and packing 36, whereby a tight joint is formed with the shaft. The barrel has a series of openings or hand holes 38, Fig. 10, through which the access may be had to the interior of the engine.

Near the junction of the main portion of the barrel with the hub 13, the metal is extended inwardly in the form of a gear hub 40 on which the bevel gear 41 is fixed, as by means of the nut 42. This hub is also preferably provided with the bushing 43, Fig. 4, which in effect is a continuation of the bushing 15. Interiorly of the barrel th latter is provided with track 44 by which

the thrust to the left (Fig. 2) of the plate 45, which constitutes a cylindrical wedge, is taken on the roller bearing 46. This wedge is rotatable on the shaft 10, being supported on the bushing 47; and carries a bevel gear 48 which is a duplicate of the gear 41. Between the gears 41 and 48, there is non-rotatable with the shaft 10 although free to slide longitudinally thereof, an annular pinion carrier or spider 49, Figs. 2 and 9, on which a plurality of pinions 50 are mounted as by means of the separate stud shafts 51, the bushings 52 and the thrust bearings 53. These pinions mesh with the gears 41 and 48, consequently rotation of the cylinder block and barrel about the shaft causes the element 45 to turn in the opposite direction and at the same speed, thus doubling the relative angular movement between the cylinder block and the wedge element.

The cylinder block carries a series of cylinders 1, 2, 3, 4, and 5, in the embodiment shown—see particularly Fig. 3—(that may be either integral with the block, as shown, or separated) arranged with their axes parallel to the axis of the shaft, and in these cylinders piston 58 of any suitable construction reciprocate. The pistons are provided with connecting rods 59 and the latter are jointed to a ring 60, the connections being made by spherical heads 61—62, or the equivalent. The ring rides on a roller bearing 63 that travels on a track surface 64 on the member 45, said surface being inclined to the axis of the shaft. In order to center the ring properly a ball bearing 65 is interposed between it and the hub portion 66 of the element 45, the inner race being conveniently held in place by the nut 68. By grooving the member 4 at 69 and by providing the ring with a flange 70, the construction is rendered compact. The ring is operatively connected to the barrel or housing through the medium of the diametrically opposite pins 71 and blocks 72 pivoted thereon, Figs. 2 and 6, said blocks being arranged to reciprocate in the slots 73, Figs 2, 5 and 10, formed in the barrel 25. Preferably the walls of the slots are formed by separate hardened plates 74, Fig. 6. The thrust of the element 45 to the right (Fig. 2) is taken by the thrust bearing 75 which seats against a gear 76 keyed or otherwise rigidly secured to the shaft.

It will be evident from the foregoing that the reciprocation of the pistons causes the ring 60 to turn about the axis of the bearings 63—65, and that the torque of the ring is applied to the rigid element 30—25—13—18, to rotate the latter about the shaft and drive any suitable mechanism or part which may be attached to the coupling 18. The movement of the member 45 oppositely to the ring, as stated heretofore, results, in effect, in a much sharper angle of reaction between the moving parts than could be obtained were the member 45 stationary; and the travel of the piston is thus accomplished in a quarter turn of the engine instead of in a half turn as in earlier constructions.

It is evident that the necessary bearing adjustments between the bearings 46 and 75 for the wedge can be made by the tightening up on the nut 21. Likewise by inserting shims 77 between the track 44 and the annular rib or flange 78 against which it rests, or by removing one or more of said shims, as may be required, it is evident that the gears 41—48 may be brought into proper mesh with the pinions 50, it being remembered that the spider 49 is slidable on the shaft.

As is best indicated in Fig. 1a, it is preferred to incline the connecting rods 59 forwardly (say three degrees) in respect to the center line of the corresponding cylinder, thus doing away with dead centers.

Valves and valve gears.—Various types of valves and valve operating mechanism may evidently be used, and the position of the carbureter and the inlet passages of course depends somewhat on the type selected. However, it is preferred to utilize the hollow shaft for the admission of combustible mixture in which case the carbureter may be attached directly to a fitting 80 on the end of the shaft or to the mixture pipe 81, Fig. 1, the mixture being distributed from the passage 82 through the ports 83, and 84 in the shaft and in the spacer 35 and through the branch passages 85 to the several cylinders. It is also preferred to provide sleeve valves 86 that are interposed between the pistons and the cylinders and are received at the firing ends between the detachable heads 87 and the adjacent walls of the cylinders. Sealing rings 88 set into grooves in the heads serve an obvious purpose. These valves are provided with inlet ports 89 and exhaust ports 90 adapted to register respectively with the inlet passages 85 and the exhaust passages 91, the latter preferably being connected by fittings 92 to a muffler 93.

In the embodiment shown, the fixed gear 76 is of the helical type, and meshes with a series of helical gears 95, one for each cylinder, that are provided with thrust bearings 94, Fig. 6, and turn on shafts 96 carried in bosses 97 formed on the cylinder block 30; and the gears 95 in turn mesh with gears 98 which are arranged radially about the shaft and supported in bearings 99 carried by the block 30. The pitch of the teeth of the gears 76—95—98 is such that the gears 98 make one complete revolution for each revolution of the cylinder block. It will be observed that each of the gears 98 carries an eccentric pin 101 with respect to which the corre-

sponding gear freely turns (a bushing 102 being preferably interposed) and that the pins are pivotally connected to the corresponding sleeve valves 86 by pins 103 the axes of which are parallel to the shaft 10. Therefore, there is imparted to the valves 86 a compound sliding and oscillating motion, it being understood that the ports are so arranged as to bring a particular port 89 into registration with the corresponding passage 85 for inlet purposes during one outward stroke of the piston (which is accomplished during the time the cylinder block turns ninety degrees) and that the exhaust port 90 in like manner registers with the passage 91 while the piston is traveling in the opposite direction but not in the stroke immediately following. In other words, the engine shown operates on the four-cycle principle and each cylinder completes a full cycle for each revolution of the cylinder block.

Ignition.—Current may be derived from any suitable source but in the embodiment shown the support 12 carries a magneto 110 the armature shaft 111 of which is driven by a pinion 112 which meshes with a gear 113 secured to the cylinder block 30 by the same bolts 114 that hold the cylinder heads in place. The spark plugs appear at 115 and each is connected to a corresponding contact 116, Fig. 8, by a conductor cable 117 and conductor 118. The contacts are carried in an insulator block 119 that is secured in the hub of the gear 113. A timer plate 120 formed of insulating material and fixed nonrotatably to the shaft 10 carries a suitable brush 121, connected to the magneto by a cable or conductor 123 and pressed against the face of the block 119 by a spring 125. The other branch of the circuit is formed by grounding the magneto to the support 12, as is obvious. A pad or ring 126 of soft material such as felt excludes dirt from the working parts.

By properly connecting the cables 117 to the spark plugs, the cylinders may be fired in the sequence shown in Fig. 3, that is, 1—4—2—5—3—1, (the engine turning in the direction of the arrow), which gives rise to a very desirable overlapping of impulses. Thus, in a five cylinder engine, assuming that the piston in cylinder 1 is at the beginning of its working stroke, cylinder 2 will have finished two fifths of its suction stroke, cylinder 3 will have completed four fifths of its working stroke, cylinder 4 will have completed one fifth of its compression stroke and cylinder 5 will be through three fifths of its exhaust stroke. That is, the main pressures are, at the instant under consideration, transmitted to the ring from the cylinders 1 and 3 (working pressures) and from the cylinder 4 (compression), and cylinders 3 and 4 tend to balance the pressure from 1 so far as stresses tending to tilt the ring 60 on the member 45 are concerned. The same general advantages occur at all times and regardless of the direction of rotation of the engine. This firing system may, of course, be modified and adapted to engines of this type wherein the number of cylinders is different from that shown.

It is evident that the same number of impulses are secured per revolution with a five cylinder four-cycle engine of this type as have been attained heretofore in a ten cylinder engine; in other words the present engine is, in this respect, the equivalent of prior engines of double its number of cylinders.

Modified power transmission, Fig. 9.—In some cases the driving force may be transmitted from the ring 60 to the cylinder block 210, which corresponds to the block 30, by means of an inner barrel 211 which may be either separate from said block, as shown, and rigidly connected thereto in any suitable manner, or integral therewith. In the embodiment shown, the barrel has an end wall 212 which bears on the hub 213 of the member 45, thus securing a rigid support. By slotting the barrel at 214 and providing the pins 215 and shoes 216 corresponding to the pins 71 and shoes 72 heretofore described, it is evident that torque is transmitted to drive the cylinder block substantially as before.

Modified valve gears, Figs. 9 and 10.—A somewhat more direct drive for the valves may be secured by substituting for the gear 76 a similar gear 220 keyed to the shaft at 221 the helical teeth of which mesh with those of the gears 222 which are supported in bearings 223 and carry the pins 224 corresponding to the pins 101. The connection between the pin and the associated sleeve valve 86 is as before, and the diameter and pitch of the gears is such as to cause one complete turn of the gears 222 for each revolution of the engine.

The engine thus constructed is especially adapted to aeroplane motors as it permits the use of aluminum to a great extent. The cylinders and pistons may be made of light metal and the sleeve valves of cast iron or steel. The element 13—25 may also be made of aluminum. This, with the lesser number of cylinders, pistons, connecting rods, etc., involved, results in a motor of very light weight as compared with existing types. The engine is equally well adapted for general purposes, such as on vehicles or motor boats; and certain features thereof, for example, the power transmitting elements and valve gear, may be applied to steam engines as well as to those of the internal combustion type or other mechanism such as pumps or compressors.

Various changes may be made in the details of construction of the several features

involved without departing from the spirit of the invention. I do not, therefore, wish to be limited except as indicated by the subjoined claims.

I claim:—

1. An engine comprising a non-rotatable shaft, a rotatable structure embodying cylinders and pistons, a wabbling element having an axis inclined to that of the shaft, said element being rotatable about the shaft, means whereby the reciprocation of the pistons tends to rotate the rotatable structure in one direction, and means for simultaneously rotating the wabbling element in the opposite direction.

2. A rotary internal combustion engine including a fixed shaft and a plurality of cylinders parallel thereto and rotatable about the shaft, pistons reciprocable therein, and means connecting the pistons and shaft whereby an intake stroke, a compression stroke, an explosion stroke and a scavenging stroke are set up in the cylinders in the order stated during each complete revolution of said cylinders, said means including an element rotatable about an axis at an acute angle to, and intersecting the axis of the shaft and a support for said last named element rotatable about the shaft in the opposite direction.

3. A rotary engine including a fixed shaft and comprising a plurality of cylinders disposed around the shaft and parallel thereto and rotatable about the shaft, a wedge rotatable on the shaft, a ring traveling on the wedge and rotatable about an axis at an acute angle to the axis of the shaft, pistons for the cylinders, means for applying force from the pistons to the ring to cause the latter to turn about its axis, means for causing the ring to rotate the cylinders, and means associated with the cylinders and the wedge for turning latter about the shaft in a direction opposite to the movement of the cylinders and at the same speed.

4. A rotary engine including two elements, the first a shaft, the second element having a plurality of cylinders spaced about the shaft and substantially parallel thereto, means for transmitting force from one of said elements to the other to cause relative rotation, said means including pistons for the cylinders, a ring on which pressure from the pistons is exerted, said ring being inclined to the axis of the shaft, a wedge concentric with the shaft and receiving the thrust of said ring, means connecting the ring to one of the elements to transmit torque, means for turning the wedge about the axis of the shaft and relatively to both of said elements, said second element having a track on which pressure from the ring is exerted, said track being farther from the axis of the shaft than is the means for turning the wedge.

5. A rotary engine including a shaft and a structure rotatable about the shaft and having a plurality of cylinders spaced about the shaft and substantially parallel thereto, pistons reciprocable in the cylinders, means connecting the pistons with the rotatable structure to cause the latter to turn as the pistons reciprocate, said means including a ring having its axis inclined to that of the shaft, a wedge concentric with the shaft and on which the ring is rotatable, means for rotating the wedge oppositely to the direction of movement of the rotatable structure, said structure having a track, co-axial with the shaft, on which the wedge travels, the track being positioned farther from the axis of the shaft than are the inner edges of the bores of the cylinders.

6. An engine comprising a first member forming a shaft, a second member disposed about the shaft and having cylinders parallel thereto, pistons for the cylinders, means for causing the pistons to rotate one of the members, said means including a ring through which the shaft passes, said ring being inclined to the axis of the shaft, means for transmitting torque from the ring to the rotatable member, a wedge concentric with the shaft and co-operating with the ring, means for rotating the wedge oppositely to the direction of movement of the rotatable member and at the same speed, a bearing, concentric with the shaft and positioned substantially at the extreme outer edge of the wedge on the side thereof nearest the wedge rotating means, whereon the thrust of the wedge is received.

7. An engine comprising a fixed shaft, a member rotatable about the shaft and having cylinders parallel thereto, pistons for the cylinders, a ring through which the shaft passes, said ring being inclined to the shaft and being connected to the rotatable member to turn the latter by a sliding connection, a rotatable wedge through which the shaft passes and on which the ring is mounted, and means for rotating the wedge oppositely to the movement of the first named rotatable member, said means including a pair of gears, one fixed to the first named rotatable member and the other to the wedge, and a pinion rotatable about a fixed pivot carried by the shaft and meshing with the gears.

8. An internal combustion engine comprising a shaft, a cylinder block rotatable thereon and having a plurality of cylinders disposed parallel thereto, an annular track having an axis at an angle to and intersecting the axis of the shaft, a ring rotatable thereon and connected to the block to drive the latter, pistons for the cylinders, said pistons exerting pressure on the ring to rotate the latter about the axis of the track, means for imparting to the track an angular

movement relative to the ring, and a bearing supporting the track along the outer edge thereof, said bearing being located on the side of the track opposite to that at which the ring is located.

9. An engine comprising a first element forming a shaft and a second element forming a plurality of cylinders parallel thereto, pistons for the cylinders, one of the elements being rotatable in respect to the other, a rotatable wedge co-axial with the shaft and having an annular track the axis of which is inclined to that of the shaft, a ring-like member co-axial with the track and rotatable thereon, means connecting the ring-like member to the rotatable element to drive the latter, a bearing interposed between the ring-like member and the track, a second bearing interposed between the wedge and the ring-like element and being positioned considerably nearer the shaft than the first mentioned bearing, and a third bearing co-axial with the shaft and interposed between the wedge and the rotatable element, and means for rotating the wedge oppositely to the movement of the rotatable element.

10. An internal combustion engine comprising two elements, one a shaft and the other a plurality of parallel cylinders spaced around the shaft and parallel thereto, one of the elements being rotatable about the axis of the shaft, pistons for the cylinders, means connecting the pistons to the shaft for causing the pistons to turn the rotatable element, a casing for the connecting means, said casing including a pair of sheet metal members one of which is telescopic on the other longitudinally of the shaft.

11. In an internal combustion engine having a plurality of parallel cylinders disposed about a shaft and pistons for the cylinders, together with means for turning the cylinders about the shaft as the pistons reciprocate, casing means for said last named means, said casing means including a tubular sheet metal member having an end portion with an inturned end and a second flaring sheet metal member having an end portion with an outturned edge enclosed by the first named end portion, and packing between said edges.

12. An engine comprising a first element forming a shaft and a second element having a plurality of cylinders parallel thereto, one of the elements being rotatable about the axis of the shaft, pistons for the cylinders, a ring revoluble about an axis inclined to that of the shaft, connecting rods joining the pistons and ring, said rods being inclined slightly forwardly in respect to the axes of the cylinders, whereby dead centers are avoided.

13. An internal combustion engine having an odd number of cylinders rotatable around a fixed shaft, a wabbler ring rotatable on said shaft, means interposed between said cylinders and wabbler ring to cause them to rotate in opposite directions and means for successively firing said cylinders in the order of first, third, fifth etc. whereby the forces acting on said wabbler ring will be substantially balanced.

14. Means for transmitting force from a plurality of parallel cylinders to an element rotatable about an axis parallel thereto, said means including pistons for the cylinders, a ring on which the pistons exert pressure, said ring being inclined to the axis of the rotatable element, said rotatable element being slotted lengthwise of the shaft, and a block pivotally connected to the ring and slidable in the slot for transmitting torque from the ring to the rotatable element.

15. A rotary engine comprising a hollow shaft and a cylinder block having a cylinder parallel to said shaft, means for supplying fuel mixture to the opening in the shaft, a branch passage in the block leading to the cylinder, a bearing interposed between the block and the shaft, a tubular spacer surrounding the shaft and having a port connecting the space within the shaft to the branch passage, and means, separate from the spacer, for sealing the joint between the shaft and the block, on both sides of the spacer.

16. A rotary engine comprising a hollow shaft and a cylinder block having a cylinder parallel to said shaft, means for supplying fuel mixture to the opening in the shaft, a branch passage in the block leading to the cylinder, a bearing interposed between the block and the shaft, a tubular spacer surrounding the shaft and having a port connecting the space within the shaft to the branch passage, packing interposed between the spacer and the bearing, and a gland for sealing the joint between the shaft and the block on the opposite side of the spacer.

17. An engine comprising a fixed shaft, a member rotatable about the shaft and having cylinders parallel thereto, pistons for the cylinders, a ring through which the shaft passes, said ring being inclined to the shaft and being connected to the rotatable member to turn the latter, a rotatable wedge through which the shaft passes and on which the ring is mounted, a bevel gear carried by the wedge, another bevel gear carried by the rotatable member, bevel pinions radially disposed about the shaft and meshing with the gears, said pinions being movable longitudinally of the shaft, and means for establishing proper relative adjustment between the gears, whereby they may be made to mesh properly with the pinions.

18. An engine comprising a first member forming a shaft, a second member disposed about the shaft and having cylinders

parallel thereto, pistons for the cylinders, means for causing the pistons to rotate one of the members, said means including a ring through which the shaft passes, said ring being inclined to the axis of the shaft, means for transmitting torque from the ring to the rotatable member, a wedge concentric with the shaft, and co-operating with the ring, means for rotating the wedge oppositely to the direction of movement of the rotatable member and at the same speed, a thrust bearing between the wedge and shaft, and means for adjusting the second member longitudinally of the shaft to secure proper adjustment of the bearing.

19. A rotary internal combustion engine comprising a non-rotatable shaft and an odd number of cylinders parallel thereto and rotatable about the shaft, pistons reciprocable therein, means connecting the pistons and shaft whereby an explosion stroke and an exhaust stroke are set up in each cylinder during each revolution of said cylinders, said means including an element rotatable about an axis at an acute angle to and intersecting the axis of the shaft, and means for successively firing non-adjacent cylinders whereby force tending to twist the ring across its axis is reduced.

20. In a rotary internal combustion engine, a shaft, a plurality of cylinders parallel to said shaft and revoluble therearound, a support for said shaft, a cylinder carrying element on which said cylinders are mounted, a sleeve extension rotatable with said cylinder carrying element passing through said support and anti-frictional bearings between said extension and support.

CHARLES L. NEDOMA.