Dec. 9, 1952 T. DUCKWORTH 2,620,778

ALTERNATING PISTON ROTARY MOTOR

Original Filed Sept. 25, 1946 4 Sheets-Sheet 1

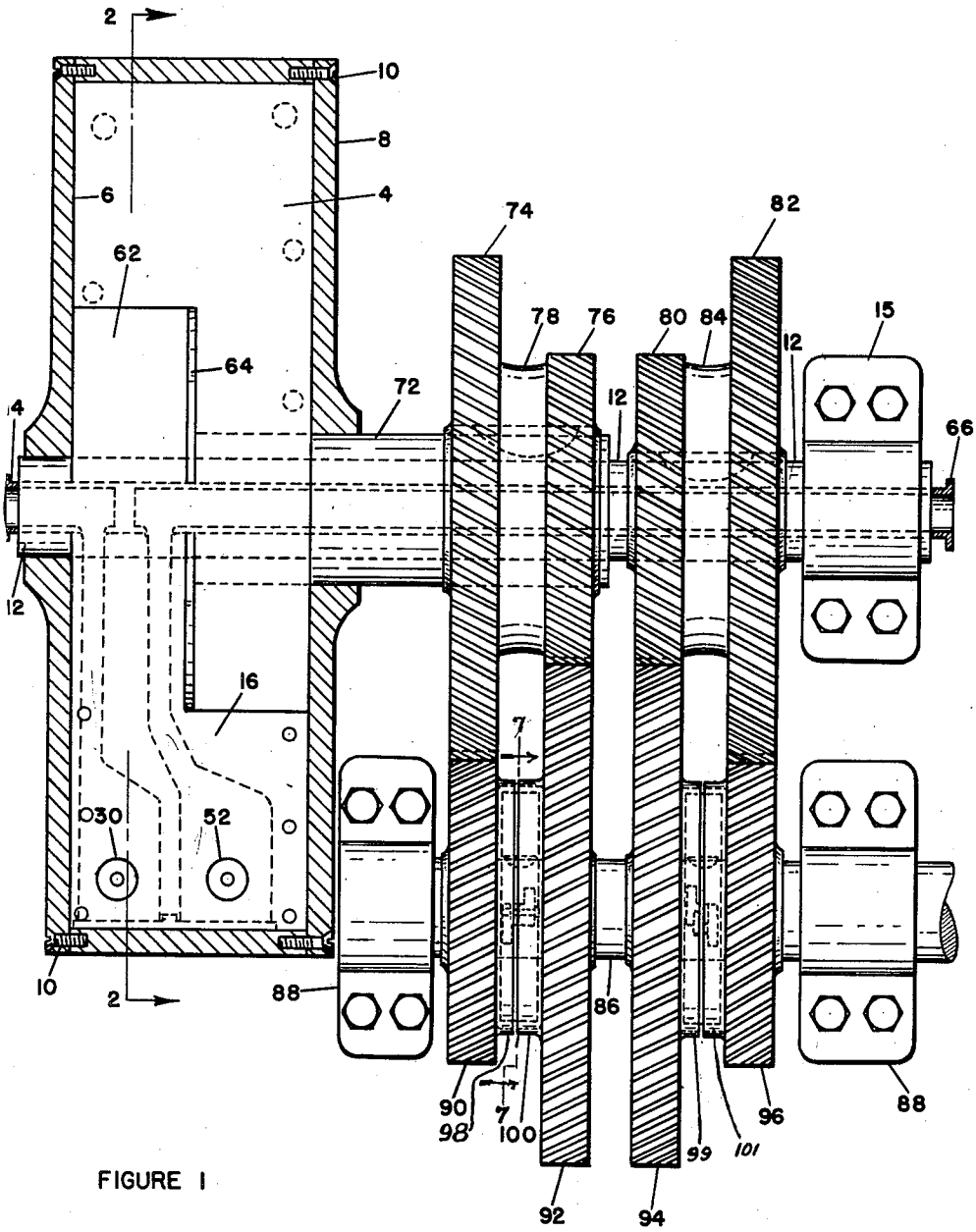


FIGURE 1

INVENTOR.

THOMAS DUCKWORTH

BY Victor J. Evans & Co.

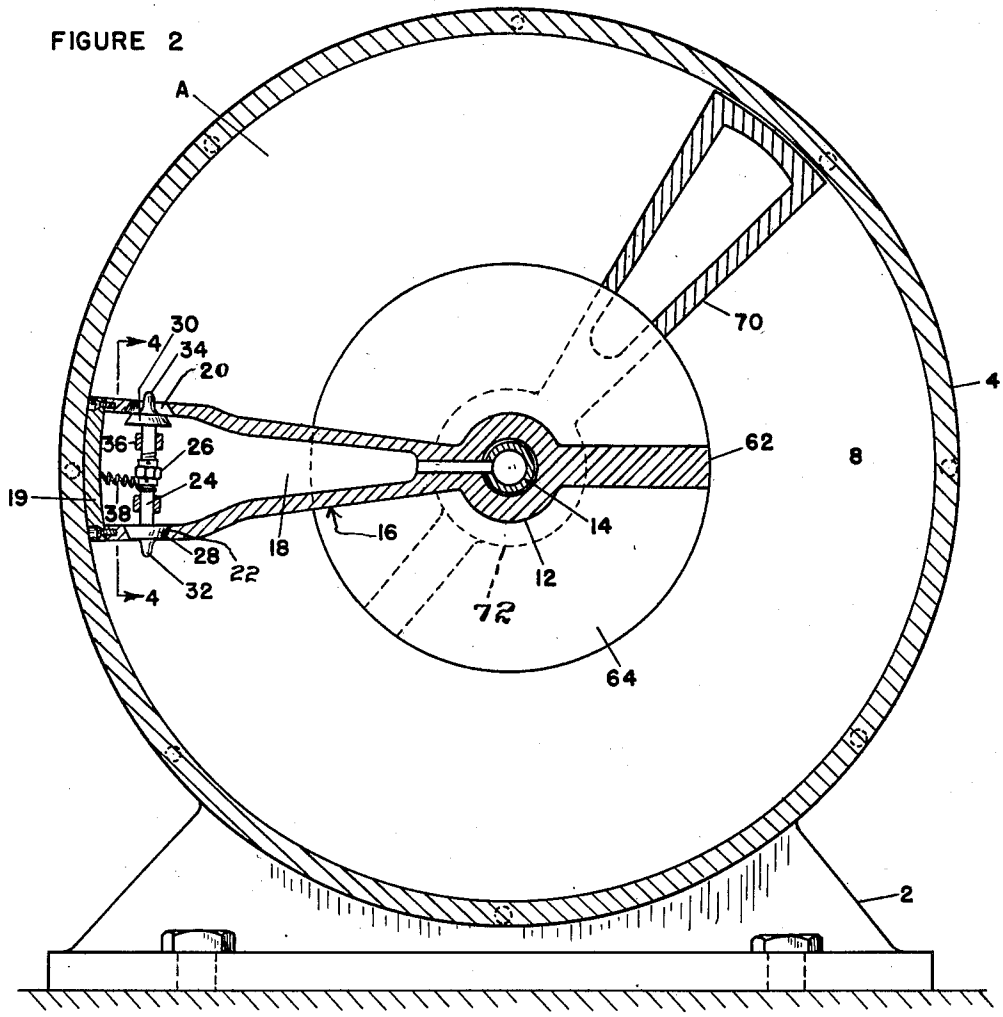
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FIGURE 2



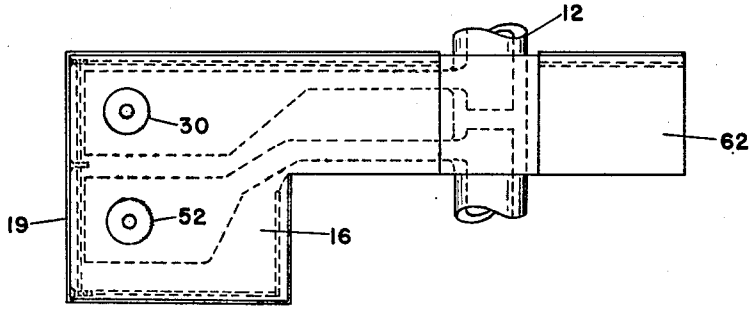


FIGURE 3

INVENTOR.

THOMAS DUCKWORTH

BY *Victor J. Evans & Co.*

ATTORNEYS

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FIGURE 4

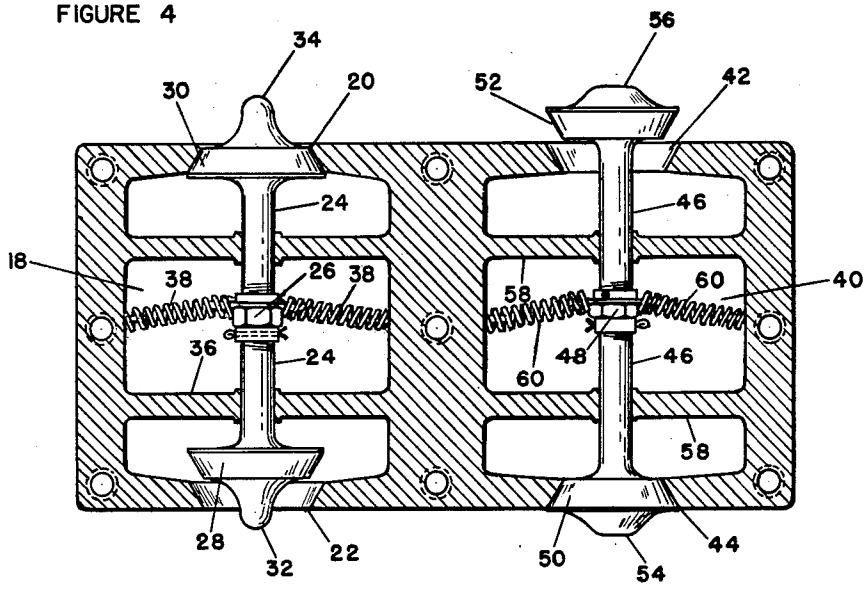


FIGURE 5

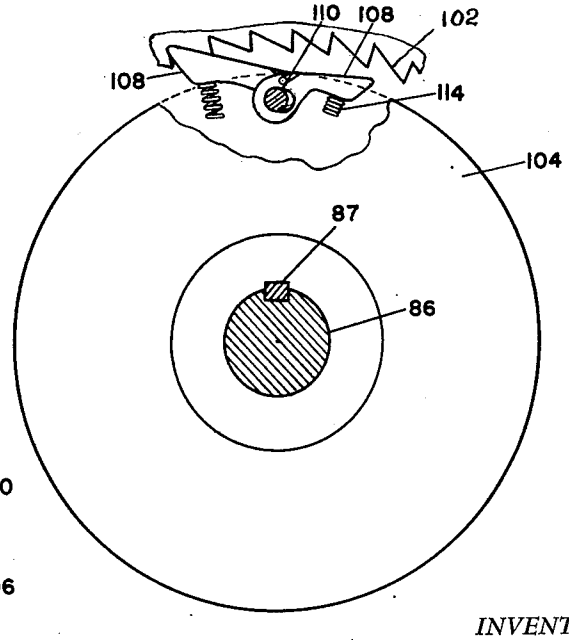
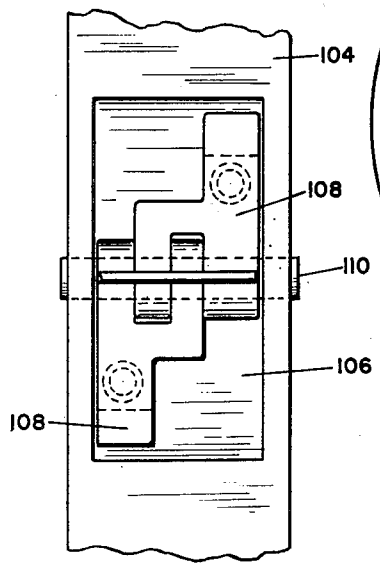


FIGURE 6



INVENTOR.

THOMAS DUCKWORTH

BY Victor J. Evans & Co.

ATTORNEYS

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FIGURE 7

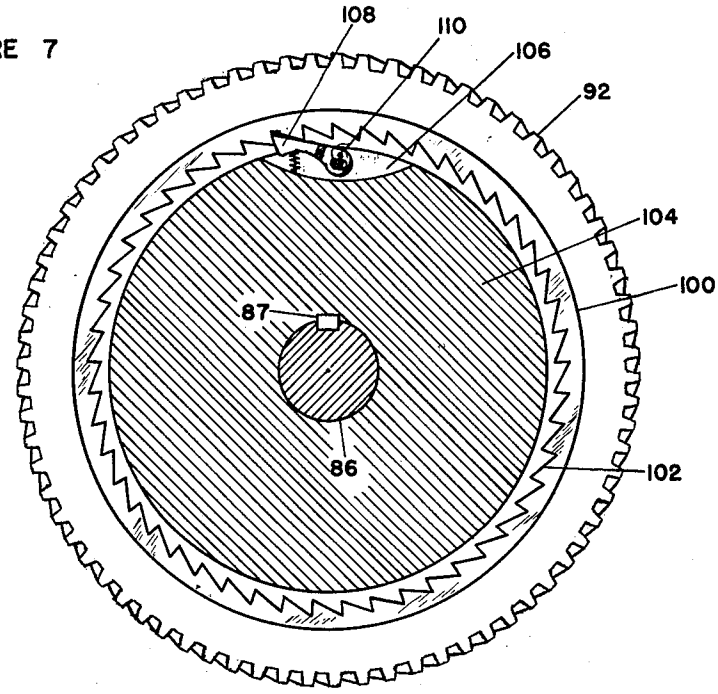


FIGURE 8

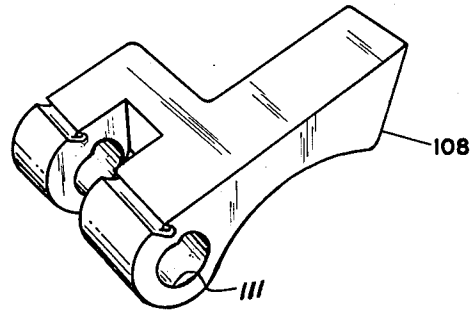
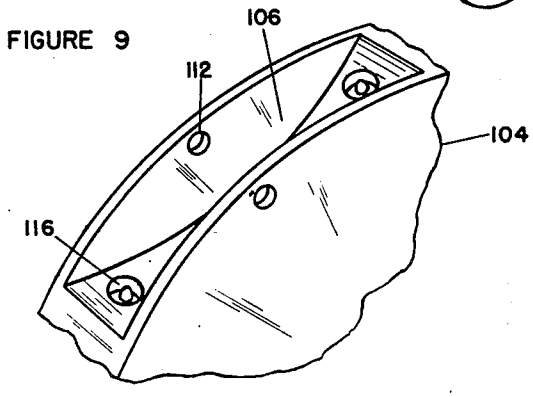


FIGURE 9



INVENTOR.

THOMAS DUCKWORTH

BY *Victor J. Evans & Co.*

ATTORNEYS

Patented Dec. 9, 1952

2,620,778

UNITED STATES PATENT OFFICE

2,620,778

ALTERNATING PISTON ROTARY MOTOR

Thomas Duckworth, Glenview, Ill.

Continuation of abandoned application Serial No. 699,234, September 25, 1946. This application November 12, 1949, Serial No. 126,849

7 Claims. (Cl. 121—49)

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My present invention relates to an improved expansible chamber engine and more particularly to the type of engine comprising a confining chamber with rotors therein movable relative to the housing in the chamber and movable relative to each other under the pressure of admitted vapor under pressure.

In the structure of my invention all parts with the exception of the reciprocating valves are unidirectional and the powered shaft usable as desired for providing power for automobiles, airplanes and the like is continuously driven in a single direction with no perceptible break in the supply of power as is unavoidable in reciprocating engines.

The invention will be described in conjunction with the accompanying drawings, in which:

Fig. 1 is a top plan view of the engine and gearing with the housing cut away to show the interior thereof;

Fig. 2 is a vertical sectional view at line 2—2 of Fig. 1;

Fig. 3 is a detail view of a rotor arm;

Fig. 4 is a sectional view of the rotor at line 4—4 of Fig. 2;

Fig. 5 is a front elevational view of the clutch disk;

Fig. 6 is a detail view of a clutch dog;

Fig. 7 is a vertical sectional view of the clutch;

Fig. 8 is a detail view of the dog; and

Fig. 9 is a detail view of the clutch disk showing the well for the dogs.

While the invention is susceptible of various modifications and alternative constructions, it is herein shown and will hereinafter be described in a preferred embodiment, but it is not intended, however, that the invention be limited thereby to the particular embodiment shown. On the contrary, it is intended to cover all modifications and alternative constructions falling within the spirit and scope of the invention as defined in the appended claims.

Referring now to the drawings wherein like characters indicate like parts, I have illustrated the engine of my invention comprising a supporting base 2 upon which is mounted the cylinder or drum 4 enclosed by the end plates 6 and 8, secured to the drum by means of screws 10.

A rotor shaft 12 is provided centrally of the drum or cylinder 4 and this shaft is hollow to accommodate the intake tube 14. The outer end of the shaft is journaled and supported as at 15. Vapor under pressure is admitted through suitable connections and from a desirable source to the inlet tube 14 from whence the vapor passes into the rotor 16 mounted on and secured

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to the shaft 12. An inlet passage 18 connects with the inlet tube 14 and the outer end of the rotor is closed as by end plate 19. Suitable sealing rings are provided to prevent the expanding vapor and/or gases from passing by the rotor as the vapor exhausts from the rotor.

Opposed ports 20 and 22 are provided in the walls of the rotor and in communication with the passage 18, and the valve rods 24 adjustably secured together by collar 26 are formed with valves 28 and 30 on the respective rods, and these valves are provided with extensions 32 and 34 respectively. The rods reciprocate in the guides 36 against the tension of the springs 38. It will be apparent that the opposed ports cannot be simultaneously closed inasmuch as the distance between the valves is less than the distance between the ports so that one port only will be closed at any given time.

An outlet passage 40 in the rotor communicates with the opposed outlet ports 42 and 44 and the valve rods 46 adjustably secured to each other by collar 48 are fashioned with the valves 50 and 52 operable outside the rotor to selectively close the ports 42 or 44, and these valves also have extensions thereon as 54 and 56. Guides 58 for these rods permit the reciprocation thereof and the spring 60 provides the necessary tension.

Counterweight 62 extends on the opposite side of the shaft from the rotor while the disk 64 forms a nave in the chamber. The outlet passage in the rotor communicates with the exhaust tube 66 in the shaft 12 terminating at the outer journaled end thereof.

Also located within the drum is the rotor 70 secured to a hollow rotor shaft 72 and this rotor presents plane surfaces to the expanding vapors discharged into the housing chamber while the rotor 70 is fashioned with suitable sealing devices to prevent the passage thereby of the vapors.

On the shaft 72 I provide a large driven gear 74 and a small drive gear 76 with the intermediate hub 78 suitably keyed to the shaft. On the shaft 12 I provide a small drive gear 80 and a large driven gear 82 with the intermediate hub 84.

A parallel torque transmitting shaft 86 is journaled as at 88 alongside the concentric rotor shafts 12 and 72 and on this shaft I provide a small drive gear 90 meshing with the driven gear 74; a large driven gear 92 meshing with the drive gear 76; a large driven gear 94 meshing with the drive gear 80 and a small drive gear 96 meshing with the driven gear 82.

Each of the gears on the torque transmitting

shaft 86 is free to rotate on the shaft and is adapted, during operation of the motor, alternately to be connected and disconnected from the shaft through over-running clutch means.

Thus, between the drive gear 90 and the driven gear 92 I provide a ratched drum 98 integrally connected to the gear 90 and a second ratched drum 100 similarly connected to the gear 92. As best seen in Fig. 7, a disk 104 is keyed to the shaft 86 by a key 87 and is provided with a well 106 in the periphery thereof. A pin 110 is mounted in the holes 112 located on that portion of the periphery of the drum which forms the side walls of the well and carries dogs 108. The dogs are pivotally and slidably mounted on the pin through the medium of slotted bearings 111. Springs 114 seated at 116 in the well urge each of the dogs outwardly into contact with the ratches of drums 98 and 100, respectively. The dogs and ratches for the drum 98 are directed opposite to the dog and ratches for the drum 100.

The gears 94 and 96 are similarly connected to the shaft 86 through the medium of over-running clutches 99 and 101 constructed in the same manner as the clutches 98 and 100.

By virtue of the arrangement just described, I provide two gear trains. The first gear train includes the gears 76, 92, 96 and 82, while the second is through the gears 80, 94, 90 and 74.

The operation of my device is as follows: With the parts in the position shown in Fig. 2, vapor under pressure introduced through the inlet 14 passes through the interior 18 of the rotor 16 and exhausts through the port 20 into the chamber A formed by the side walls of the drum and the two rotors. The effect of the expanding vapor is to urge both rotors toward rotation in opposite directions. The rotors, however, are connected together by one of the gear trains just described to give one of the rotors a mechanical advantage over the other. Thus, in the operation described, the rotor 16 urges the shaft rotor 12 toward rotation in a counterclockwise direction (as seen in Fig. 2) while the rotor 70 urges the rotor shaft 72 toward rotation in a clockwise direction. Drive gear 80 meshing with the driven gear 94 is clutched to the torque transmitting shaft 86 through the over-running clutch 99 to rotate the shaft. Gears 92 and 96 are free to rotate on the shaft when power is supplied in the manner described, and gear 90 is clutched to the torque transmitting shaft to drive gear 74. Thus, the rotor 16 is given a mechanical advantage over the rotor 70 to drive the rotor 70 in the same direction as the rotor 16 but at a slower rate. When the rotor 16 overtakes the rotor 70, the intake and exhaust valves are reversed and vapor is admitted to the space between the rotors but on the opposite side of the rotors. When this occurs the rotors attempt to rotate in a direction opposite to the attempted direction of rotation first described. When this occurs the shaft 86 is rotated through the medium of drive gear 76 and driven gear 92 while the gear 90 idles freely on the shaft. At the same time the gear 94 also may idle on the shaft while drive gear 96 is clutched to the torque transmitting shaft to drive the rotor shaft 12 in the same direction as the rotor shaft 72 (but at a slower rate) through the driven gear 82.

It can be seen from the foregoing, that by changing gear ratios in the gear trains I can alter the operation of the motor to suit any required operating condition. By providing a 1:4 mechanical advantage of one rotor over the other, the slow rotor will rotate but a quarter of a turn while the faster rotor rotates a complete turn, and reversal takes effect after the faster rotor has rotated approximately 480°. By making the ratio 1:10, the slow rotor will rotate 36° while the faster rotates 360° and reversal will take effect when the faster rotor has rotated approximately 400°. By making the ratio 1:1.5, the faster rotor will rotate three times or 1080° before the reversal takes place, during which time the second rotor of course rotates 720° or two revolutions. By this arrangement my motor can be run as a slow speed, high power motor, or as a high speed, low torque motor.

This application is a continuation of my pending application, Serial No. 699,234, filed on September 25, 1946, now abandoned.

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

1. A rotary engine comprising an annular cylinder, a single pair of rotors in the cylinder and defining therebetween and with the cylinder a chamber, a passage in one rotor communicating with a source of fluid under pressure, opposed ports in said rotor to connect the passage with the chamber on either side of the rotor, connected valves for the ports selectively operable to close one port and permit discharge of fluid from the other port, an exhaust passage in the rotor and connected valve means to connect the exhaust passage with the chamber on either side of the rotor, means operating upon contact of the rotor with the other rotor to shift the valves to reverse the direction of discharge and exhaust, a first rotatable rotor shaft having one of the rotors mounted thereon, a second rotatable rotor shaft surrounding the first shaft and having the other rotor mounted thereon, a first pair of gears of different diameter fixed to the first rotor shaft with the larger of the gears being a driven gear and with the smaller being a drive gear, a second pair of gears of different diameter fixed to the second rotor shaft with the larger of the last mentioned pair of gears being a driven gear and with the smaller being a drive gear, a torque transmitting shaft, a third pair of gears of different diameter on the torque transmitting shaft with the larger of the last mentioned pair of gears being a driven gear and with the smaller being a drive gear, a fourth pair of gears of different diameter on the torque transmitting shaft with the larger of the last mentioned pair of gears being a driven gear and having a diameter greater than the drive gear on the rotor shaft and with the smaller being a drive gear, with the drive gears on the rotor shafts being smaller in diameter than and in constant mesh with the driven gears on the torque transmitting shaft and with the drive gears on the torque transmitting shaft being smaller in diameter than and in constant mesh with the driven gears on the rotor shafts, an over-running clutch for each gear on the torque transmitting shaft and connecting said gears to the torque transmitting shaft, the clutches for the drive gears on the torque transmitting shaft permitting over-running of said drive gear in opposite directions and the clutches for the driven gears on the torque transmitting shaft permitting over-running of said driven gears in opposite directions.

2. A rotary engine comprising an annular cylinder, a single pair of rotors in the cylinder defining therebetween and with the cylinder a pair of alternately expanding and contracting chambers, one of said rotors having formed therein

a fluid supply passage and a fluid exhaust passage each opening to the chambers formed on opposite sides of said rotor, valve means carried by said passaged rotor controlling the passages therein and operable upon coming together of said rotors to reverse the supplying and exhausting of fluid to and from said chambers, a first rotor shaft having said passaged rotor fixed thereon and having therein a first axial passage communicating with the supply passage in said rotor and opening through one end of said shaft and a second axial passage communicating with the exhaust passage in said rotor and opening through the other end of said shaft, a second rotor shaft surrounding said first shaft and having the other of said rotors fixed thereon, a first pair of whole gears fixed on said first rotor shaft, a second pair of whole gears fixed on said second rotor shaft, a torque transmitting shaft, a third and a fourth pair of whole gears rotatably mounted on said power torque transmitting shaft, the individual gears of said third and said fourth pair being in constant mesh with individual gears of said first and said second pair, said gears being of a diameter such that one set of meshing gears of each said first and third and second and fourth pairs is adapted to form a gear train giving the rotor fixed on said first rotor shaft a mechanical advantage over the rotor on said second rotor shaft and the remaining gears are adaptable to form a gear train giving the rotor on said second rotor shaft a mechanical advantage over the rotor on said first shaft, and an over-running clutch operatively interposed between said torque transmitting shaft and each of the gears thereon, said clutches permitting one gear of each said third and fourth pair to overrun said torque transmitting shaft in one direction and permitting the remaining gears to overrun said torque transmitting shaft in the opposite direction.

3. A rotary engine comprising an annular cylinder, a single pair of rotors in the cylinder defining therebetween and with the cylinder a pair of alternately expanding and contracting chambers, fluid supplying and exhausting passages communicating with said chambers through said rotors, valve means carried by said rotors controlling said passages and operable upon coming together of said rotors to reverse the supplying and exhausting of fluid to and from the chambers, a first pair of gears of different diameter fixed to rotate with one of said rotors, a second pair of gears of different diameter fixed to rotate with the other of said rotors, the smaller and the larger gears of said first and said second pair of gears being respectively of the same diameter, a torque transmitting shaft, a third pair of gears of different diameter rotatably mounted on said torque transmitting shaft with the smaller of said third pair of gears being smaller than and constantly in mesh with the larger of said first pair of gears and the larger of said third pair of gears being larger than and constantly in mesh with the smaller of said first pair of gears, a fourth pair of gears of different diameter rotatably mounted on said torque transmitting shaft with the smaller of said fourth pair of gears being smaller than and constantly in mesh with the larger of said second pair of gears and the larger of said fourth pair of gears being larger than and constantly in mesh with the smaller of said second pair of gears, the smaller and the larger gears of said third and said fourth pair of gears being respectively of the same diameter, and an over-running clutch operatively interposed between said torque transmitting shaft and each of the gears thereon, said clutches permitting the larger gears to overrun said torque transmitting shaft in one direction and permitting the smaller gears to overrun said torque transmitting shaft in the opposite direction.

4. A rotary engine comprising an annular cylinder, rotary means including a single pair of rotors in said cylinder defining therebetween and with the cylinder a pair of alternately expanding and contracting chambers, fluid supplying and exhausting passages communicating with said chambers through said rotary means, valve means carried by said rotary means controlling said passages and operable upon coming together of said rotors to reverse the supplying and exhausting of fluid to and from said chambers, a torque transmitting shaft, a first gear unit comprising a pair of relatively fixed gears rotatable with one said rotors, a second gear unit comprising a pair of relatively fixed gears rotatable with the other of said rotors, four clutch gears rotatable on said torque transmitting shaft and each constantly in mesh with a different one of the gears of said gear units, said gears being selected to form two gear trains between said rotors having the same gear ratio but with the ratio running in opposite directions, and said gear trains connecting said rotors for rotation in the same direction relative to each other, and an over-running clutch between each of said clutch gears and said torque transmitting shaft selectively operable dependent upon the attempted direction of rotation of said clutch gears relative to the shaft to couple two of the clutch gears to said torque transmitting shaft to complete one of said gear trains between said rotors and to couple the rotor having the mechanical advantage to said shaft whereby to drive said shaft constantly in one direction and the rotors constantly in the same direction but at alternately faster and slower relative speeds.

5. A rotary engine comprising an annular cylinder, rotary means including a single pair of rotors in said cylinder defining therebetween and with the cylinder a pair of alternately expanding and contracting chambers, fluid supplying and exhausting passages communicating with said chambers through said rotary means, valve means carried by said rotary means controlling said passages and operable upon coming together of said rotors to reverse the supplying and exhausting of fluid to and from said chambers, a torque transmitting shaft, a pair of whole gear trains adapted to connect said rotors for rotation in the same direction, each of said gear trains including a pair of clutch gears free on said torque transmitting shaft, said gear trains reversing the mechanical advantage between said rotors, and an over-running clutch operatively interposed between said torque transmitting shaft and each of said clutch gears, said clutches being arranged selectively to clutch the clutch gears of one or the other gear trains to said take-off shaft dependent upon the attempted direction of rotation of said clutch gears relative to the torque transmitting shaft.

6. A rotary engine comprising an annular cylinder, rotary means including a single pair of rotors in said cylinder defining therebetween and with the cylinder a pair of alternately expanding and contracting chambers, fluid supplying and exhausting passages communicating with said chambers through said rotary means,

valve means carried by said rotary means controlling said passages and operable upon coming together of said rotors to reverse the supplying and exhausting of fluid to and from said chambers, a pair of gear trains interposed between said rotors and including whole gears constantly in mesh and a torque transmitting shaft, each of said gear trains when operative giving one of the rotors a mechanical advantage over the other to rotate the other rotor in the same direction at a slower relative speed, and a plurality of over-running clutches operatively interposed between said torque transmitting shaft and certain gears of each gear train selectively rendering said gear trains operative and selectively coupling the gear trains to the torque transmitting shaft dependent upon the attempted direction of rotation of said certain gears of the gear trains relative to the shaft.

7. A rotary engine comprising an annular cylinder, rotary means including a single pair of rotors in said cylinder defining therebetween and with the cylinder a pair of alternately expanding and contracting chambers, fluid supplying and exhausting passages communicating with said chambers through said rotary means, valve means carried by said rotary means controlling said passages and operable upon coming together of said rotors to reverse the supplying and exhausting of fluid to and from said chambers, a

torque transmitting shaft, gear means comprising only whole gears constantly in mesh and adapted to connect said rotors to said shaft, and a plurality of over-running clutch means operatively interposed between said torque transmitting shaft and certain of the gears of said gear means and selectively operable to complete gear trains including said shaft connecting said rotors together for rotation in the same direction, said gears trains alternately giving each one of said rotors a mechanical advantage over the other.

THOMAS DUCKWORTH.

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