This invention relates to rotary sleeve valve engines in which the sleeve is simultaneously given a reciprocating and a rotary movement.

5 Heretofore considerable difficulty has been experienced in simultaneously reciprocating and rotating a sleeve in an engine of this type primarily due to the tendency of the sleeve actuating means to cause the sleeve to bind in the cylinder. This binding tendency of the sleeve has increased wear between the sleeve and cylinder and also causes wear in the sleeve actuating means, so that use will render the operation of the parts inefficient.

The general object of the present invention is to overcome the foregoing disadvantages of the prior art by the provision of improved sleeve actuating means and of means for frictionlessly positioning the sleeve so that the tendency of the sleeve to bind is eliminated.

20 A further object of the invention resides in providing the intake and exhaust ports on the same side of the cylinder in alignment with the bearing means for positioning the sleeve whereby the differential pressure on the inside and outside of the sleeve will hold the sleeve in substantial leak-proof engagement with the cylinder wall adjacent the ports.

Another object of the invention is the provision of sealing rings in conjunction with the rotating reciprocating sleeve which serve to seal between the sleeve and the cylinder.

It is an object of the invention to provide an engine of this type in which the arrangement and movement of the parts gives a long-wearing, smoothly-performing and efficient engine.

The above and other objects of the invention are achieved by the apparatus illustrated in the accompanying drawings wherein:

Figure 1 is a transverse, vertical sectional view taken through an embodiment of the invention;

Figure 2 is a horizontal sectional view on line 2—2 of Figure 1, with the view being broken off so that only one cylinder and its mechanism is shown;

Figure 3 is a horizontal sectional view on line 3—3 of Figure 1; and

Figure 4 is a fragmentary view of a modified form of means for moving the sleeve.

For illustrative purposes the invention has been shown and described in conjunction with a four stroke cycle gasoline engine having aligned air cooled cylinders, although it will be understood that the principles of the invention are broadly applicable to pumps and motors of all types.

Referring to the drawing the numeral 6 indicates a motor crank case upon which is mounted a plurality of aligned cylinders which may take the form of individual air cooled cylinders 7, one only being shown in the drawing. Each cylinder 7 is capped by a suitable head 8, formed to receive charge firing means such as a spark plug 9. A crank shaft 11 is journaled in the case 6 and is connected to a piston 12 in the cylinder 7 through the agency of a connecting rod 13.

A sleeve 14 is provided between the piston 12 and the cylinder 7, which sleeve is formed with diametrically opposite openings or ports 15, which are adapted to register with an exhaust port 16, and an intake port 17 formed in the cylinder 7.

(See Figure 3.) Expanding piston rings 18 and internal contracting rings 19 serve to seal between the piston and sleeve and between the sleeve and cylinder respectively.

The lower end of the sleeve 14 is cut on an angle (see Figure 1) so that one side thereof is a distance "X" above the other side thereof. A worm gear 21 is provided on the bottom of the sleeve 14, which gear is cut or generated to conform with the angle on the bottom of the sleeve.

The worm gear 21 is driven from an auxiliary shaft 22, journaled in the crank case 6, which shaft is provided with a worm 23 which engages with the worm gear 21. The auxiliary shaft 22 is driven from the crank shaft 11 thru suitable gearin 24, 25 and 26.

The relation between the gearing 24, 25 and 26 and the worm 23 and worm gear 21 is such in the embodiment of the invention shown, that the sleeve 14 will revolve one half a revolution while the crank shaft 11 is revolving twice.

In order to prevent the sleeve 14 from binding in the cylinder, frictionless bearing means are provided to hold the worm gear 21 in engagement with the worm 23. In the form of the invention illustrated these means comprise a combined radial and thrust bearing 27, journaled on a suitable boss 28 in the crank case 6, which bearing is formed with a flange 29 engaging with and behind a bevel 30 on the lower end of the sleeve 14.

To assist in properly positioning the worm gear 21 with respect to the worm 23, the bottom of the cylinder 7 is not cut on an angle but is formed with a narrow arcuate lug 31 which extends downward and bears against the upper side of the worm gear 21.

In utilizing the invention with a plurality of aligned cylinders every other worm and mating worm gear is made of opposite hand so that there is no end thrust on the shaft 22. Moreover the shaft 22 revolves as shown in the arrows so that the downward thrust of the worm on the sleeve is received by the bearing 27, so that there is but little frictional wear between the lug 31 and the upper edge of the worm gear 21.

In the embodiment of the invention illustrated in Figure 4, the worm 23 and the worm gear 21 have been replaced by helical gears 32 and 33. The bearing means for preventing the sleeve...
What is claimed is:

1. In combination in an engine, a cylinder, a valve sleeve in said cylinder, means for simultaneously reciprocating and rotating said sleeve, a piston mounted for reciprocating movement in said sleeve, means synchronizing the movements of said piston and said sleeve and holding the sleeve out of substantial wearing contact with any one portion of the cylinder wall.

2. In combination in an engine, a cylinder, a valve sleeve in said cylinder, means for rotating said sleeve, and means for holding the sleeve out of substantial wearing contact with any one portion of the cylinder wall.

3. In combination in an engine, a cylinder, a valve sleeve in said cylinder, gear means for actuating said sleeve, a piston mounted for reciprocating movements in said sleeve, means synchronizing the movements of said piston and said sleeve and holding the sleeve out of substantial wearing contact with any one portion of the cylinder wall.

4. In combination in an engine, a cylinder, a valve sleeve in said cylinder, gear means for simultaneously reciprocating and rotating said sleeve, a piston mounted for reciprocating movement in said sleeve, means synchronizing the movements of said piston and said sleeve and means for holding said gear means in engagement and the sleeve out of substantial wearing contact with any one portion of the cylinder wall, said means including a circular member which is journaled adjacent the lower edge of the sleeve, the lower and inner edge of the sleeve being beveled and the outer periphery of the circular member being cut to engage with and behind the beveled end of the sleeve.

5. In combination in an engine, a cylinder, a valve sleeve in said cylinder, gear means for simultaneously reciprocating and rotating said sleeve, a piston mounted for reciprocating movement in said sleeve, means for holding the sleeve out of substantial wearing contact with any one portion of the cylinder wall, said means including a circular member which is journaled adjacent the lower edge of the sleeve and which engages with and behind the lower edge of the sleeve.

6. In combination in an engine, a cylinder, a valve sleeve in said cylinder, and means for holding the sleeve out of substantial wearing contact with any one portion of the cylinder wall, said means including a circular member which is journaled adjacent the lower edge of the sleeve, the lower and inner edge of the sleeve being beveled and the outer periphery of the circular member being cut to engage with and behind the beveled end of the sleeve.

7. In combination in an engine of the type described, a cylinder, a sleeve valve in said cylinder, gear means including a helical gear on the bottom of the sleeve valve for simultaneously reciprocating and rotating said valve, bearing means engaging the lower edge of the sleeve and holding the helical gear on the bottom of the sleeve in engagement with its actuating gear means, said cylinder being formed with intake and exhaust ports in alignment with the bearing means.

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