J. E. FRIEND.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED AUG. 27, 1912.

1,101,794.

Patented June 30, 1914.

6 SHEETS—SHEET 1.

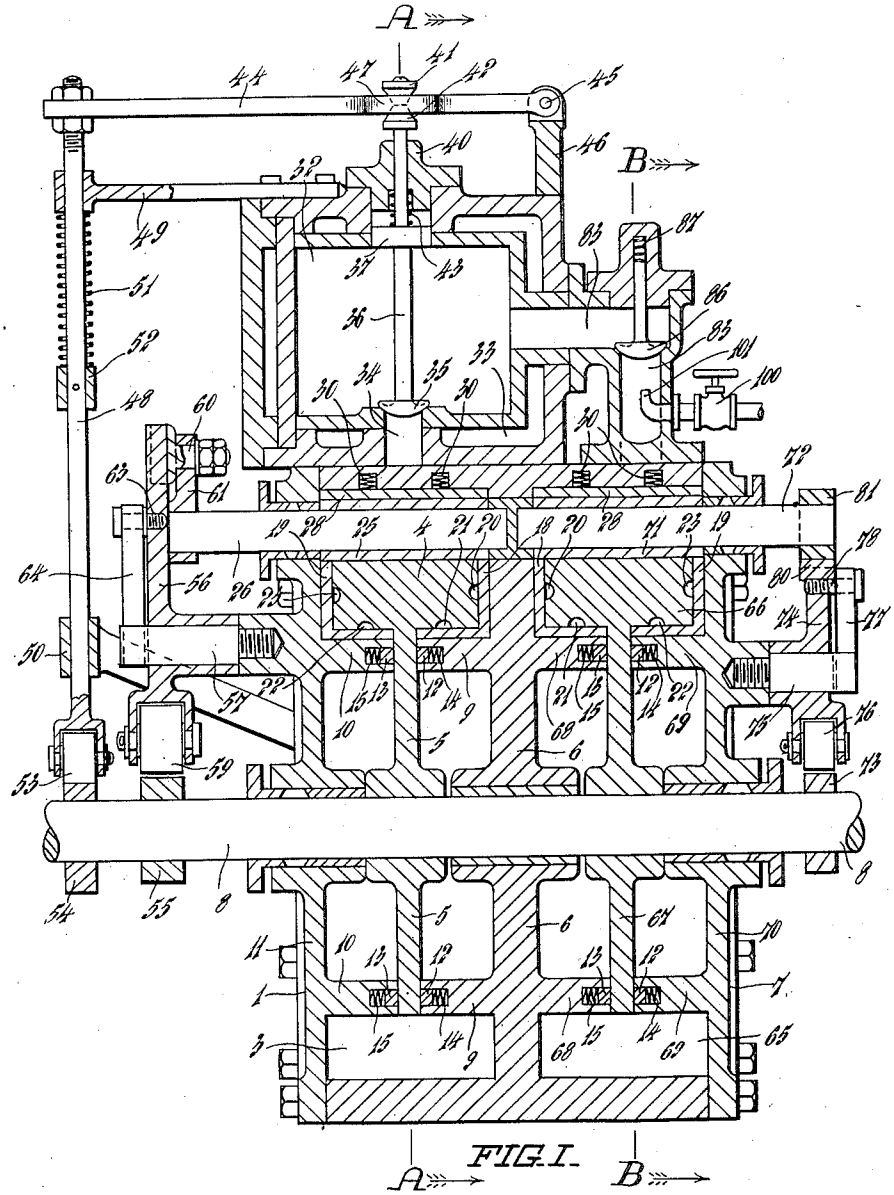


FIG. I.

WITNESSES:—

Charles B. Crompton.

Fred Duenther.

INVENTOR.

J. E. FRIEND.

BY Croydon Marks

ATTORNEY.

J. E. FRIEND.

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6 SHEETS—SHEET 2.

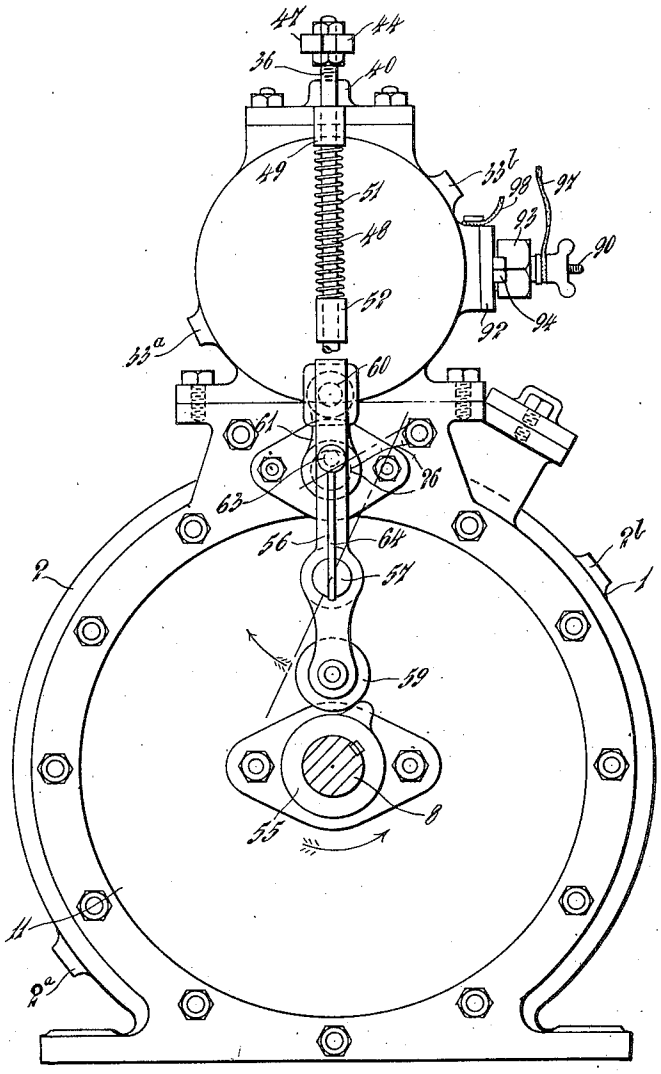


FIG. 2.

WITNESSES:-

Charles R. Crompton

Fred Guenther.

INVENTOR.

J. E. FRIEND.

BY. Croydon Marks

ATTORNEY.-

J. E. FRIEND.

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6 SHEETS—SHEET 3.

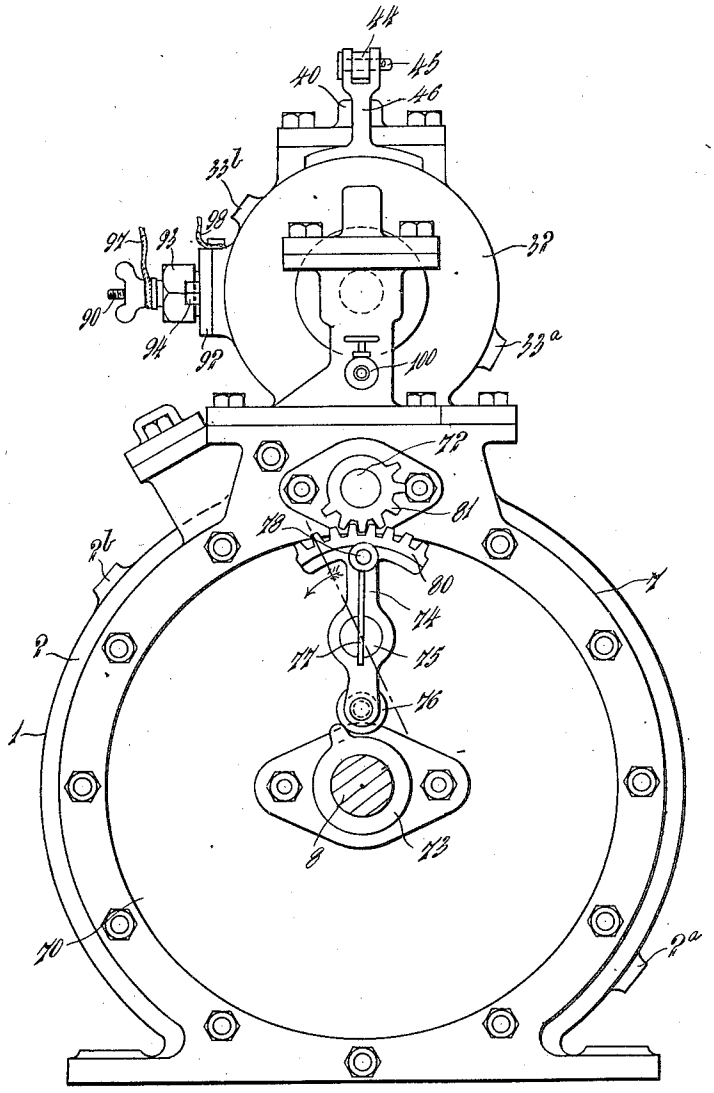


FIG. 3.

WITNESSES:-

Charles B. Brompton

Fred J. Wuenther.

INVENTOR.

J. E. FRIEND.

BY Sprague & Sprague

ATTORNEY.

J. E. FRIEND.

INTERNAL COMBUSTION ENGINE.

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6 SHEETS—SHEET 4.

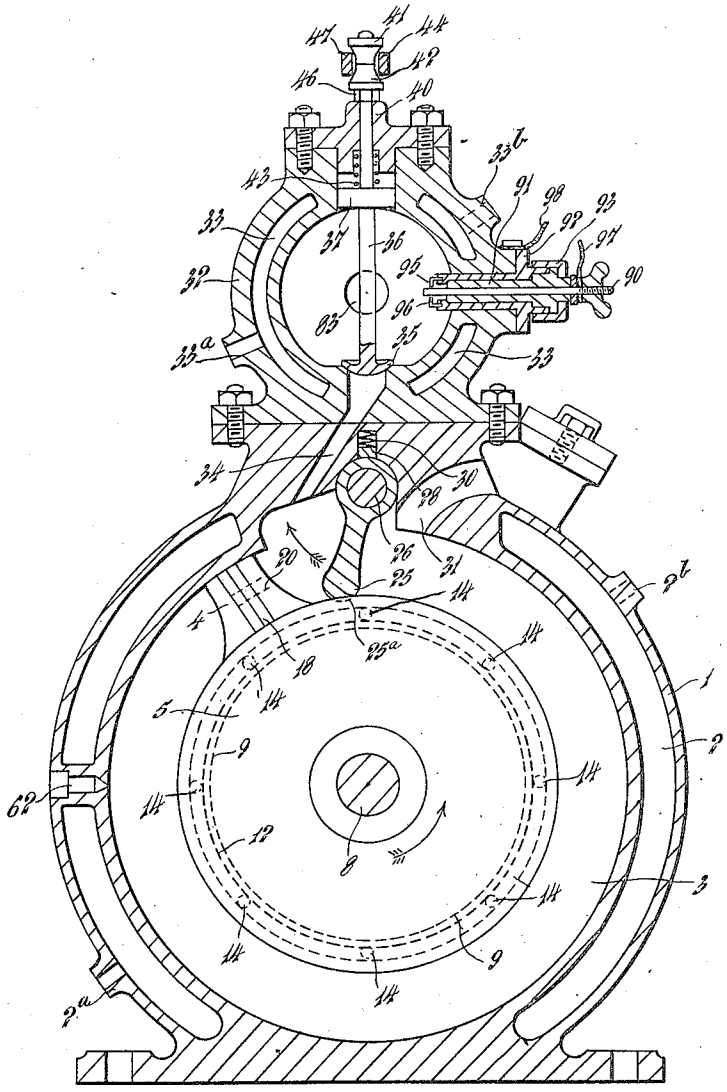


FIG. 4.

WITNESSES:-

Charles R. Crompton.

Fred J. Guenther.

INVENTOR.

J. E. FRIEND.

BY Croydon Sparks

ATTORNEY.

J. E. FRIEND.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED AUG. 27, 1912.

1,101,794.

Patented June 30, 1914.

6 SHEETS—SHEET 5.

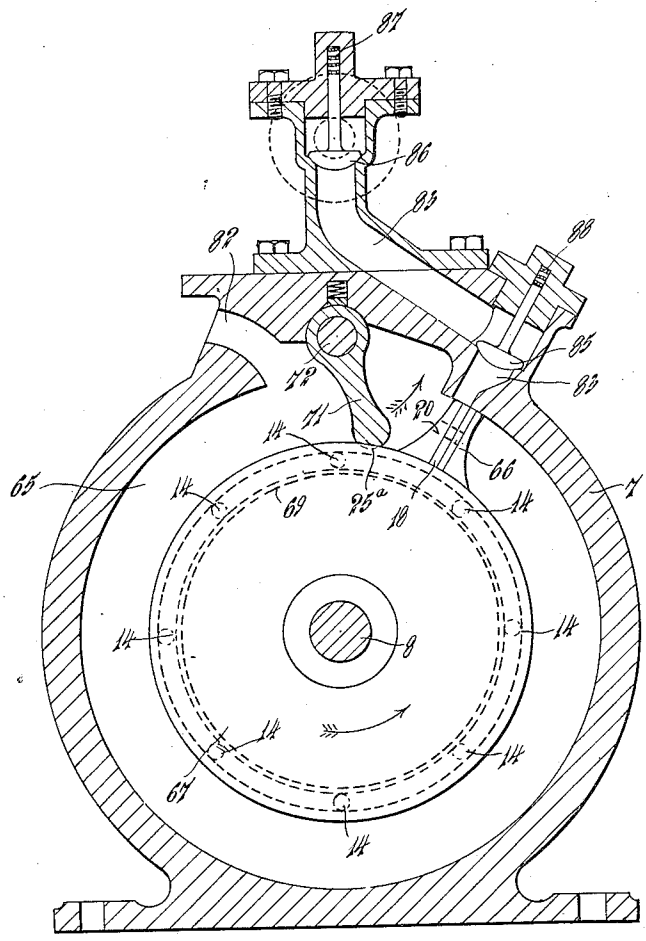


FIG. 5.

WITNESSES:-

Charles R. Crompton.

Fred Guenther.

INVENTOR.

J. E. FRIEND.

BY Croydon Marks

ATTORNEY.

J. E. FRIEND.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED AUG. 27, 1912.

1,101,794.

Patented June 30, 1914.

6 SHEETS—SHEET 6.

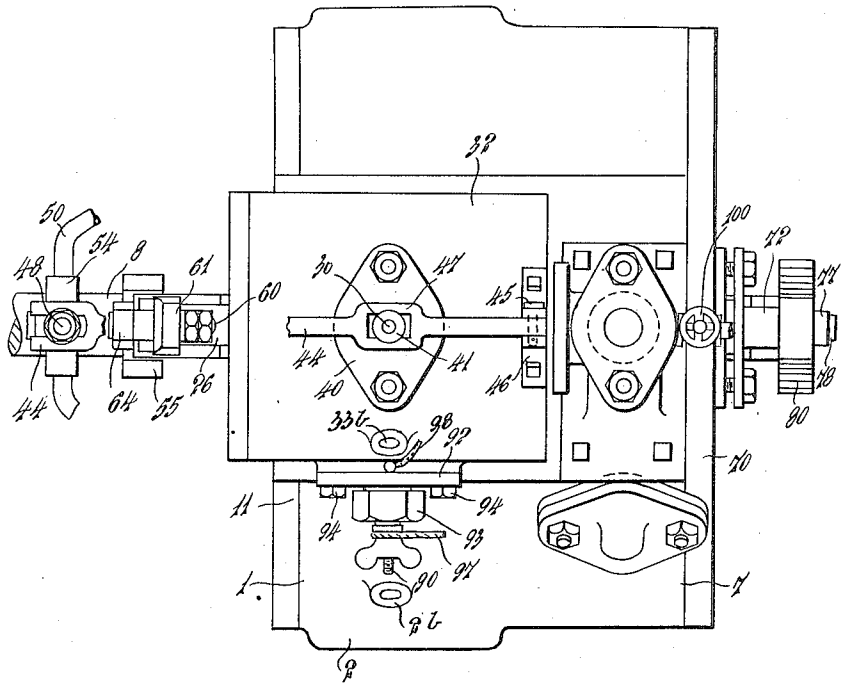


FIG. 6.

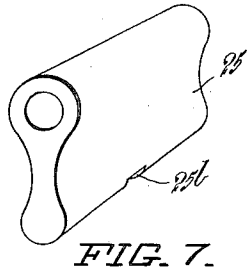


FIG. 7.

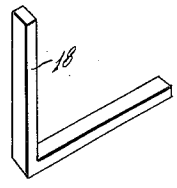


FIG. 8.

WITNESSES:-

Charles B. Crompton.

Fred Guenther.

INVENTER.

J. E. FRIEND.

BY Croydon Marks

ATTORNEY.

UNITED STATES PATENT OFFICE.

JOHN EDWARD FRIEND, OF BROOKLYN, AUCKLAND, NEW ZEALAND, ASSIGNOR OF SEVEN THIRTY-SECONDS TO WILLIAM FENWICK McALLUM, SEVEN THIRTY-SECONDS TO WILLIAM CHICK PHILLIPS, AND TWO THIRTY-SECONDS TO DOUGLAS ROLLO REVELL, ALL OF AUCKLAND, NEW ZEALAND.

INTERNAL-COMBUSTION ENGINE.

1,101,794. Specification of Letters Patent. Patented June 30, 1914.

Application filed August 27, 1912. Serial No. 717,316.

To all whom it may concern:

Be it known that I, JOHN EDWARD FRIEND, a citizen of the Dominion of New Zealand, and resident of Brooklyn, in the Provincial District of Auckland, in the Dominion of New Zealand, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to rotary engines which are operated by the firing of an explosive mixture and provides improved means which are detailed in the following specification.

More particularly my invention relates to that class of rotary engines in which a cylinder has an annular chamber fitted with a piston adapted to revolve in the said annular chamber. In this class of turbines it is necessary to provide means for forming an explosion inclosure or chamber, the said means being movable to allow the piston to pass in its revolution. According to my invention this movable means comprises a tongue which is operated by a cam and lever to allow the piston to pass and in its closed position forms with the cylinder and piston an explosion chamber.

The explosive mixture is supplied to the cylinder by a pump constructed similarly to the engine, and having its tongue operated by a cam and lever, but reversely as regards the turbine, by means of toothed quadrants.

The explosive mixture is drawn by the pump from a carbureter and delivered through a passageway to a combustion chamber upon the turbine, non-return valves being provided in the said passage way. A valve in the combustion chamber opens to allow the explosive force to operate in the explosion inclosure or chamber. A piston upon the spindle of the said valve has a diameter larger than the said valve and is exposed to the explosive force, thus assisting the operating of the valve by means of a lever, spring operated rod and cam.

For the purpose of a detailed description, reference will now be made to the accompanying drawings, in which—

Figure 1, is a longitudinal sectional elevation of the turbine and pump. Fig. 2, is an elevation of the end of the turbine. Fig. 3, is an elevation of the end of the pump. Fig. 4, is a cross sectional elevation of the engine on line A—A, Fig. 1. Fig. 5, is a cross sectional elevation of the pump on line B—B, Fig. 1. Fig. 6, is a plan of the engine and pump. Fig. 7, is a perspective view of a tongue, and Fig. 8, a perspective view of a piston packing strip.

Referring to the drawings and more particularly, Figs. 1, 2 and 4, the engine cylinder proper 1 has a water jacket 2 and annular chamber 3 fitted with a piston 4 integral with or mounted upon a disk 5. A partition 6 divides and is common to the engine and the pump 7, and a disk 5 which is fixed to the main shaft 8 rotates between the annular wall 9 integral with the partition 6 and an annular wall 10 integral with the cover 11. Packing rings 12 and 13, operated by springs 14 and 15 respectively, make tight joints between the walls 9 and 10 and the disk 5. Tight joints between the piston 4 and the partition 6 and wall 9, and between the cover 11 and the wall 10 are made by the packing strips 18 and 19 respectively. Water to the jacket 2 is admitted through a boss 2^a and is discharged through another boss 2^b. These packing strips are kept up to their work by the force of the explosive mixture, holes 20, 21, 22 and 23 forming passages through which the explosive force can act.

A tongue 25 shown clearly in Fig. 7 is fixed upon a rocking shaft 26 and a tight joint is made with the said tongue by means of a packing strip 28 and springs 30. Recesses 25^a formed in the annular walls 9 and 10 form a bed wherein the tongue 25 rests and makes a tight joint, a recess 25^b in the tongue 25 admitting the rim of the disk 5.

The waste gases from the chamber 3 pass away through an exhaust passage 31 at the back of the tongue 25, being expelled by a piston 4.

A combustion chamber 32 mounted upon the turbine has a water jacket 33. Water is admitted to the jacket through a boss 33^a and discharged through a boss 33^b. The chamber 32 communicates with the annular chamber 3 by a passage 34 at the front of the tongue 25. A valve 35, adapted to close the passage 34, has a spindle 36 provided with a piston 37 of larger diameter than the said valve. The spindle 36 continues beyond the

piston 37, passes through a cover 40, and is provided with collars 41 and 42. A light spring 43 assists in returning the valve 35 to its seat.

A lever 44 fulcrumed by a pin 45 to a bracket 46 has a loop 47, which passes upon the spindle 36, and is engaged by the collars 41 and 42. The other end of the lever 44 is attached to a rod 48 passing through guides 49 and 50, and is provided with a spring 51 in compression between the bracket 49 and the collar 52, fixed to the said rod 48. The roller 53, mounted upon the rod 48, rests upon a cam 54 fixed to the main shaft 8, the rotation of which operates the rod 48, the lever 44 and the valve 35. A second cam 55, fixed to the main shaft 8, operates a rocking lever 56 fulcrumed upon a pin 57 projecting from the cover 11. A roller 59 reduces the friction of the cam 55. The other end of the lever 56 is pivoted by a pin 60 to an arm 61 fixed to the shaft 26. The return stroke of the lever 56 is effected by a flat spring 64, which is fixed at one end to a stud 63 secured to the lever 56. The other end of the spring fits in a groove formed diametrically through a pin 57.

Water in the form of spray is admitted to the chamber 3 by a nozzle 62, and has the effect of cooling the cylinder and by expanding imparts an impulse to the piston.

Referring now to Figs. 1, 3 and 5 which refer more particularly to the pump, the annular chamber 65 is fitted with a piston 66 mounted upon a disk 67 which rotates between annular walls 68 and 69 integral with the partition 6 and the cover 70 respectively. Packing rings 12 and 13 and springs 14 and 15 similar to the rings and springs used in the engine cylinder are employed to make tight joints between the walls 68 and 69 and the disk 67 also. Packing strips 18 and 19 similar to the strips used in the engine piston have holes 20, 21, 22 and 23 through which the compressed explosive mixture acts. The tongue 71 fixed upon a shaft 72 is operated by a cam 73, fixed to the main shaft 8, and by a rocking lever 74 mounted upon a pin 75. A roller 76 reduces the friction of the cam 73. The other end of the lever is provided with a quadrant rack 80 which gears with a toothed pinion or quadrant 81 fixed to the shaft 72. The return stroke of the lever is effected by the spring 77 which is fixed at one end to a stud 78 secured to the lever 74. The other end of the spring fits in a groove formed diametrically through the pin 75. A packing strip 28 and springs 30 similar to the strip and springs used in the engine cylinder are employed to make a tight joint with the tongue 71. A passage way 82 leads from the chamber 65 to a carbureter not shown on the drawings. The passageway 83 leads from the chamber 65 to the combustion chamber 32. The said passageway 83 is provided near the pump with a non-return valve 85 and near the chamber 32 with another non-return valve 86. The said valves are operated by springs 87 and 88 respectively. The said valves prevent return of the explosive mixture from the combustion chamber 32 and prevent firing back.

The sparking plug for firing the explosive mixture comprises a nickel rod 90 (see Fig. 4) passing through an insulation plug 91, and held in a socket 92 by means of a screw cap 93, the said socket 92 being fixed to the chamber 32 by screws 94. Terminals of nickel wire 95 and 96 are fixed to the socket 92 and project at right angles toward the nickel rod 90. Wires 97 and 98 connect the rod 90 and the socket 92 to an ordinary commutator for making and breaking the current.

A tap 100 has a nozzle 101 projecting into the passageway 83. The tap is connected to an oil supply so that by opening the said tap an extra supply of oil can be supplied and driven by the action of the pump into the combustion chamber.

In operation the explosive mixture drawn by the pump piston 66 through the passage way 82 from the carbureter (see Fig. 5) is compressed between the said piston 66 and the tongue 71. The compressed mixture lifts the valves 85 and 86, passes into the combustion chamber 32 where it is fired by the sparking plug, at the same time the cam 54 lifts the valve 35, the explosive force against the piston 37 assisting in the raising the said valve 35. The cam 54 holds the valve 35 raised during the greater part of revolution of the piston 4. At the time of the explosion the tongue 25 and the piston 4 are in the positions shown in Fig. 4, the space inclosed by the said tongue, piston and the cylinder forming the explosion inclosure or chamber from which the gases act upon the piston 4, and rotate the disk 5 and shaft 8. The cam 55 is set upon the shaft 8 to rock the lever 56 in the direction shown by the arrow (see Fig. 2) to the position shown by the dotted line at the correct period of time to allow the piston 4 to pass during its rotation, and similarly the cam 73 is so set upon the said shaft 8 that the tongue 71 (see Fig. 5) is raised to allow the piston 66 to pass during its rotation. The tongues 25 and 71 close immediately after the piston in each case has passed.

What I do claim and desire to secure by Letters Patent of the United States is:—

1. Apparatus of the kind described comprising engine and pump cylinders, a partition common to the said cylinders and having annular walls, covers to the turbine and pump having annular walls, a main shaft passing through the covers and partition, disks fixed to the shaft and rotating between

the annular walls, pistons fixed to the disks and revoluble in the cylinders, tongues controlling the annular piston chambers, cams on the main shaft, levers actuated in one direction by the cams and returned to initial position by resilient means, one lever controlling one of said tongues, the other controlling the other tongue, as set forth.

2. Apparatus of the kind described, comprising an engine cylinder having an annular chamber, a pump cylinder having an annular chamber, a main shaft passing through both cylinders, disks fixed to the said shafts, pistons integral with the disks and revoluble in the said annular chambers, tongues pivoted in the annular chambers, a cam fixed to the main shaft, a rocking lever operated by the cam, shafts to which the tongues are fixed, an arm on the shaft of the motor tongue pivoted to the rocking lever, means for operating the tongue of the pump chamber, a combustion chamber in communication with the annular chamber and means for igniting the explosive fluid in the combustion chamber, substantially as set forth.

3. Apparatus of the kind described, comprising an engine cylinder having an annular chamber, a pump cylinder having an annular chamber, a main shaft passing through both cylinders, disks fixed to the said shafts, pistons integral with the disks and revoluble in the said annular chambers, tongues pivoted in the annular chambers, a cam fixed to the main shaft, a rocking lever operated by the cam, a quadrant upon the end of the rocking lever, shafts to which the tongues are fixed, a segment of a gear on the shaft of the pump tongue gearing with the said quadrant, means for operating the tongue of the engine chamber, a combustion chamber in communication with the annular chambers of the engine and pump cylinders, and means for igniting the explosive in the combustion chamber, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two witnesses.

JOHN EDWARD FRIEND.

Witnesses:

ERNEST SMITH BALDWIN,

CECIL BALFOUR MEHILLE.