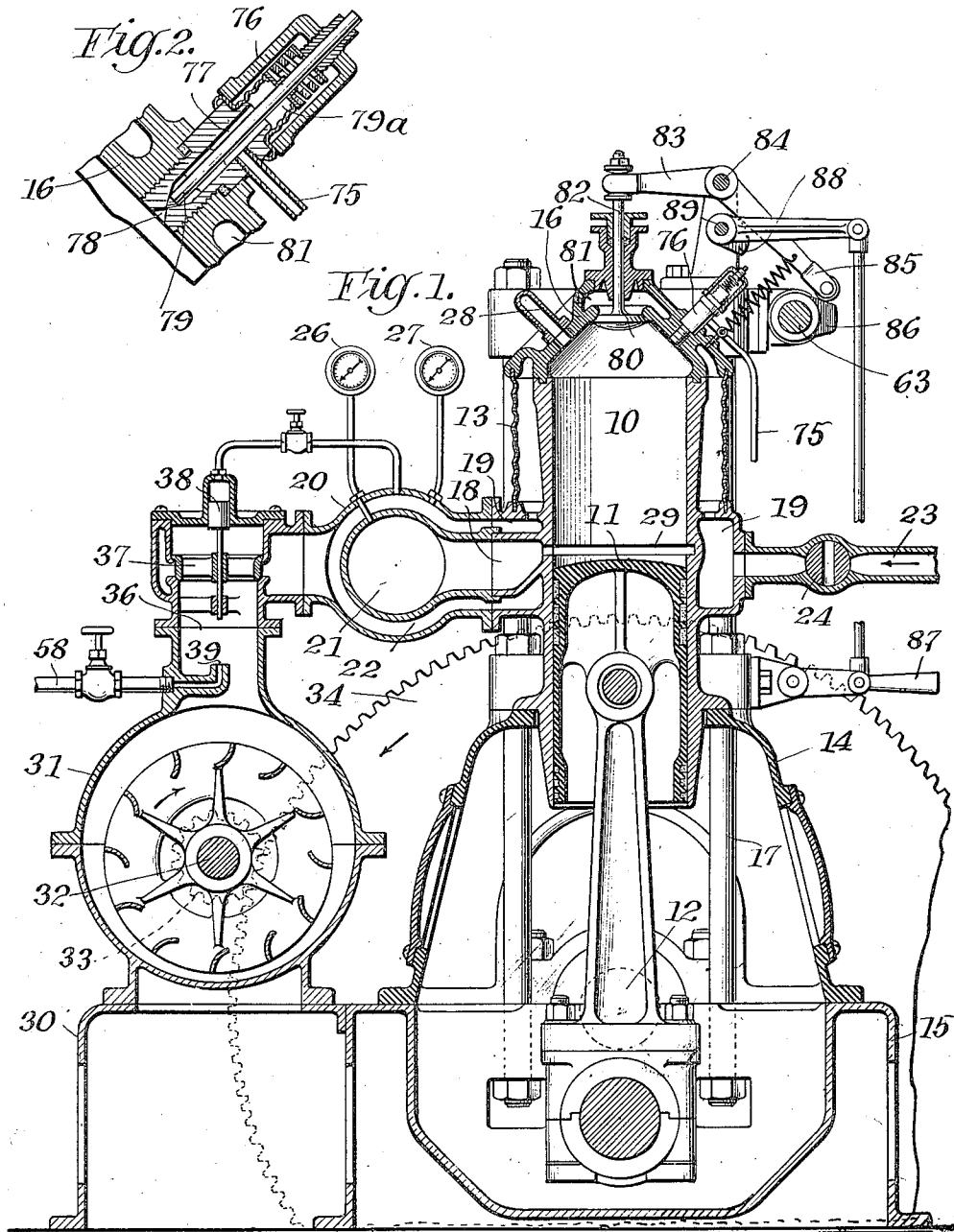


O. P. OSTERGREN.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED NOV. 13, 1914.

1,281,644.

Patented Oct. 15, 1918.
5 SHEETS—SHEET 1.



WITNESSES
R. J. Carlson
J. Graves

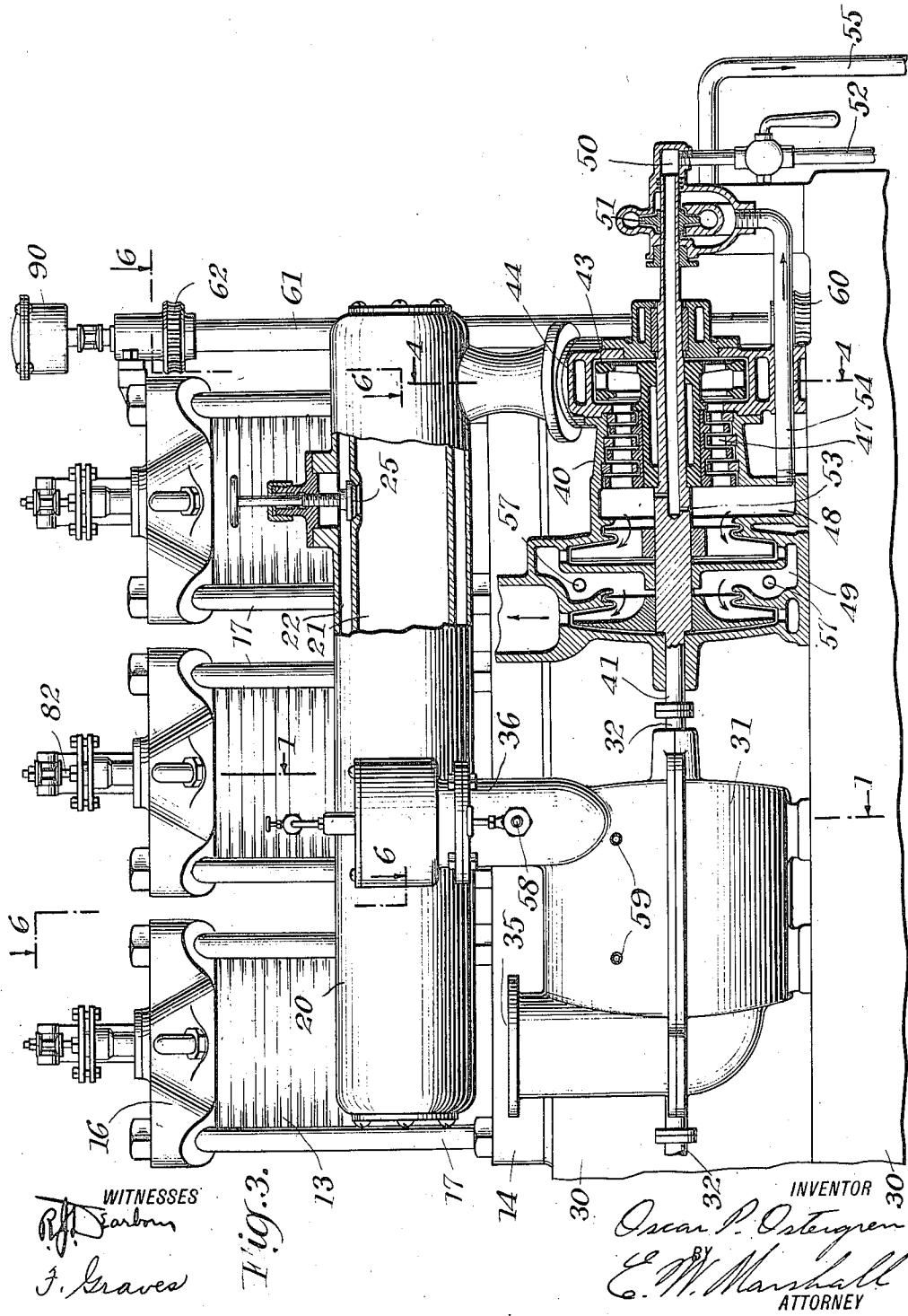
INVENTOR
Oscar P. Ostergren
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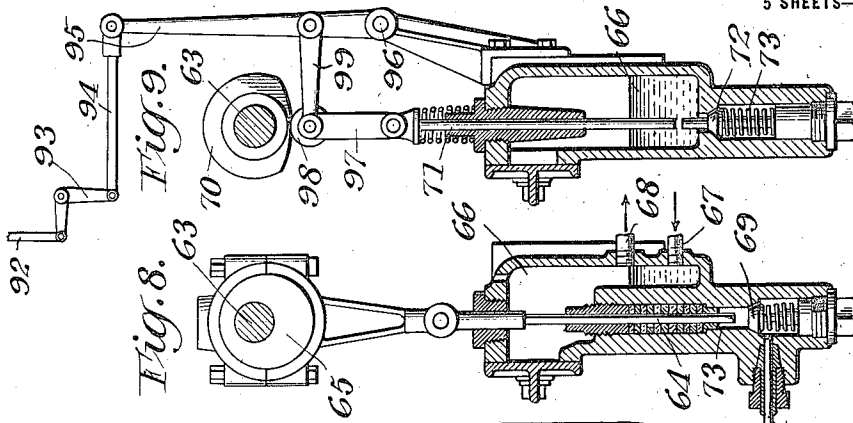
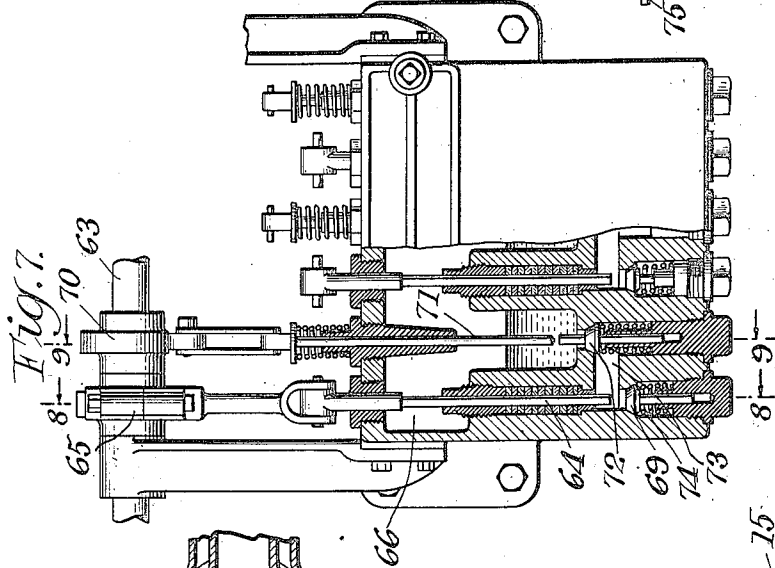
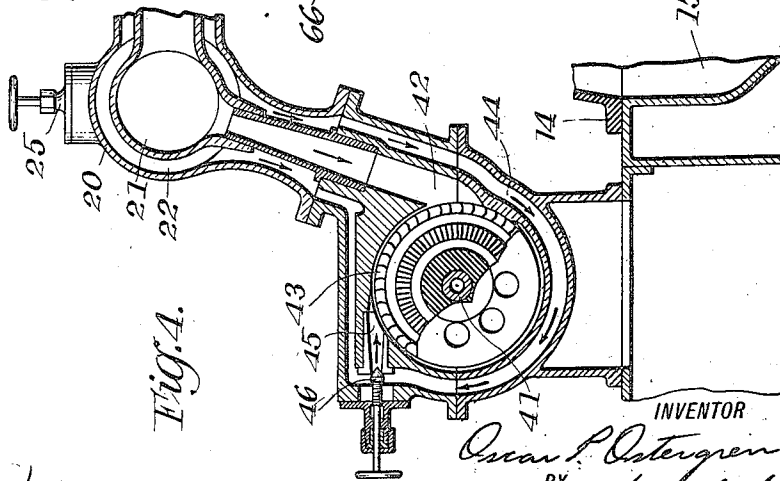


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5 SHEETS—SHEET 3.



WITNESSES
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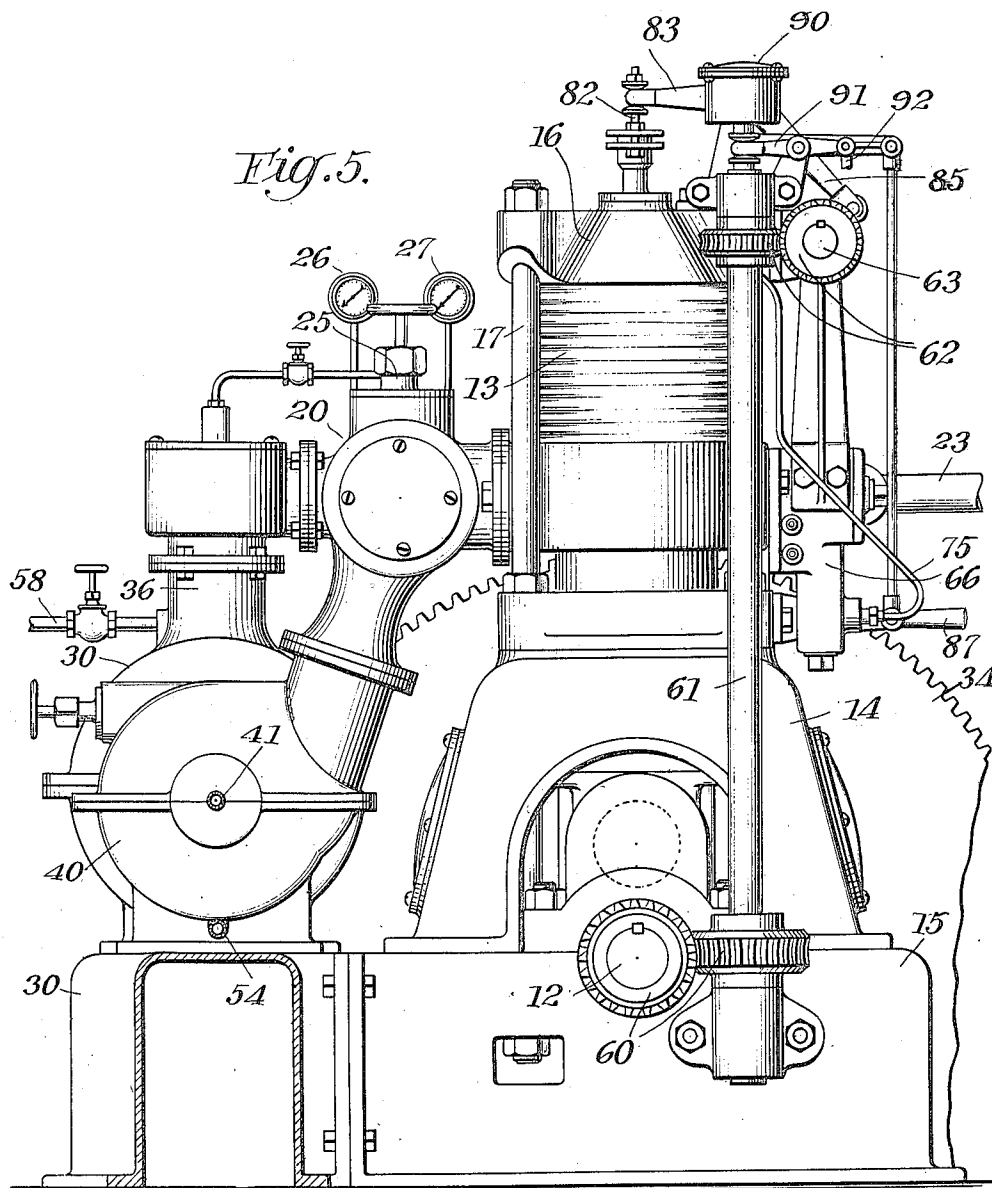
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5 SHEETS—SHEET 4.



WITNESSES
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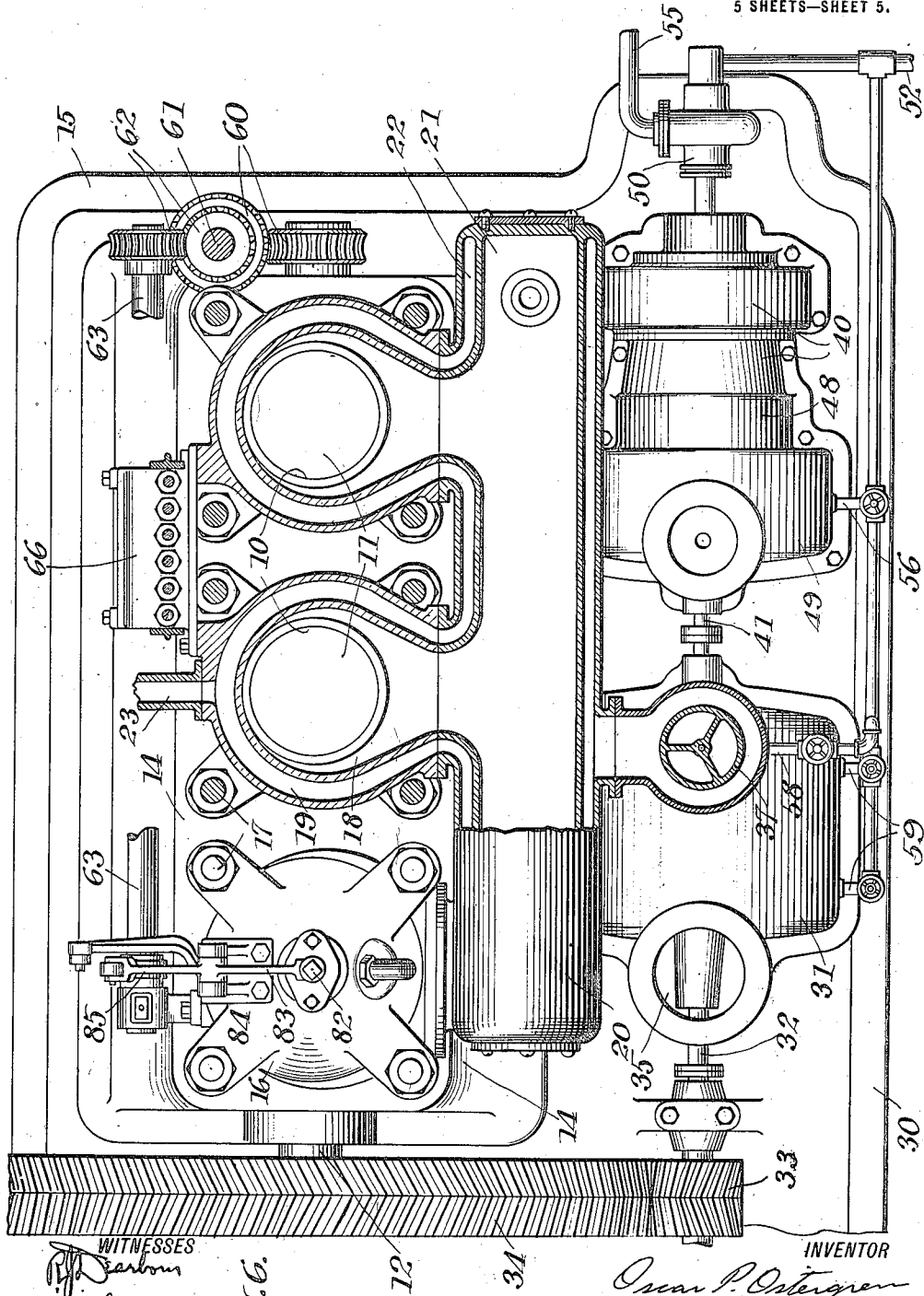
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5 SHEETS—SHEET 5.



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Fig. 6.

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UNITED STATES PATENT OFFICE.

OSCAR P. OSTERGREN, OF BROOKLYN, NEW YORK, ASSIGNOR OF ONE HALF TO EMIL ANDERSON, OF NEW YORK, N. Y.

INTERNAL-COMBUSTION ENGINE.

1,281,644.

Specification of Letters Patent.

Patented Oct. 15, 1918.

Application filed November 13, 1914. Serial No. 871,863.

To all whom it may concern:

Be it known that I, OSCAR P. OSTERGREN, a subject of the crown of Sweden, (who have declared my intention of becoming a citizen of the United States of America,) and a resident of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

My invention relates to improvements in internal combustion engines and its object is to improve upon the construction of engines of this general type and to provide an engine which will work upon a new cycle of operations and have a higher efficiency of operation than has heretofore been possible with apparatus of this kind.

Another object of my invention is to provide an engine which may use a low and inexpensive grade of fuel.

A further object is to provide a combination of a reciprocating oil engine with turbine machinery in such a manner that the former constitutes a high pressure stage and the latter a low pressure stage in a compound compression and expansion system.

Other objects are to provide an apparatus and a system in which the fuel ignition point is easily reached at a moderate pressure and in which a maximum amount of the heat produced is absorbed and power produced from it.

Other objects, purposes and advantages of this invention will appear in the following specification in which I will describe the construction and operation of one form of apparatus which embodies this invention, the novel features of which will be set forth in appended claims.

Referring to the drawings—

Figure 1 is a sectional end elevation of an engine embodying the present invention. The section in this figure is taken on the line 1—1 of Fig. 3.

Fig. 2 is a sectional elevation of one of the spray nozzles by means of which fuel oil is forcibly injected into the cylinders.

Fig. 3 is a side elevation partly in section of the same engine.

Fig. 4 is a sectional end elevation of certain parts of the engine, the section being taken on the line 4—4 of Fig. 3.

Fig. 5 is an end elevation of the apparatus.

Fig. 6 is a plan view of the apparatus with some of its parts shown in section. The line 6—6 in Fig. 3 shows the plane of section of such parts as are shown in section in this Fig. 6.

Fig. 7 is a side elevation partly in section of a force pump mechanism which forms part of this apparatus.

Figs. 8 and 9 are sectional end elevations of this pump mechanism, the sections in these figures being taken respectively on the lines 8—8 and 9—9 of Fig. 7.

Like characters of reference designate corresponding parts in all the figures.

10 designates the cylinders of the engine and 11 the pistons therein which are connected in the usual manner with the main crank shaft 12. A cooling jacket, which as will be shown is to be supplied with air, is formed between the outer walls of the cylinders and a sleeve or shell 13 of corrugated metal.

The castings which form the cylinders are constructed to fit and to rest upon a base 14 which is supported upon a sub-base 15, and upon the top of each cylinder casting is a cylinder head 16. The jacket sleeves 13 fit between grooves in the cylinder castings and in the heads 16 and all of these parts are connected together rigidly by vertical tie bolts 17.

The intermediate parts of the cylinder castings are each constructed to form an inner chamber 18 and an outer surrounding chamber 19. The inner chambers communicate with the inside of their respective cylinders just above the pistons when they are in their lowest positions as is shown in Fig. 1.

A double air drum 20 which lies parallel with main shaft 12 is affixed to all of the cylinder castings. The inner part 21 of this drum communicates with the inner chambers 18 and the outer part 22 of the drum communicates with the outer surrounding chambers 19. A supply of compressed air under suitable pressure may be admitted to the chambers 19 and the outer part 22 of drum 20 through a pipe 23 and a manually controlled valve 24. This, however, is only used for starting, as will be more fully described hereinafter.

Provision is made for the admission of

air from the outer part 22 of the drum 20 to the inner part 21 of the drum through a port controlled by a hand valve 25. For the purpose of observing the conditions within the two parts of the drum 20 during operation, two pressure gages 26 and 27 are provided, the first connected with the inner part 21 and the second connected with the outer part 22 of the drum.

10 Affixed to one side of the sub-base 15 is an auxiliary base 30 upon which certain parts of the apparatus are mounted. These are primarily an air compressor 31 and a turbine 40. The compressor is of the multi-stage rotary type and its shaft 32 carries a pinion 33 which is in mesh with a gear 34 on the main shaft 12. Air is drawn in at 35 and forced out through a cylindrical chamber 36 into the outer part 22 of drum 20. 37 is a check valve in this cylindrical chamber and 38 a valve controlled plunger connected with the check valve by means of which its action may be regulated. A nozzle 39 projects into the chamber 36 by means of which a limited amount of water may be admitted in spray with the air.

The shaft 32 of the compressor is connected directly with the shaft 41 of the turbine. The inner part 21 of the drum 20 is in communication with a nozzle 42 which discharges all the gases against an impulse wheel 43. The outer part 22 of the drum is connected with a casing 44 which surrounds the impulse wheel and is constructed with an auxiliary nozzle 45 controlled by a manually actuated valve 46 by means of which air from the outer part of the drum 20 also may be discharged against the impulse wheel 43. These parts of the apparatus are best shown in Fig. 4.

From the impulse wheel 43 the gases and air are discharged through a multi-stage low pressure turbine rotor 47 and thence into a condensing chamber 48 from which they are drawn out by an expulsion turbine 49.

A rotary water pump 50 is also mounted upon the auxiliary base 30 and its rotary member 51 is affixed to shaft 41. 52 is a water supply pipe from which water is forced through the shaft 41, one end of which is hollow, and into the cooling chamber 48 through radial holes 53. From the cooling chamber the water is drawn out through pipe 54 into the pump 50 by means of which it is discharged through pipe 55.

The water supply pipe is also connected by valve controlled branch pipes 56 with inlet ports 57, 57 in the expulsion turbine 49, and by valve controlled branch pipes 58 with the spray nozzle 39. At 59 water sprays are introduced into the air compressor. By means of these water sprays the temperature of the air may be regulated and predetermined.

Gears 60 transmit the rotation of main shaft 12 to a vertical shaft 61, and other

gears 62 transmit this rotation to the cam shaft 63. This cam shaft actuates the fuel feed mechanism and the air inlet valve. The fuel feed mechanism will now be described.

For each engine cylinder there is a plunger pump 64 which is driven from an eccentric 65 on shaft 63. The plunger of this pump reciprocates into and out of an oil reservoir 66 to which fuel oil is supplied through a pipe 67 and prevented from rising above a given level by the provision of an overflow pipe 68. Directly below each plunger pump is a spring closed check valve 69.

70 is a cam which acts upon a push-rod 71 to depress it and to open a check valve 72 which controls a passage between the reservoir 66 and a chamber 73 therein. The check valve 69 controls a passage between chamber 73 and another chamber 74 with which is connected an oil pipe 75 which leads to the automatically actuated fuel inlet valve 76 in the cylinder head 16. The parts described in this and the preceding paragraph are best illustrated in Figs. 7, 8 and 9. The fuel inlet valve 76 is shown in Figs. 1 and 2.

The fuel inlet valve comprises a pressure chamber 77 with which pipe 75 communicates and a spray nozzle 78 which is closed by a spring pressed needle valve 79. The needle valve is raised from its seat at suitable intervals by oil forced through pipe 75 into chamber 77 by a bellows-like structure 79A.

The air valve 80 is mounted in the upper central part of the head 16 and controls a port leading from the air jacket between the cylinder casting and the shell 13 and the hollow portion 81 of the head, into the engine cylinder 10. 82 is the valve stem and this is connected with one arm 83 of a bell crank lever which is pivoted at 84 and the other arm 85 of which is actuated by a cam 86 on shaft 63 to open the air valve.

Means are also provided for opening the air valve by hand, these means comprising a handle 87 connected to rotate a cam 88 which is pivoted at 89 and is arranged to act upon the arm 85 of the bell crank lever (see Fig. 1).

90 is a governor on the upper end of shaft 61 which when the speed of the engine reaches a predetermined degree, raises one end of a pivoted lever 91 and depresses the other end to which is connected a rod 92. The other end of the rod 92 is connected with one arm of a bell crank lever 93 (Fig. 9) the other end of which is connected by rod 94 with the upper end of a lever 95 which is pivotally supported at 96. 97 is a link between the upper end of the push rod 71 and a roller 98 upon which cam 70 acts, and 99 is another link connecting the upper end of link 97 with lever 95 at a point intermediate the ends of the latter.

I will now describe the operation of this

apparatus. In starting, the valves 24 and 25 are opened. Air from a suitable source of supply is then led through chamber 19, the outer part 22 of the drum 20, through the port controlled by valve 25 into the inner part 21 of the drum and thence through the nozzle 42 into the turbine where it first strikes and impels the impulse wheel 43 after which it goes through rotor 47. This causes shafts 41 and 32 to rotate and through gears 33, 34 the main shaft 12 and the parts connected therewith are driven. An ignition tube 28 in each head 16 has been previously heated. At suitable intervals when the piston is near the lower end of its stroke, the air valve 80 will be opened and before the piston reaches the upper end of its stroke, fuel oil will be forced in through inlet valve 76 and the mixture ignited by the heat of tube 28. This will cause the engine to run of itself and then valves 24 and 25 may be closed.

After this air is supplied from the air compressor 31 mixed with a desired amount of water vapor from nozzle 39 for as soon as sufficient air pressure has been created by the compressor 31 the valve 37 will be raised automatically. This air will be somewhat heated in the drum from which it passes through the space between the engine cylinders and the shells 13 which are corrugated to provide for expansion, where it serves the purpose of cooling the cylinders and where it is itself heated before it enters the engine cylinders through the air valves 80.

The fuel oil is forced into the cylinders through valves 76 by means of the mechanism illustrated in Figs. 7, 8 and 9. It has been seen that there is for each cylinder an oil pump 64 and a cam actuated valve 72. The pump is driven by an eccentric so that its movement is proportional to that of the engine piston. During the greater part of its stroke the valve 72 is held open by the cam 70 so that the pump piston does not force the oil out of chamber 73. But at the desired time during the downward stroke of the pump piston, the cam 70 allows valve 72 to close and it then forces the oil past valve 69, through pipe 75 and inlet valve 76 into the engine cylinder. By means of the governor mechanism which has been explained, the time of closing valve 72 is controlled automatically.

The oil then mixed with air is ignited by compression and the expansion stroke follows until the top of the piston uncovers port 29, when the exhaust gases flow out through chamber 18, inner part 21 of the drum 20, where they heat the incoming air in the outer part of the drum, and thence through nozzle 42 into the turbine.

If desired, some of the incoming air from outer part 22 of the drum may be passed

through a chamber which surrounds nozzle 42 and the turbine casing and discharged through the auxiliary nozzle 45 into the turbine. When this is done, this incoming air aids in cooling the turbine.

From the impulse wheel and the stages of the low pressure turbine, the gases are discharged into the condensing chamber 48 where they are mixed with the water sprays and from this chamber they are led off by the fan 49 and discharged into the atmosphere.

The air valve 80 is opened at about the time the port 29 is first opened so that thorough scavenging is insured. The air valve remains open during about one-third of the upward stroke of the piston so that part of the fresh air is returned to the jacket for the purpose of reducing the volume of the charge to a suitable proportion in relation to its volume after expansion in the cylinder.

The cycle of this engine is novel and I will therefore add a full description of it. Beginning with the piston at the lower end of its stroke and the air valve open, the air is rushing out through port 29 at a suitable pressure. The piston moves up and closes port 29 and the air valve remains open until the piston has completed about one-third of its upward stroke. During the remainder of the upward stroke the air is compressed until it reaches a sufficient temperature to ignite the explosive mixture when just before the completion of this upward stroke the fuel oil is injected under considerably higher pressure than that in the cylinder. It will be noted that the temperature required for ignition is reached by a relatively moderate compression on account of the preheating of the air. The mixture ignites and this, of course, raises the pressure which during the downward pressure expands on a polytropic curve until the exhaust port 29 is opened. At this time the air valve is opened and during the time the port 29 is opened the pressure drops to some extent while the volume of the escaping gases is greatly increased due to the abundant addition of air through valve 80.

This accumulated volume of spent gas and air then acts upon the turbine where on the impelling wheel and on the multi-stage rotor it has a further driving effect upon the apparatus. Thus the energy of the escaping gases is made to produce useful work. In the cooling chamber the heat of the gases is taken up to a degree to reduce the volume before they enter the expulsion turbine 49 at a pressure less than that of the atmosphere after which they are forced out by the expulsion turbine. The cooling water is expelled by rotary pump 50 as previously described.

Thus practically all of the heat units are turned into useful work. The foregoing de-

scription is intended to point out a mechanism by means of which my invention may be utilized. It is obvious that many of the novel features herein disclosed may be utilized in other mechanisms than those illustrated and I therefore intend no limitations other than those set forth in the appended claims.

What I claim is:

1. An internal combustion engine comprising a cylinder, an inclosed air jacket surrounding said cylinder, an air valve controlling a port between the cylinder and said jacket, a fuel inlet nozzle, means for automatically actuating said air valve, a pump for forcing liquid fuel through said inlet nozzle, a pump valve for controlling the fuel flow, and means for actuating the pump valve at predetermined intervals.

2. An internal combustion engine comprising a cylinder, an inclosed air jacket surrounding said cylinder, an air valve controlling a port between the cylinder and said jacket, a fuel inlet nozzle, means for automatically actuating said air valve, a pump for forcing liquid fuel through said inlet nozzle, a pump valve for controlling the fuel flow, means for actuating the pump valve at predetermined intervals, and automatic means for regulating the fuel flow.

3. An internal combustion engine comprising a cylinder, an inclosed air jacket surrounding said cylinder, an air valve controlling a port between the cylinder and said jacket, a fuel inlet nozzle, means for automatically actuating said air valve, a pump for forcing liquid fuel through said inlet nozzle, a pump valve for controlling the fuel flow, means for actuating the pump valve at predetermined intervals, and a governor for varying the time at which said pump valve actuator operates.

4. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, an exhaust port arranged to be closed and opened by the piston, an inclosed air jacket surrounding the cylinder, an admission port between the air jacket and the cylinder, an air valve controlling said admission port, and means for opening said air valve when the exhaust port is open and for maintaining the air valve in its open position during a part of the compression stroke of the piston.

5. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, an exhaust port arranged to be closed and opened by the piston, an inclosed air jacket surrounding the cylinder, an admission port between the air jacket and the cylinder, an air valve controlling said admission port, a fuel inlet nozzle leading to said cylinder, and means for opening said air valve when the exhaust port is open and for maintaining the air valve in its open position

during a part of the compression stroke of the piston; and means for forcing liquid fuel through said nozzle when the piston is near the end of its compression stroke.

6. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, a crank shaft and a connection between the piston and the crank shaft; an inclosed air jacket surrounding the cylinder and adapted to be connected thereto, a turbine engine connected with the crank shaft and means for leading the exhaust from the cylinder through said turbine.

7. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, a crank shaft and a connection between the piston and the crank shaft; an inclosed air jacket surrounding the cylinder, an admission port between the air jacket and the cylinder, a turbine engine connected with the crank shaft and means for forcing air through said jacket, cylinder and turbine.

8. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, a crank shaft and a connection between the piston and the crank shaft; an inclosed air jacket surrounding the cylinder, an admission port between the air jacket and the cylinder, a liquid fuel inlet nozzle leading to the cylinder, a turbine engine connected with the crank shaft and means for forcing air through said jacket into the cylinder and for leading the exhaust gases through the turbine.

9. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, a crank shaft and a connection between the piston and the crank shaft; an inclosed air jacket surrounding the cylinder, an admission port between the air jacket and the cylinder, a liquid fuel inlet nozzle leading to the cylinder, and means for forcing air through said jacket into the cylinder, a turbine engine connected with the crank shaft, a passage for leading the exhaust gases through the turbine, and means for connecting the jacket to the turbine whereby said means for forcing air into the cylinder is arranged to augment the volume of gases passing through the turbine by the addition of air to the burnt gases.

10. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, a crank shaft and a connection between the piston and the crank shaft; an inclosed air jacket surrounding the cylinder, a turbine engine, and an air compressor connected with the crank shaft; and means for leading air from the compressor through the jacket, the cylinder and the turbine.

11. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, a crank shaft and a connection between the piston and the crank shaft; an inclosed air jacket surrounding the cylinder

and adapted to be connected thereto, a turbine engine connected with the crank shaft and means for leading the exhaust from the cylinder through said turbine, a cooling chamber connected with the turbine, and an expulsion turbine connected with the turbine and with the crank shaft.

12. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, a crank shaft and a connection between the piston and the crank shaft; an inclosed air jacket surrounding the cylinder, a turbine engine, an air compressor connected with the crank shaft, means for leading air from the compressor through the jacket, the cylinder and the turbine, a condenser connected with the turbine, and an expelling fan connected with the condenser and with the crank shaft.

13. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, a crank shaft and a connection between the piston and the crank shaft; an inclosed air jacket surrounding the cylinder and adapted to be connected thereto, an auxiliary shaft parallel with and geared to said crank shaft, a condenser and an air compressor having a rotor and a turbine engine having a rotor, both of said rotors being on said auxiliary shaft, said turbine being supplied from the cylinder and discharging into the condenser.

14. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, a crank shaft and a connection between the piston and the crank shaft; an inclosed air jacket surrounding the cylinder adapted to be connected thereto, an auxiliary shaft parallel with and geared to said crank shaft, a condenser, an air compressor having a rotor and a turbine engine having a rotor, both of said rotors being on said auxiliary shaft, and means for forcing air

under pressure through said turbine to start the engine, said turbine being supplied from the cylinder and discharging into the condenser.

15. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, a crank shaft and a connection between the piston and the crank shaft; an inclosed air jacket surrounding the cylinder adapted to be connected thereto, an auxiliary shaft parallel with and geared to said crank shaft, a condenser, an air compressor having a rotor, a turbine engine having a rotor, and an expulsion turbine having a rotor, all of the rotors being on said auxiliary shaft, said turbine being supplied from the cylinder and discharging into the condenser.

16. In an internal combustion engine an inclosed air jacket surrounding said cylinder, a port leading from said jacket to said cylinder, secondary motor means, and means for passing air from said jacket to said secondary motor means, through said cylinder.

17. An internal combustion engine comprising a cylinder, a reciprocatory piston therein, a crank shaft and a connection between the piston and the crank shaft; an inclosed air jacket surrounding the cylinder, a turbine engine forming a secondary motor means and connected with the crank shaft, and means for leading the exhaust from the cylinder through said turbine and for passing air from said jacket to the turbine through said cylinder.

In witness whereof, I have hereunto set my hand in the presence of two subscribing witnesses, this 31 day of October, 1914.

OSCAR P. OSTERGREN.

Witnesses:

R. J. DEARBORN,
F. GRAVES.