No. 877,834. PATENTED JAN. 28, 1908.

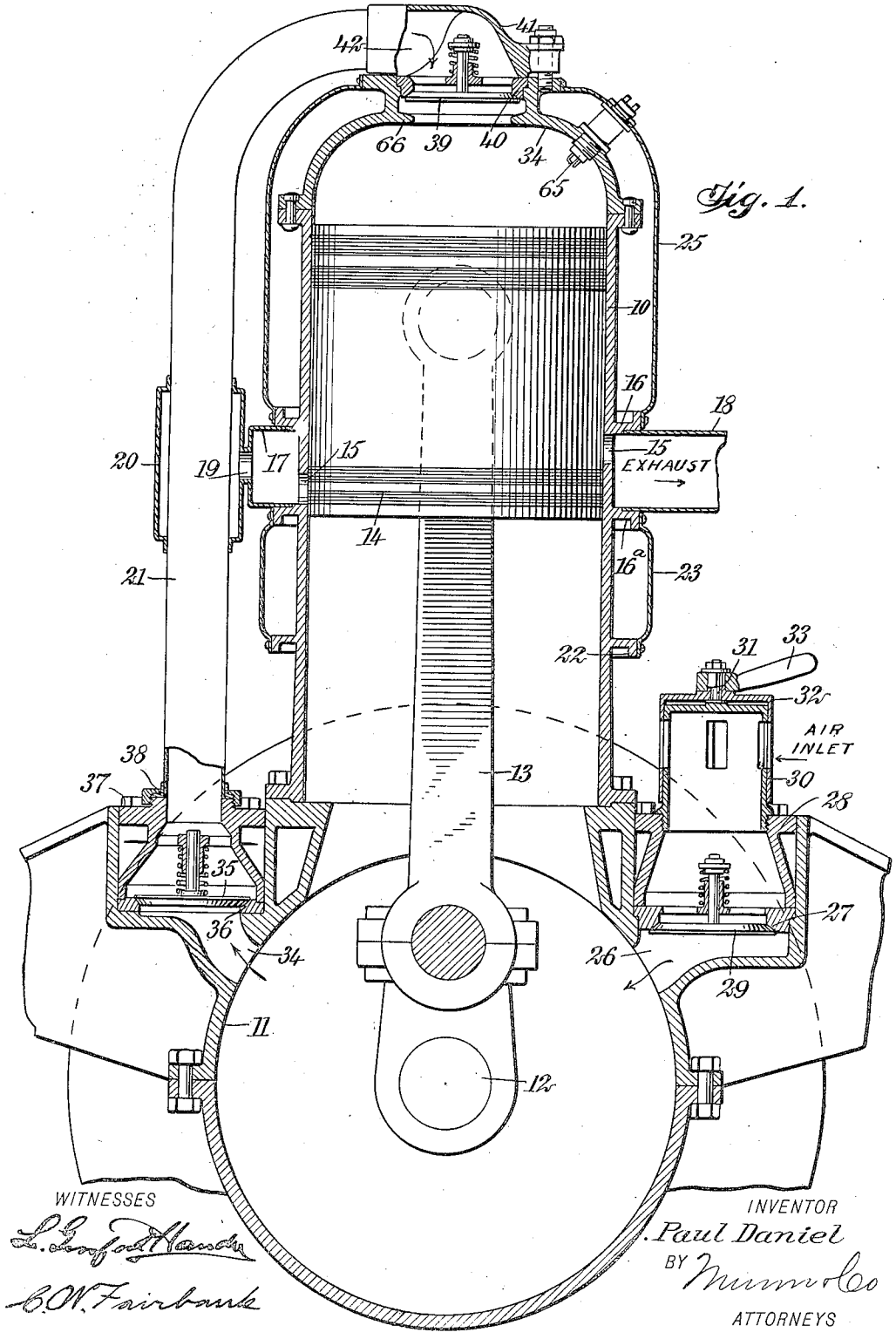
P. DANIEL.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAR. 11, 1907.

2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

L. Bonfort Hawley

C. W. Fairbanks

INVENTOR

Paul Daniel

BY Munn & Co

ATTORNEYS

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2 SHEETS—SHEET 2.

Fig. 2.

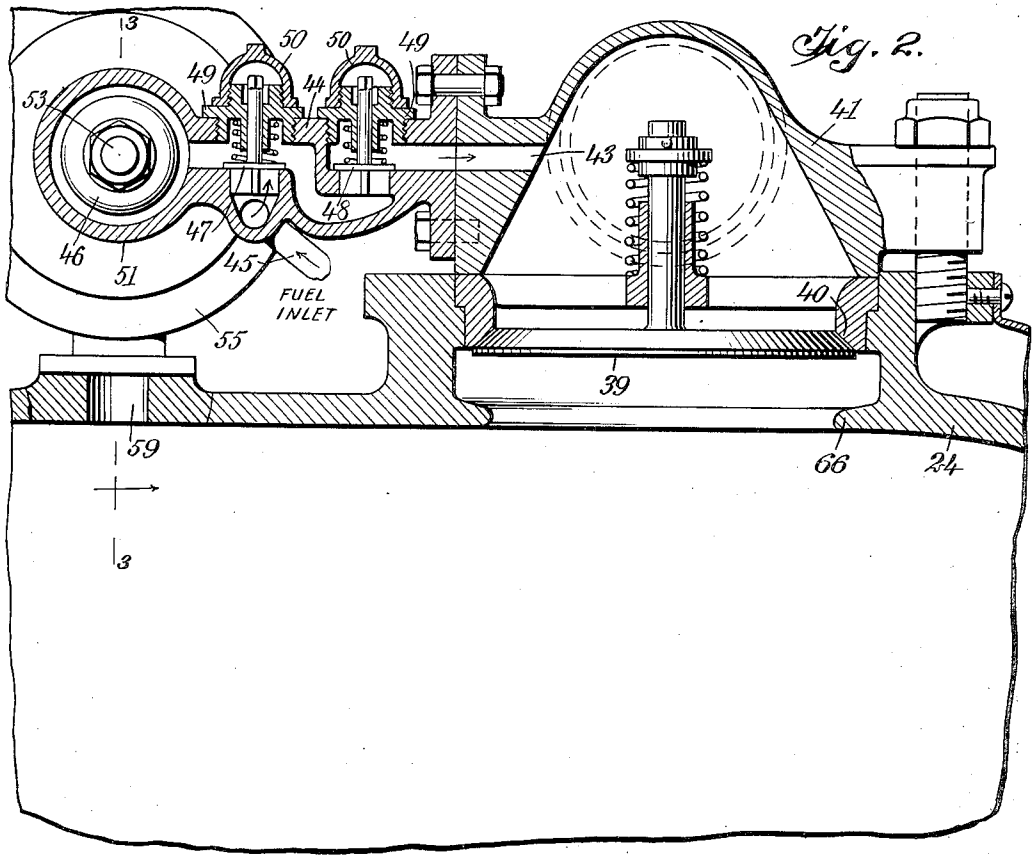
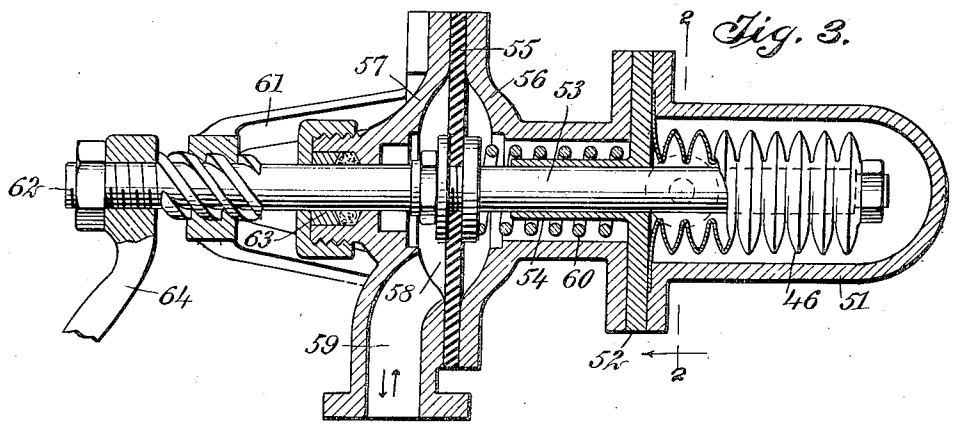


Fig. 3.



WITNESSES

L. Gerhard Hendry

C. W. Fairbank

INVENTOR

Paul Daniel

BY Munn & Co

ATTORNEYS

UNITED STATES PATENT OFFICE.

PAUL DANIEL, OF NEW YORK, N. Y.

INTERNAL-COMBUSTION ENGINE.

No. 877,834. Specification of Letters Patent. Patented Jan. 28, 1908.

Application filed March 11, 1907. Serial No. 361,845.

To all whom it may concern:

Be it known that I, PAUL DANIEL, a citizen of the Republic of France, and a resident of the city of New York, borough of Manhattan, in the county and State of New York, have invented a new and improved Internal-Combustion Engine, of which the following is a full, clear, and exact description.

This invention relates to certain improvements in internal combustion engines, and more particularly to means for forming the explosive charge and delivering the same to the engine cylinder; the object of the invention being to utilize the pressure generated in the cylinder at the time of the explosion for delivering the desired quantity of fuel to the air supply and to compress said air supply within the crank case of the gas engine.

My improvements are more applicable to two-cycle engines than to four-cycle engines, although it is evident that with slight modification the invention may be incorporated in engines of the latter type.

The invention consists in certain features of construction and combination of parts, all of which will be fully set forth hereinafter and particularly pointed out in the claims.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures, in which

Figure 1 is a longitudinal section through an engine provided with my improvements; Fig. 2 is a transverse section through the cylinder head, showing the fuel-feeding means, said section being taken on the line 2—2 of Fig. 3: and Fig. 3 is a transverse section through the fuel-injecting means, said section being taken on the line 3—3 of Fig. 2.

In my improved engine I employ a main working cylinder 10 of any suitable construction and united at its lower end to a closed crank case 11, within which operates the crank shaft 12 and piston rod 13, the latter being connected to a piston 14 of any suitable character and located within the working cylinder. The cylinder is provided with exhaust ports 15 intermediate its ends and adapted to be uncovered by the piston when the latter is near the end of its power stroke, and said exhaust ports communicate with a narrow jacket or annular chamber formed between flanges 16—16ª on the engine cylinder and inclosed by a sheet metal casing 17. This casing is provided with an exhaust conduit 18 at one side and at the other side communicates by a short conduit 19 with a jacket 20 surrounding the compressed air delivery conduit 21. The engine cylinder also supports a flat flange 22 similar to the flange 16ª and spaced therefrom, the outer edges of these flanges being connected by a sheet metal casting 23 forming a water jacket for the cylinder below the annular exhaust chamber. The flange 16 is connected to a flange on the cylinder head 24 by a casing 25 forming with the cylinder wall and cylinder head a cooling jacket for the last mentioned parts. Any suitable means may be provided for circulating the cooling fluid through these two jackets, said means constituting no portion of my invention.

The crank case 11 is provided with an air inlet passage 26, adjacent one upper side thereof, and means are provided for suitably controlling the flow of air through this passage. As shown, a valve seat 27 is held in place in the passage by a hollow plug 28 and carries an inwardly opening spring-pressed valve 29 adjacent the outlet from said passage into the crank case. The plug 28 carries at its outer end a hollow cylindrical casing 30 provided with ports in its cylindrical walls and supporting a spindle 31 in alinement with the axis of said casing. Surrounding this casing and mounted to rotate upon the spindle 31 is a sleeve 32 provided with ports adapted to register with the ports in the casing 30, and also provided with any suitable means, as, for instance, a lever 33, whereby the sleeve may be rotated to bring the ports of the sleeve into or out of registry with the ports of the casing.

The crank case 11 is provided with an air supply passage 34 oppositely disposed to the inlet passage 26 and controlled by an outwardly opening spring-pressed valve 35 normally resting upon a seat 36, which latter is held in place by a plug 37 somewhat similar to the oppositely disposed plug 28. This plug is connected by any suitable form of coupling means 38 to the compressed air delivery conduit 21 previously referred to, which conduit extends through the heating jacket 20 and delivers to the inlet valve 39 of the engine cylinder. This inlet valve is preferably a spring-pressed inwardly opening valve normally contacting with a valve seat 40 carried by the cylinder head 24.

Surrounding the valve seat and rigidly connected to the cylinder head is a casing 41 hav-

ing an inlet port 42 in communication with the compressed air delivery conduit 21, and having a fuel inlet port 43 connected to the fuel measuring and injecting mechanism illustrated in Figs. 2 and 3.

In the specific form of fuel measuring and injecting means illustrated in the drawings, I employ a delivery conduit 44 having a plurality of valves located therein and having the delivery end thereof rigidly secured to the wall of the casing 41. Connected to the opposite end of the conduit is an expansible device, the movements of which are controlled by the variations in pressure within the working cylinder and which movements result in the drawing in of the liquid fuel and delivering the same through the conduit 43 of the casing 41 above the main inlet valve 39 of the working cylinder. The valves in the conduit 44 are preferably two in number and are both inwardly opening in respect to the supply conduit 45, but one of which valves is outwardly opening in respect to the expansion device 46. The last mentioned valve 47 rests upon a valve seat formed in the lower wall of the passage through the conduit 44 and is normally held against said seat by a suitable coil spring. The fuel delivery conduit 45 leads to a recess directly below the valve 47 and can only escape into the conduit 44 when said valve is open. The other valve 48 controlling the conduit 44 is similar in all respects to the valve 47, save that it rests upon a seat in the partition crossing the conduit 44, whereby fluids may pass through said conduit only while this valve is open. The valve stems of each of the valves are preferably mounted and guided within plugs 49 screw-threaded into the side wall of the conduit 44, and the outer ends of the valve stems are preferably protected by small inclosing casings 50.

The end of the conduit 44 opposite to the port 43, communicates with a cylindrical chamber 51 containing the expansion device 46. This last mentioned device may be of any suitable character, but is preferably of imperforate corrugated metal having one end rigidly secured in place between the base of the chamber 51 and a supporting collar 52, and having its outer end closed and rigidly secured to a reciprocating rod 53. By the inwise movement of this rod the member 46 is caused to expand and more completely fill the chamber 51, while when the rod is moved in the opposite direction the member 46 collapses and leaves a larger percentage of free space within its inclosing chamber. The opposite end of the rod 53 extends through a guiding and supporting sleeve 54 carried by the collar 52 and is rigidly connected to a diaphragm 55. The circumferential edges of this diaphragm are supported between the opposite sections 56 and 57 of a casing, and the body of the diaphragm forms with the last mentioned section a chamber 58 communicating at all times with the cylinder of the engine through a conduit 59. The section 56 may or may not be imperforate and its outer end surface has a support for the collar 52 and chamber 51. Surrounding the guiding sleeve 54 and normally pressing the diaphragm away from the chamber 51, so as to collapse the member 46, is a coil spring 60 of any suitable character. The section 57 of the casing around the diaphragm carries a skeleton frame 61 within which is screw-threaded a rod 62, one end of which extends through a suitable packing 63 and contacts with the diaphragm within the chamber 58. The threads upon the rod 62 by which said rod is held in the frame 61 are preferably of very high pitch, so that a slight rotation of the rod causes an appreciable longitudinal movement, while for rotating the rod I provide a lever 64 or other suitable means for manually or automatically controlling the same. The rod 62, as previously stated, contacts with the diaphragm 55 but is unattached thereto. As the chamber 58 is in free communication with the engine cylinder at all times and the pressure within the chamber varies at different points in the cycle, the position of the diaphragm is varied accordingly, but the extent of its movement may be controlled by means of the rod 62, which serves as an abutment or stop.

In the operation of my improved engine, the conduit 45 is connected to the fuel supply tank, the sleeve 32 is rotated to open the air inlet ports to the desired extent, and the expansion and contraction of the member 46 is controlled by rotating the rod 62 to the desired point. The high pressure created in the working cylinder at the instant of explosion is communicated through the conduit 59 to the diaphragm 55, and the movement of the latter expands the member 46 to its limiting position, thus forcing a portion of the contents of said chamber out through the conduit 44 and port 43 into the casing 51 above the inlet valve 39. At the end of the power stroke the gases exhaust through the port 15, and the presssure within the cylinder and chamber 58 readily drops to approximately that of the atmosphere. The diaphragm 55 is now moved back into contact with the rod 62 by the action of the spring 60, and the contraction of the member 46 draws the liquid fuel from the conduit 45 past the valve 47 into the chamber 51. Thus at each explosion the oil previously drawn into the chamber 51 is forced out and deposited within the casing 41 and upon the upper surface of the valve 39; while upon each explosion stroke the air which has been drawn into the crank case through the valve 29 is forced out past the valve 35 into the conduit 21, but as the pressure of this compressed air can never exceed the explosion pressure, the valve 39

does not open until the piston passes the exhaust ports 15 and the pressure within the working cylinder drops to that of the atmosphere. At this instant the compressed air within the crank case and conduit 21 press upon the valve 39 and together with the fuel upon the upper surface of this valve enter the working cylinder where they force outward the remainder of the exhaust gas and air in turn compressed by the return of the piston 14 and at the proper instant ignited by any suitable form of ignition device 65. Directly below the valve 39 there is preferably provided an inwardly directed flange 66 lying in the path of the incoming explosive charge and serving to bring the constituents of said charge into more intimate relationship and causing a more thorough mixture thereof. As the pressure within the working cylinder at the instant of explosion is greater than that within the compressed air delivery conduit 21 and oil delivery port 43, the valve 48 may readily open against the latter pressure when the oil is forced against its under side by the expanison of the member 46.

The inlet valve 39 to the working cylinder is subjected to the high temperature existing within said cylinder at the time of the explosion, and as the oil is delivered onto the upper surface of the valve at substantially the same time that the explosion occurs, a large portion, if not all, of the fuel is vaporized before the inlet valve is opened to deliver the same into the working cylinder. This vaporization is further aided by the contact with the heated air in the conduit 21, said air having been raised to a comparatively high temperature by the exhaust gas within the jacket 20.

My improved engine is particularly adapted for use upon motor vehicles. When so employed, the levers 33 and 64 could be secured to operating mechanism extending to points within reach of the chauffeur. Thus the speed of the engine may be readily controlled by controlling the air inlet to the crank case and by controlling the movement of diaphragm 55, and thus regulating the amount of fuel delivered to the upper surface of the inlet valve 39 upon each stroke of the piston. The levers 33 and 64 may, if desired, be connected to a governor so as to automatically control the speed of the engine.

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

1. An internal combustion engine, comprising a working cylinder having an inlet valve, a conduit for delivering compressed air to said valve, and means for delivering liquid fuel to said conduit, said means comprising an expansible device adapted to operate as a piston and a diaphragm connected to said expansible device and subjected to the pressure existing within the cylinder.

2. An internal combustion engine, comprising a working cylinder having an inlet valve, a conduit for delivering compressed air to said valve, means for delivering liquid fuel to said conduit, said means comprising an expansible device adapted to operate as a piston, and a diaphragm connected to said expansible device and subjected to the pressure existing within the cylinder, and means for controlling the movement of the diaphragm.

3. An internal combustion engine, comprising a working cylinder having an inlet valve, a conduit for delivering compressed air to said valve, and means for delivering liquid fuel to said conduit, said means comprising an oil delivery conduit having inlet and outlet valves, a chamber of variable capacity in communication therewith, and a diaphragm secured to one wall of said chamber and having one surface thereof subjected to the pressure existing within the working cylinder.

4. An internal combustion engine, comprising a working cylinder having an inlet valve, a conduit for delivering compressed air to said valve, and means for delivering liquid fuel to said conduit adjacent the outer surface of said valve, said means comprising an oil delivery conduit having inlet and outlet valves, a chamber communicating with said conduit intermediate said valves, said chamber being of variable capacity, a casing adjacent said chamber, a diaphragm within said casing and having one surface thereof subjected to the pressure existing within the working cylinder, and means operatively connected to said diaphragm for varying the capacity of said chamber, whereby when low pressure exists in the cylinder, liquid fuel is drawn into said chamber, and when high pressure exists in the cylinder, the liquid fuel is forced outward into the air conduit.

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

PAUL DANIEL.

Witnesses:
CLAIR W. FAIRBANK,
EVEARD B. MARSHALL.