No. 885,598. PATENTED APR. 21, 1908.

W. H. FROST.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED APR. 29, 1907.

Fig. 1.

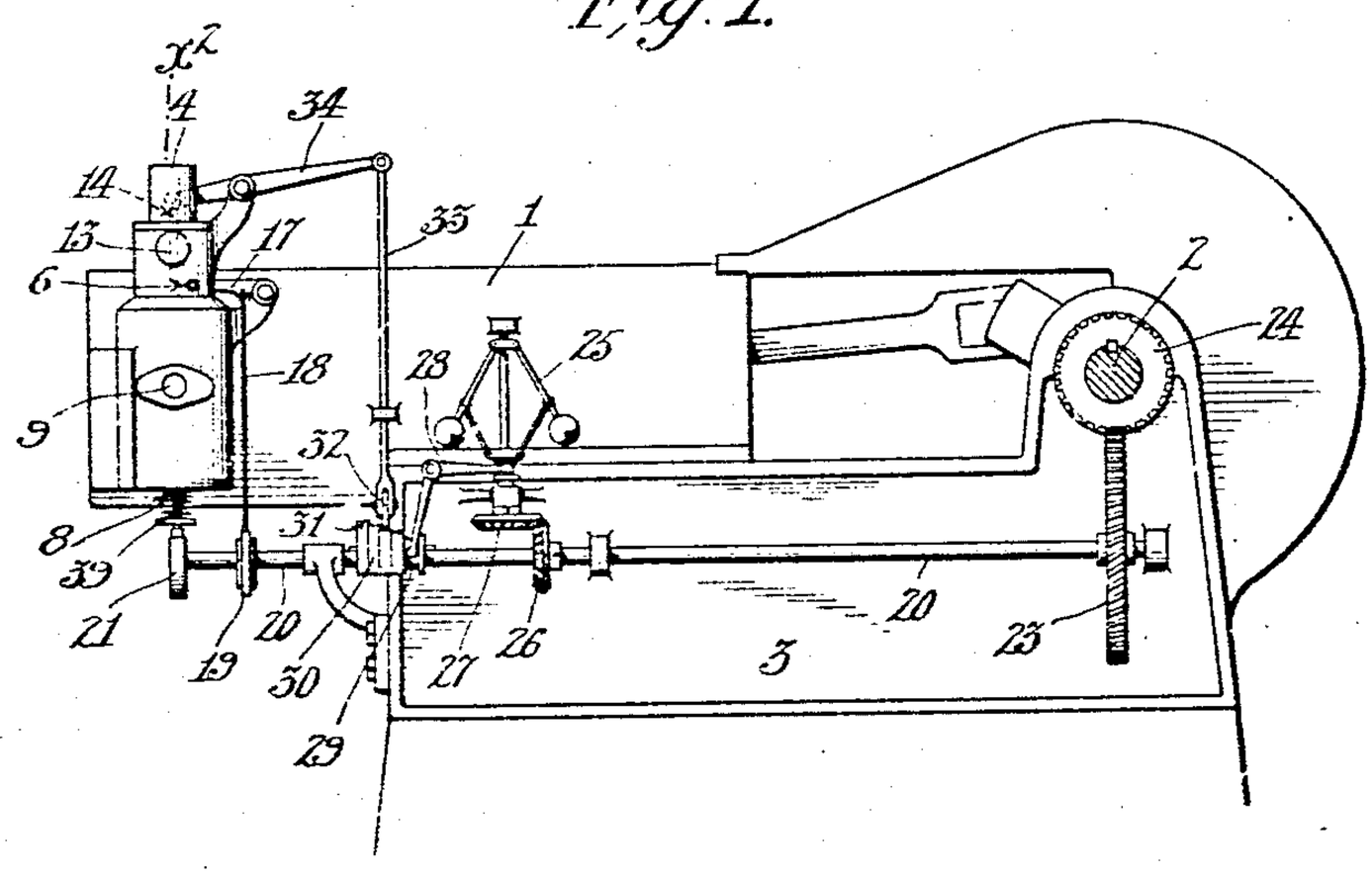


Fig. 3.

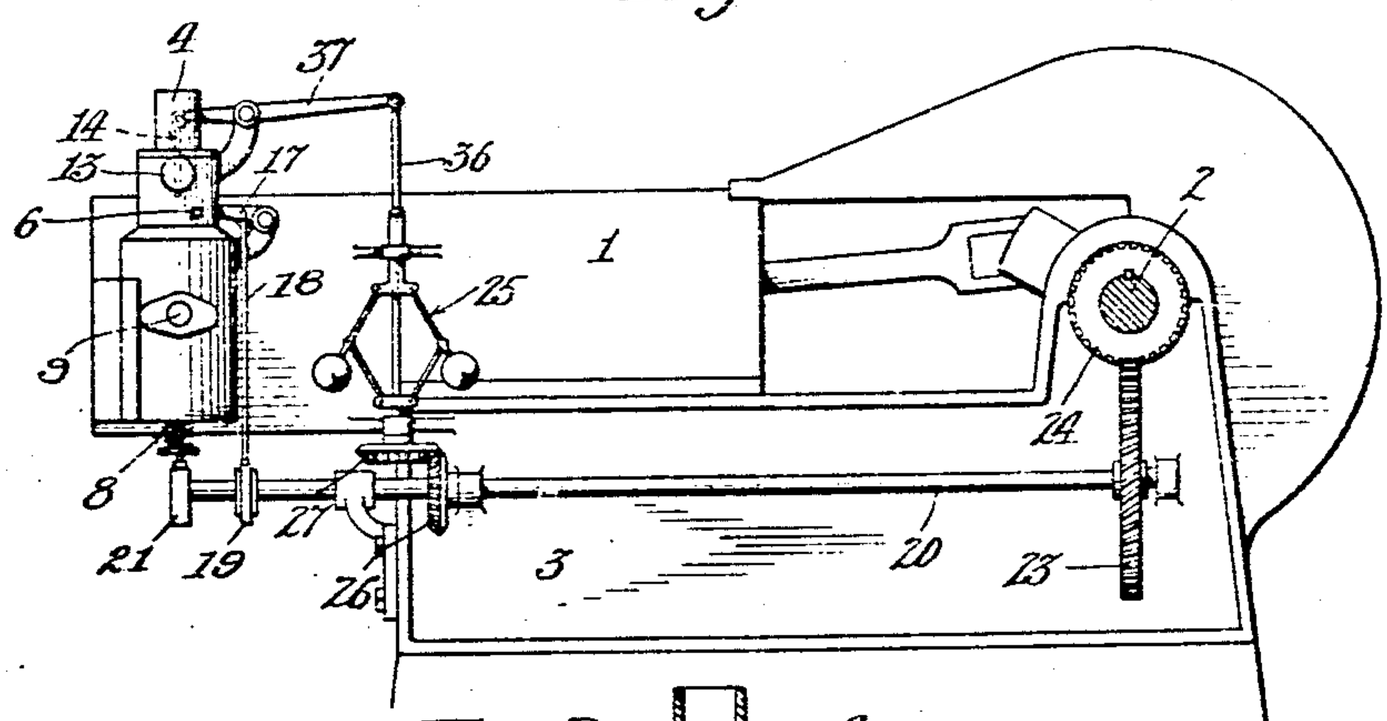
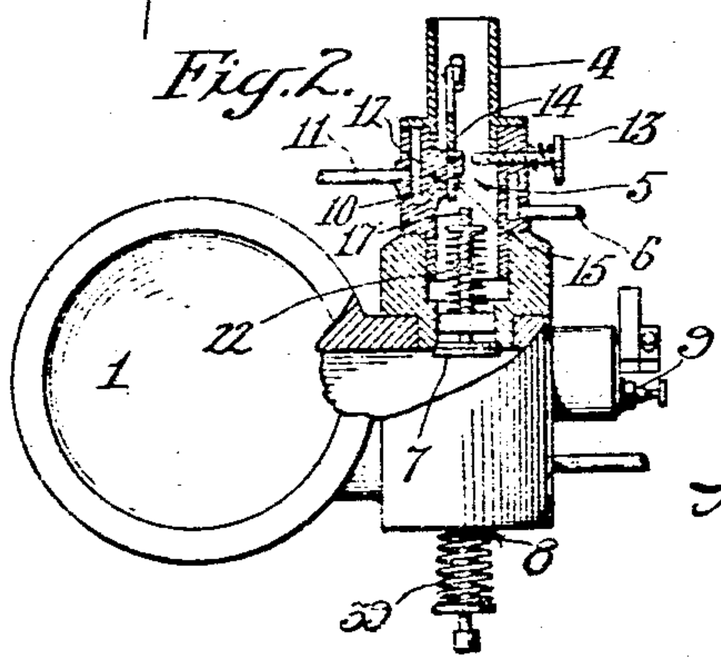


Fig. 2.



Witnesses:—
Frank L. A. Graham.
Louis W. Gratz.

Inventor;
Warren H. Frost.

By
Townsend, Lyon, Hadley & Kemper
his attorneys

UNITED STATES PATENT OFFICE.

WARREN H. FROST, OF LOS ANGELES, CALIFORNIA.

INTERNAL-COMBUSTION ENGINE.

No. 885,598. Specification of Letters Patent. Patented April 21, 1908.

Application filed April 29, 1907. Serial No. 370,874.

To all whom it may concern:

Be it known that I, WARREN H. FROST, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

The main object of the present invention is to provide for regulation of the fuel supply in an economical and efficient manner.

A further object of the invention is to provide for cut-off of the fuel supply during a variable portion of each stroke responsively to the load on the engine.

Another object of the invention is to provide efficient means for the operation of the valves of the engine.

In the accompanying drawings:—Figure 1 is a side elevation of an embodiment of the invention. Fig. 2 is a vertical section on the line x^2 Fig. 1. Fig. 3 is a side elevation of an engine with a variable throttle for the fuel controlling valve.

Referring to Fig. 1, the engine cylinder is designated at 1, the main shaft at 2, the frame at 3. The engine is supplied with mixture through intake means comprising a tubular member 4 having an intake passage 5 extending downwardly thereinto and communicating through a port with the engine cylinder, said port being controlled by a mixture admission valve 7.

8 designates the exhaust valve and 9 the igniter (see Fig. 2). The fuel, for example, oil or other liquid fuel, is supplied by pipe 6 to a fuel supply chamber 10 in the upper portion of the tubular member 4, and an overflow pipe 11 is provided to maintain a definite level therein. From said fuel supply chamber an upwardly inclined duct or orifice 12 leads to the intake passage 5 aforesaid, its outlet being controlled by a manual regulating means 13.

A valve 14, formed for example as a rod sliding vertically across the duct 12 and provided with a port or opening 15, serves to control communication therethrough, this valve being preferably located at a point above the normal fuel level, so that the valve controls the suction of fuel through said duct into the intake. Said valve 14 is operated by means hereinafter described, responsively to the load on the engine. The admission valve 7 is normally closed by a spring 22 and is operated by a lever 17 connected by a link or rod 18 with an eccentric 19 on a side shaft 20 on one side of the engine, and a cam 21 on the said side shaft also operates the exhaust valve 8 which is normally held closed by a spring 39. Said side shaft is operated by the main shaft 2 of the engine by gearing, such as spiral gears 23, 24, the same being two to one gears for a four stroke cycle. The governor 25 is mounted at the side of the engine and operated by gears 26, 27 from said side shaft. Said governor operates a lever 28 engaging in a yoke 29 on a stepped cam 30 mounted to slide longitudinally on, but to rotate with, the said side shaft 20. Said stepped cam has a plurality of step portions 31 of different effective length or extension and adapted to engage with a roller 32 on one end of a rod 33 connected to a lever 34 which operates the fuel controlling valve 14, one or another of said step portions operatively engaging according to the longitudinal position of the step cam as determined by the position of the governor. These steps of the cam are grooved so as to hold the roller from slipping off of any step and to cause the roller to travel definitely over one step or another.

When the engine is at low speed, the governor 25 holds the step cam to position of least effective stroke and at each suction stroke of the engine fuel is drawn up through duct 12 to the intake and is mixed with the air coming through passage 5, the valve 7 being at the same time opened by lever 17, rod 18 and eccentric 19 operated by side shaft 20. If the speed of the engine increases, the governor 25 moves the stepped cam over to bring a step or portion of greater stroke into action and thus to close the suction inlet for fuel during a small part of the stroke. On further increase, the stepped cam will be further moved to bring a step portion of a yet larger stroke into action, causing opening of the fuel suction through a greater stroke. The cam is operated by the side shaft so as to operate the valve once during each suction stroke of the engine, the time during which the valve is held open depending on the position of the cam, as controlled by the engine.

The effect of the above described operation is to lengthen the time of fuel intake with increase of load, and to shorten the time of fuel intake with decrease of load. The maximum opening of the valve may also be varied, or it may remain the same, only the time of opening be varied, according to the conformation of the cam steps.

An important feature of the invention is the provision for operation of all of the valves of the engine in the manner shown, from a side shaft, whereby minimum economy and simplicity of construction and operation is attained.

In some cases the control of the fuel suction may be by throttling as in the form shown in Fig. 3, wherein the governor 25 operates the valve 14 directly through a rod 36 and lever 37 to throttle the suction more or less according to the load. In any case, however, the control is by varying the admission of fuel rather than by varying the opening of the admission valve of the engine.

What I claim is:—

1. In an internal combustion engine, a cylinder therefor, a fuel inlet passage for the cylinder, an inlet valve between said passage and the cylinder, a fuel supply chamber adjacent the inlet passage and having an upwardly inclined duct extending into the inlet passage, a manually operated valve for controlling the discharge mouth of said duct, a slide in the inlet passage and operating through a slot in said duct and having a port adapted to register with the channel of said duct, said slide restricting the passage of oil from said duct and being arranged longitudinally of the inlet passage whereby passage of air through the inlet passage is unrestricted irrespective of the position of the slide, and means operated by the engine for sliding said slide into positions according to the load on the engine.

2. In an internal combustion engine, a cylinder therefor, a fuel inlet passage for the cylinder, an inlet valve between said passage and the cylinder, a fuel supply chamber adjacent the inlet passage and having a duct extending into the inlet passage, a manually operated valve for controlling the discharge mouth of said duct, a slide operating through a slot in said duct and having a port adapted to register with the channel of said duct, said slide restricting the passage of oil from said duct and being arranged longitudinally of the inlet passage whereby passage of air through the inlet passage is unrestricted irrespective of the position of the slide, and means operated by the engine for sliding said slide into positions according to the load on the engine.

3. In an internal combustion engine, a cylinder therefor, a fuel inlet passage for the cylinder, an inlet valve between said passage and the cylinder, a fuel supply chamber surrounding said inlet passage and having a duct extending into the inlet passage, means for maintaining a substantially constant level of liquid fuel in the fuel chamber at a level below the discharge mouth of said duct, an adjustable valve opposite the discharge mouth of said duct, longitudinally of said inlet passage and a valve sliding in said duct across the passage of the duct and above the level of fuel in the fuel chamber, and means operated by the engine for sliding said slide into positions according to the load on the engine.

4. In an internal combustion engine, a cylinder therefor, a fuel inlet passage for the cylinder, an inlet valve between said passage and the cylinder, a fuel supply chamber adjacent said inlet passage and having a duct extending into the inlet passage, means for maintaining a substantially constant level of liquid fuel in the fuel chamber at a level below the discharge mouth of said duct, an adjustable valve opposite the discharge mouth of said duct, a valve sliding in said duct across the passage of the duct and above the level of fuel in the fuel chamber, a pivoted lever connected to the slide, a side shaft operated by the engine, a stepped cam on the side shaft, a rod connected to said lever and operated by the stepped cam, a governor geared with the side shaft, and means operated by the governor for shifting the stepped cam to impart regularly timed movements to the slide of different lengths according to the load on the engine.

In testimony whereof, I have hereunto set my hand at Los Angeles California this 13th day of April 1907.

WARREN H. FROST.

In presence of—
ARTHUR P. KNIGHT,
FRANK L. A. GRAHAM.