W. H. FROST.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JULY 22, 1907.

917,283.

Patented Apr. 6, 1909.

Fig. 1.

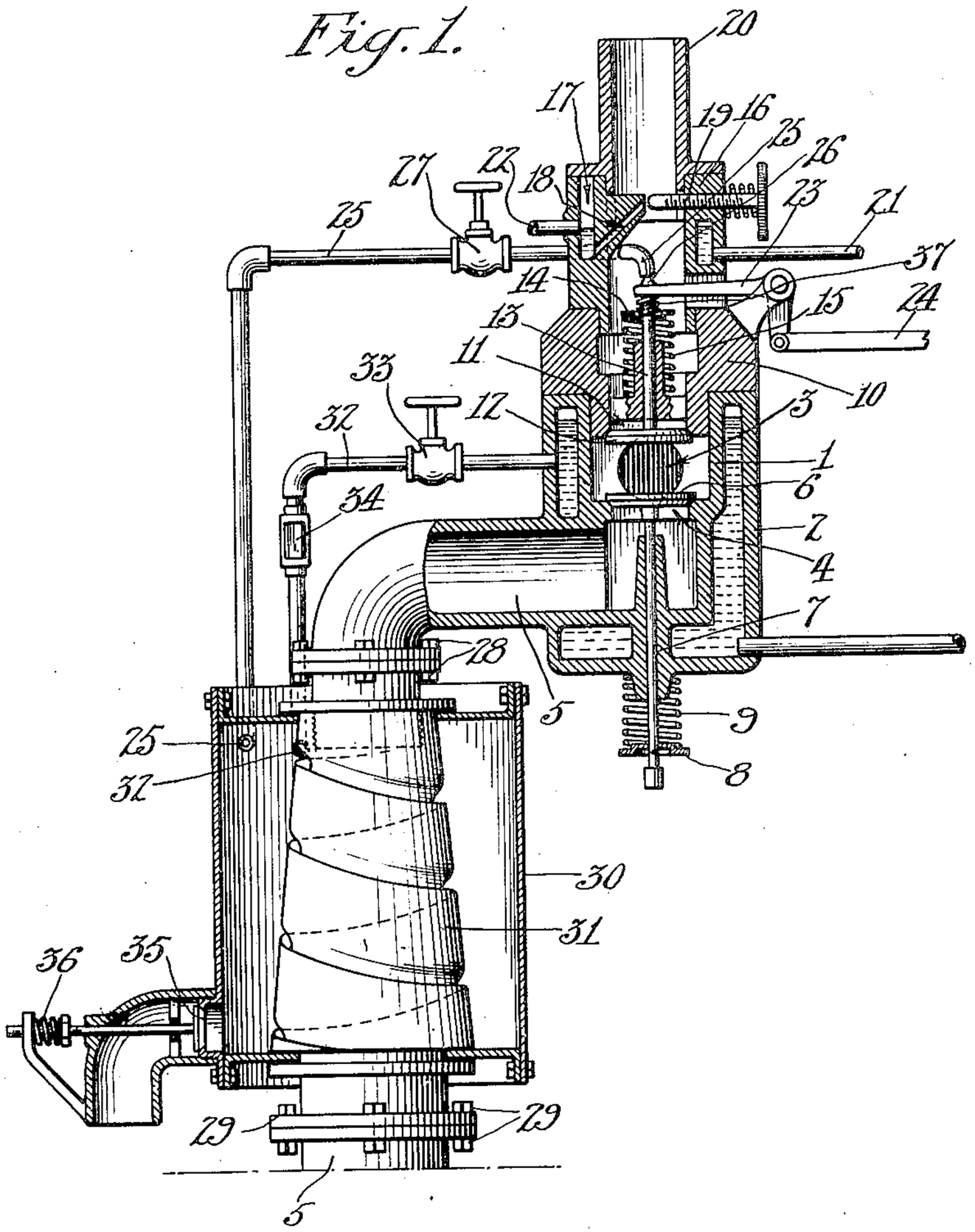
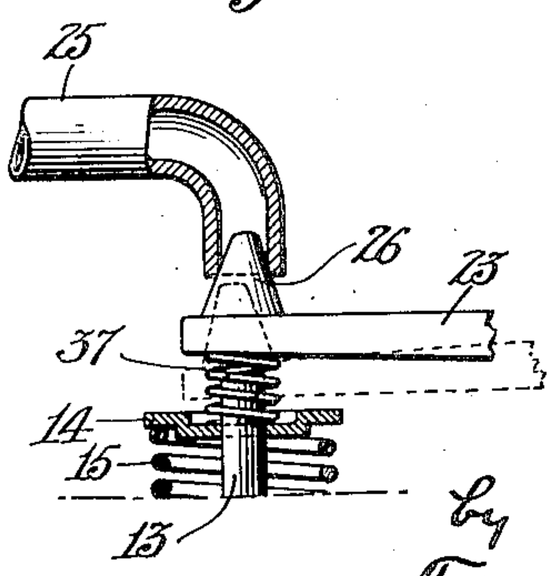


Fig. 2.



Witnesses:—

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UNITED STATES PATENT OFFICE.

WARREN H. FROST, OF LOS ANGELES, CALIFORNIA.

INTERNAL-COMBUSTION ENGINE.

No. 917,283. Specification of Letters Patent. Patented April 6, 1909.

Application filed July 22, 1907. Serial No. 385,049.

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.

This invention relates to internal combustion engines and particularly to vaporizing the liquid fuel. In such engines it has been found advantageous to introduce a certain amount of water with the explosive mixture to the engine to increase the efficiency of the engine. This practice, while advantageous, is open to the objection that incrustations form on the valves and adjacent parts, due to the solids contained in the water, and the principal object of the present invention is to obviate the formation of any deposit on the parts and yet secure an equal or greater efficiency. This object is attained by admitting steam, instead of water, to the vaporizer to combine with the mixture, the steam being free from solids which would cause incrustation. The steam also mixes more easily with the mixture and permeates thoroughly and evenly throughout, while the water cannot be so fully distributed through the mixture.

A further object is to admit the steam intermittently, *i. e.*, periodically at each intake movement of the mixture and thereby regulate the admission of steam properly, giving greatest efficiency and economizing the steam.

Another object is to produce the periodic admission of steam automatically by the valve actuating mechanism, so that absolute synchronism between the movement of the intake valve and the admission of steam is attained.

Another object is to provide simple and effective means for producing the steam.

Other objects and advantages of the invention relate to details of construction and arrangement which will be hereinafter pointed out.

Referring to the drawings:—Figure 1 is a vertical cross section taken diametrically through the vaporizer and adjacent parts constructed in accordance with my invention. Fig. 2 is a detail view, partly in section, of the automatic steam admission valve.

1 designates a valve chamber having a water jacket 2 and provided with a port 3 through which communication is had with the cylinder of the engine. The chamber 1 is also provided with an exhaust port 4 for the exit of exhaust gas from the chamber, the exhaust gas being conveyed from the port 4 by an exhaust pipe 5 which is preferably cast integral with the chamber 1. An exhaust valve 6 controls the port 4 and has a stem 7 with a collar 8 against which spring 9 bears to normally hold the valve 6 closed. The stem 7 is actuated to open the valve by mechanism, not necessary to show or describe. The valve chamber 1 is closed at the top by a cap 10, the latter being provided with an inlet port 11 which communicates with the interior of valve chamber 1. The inlet port 11 is controlled by an inlet valve 12 having a stem 13 with a collar 14, and a spring 15 bearing against the collar 14 serves to close the valve 12. Mounted above the cap 10 is a vaporizer 16 having an annular fuel chamber 17 which communicates with the interior of the vaporizer through an upwardly slanting duct 18, opposite the mouth of which is a screw 19. The incoming liquid fuel as it is sucked through the duct 18 strikes the end of screw 19 and is formed into a spray with which is combined a supply of air which enters through a thimble 20 arranged above the vaporizer 16. Liquid fuel may be admitted to the chamber 17 through a pipe 21, and a constant level maintained in the chamber by an overflow pipe 22. One side of the vaporizer wall 16 has an opening through which projects a tappet 23, the latter being actuated, by an operating rod 24, against the end of valve stem 13 to open the valve.

Steam is admitted to the vaporizer 16 through a pipe 25 and, as clearly shown in Fig. 2, the mouth of pipe 25 is formed with a valve seat, and the exit of steam therefrom is controlled by a conical valve 26 which is mounted on the end of the tappet 23. To insure proper seating of the valve 26 in the mouth of pipe 25, a spring 37 is provided which rests upon the collar 14 and bears against the under side of the tappet 23. Spring 37 is weaker than spring 15 and its purpose is to permit a slight differential movement between stem 13 and tappet 23, for if tappet 23 rested directly upon stem 13, when the stem 13 was at its upper limit it might not raise the tappet high enough to close valve 26. Thus as the tappet 23 moves down and opens the valve 12 it at the same

time opens valve 26 and allows steam to enter the vaporizer chamber and, as at this time there is an inrush of fuel mixed with air, the steam combines with the mixture and the combined mixture passes down past the valve 12 and through the passage 3 into the cylinder. Upon the closing of valve 12, which is permitted by the tappet 23 rising, the valve 26 closes the end of steam pipe 25 and prevents entrance of steam to the vaporizer until again opened; thus the admission of steam takes place periodically at each intake of fuel mixture.

A valve 27 is arranged in the pipe 25, near the vaporizer, to control the passage of steam therethrough, so that the amount of steam admitted at each period may be regulated. The exhaust pipe 5 is preferably made in flanged sections and bolted together as shown at 28 and 29. Surrounding a section of the exhaust pipe 5 is a steam drum 30, and formed on the pipe 5 and within the steam drum is a threaded or spirally grooved enlargement forming a distributer 31 over which water is spread as it flows down around the distributer. The water is admitted to the steam drum in a small stream so that steam is quickly formed, the heat being derived from the exhaust gases which pass through the center of the enlargement 31. Water is delivered to the enlargement 31 by a pipe 32 which may connect with the water jacket of the cylinder or of the chamber 1, as shown, so that the water is already heated when it reaches the enlargement 31, and steam is thus formed very quickly. A valve 33 is arranged in pipe 32 to control the passage of the water therethrough, and in order to determine the rate of admission of the water a sight glass 34 is provided in pipe 32. The pipe 25, before referred to, communicates with the steam drum 30.

In order to prevent an excess steam pressure in the steam drum, a relief valve 35 is provided which is held closed by a spring 36, the tension of which is proportioned to the amount of pressure it is desirable to maintain in the steam drum, the spring 36 allowing the valve 35 to open when the steam pressure exceeds the point desired. If it becomes necessary to clean out the steam drum of any accumulations the section of the exhaust pipe carrying the steam drum may be removed laterally by removing the bolts at 28 and 29.

What I claim is:—

1. In an internal combustion engine, an exhaust pipe therefor, a steam drum surrounding the exhaust pipe, a threaded distributer on the exhaust pipe within the steam drum, a water pipe for delivering water to the distributer, charge forming means for the engine, a pipe for conducting steam from the drum to the charge forming means, and means for periodically admitting steam from the latter pipe to the fuel in the charge forming means.

2. In an internal combustion engine, an exhaust pipe therefor, a steam drum surrounding the exhaust pipe, a threaded distributer on the exhaust pipe within the steam drum, a water pipe for delivering water to the distributer, charge forming means for the engine, a pipe for conducting steam from the drum to the charge forming means, means for periodically admitting steam from the latter pipe to the fuel in the charge forming means, a sight tube in the water pipe, a valve in the water pipe, and a valve in the steam pipe.

3. In an internal combustion engine, an inlet valve with its stem, a steam pipe for conveying steam to combine with the fuel mixture to be admitted by the inlet valve, a tappet which actuates the stem of the inlet valve, and a valve on said tappet for controlling the exit of steam from the steam pipe.

4. In an internal combustion engine, an inlet valve with its stem, a steam pipe for conveying steam to combine with the fuel mixture to be admitted by the inlet valve, a tappet which actuates the stem of the inlet valve, a valve on said tappet for controlling the exit of steam from the steam pipe, and a spring intermediate the tappet and inlet valve stem to insure a perfect seating of said steam valve.

5. In an internal combustion engine, an inlet valve with its stem, a steam pipe for conveying steam to combine with the fuel mixture to be admitted by the inlet valve, a tappet which actuates the stem of the inlet valve, a spring for closing the inlet valve, a valve on the tappet for controlling the steam pipe, there being a clearance between the tappet and inlet valve stem when both said valves are closed, and a spring weaker than the first spring intermediate the tappet and inlet valve stem.

6. In an internal combustion engine, an inlet valve, a steam pipe for conveying steam to combine with the fuel mixture to be admitted by the inlet valve, a valve for controlling the steam pipe, and means for operating both said valves and allowing a slight differential movement between said valves to insure their perfect seating.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 26th day of June 1907.

WARREN H. FROST.

In presence of—
GEORGE T. HUCKLEY,
FRANK L. A. GRAHAM.