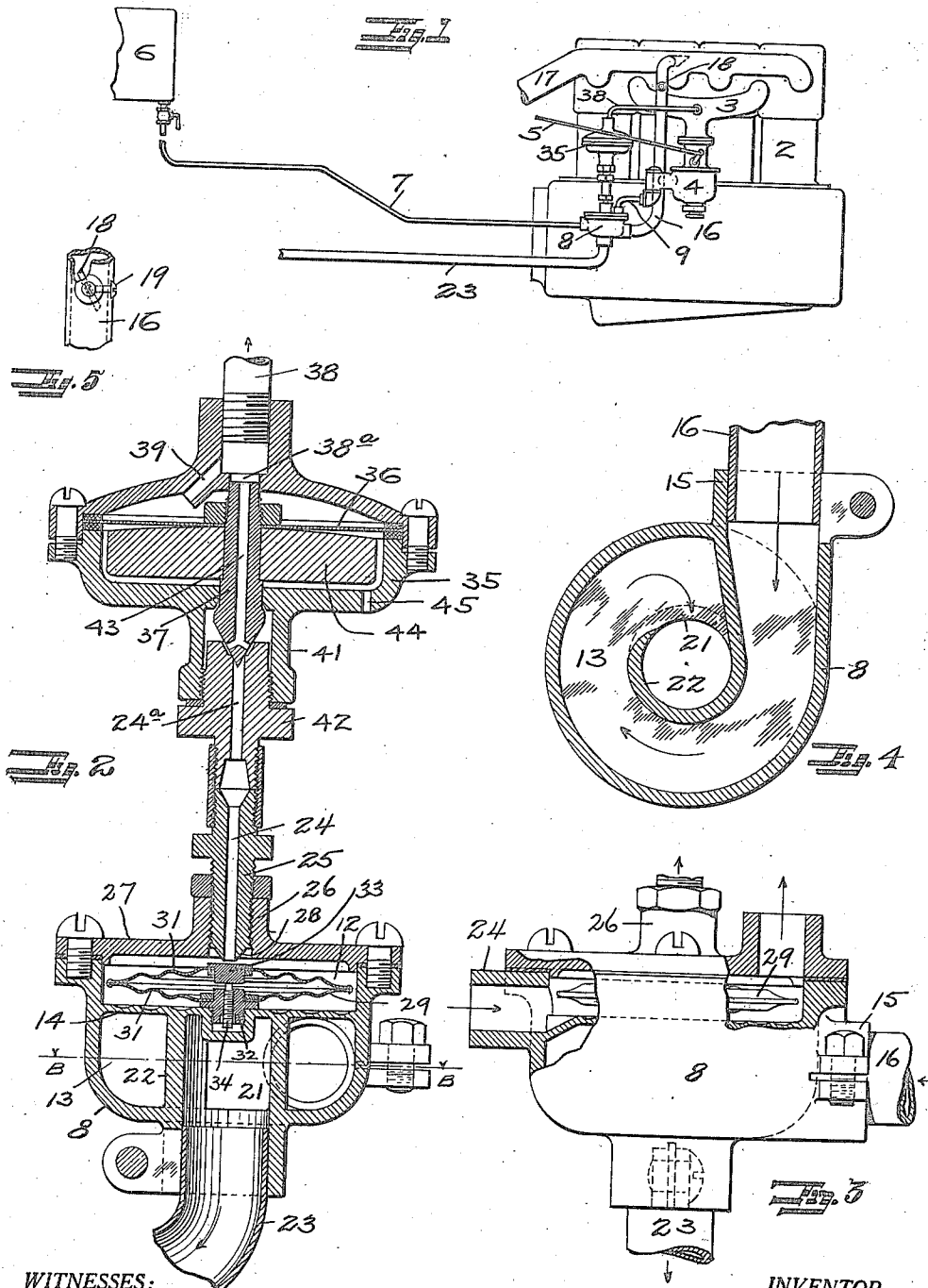


T. C. LEAKE.
 APPARATUS FOR CONTROLLING THE FLOW OF FUEL TO INTERNAL COMBUSTION ENGINES.
 APPLICATION FILED MAR. 24, 1915.

1,229,481.

Patented June 12, 1917.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR CONTROLLING THE FLOW OF FUEL TO INTERNAL-COMBUSTION ENGINES.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, THOMAS C. LEAKE, a citizen of the United States, and a resident of the city and county of San Francisco, State of California, have invented a certain new and useful Apparatus for Controlling the Flow of Fuel to Internal-Combustion Engines, of which the following is a specification.

The invention relates to an attachment for internal combustion engines, by means of which the flow of fuel to the engine at starting is automatically controlled, and relates to subject matter similar to that disclosed in Patent No. 1,137,219 issued to me April 27, 1915.

It is desirable to employ comparatively heavy hydrocarbons, such as kerosene or distillate, as the fuel in internal combustion engines, owing to its low cost in comparison with the cost of the lighter hydrocarbons such as gasoline, but difficulty is experienced in starting a cold engine on the heavier hydrocarbons.

It is one of the objects of my invention to provide an attachment for internal combustion engines, whereby the engine, when cold, may be readily started on the heavier hydrocarbons as fuel.

Another object of the invention is to provide means for feeding the fuel directly to the engine cylinders when the engine is cold, for heating the fuel by the heat of the exhaust gases of the engine and for automatically cutting off the direct feed to the cylinders and supplying the fuel in the usual way through the carbureter when the fuel and engine become sufficiently warm so that the fuel may be properly vaporized in the carbureter.

Another object of the invention is to provide means for preventing the flow of the fuel to the engine cylinders when the engine is not running.

A further object of the invention is to provide a simple, reliable and compact apparatus for performing the aforesaid functions.

The invention possesses other advantageous features, some of which, with the foregoing, will be set forth at length in the following description, where I shall outline in full that form of the invention, which I have

selected for illustration in the drawings accompanying and forming part of the present specification. In the drawings I have shown only one form of my invention but it is to be understood that the invention may be embodied in other forms without departing from the spirit of my invention. It is also to be understood that by the claims succeeding the description of my invention I desire to cover the invention in whatever form it may be embodied.

In said drawings:

Figure 1 is a side view of an internal combustion engine showing the apparatus of my invention attached thereto.

Fig. 2 is a vertical section of the apparatus of my invention.

Fig. 3 is a side view, partly in section, of the fuel heating device.

Fig. 4 is a cross section taken on the line B—B Fig. 2.

Fig. 5 is a detail showing a valve in the exhaust gas line.

The heavier hydrocarbon fuels, such as distillate, do not readily vaporize at ordinary temperatures, so that they cannot be properly introduced into the engine in the ordinary manner through the carbureter, when the fuel and the engine are cold, so that it is very difficult to start a cold engine on the heavier hydrocarbons, when the fuel is introduced only through the carbureter. In accordance with my invention, means are provided for introducing the liquid fuel directly to the cylinders when the cold engine is started and fuel so introduced is ignited by the spark and the engine started. The heat of the exhaust gases is used to raise the temperature of the fuel and when the temperature becomes sufficiently high that the fuel may be properly vaporized in the carbureter, the flow of fuel direct to the cylinders is cut off and all of the fuel passes through the carbureter. The connection between the fuel supply tank and the carbureter is always maintained, but until the fuel becomes heated it does not pass through the carbureter in sufficient quantity to operate the engine.

The engine 2 is provided with an inlet manifold 3 to which is connected the carbureter 4. The carbureter is of the usual construction, being provided with a float and

float chamber, whereby the level of the fuel at the fuel nozzle is maintained substantially constant and the manifold is provided with a throttle valve which is controlled by the rod 5. The fuel flows from the tank 6, either by pressure or gravity, through the pipe 7, heater casing 8 and pipe 9, to the carbureter. The heater casing 8 is divided into two chambers 12 and 13 by the wall 14, which is preferably corrugated or grooved on its upper surface to increase the area of such surface. The chamber 13 is substantially annular in shape and is provided with a tangential inlet 15, to which is connected the pipe 16, which at its other end is connected to the engine exhaust manifold 17, the pipe 16 preferably extending into the manifold 17. Exhaust gases pass through the pipe 16 into the chamber 13 and heat the casing 8. The amount of exhaust gases passing through the pipe 16 may be controlled by the valve 18, which is held in adjusted positions by the screw 19, or if it is desirable or necessary to employ a light hydrocarbon fuel which does not require heating the valve 18 may be closed. The exhaust gases pass from the chamber 13 through the aperture 21 in the central wall 22 and discharge through the pipe 23. The fuel supply pipe 7 is connected to the inlet 24 of the fuel heating chamber 12 and the pipe 9 is connected to the outlet of chamber 12. It is evident that when the engine is operating the fuel passing through the chamber 12 becomes heated through thermal contact with the hot exhaust gases. The chamber 12 is provided with a second fuel outlet, through which the fuel may pass directly to the manifold 3 when the engine is operating and the fuel is cold. This second outlet consists of the passage 24 through the nipple 25 which is screwed into the boss 26 formed centrally on the top plate 27 of the casing. The nipple is provided with a tapered end 28 which forms a seat for the valve which operates to close the passage 24 when the temperature of the fuel is sufficiently raised. Arranged in the chamber 12 is a flexible walled sealed casing 29 which is adapted to vary its volume with variations in temperature. The walls of the casing 29 preferably consist of circularly corrugated diaphragms 31 and the casing preferably contains a small amount of alcohol or ether, so that the pressure therein varies with variations in temperature, and since the walls are flexible, the volume of the casing varies with variations in temperature. The casing 29 is preferably horizontally disposed in the chamber 12 and variations in volume produce variations in the vertical thickness of the casing. Secured to the bottom of the casing 29 at the center is a hollow nut 32 which is screwed into a seat formed in the wall 14 and secured

to the upper wall of the casing is a plug 33 of soft metal, such as lead or Babbitt metal, which is alined with the tapered end of the nipple 25. Seated in the nut 32 is a screw 34 the inner end of which projects into the casing and forms a stop, to limit the amount of collapse of the casing. When the fuel is cold, the plug or valve 33 is depressed so that the passage 24 is open, but when the fuel becomes heated, the plug is moved to a seat on the end of the nipple, closing the passage. By tapering the end of the nipple and making the plug of soft metal the soft metal conforms to the end of the nipple and a seat is formed in the plug, so that the passage is securely closed.

Since the fuel is supplied to the carbureter under pressure, means are provided for preventing the fuel from flowing into the engine manifold when the engine is not operating and the passage 24 is open. Interposed between the nipple 25 and the manifold 3 is a valve which is open only when the engine is in operation. This valve comprises a casing 35 divided horizontally into two parts by a diaphragm 36. Secured to the diaphragm and movable therewith is a hollow needle 37, the upper end of which fits into the passage 38^a which is in communication with the pipe 38 which is connected to the engine manifold 3. The pipe 38 is also in communication with the chamber above the diaphragm through the passage 39. The needle 37 fits rather snugly in an aperture formed in the bottom wall of the casing and extends into a chamber formed in the hollow boss 41 by the nipple 42, which nipple is connected with nipple 25. The nipple 42 is provided on its upper end with a flaring seat into which the needle 37 extends. The passage 43 in the needle branches at its lower end and the branches terminate above the point of the needle, so that the point may extend into and close the passage 24^a in the nipple 42. When the engine is not operating the needle is held in its depressed position by means of the weight 44 secured thereto. Since the needle must move vertically, the joint between the needle and the bottom wall of the casing cannot be made leak-proof, and the small amount of fuel which passes through the joint when the engine is starting, drains or evaporates through the aperture 45 in the casing.

The operation of the apparatus is as follows:

Assuming the engine to be cold and at rest, the passage 24 is open at its lower end and closed at its upper end 24^a by the needle 37. The engine is then cranked or turned over, by power or by hand. The cranking of the engine produces a partial vacuum in the manifold 3 which is communicated to the chamber in the casing 35 above the dia-

phragm. This lowering of pressure raises the diaphragm, moving the needle 37 from its seat and allows and causes the fuel to flow through the needle 37, through the pipe 38 into the manifold, whence it is drawn into the cylinders and ignited, causing the engine to run. A part of the exhaust gases pass through the pipe 16 into the chamber 13 and heat the fuel in chamber 12. This causes the casing 29 to expand and when the fuel is sufficiently warm to be vaporized in the carbureter, the plug 33 reaches its seat and closes the passage 24. All of the fuel then enters the engine through the carbureter. The needle valve 37 is raised whenever the engine is running and the passage 24 is open when the engine is cold and closed when the engine is warm.

I claim:

1. An attachment for an internal combustion engine having a manifold, consisting of means for introducing liquid hydrocarbon directly into said manifold, means for heating the hydrocarbon before it enters the manifold, means operated by a rise in temperature of the hydrocarbon for cutting off the direct supply thereof to the manifold, and a normally closed valve arranged in the said introducing means and adapted to be opened by the suction produced by the turning over of the engine.

2. In a device of the character described, a casing having two separated chambers therein in thermal communication, one chamber being arranged for the passage of fuel to the engine and the other chamber being arranged for the passage of exhaust gases from the engine, a flexible walled closed casing in the fuel chamber adapted to increase its volume with an increase in temperature and means arranged in said flexible casing for varying its minimum volume.

3. In a device of the character described, a casing having two separated chambers therein in thermal communication, one chamber being arranged for the passage of fuel to the engine and the other being arranged for the passage of exhaust gases from the engine, a hollow nipple provided with a conical end arranged in said fuel chamber, a flexible walled closed casing in

the fuel chamber adapted to expand with an increase in temperature, and a soft metal plug on said casing adapted to be seated on said conical end to close the passage in said nipple when said casing expands.

4. In a device of the character described an annular exhaust gas chamber having a tangential inlet and a central outlet, a fuel chamber arranged above said annular chamber and separated therefrom by a relatively thin wall having a corrugated surface whereby the heat of the exhaust gases is communicated to the fuel in the fuel chamber, and a flexible walled closed casing in the fuel chamber overlying said corrugated surface.

5. In a device as described an annular exhaust gas chamber, a fuel chamber overlying said annular chamber and separated therefrom by a relatively thin corrugated wall, a cone surface having an outlet port therein in said fuel chamber, a flexible walled closed casing in the fuel chamber adapted to expand with an increase in temperature and a soft metal plug on said casing adapted to be seated against said cone surface to close said port when the said casing expands.

6. A device for heating and controlling the flow of fuel to an internal combustion engine, comprising a circular casing divided into two chambers by a horizontal wall, means for conducting gases of combustion to one of said chambers, means for conducting fuel to the other of said chambers, a pipe connecting said second chamber with the engine carbureter, means connecting said second chamber with the engine manifold, a closed flexible walled casing secured to said horizontal wall, said casing being adapted to expand upwardly with an increase in temperature and a soft metal plug on said casing adapted to close the outlet from said chamber to the manifold when the casing expands.

In testimony whereof, I have hereunto set my hand at San Francisco, California, this 11th day of March, 1915.

THOMAS C. LEAKE.

In the presence of—

H. G. PROST,
N. THREW.