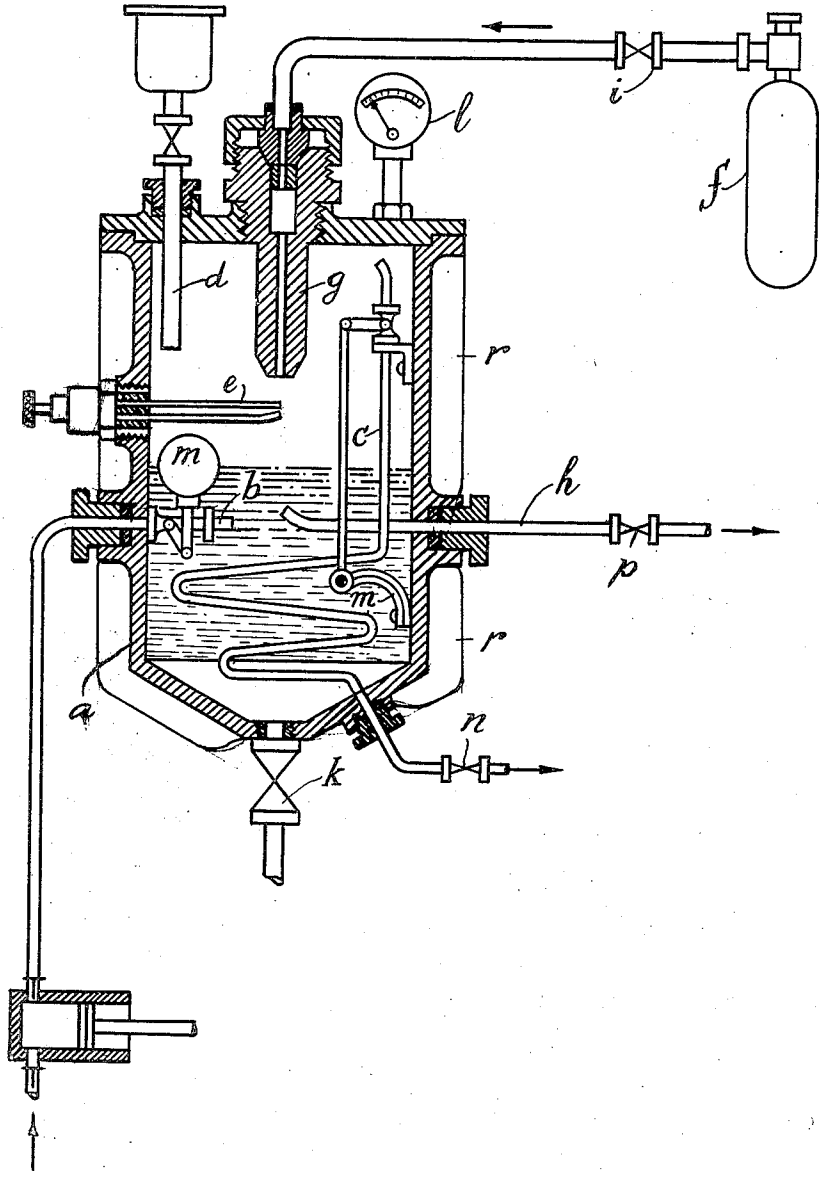
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HEATING DEVICE FOR LIQUID FUELS

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HEATING DEVICE FOR LIQUID FUELS

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Devices for heating of liquid fuels are used for the purpose of internal combustion engines, furnaces, etc., where vaporizable particles or vapors suitable for easy mixing with the combustion air are required, or where badly combustible or non-combustible components are to be separated. Special difficulties are encountered in the conditioning of hydrocarbons like heavy oil fuels, naphthaline or other fuels of high boiling point, alcohols especially, at changing loads.

Known devices to convey the necessary amount of heat to the fuels use hot gases (exhaust or waste gases), heating flames or electric heating elements which act directly or through heating surfaces.

All these devices suffer, as experience shows, from the disadvantage that they are not capable of following quick changes in the demand of conditioned fuel and require complicated regulating devices if automatic action is required. Strong heating of fuels through heating surfaces causes deposits and coke formation which makes continuous operation impossible,—open flames or incandescent surfaces cannot be admitted in many cases, especially in non-stationary plants, because of the fire danger involved in their use.

These disadvantages are avoided in the new device as described herein, which, for the purpose of supplying conditioned fuel for internal combustion engines or furnaces, uses an internal partial combustion inside of a fuel tank, as known for other purposes, so provided that oxygen or air led into the tank under an approximately constant but adjustable pressure, higher than the pressure outside the tank, is burned in the vapor, or gas, atmosphere above the liquid level inside the tank, characterized by the fact that the main part of the contents of the tank is heated in liquid state by the combustion heat, and that the heating temperature is kept approximately constant by the changing of the intensity of efflux of the products of the internal combustion, in definite relation to the desired fuel temperature or the rate of discharge of hot fuel from the tank, by hand or automatically by a thermostat or a similar device, in such a way that irrespective of the amount of liquid fuel taken from the tank (while cold liquid is replacing the hot liquid withdrawn from the tank) the tank contents are kept, automatically, approximately constant at any predetermined, but at will adjustable, value.

An additional improvement is obtained in practice by dimensioning the fuel capacity of the tank in such a way that, for the purpose of supplying consumers with fluctuating demand, the tank can act as hot-fuel-accumulator.

The usual fuel supply of internal combustion engines for heavy fuels requires very high pump pressure, and the proper ignition and complete combustion makes very high compression of the air charge indispensable. Both measures entail high manufacturing cost of the engines and make for machines easily getting out of order and little suitable for high speed operation. Preheating of fuel is a recognized and known measure. For lack of suitable heating devices it could up to the present only be used to a very limited degree, mostly by using exhaust gases as heating medium.

Its main object was the improvement of injection condition, but not, which is characteristic of the present invention, the reduction of compression pressure, the speeding-up and improving of combustion, which is obtained by local and timely separation of fuel conditioning, as the case may be, up to loosening of the chemical structure of the fuel molecules, from the formation of combustible mixture and combustion in the consumer (engine or burner).

For this purpose it is important to regulate the temperature of the oil, heated as specified therein, in such a way that it is injected into the cylinder of the fed engine at a definite temperature irrespective of the rate of fuel consumption of the engine.

As the fuel need not be heated further for ignition, or only a little, it does not take heat from the compressed air to any appreciable degree, and it is possible to design the engine with a relatively low compression ratio. The hot fuel jet has also with low excess pressure in the tank sufficient piercing power.

In the accompanying drawing the figure shows an example of the fuel heating device as specified in the present invention for the purpose of supplying an internal combustion engine.

a is the fuel conditioning tank

b—fuel pipe with a float valve connected to fuel pump supplying cold fuel, the float *m* resting upon the surface of the fuel actuating the valve,

c—exhaust pipe for the products of the internal partial combustion with valve controlled by thermostat *m*. The thermostat *m* is affected by the fuel temperature in the tank.

d—intake pipe for ignition fuel of low boiling point for starting the internal combustion with the assistance of

e—electrical ignition device (spark or incandescent body)

f—oxygen or air tank under pressure

g—burner

h—fuel pipe (hot fuel) to the engine cylinder

i—regulating valve for compressed air

k—blow-off valve for residue

l—manometer

m—float of float valve *b*,

n—valve on Fig. 3,

p—manual valve on pipe *h*,

r—*ra*—dial ribs on tank *a*.

The starting and operation of the device is described as follows:

(1) Pumping of fuel into the tank by means of a cold-fuel pump until the float valve closes.

(2) Inserting of ignition fuel, for example gasoline, through *d*, which settles above the heavy fuel and saturates the air with its vapors.

(3) Switching-in of the ignition device *e*, which causes the first explosion-like combustion to occur.

(4) Gradual opening of valve *i*, which causes other explosions to follow and the tank including its contents is gradually heated. As soon as the fuel is sufficiently hot and the gasoline vapors are replaced by vapors from the heavy fuel, a steadier combustion sets in, which may reach the character of a flame.

(5) The air inlet is increased by further opening of valve *i* until the desired temperature is reached, when the thermostat does the further regulation automatically by properly regulating the opening of the exhaust valve and keeps the temperature constant.

(6) Opening of pipe *h* to the fuel valve of the engine which is now ready to start. The starting of engine is done in the usual way by hand or auxiliary power. The automatic regulation which is claimed as characteristic for the invention is attained as follows:—

If the consumption of fuel increases, the feeding of cold fuel via the float valve causes a certain temperature drop, which again affects the thermostat to open pipe *e* a little more, thus creating a small pressure drop inside the tank. This again makes for an increase of air intake and consequently a more intensive internal combustion, which will last until the temperature reaches again its predetermined value, and the thermostat operates in the opposite direction reducing the combustion intensity to its previous value.

In case the fuel consumption drops down to zero the thermostat will close the pipe *c* completely; the pressure inside the tank increases in this case to the same pressure as exists in the compressed air container *f*, the air intake ceases and the internal flame is extinguished. It will be seen that it is absolutely impossible for dangerous pressures or temperatures to arise. At consumption zero, but desired readiness for service of the device, the extinguishing of the flame can be prevented by keeping a small opening, for instance, to the atmosphere, in which case the opening is adjusted suitably in such a way that a reduced internal combustion is maintained of such intensity as to cover the unavoidable losses by cooling (convection and radiation). On the other hand, it may sometimes be desirable to provide for heat radiation and thus slightly lower the temperature of the tank, and for this purpose radial ribs as shown at *r* may be formed or fixed upon the tank. One method of maintaining combustion when the fuel consumption is substantially zero is practiced by leaving valve *n* in pipe *c* slightly open when the manual valve *p* in pipe *h* is closed. This is of a particular value for internal combustion engines which must be ready to start at any moment, vehicles, boats. etc.

As is well-known the heating of hydrocarbons of high boiling point causes, under certain circumstances, a chemical loosening of the molecules or even a cracking through which the combustion properties are improved. Since, however, the components, liable to be chemically loosened first, are partly unstable compounds, they are proposed to be burned hot in statu nascendi.

A very valuable use for the heating device as specified herein can be made by designing part or all of the tank surface as a heat radiator with or without ribs for heating the air or other medium in contact with the exterior surface of the tank. The ribs *r* already mentioned will serve in this capacity. The intensity of the internal combustion can be controlled by hand or automatically by the temperature of the ambient air or other medium to be heated. A centralized supply of air and cold fuel to any number of stoves makes this system of central heating superior to other known systems, because heat losses for starting and in pipes are avoided and metering of the heat supplied to individual users, for example in apartment houses, is simplified in so far as the provision of cold-oil meters is sufficient.

Having now fully described my invention and the manner of using the same to advantage, I claim:

1. In apparatus for heating and feeding liquid fuels including such solid fuels as can be liquefied by heating, the combination of a closed tank, means for feeding the liquid fuel into said tank, a constant level maintaining means controlling the fuel feed to said tank up to an approximately constant level, an electrical ignition device operatively positioned to ignite the fuel in said tank, regulatable means for supplying a compressed free oxygen containing gas into the tank to maintain combustion therein by burning part of the fuel content and maintaining the rest of the fuel content under a pressure above atmospheric pressure, a valve controlled outlet for the efflux of the products of combustion, a valve controlled outlet for the heated fuel and means responsive to the temperature of the heated fuel controlling the efflux of combustion gases whereby the pressure within said tank, the influx of the oxygen containing gas, and the rate of combustion within said tank are varied in accordance with fuel temperature to maintain the same uniform.

2. In apparatus for heating and feeding liquid fuels including such solid fuels as can be liquefied by heating, the combination of a closed tank, means for feeding the liquid fuel into said tank, a constant level maintaining means controlling the fuel feed to said tank up to an approximately constant level, an electrical ignition device operatively positioned to ignite the fuel in said tank, regulatable means for supplying a compressed free oxygen containing gas into the tank to maintain combustion therein by burning part of the fuel content and maintaining the rest of the fuel under a pressure above atmospheric pressure, means allowing the escape of combustion gases, a valve controlled outlet for the heated fuel, means responsive to the temperature of the heated fuel controlling the efflux of combustion gases, and means for introducing such light fuels into said tank as will form a combustible mixture with the free oxygen containing gas above the fuel level at normal air temperature in said tank for initiating combustion therein.

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