Dec. 12, 1933. M. F. HEANEY 1,939,302

APPARATUS FOR AND ART OF CARBURATION

Filed April 12, 1929 2 Sheets-Sheet 1

Fig. 1

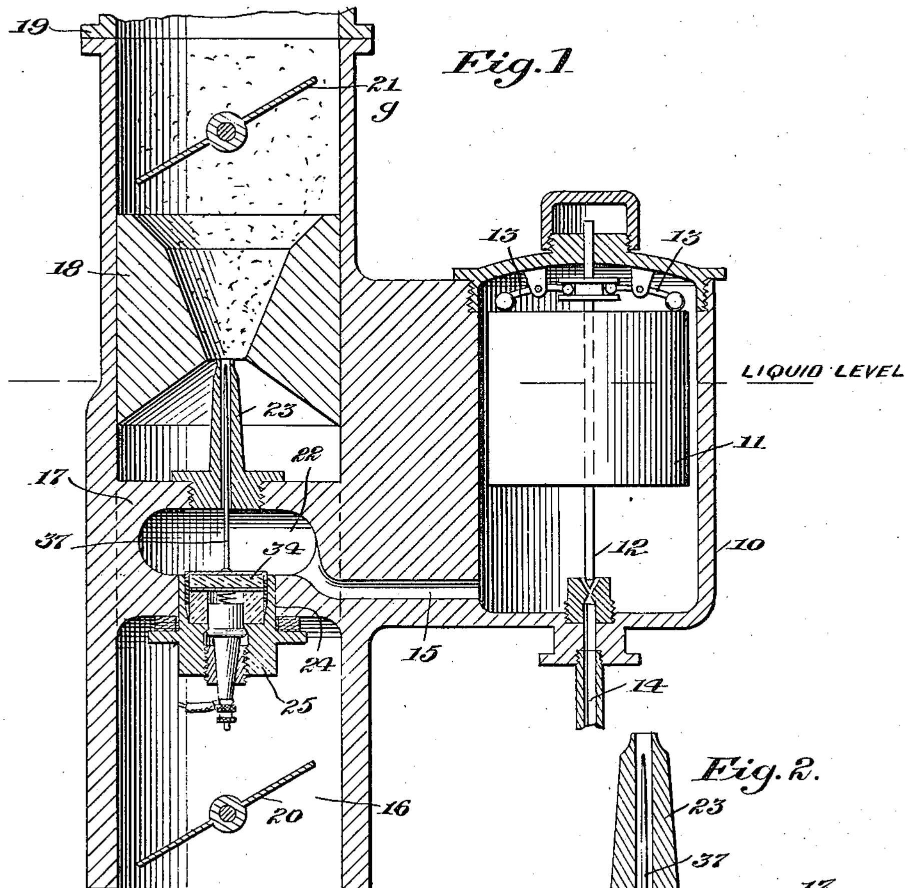
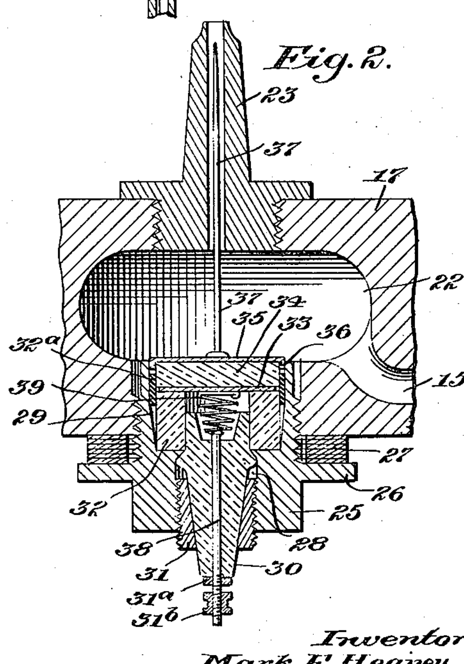


Fig. 2.



Inventor:
Mark F. Heaney,

By Sturtevant & Mason,
Att'ys.

Dec. 12, 1933. M. F. HEANEY 1,939,302

APPARATUS FOR AND ART OF CARBURATION

Filed April 12, 1929 2 Sheets-Sheet 2

Fig. 3.

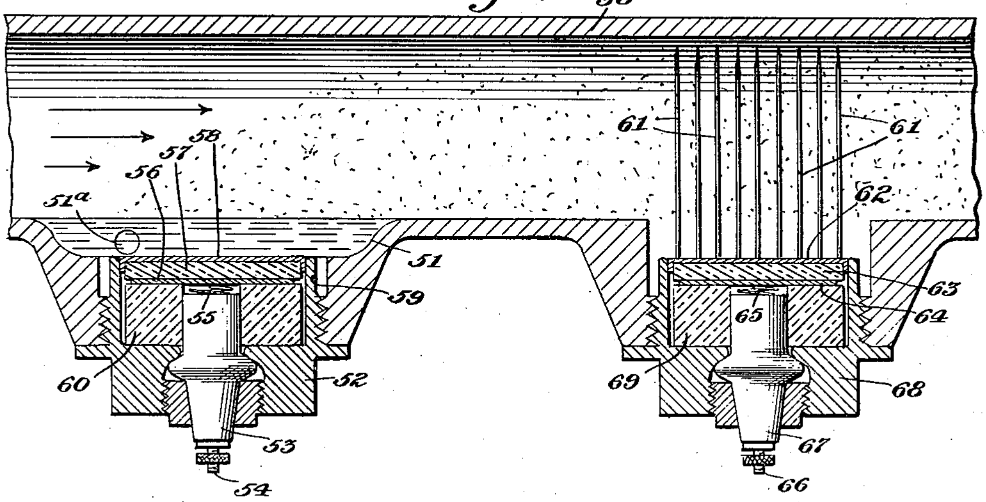


Fig. 4.

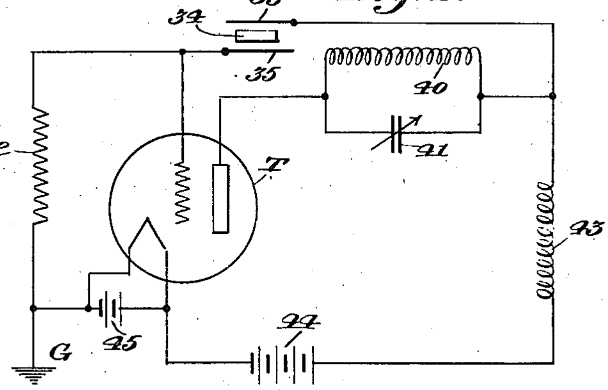
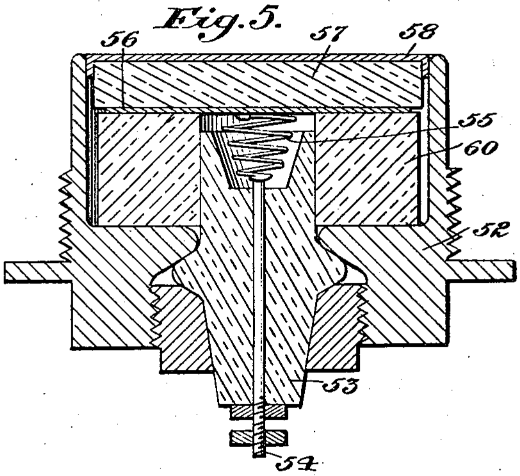


Fig. 5.



Inventor:
Mark F. Heaney,

By Strutevant & Mason,
Att'ys.

Patented Dec. 12, 1933 1,939,302

UNITED STATES PATENT OFFICE

1,939,302

APPARATUS FOR AND ART OF CARBURATION

Mark Finlay Heaney, Cambridge, Mass., assignor of forty percent to Edward B. Benjamin, New Orleans, La.

Application April 12, 1929. Serial No. 354,532

9 Claims. (Cl. 261—1)

This invention relates to improvements in the art of carburation, and more particularly concerns an improved manner and apparatus for the distribution of a liquid fuel in a combustible gas whereby to produce the fuel gas mixture itself.

This invention proposes to accomplish a comminution of the liquid fuel by means of an oscillation thereof at such a rate that particles of the fuel are projected from the surface of the liquid and of such dimensions that they are suspensible in the combustion-supporting gas. Such a rate of oscillation will hereinafter be referred to as of "high frequency", denoting that the frequency is of a rate and intensity to cause this physical projection of minute particles from the surface of the liquid in distinction from the mere agitation and wave formations produced at low frequencies.

A particular means of accomplishing the method comprises the employment of oscillations of the liquid body of the fuel at a rate commonly known as "superaudible", induced by an oscillator of the quartz crystal type, the crystal in turn serving in a circuit including an electron discharge tube to establish and fix the rate of the vibrations produced.

Another feature of the invention is the breaking down of relatively large bodies of liquid into small particles of substantially molecular size, whether this liquid be present as a pool in a carbureting apparatus or temporarily suspended as droplets in a gas.

With these and other objects in view as will appear in the course of the following specification and claims, illustrative examples of practicing the invention are shown by apparatus set forth in the accompanying drawings, in which:

Figure 1 represents a vertical section through a carbureting apparatus, taken substantially through the axis of the air-pipe and the float chamber.

Fig. 2 is a detail of the jet and oscillator of Fig. 1, on an enlarged scale.

Fig. 3 is a modified form of construction in which two oscillators are employed, one serving to produce comminution at the surface of a pool of liquid fuel and the other serving to break down relatively large droplets of fuel which have already been suspended in the combustion-supporting gas.

Fig. 4 is a circuit diagram showing the manner of connecting the quartz crystal for accomplishing the method.

Fig. 5 is a detail of one of the oscillators of Fig. 3, on an enlarged scale.

In Fig. 1 of these drawings, an ordinary float chamber 10 contains the float 11 operating the needle valve 12 through the levers 13. The needle valve 12 controls the admission of a liquid fuel from the supply conduit 14 into the interior of the float chamber 10 from which it passes through the conduit 15 to the carbureting apparatus proper. These elements are old and well known and form no part of the present invention save insofar as they determine a proper level of liquid fuel within the carbureting apparatus.

Air can enter at the bottom into the air pipe 16, passing upward around a bridge 17 and through the Venturi sleeve 18 through a connection 19 to the internal combustion engine or other point of employment. The admission of air to the carbureting apparatus is controlled by a butterfly valve 20, while the delivery of the fuel mixture to the engine is controlled by a similar butterfly valve 21, both in known manner.

The bridge 17 has a liquid chamber 22 to receive and contain a supply of liquid fuel admitted by the conduit 15 from the float chamber 10. A nozzle 23 is mounted in the bridge 17 and has its passage in constant communication with the chamber 22: the upper end of the nozzle 23 terminates slightly above the liquid fuel level maintained by the float 11.

In the wall of the bridge 17, below the chamber 22 is formed an aperture 24 which receives a sleeve 25 threaded into the walls of this aperture. The sleeve 25 has a peripheral flange 26 to engage the spacing washers or shims 27 by which the location of the sleeve 25 with respect to the top of the nozzle 23 may be exactly adjusted and fixed. The sleeve 25 is hollow and is shown as formed with a lower chamber 28 and an upper chamber 29. An insulating member 30 resembling the usual porcelain of a sparkplug has its peripheral flange seated in the lower chamber 28 and is sealed against leakage and movement by a packing gland nut 31. The upper end of the porcelain projects into the chamber 29 and receives an annular resilient and insulating member 32 upon which is mounted the lower or positive plate 33 of the oscillating crystal system proper. The crystal 34 is mounted on this lower plate 33, while the upper or negative plate 35 is mounted on the crystal itself, being preferably provided with downwardly extending peripheral flanges 36 which grip the inner wall of the sleeve 25. A needle 37 is fixed to the upper plate 35 and projects upward into the passage of the nozzle 23 and extends to near the upper end thereof. The central electrode 38 through the porcelain body 30 is connected at its upper end to a helical coil spring 39 which in turn is connected to the lower plate 33. The two plates themselves are secured to the crystal as by cementing.

The central electrode 38 is threaded at its lower end and preferably formed with a tight but sliding fit in the insulating member 30. As the lower nut 31ª therein is drawn tight, the load is moved lengthwise downward, and through the spring 39 an increased tension is applied to seat the pieso-electrically responsive device 33, 34, 35 upon the member 32. The conducting wire from the lower plate of this device is clamped by the thumb nut 31*b*: while the electrical connection to the upper plate is grounded on some part of the frame, and by the grounded relationship of the rebent flange 36 of the upper plate with respect to the bushing 25, the circuit is completed. It is preferred to provide an insulating ring 32*a* covering the projecting edge of the lower plate 33 and assuring against any short-circuiting at this point.

Referring to Fig. 4, it will be seen that the crystal 34 and its plates 33, 35 are connected in circuit with an electron discharge tube T. A conductor leads from the plate 33 to a parallel resonance circuit comprising the inductance 40 and variable condenser 41 and thence to the anode of the tube T. The other plate 35 of the crystal oscillator is similarly connected to the grid of the tube T. The grid of the tube is connected directly through a leak resistance 42 to the ground G and to the cathode of the tube. An anode return is established from a point between the plate 33 and the loop 40, 41, through a load inductance 43 and the anode battery 44 to the cathode, while a battery 45 is employed for heating the cathode itself. This is one method of operating with a quartz crystal whereby to produce mechanical vibrations therein at a definite and controlled rate. This is a known method of operation and forms no part of the present invention, being illustrated only for the purpose of showing, in conjunction with the crystal itself, a means of securing mechanical vibrations at a high frequency, in the present instance preferably of a superaudible frequency, of a mechanical element.

The operation of the device may be described as follows:

When fuel is admitted through the conduit 14 past needle valve 12 into the float chamber it establishes a predetermined maximum level therein and in the nozzle 23.

The crystal 34 is now set in vibration by the means indicated with respect to Fig. 4, whereby the upper plate causes the needle 37 to move at a very high speed, the needle being of low mass and inertia so that the movement may be accomplished without undue requirements of power: thus causing a continuous projection of liquid particles from the end thereof above the liquid level. The upper plate 35 of the crystal system likewise tends to impose a slight compressional wave upon the contents of the chamber 22 and forces the latter to ascend slightly in the nozzle 23, this being facilitated by the obstruction to liquid movement afforded by the distortion in direction of the conduit 15, whereby an escape of the liquid through this conduit at the high frequency is substantially prevented.

As a result of the high frequency of oscillation imparted to the body of the liquid in the chamber 22 and in the nozzle 23, particles of the liquid are thrown from the opening of this nozzle into the air current passing upward in the tube 16, and are drawn along by this air and thus produce a fuel mixture therewith to be delivered at the connection 19.

In the modified form of construction shown in Fig. 3, the pipe 50 is substantially horizontal and has a recess 51 in its lower wall to contain a pool of liquid fuel. A sleeve 52 as before receives the insulating body 53 with the electrode 54 connected by the coil spring 55 with the lower plate 56 of the crystal 57 having the upper plate 58 in electrical contact with the upper surrounding wall 59 of the sleeve 52. A resilient and insulating dampener 60 is provided to permit the free oscillation of the crystal body. The pool of liquid fuel is maintained by the delivery of liquid through the inlet conduit opening 51*a*: and the level thereof may be controlled in any suitable manner.

The pool of liquid is set in vibration and particles are projected upward from its surface as shown by the dots in Fig. 3, being carried along by the current of combustion supporting gas entering at the left. As the particles thus formed move along in the pipe 50 they pass through a series of needles 61 supported by the upper plate 62 of a further crystal 63 having its lower plate 64 connected by a coil spring 65 with the electrode 66 of an insulating body 67 mounted in the sleeve 68. A resilient washer 69 is provided as before. As the primary fuel mixture, comprising the particles projected from the pool in chamber 51 and the combustion supporting gas, pass these needles, which are moved in rapid longitudinal vibration by the crystal 63 in the manner previously described, any large droplets of fuel therein are set into oscillation at such a rate as to overcome the intermolecular cohesion and the so-called surface tension in these droplets, whereby they are broken apart and a final comminution produced. It will thus be noted that in this second modification not only is the primary distribution of droplets of fuel in gas suspension produced by oscillations in the body of fuel while collected in a pool, but likewise large droplets are broken down into small particles even though these droplets be then suspended in a gas.

Quartz crystals may be employed as the oscillators, in well known manner. The frequency of vibrations produced may vary from the upper so-called audible frequencies such as 10,000 cycles per second, to superaudible ones, such as 500,000 cycles per second; the greater the frequency, ordinarily the greater the comminution produced by the system.

The invention is therefore particularly applicable to the production of intimate suspensions of minute particles of liquid fuel in a combustion supporting gas such as air. Even heavy fuels may be successfully vaporized or comminuted in the presence of a gas in this manner, and after the production of the primary mixture, the larger particles may be further broken down by producing vibrations thereof as they are suspended in the fuel gas.

It will be understood that the invention is not limited to the forms of execution shown, nor to the particular described method of producing oscillations in the body of the liquid, but that many equivalents therefor may be employed within the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. The method of carburation which comprises

agitating a body of liquid fuel in the presence of a combustion-supporting gas and at an oscillation frequency of more than 10,000 cycles per second for counteracting the cohesion and surface tension thereof whereby to cause a disruption thereof into minute particles suspensible in the gas, establishing a flow of the gas to carry away the particles as they are formed, and agitating the particles while suspended in the gas at a frequency greater than 10,000 cycles per second.

2. An apparatus for carburation comprising means for suspending particles of liquid fuel in a current of combustion-supporting gas, and piezo-electric means for agitating the particles in the current at a frequency greater than 10,000 cycles per second whereby to break up the particles by counteracting the cohesion and surface tension thereof.

3. An apparatus for carburation comprising means for holding a pool of liquid fuel, means for passing a current of combustion-supporting gas over said pool, means to project gas suspensible particles from said pool into said gas, and means for imparting to the current of mingled particles and gas an agitation at a frequency of more than 10,000 cycles per second.

4. In a carbureting apparatus, a carburetor casing adapted to contain liquid fuel, a bushing constituting a lower part of said casing, a piezo-electrically responsive crystal in said bushing, and having upper and lower electrode plates, said upper electrode plate constituting a part of the casing wall and being electrically connected to said bushing, a resilient member insulatedly supporting said lower electrode plate, a conductor connected to said lower electrode plate and extending through said bushing, and insulating means to seal said bushing and to support said conductor.

5. A carbureting apparatus as in claim 4, in which a spring connection is employed for mechanical and electrical connection between said conductor and the lower electrode plate whereby the pressure of said lower electrode plate against said resilient member may be varied by moving said conductor longitudinally.

6. A carbureting apparatus as in claim 4, in which the upper electrode plate is provided with an upwardly projecting needle to be vibrated longitudinally by the movements of said plate, said needle being adapted to come into contact with the fuel.

7. In a carbureting apparatus, a piezo-electrically responsive element and electrodes plates therefor, a needle connected to and located at a right angle with respect to one of said plates whereby it is adapted to be moved longitudinally during the oscillation of the element, means to bring a suspension of fuel particles in a combustion supporting gas into contact with said needle, and means to actuate said element to cause said one plate to vibrate mechanically at high frequency whereby to impart high frequency mechanical oscillations to said needle and to the said suspension whereby to break said particles down into smaller ones.

8. In a carbureting apparatus, a piezo-electrically responsive crystal and electrode plates therefor, means for forming a pool of liquid fuel upon and above one of said plates, means for actuating said crystal to cause said one plate to vibrate mechanically at a high frequency whereby to impart high frequency mechanical oscillations to the liquid to produce minute particles therefrom, and means for passing a current of combustion-supporting gas over the surface of the liquid whereby to sweep away the suspended particles as formed and to produce therewith a combustible mixture.

9. In a carbureting apparatus, an air conduit having a restriction, a vertical nozzle opening at its top into said conduit adjacent said restriction, a needle in said nozzle, means for vibrating said needle longitudinally at a high frequency, and means for maintaining a level of liquid fuel in said nozzle substantially at the upper end thereof.

MARK FINLAY HEANEY.