

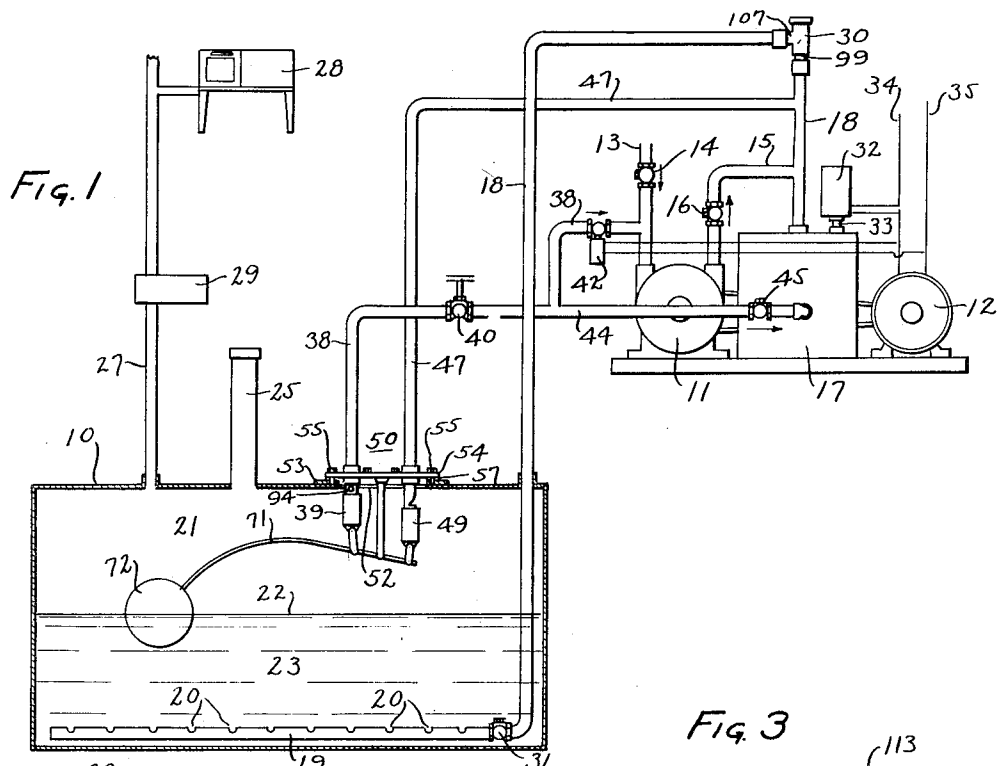
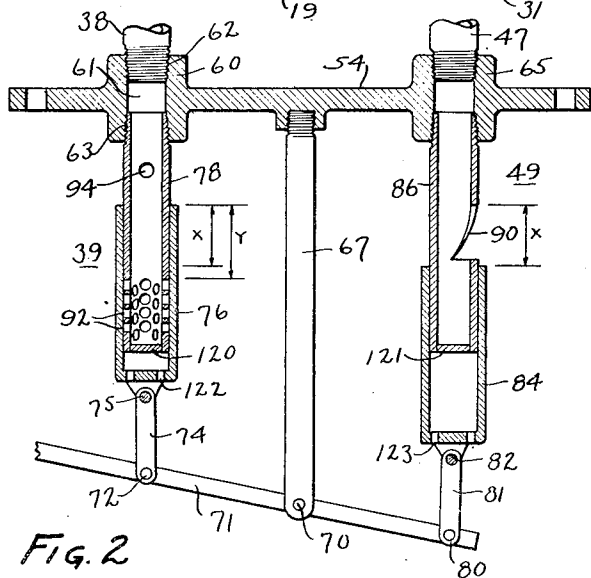
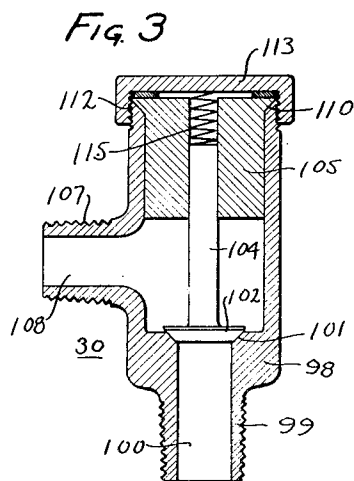
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GAS GENERATION

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UNITED STATES PATENT OFFICE

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GAS GENERATION

Application filed April 10, 1930. Serial No. 443,151.

This invention relates to gas generation, and particularly to the generation of combustible gas from a liquid fuel, such as gasoline and the like.

One of the principal objects of the invention is the provision of an apparatus for generating gas from liquid fuel, having improved regulating means responsive to the amount of liquid fuel in the system for controlling the gas generation.

Another object of the invention is the provision of a float controlled regulating unit for the fuel tank having a plurality of float controlled valves the operative parts of which are all maintained at tank pressure.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawing, in which like characters of reference designate like parts throughout the several views thereof,—

Fig. 1 is a diagrammatic showing of a gas generating apparatus constructed in accordance with this invention;

Fig. 2 is an enlarged sectional view of the control valve unit; and

Fig. 3 is an enlarged sectional view of the flow resisting valve.

The present invention is concerned with a gas generating system embodying a bubbling means for bubbling air or other combustion supporting fluid through a quantity of gasoline or other volatile liquid fuel, and is an improvement on my prior application for Gas generation, Serial No. 394,907, filed September 24, 1929.

In the drawing, which illustrates a preferred embodiment of the invention, the fuel container or tank is indicated at 10, this tank being suitably located preferably exteriorly of the building and buried below ground level. A pump 11 for generating air pressure is driven by a suitable electric motor 12 so as to draw air through an intake pipe 13 in which there is provided a suitable check valve 14. The air thus compressed is forced from the discharge side of the pump through a pipe 15, containing a check valve 16, to a pressure equalizing tank 17 that may be provided to

smooth out the pump impulses. A pipe 18 is connected at one end with the pressure equalizing tank or to the adjacent end of the pipe 15 and extends through a wall of the fuel tank 10 to a perforated distributing or bubbling pipe 19 disposed adjacent the bottom of the tank. A suitable flow resisting valve 30 and a check valve 31 are provided in the pipe 18, the check valve operating to prevent a back flow from the bubbling pipe 19 towards the pump and equalizing tank. Combustion supporting fluid supplied by the pump 11 through the pipe 18 is thus caused to bubble up through the series of openings 20 in the bubbling pipe 19 for the creation of combustible gas which is stored in the space 21 above the level 22 of the liquid fuel 23 which may be gasoline or like substances. The fuel may be supplied to the tank 10 through a suitable filler pipe 25.

An offtake pipe 27 leads from the upper portion of the tank 10 to a work device or a place of use for the gas such as the gas stove 28, the offtake pipe preferably having a suitable diaphragm regulator 29 for reducing the pressure of the gas supply.

The control of the pump driving motor 12 is automatically effected in accordance with the pressure of generated gas. A suitable pressure switch designated generally 32 and connected to the pressure side of the system by means of a suitable pipe connection 33 is provided to control the starting and stopping of the motor in accordance with the pressure of gas in the system. The switch 32 is connected in series with the feed lines 34 and 35 to the motor and is adapted to energize and deenergize this circuit to maintain a pressure in the system between certain predetermined limits, for example, between two and six pounds per square inch.

A portion of the generated gas under certain conditions of operation is recirculated back through the pump and is again pumped through the liquid fuel to enrich or increase the heat value of the generated gas. A recirculation pipe 38 is provided which is connected to the upper portion of the tank 10 by means of a suitable control valve 39. The pipe 38, as shown, is provided with a manu-

ally controlled regulating valve 40 which is positioned between the control valve 39 and the connection of the pipe 38 with the intake pipe 13 of the pump. An electrically operated solenoid valve 42 connected to the feed lines 34 and 35 is provided in the pipe 38 and is adapted to be automatically operated to tightly close the passage through this pipe when the pump stops, to prevent loss of pressure in the fuel tank. Recirculating pipe 38 is also connected by means of a pipe 44 with the pressure equalizing chamber 17, a check valve 45 being positioned therein to permit a flow of gas towards the equalizing chamber but preventing a flow in the reverse direction. An air dilution pipe 47 is provided having one end connected into the pipe 18 between the flow resisting valve 30 and the pump 11 and communicating at its opposite end with the tank 10 through a suitable control valve 49. A supplementary flow of combustion supporting gas, either air from the outside or a mixture of air and fuel already forced from the fuel tank by the pump 11 may be introduced directly into the gas storage portion 21 by means of the pipe 47 without being bubbled through the fuel to thereby decrease or dilute the richness of the generated gas contained within the space 21.

The recirculation pipe 38 being connected to the inlet side of the pump causes a recirculation of the gas from the space 21 back through the pump and then again through the bubbling means so that the gas may be bubbled a number of times through the fuel before it is consumed to thus increase the quality or heat value of the gas and to effectively agitate and mix the liquid fuel. This recirculation or rebubbling of the gas through the fuel is exceptionally desirable when most of the more easily volatilized constituents of the fuel have been driven off, such as occurs when most of the contents of the tank have been converted into gas and but a small quantity of the liquid fuel remains in the tank. In cases where the generated gas is too rich as where there is a large quantity of fresh fuel in the tank, dilution air may be supplied through the pipe 47 to the space 21 above the fuel level, the control of the recirculation and the control of the supply of dilution air being effected so that the quality of the gas generated will be substantially uniform in spite of changing characteristics of the liquid fuel.

The control of the recirculation and the control of dilution gas is preferably accomplished automatically. As shown, a valve structure 50 is provided for maintaining the generated gas of substantially uniform heat value and comprises the recirculation control valve 39 and the dilution air control valve 49. The tank 10 is provided with an opening 52 on the upper side thereof for the reception of

parts. This opening is provided with a rim or flange 53 to which a cover member 54 of the valve structure may be attached by suitable means such as the bolts 55. A suitable sealing means such as the gasket 57 is provided between the flange 53 and the cover plate 54 so that upon drawing the bolts 55 tight a fluid tight joint will be provided between the tank 10 and the cover plate 54. A suitable gas tight passageway may be formed through the cover plate 54 for the reception of the recirculating pipe 38 and its attached control valve 39, the cover being shown with an integrally formed sleeve portion 60; the passage 61 therethrough being internally threaded at one end 62 for the reception of the pipe 38 and similarly threaded at the opposite end 63 for the attachment of the recirculating control valve 39. A similar sleeve portion 65 provides a threaded engagement at one end for the air dilution pipe 47 and at the opposite end for the air dilution control valve 49. A downwardly depending rod 67 is provided rigid with the plate 54. A pivotal connection 70 is provided adjacent the end of the member 67 for the attachment of an actuating arm 71 which carries a float 72. The float is adapted to rest upon the surface of the liquid fuel and to move the actuating arm 71 in accordance with the changes in the level of the fuel.

On one side of the pivotal connection 70 of the actuating member 71 is pivotally connected at 72 a link 74, the opposite end of which is pivotally connected at 75 to a sleeve 76 which slidably engages the valve member 78 of the control valve 39. On the opposite side of the pivot point 70 there is pivotally connected at 80 a link 81 which is connected at 82 to a sleeve 84 slidably mounted on the valve member 86 of the control valve 49. The arrangement of the sleeves is such that as the float 72 falls with the lowering of the liquid level, the sleeve 76 will move downwardly with respect to the valve member 78 while the sleeve 84 will move upwardly with respect to its valve member 86. The position shown in Fig. 2 is that for maximum fuel level, or when the tank has just been filled with a fresh supply of fuel. In this position the sleeve 84 fully uncovers the opening 90 in the valve member 86, this opening being preferably shaped in the manner illustrated by taking a diagonal cut on one side of the pipe so that an effective opening of progressively increasing cross-section is provided from the upper to the lower part thereof. When the tank is full the sleeve 76, being in its upward position fully closes the openings 92 provided in the valve member 78 and these openings are maintained closed during the movement of the actuating arm 71 and its associated parts until after the air dilution opening 90 is closed by the sleeve 84. As shown, the sleeve 84 must move upwardly a distance marked x

before the air dilution valve 90 is fully closed. During this time the sleeve 76 will be lowered a corresponding amount, the pivot points 72 and 80 being suitably spaced from the fulcrum point 70. However, as shown, the sleeve 76 must move a distance indicated by y before the openings 92 of the valve member 78 can provide communication between the recirculating pipe 38 and the interior of the tank 10.

The valve member 78 is provided with a small permanent opening 94 which is adapted to permit pressure equalization between the gas space 21 of the tank 10 and the equalizing tank 17 during times that the openings 90 and 92 may both be closed. This equalization of pressures is desirable for there might be times when the pressure within the tank 10 might exceed the pressure in the equalizing tank 17 due to leaky valves, etc., under which conditions, without the equalizing means, the liquid fuel would tend to be forced through the pipe 18 towards the equalizing tank 17 and the pump. The connection provided through the permanent opening 94, the pipes 38 and 44, and check valve 45 to the equalizing tank 17 and to the outlet side of the pump effectively prevents this.

As mentioned above, a flow resisting valve 30 is incorporated in the pipe 18. This valve is adapted to exert a limited resistance to the passage of air through the pipe 18 to the bubbling means 19 so that during times that the dilution control valve 49 is open the air compressed by the pump 11 will not flow through the bubbling means 19 until the flow through the valve 49 has been restricted by movement of the sleeve 84 to such an extent that the resistance of the valve 30 is overcome to permit flow through the pipe 18 to the bubbling means. This flow resisting valve is preferably of the spring loaded check valve type and comprises a valve body 98 having a stem portion 99 threaded for attachment to the pipe 18. The stem portion 99 is provided with a passage 100 terminating in a conical valve seat 101 upon which the valve member 102 is adapted to seat. The valve member 102 is provided with a stem portion 104 which passes up through a suitable valve guide 105. A second stem portion 107 also threaded for attachment of the pipe 18 is provided with a passageway 108 communicating with the interior of the valve body above the valve member 102; the flow of fluid through the valve being from the direction of the equalizing tank 17 through the passage 100, past the valve 102, and out through the passage 108 towards the tank 10. The valve guide 105 is preferably formed with an upper flange 110 which is supported on the upper end of the valve body 98. The upper end of the valve body is threaded, as at 112, for the reception of a cap member 113. Positioned between the cap member 113 and the end of

the valve stem 104 is a spring 115, the tension of which may be varied to control the resistance of the check valve to the passage of fluid therethrough.

The operation of the device will now be apparent. When starting with a full tank of gas it is generally desirable to operate with maximum air dilution and with no recirculation. With certain grades of fuel which are easily volatilized it may be desirable to have no bubbling. This is accomplished by means of the construction shown in which the outlet side of the pump 11 is in communication with both the air dilution pipe 47 and the bubbling pipe 18. Upon filling the tank the float 72 will rise to its uppermost position and will move the sleeves 76 and 84 to the position shown in which the opening 90 of the valve member 86 is fully opened and the openings 92 of the valve member 78 are fully closed. With the opening 90 fully exposed there is a minimum of resistance to the flow of air through the air dilution pipe and consequently the air supplied by the pump 11 is free to flow into the space 21 by means of the dilution pipe 47 and the opening 90. The flow resisting valve 30 remains closed during this time inasmuch as the pressure air may flow freely through the pipe 47 without building up sufficient pressure to lift the valve member 102 against the action of the spring 115. The more volatile constituents of the fuel which evaporate readily into the upper portion 21 of the tank are thus mixed with dilution air to form a combustible gas of suitable heat value. When the fuel level is lowered a small amount, which means that a portion of the highly volatile constituents have passed off, the sleeve 84 will then begin to close the port 90. Due to the shape of the port 90 the initial closing movement will be quite rapid for a given decrease in fuel level so that the opening will be considerably restricted with only a small movement downwardly of the float 72. Sufficient resistance is thus developed in the pipe 47 to force the check valve 102 from its seat to thereby deliver air through the pipe 18 through the bubbling means 19. As the fuel level continues to fall the port 90 is further restricted by upward movement of the sleeve 84 until the port closes completely. At this time the total air output of the pump 11 is forced through the bubbling means 19. Upon further reduction of the fuel level the sleeve 76 will uncover the uppermost of the openings 92 in the valve member 78 of the recirculation valve 39. Recirculation then starts in a limited and controlled amount, and as the fuel level continues to fall the amount of recirculation will be increased by regular amounts until the tank is nearly empty at which time the openings 92 are fully uncovered to provide a maximum of recirculation. Suitable control means are provided in the

adjustment of the tension of the flow resisting valve spring 115 to properly regulate the passage of air through the dilution and bubbling pipes in accordance with the characteristics of different fuels that may be used.

The lowermost ends of the valve members 78 and 86, which as mentioned above may be the ends of the pipes 38 and 47 respectively, are closed by means of the plugs 120 and 121. The lower ends of the sleeves 76 and 84 are provided with openings 122 and 123 respectively so that the sleeves may operate freely without resistance due to pressure or suction forming between the ends of the members 78 and 86 and their respective sleeves.

It will thus be understood that in accordance with the present invention a system is provided requiring practically no attention or care in which the parts are adapted to be automatically actuated to take care of such variable factors as change in fuel level and changes in pressure of the system.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for bubbling combustion supporting gas through said fuel to generate a combustible gas, means for introducing a supplementary flow of combustion supporting gas to said tank, a valve for controlling said introducing means, said valve being positioned entirely within said tank, and means in the tank responsive to the level of the fuel in said tank for actuating said valve.

2. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, means for introducing air to said tank above the normal liquid fuel level thereof, a valve in said air introducing means, said valve being adapted to close in progressively decreasing amounts as the fuel level is lowered in equal amounts, and means responsive to the level of the fuel in said tank for actuating said valve.

3. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for introducing dilution air to said tank, means for supplying air to said tank below the liquid fuel level thereof for bubbling therethrough to generate a combustible gas, a valve in said air introducing means, and an adjustable flow resisting valve in said bubbling means responsive to the resistance offered

to the passage of air by said air introducing valve for controlling the passage of air through said bubbling means.

4. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for introducing dilution air to said tank, means for supplying air to said tank below the liquid fuel level thereof for bubbling therethrough to generate a combustible gas, a common source of air supply for said means, a valve in said air introducing means, means responsive to the level of the fuel in said tank for actuating said valve, and an automatically operable flow resisting valve in said bubbling means responsive to the resistance offered to the passage of air by said air introducing valve for controlling the passage of air through said air bubbling means.

5. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for introducing air to said tank above the liquid fuel level thereof, means for supplying air to said tank below the liquid fuel level thereof for bubbling therethrough to generate a combustible gas, a common source of air supply for said means, a valve in said air introducing means, means responsive to the level of fuel in said tank for actuating said valve, and an adjustable spring loaded check valve positioned in said bubbling means and responsive to the resistance offered to the passage of air by said air introducing valve for automatically controlling the passage of air through said bubbling means.

6. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, means for introducing supplementary air to said tank, means for supplying air to said bubbling means and air introducing means, means for passing generated gas from said tank to said air supply means to be thereby recirculated through said tank, a unitary valve structure attached to said tank, said valve structure comprising valve means attached to said air introducing means and to said recirculating means and adapted to provide communication with the interior of said tank, and a single means supported by said valve structure and responsive to the level of the fuel in said tank for simultaneously actuating said valve means.

7. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, means for introducing air to said tank above the normal fuel level thereof, means for supplying air to said bubbling means and air introducing means, means for passing generated gas from said tank to said air supply means to be thereby recirculated

through said tank, a unitary valve structure attached to said tank, said valve structure comprising valve means attached to said air introducing means and to said recirculating means and adapted to provide communication with the interior of said tank, a single means supported by said valve structure and responsive to the level of the fuel in said tank for simultaneously actuating said valve means, said recirculating valve means being adapted to open with a decrease in fuel level, said air introducing valve means being adapted to close with a decrease in fuel level and to be entirely closed before the recirculating valve means begins to open.

8. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, means for introducing supplementary air to said tank, means for supplying air to said bubbling means and air introducing means, means for passing generated gas from said tank to said air supply means to be thereby recirculated through said tank, a unitary valve structure attached to said tank, said valve structure comprising valve means attached to said air introducing means and to said recirculating means and adapted to provide communication with the interior of said tank, a single means supported by said valve structure and responsive to the level of the fuel in said tank for simultaneously actuating said valve means, said air introducing valve means being adapted to close with a decrease in fuel level, said recirculating valve means being adapted to open with a decrease in fuel level, and an adjustable flow resisting valve positioned in said bubbling means and responsive to the resistance offered by said air introducing valve for controlling the passage of air through said bubbling means.

9. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, means for supplying air to said bubbling means, means for passing generated gas from said tank to said air supply means to be thereby recirculated through said tank, a unitary valve structure attached to said tank, said valve structure comprising valve means attached to said recirculating means and adapted to provide communication with the interior of said tank, a single means supported by said valve structure and responsive to the level of the fuel in said tank for simultaneously actuating said valve means, and a passage in said recirculating means providing a permanent opening between said recirculating means and the interior of said tank.

10. In a gas generating apparatus of the character described, a tank adapted to con-

tain a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, means for introducing air to said tank above the normal fuel level thereof, means for supplying air to said bubbling means and air introducing means, means for passing generated gas from said tank to said air supply means to be thereby recirculated through said tank, a unitary valve structure attached to said tank, said valve structure comprising valve means attached to said air introducing means and to said recirculating means and adapted to provide communication with the interior of said tank, a single means supported by said valve structure and responsive to the level of the fuel in said tank for simultaneously actuating said valve means, and a passage in said recirculating means providing a permanent opening between said recirculating means and the interior of said tank.

11. In a gas generating apparatus of the character described, a tank for containing a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, pipes connected to said tank and adapted to convey dilution air to said tank and generated gas from said tank, a common pipe supporting means detachably connected to said tank and adapted to provide a gas tight closure between said tank and both of said pipes, and valve means positioned entirely within said tank for regulating the flow through said pipes.

12. In a gas generating apparatus of the character described, a tank for containing a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, a detachable cover for said tank, means for attaching said cover to said tank in gas tight relation thereto, said cover having passages therethrough adapted to be connected to pipes for conveying a dilution flow to said tank and generated gas from said tank, a float connected to said cover, and means operated by said float for controlling communication between said passages and the interior of the tank.

13. In a gas generating apparatus of the character described, a tank for containing a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, a detachable cover for said tank, means for attaching said cover to said tank in gas tight relation thereto, said cover having passages therethrough adapted to be connected to pipes for conveying a flow of fluid to said tank and generated gas from said tank, valves connected to said cover and comprising terminals for said passages, a float connected to said cover, and means operated by said float for actuating said valves.

14. In a gas generating apparatus of the character described, a tank for containing a quantity of liquid fuel, means for bubbling

air through said fuel to generate a combustible gas, a detachable cover for said tank, means for attaching said cover to said tank in gas tight relation thereto, said cover having passages therethrough adapted to be connected to pipes for conveying a dilution flow to said tank and generated gas from said tank, valves connected to said cover and comprising terminals for said passages, a float connected to said cover, and means operated by said float for actuating said valves, said float, float operated means, valves and cover comprising a structure adapted to be assembled to the tank as a unit.

15 15. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, valve means attached to said tank and adapted to be actuated by the change in level of the fuel contained therein to regulate the heating value of the generated gas, said valve means comprising a unitary valve structure, tubular valve members provided thereon entirely within said tank, a gas passageway in each of said members, sleeve members movably positioned on said valve members in substantially gas tight relation therewith, and a single means responsive to the level of fuel in the tank for simultaneously actuating said sleeves to vary the degree of opening of said passages.

16. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, valve means attached to said tank and adapted to be actuated by the change in level of the fuel contained therein to regulate the heating value of the generated gas, said valve means comprising a unitary valve structure, valve members provided thereon, valve controlling members movably positioned on said valve members and adapted upon actuation to vary the degree of opening of said valves, and a single means responsive to the level of the fuel in the tank for simultaneously actuating said valve controlling members, one of said valve controlling members being adapted to close upon decrease of the level of the fuel, the other valve controlling member being adapted to open upon decrease of the level of the fuel and to open after the first mentioned valve controlling member has entirely closed.

17. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, valve means attached to said tank and adapted to be actuated by the change in level of the fuel contained therein to regulate the heating value of the generated gas, said valve means comprising a unitary valve structure, valve mem-

bers provided thereon, valve controlling members movably positioned on said valve members and adapted upon actuation to vary the degree of opening of said valves, and means responsive to the level of fuel in the tank for simultaneously actuating said valve controlling members, to vary the degree of opening of one of said valve controlling members in progressively changing amounts for like amounts of change of level of the fuel and vary the degree of opening of the other valve controlling member in like amounts for like amounts of change of level of the fuel.

18. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for bubbling air through said fuel to generate a combustible gas, valve means attached to said tank and adapted to be actuated by the change in level of the fuel contained therein to regulate the heating value of the generated gas, said valve means comprising valve members, valve controlling members adapted upon actuation to vary the degree of opening of said valves, and means responsive to the level of the fuel in the tank for simultaneously actuating said valve controlling members and for alternately actuating said valves so that one of said valves is entirely closed while the other valve is being actuated.

19. In a gas generating apparatus of the character described, a tank adapted to contain a quantity of liquid fuel, means for introducing dilution air to said tank, means for supplying air to said tank below the liquid fuel level thereof for bubbling therethrough to generate a combustible gas, and float controlled valve means entirely within said tank responsive to the liquid level of fuel in the tank for automatically controlling the proportionate flow of dilution air and bubbling air.

20. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, means for bubbling air through said fuel to generate combustible gas, a pump for supplying air to said bubbling means, a passage from said tank to said pump for recirculating generated gas through the pump, said passage extending into the tank and having a permanent opening within the tank permanently connecting the interior of the tank in communication with said recirculating passage and equalizing pressures in the air bubbling means and the recirculating passage during periods of inactivity of the pump.

21. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, means for bubbling air through said fuel to generate combustible gas, a pump for supplying air to said bubbling means, a passage from said tank to said pump for recirculating generated gas through the pump, valve means between said passage and

the interior of the tank, and control means responsive to the liquid level in the tank for automatically operating said valve means, said passage having an opening within the tank permanently connecting the interior of the tank in communication with said recirculating passage to equalize pressures in the air bubbling means and the recirculating passage during periods of inactivity of the pump.

22. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, means for bubbling air through said fuel to generate combustible gas, a pump for supplying air to said bubbling means, a passage from said tank to said pump for recirculating generated gas through the pump, a check valve in said passage between the tank and the pump preventing flow from the pump toward the tank in said passage, valve means between said passage and the interior of the tank, control means for operating said valve means, said passage having an opening within the tank permanently connecting the interior of the tank in communication with said recirculating passage for equalizing pressures in the air bubbling means and the recirculating passage during periods of inactivity of the pump.

In testimony whereof I hereto affix my signature.

GEORGE W. LORIMER.

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25	90
30	95
35	100
40	105
45	110
50	115
55	120
60	125
65	130