April 5, 1932. G. W. LORIMER 1,852,172

GAS GENERATION

Filed Sept. 24, 1929

Fig. 1

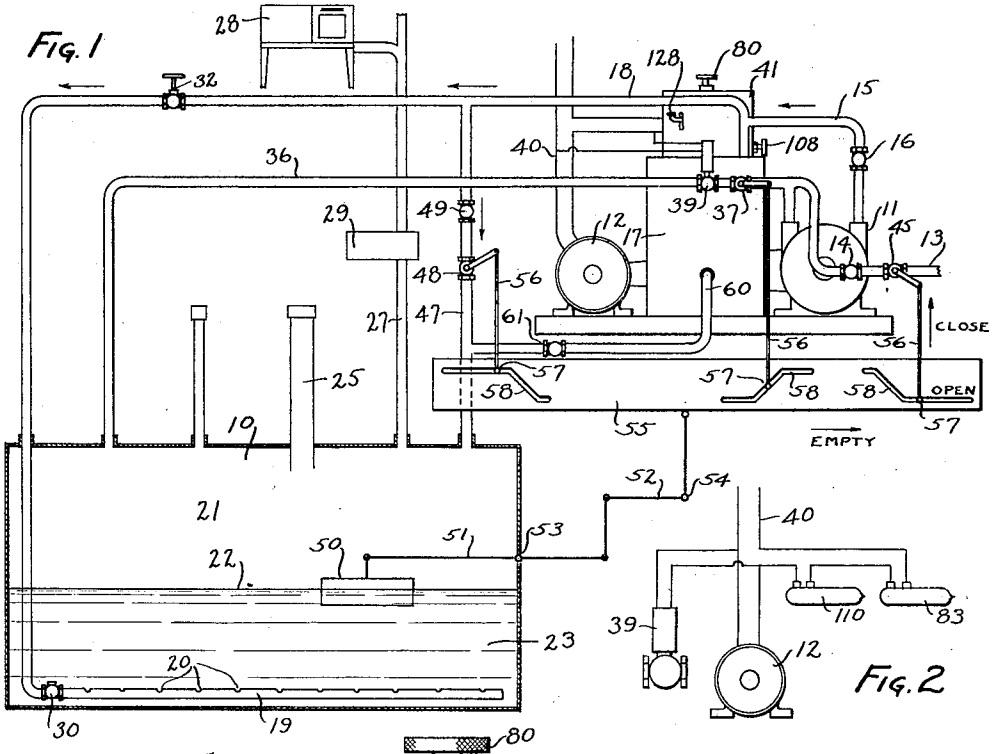
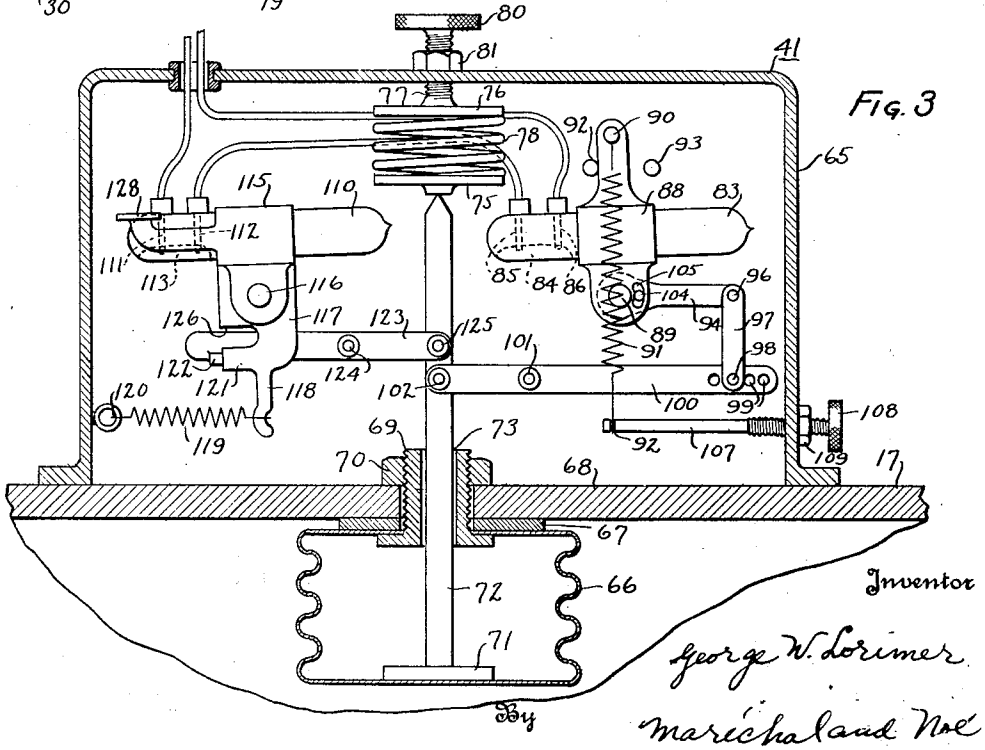


Fig. 2

Fig. 3



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UNITED STATES PATENT OFFICE

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GAS GENERATION

Application filed September 24, 1929. Serial No. 394,906.

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 object of the invention is the provision of an apparatus for generating gas from liquid fuel having improved means for automatically controlling the generation of gas to maintain the quality of the gas substantially uniform in spite of variations in the quality of the fuel.

Another object of the invention is the provision of a gas generating apparatus in which air or the like is forced to bubble through liquid fuel, the bubbling means being so connected that dilution air or gas may be supplied to the tank above the fuel level therein to dilute the generated gas when there is a large quantity of fuel in the tank.

Still another object of the invention is the provision of a gas generating apparatus in which the generated gas is recirculated through the bubbling means, there being provision to control the supply of outside air to the bubbling means to effectively control the amount of recirculation taking place.

A further object of the invention is the provision of a gas generating apparatus in which air or the like is bubbled through liquid fuel, the bubbling means being connected by a pressure equalizing passage to a point above the fuel level in the tank to prevent any back flow of the liquid fuel from the generating tank.

A further object of the invention is the provision of a novel circuit controlling arrangement, particularly adapted for pressure systems of the character mentioned, in which a stopping switch is automatically controlled so as to permanently disconnect or shut down the motor controlled thereby when the pressure in the system reaches a predetermined minimum.

A further object is the provision of a novel switch arrangement adapted to quickly make and break the motor controlling circuit, the switch having provision for adjusting its operation to obtain the desired characteristics.

Still other objects and advantages will be apparent from the following description, the accompanying drawings, and the appended claims.

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

Fig. 1 is a diagrammatic side elevation of a gas generating apparatus, embodying the present invention;

Fig. 2 is a diagrammatic view of the electrical connections; and

Fig. 3 is a vertical section through the pressure switch mechanism.

The present invention is concerned with a gas generating system embodying a bubbling means for bubbling air or other combustion supporting gas through a quantity of gasoline or other volatile liquid fuel, and is an improvement on my prior application for gas generation, Serial No. 303,826, filed September 4, 1928.

Referring more particularly to the drawings, the gas tank is indicated at 10, this tank preferably being suitably located exteriorly of the building, being buried below the ground level or otherwise positioned so as to minimize the fire hazard. A pump 11 is driven by a suitable electric motor 12 so as to draw air through an intake pipe 13, in which there is a suitable check valve 14, and the air is forced from the distributing side of the pump through a pipe 15 containing 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 the adjacent end of the pipe 15, and extends through a wall of the generating tank 10 to a perforated distributing or bubbling pipe 19 disposed adjacent the bottom of the tank. A suitable check valve 30, and the manually operable valve 32 are shown in the pipe connection of the bubbling means, the check valve operating to prevent a back flow from the bubbling pipe 19. Combustion supporting gas supplied by the pump through the pipe 18 is thus caused to bubble up through the series of openings 20 in the bubbling pipe for the creation of combustible gas which is stored in the space 21 above the level 22 of the liquid fuel such as the gasoline or the

like 23. This fuel may be supplied to the tank through the filler pipe 25.

An off-take 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 off-take pipe preferably having a suitable diaphragm regulator 29 for reducing the pressure of the gas supply.

The gas that bubbles up through the gasoline preferably is recirculated so that it may again pass up through the liquid fuel, recirculating pipe 36 being in communication with the space 21 of the tank, at one end, and extending back to the inlet side of the pump. A regulating valve 37 is shown in this pipe connection. An electric or solenoid valve 39, connected to the motor line branch wires 40 is adapted to close the passage through this recirculating pipe when the motor is deenergized to take the tank pressure off of the pump. The control of the motor is automatically effected in accordance with the pressure in the system, a suitable pressure switch designated generally 41 being provided to control the starting and stopping of the motor to maintain the pressure in the system between certain predetermined limits, say between 2 and 6 pounds per square inch.

It should be understood that the recirculation connection, being connected to the inlet side of the pump, causes a recirculation of the gas from the space 21 back through the pump and through the bubbling means so that the gas may be bubbled a number of times through the gasoline before it is consumed to increase the quality of the gas and to effectively agitate and mix the liquid fuel. The tailings or that portion of the gasoline or liquid fuel that is not as easily volatilized as the more volatile substances that make up the fuel are not wasted, but are effectively utilized and changed into gas. This recirculation or continued bubbling of the gas through the liquid fuel is exceptionally desirable when most of the more easily volatilized constituents of the fuel have been taken off. With some grades of fuel this recirculation is desirable even when there is a fresh supply of fuel in the tank, but in many grades it will not be necessary to recirculate the gas through the fuel when there is a fresh supply in the tank, for the more easily volatilized constituents will be readily carried off by the air and the quality of the gas will be satisfactory by merely bubbling the air through once. In some cases it will be found that the gas generated is too rich in fuel, and in accordance with this invention, dilution air or gas is supplied to the space above the fuel in the gas tank when there is a considerable quantity of fuel in the tank, the control of the recirculation, and the control of the supply of dilution gas being effected so that the quality of the gas generated will be substantially uniform in spite of changing characteristics of the liquid fuel.

The air supply to the intake side of the pump from the external air comes through the pipe 13 which is provided with a regulating valve 45 adapted to throttle the fresh air supply to the pump. When the fresh air supply is partially cut off by means of this valve, the suction will be increased in the recirculation pipe 36, causing an increased amount of recirculation, this action being desirable when there is only a small quantity of liquid fuel in the tank, the more easily volatilized constituents having previously been taken off. Control of the recirculation may also be effected by means of the regulating valve 37 provided in the recirculating pipe 36.

Just after replenishing the liquid fuel in the tank 10, the regulating valve 37 should be closed and the valve 45 should be opened so that recirculation is stopped. At this time it is desired to supply dilution gas to the space 21, and this is accomplished by means of the pipe connection 47, communicating at one end with the space 21 of the tank, and at its other end with the gas supply pipe 18 and consequently in communication with the outlet side of the pump. In the dilution pipe or connection 47 is a regulating valve 48, and a check valve 49 is preferably likewise provided in this connection to prevent flow from the tank towards the pipe 18. The regulating valve 48, which may if desired be manually operated, is so controlled that when the liquid level in the tank 10 is high the valve 48 is opened, and as the level falls the valve 48 is partially closed. When the level of liquid in the tank reaches some predetermined limit, the regulating valve 48 should be completely closed and the flow of air or gas and air from the pump 11 through the connection 47 will then cease. At this time there is preferably no recirculation taking place, as the regulating valve 37 is closed, and this valve should preferably remain closed until the liquid level in the tank falls still further, to some predetermined level depending upon the particular characteristics of the fuel. After the liquid falls to this level it is then desired to start the recirculation, and the valve 37 is opened, the recirculation being increased as the liquid level falls by further opening the valve 37 and closing the choke valve 45 at the pump inlet. Thus when there is only a small quantity of fuel in the tank, and this fuel is composed mainly of tailings, the recirculation will be a maximum, effecting an effective mixing of the liquid fuel and its efficient carburization.

The control of the recirculation and the control of the dilution is preferably accomplished automatically. As shown, an element 50, such as a float or the like, is responsive to the amount of liquid in the tank,

this float being mechanically connected in any suitable manner as by means of the levers 51 and 52, pivoted at 53 and 54 respectively to a cam or other suitable operating means 55 operably connected to the regulating valves 48, 37 and 45. The connection between the cam 55 and the valves may comprise links 56 having pins 57 operating in the cam slots 58 of the cam 55. The three cam slots 58 which control the three valves are so arranged that the valves may be operated successively in the proper manner. As shown in Fig. 1, the valve 48 is closed and no dilution gas is being supplied to the top of the tank at this time. The valve 37 is partly opened and some recirculation is taking place, as the liquid level is about at the middle of the tank, and most of the easily volatilized parts of the fuel have been taken off. The choke valve 45 is open. As the liquid level falls, the cam plate 55 will move towards the right, and the choke valve 45 will start to close, the valve 37 will open, and the valve 48 will remain closed. When the tank contains its maximum supply of liquid fuel, the cam plate 55 will be at the left of the position shown, the valve 48 being open at that time to supply dilution air to the top of the tank, the valve 37 being closed and the choke valve 45 being open, no recirculation taking place.

During operation of the apparatus, the pump forces air to the bubbling pipe 19 and causes a recirculation of the gas when the liquid level in the tank is low. The motor is maintained in operation until the desired pressure of the system is attained and it will then be de-energized by the action of the pressure switch. The space 21 remains full of combustible gas under pressure, and when some of this is consumed, and the pressure falls to a predetermined minimum, the motor will again be started. At the time the motor stops running the pressure in the equalizing tank 17 will be somewhat above that in the main tank 10, and the air or gas will bubble rather slowly through the fuel and keep the fuel well stirred up. Then as the gas is consumed and withdrawn from the space 21 in the tank, this causes a drop in pressure which will cause a further passage of gas from the equalizing tank 17 through the distributing pipe 19, and therefore even during the periods of inactivity of the pump the fuel will be agitated and well mixed for the effective generation of gas.

When the pump stops operating the tank 10 should be at a somewhat lower pressure than the equalizing tank 17, and these conditions should prevail under all normal conditions of operation. However, if there should be a leak through the pump so that there might be a loss in pressure in the equalizing tank 17, or if a loss of pressure should occur for any other reason, it will be seen that the gasoline might be forced up the pipe 18 by the pressure that prevails in the tank 10. Such a back flow of gasoline might occur in spite of the check valve 30, as it is difficult to provide check valves that will satisfactorily operate under all conditions and throughout long periods of time and for the particular kinds of fuel mentioned. The failure of the chack valves and the loss in pressure in the equalizing tank 17 would cause a flow of gasoline from the buried tank into the cellar or room in which the pump and the associated parts of the apparatus are contained and this of course is seriously objectionable due to the fire hazard, the loss of gasoline and the flooding of the cellar or room. To guard against this, pressures in the system are so balanced as to prevent any back flow through the bubbling means. As shown, there is an equalizing pipe 60 communicating at one end with the equalizing tank 17 and communicating at its other end with the space 21 in the main tank 10, either being connected directly to the main tank at an upper portion thereof or to the pipe 47 below check valve 49, as most convenient. In this pipe 60 there is a check valve 61 which permits flow from the space 21 in the tank 10 towards the inlet side of the pump and to the equalizing tank 17, but prevents flow through pipe 60 in the reverse direction. There can therefore be no tendency for the gasoline to be forced back through the pipe 18 to the pump, which is preferably located above the level of the liquid in the tank 10, as any pressure in the tank 10 tending to cause the back flow of gasoline would be balanced through the check valve 61 and the pipe connection 60. The check valve 61 however, permits the pressure in the equalizing tank 17 normally to be somewhat above that in the tank 10 while preventing the pressure of the equalizing tank 17 from ever falling below the pressure in the space 21.

The electrical connections are so arranged that the motor will be automatically started and stopped in accordance with the pressures prevailing in the system, the controlling means including an arrangement for permanently interrupting the supply of current to the motor in case the pressure in the system falls below a predetermined minimum value. The entire apparatus will thus be automatically shut down upon a failure in electrical power source for driving the blower if the pressure in the tank 10 falls below a predetermined lower limiting value. When the power fails, and the blower is not actuated for a considerable period of time, substantially all of the generated gas in the space above the fuel in the tank 10 may be used or consumed in open burners before the power again comes on. Should this occur the flame at an open burner would go out and then when the power comes on again additional gas would be generated which would

pass unburned through the open burner into the room with danger of explosion or asphyxiation. However, it is not desired to cause the machine to be shut down upon failure in the electrical power source if that failure should occur only for very brief periods of time.

This safety control is embodied in the pressure switch 41 some of the details of which are shown in Fig. 3. The switch is preferably mounted in a box or housing 65 on the top of the pressure equalizing tank 17. In the tank is a sylphon or metal bellows 66, the upper end of which is held against a washer 67 on the lower side of the top wall 68 of tank 17, by means of the hollow threaded fastening bolt 69 which passes through a hole in the wall 68 and which is held tightly in place by the nut 70. The lower wall of the bellows is fastened by a suitable plate 71 to a rod 72 which extends up through a clearance hole 73 in the bolt 69. This rod therefore moves up and down in accordance with the pressure in the equalizing tank 17. When the pressure is high the rod 72 will be elevated, and then when the pressure in the tank 17 falls the rod will be lowered. The upper end of the rod engages a seat in a suitable washer 75, and a second washer 76 is mounted on the end of an adjusting screw 77 threaded in the upper wall of the housing 65. Between the two washers is a spring 78, of suitable strength to properly balance the pressure of the equalizing tank. The adjusting screw 77 may be easily turned by means of the controllable head 80 and held in adjusted position by the lock nut 81. This arrangement forms a device for determining the limiting pressures at which the switch operates, permitting considerable variation in the pressures in a simple manner.

In series with the electric motor 12 is the controlling switch or circuit controlling mechanism shown in the form of a mercury tube 83 containing a quantity of mercury 84 adapted to bridge the space between the two switch points or electrodes 85 and 86, to close the circuit through the motor. When the mercury tube 83 is in the position as shown in Fig. 3, the circuit to the motor will be closed through this switch, and the motor will operate under normal conditions. Tube 83 is mounted in a tube holder 88 which is pivotally mounted at 89 on one of the walls of the housing 65. A pin 90 on the holder 88 is connected to a spring 91 which is anchored at 92, the spring extending along one side of the pivot axis at 89 when the switch is closed, spring 91 thus holding the tube in position shown in Fig. 3, although it will be understood that when the tube is tilted reversely to open the motor circuit the spring will shift over to the other side of the pivot axis and hold the tube in motor de-energized position. Movement of the holder 88 takes place between the two stops 92 and 93 provided on the housing. The switch is moved by an arm 94 pivotally mounted on the fixed post or pin at 89 at one end and pivotally connected at 96 to a link 97 at its other end. Link 97 is pivotally connected by a suitable pin 98 adapted to be adjustably placed in any one of several positioning holes 99 to a lever 100. This lever is pivotally fulcrumed at 101 to a wall of the housing 65 and is pivotally connected at 102 to the rod 72. This rod, when moved upwardly, will pull down on the free end of arm 94, and motion will be transmitted to the holder 88 by means of a pin and slot connection, the arm 94 having a pin 104 which operates in a slot 105 in the holder 88, the slot being sufficiently long to provide desired lost motion between the arm 94 and the holder so that the holder may be moved towards a position intermediate of the stops 92 and 93 after which the spring 91 will snap the holder over and cause the rapid making or breaking of the circuit.

The lower end of the spring 91 is anchored or connected to a spindle 107 which is adjustably threaded in a wall of the housing 65, adjustment being permitted by the knurled head 108, locking nut 109 serving to fix the spindle in adjusted position. The point of connection of the lower end of the spring 91 can therefore be adjusted towards one side of the pivot mounting 89 of the holder and this forms a control which readily permits rather fine variations in the pressures of the system controlled by the switch. It is apparent that when the point 92 is moved to the left as viewed in Fig. 3 the circuit through the contacts 85 and 86 will remain closed longer, and a correspondingly greater upward movement of the rod 72 is required to cause breaking of the circuit.

The starting and stopping of the motor will be controlled through the mercury tube 83 provided the disconnecting or shut-down switch designated generally 110 remains closed. This switch is provided with the terminals 111 and 112, the space between the terminals normally being bridged by the quantity of mercury 113 in the mercury tube. Terminal 112 is connected electrically to the terminal 85 of switch 83, while the terminal 111 is connected to one side of the line as shown in Fig. 2, so that the two switches are both in series with each other and with the motor. The tube 110 is mounted on a carrier 115 which is pivotally supported on a pin or the like 116 projecting from one side of the housing 65. On the lower end of the holder 115 is a tail portion 117 having an arm 118 serving as an anchorage for the spring 119 the end of which is fastened at 120 to the housing. This spring 119 tends to pull the holder clockwise about its pivot, tending to interrupt the motor circuit, but this action is normally prevented by a stop 121 provided

on the tail portion 117, this stop cooperating with an abutting stop 122 provided on lever 123 which is pivotally mounted at 124 on the housing and pivotally connected at 125 to the rod 72. The stop 122 is moved up and down in accordance with the pressure existing in the equalizing tank 17, and when raised sufficiently far to clear the stop 121 the tail portion 117 of the holder may be swung to the left, the stop 122 being received in a slot 126. Thus the shut down switch 110 will be maintained closed at all times, even if the supply power source should be interrupted temporarily, until the pressure within the tank 17 falls below some predetermined limit. When this occurs however the stop 122 will enter the slot 126 as the holder is moved clockwise by the spring, this operation causing the breaking of the motor circuit in a more or less permanent manner requiring manual adjustment of the switch before the system can again be operated. Preferably the holder 115 is provided with a convenient manually operable finger or handle 128 which may be depressed and held down temporarily until the motor has built up the pressure in the system for enough to cause the stop 122 to be moved down opposite the stop 121. After this occurs the switch may be released, and the motor will continue operation until the pressure is built up to the desired amount. The starting and stopping of the motor will then be automatically controlled by the pressure responsive switch 83 until the pressure in the system should again fall below some predetermined lower limiting value, substantially lower than the normal lower value at which the motor is started by the pressure control switch 83.

It will thus be understood that in accordance with the present invention a system is provided requiring practically no attention or care, as the various parts are automatic in their operation automatically taking care of any variable factors such as changes in the liquid level and changes in pressure in 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 pressure regulated gas generating apparatus of the character described, a tank adapted to contain liquid fuel, bubbling means for bubbling air through the fuel in said tank, means for supplying dilution gas to said tank, and means for automatically controlling the supply of dilution gas in accordance with the amount of fuel contained in the tank.

2. In a pressure regulated gas generating apparatus of the character described, a tank adapted to contain liquid fuel, bubbling means for bubbling air through the fuel in said tank, means for supplying dilution gas to said tank above the liquid level therein, a float in said tank, and a valve operated by said float for automatically controlling the supply of dilution gas to the tank to increase the supply of dilution gas at higher liquid levels and decrease the supply at lower liquid levels.

3. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, bubbling means for bubbling combustion supporting gas through the liquid fuel in the tank, means for recirculating some of the gas so that it is again passed through the fuel and the tank, means for controlling the recirculation of gas, and means for supplying dilution gas to the space above the liquid level in the tank.

4. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, a pump, a bubbling pipe in said tank, a pipe connection from said bubbling pipe to the outlet side of said pump, a second pipe connection from the inlet side of said pump to an upper portion of said tank above the liquid level therein, and a pipe connection from the outlet side of said pump to an upper portion of said tank for supplying dilution gas to the space above the fuel in the tank.

5. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, a pump, a bubbling pipe in said tank, a pipe connection from said bubbling pipe to the outlet side of said pump, a second pipe connection from the inlet side of said pump to an upper portion of said tank above the liquid level therein, a pipe connection from the outlet side of said pump to an upper portion of said tank for supplying dilution gas to the space above the fuel in the tank, and means responsive to the amount of liquid in the tank for automatically controlling both the amount of recirculation and the supply of dilution gas to the tank.

6. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, a pump, a bubbling pipe in said tank, a pipe connection from said bubbling pipe to the outlet side of said pump, a second pipe connection from the inlet side of said pump to an upper portion of said tank above the liquid level therein, a pipe connection from an outlet side of said pump to an upper portion of said tank for supplying dilution gas to the space above the fuel in the tank, and means for choking the supply of external air to the pump.

7. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, a pump, a bubbling pipe in said tank, a pipe connection from said bub-

bling pipe to the outlet side of said pump, a second pipe connection from the inlet side of said pump to an upper portion of said tank above the liquid level therein, a pipe connection from the outlet side of said pump to an upper portion of said tank for supplying dilution gas to the space above the fuel in the tank, means for choking the supply of external air to the pump, and means operated in accordance with the amount of liquid in the tank for controlling the recirculation, dilution and choking to maintain the quality of the gas substantially uniform.

8. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, a bubbling pipe in said tank, a pump, a pipe connection from the outlet side of said pump to said bubbling pipe, a pipe connection from the inlet side of said pump to an upper portion of said tank for recirculating gas from the upper portion of said tank through said bubbling pipe, means supplying external air to the inlet side of said pump, and a controllable valve in said means for choking the supply of external air to said pump.

9. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, a bubbling pipe in said tank, a pump, a pipe connection from the outlet side of said pump to said bubbling pipe, a pipe connection from the inlet side of said pump to an upper portion of said tank for recirculating gas from the upper portion of said tank through said bubbling pipe, means supplying external air to the inlet side of said pump, a controllable valve in said means for choking the supply of external air to said pump, and means responsive to the amount of liquid in said tank for automatically controlling said valve.

10. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, a bubbling pipe in said tank, a pump, a pipe connection from the outlet side of said pump to said bubbling pipe, a pipe connection from the inlet side of said pump to an upper portion of said tank for recirculating gas from the upper portion of said tank through said bubbling pipe, means supplying external air to the inlet side of said pump, a controllable valve in said means for choking the supply of external air to said pump, a float in said tank and a connection from said float to said valve for increasing the choking effect of said valve automatically as the level of liquid falls in the tank, and means preventing back flow of fuel to the outlet side of the pump when the pump is idle comprising a pipe connection from the outlet side of the pump to the space above the liquid in the tank, said pipe connection including a check valve preventing flow through said pipe connection towards the tank.

11. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, bubbling means for bubbling air through the liquid fuel in the tank, means for recirculating gas from an upper portion of said tank again through said bubbling means, provision for supplying air to said bubbling means, choking means for the air supply, means for supplying dilution gas to an upper portion of said tank, and mechanism for automatically controlling the recirculating means, the choking means, and the dilution gas supplying means to maintain the quality of the generated gas substantially uniform.

12. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, bubbling means for bubbling air through the liquid fuel in the tank, means for recirculating gas from an upper portion of said tank again through said bubbling means, provision for supplying air to said bubbling means, choking means for the air supply, means for supplying dilution gas to an upper portion of said tank, a float responsive to the liquid level in said tank, and means operated by said float for automatically controlling the choking means, the recirculation means, and the air dilution means to maintain the quality of the generated gas substantially uniform.

13. In a pressure regulated gas generating machine adapted to bubble air through liquid fuel, a tank, bubbling means for bubbling air through the fuel in said tank, an electric motor for effecting operation of said bubbling means, a pressure switch operated in accordance with the pressure in the tank for controlling the starting and stopping of said motor, a pipe connection for recirculating gas from an upper portion of said tank again through said bubbling means, and means for supplying dilution gas to an upper portion of said tank.

14. In a gas generating apparatus of the character described, a tank adapted to contain liquid fuel, a pump, a connection from the outlet side of said pump to a point adjacent the bottom of the tank, a pipe connection from the upper portion of said tank to the inlet side of the pump, and means for preventing back flow of liquid through said first named connection comprising an equalizing conduit from said tank above the liquid level therein extending to said first named connection between the outlet side of the pump and said tank, and a check valve in said equalizing conduit preventing flow towards the tank.

15. In a pressure regulated gas generating machine for bubbling air through gasoline, a tank adapted to contain gasoline at various levels, a pump, a perforated distributing pipe within said tank, a pipe connection from the

outlet side of said pump to the inlet side of said distributing pipe, a recirculating pipe extending from a point above the liquid level in the tank to the inlet side of the pump, a pressure equalizing pipe communicating at one end with the gas in the tank and at its other end with the outlet side of the pump, a check valve in said equalizing connection preventing flow towards the tank, and a float in said tank controlling the amount of recirculation.

16. In a pressure regulated gas generating machine for generating combustible gas by bubbling air through liquid fuel, a tank adapted to contain liquid fuel, bubbling means for bubbling air through said liquid fuel, an electric motor for operating said bubbling means, and pressure switch mechanism for controlling the starting and stopping of said motor in accordance with the pressure in the system to maintain the system pressure between predetermined limits, and for permanently interrupting the supply of current to said motor when the pressure of the system falls below a predetermined minimum so that the motor will not be again energized regardless of the pressure in the system and manual resetting means for said pressure switch mechanism for rendering it effective again after the supply of current has been permanently interrupted.

17. In a pressure regulated gas generating machine for generating combustible gas by bubbling air through liquid fuel, a tank adapted to contain liquid fuel, bubbling means for bubbling air through said liquid fuel, an electric motor for operating said bubbling means, and a pressure switch for controlling the starting and stopping of said motor automatically in accordance with the pressure in the system to maintain the system pressure between predetermined limits, said switch comprising a contact member, stop means on said member, and cooperating stop means automatically operated in accordance with the pressure in the system and holding said switch in a certain position after a predetermined minimum pressure of the system has been attained.

18. In a pressure regulated gas generating machine for generating combustible gas by bubbling air through liquid fuel, a tank adapted to contain liquid fuel, bubbling means for bubbling air through said liquid fuel, an electric motor for operating said bubbling means, and a pressure switch for controlling the starting and stopping of said motor automatically in accordance with the pressure in the system to maintain the system pressure between predetermined limits, said switch comprising a contact holding tube, pivoted holding means for said tube, a lost motion connection to said holding means, a lever connected to said last named connection, a fluid pressure element for operating said lever, a spring connected at one end to said holding means and adapted to move to opposite sides of the tube pivot and adjusting means for the other end of said spring for controlling its normal position.

In testimony whereof I hereto affix my signature.

GEORGE W. LORIMER.