April 16, 1940. R. REICHHELM 2,197,347

GASIFYING APPARATUS

Filed June 9, 1938 2 Sheets-Sheet 1

Fig.1.

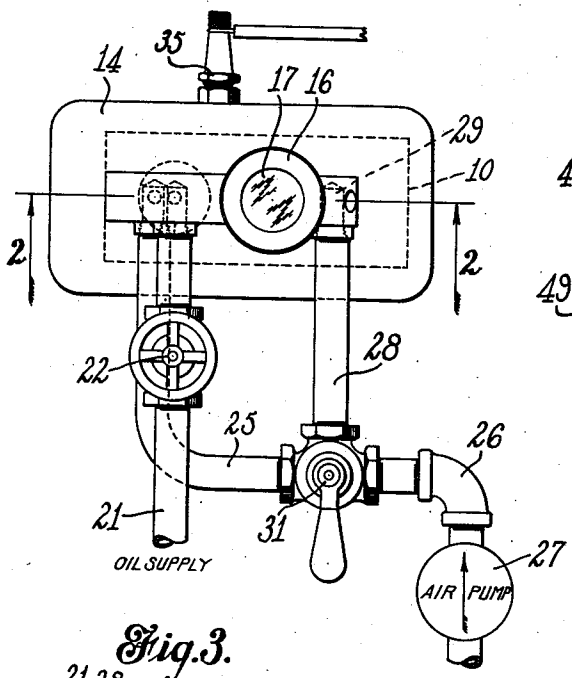


Fig.2.

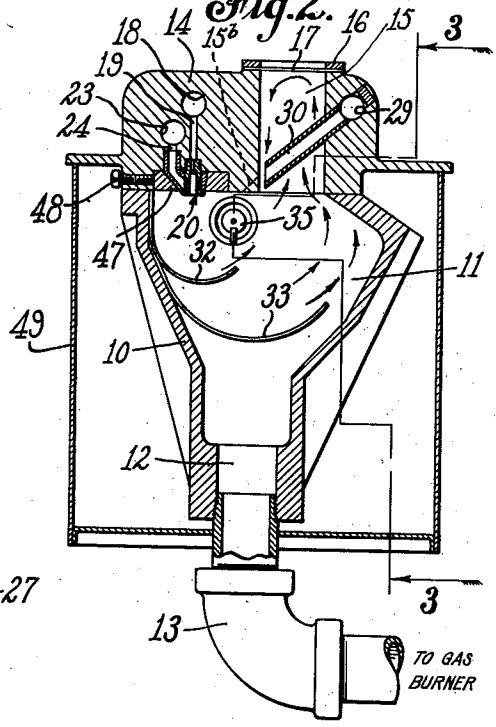


Fig.3.

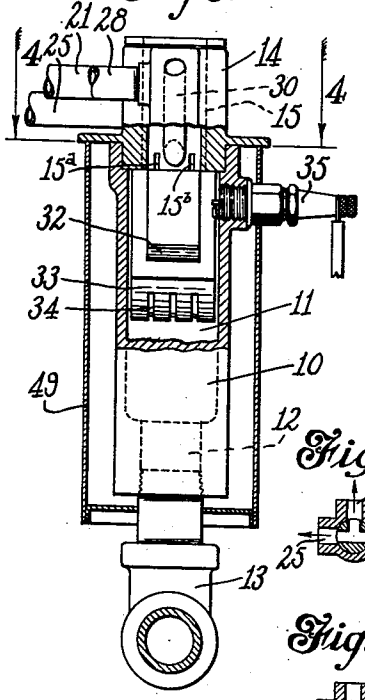


Fig.4.

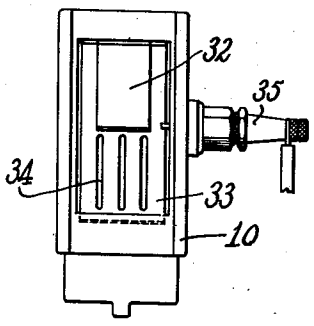


Fig.5.

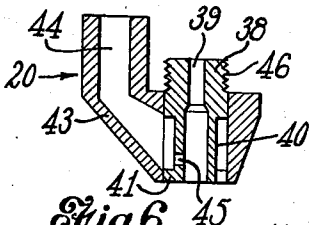


Fig.6.

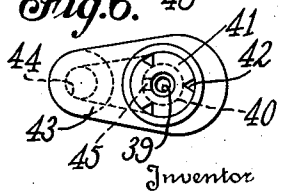


Fig.7.

Fig.8.

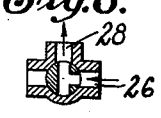


Fig.9.



Inventor

Robert Reichhelm

By Rockwell & Barnhorst

Attorneys

April 16, 1940. R. REICHHELM 2,197,347

GASIFYING APPARATUS

Filed June 9, 1938 2 Sheets-Sheet 2

Fig. 10.

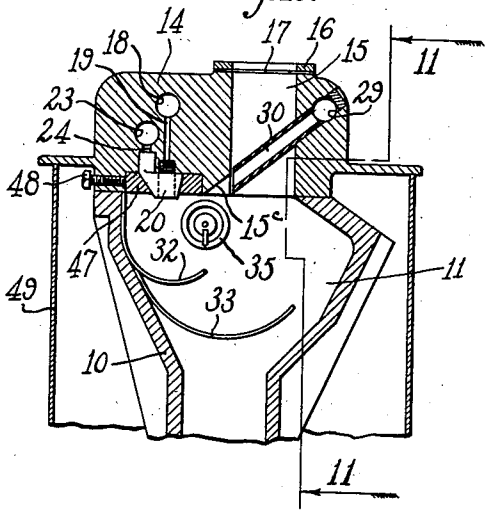
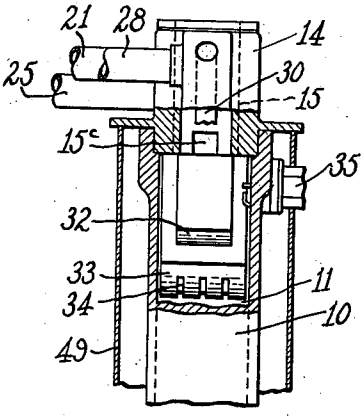


Fig. 11.



Inventor

Robert Reichhelm

By Borchardt & Bartholow

Attorneys

Patented Apr. 16, 1940

2,197,347

UNITED STATES PATENT OFFICE

2,197,347

GASIFYING APPARATUS

Robert Reichhelm, New Haven, Conn., assignor to The Eastern Oil Refining Company, Inc., Wallingford, Conn., a corporation of Connecticut

Application June 9, 1938, Serial No. 212,785

11 Claims. (Cl. 48—76)

The present invention relates to the production of a combustible gas from liquid fuels, and more particularly low grade fuels, such as heavy fuel oils, for example. Such fuels contain the ingredients for the manufacture of a highly combustible gas substantially equal to ordinary manufactured gas, and can be converted into such a gas by being subjected to heat or to a hot flame which serves to gasify without burning the heavy fuel. In the present instance a part of the fuel is employed to provide the flame or heat to gasify the remainder. In initiating the operation of the device for producing the combustible gas, a spark plug or some other extraneous ignition means is provided. However, as will be apparent from the following description, after the operation has once been initiated, no such ignition means is employed, as the flame secured from burning a part of the fuel will be self-sustaining and the operation will continue without the necessity of any other ignition.

One object of the present invention is to provide a process and apparatus for the gasification of liquid fuels such as heavy oils.

A further object of the invention is to provide an improved device for producing a highly combustible gas from a heavy fuel in an efficient manner, so that no carbon deposit will remain from the burned fuel, and a gas will be produced which may be readily burned in a manner similar to the combustion of ordinary fuel gases.

A further object of the invention is the provision of a gas generator for producing gas from a fuel oil or other hydrocarbon, such that each burner or furnace unit will have its own gas plant to supply the gaseous fuel therefor.

A still further object of the invention is the provision of an apparatus for generating gas from a liquid fuel such that a portion of the fuel may be consumed and the heat thus generated employed to convert the remainder of the fuel into a combustible gas.

Still another object of the invention is the provision of a gas-generating apparatus to which a liquid fuel may be supplied, and a small percentage of the fuel consumed or burned to supply heat to gasify the remainder, whereby the gas so generated may be carried to a furnace or burner to be consumed as desired.

Also, the present invention has for its object the provision of a gas generator to gasify a hydrocarbon fuel by burning a small percentage of the fuel in the presence of the remainder by atomizing a part of the fuel and supplying oxygen thereto in such a manner that substantially all of the oxygen is united with the part of the fuel which is burned, so as to produce and deliver a gas devoid of free oxygen, which may be piped or carried to a burner without danger of backfiring.

To these and other ends the invention consists in the novel features and combinations of parts to be hereinafter described and claimed.

In the drawings:

Fig. 1 is a top plan view of a gas generator embodying my invention;

Fig. 2 is a sectional view on line 2—2 of Fig. 1;

Fig. 3 is a sectional view on line 3—3 of Fig. 2;

Fig. 4 is a sectional view on line 4—4 of Fig. 3;

Fig. 5 is a detailed sectional view of the atomizing nozzle;

Fig. 6 is a bottom plan view of the nozzle shown in Fig. 5;

Figs. 7, 8 and 9 are detailed sectional views of the three-way valve employed in the air line of the generator; and

Figs. 10 and 11 are views similar to Figs. 2 and 3 showing a modified form of apparatus.

To illustrate a preferred embodiment of my invention, I have shown casing 10 which provides therewithin a combustion or gasifying chamber 11, which, as will be noted, is enlarged at its upper portion and tapers downwardly so as to merge into a relatively smaller outlet 12, to which is connected a pipe or other conduit 13 through which the generated gas or gasified fuel may pass from the chamber to a furnace, burner or other device in which the gas is to be used. The combustion chamber 11 is provided with a cover 14 formed with a well or dome 15 extending upwardly through the cover, and provided at its upper end with a cap 16 having a transparent member 17 of mica or heat-resisting glass, so that a peephole is provided through which the operator may watch the action taking place in the chamber 11.

The chamber is provided with an oil passage 18 from which a duct 19 leads to the outlet nozzle designated generally by the numeral 20, and which will be more particularly described hereinafter. An oil supply line 21 controlled by the valve 22 of any approved form communicates with the oil passage 18, the supply line leading to a tank or other source of supply.

The member 14 is also provided with an air passage 23 communicating through a short duct 24 with the nozzle 20. To the passage 23 is connected a branch 25 of the main air line 26, supplied with air under pressure by a pump 27.

A further branch air line 28 leads from the line 26 to an air passage 29 formed in the member 14, the passage 29 being in communication with a pipe or nozzle 30, which delivers air for purposes of combustion to the chamber 11. It will be noted that the pipe 30 leads into the dome or well 15, and discharges against the side wall of this well in a downwardly inclined direction.

Slots 15a and 15b, which are shown as of triangular shape and one disposed upon each side of the mouth of the pipe 30, are provided in the

wall of the well 15. These slots lessen the velocity of the flame as driven from the well by the air issuing from the pipe 30 so that there will be no tendency for it to extinguish the flame, which results from the burning of the gas in the well 15. These slots also redirect the premixture of air and gas in the well toward the flame or baffle plates.

The branch air lines 25 and 28 communicate with the main air line 20 by means of a three-way valve 31, which, as shown in Figs. 7, 8 and 9, is capable of being moved to positions to supply either or both of the branch lines 25 and 28 with air as desired. For example, if the valve is in the position shown in Fig. 9, air will be supplied to the branch 25 only. If, however, the valve is in the position shown in Fig. 7, air will be supplied to both of the branch lines 25 and 28, while, if the valve is in the position shown in Fig. 8, air will be supplied to the line 28 only, and shut off from the line 25. This valve may, of course, be any of the conventional three-way valves, and is not a part of the present invention, except that it is contemplated that the air should be controlled in such a manner that it may be admitted to either of the branch lines 25 and 28 and excluded from the other line, or be admitted to both lines at the same time.

Mounted in the combustion chamber 11 are baffle or flame plates 32 and 33. While only two such baffle plates are shown in the drawings, the number of such plates may be varied as desired, and a greater or fewer number provided. It will be noted that the upper baffle plate 32 comprises a relatively flat member curved in arcuate shape along its longitudinal dimension, so that it presents an upwardly facing concave contour. The lower baffle plate 33 is of similar contour, but is of greater length than the upper plate, so that it extends beyond the free edge of the upper plate to a point adjacent the wall of the chamber opposite that upon which the plates are secured. The baffle plate 33 is also provided with a number of openings, which, as shown, may take the form of parallel slots 34, these slots, as will hereinafter be explained, permitting a part of the generated gas to flow directly downwardly through these openings toward the outlet 12. Mounted in an opening in the chamber wall above the flame plates is a spark plug 35, which may be employed to initiate combustion within the chamber 11. As will be hereinafter explained, after the generator is once placed into operation, current may be cut off from the spark plug, as it will be no longer required.

It will be noted that the baffle plate 32 is placed below the atomizing nozzle 20 heretofore generally referred to, and which will now be described in detail. This nozzle, shown more particularly in Fig. 5, comprises an oil nozzle 38 having an oil passage 39 which communicates with the passage 19. The wall of the nozzle 38 is provided with an external annular recess 40, leaving a flange or web 41 adjacent its lower edge, within which flange may be provided one or more notched openings 42, which communicate with the recess 40. Surrounding the lower recessed portion of the nozzle 38, and extending upwardly therefrom, is the air nozzle 43 having a passage 44 communicating with the short passage 24 in the top 14 of the chamber 11. The passage 44, as will be seen from Figs. 5 and 6, communicates with the annular recess 40 about the oil nozzle 38, and the wall of this latter nozzle is provided with an opening 45, which permits the entry of atomizing air to the oil passage 39. The oil nozzle 38 may be provided with a threaded portion 46 adjacent its upper end, so that it may be screwed into place, and the air nozzle 43 may be held in position by means of a washer 47 secured in turn by a set screw 48. It will be obvious that air entering through the passage 44 will pass into the nozzle 39 through the port or opening 45, and will also pass into the annular channel 40 and be discharged into the chamber through the notched openings 42. Thus a part of the air supply through the passage 44 will enter the oil stream before it is discharged into the chamber 11, while another part thereof will be discharged into the chamber around the oil stream through the notched openings 42. This, as will be explained, results in providing for the admission of fuel into the chamber generally in the form of a central fuel core surrounded by a fine spray of atomized fuel.

About the casing 10 of the combustion chamber 11 is provided an outer casing 49. The space between this outer casing and the casing 10 may be filled with heat insulating material so as to prevent the operator from being exposed to the heat from the combustion chamber, or, on the other hand, it may be left as a dead air space, or the air may be exhausted therefrom in order that the walls of the casing 49 will be relatively cool.

The operation of the device will now be described. When it is desired to place the generator into operation, the valve 31 is turned to the position shown in Fig. 9, in which air is admitted to the branch pipe 25 and thence to the passage 44 to the air nozzle. The spark plug 35 is also supplied with current, and the oil valve 22 is open to a slight extent. This results in discharging into the combustion chamber 11 a mixture of the atomized air and oil in a relatively fine spray, which on account of the inclination of the lower end of passage 44, will be directed toward the spark plug 35 and be ignited. The generator is allowed to operate for a short time under these conditions until the combustion chamber and the baffle plates therein become heated. This should require only a few seconds. Thereafter, the valve 31 is turned to the position shown in Fig. 7 to supply air to both branch air lines 25 and 28, the oil valve is opened to the extent required to furnish sufficient oil to generate the desired amount of gas, and the spark plug is cut off, as this form of ignition will no longer be required due to the fact that the flame in the chamber will be self-sustaining. Combustion air being supplied through the pipe 30, and a mixture of air and oil being supplied through the nozzle 20, as will now be the case, the generator is in its normal operation.

When the burner is first put into operation from a cooled state and air and oil are supplied through the passages 44 and 39, respectively, it will be seen that, due to the direction of the lower end of the passage 44, a part of the air which enters the lower enlarged end of the passage 39 will tend to pass downwardly in the general direction of the lower end of the passage 44, and will, therefore, be directed toward the center of the chamber 11, past the spark plug 35. This part of the air has a higher velocity than the remainder, which strikes against and is baffled to some extent by the walls of the passage 39, and it is this higher velocity portion of the issuing air that contains the finest spray, which insures immediate ignition by the spark plug. The slower moving part of the atomized stream of air

and oil issues from the nozzle **20** in a generally downward direction, and this permits the larger, slower moving particles to virtually drop upon the flame plate **32**. This plate is, of course, cool initially, and the initial supply of oil is so regulated that the greater part of it will be consumed so as to bring the heat of the chamber to the required degree in a very short time. The flame plates **32** and **33** are both brought to a red heat in a very short time, and additional oil can then be supplied to generate the gas.

When additional oil is supplied, it is also necessary to supply additional air through the duct **30**. Otherwise the disproportion of vapor to air would result in extinguishing, or nearly extinguishing, the flame, and the flame plate would be cooled. With additional supplies of both air and oil, however, an additional amount of fuel is consumed, which is sufficient not only to keep the combustion chamber and flame plates hot, but in addition to gasify a considerable quantity of the fuel while actually burning only a small quantity. When additional fuel is supplied, and also additional air, the gases are directed against the curved flame plates **32** and **33** (the flame plate **32** being narrower than plate **33**, as well as shorter), which, on account of their shape, tend to deflect these gases in the general direction of their curved ends and cause them to move generally upwardly into the well **15**, and particularly against the right-hand wall of this well, as shown in Fig. 2, and as indicated by the arrows in this figure. Air issuing from the nozzle or duct **30** tends to augment this action by its effect as an inspirator, thus serving to draw the gases up into the well, and also to supply them with air for combustion, and direct them generally downwardly toward the flame plates.

The proportion of the total fuel thus consumed can be regulated to a relatively fine degree by the curvature of the flame plates, and by supplying the proper quantity of combustion air through the duct **30**. The air issuing from this duct is baffled to some extent against the wall of the well **15**, but a part thereof issues into the chamber **11** in the direction of the tube **30**, so as to impel the burning gases against the flame plates **32** and **33** to maintain them at a high degree of heat.

The slotting of the lower plate permits excess gases which are generated to immediately descend and flow out of the chamber through the outlet **12**, so that excessive cooling of the plates will be prevented. When a relatively large quantity of oil is supplied, some of this oil may not be atomized, but will drop directly upon the flame plates and be converted directly into gas. This gas will be directed toward the well **15** and some of it will burn in the chamber in the atmosphere supplied by the pipe **30**. These flame plates, therefore, not only function as deflectors or baffles for the stream of atomized oil and air, but also serve to vaporize these large drops, which might otherwise pass through the device as oil. The effect of these flame plates as baffles also assures a homogeneity of mixture whereby substantially all of the free oxygen will be consumed, so that the gas discharged from the gasifier will not contain free oxygen, and therefore will not be a combustible mixture.

The flame directed by the flow of air from the tube **30** will be blue in color, so that it is most efficient and will insure complete combustion and prevent the formation of any carbon deposit within the chamber.

After the burner has been brought up to heat and additional air supplied through the tube **30**, the quantity of oil delivered to the chamber can be regulated by the valve **22**, depending upon the amount of gas desired for use, and within limits, the quantity of oil supplied can be varied without changing the supply of combustion air, for, while the amount of fuel actually burned may be in excess of that required to generate gas from the remainder of the fuel when a relatively small quantity of fuel is supplied, it will be sufficient to generate gas from a larger quantity of fuel.

The swirling or turbulence of the gases in the chamber effected by the baffle plates in conjunction with the action of the tube **30** as an inspirator, insures a complete mixture of the combustion air with the atomized oil, and therefore complete combustion of the fuel which is consumed, thus giving the double advantage of insuring against any carbon deposit and also against the presence of any free oxygen in the gas delivered by the generator.

It will be noted that the slots **15***a* and **15***b* in the wall of the well **15** serve to lessen the baffling effect of the lower portion of the wall of the well upon the air issuing from the pipe **30**. The degree of this baffling effect may be varied as desired by changing the number or arrangement of the slots. In some instances, and particularly when the valve **31** is so positioned that no air will be supplied to the nozzle **20**, it may be desirable to provide for the air introduced through the tube **30** to issue therefrom without any baffling effect. Such a structure is shown in Figs. 10 and 11, where the lower portion of the wall of the well may be notched out or cut away at that portion opposite the mount of the tube **30**, as illustrated at **15***c*, so that the air issuing from this tube will be directed freely into the chamber in the direction of the outlet of the tube.

As will be apparent from Figs. 6, 10 and 11, for example, in this case the air issuing from the tube will be directed in a downwardly inclined direction across the stream of oil issuing from the nozzle **20**, and toward the wall of the chamber adjacent this nozzle. This will serve to blow the flame of the gas burning in the well **15** directly across the stream of oil issuing from the nozzle **20**, so as to spray the stream of oil with the flame as well as suppying combustion air to mix with the oil.

While I have shown and described a preferred embodiment of my invention, it is to be understood that it is not to be limited to all of the details shown, but is capable of modification and variation within the spirit of the invention and within the scope of the appended claims.

What I claim is:

1. A gasifying apparatus for heavy liquid fuels comprising a gasifying chamber, a fuel nozzle having a passage communicating with the upper portion of the chamber, a curved baffle plate in said chamber below said nozzle, having its concave side toward said nozzle to receive thereon the fuel discharged from the nozzle and create a turbulence therein, and means for delivering a supply of air into said fuel passage above the discharge end thereof to mix with the fuel, said delivery being generally in the direction of said baffle plate, and ignition means disposed generally in the path of said delivery.

2. A gasifying apparatus for heavy liquid fuels comprising a gasifying chamber, an atomizing nozzle communicating with the chamber to deliver a mixture of fuel and air thereto, a plural-

ity of baffle plates extending into said chamber from a wall thereof and below and in proximity to said fuel nozzle to receive the discharge therefrom, said baffle plates being in spaced relation one below the other, and the lower of said baffle plates being longer than the upper to extend to a further distance into the chamber, and said baffle plates being upwardly curved to present their concave surfaces toward the nozzle.

3. A gasifying apparatus for heavy liquid fuels comprising a gasifying chamber, an atomizing nozzle communicating with the chamber to deliver a mixture of fuel and air thereto, a plurality of baffle plates extending into said chamber from a wall thereof and below and in line with and in proximity to said fuel nozzle to receive the discharge therefrom, said baffle plates being in spaced relation one below the other, the lower of said baffle plates being longer than the upper to extend to a further distance into the chamber, and one of said baffle plates being provided with openings to permit the passage of a part of the fuel therethrough.

4. A gasifying apparatus for heavy liquid fuels comprising a combustion chamber having an auxiliary chamber in a wall of the combustion chamber and in communication therewith, means for delivering to said combustion chamber a mixture of fuel and air, baffle means within said combustion chamber to receive said mixture and deflect it toward said auxiliary chamber, additional air supply means to discharge air into the first chamber adjacent the lower end of said auxiliary chamber in the general direction of said baffle plate to furnish oxygen for combustion of the fuel and to redirect the mixture toward said baffle plate.

5. A gasifying apparatus provided with a combustion chamber having an auxiliary chamber in a wall thereof in communication with the first chamber, means for delivering to the combustion chamber a mixture of fuel and air, means for deflecting said mixture along a wall of said auxiliary chamber, an air supply nozzle having its outlet adjacent the opposite wall of the auxiliary chamber for discharging additional air into the combustion chamber in a direction generally toward said deflecting means.

6. A gasifying apparatus provided with a combustion chamber having an auxiliary chamber in a wall thereof in communication with the first chamber, means for delivering to the combustion chamber a mixture of fuel and air, means for deflecting said mixture along a wall of said auxiliary chamber, an air supply nozzle having its outlet adjacent the opposite wall of the auxiliary chamber for discharging additional air into the combustion chamber in a direction generally toward said deflecting means, and said nozzle creating an inspirating action to assist in drawing the mixture of fuel and air into the auxiliary chamber.

7. A gasifying apparatus comprising a combustion chamber, said chamber having an outlet at its lower end and being reduced in size adjacent to the outlet relatively to the upper end of the chamber, a wall of said chamber being provided with an auxiliary chamber communicating with the combustion chamber at the top thereof, a baffle plate extending into the combustion chamber from a wall thereof, an atomizing nozzle disposed at the upper portion of the combustion chamber for directing a mixture of fuel and air thereinto toward said baffle plate, said baffle plate being curved to deflect said mixture into the auxiliary chamber, and an air discharge nozzle discharging against a wall of the auxiliary chamber at the end thereof adjacent the combustion chamber to supply additional combustion air and to redirect the mixture toward said baffle plate.

8. A gasifying apparatus comprising a combustion chamber, said chamber having an outlet at its lower end and being reduced in size adjacent to the outlet relatively to the upper end of the chamber, a wall of said chamber being provided with an auxiliary chamber communicating with the combustion chamber at the top thereof, a baffle plate extending into the combustion chamber from a wall thereof, an atomizing nozzle disposed at the upper portion of the combustion chamber for directing a mixture of fuel and air thereinto toward said baffle plate, said baffle plate being curved to deflect said mixture into the auxiliary chamber, and an air discharge nozzle discharging against a wall of the auxiliary chamber at the end thereof adjacent the combustion chamber to supply additional combustion air and to redirect the mixture toward said baffle plate, and said air discharge nozzle discharging against the wall of the auxiliary chamber in an inclined direction generally toward the combustion chamber.

9. A gasifying apparatus comprising a chamber, a nozzle for discharging a mixture of fuel and air into said chamber, additional air supply means for supplying combustion air to said chamber, a baffle plate in said chamber extending across the discharge from said fuel nozzle and presenting a concave surface thereto to receive thereon the discharge from the nozzle, and said baffle plate having openings therein to permit the passage therethrough of a portion of the fuel to prevent excess cooling of the plate.

10. A gasifying apparatus comprising a combustion chamber having an outlet at its lower end and having an auxiliary chamber in a wall thereof adjacent the upper end in communication with the combustion chamber, a baffle plate extending into the combustion chamber from a wall thereof, a nozzle disposed at the upper portion of the combustion chamber for directing fuel and air toward said baffle plate, said baffle plate having an upwardly directed end portion to deflect into the auxiliary chamber the fuel and air and also gas generated by the baffle plate from said fuel, and an air discharge nozzle discharging against a wall of the auxiliary chamber at the end thereof adjacent the combustion chamber to redirect the mixture toward said baffle plate and to supply additional combustion air for combustion of said gas.

11. A gasifying apparatus comprising a combustion chamber having an outlet at its lower end and an auxiliary chamber communicating with the combustion chamber at the upper portion thereof, a baffle plate extending into the combustion chamber from a wall thereof, a nozzle disposed at the upper portion of the combustion chamber to direct fuel downward against said baffle plate, said baffle plate having a curved end to deflect the fuel toward said auxiliary chamber, an air nozzle having an outlet adjacent that portion of the auxiliary chamber communicating with the combustion chamber to supply combustion air for the fuel, said air nozzle discharging in a direction across the stream of fuel issuing from the fuel nozzle toward the baffle plate.

ROBERT REICHHELM.