May 8, 1934. L. B. HARRIS 1,957,535

OIL GAS GENERATOR

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Fig. 2

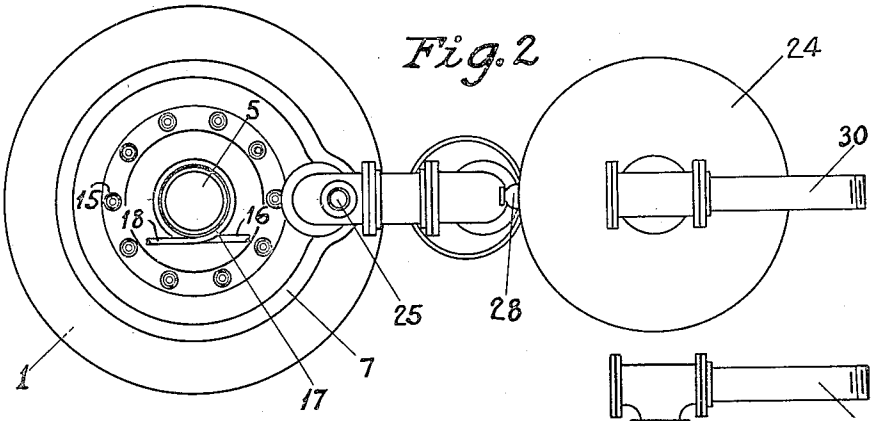
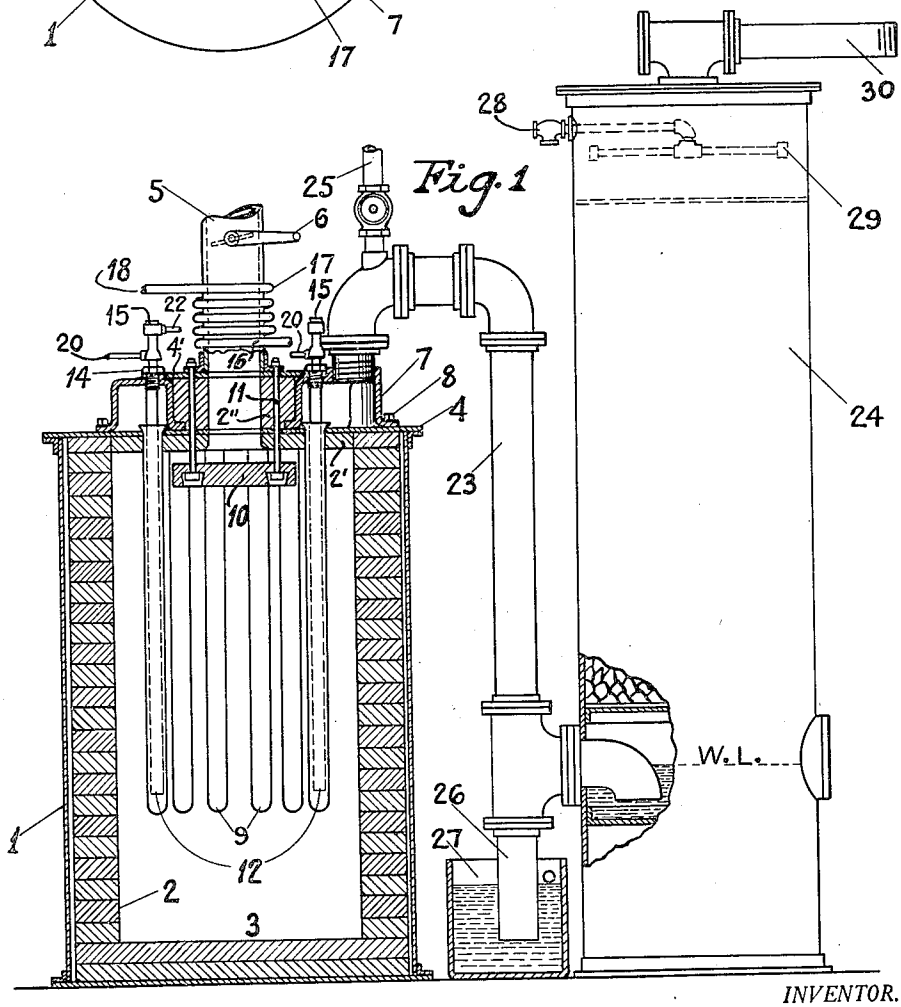


Fig. 1



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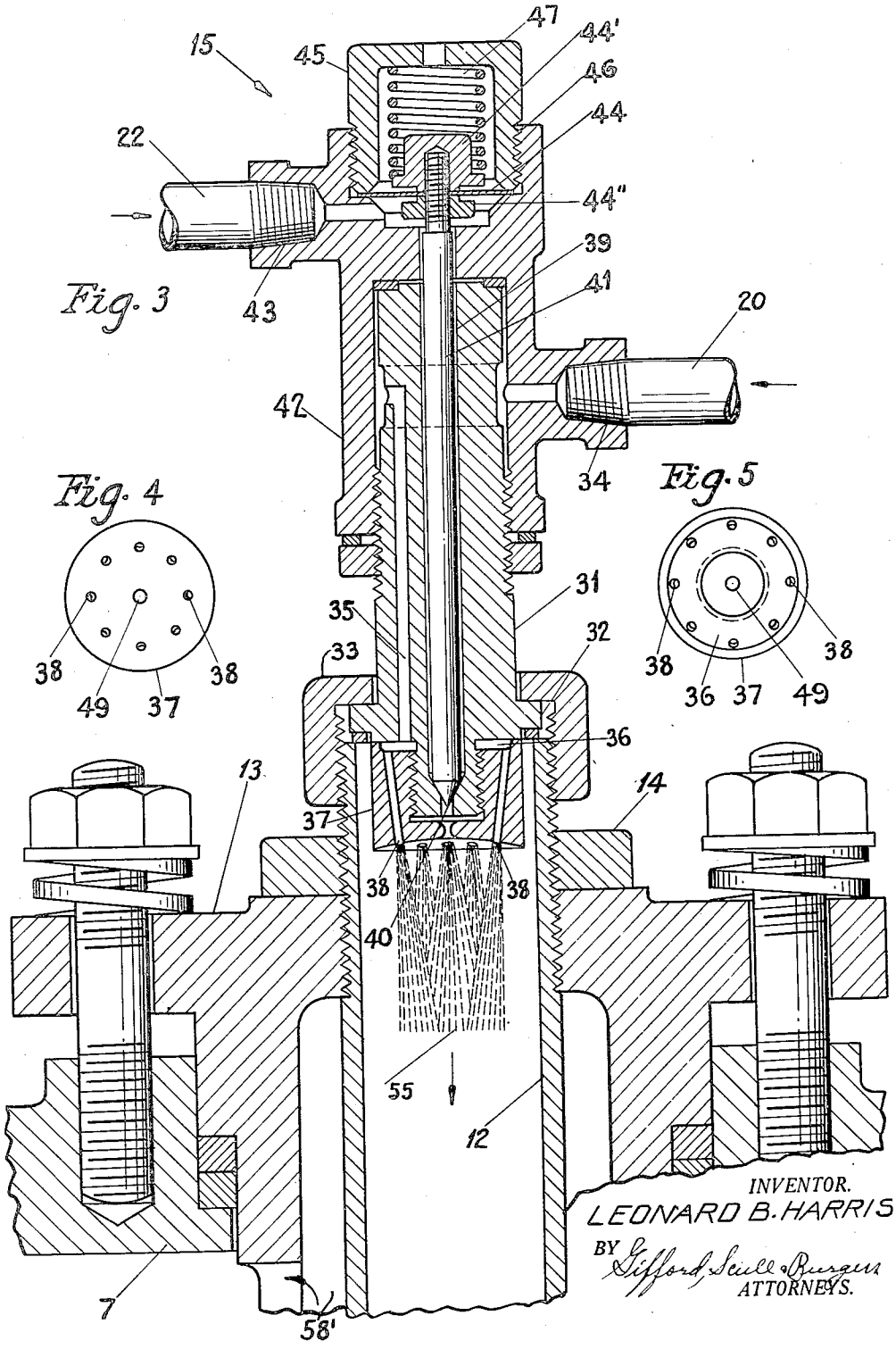


Fig. 3

Fig. 4

Fig. 5

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Fig. 6

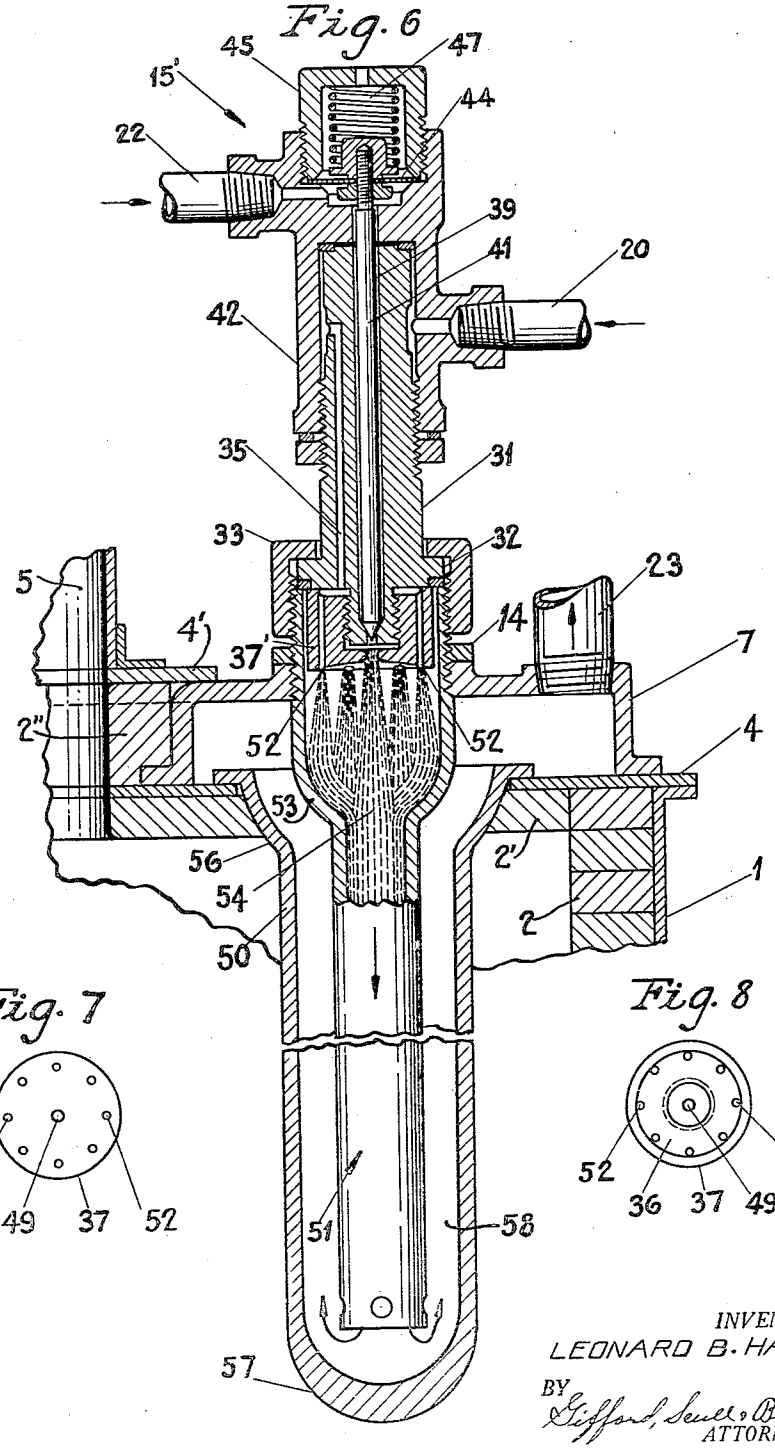


Fig. 7

Fig. 8

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OIL GAS GENERATOR

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Fig. 11

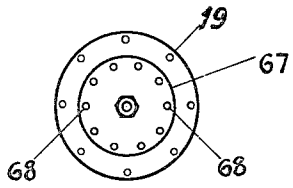


Fig. 10

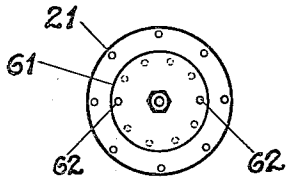
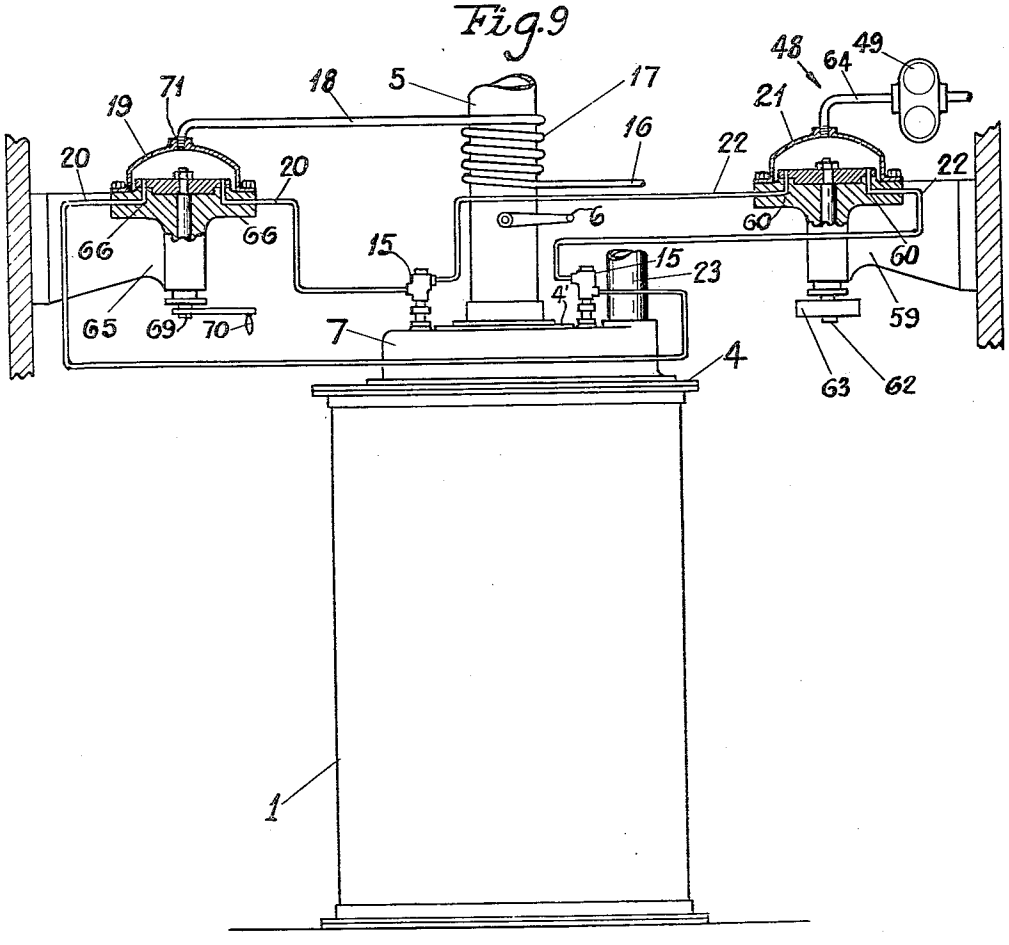


Fig. 9



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UNITED STATES PATENT OFFICE

1,957,535

OIL GAS GENERATOR

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Application November 25, 1932, Serial No. 644,150

3 Claims. (Cl. 48—94)

The present invention relates to an improved oil gas generator and process of manufacturing oil gas and the primary object resides in the generation of high B. t. u. oil gas formed through the dissociation and recombination of the elements of steam and hydrocarbon oil.

The present application is a continuation in part of my application for patent for oil gas generator Serial No. 405,913, filed November 9, 1929.

The atomizing apparatus at the upper end of each of the inner tubes as disclosed in the said application consists of a centrally disposed movable spindle atomizer for forming an atomized oil jet, and a multiple-jet nozzle having steam passages arranged in concentric relation with the oil jet. I have found in actual practice that by providing means for causing the jets of steam to converge and to be projected across the oil jet, that the jet of oil is atomized before entering the retort and is further atomized by the jets of steam after entering the retort and is more intimately mixed with the steam.

The gas collecting header being of annular form was partly exposed at its central portion to the heat from the high temperature exit gases from the furnace. To prevent direct exposure of the header and the portion of the inner tubes passing through the header to the furnace heat and to prevent preheating and premature cracking of the oil, I have placed the header entirely outside the furnace, on top thereof, and have insulated the header from the furnace.

An object of this invention is to introduce a continuous supply of convergingly directed jets of steam, disposed in a circular row and spaced part, into respective inner tubes in each of a plurality of closed retorts which are subjected externally to a constant source of intense heat. The steam being in direct contact with the heated walls of the retort tubes becomes superheated. The retorts are preferably made of material such as nickel having catalytic properties. The steam travels downwards towards the lower portion of the inner tubes and reaches a temperature of approximately 1800° F., and in the presence of the catalyst a major portion of the steam becomes dissociated into free hydrogen and oxygen, thus providing hydrogen in the retorts that is available for combining with the hydrocarbon oil.

In carrying out this invention, the hydrocarbon oil supply for each retort is atomized in an individual atomizing mechanism having a movable spindle. Oil is supplied to the atomizers from a common oil supply such as a pressure pump in groups or multiples spaced apart and in succession, by means of a timed sequence distributing and regulating apparatus. The oil is atomized into a mist-like spray while it is introduced into the retorts. Each atomized oil spray is introduced into the central portion of each individual retort and at the center of the circular row of jets of steam. Each atomized oil spray is introduced intermittently into the retorts, thus preventing continuous chilling of the retorts and enabling the said desired high temperature to be maintained.

The continuous jets of steam surrounding the central intermittent oil jet function as conveying means for the atomized oil flowing downward through the central portion of the inner tubes of the retorts and prevent the oil from coming in contact with the walls thereof until the steam reaches a temperature high enough to become dissociated, so that the formation of carbon on the walls of the retorts is avoided.

The convergingly directed jets of steam surrounding the oil jet are caused to issue in a conical and converging direction, so as to cause the steam to be projected across the oil jet and collide at high speed with the jet of oil and the superheated steam further effects a very fine atomization of the oil after entering the retort and the double atomized oil and the steam become intimately mixed.

The intermittently atomized oil in the retorts is subjected to an intense heating medium applied externally of the retorts so that it does not come into actual contact with the oil. This heat causes a temperature rise high enough to crack the complex hydrocarbon oil into lighter hydrocarbons. The cracked hydrocarbons combine with the hydrogen from the dissociated steam already present in the retorts and forms high B. t. u. oil gas in the retorts intermittently, a multiple of the retorts operate at any instant, and all operate in succession. The retorts are operated in a predetermined timed sequence so that a continuous supply of high B. t. u. oil gas is obtained from the generator as a whole.

With this general statement of the invention, the invention will be hereinafter more particularly disclosed, and the operation of a preferred form of apparatus in which to carry out the process will be described. It is, however, understood that the process is not limited to any particular apparatus.

Reference will now be had to the drawings, wherein like numerals of reference designate cor-

responding parts throughout the several views, in which:

Figure 1 is a vertical section through an improved form of apparatus comprising my high B. t. u. oil gas generator in combination with a gas scrubber shown partly in side elevation and partly in section attached to the oil gas generator.

Figure 2 is a plan view of the oil gas generating plant.

Figure 3 is a vertical section through one of the retorts and an atomizer and shows a multiple-jet nozzle having converging steam passages.

Figure 4 is a bottom view of a multiple-jet nozzle having converging steam passages.

Figure 5 is a top view of the multiple-jet nozzle having converging steam passages.

Figure 6 is a vertical section through a modified retort providing means for directing the jets of steam to converge and to be projected across the oil jet and shows a multiple-jet nozzle having parallel steam passages.

Figure 7 is a bottom view of the multiple-jet nozzle having parallel steam passages.

Figure 8 is a top view of the multiple-jet nozzle having parallel steam passages.

Figure 9 is a diagrammatic view of the oil gas generator and shows a timed sequence oil distributing apparatus and a continuous flow steam distributing apparatus in operating relation with two atomizers.

Figure 10 is a plan view of the timed sequence oil distributing apparatus with the cover removed.

Figure 11 is a plan view of the steam distributing apparatus with the cover removed.

In the illustrated embodiment of the invention, reference character 1, indicates a metal container, preferably circular in cross section, that is lined circumferentially on the inside with refractory material such as fire brick 2, and is lined at the top with refractory material 2' and around the stack outlet with refractory material 2''. The lower portion 3, of the container represents the combustion chamber proper into which fuel can be introduced through the side walls of the device by means of burners (not shown), or in any other convenient or desirable way. The top of the container 1, is covered by means of a metal plate 4, that is provided with an outlet at the center to which the stack 5, for waste products of combustion is connected. A damper 6, is provided in the stack.

An annular header 7, made of high heat resisting metal containing a high percentage of nickel, for example, which will act as a catalyst, is mounted on the upper side of and is secured to the cover 4, and surrounds the opening through which waste products of combustion pass to the stack 5. The header 7, is connected to the cover 4, by means of bolts 8. A circular row of retorts 9, made of high heat resisting metal, which may contain a high percentage of nickel, for example, to act as a catalyst, having their lower ends closed, depends from the cover 4, with their upper open ends extending into the header. A disk-shaped baffle 10, of refractory material is suspended by means of rod bolts 11, from a plate 4' centrally positioned on top of the header 7. The baffle 10, is positioned within the row of retorts 9, below the opening for the stack 5.

A row of metal tubes 12, made of high heat resisting metal, containing a very high percentage of nickel or other catalyst, corresponding in numbers and centers to the retorts 9, having smaller external diameters than the internal diameters of the retorts 9, extends through the header 7, and through the cover plate 4, almost to the bottom of the retorts 9, and have their lower ends open. The upper ends of the tubes 12, are threaded and are screwed into threaded openings in the header 7, as shown in Figures 1, and 6, or preferably screwed into flanged glands 13, seating in the header 7, as shown in Figure 3. Lock nuts 14, clamp the tubes 12, in place. Atomizers 15, to be described later, are located at the upper ends of each of the respective tubes 12. A pipe 16, from a source of water (not shown) leads to a heating coil 17, that is located outside the lower end of the stack 5. A pipe 18, leads from the coil 17, to a steam distributing apparatus 19, to be described later, and branch pipes 20, lead from the steam distributor 19, to the lower portions of the respective atomizers 15.

A timed sequence oil distributing apparatus 21, to be described later, contains a plurality of leads 22, connected to the upper portions of the respective atomizers 15. It is to be noted that the word "timed" as applied to the oil distributing apparatus employed in combination with the other apparatus described herein, relates to the sequence in which the impulses through the individual leads 22, are operatively related with respect to each other, such as successive, overlapping or staggered, and that since the respective retorts and atomizers are cooperatively associated with the leads 22, oil is fed to the retorts in successive, overlapping or staggered relation.

An oil gas outlet pipe 23, leads from the header 7, to a gas scrubber 24, of a well known type. The outer periphery of the scrubber 24, being partly broken away to show a "water level" therein as indicated by "W. L.". A valved branch pipe 25, is connected to the pipe 23, and a branch pipe 26, leads into a sump 27, that contains liquid of sufficient depth to seal the lower end of the branch pipe 26. A valve 28, serves to admit water to a spraying device 29, so that water is distributed over the entire cross-section of the scrubber 24. A pipe 30, for washed gas leads to a gas main or place of consumption of the gas, (which is not shown).

Each one of the atomizers 15, (Figs. 3 to 5 inclusive) at the upper ends of the tubes 12, comprises a body portion 31, having a flange 32, that rests upon the upper end of the tube 12. A threaded thimble 33, keeps the body portion 31, in firm contact with the tube 12. An opening 34, is provided in the side of the atomizer for the pipe 20, and a port 35, leads from the opening 34, to an annular space 36, at the lower end of the body portion 31. A multiple-jet nozzle 37, having a circular series of spaced holes 38, arranged in inclined and converging conical formation therethrough is screwed upon the lower threaded end of the body portion 31, of the atomizer so that the holes 38, communicate with the annular space 36. These holes may be parallel as shown in Figure 6, or inclined or spiral, but are preferably inclined as shown in Figure 3.

A central hole 39, for oil extends through the body portion 31, and a conically shaped valve seat 40, is provided at the bottom. An atomizer spindle 41, with a conically shaped lower end to form a valve is located in the hole 39. A head piece 42, is threaded upon the upper end of the body portion 31, and is provided with a central opening through which the spindle 41, extends. A hole 43, is provided in one side of the head

piece 42, for the oil pipe 22. A flexible diaphragm 44, is clamped to the spindle 41, by threaded nuts 44' and 44'' on opposite sides of the diaphragm. The peripheral circumferential edge of the diaphragm 44, is clamped in place against a shoulder in the head piece 42, by means of a hollow threaded nut 45, screwed into the internally threaded recess 46, in the head piece 42. A compression spring 47, is interposed between the top of the hollow nut 45, and the upper nut on the spindle 41, tending to keep the valve 40, closed. The hole 43, enters the head piece 42, at a point below the diaphragm 44, so that oil under pressure entering through the pipe 22, will cause the diaphragm 44, to yield and the atomizer spindle 41, to lift off its seat 40, in synchronism with the timed oil injecting means 48, consisting of a pressure pump 49, and the timed sequence oil distributor 21, operating in unison, as shown in Figure 9.

Figures 6, 7, and 8, show an atomizer 15' attached to a modified retort 50, and a modified inner tube 51. The atomizer 15' is provided with a multiple-jet nozzle 37' having a circular series of holes 52, which are not converging towards the center of the atomizer. The holes 52, are parallel with the longitudinal axis of the atomizer. It will be noted that the inner tube 51, is provided with a spherically shaped upper end 53. The steam jets issuing from the circular series of holes 52, are constrained by the curved upper walls of the inner tube to converge towards the center of the atomizer, and causing the steam jets to be projected across the path of the central oil jet at the point of junction of the jets 54, thereby producing an equivalent effect produced by the inclined circular series of holes 38, in the nozzle 37, shown in Figure 3, which inclined holes also cause the steam jets in the atomizer 15, to be projected across the path of the central oil jet at the point of junction of the said jets 55. It will be noted that the retort 50, is provided with a spherically shaped upper end 56, forming a casing which conforms to the spherically shaped upper end 53, of the inner tube 51. The tube 51, extends downwardly within the depending part 57, of the retort 50, in such a manner as to form about itself an upward passage for the hydrocarbon vapors which pass upwards through an elongated annular space 58, formed between the retort 50, and the tube 51.

As shown in Figures 9 and 10, the timed sequence oil distributing apparatus 21, comprises a stationary housing 59, having a circular series of ten radial apertures 60, 60, corresponding to the number of retorts 9, and a disk member 61 having two radial apertures 62, 62, of the same diameter and spaced in the same circumference as the apertures 60 in the housing. The disk member 61 is rotatably mounted on a shaft 62, and is driven by suitable operating means 63. When the shaft 62 is rotated, the oil supplied under pressure by the pump 49 enters the oil distributor 21 through a single inlet 64, and passes through the apertures 62, 62, in the disk 61, and is injected into the leads 22 and into the retorts 9, in intermittent jets and in a timed sequence, depending on the speed of the shaft 62.

As shown in Figures 9 and 11, the steam distributor 19, comprises a stationary housing 65, having a circular series of ten radial apertures 66, 66, corresponding to the number of retorts 9 and a disk member 67, having ten radial apertures 68, 68, of the same diameter and spaced in the same circumference as the apertures 66, in the housing. The disk member 67 is mounted on a shaft 69 which may be given a limited rotary displacement by means of a crank arm 70, and cause a variation in the alignment of the apertures in the disk member and in the housing, and thus regulate the quantities of steam entering the branch pipes 20, and the retorts 9. The steam entering the steam distributor 19, through the single inlet 71, passes through the apertures 68, in measured quantities and finally passes through the converging holes 38, in the atomizer nozzles 37, into the retorts 9, in a circular series of small continuous jets.

Referring to Figure 1, it will be noted that the refractory material 2' at the top of the container 1, insulates the plate 4, constitutng the lower surface of the header 7. Also that the refractory material 2'' around the stack outlet insulates the annular portion of the header adjacent to the stack outlet. The provision of these insulating materials and the placing of the header 7 entirely outside the furnace provides effective means for preventing the preheating or exposure of the portion of the inner tube 12, passing through the header 7, to direct heat from the furnace gases and preventing the preheating and cracking of the oil injected into the inner tube. The importance of introducing the oil intermittently and the prevention of preheating of the oil is evident from the fact that hydrocarbon oil cracks at about 800° F., and steam requires a temperature of 1800° F. to dissociate. If the oil were introduced continuously and would enter the retort before the steam reached its temperature of dissociation, the oil would be cracked during the interval of time required to reach the temperature of 1800° F., thereby throwing down a deposit of carbon on the walls of the retorts, preventing the transmission of the furnace heat through the walls and quickly burning out the retorts.

The operation is as follows:

The oil gas generator is heated by combustion of fuel in the lower portion 3, thereof and the hot products of combustion contact with the outside of the retorts 9, and pass around the lower edge of the baffle 10, into the stack 5. Water passes into the heating coil 17, where steam is generated and the steam passes into the steam distributor 19, which subdivides the steam supply equally to the branch pipes 20, finally passing through the series of converging holes 38, in the multiple-jet nozzles 37, as small continuous jets of steam into each of the respective tubes 12. Oil passes intermittently from the oil injecting means 48, through the leads 22, into the atomizers 15, below the diaphragms 44, thereby causing the diaphragms to yield slightly due to the pressure at each impulse through the timed oil leads 22, and raise the atomizer spindles intermittently off their seats 40. The oil passes through the central opening 49, in the nozzle 37, and thence into the central portions of the tubes 12, in the desired amount as atomized oil to meet the jets of steam which have become highly superheated in the tubes 12. The jets of steam and oil are projected one across the path of the other at the point of junction of said jets 55, and the superheated steam further effects a very fine atomization of the oil and the steam and oil become intimately mixed. The vaporous mixture continues further down the tube 12. The steam becomes heated to a sufficiently high temperature to cause dissociation of the major quantity thereof into free hydrogen and oxygen in the presence of

the nickel catalyst upon coming in contact with the heated walls at the lower end of the tubes where the temperature is about 1800° F., reaction takes place between hydrogen and carbon, thereby generating high B. t. u. oil gas which passes intermittently out of the lower ends of the respective tubes 12, into the annular spaces 58' between the retorts 9, and tubes 12, and thence as a continuous supply of high B. t. u. oil gas from the generator as a whole through the annular header 7, and the outlet pipe 23, into the gas scrubber 24 and finally to the gas mains.

It is to be noted that while the steam is supplied in continuous jets and the oil is supplied intermittently as previously mentioned, that it is advantageous to have a surplus supply of steam as my experience with my oil gas generator has shown that the quantity of initial steam has very little bearing on the quality of the gas, as apparently the hydrocarbons combine with a definite quantity of hydrogen from the dissociated steam and the surplus steam is carried over and condensed in the scrubber. Moreover, it is desirable to maintain a surplus of steam to surround and act as conveying means for the centrally disposed atomized oil in order that the oil will not immediately come into contact with the walls of the retort tubes so that the process can be effectively carried out continuously without the formation of carbon on the walls of the tubes 12. The excess steam also aids in preventing carbon from depositing in the retorts 9.

The following is given as a specific example of carrying out my "timed sequence" process of oil gas making, but it is to be understood that the invention is not restricted to the particular example of proportions, etc.

Oil such as petroleum, for example, is atomized and introduced intermittently with a continuous supply of jets of steam into the tubes 12, and the furnace of the oil gas generator is fired at such a rate that the temperature around the retorts 9 is approximately 1600° F. to 1900° F.

I claim:

1. In an oil gas generating apparatus comprising a furnace, a central outlet for waste gases at the upper portion of the furnace, a plurality of vertically disposed retorts surrounding said outlet, a plurality of inner tubes respectively extending into said retorts and being connected to a source of oil and steam supply, and an annular gas collecting header through which said inner tubes extend outwardly; the improvement which comprises means for preventing exposure of the portion of the inner tubes passing through the header to direct furnace heat, said means comprising a header mounted exteriorly of said furnace and insulated therefrom by refractory material.

2. In an oil gas generating apparatus comprising a furnace, a central outlet for waste gases in a cover plate at the upper portion of the furnace, a plurality of vertically disposed retorts depending from said cover plate and surrounding said outlet, a plurality of inner tubes respectively extending into said retorts and being connected to a source of oil and steam supply, and an annular gas collecting header through which said inner tubes extend outwardly; the improvement which comprises means for preventing exposure of the portion of the inner tubes passing through the header to direct furnace heat, said means consisting in placing said header outside said furnace and on top of said cover plate and in insulating said header from said furnace by lining said cover plate and said waste gas outlet with refractory material.

3. In an oil gas generating apparatus comprising a furnace, a central outlet for waste gases in a cover plate at the upper portion of the furnace, a plurality of vertically disposed retorts depending from said cover plate and surrounding said outlet, a plurality of inner tubes respectively extending into said retorts and being connected to a source of oil and steam supply, and an annular gas collecting header having an upper wall through which said inner tubes extend outwardly, said header being positioned outside said furnace and on top of said cover plate, said header being insulated from said furnace by lining said cover plate and said waste gas outlet with refractory material, said header having apertures in said upper wall and having glands removably seated in said wall, said glands being threaded to receive said threaded inner tubes.

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