

May 6, 1930.

J. BECKER

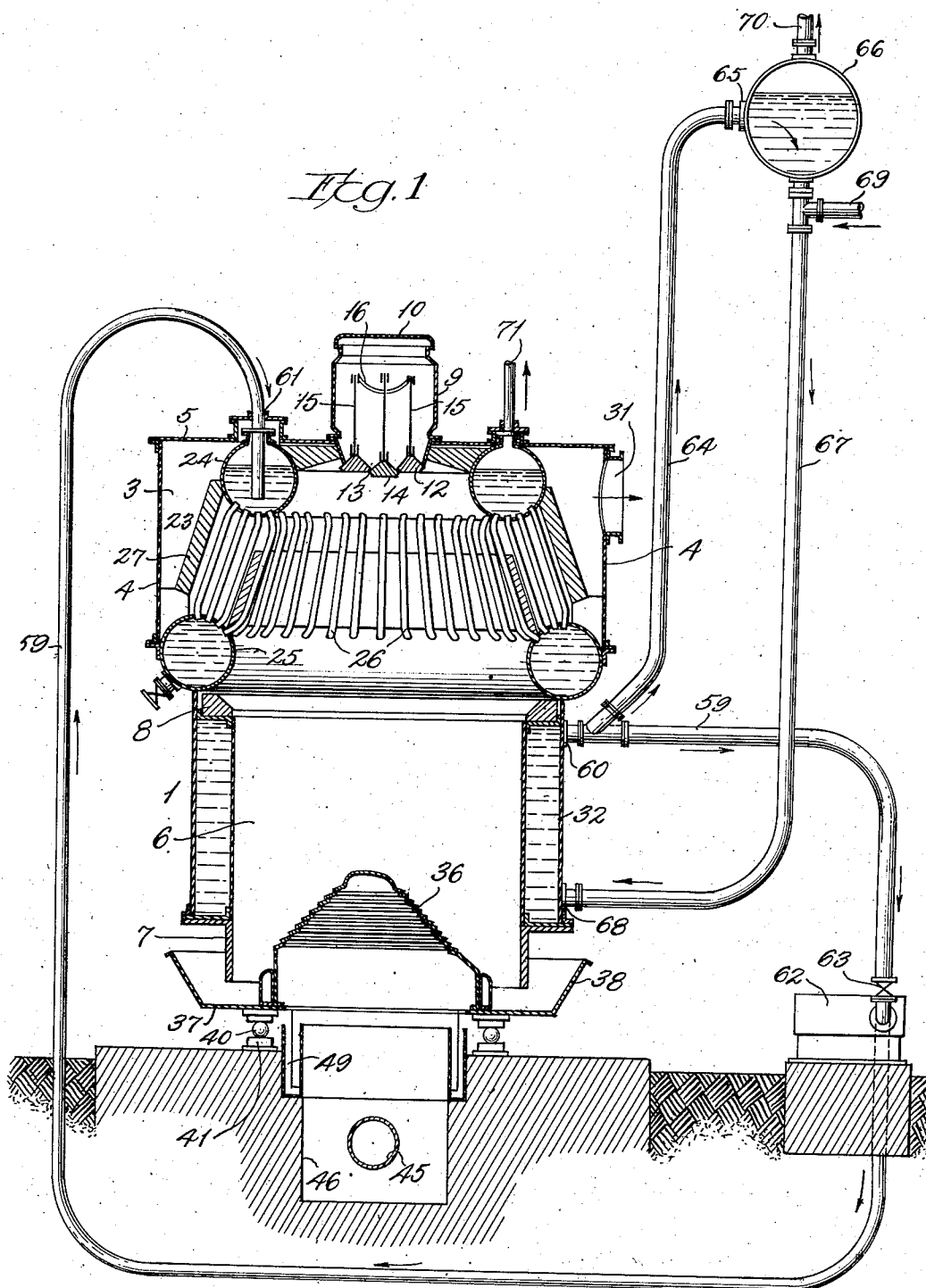
1,757,232

GAS PRODUCER

Filed Oct. 24, 1923

2 Sheets-Sheet 1

Fig. 1



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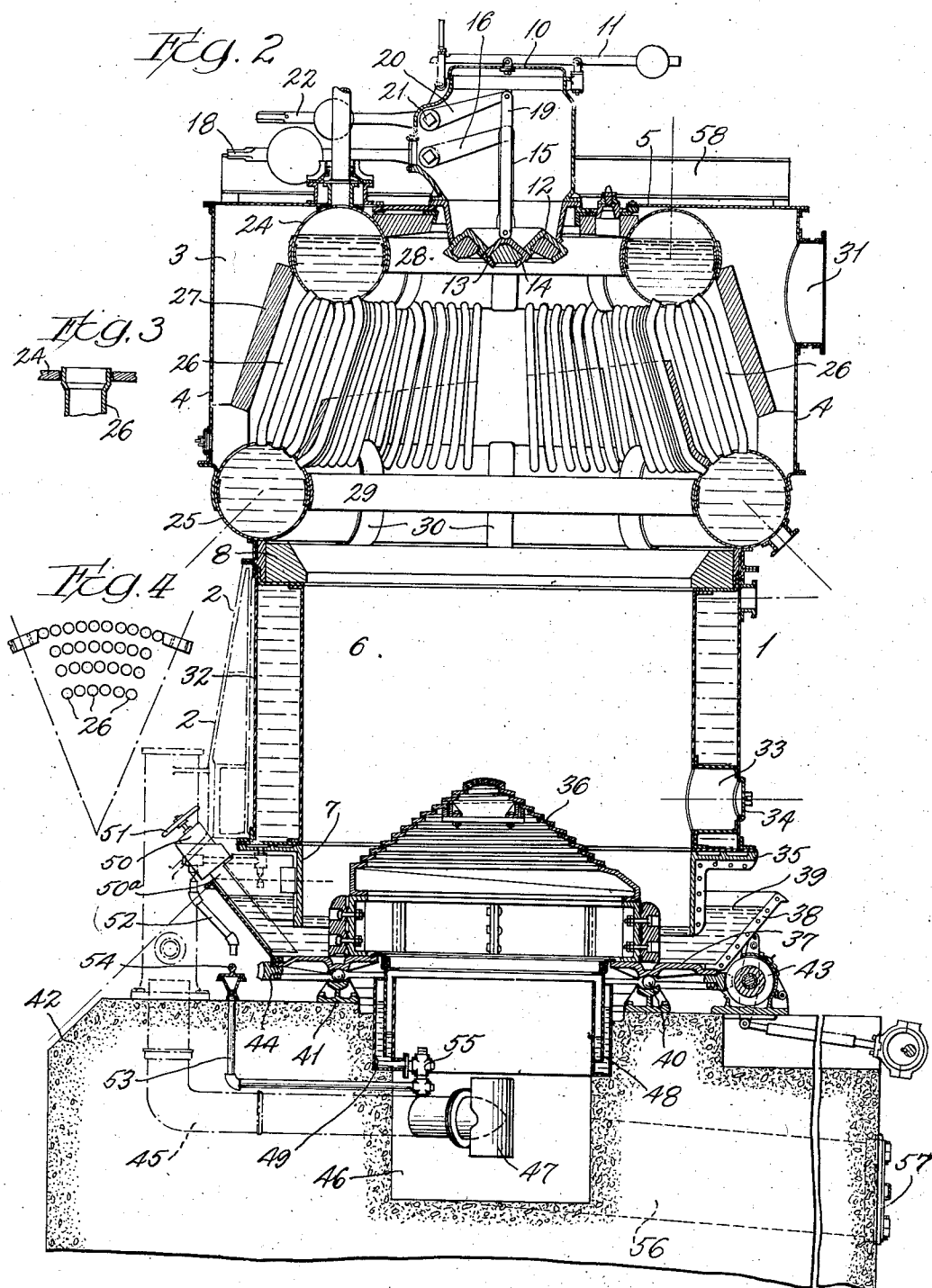
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UNITED STATES PATENT OFFICE

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GAS PRODUCER

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This invention relates to improvements in gas producers, and more particularly to means for cooling the shaft thereof at the fire zone in a manner that will not cause premature deterioration of the metallic linings of the shaft, and the invention also relates to a simple, practical and economical arrangement for utilizing the heat of said producer to produce both low pressure steam and high pressure steam without impairing the efficient operation of the gas producer.

Objects of the invention are to provide a constant circulation of a cooling medium around the portion of the shaft to be cooled, and at a temperature which will not cause condensation of steam from the blast on the inner linings of the gas producer shaft, and under pressure so that the warm cooling medium will not be converted into steam in the cooling jacket; the provision of means for conducting such cooling medium, after passing through the jacket to a low pressure steam drum which supplies the cooling medium to the jacket; the provision of a feed water inlet to said cooling circulating medium at a point in the system which will insure the preheating of the feed water so that such feed water will not reach the jacket at a temperature which will cause condensation on the metallic linings of the shaft; the provision of means for conducting a portion of such cooling medium, after passing through the jacket, to a high pressure steam boiler arranged in the upper part of the gas producer, where it is not so essential to effect such a proper cooling, so that such water may be converted into high pressure steam and subjected to relatively prolonged heating without affecting the heating efficiency of said gas producer; to provide a continuous circulation of water through the low pressure boiler and also the high pressure boiler with attendant conservation of heat; and such other objects and advantages of the invention as are found to obtain in the structure hereinafter set forth and claimed.

In order to make the invention more clearly understood there are shown in the accompanying drawings means for carrying the same into practical effect, without limiting

the improvements, in their useful applications, to the particular constructions which, for the purpose of explanation have been made the subject of illustration.

In said drawings:

Figure 1 is a vertical sectional view, partially diagrammatic in character, of a gas producer structure, illustrating the invention.

Fig. 2 is an enlarged vertical sectional view, partly diagrammatic, on a plane at right angles to Fig. 1, showing the producer in more detailed form.

Fig. 3 is an enlarged sectional view of an end of one of the water tubes forming a part of the high pressure boiler and illustrating the method of connection to the annular chambers of said boiler.

Fig. 4 is a diagrammatic horizontal sectional view through a group of water tubes, constituting one section of the high pressure boiler.

Referring to the drawings; the producer shell is indicated as an entirety by the reference character 1, and is mounted upon a plurality of supporting frame members 2. The producer shell comprises an upper gas-collecting and fuel charging chamber 3, enclosed by side walls 4 and a top wall 5, and a lower fuel chamber 6, communicating with the chamber 3, and terminating at its lower portion in an annular wall or apron 7. An annular ring 8 of refractory material, constituting the upper extremity of the gas-producing fuel chamber 6, is supported by the frame members 2 and serves as a structural reinforcing and supporting member for various portions of the producer structure. The fuel chamber 6 is provided at its lower portion with one or more openings 33 normally closed by removable covers 34 and through which access may be had to the interior of the fuel chamber.

The top wall 5 of the chamber 3 is provided centrally thereof with a fuel charging hopper 9 having a removable cover 10 actuated by an operating lever 11. The lower portion of the hopper 9 is normally closed by a removable annular sealing ring member 12 having a central orifice 13 normally closed by a removable valve member 14. The ring

member 12 is mounted for vertical reciprocation with respect to the hopper by means of supporting links 15, pivoted at their upper ends to a U-shaped yoke 16, which in turn is pivoted at 17 to the wall of the hopper 9, and which terminates at its outer end in a suitably counterbalanced operating lever 18. The valve member 14 is similarly supported for vertical reciprocation independently of and relative to the ring 12, by means of a link 19, pivoted at its upper end to one end of a lever 20, which in turn is pivoted at 21 to the wall of the hopper 9; the lever 20 terminating at its outer end in a suitably counterbalanced operating lever 22, similar to the lever 18. The charging hopper 9 and the various operating parts thereof are mounted in any desired manner at the top of the producer and are preferably connected to one or more horizontal frame members 58. The particular means of operating the feed of fuel to the hopper and thence to the producer, forms no part of the present invention and will not be further described.

The gas chamber 3 is provided with any desired number of outlet ports 31 serving as exits for the gases generated within the producer and from which they may be conducted to any desired point.

An eccentric rotary step grate 36 of well known construction is contained within the lower portion of the gas producing fuel chamber 6, the lower portion of which grate rests upon and is suitably secured to the base portion 37 of an annular ash pit 38, having a water seal 39 therein to prevent the escape of gases from the interior of the producer. The base portion 37 of the ash pit 38 containing the grate 36 is anti-frictionally supported for rotation upon a ball race 40, which in turn rests upon an annular circular track 41 rigidly mounted upon the concrete base or foundation 42 of the producer structure. The ash pit 38 together with rotary step grate 36 is adapted to be rotated by external motor power arranged to drive a worm 43 meshing with a worm wheel 44 fixed to the base portion of the ash pit.

Air to support combustion within the fuel chamber is admitted through a header 45 embedded in the foundation and which communicates with an internal chamber 46 contained within the foundation below the grate. The air from the header 45 is diverted by a plate or baffle 47 upwardly to the interior of the grate 36, from whence it enters the chamber 6 through suitable apertures or orifices provided between the steps of and at the top of the grate structure. The lower portion of the grate 36 is provided with an annular apron 48 which depends into a second water seal pit 49 mounted in the foundation, the purpose of which is to prevent the escape of gases from the producer through the orifices or apertures in the grate. Water for supply-

ing the seal 39 is admitted from without the producer through a pipe 50^a communicating with a header 50, which latter is provided with a valve 51; while water is supplied to the seal 49 through a branch pipe 52 communicating at its upper end with the header 50 and adapted at its lower end to communicate with a pipe 53, connected by unions 55 with the water seal 49. The upper end of the pipe 53 is normally closed by a removable cover 54. Access to the interior of the chamber 46 is obtained by means of a tunnel 56 terminating in the wall of the foundation or base and normally closed by a removable cover plate 57.

Mounted within the chamber 3 above the fuel chamber 6 and suitably supported by the walls of the producer shell is a high pressure steam and water boiler designated as an entirety at 23. In its present form the boiler 23 consists of upper and lower annular concentric chambers 24 and 25, and a plurality of intermediate inclined connecting water tubes 26 arranged to present a maximum heat absorbing area to the interior of the fuel chamber 6. The annular chamber 25 is supported by the upper portion of the walls of the fuel chamber and the chamber 24 is in turn supported and spaced from the chamber 25 by means of an annular frame member or wall 27. The chambers 24 and 25 are further reinforced by concentric rings 28 and 29 and a plurality of ring members 30, the latter being arranged at intervals around the upper and lower chambers.

As best seen in Figs. 2 and 4, the water tubes 26 are arranged in eight groups around the peripheries of the annular chambers 24 and 25, said groups being spaced from one another by the reinforcing ring elements 30. In Fig. 3 is illustrated the manner of connection of the water tubes 26 to the annular boiler chambers 24 and 25. The tubes 26 are enlarged at their ends and slightly smaller in diameter than the apertures in the walls of the chambers 24 and 25 and are suitably beaded over the metal of the chambers to provide a fluid-tight connection.

In order to prevent overheating of the shaft of the gas producer at the fire zone, this shaft is constructed to provide inner and outer walls 32 extending around the fire zone and providing a jacket adapted to contain a circulating cooling medium. In accordance with this invention the circulating cooling medium, usually water, is supplied to the jacket at a temperature which will not cause condensation of steam from the blast on the inner metallic linings at the ash zone. Such condensation of steam on the inner linings of the shaft takes up the H₂S to form a destructive solution which is further assisted by the heat of the fire zone and the vapors arising in the usual water pan and causes premature deterioration of said linings. By main-

maintaining a cooling medium in circulation about the portions of the shaft to be cooled at a temperature about the boiling point of water, the steam will not be condensed, and yet the shaft will be properly and effectively cooled as it need not be cooled down below 212° F. By maintaining the cooling medium under pressure, the boiling point of the medium will be raised thereby providing a better cooling effect, and also preventing formation of steam, which is difficult to regulate and also is not desirable because steam may be heated to much higher temperatures than water without necessarily circulating, and of course such heating of steam would not cool the shaft down to 212° F. as it would have a higher temperature at this portion of the shaft. This jacket 32 is connected with the horizontal flange 35 of the annular wall or apron 7.

Communication is established between the jacket 32 and the high pressure steam boiler 23 by means of a pipe 59 communicating at one end at 60 with the upper portion of the boiler jacket 32 and communicating at its other end at 61 with the upper chamber 24 of the high pressure boiler 23. A high pressure pump 62 is interposed in the line of the pipe 59 and serves to insure an adequate supply of fluid from the low pressure boiler jacket 32 to the high pressure boiler 23. A valve 63 is further provided in the pipe line 59 above the pump 62, the purpose of which is to control the flow of fluid from the boiler 32 through the line 59 to the pump 62. The pipe line 59 is further provided at a point preferably adjacent the boiler 32, with a branch line 64 communicating at its upper end at 65 with a low pressure boiler or drum 66 suitably carried in any desired and preferred manner outside of the producer structure at a height to provide a sufficient head to supply adequate pressure to the water to prevent formation of steam in said jacket 32. In this drum 66 the hot water from the jacket may expand into steam to provide low pressure steam which may be conducted to the grate of the producer. A return pipe 67 is provided to insure a return flow of fluid from the drum 66 to the boiler jacket 32, the lower end of the pipe 67 communicating at 68 with the lower portion of the jacket.

The feed-water to the inter-communicating boiler system described is admitted through a pipe 69 at a point preferably immediately below the low pressure steam drum 66, at which point the feed-water is thoroughly mixed with the hot water returning from the low pressure drum 66 to the boiler jacket 32.

The system of circulation of water and steam through the high and low pressure boiler system above described during the operation of the producer is as follows:

Warm water which is further heated in the low pressure boiler jacket 32 by the heat generated in the fuel chamber 6 and there-

by cooling the jacket, circulates through the pipes 59 and 64 to the low pressure steam drum 66 and is there partially expanded into steam which may be utilized for various purposes. For example, the steam so expanded in the drum 66 may be conducted through the pipe 70 to the grate 36, where it passes through the apertures therein, and is utilized to combine with the incandescent fuel in the chamber 6 to facilitate the combustion and the generation of gases therefrom. Part of the heated water from the upper portion of the boiler jacket 32 is forced by the high pressure pump 62 through the pipe line 59 and utilized to supply the high pressure boiler 23 located around the upper portion of the producer. The heated water which is not expanded into steam in the low pressure drum 66 is returned to the boiler 32 by means of the return pipe 67, thereby maintaining a continuous circulation of water between the boiler 32 and drum 66. The feed-water supply to the system is admitted through the pipe 69 to the pipe 67 where it is thoroughly mixed with the return flow of heated water from the low pressure drum 66, and the disadvantage of having cold water admitted to the boiler jacket 32 is thereby effectually prevented.

The location and construction of the high pressure boiler 23 is such that steam under high pressure is expanded in the same by the intense heat generated in the fuel chamber, and the steam so generated may attain a much higher temperature than the water in the jacket because the problem of cooling down is not present at the upper part of the producer as it is in the lower part and such heating may be attained without affecting the operation of the producer and with a great saving in heat. The steam can be conducted from the boiler 23 through the pipe 71 and utilized for any desired purpose. It will be apparent that I have afforded a means of pre-heating the water which is admitted to the high pressure boiler 23, it being apparent that the water pumped through the line 59 from the boiler jacket 32, is of an initial high temperature, thereby effecting the expansion into steam of the water in the boiler 23 and facilitating the production of superheated steam.

The invention as hereinabove set forth is embodied in a particular form of construction but may be variously embodied within the scope of the claims hereinafter made.

What I claim is:

1. In a gas producer, in combination with a rotary grate and fuel charging device: a fuel chamber above said grate; a water jacket surrounding said fuel chamber; a high pressure boiler mounted above said fuel chamber and within the producer shell; a low pressure steam drum mounted without said producer for expanding into steam a portion of the fluid from water jacket; fluid conducting

means connecting said jacket to said drum; fluid conducting means connecting said jacket to said boiler; means for forcing fluid from said jacket to said boiler; return fluid conducting means connecting said drum to said jacket for returning to said jacket a portion of the fluid from said drum, a fluid feed inlet connecting with said latter mentioned return fluid conducting means and disposed below said drum, whereby the fluid supply to said jacket is mixed and heated with the return fluid from said drum; and means for conducting to any desired points the steam expanded in said low pressure drum and said high pressure steam boiler, substantially as specified.

2. In a gas producer, in combination: a fuel chamber; a water jacket adjacent said fuel chamber for absorbing heat therefrom; a high pressure boiler disposed above and adapted to be heated from said fuel chamber; a low pressure steam drum without the producer for expanding into steam a portion of the heated fluid from said jacket; fluid conducting means connecting said jacket to said drum; fluid conducting means connecting said jacket to said boiler; means for forcing fluid from said jacket to said boiler; and fluid conducting means connecting said drum to said jacket for returning to said jacket a portion of the fluid from said drum, said latter mentioned fluid conducting means combining with a fluid feed inlet, whereby the liquid supply to said jacket is mixed with the return fluid from said drum, substantially as specified.

3. In a gas producer, in combination: a fuel chamber; a water jacket adjacent said fuel chamber for absorbing heat therefrom; a high pressure boiler adjacent said fuel chamber for absorbing heat therefrom; a low pressure steam drum without the producer for expanding into steam a portion of the heated fluid from said jacket; fluid conducting means connecting said jacket to said drum; means for effecting delivery of water from said jacket to said boiler; return fluid conducting means connecting said drum to said jacket for returning to the latter a portion of the fluid from said drum; and means for conducting to any desired points the steam expanded in said high pressure boiler and said low pressure drum, substantially as specified.

4. In a gas producer, in combination: a fuel chamber; a cooling jacket adjacent said fuel chamber for absorbing heat therefrom; a high pressure boiler adjacent said fuel chamber for absorbing heat therefrom; a low pressure steam drum without the producer for expanding into steam a portion of the fluid from said jacket; fluid conducting means connecting the upper part of said jacket to said low pressure steam drum near but below the water level therein; fluid conducting means connecting the upper part of

said jacket to said boiler; means for effecting delivery of water from said jacket to said boiler; fluid conducting means connecting the lower part of said drum to the lower part of said jacket for returning to the latter a portion of the fluid from said drum; and a fluid feed inlet connected to said latter-mentioned fluid conducting means, whereby the fluid supply to said jacket is mixed with the return fluid from said drum, substantially as specified.

5. In a gas producer, in combination: a fuel chamber, a water jacket surrounding said fuel chamber and adapted to be heated thereby; a high pressure water tube boiler mounted above said fuel chamber; a low pressure steam drum mounted without the producer and connected to said water jacket and adapted to expand into steam a portion of the heated water received from said jacket; means connecting said jacket to said high pressure water tube boiler; means for forcing a portion of the water from said water jacket to said high pressure boiler; and means connecting said low pressure steam drum to said water jacket for returning to said jacket a portion of the water from said steam drum, said latter mentioned connecting means having connected thereto a feed-water inlet for thoroughly mixing the feed supply to said steam and water jacket with the return water from said low pressure drum, substantially as specified.

6. A gas producer structure, comprising a shell carrying at its lower portion a water jacket surrounding the fuel chamber of the producer; and within its upper portion a high pressure water boiler; means externally of the gas producer for circulating fluid between said water jacket and said boiler; means for promoting the flow of fluid from said water jacket to said boiler through said circulating means; a low pressure steam drum connected for thermo-syphonic circulation with said water jacket; and means for conducting steam from said boiler and said drum, substantially as specified.

7. A gas producer structure, comprising a shell having at its lower portion a water jacket; and carrying within its upper portion a high pressure boiler; means for circulating fluid between said water jacket and said boiler; means for actively promoting the flow of fluid from said water jacket to said high pressure boiler through said circulating means; a low pressure steam drum mounted without said shell and entirely above said water jacket, means for conducting a heated fluid from the upper portion of said water jacket to said low pressure steam drum; means for conducting fluid of lesser temperature from said low pressure steam drum to the lower portion of said water jacket, said latter fluid conducting means being also connected to a source of fluid supply, whereby

a continuous thermo-syphonic circulation is maintained between said water jacket and said low pressure drum and whereby a continuous supply of preheated water may be maintained from said water jacket to said boiler, and means for conveying steam from said drum and said boiler, substantially as specified.

8. In a gas producer, in combination with a fuel charging means and a rotary grate; a shell having at its lower portion a hot water jacket, and carrying within its upper portion a high pressure steam boiler, means for circulating fluid between said water jacket and said boiler, means for actively promoting the flow of fluid from said water jacket to said boiler through said fluid circulating means, a low pressure steam drum mounted without said shell, means for conducting a heated fluid from the upper portion of said water jacket to beneath the water level in said drum, means for conducting fluid of lesser temperature from said drum to the lower portion of said water jacket, said latter fluid conducting means being also connected to a source of fluid supply, whereby a thermo-syphonic circulation is maintained between said water jacket and said low pressure drum, and a forced circulation is effected from said water jacket to said boiler at a temperature which will not cause condensation on the inner linings of the shaft, and means for conveying steam from said drum and said boiler, substantially as specified.

9. A gas producer having in combination: a fuel chamber, a cooling jacket surrounding said chamber, a low pressure steam drum, connections between said jacket and drum providing for thermo-syphonic circulation of heated cooling water therebetween; a high pressure boiler mounted within the upper portion of the producer above said fuel chamber, means for effecting diversion of a portion of the cooling medium, after passing through said jacket, from said thermo-syphonic circulation system to said high pressure boiler, where said cooling medium is converted into high pressure steam.

10. In a gas producer, in combination: a generator shell, a hot water jacket carried by the lower portion of said shell, a high pressure boiler mounted within the upper portion of said shell and communicating with said water jacket, means for promoting fluid flow from said water jacket to said high pressure boiler, a low pressure steam drum mounted without said shell, means for circulating fluid between said drum and said water jacket, and means for separately conducting to any desired points steam from said high pressure boiler and said drum, substantially as specified.

11. A cooling and heat utilization system for gas producers, comprising in combination with a gas producer having a fuel chamber:

a metallic water jacket surrounding said fuel chamber; a steam drum disposed externally of said gas producer and having a space therein for the expansion into steam of a portion of the water fed therein from said water jacket; means for conducting a portion of the water from said water jacket to said steam drum; means for returning to said water jacket the non-expanded water in said drum; a high pressure steam boiler mounted above said fuel chamber for expanding into steam water conducted thereto from said water jacket; means for effecting delivery of a portion of the water from said water jacket to said high pressure steam boiler; and means for admitting feed water to the water jacket and steam drum circulation system only at a point where the feed water is thoroughly mixed with water returning to said jacket from said steam drum.

12. In a gas producer, in combination: a substantially cylindrical gas generator shell having a charging opening in its top and a fuel bed space below said charging opening and having in its upper portion a gas offtake and a high pressure boiler located entirely within the space between the charging opening and the fuel bed space, and having a water preheater separate from and independent of said high pressure boiler surrounding the lower portion of said fuel bed space and connected with said high pressure boiler for feeding preheated water thereto; said high pressure boiler comprising a lower annular boiler chamber disposed directly above said fuel bed space, an upper annular boiler chamber disposed directly below said charging opening and above and substantially concentric with respect to said lower annular boiler chamber, and a plurality of water tubes connecting said upper and lower annular boiler chamber, whereby the fuel charged into said fuel bed space passes through and out of contact with said upper and lower annular boiler chambers.

13. In a gas producer, in combination: a substantially cylindrical gas generator shell having a charging opening in its top and a fuel bed space below said charging opening and having in its upper portion a gas offtake and a high pressure boiler located entirely within the space between the charging opening and the fuel bed space, and having a water preheater separate from and independent of said high pressure boiler surrounding the lower portion of said fuel bed space and connected with said high pressure boiler for feeding preheated water thereto; said high pressure boiler comprising a lower annular boiler chamber; an upper annular boiler chamber of shorter annulus than said lower boiler chamber disposed above and concentrically with said lower boiler chamber, and a plurality of water tubes connecting said upper and lower boiler chambers, said

tubes being arranged in groups around the peripheries of said boiler chambers to present a maximum of heating surface to the gas flowing off from the producer, whereby the fuel charged into said fuel bed space passes through and out of contact with said upper and lower annular boiler chambers.

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