

April 19, 1932.

A. R. STRYKER

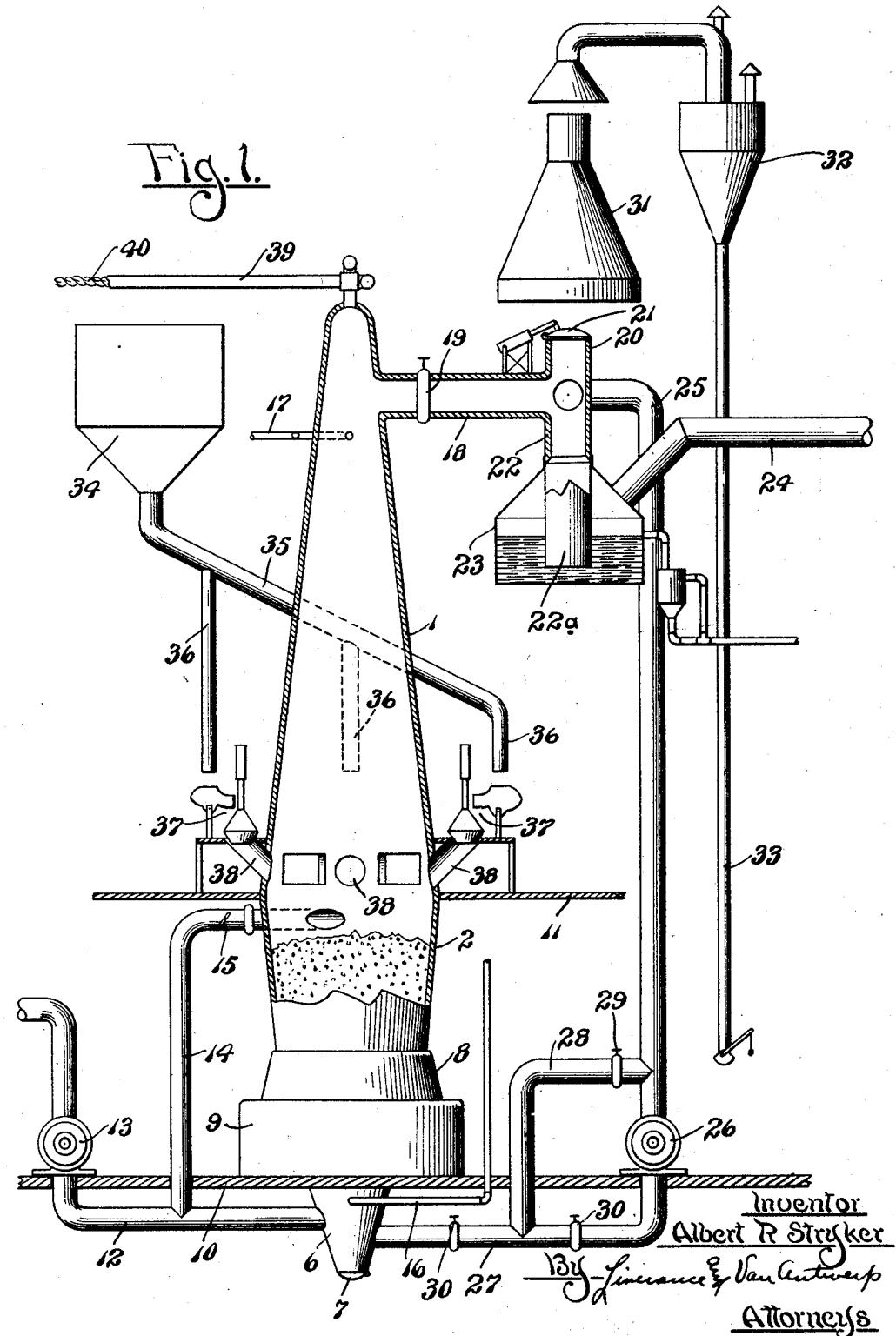
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## GAS PRODUCING APPARATUS

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2 Sheets--Sheet 1

Fig. 1.



Inventor  
Albert R Struker

Albert H. Stigker  
134 Finance & Van Antwerp  
Attorneys

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A. R. STRYKER

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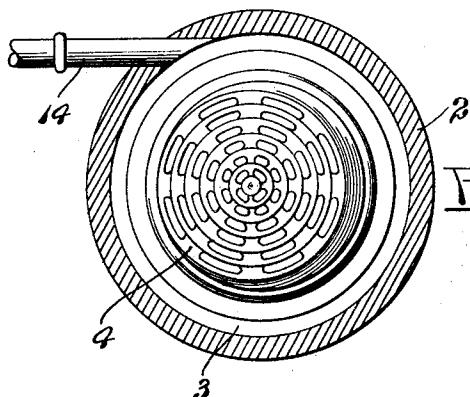
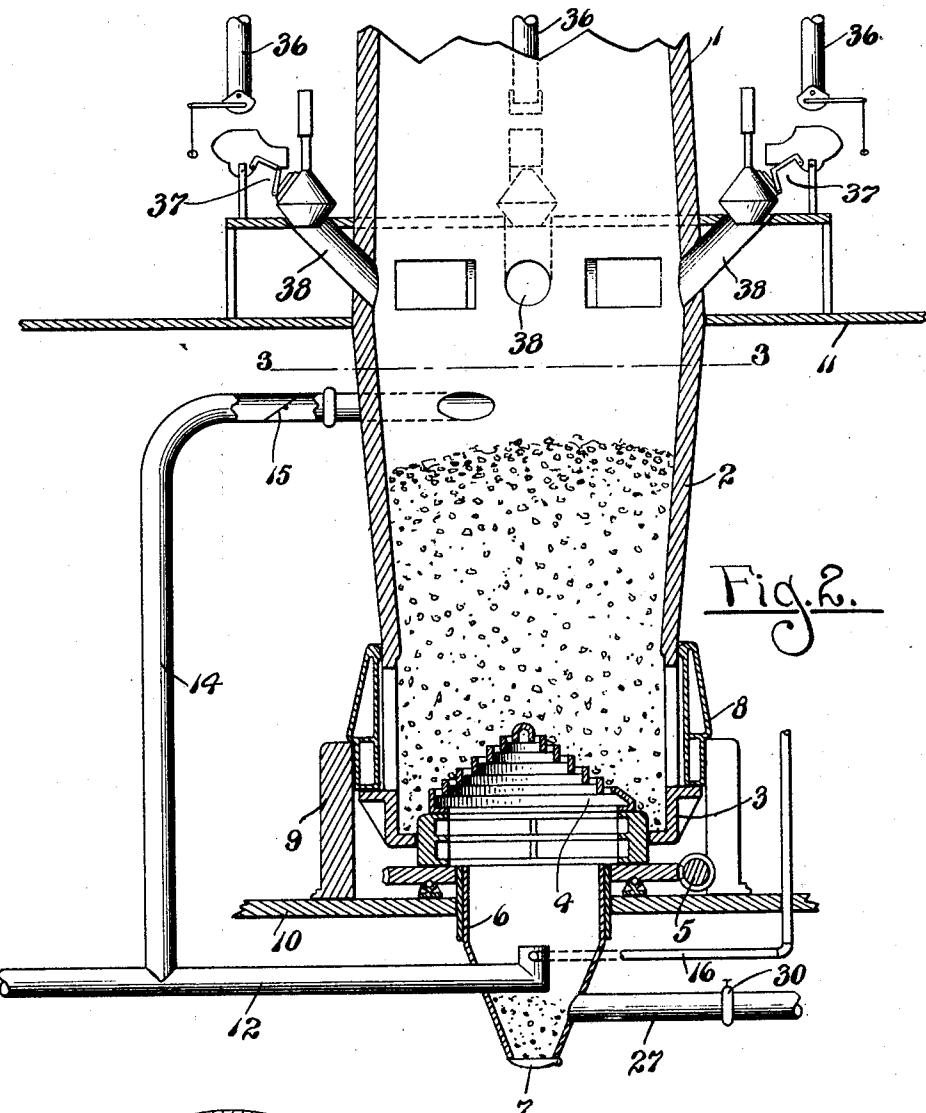


Fig. 3.

Inventor  
Albert R. Stryker  
By Leverance and  
Van Antwerp  
Attorneys

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# UNITED STATES PATENT OFFICE

ALBERT R. STRYKER, OF ST. JOSEPH, MISSOURI

## GAS PRODUCING APPARATUS

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This invention relates to gas production and is primarily concerned with a novel apparatus for converting the entire volatile and fixed carbon constituents of coal, irrespective of its grade, into gas which by the use of my apparatus and process may be of different characters, such as illuminating gas, gas for heating purposes and the like.

It is a primary object and purpose of the present invention to produce gas from coal, particularly the inferior grades of coal, utilizing and extracting all of the heat producing elements of the coal and separating the same from the mineral matter, ash and the like. By this process and apparatus it is designed that many grades of soft or bituminous coal, not now suitable for gas production, may be used with a consequent greater reduction in the cost of production; and that also the waste coal at the mines, which is now universally thrown away, may be utilized even though it many times contains a very high percentage of slate, rock and the like. Furthermore, brown lignite may be used by my process and with the apparatus which I have invented in the same manner.

By utilizing the inferior grades of soft or bituminous coal, lignite or the like, or waste, which now is a source of loss, trouble and annoyance, not only is the raw material required for gas production greatly reduced in cost but it is not necessary to ship higher grades of gas producing coal long distances to the places where they are used; for in practically all sections of the United States there can be found bituminous coal or lignite or the like and the transportation thereof to any given place is relatively short compared to the transportation now required in many places for the proper grades of bituminous coal necessarily used.

It is also contemplated with my invention that the apparatus may be installed at or adjacent a mine and the gaseous fuel produced thereby piped over a large area with a total elimination of freight costs.

A further object of my invention is to provide an apparatus and operate the same in accordance with a novel process thereby obtaining an elimination of the use of so-called

gas oil now used for carbureting what is known as blue or water gas.

With these objects in view I have devised the apparatus for carrying out the process of my invention, all of which will appear fully and in detail in the following description, taken in connection with the accompanying drawings, in which,

Fig. 1 is a partial vertical section and side elevation of the essential elements of the apparatus which I have devised.

Fig. 2 is a fragmentary enlarged vertical section through the lower part of the retort of the apparatus, and

Fig. 3 is a horizontal section substantially on the plane of line 3-3 of Fig. 2.

Like reference characters refer to like parts in the different figures of the drawings.

In the construction illustrated a retort shell 1, preferably of steel, suitably lined at its inner side with refractory material, is provided, the upper section of which tapers upwardly and the lower section 2 of which tapers downwardly, as shown. In practice the retort may be between 80 and 90 feet in height and 11 feet in diameter at the bottom, tapering to 4 feet in diameter at its top, though, of course, these dimensions are not necessarily the only dimensions which may be used. The retort at its bottom rests upon a suitable support 3 within which an eccentrically located and rotatably mounted grate 4 is positioned which may be driven at any suitable speed through the worm and tangent construction illustrated at 5, it being understood that the worm 5 is driven from any suitable source of power.

Below the grate is a hopper 6 into which the ash drops as it is passed through the grate, the lower end of which is equipped with a suitable outlet closure 7 which may be opened to deliver the ash from the hopper. The lower end of the retort is not lined with refractory material but is surrounded by a hollow ring or drum 8 in which water is carried, said drum resting upon the member 3 and upon the surrounding supporting wall 9, as shown. It is to be understood that the apparatus is mounted upon a suitable floor 10, the hopper 6 extending therethrough and that the retort

may extend upwardly through other floors of a building, one of which is indicated at 11.

A pipe 12 leads into one side of the ash collecting hopper 6 below the grate 4 in the 5 length of which is a blower 13 to force air to below the grate. A branch pipe 14 extends from the pipe 12 upwardly and is then turned horizontally, its end passing through the side of the retort in substantially tangential relation thereto. A control damper 15 is mounted in the pipe 14, the purpose of which will later appear. A steam carrying pipe 16 at one end passes through a side of the hopper and connects with the inner end of the pipe 12, 10 and in practice this pipe 16 may also connect with the upper pipe 17 leading into the upper end of the retort, it being understood that steam generated in the shell 8 may be carried through said pipes to either the upper or lower end of the retort, as shown.

Near the upper end of the retort is a branch pipe 18 having a closing valve or damper 19 therein. At its outer end the pipe 18 is formed with a vertical extension, the upper part 20 of 25 which has an open upper end with a closure 21 therefor, while the downwardly extending part 22 enters the upper end of a wash box 23, connecting with a sleeve 22a which, at its lower end, enters into and extends below the 30 level of the water in the box. An outlet pipe 24 leads away from the wash box to a gas relief holder (not shown) at a point above the level of the water.

A pipe 25 connects to the vertical extension 35 at the end of the outlet pipe 18 and is then carried downwardly to adjacent the floor 10, there being equipped with a power driven exhaust or suction apparatus 26, and after it has passed through the floor 10 it is extended 40 as a horizontal pipe 27 to the hopper 6 with which it connects and into which it leads. A by-pass pipe 28 around the suction exhaust 26 connects the pipes 25 and 27, as shown, in 45 which is a valve 29 to open and close said by-pass pipe. Likewise two valves 30 are located in the pipe 27, one at each side of the point of connection of the by-pass 28 therewith. Over the upper end of the vertical member 50 20 is a dust collecting apparatus including the various elements 31, 32 and 33 which not being in themselves of novel construction are not specifically illustrated or described. Such dust collecting apparatus is old and well known and its use in conjunction with the apparatus which I have devised will later 55 appear.

A bin or hopper 34 for holding coal for the blasting charges is located to one side of and near the upper end of the retort having an outlet pipe 35 with vertical branches 36 which are disposed around the retort at spaced apart intervals and which deliver coal to suitable automatic weighing and charging machines 37 which serve to deliver the coal carried 60 thereto to inlet chutes 38 to the lower part of

the retort. An inlet pipe conduit 39 is connected with the upper end of the retort in which is a screw conveyor 40 which conveys powdered coal into the retort. The powdered or pulverized coal is reduced to a powdered or pulverized state by suitable apparatus now well known and used commercially. The coal pulverizing unit, of course, will be associated with the retort but as it in itself is not new and forms no part of the present invention 70 it is not shown or described.

Operation: In the use and operation of the apparatus described a charge of coal is entered into the retort from the bin or hopper 34, known as the blasting charge. This coal 80 enters the lower part of the retort and rests against the grate. It is ignited and air is forced by the blower 13 through the coal to burn the same. The damper at 15 is opened and a part of the air passes into the retort 85 above the coal.

The air which enters through the pipe 12 below the grate is forced upwardly through the coal and its oxygen combines therewith with a resultant production of producer gas 90 which ordinarily contains, roughly, 20% carbon monoxide and 80% nitrogen. The producer gas is acted upon by the air above the coal which enters through the branch pipe 14 and the carbon monoxide is burned so 95 that a complete reduction of the carbon in the coal to carbon dioxide is obtained with the resultant production of high heat. The tangential entrance of air into the retort through the pipe 14 causes a spiral upward 100 movement of the products of combustion and the heat produced by the consumption of the coal is absorbed by the refractory walls of the retort so that the retort is heated to a very high degree of temperature. The 105 products of combustion from the blast pass outwardly through the branch pipe 18 and through the upper extension 20, the closure 21 being open, and any dust which is carried by the gases is collected in the dust 110 collector.

It is, of course, apparent, that all of the heat of the products of combustion is not absorbed by the walls of the retort and it is contemplated that utilization of this waste 115 heat may be had for drying the pulverized coal, or it may be used for the production of steam as desired. The utilization of waste heat in itself is not new and the details of mechanism or apparatus which may be required therefor is not shown in the present 120 application.

The air blasting step of the process is continued until the temperature at the inner sides of the walls of the retort reaches from 125 1500 to 1800° F. Of course, it is not essential that all of the blasting charge be consumed for if any of the carbon of the coal is left unconsumed it can very readily be utilized with additional coal in the succeeding gas 130

making step of the operation. In fact it is contemplated that a predetermined amount of coal, sufficient to maintain a proper fire level, shall be charged into the retort in small amounts at set intervals by the weighing and charging machines.

In the succeeding step of the operation the closure 21 is moved to a closed position, the damper 15 is closed, the blower 13 stopped, and the exhauster at 26 is started in operation. Simultaneously the screw conveyer at 40, which is motor driven, is started and pulverized coal is fed continuously in at the top of the heated retort and evenly distributed therein. As the coal passes down the heat of the walls of the retort acts thereupon to drive off the volatile gases, which are drawn downwardly and carried through the pipes 27 and 25 and thence downwardly from the downward extension 22 to and through the wash box 23. It is to be understood that the valve or damper at 19 is closed during this step of operation. The gas passes outwardly through the pipe 24 to the relief holder therefor.

The operation continues until there is insufficient heat left in the walls of the retort to drive off volatile material. There will be deposited on the ignited fuel bed at the bottom of the retort the residue of the coal, namely, the ash and the fixed carbon which ordinarily is known as gas coke. This operation continues from 10 to 12 minutes and between 2,000 and 3,000 pounds of coal may be treated in this period of time.

The fixed carbon or coke deposited upon the ignited fuel bed is heated to a very high degree but is not consumed due to the absence of oxygen. After the volatile constituents of the coal are driven off the exhauster at 26 is stopped from operation, the various valves at 30 may be closed, steam which has been produced in the jacket 8 is introduced through the pipe 16 into the hopper 6 and forces itself upwardly through the incandescent mass. This passage of steam may be later reversed; that is, steam is entered through the pipe 17 into the upper part of the retort, the valve 19 is closed, the blower 13 stopped from operation, the first valve 30 opened, whereupon the steam forces downwardly through the mass of incandescent material and blue water gas produced which by-passes the exhauster through pipe 28 and passes outwardly through the wash box as is evident.

The reversal of the passage of the steam serves to withdraw additional heat from the walls of the retort and to completely consume the upper portion of the incandescent coke, it being apparent that on the upward passage of steam through the mass of incandescent material, the lower portion thereof is consumed and combined with the water for the production of water gas first and be-

comes coke while the upper portion remains in an incandescent state.

Of course, it is possible and many times desirable to produce other types of gas than the water gas. For instance, producer gas alone may be desired, in which case air is blown upwardly by the blower 13 through the incandescent coke combining therewith for the production of producer gas alone.

This completes the cycle of operations. The succeeding cycles are identical with that described. After a charge of coal has been treated first to drive off the volatile or gaseous constituents thereof and then to convert the carbon into either producer or water gas, a new fuel charge is admitted into the retort and the cycle of operations repeated. It is, of course, apparent that many gas making combinations are possible in that producer gas may be made for a short period and after that the water or blue gas and any desired mixture of gases for the attainment of a proper and desired heating value of the gas obtained.

The air blasting step of the process takes from 4 to 5 minutes and in some cases a little longer depending upon the grade of coal used, while the gas making step, as previously stated, requires approximately from 10 to 12 minutes.

With this construction soft or bituminous coal of any and all grades may be used for gas making. Also waste which contains a large percentage of carbon may be used. The ash from the coal is taken care of readily by the apparatus. All of the volatile constituents of the coal are driven off by heat and all of the fixed carbon which will not distill into gas is consumed in the production of either producer or water gas. The apparatus is very practical and efficient. It is to be understood that the various controls for the valves, the blower and the exhauster, are of well known and standard construction and are operative from a central control board in the plant. The invention is defined in the appended claims and is to be considered comprehensive of all forms of structure coming within their scope.

I claim:

1. A gas generating apparatus comprising a vertical retort, a grate located at the lower end of said retort, an outlet conduit at the upper end of the retort, means to close said outlet, a pipe leading from said outlet conduit downwardly and opening into the retort below the grate, and means for delivering fuel into the retort at a point above said grate and below the outlet conduit.

2. An apparatus for making gas comprising, an elongated vertical retort having an outlet conduit adjacent its upper end, said conduit terminating in a vertical section open at both ends, a removable closure for closing the upper end of said section, a wash box

attached to the lower portion for said section, a pipe leading from said section between the upper and lower ends thereof, a valve in said outlet conduit for opening and closing the same, a grate at the lower end of the retort, a closed hopper below said grate, an air carrying conduit entering said hopper, means for forcing air therethrough, a branch conduit extending from said air conduit into said hopper at a side thereof a distance above its lower end, a damper for closing the branch conduit, an exhauster connected in said pipe between the ends thereof, said pipe leading at its lower end into said hopper, means for delivering fuel into the retort at a point adjacent the entrance of said branch conduit thereinto, and additional means for entering fuel into the retort at the upper end thereof.

3. A construction containing the elements in combination defined in claim 2, combined with a by-pass pipe connected with the first mentioned pipe and passing around said exhauster, said by-pass pipe having a valve therein to open and close the same, and said first mentioned pipe having two valves therein, one at each side of where the by-pass pipe connects therewith.

4. A construction containing the elements in combination defined in claim 2, combined with means for admitting steam into said hopper below the grate.

5. A construction containing the elements in combination defined in claim 2, combined with means for admitting steam into the retort adjacent the upper end thereof.

In testimony whereof I affix my signature.

ALBERT R. STRYKER.

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