

Oct. 4, 1927.

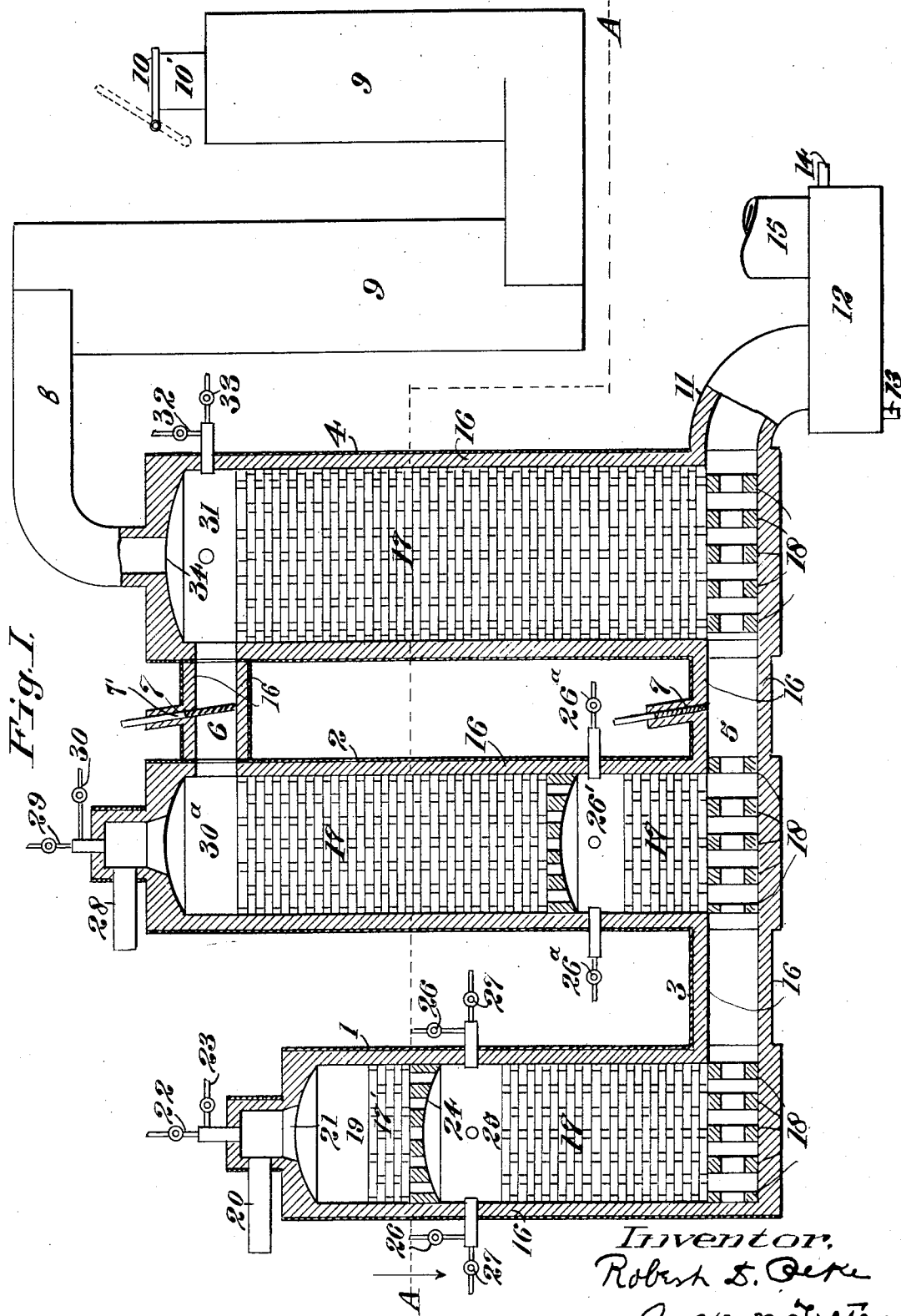
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R. D. PIKE

METHOD OF MANUFACTURING OIL GAS

Original Filed May 2, 1923

3 Sheets-Sheet 1



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Fig. 2.

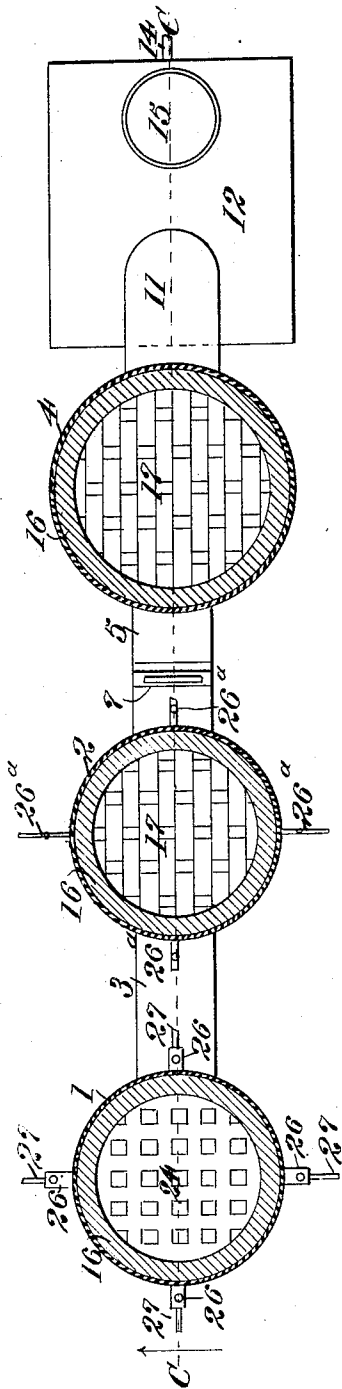
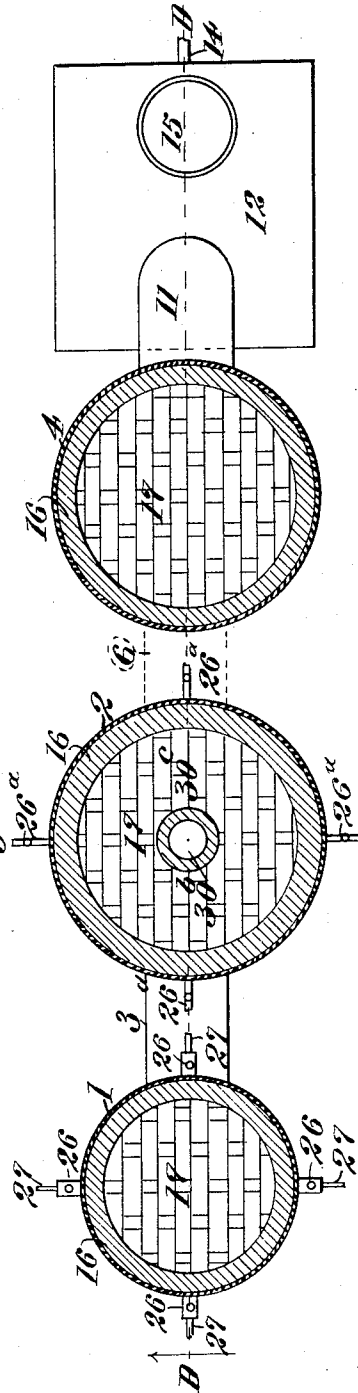


Fig. 4.



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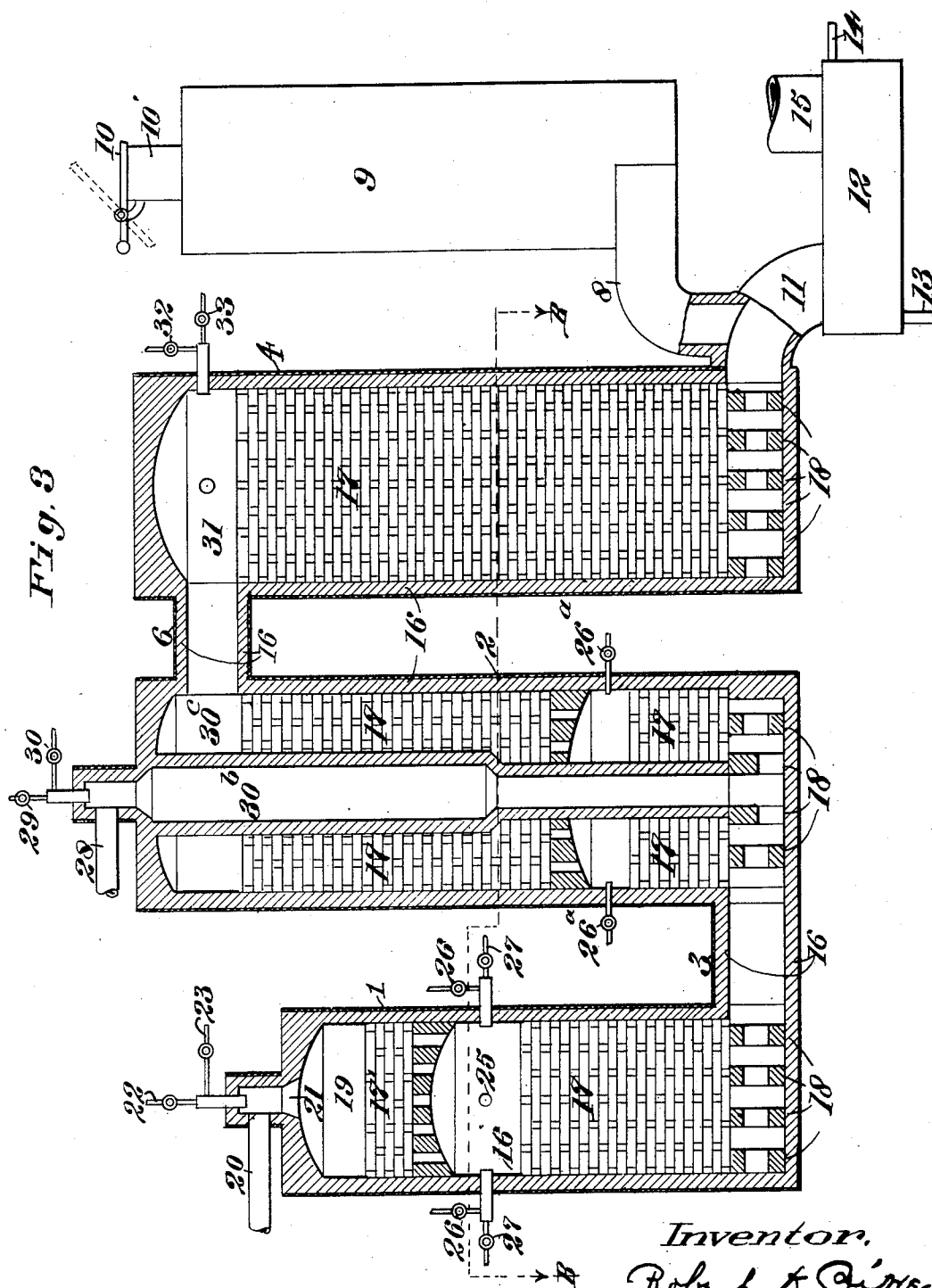
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METHOD OF MANUFACTURING OIL GAS

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UNITED STATES PATENT OFFICE.

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METHOD OF MANUFACTURING OIL GAS.

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The hereinafter described invention relates to a method for the making of gas from oil in internally heated periodically operated generators, and the object thereof is the elimination of the so-called by-product "lamp black" and the conversion of all solid carbon materials derived from the oil into gas within the generating apparatus without allowing the same to be discharged therefrom; thus effecting a great economy in the manufacture of the gas as well as overcoming the present nuisance connected with the manufacture of gas involved in the handling and disposing of the solid carbonaceous by-product of gas manufacture usually referred to as the waste, or by-products, "lamp black."

One of the more important present day methods for the manufacture of gas from oil in internally heated periodically operated generators comprises the spraying of steam and oil onto highly heated checker bricks within enclosed shells for a period of usually ten minutes duration, then blasting air and fuel through the checker bricks for another period, usually ten minutes duration, to burn out deposited carbon and restore to the checker bricks the heat abstracted therefrom during the gas making period the checker bricks are arranged in two shells commonly known as the primary and secondary. During the heating operation the principal combustion originates at the top of the primary shell; the gases of combustion passing downwardly therethrough and then through a connection known as the "throat" into the bottom of the secondary shell and thence upwardly and out to the atmosphere through a valve at the top of the secondary shell. During the gas making period oil and steam are sprayed into the chambers at or near the top of both the primary and the secondary shells, and the gas therefrom passes downwardly in both. The gases pass from the primary to the secondary through the throat, and thence upwardly about a third of the height of the secondary where they mix with the gases which have come down through the secondary, and thence pass outwardly through an offtake which is so disposed as to force the gas to bubble through water in a so-called wash box; which water serves to seal the generator against the outside atmosphere during the heating period and to separate the lampblack from the gas.

The oil used for making gas by this process weighs about 7.9# per gallon at 60° F. and is of about the following analysis by weight.

	Per cent.	
Carbon-----	85.0	60
Hydrogen-----	12.0	
Sulphur-----	.8	
Nitrogen-----	.2	
Oxygen-----	1.0	65
Water-----	1.0	
	100.00	

The gas made has about 550 B. t. u. per cubic foot at 60° F. and 29.92" Hg. barometric pressure, and is of about the following analysis by volume.

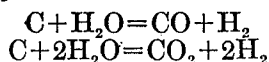
	Per cent.	
CO ₂ -----	6.5	75
C ₆ H ₆ -----	1.2	
C ₂ H ₄ -----	3.2	
O ₂ -----	.5	
CO-----	13.2	
H ₂ -----	45.9	80
CH ₄ -----	26.2	
N ₂ -----	3.3	
	100.00	

The gas leaving the generator contains per thousand cubic feet of finished gas about 12# of solid carbon in finely divided condition known as waste, or by-product lampblack, about 3# of tar and minor impurities such as naphthalene and sulphur compounds. The lampblack must be entirely removed from the gas, which is done by washing with water and its handling and disposition constitutes a serious handicap to the present process.

From 40# to 50# of steam per thousand cu. ft. of gas produced is introduced into the generator with the oil, and were it not for this steam, the lampblack production would be much larger than above stated. This will be understood from a brief consideration of the reactions involved.

When the oil spray strikes the checker brick the oil is decomposed into carbon (C), hydrogen (H₂), methane (CH₄), and higher hydrocarbons such as benzol (C₆H₆), ethylene (C₂H₄), and naphthalene (C₁₀H₈). Further application of heat tends to break down the methane and higher hydrocarbons into carbon and hydrogen. The presence of

steam leads to the following reactions which gasify the solid carbon.



5 which reactions partly account for the presence of carbon monoxide (CO) and carbon dioxide (CO₂) in the gas. But these reactions absorb much heat and unless the heat
10 energy is furnished the temperature becomes rapidly lowered to a point where these reactions practically cease. The first reaction producing CO, which is the one most desired, practically ceases at 1650° F.

15 My method invention is the elimination of the solid carbon constituents carried in suspension in the gas formed and discharged from the primary shell and prior to an enrichment of said gas and the invention is
20 preferably carried out by passing the gases discharging from the primary shell and commonly termed a "lean gas" containing solid particles of lampblack in suspension, with a suitable quantity of steam through an en-
25 closed space containing checker brick heated to a maintained temperature by suitable means at a necessary high level for effecting the requisite water gas reaction between the steam and the solid carbon present, so that
30 all the carbon carried in suspension in the gas may be gasified.

Any suitable type of apparatus may be employed for the carrying out of the method invention, in the accompanying drawings
35 being illustrated two forms of apparatus for the carrying out of the said invention, and wherein:

Figure 1 illustrates a transverse vertical sectional view taken through an apparatus
40 of the countercurrent type, and incorporated therewith and interposed between the primary and secondary shells thereof a means for gasification of the solid constituents carried in suspension by the gas formed within and
45 discharged from the primary shell of the apparatus.

Fig. 2 is a top plan sectional view taken on the line A—A, Fig. 1 of the drawings.

Fig. 3 is a transverse vertical sectional
50 view of an apparatus of so-called parallel current type with the gasifying means for the solid carbon constituents of the gas interposed between the primary and secondary shells of the apparatus, this form of apparatus
55 differing from the type disclosed in Fig. 1 of the drawings merely to the extent of the different relative directions which are imparted to the flow of gas and combustion gas.

60 Fig. 4 is a top plan longitudinal sectional view taken on the line B—B Fig. 3, of the drawings.

Referring to Figs. 1 and 2 of the drawings, the numeral 1 indicates the primary shell of
65 the gas making apparatus, the numeral 2

the intermediate or lampblack eliminating shell and 3 the open connection establishing communication between the bottoms of the shells 1 and 2. To one side of the shell 2 is situated the shell 4 which constitutes the
70 secondary shell and which is utilized for the enrichment of the gas formed within and delivered from the primary shell 1 of the apparatus. The bottoms of the shells 2 and
75 4 communicate by means of the valve controlled connection 5, while the top portions of the said shells 2 and 4 are in communication through the medium of the valve controlled connection 6. The connection 5 is
80 provided with a controlling valve 7 and the connection 6 with a controlling valve 7', which valves are preferably of the same design and actuated by suitable controlling mechanism not shown and of such construction that the two valves 7 and 7' act as re-
85 versing valves, that is, when the valve 7 is thrown to close the connection 5, the valve 7' is thrown to open the connection 6 or vice versa. From the shell 4 is extended a connection 8 for the flow of the gases of com-
90 bustion therefrom, which connection communicates with the waste heat boilers 9, the stack 10' of one of said boilers being controlled by a stack valve 10 which is controlled
95 by suitable mechanism not shown for opening and closing the stack outlet 10'. From the bottom of the shell 4 is extended a connection 11 which leads to a suitable wash
100 box 12 which is provided with a pipe 13 for supplying water thereto. From the wash box 12 is extended a liquid outlet pipe 14 and the said box is provided with an outlet 15 for the escape of gas therefrom.

The shells 1, 2 and 4 as well as the connections 3, 5, 6 and 11 are lined with a suitable refractory lining 16 which is broken
105 only at the necessary point for admitting sight holes and holes for pipes for conveying steam, air and oil to the interior of the shells 1, 2 and 4. Each of these said shells, except for occasional open spaces, is filled
110 with checker brick 17 resting on suitable piers 18.

Within the primary shell 1 at or near the top thereof is provided a space 19 for com-
115 bustion and into which is admitted through the centrally disposed opening 21 air under pressure, oil and steam, respectively, through the pipe connections 20, 22 and 23. With-
120 in the chamber 19 is disposed a small set of checker bricks 17' which rest on a perforated crown 24 below which crown is provided a space 25 into which steam and oil may be admitted by the pipes 26 and 27, respectively.

The shell 2 is provided at its top portion with an open space 30 similar in all respects
125 to the chamber 19 of the shell 1 and into which chamber 30 air, oil and steam, may be admitted through the pipes 28, 29, and
130 30, respectively.

The shell 4 is provided at its upper portion interiorly with a chamber 31, into which steam and oil may be admitted through the pipes 32 and 33, respectively, the gases of combustion when desired being discharged from the chamber 31 through the outlet 34 and being delivered in the present case through the connection 8 into the waste heat boilers 9.

10 My method for the gasifying of the solid carbon constituents during the gas making period as carried out in the above described apparatus is as follows.

15 The complete cycle for the making of the gas is divided into substantially two equal periods, usually of ten minutes duration each and which are known as the heating and making periods.

20 During the heating period the valve 10 of one of the waste heat boilers 9 is open to the outside atmosphere, while the water contained within the wash box 12 seals the shell 4 against the outside atmosphere at its bottom. Air for combustion is admitted under pressure through the pipe 20 into the combustion chamber 19 and oil through the pipe 22 and the steam for the atomization of the oil through the pipe 23. Combustion is complete in the chamber 19 and the gases of combustion pass down through the shell 1 and the heated checker work therein and escape therefrom through the open connection 3 into the bottom of the shell 2 and thence through the connection 5 into the bottom of the shell 4, the valve 7 at such time being in open position while the valve 7' of the connection 6 is closed. The hot gases of combustion then move upwardly through the checker bricks 17 of the shell 4 into the chamber 31 at the top thereof and escape therefrom through the opening 34 and into the waste heat boilers 9 through the connection 8 and from the waste heat boilers through the open stack 10' to the atmosphere. At the same time air for combustion is admitted into the shell 2 through the pipe 28 and oil through the pipe 29, while steam for atomizing the oil is admitted through the pipe 30 into the space 30^a and combustion is completed within said space or chamber, the gases of combustion from the chamber 30^a moving downwardly through the checker work of the shell 2 and thence into the bottom of the shell 4 following the same course as the gases of combustion from the shell 1. During this period of operation the interior of the shells 1 and 2 are independently heated while the interior of the shell 4 is heated by the gases of combustion from both shells 1 and 2.

65 During the gas forming or making period the valve 10 of the stack 10' is closed and the gas leaves the generator by bubbling through the water seal (not shown) in the wash box 12. Steam is admitted into the

combustion chamber 19 of the shell 1 through the pipe 23 and passes downwardly through the checkers 17', becoming highly superheated and passes into the chamber or space 25.

70 Oil and steam is admitted respectively through the pipes 27 and 26 and mingling with the superheated steam contained within the chamber 25 passes downwardly through the highly heated checkers 17 and escapes from the shell 1 through the open connection 3 into the bottom of the shell 2. During the gas making period the valve 7 is closed and the valve 7' stands open, so that the gases from the shell 1 which carry a heavy suspension of lampblack are constrained to pass upwardly through the highly heated checkers within the chamber 2. Additional steam may, if so desired, be admitted within the shell 2 through the pipe connections 26^a into the chamber 26 or at any other desirable point.

The checker bricks 17 within the shell 2 are maintained at such a temperature that the steam is caused to react with the carbon (lampblack) contained and carried by the gas from the shell 1 flowing upwardly through the shell 2 so that the gas passing into the chamber 30^a and escaping therefrom through the connection 6 is free from lampblack and rich in carbon monoxide and hydrogen. The gas therefore escaping or discharging from within the shell 2 is a so-called "lean" gas; that is, one having a relatively small heating value per unit volume, and for most uses requires enriching. This latter step is accomplished by introducing into shell 4 a spray of oil through the pipe 33, which oil intermingles with the lean gas entering into the chamber 31 and in passing downwardly through the highly heated checkers within the shell 4 becomes converted into a rich gas, with the result that by properly regulating the amount of oil admitted through the pipe 33 the heating value of the gas per unit volume may be varied within wide limits.

No novelty is claimed for taking the gas made in shell 1 and causing the same to be enriched by the admixture of oil in shell 4, but the novelty of my invention resides in passing the lean gas containing in suspension the carbon particles (lampblack) discharging from the shell 1 and passing the same through a shell which furnishes the necessary amount of heat at the correct temperature and with sufficiently large internal exposed heating surfaces for effecting the required water gas reaction between the carbon (lampblack) and steam, so that substantially all of the solid carbon particles carried in suspension may be gasified and flow with the lean gaseous mixture into the shell 4 for enrichment, so that the enriched gas discharging from the shell 4 shall be free of the

solid carbon particles usually carried thereby and at a subsequent period of treatment removed therefrom as a waste solid carbonaceous by-product usually referred to as waste product lampblack.

In the carrying out of my method invention by the use of an apparatus as above described, it is necessary and required that the interior of the shell 2 be heated from an independent combustion chamber at the top thereof, because the temperature of the checker brick within the shell 2 must be at least as high as the temperature of the checker work within the chamber 1 and preferably higher for the carrying out of the water gas reaction necessary during the flow of the gas from the shell 1 into and upwardly through the heated checker work in the shell 2.

Any suitable means may be employed for maintaining the checker brick contained within the shell 2, properly heated for the elimination of the solid carbon constituents of the gas discharging from the shell 1 by the gasification thereof during the flow of such lean gas into and through the said shell 2.

The apparatus above described for use in the carrying out of my method invention is known as the "counter current" type because of the direction of the gas flow during the gas making period, which arrangement of counter current is conducive to efficiency in effecting a transference of heat.

Another form of apparatus for the carrying out of my method invention is disclosed by Figs. 3 and 4 of the drawings and which illustrate an apparatus of the so-called parallel current type, the significance of which designation being that in both shells 2 and 4 the heating gases pass into the same direction as the gases during the period of gas making. The same reference numerals are employed in connection with the apparatus illustrated by Figs. 3 and 4 of the drawings to designate the corresponding parts appearing in the apparatus disclosed by Figs. 1 and 2 of the drawings, but in the apparatus of the parallel current type the connection 5 and the valves 7 and 7' of Fig. 1 and Fig. 2 are omitted, and the interior construction of the shell 2 differs in certain respects from that of the shell 2 disclosed by Fig. 1 of the drawings. In the shell 2 of the parallel current type of apparatus during the heating period of the shells 1, 2 and 3, combustion within the shell 2 takes place downwardly within a centrally disposed well 30^b, lined interiorly with a refractory lining 30^c, and gases of combustion leaving the well 30^b at the bottom thereof flow or pass upwardly into and through the checkers 17 and escape from within the shell 2 through the open connection 6 into the interior of the shell 4 and move downwardly within said shell

through the checkers 17 and thence outwardly through the connection 8 into the waste heat boiler 9, escaping therefrom to the outside through the valve controlled outlet stack 10'. During the gas making period the procedure and the flow direction of the gases is the same as with the counter current type of apparatus, the result being that in the shell 2 the gases both during the making period and heating period pass upwardly through the heated checkers 17 of said shell, the heated surfaces within the shell 2 during such flow of the made gas from the shell 1 gasifying the solid carbon particles or constituents suspended within the flowing body of gas.

The only advantage possessed by the parallel current type of apparatus illustrated by Figs. 3 and 4 of the drawings over the counter current type of apparatus illustrated by Figs. 1 and 2 of the drawings, is that in the former the valves 7 and 7' and connection 5 are not employed, although the efficiency of heating by the use of the parallel current type of apparatus is not as high as in the counter current type.

While I have described two types of apparatus for the carrying out of my method invention, it will be understood that any other suitable form of mechanism may be employed for this purpose which will answer to permit of the passing of formed gases carrying solid carbon in suspension and mixed with steam through and by heating surfaces furnished with sufficient heat at the requisite temperature to effect a water gas reaction between the carbon and the steam to cause substantially complete gasification of the carbon constituents present in the flowing body of gas. No claim is made in the present application for the apparatus for the carrying out of the method invention herein disclosed, inasmuch as the same will be set forth in an application to be filed hereafter as a division of the present application.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. The method of making oil gas and eliminating carbon particles therefrom, which resides in bringing oil into contact with suitably heated surfaces within an enclosed space, then passing the generated gas carrying carbon particles in suspension and mixed with steam through an enclosed chamber containing heating surfaces maintained at the requisite temperature for effecting gasification of the carbon by reaction with the steam, and then enriching the resulting gas by intermixing oil therewith in the presence of hot surfaces within an enclosed space.

2. The method of making oil gas and eliminating carbon particles therefrom,

which resides in bringing oil and steam into contact with suitably heated surfaces within an enclosed space, then passing the generated gas carrying carbon particles in suspension and mixed with steam through an enclosed chamber containing heating surfaces maintained by an independent source of heat at the requisite temperature for effecting the gasification of the carbon constituents of the gas by reaction with the steam, and then enriching the resulting gas by intermixing oil therewith during a flow in the presence of heated surfaces within an enclosed space.

3. The method of making gas from oil, consisting in first treating a supply of oil with steam and passing it over heated surfaces in a closed chamber for converting the oil and steam into a lean gas carrying suspended carbon particles, then treating said lean gas and suspended carbon in another closed chamber with a predetermined degree of heat in the presence of a supply of steam for converting the carbon into gas, and subsequently enriching the lean gas mixture in a further treatment.

4. The method of making gas from oil, consisting in first treating a quantity of oil

in a closed chamber with heat in the presence of steam for making a lean gas carrying carbon particles in suspension, secondly, in treating said lean gas and suspended carbon in a second closed chamber heated to a predetermined degree by introducing a charge of steam for treatment therewith to gasify the carbon particles, and subsequently enriching the lean gas mixture after leaving said second chamber with oil vapor.

5. The method of making gas from oil, which consists in mixing a charge of oil and steam in a closed chamber and conducting the same downwardly through the chamber having a predetermined amount of heat therein to form a lean gas carrying suspended carbon particles, conveying said lean gas and suspended carbon to an adjacent closed chamber for a predetermined heat treatment in the presence of steam in rising through said chamber for gasifying said carbon particles and forming a lean gaseous mixture, and subsequently enriching said lean mixture for use.

In testimony whereof I have signed my name to this specification.

ROBERT D. PIKE.