F. H. BATES.

GENERATING OIL GAS.

APPLICATION FILED JAN. 7, 1909. RENEWED MAY 4, 1912.

1,046,542.

Patented Dec. 10, 1912.

4 SHEETS—SHEET 1.

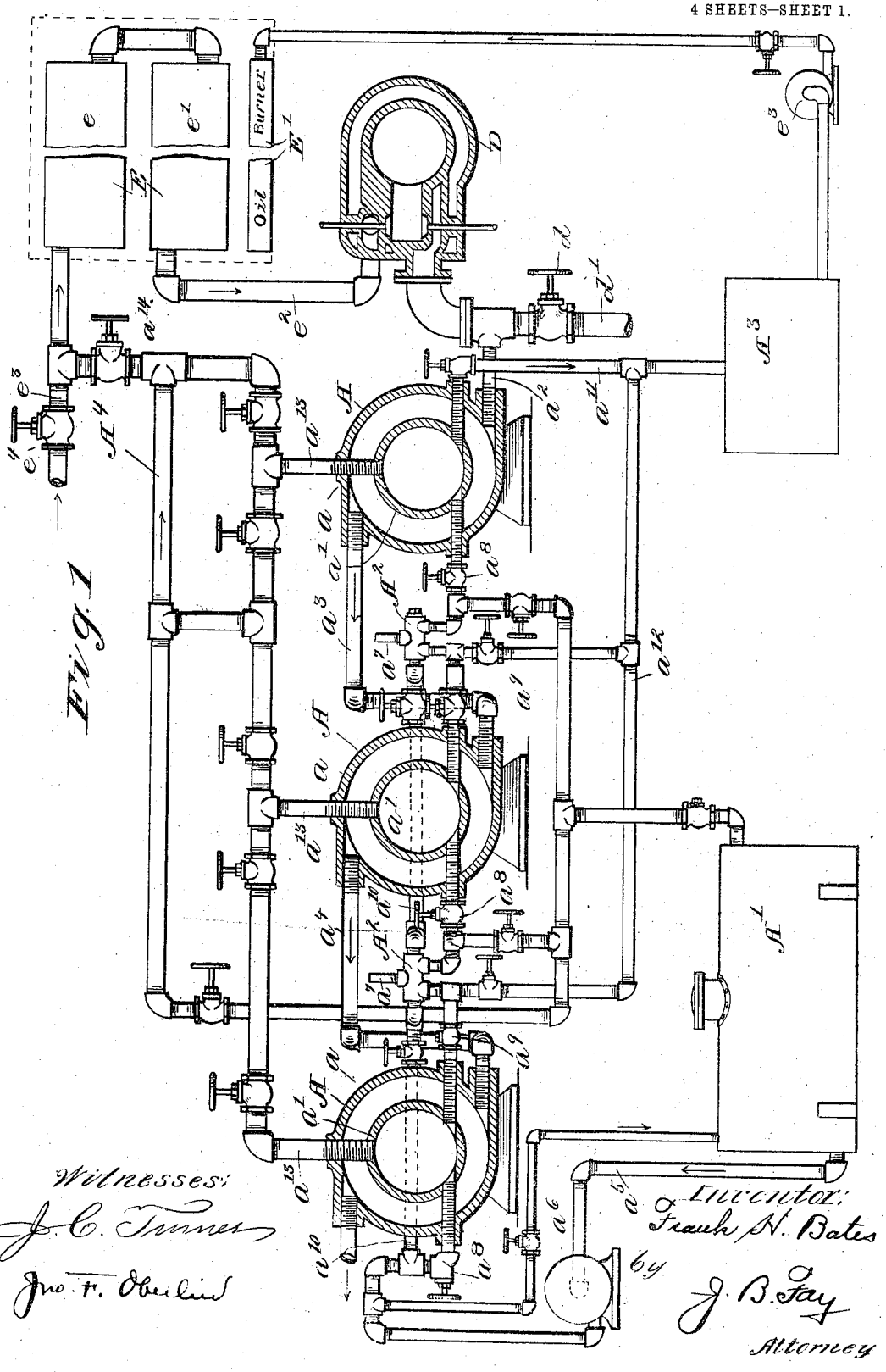

Fig. 1.

Witnesses:
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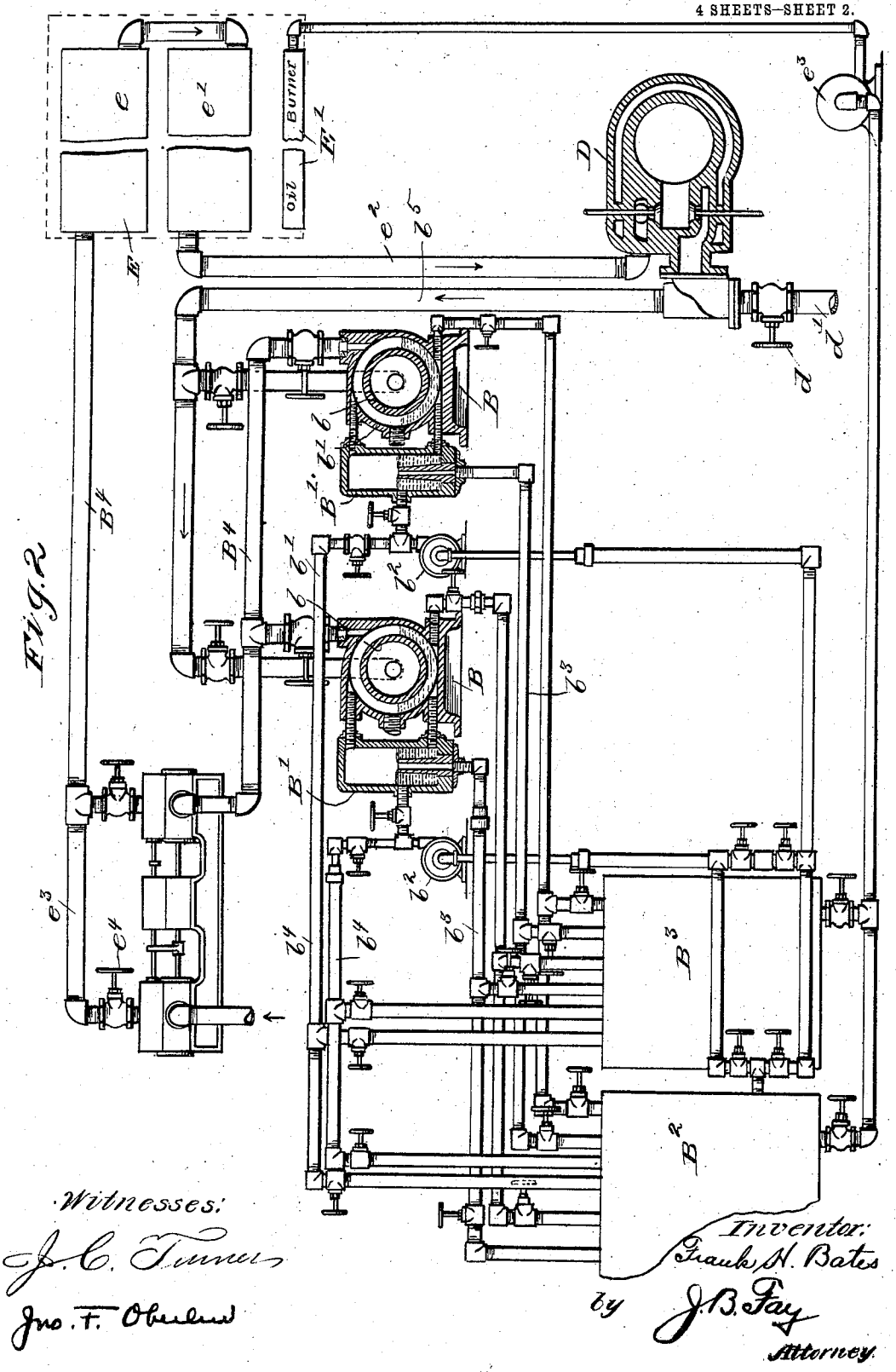

Fig. 2.

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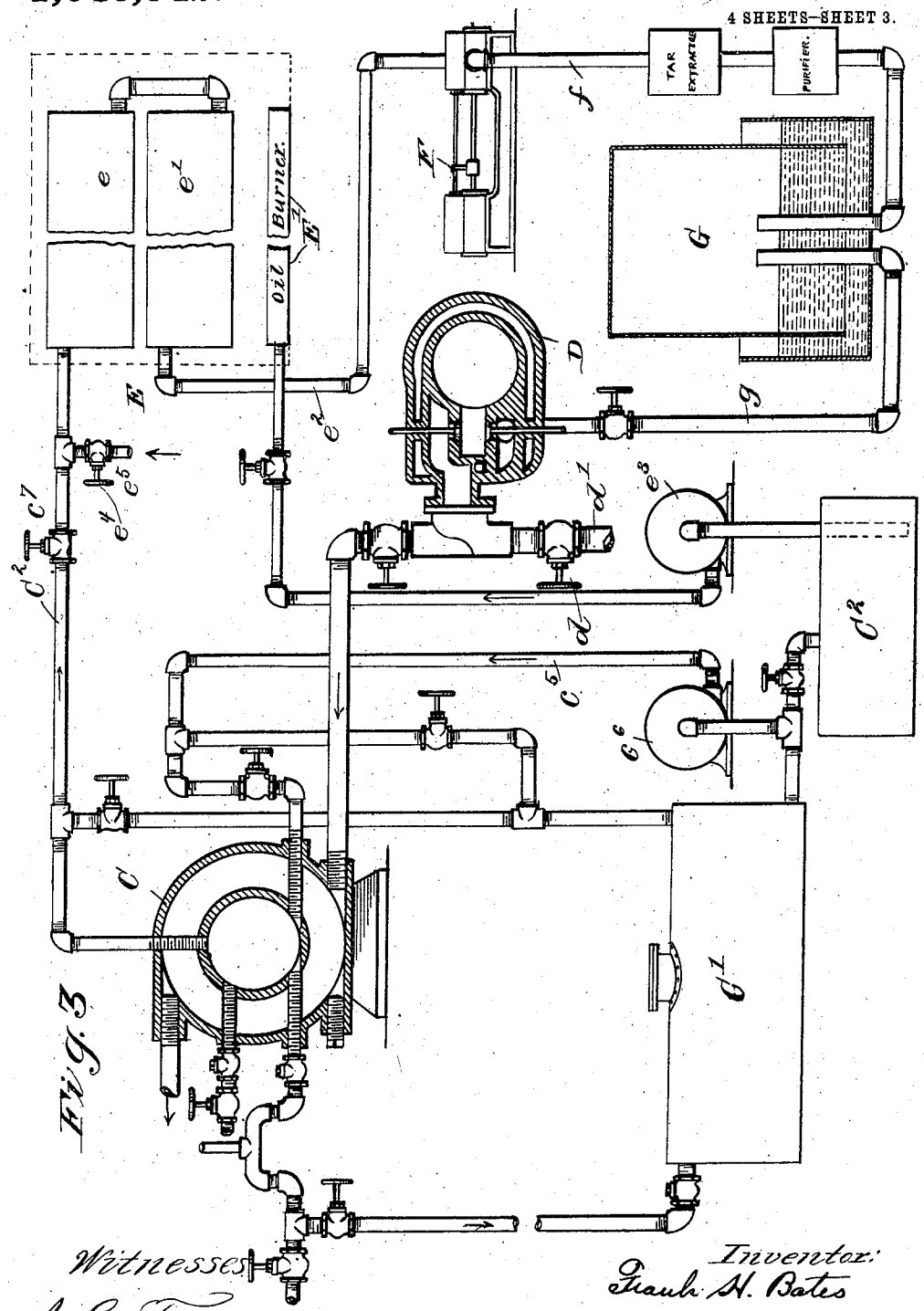

Fig. 3.

Witnesses:
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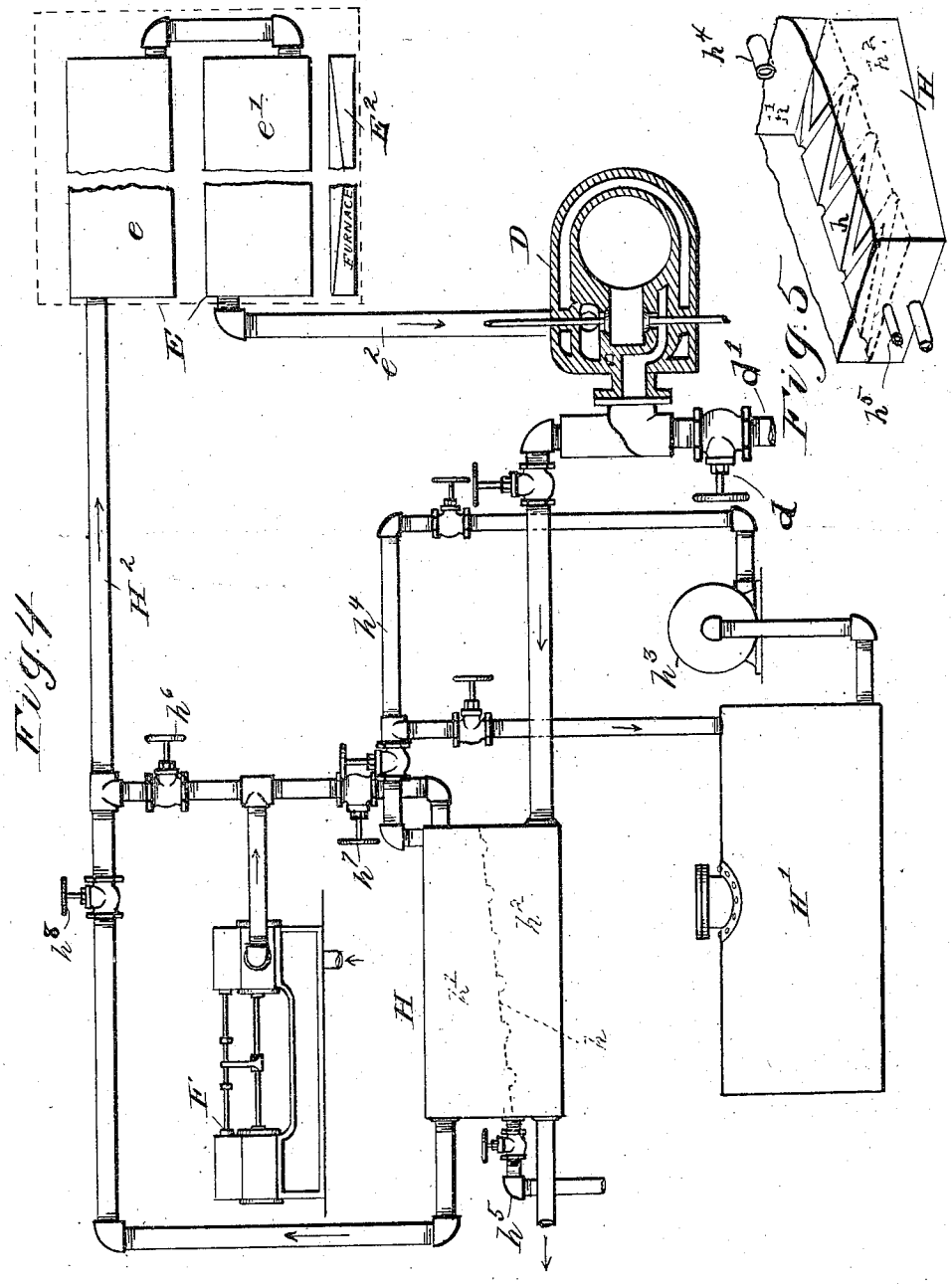

Fig. 5.

Fig. 4.

Witnesses:

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Jno. F. Oberlin

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UNITED STATES PATENT OFFICE.

FRANK H. BATES, OF ELYRIA, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO POWER PLANT ENGINEERING CO., A CORPORATION OF PENNSYLVANIA.

GENERATING OIL-GAS.

1,046,542. Specification of Letters Patent. Patented Dec. 10, 1912.

Application filed January 7, 1909, Serial No. 471,066. Renewed May 4, 1912. Serial No. 695,317.

To all whom it may concern:

Be it known that I, FRANK H. BATES, a citizen of the United States, and a resident of Elyria, county of Lorain, and State of Ohio, have invented a new and useful Improvement in Generating Oil-Gas, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

The object of the present invention is the provision of means for economically using petroleum, either crude or partially refined, as a source of power, by generating oil gas therefrom, which gas is utilized in a suitable explosive engine.

Such invention has more particularly in view, the provision of a unitary plant for deriving power from fuel of the character described, wherein shall be included in compact and convenient form, the several apparatuses required in connection with such utilization of the fuel.

A further object is to so relate and connect these apparatuses as to render such utilization economical to a marked degree.

To the accomplishment of these and related ends, said invention, then, consists of the means and steps hereinafter fully described, and particularly pointed out in the claims.

The annexed drawings and the following description set forth in detail certain means and modes of carrying out the invention, such disclosed means and modes illustrating, however, but several of the various ways in which the principle of the invention may be used.

In said annexed drawings: Figures 1, 2, 3 and 4 respectively illustrate diverse arrangements of apparatus exemplifying, in their operation, my improved process or method of generating oil gas; and Fig. 5 shows a detail of the apparatus of Fig. 4.

The diversity referred to as existing in the several forms of illustrated apparatus resides among other things in the different form of generator proper, that I show in each connection.

In the case of the first three figures such generators, and the specific methods of oil gas generation proper, exemplified therein, respectively form the subject matter of separate co-pending applications, Serial Nos. 435,628, 439,727 and 442,027, and are not claimed as a part of the present invention. In other words, it is to the general arrangement of these generators, whatever their specific form, or mode of operation, when taken in conjunction with the other parts of the plant, to which attention is herein desired as constituting such present invention. It will be necessary, however, in order to explain the correlation of such different parts, that the construction and mode of operation of the generators, as well as of the other parts, be described in more or less detail. The three typical plants illustrated in the several figures above described, will accordingly be taken up and considered in their order.

In Fig. 1, then, the oil gas generating apparatus comprises a plurality of generators, three, as shown, preferably of the receptacle type, wherein may be maintained a certain body of oil at all times. Each generator comprises an outer shell a, and an inner shell a', the former affording between its inner side and the outer side of the inner shell, a passage for the heating medium, and the latter providing the receptacle for the oil to be vaporized. The outer passages for the heating medium thus formed in the respective generators are connected in series in the line provided for conducting the heated waste gases, or exhaust, from the engine D by means of pipes a^2 a^3 a^4, the amount of such heated gases thus employed being regulated by suitable adjustment of the valve d in the direct exhaust discharge pipe d' from the engine.

The oil for use in the generators, which as has been indicated, will generally be crude petroleum, is conveniently kept in a reservoir A', from which it is supplied to the first of the series of generators A through a supply line a^5 by means of a pump a^6, such oil being thence conducted serially through the inner chambers of the respective generators in a direction opposite to that in which the waste gases are conducted from the engine. To this end connecting pipes A^2 formed with loops are provided between the generators, by means whereof a predetermined level of oil may be maintained in the chamber next preceding the same, such loops having air vents a^7 to prevent siphonic action. Stop valves a^8 and check valves a^9 are also provided in the

connections in question, the use of which will be obvious. By means of these and other valve-controlled connecting pipes a^{10}, either of generators A may be cut out of the circulation, as will be evident. The last generator of the series is provided with valve-controlled outlet pipe a^{11} through which the contents of such generator may be withdrawn as desired, into a second reservoir, or storage tank A^3. A branched pipe a^{12} connected with outlet pipe a^{11} is similarly adapted to drain either of the other generators should such last one of the series be cut out.

The vapors arising from the several generators A are conducted throughout pipes a^{13}, and a common line A^4 wherewith the latter are connected, to a retort or superheater E, which may be of any suitable form, but which is shown as consisting of two chambers e e' one above the other, through which the vapor in question is adapted to be serially passed, thence being conducted by a pipe e^2 to the explosion engine D previously referred to as providing the heating medium for the several generators. While it is contemplated that such retort may be heated by any suitable form of furnace, employing any of the usual fuels, in my preferred arrangement, I propose to employ an oil burner E′, wherein is used as fuel the oil drained from the last of the series of generators A, such oil being supplied to the burner by means of a pump e^3 from the reservoir A^3 into which it is collected.

The operation of the power plant as thus described, should be fairly obvious. By means of the arrangement of generators A and connections for supplying oil thereto from reservoir A′, it will be seen that the oil will pass in succession through such generators whatever their number, encountering successively higher temperatures, so that the oil finally discharged from the last of their series will be deprived of all its more volatile constituents, these being conducted and intermingled in the common line A^4 leading to the superheater E. Here they are subjected to such a temperature as to fix them, so that when admitted finally to the engine D, a gas suitable in every way for use in forming an explosive mixture for the latter is provided. At the same time that the volatile constituents of the original body of oil are being thus utilized, the heavier oil remaining over from the last of the series of generators, is conducted as needed to the burner E′, wherewith retort E is heated, so that none of the constituents are wasted. By means of the various connections between the reservoir A^3 and the several generators A, as also between the latter and the fresh fuel supply line a^5, one or more of the generators may be temporarily cut out of service without interfering with the operation of the plant as a whole. It will of course be understood that a suitable correlation will be had between the rate of fuel supply and the degree of impoverishment finally arrived at in the treatment of the oil in the generators, so as to leave over approximately a sufficient amount of heavier oil for use in the burner below the superheater. Obviously, then, such arrangement of apparatus provides for maximum economy in the utilization of fuels of the class in hand.

In the second typical installation illustrated in Fig. 2, I employ, as has been indicated, a different construction of generator (here designated B), such construction differing from the one shown in the previously described installation, in that the heating medium is here conducted through an inner drum b, the oil body, from which the vapor is generated, lying in the chamber b' surrounding such drum. The level, moreover, of oil in such chamber, is maintained by means of a unique construction of overflow B′, connected, one with each generator B, and adapted to be supplied with oil by means of a corresponding pump b^2 from either of two reservoirs B^2 B^3. Connections b^3 are provided for returning to the particular reservoir from which the oil thus happens to be drawn, the excess from the overflow, as also connections b^4 for similarly returning the excess bypassed from the pumps b^2 and not admitted to the overflow at all, as will be readily understood.

The exhaust gases from engine D are utilized as before as the heating medium, being conducted through the respective inner heating drums b of the generators B by means of a branched pipe b^5 leading from the engine. Similarly the vapors arising from the oil chambers b' of the respective generators are collected and conducted through a line B^4 to a retort or superheater E, before being admitted to the engine. In this case, however, I do not propose to rely wholly on the suction of the engine, to thus draw the vapors from the generators through the connecting lines and the retort, but interpose between the generators and such retort a compressor and pump F of familiar design, whereby gas may be supplied to the engine without imposing any burden upon the latter, and whereby such gas may even be supplied under pressure, if so desired, the compressor being controlled or governed in the latter case by such pressure in the usual manner.

In this plant again, the impoverished oil is designed to be utilized as the fuel for the burner E′ beneath the retort E, such impoverished oil being supplied thereto by a pump e^3 as before, from one or the other

of the reservoirs B^2 B^3, depending upon the particular manner in which the generators B are being supplied therefrom; for, as should be explained, the arrangement of connections between the generators admits of various methods of using the latter. Thus, either generator, with the corresponding feed apparatus, may be regarded a unit for operative purposes, which unit if desired, may be utilized alone in supplying the engine with the gas required for operating the same. Such use would be only practicable, however, where a relatively high grade of oil was employed. While there would not be the heavy residuum in such case as where the cruder product is used, there would, of course, be certain constituents less readily volatilizable than others, which constituents would be conducted to the reservoir not in use, and thence supplied to the burner as required in the same fashion as in the previously described arrangement of apparatus.

When emp'oying the cruder oils, however, for which the apparatus in hand is more particularly designed, it is contemplated that both generators will be simultaneously supplied with oil, the one with fresh or unimpoverished oil, and the other with oil from which the more volatile constituents have been removed by previous operation in the other generator, such grades of fuel being respectively stored in the two reservoirs and supplied to the generators at a rate such as to maintain a circulation of the oil body and a gradual continuance of their impoverishment. At the same time that the generators are being thus supplied the necessary fuel for the burner beneath the superheater will be withdrawn from the reservoir containing the impoverished residuum, which can, as before, be economically utilized in this fashion. By the time that such residuum has been disposed of, the first reservoir will have reached the stage of impoverishment rendering it necessary to have a fresh body of oil in order to keep up the richness of the mixture supplied to the engine through the several intervening apparatuses. Fresh oil is accordingly now put in the second reservoir, and connection with the oil burner switched from such second to the first reservoir, which will now contain the more nearly exhausted fuel body.

In the arrangement of apparatus illustrated in Fig. 3, a simpler form of generator than either of those previously illustrated is shown, such generator comprising, in fact, a single unit (here designated C) of the kind appearing in Fig. 1. Oil is supplied thereto from a reservoir C′ by a pump c^6 and feed line c^5, as before, preferably being circulated at a rate such as only gradually to impoverish the relatively large body contained in such reservoir. As such impoverishment proceeds, the degree of heat applied to the generator will be correspondingly increased by suitably controlling the valve d in the direct exhaust opening d' of the engine that furnishes such heating medium to the generator. When, finally the limit of economical impoverishment has been reached, the residual body of oil in reservoir C′ is transferred to a second reservoir C^2, and a fresh body of oil placed in the first, permitting a repetition of the generator operation just described. From such second reservoir the oil is supplied to the burner E′ under retort E as before, whither the vapors rising from the generator are conducted by a line C^2 to be superheated and fixed. In the present instance, I propose to locate the compressor and pump F, by which the gases are forced through the system, on the farther side of such retort, and instead of supplying the gas therefrom directly to the engine, a holder G of any suitable form is interposed in the line f leading therefrom, and the gas then taken as desired to the engine by another line g. While this use of the holder is particularly appropriate in connection with the type of generator shown, the operation of such generator being of necessity, intermittent or discontinuous, it will of course be understood that such a holder may be, if desired, utilized in connection with either of the other arrangements of apparatus. So, too, the inclusion or omission of the compressor F is determined by the requirements of each particular installation. Quite irrespective, however, of any variation in these or other details of the plant, it should be obvious that the cooperative effect of the generator, engine, and superheater, especially where the latter is supplied with fuel in the manner hereinbefore described, is the avoidance of waste and the conservation of energy at every point. The economy thus secured, it is contemplated, will render the use of liquid fuels of the character in hand, not only more desirable in localities where such fuel is at present employed, but also feasible in situations that have not as yet been exploited.

Fig. 4, in addition to showing yet another form of generator H, illustrates also another disposition of the pump and compressor F, namely before the generator in the series of mechanisms that constitute the plant. Generator H consists of a chamber separated by an inclined partition h (see Fig. 5) into two chambers h' h^2. The oil is supplied to the generator from a reservoir H′ by a pump h^3 and pipe h^4 as usual, being received in the generator on the corrugated plate or partition h down which it flows in a more or less attenuated stream to the outlet pipe h^5. As the oil thus passes over plate h, the exhaust from engine D is passed through the lower chamber h^2 and simultaneously therewith air, in predetermined

quantity, is forced through the upper chamber h' by compressor F. Such air, charged with the vapors arising from the oil, is thence conducted by line H^2 to the retort E and finally to the engine. The retort, by way of variation, is shown as being heated by an ordinary furnace E^2 instead of an oil burner, it being intended that the oil shall be reduced to a practically worthless residuum by the generator.

It has already been observed that my improved system of oil-gas generation, as it may with propriety be termed, is susceptible of various modifications to meet the demands of different installations, as for example the variation shown in the location of the compressor and pump F, the omission or inclusion of the holder G and the form of vaporizer or generator, proper, that is employed. Similar flexibility obtains in other particulars such as the use of tar extractors and gas purifiers, which may be included at a suitable point in the gas line from the superheater to the engine. It will be understood, furthermore, that in speaking of retort E as a superheater it is not intended to indicate that the vapors passed therethrough are of necessity all rendered a fixed gas, or in other words, that the vaporized liquid hydro-carbons are "cracked" into other, permanently gaseous, hydro-carbons. Such treatment may be necessary or desirable where the engine is located at a distance, or where the gas requires to be stored for a considerable period of time, but it is contemplated that more often only an approximation of this condition will be desired. In this event a lower temperature in the retort will suffice. The term superheater is intended, accordingly, to refer to any suitable heating means interposed in the line between the vaporizer and engine to more thoroughly gasify the fuel than would be the case were it supplied to such engine direct from the vaporizer.

Finally, I should call attention in connection with the retort to the unique and highly satisfactory arrangement which I employ to clear the latter of the deposit of carbon or heavy hydro-carbons such as is apt to form therein incidentally to the super-heating of the oil vapors. Such arrangement consists simply in the provision of means for supplying air, unmixed with vapor, directly to the retort, whereby any such deposit may be oxidized and thus expeditiously cleared away. The means provided for thus supplying air to the retort may take on various forms in the different types of apparatus hereinbefore described. In that shown in Figs. 1 and 2, an auxiliary air inlet pipe e^3 joined with vapor line A^4 (or C^2 as the case may be) just previously to the entrance of the latter into the retort, constitutes the means in question. Valves e^4 and a^{14} (or c^7) in such inlet pipe and line, respectively, afford the necessary control for shutting off the one supply when the other is open. It will be understood, however, that under some circumstances an admixture of air with the vapor previously to the passage of the latter through the retort may be desired. In such event valve e^4 will be always left partly open. This will not be necessary, where, as in Fig. 2, air-inlet openings b^7 are formed in the generators themselves. Here, moreover, I employ a double-acting compressor F, and so am enabled to utilize one cylinder of the same for forcing air into the retort by the inlet pipe e^3, which connects with the vapor line B^4 just as with line A^4 or C^2. In Fig. 4, on the other hand, air may be supplied to the retort in any desired quantity along with the vapor, or exclusively when it becomes desirable to clean out the retort in the fashion just described, suitable valves h^6, h^7, h^8 being adapted thus variously to control the discharge from the compressor.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the means and the steps herein disclosed, provided those stated by any one of the following claims or their equivalents be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. In apparatus for producing gas from oil, the combination of an explosive engine, an oil gas generator connected to be heated by the exhaust from said engine, a line for conducting the vapor from said generator to said engine, a superheater interposed in such line, and means for utilizing the impoverished oil from said generator to heat said superheater.

2. In apparatus for producing gas from oil, the combination of an explosive engine, an oil gas generator connected to be heated by the exhaust from said engine, a line for conducting the vapor from said generator to said engine, a superheater interposed in such line, an oil burner for heating said superheater, means for supplying oil to said generator, and means for suppying the oil, after passing through the latter, to said burner.

3. In apparatus for producing gas from oil, the combination of an explosive engine, an oil gas generator connected to be heated by the exhaust from said engine, a line for conducting the vapor from said generator to said engine, a superheater interposed in such line, an oil burner for heating said superheater, a reservoir for oil, means for maintaining a circulation of the body of oil in said reservoir through said vapor generator until the mass becomes too impoverished to yield vapor of the required richness, and

means for supplying the residual body of oil to said burner.

4. In apparatus for producing gas from oil, the combination of an explosive engine, an oil gas generator connected to be heated by the exhaust from said engine, a line for conducting the vapor from said generator to said engine, a superheater interposed in such line, an oil burner for heating said superheater, two reservoirs for oil, means for maintaining a circulation of the body of oil in either of said reservoirs through said vapor generator until the mass becomes too impoverished to yield vapors of the required richness, and means for supplying the residual body of oil thus left in either reservoir to said burner.

5. In apparatus for producing gas from oil, the combination of an explosive engine, an oil gas generator connected to be heated by the exhaust from said engine, a line for conducting the vapor from said generator to said engine, a superheater interposed in such line, and means for inducing a circulation of vapor through said generator and superheater independently of said engine.

6. In apparatus for producing gas from oil, the combination of an explosive engine, an oil gas generator connected to be heated by the exhaust from said engine, a line for conducting the vapor from said generator to said engine, a superheater interposed in such line, and a pump and compressor for inducing a circulation of vapor through said generator and superheater independently of said engine.

7. In apparatus for producing gas from oil, the combination of an explosive engine, an oil gas generator connected to be heated by the exhaust from said engine, a line for conducting the vapor from said generator to said engine, a superheater interposed in such line, and means for cutting off said generator from said superheater and supplying air to the latter.

8. In apparatus for producing gas from oil, the combination of an explosive engine, an oil gas generator connected to be heated by the exhaust from said engine, a line for conducting the vapor from said generator to said engine, a superheater interposed in such line, and a pump and compressor for inducing a circulation of vapor through said generator and superheater independently of said engine, said pump and compressor being also adapted to supply air, unmixed with vapor, to said superheater.

Signed by me this 23rd day of December, 1908.

FRANK H. BATES.

Attested by—
MARY GLADWELL,
JNO. F. OBERLIN.