May 22, 1956 E. E. RICHARDSON ET AL 2,746,852

OIL GAS PROCESS AND APPARATUS

Filed July 8, 1954 4 Sheets-Sheet 1

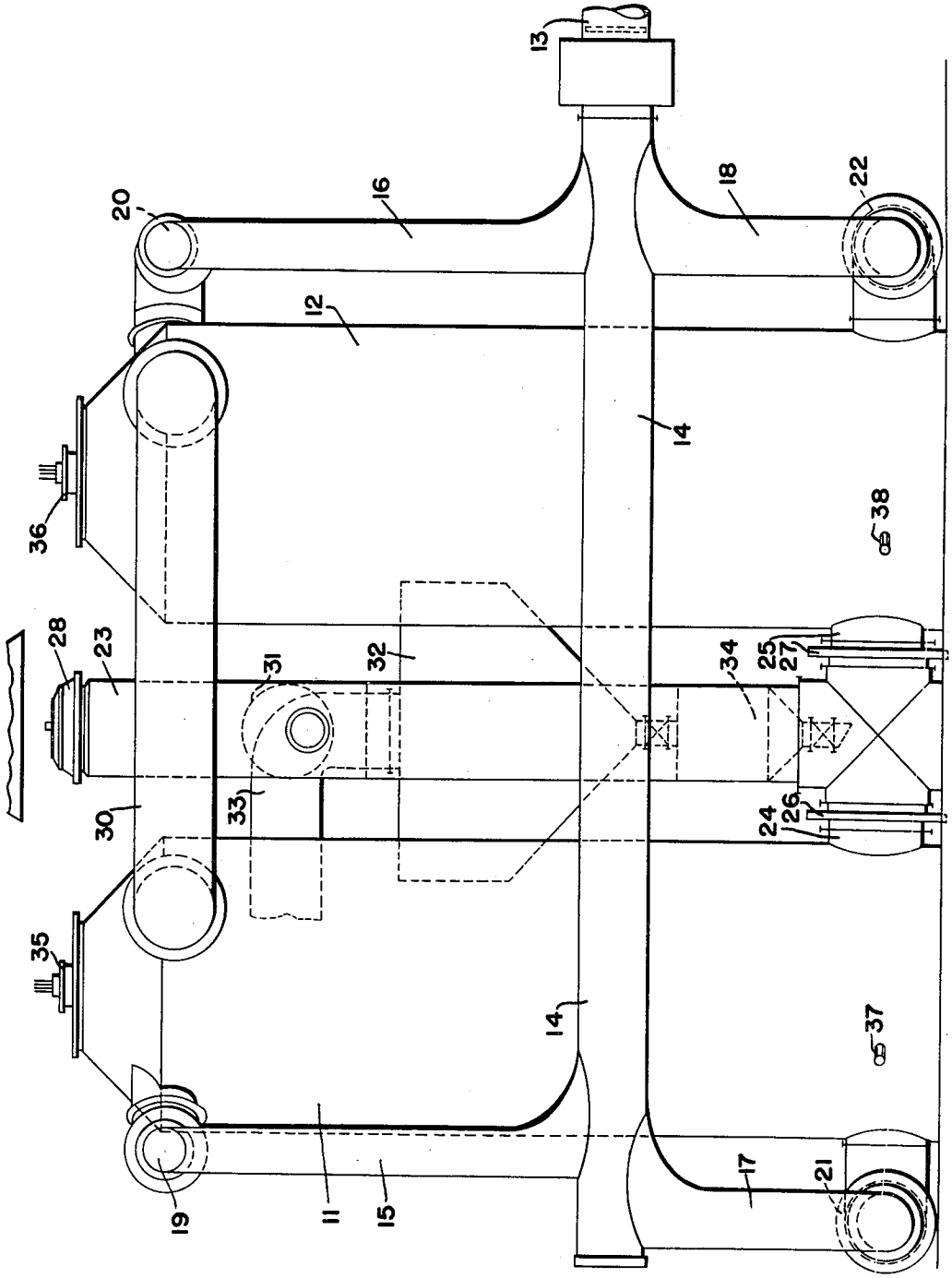


FIG. 1

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OIL GAS PROCESS AND APPARATUS

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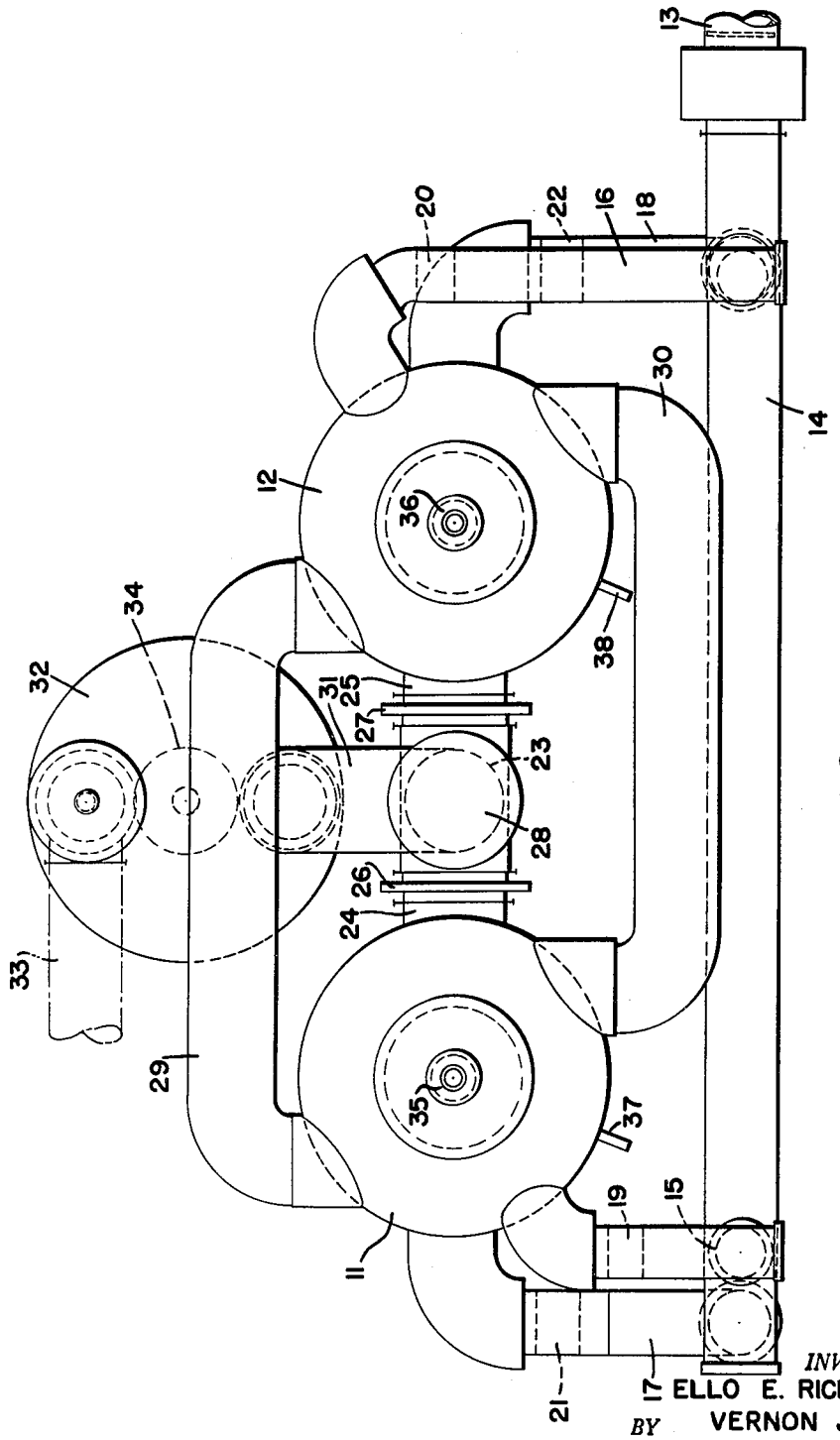


FIG.2

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OIL GAS PROCESS AND APPARATUS

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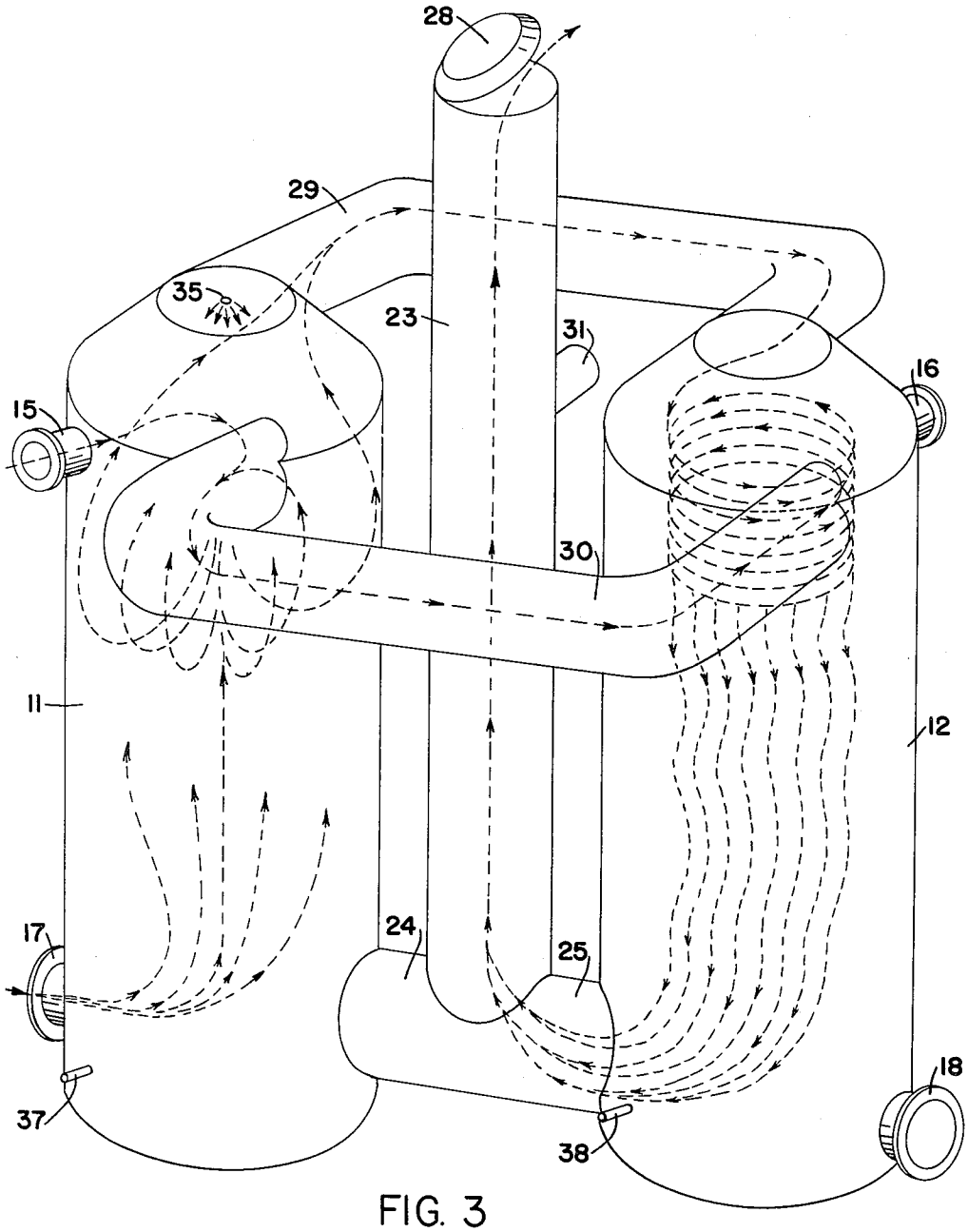


FIG. 3

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OIL GAS PROCESS AND APPARATUS

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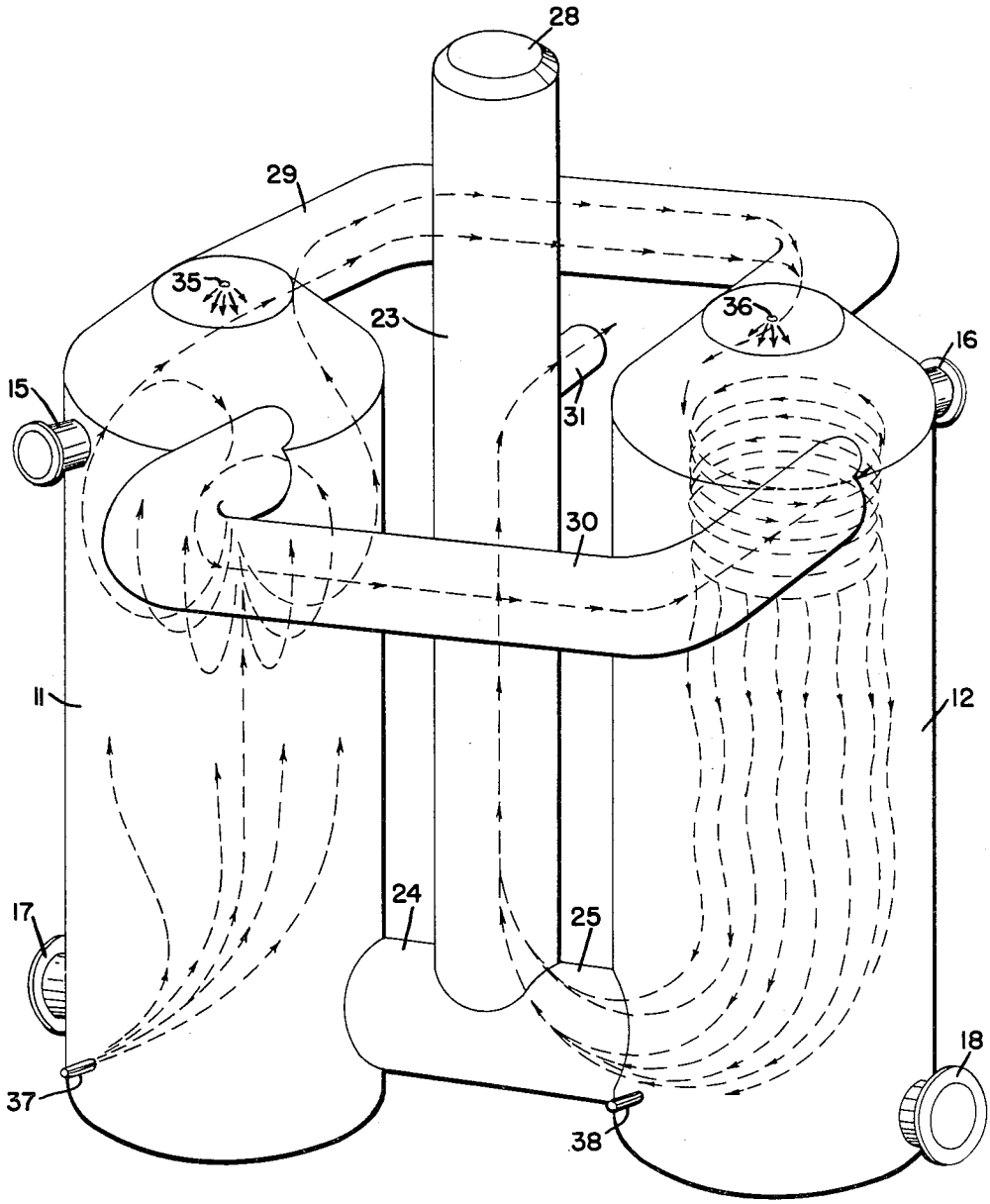


FIG. 4

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OIL GAS PROCESS AND APPARATUS

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Application July 8, 1954, Serial No. 441,996

4 Claims. (Cl. 48—215)

The present invention relates to a new and improved process for making oil gas and to the apparatus for carrying out said process.

As is known, oil gas may be made by the controlled pyrolytic treatment of a hydrocarbon oil in a heated chamber or twin regenerative sets having two heated chambers, which are alternately heated and alternately used for making oil gas. One such set is shown in the U. S. application for patent filed October 3, 1949, Serial No. 119,364, in the names of Kenneth W. Stookey, Robert T. Kyle and William E. Steinwedell and now Patent No. 2,714,058.

In all oil gas processes it is desired that the chambers, or shells as they are usually called, be heated uniformly so that substantially the same temperature exists throughout any particular horizontal cross-section and so that there is a substantially uniform temperature gradient from the top to the bottom of the shells.

The shells usually contain quantities of refractory heat storage materials such as checkerbrick or the like, and these materials, as well as the refractory lining of the shells, are heated to the desired oil treating temperature by introducing heat oil or other fluid fuel into the shell, burning said fuel and passing the hot combustion products through the refractory structure. The fuel is usually sprayed into the shell in admixture with air, either centrally at the top of the shell or at the side near the top of the shell. In either case, the flame and hot combustion gases do not pass uniformly down through the checkerbrick or other refractory material and, thus, there are variations in temperature at any particular horizontal cross-section. This, in turn, means that when make oil is introduced for conversion into oil gas, it will be subject to non-uniform pyrolytic treatment.

It is therefore an object of the present invention to provide a process for making oil gas and apparatus for carrying out said process in which the shells, and the refractory material therein, are heated more uniformly at any particular horizontal cross-section and also are heated to a more uniform temperature gradient between the tops and bottoms of the shells than was possible heretofore.

By virtue of the present invention, it is not only possible to exercise greater control over the process but also to obtain a more uniform oil gas product.

The present invention enables one to avoid, or at least greatly reduce, the disadvantages mentioned above by providing a method of and means for uniformly heating the shells whereby a more uniform and homogeneous product is obtained. To accomplish these results, the combustion products of blast air and fluid fuel are subjected to a high degree of turbulence so as to give the gases a very uniform temperature throughout and then introducing the gases into the top of the zone to be heated in a substantially uniform helical or spiral flow so that the gases are distributed substantially uniformly across the zone. The gases then pass uniformly down through the checkerbrick and impart a uniform temperature increase at each succeeding horizontal cross-section of the checkerbrick.

This process may be carried out in a twin regenerative set, as referred to above, in which case the fluid fuel is introduced downwardly into one shell against an upflowing current of air. Combustion takes place in the top of the shell, and the products or gases are conducted with turbulence to the top of another shell into which they are introduced tangentially to provide the helical or spiral flow, thus producing uniform distribution of the gases across the shell.

The present invention will be described more fully hereinafter with particular reference to the accompanying drawings in which:

Figure 1 illustrates a front elevation of a gas set according to the present invention;

Figure 2 illustrates a top plan view of the set shown in Figure 1; and

Figures 3 and 4 illustrate diagrammatically and in perspective the flow of gases within the set during a heating stage and a gas making stage, respectively.

With reference to Figure 1 of the drawings, two shells 11 and 12 are provided, each having checkerbrick structures or other refractory structures therein, as is conventional in oil gas sets. The checkerbrick may extend only about halfway up the shells or may extend to a point a short distance below the top thereof. An air supply line 13 connects with a manifold 14 provided with side conduits 15, 16, 17 and 18 which are provided, respectively, with valves 19, 20, 21 and 22. Conduits 17 and 18 enter the bottoms of the shells beneath the checkerbrick therein, either in a radial direction, as shown in the drawings and particularly in Figure 2, or in a tangential direction, if desired. The upper conduits 15 and 16 enter the tops of the shells in a radial direction, as best shown in Figure 2.

A riser pipe 23 is located between the shells, extending upward to a point at least as high as the tops of the shells 11 and 12, or higher if preferred. The bottoms of the shells are connected to the bottom of the riser pipe 23 by conduits 24 and 25, provided with hot valves 26 and 27, respectively. The riser pipe, of course, is provided with a conventional stack valve 28.

The tops of the shells are connected by conduits 29 and 30, although three or more conduits may be employed, if desired.

Conduit 29, as shown in Figure 2, enters the top of shell 11 tangentially and enters the top of shell 12 tangentially. Likewise, conduit 30 enters the tops of each shell tangentially. It is to be noted that when gases or fluids pass through conduits 29 and 30 at the same time from shell 11 toward shell 12, the gases or fluids enter shell 12 tangentially so as to complement each other. As shown, the direction of flow within shell 12 will be counter-clockwise. In a similar manner, when gases or fluids pass from shell 12 toward shell 11, the direction of flow within the shell 11 will be counter-clockwise. If desired, the arrangement of conduits 29 and 30 may be such as to produce a clockwise direction of gases or fluids within the shells. It is important to note that the point where conduit 29 enters shell 11 is substantially diametrically opposed to the point where conduit 30 enters shell 11. Also, conduit 29 enters shell 12 diametrically opposite to conduit 30.

The term "tangential" as used herein and as applied to the arrangement of conduits 28 and 30 means any direction which will produce a spiral or helical flow of the gases entering the top of the shell through said conduits.

The conduits 29 and 30 have substantially the same length, size and construction so that substantially equal volumes of gas at substantially equal velocities will pass therethrough when the set is in operation. Thus, the arrangement of the two conduits ensures an evenly balanced distribution and uniform flow of the gases in the tops of the shells.

If more than two conduits are used, they are arranged

so as to provide for a balanced, uniform distribution of gases, as explained above.

In this connection it will be noted that conduits **15** and **16** enter their respective shells at points equidistant from the points where conduits **29** and **30** are connected to the shells. If desired, conduits **15** and **16** may be arranged tangentially so that the air entering therefrom will pass in a clockwise direction.

Leading off from the riser pipe **23** is a conduit **31**, leading to a conventional wash box **32**, which is provided with a tar removal tank **34** and a gas outlet **33**.

At the tops of the shells **11** and **12** there are provided oil spray inlets **35** and **36**, respectively for introducing a hydrocarbon oil for making oil gas during the gas making portion of the cycle and for introducing a fluid fuel, such as hydrocarbon oil, tar or gas, during the blasting or heating-up portion of the cycle, as will be described more fully below. The spray inlets are two separate devices, one for the make oil and one for the fluid fuel, which, as shown in the drawings, are built into a single unit; if desired, however, two or more separated spray devices may be used. At the bottom of each shell are provided steam inlets **37** and **38**, respectively.

The apparatus described above may be operated in the following manner to produce oil gas. The process includes, in general, a four-stage cycle comprising a forward heat or blast run, a forward make run, a reverse blast run and a reverse make run, the first two stages being illustrated diagrammatically in Figures 3 and 4.

The forward blast run succeeds the reverse make run and is carried out, as shown in Figure 3, by introducing air through conduit **17** to the bottom of shell **11** and passing it upwardly therethrough. During passage upwardly through the checkerbrick structure in shell **11**, the air is preheated by the hot checkerbrick and burns off any carbon that may have been deposited therein during the preceding reverse make run. Additional air may be introduced, if desired, through conduit **15** to the top of shell **11**. A fluid fuel, such as a hydrocarbon oil, tar or gas, is introduced through spray means **35**. Combustion of the fuel takes place in the presence of the air rising through shell **11**, and the hot combustion products and gases pass in two streams through conduits **29** and **30** to preceding reverse make run. Additional air may be inenter the top of shell **12** tangentially at diametrically opposed points, flow in a helical or spiral path, and are evenly and uniformly distributed over the top of the checkerbrick structure. The gases then pass downwardly through the checkerbrick in shell **12** and supply heat uniformly thereto.

It will be seen that the turbulence occurring during the combustion of the fuel in the top of shell **11**, the passage of the combustion gases in at least two streams over to shell **12**, and the tangential introduction of said gases into the top of said shell all contribute to give the gases in shell **12** a very uniform temperature which is necessary to heat the checkerbrick uniformly.

The combustion gases then pass through conduit **25** to riser pipe **23** and are vented through stack valve **28**. When the desired temperature, of the order of from about 1500° F. to 1800° F., or higher, has been attained in the top of shell **12**, the air and fuel are cut off and the set is ready for the forward gas make run.

At this stage of the cycle, a short steam purge is usually carried out by introducing steam into the bottom of shell **11** at **37**, so as to clear the set of products of combustion.

In the forward gas make run, as illustrated in Figure 4, make oil is introduced through both spray means **35** and **36**. The relative quantities of oil introduced through the two spray means may be varied within wide limits—for example, by introducing a greater amount of make oil into the shell which has just been heated than is introduced into the other shell, or vice-versa.

All of the outlets at the bottom of shell **11** are closed off by the various valves, so that the oil sprayed into

shell **11** will be partially vaporized and partially converted to oil gas by the residual heat in the top of the shell. The gases and fluids then flow out in two streams through conduits **29** and **30**. If desired, steam may be introduced through inlet **37** so as to prevent any substantial downward flow of oil vapors and/or oil gas through shell **11**, the steam rising through the shell and passing in admixture with said vapors and gas through the conduits **29** and **30** into shell **12**. The gases and vapors, with or without steam, enter shell **12** tangentially and flow downwardly from the top of shell **12**. The make oil that is introduced into the top of shell **12** is preferably in the form of a solid cone so as to be spread substantially evenly over the entire cross-section of the shell.

The mixed gases pass downwardly through the heated checkerbrick in shell **12** where they are pyrolyzed and fixed into oil gas which then passes through conduit **25** to the bottom of riser pipe **23**. Since the stack valve **28** is now closed, the oil gases pass out of the riser pipe **23** through conduit **31** and down into wash box **32**, as shown in Figures 1 and 2, which functions as a water seal and also accomplishes the partial removal of tar and condensibles. The gases leave the wash box **32** via conduit **33** and are passed to storage or to a distribution system.

At the conclusion of the forward make run, when the temperature of shell **12** has decreased to a degree at which the production of oil gas is no longer efficient, a reverse blast run, preceded by a short steam purge, is carried out in the manner shown in Figure 3, except that the entire procedure is reversed—the steam entering shell **12** through conduit **38** and the air entering shell **12** via conduit **18** and passing upwardly therethrough. The air, during its travel, burns any carbon which may have been deposited in said shell during the preceding make run.

Fluid fuel is introduced through spray means **36**. Secondary air may be introduced, if desired, through conduit **16** into the top of shell **12**. Combustion of the fuel takes place in the presence of the air at the top of shell **12**, and the hot combustion products and gases pass in two streams through conduits **29** and **30** to the top of shell **11** where the gases enter tangentially at diametrically opposed points. The gases have a very uniform temperature and are distributed evenly and uniformly over the top of the checkerbrick structure in shell **11**. The gases then pass downwardly through the checkerbrick, are withdrawn at the bottom through conduit **24**, riser pipe **23**, and are then vented through stack valve **28**.

When the temperature of shell **11** has been raised to the desired degree, the reverse blast is stopped, and, if desired, a short steam purge is carried out by introducing steam through line **38**.

A reverse make run is now carried out in the manner shown in Figure 4, except that the procedure is reversed. Steam may, if desired, be introduced at **38**; the make oil introduced at **36** is partially vaporized and gasified in shell **12** and then leaves said shell together with the steam, in two streams via conduits **29** and **30** where they are introduced tangentially into the top of shell **11** and where additional make oil is introduced through spray means **35**. The combined oil gases pass downwardly through the heated checkerbrick of shell **11**, thence, via conduit **24**, riser pipe **23**, conduit **31**, wash box **32** and outlet **33**, to storage.

The tangential introduction of the two streams of combustion products into the top of shell **12** during the forward blast run and into the top of shell **11** during the reverse blast run produces a far more uniform heating of the respective shells than had been possible in previously known apparatus. With radial introduction, it was impossible to prevent a large proportion of the air and combustion products from taking a fixed course through one section of the shell, while a much smaller proportion would pass through a different section of the shell, thus producing an uneven heating of the checkerbrick.

Such would also be the case if only one tangential inlet for the air were provided. Thus it will be seen that when the shell is heated unevenly, one portion becomes far hotter than other adjacent portions. This, in turn, leads to uneven pyrolytic treatment of the make oil during the make runs and results in a non-uniform gas product composed of gases which have been over-treated, over-cracked or under-cracked. However, when the combustion products are introduced tangentially in two or more uniform streams at uniformly spaced points around the top of the shell, a far more uniform flow throughout the entire shell is obtained by which the shell is uniformly heated and then results in a more uniform pyrolytic treatment of the make oil.

The uniformity of the oil gas product obtained by the present invention is a result not only of the uniform heating of the shells, as noted above, but the uniformity of the product is also improved by the introduction of the steam, oil vapors and oil gas tangentially and uniformly into the shell as received from the other shell to form a homogeneous and uniform mixture with the fresh make oil, which uniform mixture passes uniformly downwardly through the checkerbrick as during the preceding blast run.

Although the present invention has been described with particular reference to the drawings, it will be understood that various alterations and modifications are to be included herein. For example, the present description refers to two shells, each functioning as a gas generator in the top section and as a superheater or fixing zone in the lower section, but one might use a four-shell set connected in series wherein two of the shells function as gas generators and the other two shells function as superheaters.

The present application is related to U. S. application 382,116 filed September 24, 1953 in the name of Ello E. Richardson and entitled "Oil Gas Process and Apparatus."

The scope of the present invention is limited only by the claims appended hereto.

What is claimed is:

1. A method of producing oil gas in a set provided with a pair of shells, A and B, each containing checkerbrick

therein, said process comprising a heat run to heat shell A by passing air upwardly through shell B, introducing a fluid fuel downwardly into the top of said shell B, withdrawing the combustion products in a plurality of streams from the top of shell B, introducing said streams of combustion products substantially tangentially into the top of shell A to produce helical flow in the top thereof, passing the combustion products down through the checkerbrick of shell A and venting said gases, carrying out a make gas run by introducing make oil into the tops of shells A and B, withdrawing oil vapors and oil gas produced in shell B in a plurality of streams from the top of shell B and introducing said streams of oil vapors and oil gas substantially tangentially into the top of shell A to produce helical flow in the top thereof where said oil vapors and oil gas are admixed with the make oil, vapors and gases obtained from the make oil introduced into the top of shell A, passing said mixture of oil gases downwardly through shell A and withdrawing said oil gases from the bottom of shell A, passing said gases to storage, heating shell B by carrying out the first mentioned heat run in the reverse direction, then making oil gas by carrying out said make gas run in the reverse direction and then repeating the cycle of steps.

2. A method as claimed in claim 1 wherein two streams of combustion products are withdrawn from shell B and are introduced tangentially into the top of shell A at diametrically opposed points thereof.

3. A method as claimed in claim 2 and further comprising introducing additional air into the top of shell B during the tangential introduction of said two streams of combustion products into shell A from shell B, said additional air being introduced at a point equidistant from the two outlets from shell B from said two streams of combustion products.

4. A method as claimed in claim 1 and further comprising introducing steam into the bottom of shell B while introducing make oil into the top of shell B and passing said steam upwardly therethrough thus causing said make oil vapors and oil gas generated in shell B to be withdrawn from the top thereof in a plurality of streams.

No references cited.