W. B. PRICE AND E. DIETZ.

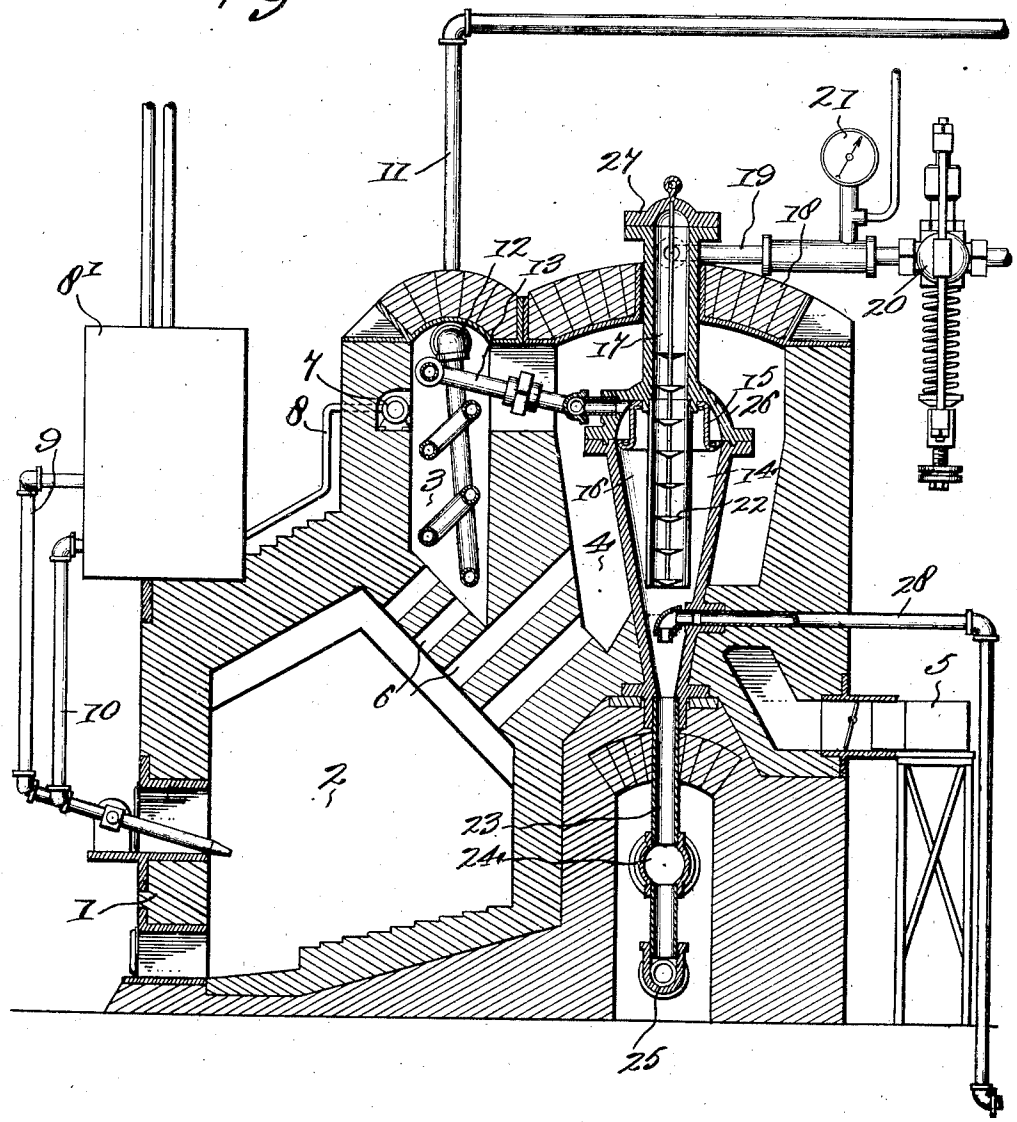
PROCESS AND APPARATUS FOR CONTINUOUSLY CRACKING OILS.

APPLICATION FILED JULY 6, 1916.

1,349,294. Patented Aug. 10, 1920.

3 SHEETS—SHEET 1.

Fig. 1.



Witness
Edwin J. Beller.

Inventors.
E. Dietz and
W. B. Price.
by Wilkinson, Gisela & MacKaye
Attorneys.

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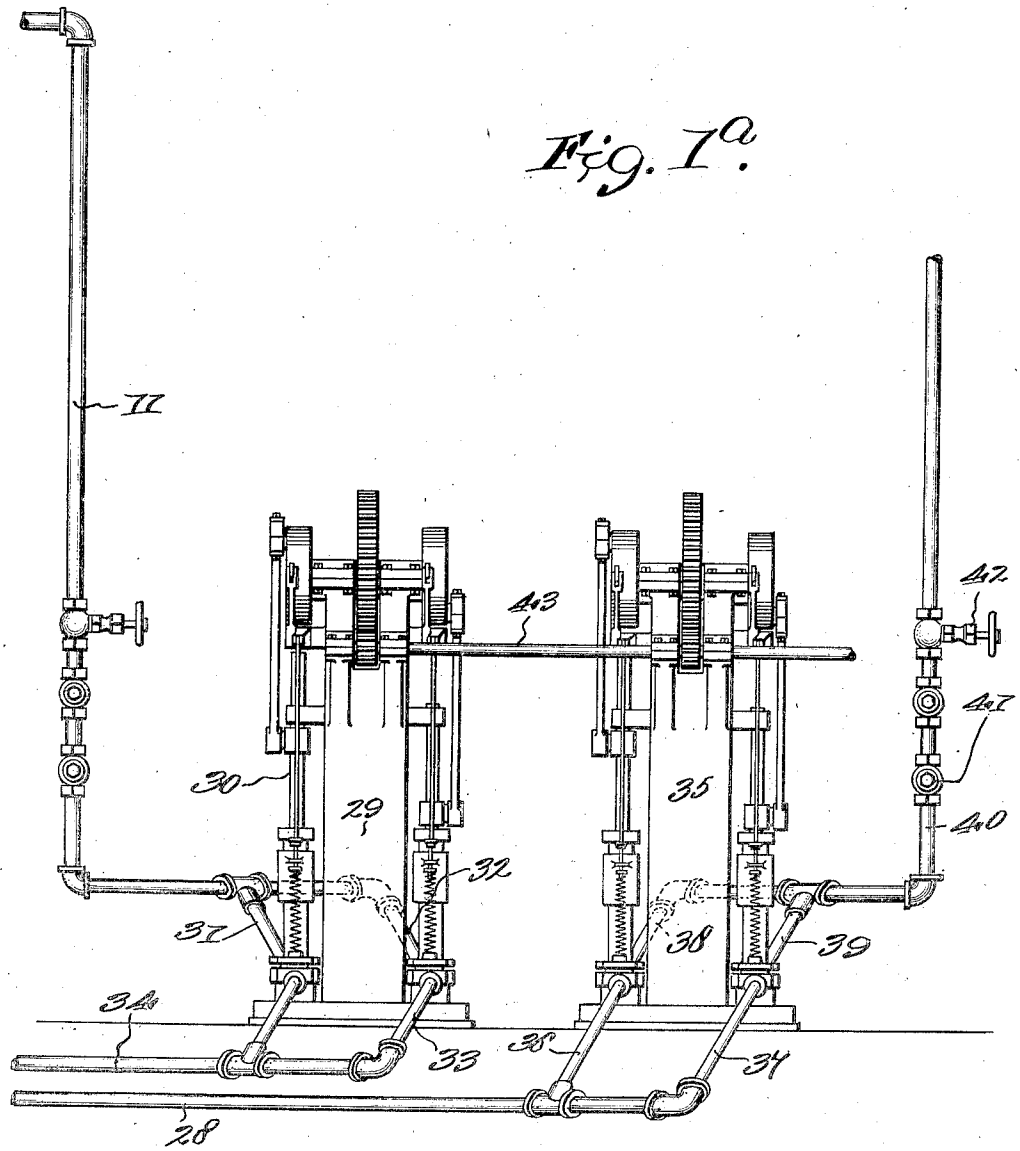
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3 SHEETS—SHEET 2.

Fig. 1a.



Witness
Edwin J. Beller

Inventors.
E. Dietz and
W. B. Price.
by Wilkinson, Gjusta & Mackay.
Attorneys.

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3 SHEETS—SHEET 3.

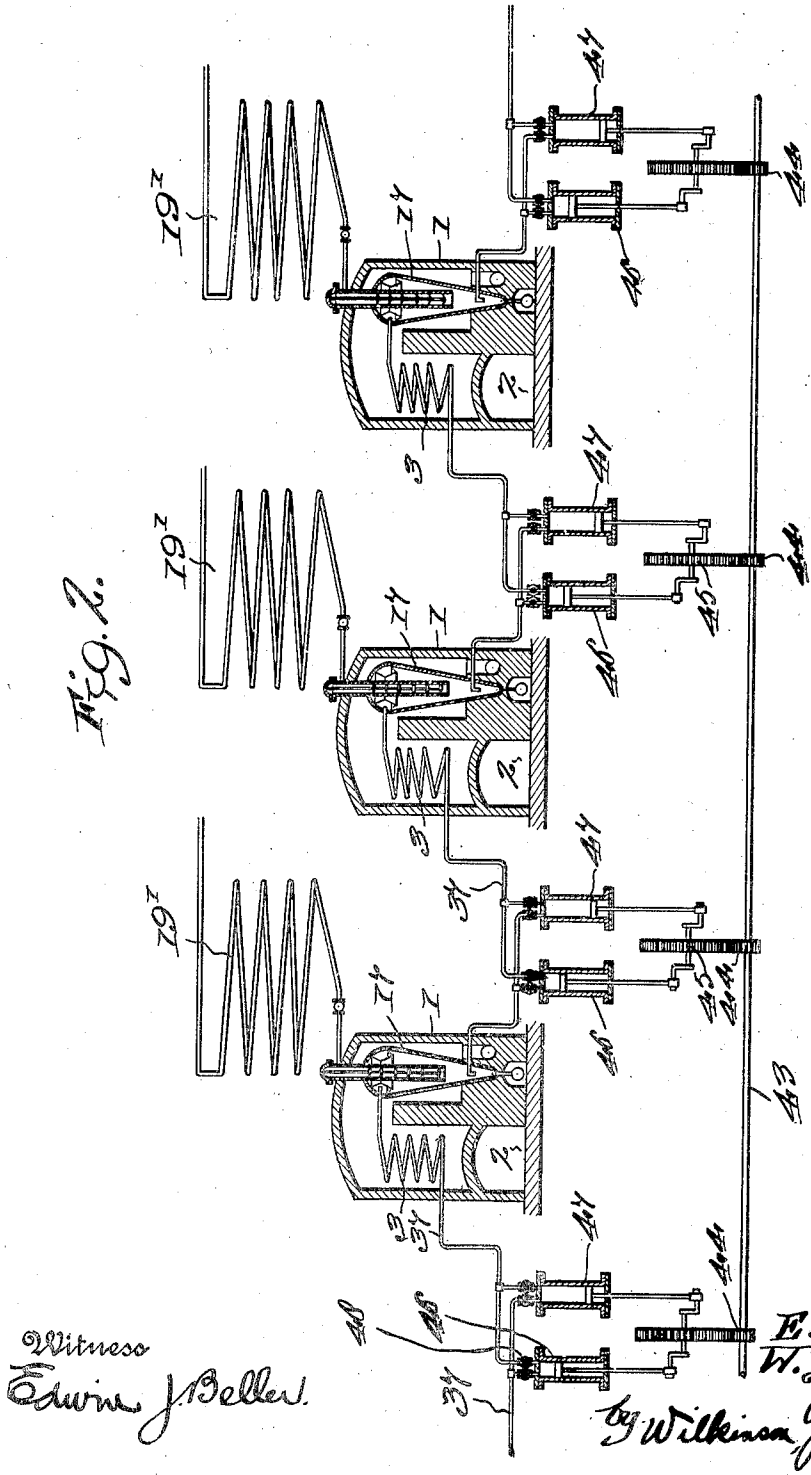


Fig. 2.

Witness
Edwin J. Beller.

Inventors
E. Dietz and
W. B. Price.
by Wilkinson, Giusta & Mackay
Attorneys

UNITED STATES PATENT OFFICE.

WALTER B. PRICE, OF LOS ANGELES, CALIFORNIA, AND ERNEST DIETZ, OF NEW ORLEANS, LOUISIANA.

PROCESS AND APPARATUS FOR CONTINUOUSLY CRACKING OILS.

1,349,294. Specification of Letters Patent. Patented Aug. 10, 1920.

Application filed July 6, 1916. Serial No. 107,845.

To all whom it may concern:

Be it known that we, WALTER B. PRICE and ERNEST DIETZ, citizens of the United States, residing at Los Angeles and New Orleans, in the county of Los Angeles and parish of Orleans, States of California and Louisiana, respectively, have invented certain new and useful Improvements in Processes of and Apparatus for Continuously Cracking Oils; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to processes of cracking oils continuously under such conditions that we obtain a continuous supply of lighter hydrocarbons of substantially uniform quality, and under conditions such that we are able to convert a very large percentage of heavy hydrocarbon oils into lighter oils. Our invention also includes the apparatus.

Our invention is particularly directed to the conversion of heavy distillates, particularly those from southern and western oils, into gasolene.

In carrying out our process in the apparatus which we show herewith, we carry into said apparatus a stream of oil of the character indicated, and we subject the oil of this stream to heat and pressure in a series of cracking retorts, the heat and pressure being constant for each retort but gradually increasing in the series. We take off at each station in the series, that is, at each retort, a percentage of gasolene, the pressure and temperature being set at each retort to effect the conversion in that retort, of as large a percentage as is practicable under the conditions imposed by the factors which govern such conversion at this stage. We move the residuum, that is, that portion which is not converted, from each stage to the next by means of a pump, since this movement has always to be against pressure.

Another factor to be considered, and which is important in the present connection, is the element of time. In fact, given material of constant quality, the chief factors are pressure, temperature, and time in determining the character and quantity of the product. By time is meant the period during which any part of the heavier oil is exposed to the effect of a given temperature under a given pressure. This factor is controlled by the extent of heated surface with which the oil is brought into contact, and also by the rapidity of the flow.

We may carry our process through successive stages until but a very small percentage of the original oil is left. As the process proceeds through these different stages, the hot residuum becomes more and more difficult and refractory, until it reaches a condition at which economic conversion cannot be effected. We may use up in our process, however, more than eighty per cent. of a hydrocarbon of the character referred to. The final residuum may be used for fuel, or road making, or be thrown away. The residuum is always hot when removed.

It is to be observed that the product at each stage is substantially uniform with the product of the other stages. That is, while the passing oil changes in character as it goes through the different stages, we achieve uniformity in result by modifying, as may be necessary, the three factors before mentioned, to bring about such uniformity.

Another feature of our invention, is the provision of means by which the gases produced by the conversion are purified or freed from their sulfur, by being brought into contact while they are still gases, with suitable metallic oxids of sufficient extent of surface, whereby the sulfur, in reducing said oxids, is removed from the vapors.

For making our cracking or freeing retort, we employ a substance which has a somewhat catalytic effect upon the liquids which flow over it. Many substances have this effect, but we find the cheapest and most convenient to be steel.

We are enabled by using the apparatus, which we have indicated, in carrying out the process which, with the apparatus, constitutes the subject of our invention, to reduce the danger of fire from explosion, to a very large extent, because the material which

we treat is, for the most part kept in a vaporous condition, and the quantity of liquid present in our apparatus, as such is comparatively small.

The foregoing constitutes certain objects of our invention. Others will be developed.

In the drawings:

Figure 1 represents in section the furnace which we employ;

Fig. 1ª is a continuation of said view, showing certain pumps; and

Fig. 2 is a diagrammatic showing, on a reduced scale, of several reduction units and pumps alternately in series.

In the drawing, 1 is a brick furnace provided with a refractory lining. In this furnace are provided the combustion chamber 2, the preheating chamber 3, and the main or reduction chamber 4. The stack or flue connections are shown at 5. The passages shown at 6, connect the combustion chamber to the preheating chamber 3 and the main chamber 4. The furnace gases pass from the furnace 2 partly into the preheating chamber and partly into the main or reduction chamber 4, and thence pass out through an opening, not shown, in this section, to the flue and stack.

We arrange in one of the walls of the furnace, at some desirable point, and preferably either in the preheating chamber or the main chamber, a thermostat 7, arranged to control through the pipe 8 a feed regulating device 8′, in any suitable manner.

We have shown our furnace heated by oil. The oil is conducted through the pipe 9 by means of steam through pipe 10, and the flow of oil and steam are controlled by any suitable device 8′, not shown in detail, in response to the thermostat 7, so that the temperature of the preheating chamber, and consequently of the furnace, is kept substantially constant by regulation of the fuel supply.

From a suitable source, and by means to be referred to later, through the pipe 11, we lead a supply of oil to be treated. The pipe 11 enters the preheating chamber at 12, and passes in a coil through said chamber and out through pipe 13 into the retort 14. Our retort 14 we make of the shape shown in Fig. 1, and make the walls of said retort inclined toward the bottom.

The fluid entering through pipe 13 is conducted behind a baffle plate 15, whence it is distributed about the retort and permitted to trickle over the edge of said baffle plate down the sides 16 of the retort. As the oil trickles down these sides, it is subjected to the catalytic action of the steel walls of the retort, and at the temperature maintained in this main furnace, and under the pressure determined by a pressure valve, it becomes converted into lighter hydrocarbons. These more volatile constituents become vaporized at the temperature and under the pressure, maintained just sufficient to produce this effect. For the escape of these vapors we provide the tube 17, extending from the central or lower portion of the retort up through the removable roof 18 of the furnace. From this tube we lead another tube 19, and in said tube 19 we arrange a fluid pressure valve 20, which we set for the pressure best suited for this stage. The gases are then led off through the same pipe 19 to a condenser 19′. We may provide a pressure gage 21, if desired.

In the tube 17 we arrange a series of trays 22, for holding metallic oxid, or other purifying agent. The gases pass up the tube 17, pass through and around the material on the trays, and any sulfur which the gases contain is caught and fixed by the substance on the trays; if the latter be metallic oxids, corresponding sulfids are, of course, formed.

The lower part of the retort is continued in a pipe 23, which may be provided with a shut-off valve 24. The bottom of this pipe or tube is closed by a suitable cap 25, which may be removed if the pipe or retort becomes clogged, for cleansing purposes. The top 26, of our retort, is also removable, together with the tube 17 carried thereby, for cleansing and re-charging trays 22, the top 18 being removed. We may also provide the tube 17 with a separable top 27, if desired.

The residuum from the treatment fills the lower part of the retort over the mouth of the tube 28. From the tube 28 said residuum may be passed by a suitable pump to the second furnace and retort of the series.

For getting the material into and through the first retort of this series, we preferably employ a pump of the construction shown at 29 in Fig. 1ª. This pump consists of two cylinders so arranged, as indicated in Fig. 1ª, that when the piston of one is up, the piston of the other is down; thus, in the position shown in said figure, the valve on the inlet side of the plunger 30 has just been closed, and said plunger is just beginning its descent to force oil through the branch 31. The valve on the discharge side, 32, of the pump has just been closed, and the valve on the inlet side has just been opened to permit the entrance of a fresh supply of oil on that side. Through the pipe 11, the plunger on the left is beginning to force oil, while oil is entering the other cylinder of this pump 29 through a branch 33 of the oil intake pipe 34.

Since the current of oil is moved forward against pressure which rises step by step, it must be each time pumped or forced into the next retort. We arrange a pump similar to the pump 29 after every retort, therefore, though it may be omitted after the final

one. Such a pump is indicated at 35 in Fig. 1ª, and in all essential respects is like the pump 29, the pistons being arranged for alternative operation, so that a constant stream of residuum is forced from one station to the next. This residuum comes in through the branches 36, 37, and is forced out through the branches 38, 39, through the pipes 40 controlled by the valves 41, 42.

We preferably arrange these pumps all in line and control their operation by a single shaft 43, driven by any suitable source of power. Said shaft 43 is provided at suitable stations with gear wheels 44. Each of these gear wheels meshes with a wheel 45 mounted on the frame of the pump and carrying the cranks which work the pumps, as shown in Fig. 2.

It will be observed from Fig. 2, that when one piston 46, of any given pump, is near one end of its stroke, the piston in cylinder 47 of the same pump is near the other end of its stroke. It will be seen that the oil entering through the pipe 37 is passing into the cylinder 47, while oil passing from the cylinder 46 goes through the open valve 48 to the pipe 37, and thence on to the next unit of the series. Of course, pumps of any preferred form may be used. We have indicated pumps of simple construction and easily operated.

It will thus be seen that we have provided an apparatus whereby a current of oil undergoing treatment, is constantly and uniformly moved through a series of cracking devices or converters, a portion of said oil being removed at each stage, or in each converter.

It will be seen that we provide means whereby pressure and temperature at each stage may be adjusted to meet the character of the oil which comes from the preceding stage, said oil having lost a portion of its constituents at the preceding stage or in the preceding retort. It is merely necessary to adjust the thermostatic control for each furnace to suit the condition at that furnace, at the same time adjusting the pressure gage to meet like conditions.

Similarly, the feed of the pump must be reduced along the line, since the quantity to be pumped from each stage station diminishes at such station. Thus, if at our first retort, we crack and vaporize, say, twenty-five per cent. of our initial inflow, the pump between the first and second retorts should be adjusted to discharge only three-fourths as much as we discharge by the pump before the first retort. Similar adjustment must be provided for at other stages.

As a specific illustration we give the following example. We have obtained best results operating on a gas oil distillate having a gravity of from 40° to 42° Bé. by a temperature of from 1000° F. to 1150° F. at a rate of feed of two gallons per minute, the resultant pressure being from 75 lbs. to 85 lbs. per square inch.

It will thus be seen that if the character of our heavy oil remains constant, we can impose upon that oil, by the apparatus which we disclose herewith, uniformity of conditions unattainable in other forms of apparatus. Each particle of oil passing through is subjected to a succession of conditions exactly like those imposed upon every other particle passing through; and by adjusting our temperature and pressure controlling means to suit the character of the oil, and adjusting the flow of oil to bring the time during which the oil, in passing through the retorts, is exposed to said conditions of heat and pressure, we can suit our apparatus and process to oils of great variety.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States, is:

1. The process of converting heavy hydrocarbon oils into oils of lower boiling point, which consists in subjecting a stream of such heavier oils to a succession of conditions in that successive portions of the same material are subjected simultaneously to progressively higher temperatures and pressures in a step by step way, to produce a uniform product, and removing the lighter hydrocarbons constantly as they are formed.

2. The process of forming from heavy hydrocarbon oils, purified lighter oils, which consists in subjecting a stream of such heavier oils to a succession of conditions in that successive portions of the same material are subjected simultaneously to progressively higher temperatures and pressures in a step by step way, each set of said conditions adapted to effect production of vapor of substantially identical lighter hydrocarbons, constantly removing said vapors as formed, subjecting them during removal to the effect of purifying agents, and condensing.

3. The process of forming from heavy hydrocarbon oils, purified lighter oils, which consists in subjecting a stream of such heavier oils to a succession of conditions in that successive portions of the same material are subjected simultaneously to progressively higher temperatures and pressures in a step by step way, each set of said conditions adapted to effect production of vapor of substantially identical lighter hydrocarbons, constantly removing said vapors as formed, subjecting them during removal to the effect of metallic oxids, and condensing.

4. The process of cracking heavy hydrocarbon oils, which consists in cracking a stream of said oils under a succession of conditions in that successive portions of the

same material are subjected simultaneously to progressively higher temperatures and pressures in a step by step way, and releasing under regulated pressure light hydrocarbon vapors as fast as they are formed, under said rising conditions, whereby but a small amount of vapor is at any time present in the apparatus and danger is greatly reduced.

5. In a device for converting heavy oils into lighter oils, a retort, said retort having a converging bottom and a continuous deflector plate, means for introducing oil behind said deflector plate and permitting it to distribute itself as a liquid over the converging bottom, a pipe and pressure valve permitting the vapors of said lighter oils, as formed, to escape under constant pressure, a pump for conducting oil in constant stream into the retort, and a pump for constantly taking away residuum into a second cracking retort kept at higher temperature and pressure.

6. A series of cracking retorts, having sides made of catalytic material, a series of pressure valves in connection with said retorts, a series of pumps alternating with said retorts, heating means for all the retorts, and an oil pipe leading through said retorts and pumps, whereby when the gages are set at successively higher pressure, gases formed in the retorts may escape at the successive pressure valves and be led to condensers, while residuum from each retort is pumped in turn against the pressure of the next succeeding valve to the end of the series.

In testimony whereof we affix our signatures.

WALTER B. PRICE.
ERNEST DIETZ.