

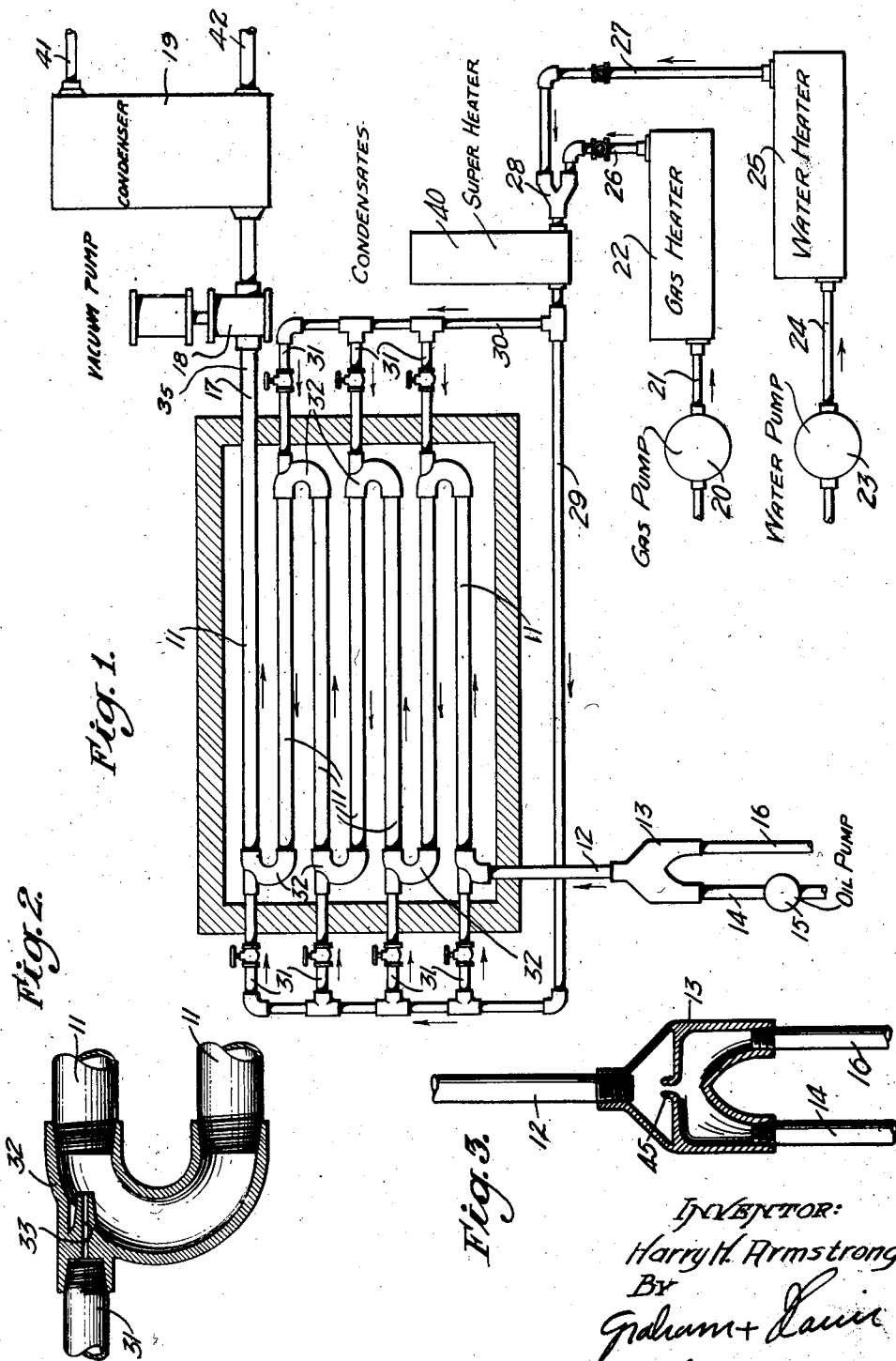
Jan. 4, 1927.

1,613,010

H. H. ARMSTRONG

CONVERSION PROCESS

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UNITED STATES PATENT OFFICE.

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CONVERSION PROCESS.

Application filed July 9, 1923. Serial No. 650,242.

My invention relates to the art of producing a definite hydrocarbon from a mixed series of hydrocarbons. There is at the present time a large demand throughout the world for certain very definite hydrocarbon products, notably motor fuels. Petroleum oils, as produced in nature consist of a large number of hydrocarbons, some of which are lighter than motor fuel and some of which are heavier than motor fuel. The lighter hydrocarbons may be substances normally in gaseous form, as, for example, methane, or they may be substances which are liquid under ordinary conditions of temperature and pressure but which are so volatile that they readily pass into a vapor form such as butane and pentane; or they may be mixtures of these gaseous and liquid substances. My invention relates to a process of producing certain intermediate hydrocarbons, such, for example, as motor fuel, from these lighter and heavier hydrocarbons.

The principal object of my invention is to provide a process by which both the lighter and the heavier hydrocarbons may be used in the manufacture of motor fuel or some other definite hydrocarbon. In the following specification the application of the process to the manufacture of motor fuel will be described without the intention of limiting the invention to this particular application, however.

Further objects and advantages will be made evident hereinafter.

Referring to the drawing which is for illustrative purposes only,

Fig. 1 is an elevation partly in section, showing in diagrammatical form one embodiment of an apparatus suited to carry on my invention.

Fig. 2 is a section through an expander.

Fig. 3 is a section through an exploder.

In the form of the invention shown, I provide a reaction chamber 11, which in the form shown is made up of a continuous pipe. The vapors of a heavy hydrocarbon are supplied to the reaction chamber 11 through a pipe 12 from an exploder. This heavy hydrocarbon, hereinafter sometimes referred to as oil, may be delivered through a pipe 14 from a pump 15 into the exploder 13, and steam may also be supplied to the exploder 13 through a pipe 16. Oil vapors are taken from the reaction chamber 11 through a pipe 17, a pump 18 being in some cases used to draw the vapors from the re-

action chamber 11 and thus maintain a partial vacuum therein. The light hydrocarbon, which may be natural gas or some substance which is of higher Baumé gravity and which is more volatile than the desired product, such as butane, propane or ethane (all of these substances being hereinafter called gas), is delivered through a gas pump 20 and a pipe 21 into a gas heater 22, in which the gas is heated to its decomposition temperature. Water is delivered through a water pump 23 and a pipe 24 into a water heater 25, in which the water is preferably converted into steam. The steam is delivered through a pipe 27, and the gas through pipe 26 to an exploder 28 like exploder 13, into a superheater 40 from which it passes to pipes 29 and 30. From the pipes 29 and 30 the mixture of steam and gas is delivered through pipes 31 into expanders 32. The pipes 31 extend into the expanders 32 and terminate in constricted orifices 33 therein, which project into the path of the oil vapor passing through the reaction chamber 11. The combined products produced in the reaction chamber are drawn by the pump 18 through a pipe 35 through the condenser 19, from which gas is removed through a pipe 41 and condensates are removed through a pipe 42.

The method of operation of the invention when operating to produce a motor fuel is as follows:

Oil, preferably heated above its decomposition temperature and held under a sufficient pressure by the pump 15 to prevent vaporization thereof, is delivered through the pipe 14 to the exploder 13, which is provided with a small orifice 45 through which the oil is violently projected and in which the pressure is released. This sudden expansion of the oil takes place in company with steam or superheated water delivered through the pipe 16. The sudden expansion of the oil and water produces a very intimate mixture of oil and water in a vapor or mist form. This vapor or mist may be at a temperature close to the cracking temperature of the oil, that is to say the temperature at which molecular decomposition starts. This vapor is delivered by the pipe 12 to the reaction chamber 11 and passes through the pipes thereof in the direction shown by the arrows. The gas is delivered through the pipe 21 into the gas heater 22, wherein it may be heated and afterward in-

jected into the reaction chamber 11 through the exploders 32, or the gas may be injected with the water or steam into the exploder 28 and raised to its decomposition temperature by the use of the superheater 40.

The decomposition temperature of heavy oil may be taken, for example, as 700° F., the oil vapor delivered through the pipe 12 being at or somewhat below this temperature. It is necessary to heat the gas to a much higher temperature, butane, for example, requiring a temperature of about 1300° F. for effective decomposition. The temperature of the decomposed gases and steam entering the cracking chamber 11 through the pipes 31 is therefore considerably above the cracking temperature of the oil vapors already present therein. The pipes 29 and 30 are preferably maintained under a pressure in excess of 30 pounds per square inch. This pressure is relieved in the orifice 33, through which the gas and water vapor pass at a very high velocity and in which they are rapidly expanded. The orifices 33 are so directed that they tend to mix the nascent hydrocarbons delivered by the orifices 33 with the hydrocarbon vapors already present in the reaction chamber 11. The introduction of these high temperature nascent hydrocarbon products into the reaction chamber induces a combination between the hot products derived from the light hydrocarbons so introduced and the vapors from the exploder 13 which are already heated to or near the correct cracking temperature. The result is that the heavy hydrocarbons are cracked by the hot products injected therein and combine therewith. The combined intermediate product, if the apparatus is properly regulated, may consist largely of motor fuel or any other desired product which is intermediate between the light and heavy hydrocarbons used. The reaction chamber 11 and other parts are preferably heat insulated, as the introduction of the highly heated light hydrocarbon products is sufficient to maintain the interior of the reaction chamber at the proper cracking temperature. The products delivered to the condenser 19 are separated into gas which is delivered through the pipe 41 and into condensates which are delivered through the pipe 42. These condensates contain water which may be separated from the other condensates by any well known means. A considerable portion of the condensates, however, are the desired intermediate hydrocarbon, or, in the case being considered—motor fuel.

Obviously the process can be supplied to the production of other intermediates than motor fuel, the substance produced being dependent upon the raw materials used and the temperatures maintained. For example, if the temperature in the exploder 13 is in-

creased and the reaction chamber is maintained at a hotter temperature, a product more volatile and of higher Baumé gravity than motor fuel may be produced. On the other hand, by lowering the temperatures, kerosene or other heavy distillate may be produced.

My process is particularly applicable to the utilization of the so-called liquid gases now produced as by products in commercial absorption plants in extracting gasoline from natural gases. These liquid gases are largely propane and butane and are now generally allowed to escape into the air since they are too volatile to remain in the gasoline although isolated therewith. Propane and butane are heavy gases, being one and one-half and twice the specific gravity of air respectively. By using the heavy gases in my process in combination with heavier oils, I am able to produce a motor fuel which is intermediate, as to volatility and specific gravity, between the heavy gas and heavier oils used and which is commercially of great value.

I am not sure as to the principle upon which my invention operates but apparently, since I produce substantially no carbon, it is not a true cracking process but merely a conversion process by which the hydrocarbons of one or more series are converted into other hydrocarbons which are physically different but perhaps not chemically so. Whatever the principle, however, the apparatus shown, if operated as described, will produce motor fuels from gas and oil, these motor fuels being of higher Baumé gravity and of higher volatility than the oil used.

It is, of course, understood that the apparatus is equipped with gauges and thermometers, not shown, so that conditions can be accurately governed. It is also obvious that in any case the exact temperatures and pressures required to produce any desired product from any of the many available combinations of oil and gas must, and can be, readily determined by trial by any one skilled in the art, these given above being merely for illustrative purposes. The scope of my invention should, therefore, be determined wholly by the annexed claims.

I claim as my invention.

1. A process of converting heavy hydrocarbon oils which comprises: heating said heavy hydrocarbons to a temperature slightly below their cracking temperature; passing the vapors of said heavy hydrocarbons together with water vapor into a reaction chamber in which a partial vacuum is maintained; heating light hydrocarbons to a temperature in excess of the cracking temperature of said heavy hydrocarbons; and passing said heated light hydrocarbons into said reaction chamber in such quantities

as to maintain the temperature of said reaction chamber at the cracking temperature of said heavy hydrocarbons.

2. A process for converting heavy hydrocarbon oils, which comprises: heating said heavy hydrocarbons to a temperature approaching the cracking temperature thereof; heating a light hydrocarbon to substantially the cracking temperature of said heavy hydrocarbons; expanding said heated heavy hydrocarbons into a reaction chamber in a manner to atomize said heavy hydrocarbons; and expanding said heated light hydrocarbon into the atomized heavy hydrocarbons in said reaction chamber in such quantities as to maintain the temperature of said reaction chamber at the cracking temperature of said heavy hydrocarbons.

3. A process for converting heavy hydrocarbon oils, which comprises: heating said heavy hydrocarbons to a temperature approaching the cracking temperature thereof; heating a light hydrocarbon to substantially the cracking temperature of said heavy hydrocarbons; expanding said heated heavy hydrocarbons into a reaction chamber in the presence of steam in a manner to atomize said heavy hydrocarbons; and expanding said heated light hydrocarbon into the atomized heavy hydrocarbons in said reaction chamber in such quantities as to maintain the temperature of said reaction chamber at the cracking temperature of said heavy hydrocarbons.

4. A process for converting heavy hydrocarbon oils, which comprises: heating said heavy hydrocarbons under pressure to a temperature approaching the cracking temperature thereof; heating a light hydrocarbon under pressure to substantially the cracking temperature of said heavy hydrocarbons; expanding said heated heavy hydrocarbons into a reaction chamber in a manner to atomize said heavy hydrocarbons, said reaction chamber being maintained at a relatively low pressure; and expanding

said heated light hydrocarbon into the atomized heavy hydrocarbons in said reaction chamber in such quantities as to maintain the temperature of said reaction chamber at the cracking temperature of said heavy hydrocarbons.

5. A process for converting heavy hydrocarbon oils, which comprises: heating said heavy hydrocarbons under pressure to a temperature approaching the cracking temperature thereof; heating a light hydrocarbon under pressure to substantially the cracking temperature of said heavy hydrocarbons; expanding said heated heavy hydrocarbons into a reaction chamber in a manner to atomize said heavy hydrocarbons, said reaction chamber being maintained at a partial vacuum; and expanding said heated light hydrocarbon into the atomized heavy hydrocarbons in said reaction chamber in such quantities as to maintain the temperature of said reaction chamber at the cracking temperature of said heavy hydrocarbons.

6. A process for converting heavy hydrocarbon oils, which comprises: heating said heavy hydrocarbons under pressure to a temperature approaching the cracking temperature thereof; heating a light hydrocarbon under pressure to substantially the cracking temperature of said heavy hydrocarbons; exploding said heated heavy hydrocarbons into a reaction chamber in a manner to atomize said heavy hydrocarbons, said reaction chamber being maintained at a partial vacuum; and exploding said heated light hydrocarbon with superheated steam into the atomized heavy hydrocarbons in said reaction chamber in such quantities as to maintain the temperature of said reaction chamber at the cracking temperature of said heavy hydrocarbons.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 26 day of June, 1923.

HARRY H. ARMSTRONG.