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METHOD OF PRODUCING HYDROGENATED LIQUID HYDROCARBON PRODUCTS

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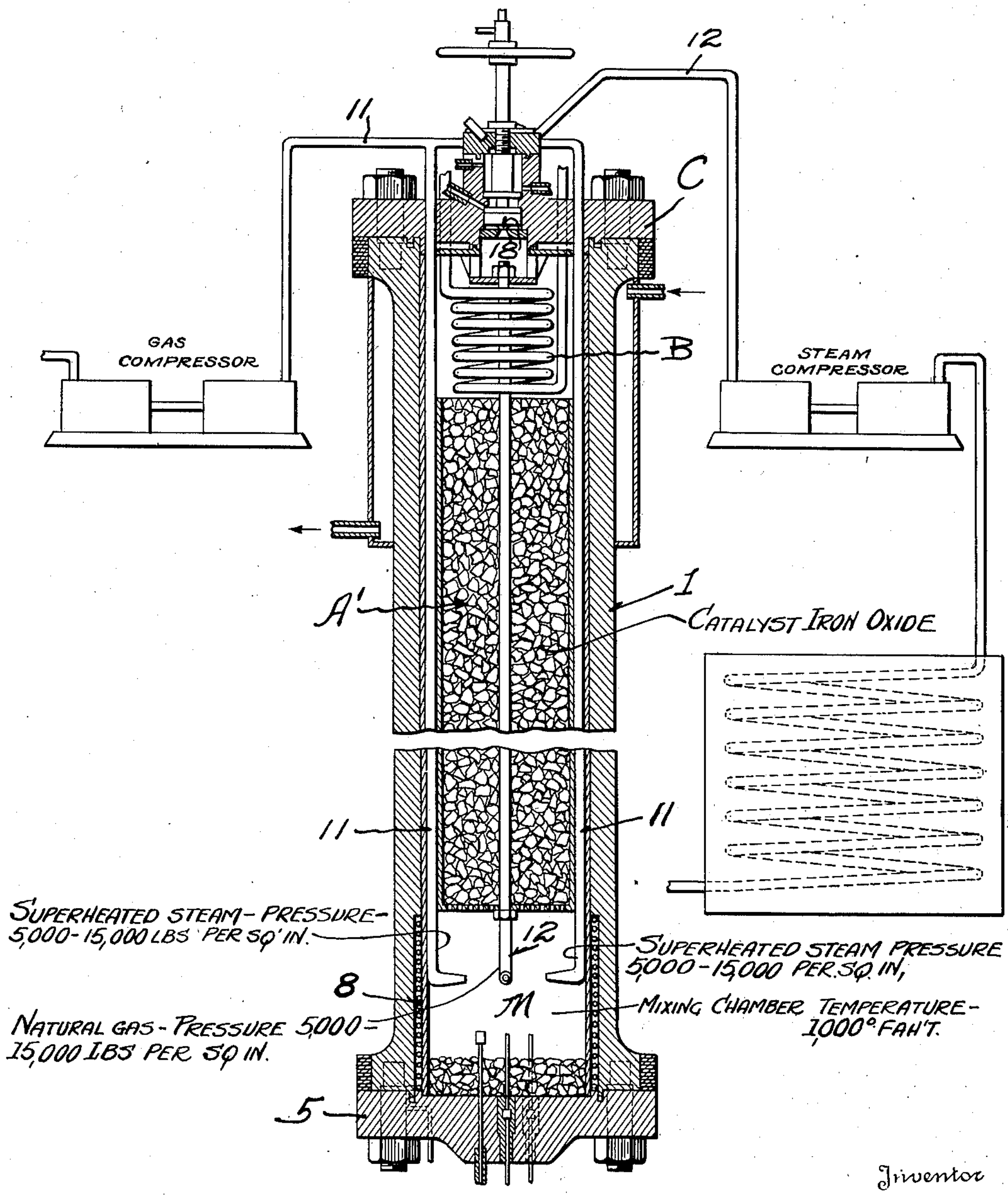

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METHOD OF PRODUCING HYDROGENATED LIQUID HYDROCARBON PRODUCTS

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3 Claims. (Cl. 260—449)

This invention relates to the production of hydrocarbon motor fuels, lubricating oils and the like utilizing natural gas as the basic hydrocarbon material.

Natural gases, depending on their origin contain various hydrocarbons but commonly consist largely of methane with smaller percentages of ethane, propane, etc. According to the present invention it is proposed to use such natural gases to obtain gasoline of high octane value. That is to say, the present invention uses natural gas in conjunction with super-heated steam and a suitable catalyzer to produce a new hydrocarbon gas which can be condensed into a liquid motor fuel of the desired quality.

While any suitable form of apparatus may be utilized to carry out the present processes, reference may be made to the accompanying drawing in which the figure is a view diagrammatically illustrating one form of apparatus which may be conveniently used.

In carrying out the present process, it is proposed to employ a suitable column or retort 1 closed at its upper end by a removable cap or cover structure C and at its lower end by a base member 5. Within the retort there is provided a mixing chamber M heated by suitable electrical heating means 8. Above the mixing chamber M, a suitable catalyst A', for example iron oxide, preferably in nodule form, is mounted in a foraminous basket which is carried by or suspended from the cover C. The cap or cover C is also provided with a valve 18 which may be adjusted relative to its seat with a fine degree of accuracy to control the time during which the gases passing upwardly in the retort are in contact with the catalyst, and to also control the exit of the gases to the condenser. The cover or cap C also carries suitable cooling means B located between the upper end of the catalyst containing means and the valve 18; and, in addition, the said cover or cap C may carry the natural gas inlet pipes 11—11 and the superheated steam inlet pipes 12—12. The said pipes 11—11 and 12—12 each have laterally projecting nozzles at their lower ends all arranged in the same horizontal plane. Thus, when natural gas and super-heated steam issue from the pipes 11 and 12 they will impinge or collide directly upon each other and become thoroughly mixed before ascending through the catalyst A'.

In practice, it is proposed to heat the mixing chamber M to approximately 1,000° F. to 1,100° F. and to introduce the natural gas and superheated steam into the mixing chamber through the nozzles referred to at pressures within the range 5,000–15,000 lbs. per square inch, and preferably within the range of 12,000–14,000 lbs. per square inch pressure, the natural gas and the steam both having a temperature of approximately 1,000° to 1,100° F.

The super-heated steam and the natural gas are both supplied to their respective pipes 11 and 12 under pressure produced by suitable compressors X and Y. Thus, the natural gas and the super-heated steam impinge directly upon each other in the heated mixing chamber M and proceed upwardly through the catalyst A' where, by chemical reaction, the constituent gases become transformed into new hydrocarbon products which may be led off and condensed in an appropriate manner.

Under the conditions of temperature and high pressure and in the presence of the catalyst the methane and other hydrocarbons in the natural gas react with the steam to produce carbon monoxide and hydrogen in equilibrium with various products of the hydrogenation of carbon monoxide. Residual or uncondensed hydrogen is one of the products of my process. The carbon monoxide of water gas has been reduced, or hydrogenated, as in the well known Fischer process under conditions quite different from those maintained in my process. Whereas the Fischer process produces gasoline consisting of a mixture of normal or straight chain hydrocarbons which have such a low actane value that such gasoline has to be cracked or re-formed before it can be used satisfactorily as a motor fuel, the liquid hydrocarbon motor fuel produced by my process does not consist of the normal paraffins and has a very high octane value.

Since natural gas and water or steam alone produce a relatively large excess of hydrogen, I find it advantageous, in one modification of my process to introduce carbon monoxide or water gas in addition to the natural gas and steam. The carbon monoxide thus introduced enters into the reaction and increases the yield of liquid motor fuel. As is well understood by those familiar with the art, water gas, as made from coal and steam is deficient in hydrogen for the purpose of hydrogenating into liquid hydrocarbons and various expedients have been resorted to in overcoming this deficiency, extra hydrogen being added or a portion of the carbon monoxide being removed, or the latter specially treated with steam and a catalyst at comparatively low temperatures to form hydrogen and carbon dioxide, the latter being removed from the mixture before the motor fuel synthesis operation. Under the novel conditions of my process the methane, which is normally the principal constituent of natural gas, reacts with the steam to give normally liquid hydrocarbons and surplus hydrogen.

In practicing this modification of my invention the carbon monoxide may be produced from coal and steam, mixed with some hydrogen or in any other suitable manner. For example, natural gas may be burned with insufficient air, to produce a form of water gas, i. e. a mixture of carbon monoxide nitrogen and hydrogen and water vapor, or a small proportion of air may be introduced into my reaction chamber, but I prefer to use water gas or carbon monoxide and avoid diluting the mixture with inert nitrogen.

In a typical example of my modified process, using natural gas, water and water gas, I have found that six volumes of natural gas and ten volumes of ordinary water gas will give very nearly complete reaction with the production of liquid motor fuel and a slight excess of unused hydrogen, when carried out under the conditions of temperature and pressure specified for my normal operation.

By varying the degree of opening between the head of the valve 18 and its seat, the gases issuing from the catalytic mass may be controlled so as to produce different grades of final product. That is to say, by decreasing the area of valve opening products of higher grade may be obtained due to the fact that the gases are held in contact with the catalyst for a longer period of time while on the other hand, a larger area of valve opening will produce final products of lower grade or quality due to the fact that the constituents of the mixture have been held in contact with the catalyst for a relatively short period.

The hydrogen and oxygen in the superheated steam, and the natural gas, with the aid of the catalyzer, pressure, and heat, transform the mixture supplied to the chamber M into hydrocarbon compounds which, as previously indicated may be led off and condensed to produce a mixture of hydrocarbons suitable for use as a high grade motor fuel of high octane value.

I claim:

1. A process for producing liquid hydrocarbon products which consists in simultaneously injecting natural gas and superheated steam under a pressure in excess of a minimum of 5,000 pounds per square inch into a chamber heated to approximately 1000° F. to 1100° F. and then subjecting the heated mixture to a catalyst of iron oxide and subsequently conducting the catalyzed product to a condenser.

2. A process for producing liquid hydrocarbon products which consists in simultaneously injecting natural gas and superheated steam between a pressure range of from at least 5000 to 15,000 pounds per square inch into a chamber heated to approximately 1000° F. to 1100° F., passing the resultant product through a catalyst of iron oxide in nodule form, and subsequently conducting the catalyzed product to a condenser.

3. A process of producing liquid hydrocarbon which consists in simultaneously injecting natural gas, water and water gas in proportion of six volumes of natural gas and ten volumes of water gas under a pressure in excess of a minimum of 5000 pounds per square inch, into a chamber heated to approximately 1000° F. to 1100° F., then flowing the resultant products through a catalyst consisting of an oxide of an iron group metal. and subsequently conducting the catalyzed product to a condenser.

RENE LEPRESTRE.