

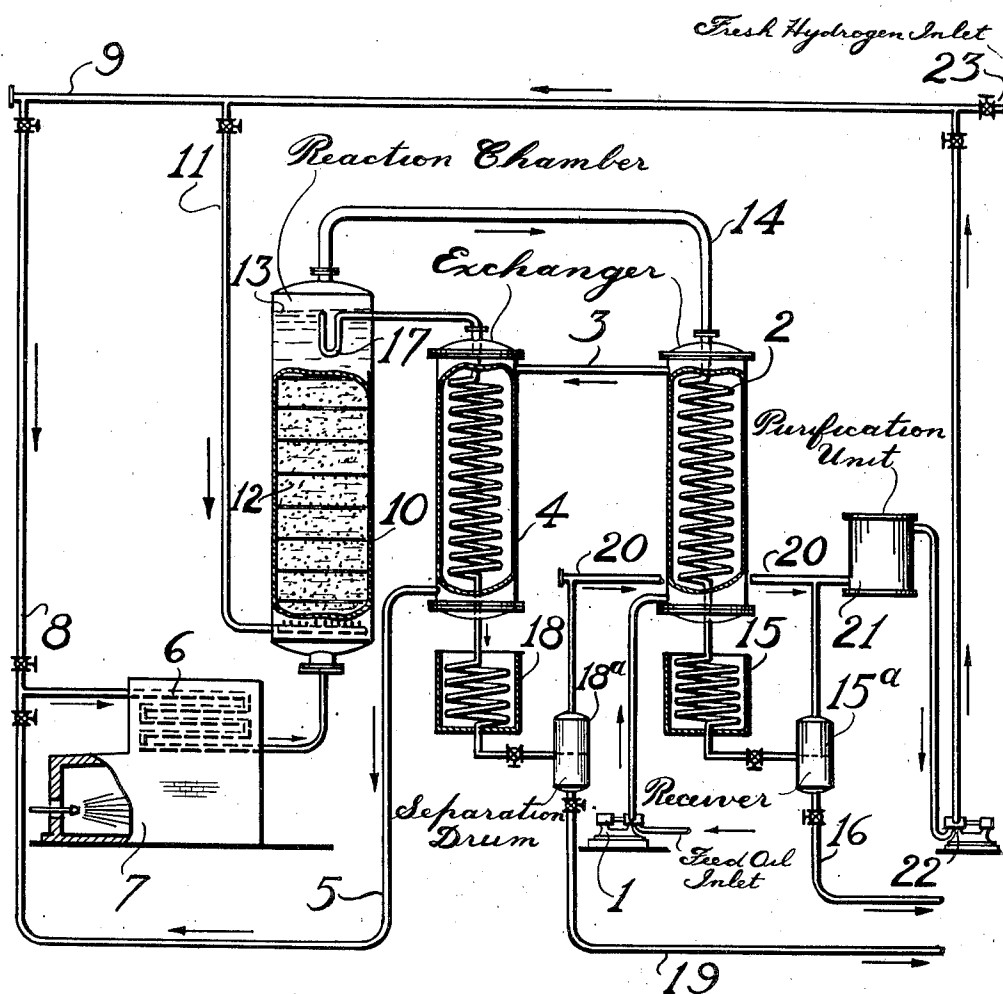
Jan. 23, 1934.

R. T. HASLAM

1,944,236

PROCESS FOR SIMULTANEOUSLY PRODUCING HIGH GRADE MOTOR FUELS AND
LUBRICANTS FROM HEAVY HYDROCARBONS BY THE ACTION OF HYDROGEN

Filed Jan. 25, 1930



INVENTOR
Robert T. Haslam
BY
W. E. Currie
ATTORNEY

UNITED STATES PATENT OFFICE

1,944,236

PROCESS FOR SIMULTANEOUSLY PRODUCING HIGH GRADE MOTOR FUELS AND LUBRICANTS FROM HEAVY HYDROCARBONS BY THE ACTION OF HYDROGEN

Robert T. Haslam, Westfield, N. J., assignor to Standard-I. G. Company

Application January 25, 1930. Serial No. 423,304

6 Claims. (Cl. 196—53)

The present invention relates to an improved refining method for producing low boiling hydrocarbons suitable for motor fuels and at the same time heavier products which may be used for lubricants. More specifically the invention comprises an improved process for the refining of oils with high pressure hydrogen at elevated temperature.

My invention will be fully understood from the following description and the drawing.

The drawing is a semidiagrammatic view in sectional elevation of an apparatus constructed to carry out my invention and indicates the flow of the various materials.

There have been previous disclosures of the fact that heavy hydrocarbons might be converted to low boiling liquid distillates suitable for motor fuels by the action of high pressure hydrogen at elevated temperatures with or without suitable catalytic materials. It is also known that heavy oils can be refined by the action of high pressure hydrogen for the production of superior grades of motor and other oils which are marked by their similarity to the Pennsylvania type of lubricants with respect to the relation between viscosity and temperature. While these two types of processes bear some similarity it has been hitherto believed impossible to simultaneously produce a naphtha suitable for high grade motor fuels and a lubricating oil of a Pennsylvania or paraffin-base type. The reason for this belief lies in the fact that the lubricating oils are generally of a saturated nature, while the better types of motor fuels, which are characterized by low knocking tendencies are composed generally of unsaturated hydrocarbons. I have succeeded in producing excellent oils both for motor fuel and for lubricating purposes in a single operation.

Turning now to the drawing, reference character 1 indicates a pump which forces feed oil from any convenient source through a heat exchanger 2, line 3 and a second heat exchanger 4. The preheated oil is then conducted by pipe 5 to a heated coil 6 which may be mounted conveniently in a furnace setting 7. Hydrogen is forced into the inlet of the heating coil by a line 8 which is fed from a hydrogen manifold 9. The mixture of oil and gas then passes into a reaction chamber 10 which is adapted to withstand pressures of 2,000 to 3,000 pounds per square inch at elevated temperatures of say 700 to 850° F., as well as the corrosive effects of the oil and gas. Additional hydrogen may be forced into the drum by a line 11 which is also fed from the manifold 9. Drum 10 is preferably filled with a suitable

catalytic material which may be in the form of small cubes say $\frac{1}{2}$ to $\frac{1}{4}$ inch in size. The nature of this material will be fully disclosed below. It is also preferable to hold the level in the drum as indicated at line 13 thereby maintaining the drum substantially filled with liquid oil and to remove vapor and gas by a vapor line 14 which is in connection with heat exchanger 2, condenser 15 and receiver 15a from which the liquefied product may be withdrawn to the light oil storage tank, not shown, by line 16. Heavy oil in a liquid condition is also withdrawn from drum 10 preferably through a trap line 17 as shown in the drawing. The line 17 is in communication with heat exchanger 4, final cooler 18 and receiver or separation drum 18a. From this drum the heavy lubricating oil is removed to storage, not shown, by line 19. Gases from the two receiving drums—15a and 18a respectively, are withdrawn to a manifold 20 and are conducted thereby to a purification plant 21. The purification unit is shown in a diagrammatic form and may consist simply of an oil scrubbing system adapted to operate at an elevated pressure whereby the major quantity of hydrocarbons and hydrogen sulfide are removed from the gas. Purified gas comprising hydrogen with less than 1 or 2% of impurities is recompressed by a booster pump 22 and again forced into the hydrogen manifold 9. Fresh or makeup hydrogen may be added under high pressure through a line 23.

In the operation of my improved process the feed stock preferred is a heavy distillate substantially free from asphaltic or tarry materials, although it will be understood that materials of a tarry nature may be used. In the latter case the load on the hydrogenation unit is greater and the loss will be correspondingly increased. The heavy oil is chosen in accordance with the product desired and it will be understood that in all cases the lubricating oil produced by this process is less viscous than the oil fed. The stock may contain considerable quantities of sulphur and the catalysts are comprised of sulphur immune materials, that is, materials that are operative or adequately active in the presence of sulfur compounds such as chromium, molybdenum and tungsten oxides, either alone or in mixtures with each other or with other materials such as alkali or alkaline earth oxides or aluminum oxides, zinc oxides and the like. The oil is fed at a rate of .2 to .8 volumes per volume of reactor per hour, say .5 as an average, to produce highest grade materials and if lower grade materials are required the feed rate may be so m-

creased, as will be understood. The temperature of the drum is ordinarily in excess of about 700° F. and is preferably within the range of about 750 to 850° F. Pressures in excess of 50 atmospheres are used at all times and preferably the pressure is in excess of 200 atmospheres.

An excess of hydrogen over that actually required to react with the oil is always fed and it is of particular importance to maintain the rate of gas circulation at a high rate. For example: the amount of gas circulated should be not less than about 10,000 cubic feet per barrel of oil fed to produce the better grades of naphtha with high anti-detonation characteristics. I have found that gas recirculation rates from 10,000 to 15,000 cubic feet per barrel of oil are desirable and gas and vapor formed should be removed from the reactor immediately.

The total volume of oil produced by the process is generally slightly greater than 100% of the volume of the feed. The feed rate and temperature are adapted to produce a quantity of naphtha boiling below say 400° F., ordinarily from 5 to 15% of the total oil, but may be somewhat higher, say to 20% in some cases. The naphtha is highly unsaturated, as shown by high bromine numbers and sulphuric acid absorption. The gum content is low and when distilled to the proper end point and finished by steam distillation or equivalent methods the naphtha shows high anti-detonation characteristics. For example, the naphtha may be of a quality equivalent to gasoline obtained from ordinary sweet crudes to which 10-20 or even 40% of benzol has been added. The heavy oil removed from the system may be reduced to the proper viscosity by distillation at atmospheric pressure or under vacuum and may be finished in the customary manner with acid or with clay, but it ordinarily requires less treatment by either or both of these methods than fractions of the same viscosity obtained from most crude oils by ordinary methods now in use. The grade of the oil obtained is somewhat dependent on the nature of the oil fed, but it is possible to produce lubricating oil, equivalent in every respect to the Pennsylvania oils, from Texas Coastal, Winkler and Venezuelan crudes or such crude oil fractions and it is especially when bringing in such low grade oils that the motor fuel produced has markedly high anti-detonation characteristics. Although the method shown is continuous it will be readily understood that a batch method may be satisfactorily used.

My invention is not to be limited by any theory of the mechanism of the reaction nor to any specific example which may have been given merely for illustrating purposes, but only by the following claims in which I wish to claim all novelty inherent in my invention.

I claim:

1. A destructive hydrogenation process for

simultaneously producing improved lubricants and high grade naphthas suitable for motor fuel from heavier hydrocarbon oil which comprises maintaining a liquid body of such oil in a reaction zone at a temperature in excess of 700° F. and under pressure in excess of 50 atmospheres, forcing a gas rich in hydrogen through the body of oil at a rate so rapid that the vapors of lighter hydrocarbons are swept out of the liquid as fast as formed, immediately removing the vapors from the reaction zone and subjecting the remaining liquid to the hydrogen treatment for a materially longer period.

2. Process according to claim 1 in which the heavy oil is continuously fed to and withdrawn from the system at a rate from .20 to .80 volumes per hour per volume of the reactor.

3. Process according to claim 1 in which the rate of gas flow is not less than about 10,000 cubic feet per barrel of oil fed.

4. An improved destructive hydrogenation process for simultaneously producing superior grades of lubricating oils and naphthas of high anti-detonation characteristics from heavy hydrocarbon oil which comprises passing such oil through a reaction zone containing a catalyst immune to sulfur poisoning maintained at a temperature between the limits of 700 and 850° F. and at a pressure in excess of 50 atmospheres, maintaining the reaction zone substantially filled with liquid oil, passing a gas rich in free hydrogen through the zone at a rate not less than 10,000 cubic feet per barrel of oil fed, and separately removing oil both in liquid and vapor form.

5. Process according to claim 4 in which a distillate oil free of asphaltic material is used as the feed stock.

6. In a destructive hydrogenation process for producing valuable lubricating oils from heavy unrefined hydrocarbon oil by subjecting such unrefined oil to the action of hydrogen at destructive hydrogenation temperatures and pressures and limiting the formation of hydrocarbons boiling below 400° F. to below about 20 percent, the method of obtaining such low boiling hydrocarbon as are formed in a condition in which they are especially suitable for motor fuel and are characterized by high anti-detonation value simultaneously with the formation of valuable lubricating oil which comprises regulating the oil feed rate to between .20 and .80 volumes per volume of reaction space per hour, circulating hydrogen through the reaction space at a rate not less than 10,000 cubic feet per barrel of oil, while maintaining the reaction space substantially filled with liquid oil, whereby the low boiling hydrocarbons formed are removed as vapor from the reaction space substantially as fast as formed and are obtained in a substantially unsaturated condition.

ROBERT T. HASLAM.