Nov. 13, 1928. 1,691,085

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PROCESS OF TREATING HYDROCARBONS

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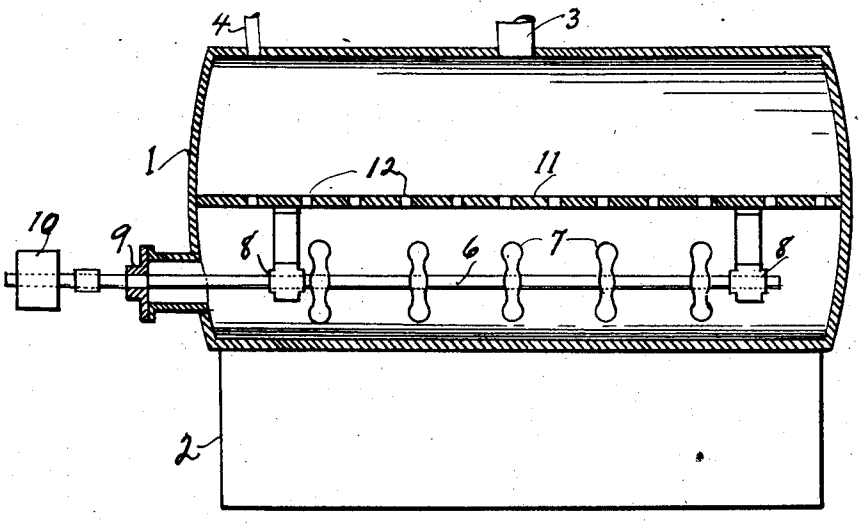


Fig. 1.

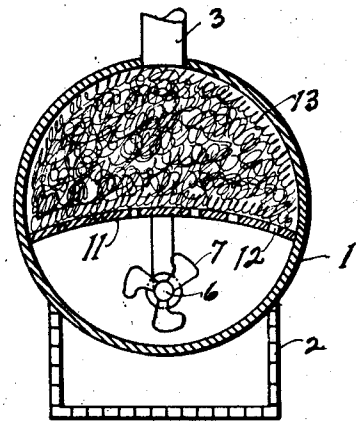


Fig. 2.

Alfred Schwarz, Inventor

By his Attorney

Chas. W. Mortimer

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UNITED STATES PATENT OFFICE.

ALFRED SCHWARZ, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO PETROLEUM SAND PRODUCTS CORPORATION, A CORPORATION OF DELAWARE.

PROCESS OF TREATING HYDROCARBONS.

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In my Patent #1,458,443 I have described the use of agitation for the purpose of forming a vapor oil emulsion between hydrocarbons already vaporized at a given temperature and oils not yet vaporized. Heretofore I have often used such an agitator in vessels attached to the still although my previous patent is not limited to the use of agitators at such places. I have found, however, that the place where the agitator is used, its location with reference to the heating element or elements, its speed and the direction of flow caused by said agitating means all have a great bearing on other results in the process of cracking oils besides those already described in my previous patent.

For example, the heat exchange between the heated surfaces and the oil is greatly facilitated by such agitation. When a liquid is heated to its boiling point, as can be observed in any glass receptacle, vapor first forms next to the hottest point. Such vapor displaces the oil and such action is customarily called "bubble formation". When a bubble forms it will displace the liquid and temporary insulate the heated surface from the liquid, (which is a much better conductor of heat than the vapor). In the process of cracking oil, thin films of oil exist or are present between the heated surface and the vapor space within the bubble and it is obvious, therefore, that such fraction of oil receives a proportionately greater amount of heat than the other portion of the oil contained in the vessel. It has been demonstrated in my investigations that such isolation of fractional amounts of oil against the heated surface and the consequent overheating causes an excessive cracking reaction with the result of direct decomposition of molecules into carbon and fixed gases. Such a reaction is undesirable since neither carbon nor fixed gases are wanted in the process of cracking oils into relatively lighter oils as in the case for example in the production of motor fuel from fuel oil or heavy residues.

As is well known, fixed gases have a much higher hydrogen content than the hydrocarbon compounds that are liquid at normal temperatures which are desired for motor fuel. Since it is costly and commercially impractical to obtain hydrogen and combine the same with carbon in order to form gasoline compounds and similar oils, the preservation of hydrogen in any cracking process is an exceedingly important factor. The loss of hydrogen, therefore, in the form of fixed gases, (although such gases might be used for fuel) is highly undesirable and means to prevent this loss is important and very desirable in any cracking process.

Furthermore, deposition of carbon upon the heated surface reduces the heat conductivity of such surface toward the oil under treatment to such a degree that with the increasing amount of carbon so deposited, such surface will be insulated from the oil to a considerable extent and soon will no longer conduct the heat efficiently into the oil. This causes what is known in the refining practice as "hot spots" or "hot bottoms" in the apparatus used and as is well known to those versed in the art, such overheating takes place very frequently to the point of red and white heat which weakens and finally destroys the apparatus. Since cracking processes are dependent upon the transfer of heat from a suitable source into the oil, the efficiency of such heat transfer is a very important factor in the process. Such efficiency is in inverse proportion to the carbon deposition upon the heated surface. It appears, therefore, that the formation of low boiling point compounds from high boiling point compounds when conducted in externally heated vessels should preferably take place within the liquid and not against the heated surface. It is highly desirable, therefore, that the main body of liquid should not be segregated by the vapor from the heated surface and if such tendency does exist, it should be destroyed immediately.

It is well known that when oil is heated in so-called "pipe stills" it must be kept in motion but such motion will tend to roll the bubbles along on the heated surface and unless means are available to actually disperse larger bodies of vapors into, or mix them with the liquid as soon as they are formed, the result of circulation is not sufficient to overcome the defects in the process above described.

It should be further understood that the degree of temperature to which an oil is raised is a direct means of obtaining compounds of different characteristics. An oil that is heated to 600° F. will give entirely different end compounds from the same oil heated to 1000° F. If products are desired such as are obtained by heating the oil to 600° F. any portion of the oil which is heated

to 1000° F. will produce end products of a different character which may or may not be suitable for the purpose desired. It is, therefore, quite obvious that in order to obtain a maximum output of definite compounds or compounds within definite ranges, it is necssary to heat all the oil to a uniform maximum temperature and none of it to temperatures above such desired ranges and by eliminating the isolation of small bodies of oil between the vapor formed against the heated surface, I not only eliminate the dissociation of the molecules into fixed carbon and fixed gases, but I obtain a maximum output of liquids condensable at normal temperature.

In the accompanying drawing I illustrate one form of my invention. It is, of course, understood that I may place the agitating impellers in any suitable position into the still and that I may cause the agitation also by other means than by impellers. My preferred form, however, is illustrated in drawing. The agitation should be sufficient to cause the formation of a vapor-oil emulsion.

In the drawings Fig. 1 is a longitudinal section through the apparatus.

Fig. 2 is a cross sectional view of the same.

Reference character 1 indicates a still which may be heated in the usual manner by means of the furnace 2. The still is provided with a vapor outlet 3 and a liquid inlet 4 near its top. A stirrer 6 carrying propellers 7 is mounted in bearings 8 in the still, the shaft of the propeller passing outwardly through the stuffing box 9 and being driven from any convenient source, such as a pulley 10.

A partition 11 which may be a sheet of iron, for example, having perforations 12, is placed longitudinally across the still dividing the same into a lower compartment in which the stirrer is mounted and an upper portion which is filled with steel borings, wool, or the like, 13.

In operating this device, fire is supplied under the still 1 in the usual manner and the still is filled with the oil to be distilled nearly up to the level of the partition 11 and the impellers are revolved rapidly, say at a speed of about 400 to 600 R. P. M. so as to cause a rapid flow and thorough beating of the oil in the still, as well as an emulsification of the vapor bubbles with the oil. The flow caused by the impellers in one direction is reversed at the other end of the still and at this point the stream parts and returns in the opposite direction, thus causing eddy-currents which help to break up the vapor bubbles and prevent the same from being retained for any considerable length of time in one place. The still may be operated at any suitable temperature and with or without pressure.

When I use the term "agitation", I mean that agitation which causes the formation of a vapor-oil emulsion. If for instance, an impeller is used to cause agitaion and the impeller is revolved at relatively slow peripheral speed, say 100 feet per minute, the suction created by such speeds is entirely insufficient to cause incorporation of vapors in the liquids and such agitation is not of any value in the process herein described but if velocities are used such as for example, 2000 peripheral feet per minute, then a suction is created which causes any vapor that may be present to flow to the center of the stream, thereby passing through the impeller and there larger vapor bubbles will be broken up into smaller ones, thus causing the production of a vapor-oil emulsion. The same may hold good if an injector, for instance, were used to cause the agitation. When the velocity of the liquid passing through the Venturi tube of the injector is at a relatively low speed, no suction is created and therefore substantially no vapor will be incorporated but if the velocity is great, suction is created and vapor is passed also through the injector which again is dashed either against obstructions or against stagnant or semi-stagnant oil and there emulsions are formed. Either slow or fast straight line movement may therefore permit segregation of vapor and liquid, whereas, fast movements interrupted by suitable means will create on the suction side of the apparatus, sufficient vacuum to take in vapors and at the discharge side of the apparatus such vapor taken in should preferably meet obstructions or semi-stagnant bodies of liquids which will aid emulsification.

I have treated in this still Panuco crude and other heavy oils, as well as heavy residues from other cracking processes and have been able to avoid successfully the formation of carbon on the heated surfaces. For example, a Panuco oil of 10 degrees Bé. gravity was cracked in the still with the agitator in motion and in five days operation no carbon deposition was found in the still, whereas, in two days operation without the agitator, from one-quarter inch to three inches of carbon was formed against the still shell by treating the same oil in the same manner.

I claim:

1. The process which comprises heating heavy oil sufficiently to evolve vapor and violently agitating the vapor and oil while being heated to a cracking temperature by means of an agitator rotating at a speed of about 400 to 600 revolutions per minute thereby forming a vapor-oil emulsion.

2. The process of converting heavy oil into light oil which comprises heating heavy oil sufficiently to evolve vapors, mechanically agitating said vapors and oil with sufficient vigor to form a vapor-oil emulsion, simultaneously heating said emulsion to a decomposing temperature, and removing and condensing the light oil vapors formed.

In testimony whereof I affix my signature.

ALFRED SCHWARZ.