

Jan. 11, 1938.

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2,105,191

METHOD FOR CRACKING PETROLEUM OILS

Filed Oct. 21, 1935

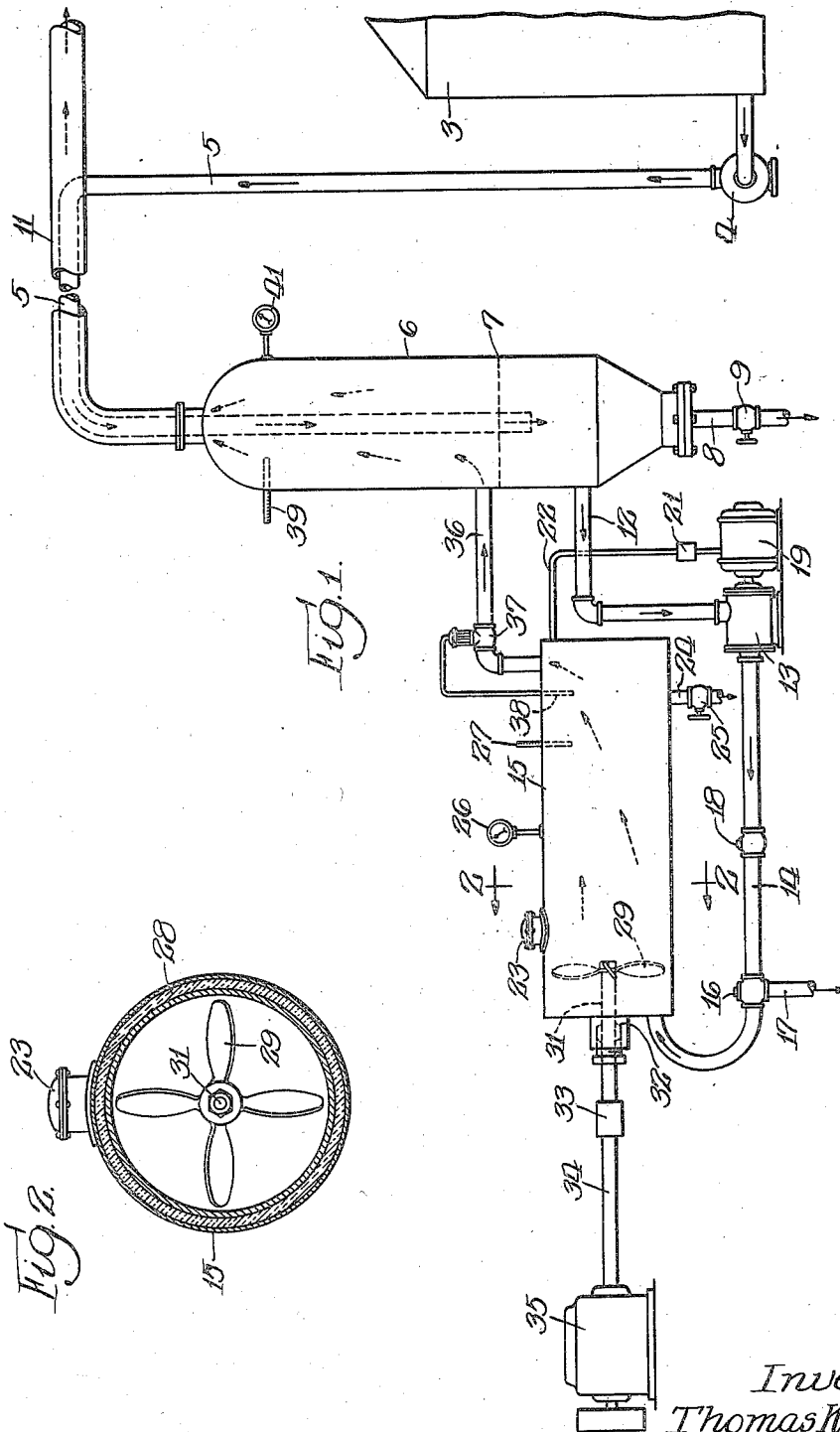


Fig. 1.

Fig. 2.

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UNITED STATES PATENT OFFICE

2,105,191

METHOD FOR CRACKING PETROLEUM OILS

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Application October 21, 1935, Serial No. 45,942

2 Claims. (Cl. 196—68)

This invention relates to the cracking of petroleum oil and aims primarily to obtain from the crude oil a very much higher percentage of cracked product than has heretofore been obtained, and to attain this result at a lower cost per unit of volume by employing apparatus which can be installed and operated more economically than that heretofore used, and which will obviate the frequent shut-downs heretofore required for cleaning purposes, and will also eliminate the difficulties heretofore encountered as the result of the formation of coke or carbon deposits in the apparatus heretofore employed.

In the commercial cracking methods now commonly employed the crude oil is first run through a still which drives off about 75 to 80% of the admitted oil, the remainder being left as a viscous heavy tar which is drawn off without vaporizing. A small amount of cracking is done in this still and the cracked products are segregated as far as possible while the remainder, consisting of over fifty percent of the crude oil admitted to the still, is condensed and sent through a cracking still where it is heated to cracking temperature. The cracked product from this still is segregated while the remainder is circulated around and again passed through the still, this process of recirculation being continued from four to six times, each passage through the still resulting in the cracking of from 10 to 15% of the product circulated into the still while 85 to 90% comes out of the cracking still in practically the same condition that it entered.

This repeated recirculation through the still makes the process very expensive not only because of the repeated heating and cooling off of the noncracked oils being circulated, but also because of the time consumption required in carrying out the process. Furthermore, those portions of the oils in immediate contact with the inner surfaces of the coils in the stills where the oil is heated become overheated to a point of carbonization, with the result that carbon or coke accumulates so rapidly on the inner surfaces of the coils that frequent shutdowns of the still are necessary for the purpose of cleaning out the accumulated coke and carbon or replacing the clogged coils with new ones. The necessarily frequent shutting down and cooling off of the plant and the cleaning or replacement of the coils are a large item of expense in the operation of these stills which adds materially to the cost of production of the cracked product.

In accordance with my present invention the heretofore frequent shut-downs of the plant and the expense of cleaning and replacing clogged still coils are entirely eliminated, and, in fact, the production of coke and carbon which causes these shut-downs is itself obviated by my method of cracking.

My invention contemplates the passage of the product to be refined only once through a still in which the product is brought to a cracking temperature without heating any portion of it to a point which will result in carbonization or coke production. Consequently the production of coke or carbon is obviated and the total constituents of the crude oil are subject to cracking and, in fact, will be practically all cracked, so that the quantity of residuum left will be practically negligible, consisting of only a very small fraction of the amount left in the first heating still of the present commercial apparatus above described.

These results are obtained in accordance with my invention by entirely eliminating the furnace and all combustion or direct heating apparatus which have heretofore been considered necessary for heating the oil. The elimination of the high temperature in the still which inevitably produced coking and carbonization obviously does away with these detrimental factors. The cracking temperatures are produced with my invention by a prolonged mechanical agitation of the still contents so that the entire contents are thoroughly and homogeneously mixed and uniformly raised in temperature under a predetermined pressure until the desired cracking temperature is reached, whereupon a portion of the cracked contents are removed and segregated and at the same time the still is replenished with crude oil to maintain the requisite still pressure. This method enables a practically continuous operation during which the still contents are being practically continuously heated, drawn off, and replenished.

To facilitate an understanding of my invention I have shown rather diagrammatically on the accompanying drawing a preferred form of apparatus by which my improved method may be practiced.

Referring to the drawing:

Fig. 1 represents diagrammatically the apparatus contemplated by my invention; and

Fig. 2 is an enlarged sectional view through the still taken on the line 2—2.

Referring to the drawing more specifically, reference character 3 indicates a petroleum oil storage tank from which the crude oil is delivered by a pump 4 through a pipe 5 to the tower 6 at a point below the oil level therein indicated by 7. A discharge pipe 8 leading from the bottom of the tower to a sump is equipped with an emergency relief valve 9.

Enroute to the tower the crude oil pipe 5 passes throughout a portion of its length through the vapor line 11 leading from the top of the tower and through which the cracked product is discharged to the usual condenser. The length of piping in which the oil pipe is disposed within the vapor line serves as a heat exchanger in

which heat units are transferred from the hot issuing vapors to the incoming crude oil, which in normal operation will raise the temperature of this crude oil to 400 or more degrees Fahrenheit.

From the lower portion of the tower the crude oil is withdrawn through a pipe 12 by a pressure pump 13 from which it is discharged through a line 14 into the still 15, which comprises a closed container of suitable shape and size adapted to contain the oil under a pressure of approximately 200 pounds, at which it is delivered by the pump 13. A pressure relief valve 16 adapted to open under excessive pressure, if such be generated in the still, may be connected at any suitable point to the still, but in this instance is illustrated as being located in the pipe 14 and equipped with a discharge pipe 17 leading to a sump, or elsewhere, through which excess pressure may be discharged. A check valve 18 interposed in the pipe 14 prevents reverse flow toward the pump.

The pump 13 may be driven in any suitable manner, but is here illustrated as driven by an electric motor 19 which is started and stopped by a pressure actuated controller 21 connected through suitable piping 22 with the still, so that the pump is operated just sufficiently to maintain the predetermined desired pressure in the still.

The still is preferably equipped with the usual manhole 23 through which access to the interior of the still may be obtained, with a drain pipe 24 having a manually operable valve 25, with a pressure gauge 26 and a thermometer 27. The still also, as will be observed from Fig. 2, is enclosed in a heavy insulated jacket 28 to prevent heat losses from the still.

Instead of heating the still contents by the application of heat to the exterior of the still as has heretofore been customary, the contents, in accordance with my invention, are heated by mechanical agitation. For this purpose one or more agitators 29 are disposed within the still and mounted upon a shaft 31 projecting through one end of the still and sealed against leakage around the shaft by a packing gland 32. End thrust of the shaft is absorbed by a suitable bearing 33, preferably of roller or ball bearing type. A power shaft 34 connected with or forming a continuation of shaft 31 is driven by a prime mover 35, which may be a Diesel engine, a gasoline motor, or other economical power unit.

A discharge pipe 36 leading from the top of the still is adapted to deliver into the tower 5, discharge through this pipe being controlled by a thermostatically controlled valve 37, the thermo element 38 of which projects into the still, as shown. The tower may also be provided with a thermostat 39 and a pressure indicator 41, if desired.

In accordance with my invention the crude oil is pumped from the storage tank 3 through the heat exchanger in which it is heated to 400 or more degrees, thence into the lower portion of the tower from which it is delivered by the pressure controlled pump 13 into the still 15 at approximately 200 pounds or other desired pressure, which pressure is maintained through the pressure pump control device 21. Within the still the oil under pressure is subjected to agita-

tion by the agitator 29 until, as the result of the agitation, its temperature is raised to a cracking range in the neighborhood of 800° Fahrenheit for which the thermostatically controlled discharge valve 37 is set. When this temperature is reached the valve 37 automatically opens, permitting discharge of cracked products into the tower, from whence they are discharged through the vapor line 11 to the usual condenser. Since the pressure in the still is relieved by the opening of the valve 37 and the discharge of a portion of the cracked products, the still is replenished with crude oil by the starting of the pump 13 which continues to operate until the predetermined pressure in the still has been restored. The operation of the valve 37 and the pump 13 may be intermittent, but when the apparatus has been operating for some time the valve 37 will usually stand in a substantially uniform position and the pump 13 will operate practically continuously, thereby enabling the cracking to be performed in a substantially continuous operation.

Since there is no application of flame to the still and the still contents are never subjected to a temperature in excess of the desired cracking temperature, the production of coke and carbonized solids is obviated and practically all of the crude oil delivered to the still is eventually cracked and segregated as a cracked product.

Obviously the details disclosed may be varied within considerable limits, as may the steps of my improved method, without departing from the essence of the invention as defined in the following claims.

I claim:

1. A hydrocarbon oil conversion process which comprises introducing the oil at below cracking temperature into an unheated reaction zone, subjecting the oil in said zone to thorough and homogeneous mechanical agitation to raise the temperature of the oil, maintaining the oil under superatmospheric pressure during such agitation and continuing the agitation until the oil has attained a cracking temperature and substantial cracking thereof has been effected, the oil in said zone being raised to cracking temperature and cracked solely by the heat generated by said mechanical agitation, and removing resultant cracked products from said zone.
2. A hydrocarbon oil conversion process which comprises introducing the oil at below cracking temperature into an unheated reaction zone, subjecting the oil in said zone to thorough and homogeneous mechanical agitation to raise the temperature of the oil, maintaining the oil under superatmospheric pressure during such agitation and continuing the agitation until the oil has attained a cracking temperature and substantial cracking thereof has been effected, the oil in said zone being raised to cracking temperature and cracked solely by the heat generated by said mechanical agitation, releasing resultant cracked products from the reaction zone in response to a predetermined cracking temperature in said zone, and replenishing the reaction zone with fresh charging oil in response to pressure drop in said zone resulting from the release of said cracked products.

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