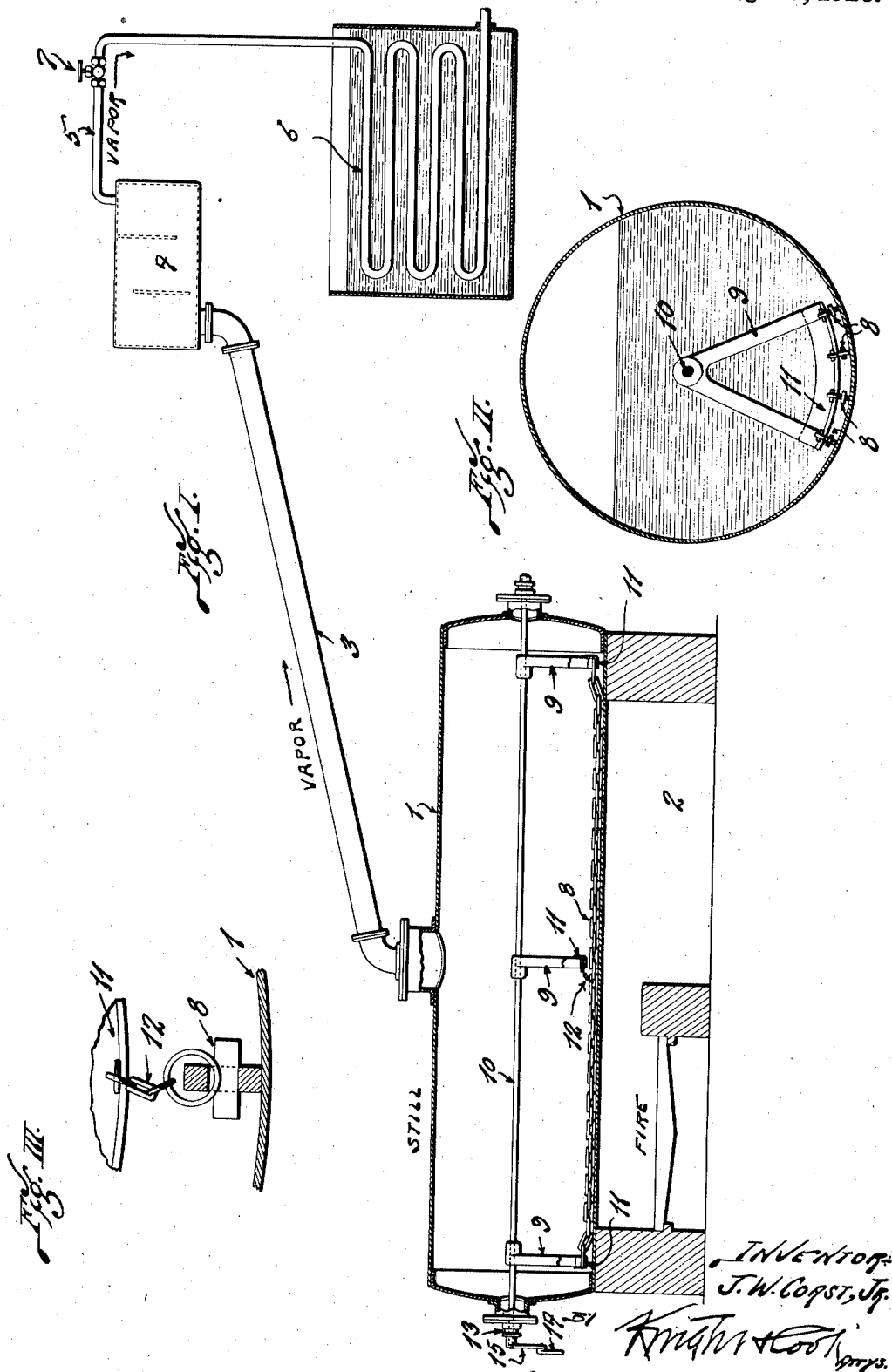


J. W. COAST, JR.
ART OF CRACKING HYDROCARBONS.
APPLICATION FILED SEPT. 27, 1917.

1,349,816.

Patented Aug. 17, 1920.



UNITED STATES PATENT OFFICE.

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ART OF CRACKING HYDROCARBONS.

1,349,816.

Specification of Letters Patent.

Patented Aug. 17, 1920.

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To all whom it may concern:

Be it known that I, JOHN W. COAST, Jr., a citizen of the United States of America, a resident of Tulsa, in the county of Tulsa, State of Oklahoma, have invented certain new and useful Improvements in the Art of Cracking Hydrocarbons, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

This invention relates to improvements in the art of cracking hydrocarbons, and more particularly to a method involving the use of a fire-heated cracking still wherein a body of hydrocarbon oil is confined under pressure.

While the oil is undergoing distillation under high pressure and at a high temperature, a heavy carbonaceous substance known as coke and coke-forming matter drops by gravity and settles on the bottom of the still. This heavy substance is a heat insulator and it is usually permitted to accumulate on the hot still bottom, directly above the fire, thus preventing the free transmission of heat from the still bottom to the oil. One of the important problems in this art lies in the elimination of the danger and expense due to the presence of large bodies of coke-forming matter on the hottest parts of cracking stills. In following the ordinary practice it is necessary to increase the temperature of the still bottom as the cracking operation progresses, so as to maintain the oil at the necessary high temperature. As a consequence, the still bottom is liable to be overheated and become redhot, and in this event some immediate steps must be taken to avoid a rupture at the overheated portion of the still. The still may be cooled and the operation discontinued for the purpose of removing the residue, or the cracking operation can be continued at a lower temperature. Obviously, both of these steps are very undesirable.

The accumulation of coke-forming matter on the hottest part of the cracking still is therefore a source of danger, and it results in many losses. A waste of fuel results from the transmission of heat through the thick body of insulating matter, and the life of the still is decreased by exposure to high temperatures. However, the greatest loss is due to the fact that the necessary

high pressure and high temperature cannot be maintained for a period long enough to obtain the maximum yield from the heavy oil. By prematurely stopping the operation on account of the presence of the coke-forming matter, a very large volume of unconverted and partially converted hydrocarbons remain in the cracking still as residue, instead of being transformed into the desired low boiling point product.

My objects are to avoid the danger and heat losses which have resulted from the presence of coke-forming matter in large cracking stills; and to crack and distill the oil very rapidly, thus increasing the capacity of the still. However, a most important advantage lies in the greatly increased yield of low boiling point hydrocarbons, which I obtain by maintaining the oil at the necessary high pressure and temperature, until it no longer responds readily to the cracking treatment. The statements contained herein, as to the greatly increased yield, have been borne out by actual results obtained by the use of the invention in ordinary cylindrical cracking stills.

In the preferred form of the invention, all of the foregoing advantages are obtained by confining a body of hydrocarbon oil in a large horizontal cylindrical fire-heated cracking still, the arcuate bottom of the still being exposed to the fire, maintaining the contents of the still at a high pressure and at a high temperature, and at the same time continually sweeping coke-forming matter from one part of the still to another. The coke-forming matter may be swept across the fire-heated arcuate still bottom, from the middle to opposite sides of the still. In actual practice I have found that this will cause relatively large bodies of the coke-forming matter to accumulate on the curved inner face of the still, at high elevations, instead of remaining at the hottest part of the still. Therefore, the heat is transmitted freely from the fire-heated still bottom to the oil, and the high temperature can be maintained without overheating the still. In addition to greatly increasing the yield of low boiling point fractions, and obtaining the other advantages referred to above, I have found that the cracking operation can be carried on continuously for a considerable period of time, by introducing a fresh charge into the still without remov-

ing the coke-forming matter from the original charge.

I am aware that scrapers have been used in stills wherein crude petroleum, shale, etc., is treated under atmospheric pressure, but the conditions in such stills are radically different from the conditions existing in a cracking still where a high boiling point product is subjected to high pressure and vaporized to form a low boiling point product. I believe it is new to crack petroleum hydrocarbons under pressure, as herein disclosed, and at the same time sweep the coke-forming matter from one part of the still to another. Furthermore, this new method has resulted in a yield much greater, I believe, than that obtained by any other known method of cracking hydrocarbons. In other words, I believe the method is new and that it affords a solution of the greatest problem in this art.

Figure I is a diagrammatical view of a cracking apparatus adapted for use in following the new method.

Fig. II is an enlarged transverse section of the cracking still.

Fig. III is an enlarged fragmentary detail view showing a portion of the still bottom and one of the chains resting thereon.

The apparatus shown to illustrate the invention comprises a large horizontal cylindrical cracking still 1, arranged above a heating chamber 2 and connected, by means of a vapor pipe 3, to an air cooled reflux condenser 4. 5 designates a vapor pipe leading from the reflux condenser to a water cooled condensing coil 6 from which the low boiling point product is recovered.

The apparatus herein shown is particularly adapted for use in cracking high boiling point products of distillation, such, for example, as distillates or residues resulting from the distillation of crude petroleum. The oil to be treated may be introduced into the still in any suitable manner, and any desired pressure may be obtained by regulating a valve 7, preferably arranged in the vapor pipe 5. The pressure in the still is preferably greater than three atmospheres, for example, about 80 pounds per square inch, and the temperature of the contents of the still preferably ranges from about 600° F. to 800° F. The arcuate bottom of the still is exposed directly to the fire in the heating chamber 2.

While the oil is undergoing distillation under a high pressure and at a high temperature, heavy coke-forming matter will accumulate in the still and tend to settle on the arcuate bottom, directly above the fire, as previously pointed out. To avoid the danger and expense heretofore incurred by the presence of the coke-forming matter, at the same time very greatly increasing the yield of low boiling point fractions, I continually

sweep the coke-forming matter from one part of the still to another. The sweeping device herein shown comprises four long chains 8 arranged on the arcuate lower portion of the still and extending approximately from one end of the still to the other. Pairs of diverging arms 9, depending from an oscillatory shaft 10 at the center of the still, are connected at their lower ends to arcuate angle bars 11. The ends of the long chains 8 are fastened to the angle bars 11 near the ends of the still, and short chain sections 12 may be used to connect the chains to the angle bars 11 near the middle of the still. The shaft 10 extends through a stuffing box 13 at one end of the still, and it may be oscillated by transmitting power through a link 14 to a crank or operating arm 15 at the outside of the still. This shaft 10 is oscillated continually so as to drag the long, heavy chains 8 back and forth across the arcuate still bottom, thus sweeping coke-forming matter from the middle to the sides of the still. The links of the chains 8 are preferably square in cross section, as shown in Fig. III, to provide a number of sharp corners which act very effectively on the coke-forming matter tending to adhere to the arcuate still bottom. Actual experience has shown that large bodies of coke-forming matter will accumulate at opposite sides of the still, instead of collecting on the hottest part of the arcuate still bottom. This insulating matter is thus swept from the fire heated bottom of the still and permitted to accumulate in the still at relatively high elevations, where it will not materially interfere with the transmission of heat from the fire to the oil. The cracking operation can therefore be continued long enough to obtain a greatly increased yield from the heavy oil, and since the danger of overheating the still is almost entirely eliminated, the oil can be distilled very rapidly.

I have herein disclosed a specific method which I know will obtain the increased yield and many other advantages, and have endeavored to state the reasons for such results. However, there may be other contributory reasons of which I am not aware; for the precise actions of the hydrocarbons undergoing cracking treatment are not understood, and it is possible that the highly successful treatment is due, partly, to some other advantageous action resulting from the agitation and sweeping of the coke-forming matter while the body of oil is subjected to the cracking treatment.

I claim:

In the art of cracking petroleum hydrocarbons, the method which comprises confining a body of hydrocarbon oil in a large horizontal cylindrical fire-heated cracking still, the arcuate bottom of the still being exposed to the fire, maintaining the contents

of said still under a pressure greater than
three atmospheres, condensing the vapor
passing from the still, at the same time con-
tinually scraping coke-forming matter across
5 the fire-heated arcuate bottom, from the
middle to opposite sides of the still, and per-
mitting such coke-forming matter to accu-

mulate in the still at relatively high eleva-
tions beyond the hottest portion of said arcu-
ate bottom.

In testimony that I claim the foregoing I
hereunto affix my signature.

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JOHN W. COAST, JR.