W. H. YOUNG.

APPARATUS FOR CRACKING AND REFINING PETROLEUM PRODUCTS.

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1,378,307. Patented May 17, 1921.

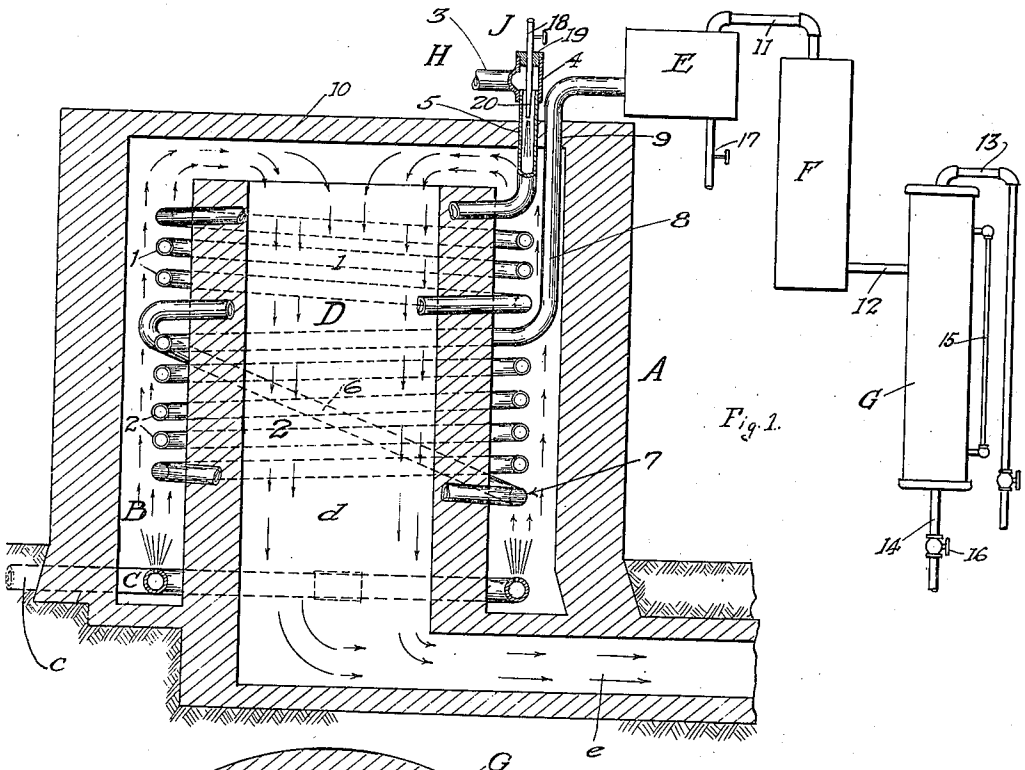

Fig. 1.

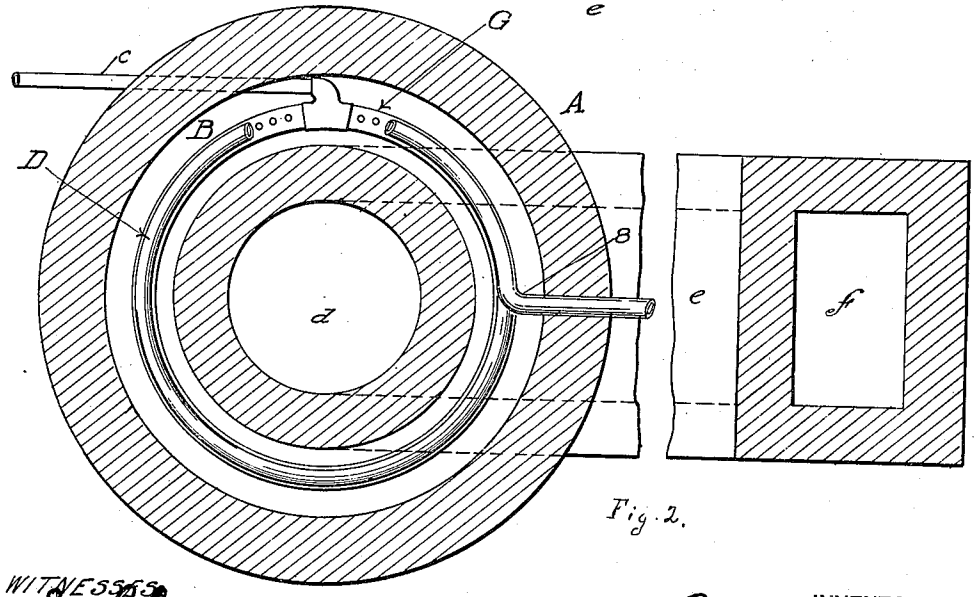

Fig. 2.

WITNESSES:

J. Shutt

Chas. J. Chenney

INVENTOR,

William H. Young;

BY Raymond Sen Blomley,

his ATTORNEY.

UNITED STATES PATENT OFFICE.

WILLIAM HERBERT YOUNG, OF LOS ANGELES, CALIFORNIA.

APPARATUS FOR CRACKING AND REFINING PETROLEUM PRODUCTS.

1,378,307. Specification of Letters Patent. Patented May 17, 1921.

Application filed November 5, 1917, Serial No. 200,389. Renewed January 10, 1921. Serial No. 436,402.

To all whom it may concern:

Be it known that I, WILLIAM HERBERT YOUNG, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Improved Apparatus for Cracking and Refining Petroleum Products, of which the following is a specification.

This invention relates to an improved apparatus for the treatment of petroleum products.

The invention resides principally in the provision of a still of simple and economical construction, which is particularly adapted for raising the Baumé gravity of petroleum products by the method known as "cracking."

One of the objects of the invention is to provide apparatus of the character disclosed with which petroleum products may be effectively cracked and their Baumé gravities raised, with minimum expense and in an expeditious manner, the apparatus being so constructed and the method employed being of such character that cracking and also refining operations may be carried out in an exceptionally inexpensive, thorough and efficacious manner.

The invention further consists in the peculiar combination, inter-relation, and association of the various parts and features thereof, all as hereinafter described, shown in the drawing and finally pointed out in claims.

In the drawing:

Figure 1 is a vertical sectional view of a still apparatus constructed in accordance with this invention, showing parts broken away and in section and other parts in side elevation; and

Fig. 2 is a horizontal sectional view taken on the line x^2—x^2 of Fig. 1.

Referring particularly to the drawing, A designates a furnace, B the fire-box of said furnace, C the burner, D the means for cracking or refining petroleum products, E a separator, F a condenser, and G a gas separator connected with said condenser, all of such elements and parts of the apparatus providing for the carrying out of the method or process forming a part of the invention.

The furnace A is preferably of an upright type, the fire-box B being annular and having disposed at the bottom thereof the annular burner C. A feed pipe *c* is connected with the burner C and with a suitable source of supply, not shown. There is provided a flue *d* communicating with the upper end of the fire-box and which has an extension *e* for directing the products of combustion to one side of the furnace, to the chimney *f*.

The means D is disposed within the furnace A in the fire-box B thereof, and preferably comprises an upper pipe coil 1 and a simlar lower coil 2, said coils being superimposed and providing heating zones which cause the petroleum product to be initially gradually heated and then finally subjected to a maximum cracking temperature. These coils 1 and 2 preferably comprise a single length of pipe formed into helical upright coils and arranged to provide the separate sets of coils 1 and 2, both sets being disposed directly above the burner C.

There is provided a means H for introducing the oil to be treated into the upper coil 1, such means comprising a supply pipe 3 having connection with a suitable source of supply, not shown, and which is connected by a T 4 with an upright extension 5 of the uppermost coil of the pipe coil 1. The lowermost coil of the pipe coil 1 is formed with a downwardly inclined extension 6 that terminates as at 7 in communication with and is formed into the lowermost coil of the lower set 2 of pipe coils. This improvement is provided so that the oil after passing through the upper set is quickly conducted to the lower end of the lower set of coils and to the point of maximum temperature. The uppermost coil of the lower set 2 extends upwardly as at 8 to one side of the upper coil set 1 and out through an opening 9 in the closed upper side 10 of the furnace, to the separator E. A pipe 11 connects the separator E with the condenser F and a pipe 12 connects the condenser F with the gas separator G. A pipe 13 is connected with the upper side of the gas separator and leads to a reservoir or gasometer, not shown. The pipe 14 is connected with the lower portion of the separator G and from thence is extended in a manner, not shown, to a reservoir or tank also not shown. There is preferably provided a side gage 15 on the separator G so that the oil level within said separator may be readily determined when desired. The pipe 14 is suitably valved as at 16. There is provided a valve drain pipe 17 for the separator E.

I preferably provide a means J for introducing superheated steam into the extension 5 of the upper coil of the set 1. Superheated steam of the proper temperature dependent upon the gravity of the oil being treated is thus introduced by the means J so that the formation of carbon during the cracking process is materially retarded. The proper temperature of the superheated steam depends upon the gravity of the oil being treated, a higher temperature in general bringing better results in connection with heavier oils. Superheated steam is now used in this art in connection with many stills, and any person skilled in the art can readily determine the proper temperature at which the steam should be admitted to operate in the most effective manner upon any particular grade and weight of oil. The temperature of this superheated steam ordinarily ranges from 750° F. to 930° F. It is impossible to state any exact temperature which might be used, and this seems to be unnecessary since it could be readily determined by any person familiar with this kind of work. The means J consists of a valved pipe 18 having suitable connection with the source of supply, not shown, and which extends through bushing 19 into said pipe 5, terminating in a nozzle 20.

The apparatus hereinbefore described and illustrated in the accompanying drawing constitutes the preferred embodiment of my still but it is to be understood that various minor changes as to details of construction and as to the size, shape and proportion of the parts, elements and features of said apparatus may be resorted to when desired without departing from the spirit and scope of the invention as disclosed.

In carrying out my improved method and in the operation of the apparatus hereinbefore specifically described and also illustrated in the accompanying drawing, when it is desired to increase the Baumé gravity of heavy crude petroleum products, for example, heavy crude virgin oil, such heavy crude oil is introduced through the pipe 3 and the pipe 5 into the upper coils 1, the burner C having been previously started and the valved pipe 18 opened to allow the super-heated steam to be injected into the pipe 5. Dependent upon the specific gravity of the crude oil the temperature of the super-heated steam is determined. In this connection it is to be noted that in order to provide for a desired prevention of the formation of carbon during the cracking process and to retard the said formation of carbon the super-heated steam must bear a predetermined relation as to temperature to the oil and when this temperature has been determined and is provided for, the steam is introduced as described. The oil entering the coils of the upper set 1 is cold and will immediately become heated through the agency of the heat provided by the burner C. By having these coils 1 disposed within the fire-box B and because of the introduction of the super-heated steam the oil is pre-heated prior to its being subjected to the cracking temperature; thus the oil will pass from the set 1 of coils through the pipe 6 which is an extension of the lowermost coil of the set 1, to the lowermost coil of the set 2 of coils, and at such lower coil is subjected to the maximum heat provided by the burner C, such heat being sufficient to produce a thorough cracking action. The oil then passes upwardly through the coils 2 and is maintained at the maximum of cracking temperature while thus passing through said coils, the gradual heating of the oil prior to its being subjected to the maximum cracking temperature prevents the burning or scorching thereof which would result in the discoloration of the oil and cause it to take on an objectionable odor. Further, this method of subjecting the oil to the cracking temperature provides for a more thorough cracking action. The oil vapors and steam pass from the coils 2 through the pipe 8 into the separator E and are cooled sufficiently in its passage through said pipe and into the said separator to cause vapor constituents of the heavier parts of the oil to be liberated by slight condensation, such liquid being readily drained through the valved outlet or drain 17, the latter being open for this purpose. This liquid draining through said pipe 17 is preferably collected in a suitable reservoir, not shown, whereas the vapors will pass through the pipe 11 and into the condenser F. By draining off the heavy dark oil which is the product of condensation taking place in the separator E, the other oil vapors pass into the condenser free from such heavy dark oil upon condensation and when such other oil vapors are condensed the product of condensation is light in color possessed of a high Baumé gravity and a low viscosity. The vapors condensed will pass through the pipe 12 into the gas separator G; from thence the gas is conducted through the pipe 13 to the gasometer not shown, and the oil collecting in the separator G will pass through the pipe 14 to the receiving tank, not shown, such oil being the finished product as provided by my improved method and with the apparatus constituting my invention. This oil drained from the separator G and the oil drained from the separator E has been thoroughly cracked and is of a higher Baumé gravity than the crude oil first introduced into the still, the viscosity of such oil being materially reduced without the admixture of lighter petroleum products

such as distillate as is usually the case. It will thus be seen that I may take heavy virgin crudes such as ordinarily require the admixture of lighter petroleum products of the distillate variety to reduce the viscosity thereof sufficiently to permit of its being cracked in the ordinarily employed apparatus, and without such admixture introduce it into my improved apparatus and produce thorough cracking thereof, materially raising the Baumé gravity of such heavy crude oil and reducing the viscosity thereof without burning and discoloring such oil or causing it to take on an objectionable odor, all within a relatively short duration of time and with minimum consumption of fuel, there being also provided a marked B. T. U. increase in the residuum of such oil owing to the thorough cracking action that I provide. Likewise low Baumé gravity distillates may be treated with my apparatus and method or process so as to increase the Baumé gravity thereof, and I have found that I may also increase the Baumé gravity of the by-products of crude oil ranging within the gravities as between gasolene and lubricating oil.

It is to be noted that I may also remove the vapors or toppings of the oil if so desired and thus carry on refining actions upon petroleum products as desired.

By the particular conservation and peculiar application of heat provided for in my apparatus, in view of the simplicity thereof and also because of the particular arrangement of the coils, a great saving in fuel is provided and my method may be effectively carried out with little or no expense and expeditiously.

My apparatus may be utilized for the production of artificial gas by increasing the furnace heat and reducing the amount of oil passing through the pipe coils as compared to the amount of furnace heat and amount of oil used in the cracking operation. Gas obtained with my apparatus is found to be superior in many respects to the ordinary artificial gas and has a greater B. T. U. content, the residuum being far less than in other well-known apparatus.

Having thus disclosed my invention, I claim and desire to secure by Letters Patent;

1. In improvements of the character disclosed, a furnace having a fire box, a pair of superposed coils arranged within the fire box and burner under the superposed coils, means for feeding petroleum and steam to the upper coil, an outlet for the lower coil, and connecting means between the upper and lower coils, the coils and connecting means being arranged so that the oil will course downwardly through the upper coil at a moderate heat and then be directed to the bottom of the lower coil where it is intensely heated, after which it courses upwardly through the lower coil.

2. In improvements of the character disclosed, a furnace having a fire box, a pair of superposed vertically disposed helical coils arranged within the fire box, the lower end of the upper coil being directly connected to the lower end of the lower coil, a burner under the lower coil, means for feeding petroleum and steam to the upper end of the upper coil, and an outlet at the upper end of the lower coil, the oil coursing downwardly through the upper coil at a moderate heat and then being directed to the bottom of the lower coil which is intensely heated by the burner, after which it courses upwardly through the lower coil.

3. In improvements of the character disclosed, a furnace having an annular fire box, a down-draft flue surrounded by the fire box and opening at its upper end into the top of the furnace, a pair of superposed coils surrounding the down-draft flue and arranged within the fire box, the lower end of the upper coil being directly connected to the lower end of the lower coil, a burner under the lower coil, means for feeding petroleum and steam to the upper end of the upper coil, and an outlet for the final products at the upper end of the lower coil, the oil coursing downwardly through the upper coil at a moderate heat and then being directed to the bottom of the lower coil where it is intensely heated, after which it courses upwardly through the lower coil.

4. In improvements of the character disclosed, a furnace having an annular fire-box, an annular burner disposed within the lower end of the fire-box, said furnace having a flue surrounded by the fire-box and communicating therewith, a pipe coil mounted in the fire-box above the burner and having its lowermost coil directed downwardly, another pipe coil communicating with the lower end of said lowermost coil, an outlet connected with the upper end of said last named pipe coil, and means for introducing super-heated steam into the first named coil.

5. In improvements of the character disclosed, a furnace, a burner within the furnace, means for first subjecting a petroleum product to be treated to a moderate heat and being located above said burner, and means beneath the first named means and above the burner adapted to receive the petroleum product to be treated from the first-named means and subject said product to intense heat, said last named means causing the product to course from a point in close relation to the burner in a direction away from the burner, and an outlet connected with said last named means to carry off the treated petroleum product.

6. In improvements of the character disclosed, a furnace having a burner; pipe coils

mounted within the furnace one above the other and constructed so that oil upon entering the uppermost of the coils will course downwardly in the direction of the burner for a pre-determined distance and then be directed to the lowermost point of the lowermost coil and caused to course upwardly to a point intermediate the upper and lower ends of the coil from which point the oil is removed from the coil, means to introduce oil to the coils and means to conduct vapors which have been treated away from the coils.

7. In improvements of the character disclosed, a furnace having a burner and pipe coils mounted within said furnace one above the other and constructed so that oil upon entering the uppermost of the coils will course downwardly in the direction of the burner for a pre-determined distance and then be directed to the lowermost point of the lowermost coil and caused to course upwardly to a point intermediate the upper and lower ends of the coil from which point the oil is removed from the coil, means to introduce oil to the coils, means to conduct oil which has been treated away from the coils, and means coöperating with the means for introducing oil to the coils adapted to introduce super-heated steam into the coils.

8. In improvements of the character disclosed, a furnace inclosing a burner and pipe coils mounted within the furnace one above the other and constructed so that oil upon entering the uppermost of the coils will course downwardly in the direction of the burner for a pre-determined distance and then be directed to the lowermost point of the lowermost coil and caused to course upwardly to a point intermediate the upper and lower ends of the coil from which point the oil is removed from the coil, means to introduce oil to the coils, means to conduct oil which has been treated away from the coils, a separator connected with the last named means, a condenser connected with the separator, and a gas separator operatively associated with the condenser.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM HERBERT YOUNG.

Witnesses:

F. H. KIFF,

CHAS. J. CHUNN.