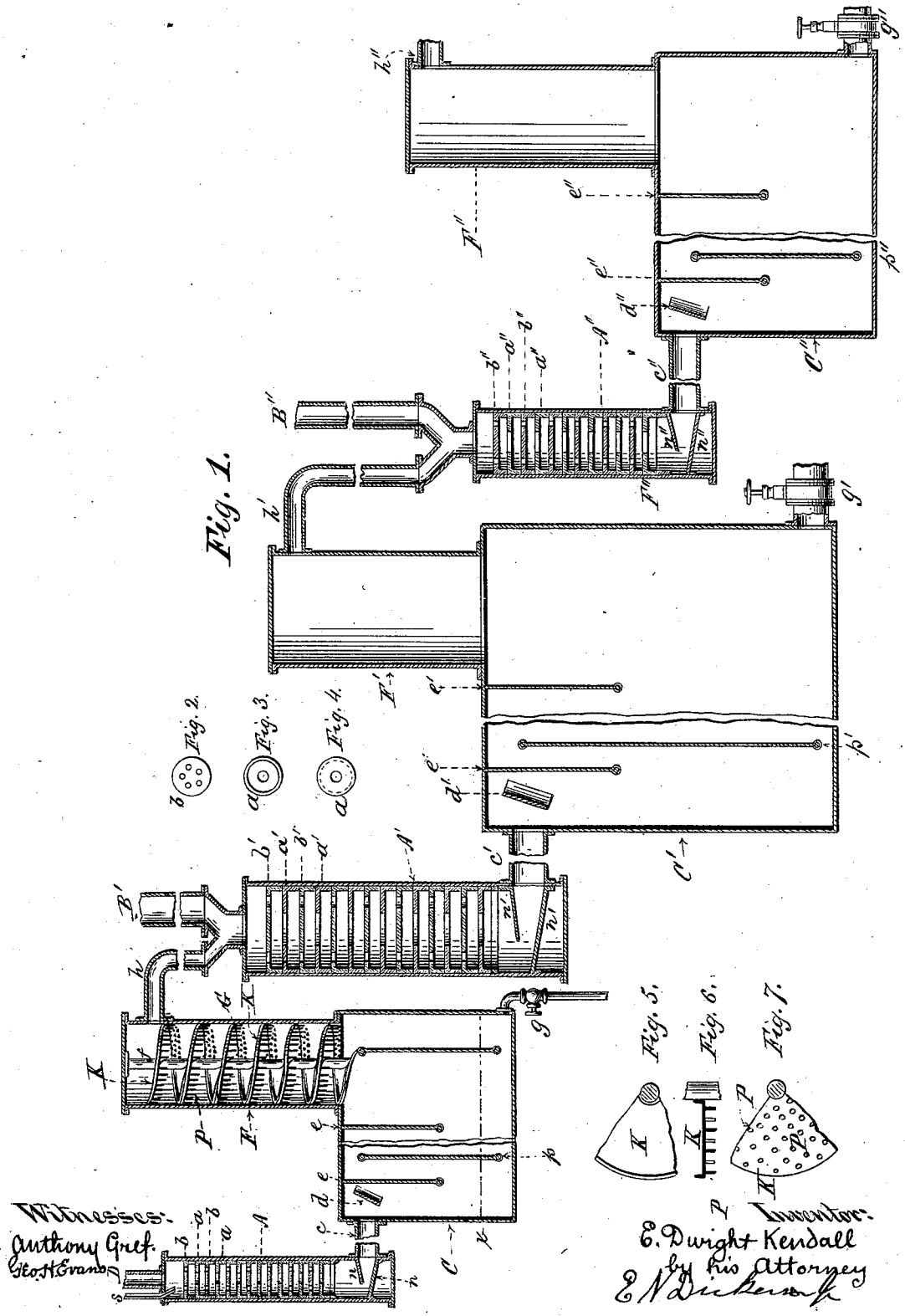
(No Model.)

E. D. KENDALL.

PROCESS OF AND APPARATUS FOR REFINING HYDROCARBONS.

No. 359,357. Patented Mar. 15, 1887.



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UNITED STATES PATENT OFFICE.

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PROCESS OF AND APPARATUS FOR REFINING HYDROCARBON.

SPECIFICATION forming part of Letters Patent No. 359,357, dated March 15, 1887.

Application filed December 18, 1884. Serial No. 150,645. (No model.)

To all whom it may concern:

Be it known that I, EDWARD D. KENDALL, a citizen of the United States, residing at Brooklyn, county of Kings, and State of New York, have invented new and useful Improvements in Process of and Apparatus for Refining Hydrocarbons, of which the following is a specification.

My invention relates to improvements in process of and apparatus for refining the crude hydrocarbons of petroleum and coal-tar by means of sulphuric acid and other liquids; and the objects of my invention are, first, to provide a continuous time-saving method of refining, requiring little mechanical power, and by which the action of detergent bodies may be regulated and equalized; and, second, to furnish a means of agitating and commingling the hydrocarbons and sulphuric acid, or other refining agents, without employing paddles or similar appliances, which are inefficient in large operations, and avoiding the use of a driven current of air, which conveys moisture to the acid, thereby reducing its efficiency, forms explosive mixtures by taking up hydrocarbon vapors, and is also attended by the disadvantage that in treating a large volume of petroleum, crude burning-oils, or so-called "distillate" with a considerable quantity of sulphuric acid the part first chemically and sufficiently acted on by the acid is again and repeatedly subjected to contact with the acid, in order to completely treat the succeeding and later portions, and the oil so "overtreated," being of dark color, is apt to discolor the entire body of refined oil.

The process by which I secure the advantages alluded to consists in passing a stream of distillate (which word I will use to represent crude liquid-distilled hydrocarbons generally) and a jet of sulphuric acid together through the hereinafter-described mixing and agitating chamber, thence into a settling-tank, where the greater part of the acid and products of its chemical action subside by their greater specific gravity, then conducting the acid-treated distillate through a second agitating-chamber accompanied by a current of water, both liquids afterward passing together into a second settling-tank, where the water separates by its gravity, and finally sending the treated and washed distillate with an exceedingly dilute solution of alkali or alkaline earth through a third agitating-chamber and a third settling-tank, from which the finished refined oil may be conveyed to storage-tanks. The use of dilute alkaline solution may precede the washing with water alone, or one of these steps may be omitted. The distillate and the acid are caused to enter the agitating-chamber with the required velocity by drawing them from elevated reservoirs, or by means of forcing-pumps.

The apparatus which enables me to conduct the above-described process successfully is shown in the accompanying drawings, in which—

Figure 1 is a sectional view of the apparatus; Figs. 2, 3, and 4, views showing perforations and flanges of diaphragms, herein to be mentioned; Figs. 5, 6, and 7, views of the top, side, and bottom, respectively, of partly broken-away parts of the apparatus.

Similar letters indicate similar parts.

A indicates a cylinder of cast-iron or other suitable material. It is divided into numerous cells by perforated diaphragms *b a b a*, &c., made of cast-iron, clay, or other material. Fig. 2 shows the perforations in each diaphragm like those marked *b*, and Figs. 3 and 4 the single central opening in each diaphragm like those marked *a*. The diaphragms may be simple disks or plates, separated from each other by interposed rings, or may be formed, as shown in Figs. 3 and 4, with flanges at the peripheries, which serve to support the diaphragms one on another. They are arranged alternately *b a*, *b a*, &c. The combined areas of the perforations in each diaphragm marked *b* should approximate in extent to the area of the single central opening in a diaphragm marked *a*, and each of these should have about the same diameter as the interior of the pipe D, which conducts the distillate, under pressure, to the cylinder A. The small pipe *s* conveys the proportionate quantity of sulphuric acid, the supply of which may be regulated by means of a cock at some convenient point, or by a pump with adjustable stroke of piston. Inclined shelves at *n n* are placed in the lower part of the cylinder A.

A pipe, *c*, connects the agitating-chamber

with the interior of a settling-tank, C, which should be lined with lead. A plate, *d*, of cast-iron or lead, curved horizontally, is supported in an inclined position in the tank C opposite the opening that receives the pipe *c*. Several partitions, *e e*, extend downward from the closed top of the tank, and others, like *p*, extend upward from near the bottom of the tank.

F is a cylinder of metal, the lower end of which is open and in communication with the tank C. The upper end of the cylinder is closed, and the cover supports a bar, *f*, of metal or of wood wrapped with sheet-lead. A series of rods project horizontally from this bar in a spiral line, and serve to support sheets of lead or other material shaped and joined so as to form a long inclined plate with raised edges curved spirally and extending from end to end around the bar *f*. Across this spiral plate, and projecting from its under side, are many rows of pins, P, arranged so that each pin in a row shall be opposite the space between two pins of an adjoining row. Fig. 5 shows the upper surface of a segment of the inclined spiral plate. Fig. 6 is a vertical section, showing two adjoining rows of the said pins, the disposition of which is further shown in Fig. 7.

Near the top of the cylinder F is a pipe, *h*, which conveys acid-treated distillate to the second agitating-chamber, A′, with water, which enters by the pipe B′. This agitating-chamber is constructed substantially in all respects like the first described, A, differing only in dimensions.

C′ is a settling-tank, similar to the tank C, but larger, connected with the chamber A′ by the pipe *c′*.

F′ is a cylinder like F; but it contains no mechanical device.

h′ is a pipe to convey the washed distillate from the cylinder F′ to the third agitating-chamber, A″, which is substantially in every respect, excepting size, like A and A′. The pipe B″ conveys alkaline water to the chamber A″, which chamber or cylinder is connected by the pipe *c″* with the third settling-tank, C″, constructed like the first two, C and C′.

F″ is a cylinder like F′, and *h″* is a pipe which conducts the finished refined oil to storage-tanks.

The operation of the above-described plant is as follows: Distillate and sulphuric acid, under pressure, enter the agitating-chamber by the pipes D and *s*, and, passing together rapidly through the perforations of a diaphragm, are abruptly diverted from their course by the opposing material of the next diaphragm, and so on repeatedly. The tumultuous currents dash against the walls of the cells, return upon themselves, and thus the liquids are thoroughly commingled with violence conducive to required chemical action. The intermixed fluids, after passing through all the diaphragms, fall on the inclined shelves at *n n* in the lower part of the chamber A, and enter the lead-lined settling-tank C through the pipe *c*, which is of sufficient diameter and length to induce a tranquil flow of the liquids, so that the greater part of the acid and acid products separate, and on entering the tank at once fall to the bottom. The acid-treated distillate, holding some acid and acid products in suspension, and having itself an acid character, when it pours into the tank impinges on the inclined and curved plate *d*, which spreads the current laterally, so that after the tank C is filled with distillate and waste or "sludge" acid (the average height of the latter being indicated by the dotted line *x*) motion is imparted to the whole body of distillate, which flows slowly under the partitions like *e* and over the partitions represented by *p*, the space under the latter being sealed by the heavy sludge acid. During its passage through the settling-tank the distillate will generally be freed, by subsidence, from all but a trace of acid matters, but it will exhibit an acid reaction, and some hydrocarbons are persistently accompanied by small quantities of flocculent or viscid matters. The current of distillate from the tank C slowly follows the spiral way within the cylinder F and finds exit through the pipe *h*. During its passage all suspended viscous bodies will be abstracted by the pins P, will aggregate into slimy masses, drop down and collect on the upper surface of the spiral plate, and gradually slide down and fall to the bottom of the tank C. The sludge acid is drawn off continuously by the adjusted cock *g*, or at intervals, determined by try-cocks. I have devised an automatic valve for the purpose of keeping a constant level of waste acid; but, as it is adaptable to various uses, I propose to make it the subject of a separate patent. The acid-treated distillate passes from the cylinder F, through the pipe *h*, to the agitating-chamber A′, where it is thoroughly washed with water brought by the pipe B′ and drawn off, with contained impurity, by the cock *g′*.

From the cylinder F′ the washed distillate proceeds by the pipe *h′* to the third agitating-chamber, F″, the pipe B″ at the same time bringing a stream of water that has been rendered slightly alkaline by lime or caustic soda. This alkaline water passes with the distillate, which now exhibits slight alkaline reaction, into the tank C″, whence it is removed by the cock *g″*, and the finished "refined oil" or other purified hydrocarbon is delivered through the pipe *h″*.

It will be observed that by the arrangement which I have proposed I have dispensed with the use of any moving mechanical parts in my apparatus, as in apparatus heretofore used—such as paddles rotating in a vat containing the distillate—the said apparatus being automatic in its operation and requiring only the introduction of suitable liquids at suitable points. It will be further observed that I have combined in one process and one movement a number of processes which have hith-

erto been performed in distinct or separate operations.

I do not limit myself to the exact construction shown; but that is the best one known to me. It is obvious, for example, that the plates *n* and *d* might be varied or omitted, and in certain peculiar constructions even the separating-plates *e* and *p* might be omitted. The peculiar arrangement of spiral and pins may be also varied, and for certain qualities of distillate the pins themselves might be omitted, though I prefer to use them for greater safety. It will be observed, moreover, that these pins are readily cleaned by the removal of the center post or bar, for removing the cover of the cylinder G will remove the spiral and pins, which will then be readily accessible for cleansing.

I do not claim, broadly, the use of sulphuric acid nor of alkali water in the treatment of distillate, nor, broadly, the use of agitation of the distillate with sulphuric acid, the same being old; but

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The process of treating distillate with sulphuric acid, which consists in forcing together regulated quantities of the acid and the distillate, and causing them to pass together under pressure through a pipe or tube provided with stationary obstructions, whereby they are thoroughly mingled by the force of the liquid itself, substantially as described.

2. The process of treating distillate with sulphuric acid, which consists in forcing together regulated quantities of the acid and the distillate, and causing them to pass together through a pipe or tube containing stationary deflecting or mingling diaphragms, whereby the said acid and distillate are thoroughly mingled by the force of the liquid itself and the action of the acid upon the distillate increased, substantially as described.

3. As an improvement in the process of removing the viscous sulpho compounds from refined distillate, the method herein described of causing it to pass in contact or across retaining-pins, whereby they may be removed from the distillate, substantially as described.

4. As an improvement in the process of removing the viscous sulpho compounds from refined distillate, the method herein described of causing it to pass in contact or across retaining-pins, whereby they may be removed from the distillate, and of causing them to drop upon a suitable conveyer, whereby they may be removed to a vessel or a part of a vessel distinct from that containing the distillate, whence they may be withdrawn, substantially as described.

5. The process of washing distillate, which consists in forcing the distillate, in connection with a suitable stream of water, through a mingling pipe or tube provided with stationary obstructions, whereby they are thoroughly brought in contact with each other and are mingled by the force of the liquid itself, and of then allowing the mingled distillate and water to substantially come to rest in a settling-tank, whereby the water and distillate are separated from each other, substantially as described.

6. The improved process of refining distillate herein described, which consists in forcing the distillate through a suitable mixing-tube, in combination with a regulated quantity of acid, in then permitting the mingled acid and distillate to separate from each other in a settling-tank, in then causing the distillate containing certain viscous sulpho acids to come in contact with an independent separating apparatus for relieving the distillate of such viscous sulpho compounds, in then causing the distillate to flow through a suitable mixing-tube, in combination with a suitable amount of water for washing the same, and in then settling the distillate from the wash-water in a suitable separating-tank, substantially as described.

7. The improved apparatus for mixing distillate and sulphuric acid or other liquids herein described, which consists of a tube or tubes provided with a pipe or pipes for introducing the distillate and sulphuric acid at one end thereof, and with a series of stationary distributing or deflecting diaphragms arranged transversely to its length, thereby insuring the mingling of such bodies, and provided at its other end with a delivery-port, substantially as described.

8. The improvement in settling-tanks herein described, which consists in a tank, C, provided with the vertical partitions *e* and *p*, substantially as described.

9. The improved separator herein described, which consists of a cylindrical chamber containing a spiral shelf provided with retaining pins or projections, around which the material to be separated is caused to flow, substantially as described.

10. The improved settling-tank herein described, which consists of the outer tank, C, the diaphragms or partitions *e* and *p*, and the deflecting-plate *d*, substantially as described.

11. As an improvement in the process of removing viscous impurities from refined distillate, the method herein described of causing it to flow upward under pressure in contact with collecting devices, which retard the viscous impurities, substantially as described.

EDWARD D. KENDALL.

Witnesses:

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