Nov. 1, 1932. W. G. WILLIAMS 1,886,142

FRACTIONAL DISTILLATION PROCESS AND APPARATUS

Filed June 6, 1929 3 Sheets-Sheet 1

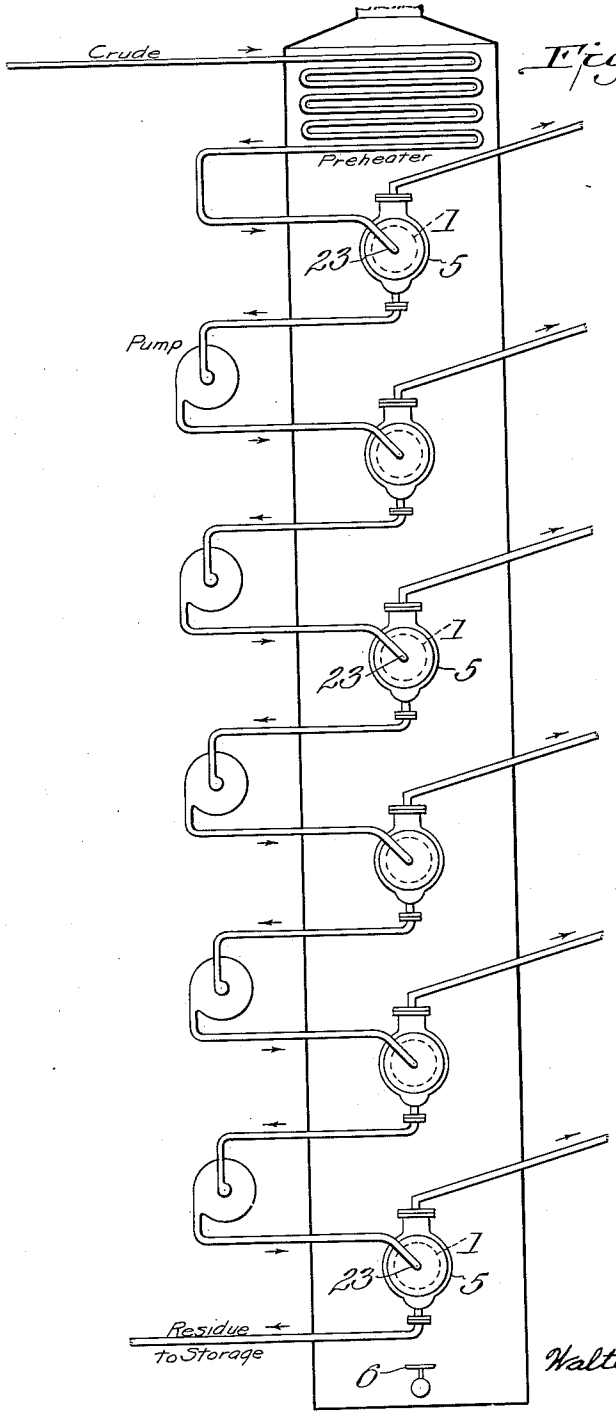


Fig 1.

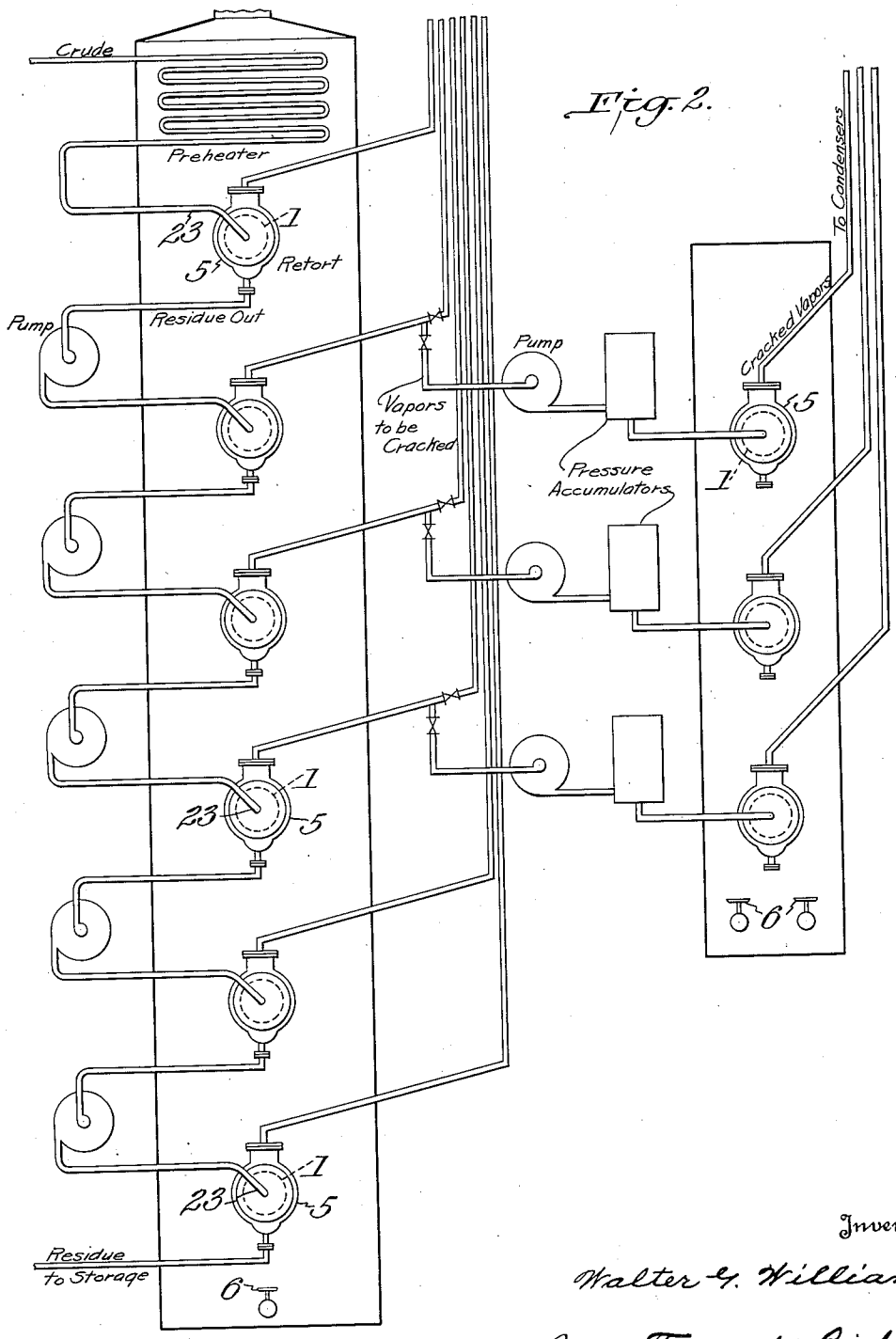
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FRACTIONAL DISTILLATION PROCESS AND APPARATUS

Filed June 6, 1929 3 Sheets-Sheet 2

Fig. 2.



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FRACTIONAL DISTILLATION PROCESS AND APPARATUS

Filed June 6, 1929 3 Sheets-Sheet 3

Fig. 3.

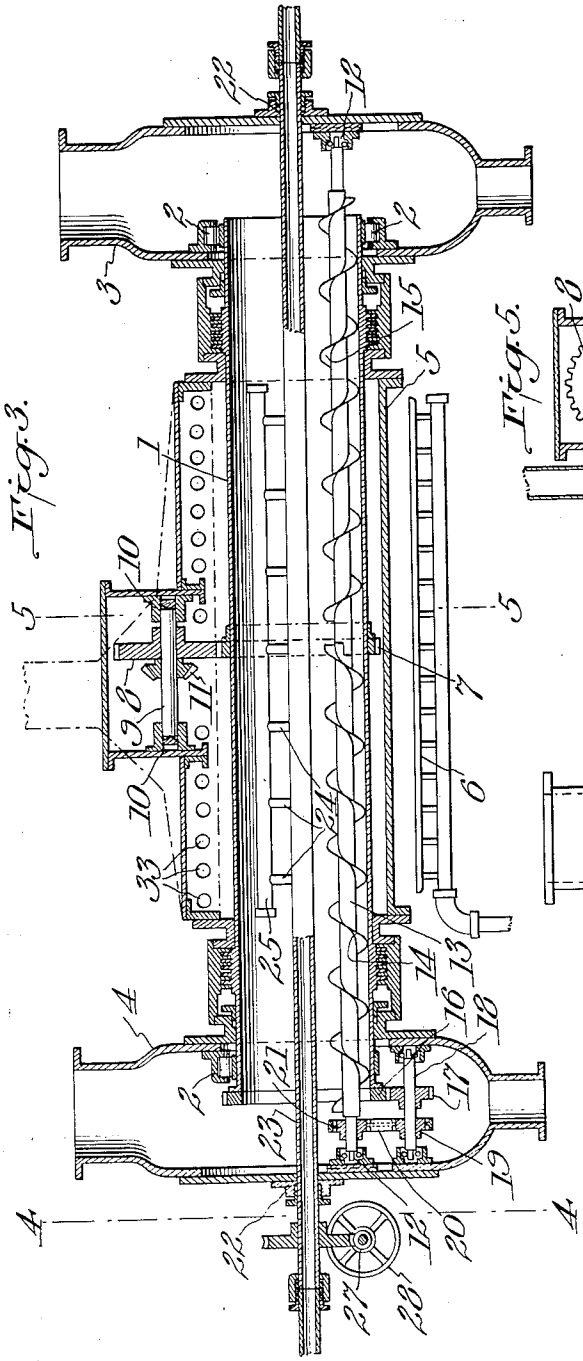


Fig. 5.

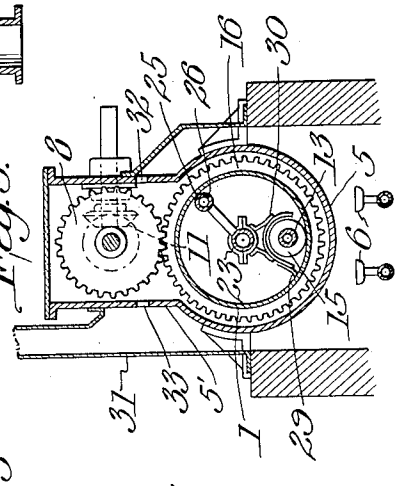
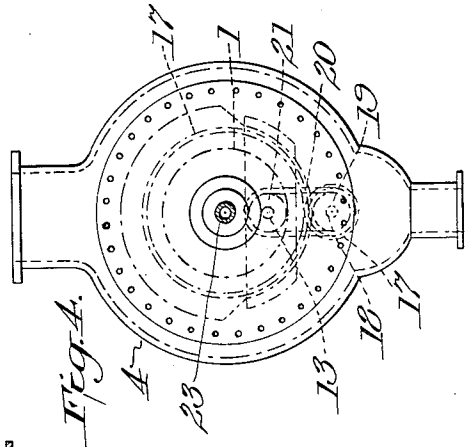


Fig. 4.



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UNITED STATES PATENT OFFICE

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FRACTIONAL DISTILLATION PROCESS AND APPARATUS

Application filed June 6, 1929. Serial No. 368,826.

The present invention relates to processes for the fractional distillation of liquids, and to apparatus therefor. More particularly, it is concerned with a process of, and apparatus for, fractionally distilling petroleum oils.

Oil distillation procedures of commercial application heretofore have been confined largely to direct-fired shell stills and pipe stills. It is well known that, in operating stills of the types named, some overheating, and consequent destructive distillation or "cracking", is practically inevitable, with resultant production of fixed gases and deposition of free carbon on the still bottom.

An object of the present invention, therefore, is to provide a commercially practical apparatus whereby relatively close fractionation of petroleum oils is made possible, the use of which apparatus avoids production of undesirable pressure within the distillation apparatus, overheating, and decomposition of the oils. These, and other objects of the invention, will be more fully set out hereinafter.

The invention includes a process of, and means for, practicing a series of treatments each of which (except the first and last) comprises providing a film of oil, of constant and predetermined thickness, upon a moving surface, maintaining said surface at a constant predetermined temperature sufficient to effect vaporization of at least some of the constituents of the oil, withdrawing the resulting separated vapors and non-vaporized residue, and subjecting the residue to a repetition of the foregoing operations,—each succeeding cycle of operations being practiced at successively higher temperature. The invention furthermore includes the foregoing complemented, as to one or more of the intermediate cycles of the series of treatments, by means for separately carried out "cracking" treatments of separated vapors.

The invention will be more fully understood by reference to the appended drawings, in which:

Fig. 1 is a view illustrating schematically an organization of units embodying the features of my apparatus, and adapted to carry out the method of my invention, in one aspect.

Fig. 2 illustrates schematically an arrangement of apparatus including the apparatus illustrated in Fig. 1 but showing in addition thereto an assembly of elements whereby further steps in my method may be carried out.

Fig. 3 is an axial longitudinal vertical sectional elevation illustrating a single unit of the apparatus for carrying out the method of my invention.

Fig. 4 is an end view looking at the left hand end of Fig. 3.

Fig. 5 is a section taken on the line 5—5 of Fig. 3.

The apparatus comprises essentially a cylinder 1 arranged horizontally and mounted for rotation in bearings 2 carried by headers 3 and 4, respectively. The headers are formed with separate liquid and vapor outlets and when placed in position over the open ends of the cylinder 1, form receiving chambers for the vapor and undistilled portions of the liquid. This cylinder is enclosed throughout a portion of its length, preferably its mid portion, by a casing 5 adapted to contain a bath of liquid, e. g., molten metal (not shown), preferably completely surrounding the enclosed portion of the cylinder. Beneath the casing 5 is arranged a burner or burners 6 whereby the bath of metal is kept in the desired molten condition and at temperature requisite for the carrying out of my method.

Upon the cylinder 1 is arranged a ring gear 7 which meshes with a pinion 8, carried on a shaft 9, supported in suitable bearings 10, in the casing 5, and driven by means of bevel or other gearing 11, whereby rotation is imparted to the cylinder in its bearings 2.

Extending longitudinally of the cylinder 1 and carried in bearings 12 in the headers 3 and 4, respectively, is a divided shaft 13, provided with two screw conveyors 14 and 15 arranged, respectively, left and right hand, so as to clear the adjacent portion of the cylinder of material in opposite directions from its longitudinal center toward its ends and into the headers 4 and 3, respectively.

For the purpose of driving the shaft 13 which carries the conveyors 14 and 15, I provide the cylinder 1 with a ring gear 16 mesh-

ing with a pinion 17 carried on a shaft 18 mounted for rotation within the header 4 and provided, in addition to the pinion 17, with a sprocket 19 connected, preferably by a silent drive chain 20, with a similar sprocket 21 on shaft 13.

Carried in suitable bearings 22 in the headers 3 and 4 is a tubular shaft 23 carrying, upon radially arranged tubular arms 24, a distributor pipe 25 provided with a plurality of perforations 26, and to this tubular shaft 23 may be fed the liquid to be treated, which liquid finds its way through the tubular arms 24 to the distributor pipe 25. The liquid is thereafter distributed, by means of the perforations 26, in a thin film against the inner peripheral surface of the rotating cylinder 1.

In order that the circumferential position of the distributor pipe 25 may be varied relatively to the inner peripheral surface of the cylinder 1, I provide a worm and worm wheel mechanism indicated at 27, the worm of which may be operated by means of a hand wheel 28 to so rotate the shaft 23 as to accomplish the desired adjustment of the distributor pipe 25.

As shown in Fig. 5, I provide, within the cylinder 1, a scraper 29 mounted upon a suitable support 30, and by which material deposited upon the inner periphery of the cylinder 1 may be scraped therefrom and directed into the zone of operation of the conveyors 14 and 15 whereby it may be carried out of the cylinder and discharged into the headers 3 and 4.

For the purpose of confining the gases which are utilized for heating the bath of molten metal surrounding the cylinder 1, I may enclose the apparatus within a housing 31. Where a plurality of units is to be used in combination, and a single set of heating burners (or a number of heating burners, usually less than the number of units used), is to supply heat to all such units, this housing may be so formed as to conduct such gases from contact with the casing 5 of one of the units to that next above it in the series of units, and so on to the uppermost unit of the series. In such an arrangement I may provide the portion 5' of the casing 5 with a plurality of ports 32 and 33 which communicate with the interior of the housing 31, and provide a means of communication between the portions of such housing enclosing the several units of the series and the casings 5.

As has been stated briefly hereinbefore, and as indicated in Figs. 1 and 2, a feature of my invention consists in an organization of a plurality of units, illustrated in Fig. 3, in a vertically arranged bank wherein any one unit above the lowermost is heated at a somewhat lower temperature than the unit or units beneath it, whereby the crude oil, without or preferably with a pre-heating treatment, may be introduced into the topmost unit of fractional distillation apparatus, where only the lightest (or most readily volatile) constituents of the oil will be vaporized, in the brief treatment, and thereafter the liquid residue thereof progressively re-treated, in a plurality of steps, at successively increased temperatures. In this manner "sharp cuts" may be cleanly removed, and objectionable overheating and decomposition may be avoided.

Those fractions which require no further heat-treatment pass directly to condensers (not shown). Those fractions which require "cracking" I divert to rotary pressure pumps (as illustrated in Fig. 2) or other equivalent means for subjecting the vaporous material to the required pressure for cracking, and then move the vaporous material under pressure through a pressure accumulator (additional heat being added, in transitu, if found desirable) and expand the same against the inner walls of the cracking retorts. These latter retorts have the same design as have the primary retorts previously described in detail, but the rotatable cylinders 1 are here fabricated of, or lined with, a non-ferrous metal,—preferably, a metal having catalytic properties. The cracking units are heated to the desired temperature for the decomposition reaction by means of suitable burners 6 located below the units. Any non-vaporous residue from the cracking treatment is removed from the zone of reaction by means of the scrapers 29, and conveyors 14 and 15, previously described.

It is to be understood that the invention embraces the provision of well known means for varying temperatures, pressures, and rates of input and output; also, the provision of suitable piping, connections, valves and the like, and of suitable by-passes for cutting out either the preheater, and/or one or more of the series of primary retorts, and/or one or more cracking retorts. Thus, it is within the scope of my invention to provide any suitable means for regulating the volume of the hot gases contacting with any particular unit of the series, or to provide auxiliary heating means intermediate the bottom and the top of the bank of the retorts.

I claim:

1. An apparatus for the fractional distillation of liquid hydrocarbons comprising a plurality of interconnected revolvable retorts, means for introducing liquids into said retorts, and for separately withdrawing therefrom vaporized and unvaporized portions of said liquids an independent liquid bath for each of said retorts, a common source of heat for said baths, and means within each retort for applying a film of liquid upon the inner surface thereof adjacent the liquid bath thereof.

2. An apparatus for the fractional distillation of liquid hydrocarbons comprising a plu-

rality of interconnected revolvable retorts, means for introducing liquids into said retorts, an independent liquid bath for each of said retorts, a common source of heat for said baths, means within each retort for applying a film of liquid upon the inner surface thereof adjacent the liquid bath thereof, and means adapted to convey undistilled liquid from the central portions of said retorts into headers at the ends thereof.

3. An apparatus for the fractional distillation of liquid hydrocarbons comprising a vertical bank of interconnected horizontal cylindrical revolvable retorts having the major portions of their length intermediate their ends encased in a common casing, a source of heat at the lower end of said casing, a preheater within said casing communicating between a source of liquids to be treated and the topmost of said retorts, each of said retorts being encased for so much of its length as lies within the common casing in a jacket adapted to confine about said retort a body of heat-resistant liquid substance, each of said retorts being provided with means for applying a film of liquid to be treated upon the inner surface thereof, with means for scraping residue from said surface, and with means adapted to convey residue from the central portion of said retort into stationary headers at the ends thereof.

4. An apparatus for the fractional distillation and heat treatment of liquid hydrocarbons comprising a plurality of interconnected revolvable retorts, means for introducing liquids into said retorts, an independent liquid bath for each of said retorts, a common source of heat for said baths, means within each retort for applying a film of liquid upon the inner surface thereof adjacent the liquid bath thereof, means adapted to convey undistilled liquid from the central portions of said retorts into headers at the ends thereof, means communicating between the upper portions of the headers of at least one of said retorts and a means adapted to compress gases, a second horizontal cylindrical revolvable retort having an inner surface of non-ferrous metal, a liquid bath for said second retort, a source of heat for said bath, and pressure-regulating means communicating between said pressure means and said second retort.

5. In a retort for the distillation of liquid hydrocarbons, means to supply the liquid to the central portion of the cylinder, an open ended horizontal cylinder, headers at each end of the cylinder and means adapted to convey undistilled portions of the liquid from the center of the cylinder into the headers provided at the ends of said cylinder.

6. In a horizontal retort for the distillation of liquid hydrocarbons, a revolvable horizontal cylinder, a header at each end of the cylinder, means adapted to apply a film of the liquid upon the inner surface of said cylinder, and means adapted to convey undistilled portions of the liquid from the center of the cylinder into the headers provided at the ends of said cylinder.

7. In a retort for the distillation of liquid hydrocarbons, a revolvable horizontal cylinder, a header at each end of the cylinder, a heating bath surrounding at least a portion of said cylinder, means for delivering the liquid upon the inner surface of said cylinder, and means adapted to convey undistilled portions of the liquid from the center of the cylinder into the headers provided at the ends of said cylinder.

8. In a retort for the distillation of liquid hydrocarbons, a revolvable horizontal cylinder, a heating bath surrounding at least a portion of said cylinder, means adapted to deliver liquid upon the inner surface of said cylinder, and means actuated by the rotation of said cylinder and adapted to convey undistilled portions of liquid from the center of the cylinder into headers provided at the ends of said cylinder.

9. Continuous process for the fractional distillation of petroleum oils, which comprises a plurality of operations each of which consists in maintaining a movable surface forming the interior boundaries of a closed space at a constant and predetermined temperature sufficient to effect vaporization of at least some of the constituents of the material to be treated, continuously applying thereon a film of oil of constant and predetermined thickness, continuously withdrawing the resulting separated vapors and non-vaporized residue, subjecting the vapors to cracking treatment, condensing the vapors and subjecting the residue to a succeeding similar operation, each succeeding operation being practiced at successively increased temperature.

In testimony whereof, I affix my signature.

WALTER G. WILLIAMS.