May 19, 1925. 1,538,490

J. W. H. RANDALL

ROTARY RETORT

Filed May 13, 1920 3 Sheets-Sheet 1

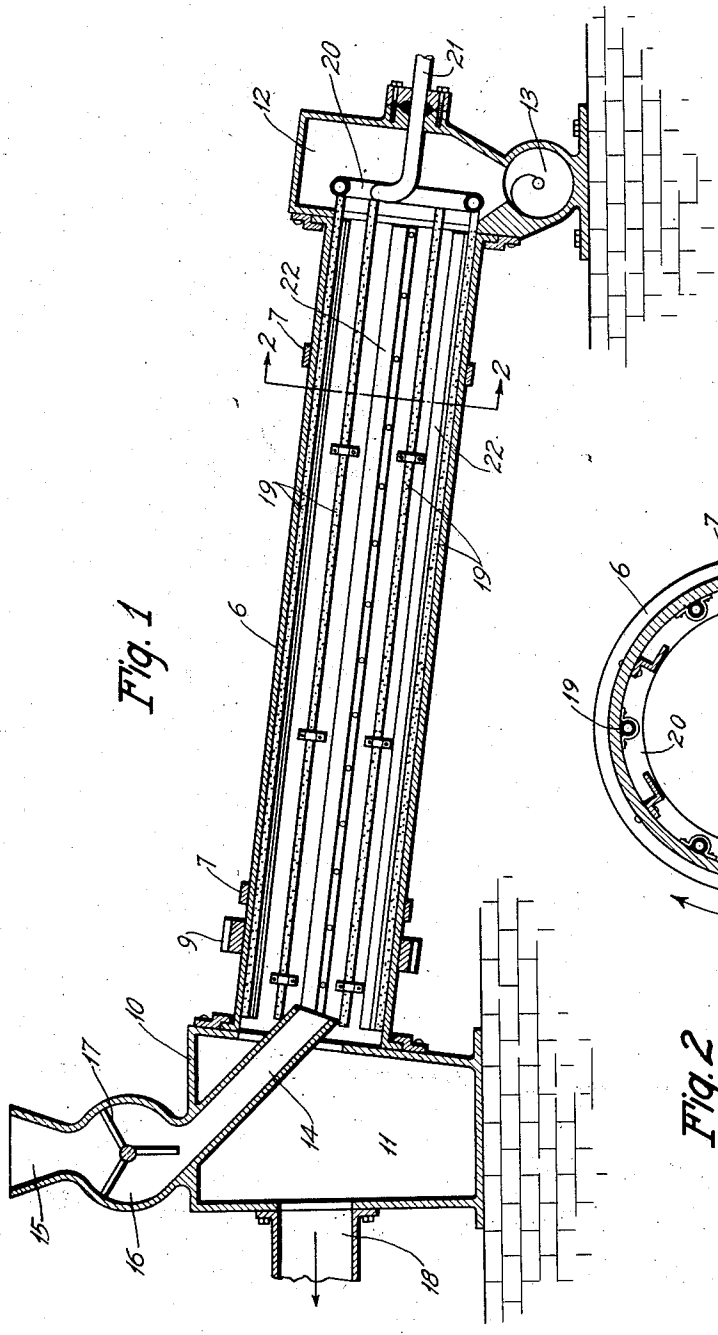


Fig. 1

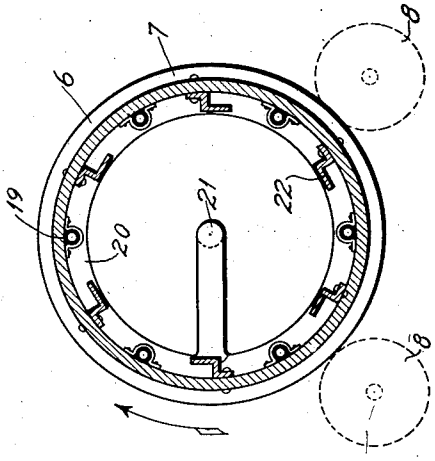


Fig. 2

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Fig. 4

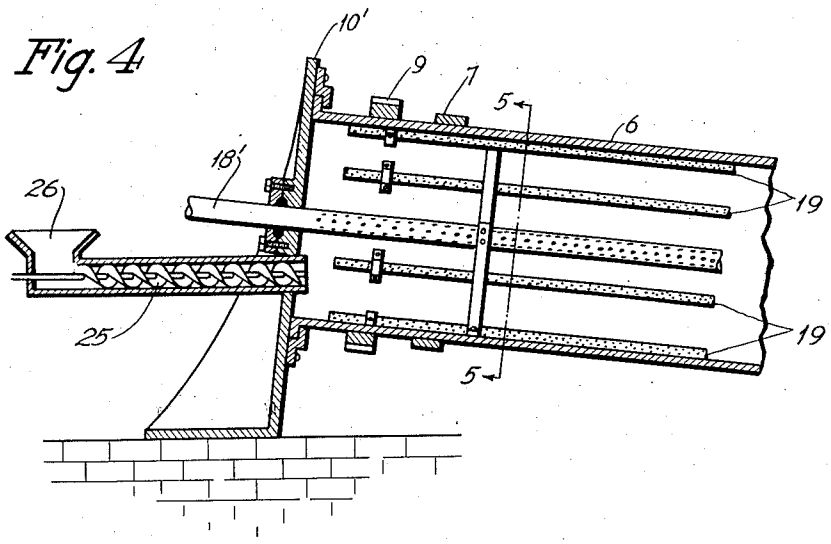


Fig. 5

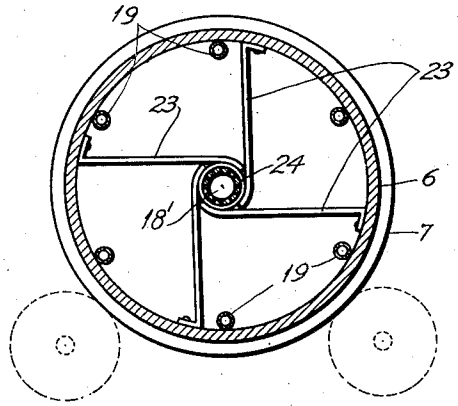
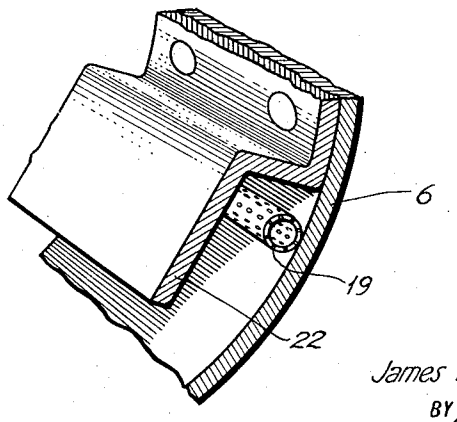


Fig. 3



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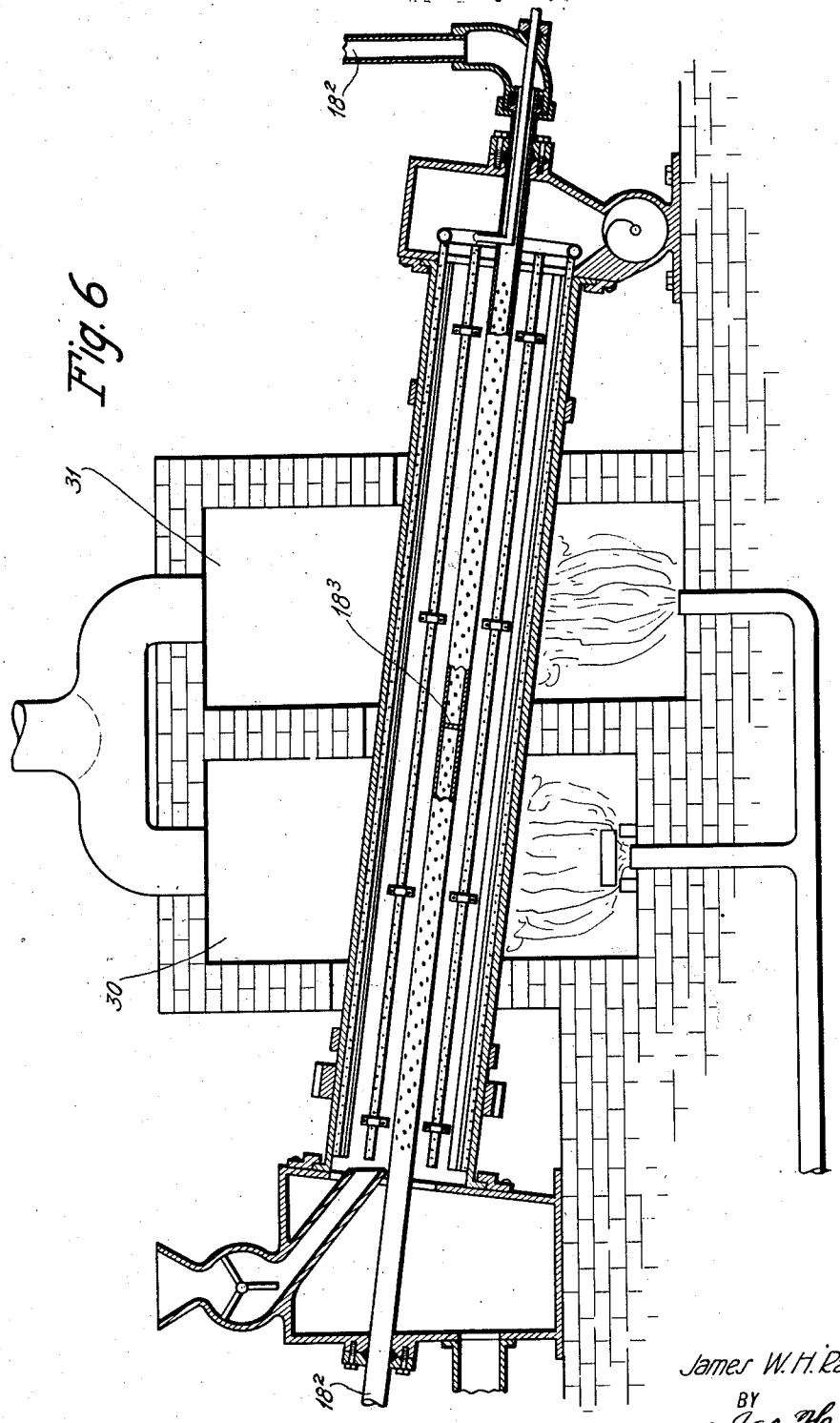
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ROTARY RETORT

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Fig. 6



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Patented May 19, 1925. 1,538,490

UNITED STATES PATENT OFFICE.

JAMES W. H. RANDALL, OF NEW YORK, N. Y.

ROTARY RETORT.

Application filed May 13, 1920. Serial No. 380,967.

To all whom it may concern:

Be it known that I, JAMES W. H. RANDALL, a subject of the King of Great Britain (but having taken out his first papers with the intention of becoming a citizen of the United States), residing at New York city, borough of Manhattan, county and State of New York, have invented a certain new and useful Rotary Retort, of which the following is a specification.

This invention is a rotary retort for use, more particularly, in the treatment of oil shale, bituminous material, saturated oil sands, and all other materials that contain hydrocarbons and their derivatives, and the object of the invention is to provide a rotary retort which will operate with high efficiency in the separation of the hydrocarbons from the material operated upon.

While the present invention embodies many novel features of construction, it is more particularly directed to means, whereby steam may be efficiently introduced into a closed retort to assist in the driving off of the vapors generated within the retort, to lower the temperature of distillation and to assist in the breaking down of the nitrogen compounds for the production of ammonium compounds.

A further feature of the invention is the drawing off of the generated vapors throughout the entire length of the retort for the purpose of increasing the efficiency of the retort and increasing its production.

A still further important feature is the provision of novel means interiorly of the retort for facilitating the agitation of the material operated upon for the purpose of further raising the efficiency of the structure.

Features of the invention, other than those adverted to, will be apparent from the hereinafter detailed description and claims, when read in conjunction with the accompanying drawings.

The accompanying drawings illustrate different practical embodiments of the invention, but the constructions therein shown are to be understood as illustrative, only, and not as defining the limits of the invention.

Figure 1 is a central vertical longitudinal section of the retort embodying the present invention.

Figure 2 is a section on line 2—2 of Figure 1;

Figure 3 is a detail fragmental section perspective of the shell of the retort and associated adjuncts.

Figure 4 is a central section of the charging end of a retort of slightly modified construction;

Figure 5 is a section on line 5—5 of Figure 4; and,

Figure 6 is a further modified form of the invention.

Referring to the drawings, and more particularly to Figures 1 to 3 inclusive, 6 designates a tubular shell which forms a rotary retort. This shell may be of any suitable construction and may be fabricated in any desired manner in any length or in any suitable number of sections jointed together as will be appropriate for the nature or extent of the work to be carried on. The shell 6 is provided at suitable spaced intervals with circumferential bearing rings 7 adapted to rest upon supporting wheels or rollers 8, whereby said shell is mounted for rotation, in a substantially horizontal position though preferably with one end thereof somewhat lower than the other as shown in Figure 1. Rotation may be imparted to the shell through a gear 9 positioned circumferentially thereof and driven at a desired speed by any suitable driving means or prime mover.

In the form of the invention shown in Figure 1, the higher end of the shell is rotatably associated with a chambered casing 10, which in this embodiment of the invention, encloses a settling chamber 11. The lower end of the shell is in turn rotatably associated with a discharge casing 12 in the base of which is preferably mounted a screw conveyer 13. The materials to be operated upon may be fed into the shell 6 through a chute 14 which extends downwardly through the chamber 11 with the discharge end interiorly of the shell, and material is fed to the chute from a hopper 15 through a sealing chamber 16 in which is mounted a valve 17. The valve 17 is provided with three or more wings as shown and is adapted to rotate within the sealing chamber 16 for the purpose of allowing material to be fed to the chute 14 yet precluding the exit of vapor through said chute and out of the hopper. The valve 17 may be rotated by any suitable means forming no part of the present invention.

Material fed through the chute 14 falls

into the upper end of the shell or rotary retort 6 and, through rotation of said retort works down to the lower end thereof and falls through the discharge chamber 12 into the base thereof from which it is carried away by the screw conveyer 13. In practice, the shell for its entire length is enclosed in suitable brick work or masonry including one or more fire boxes, burners or retorts, but the manner of exteriorly heating the shell 6 forms no part of this invention and such exterior heating may be carried out in any well known and conventional manner heretofore practiced. Suffice it to say that the shell 6 is exteriorly heated throughout substantially its entire length, and that the lower end is preferably heated at a higher temperature than the upper end.

During the passage of material through the heated shell, it becomes highly heated and the hydrocarbon oils and greases contained therein are volatilized, a hydrocarbon vapor being generated interiorly of the shell 6. This hydrocarbon vapor which contains the material which it is desired to recover, is drawn off through the settling chamber 11 through an outlet pipe 18 leading to suitable condensers or other recovering apparatus, but during its passage through the settling chamber 11 dust or other heavy impurities settle to the base of the chamber 11 and may be drawn off or removed therefrom in any desired way. The products drawn through the outlet 18 are subsequently fractionally distilled or otherwise treated to obtain lubricating oils, kerosene, gasoline and other derivatives as will be clearly understood by those skilled in the art.

While the vapors may be drawn off by suction in any suitable way, the discharge of such vapors will be facilitated by the introduction of live steam in the retort, and it is preferable that this live steam be introduced for substantially the entire length of the retort. This may be accomplished by securing a plurality of pipes 19 to the interior of the shell 6 so as to extend over substantially the entire length of said shell. These pipes are preferably perforated and lead from a common header 20 positioned adjacent the discharge end of the shell. The header may be fed through a feed pipe 21, which extends through the wall of the discharge chamber 12 co-axially with the shell 6, so as to permit of rotation of the shell with the steam pipes 19 interiorly thereof. The supply pipe 21 has a suitable sliding and rotary connection with a suitable source of steam supply to permit of proper expansion of the pipes under varying conditions of temperature and to permit of rotation of the parts. The pipes 19 may be made straight and extend in parallel relation throughout the length of the shell 6 as shown, or if desired, they may be wound spirally within the shell, so as to constitute, in effect, a worm which will facilitate the feed of the material to be treated longitudinally of the shell when the same is rotated.

The positioning of the pipes 19 within the shell as described will, when the shell is rotated, serve to agitate the material so that all parts thereof may be brought into intimate contact with the hot shell, and this intimacy between the shell and the material may be further accomplished by extending pockets 22 longitudinally of the shell, either between the pipes 19, as shown in Figure 2, or in a position to overlie the pipes as shown in Figure 3. These pockets or scoops will cause a thorough tumbling of the material contained within the shell but will through a portion of each revolution cause portions of the material to be maintained in intimate engagement with the hot shell. In this way, the operation of destructive distillation may be more rapidly carried out.

When steam is introduced in the manner described, it will not only assist in the removal of vapors, but will lower the temperature of distillation required in the carrying out of the process. Moreover, the steam also assists in the breaking down of the nitrogen compounds in the material operated upon, and the formation of ammonium compounds, which may be separated out of the vapors, or condensed vapors, after leaving the apparatus.

In the construction of Figures 4 and 5, the settling chamber of the preferred embodiment is dispensed with and the vapors are drawn from the apparatus through a discharge pipe 18′, which extends for substantially the entire length of the shell 6 and is preferably concentric therewith. The discharge pipe 18′ is spaced from the interior walls of the shell 6 at suitable intervals by means of supporting straps 23 which are riveted to the interior of the shell at their outer ends and to a ring or band 24 at their inner ends. The structure is clearly shown in Figure 5, wherein it will be noted that the band 24 surrounds the pipe 18′ and that the straps 23 extend substantially tangent to the band 24. By this construction, expansion or contraction of the parts due to change in temperature will not effect a warping or binding of the straps 23. The structure shown in Figure 5 may be duplicated at suitable intervals throughout the length of the shell to properly maintain the pipe 18′ in a centrally disposed position. Pipe 18′ is preferably perforated throughout that portion thereof which extends interiorly of the shell and has a suitable rotary and sliding connection with any desired form of exhaust connection at its end exteriorly of the shell. It is mounted for rotation within the end plate 10′ which serves to close the upper

end of the retort. The construction of Figure 4 preferably embodies steam pipes corresponding to the steam pipes 19 and may be provided with pockets or scoops 22.

Material is fed in the construction of Figure 4 through the end plate 10′ into the shell preferably by a screw conveyer 25, which is in turn fed from a hopper 26. The feed from the hopper to the screw conveyer may be accomplished through a sealing chamber similar to the chamber 16 of Figure 1, though this is not essential.

The advantage of the construction of Figure 4 over that of Figure 1 is that the vapors are drawn off throughout the entire length of the shell, thereby rendering the apparatus more rapid in its operation. Furthermore, the construction of Figure 4 is cheaper to install and requires less space than the construction of Figure 1.

In Figure 6, a still further modified form of construction is illustrated, and for the purpose of the showing, two furnaces are disclosed for heating the shell of the retort. In practice, however, any number of furnaces may be employed and the heating of the retort may be accomplished in any desirable way. The chief difference between the modification of Figure 6 and the form of the invention shown in Figure 4 is that, instead of drawing off the evolved vapors, through the pipe 18′ at one end of the apparatus, a pipe 18^2 is extended the full length of the apparatus and beyond the ends thereof and is provided with a partition 18^3 intermediate its ends, whereby the evolved vapors may be drawn from both ends of the apparatus. In other words, the vapors produced through heating of the material by the furnace 30 are drawn off at the left hand end of the apparatus, while the vapors resulting from the heating of the material by the furnace 31 are drawn off at the right hand end of the apparatus. The apparatus is provided with suitable glands or stuffing boxes to preclude the entrance of air or the exit of gases or vapors through the connections between the revolving stationary parts of the apparatus.

Having thus fully described the invention, what I claim as new and desire to secure by Letters Patent is:

1. A fractionating apparatus embodying an inclined retort mounted for rotation, means for introducing material into the upper end of the retort, the rotation of which retort tumbles the material to the lower end of the retort from which the spent material is discharged, means for heating different portions of the length of the retort at different, definitely determined temperatures for the purpose of fractionally distilling material passing through the retort, and perforated fluid inlet ducts positioned within and longitudinally of the retort in close proximity to the wall of the retort and adapted to be successively buried as the retort revolves, whereby fluid may be passed through said ducts and find exit through the material for the purpose of driving off the vapors evolved through contact of said material with the heated surface of the retort and to lower the temperature at which the vapors are evolved.

2. A fractionating apparatus embodying an inclined retort mounted for rotation, means for introducing material into the upper end of the retort, the rotation of which retort tumbles the material to the lower end of the retort from which the spent material is discharged, means for heating different portions of the length of the retort at different, definitely determined temperatures for the purpose of fractionally distilling material passing through the retort, and perforated fluid inlet ducts positioned within and longitudinally of the retort in close proximity to the wall of the retort and adapted to be successively buried as the retort revolves, whereby fluid may be passed through said ducts and find exit through the material for the purpose of driving off the vapors evolved through contact of said material with the heated surface of the retort and to lower the temperature at which the vapors are evolved, and means for drawing off the evolved vapors directly from the regions of their evolution.

3. A fractionating apparatus embodying an inclined retort mounted for rotation, means for introducing material into the upper end of the retort, the rotation of which retort tumbles the material to the lower end of the retort from which the spent material is discharged, means for heating different portions of the length of the retort at different, definitely determined temperatures for the purpose of fractionally distilling material passing through the retort, perforated fluid inlet ducts positioned with and extending longitudinally of the retort in close proximity to the walls of the retort, and adapted to be successively buried by the material under treatment as the retort revolves, and means associated with the fluid ducts for agitating the material in the retort and for prolonging the subjection of such material to the action of the incoming fluids.

4. A fractionating apparatus embodying an inclined retort mounted for rotation, means for rotating the retort, means for heating different portions of the length of the retort at definitely determined progressively higher temperatures, a plurality of perforated fluid inlet pipes extending longitudinally of the retort and secured to the inner surface thereof and adapted for rotation therewith and adapted to be successively buried beneath the material under

treatment, means for feeding fluid to said ducts, in combination with means for feeding material to the upper end of said retort, whereby it is tumbled the length of the retort, by virtue of the rotary movement of the inclined retort and the fluid feed pipes therein, to be discharged at the lower end of the retort, and means for removing the evolved vapors.

5. A fractionating apparatus embodying an inclined retort mounted for rotation and communicating at one end with a stationary feed chamber and at its other end with a stationary discharge chamber, means for rotating the retort, a plurality of perforated pipes secured to the inner surface of the retort and extending substantially the full length of the retort said pipes being adapted to be successively buried beneath the material under treatment as the retort revolves, a header at one end of the retort for feeding said pipes and a feed pipe leading to the header which feed pipe passes through the end wall of one of the chambers coaxially with the axis of rotation of the retort to permit of rotation of the latter.

6. A fractionating apparatus embodying an inclined retort mounted for rotation, means for rotating the retort, a plurality of perforated fluid inlet ducts associated with the inner surface of the retort and bodily movable therewith, and scoop-like members also associated with the inner surface of the retort and so positioned with respect to the fluid inlet ducts that material scooped up by the scoop like members during the rotation of the retort will effect a prolonged burying of the fluid ducts.

7. A fractionating apparatus embodying an inclined retort mounted for rotation, means for rotating the retort and a plurality of perforated fluid inlet ducts extending longitudinally of the retort and positioned between the axis of the retort and the inner circumference of said retort, said ducts being mounted for bodily rotation with the retort and adapted to be successively buried by the material under treatment for the purpose of lowering the temperature at which the vapors are evolved and to also drive off the vapors immediately upon their evolution.

In testimony whereof, I have signed my name to this specification.

JAMES W. H. RANDALL.