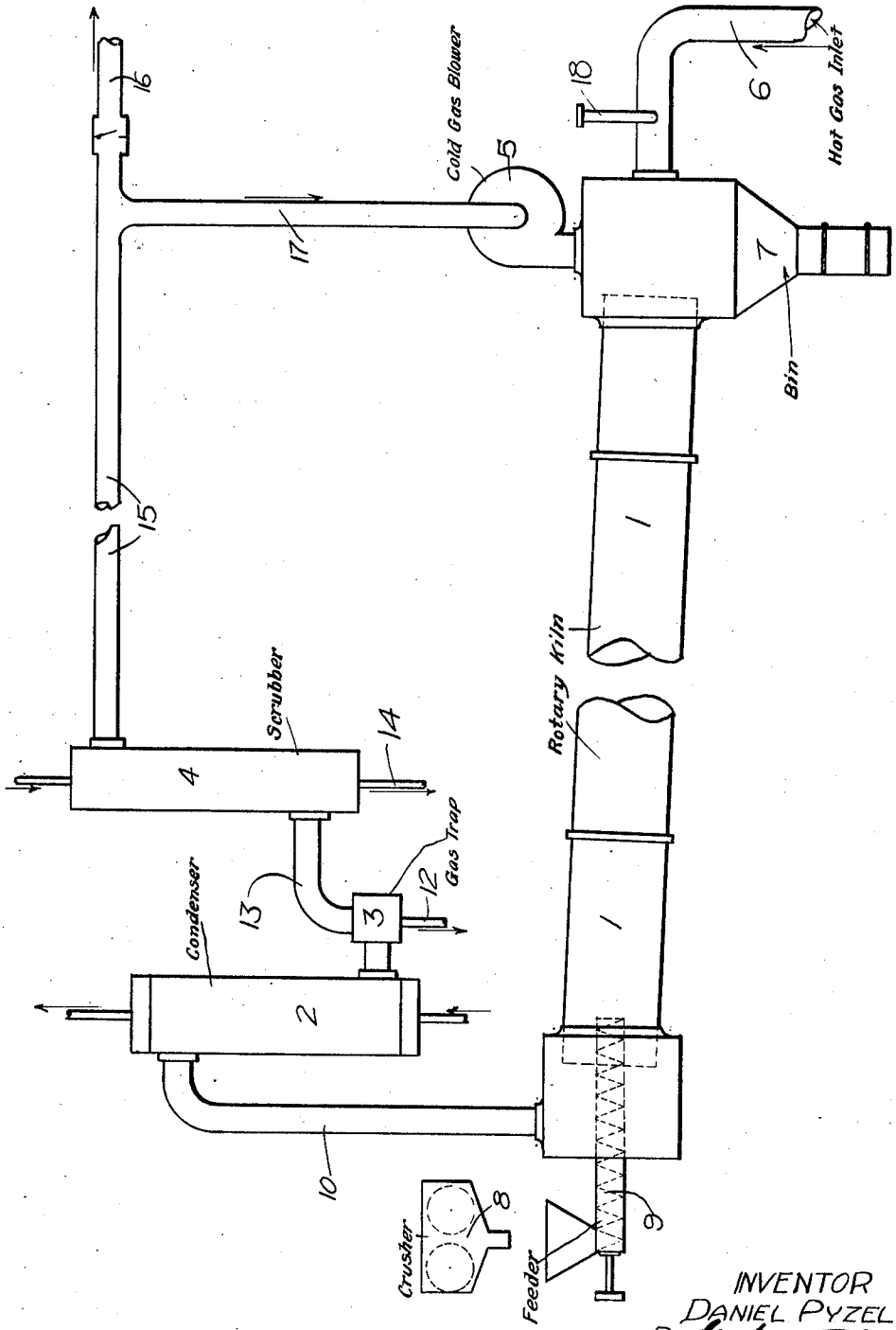
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D. PYZEL

PROCESS OF DISTILLATION

Original Filed Nov. 3, 1919



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UNITED STATES PATENT OFFICE.

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PROCESS OF DISTILLATION.

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To all whom it may concern:

Be it known that I, DANIEL PYZEL, a subject of the Queen of Holland, residing at Piedmont, in the county of Alameda and State of California, have invented a new and useful Improvement in the Art of Distilling Bituminous Materials Comprising the Process of Distillation, of which the following is a specification.

My invention relates to the art of distilling bituminous materials. It is particularly applicable to the distillation of asphaltums, asphaltic residuums and heavy petroleum oils, which although liquid at ordinary or higher temperatures, yield a solid or semisolid residuum in the process of distilling.

The problem of disposing of the heavy asphaltic residuums of certain crude oils and similar materials, is one which many refiners have been unable to meet. Although such residuums have a limited commercial value in certain markets, there is, in many places, an oversupply of such materials, which reduces their commercial value to an extremely low figure or even to such an extent that they can only be considered as troublesome waste products. The transportation of such materials to the markets by pipelines or tank-steamers is impossible as they are only liquid at high temperatures, while at the same time they are not sufficiently solid at ordinary temperatures to be transported in bulk as coal or coke is transported, the pieces of these materials welding themselves together to a semi-solid mass when allowed to stand, this mass being extremely difficult and costly to handle.

Bituminous materials of a semi-solid nature can be reduced to products of a higher total commercial value by subjecting them to a distillation to dryness, the products in this case being an oil distillate (fuel oil) coke and gas. However, if for such a distillation process fireheated stills or retorts of the usual types are used, the coke which is formed during the process, settles on the heated bottoms and walls of such stills or retorts, and prevents a ready transmission of the heat required for the distilling process. The rate of distillation and in consequence the distilling capacity of the apparatus is thereby greatly reduced, other results being high fuel consumption, overheating, blistering and rapid destruction of the still or retort material, and an excessive formation of gas through partial overheating of the oil in the still or retort. The high cost of repairing and replacing such stills or retorts, the high fuel consumption, the reduced yield of oil, and the small capacity on account of the slow rate of distillation, to which must be added the necessity of cooling and cleaning the still or retort after each operation, render this method of distilling such material in most cases quite uneconomical.

As regards the distillation of solid bituminous materials, in the usual processes for distilling such materials, these substances are charged in externally fired retorts of various shapes, in which they are heated to a temperature sufficiently high to volatilize the bituminous matter and to form oily distillates and gases which in many cases contain considerable quantities of ammonia. A very high temperature is necessary to obtain the largest possible yield of ammonia while for the production of the maximum yield of valuable oily distillates a considerably lower temperature should not be exceeded.

The slow rate of penetration of the heat supplied to the retort walls into the solid mass of the retort charge causes a very uneven distribution of this heat through the material in course of distillation, the result being that part of the oil vapors generated in the more centrally located and therefore cooler parts of the charge, are decomposed by contact with the overheated parts of the charge lying closer to the heated retort walls. Various methods have been proposed to avoid this drawback, including the injection of steam at the retort bottom to carry the oil vapors rapidly away and out of reach of the overheated zone, and the use of stirring devices in the retorts, but all these methods are more or less unsatisfactory for reasons which need not be discussed here.

Other drawbacks of the usual methods of distilling bituminous materials in retorts are the high fuel consumption and the comparatively small distilling capacity of such retorts due to the slow transmission of the required heat into the solid mass of the retort charge.

An object of my invention is to provide an improved process by which liquid or semi-solid bituminous materials like asphaltum, asphaltic residuums and heavy petroleum oils, can be readily reduced in an economical way to products which can be easily handled and for which there is a considerable commercial demand. More particularly I reduce these materials to commercially valuable oils, gas, and coke, coky substance or other solid matter.

Further objects and advantages will be made evident hereinafter.

For convenience, I have in the following description included heavy crude oils, asphaltic residuums, asphaltums and similar liquid or semi-solid materials under one general term as "liquid bituminous material" while mixtures of liquid bituminous material with extraneous matter are hereinafter called "bituminous mixtures."

In the drawing which is extremely diagrammatic and in which no attempt has been made to preserve the proper proportion of the parts, 1 is a rotary kiln, 2 is a condenser, 3 is a gas separator or trap, 4 is a scrubber, 5 is a cold gas blower, 6 is a hot gas inlet, 7 is a bin, 8 is a crushing and mixing apparatus, and 9 is a feeder.

Each of these pieces of apparatus is well known in the arts and various types thereof can be employed without departing from the spirit of my invention or exercising more than mere mechanical skill, the types shown being merely selected as illustrative of a class.

The rotary kiln 1 is similar in construction to the standard type of kiln used for manufacturing Portland cement except that it is provided with a somewhat better closure means at either end for the purpose of retaining the gases therein.

Liquid bituminous material is delivered to the crushing and mixing apparatus 8 where it can be mixed with solid or liquid extraneous substances to a bituminous mixture which is delivered from the mixer by means of the feeder 9 into the upper end of the rotary kiln 1.

This bituminous mixture must be of such a consistency that during its passage through the rotating kiln 1, where it is subjected to the action of hot gases, it will at no time stick or adhere to the walls of this kiln, but will form lumps or "marbles" of a suitable size to allow a rapid penetration of the heat therein while the combined action of the rotation and the inclination of the kiln causes these lumps or marbles to be gradually moved to the lower end of the kiln.

For the purpose of producing a material having the characteristics I mix liquid bituminous materials with extraneous solids like sand, sawdust, powdered coke, powdered coal, oil sand or other material, to form a coherent but non-adherent pasty mixture, the percentage of admixture being largely dependent on the character of the bituminous matter to be treated.

During the passage of the bituminous mixture through the kiln which is rotated by any convenient means (not shown) it is subjected to the action of hot gases, these gases serving to thoroughly heat the pieces, lumps or marbles of bituminous mixture, and drive off all the volatile constituents thereof. As the mixture slowly moves in counter current to the hot gases, and the small size of the lumps of material allows a rapid penetration of the heat therein, this volatile matter is carried off at comparatively low temperatures, especially as the large volume of the heating gases causes the oil constituents to evaporate at temperatures below their normal boiling points. Moreover, these volatile matters are immediately carried off to cooler zones of the kiln so that the danger of the oil vapors being decomposed by excessively high temperatures is greatly diminished.

The non-volatile solid residuum of the bituminous mixture left after driving off its volatile constituents is delivered from the lower or discharge end of the kiln into the bin, 7. According to the character of the bituminous material charged and of the mixture, this residuum may be a commercially valuable product like coke, or a less valuable mixture of coke and mineral matter or even a valueless mineral matter like spent shale. This solid residuum is discharged from the bin and disposed of in a suitable way, and in case a liquid bituminous material is treated, which requires an admixture of solid matter to give it the proper consistency for the process, part of this solid residuum may be returned to the mixing apparatus 8.

The volatile products driven off from the bituminous mixture by the action of the hot gases are carried together with these gases from the upper end of the rotary kiln through the pipe 10, to the condenser or cooler 2. This apparatus may be in the form of a tubular watercooled condenser as shown in the diagram, or it may be in the form of any other cooling or condensing apparatus known in the arts and suitable for the purpose, like air-cooled or water-sprayed coolers. In this cooler or condenser the mixture of gases and vapors is reduced to a low temperature, so that the majority of the vapors are condensed and precipitated. The condensate which consists mainly of oil distillates but which may also contain other liquids, like ammoniacal water and other watery solutions, dependent on the character of the bituminous material treated, is separated from the remaining un-

condensed gases by means of the gas separator or trap 3, and carried off to a suitable receiver through the pipe 12.

The remaining gases, which may still contain vapors of desirable products, are then passed through the pipe 13, to the scrubber 4, where they are further freed from such products. The form of scrubber to be used is also dependent on the character of the crude material treated and the products to be collected. The diagram shows one scrubber only, but a plurality of apparatus of various well known forms may be used to free the gases of liquid oil carried over in the shape of a fog or mist, and of vapors of light hydrocarbons and other substances like ammonia gas. Such products are carried off together with the absorbing medium used in the scrubbing process through the pipe 14, to a suitable receiver.

The permanent gases leave the scrubbing apparatus through the pipe 15, and can be carried away through the outlet 16, to be used for any purpose for which they are suitable. Part of these gases can also be led through the pipe 17 to the cold gas blower 5, which delivers the gas to the lower or heating end of the rotary kiln 1.

It is of the utmost importance in order to obtain the highest possible output of valuable products from the bituminous material treated, to provide means for the exact adjustment of the temperature of the hot gases entering the lower end of the rotary kiln.

The heat necessary for the distilling process in the kiln is supplied by means of hot combustion gases obtained by burning any kind of suitable fuel, these gases entering the apparatus through the hot gas inlet 6. To avoid oxidation of the volatile products evolved from the bituminous material in the kiln 1, any excess of air over the theoretical quantity required for burning this fuel should be avoided. As a rule the combustion gases obtained in this way will have a temperature far in excess of the maximum which can be allowed at the point where these gases enter the kiln, and their temperature must therefore be reduced to this maximum. It is obvious that this can be done by using the excess heat of these gases for other purposes before they are introduced to the kiln. This, however, necessitates the combination of the rotary kiln with other apparatus which in many cases will be found to be impracticable. In such cases I reduce the temperature of the hot combustion gases either by injecting steam or a finely divided spray of water into these gases before they enter the kiln, for which purpose the steam or water spray-apparatus 18 is connected to the hot-gas inlet 6, or by mixing them with cold gas, drawn by the blower 5 through the pipe 17 from the scrubber outlet 15.

By using any of these three methods alone or in combination, the temperature of the gas entering the kiln can be accurately adjusted so as to obtain the highest possible yield of valuable products.

I claim as my invention:—

1. A process of refining liquid bituminous material which comprises: mixing said material with solid matter to form a bituminous mixture; rolling said bituminous mixture in the form of coherent balls through a chamber; and passing hot non-oxidizing gases through said chamber in contact with said balls.

2. A process of refining liquid bituminous material which comprises: mixing said material with solid matter to form a bituminous mixture; rolling said bituminous mixture in the form of coherent balls through a rotating chamber; and passing hot non-oxidizing gases through said chamber in contact with said balls.

In testimony whereof, I have hereunto set my hand at San Francisco, California, this 22nd day of October, 1919.

DANIEL PYZEL.