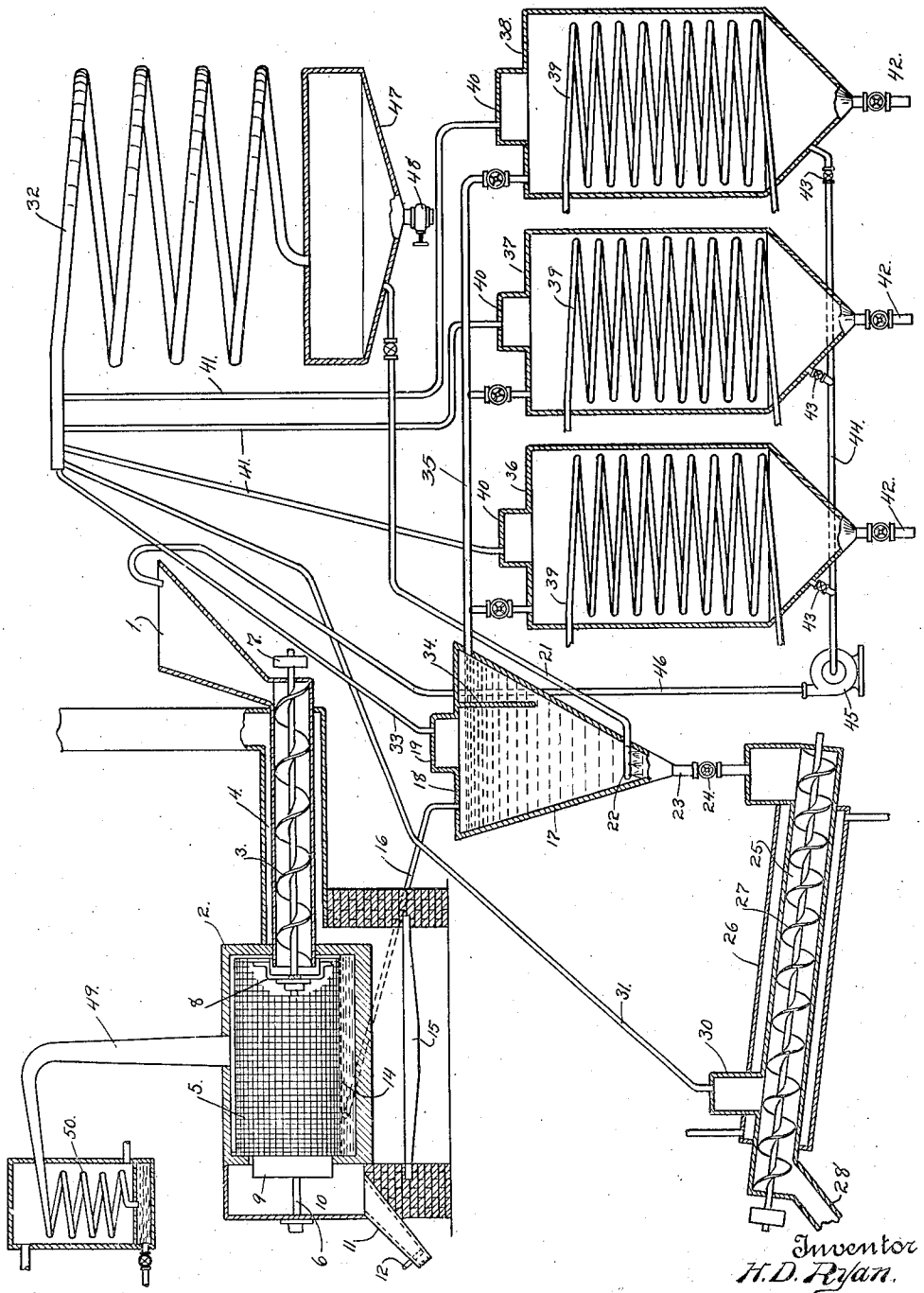
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PROCESS OF RECOVERING BITUMINOUS MATTER FROM SHALE.

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PROCESS OF RECOVERING BITUMINOUS MATTER FROM SHALE.

1,327,572. Specification of Letters Patent. Patented Jan. 6, 1920.

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To all whom it may concern:

Be it known that I, HENRY D. RYAN, a citizen of the United States, and a resident of the city and county of Boulder and State of Colorado, have invented a certain new and useful Improvement in Processes of Recovering Bituminous Matter from Shale, of which the following is a full, clear, and exact description.

My invention is a process of recovering bitumens from bitumen-carrying solids and especially shale and its principal object is the accomplishing of such recovery without destructive distillation of the various hydrocarbons as they exist originally in the solids. In the method of recovery of these values as at present carried out by dry distillation among other products there are driven off large volumes of fixed gases which result, relatively speaking, in considerable losses of the values; the principal object of my invention is the obviation of such losses.

In the single sheet of drawings accompanying this application and forming a part hereof, the single figure shown illustrates partially in side elevation and partially in vertical section, in a diagrammatic manner, an apparatus adapted for use in carrying out my invention. I wish it distinctly understood, however, that I do not desire to be considered as limited to the use of any particular apparatus in carrying out my process.

Broadly speaking my invention contemplates digestion of the shale in a closed retort with a body of relatively heavy oil under the influence of heat. By some action, the exact nature of which is now unknown to me, this step results in a conversion of the bitumen in the shale from its relatively solid state into a liquid and this without the evolution of any considerable quantity of fixed gases or extensive distillation of heavy oil fractions, but merely with the vaporization of some of the more highly volatile oils, enough of the heavier oils remaining unvaporized in the retort or digester to insure a fluid digestion mixture. I have discovered, however, that if this heated fluid product of the digester be allowed to cool many of the bitumens will return to the solid state. Accordingly the next step of the treatment is discharging the still highly heated mixture of fluid oils into a bath of gasolene or other relatively light oil. This treatment renders the bituminous products of the digester permanently liquid and at the same time serves to wash from the admixed clayey insoluble residue of the shale the larger part of its oily content. From the light oil bath the liquid under treatment and a portion of the bath are drawn off to a tank where they are gently heated to drive off the greater portion of the light oil content of the mixture. The oil is now ready for the refining processes, which may be those ordinarily employed in the refining of petroleum oils.

By referring to the drawings I will describe an apparatus adapted for carrying out my process and the various steps of my process as employed in connection with this apparatus. The shale to be treated is fed continuously through the hopper 1 into the retort 2. In the preferred construction shown in the drawings there is provided a screw conveyer 3 for accomplishing this feeding, the passage in which this screw works being preferably contained within the flue 4 in order that the substances fed into the retort may be preliminarily heated. Within the retort 2 I provide some stirring means. These may conveniently consist in a cylindrical screen 5 mounted upon a shaft 6 which is a continuation of the shaft of the screw 3 and is driven by that pulley 7. At the feed end of the retort support for the screen 5 is had in the spider 8 which allows the substances fed therethrough to fall in the interior of the screen 5. At its opposite end the screen 5 is provided with a circular opening defined by a collar 9 through which any material not subject to the treatment may be discharged into a chamber 10 where it will fall into a spout 11 from which it may be withdrawn through a valve 12 which is normally closed. Within the retort 2 a bath of heavy oil 14 is maintained at a level such that the lower part of the cylindrical screen 5 is immersed therein.

A fire being maintained on the grate 15 and the apparatus being charged as previously described (the shale being reduced to a suitable fineness preferably coarser than the meshes of the screen 5) as the screen 5 is rotated the solids under treatment will be agiatated in the bath of hot oil 14. The degree of heat required to render the bitu-

mens in the solid under treatment soluble in the heavy oils used varies somewhat with the nature of the solids treated and I do not wish to limit myself to the application of any particular degree of heat but prefer to experiment to determine the most advantageous temperature for treating each particular substance. I have found, however, that a temperature of six hundred (600) degrees Fahrenheit is sufficient for certain shales treated and that other shales require higher temperature.

If the solids are amenable to this treatment the bituminous matter contained will be digested out and the remaining solids will be reduced to a clayey mass. If they are not amenable to the treatment (as would be the case with rocky matter) they will collect within the screen and will be discharged into the chamber 10. A pipe 16 leads from the retort 2 near the upper surface of the liquid therein and discharges into the tank 17 which tank is conical in shape and is provided with a top closure 18 having a drum 19 therein. Leading into the tank 17 near the bottom thereof there is a pipe 21 which terminates in a perforated ring 22 within the tank 17. A pipe 23 controlled by a valve 24 leads from the bottom of the tank 17 and discharges into the inclined chamber 25. This chamber is provided with a steam jacket 26 and with a screw conveyer 27 which carries any solids within the chamber to the upper end where they are discharged into a spout 28 the lower end of which is immersed in a water seal (not shown). Near the upper end of the chamber 25 there is a drum 30 connected by a pipe 31 to the upper end of a condensing coil 32. A pipe 33 likewise leads from the drum 19 to the coil 32. Within the tank 17 there is preferably provided a baffle plate 34 and from the tank 17 behind the baffle plate 34 there leads a pipe 35 provided with valve controlled connections to each of a series of tanks 36, 37, 38. These tanks are each provided with a heating coil 39 and with drums 40 which are connected by pipes 41 with the top of the coil 32. Each of the tanks 36, 37, 38, is provided with a valve controlled discharge pipe 42 leading from the bottom of the tanks and also with valve controlled connections 43 leading into a pipe 44 which connects with a pump 45 for lifting liquid through a pipe 46 and discharging it into the hopper 1. The condensing coil 32 discharges into a collecting tank 47 provided with a valve controlled outlet 48 and also with valve controlled connections to the pipe 21.

The products produced by the digestion operation in the tank 2 comprise volatile light oil which escapes through the pipe 49 and heavy liquid oils and clayey matter which are drawn off through the pipe 16. Such of the volatile matters as pass off through the pipe 49 are collected in the condensing coil 50. The liquid bituminous matter and substances are directly discharged at their relatively high temperature into a relatively large volume of light oil in the tank 17, thereby volatilizing considerable of this oil which passes through the pipe 33 to the condenser 32. Loss of the light oil in the tank 17 is compensated for by oil introduced through 21 and consequently the substances entering the tank 17 through the pipe 16 meet a current of rising light oils, constantly decreasing in temperature toward the bottom of the tank. The clayey matter is washed by this oil and settles into the bottom of the tank and the bituminous portion of the matter entering the tank 17 is carried upward by the rising current of light oil, drawn around by the baffle 34 and discharged with a considerable amount of light oil through the pipe 35 into one of the tanks 36, 37, 38. Here the mixture is subjected to the action of heat from the coil 39 and such of light oils as it contains are vaporized and passed through the pipes 41 to the condensing coil 32. Such of the heavy oils remaining in the tank 36, 37, or 38 as is required to replace the heavy oils in the retort 2 is returned thereto by the pump 45 and the pipe 46. The excess over the oil required for the retort 2 is drawn off through the pipe 42 for further treatment by way of refining and distillation.

The clayey matter collected in the bottom of the tank 17 is discharged through the pipe 23 into the chamber 25 and is slowly moved through said chamber while being subjected to the action of the heat from the steam jacket 26. Any of the volatile oils remaining in the clay are thus vaporized and returned through the pipe 31 to the condenser 32. The dried argillaceous matter is discharged through pipe 28.

Three similar tanks 36, 37, 38 are shown and these are employed serially, one being filled, another being heat treated and the third being in the process of being emptied at the same time.

While in the above description I have referred to the matter to be treated as shale I do not wish to be considered as limited to the treatment of this particular source of bitumen but I may treat any bitumen carrying solids, such as coal, bituminous sands and the like. It will also be obvious that certain of the steps described may be modified and I do not, therefore, desire to be considered as limited to the practice of the precise process described further than is indicated by the appended claims.

Having thus described my invention what I claim and desire to secure by Letters Patent is:

1. A step in the recovery of bitumen from

solids which consists in digesting said solids with heavy oil under the action of heat at a temperature insufficiently high to effect substantial distillation of heavy fractions, but high enough to effectively liquefy heavy hydrocarbons contained in said solids.

2. A step in the recovery of bitumen from solids which consists in digesting said solids with heavy oil under the action of heat and agitation at a temperature insufficiently high to effect substantial distillation of heavy fractions, but high enough to effectively liquefy heavy hydrocarbons contained in said solids.

3. A step in the recovery of bitumen from solids which consists in discharging highly heated, bitumen-carrying heavy oil into a relatively large bath of light oil.

4. A step in the recovery of bitumen from solids which consists in discharging highly heated, bitumen-carrying heavy oil into a bath comprising a relatively large volume of light oils in which there is maintained a rising current of relatively cool light oils.

5. A process for the recovery of bitumen from solids which comprises digesting said solids with heavy oil under the action of heat and then discharging the product of such digestion into a relatively large bath of light oil.

6. A process for the recovery of bitumen from solids which comprises digesting said solids with heavy oil under the action of heat and then discharging the product of such digestion while highly heated into a relatively large bath of light oil.

7. A process for the recovery of bitumen from solids which comprises digesting said solids with heavy oil under the action of heat, discharging the product of such digestion into a relatively large bath of light oil in which there is maintained a rising current of said light oil, withdrawing liquid from said bath near its upper surface, and withdrawing insoluble, non-bituminous constituents of said solids from the bottom of said bath.

8. A process for the recovery of bitumen from solids which comprises digesting said solids with heavy oil under the action of heat, discharging the product of such digestion into a relatively large bath of light oil in which there is maintained a rising current of said light oil, withdrawing liquid from said bath near its upper surface, withdrawing insoluble, non-bituminous constituents of said solids from the bottom of said bath, heat treating said non-bituminous constituents to volatilize the light oils with which they are impregnated, and condensing said light oils.

9. A process for the recovery of bitumen from solids which comprises digesting said solids with heavy oil under the action of heat, discharging the product of such digestion into a relatively large bath of light oil in which there is maintained a rising current of said light oil, withdrawing liquid from said bath near its upper surface, withdrawing insoluble, non-bituminous constituents of said solids from the bottom of said bath, heat treating the liquid withdrawn from the bath to volatilize the light oils carried over therewith, and condensing said light oils.

10. A process for the recovery of bitumen from solids which comprises digesting said solids with heavy oil under the action of heat, discharging the product of such digestion into a relatively large bath of light oil in which there is maintained a rising current of said light oil, withdrawing liquid from said bath near its upper surface, withdrawing insoluble, non-bituminous constituents of said solids from the bottom of said bath, heat treating the liquid withdrawn from the bath to volatilize the light oils carried over therewith, and subjecting the residue so obtained to refining.

11. A process for the recovery of bitumen from solids which comprises digesting said solids with heavy oil under the action of heat, discharging the product of such digestion into a relatively large bath of light oil in which there is maintained a rising current of said light oil, withdrawing liquid from said bath near its upper surface, withdrawing insoluble, non-bituminous constituents of said solids from the bottom of said bath, heat treating the liquid withdrawn from the bath to volatilize the light oils carried over therewith, subjecting a portion of the residue so obtained to refining, and employing the remainder of said residue in the first step herein mentioned.

12. A process for the recovery of bitumen from solids which comprises digesting said solids with heavy oil under the action of heat, in a retort, at temperatures sufficiently high to effectively liquefy heavy hydrocarbons contained in said solids, volatilizing a portion of the light oils contained in said solids without destructive distillation, and condensing the oils so volatilized.

13. A process for the recovery of bitumen from solids which consists in feeding a mixture of heavy oils and said solid in finely divided condition into a closed retort, heating and agitating said mixture, volatilizing a portion of the light oil contained in said solids, condensing the oils so volatilized, discharging the remaining products of said digestion while highly heated into a relatively large bath of light oil in which there is maintained a rising current of said light oil, withdrawing liquid from said bath near its upper surface, withdrawing insoluble, non-bituminous constituents of said solids from the bottom of said bath, heat treating said non-bituminous constituents to volatilize the

light oils with which they are impregnated, condensing said light oils, heat treating the liquid withdrawn from said bath to volatilize the light oils carried over therewith, condensing said light oils, and subjecting a portion of the residue obtained from said last mentioned heat treatment to refining.

14. The process of obtaining valuable hydrocarbons from bituminous solids such as shale and the like, which comprises digesting a mixture of such a bituminous solid with a hydrocarbon liquid, the digestion being conducted at a temperature high enough to effectively liquefy heavy bituminous matter contained in said solid but insufficiently high to effect substantial distillation of heavy bituminous matter, and separating a resultant liquid mixture of hydrocarbons from the residue of such bituminous solid.

15. The process of obtaining valuable hydrocarbons from bituminous solids such as shale and the like, which comprises digesting a mixture of such a bituminous solid with a hydrocarbon liquid, the digestion being conducted at a temperature high enough to effectively liquefy heavy bituminous matter contained in said solid but insufficiently high to effect substantial distillation of heavy bituminous matter, separating a resultant liquid mixture of hydrocarbons from the residue of such bituminous solid, and refining said liquid mixture.

16. The process of treating solid bituminous material such as shale and the like to obtain valuable products therefrom which comprises digesting such material with heavy hydrocarbon oil under the action of heat, and then diluting the resultant digestion mixture with a lighter oil, whereby separation of non-bituminous constituents of said material is facilitated.

17. The process of treating solid bituminous material such as shale and the like to obtain valuable products therefrom, which comprises digesting a mixture of such solid bituminous matter with a heavy liquid hydrocarbon at a temperature sufficiently high to effectively liquefy the heavy bituminous constituents of said solid matter but insufficiently high to substantially vaporize said heavy liquid hydrocarbon, and separating the digestion liquid from residual matter.

In testimony whereof I have hereunto affixed my signature.

HENRY D. RYAN.