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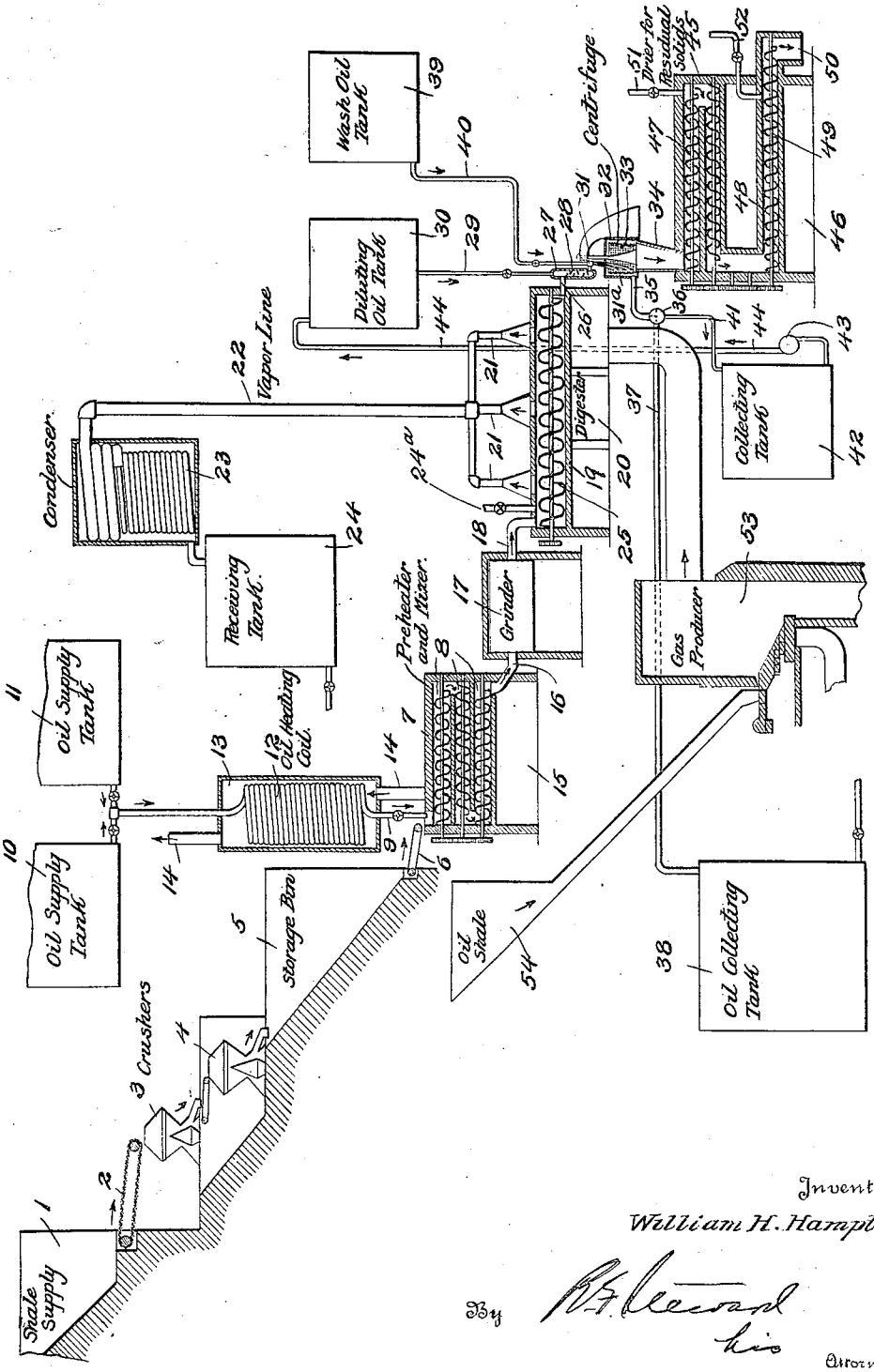

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TREATMENT OF SOLID BITUMINIFEROUS MATERIAL.

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This invention relates to treatment of solid bituminiferous material; and it relates more particularly to a process of treating bituminous shale or the like to obtain valuable hydrocarbons therefrom, wherein the shale or other bituminous solid to be treated is digested under heat with a suitable hydrocarbon solvent, such as a heavy oil, to liquefy and extract bitumens from the shale, and separation of the residual solid matter from the accompanying liquid is best accomplished by centrifuging, most desirably after first diluting or thinning the digestion mixture with a lighter oil.

The principles of the invention will be more fully understood from a description of a concrete example illustrating one particularly desirable way of practicing the invention. It is to be understood that the invention is not limited to the specific details of procedure to be set forth in the following description.

In a typical instance, a shale which yields about 27 gallons of distillate per ton when subjected to destructive distillation in the usual manner is mixed, after crushing coarsely, say to one-half inch mesh size, with about one-half its volume of a heavy paraffin base oil yielding substantially no distillate below 700° F. Any other suitable heavy oil may of course be employed, but that specified has given good results in practice. The mixture is first preheated to a temperature sufficiently high to soften the bitumen in the shale and render the latter friable and easily reducible to finely divided condition. In practice this may be accomplished by preheating to around 300° to 400° F. The mass is then introduced into a grinder of some kind, such as a ball or tube mill, for example, and is thoroughly ground, preferably until 60 per cent or more of the solid particles will pass a 200-mesh sieve. The mixture, which at this stage is a semi-fluid pasty mass, is next passed to a retort or digestor and is therein heated to a temperature high enough to effect liquefaction of the shale bitumens as completely as is practicable, but not high enough to cause substantial cracking in the generally accepted sense of that term. In practice, digestion at around 665° to 675° F. and atmospheric pressure has given excellent results; and ordinarily about 700° F. may be taken as a desirable upper limit when it is essential to avoid substantial cracking. The temperatures mentioned are those of the fluid mass in the retort or still. In this connection it may be pointed out that, in the broader aspects of the invention, avoidance of cracking is not absolutely essential, but it is much to be preferred as giving a better yield. During the digestion, certain fractions of the shale oil distil off and are recovered in any suitable condensing system. In practice, the distillate thus obtained amounts to 40 gallons or more per ton of this particular shale. Not only is the yield at least 50 per cent higher than by the old method of destructive distillation, but the quality of the distillate is much better. The distillate in the present case averages 44° B., with about 24 per cent unsaturated compounds; whereas the distillate obtained by the old method is much heavier, say about 36° B., and contains 80 per cent of unsaturated compounds.

The period required for proper digestion of the pulverized shale with the admixed heavy oil depends somewhat upon the particular shale used; but in general it should be long enough to ensure thorough liquefaction of the shale bitumens and the driving off of the said oil fractions. The distillation may be advantageously facilitated by introducing live steam into the retort or operating at reduced pressure, either expedient having the effect of distilling off at 700° F. certain paraffins and the like which would not distil below 850° F. under ordinary conditions. The steam may be introduced below the surface of the mass in the retort, or it may be caused to sweep over the surface. In place of steam, some other inert gas may be used; and where it is desired to still further reduce the proportion of unsaturated compounds in the distillate, a reducing gas such as hydrogen may be introduced instead of, or in conjunction with, steam.

After the digestion is completed, the contents of the digestor in highly heated condition are mixed with a sufficient quantity of a relatively light oil to ensure the production of a mixture which is quite fluent at considerably lower temperatures. Most desirably, the lighter oil thus added is a kerosene fraction which may have been used to wash the tailings at a later stage of the process; and it is convenient to mix this kerosene fraction with the digestion mass while the latter is in transit to a centrifugal separator,

using an agitator or other suitable means if necessary to effect complete mixture and to ensure solution of the heavy oils, paraffins, etc., present in the mixture. The amount of lighter oil thus used to thin down the digestion mixture may vary considerably in practice, but it is desirable to keep the amount down as much as possible, and the method of separation to be hereinafter described is especially effective in accomplishing this end. In a typical instance, the amount of kerosene or kerosene fraction added as a thinner amounts to about 1 part of thinner to 1 part of digestion mixture, by volume, though of course the proportion necessarily varies with the character of the shale being treated.

After the digestion mixture has been properly thinned down as described, the resultant fluent mixture is passed into a centrifugal separator provided with a very fine mesh basket which will effectively catch and hold the pulverized mineral matter present, this earthy and insoluble mineral matter being herein conveniently referred to as residues or tailings. The liquid passing through the basket and leaving the centrifugal is conducted away for further treatment, while the residues or tailings are washed with a fresh portion of the light oil, such as the kerosene fraction referred to, whereby the tailings are substantially freed from adherent heavier oils, etc. If this washing leaves the tailings sufficiently clean, the tailings may be passed through a drier at a sufficiently high temperature to volatilize and drive off the residual light oil. If the washing with light oil does not sufficiently free the tailings from adherent heavy oils, etc., the tailings may be further washed with gasoline or similar light oil fraction to remove practically all the residual kerosene fraction, while the wash gasoline containing kerosene fractions, etc., may be conveyed to a still, the gasoline distilled off and the residual oil remaining in the still may be conveyed to the common stock of diluting oil or may be otherwise disposed of. The tailings washed with gasoline may be discharged from the centrifugal and conveyed to a drier to recover adherent gasoline by appropriate apparatus.

If the residues or tailings from the centrifugal, after passing through the drier either from the light oil wash or from the gasoline wash, be found still to contain a substantial percentage of valuable bitumens which have escaped liquefaction and extraction, these tailings can be conveyed to a suitable retort and subjected to distillation at higher temperatures, say 900° to 1000° F., for recovery of such bitumens. In this way an especially refractory shale can be made to yield an additional portion of heavy oil of high quality, dependent upon the nature and character of the bitumen-bearing shale or other bituminous solid treated. In the case of the shale used in this specific example, the additional heavy oil thus obtained has amounted to 13 gallons per ton of tailings in actual practice. This is high grade heavy oil which can be refined to yield valuable lubricating fractions. Heavy oil so obtained can, if desired, be added to the oil used in grinding and digesting the shale or may be otherwise disposed of.

By utilizing the heat from the drier to preheat the initial mixture of shale and heavy oil to a temperature sufficiently high to facilitate grinding or pulverizing the mixture, and by otherwise utilizing the waste heat from the several correlated steps of the process, it is possible to effect substantial economy in operation. The residues or coke from the destructive distillation of the tailings, where this is practiced, carry a substantial proportion of fixed carbon which can be used for asphalt filler and for other purposes.

The liquid matter separated from the tailings by the centrifugal machine is largely diluted digestion oil, ordinarily containing valuable heavy bitumens of the shale, and said liquid can be treated by well known methods of oil distillation and refining to separate and recover its various constituent fractions, the heavier fractions being used for digestion of fresh shale, if desired, and the lighter fractions going to the stock or supply of diluting oil. In the case of certain shales, the liquid mixture coming from the centrifugal contains but a small portion of the shale bitumens, the larger part having passed off as distillate during digestion, and most of the remainder being still held by the tailings. In the case of other shales and ozokerites, especially the softer varieties high in waxy constituents, the liquid mixture from the centrifugal contains a substantial quantity of the bitumens of the bituminous solid treated.

By centrifuging the diluted digestion mixture in the manner above described the quantity of thinning or diluting oil may be kept very much below that which must be used where separation of the insoluble mineral matter or tailings is effected by settling or ordinary methods of filtration. For example in treating the above shale, if separation of the tailings is to be effected by sedimentation or ordinary filtration, about 3 to 5 volumes of light oil must be used with 1 volume of digestion mixture to effect the necessary thinning. The present method therefore results in effecting a considerable economy both of thinning oil and in the time and labor required to handle the large volumes of liquid necessary in transit through a treating plant. Furthermore, the unavoidable losses in handling light oils, and the

danger of fire and explosion, are greatly reduced.

While the process herein above described may be carried out in various types of apparatus, one particularly desirable arrangement is illustrated in the accompanying drawing which shows more or less diagrammatically a typical assembly of apparatus elements. Referring to this drawing, 1 is a supply hopper containing uncrushed shale or the like from which shale may pass over a conveyor screen 2, the larger pieces going to and through gyratory crushers 3 and 4 which are arranged in series in the particular arrangement here illustrated. From the crushers, the shale goes to a storage bin 5, from which it may pass over a conveyor 6 and be introduced in regulable quantities into a mixer and preheater 7, in which are arranged a series of helical conveyors 8. Adjacent the inlet for the crushed shale is an oil supply pipe 9 through which is introduced a heavy hydrocarbon oil for admixture with the crushed shale. It is desirable to preheat this digestion oil, and to this end the oil is conducted from either one of the supply tanks 10, 11, through a coil 12 which may be placed in an enlargement 13 of the flue 14 leading from the preheater furnace 15.

The preheated mixture of crushed shale and digestion oil passes by way of discharge conduit 16 into a grinding or pulverizing device such as a tube mill or ball mill 17, the finely ground mixture passing thence through pipe 18 into the retort or digestor 19, or a series of such digestors, the digestor or digestors being heated by suitable furnace means indicated at 20. Vapor pipes 21 carry volatilized oil fractions into vapor line 22 which leads to a condenser 23, discharging into a receiving tank 24. Suitable means, 24a, may be provided for introducing steam or other gas into the retort or digestor. The material introduced into the digestor or digestors is moved slowly therethrough by suitable conveyor means, in this instance by a rotary helical conveyor indicated at 25. The conveyor blades also serve the purpose of scraping the bottom of the retort or retorts and thus keeping them free from accumulations. From the digestor means the digestion mixture is discharged through 26 into a chamber 27 provided with baffle means 28. Into the top of this chamber, diluting oil, such as a kerosene fraction is introduced in proper quantity through pipe 29 connected to supply tank 30. In chamber 27 the digestion mixture and diluting oil are thoroughly mixed, the mixture passing thence through pipes 31 and 31a into a centrifugal 32. The residual solid matter is retained on the rotary centrifugal screen 33 and may be discharged downwardly into chute 34. The separated liquid leaves centrifugal through pipe 35, 3-way valve 36, and pipe 37, to collecting tank 38. Residual solids accumulating on screen 33 may be washed by means of suitable wash oil, such as kerosene or gasoline, supplied from tank 39 through conduit 40. By suitably setting valve 36, this wash oil containing some of the diluted digestion oil, may be passed through pipe 41 to a separate collecting tank 42, from which it may be conveyed by pump 43, through pipe 44 to the stock tank 30.

The residual solids discharged into chute 34 go to a drier chamber 45 arranged to be heated by waste combustion gases from a furnace 46. This drier chamber contains rotary conveyors 47 which move the washed residual solids in the direction of the arrows and discharge them into a retort 48 which is heated by said furnace 46, and through which the solids are moved by rotary conveyor 49 to a point of discharge at 50. The drier is provided with a valved vapor outlet 51 leading to a suitable condenser; and a similar vapor outlet 52 is provided for the retort 48. Any suitable means for heating the retorts may be provided, but in the present example, the retort furnaces are adapted to be fired with combustible gas provided by a producer 53 of the mechanical stoker type which is adapted to burn oil shale supplied from hopper 54.

By means of the novel combination or system of apparatus above described, which also constitutes a part of this invention, the treatment of shale or the like in accordance with the invention may be carried on practically continuously for long periods of time without shutting down for purposes of adjustment or cleaning out.

What I claim is:

1. The process of treating solid bituminiferous material of shale-like character to obtain valuable products therefrom, which comprises digesting at temperatures above 500° F. a fluent mixture of such material all in pulverized condition with a solvent for heavy bitumens while agitating said mixture, and thereafter separating residual solid matter by centrifuging.

2. The process of treating solid bituminiferous material of shale-like character to obtain valuable products therefrom, which comprises digesting a fluent mixture of such material all in pulverized condition with a heavy oil under the action of heat and agitation, diluting the resultant digestion mixture with a lighter oil, and centrifuging to separate residual solid matter.

3. The process of treating solid bituminiferous material of shale-like character to obtain valuable products therefrom, which comprises heating a mixture of such material with a hydrocarbon liquid to a temperature sufficient to soften said material, treating the heated mixture to reduce said mate-

rial to more finely divided condition, continuing to heat at a higher temperature with agitation to extract heavy bitumens from said material, and centrifuging to separate residual solid matter.

4. The process of treating solid bituminiferous material of shale-like character to obtain valuable products therefrom, which comprises digesting a fluent mixture of such material all in finely divided condition with a heavy oil under the action of heat, diluting the resultant digestion mixture with a lighter oil, centrifuging to separate residual solid matter, washing such separated solid matter with a relatively light oil, and using the wash oil to dilute further digestion mixture.

5. The process of treating solid bituminiferous material of shale-like character to obtain valuable products therefrom, which comprises mixing with coarsely comminuted material of the character described a heavy oil yielding substantially no distillate below about 700° F., heating the mixture to around 300° to 400° F. approximately, grinding the mixture, digesting the resultant mass at a temperature not substantially exceeding about 700° F., thinning the digestion mixture with the aid of a lighter oil, centrifuging to separate residual solid matter, washing with a relatively light oil, and using the wash oil to thin further digestion mixture.

6. The process of treating solid bituminiferous material of shale-like character to obtain valuable products therefrom, which comprises digesting such material in finely divided condition with a heavy oil at temperatures around 600° to 700° F. with agitation of the mixture, separating residual solid matter, and distilling such separated residual solid matter at around 900° to 1000° F.

7. The process of treating solid bituminiferous material of shale-like character to obtain valuable products therefrom, which comprises digesting such material, in finely divided condition, 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 material, passing a gaseous mixture into contact with the mass undergoing digestion, and recovering a condensate from the resultant distillate.

8. The process of treating solid bituminiferous material of shale-like character to obtain valuable products therefrom, which comprises digesting such material with a heavy hydrocarbon oil under the action of heat, and then diluting the resultant digestion mixture with a kerosene fraction, whereby separation of residual solid matter is facilitated.

9. The process of treating solid bituminiferous material of shale-like character to obtain valuable products therefrom, which comprises digesting such material with a heavy hydrocarbon oil under the action of heat, then diluting the resultant digestion mixture with a kerosene fraction, separating undissolved solid matter from the liquid, and washing the separated solid matter with gasoline.

10. The process of treating solid bituminiferous material of shale-like character to obtain valuable products therefrom, which comprises heating and agitating a mixture of such material in pulverized condition with a hydrocarbon solvent, the bulk of said material being fine enough to pass a 100-mesh sieve, and thereafter separating residual solid matter from the resultant liquid.

11. The process of treating solid bituminiferous material of shale-like character to obtain valuable products therefrom, which comprises heating and agitating a mixture of such material in pulverized condition with a hydrocarbon solvent, over half of said material being fine enough to pass a 200-mesh sieve, and thereafter separating residual solid matter from the resultant liquid.

12. The process of treating solid bituminiferous materials, of shale-like character, to obtain valuable products therefrom, which comprises bringing pulverized material of the character described preheated to a relatively low temperature into contact with a hot digestion bath at a substantially higher temperature, said bath comprising heavy oil fractions non-volatile under the conditions of digestion, leading away and recovering volatilized products, and separating unvolatilized bituminous matter from the digestion mixture.

13. The process of treating solid bituminiferous materials, of shale-like character, to obtain valuable products therefrom, which comprises preparing a heated mixture of an oil with pulverized material of the character described, the temperature of the mixture being below that at which substantial distillation occurs, then subjecting the mixture to the effect of a substantially higher temperature, and recovering both volatile and non-volatile products therefrom.

14. The process of treating solid bituminiferous materials, of shale-like character, to obtain valuable products therefrom, which comprises preparing a heated mixture of an oil with pulverized material of the character described, commingling said mixture with a substantially hotter digestion bath comprising oil fractions non-volatile under the conditions of digestion, and recovering both volatile and non-volatile products of digestion.

15. The process of treating solid bitumi-

niferous materials, of shale-like character, to obtain valuable products therefrom, which comprises preparing a heated mixture of pulverized shale or the like and an oil having a temperature not exceeding approximately 500° F., then commingling said mixture with a digestion bath heated to a temperature exceeding 500° F., but not substantially exceeding 700° F., said bath comprising oil fractions non-volatile under the conditions of digestion, agitating the resultant mixture, and recovering both volatile and non-volatile products therefrom.

16. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process consists of subjecting the earthy material to be treated to immersion in a bath of liquid oil in a container, separating the earthy material from said bath of oil, subjecting all of said earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, and passing the material thus driven off into the container of said bath of oil and utilizing the hydrocarbon material so driven off as the material of said bath of liquid oil.

17. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process consists of subjecting the earthy material, to be treated to immersion in a bath of liquid oil in a container, separating the earthy material from said bath of oil, subjecting all of said earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, passing the material thus driven off into the container of said bath of oil and utilizing the hydrocarbon material so driven off as the material of said bath of liquid oil, and withdrawing liquid oil from said bath.

18. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process consists of subjecting the earthy material to be treated to immersion in a bath of liquid oil in a container, separating the earthy material from said bath of oil, subjecting all of said earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, passing the material thus driven off into the container of said bath of oil and utilizing the hydrocarbon material so driven off as the material of said bath of liquid oil, and withdrawing aeriform material from the region of said bath of oil.

19. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process consists of subjecting the earthy material to be treated to immersion in a bath of liquid oil in a container, separating the earthy material from said bath of oil, subjecting all of said earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, passing the material thus driven off into the container of said bath of oil and utilizing the hydrocarbon material so driven off as the material of said bath of liquid oil, withdrawing liquid oil from said bath, and withdrawing aeriform material from the region of said bath of oil and subjecting the aeriform material to a condensing treatment.

20. The process of continuously obtaining hydrocarbon oil from oil bearing earthy material which process consists of continuously subjecting the earthy material to be treated to immersion in a bath of liquid oil in a container, continuously subjecting all of said earthy material so treated to heat treatment to drive off substantially all volatilizable material therein and passing the material thus driven off into the container of said bath of oil and utilizing the hydrocarbon material so driven off as the material of said bath of liquid oil.

21. The process of continuously obtaining hydrocarbon oil material from oil bearing earthy material which process consists of continuously subjecting earthy material to be treated to immersion in a bath of liquid oil in a container, continuously separating the earthy material from said bath of oil, continuously subjecting all of said earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, passing the material thus driven off into the container of said bath of oil and utilizing the hydrocarbon material so driven off as the material of said bath of liquid oil, and continuously withdrawing liquid oil from said bath.

22. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process consists of continuously subjecting the earthy material to be treated to immersion in a bath of liquid oil in a container, continuously separating the earthy material from said bath of oil, continuously subjecting all of said earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, passing the material thus driven off into the container of said bath of oil and continuously withdrawing aeriform material from the region of said bath of oil.

23. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process consists of continuously subjecting the earthy material to be treated to immersion in a bath of liquid oil in a container, continuously separating the earthy material from said bath of oil, continuously subjecting all of said earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, passing the material thus driven off into the container of said bath of oil and

utilizing the hydrocarbon material so driven off as the material of said bath of liquid oil, continuously withdrawing liquid oil from said bath, and continuously withdrawing aeriform material from the region of said bath of oil and subjecting the aeriform material to a condensing treatment.

24. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process consists of subjecting the earthy material to be treated to digestion with solvent liquid oil to effect the solvent removal from said earthy material of a portion of its oil content, separating the earthy material from said liquid oil, subjecting the earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, and utilizing the hydrocarbon material so driven off in digesting a further quantity of said earthy material.

25. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process consists of subjecting the earthy material to be treated to digestion with solvent liquid oil to effect the solvent removal from said earthy material of a portion of its oil content, separating the earthy material from said liquid oil, subjecting the earthy material so separated to heat treatment sufficient to drive off substantially all volatilizable material therefrom and crack a portion of the same, and utilizing the hydrocarbon material so driven off in digesting a further quantity of said earthy material.

26. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process consists of subjecting the earthy material to be treated to immersion in a bath of solvent liquid oil to effect the solvent removal from said earthy material of a portion of its oil content, separating the earthy material from said bath of oil, subjecting the earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, and utilizing the hydrocarbon material so driven off as the material of said bath of solvent liquid oil.

27. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process consists of subjecting the earthy material to be treated to immersion in a bath of solvent liquid oil to effect the solvent removal from said earthy material of a portion of its oil content, separating the earthy material from said bath of oil, subjecting the earthy material so separated to heat treatment sufficient to drive off substantially all volatilizable material therefrom and crack a portion of the same, and utilizing the hydrocarbon material so driven off as the material of said bath of solvent liquid oil.

28. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process consists of subjecting the earthy material to be treated to immersion in a bath of solvent liquid oil to effect the solvent removal from said earthy material of a portion of its oil content, separating the earthy material from said bath of oil, subjecting the earthy material so separated to heat treatment sufficient to drive off substantially all volatilizable material therefrom and crack a portion of the same, and utilizing the hydrocarbon material so driven off at a temperature of at least 300° F. as the material of said bath of solvent liquid oil.

29. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process comprises subjecting such earthy material to digestion with liquid oil in a container, separating the earthy material from the digestion mixture, subjecting all of said earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, passing the material thus driven off into the container and utilizing the hydrocarbon material so driven off in digesting a further quantity of said oil bearing earthy material.

30. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process comprises subjecting such earthy material to digestion with liquid oil in a container, separating earthy material from the digestion mixture, subjecting all of the earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, passing the material thus driven off into said container and utilizing the hydrocarbon material so driven off in digesting a further quantity of said oil bearing earthy material, and withdrawing liquid oil from the digestion mixture.

31. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process comprises subjecting such earthy material to digestion with liquid oil in a container, separating earthy material from the digestion mixture, subjecting all of the earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, passing the material thus driven off into said container and utilizing the hydrocarbon material so driven off in digesting a further quantity of said oil bearing earthy material, and withdrawing aeriform material from the region of the digestion mixture.

32. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process comprises subjecting such earthy material to digestion with liquid oil in a container, separating earthy material from the digestion mixture, subjecting all of said earthy material so separated to heat treatment to drive off substantially all vola-

tilizable material therefrom, passing the material thus driven off into said container and utilizing the hydrocarbon material so driven off in digesting a further quantity of said oil bearing earthy material, withdrawing liquid oil from the digestion mixture, withdrawing aeriform material from the region of said digestion mixture, and subjecting the aeriform material to a condensing treatment.

33. The process of continuously obtaining hydrocarbon oil from oil bearing earthy material which process comprises continuously separating earthy material from the digestion mixture, continuously subjecting such earthy material to digestion with liquid oil in a container, continuously subjecting all of said earthy material so separated to heat treatment to drive off substantially all volatilizable material therein and passing the material thus driven off into said container, and utilizing the hydrocarbon material so driven off in digesting a further quantity of said oil bearing earthy material.

34. The process of continuously obtaining hydrocarbon oil material from oil bearing earthy material which process comprises continuously subjecting earthy material to digestion with liquid oil in a container, continuously separating earthy material from the digestion mixture, continuously subjecting all of said earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, passing the material thus driven off into said container and utilizing the hydrocarbon material so driven off in digesting a further quantity of said oil bearing earthy material, and continuously withdrawing liquid oil from the digestion mixture.

35. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process comprises continuously subjecting such earthy material to digestion with liquid oil in a container, continuously separating earthy material from the digestion mixture, continuously subjecting all of said earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, passing the material thus driven off into said container, and continuously withdrawing aeriform material from the region of said digestion mixture.

36. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process comprises continuously subjecting such earthy material to digestion with liquid oil in a container, continuously separating earthy material from the digestion mixture, continuously subjecting all of the earthy material so separated to heat treatment to drive off substantially all volatilizable material therefrom, passing the material thus driven off into said container and utilizing the hydrocarbon material so driven off in digesting a further quantity of said oil bearing earthy material, continuously withdrawing aeriform material from the region of said digestion mixture, and subjecting the aeriform material to a condensing treatment.

37. The process of obtaining hydrocarbon oil material from oil bearing earthy material which process comprises subjecting such earthy material to digestion in liquid oil to effect the solvent removal from said earthy material of a portion of its oil content, separating earthy material from the digestion mixture, subjecting the earthy material so separated to heat treatment sufficient to drive off substantially all volatilizable material therefrom and crack a portion of the same, and utilizing hydrocarbon material so driven off at a temperature of at least 300° F. in digesting a further quantity of said oil bearing earthy material.

In testimony whereof I hereunto affix my signature.

WM. HUNTLEY HAMPTON.