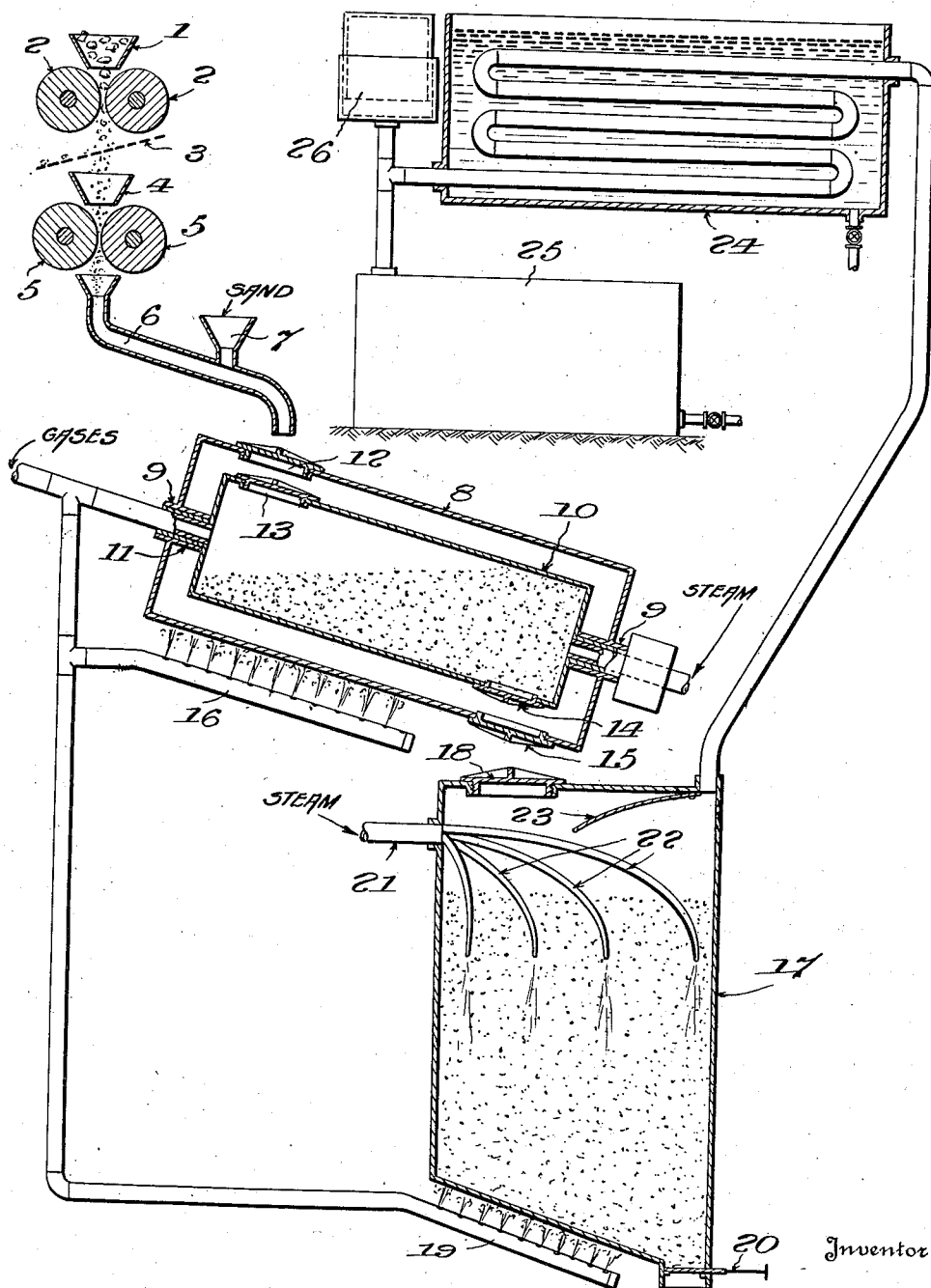


A. G. CRANE,
 PROCESS OF EXTRACTING HYDROCARBON MATERIALS FROM SHALE AND SIMILAR EARTHY MATERIAL.
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ADOLPHUS G. CRANE,

By *Openen B. Prentiss*,
 Attorney

UNITED STATES PATENT OFFICE.

ADOLPHUS G. CRANE, OF RENO, NEVADA, ASSIGNOR TO CRANE SHALE OIL CORPORATION, OF RENO, NEVADA.

PROCESS OF EXTRACTING HYDROCARBON MATERIALS FROM SHALE AND SIMILAR EARTHY MATERIAL.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, ADOLPHUS GEORGE CRANE, a citizen of the United States, residing at Reno, in the county of Washoe and State of Nevada, have invented new and useful Improvements in Processes of Extracting Hydrocarbon Materials from Shale and Similar Earthy Material, of which the following is a specification.

10 This invention relates to the extraction of hydrocarbon material from shale and similar rocky, ore like, and earthy material. The invention pertains particularly to the extraction of oil and paraffin material from
15 petroleum bearing shale and includes the steps of a distillation process whereby the extraction is brought about.

The invention has for its object the obtaining of the hydrocarbon material by the
20 use of a simple and easily operated apparatus. The process makes possible the utilization of the gases generated as a source of fuel supply, and also the use of oil bearing shale for the extraction of the oil and paraffin content.
25

The process provides for the extraction of a maximum amount of hydrocarbon material by the special preparation of the shale previous to any heat treatment.

30 Heretofore shale or oil bearing rock has been treated in retorts with only a fair degree of success because of the small percentage of material extracted compared to the cost of operation. I have found that by
35 grinding, crushing and pulverizing the shale to a powder of about 80 mesh a process of extraction in a retort with dry steam and certain temperatures may be operated most advantageously. Simple pulverization of
40 the shale provides remarkable results. However, the invention provides for a mixture of dry silicious sand combined with the shale powder, and with this mixture the retorts or extraction chambers may be used
45 without clogging or choking and the mixture is maintained inherently in a light open condition free for discharge of oil vapors.

Referring in detail to the operation of the process and to the drawing representing
50 diagrammatically the steps of the process and the apparatus in which the process is conducted, 1 represents a hopper containing the original oil bearing shale in the form of lumps of rock in the condition as taken

from the ground. 2 is a grinder or roller 55 provided for reducing the size of the rock or shale. 3 represents a screen or sifting machine for separating the large from the small pieces of shale. The finer particles of the shale passing through the screen 3 are 60 collected in a hopper 4 and directed to a second crusher or roller machine 5 adapted to reduce the material to a pulverized condition of a size at least as small as 80 mesh. The pulverized oil bearing material passes 65 from the machine 5 into a conveyer pipe 6 and receives from the hopper 7 a charge of sand so as to form a mixture of the oil bearing shale and sand for the treatment in the heating members as will be described. The 70 mixture discharged from the lower end of the conveyer pipe 6 enters an agitating heater member which provides for the treatment of the mixture at a suitable distillation temperature in the presence of dry steam 75 and under the treatment of a constant agitating movement caused by the oscillation of the container holding the mixture.

The agitating heater member includes a stationary heating chamber having the walls 80 8 and end bearings 9. The walls 8 and the bearings 9 are preferably inclined and are to be compared to a cylinder in form. Extending substantially the length of the walls 8 and within the same is the oscillating agitating 85 chamber 10 having the end supporting axles 11 journaled in the bearings 9. The chamber 10 is provided with a half rotary or oscillating movement by a suitable drive connection, not shown, and this is for the 90 purpose of keeping the mixture in constant movement so as to prevent the caking of the mixture and so as to facilitate the ready generation of gases from the same. The mixture after leaving the pipe 6 enters the 95 opening normally closed by the plate 12 in the wall 8 of the heating chamber and enters the chamber 10 through the opening covered by the plate member 13. At the lower end of the chamber 10 a similar plate member 100 14 covers the outlet for the mixture and a plate member 15 covers the corresponding opening in the wall of the heating member 8. The axles of the agitating chamber 10 are hollow and adapted to serve as pipes for 105 the injection of the steam at one end of the chamber and for the removal of the gases generated at the other end of the chamber.

The gases taken off contain considerable material suitable for fuel and these fuel gases are used in the burner 16 which is located below the lower surface of the heating chamber 8. The steam which is forced into the chamber 10 is dry steam and the mixture within the chamber becomes heated without becoming moist due to any possible condensation of the steam. In the treatment of shales containing nitrogenous material, such as certain Nevada shales, the gases which are led off from the chamber 10 will contain considerable amounts of ammonia which may be separated and used in the condenser as will be described.

When the mixture is discharged from the lower end of the agitating heater 10 and through the two openings covered by the plates 14 and 15, it enters a retort member 17 through an opening having the covered plate 18. This retort member is preferably stationary in character and is provided with a heater member 19 extending below the under surface of the retort 17. A discharge gate is indicated at 20. Material entering the retort 17 is permitted to fill the same to a point adjacent the top of the structure so that but little space is left between the mixture of comminuted shale and sand and the top wall of the retort. Steam enters the retort by means of the pipe 21 and is injected into the mixture of ground shale and sand by means of the pipes 22 projecting downwardly into the mixture. In the retort the mixture is subjected to a heat treatment at a temperature higher than that used in the agitating heater member and to a pressure greater than atmospheric pressure, due to the action of the heater 19 and to the injection of the steam, which is dry steam as in the case of the steam used in the agitating chamber 10. Vapors generated within the retort 17 and the gases generated are collected at the top of the retort by means of a hood 23 projecting over the mixture and downwardly. The vapors and gases are led to a condenser member 24. All condensed material is led from the discharge end of the condenser 24 to a storage tank 25, and permanent gases or those not condensing at the temperatures within the condenser 24 are conducted to a storage tank for gases as indicated at 26.

The process outlined in the foregoing description provides a most advantageous method of extracting oils such as petroleum oil and particularly oils containing paraffin from the natural shale.

The temperatures and pressures incident to the operation of the process may vary with the altitude in which the apparatus or process is operated. It is to be understood that the temperatures stated are substantially the minimum temperatures for the extraction of the oil content of the shale and that the

temperatures may be used which are generally known to be necessary for the vaporization of various products obtained by distillation. It will be evident from the foregoing that the process provides for a higher temperature and pressure in the second heating chamber than in the first and that the temperatures stated are but indicative of the comparative relation of these temperatures. Changes in design and shape as well as the materials of construction of the apparatus may be made without departing from the scope of the invention.

What I claim is:

1. The process of extracting hydrocarbon material from shale and similar earthy material, which consists in reducing the material to be treated by mechanical action to a pulverized condition, subjecting the material so pulverized in a first container to a continuous agitating movement and to a heat treatment and to the action of dry steam, leading off the gases and vapors generated in said first container, conducting said material so treated into a second container and subjecting said material to a temperature higher than that in said first container to generate hydrocarbon vapors and dry the material, and condensing the vapors so generated.

2. The process of extracting hydrocarbon material from shale and earthy material, which consists in reducing the material to be treated by mechanical action to a pulverized powderlike condition, mixing the material so treated with sand to keep separate the oil bearing particles of shale and prevent packing of the mass of shale, subjecting the mixture of pulverized material and sand in a first container to a continuous agitating movement and to a heat treatment and to the action of dry steam, leading off the gases and vapors generated in said first container, conducting said material so treated into a second container and subjecting said material to a temperature higher than that in said first container to generate hydrocarbon vapors and dry the material, and condensing the vapors so generated.

3. The process of extracting hydrocarbon material from shale and earthy material which consists in reducing the material to be treated by mechanical action to a pulverized powderlike condition of a fineness of 80 mesh, mixing the material so treated with sand to keep separate the oil bearing particles of shale and prevent packing of the mass of shale, subjecting the mixture of pulverized material and sand in a first container to a continuous agitating movement and to a heat treatment and to the action of dry steam, leading off the gases and vapors generated in said first container, conducting said material so treated into a second container and subjecting said material to a

temperature higher than that in said first container to generate hydrocarbon vapors and dry the material, and condensing the vapors so generated.

5 4. The process of extracting hydrocarbon material from shale and similar earthy material, which consists in reducing the material to be treated by mechanical action to a pulverized condition of a fineness of 80
10 mesh, subjecting the material so pulverized in a first container to a continuous agitating movement and to a heat treatment and to the action of dry steam, leading off the gases and vapors generated in said first container, conducting said material so treated into a second
15 container and subjecting said material to a temperature higher than that in said first container to generate hydrocarbon vapors and dry the material, and condensing
20 the vapors so generated.

5 5. The process of extracting hydrocarbon material from shale and similar earthy material, which consists in reducing the material to be treated by mechanical action to a pulverized condition, subjecting the material
25 so pulverized in a first container to an agitating action and to the action of dry steam and to a temperature sufficiently high to drive off volatile gases and vapors, leading
30 off the gases and vapors generated in said first container, conducting said material so treated into a second container and subjecting said material to a pressure greater than atmospheric pressure and to a higher temperature
35 than the temperature in said first mentioned container and sufficient to drive off substantially all hydrocarbon material as vapor, and condensing the vapors so generated.

40 6. The process of extracting hydrocarbon material from shale and earthy material, which consists in reducing the material to be treated by mechanical action to a pulverized powderlike condition, mixing the
45 material so treated with sand to keep separate the oil bearing particles of shale and prevent packing of the mass of shale, subjecting the mixture of pulverized material and sand in a first container to an
50 agitating action and to the action of dry steam and to a temperature sufficiently high to drive off volatile gases and vapors, leading off the gases and vapors generated in said first container, conducting said material
55 so treated into a second container and subjecting said material to a pressure greater

than atmospheric pressure and to a higher temperature than the temperature in said first mentioned container and sufficient to drive off substantially all hydrocarbon material as vapor, and condensing the vapors
60 so generated.

7. The process of extracting hydrocarbon material from shale and similar material which consists in mixing the shale-like material containing the desired hydrocarbon
65 material in a pulverized condition with sand to keep separate the oil bearing particles of shale and prevent packing of the mass of shale, heating the mixture in a retort, and
70 condensing the vapors generated by said heat treatment.

8. The process of extracting hydrocarbon material from shale and similar material which consists in mixing the shale-like material containing the desired hydrocarbon
75 material in a pulverized condition with a neutral granular substantially non-absorbent material to keep separate the oil bearing particles of shale and prevent
80 packing of the mass of shale, heating the mixture in a retort, and condensing the vapors generated by said heat treatment.

9. The process of extracting hydrocarbon material from shale and similar material
85 which consists in mixing the shale like material containing the desired hydrocarbon material in a pulverized condition with sand to keep separate the oil bearing particles of shale and prevent the packing of the mass
90 of shale, heating the mixture in a retort in the presence of dry steam and subjecting the mixture to a pressure greater than atmospheric pressure, and condensing the vapors generated by said heat treatment.
95

10. The process of extracting hydrocarbon material from the shale and similar material which consists in mixing the shale like material containing the desired hydrocarbon
100 material in a pulverized condition with a neutral granular substantially non-absorbent material to keep separate the oil bearing particles of shale and prevent packing of the mass of shale, heating the mixture in a
105 retort in the presence of dry steam and subjecting the mixture to a pressure greater than atmospheric pressure, and condensing the vapors generated by said heat treatment.

In testimony whereof I have hereunto set my hand.

ADOLPHUS G. CRANE.