J. T. FENTON.

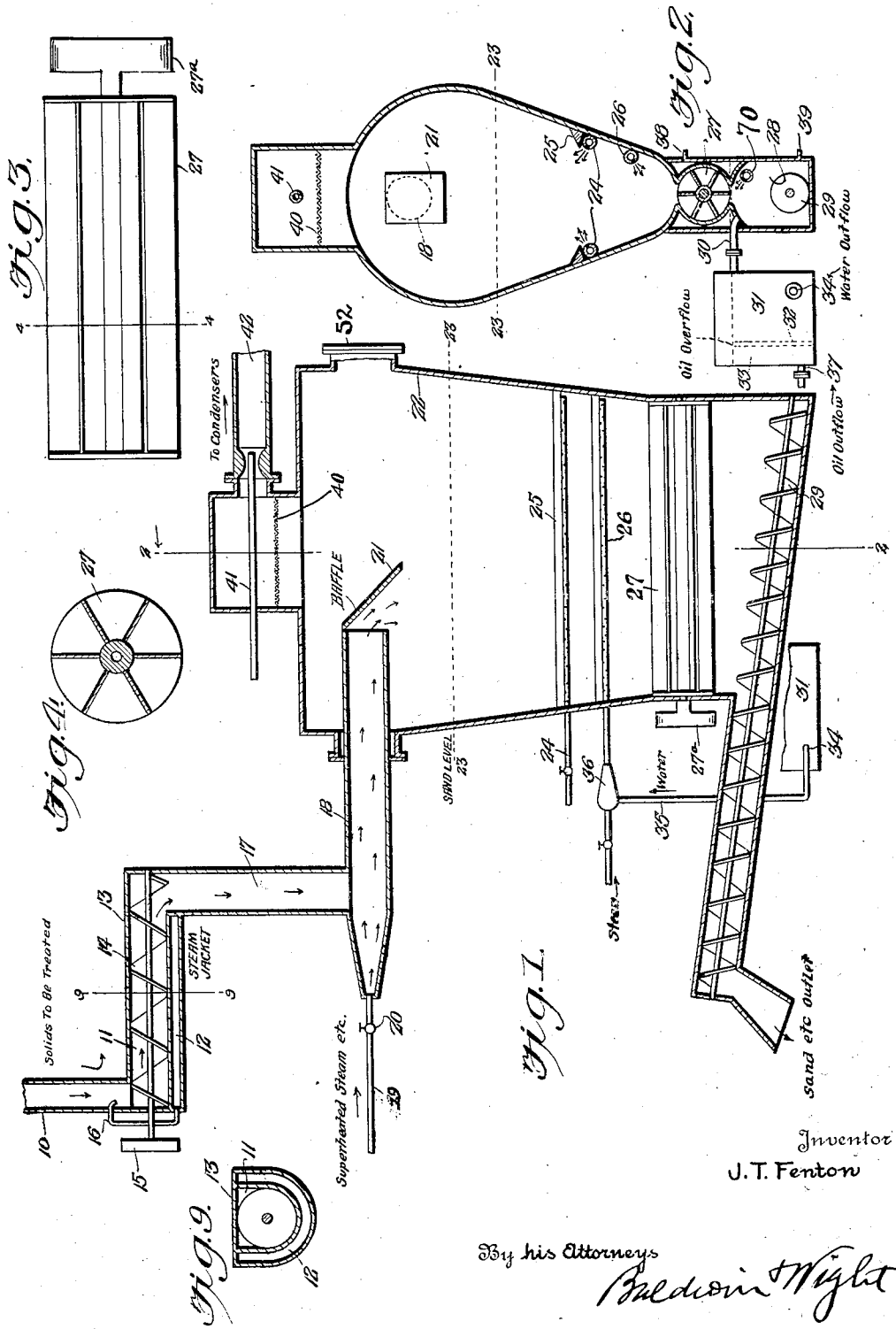
PROCESS AND APPARATUS FOR TREATING OIL BEARING SOLIDS.

APPLICATION FILED DEC. 13, 1920.

1,396,173.

Patented Nov. 8, 1921.

2 SHEETS—SHEET 1.



Inventor

J. T. Fenton

By his Attorneys

Baldwin & Wight

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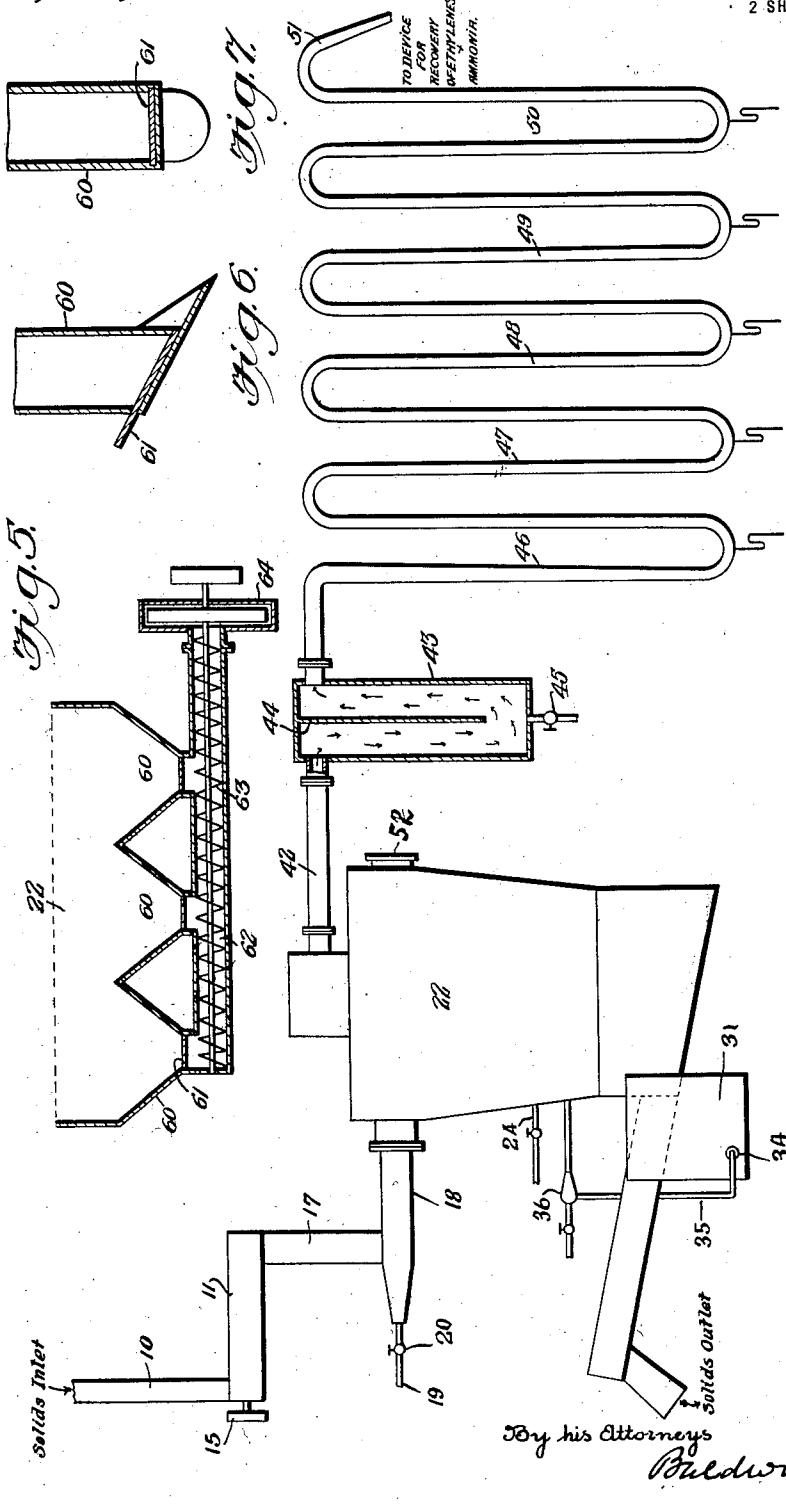
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UNITED STATES PATENT OFFICE.

JAMES T. FENTON, OF SALT LAKE CITY, UTAH.

PROCESS AND APPARATUS FOR TREATING OIL-BEARING SOLIDS.

1,396,173. Specification of Letters Patent. Patented Nov. 8, 1921.

Application filed December 13, 1920. Serial No. 430,259.

To all whom it may concern:

Be it known that I, JAMES T. FENTON, a citizen of the United States of America, residing at Salt Lake City, Utah, have invented certain new and useful Improvements in Processes and Apparatus for Treating Oil-Bearing Solids, of which the following is a specification.

The present invention relates to a process and an apparatus for the treatment of shale, oil sands or other material of like character containing oil which can be vaporized, the treatment of the material comprising subjecting the material for a substantial period of time, to the action of highly superheated steam, after which the material is preferably treated with hot water for the removal of a further quantity of oil or like material, after which the spent shale is withdrawn from the lower part of the treating chamber under conditions which permit the water to form a hydraulic seal to prevent the escape of vapors at the solid material outlet.

Apparatus within the scope of my invention, and suitable for carrying out the process, is shown in the accompanying drawings in which Figure 1 shows a vertical section of the essential portion of the steam treating and water treating apparatus, Fig. 2 shows a section at right angles to Fig. 1, this being taken approximately on the line 2—2 of Fig. 1, looking in the direction of the arrow. Fig. 3 shows a cylindrical member which with other elements constitutes one form of outlet for solid material. Fig. 4 is a section at right-angles to Fig. 3. Fig. 5 shows another form of outlet for solid material, Fig. 6 and Fig. 7 are detail views of the latter and Fig. 8 is a diagrammatic showing of the entire plant, this being partly in section and partly in elevation. Fig. 9 is a section on the line 9—9 of Fig. 1.

Referring now more particularly to Figs. 1 and 2, of the drawing, the shale or light material (hereinafter referred to generically as shale) is fed in a suitable manner through the vertical spout 10, into a preheater 11, which is a trough shaped covered device having a jacket 12 for heating the same and a cover 13, and also having a screw conveyer 14 operated by a suitable drive wheel 15. The steam, after being used in the jacket 12 is preferably introduced through the pipe 16 into the spout 10. This device is claimed in my application for patent for sulfur extraction, filed February 9, 1921, No. 443,614. The shale in a preheated state reaches the right hand end of the preheater 11 and drops through the closed spout 17 into the tubular inlet 18. At 19 is shown a pipe for the introduction of highly superheated steam under high pressure. In practice, I preferably supply superheated steam, preheated to a temperature of over 600° F., say 700 to 1000° F., through the pipe 19, which is regulated by means of suitable valve 20. The steam is preferably supplied under considerable pressure, for example about 60 to 100 pounds per square inch. The force of the steam is sufficient to drive the pulverulent shale through the inlet pipe 18 and the hot shale and steam strike against the baffle 21, which throws the shale downwardly. The apparatus is preferably so operated that shale or solid material in the chamber 22 stands at about the lever 23, although, of course, it is understood that the material may pile up to some extent directly under the baffle 21.

The baffle 21 is preferably made rather thick and is readily removable, since the pulverulent material striking against the same with great force tends to wear this out rather rapidly.

Entering the chamber 22 at a level considerably below 23 is a valved pipe 24, through which superheated steam, at about the temperature and pressure above referred to, is introduced into the body of pulverulent material in the chamber 22. This pipe is perforated, the perforations being preferably more numerous on the upper part of this pipe so as to direct the steam in an upward direction through the shale. Located along the wall of chamber 22 is a plate or fin 25, which serves to hold the shale a little away from the pipe 24 to prevent injury to this pipe and also to allow the steam to escape therefrom into the body of shale freely.

Located below the pipe 24 is a pipe 26 through which water preferably at or near the boiling point is introduced into the shale. This pipe is likewise perforated, the perforations being less numerous on the top of this pipe than on its sides, so as to direct the water largely in a horizontal or downwardly inclined path through the shale.

In the apparatus shown in Figs. 1, 2 and 8 a rotary cylindrical pocketed member 27 which may be rotated by power applied to a pulley 27ª delivers the treated shale from the steaming chamber 22 into the outlet

chamber 28. From this latter a helical screw 29 placed at an angle illustrated raises and carries away the spent shale. The hot water carrying oil on its surface, which it has extracted from the shale leaves by pipe 30 to a seal trap 31, containing an overflow weir 32, the oil overflowing this weir into compartment 33, and water being drawn out from this compartment through pipe 34, this water being raised through pipe 35, and blown by injector 36 into the inlet end of pipe 26, this water being thus caused to circulate and being maintained at or near the boiling point by the steam introduced at 36 and by the hot shale in the chamber 22. The liquid from compartment 33 flows off by pipe 37 to a separator in which the oil and water are separated from each other in known manner and the water can be reintroduced into the pipe 34 or run to waste or treated for the recovery of soluble matter extracted from the shale.

For the purpose of repairs, one side of the lower part of the apparatus, from 38 to 39 is made readily removable, whereby access may be had to the discharge screw and the rotary cylindrical pocketed member. In the upper part of the chamber 22 is preferably placed a screen or fabric 40 for separating fine particles of shale carried by the vapors in the upper part of the steaming chamber. Steam is preferably introduced through pipe 41 into a constricted portion of the vapor outlet pipe 42 in order to assist the vapors out of the steaming chamber, and a sufficient amount of steam is preferably so admitted to maintain a slight vacuum (or a pressure slightly below atmospheric) in the chamber 22. The pipe 42 leads the gases to a condensing system, which may comprise as its first element a separator 43, in which is located a baffle 44 and in which heavy oils, dust and the like are deposited and may be drawn off through the cock 45. The vapors then pass through a series of condensers 46, 47, 48, 49 and 50, which condensers are maintained at successively lower and lower temperatures, whereby the heavier oils will collect in the earlier condensers and the lighter oils in the later condensers. The outlet pipe 51 of the condenser system may lead to a device for the recovery of ethylenes and ammonia.

At 52 is shown a nipple through which another inlet such as that shown at 18 may deliver pulverized shale and steam. If desired, any number of such material inlets may be provided, depending upon the capacity of the apparatus.

In Fig. 5 a different device is shown for the withdrawal of the spent shale. This form of outlet may take the place of the rotary cylinder 27 and conveyer 29. As here shown the bottom of the chamber 22 is provided with a number of hoppers 60 each of which may have a discharge gate 61 leading into a closed trough 62, carrying a screw conveyer 63 or any other kind of a conveying mechanism. At 64 is shown a sand pump by means of which the liquid mixture of sand, water and oil is pumped up into a receptacle in which the sand, oil and water are separated from each other, the water being led back to the pipe 26, as hot water for further treatment of the shale. Figs. 6 and 7 illustrate two different views of a suitable outlet gate 61 and its associated parts.

By the use of the process and apparatus above described, I am able to completely recover the oil from shale and other materials, of the character set forth, as well as to recover the by-products in a complete manner. The apparatus and process possess the great advantage over many of those hertofore employed or suggested in the treatment of shale in that no fire is employed in any part of the apparatus and hence there is no danger of explosion or fire from this source.

It will be noted that in Fig. 1, I have shown the steam inlet to the tubular shale inlet 18, as being cone-shaped. By this means the steam expands so that the steam current fills the entire cross section of 18, and the steam blast thereby acts to carry the pulverulent shale readily and with great force through the inlet 18.

The steam from the jacket 12 being blown into the chute 10, acts to prevent any great quantities of air from being drawn into the apparatus with the shale, and also helps to heat the shale.

At 70 is shown a spray pipe through which water may be driven, to wash out any of the sand sticking in the pockets of the cylinder.

It will be understood that the high temperature of the superheated steam will, to some extent, cause a cracking of the heavier components of the shale oil. The amount of cracking, as well as the character of the cracking, can be readily controlled by the temperature of the steam.

In the separator 43, the rapid change of direction of the vapors and gases will tend to quickly throw out any drops of mist and any fine solid particles which have passed the metal or other screen 40. Fine metal screens or cloths may also be stretched across this chamber 43, if desired.

While I have referred above to the use of high pressure superheated steam as the preferred agent for supplying the heat, I desire it to be understood that other elastic fluids which are chemically inert, at the temperatures employed can be also used. As examples, I mention air, nitrogen, carbon dioxid, helium, or ordinary chimney gases (products of combustion). Such gases

and steam may be embraced within the term "hot gases", it being understood that for many purposes such hot gases will perform the same functions as superheated steam. Such hot gases may be introduced both at 19, 24 and into the injector 36, or the fixed gases can be introduced at one or two of these, while steam is used at the other or others thereof.

I claim:

1. A process of treating shale and like material in a finely divided or granular condition which comprises injecting the same by superheated steam under pressure into an expansion chamber, subjecting the material, while being thus injected and while in mass in the chamber, to a further treatment with superheated steam which acts on the finely divided material while entering and through the granular mass in the chamber, continuously condensing the resulting vapors and continuously withdrawing the barren solids.

2. A process of treating shale and like material in a finely divided or granular condition which comprises injecting the same by superheated steam under pressure into an expansion chamber, subjecting the material, while being thus injected and while in mass in the chamber, to a further treatment with superheated steam which acts on the finely divided material while entering and through the granular mass in the chamber, continuously condensing the resulting vapors and continuously withdrawing the barren solids; the heat for performing these operations being supplied solely by superheated steam of sufficient temperature and under sufficient pressure within said chamber.

3. A process of treating shale and like material in a finely divided or granular condition which comprises preheating the material, injecting the hot material by superheated steam under pressure into an expansion chamber, subjecting the material while being thus injected and while in mass in the chamber to a further treatment with superheated steam at a temperature considerably above 600° F., continuously condensing the resulting vapors and continuously withdrawing the barren solids.

4. A process of treating shale and like material in a finely divided or granular condition which comprises injecting the same by superheated steam under pressure into an expansion chamber, subjecting the material while being thus injected and while in mass in the chamber to a further treatment with a multiplicity of jets of superheated steam, continuously condensing the resulting vapors and continuously withdrawing the barren solids.

5. A process of treating shale and like material in a finely divided or granular condition which comprises injecting the same by superheated steam under pressure into an expansion chamber, subjecting the same while being thus injected and while in mass in the chamber to a further treatment with superheated steam, further treating the mass of material with hot water supplied to the expansion chamber under pressure, continuously condensing the resulting vapors and continuously withdrawing the barren solids.

6. Apparatus for the treatment of shale, oil sands and like material, comprising an expansion chamber provided with an inlet pipe for the material, an injector for blasting superheated steam through said pipe, a supply pipe for material in granulated form opening into said inlet pipe, means in the bottom of said expansion chamber for discharging barren material, means for carrying off the vapors resulting from the treatment, a perforated water supply pipe in the lower portion of the expansion chamber below the normal solids level therein, means for conveying mixed oil and water from the lower part of the appraratus, means for separating oil from the water, and means for delivering water from said separator to the water inlet pipe of the expansion chamber.

7. In an apparatus for treating shale, oil sands and the like, a steam-treating chamber, a tubular inlet device for introducing pulverulent material thereinto, a steam connection adapted to blow the material through such inlet into such steam chamber, a baffle in front of such tubular inlet, adapted to cause a downward motion of solid material striking the same, another steam inlet to said chamber located a substantial distance below said tubular inlet, a liquid inlet below said last mentioned steam inlet, a withdrawal device for solids connected to the lower part of said chamber below said water inlet, a liquid outlet from said chamber located above the bottom thereof but below said second mentioned steam inlet, and a vapor outlet connection from said chamber.

In testimony whereof, I have hereunto subscribed my name.

JAMES T. FENTON.