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HYDRAULIC JET CUTTING AND PUMPING APPARATUS FOR MINING HYDROCARBONACEOUS SOLIDS

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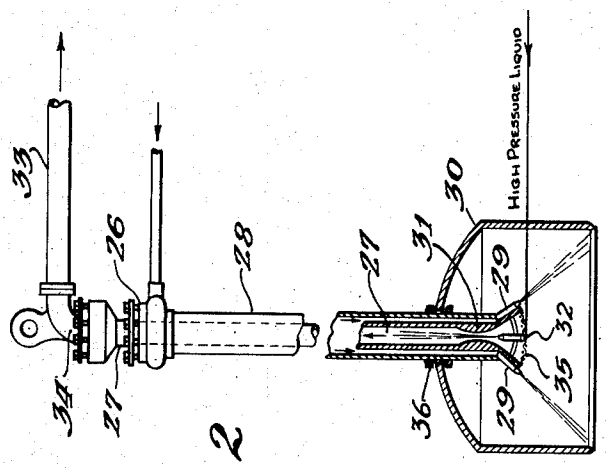


Fig. 2

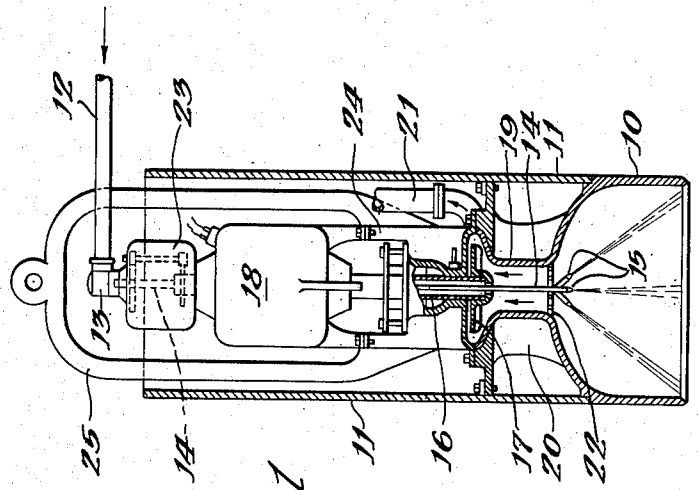


Fig. 1

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HYDRAULIC JET CUTTING AND PUMPING APPARATUS FOR MINING HYDROCARBONACEOUS SOLIDS

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3 Claims. (Cl. 262—2)

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This application is a division of my previously filed application, Serial No. 673,506, filed May 31, 1946, now Patent No. 2,587,729, March 4, 1952.

This invention relates to improvements in the mining of hydrocarbonaceous solids, such as oil-saturated sands, tar sands, oil-shale, bitumen or asphalt deposits, and the like which may be found in natural beds and deposits. More particularly, the invention relates to improved means for the high pressure hydraulic cutting of the solid material from the bed and for hydraulically transferring the material to an improved processing operation which operates in combination with the hydraulic mining operation. The improved process is disclosed in my above-mentioned patent and employs the steps of flash distillation, drying, and coking or asphalting, all of which may be carried on simultaneously and continuously by means of alternate chambers.

In the mining and cutting operation, a bell or hood-like chamber, which is open at the bottom, is used to enclose cutting nozzles and pumping means to remove the material cut away and dislodged by the high pressure streams or jets from the nozzles therein. The hood confines the liquid cutting agent and the removed solid material such that the mixture is all removed and sucked away by pumping means which is also within the chamber. A portable crane may be employed to handle the hood and its internal hydraulic cutting and pumping apparatus such that it may be moved from one spot to another over the entire bituminous deposit.

A hot hydrocarbon solvent material is preferably used as the cutting liquid in the mining operation and the solvent is also preferably an oil fraction obtained from the processing of the material being mined, however, steam, hot water or other fluid may be employed under high pressure as the cutting medium and the fluidizing or transporting medium for transferring the solid material to the processing unit.

Various methods have been tried in the past and are in use at present for the extraction of solid bituminous materials, such as tar sands, which are removed from open pits. A shale "planner" has been used to some extent, but in general has been found to be rather unsatisfactory, particularly for the "gummy" types of tar sands. A method which employs dynamiting, picking the material up by steam-shovel, and hauling it by tractor to the processing plant has also been used, but this method has been found to be rather slow and expensive. In comparison, the mining method embodied in this invention

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is highly efficient and less expensive to carry out. The hydraulic cutting provides easy and efficient means for cutting away and dislodging the material and the solvent is entirely recovered by being pumped away with the dislodged solid material and returned to the processing plant.

The features and advantages of the present invention will be more apparent upon reference to the accompanying drawings and the following description thereof.

Figure 1 of the drawing shows a cross-sectional view through one form of the high pressure hydraulic jet cutting and pumping apparatus which is used to remove the solid carbonaceous material.

Figure 2 of the drawing is a cross-sectional view through another form of apparatus having liquid jet nozzles, for high pressure cutting of the bituminous material and a Venturi nozzle and liquid ejection stream to remove the liquid cutting agent and the dislodged solid material from the mining zone.

Referring now to Figure 1 of the drawing, the lower end of the apparatus comprises a circular hood-shaped section 10, which is open at the bottom and is adapted to contact the bed of natural deposit of the bituminous material. Above the hood 10 is a shell section 11 which serves as a shield and supporting frame for the internal mechanical apparatus. The high pressure cutting liquid or solvent material is supplied to the apparatus by way of inlet line 12, at the upper end of the device. The fluid passes through a swivel pipe joint 13 to an internal line or conduit 14 which is centrally positioned and passes downwardly to the lower portion of the apparatus. Conduit 14 terminates in a series of nozzles 15 which discharge the medium in jet-like high pressure cutting streams, which in turn are directed angularly downward such that the solid bed will be cut away and dislodged for removal within the area covered by the hood 10. Around the internal line 14, there is positioned a rotatable shaft 16 and an impeller blade 17 suitable for a centrifugal type pump. The shaft 16 and the blade 17 may be driven by a motor 18 which is supported in the upper portion of the apparatus. The housing 19 for the impeller blade 17 is supported from the shell 11 and connects directly with the top of the hood 10 by way of the short connecting conduit 20, as indicated in the drawing. The centrifugal pump, provided by the rotating blade 17 and the housing 19, draws the solid material, that has been cut away, and the cutting liquid upwardly through the conduit 20 and discharges it to the outlet line 21. The

outlet 21 may in turn connect with flexible piping for supplying the mixed solids and liquid to suitable processing equipment such as shown in my above-mentioned patent. A perforated plate or screen 22 is placed across the entrance of the inlet conduit 20 and serves to keep out any over sized material that would cause damage in being drawn through the centrifugal pump. The screen 22 may be attached to the conduit 14 and thus be made to rotate with the conduit and discharge nozzles. In the apparatus shown, a system of gears is used in the box 23 above the motor 18, in order to rotate the interior line 14 and the jet nozzles 15. However, in an alternative method of construction, the jet nozzles 15 may be placed at a slight angle such that the high pressure stream will cause their rotation, and the gear box 23 may be eliminated. Above the pump housing 19, a supporting frame 24 is provided to carry the motor 18 and to furnish attachment means for a yoke 25. The yoke 25 is provided with a lifting eye at its upper end which makes the apparatus adaptable for handling by any type of hoist or movable crane such as previously indicated.

In a somewhat simplified form of the cutting and pumping apparatus, as indicated in Figure 2 of the drawing, the centrifugal pump is eliminated and in its place an ejector type of pump is used. High pressure liquid or solvent material enters the upper end of the apparatus through inlet 26 and passes downwardly through the annular channel between an inner conduit 27 and an outer conduit 28. At the lower end of the annular flow channel there are provided a plurality of discharge nozzles 29 which provide high pressure jet streams for cutting away and dislodging the solid bituminous material. An open bottom hood member 30 serves to confine the cutting liquid and the dislodged solid material such that both may be removed by way of the internal pumping means provided. The inner conduit 27 is provided with a Venturi nozzle 31 at its lower end such that a high pressure jet stream of liquid from a centrally located nozzle 32 will cause a jet pump action to draw the solids and liquid mixture upwardly therethrough into conduit 27 and be discharged therefrom, through outlet line 33. A swivel type of pipe joint 34 is used between the upper end of conduit 27 and the discharge line 33 such that the apparatus may be readily moved about by means of a movable crane or like equipment. The discharge nozzles 29 are preferably placed at an angle which will cause the conduits 27 and 28 to rotate from the pressure of the jet streams and provide a full circular cutting action on the solid material bed. Since it is desirable to rotate the nozzles 29, the inlet joint 26 and the outlet joint 34 must be of a swivel type of construction as well as a type that will withstand high pressure service. Also a rotatable joint or bearing 36 is provided between the exterior conduit 28 and top of the hood 30. A perforated plate or screen 35 is positioned across the flared inlet to the ejector or Venturi nozzle 31 in order to prevent its clogging with large pieces of solid matter.

When employing a hydrocarbon solvent for the high pressure cutting fluid, the bituminous material in the tar sands will be substantially dissolved and removed from the mineral material by the time the mixture has been pumped to the processing unit. In the preferable embodiment of the combination process, an intermediate gas oil fraction, which is a product of the distilling process, is heated and passed to the mining apparatus as the hot solvent material.

In an alternative method of carrying out the mining operation, hot water or steam may be used in the high pressure jets in the mining hood to cut away the bituminous deposit and fluidize the particles such that they may be conveyed by pipe line to the processing unit. The passage of the water and solids mixture directly to the distillation chambers, however, means the expenditure of considerable heat and energy in flashing off the large quantity of water present. It is, therefore, advisable to remove the oil from the water by employing conventional settling basins, mixers, and skimming basins which have been used in connection with such types of material.

I claim as my invention:

1. An apparatus for hydraulically removing solid material from natural deposits thereof, which comprises in combination, an open bottomed confining hood adapted for encompassing a small area of said deposit, an inlet for a high pressure fluid medium and outlet means from said hood for particles of said material and said fluid medium, a rotatable conduit communicating with said inlet and terminating in a plurality of discharge nozzles, said nozzles directed angularly downwardly toward the lower periphery of said hood and suitable for effecting rotating jet-like cutting streams of said fluid medium and the dislodging of said solid material, and slurry pumping means in said outlet means for discharging resulting dislodged solids and fluid medium.

2. An apparatus for hydraulically removing solid material from natural deposits thereof, which comprises in combination an open-bottomed pressure tight hood adapted to encompass a small area of said solid material deposit, inlet means for a high pressure fluid medium, outlet means for solid particles of said material and said fluid medium, a rotatable fluid inlet conduit extending centrally through said apparatus and terminating in a plurality of discharge nozzles, said nozzles being directed angularly downwardly toward the lower end of said hood, and effecting jet-like cutting streams of said fluid medium, a swivel joint connecting said inlet and said rotatable conduit, motor driven centrifugal pump having a housing and a rotatable impeller blade, a short fluid channel connecting the upper portion of said hood with said pump housing whereby said pump passes dislodged solids and fluid material from within said hood to said outlet means, a prime mover for said centrifugal pump having an extended hollow drive shaft connecting with said rotatable impeller blade and concentric around said rotatable conduit which connects said inlet means to said discharge nozzles within said hood, and an open shell attached to and extending beyond said hood adapted to enclose and support said pump housing and said prime mover.

3. An apparatus for hydraulically removing solid material from natural deposits thereof, which comprises in combination, an open-bottomed confined hood adapted to encompass a small area of said solid material deposit, an inlet conduit for a high pressure fluid medium, an outlet for solid material and said fluid medium, two concentric and rotatable conduits providing an annular flow channel therebetween, a swivel pipe joint between and connecting said inlet conduit with said annular flow channel, a second swivel joint between said outlet and the

inner of said concentric conduits, and a rotatable joint between the exterior of said conduits and said hood, a plurality of discharge nozzles at the end of said channel between said conduits and opposite said fluid inlet and said outlet, said nozzles being positioned to have similar angularity with respect to said hood and are directed angularly downward to discharge high pressure fluid medium from said annular flow channel in jet-like cutting streams at the lower periphery of said hood, a Venturi shaped inlet within the lower end of said inner conduit, a jet nozzle positioned centrally between the other of said discharge nozzles and directed upwardly into said inner conduit providing thereby a high pressure fluid

stream directly into said venturi, said venturi and last said jet nozzle effecting jet pumping of dislodged solid particles and fluid medium from within said hood to said outlet at the opposite end of said inner conduit, and a perforate screening member across the Venturi inlet to said inner conduit.

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