Feb. 28, 1939. A. M. WHITNEY 2,148,717

PROCESS OF EXTRACTING OIL FROM OIL SANDS

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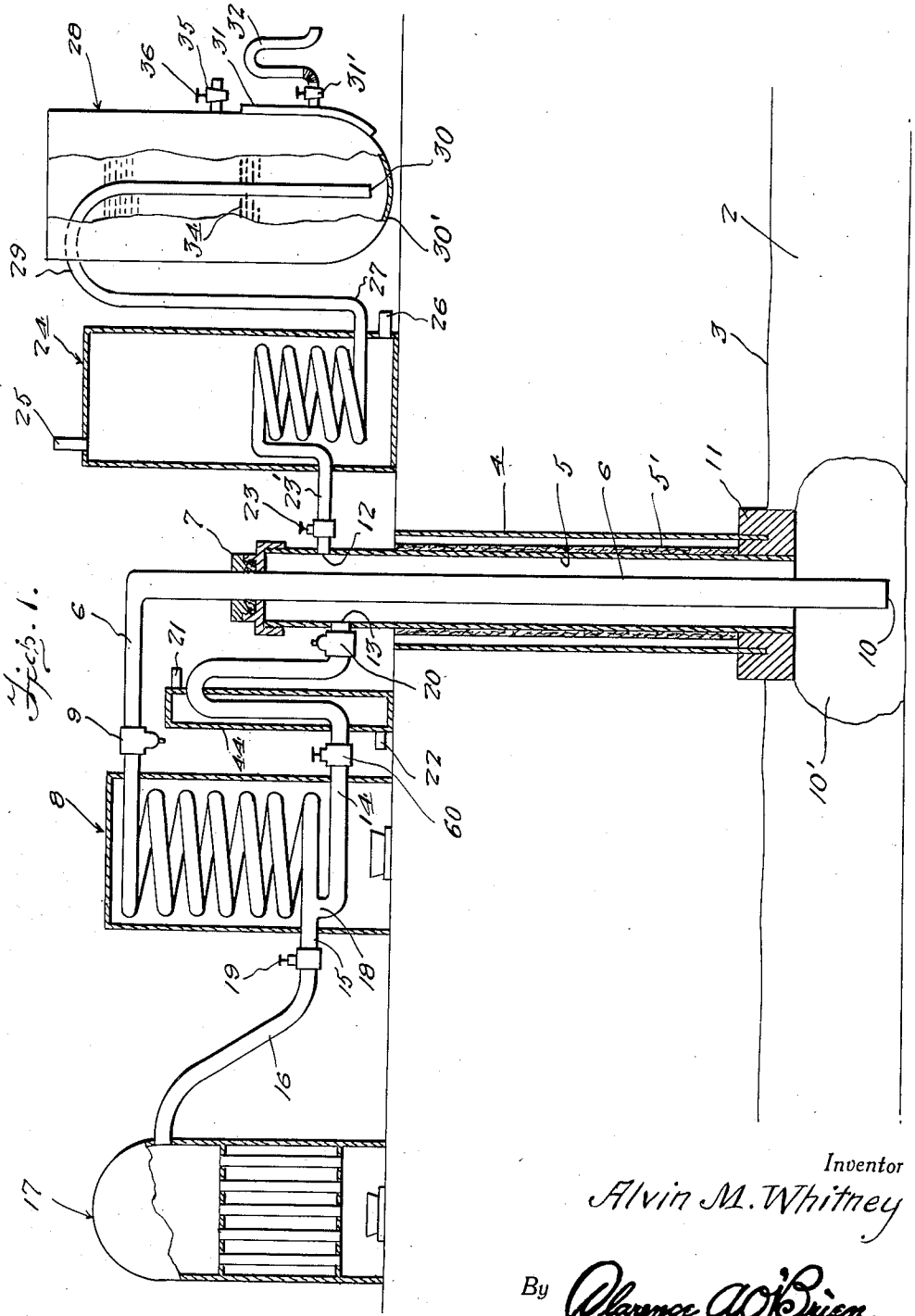

Fig. 1.

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Fig. 2.

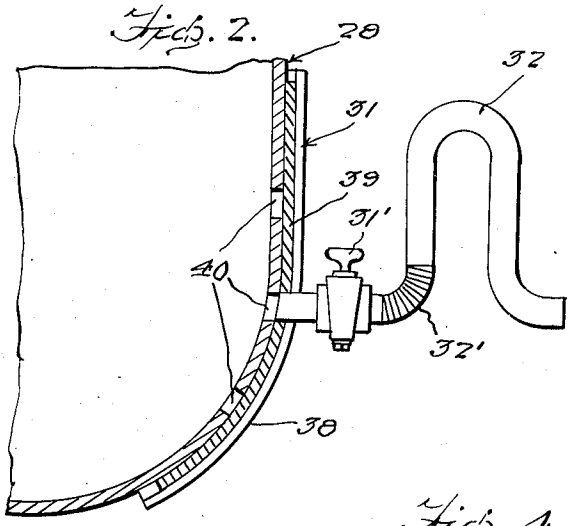


Fig. 3.

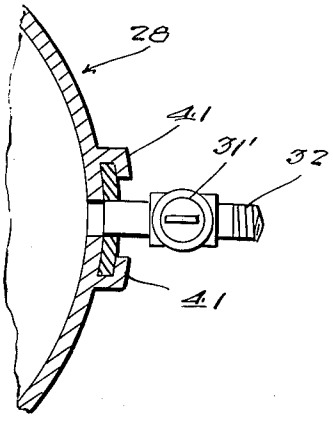
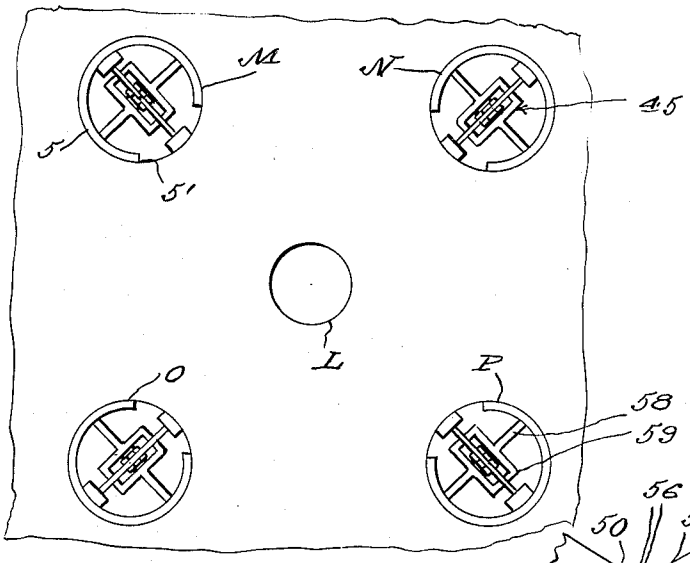


Fig. 4.



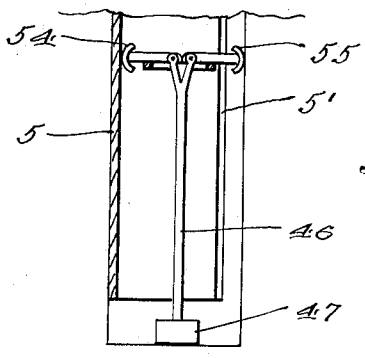


Fig. 5.

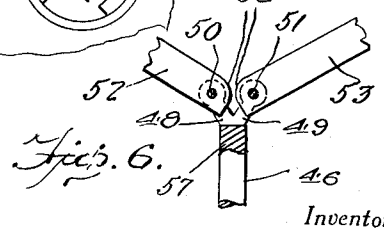


Fig. 6.

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PROCESS OF EXTRACTING OIL FROM OIL SANDS

Alvin M. Whitney, Bradford, Pa.

Application January 21, 1937, Serial No. 121,669

3 Claims. (Cl. 166—21)

My invention relates generally to means for extracting oil and similar material from shale, sand, or other bituminous material which is in its natural condition in the ground, and particularly to process and apparatus for more economically and efficiently extracting oil and the like from the ground by means of recovery wells, and an important object of my invention is to provide practical and economical means whereby substantially the whole oil content of a given area of ground may be extracted and the process carried on without substantially affecting adjacent areas.

Other important objects of my invention will be apparent from a reading of the following description taken in connection with the drawings, wherein for purposes of illustration I have shown a preferred embodiment of the apparatus of my invention.

In the drawings:—

Figure 1 is a sectional elevational view of circulatory apparatus for performing the process of the present invention.

Figure 2 is an enlarged transverse vertical sectional view taken through the lower part of the recovery tank showing the vertically adjustable syphon connection.

Figure 3 is a horizontal sectional view taken through Figure 2.

Figure 4 shows an arrangement for extracting oil from a given area of ground, wherein protected pipes are arranged at the corners of the area and are formed with inwardly facing openings directed toward a centrally located recovery well, and showing expanding means for engaging the pipe and the opposed side of the hole to press the pipe against the side of hole to prevent escape of heat in a radially outward direction.

Figure 5 is a transverse vertical sectional view taken through one of the open sided pipes and showing the expanding means in position.

Figure 6 is an elevational detail of the expanding means.

It has been the practice prior to the present invention to recover oil from selected areas by either pumping the oil from wells drilled into the oil strata, or to mine it by various processes, including processes which have been devised with a view to extracting the oil from the shale or sand by application of heat to the shale or sand itself. Of the last mentioned processes, none has proven satisfactory from a practical standpoint, the cost of operation being too great for general use. But the present process and apparatus operates with sufficiently great improvements in efficiency and output, so that the same is practical from every standpoint.

In accordance with the present invention the process consists in drilling an ordinary oil well into and through the oil bearing sand 2, as shown in Figure 1 of the drawings, the numeral 3 designating the taprock or layer of slate which seals the oil and gas in the sand, and is always present. The numeral 4 generally designates the casing of the oil well, and the numerals 5 and 6 pipes inserted in the well, 5 and 6 being covered with insulating material 5' to conserve heat, and these pipes are circumferentially spaced as shown in the drawings. The inner and smallest pipe 6 passes through a stuffing box and tap screw 7 at the top of the well and connects with the outlet of a superheater which is generally designated 8, at the point 9 which is constituted by an adjustable diaphragm pop-valve. The pipe 6 leads from the helical coil to the bottom of the well which is constituted by the shot-hole 10' in the oil bearing strata 2. The pipe 5 depends only to the top of the shot-hole 10' and is sealed off by a packer 11 at the top of the oil bearing strata 2.

Adjacent its top the pipe 5 has opposed openings 12 and 13. 13 opens into the intake end of the superheater 14, after passing through a water cooling box or jacket 44. At the point 15 the pipe section 14 is connected with the lower convolution of the superheater coil and with the intake pipe 16 which carries steam from the boiler or generator which is generally designated 17. At the point 18 the superheater coil and the pipe section 14 are connected by a union or bypass so that the contents of the pipes in the superheater may be drawn from either the pipe 16 or from the pipe 5, as desired, by opening or closing the valves 19, 20 and 60.

The cooling box or jacket 44 has a cold water intake 21 and an outlet 22 for heated water.

The outlet 12 from the pipe 5 is controlled by a hand valve 23 on the condensing coil 23' in the condensing box 24, which condensing box is provided in its upper end with a cold water intake 25 and in its lower end with a heated water outlet 26. At the point designated 27, the condenser coil pipe passes outwardly and then upwardly and then curvedly over as indicated by the numeral 29 into the tank 28, whence the condenser pipe passes downwardly in the tank 28 to a point of discharge 30 which is just above the rounded bottom 35 of the tank 28.

On the side of the lower part of the tank 28, as shown in Figures 2 and 3 of the drawings, is

a sliding aperture 31 which has connected thereto the syphon pipe 32, the connection being made by a flexible joint 32' beyond a hand valve 31'.

The sliding aperture 31 consists of a suitable plate 38 conforming in curvature to a side of the tank 28 and having a conforming gasket 39 on its inner side, the side of the tank 28 being provided with a plurality of openings 40 which are vertically spaced, or with a continuous slot, as may be desired. When the aperture 31 is adjusted vertically by sliding the plate 38 between the guides 41 which are formed on the side of the tank 28, the level at which the condensed steam may be drawn off by syphoning is determined. The effect is to have control of the water level in the lower part of the tank, the water level being designated 34 for illustrative purposes. The syphonic pipe 32 discharges water, but the oil above the water and in the tank 28 is discharged at the valved opening 35 by opening the stop cock 36.

The apparatus above described is operated as follows:—

The first step is to close the valves 20 and 60 and open the valve 23, and the valve 9 and to close the valve 19. Then steam is gotten up in the generator 17 to the desired pressure, and when this desired pressure is obtained, the valve 19 is opened and admits wet steam to the superheater 8 where the steam is raised to the required temperature, say, about 700° F.

This superheated steam passes out through the valve 9 and down into the shot-hole 10' by way of the small pipe 6 and is discharged in the shot-hole at the point 10. Steam under pressure is generated by the confined steam and the resultant liberated vapors in the shot-hole, as a result of the discharge of the superheated steam in the shot-hole, and the combination of superheated steam and liberated vapors pass up through the pipe 5 and out of this pipe at the opening 12 and into the condensing coil in the condenser 24. The flow of these vapors through the valve 23 is controlled by the back pressure at the point 30 in the tank 28 after the vapors are condensed. The vapors mentioned pass through the condensing coil in the condenser 24 and on into the tank 28 where the condensed steam or water settles to the bottom of the tank 28 and the lighter materials or oil, rise to the top and may be drawn off at the outlets 32 and 35, respectively.

Thus a purpose of the invention in providing a medium for conducting heat to the bottom of the shot-hole to raise the temperature of the sand to any desired temperature, is facilitated. When the proper temperatures are reached, the elements in the oil strata are vaporized and this creates great pressure. These vapors under pressure follow the line of least resistance which is back into the shot-hole. By constantly supplying a heating medium to the shot-hole, the heat is radiated outwardly into the sand for a considerable distance and the heat vaporizes and releases a greater percentage of the oil than could be effected by any other presently known method.

The life of the well, therefore, depends upon the area of radiation at the point operated upon within the limit of efficiency.

The presently used processes for applying pressure to oil sand with water under high pressure are in the present invention supplanted by using heated vapors under pressure in the corner wells M, N, O, P of a selected area. As is well known, the radiation or pressure will force the oil in the area toward the central recovery well L.

The present invention contemplates making each of the wells M, N, O and P a pressure well and making L only a recovery well, and the result is that all of the available oil will be taken from the area through the recovery well L. In order to make pressure wells of the wells M, N, O and P, it is desirable and necessary to proceed as follows with the equipment to be described.

The four wells are drilled at four equi-distant points from the central well L. These wells can be shot if desired, but heat can be better directed toward the centralized well by drilling the well without shooting it. The equivalent of the pipe 5 is run clear to the bottom of the hole, with this pipe 5 in the form of a three-quarter circle, with the opening facing toward the centralized well L, and with the outside of the pipe 5 insulated over its entire surface, as shown in Figure 4 of the drawings, the inwardly facing opening being designated by the numeral 5' in the case of each of the wells M, N, O and P.

In order to prevent the heat from escaping through the back of the pipes 5, I provide a wedge-lever arrangement generally designated 45 which is arranged at the center of the hole or bore and is attached to the pipe, so that when the pipe 5 is forced into the bottom of the well, the back of the pipe will be forced against the wall of sand, so as to firmly engage the insulated back of the pipe against the opposite wall of the hole and thereby prevent the backward escape of heat from the well.

Reference to Figures 4, 5 and 6 will disclose the form and arrangement of the wedge-levers each of which consists of a depending shank 46 having a heavy weight 47 at its lower end and provided at its upper end with two divergent brackets 48 and 49 which have pivoted thereto as indicated by the numerals 50 and 51, respectively, the arms 52, 53 which have the curved shoes 54 and 55 at their outward ends for engagement with the wall of the hole and with the back of the pipe, respectively.

The radially inward ends of the arms 52, 53 are rounded at the points designated 56 and squared at the points designated 57 shown in Figure 6, so that as the device goes down in the well the arms are permitted to move upwardly toward each other in a free manner. The squared portions 57 are provided to lock the arms in their expanded condition so as to firmly hold the shoes 54 and 55 in engagement with the pipe and with the wall of the well as indicated in Figures 4 and 5 of the drawings. A support 58 extends across the pipe 5 and has a rectangular frame 59 on which the arms 52 and 53 rest and through which they work, the frame acting to prevent the device from falling through the well before the same has been brought to expanded condition by engagement of the weight 47 with the bottom of the hole. As the pipe 5 is forced into the bottom of the well, the plunger or shank 46 is pushed upwardly and thereby pushes the arms 52 and 53 against the pipe and the sand wall respectively, so as to firmly nest the insulated part of the pipe 5 against the outer side of the well wall.

After the wells M, N, O and P are arranged as indicated above, the steam is turned on at the point 19 after first having closed the valves 20 and 60. After the well is filled with steam and vapor at the required temperature and pressure, the valve 19 is closed and the valves 20 and 60 are opened. The vapors then under pressure come up through the pipe 5, the valve 23 being in a closed condition and pass up through the

cooling pipe section 14 in the cooling box 44. By the cooling of these vapors a tendency toward a vacuum is created which aids the travel of the vapors. By reheating the vapors in the superheater as they proceed through the coils of the superheater, a continuous pressure at the point 9 is produced so as to cause an automatic circulation of the vapors at high temperature into the shot-hole. By properly adjusting the valves 9 and 20 and 60 any desired pressure can be generated in the bottom of the well and the heat forced toward a common central point at the centralized well L.

The centralized well L is equipped as a recovery well. The oil from the area will then be available at a very low cost as compared with the present processes and apparatus which involve expensive water pressure plants and expensive pumping equipment.

Although I have shown and described herein a preferred embodiment of the process and of the apparatus of my invention, it is to be definitely understood that I do not desire to limit the application of the invention thereto, and any change or changes may be made in the structure and arrangement of the parts, and in the manner and sequence of operating the various steps of the process, within the spirit of the invention and the scope of the subjoined claims.

What is claimed is:—

1. A process of recovering oil from an area having an oil stratum, said process comprising sinking a first well in an area and a second well adjacent the first well, then forcing superheated steam into the first well so as to vaporize the oil stratum, shielding the outer sides of said first well in a manner to produce heat radiation only toward the second well, then establishing and operating said second well as a recovery well.

2. A process of recovering oil from an area having an oil stratum, said process comprising sinking a first well and a second well in said area, then establishing a continuous circulation of superheated steam and heat generated vapors into said oil stratum through said first well while positively preventing heat radiation from said second well in a direction away from said first well by first passing superheated steam under pressure into said oil stratum through said second well and then permitting the resultant combination of superheated steam and oil vapors to rise through the first well behind the original superheated steam, then establishing and operating said first well as a low pressure recovery well and substantially completely draining the area of oil.

3. A process of recovering oil from an area having an oil stratum, said process comprising sinking a plurality of wells over the area and one adjacent the center of the area, then forcing hot vapors under pressure into wells at designated points so as to vaporize the oil in the stratum, shielding the outer sides of said wells at designated points in a manner to project heat radiation and pressure toward the central well while preventing the escape of heat from said wells in other directions, then establishing and operating said central well as a recovery well.

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