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APPARATUS FOR HEATING OIL WELLS AND PUMPING OIL THEREFROM

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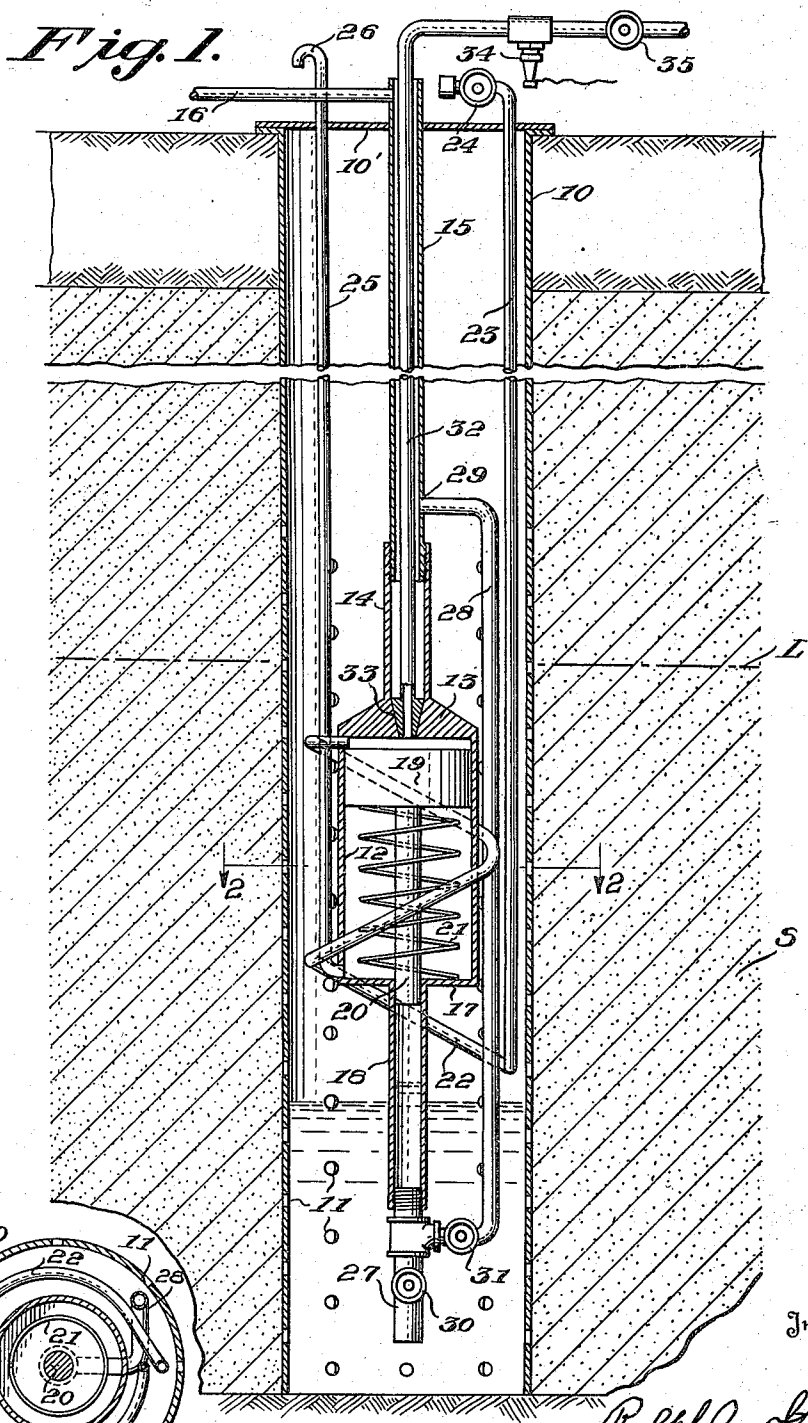
Fig. 1.



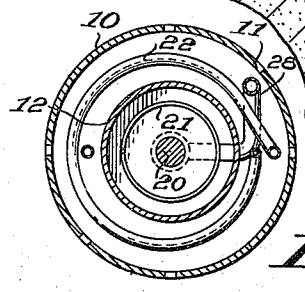


Fig. 2.

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APPARATUS FOR HEATING OIL WELLS AND PUMPING OIL THEREFROM

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10 Claims. (Cl. 166—17)

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This invention relates to apparatus for heating an oil well and pumping oil therefrom.

The primary object of this invention is to provide apparatus for augmenting the yield from oil wells.

An important object of the invention is the provision of apparatus which is applicable to existing wells to renew or increase this output, or which may be employed with equal facility in low yield shale and oil sands and in fields where normal procedures for development of the oil deposits are not practicable.

A further important object of the invention is the development of apparatus which shall concurrently condition the oil strata for increased oil flow and effect an increased output from the well.

An additional object of the invention is the development of an apparatus for heating the interior of an oil well by means of successively admitted confined charges of explosive gas and the ignition of said charges with a resultant heating of the interior of the well, and the surrounding oil bearing strata, and utilizing the pressure of the combustion gases for pumping oil from the well.

A further object of the invention is the provision of apparatus for simultaneously heating the perforated liner wall of a well to facilitate flow of oil thereinto from the surrounding oil sands, the heating being effected by successively igniting confined charges of combustible gas and the expanding gases resulting from the ignition of the gases being utilized to operate a pump for pumping the oil from the bottom of the well.

A still further object of the invention is the provision of apparatus for simultaneously heating the oil sands adjacent a well and pumping the oil therefrom which is relatively simple in construction and highly reliable and efficient in operation.

With the above recited objects in view, together with others that will become apparent in the course of the following disclosure, reference will be had to the accompanying drawing, forming part of same, and wherein:

Fig. 1 is a vertical sectional view substantially axially of an application of the invention in accordance with a preferred embodiment thereof;

Fig. 2 is a horizontal sectional view in the plane of line 2—2, Fig. 1.

Referring now in detail to the drawing, 5 designates a bed or strata of oil sand with the level of the oil therein substantially at the line L. The oil well is defined by a casing 10 having perforations 11 therein for emission of heat from within

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the casing to the oil sand, as well as to provide for the flow of oil from the sand to within the casing.

The combined oil heating and pumping structure comprises a cylindrical pump casing 12 whose upper end is thickened as at 13 and from which projects the tubular extension 14. The upper end of the extension 14 is detachably connected to the lower end of the tubular oil delivery tube 15 which as indicated in Fig. 1 projects above the ground surface and which is provided with an oil delivery conduit 16. The lower end of the casing 12 is closed by a wall 17 and from which wall projects a downwardly extending cylindrical member 18 coaxially with casing 12 and extension 14.

The casing 12 and member 18 respectively provide relatively large and small cylinders in which are respectively disposed power and pump pistons 19 and 20 which are preferably of integral construction and with the piston 20 coaxial with the piston 19. The pistons 19 and 20 are yieldably retained in their upper positions by means of a coil spring 21 which surrounds the piston 20 and whose opposite ends bear on cylinder wall 17 and the lower face of the piston 19.

A tubular heating coil 22 surrounds the casing 12 and has the upper free end thereof in communication with the interior of the casing immediately below the thickened top wall 13 and above the piston 19. The lower end of the coil 22 is continued upwardly within the casing 10 in the form of a conduit 23, which at its upper end above the ground surface is provided with a pressure relief valve 24 which may be of any known type of adjustable release, whether pressure actuated or mechanically timed and operated.

A breather conduit 25 has the lower end thereof in communication with the lower end of casing 12 and the upper end thereof in the form of a gooseneck 26. A tubular fitting 27 is detachably connected to the lower end of the cylindrical member 18, and at its lower end is in communication with the interior of the oil well casing, and intermediate its ends is connected with the lower end of an oil delivery conduit 28 whose upper end is in communication with the oil delivery tube 15 above the extension 14, and is indicated at 29.

The fitting 27 is provided with check or foot valve 30 of any known type for controlling the flow of oil into the lower end thereof and into the member 18, and another check valve 31 likewise of known construction is provided in the conduit 28 for preventing back flow of oil there-

through. An explosive mixture conducting tube 32 is removably disposed within the tube 15, and at its lower end is provided with a frusto-conical portion 33 whose external surface has a fluid-tight sealing engagement with a corresponding surface in the upper thickened casing wall 13, the weight of the tube maintaining such sealing engagement.

A suitable ignition means, such as a spark plug 34 and an electric circuit, not shown, is provided in the tube 32 between the top 10' of the casing 10 and an explosive mixture control valve 35 which may be manually or automatically operated to control the quantity of combustible mixture supplied to tube 32, and may be of any known construction.

It will be understood that the purposes of the invention may be attained by numerous arrangements. For example, I may elect to introduce a combustible mixture into the heating coil either under pressure from the source of supply or by applying suction to the discharge end, or both. Again, I may vary the pressure of the explosive mixture and/or the combustion products as the well is progressed deeper and/or local conditions dictate.

The combined pump and heating structure is capable of being lowered into the well casing 10 and the joint connection at 33 is for the purpose of permitting lowering of the tube 32 into operative position after the other parts have been positioned, which joint also permits ready removal of the tube.

In the operation of the structure above described, a mixture of explosive gas is admitted through the control valve 35 and down through the tube 32 and thence through the tubular coil 22 as well as the conduit 23 to the pressure relief valve 24. The control valve 35 is then closed and the combustible charge is ignited by means of plug 34 which results in an explosive flame within the tube 32, coil 22 and conduit 23. The substantial heat evolved thereby is radiated from the walls of the coil and conduit and penetrates the surrounding oil sand through the perforations 11 in the well casing 10.

This heating of the well and the surrounding oil sand lowers the viscosity of the entrapped oil and results in an increased flow of oil from the sand into the bottom of the well through the perforations 11. The control valve 35 and plug 34 may be operated in properly timed relation by any desired cam control means, for continuous or intermittent operation.

The operation as above described is repeated by the intermittent admission and confining of explosive gases and the succeeding ignition thereof. The pressure relief valve 24 is set to momentarily retain the expanding hot gases whereby the pressure thereof is exerted upon the top of piston 19 which is accordingly forced down against the spring 21 with a resulting downward movement of the smaller piston 20 in the cylinder or member 18. The gas pressure is thereafter released by valve 24, either by the attainment of a predetermined pressure or by mechanical means, as set forth hereinbefore, and the pistons 19 and 20 are forced upwardly to the position in Fig. 1 by the spring 21.

Attention is directed to the operation of the combustion system. It will be noted that there is a step by step unidirectional circulation through the device, the incoming charge serving to expel or replace the residual products of combustion, thereby efficiently scavenging the device of inert gases. Thus, power impulses and heat emissions of uniform intensity can be maintained and the regulation of the combustion process is effectively controlled.

Upon upward movement of piston 20 within member 18 a partial vacuum is created within the member 18 resulting in opening of the check valve 30 and the flow of oil upwardly in member 18, as indicated in Fig. 1. Upon downward movement of piston 20 by the exertion of the combustion gas pressure on piston 19, valve 30 closes and valve 31 opens, whereby the oil in member 18 is forced through conduit 28 and thence upwardly through the oil delivery tube 15 and to a point of collection through the conduit 16.

The breather conduit 25 allows escape of gases from within the casing 12 beneath the piston 19 preventing the same from acting as a dashpot. By provision of the relatively large piston 19 which may be approximately five to six times the diameter of the piston 20, the latter would move downward under a very high pressure, thereby insuring the pumping of oil from a well of considerable depth.

It is common knowledge that much residual oil is unrecovered from exhausted wells due to the great depth involved and the loss of the gas pressure of the oil field. Moreover, many oil deposits are not commercially productive, due among other factors to the temperature of the strata and/or the viscosity of the oil. It will be obvious that the invention constitutes a simple and reliable means for effectively treating such strata for optimum extractions of the oil and simultaneously therewith provides adequate pumping means for effecting its discharge to the surface of the ground, and this regardless of the depth of the well.

It should be appreciated from the foregoing that a relatively simple structure is provided for carrying into effect a novel method of heating the oil sands adjacent a well by the intermittent ignition of successive confined charges of combustible gas to facilitate flow of oil from the sands into the bottom of the well, and by utilizinng the pressure of the burning gases to operate a pump for delivering the oil from the well to a point above the ground surface.

I claim:

1. Apparatus for heating the interior of a well defined by a perforated casing extending through an oil sand strata and for pumping oil from the well comprising an oil pump disposed within the casing adjacent the lower end of the well, said pump comprising a cylinder and a cooperating piston therein yieldably retained in an upper position by a spring, a combustible gas conduit communicating with the cylinder above the piston therein, means for admitting and igniting successive combustible charges in the conduit for disposition of heat therefrom and for forcing the piston downward, an oil delivery conduit communicating with the interior of said cylinder and extending from beneath the piston to a point above the ground surface, and check valves supported by the cylinder and delivery conduit for admitting oil to the cylinder beneath the piston upon upward movement of the piston and for admitting oil from beneath said piston to the delivery conduit upon downward movement of the piston.

2. Apparatus for heating the interior of an oil well and the adjacent oil sands surrounding same to facilitate flow of oil from the sands into the well and for pumping the oil in the well there-

from, comprising a cylindrical casing supported within the well adjacent the bottom thereof by means of an oil delivery tube terminating above the top of the well, said casing defining a cylinder and having an axial tubular extension defining a substantially smaller cylinder projecting downwardly from the first cylinder, unitary pistons in the cylinders and yieldably retained in upper position by a spring disposed within the casing and engaging the lower face of the larger piston, a combustible gas conduit extending into the well and communicating with the larger cylinder above the piston therein, a control vavle in the conduit above the well for admitting successive combustible gas charges thereto, means for igniting the combustible charges whereby heat is dissipated through the conduit wall from the burning gases and the expanding burning gases acting upon the upper face of the larger piston to force same downwardly against the action of the spring, an oil delivery conduit communicating with the lower end of the smaller cylinder and the oil delivery tube, and check valves supported by the lower end of the smaller cylinder and the oil delivery conduit for effecting pumping of oil from the well upon reciprocation of the piston in the smaller cylinder.

3. The structure according to claim 2 wherein the combustible gas conduit includes a coil surrounding the larger cylinder, the coil merging into a portion extending vertically upward within the well and provided with a pressure relief valve at its upper end externally of the well for temporarily holding the burning gas pressure within the conduit for forcing the pistons downward.

4. The structure according to claim 2 together with a breather conduit communicating with the lower end of the larger cylinder and terminating in a gooseneck above the well.

5. The structure according to claim 2 wherein the control valve supporting portion of the combustible gas conduit comprises a readily removable section extending through the oil delivery tube and having a weight sealing joint connection with the upper end of the larger cylinder.

6. Apparatus for operating an oil well having

a well casing extending below the standing oil level of a surrounding oil strata, comprising; an oil pump positioned below the standing oil level of a well casing, an oil delivery conduit communicating with and supporting said pump, a combustible gas conduit, combustion products pressure actuated means for operating said pump, a combustion products heater carried by said pump and positioned below said oil level, said gas conduit communicating with said means and with said heater, additional means delivering successive charges of a combustible mixture to said gas conduit and igniting means for initiating combustion in said gas conduit.

7. The combination of claim 6 wherein said combustible gas mixture conduit is concentric with said oil delivery conduit means.

8. The combination of claim 6 wherein said combustion products heater surrounds said pressure actuating means.

9. The combination of claim 6 wherein said pressure actuated means comprises a cylinder carried by said oil delivery conduit, said cylinder having a piston reciprocable therein, said piston operating said pump.

10. The combination of claim 9 including inlet and outlet ports in said cylinder on one side of said piston communicating respectively with said gas conduit and said combustion products heater, and a vent to the atmosphere on the other side of said piston.

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