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J. L. RICH

PROCESS FOR EXTRACTING PETROLEUM BY UNDERGROUND WORKINGS

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Inventor
John L. Rich
by his Attorneys

Baldwin McGett
To all whom it may concern:

Be it known that I, JOHN L. RICH, a citizen of the United States, residing at Ottawa, in the county of Franklin and State of Kansas, have invented certain new and useful Improvements in Processes for Extracting Petroleum by Underground Workings, of which the following is a specification.

It is well known that the common method of recovering petroleum from its underground reservoirs by means of wells, fails to extract more than a small percentage of the oil originally present in the rocks. Large amounts of oil remain irrecoverable by ordinary methods after the yield of the wells becomes too small to be commercially profitable. In some places, as in Alsace, France and near Hanover, Germany, it has been found that by sinking shafts into the oil sands from the surface of the ground and driving tunnels or galleries within the oil-bearing sands, it is possible to obtain a much larger percentage of oil than was possible by means of wells alone.

This method of recovering oil by subterranean drainage into tunnels driven within the oil sand, while it has been successful in recovering a large percentage of the oil, is dangerous and costly because of the fact that a spark from a pick striking hard rock or from any other cause is sufficient to set fire to the oil seeping into the galleries. The precautions which must be taken to guard against the spread of a fire through the mine and against explosions, add greatly to the cost of this method of oil recovery.

There is, further, a large loss of the more volatile constituents of the oil by evaporation into the strong currents of air necessary for the proper ventilation of the mines.

The present invention is primarily designed to obviate the greater part of the difficulties and dangers inherent in the method of recovering petroleum by mining as heretofore practiced, while at the same time it retains the advantages of the increased percentage of recovery which the mining method makes possible.

Other objects will be apparent from the following detailed description and the appended claims.

In the drawings:

Figure 1 is a cross section of a conventional form showing the relation of galleries and channels to the oil-bearing stratum, both for cases where the gallery is driven above the oil sand and where it is driven below the sand.

Figure 2 is a longitudinal section through a shaft, gallery, and channel, showing diagrammatically their relations to each other and also illustrating a method of ventilation designed to prevent the escape of gases into the gallery while channeling is in progress.

Figure 3 shows in detail a means for closing the top of a channel so that the gases arising therefrom do not escape into the gallery but may be drawn off through the channel.

Figure 4 shows a different form of device for closing the top of a channel which is suitable for carrying off and saving a larger volume of gas than could be cared for by the device illustrated in Figure 3.

Figure 5 is a diagrammatic ground plan showing shafts, galleries, channels and pits or wells in the channels for the collection of the oil prior to its removal by pumps; and showing also wells extending from the surface of the ground to the oil sand, through which wells fluids may be introduced into the oil sand, for the purpose of driving the oil out into the channels in the galleries.

Figure 6 is a section along the line 6—6 of Figure 5, showing the movement of the fluids introduced into the wells and their relation to the oil sand, galleries and channels.

The process constituting my invention consists primarily of certain broad steps: (1) driving tunnels or galleries in the rocks either close above or close below the oil-bearing stratum, and from these galleries cutting narrow slits or channels into or through the oil-bearing stratum, these operations being performed by means of a channeling machine such as commonly employed in rock-quarrying operations, or by any desired suitable means; (2) providing means whereby gases issuing from the channel while it is being cut, or subsequently, may be removed and saved without contaminating the air of the galleries; and (3) providing means whereby, if desired, oil may be forced into the channels cut as above specified, by artificial pressure applied to the oil-bearing stratum through the agency of fluids introduced into it through wells drilled to it from the surface of the ground.

In practising the process a shaft 1 is first sunk, if necessary, to the neighborhood of the oil-bearing stratum, generally referred...
to as the oil sand, although it may be composed wholly or in part of materials other than true sand. From this shaft 1 a gallery or tunnel 3, or a plurality of such galleries, is driven in the rock either close above the oil sand as illustrated in the left hand portion of Figure 1, or close below said oil sand as shown in the right hand portion of this figure. These galleries are of any suitable or convenient dimensions and shape and are preferably constructed approximately parallel to the oil sand. I prefer to drive the gallery above the oil sand, and have so described the further details of the process, but it is to be understood that the invention is not limited to either arrangement.

From the gallery 3 a relatively narrow slit or channel 4 is cut into or through the oil sand by means of an ordinary rock tunneling machine A, or by any other suitable device. This channel may be of any desired width or depth, and may be situated at any convenient position in the gallery. It will, as a rule, extend for the full length of the gallery, but may be made shorter if desired, or may be made up of a number of sections that are not directly connected with each other. At convenient places along the gallery, there are provided pits or shallow wells 5 in the oil sand in such position that the oil may drain from the channels into them. From these pits or wells the oil may be pumped out to the surface of the ground by any suitable pumps and systems of piping (not shown).

In order to prevent the contamination of the air of the galleries by the gases which issue from the channel as it is being cut, a tube or other suitable air conductor 6 extends down the shaft and along the gallery. It is connected at its outer end to a suction or exhaust fan or air pump of any desired type (not shown) and by this means a current is induced substantially as shown by the arrows in Figure 2. The gases or impure air are drawn out through the tube 6, while fresh air passes down the shaft 1, along the gallery 3, and past the open part of the channel 4 at the point where the rock tunneling machine A is at work, and thence through the tube 6. The tunneling machine and adjacent portions of the channel are inclosed by a flexible hood 7 of suitable design and size, connected to the end of the tube 6.

It is intended to cover portions of the channel 4 as completed by some suitable device to prevent the escape of the gas from the channel into the galleries. The precise character of the covering device will depend upon the volume of gas to be handled and other considerations. Where the volume of gas to be handled is not large, the channel may be covered with a semi-cylindrical pipe or tile 8, as shown in Figure 3, which may be connected at intervals with the exhaust air pipe 6 to permit the escape of gas from the channel 4. Provision may also be made for the removal of sections of the covering 8 at desired places for the purpose of cleaning out the accumulations of mud or sand which may have gathered in the channel. The channel cover 8 may be made gas tight by the application of cement, mud, or other sealing compound 9 along the edges of the members 8, as shown in Figure 3.

If the volume of gas is very large, and its confinement to the channel 4 might produce undue pressure, a device such as illustrated in Figure 4 may be used to cover the channel. This consists of a strip of sheet metal 10 bent into convenient shape as shown in Figure 4, and having its edges 11 inserted in the channel as shown. The junction of the metal sheet with the mouth of the channel may be made gas-tight by the application of cement, mud or some similar sealing compound 12 at the side of the sheet as shown.

From the shaft 1, a single gallery with its channel may be driven, or several may be driven in various directions, and the oil to be recovered may be limited to that which naturally seeps into the channels. However, if the oil recovery contemplated by this invention is to be carried out most efficiently, artificial pressure must be placed upon the oil sand to assist in forcing the oil out into the channels.

With this end in view, the shafts, channels, galleries and oil collecting wells may be arranged somewhat as diagrammatically illustrated in Figure 5, except that the galleries need not inclose a regular area as there shown. Situated with proper relation to the galleries and channels, and preferably within the area inclosed or partly inclosed by the galleries one or more wells 13 are sunk from the surface of the ground and properly cased. These wells may or may not be shot with nitro-glycerine, as is found expedient. Into these wells 13, water, steam, air, gas, or other fluid, or combination of these fluids may be forced under pressure sufficient to cause these fluids to displace the oil from its place in the sand and cause it to move toward and into the channels 4 and thence into the wells 5 from whence it is pumped as above stated. The general movement of fluids thus set up is shown diagrammatically in Figure 6.

Obviously variations may be made in the structure employed to carry out the process, and steps of the process may be used without others. In general it is to be understood that the invention is limited only by the scope of the appended claims.

I claim as my invention:—

1. A process for the extraction of petroleum which comprises forming tunnels or
galleries adjacent to the oil-bearing stratum, cutting narrow slits or channels from said galleries into the oil-bearing stratum, and forming depressions in said channels for the collection of the oil, from which it may be removed as desired.

2. A process for the extraction of petroleum which comprises forming tunnels or galleries adjacent to the oil-bearing stratum, cutting slits or channels from said galleries into the oil-bearing stratum, and preventing escape of gas into the gallery while the channel is being cut.

3. A process for the extraction of petroleum which comprises sinking a shaft to a point adjacent to the oil-bearing stratum, forming a tunnel or gallery adjacent said stratum, cutting slits or channels from the gallery into said stratum, and drawing off through the shaft the gases from the channel as it is being cut thereby preventing the escape of said gases into the gallery.

4. A process for the extraction of petroleum which comprises forming a gallery adjacent to the oil-bearing stratum, cutting a channel from said gallery into said stratum, drawing off the gases from the channel as it is formed, and closing said channel as completed, whereby said gases are prevented from escaping into the gallery.

5. A process for the extraction of petroleum which comprises forming a gallery adjacent to the oil-bearing stratum, cutting a channel from said gallery into said stratum, forming depressions in said channel for the collection of oil, sinking a well into the oil-bearing stratum, and forcing fluids under pressure through said well into said stratum to drive the oil into said channels.

6. A process for the extraction of petroleum which comprises sinking a shaft to a point adjacent the oil-bearing stratum, forming a gallery leading from said shaft, cutting a channel from said gallery into said stratum, preventing the escape of gas from said channel into the gallery, forming depressions in said channel for the collection of oil, sinking a well into the oil-bearing stratum, and forcing fluid under pressure through the well into the stratum to drive the oil into said channels.

In testimony whereof, I have hereunto subscribed my name.

JOHN L. RICH.