

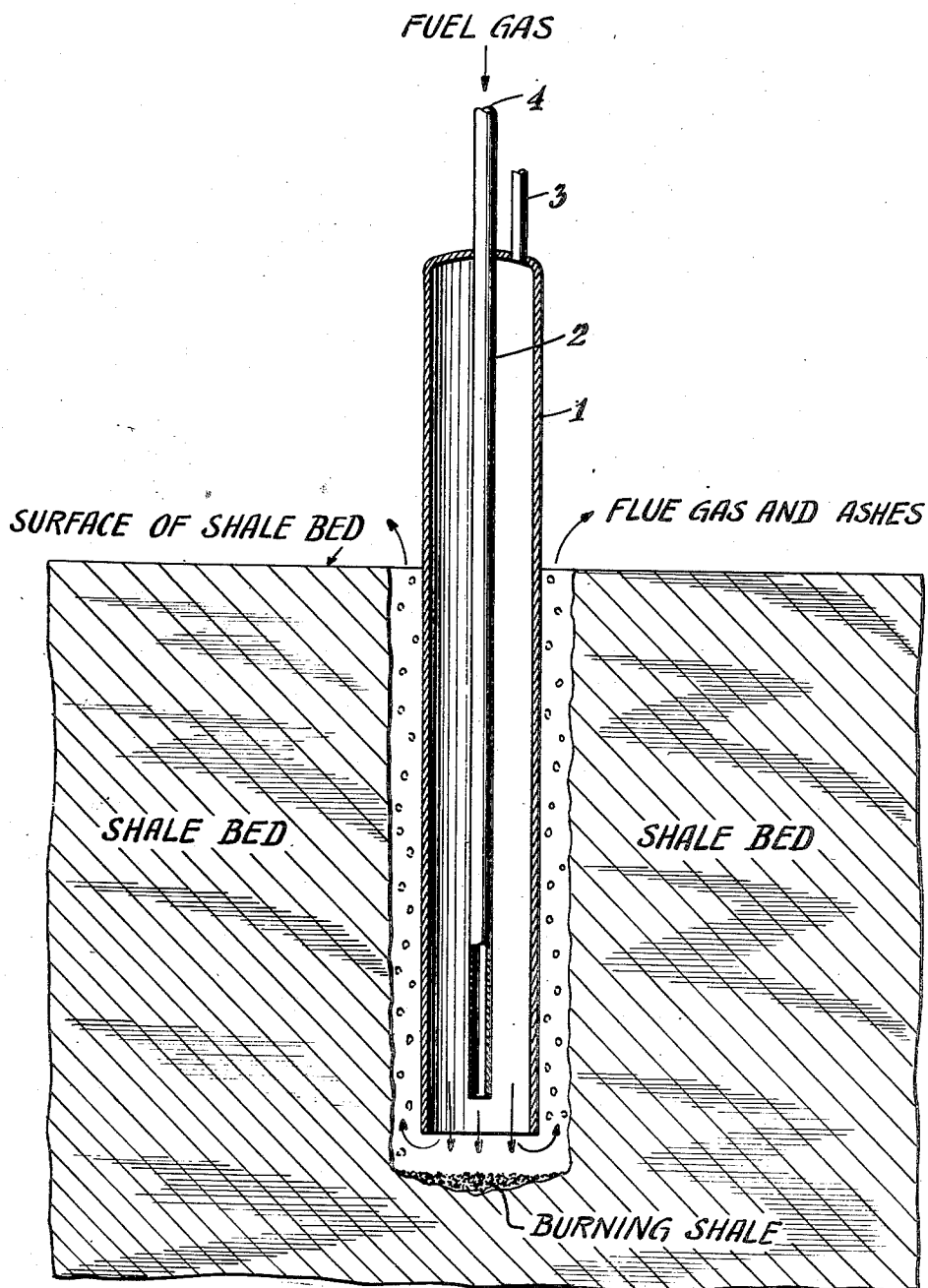
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PROCESS FOR THERMALLY WORKING OIL SHALE

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PROCESS FOR THERMALLY WORKING
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1

This invention relates to a method for piercing holes in mineral masses containing combustible matter or matter capable of yielding combustibles upon the application of heat. More particularly, the present invention is concerned with a method for boring holes in oil shale.

The increasing cost of exploring and producing petroleum in the United States is causing shale to appear more attractive than in the past as a source of oil. However, since oil shale is a dense, tough, rock-like material not easily drilled by either a rotary or percussion bit, one of the major cost items in the production of oil from shale has been the expense of mining.

It is, accordingly, a principal object of the present invention to reduce the costs of mining oil shale and to thereby increase the overall efficiency of separation of oil from shale by the provision of a novel process for rapidly and economically thermally working the shale by piercing therein holes suitable for blasting or otherwise handling the shale.

It has heretofore been known to bore holes in various mineral composites by exposing them to an intense oxy-fuel flame which melts material, leaving a hole from which molten mineral matter or slag is thereafter removed. Such methods have the disadvantage of requiring the continuous and often prolonged use of acetylene or other fuel gas. These methods have been further complicated by the presence of a flux necessary to attain the requisite intense heat and to increase the fluidity of the molten mineral matter or slag.

In accordance with the present invention, a process for thermally working oil shale and similar combustible-containing mineral composites has been discovered in which fuel requirements are minimized and in which the use of a flux is unnecessary. The process of this invention will be understood by those skilled in the art from the following detailed description considered in conjunction with the figure, wherein is presented a diagrammatic representation of a torch device suitable for operating the process of this invention.

The novel process for thermally working oil shale according to the present invention comprises separating material therefrom and forming a hole therein by initially heating the surface of the shale rock, then removing the source of heat and supplying a stream of oxygen-rich gas to the hot surface. The combustible matter in the shale brought into contact with the stream of oxygen-rich gas is thereafter sufficient to sup-

2

port combustion and to permit the attainment of sufficiently high temperatures to fuse the shale.

The highly fluid slag produced as a result of said combustion is removed from the hole in the liquid state by the pressure of the gaseous products of combustion, which may be assisted by an auxiliary ejection fluid such as compressed air. An alternative procedure is to quench the slag within the hole with water, after which it may disintegrate spontaneously or may be disintegrated mechanically. The disintegrated particles are then washed out of the hole by water or by gaseous products of combustion and any steam formed within the hole.

The instant process takes advantage of the high content of available combustible matter present in the oil shale and effects ignition and combustion of said matter to provide a flame of intense heat which is utilized in boring holes in the shale rock. It is generally recognized that oil shale does not contain oil as such but rather a solid bitumen type material known as kerogen which, when heated, breaks down into gases, petroleum-like liquids and carbon. It is the kerogen present in the oil shale which is the source of combustible matter utilized in the present process. It is, consequently, the presence of this material, peculiar to oil shale, which, in accordance with the instant procedure affords an economical and rapid method for the boring of holes in shale rock.

Initial heating of the shale rock surface is effected with any feasible means capable of raising the temperature of the rock to a point where ignition of combustible matter present therein (kerogen) takes place. The temperature of ignition will vary widely, depending upon the content of volatile matter and fixed carbon present in the particular oil shale being worked. The latter figure will in turn be dependent upon the source of the shale. For domestic shales the volatile matter and fixed carbon content is generally between about 25 and about 65 per cent by weight. The initial heating temperature necessary to effect ignition of said shales will generally be between about 800° F. and about 1400° F., although other temperatures outside of this range may be used, it being only necessary for purposes of the present invention that combustibles available in the oil shale be initially ignited. The extent of surface area heated will depend largely on the shape and nature of the hole desired. The process is particularly applicable to the piercing of deep blasting holes

of circular cross-section extending straight into a mass of shale rock. However, the principles of the process of this invention may also be applied to the production of other openings in the nature of grooves or cuts.

After initial heating of the shale rock to ignition temperature, the source of heat, which may be an oxy-acetylene torch or other convenient means, is removed from contact with the shale and a stream of oxygen or a gaseous mixture consisting of air enriched with oxygen is directed on the hot surface. The rate of flow of the gas stream is such as to supply an amount of oxygen to the heated shale surface sufficient to effect combustion of the kerogen contained therein and to attain a temperature sufficiently elevated to bring about fusion of the shale rock. The latter temperature is subject to wide variation, depending upon the particular shale being worked. Generally, however, a temperature within the range of 1800 to 2800° F. will be sufficient to cause the desired fusion of the shale.

A torch device suitable for operating the process of this invention is shown in the figure. It comprises an outer tube 1, closed at one end, having a tube 2 of smaller diameter concentrically disposed therein. The outer tube 1 is provided with an inlet 3 for oxygen-containing gas. Tube 2 is provided with an inlet 4 for a suitable fuel gas, such as acetylene. In operation, the end of the torch is directed to the surface of a bed of shale. A fuel gas, such as acetylene is introduced via opening 4 and tube 2, to be admixed with oxygen-containing gas introduced via opening 3 and the annular space between tubes 1 and 2. The mixture of fuel gas and oxygen-containing gas is ignited. The flame is directed towards a portion of the surface of the shale bed until the combustibles at that portion of the surface are ignited. Thereupon, the supply of fuel gas is discontinued; the introduction of the oxygen-containing gas being continued to maintain combustion of the combustibles in the shale. As the combustibles near the surface are burned, the torch device is continuously advanced into the shale to the vicinity of unburned combustible matter. The ash or slag resulting from combustion is blown out of the hole, thus formed, by the combustion gases.

A particularly convenient method for supplying oxygen to the hot shale surface is through a long tubular blowpipe, which can be advanced straight into the shale rock as material is melted off and a hole is formed. The molten material or slag separated from the shale mass by the flame flows from the melting zone in the fluid state. The molten slag may thereafter be quenched within the hole by water suitably discharged from the blowpipe or mechanically

crushed or disintegrated into small solid particles. The resulting small solid particles of slag thereafter are removed from the hole by steam formed within the hole and the gaseous products of combustion.

In a typical example of the thermal working of oil shale by the process of the invention, a hole two inches in diameter and six inches deep was made in less than five minutes by heating the surface of the shale to a temperature of 1200° F., removing the source of heat and thereafter directing a stream of oxygen on the heated surface through a $\frac{1}{4}$ " O. D. x $\frac{1}{8}$ " I. D. tube at a flow rate of about 5 cubic feet per minute. The resulting fused ash was blown from the hole by the combustion gases. Soft unfused ash formed the wall of the hole.

While the above process has been described in regard to the boring of holes in oil shale, it will be recognized that the method of this invention is equally applicable to the thermal working of other mineral masses containing combustible matter or matter capable of releasing combustibles upon heating. It is, accordingly, to be understood that the novel process set forth herein is capable of modification within the scope of the invention as defined by the claim attached hereto.

I claim:

A method of boring a hole in oil shale which comprises heating a portion of the surface of oil shale containing between about 25 per cent and about 65 per cent, by weight, of volatile matter and fixed carbon, at a temperature of between about 800° F. and about 1400° F. until ignition thereof is effected, discontinuing said heating and concurrently directing a stream of an oxygen-containing gas to the thus-ignited portion of the surface of said shale, controlling the rate of flow of said stream of oxygen-containing gas to maintain the combustion of said oil shale at a temperature of between about 1800° F. and about 2800° F., continuously advancing said stream of oxygen-containing gas into said oil shale, thereby directing said combustion into said shale and producing fused ash in advance of said stream of oxygen-containing gas, and continuously removing said fused ash.

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