

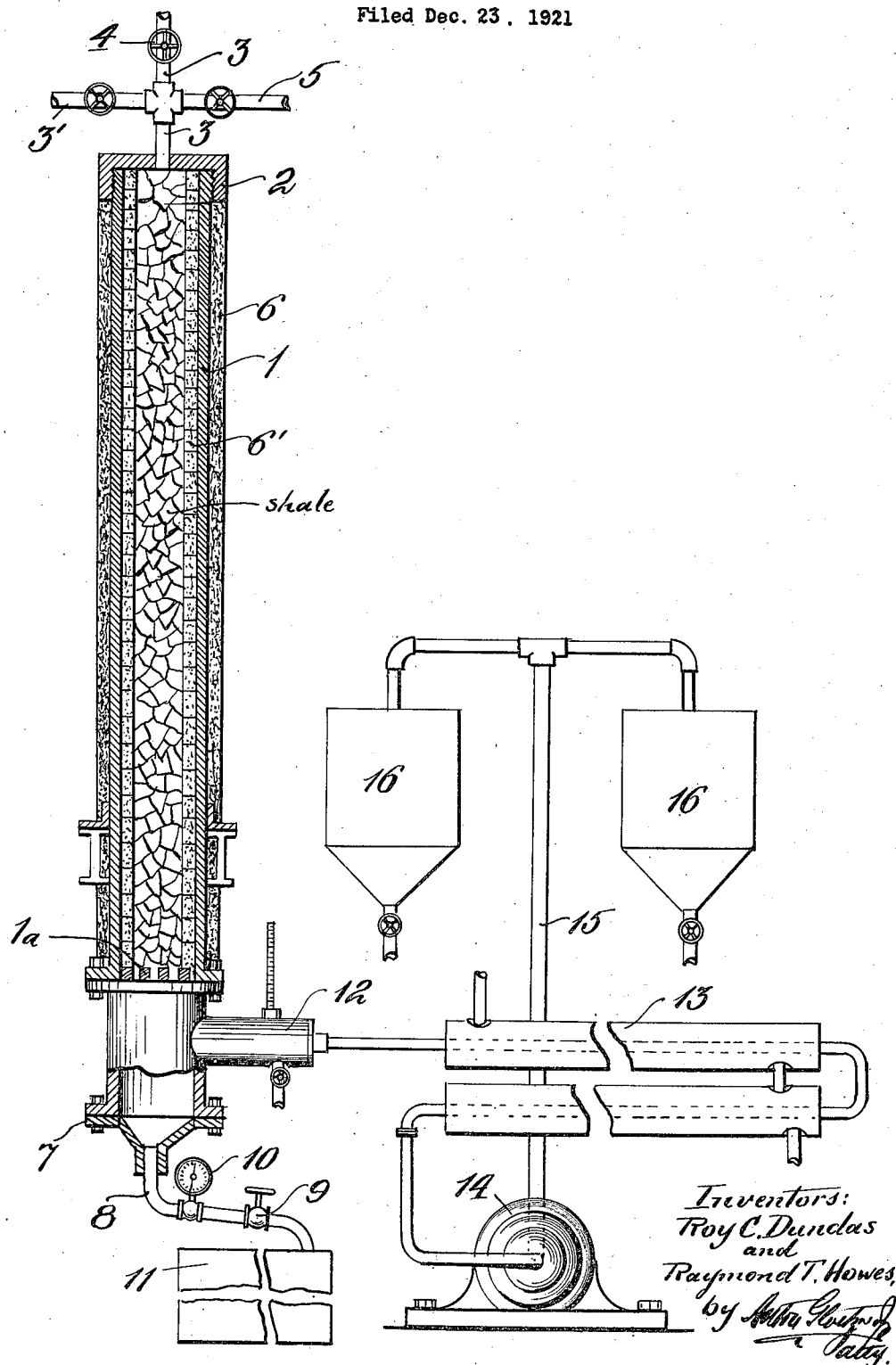
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TREATMENT OF OIL SHALE

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TREATMENT OF OIL SHALE.

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To all whom it may concern:

Be it known that we, ROY C. DUNDAS and RAYMOND T. HOWES, citizens of the United States, and residents, respectively, of Los Angeles, California, and Santa Maria, California, have invented a certain new and useful Treatment of Oil Shale, of which the following is a specification.

This invention relates to the distillation of oil shales, by which term we include all natural minerals which contain hydrocarbons and yield oils when subjected to heat, either by destructive distillation or by simple distillation.

The invention consists in using the shale itself, that is, combustible constituents of the shale, as the fuel to support the internal combustion and furnish the heat which distills off the oils. A zone of combustion is established in a charge of shale, traveling slowly downward, with the products of combustion heating underlying layers and carrying forward and away the vapors as they are formed. To maintain this zone of combustion and develop heat in the underlying distillation zones, or what may be called working zones, we supply a current of air in regulated amount and at a regulated rate, and we may control the temperature and rate of combustion by suitably modifying the current so supplied, as by using humidified air, or admixing or simultaneously introducing gas, steam, superheated steam, or any other medium capable of producing the desired result. The use of steam is particularly advantageous when the shale is rich in nitrogenous matter, as it assists in the formation of valuable by-products, such as ammonium compounds. In addition to the above, an essential feature of our process consists in so conducting it that the zone of combustion will progressively travel downward from the top to the bottom of the chamber containing the shale, driving off the oils from the shale below it as it advances downward and the oils being largely condensed by their passage through the column of relatively cool shale and in doing so, transmitting some of their heat to said shale, so that, as the zone of combustion approaches a layer of shale, the latter is gradually heated and finally freed from oil, thereby becoming a suitable fuel to maintain the combustion in the descending zone of combustion.

In the accompanying drawing, we have illustrated, by way of example, a form of apparatus in which our process can be carried out.

1 is the closed chamber and 2 the cover of the same, through which passes an air inlet pipe 3, containing valve 4 and connected to an air supply pipe 5. 3' is another inlet pipe for steam or gas. The chamber may be covered with insulation 6 and lined with fire-bricks 6'. The chamber contains a grate 1', which can be dumped, and is closed at the bottom by a door 7, which is removable to discharge the spent shale. 8 is the outlet pipe for the oils, connected to a receptacle 11 and provided with a valve 9 and a gage 10. 12 is a pipe for drawing off uncondensed vapors, leading to a condenser 13, from which the condensates are led through pipe 15 to a suitable container 16. 14 is the suction pump.

The operation is as follows: The chamber 1 is filled with shale and the top layer is ignited in any convenient way. The cover is then applied making an air-tight fit. The suction pump 14 is started and the valve 4 is opened to admit the desired amount of air, and if desired, also inert gas or steam through pipe 3'. In a very short time, a zone of internal combustion forms near the top of the column of shale, and communicates its heat to the unignited shale below, driving off its oil-content, which is carried downwardly through the column of relatively cool shale. With the proper admixture and rate of supply of the air, a layer of the shale will burn with a substantially constant temperature and evolution of heat, and the zone of combustion will slowly travel downwardly. By regulating the feed of the air and modifying its oxygen content, the progression of the zone of combustion downwardly through the chamber may be controlled as desired, so that the products liberated from the shale will not be subjected to too intense a heat. The liberated products flow downward through the relatively cool shale, being prevented by the current of air from passing upward into the zone of combustion, so that, once they are formed, they are not subjected to any secondary distillation or "cracking." Some of the products are condensed in the cooler shale, while others are drawn off into the condenser 13. As the zone of combustion approaches the bottom

of the chamber, a progressively smaller quantity of the products is condensed in the chamber and more in the condenser. During the process of combustion of the shale in the zone of combustion, its heat is communicated to the zone immediately below it. As the temperature of said lower zone reaches the critical point, say from 600° F. to 800° F., the oil formed is immediately drawn away from the zone of combustion and passes into and through the lower and successively cooler zones beneath. As the temperature in a zone rises to 800°, for example, all or nearly all of the oil has been formed and expelled from said zone, leaving behind a residual carbon which constitutes the fuel for the progressive combustion. This combustion we confine to the carbonized zone by supplying only sufficient air or oxygen to unite with the carbon. We believe that, above the temperatures mentioned above, no further combination takes place to produce hydrocarbon oils, unless they be uncondensable gases, in which case such gases are consumed in the zone of combustion and assist in maintaining its high temperature, which the pyrometer shows to be about 1910° F. This high degree of temperature is maintained during the progression of the combustion from the top to the bottom of the chamber, while that of the distillation zone, immediately below the zone of combustion, remains constant at from 600° to 800° F. The downward advance of the zone of combustion we found to be about one foot per hour, but this rate may be varied to suit conditions.

Having thus described our invention, what we claim is—

1. The method of distilling oil shale, or the like, which consists in confining a body of shale in a closed chamber, igniting the top stratum of said body, causing a current of air to pass downwardly through said body in just sufficient quantity to maintain combustion in a zone of the shale and to cause said zone to travel slowly downward through the body of shale, and recovering the products, driven off by the heat of combustion from said zone, at the bottom of the chamber.

2. The method of distilling oil shale or

the like, which consists in confining a charge of shale in a closed chamber, igniting the top stratum of said charge, causing air to pass downwardly through said charge, whereby a zone of internal combustion is created and caused to slowly move downward through the charge, introducing gas with the air to modify its oxidizing action, collecting the condensed oils from the bottom of the chamber and condensing the gaseous products drawn off from the same.

3. The method of distilling a charge of oil shale, or the like contained in a closed chamber, which consists in setting up a zone of direct internal combustion in the shale itself at the top of said chamber, supplying a downward current of air in such amount and at such a rate as to maintain combustion in said zone, suitably modifying the air of said current to prevent unduly energetic combustion and development of heat, causing said zone to progressively travel downwardly through the charge and recovering the condensed and uncondensed distillation products at the bottom of the chamber.

4. The method of treating a charge of oil shale to recover volatilizable products therefrom, which consists in confining such charge in a vertical closed chamber, initiating a zone of combustion in the shale itself at the top of the charge, passing a current of air downwardly through the chamber, mixing a modifying agent with said air to control the temperature and rate of combustion, whereby said zone is caused to travel slowly downward through the chamber, and drawing off and recovering the products from the bottom of the chamber.

5. The method of distilling oil shale or the like, which consists in slowly and progressively burning a charge of shale in a closed chamber from the top downwardly, maintaining the combustion at a substantially constant temperature by supplying and regulating a downward current of air through the chamber, and drawing off the hydrocarbon products at the bottom of the chamber.

In testimony whereof we have set our hands.

ROY C. DUNDAS.
RAYMOND T. HOWES.