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APPARATUS FOR PRODUCING OIL FROM OIL SHALE IN SITU

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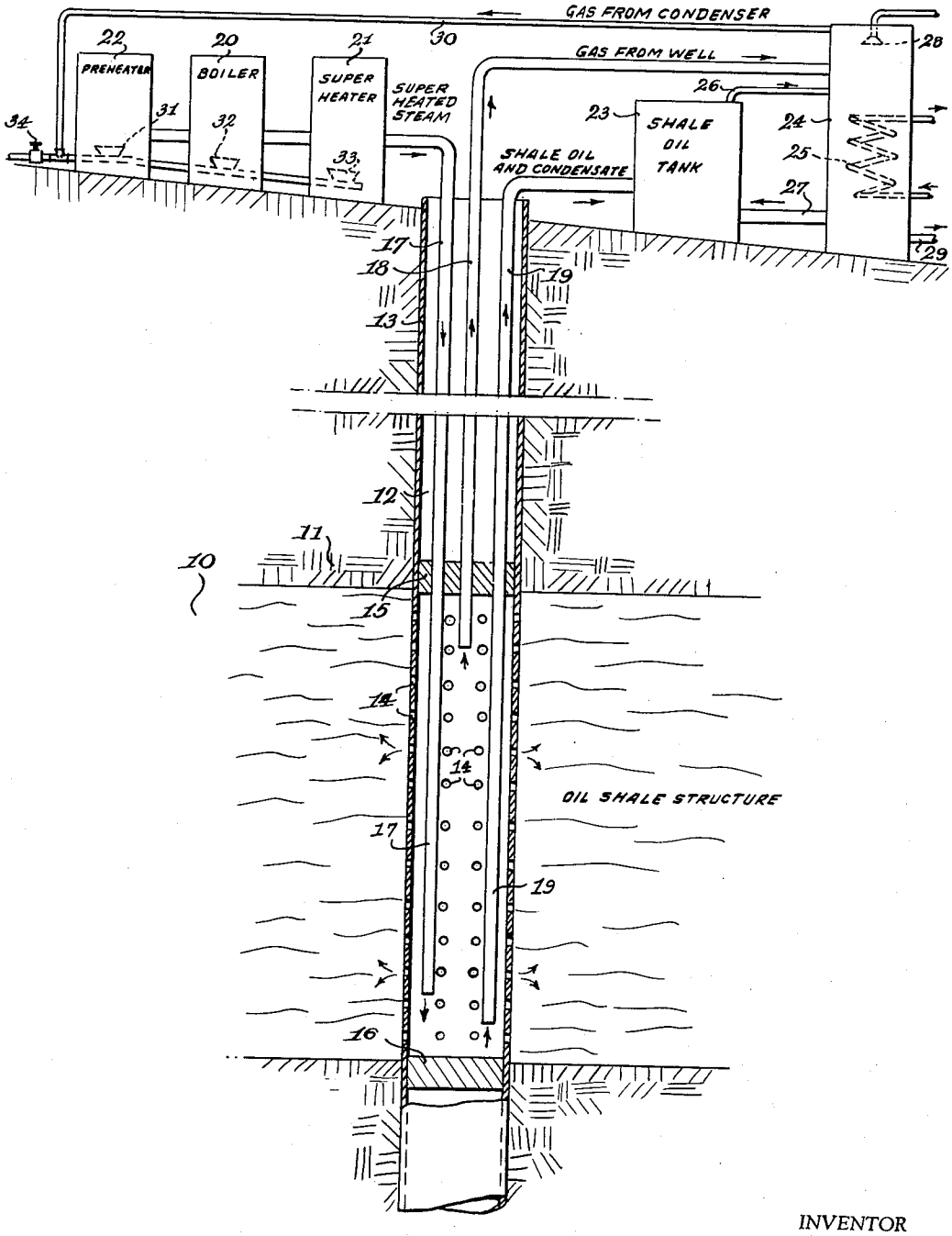

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APPARATUS FOR PRODUCING OIL FROM OIL SHALE IN SITU

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1 Claim. (Cl. 166—57)

This invention relates to a method and apparatus for producing oil from oil shale or oil bearing rock without removing the oil bearing shale or rock from its location in the ground.

It is among the objects of the invention to provide an improved method and apparatus for producing oil from oil bearing shale or rock which provides for heating the carbonaceous material in the shale or rock to a temperature at which the material separates into its liquid and gaseous components and flowing these components through separate conduits from the production level in a well; which utilizes at least a portion of the production gas from the well to produce the necessary heat; which may use either superheated steam or combustion gas as the formation heating medium; which removes the liquid and most of the gas from the well through separate conduits; and which is simple in arrangement, economical to operate, and effective and efficient in operation.

Other objects and advantages will become apparent from a consideration of the following description and the appended claim in conjunction with the accompanying drawing wherein the single figure is a diagrammatic illustration of an oil well and apparatus for carrying out the method of the invention for producing oil and gas from a formation carrying a carbonaceous material which is non-flowable at normal temperatures.

In the arrangement illustrated, the numeral **10** designates a bed or strata of oil bearing formation, such as shale or limestone, carrying a carbonaceous material, known as kerogen, which is non-flowable at normal temperatures, but which, when heated to a predetermined temperature, breaks down into freely flowable liquid and gaseous components, and the numeral **11** designates the overburden overlying the oil carrying formation **10**. A well **12** extends through the overburden **11** and into or through the formation **10** and has a well casing **13**, the portion of which extending into or through the formation **10** is provided with a large number of apertures **14**. Suitable plugs **15** and **16**, formed of concrete or other suitable material, are disposed in the well at the top and bottom surfaces respectively of the formation **10** and separate conduits **17**, **18** and **19** extend downwardly of the well through the top plug **15**. The conduit **19** terminates at its lower end adjacent the top surface of the bottom plug **16**, the conduit **17** terminates at its lower end adjacent the bottom plug **16**, but somewhat above the bottom end of the conduit **19**, and the conduit **18** terminates at its lower end above the lower ends of the conduits **17** and **19** and near the bottom surface of the top plug **15**.

A plant for heating fluid to a temperature above that at which the carbonaceous material in the formation **10** breaks down into its liquid and gaseous components is shown as including a boiler **20**, for producing steam, a steam superheater **21** connected to the boiler **20** and to the conduit **17** and a water preheater **22** connected to the water inlet of the boiler **20**. While this plant will produce steam and superheat the steam to a temperature above the predetermined temperature at which the carbonaceous material in the formation **10** is broken down into its gaseous and liquid components, it is to be understood that a suitable plant may be provided for producing heated combustion gas and that such heated combustion gas may be forced downwardly into the well through the conduit **17** without in any way exceeding the scope of the invention.

An oil storage tank **23** is provided on the surface near the head of the well and the upper end of the conduit **19** is connected into this tank. A condensing and gas washing device **24** having a water cooled condenser coil **25** therein is connected to the storage tank **23** through conduits **26** and **27** for receiving any gas accumulating in the storage tank **23**, condensing any condensible material in this gas and returning the liquid condensate to the storage tank. The upper end of the conduit **18** is connected to the condensing and washing apparatus **24** near the top of this apparatus for introducing gas from the well into the washer and condenser. In addition to the condenser coil **25**, the device **24** has at its upper end a suitable sprayhead **28** for directing a spray of water downwardly through the gas in the device to remove any water soluble contents from the gas, the water with the soluble contents of the gas therein being removed from the device **24** through the water outlet conduit **29**. A gas pipe **30** leads from the upper portion of the gas washing and condensing device **24** to the burner **31** disposed in the water preheater **22** and to burners **32** and **33** disposed in the boiler **20** and the superheater **21** respectively, to generate and superheat the steam used as the heating medium for the carbonaceous material in the oil bearing formation. Obviously, the steam generating equipment may be eliminated, if desired, and the combustion products of the gas forced directly to the bottom portion of the well through the conduit **17**.

In order to start the well, a connection **34** is provided on the pipe **30**, so that an external source of gaseous fuel can be temporarily connected to the burners **31**, **32** and **33** to produce a sufficient quantity of heated fluid to start the production of oil and gas from the well.

With the position of the bottom ends of the conduits **17**, **18** and **19**, it will be noted that the heated fluid is released into the well near the bottom of the oil bearing formation **10** and that the oil from the formation flows into the bottom end of the conduit **19** near the bottom end of the well, while the gas produced from the formation rises in this portion of the well and flows into the bottom end of the conduit **18** above the bottom ends of the conduits **17** and **19**, so that the gas and liquid components of the carbonaceous material are substantially separated in the well and are delivered to the storage and processing equipment at the surface in separated condition.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claim rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claim are, therefore, intended to be embraced therein.

What is claimed is:

Apparatus for producing oil from a stratum of oil shale in situ comprising; a well casing extending from top to bottom of said stratum; sealing plugs extending transversely of said casing at the top and bottom of the stratum, the casing being freely perforated throughout its circumference for the full portion of its length extending between said plugs; a pipe for supplying steam to the portion of the casing between the plugs, a second pipe

for leading off gaseous components of the raw shale product, and a third pipe for leading off liquid components of said product, all of said pipes extending from the surface and opening within the casing, the first at a location near the bottom of the stratum above the lower plug, the second at the top of the stratum below the upper plug, and the third near the bottom of the stratum above the lower plug but at an elevation below the first pipe; means connected with the upper end of the second pipe for breaking down the gaseous component flowing through the same into liquid and gaseous parts; means connected with the third pipe for breaking down the liquid component flowing therethrough into liquid and gaseous parts; means for supplying steam through the first pipe for passage into the stratum through said perforations for breaking down the product thereof into said liquid and gaseous components, for passage of the liquid and gaseous components into the casing through said perforations; means for uniting the gaseous parts of the liquid and gaseous components; and means for uniting the liquid parts of said liquid and gaseous components.

References Cited in the file of this patent

UNITED STATES PATENTS

171,563	Hardison	Dec. 28, 1875
193,838	West	Aug. 7, 1877
1,422,204	Hoover et al.	July 11, 1922
1,433,956	Knox	Oct. 31, 1922