

April 17, 1928.

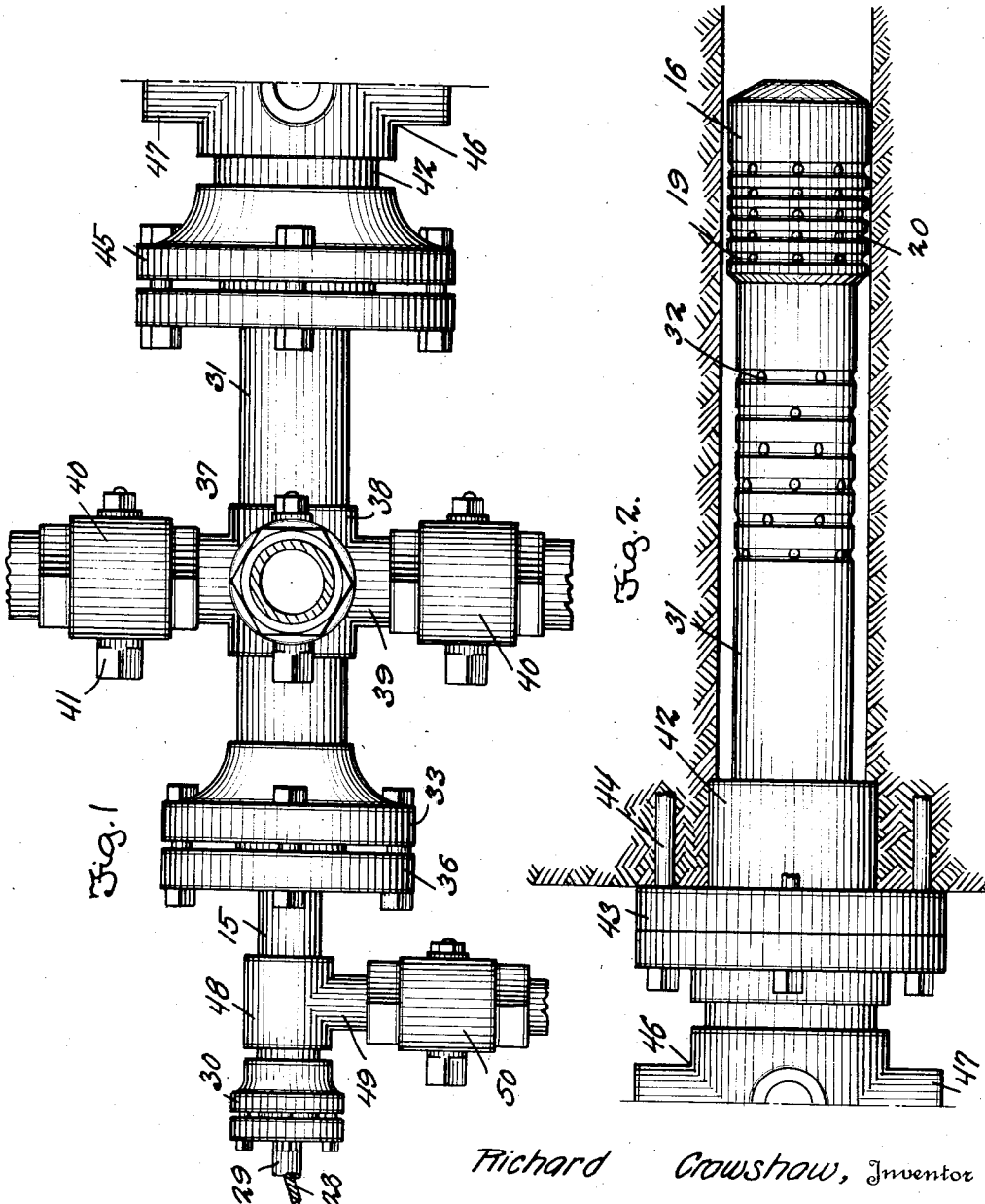
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1,666,488

APPARATUS FOR EXTRACTING OIL FROM SHALE

Filed Feb. 5, 1927

3 Sheets-Sheet 1



Witnesses
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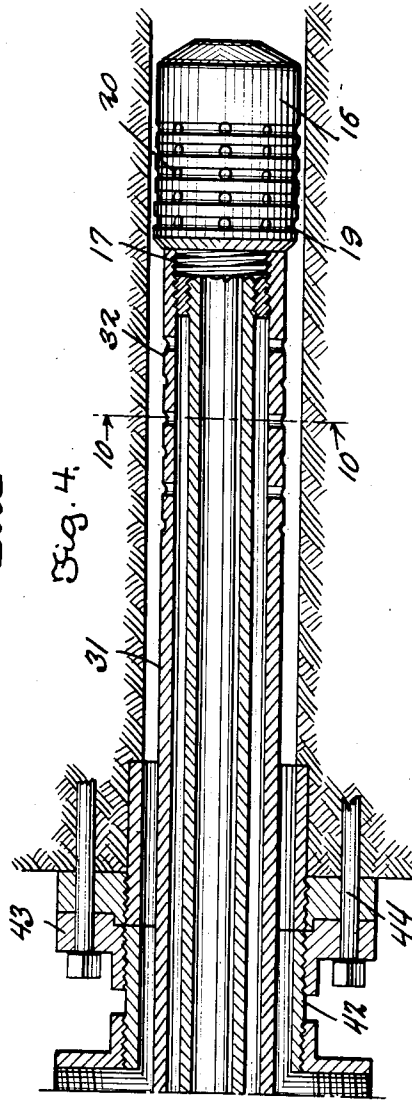
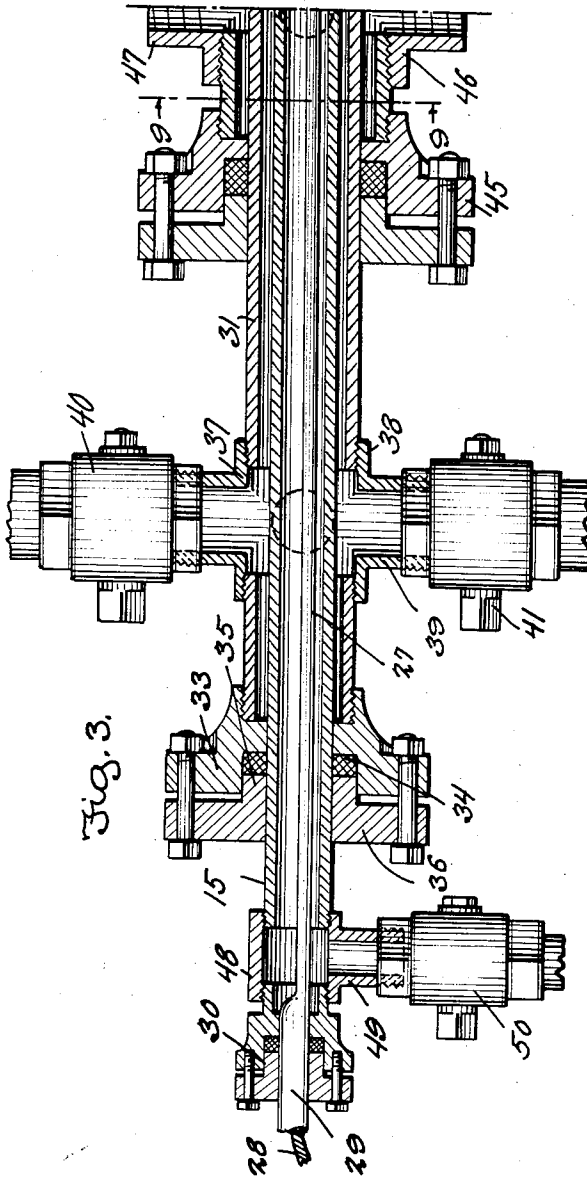
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APPARATUS FOR EXTRACTING OIL FROM SHALE

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3 Sheets-Sheet 2



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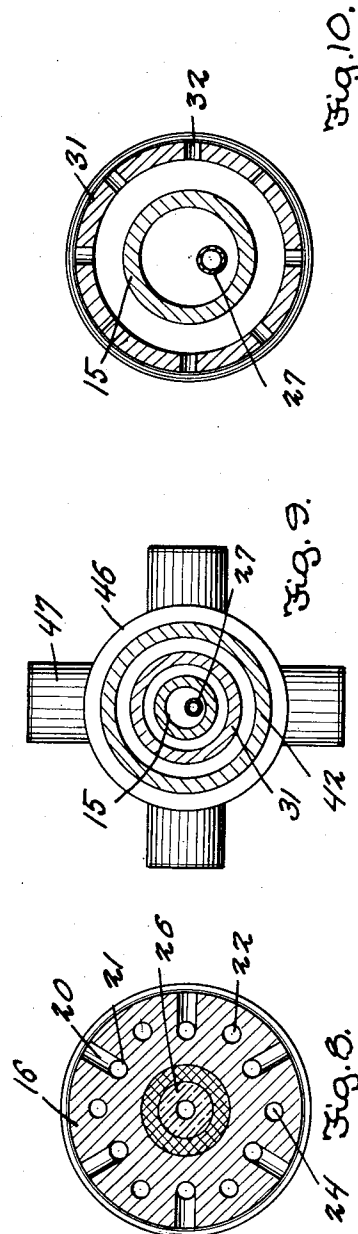
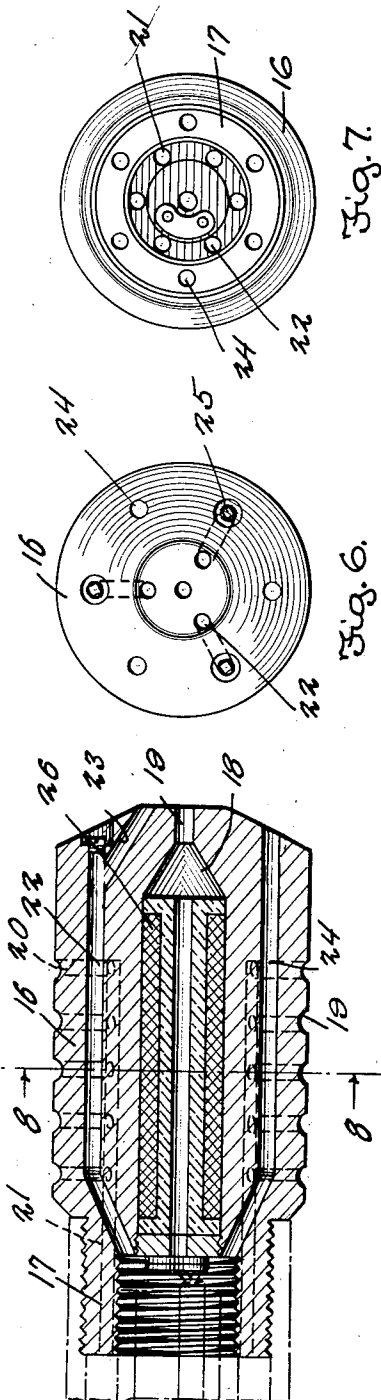
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APPARATUS FOR EXTRACTING OIL FROM SHALE

Filed Feb. 5. 1927

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR EXTRACTING OIL FROM SHALE.

Application filed February 5, 1927. Serial No. 166,223.

The present invention relates to an improved apparatus for extracting oil and by-products from shale and has for its primary object to provide means whereby the oil extraction can be effected on a practical commercial basis.

A further object of the invention is the provision of an apparatus whereby oil may be extracted from shale at a minimum expenditure of time and labor.

Another object of the invention is the provision of an apparatus designed to be operated directly in contact with the shale in situ so that the oil and gas may be extracted directly without mining of the shale.

Still another object of the invention is the provision of an apparatus which is comparatively simple and durable of construction and which will be efficient for the purpose intended.

Other objects and advantages of the invention will become apparent as the description progresses.

In the accompanying drawings forming a part of this specification and in which like reference characters are employed to designate corresponding parts throughout the same;

Figure 1 is a side elevational view of a portion of the apparatus,

Figure 2 is a similar view of the remaining portion,

Figure 3 is a vertical longitudinal sectional view through the portion of the apparatus shown in Figure 1,

Figure 4 is a similar view through the portion of the apparatus shown in Figure 2,

Figure 5 is an enlarged vertical longitudinal sectional view through the heating unit,

Figure 6 is an end elevational view of the unit,

Figure 7 is an end elevational view of the unit looking at the inner end,

Figure 8 is a transverse sectional view taken on the line 8—8 of Figure 5,

Figure 9 is a similar view taken on the line 9—9 of Figure 3, and

Figure 10 is a transverse sectional view taken on the line 10—10 of Figure 4.

As is well known to those familiar with the present method of extracting oil from

shale, it is customary under the present practice to mine the shale, preferably bituminous shale, and convey the same to crushers where it is broken up for filling in retorts. The method heretofore practiced involves a great deal of handling of the shale in the extraction of the oil so as to make this operation relatively impractical in competition with the oil produced directly by means of wells. The essential feature of my invention resides in the provision of a method and apparatus whereby the oil will be directly extracted from the shale in situ so as to obviate the mining and transportation of the shale from the mines to the heating retorts.

With this in mind, my improved apparatus embodies a series of conducting pipes arranged in concentric position extending to and in communication with a heating unit embedded in the shale strata. The heating unit is arranged to sufficiently heat the immediate shale so as to separate the oil and gases therefrom, the oil and gas being conducted through suitable conducting pipes to a suitable reservoir.

Referring particularly to the drawings, the numeral 15 generally designates a longitudinal tube section threaded at its ends. Connected with one end of the tube 15 and arranged to be embedded in the shale is a cylindrical heater 16 provided on its inner end with a reduced interiorly and exteriorly screw threaded nipple 17. The interior threads of the nipple 17 threadedly engage the tube 15.

The heating unit 16 is formed with a central longitudinal bore tapered adjacent the outer end as at 18 and terminating in a reduced central bore 19 opening through the end of the heating unit. The exterior surface of the unit is formed with a plurality of annular circumferential grooves 19 communicating a series of radial bores 20. The radial bores 20 communicate at their inner ends with a series of longitudinal bores 21 extending longitudinally through the unit and opening through the inner end thereof. Formed longitudinally within the unit between the longitudinal bores 21 are bores 22 having their inner ends directed angularly toward the center of the unit. The present illustration embodies six such bores, three

of the bores 24 extending in a straight line and opening through the outer end of the unit, while the remaining three are in communication with angular bores 23 opening through the rear end of the unit near the center thereof. The ends of the bores 22 are closed by plugs 25. Fitted into the large central bore of the unit and extending for the major portion of the length thereof is an electric heating element 26 embodying a resistance coil or any preferred type of heating element terminating at the inner end of the unit. Extending through the tube 15 and terminating at the inner end of the unit is a casing 27 forming an insulated covering for electric conductor wires 28 having their inner extremities connected with the heating element 26. The outer end of the casing 27 is formed with an enlarged sleeve portion 29 held in position by a packing gland 30 connected with the tube 15.

Arranged concentrically about the major portion of the tube 15 and having its inner end threadedly connected with the nipple 17 of the unit is a conducting pipe 31 provided with apertures 32 adjacent its inner extremity, the longitudinal bores 21 communicating with said pipe 31 as shown in Fig. 5. The outer end of the conducting pipe 31 is threadedly connected with a packing gland 33, this gland being provided with an annular recess in which is compressed packing 34 tightly maintained in position by the gland 35 carried by a companion flange 36 bolted to the packing flange 33. From this construction it is apparent that the conducting pipe 31 is concentric to and spaced from the tube 15 so as to provide an annular passage between the interior of the pipe 31 and the exterior of the tube. Threadedly associated with the conducting pipe 31 adjacent its outer end is a cross fitting 37 embodying a central interiorly screw threaded sleeve 38 threadedly connected with the conducting pipe and formed with four radial outlets 39. Threadedly connected with the outlets 39 and adapted to control the discharge of matter therethrough are valves 40 of any preferred type, preferably embodying rotatable tapered plugs 41 operable by a key.

As shown in the Figures 2 and 4 of the drawings, the heating unit 16 is of greater diameter than the exterior diameter of the conducting pipe 31. During the use of the apparatus, the heating unit is gradually driven into the shale strata and thus forms a passage between the exterior wall of the conducting pipe and the bore in the shale.

A casing 42 is positioned concentrically about the intermediate portion of the conducting pipe 31 and is spaced therefrom, the inner end of the casing 42 being snugly fitted in the shale strata and securely held in position by means of flanges 43 threadedly connected to the casing and secured to the shale by longitudinal bolts 44. The outer end of the casing 42 is attached to the conducting pipe 31 by means of a stuffing box 45 snugly embracing the connecting pipe and threadedly engaging the outer end of the casing. Threadedly connected with the exterior casing 42 adjacent its outer end is a cross fitting 46 provided with four radial outlets 47 connected with suitable control valves, not shown.

From the foregoing description and the drawings, it will be readily noted that the present structure provides an exterior annular passage designed to provide a compressed air conduit communicating with the outlets 47 of the cross fitting 46. An intermediate passage is formed between the conducting pipe 31 and the interior tube 15 forming a conduit for the passage of oil and gas extracted from the shale and communicating with the outlets of the cross fitting 37. The interior central tube 15 provides a conduit for the conducting wires and also connects with a T fitting 48 threadedly connected with the interior tube 15 adjacent its outer end. The fitting 48 is provided with a right angular lateral outlet 49 which is connected with a high pressure air tank or pump and in which a control valve 50 is mounted to control the passage of compressed air. Thus, my improved method of extracting oil from shale embodies the projection of a heating unit into the natural shale strata designed to sufficiently heat the shale to extract the oil. The heating unit is gradually driven into the shale by periodic blasts of air projected through the unit designed to readily disintegrate the burnt shale immediately forward of the unit. The oil and gas extracted from the shale is also removed under suitable air pressure.

In the application of the apparatus, the heating unit 16 and conduits connected thereto are periodically driven into the shale by intermittently discharging a compressed air charge through the valve 50 and the central interior tube of the apparatus. The compressed air is discharged through the unit by passage through the longitudinal concentric bores 22, 23 and 24 so as to escape at the forward end of the unit and disintegrate the shale. During the operation of the apparatus, the unit is heated to a suitable temperature, preferably about 500 degrees Fahrenheit, by means of the electric heating element 26 which is supplied with current by the conducting wires 28. The inner ends of the wires 28 are connected with a suitable source of electricity, preferably with a water driven generator. When the shale has been sufficiently heated by means of the heating unit, the oil and gas extracted therefrom will be discharged through the radial bores 20 of the unit and the openings 32 of the pipe 31 into the intermediate pas-

sage between the pipe 31 and the interior tube 15. The oil and gas is driven through the passage by means of compressed air admitted into the exterior passage through one of the branches 47 of the cross fitting 46, and is discharged through the branches 39 of the cross fitting 37, the oil flowing downwardly through the lower branch into a suitable receptacle, while the gas will rise through the upper branch into a suitable container. Occasionally, during the use of the apparatus, it is desirable to admit air under relatively high pressure through the outlet of the fitting 46 so as to clear the radial bores 20 and openings 32 and prevent obstruction thereof.

It will thus be apparent, that the present invention provides a relatively simple apparatus for the extraction of oil and gas from shale, producing means whereby this operation may be accomplished at a minimum expense so as to effect a commercially practical oil producing method.

It is to be understood that the form of my invention herewith shown and described is to be taken as the preferred example of the same, and that various changes as to the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims;

Having thus described my invention, I claim:

1. An apparatus for extracting oil from shale comprising a heating unit adapted to be projected into the shale, a series of conducting pipes connected with the unit, one of the pipes forming a conduit for the oil accumulating about the unit, a compressed air line connected with one of the pipes and adapted to force the oil from the shale outwardly into a suitable container, and means for periodically cleaning the pipes and outlets.

2. An apparatus for extracting oil from shale including a heating unit formed with a central bore and a series of longitudinally extending bores, an electric heating element mounted in the central bore of the heating unit, conductor wires connected to the heating element and with a source of electric energy for supplying current to the said heating element, an interior tube connected with the inner end of the heating unit and forming a housing for the conductor wires, a compressed air pipe connected with the said tube and adapted to permit periodic discharge of compressed air through the pipe and heating unit, a conducting pipe arranged concentrically about the interior tube and connected with the inner end of the heating unit, the said conducting pipe being provided with series of apertures adjacent its outer end, a fitting connected with the conducting pipe for the connection therewith

of an oil delivery pipe, an exterior casing arranged concentrically with respect to and spaced from the conducting pipe and communicating with the cavity formed in the shale, a fitting connected to and communicating with the said exterior casing, a compressed air pipe line connected with the said exterior casing for the delivery of compressed air into the exterior casing and through the conducting line to force the oil therethrough, and means for connecting the said pipes with the shale formation.

3. An apparatus for extracting oil from shale comprising a heating unit provided with a central bore extending therethrough and having a plurality of longitudinal bores, the outer surface of the unit being formed with circumferential grooves communicating with radial bores in the wall of the unit, an electric heating element positioned in the central bore of the unit, a tube threadedly connected with the inner end of the unit, conductor wires extending through the tube and connected with the heating element, a conducting pipe arranged concentrically about the tube and spaced therefrom having its inner end threadedly connected with the unit, the exterior diameter of the unit being greater than the diameter of the said conducting pipe to provide an exterior passage between the cavity in the shale and the exterior wall of the conducting pipe, an exterior casing arranged concentrically about the intermediate portion of the conducting pipe and spaced therefrom to form an annular passage, several of the bores of the unit communicating with the interior of the central tube and others with the passage formed between the tube and the conducting pipe, and pipe fittings connecting the said interior pipe and exterior casing with a compressed air supply line for periodically admitting air therein for clearance of a passage for the unit and the extraction of the oil.

4. In apparatus for extracting oil from shale in situ, a heating unit adapted to enter the shale, concentric conducting pipes connected with the unit, means for supplying air under pressure to one of said pipes, the shell of the unit having passage ways communicating with the said pipe and opening through the end of the said shell of the unit, the other pipe constituting a conduit for oil extracted from the shale and the said shell of the unit having other passage ways therein in communication with the last mentioned pipe and opening through the exterior surface of the shell.

5. In apparatus for extracting oil from shale in situ, a heating unit comprising a shell having an axial bore, an electrical resistance unit within the shell, a pipe fitted to one end of the shell, the shell having an opening in its outer end communicating with

the bore of the shell, the resistance unit having a longitudinal opening therethrough, means for supplying air under pressure to the said pipe, a second pipe fitted at one end to the shell of the unit and surrounding and concentric with respect to the first mentioned pipe to provide a passage way between the pipes, and an oil delivery pipe leading from the last-mentioned pipe and communicating with the said passage way, the shell of the heating unit having oil passages communicating with said passage way between the first and last mentioned pipes. 10

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