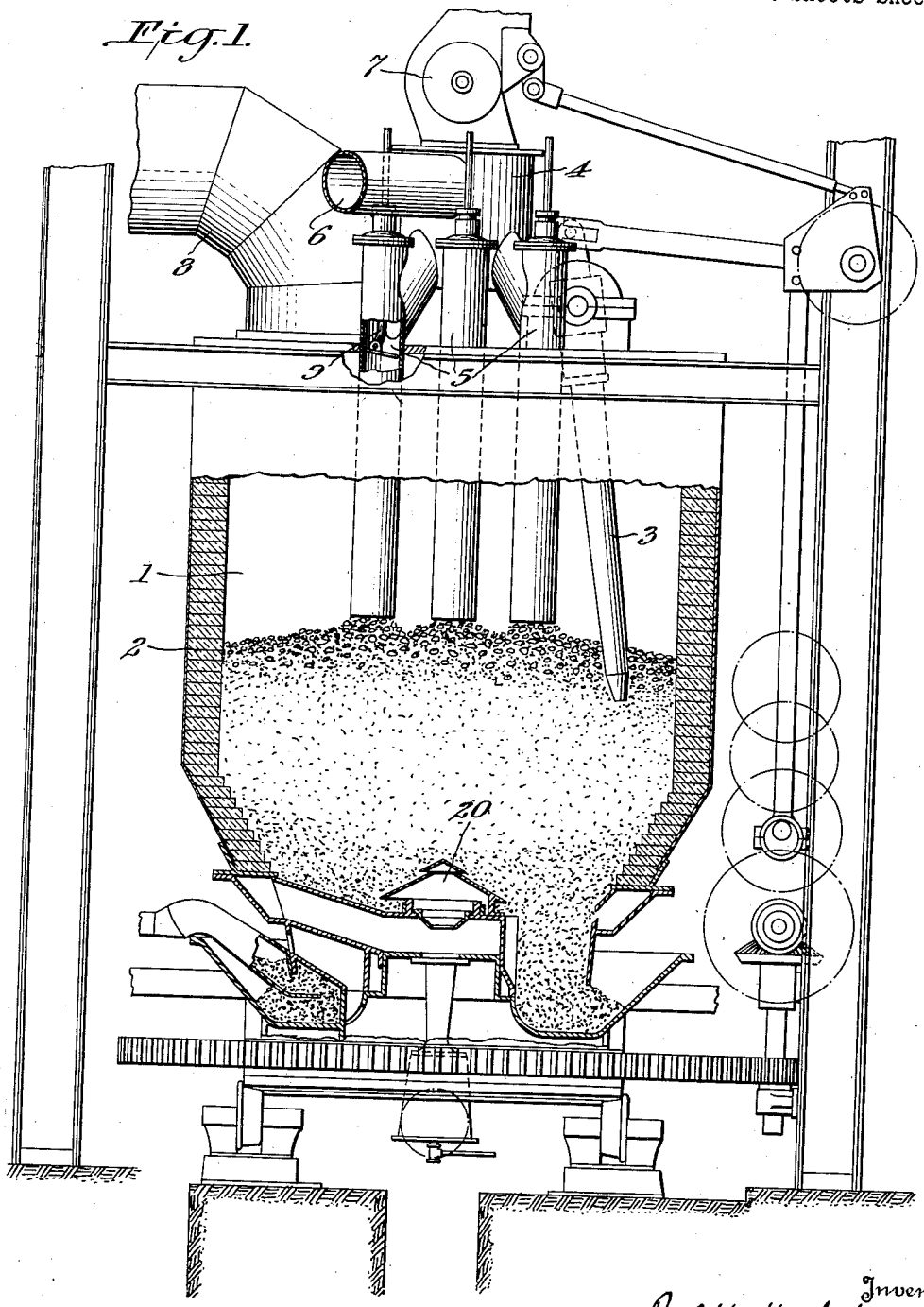
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METHOD AND APPARATUS FOR DISTILLING SHALE

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Fig. 1.



Inventor:
Ralph H. McKee

By Byrnes Townsend & Brickenstein

Attorneys.

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Fig. 2.

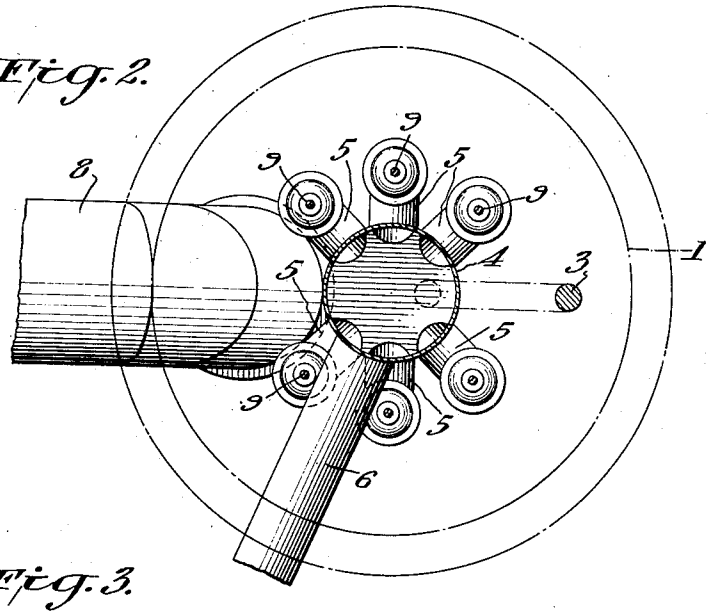


Fig. 3.

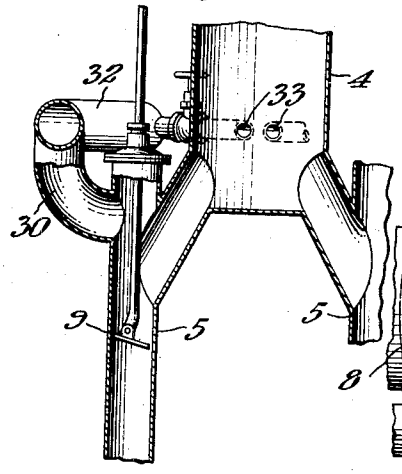
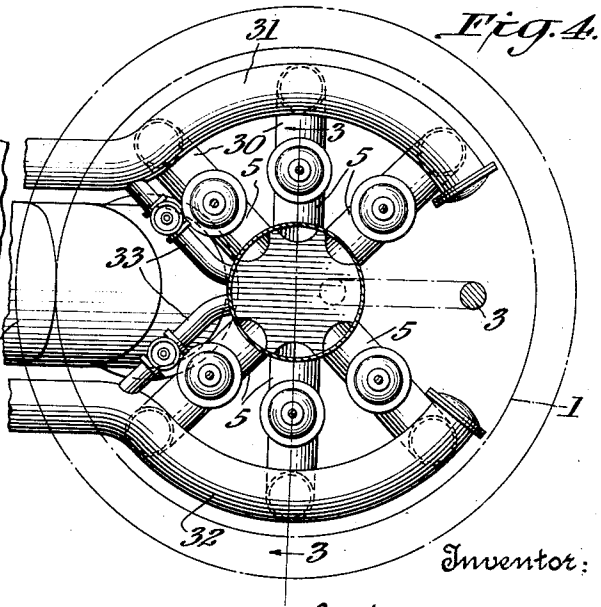


Fig. 4.



Inventor:
Ralph H. McKee
by Byrnes Townsend & Brickenstein
Attorneys.

Patented Aug. 26, 1930 1,774,391

UNITED STATES PATENT OFFICE

RALPH H. McKEE, OF NEW YORK, N. Y.

METHOD AND APPARATUS FOR DISTILLING SHALE

Application filed February 14, 1922. Serial No. 536,517.

This invention relates to method and apparatus for distilling oil-shale, lignite and the like. It is an object of the invention to provide apparatus which is, in general, of the gas producer type, but provided with special features providing for effective distillation of the shale and like materials and withdrawal and recovery both of the distillation vapors and gases, and of the fuel gas. The apparatus which I prefer to use is illustrated in the accompanying drawings, in which

Fig. 1 is an elevation of the furnace, partly in section;

Fig. 2 is a diagrammatic top plan view;

Fig. 3 is a sectional detail of a modification; and

Fig. 4 is a diagrammatic top plan view of the modification shown in Fig. 3.

Referring to Figs. 1 and 2 the furnace 1, is shown as of the well known mechanical "gas-producer" type, in which the shell 2 is arranged to rotate, and is provided with the usual accessories, including an ash pan and means 20 for introducing air and steam. The furnace is also provided with a poker device 3, suspended from the cover and extending into the fuel mass, the path of movement of the poker being indicated in dotted lines. The mechanism for operating the poker is indicated only diagrammatically, as it is well known and forms no part of my invention.

Mounted above the cover of the producer is a hopper 4, provided with any suitable form of automatic feed device 7. My invention includes retort pipes 5 extending from this hopper to the fuel level of the producer through which pipes shale is delivered to the combustion zone of the furnace. To the hopper is connected a vapor line 6 through which the vapors produced within the retort pipes are led to suitable recovery apparatus. 8 is the exit pipe for producer gas. The retort pipes 5 may be provided with reciprocating feet 9, operated by any suitable mechanism, whereby feed of the material through the pipes, without choking, is assured.

The feet themselves are like a human foot hinged at the ankle so that as the foot is pulled upward it tilts to a vertical position, toe downward, and passes easily through the shale. As the foot moves downward the toe strikes the shale first causing the foot to assume a horizontal position. The drawing shows the foot 9 carried on a shaft adapted to give a vertical movement. Any of the well-known means for producing an up and down or reciprocating motion of a shaft will serve to provide the required movement to operate the reciprocating feet and such means are therefore not shown in the drawing.

In Figs. 3 and 4 I have shown a modification in which the retort pipes 5 are provided with separate outlets 30 leading to vapor-lines 31, 32. These separate outlets are advantageous in that they provide a free exit of the gaseous matter and avoid stoppage in case of any obstructions in the hopper 4. The vapor lines 31, 32 lead into the recovery apparatus, and may also be provided with connections 33, 33 leading to the hopper.

In operation, the shale or other like material to be distilled is preferably crushed to pass a 1 or 2 inch screen and fed into the hopper or feedbox 4, from which it passes downward through the retort pipes 5, the rate of feed being dependent upon the speed of rotation of the main body of the producer and the set of the ash grate. The faster the rotation, the greater the quantity of shale fed to the producer. In its passage through the retort pipes, the shale is heated by the passage therethrough of the hot gases and also by conduction of heat through the walls of the tube, with the result that the volatilizable materials are driven off and escape through the vapor line. The shale forms a deep bed of fuel within the producer chamber, in which the usual method of gas generation is carried out. I preferably provide a mild suction for the producer gas outlet (pipe 8 in Fig. 1), and a sufficiently strong vacuum for the vapor line (pipe 6 in Figs. 1 and 2, and pipes 30 and 32 in Figs. 3 and 4) to draw into the retort pipes and through the feed chamber a moderate current of hot gas from the producer. Pipes 6 and 8 are, accordingly, a means for conducting and conveying away the gas and vapors from the

producer. The gases passing out through the vapor line are sent through a condenser and then, washed to remove any low-boiling constituents, the residual gases being used, for example, for fuel purposes. The producer gas is also preferably washed with oil to recover any low-boiling constituents. Both the gases or vapors from the vapor line and those from the producer may be washed with acid to recover ammonia. The producer is operated with air and steam in the usual way but differs from the usual construction in that the furnace chamber is preferably made higher and the outlets for ash or residue larger than when coal is used.

The process described has the following advantage, that the shale is progressively heated thereby giving time for the chemical reaction by which the oil is formed; that the oil vapors set free in the earlier stages of the shale decomposition escape without being overheated, that the shale residue is subjected in a reducing atmosphere to the final high temperature and steam needed to remove the last of its hydrocarbon content, as well as the major portion of its nitrogen in the form of ammonia; that the process uses an apparatus having a large tonnage through-put for a single unit of moderate size, and which is nearly standard in type and relatively inexpensive to construct, and that the process is efficient in its heat economies.

The invention is applicable not only to the type of producer shown in Fig. 1, but also to the stationary type of producer, which should, however, be provided with means for agitating the surface of the fuel bed to prevent clinkering, and to keep an even fuel bed.

I claim:

1. In an oil shale distilling apparatus a gas-producer, a feed-hopper having a plurality of retort pipes each of relatively small cross-sectional area depending therefrom into the producer, reciprocating feet in said retort pipes, means for reciprocating said feet, a gas outlet from the producer chamber and a vapor-line connected to the upper portions of said retort pipes.

2. The process of distilling shale and generating gas therefrom in gas producers having a plurality of dependent retort pipes which consists in progressively feeding the shale downward to retort pipes extending into the chamber of a gas-producer, mechanically feeding the shale through the retort pipes into said chamber, producing gas by introducing steam and air into the ignited mass in said chamber, causing the hot gas produced to pass both around and through the retort pipes, sufficient heat being furnished thereby to distil completely the volatile portion of the shale, and separately collecting the gas portions from the retort pipes and the producer chamber.

3. Process of distilling shale in gas producers having a plurality of dependent retort pipes which comprises continuously supplying shale to a gas producer downward through retort pipes situated in the free space above the rotating fuel bed in the producer, withdrawing producer gas through said retort pipes in quantity sufficient in conjunction with the heat imparted to the shale by conduction through the walls of said pipes to distil substantially completely the volatile portion of the shale, recovering condensable matter from the resulting gaseous product, and separately withdrawing producer gas from the producer.

4. Apparatus for distilling shale comprising a rotary gas producer a feed-hopper having a plurality of retort pipes each of relatively small cross-sectional area depending therefrom into the producer chamber and down to the surface of the fuel bed therein, reciprocating feet in said retort pipes, means for reciprocating said feet, a gas outlet from the producer chamber, and a separate gas outlet connected to the upper ends of said retort pipes.

In testimony whereof, I affix my signature.

RALPH H. McKEE.