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APPARATUS FOR PROGRESSIVELY HEATING OIL SANDS SURROUNDING OIL WELLS

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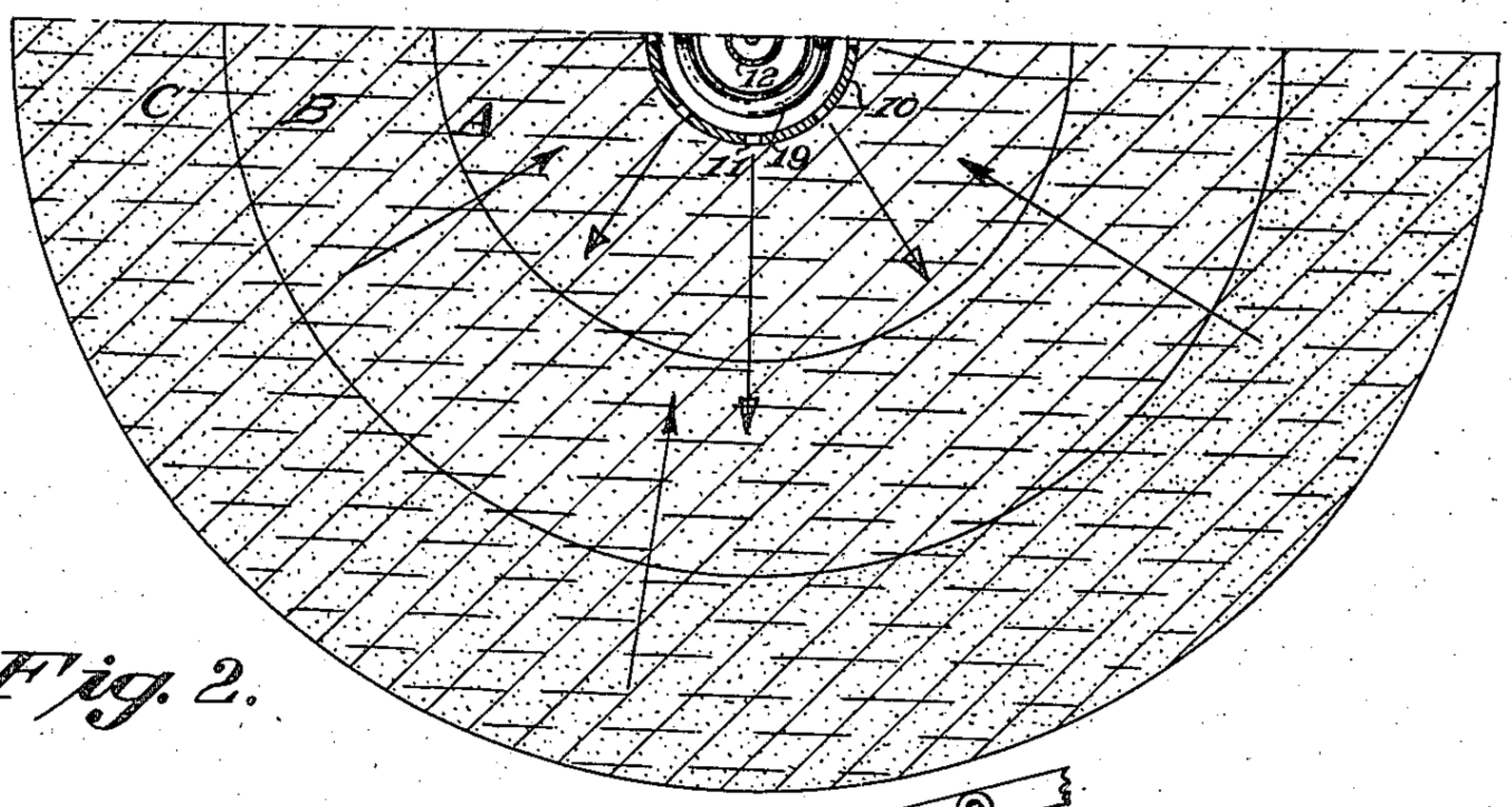

Fig. 2.

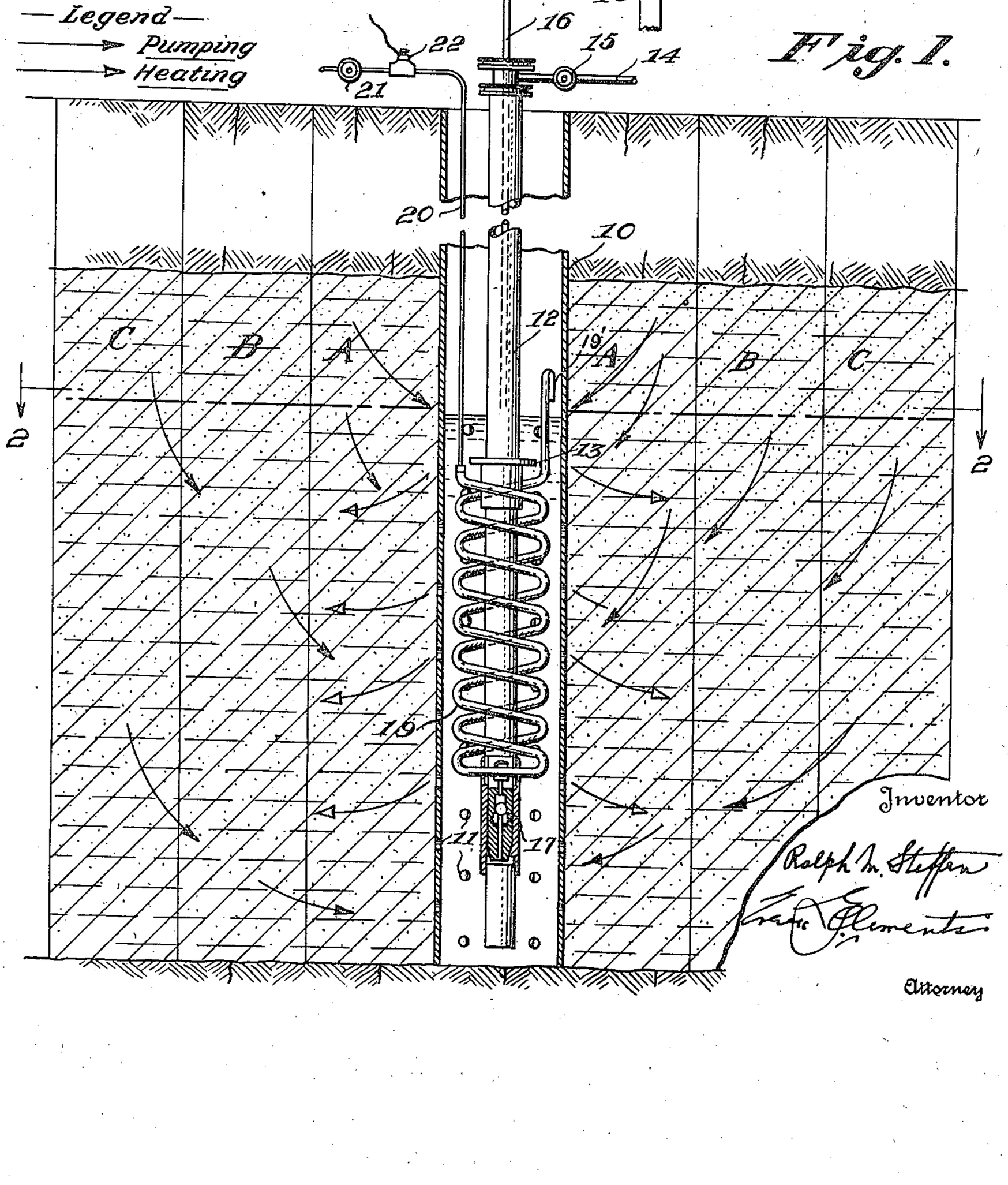

Fig. 1.

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APPARATUS FOR PROGRESSIVELY HEATING OIL SANDS SURROUNDING OIL WELLS

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6 Claims. (Cl. 166—17)

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This invention relates to apparatus for progressively heating oil sands surrounding an oil well.

The primary object of this invention is to provide a novel apparatus for augmenting the yield from oil wells.

An important object of the invention is the provision of apparatus which is applicable to existing wells to renew or increase this output, or which may be employed with equal facility in low yield shale and oil sands and in fields where normal procedures for development of the oil deposits are not practicable.

A further important object of the invention is the development of apparatus which shall concurrently condition the oil strata for increased oil flow and effect an increased output from the well.

A still further important object of the invention is the provision of an improved apparatus for efficiently heating the oil bearing sands from an immersion type heater which may be adjustably positioned in a well.

An additional object of the invention is the provision of an apparatus for heating the bottom portion of an oil well provided with a perforated casing and with an oil pump whereby the surrounding oil sands are progressively heated radially of the well for facilitating flow of oil from the sands into the well.

A further object of the invention is the provision of an apparatus for heating the oil sands surrounding an oil well having a perforated casing and an oil pump therein by the ignition of successive charges of combustible gas confined within a tubular heating coil surrounding the pump tubing, whereby heat is radiated from the walls of the coil and is transmitted through the casing and perforations into the surrounding oil sand for progressively heating in successive zones radially of the well for facilitating flow of oil from the sands to the well as well as to adjoining wells.

A still further object of the invention is the provision of a relatively simple and effective apparatus for carrying the method into effect.

With the above recited and other objects in view, the invention is set forth in the following specification and illustrated in the accompanying drawing, wherein—

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Fig. 1 is a vertical sectional view coaxially of a well and illustrating successive zones of oil sand in surrounding relation to the well;

Fig. 2 is a transverse sectional view substantially in the plane of line 2—2, Fig. 1.

Referring now in detail to the drawing, the numeral 10 designates a well casing which may be provided with perforations 11 in the lower end portion thereof. A pump delivery tubing 12 is disposed within the well casing 10 coaxially thereof and near its lower end may be provided with a flanged collar, such as indicated at 13. The pump tubing at its upper exposed end is provided with an oil delivery conduit 14 provided with a valve 15. A pump sucker rod 16 extends downwardly within the tubing 12 and at its lower end is connected with the pump 17, and at its upper end is connected with the pump jack 18. By this mechanism, oil is pumped from the bottom of the well, as in usual practice. It frequently occurs, however, that when a well ceases flowing, after pumping, that there still remains a residuum of oil in the strata, which, owing to its viscosity or the temperature of the strata has not heretofore been profitably recoverable. If, however, this strata can be effectively treated with heat, considerable oil can be induced to flow into the well and be reclaimed. This important desideratum is effected by the novel heating device now to be set forth.

In accordance with the present invention, a tubular coil 19 surrounds the pump tubing 12 below the flange 13 and is supported thereon, and as illustrated the diameter of the coil is such as to enable it to be lowered into the well and over the flange 13. The coil is preferably double or one which extends downwardly from the flange 13 and thence upwardly to the flange. This arrangement not only avoids terminating the coil below the maximum oil level in the well, but of more importance provides a greater heat radiating surface on the coil.

The coil as formed has two upper ends, one of which terminates above the maximum oil level in the form of a gooseneck 19'. To the other end of the coil is suitably secured the lower end of a tube or conduit 20 which is extended at its upper end along the ground surface, preferably by the provision of additional conduit lengths. The conduit 20 above the well is provided with

a check valve 21, and is further provided with a spark plug 22, energized by an ignition circuit, not shown, between the check valve and the top of casing 10.

In assembly, the coil 19 is lowered into the well by means of conduit 20 which in practice is constructed of readily attached successive sections, thus facilitating the positioning of the coil. It will be here noted that the flange and coil may be progressively lowered or raised in the well in conformity with a changing oil level. The coil is suspended in the well in surrounding relation to the pump tubing 12 and from the flange 13. The tubing from which the coil 19 is formed is preferably about two inches in diameter, while the diameter of tube or conduit 20 is about one-half inch in diameter, for the purpose later to appear.

In operation of the structure disclosed in carrying the heating method into effect, a combustible gas is admitted through the check valve 21 into conduit 20 extending downwardly within the casing 10 and thence into the coil 19. When a combustible charge has filled the coil substantially to the end 19' thereof, the plug 22 is energized so as to produce a spark and the charge thus ignited.

The burning gases within the coil 19 heat the tube walls thereof and the heat radiated therefrom travels through the surrounding oil medium and thence through casing 10 and into the oil sand, as indicated by the arrows having open heads, and as identified in the legend on the drawing. The gas is admitted to the coil and ignited about ten times per minute with the result that heat is continuously generated and radiated from the coil. As a result, the zone of the oil sand indicated as A will become heated and the heat will progressively penetrate the zones B and C whereby the oil sands will become heated for a substantial distance from the well, and oil will thus be caused to flow therefrom toward and into the well, as is indicated by the arrows having solid heads. Furthermore, this progressive heating of the oil sands will result in stimulating and facilitating the flow of oil in the field as a whole to adjacent wells.

While the zones A, B and C are indicated as distinct, such is for purpose of explanation only, as there is of course no clear line of demarcation between the successive zones referred to.

As before stated, the relatively large tube diameter of the coil provides a desirably large heat radiating surface, while the substantially smaller tube 20, due to its relative small surface, is rapidly cooled by the gas entering prior to ignition thereof, thereby avoiding an otherwise overheated condition occasioning pre-ignition and damage therefrom.

The operation as above described may be continuous since the plug 22 may be energized at regular timed intervals by any suitable control means, and the check valve 21 will admit gas prior to ignition and will restrict the flow immediately following ignition due to increased pressure in tube 20 and coil 19. Upon reduction of pressure within the coil after the ignition, combustible gas will again be admitted through valve 21, which will drive the burned hot gases out through the open end 19' of the coil thereby further heating the well and oil sand.

It should be understood here that I contemplate availing myself of a variety of instrumentalities for effecting this operation. The combustible mixture may be supplied under any desirable pressure, it being evident that I may vary the same during the operation to meet varying local conditions. Further, the top of the well casing may be enclosed, with a controllable vent, whereby a back pressure may be maintained, in certain instances, in the casing and coil, with beneficial influence upon the rate and extent of heat propagation through the concentric zones A, B and C. By reason of the unidirectional flow of the fuel mixture, more even heating and better scavenging of the heating element is obtained, which are important advantages, particularly in view of the frequent extreme depths at which pumping is often required.

It is to be particularly observed that the coil 19 is of a length to traverse a substantial depth of the sand, and due to its duplex form, a substantially large heat radiating surface is provided.

While I have disclosed the invention in accordance with a single specific embodiment thereof, the same is to be considered as illustrative only, and not restrictive, the scope of the invention being defined in the sub-joined claims.

I claim:

1. Apparatus for progressively heating successive zones of oil sand radially of a well having a perforated casing and a pump supported therein by a tubing extending axially of the well to a point exteriorly thereof, comprising a tubular coil surrounding the pump tubing, a conduit connected with an end of the coil and extending upwardly through the well and externally thereof to a point of combustible gas supply, a check valve in the conduit for admitting successive charges of combustible gas to the coil and means for igniting the successive gas charges whereby the coil wall is heated and the heat radiated therefrom through the casing perforations and into the surrounding oil sand, said coil being suspended from a flange on the pump tubing, the inner diameter of said coil being greater than the diameter of the flange to facilitate admission of the coil over the tubing and into the well.

2. Apparatus for progressively heating successive zones of oil sand radially of a well having a perforated casing and a pump supported therein by a tubing extending axially of the well to a point exteriorly thereof, comprising a tubular coil surrounding the pump tubing, a conduit connected with an end of the coil and extending upwardly through the well and externally thereof to a point of combustible gas supply, a check valve in the conduit for admitting successive charges of combustible gas to the coil and means for igniting the successive gas charges whereby the coil wall is heated and the heat radiated therefrom through the casing perforations and into the surrounding oil sand, the coil tube being of relatively larger diameter and the conduit of relatively smaller diameter.

3. Apparatus for heating the oil sand strata radially of an oil well having a pump supported therein by a tubing extending axially of the well to an exterior point, comprising; a supporting member on said tubing, a tubular coil surrounding the tubing and carried by said supporting member, a conduit connected with said coil and extending exteriorly of said well to a source of combustible gas, a valve in said conduit for admitting successive charges of combustible gas to the coil, and means for igniting the successive gas charges for heating said coil and thereby the surrounding oil sand strata.

4. The combination of claim 3 wherein said conduit is of less cross-sectional area than said

coil to effect more rapid cooling of said conduit than of said coil by incoming successive gas charges.

5. The combination of claim 3 wherein said coil has an outlet communicating with the interior of said well above the oil level therein.

6. The combination of claim 5 wherein said valve is a non-return admission valve, said means for igniting being disposed in said conduit adjacent said valve.

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