

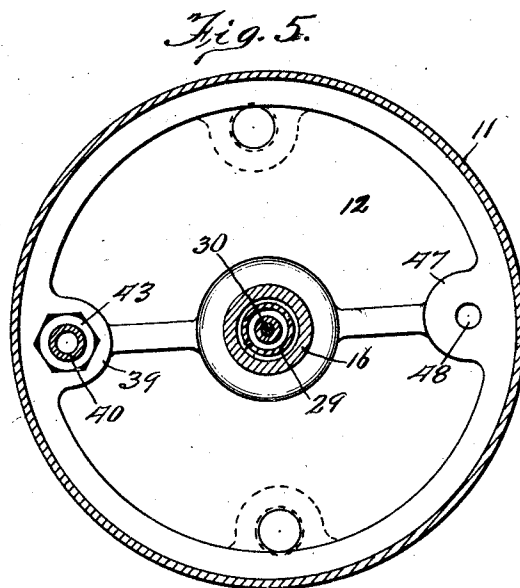
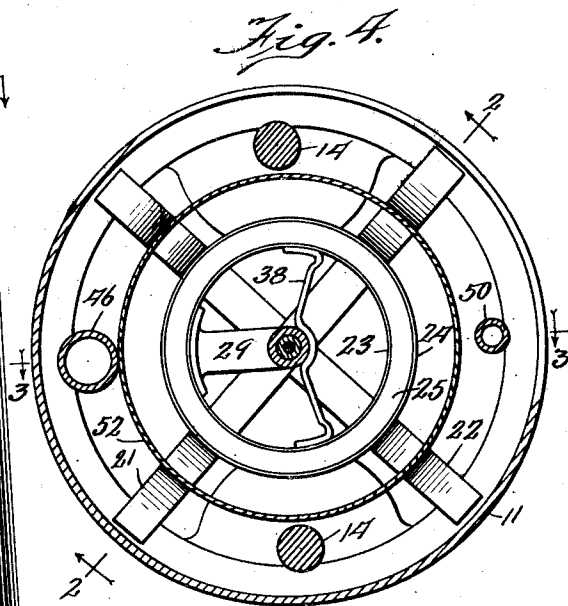
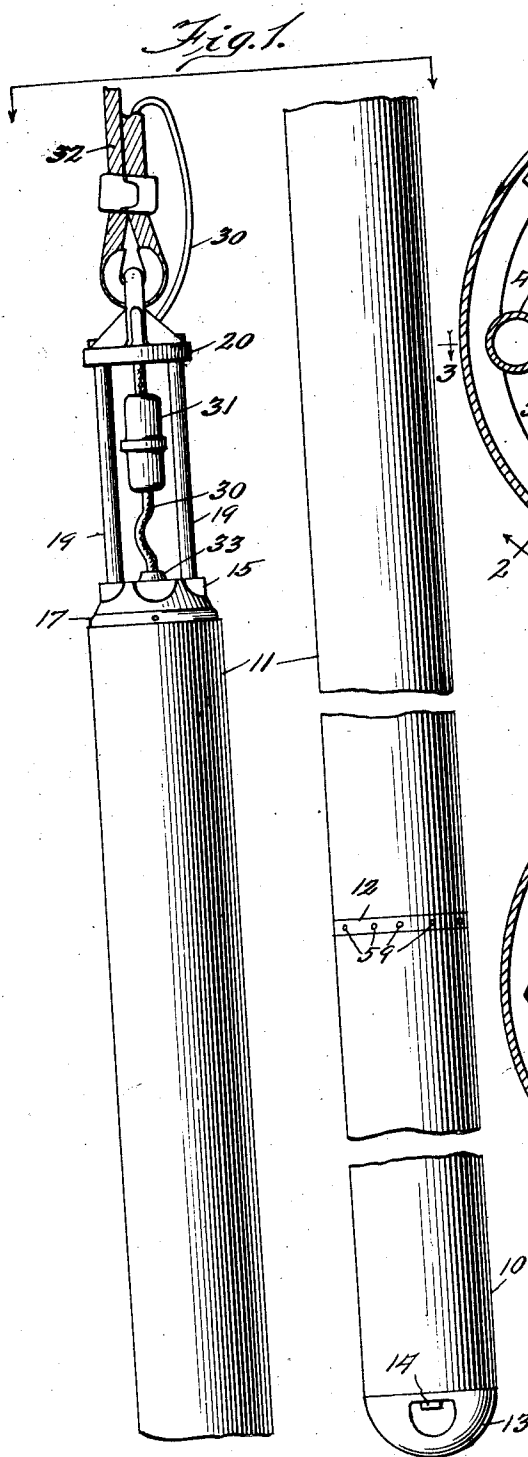
April 13, 1937.

C. L. REDFIELD ET AL
ELECTRICALLY OPERATED STEAMER

2,076,669

Filed Aug. 16, 1929

3 Sheets-Sheet 1



Inventors:
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Fig. 2.

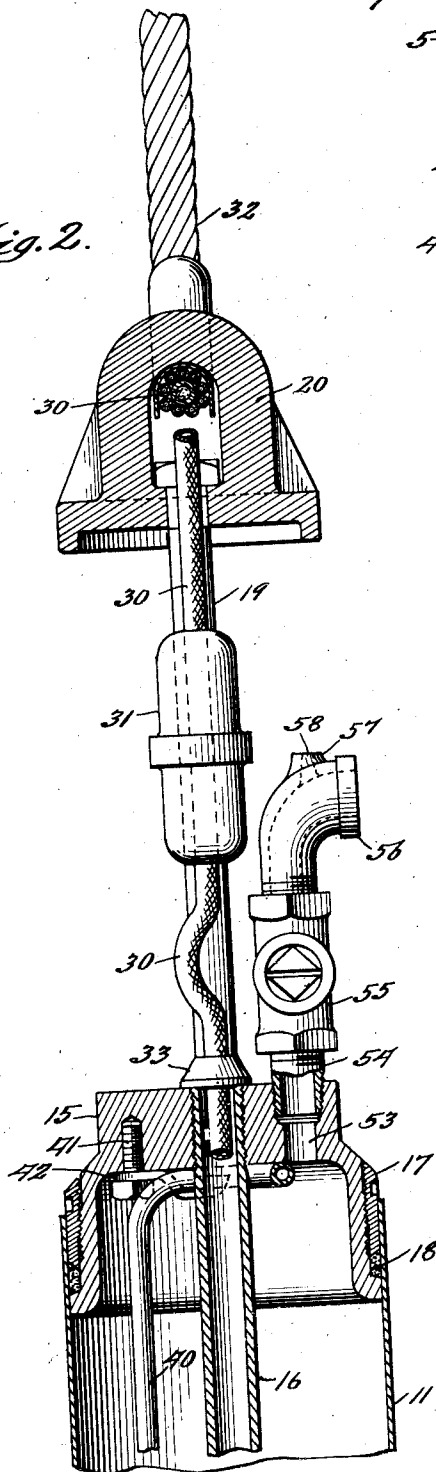
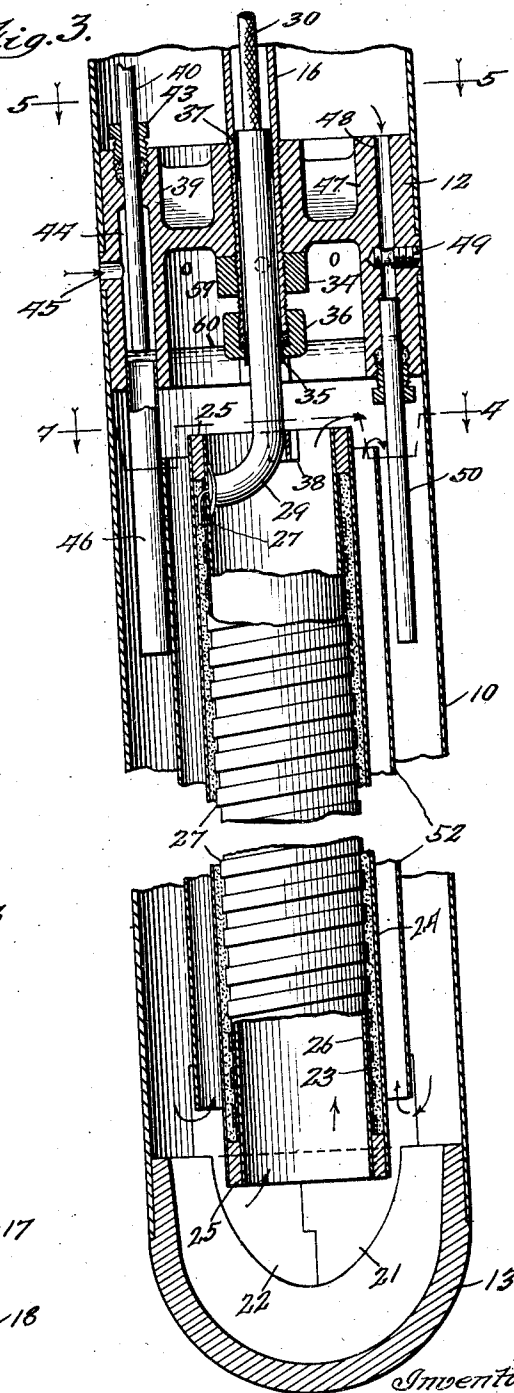


Fig. 3.



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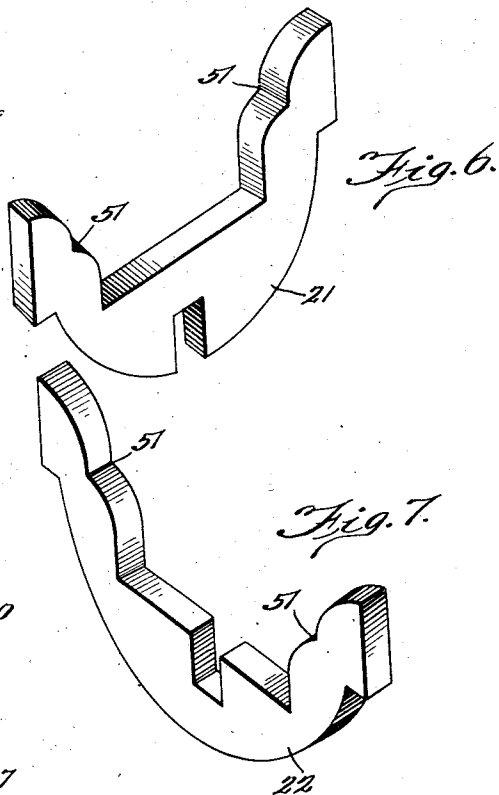
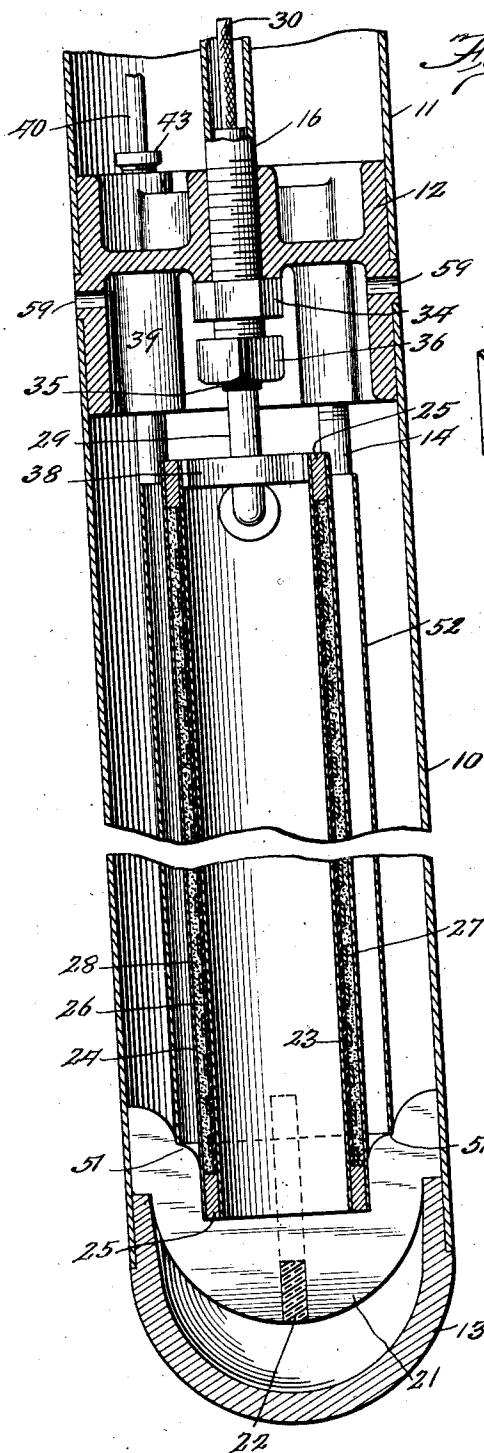
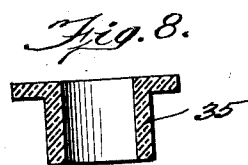


Fig. 7.



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UNITED STATES PATENT OFFICE

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ELECTRICALLY OPERATED STEAMER

Casper L. Redfield and Nelson De Long, Chicago, Ill., assignors, by mesne assignments, to Phoenix Oil Engineering Company, Chicago, Ill., a corporation of Delaware

Application August 16, 1929, Serial No. 386,457

12 Claims. (Cl. 219—33)

Our invention relates to electrically operated steamers particularly adapted to heating oil wells, and may be considered in the nature of improvements on the heater shown in Patent No. 1,525,656 granted Feb. 10, 1925, to Casper L. Redfield. In that device, oil inside of the heater was heated and the heat was then radiated thru the walls of the device to the oil in the well. In the present case, water takes the place of oil in the heater, and that water is converted into steam which escapes thru suitable openings into the well chamber. Above the steamer or heater proper, is a reservoir from which water passes to the heater to take the place of that which has become evaporated.

In the accompanying drawings:

Fig. 1 is an elevation of the apparatus as it appears ready for use;

Fig. 2 is an enlarged sectional elevation of the upper part of the apparatus and in a direction at right angles to the view in Fig. 1;

Fig. 2^a is a similar section of the lower part, Figs. 2 and 2^a being in the direction 2—2 of Fig. 4;

Fig. 3 is a section similar to Fig. 2^a, but in the direction 3—3 of Fig. 4;

Figs. 4 and 5 are sections on lines 4—4 and 5—5, respectively, of Fig. 3; and

Figs. 6, 7 and 8 are details.

Tubes 10 and 11 are connected together by a coupling 12 which also serves as a partition to divide the interiors of the tubes into upper and lower chambers. The lower end of tube 10 is closed by a head 13 which is held to the coupling 12 by bolts 14. These parts are held together by the tube 10 being clamped between shoulders on the coupling 12 and head 13 by the action of bolts 14.

The upper end of tube 11 is closed by a head 15 which is supported on the coupling 12 by an extra heavy pipe 16 which is screwed into both coupling and head. A tight joint is made between tube 11 and the head 15 by means of a stuffing box composed of a gland 17 screwed upon the head and acting upon packing 18 between head and pipe. The object is to provide for expansion and contraction and at the same time make an air tight joint between head and tube for purposes which will be set forth later.

Screwed into the upper face of the head 15 are bolts 19 upon which is supported a bail 20. Located in the lower part of tube 10, and resting upon the lower head 13, is a chair composed of insulating material 21 and 22. Supported centrally by the chair, is a tubular heating element having an inner tube 23 and an outer tube 24. The space between these tubes is hermetically sealed by rings 25 which are brazed or otherwise secured to said tubes.

Before the tubes 23 and 24 are put together,

the exterior of the inner tube is covered with a layer 25 of mica or other insulating material, and a ribbon 27 of resistance metal is wound upon the mica as shown in Fig. 3. The outer tube is then put in place, and the space between the ribbon 27 and the outer tube is filled with some powdered insulating material 28, as magnesium oxid.

The lower end of the resistance conductor 27 is electrically connected to the inner tube, and the upper end is insulated and conveyed thru the wall of the inner tube 23 to the interior of a small copper tube 29 which has its lower end brazed or otherwise secured to the inner tube 23 and its upper end projecting insulatingly into the lower end of the pipe 16.

At some convenient point, as immediately after passing thru the wall of the tube 23, the upper end of the ribbon 27 is electrically connected to an insulated conductor 30 which passes out thru the upper end of the pipe 16 to the water tight connector 31, beyond which an extension passes into and becomes the core of a suspension cable 32 connected to the bail 20. A rubber cap or other sealing device 33 serves to keep water from entering the upper end of the pipe 16.

The pipe 16 is screwed into the central boss of the coupling 12, and extends a considerable distance below the transverse web which divides the interiors of tubes 10 and 11 from each other. A jam nut 34 holds the pipe from displacement.

On the tube 29 is a thimble 35 of insulating material, and on the lower end of pipe 16 is a nut 36 which holds this thimble and hence holds the tube 29 out of electrical connection with pipe 16. The tube 29 projects a considerable distance into the pipe 16 and has further insulating material 37 separating the two electrically from each other. A bracket 38 serves as a support for the tube 29 near the place where it is connected to tube 23.

On one side of the coupling 12 is a boss 39 which is bored out for receiving the lower part of a small copper tube 40, the upper end of which is supported inside of the head 15 by a bolt 41 and clip 42. The upper face of boss 39 is counterbored to provide a stuffing box operated by gland 43, and the lower face is counterbored to leave an annular space around the lower end of tube 40, as shown at 44. A transverse hole 45 connects the space 44 with space outside of the device. In the lower end of the counterbore 44 is a pipe 46 which extends some distance down into the space within the tube 10.

Opposite the boss 39 is another boss 47 thru which is drilled a hole 48. The rib on the outside of the coupling 12, and between the ends of tubes 10 and 11, has drilled therein and tapped a hole to meet the hole 48, and in this transverse hole

is a small screw 49 which serves to close the hole 48 to any desired degree. In the lower end of the hole 48 is a pipe 50 which extends a considerable distance down into the space within tube 10.

Resting on shoulders 51 of pieces 21 and 22, is a tube 52, which surrounds the heating element and is somewhat shorter. The tube 52 has its lower end guided by the pieces on which it rests, and its upper end guided by bolts 14 and tubes 46 and 50.

In the head 15 is a hole 53 for receiving a nipple 54, and on the upper end of this nipple is a valve 55. Screwed into this valve is an elbow 56 adapted to receive the end of a hose for filling the chamber in tube 11 with water. On top of the elbow 56 is a boss 57 in which is drilled a small hole 58 communicating with the interior of the elbow.

The device here described may be of any diameter and of any length. For ordinary oil wells, four inches is a convenient diameter for the tubes 10 and 11, with other parts in proportion. A convenient length of parts would be four feet for the tube 10 and about sixteen feet for tube 11. The object of such length in tube 11 is to provide as large a reservoir as is practicable with a permissible diameter.

The kind of wells to which the present device is particularly adapted are those which have been "shot", and which consequently have chambers of considerable size in the oil bearing sand. Also, ones in which there is only a small depth of oil at the time of heating.

Old wells commonly have a "shot cavity" of considerable size, and have the walls of the cavity saturated with hardened paraffin so that oil still left in the oil bearing sand cannot percolate from the sand into the cavity. The object of the present device is to generate steam in the cavity, which steam flows from the lower chamber thru openings 59, and thence to the walls of the cavity. At that place, the steam gives up its heat to the walls, and runs down as water to the bottom of the cavity. The water, melted paraffin and oil are later pumped out in the ordinary manner.

The cable 32 is connected to a hoisting apparatus, and the insulated conductor is connected to a source of electricity, but shut off by any convenient switch until the device is lowered into the well. The next step is to connect a hose to the elbow 56 and turn on the valve 55 to admit water to the interior of the tube 11.

As water enters the chamber 11, air escapes thru pipe 40 and port 45. Some water runs down the hole 48 to the heating chamber, but this flow is regulated by the screw 49 so that by the time the upper chamber is full, the lower chamber is from one-half to three-quarters full. In this process, air in the lower or heating chamber escapes thru the ports 59. As soon as the upper chamber is full, water will spout upward thru the vent 53 in boss 57, and this will be a signal to close the valve 55.

Air may flow inward as well as outward thru the tube 40, and the hole 48 is always open. As a consequence, after closing valve 55, water will continue to flow from the upper chamber to the lower one until the water level in the lower chamber rises to the line 60 and seals the lower end of tube 40 to prevent further air entering the upper chamber. When this occurs, the water level in the upper chamber may be a foot or more below the upper end of tube 40.

After the lower end of the tube 40 is sealed by the rise of water in the lower chamber, water will

continue to flow from the upper chamber thru the hole 48 to the lower chamber, and water in the lower chamber will flow upward in tube 40 until the level in that tube is the same as the level in the upper chamber.

It is proper to note the fact that because the surface of the water in the lower chamber is in communication with outside air thru ports 59, it is under atmospheric pressure, whereas the water in the upper chamber has its surface under an initial balancing pressure of about one-half of an atmosphere. The difference is due to the head of water in tube 40 and the fact that the upper chamber is air tight above the water surface.

When the balance has been attained as just described, the heater is lowered into the well and the current is turned on. By means not necessary to describe here, the heater is positioned in the oil chamber of the well so that the ports 59 are well above the surface of the oil, and if the oil level in the well rises during the heating process, the position of the heater is adjusted so as to keep the ports 59 above the oil surface.

When the electric current is turned on the heating element, there is set up a rapid circulation of water within the tube 10. This circulation is upward where the water comes in contact with the tubular heating element, and downward elsewhere. Thus, it will flow upward inside of the tube 23 and between the tubes 24 and 52. This upward flow will be compensated for by a downward flow between tube 52 and the shell 10.

The current for this heating comes from any suitable source thru the wire 30 and ribbon 27 to the lower ring 25 and outer tube 24. From here it passes thru the water to the shell of the apparatus and then returns to the source thru the outside wires of the cable 32. A metallic conductor may, of course, connect the lower part of the heating element with the tube 10, but it is preferred to use the water as the conductor at this place.

As steam is formed in the tube 10, which tube may be considered as the shell of a boiler, such steam flows out thru the ports 59 to the walls of the well, where it serves to heat those walls and melt the paraffin. When the water level 60 falls below the lower end of tube 40, air enters thru port 45 and flows up tube 40 to the interior of the upper chamber. This admission of air to the upper chamber permits water to flow down thru hole 48 to restore the lower water level to the height of the lower end of the tube 40.

Means, not necessary to describe here, are provided so that the operator at the mouth of the well can know at all times the amount of water remaining in the reservoir. If the amount of heating required is greater than can be supplied by evaporating the amount of water in the reservoir at the time it is lowered into the well, the device is withdrawn, refilled and lowered again into the well.

If, in case of neglect or oversight on the part of the operator, the water level in the boiler falls below its intended point, there is decreased area of water to act as a conductor between tubes 24 and 10. This increases the resistance in the water and that in turn decreases the amount of current which can flow thru the ribbon 27. Such decreased current acts to prevent the heating element becoming overheated. Also, when the water is low in the boiler, the steam generated flows upward in contact with the surfaces of the heating element and flows thru ports 59 as super-

heated steam. This action, of itself, acts to prevent the heating element becoming overheated. When the water falls below the heating element, the circuit is automatically broken.

What we claim is:

1. In a steam generator, a tubular casing provided with inlet and outlet openings limited to its upper end, a tubular heating element submerged in water in the casing, a partition surrounding the heating element and serving to divide upward and downward currents of tubular water from each other, a water reservoir connected in tandem to the upper end of the casing, and automatically operating means controlled by the water level in the casing for permitting water to flow from the reservoir to the casing.

2. A long tubular body having its ends closed and its interior divided into upper and lower chambers, each of said chambers being partly filled with water, a submerged heating element located in the lower chamber and said lower chamber being provided with means for the escape of steam therefrom and also provided with an opening by which water may flow from the upper to the lower chamber, and means controlled by the level of the water in the lower chamber for admitting air to the upper chamber so that water may flow from the upper chamber to the lower one.

3. A vertical tubular body having its ends closed and its interior divided into upper and lower chambers each of which is partly filled with water, said chambers having an intercommunicating channel and each chamber having air communication with the exterior, a submerged heater in the lower chamber and serving to evaporate the water therein, and means operative by the changes of level of water in the lower chamber for controlling the air communication of the upper chamber.

4. A device providing upper and lower chambers with water in each, means for evaporating the water in the lower chamber and discharging the steam therefrom, a passageway by which water may flow from the upper chamber to the lower one, an air inlet to the upper chamber so that the water may flow, and means for controlling the open and closed condition of said inlet by the level of water in the lower chamber.

5. A tubular body having its ends closed and its interior divided into upper and lower chambers, a connection provided with a valve by which the upper chamber may be filled with water, there being a restricted channel thru which water can flow at a less rate from the upper chamber to the lower one, and a connection for admitting air to the upper chamber so that water may continue to flow from the upper chamber to the lower one after the valve is closed, said connection being automatically closed by the rise of the water level in the lower chamber.

6. In a device of the class described, upper and lower chambers, a tube extending from the upper part of the upper chamber to the upper part of the lower chamber and having its lower end terminating in a walled-in annular space, a second tube extending from the annular space down into the interior of the lower chamber, and a channel from said annular space to the exterior of the device.

7. In a device of the class described, upper and lower chambers separated from each other by a partition, a tube secured to said partition and

having its upper end in the upper part of the upper chamber and its lower end in a recess in said partition, a channel extending from the exterior of the device to said recess at a point above the lower end of said tube, and a second tube connecting the interior of the recess with the interior of the lower chamber at a point a considerable distance below said partition.

8. In a tubular device adapted to be supported by a cable in the lower part of an oil well, upper and lower chambers having their ends closed and each chamber partly filled with water, electrically operated means for generating steam in the lower chamber and permitting it to escape laterally therefrom, means for permitting water to flow from the upper to the lower chamber, and automatically operating means to admit air to the upper chamber for controlling such flow to maintain a constant water level in the lower chamber.

9. A tube provided with means by which it may be supported by a cable in the lower part of an oil well, upper and lower chambers having their ends closed and each chamber partly filled with water, electrically operated means for generating steam in the lower chamber and permitting it to escape laterally into the well, a water channel connecting the lower part of the upper chamber with the interior of the lower chamber, means including a sub-chamber in the lower chamber for permitting air from the outside to enter the upper chamber so that water may flow thru said channel by gravity, and means for controlling the admission of such air to the upper chamber by an unagitated water level in the sub-chamber.

10. In a device adapted to be used in the shot cavity of an oil well for the melting of paraffin, a boiler consisting of a receptacle and a heater therein, means for permitting steam to escape from the boiler, means normally operative to keep the heater submerged below the level in the boiler, and means by which the escaping steam is caused to flow in contact with the heating surfaces of the heater in case the normally operative means fails to keep the heater submerged.

11. A tube having closed ends and provided with means by which it may be supported by a cable in the lower part of an oil well, a partition in the tube dividing its interior into upper and lower chambers each of which is partly filled with water, electrically operated means for generating steam in the lower chamber, said chamber having openings for permitting the steam to escape laterally into the well in which the device is supported, a connection for permitting water to flow from the upper chamber to the lower one, and means operative by conditions in the lower chamber for permitting air to flow from the well to the upper chamber so as to control the flow of water to the lower chamber.

12. A tube having its ends closed and provided with means by which it may be supported by a cable in the lower part of an oil well, a partition dividing the interior of the tube into an upper chamber serving as a reservoir for water and a lower chamber serving as a boiler, and a sub-chamber located at the partition and provided with connections to the two main chambers and to the air in the well outside of the tube, said sub-chamber serving as means by which the level of the water in the boiler controls the flow of water from the reservoir to the boiler.

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