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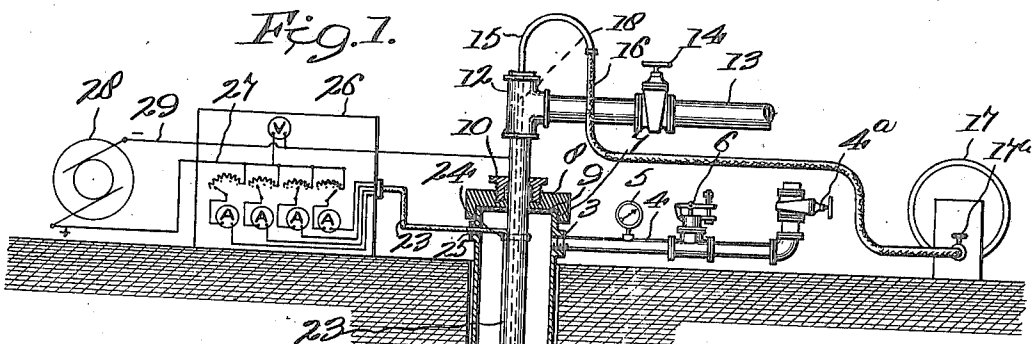
OPERATING SULFUR WELLS.

APPLICATION FILED JULY 8, 1915.

1,184,649.

Patented May 23, 1916.

Fig. 1.



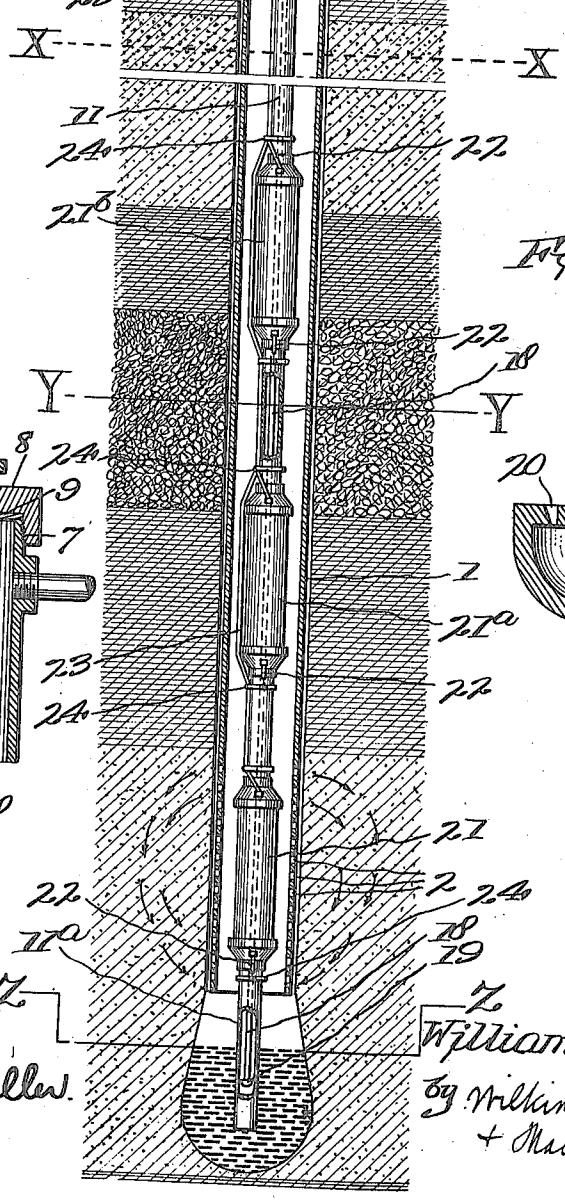


Fig. 2.

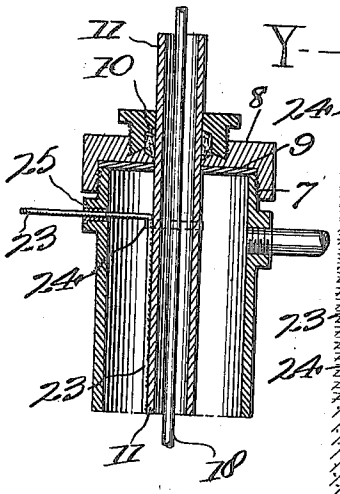
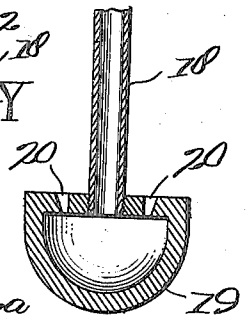


Fig. 3.



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OPERATING SULFUR-WELLS.

1,184,649. Specification of Letters Patent. Patented May 23, 1916.

Application filed July 8, 1915. Serial No. 38,737.

To all whom it may concern:

Be it known that I, WILLIAM D. HUFF, a citizen of the United States, residing at La Fayette, in the parish of Lafayette and State of Louisiana, have invented certain new and useful Improvements in Operating Sulfur-Wells, (Case B;) and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My present invention relates to the operation of sulfur wells, especially to those wells in which the sulfur is caused to flow by fusion into the bottom of a casing, and is lifted therefrom by an air jet acting after the manner of the well known aerial column.

According to the present method of operation of sulfur wells, it is customary to inject hot water from the surface down into the sulfur-bearing strata, which hot water, percolating through these strata, melts the sulfur and the sulfur flows down into the bottom of the cavity which has been previously excavated in drilling the well. The sulfur will form a layer beneath the water in this cavity because of its greater specific gravity. The temperature of the water should be high enough to melt the sulfur, but not so high as to cause it to assume the viscous or allotropic condition, which condition is generally reached at a temperature of about 380°F.

In all of the sulfur mines with which I am familiar, there is more or less water already contained in or above the sulfur-bearing strata, and it is the purpose of my invention to heat this water already naturally occuring to the proper temperature to melt the sulfur, and then to lift the sulfur up from the mine without the necessitiy for using any heating apparatus whatsoever on the surface of the ground. If, however, there should not be sufficient water *in situ* to accomplish the desired result, an additional supply of water can be delivered into the casing from the surface and allowed to flow out of the bottom thereof into the sulfur-bearing strata at the bottom of the well.

In other words, the purpose of my present invention is to apply the heat locally at the bottom of the well and heat the water already found there, to cause the convection currents of this water so heated to percolate through the sulfur-bearing strata and to melt the sulfur, and finally, by means of an air jet, to lift the sulfur so melted up from the mine to the surface of the ground.

My invention will be more fully understood by reference to the accompanying drawings, in which similar parts are indicated by similar reference symbols throughout the several views, and in which:

Figure 1 shows a central vertical section through the well casing, with the parts inclosed therein shown partly broken away and partly in elevation, and it also shows in diagrammatic form the apparatus used above the surface of the ground. Fig. 2 shows on a larger scale a central vertical section through the upper part of the well casing; and Fig. 3 is a detail showing, in section, one form of air jet for lifting the melted sulfur.

1 represents the well casing constructed in the usual way of suitable gas-tight material, and having its sides perforated toward the bottom as at 2. Near the top of this casing is provided an opening 3 to which the pipe 4 is connected, which pipe is provided with a pressure gage 5, a safety valve 6, and a valve 4^a which may be used to let off pressure or to admit liquid into the interior of the casing. The top of the well casing is screw-threaded, as at 7, to receive the cap 8 which is secured on the top of the casing above the packing 9, and this cap is provided with a suitable gland 10 through which passes the central or lifting tube 11, which tube projects down below the bottom of the casing, as shown at 11^a in Fig. 1, and the top of the tube is provided with a union 12 connecting the same to the delivery pipe 13 which is controlled by the valve 14. This union is also connected by the pipe 15 and hose 16 to a suitable source of compressed air 17, which is shown diagrammatically in said figure.

The pipe 15 connects to the inner pipe 18, passing down into the central tube 11, and terminating in a suitable air jet 19 provided with outlet openings 20 for the escape of compressed air, shown in Fig. 3.

Mounted on the exterior of the pipe 11 are a series of electric heaters 21, 21^a and 21^b, the lowest of which is preferably of greater heating capacity than the upper ones, for reasons which will hereinafter be described.

The electric heaters shown are supplied with electricity from the individual feed

wires 22, which are bound up in a suitable insulated cable 23, which cable is secured to the inner pipe in any convenient way, as by the strips 24. This cable passes up through a plug 25 in the well casing, and the individual conductors are connected to separate switches located in the switch-board 26, each of which switches is adapted to make connection with the main 27 which is supplied with electricity from any suitable source, as the dynamo 28. The return main 29 is grounded in any convenient way, preferably by connecting same to the inner pipe 11, as shown in Fig. 1, thus providing an all-metallic circuit for the electricity.

Between the mains 27 and 29 a suitable volt meter, indicated by V, is preferably provided, and suitable resistance coils and ammeters A may be provided for each switch, as shown in Fig. 1. The electric connections are shown diagrammatically in said figure, but the apparatus is intended to provide means for heating each electric coil, and for regulating the temperature of each coil, independently of all the others.

In the operation of the device the well is bored in the usual way, and an enlarged chamber is provided in the earth below the end of the casing, as shown in Fig. 1. The normal static head of the water in the ground would be at some point indicated by the line X—X, and the interior of the well casing would, of course, be normally filled with water up to this level when there is no steam or other gas pressure on the interior of the casing. At this time the static head of the sulfur in the inner tube 11 would be about the position indicated by Y—Y, see Fig. 1, the level being materially lower owing to the difference between the specific gravity of water and sulfur. Now, this would be the normal position of the water and the sulfur when the sulfur was in the melted condition and rose to its static head, and the water was not under steam or other pressure except that of its own weight. Suppose now, that the well is cold and out of operation and the water in the casing at the level indicated at X—X, and there is no sulfur, or a small amount only, in the lower portion of the tube 11; turn on the electricity to the heaters and heat the water in the sulfur strata to a temperature high enough to melt the sulfur. Where the well is sufficiently deep the pressure of the water will be sufficient to enable the water to be heated to the desired high temperature, without the generation of steam; but where the well is shallow steam is generated inside the casing and, rising above the water therein, will generate sufficient pressure to secure the desired heat of the water.

In practice there will be a series of convection currents for the heated water in the interior of the casing, out through the upper tiers of perforations 2, into the strata of earth, and down through said strata back up past the heater 21 into the casing, and out again as the water is heated by the heater 21.

The sulfur being melted in the veins will flow down into the chamber below the well casing, assuming the level indicated approximately by the line Z—Z in Fig. 1, and will continue flowing as long as the veins are maintained at a sufficiently high temperature, and there is sulfur remaining therein. As the sulfur flows into the chamber, it will rise on the interior of the inner pipe 11 to the level Y—Y, which is correspondingly lower than the normal static head of the water X—X inside of said casing, so that the column of sulfur inside of the inner pipe 11 will balance the column of water inside of the casing. As soon as the sulfur has reached the desired height, air is turned through the valve 17^a, through the hose 16 and pipe 15, and passing down through the pipe 18, escapes from the jet 19, and carries the sulfur up with it, forcing it out through the delivery pipe 13.

The heater 21 should preferably have the largest heating capacity, inasmuch as its function is to heat the water in the bottom of the well, while heaters 21^a and 21^b are intended mainly to keep the sulfur in the fused condition as it rises in the well, but, of course, these upper heaters will materially assist in maintaining the desired pressure and temperature in the interior of the well casing. The number of these heaters may be varied according to the depth of the well and other local conditions, and while I have shown three such heaters, any number from one up, may be used. While I prefer to have the heaters each independently connected to the source of electricity, the electrical connections may be of any suitable kind, as I am not claiming in this application any particular construction of heater, or any particular arrangement of electric circuits, these being described and claimed in my other applications hereinbefore referred to. Generally in such wells there is an ample supply of water found in the earth, but should an additional water supply be necessary, it may be forced in, under pressure, through the pipe 4, while there is steam pressure on the interior of the casing. But pressure may be relieved by opening the valve 4^a, and the well casing may be filled with water from an exterior source, while there is no steam pressure in the interior of the well casing, and the valve 4^a closed again, when the water in the well casing may be heated and the steam pressure forming in the top of the same will force the heated water down and out through the perforations 2, as hereinbefore described. But whether water is derived from the earth

itself or from extraneous sources, it is heated to a high temperature in the well under a pressure generated therefrom, and by this pressure is forced, while so highly heated, into the sulfur-bearing strata, and cooling slightly tends to fall through said strata with the resulting convection currents indicated by the arrows in Fig. 1.

Having thus described my invention, what I claim and desire to secure by Letters Patent of the United States, is:

1. Apparatus for operating sulfur mines comprising a well casing closed at the top and provided with perforations near its bottom, a heater mounted in said casing within the perforated area near the bottom thereof for heating the water in the well and causing said water after contacting with said heater to circulate through the perforations in the casing and into the sulfur bearing strata, thereby melting the sulfur, and means for carrying off the melted sulfur, substantially as described.

2. Apparatus for operating sulfur mines comprising a well casing provided with perforations near its bottom, a heater mounted in said casing within the perforated area near the bottom thereof for heating the water in the well and causing said water after contacting with said heater to circulate through the perforations in the casing and into the sulfur bearing strata, thereby melting the sulfur, and means for carrying off the melted sulfur, substantially as described.

3. An apparatus for operating sulfur mines, comprising a well casing closed at the top and provided with perforations near its bottom, an electric heater mounted in said casing within the perforated area near the bottom thereof for heating the water in the well and causing said water, after contacting with said heater, to circulate through the perforations in the casing and into the sulfur bearing strata to melt the sulfur, means for supplying said heater with electricity, an inner pipe for carrying off the fused sulfur projecting down in said casing and projecting beyond the lower end thereof, and means for raising the fused material from the well, substantially as described.

4. An apparatus for operating sulfur mines, comprising a well casing closed at the top and provided with perforations near its bottom, a series of electric heaters mounted in said casing within the perforated area near the bottom thereof for heating the water in the well and causing said water, after contacting with said heater, to circulate through the perforations in the casing and into the sulfur bearing strata to melt the sulfur, and for heating the interior of said casing above the level of the water therein, means for supplying said heaters with electricity, an inner pipe for carrying off the fused sulfur projecting down in said casing and projecting beyond the lower end thereof, and means for raising the fused material from the well, substantially as described.

5. An apparatus for operating sulfur mines, comprising a well casing closed at the top and provided with perforations near its bottom, means for supplying water through the upper part of said casing, an electric heater mounted in said casing within the perforated area near the bottom thereof for heating the water in the well and causing said water, after contacting with said heater, to circulate through the perforations in the casing and into the sulfur bearing strata to melt the sulfur, means for supplying said heater with electricity, an inner pipe for carrying off the fused sulfur projecting down in said casing and projecting beyond the lower end thereof, and means for raising the fused material from the well, substantially as described.

6. An apparatus for operating sulfur mines, comprising a well casing closed at the top and provided with perforations near its bottom, means for supplying water through the upper part of said casing, a series of electric heaters mounted in said casing near the bottom thereof for heating the water in the well and causing said heated water to flow through said perforations to melt the sulfur, and for heating the interior of said casing above the level of the water therein, means for supplying said heaters with electricity, an inner pipe for carrying off the fused sulfur projecting down in said casing and projecting beyond the lower end thereof, and means for raising the fused material from the well, substantially as described.

7. An apparatus for operating sulfur mines, comprising a well casing closed at the top and provided with perforations near its bottom, means for relieving the pressure in said casing when desired, and means for supplying water through the upper part of said casing, an electric heater mounted in said casing within the perforated area near the bottom thereof for heating the water in the well and causing said water, after contacting with said heater, to circulate through the perforations in the casing and into the sulfur bearing strata to melt the sulfur, means for supplying said heater with electricity, an inner pipe for carrying off the fused sulfur projecting down in said casing and projecting beyond the lower end thereof, and means for raising the fused material from the well, substantially as described.

8. An apparatus for operating sulfur mines, comprising a well casing closed at the top and provided with perforations near its bottom, means for relieving the pressure

in said casing when desired, and means for supplying water through the upper part of said casing, a series of electric heaters mounted in said casing near the bottom thereof for heating the water in the well and causing said heated water to flow through said perforations to melt the sulfur, and for heating the interior of said casing above the level of the water therein, means for supplying said heaters with electricity, an inner pipe for carrying off the fused sulfur projecting down in said casing and projecting beyond the lower end thereof, and means for raising the fused material from the well, substantially as described.

In testimony whereof, I affix my signature.

WILLIAM D. HUFF.