R. E. CARMICHAEL.

SULFUR MINING.

APPLICATION FILED APR. 29, 1918.

1,287,878. Patented Dec. 17, 1918.

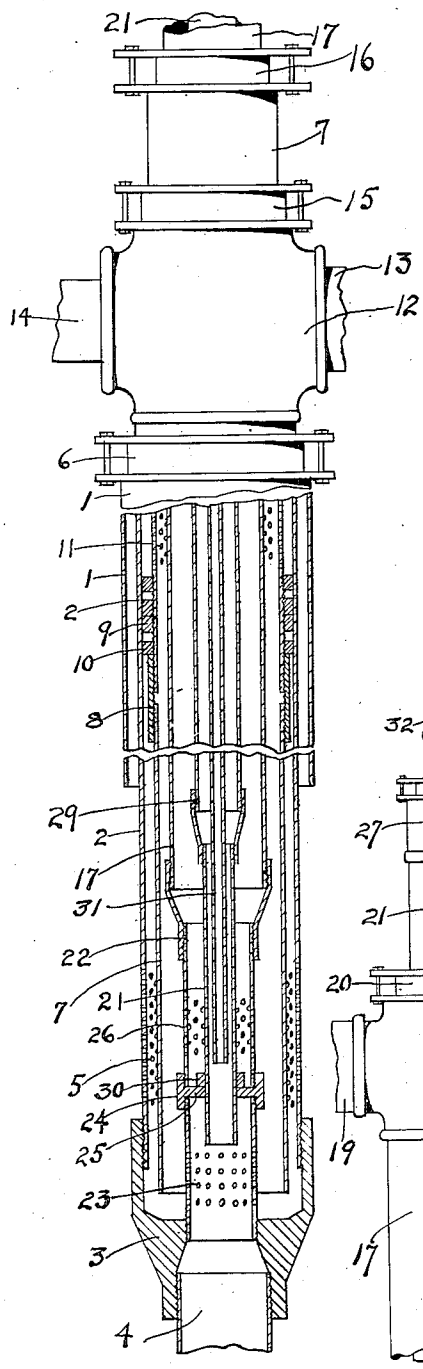


Fig. 1.

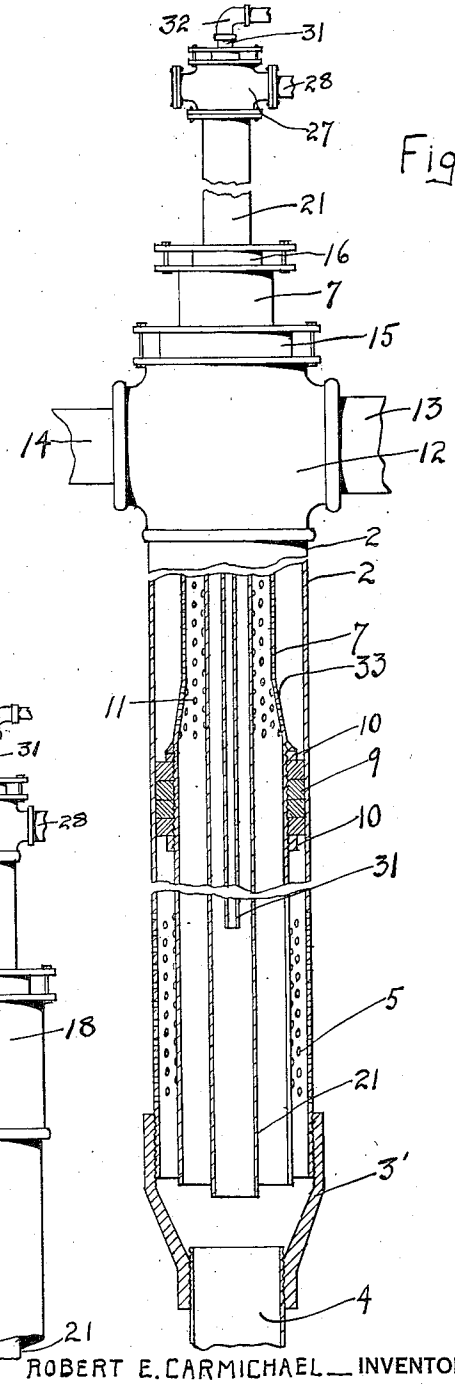


Fig. 2.

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ROBERT E. CARMICHAEL, OF DAMON, TEXAS, ASSIGNOR OF ONE-HALF TO GEORGE HAMMAN, OF HOUSTON, TEXAS.

SULFUR-MINING.

1,287,878. Specification of Letters Patent. Patented Dec. 17, 1918.

Application filed April 29, 1918. Serial No. 231,480.

To all whom it may concern:

Be it known that I, ROBERT E. CARMICHAEL, a citizen of the United States, residing at Damon, Brazoria county, Texas, have invented a certain new and useful Improvement in Sulfur-Mining, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to an improvement in sulfur mining and more particularly to an apparatus for mining subterranean sulfur, whereby the sulfur is fused by a heated fluid forced down into the well to the vicinity of the sulfur deposit and when so fused the sulfur is forced to the surface of the ground through a return pipe.

The principal object of my invention is to provide an apparatus for the purpose described by means of which the heated fluid may be directed to the desired point in the sulfur strata.

Another object is to construct an apparatus for sulfur mining which shall be of extreme simplicity and particularly efficient and economical in operation.

Other objects and advantages will more clearly appear in the description which follows and will be pointed out with more particularity in the claims.

In the usual method of mining sulfur it is customary to inject hot water through pipes from the surface down to the sulfur deposit. This heated fluid percolates through the strata of the sulfur and the heated sulfur fuses and flows down into the lower end of the well. It there forms a layer beneath the water in the well and fills the lower end of the outlet pipe. The pressure of the heated fluid which is pumped into the well causes the sulfur to rise in the outlet pipe to the surface of the ground where it is discharged. It is assisted in this upward passage by a current of air forced down through a small central pipe to the lower end of the outlet pipe from which point it bubbles up through the rising sulfur to the surface. Upon pumping the heated fluid down to the sulfur beds, it is frequently found that the heated fluid escapes outwardly into crevices or caverns in the strata to such an extent that it is mostly wasted and the sulfur in close proximity to the return pipe is not heated sufficiently to maintain it in a fused condition causing it to congeal and stop up the well.

My apparatus is adapted to so direct the discharge of the heating fluid that it will avoid the crevices through which the water can escape laterally and project it directly upon the sulfur at any desired point.

With particular reference to the drawing wherein like characters of reference are applied to like parts throughout the several views, Figure 1 is a longitudinal side view partly in section of my invention. Fig. 2 is a similar view showing a modified form of the same.

My improved apparatus consists of a system of concentric pipes to be introduced into the well after the said well has been drilled. The upper part of the well is usually reinforced and maintained in shape by the provision of a casing 1 inserted into the hole for some distance. This casing may be omitted, however, as will be seen. Within the outer casing is a system of pipes in connection with which my improvement appears. The outer pipe 2 fits within a stuffing box 6 at the upper end of the casing 1, and has a lateral inlet pipe 13 connected thereto by means of a T joint 12. The pipe 2 also has a stuffing box 15, of any common construction, at its upper end maintaining a fluid tight joint with the next inner concentric pipe 7 as will appear. On the side of the T 12 opposite from pipe 13 is a smaller pipe 14 to be provided with a relief valve, not shown, for the purpose of relieving any excess pressure which may occur in the well. The lower end of the pipe 2 is threaded into a compound coupling 3 by means of which it is firmly attached to an anchoring pipe 4 which is extended downwardly into the bottom of the well hole for a distance sufficient to firmly anchor the system of pipes into position. The pipe 2 is perforated as shown at 5 for the complete depth of the sulfur stratum which is to be mined by means of my apparatus.

Within the pipe 2 is a smaller pipe 7, imperforate for the greater portion of its length and extending upwardly through the stuffing box 15 for some distance and has at its upper end a stuffing box 16 which provides a tight fit about the next inner pipe 17. At a point somewhat toward the upper end of the pipe 7 is a coupling 8 of ordinary

construction and above this coupling the pipe is threaded for a short distance to receive two interiorly threaded clamping rings 10 between which is provided a series of packing rings 9 adapted to maintain a tight sliding contact with the interior surface of pipe 2. Immediately above the closure provided by these packing rings 9 is a series of perforations 11, sufficient in number, to allow the passage of sufficient heated fluid to heat the sulfur. The pipe 7 is slidable within the outer pipe 2 and telescopes within the stuffing box 15 and maintains a sliding fit with the pipe 17 at the upper end. The pipe 17 is extended upwardly for some distance sufficiently to allow a raising and lowering of the pipe 7 for a distance equal to the full depth of the sulfur strata.

The pipe 17 next within the pipe 7 has at its upper end a T joint 18 provided with a laterally extended inlet pipe 19 for the purpose of supplying a further volume of heating fluid when the same is needed. At the upper point of the pipe a stuffing box 20 provides a close fit with the next interior pipe 21. The pipe 17 extends downwardly into the well and is reduced in diameter by a reducing coupling or swage 22 at a point intermediate its length. This reduction in diameter is for the purpose of increasing the velocity of the heating fluid forced downwardly into the well. The lower end of this pipe 17 is threaded exteriorly and is anchored in the compound coupling 3 previously described. It has perforations 23 at its lower end for the inflow of the fused sulfur and at a short distance above the perforations a coupling 24 is used. This coupling 24 has an inwardly projecting annular flange 25 which forms a contact with the pipe 21. Above this annular flange 25 the pipe is further perforated at 26 to allow the outward passage of the heated fluid which is pumped down within the pipe 17. The pipe 21 is of still smaller diameter and provides an outlet for the fused sulfur which fills the lower part of the well. At the upper end of the pipe 21 is a T joint 27 having a lateral outlet pipe 28 for the fused material. The pipe 21 is imperforate throughout its length and is reduced in diameter somewhat by an intermediate reducing coupling 29 and has toward its lower end, and at a point immediately above the inwardly projecting flange 25 of the next outer pipe, an exterior collar 30. This collar is adapted under ordinary circumstances, to seat upon the flange 25 and maintain a tight closure between the two pipes. Thus, it will be noted that water or other heated fluid pumped in through the inlet pipe 19 and within the pipe 17 will be prevented from further downward passage by the the closure maintained by the flange 25 and will pass outwardly through the perforations 26 to the space within the slidable pipe 7. Thus the heated fluid pumped in through either of the inlets 13 or 19 will find an outlet within the slidable pipe 7 and will pass downward around the lower end of this pipe and outwardly through the perforations 5 in the outer pipe 2 and come in contact with the sulfur to be fused.

In order that this heated fluid may be directed at any point within the sulfur strata the pipe 7 may be raised or lowered as desired. This is done by any ordinary means, preferably by the usual block and tackle provided in connection with the ordinary mining derrick. A grappler or elevator at the end of the tackle is gripped about the upper end of the pipe 7 and the said pipe is thus adjusted vertically to any point desired. As the water always finds an outlet around the lower end of this adjustable pipe the raising and lowering of the pipe will cause an outward flow of the heated fluid to occur at any point. The sulfur thus fused flows downwardly into the well and through the lower perforations 5 in the outer pipe and perforations 23 in the inner pipe 17.

The pressure of the downwardly flowing fluid upon the sulfur in the bottom of the well will cause it to pass upwardly within the pipe 21 toward the outlet at the upper end thereof. It is assisted in its upward passage by means of an interior column of air projected downwardly through the small pipe 31 which is connected at its upper end through a joint or elbow 32 with an air compressor not shown. Air pumped downwardly through this inner pipe will bubble up from the lower end thereof through the upward current of fused sulfur and will assist in raising the same to the surface.

This apparatus just described is very similar to the apparatus previously set forth in my application filed April 20th, 1918, Serial No. 229,859. It differs principally in the provisions of the slidable closure on the outer surface of the slidable pipe 7. By means of this sliding closure between the two pipes the elevation of the pipe 7 will not modify, in any manner, the closure maintained between the two pipes and will cause the full volume of water pumped inwardly within the pipe 2 to pass through the perforations 11 to the space within the pipe 7.

This apparatus may be materially simplified by omission of the pipe 17 and the outer casing 1 or by the omission merely of the pipe 17. This modification is disclosed in the embodiment shown in Fig. 2. The outer casing 1 is here dispensed with and it is contemplated that the outer pipe 2 shall fit closely within the well hole so that there will be no danger of an upward passage of the heating fluid toward the surface. This pipe 2 is perforated toward the lower end

for the full depth of the sulfur bed, as previously described, and is anchored at its lower end within the compound coupling 3′ to the anchoring pipe 4 in the manner described in connection with the device shown in Fig. 1. This pipe 2 has the same connecting T 12, the lateral extending inlet pipe 13 and the opposite relief pipe 14 as described in connection with Fig. 1. The slidable pipe 7 is also quite similar to the one previously described. It is fitted within the T 12 of the pipe 2 through the stuffing box 15 and is slidable at its upper end upon the pipe 21 by means of a slidable stuffing box 16 in an obvious manner. The pipe 7 in this embodiment is enlarged in diameter somewhat, at an intermediate point as at 33 and immediately below this enlargement it is provided with an outer series of packing rings 9 clamped in place on the outer periphery of this pipe by means of the two clamping rings 10 threaded upon the outer portions of the pipe as previously described. At the point where the enlargement occurs and immediately thereabove, the pipe 7 is perforated to allow the inward passage of the heated fluid pumped downwardly within the outer pipe 2 causing the same to be forced downwardly within the slidable pipe 7 so that it may issue around the lower end of said pipe and through the perforations 5 to the sulfur.

The pipe 21 in this modification is not perforated but extends well down toward the bottom of the well and provides an outward passage for the sulfur which is forced upwardly therethrough by the pressure of the heating fluid. The sulfur is assisted in its upward passage by means of a current of air forced downwardly through the inner pipe 31 as in the previous modification.

It will be noted that the embodiment shown in Fig. 2 very much simplifies the apparatus to be used in mining sulfur and is at the same time a very efficient structure. The heating water forced inwardly through the inlet 13 and down within the pipe 2 has for the full length of its passage a wide space within which to pass, which will accommodate a large volume of water. This water is stopped in its passage outside of the pipe 7 and is forced through the perforations 11 into the space within the pipe 7 by means of the closure 9. The pipe 7 is vertically adjustable as described and serves to direct the heating fluid around its lower end and outwardly at any desired point. The fused sulfur finds an easy passage into the lower part of the pipes and passes upwardly within the outlet pipe 21 in the usual manner. When this device has been operated until all of the available sulfur around this mine has been obtained, the slidable pipe 7 is lowered to the very bottom of the well and the heating fluid is directed upon the lower part of the apparatus where all of the sulfur which may be congealed about the coupling 3 is again fused. When this fusion is accomplished the pipe is rotated to unscrew the same from the main coupling 3 or 3′ and withdrawn from the well to be used again in a subsequent operation.

It will thus be seen that I have provided a device for sulfur mining simple in structure, efficient and economical in operation.

Having thus described my invention what I claim as new and desire to protect by Letters Patent is:

1. In an apparatus for sulfur mining, a system of concentric pipes consisting of an outer pipe, perforated at the lower end to conduct a heated fluid into contact with the sulfur bed, an inner pipe for the sulfur outlet, and an intermediate slidable pipe, imperforate toward the lower end and having toward its upper end exterior packing rings thereon which close the passage between the slidable pipe and the outer pipe and perforations in said slidable pipe above said closure.

2. In an apparatus for sulfur mining the combination of an outer, perforated pipe anchored at its lower end, an inner imperforate pipe for the sulfur exit, an intermediate adjustable pipe to regulate the point of discharge of heated fluid, and a sliding closure between the outer pipe and the slidable pipe.

3. In an apparatus for sulfur mining, an outer perforated pipe, an inner return pipe, and an intermediate longitudinally slidable pipe imperforate toward the lower end but perforate intermediate its ends and a closure on said slidable pipe contacting with the outer pipe and closing the passage outside said slidable pipe.

4. In an apparatus for sulfur mining, an outer perforate pipe and an inner slidable pipe, smaller at its upper end and enlarged intermediate its length, packing rings outside said slidable pipe adjacent said enlarged portion and closing the passage between the two pipes, and perforations in said slidable pipe at the point where it is enlarged and above said closure.

5. In a system of concentric pipes for sulfur mining, an adjustable pipe, smaller at its upper end, an enlargement in said pipe, a series of exterior packing rings below said enlargement, and perforations in said pipe above said rings at the point of enlargement.

6. In a system of concentric pipes for sulfur mining, an outer perforated pipe, an inner longitudinally adjustable pipe, outwardly projecting packing rings on said inner pipe contacting with the outer pipe and perforations in said inner pipe above said rings.

7. In a system of concentric pipes for sul-

fur mining, an outer stationary pipe, an inner longitudinally adjustable pipe, the diameter of the lower part of said pipe being greater than its upper portion, a series of packing rings on its outer periphery, to close the passage between said pipes, and perforations above said closure.

8. In an apparatus for sulfur mining, an outer stationary inlet pipe for the heating fluid, an inner sulfur lift pipe and an intermediate adjustable pipe; means to discharge the heating fluid into the space between the outer pipe and the slidable pipe and means on said slidable pipe to divert the heating fluid from the passage without said slidable pipe to the space within the same for the purpose described.

9. An apparatus for discharging the heating fluid into a sulfur mine comprising an outer pipe perforated adjacent the sulfur bed, an inner adjustable pipe, means for introducing the heating fluid into the space between the pipes and means on the adjustable pipe to divert the heating fluid to the space within said adjustable pipe and around the lower end thereof.

10. An apparatus for introducing the heating fluid into a sulfur mine comprising an outer pipe to discharge said fluid into the sulfur strata, an inner adjustable pipe, and means connected with said adjustable pipe to direct the heating fluid to the space within said adjustable pipe and means to cause its discharge from said space at any level desired.

11. In an apparatus for sulfur mining, the combination of an outer perforated pipe, an inner imperforate sulfur exit pipe, an intermediate longitudinally adjustable pipe adapted to regulate the point of discharge of heated fluid through said outer perforate pipe, and a closure between said outer and intermediate pipes slidable with said intermediate pipe.

12. In an apparatus for sulfur mining, an outer perforated discharge pipe, an inner sulfur outlet pipe, and an intermediate pipe adapted to be regulated to direct the discharge of heating fluid to any desired point, said pipe being perforated above the sulfur bed and a sliding closure for the space between the outer discharge pipe and the intermediate pipe below the perforations in said intermediate pipe.

In testimony whereof, I hereunto affix my signature this the 25 day of April, A. D. 1918.

ROBERT E. CARMICHAEL.