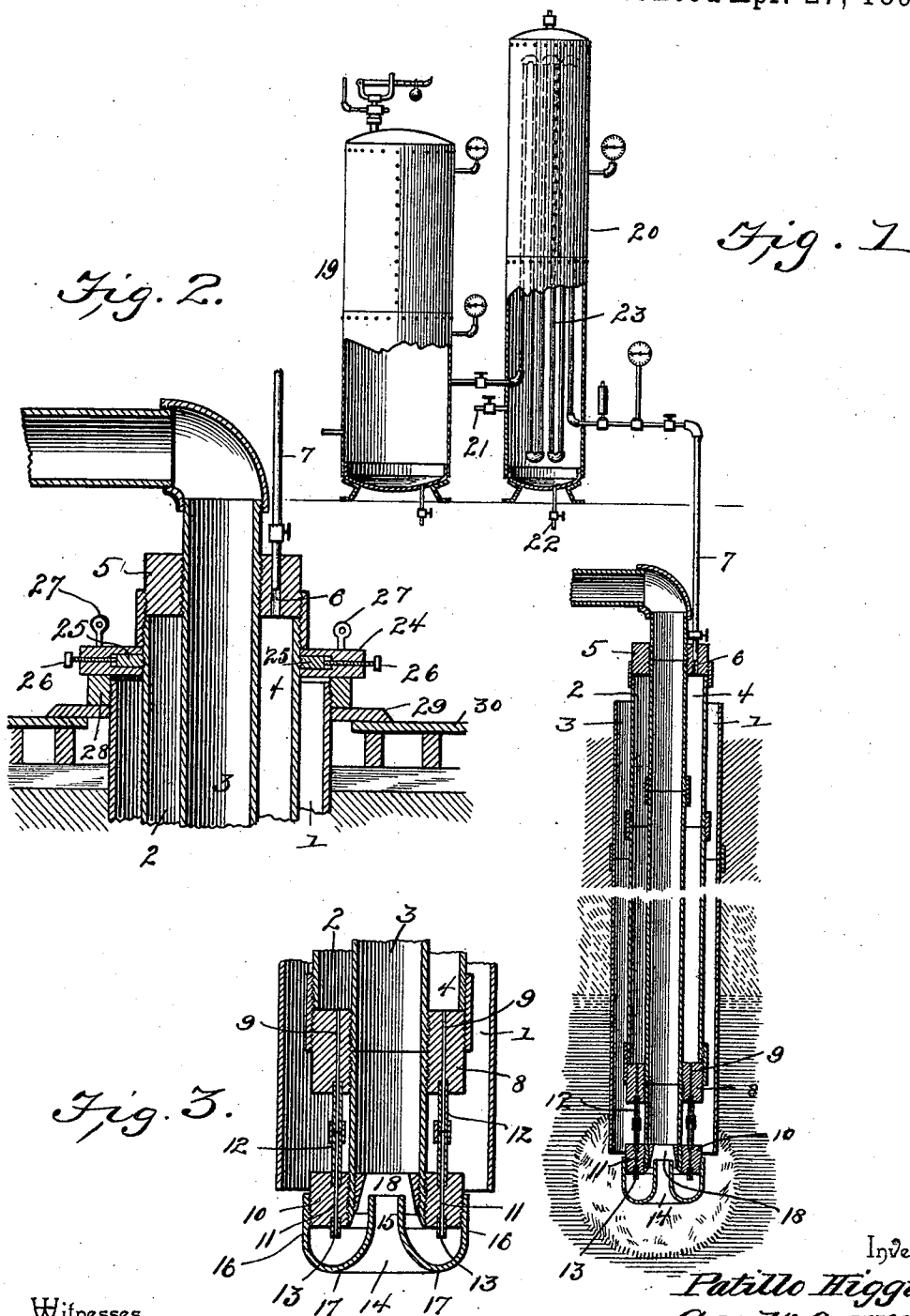


(No Model.)

P. HIGGINS & G. W. CARROLL.
MINING SULFUR.

No. 581,479.

Patented Apr. 27, 1897.



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UNITED STATES PATENT OFFICE.

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MINING SULFUR.

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To all whom it may concern:

Be it known that we, PATTILLO HIGGINS and GEORGE W. CARROLL, citizens of the United States, residing at Beaumont, in the county of Jefferson and State of Texas, have invented a new and useful Improvement in Mining Sulfur, of which the following is a specification.

This invention relates to certain new and useful improvements in mining sulfur and like mineral products which are capable of being liquefied by the application of heat thereto, and has for its objects to expedite and simplify the mining process and to reduce the cost of extracting the mineral from its bed and to prevent the loss incident to such process and apparatus which reduce the mineral to a liquid state by the application thereto of steam or other fluid or a solution or hot water which permeates the fissures of the stratum or bed and carries off valuable by-products.

In accordance with this invention air heated to a proper temperature is forced under pressure to the mineral-bearing bed or stratum and serves both to reduce the mineral to a liquid state and to raise the same to the surface by reason of the head or pressure, and in order to prevent the chilling of the liquefied mineral during its ascent and passage to a suitable point of discharge the conveyor is enveloped in a heating medium, such as hot air, steam, &c.

For a full understanding of the merits and advantages of the invention reference is to be had to the accompanying drawings and the following description.

The improvement is susceptible of various changes in the form, proportion, and the minor details of construction without departing from the principle or sacrificing any of the advantages thereof, and to a full disclosure of the invention an adaptation thereof is shown in the accompanying drawings, in which—

Figure 1 is a detail view of an apparatus for carrying out the spirit of this invention, parts being in section. Fig. 2 is an enlarged view of the upper portion of the casing and the parts associated therewith, showing the hoisting-ring in position. Fig. 3 is an enlarged view of the lower part of the casing and the parts connected therewith.

The underlying principle of this invention

resides in forcing hot air to the mineral-bearing strata at such a temperature as to liquefy the mineral, whereby the latter can be removed in any way found most convenient, either by pumping or by the pressure of the air itself, the latter being preferred, as it causes the mineral to automatically rise in a pipe or conveyer to the surface of the ground. To attain this end, the apparatus herein illustrated has been devised and will be referred to in detail hereinafter, the same reference-characters being employed to designate similar and corresponding parts in the description and all the figures of the drawings.

The shaft is preferably lined by a shell 1, so as to prevent loose formations dropping into and choking the shaft. The apparatus is shown in the shaft and comprises a casing 2 and an inner shell or pipe 3, inclosing a space 4 between their opposing sides, through which is forced hot air, steam, or other heating medium for liquefying the sulfur and maintaining the same in a molten state while passing through the shell or pipe 3. A ring 5 closes the upper end of the space 4 and is formed with an opening 6, in which is fitted a pipe 7 for conveying the hot air, steam, or other heating medium into the space 4 from a suitable source. A ring 8 closes the lower end of the space 4 and has a series of openings 9, through which the hot air, steam, or other heating medium escapes from the space 4. The shell or pipe 3 extends through the ring 8 and projects below the same a short distance and supports a nozzle, the upper member of which is a ring 10, having openings 11, corresponding in position and number with the openings 9 in the ring 8 and to which the lower ends of short pipes 12 are fitted, the upper ends of the said pipes having connection with the openings 9. Nipples 13 are fitted to the lower ends of the openings 11 and project a short distance from the lower end of the ring 10 and serve to direct the jets of hot air, steam, &c., against the inner curved wall of the lower member 14 of the nozzle. This lower member 14 is of annular form and comprises concentric walls 15 and 16, which are closed and connected at their lower ends by a cap 17, the latter being concave on its inner side to receive the impact of the jets escaping from the nipples 13, so as

to direct the said jets upward through the shell or pipe 3. The outer wall 16 has a screw-thread connection with the ring 10, and the inner wall 15 extends into the lower end of the pipe or shell 3 and is of such diameter as to leave an annular space between it and the opposing wall of the pipe 3, through which the hot air, steam, or other medium passes. A tapering ring 18 is fitted to the lower end of the pipe 3 and has a screw-thread connection therewith, and the lower portion of this ring extends into the annular space formed between the parts 15 and 3. Obviously by adjusting either the tapering ring 18 or the part 14 the annular space formed between them can be varied, thereby controlling the force and amount of hot air, steam, or other medium escaping into the shell or pipe 3. The tapering wall of the ring 18 faces inward and serves to deflect the escaping steam toward the center of the pipe 3, thereby acting as a twyer to compel the liquid sulfur to be drawn through the nozzle into the pipe or shell 3 and through the latter to the surface of the ground and to a convenient point of discharge. Thus it will be seen that the hot air, steam, or other heating medium is used, first, to reduce the sulfur in its bed to a molten condition, and, secondly, to compel it to ascend and flow to the point at which it is collected.

The pipe 7 may be connected with a blower, air-pump, or other means for supplying air under pressure to effect the desired result, but, as shown, it has communication with a receiver 19, containing air under pressure, and the air is heated in its travel through the pipe 7 by any suitable means. The heater 20 illustrated is supplied with steam from a suitable generator by means of a pipe 21, and the water of condensation is drawn off through a pipe 22, having communication with the lower end of the heater. A coil 23, located in the heater, has communication with and practically forms a continuation of the pipe 7. The heating medium being supplied to the space 4 escapes therefrom by the means herein described into the discharge-pipe 3, and the latter being closed by suitable means (not shown) the hot air or like medium will pass through the nozzle or the part 15 thereof into the bed and liquefy the sulfur, and upon opening the pipe 3 the medium confined therein will escape therefrom and create a vacuum, which will cause the molten sulfur to pass through the discharge-pipe along with the medium to the point of discharge.

It will be understood that suitable means will be provided for supporting the apparatus in the shaft 1, and, as shown in Fig. 2, a ring 24 encircles the casing 2 and is grooved on its inner side to receive bits or jaws 25, which are toothed on their outer edges and moved into engagement with the casing by means of set-screws 26. This ring 24 is supplied at opposite points with eyes 27 to receive a hoisting-tackle when it is required to

lift the apparatus from the shaft. The ring rests upon a collar 28, applied to the upper end of the shell 1, and which in turn is supported upon a plate 29, resting upon a suitable platform or base 30, provided at the mouth of the shaft.

Having thus described the invention, what is claimed as new is—

1. In an apparatus for mining mineral, a casing, a pipe passing through the casing and forming therewith a space which is closed at its ends, means for supplying a fluid medium under pressure to the said space, and a nozzle comprising concentric walls inclosing a space which is closed at one end by a cap concave on its inner side, and having the annular space formed between the walls of the nozzle in direct communication with the space formed between the pipe and casing, and having the inner wall of the nozzle projecting into the lower end of the aforesaid pipe and providing an annular escape for the fluid medium, substantially in the manner set forth for the purpose specified.

2. In an apparatus for mining mineral, a casing, a pipe passing through the casing and forming therewith a space which is closed at its ends, means for supplying a heating medium under pressure to the said space, a ring fitted to the projecting end of the pipe and having communication with the aforesaid space, and a nozzle, comprising concentric walls joined by a cap portion concave on its inner wall, secured by means of its outer wall to the aforesaid ring, and having its inner wall entering the projecting end of the pipe and forming a space for the escape of the heating medium, substantially as shown and described.

3. In an apparatus for mining mineral, a casing, a pipe passing through the casing and forming therewith a space which is closed at its ends, means for supplying a heating medium to the said space under pressure, a ring fitted within the projecting portion of the pipe and having its inner wall tapering, a nozzle, comprising concentric walls united at one end by a cap concave on its inner wall, having direct communication with the aforesaid space, and having its inner wall extending into the tapering space inclosed by the ring 18, and means for relatively adjusting the ring 18 and nozzle, substantially in the manner set forth for the purpose specified.

4. In an apparatus for mining mineral, the combination of a casing, a pipe passing through the casing and forming therewith a space closed at its ends, means for supplying a heating medium under pressure to the said space, a ring fitted externally to the lower end of the pipe, a series of small pipes connecting the ring with the lower portion of the space formed between the pipe and casing, nipples projecting from the ring and in communication with the small pipes, a ring having its inner wall tapering and adjustably fitted within the first-mentioned pipe, and a

nozzle applied to the external ring and having its inner portion extending into the space inclosed by the tapering wall of the inner ring, substantially as specified.

5 5. In an apparatus for mining mineral, the combination with a casing extending into the shaft, of a clamp-ring having eyes to receive the hoisting-tackle and grooved on its inner
10 edge, toothed jaws fitted in the groove, and set-screws to cause the jaws to grip the sides

of the casing, substantially as set forth for the purpose described.

In testimony that we claim the foregoing as our own we have hereto affixed our signatures in the presence of two witnesses.

PATTILLO HIGGINS.

GEORGE W. CARROLL.

Witnesses:

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