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METHOD OF MINING SOLUBLE BORON COMPOUNDS AND THE LIKE

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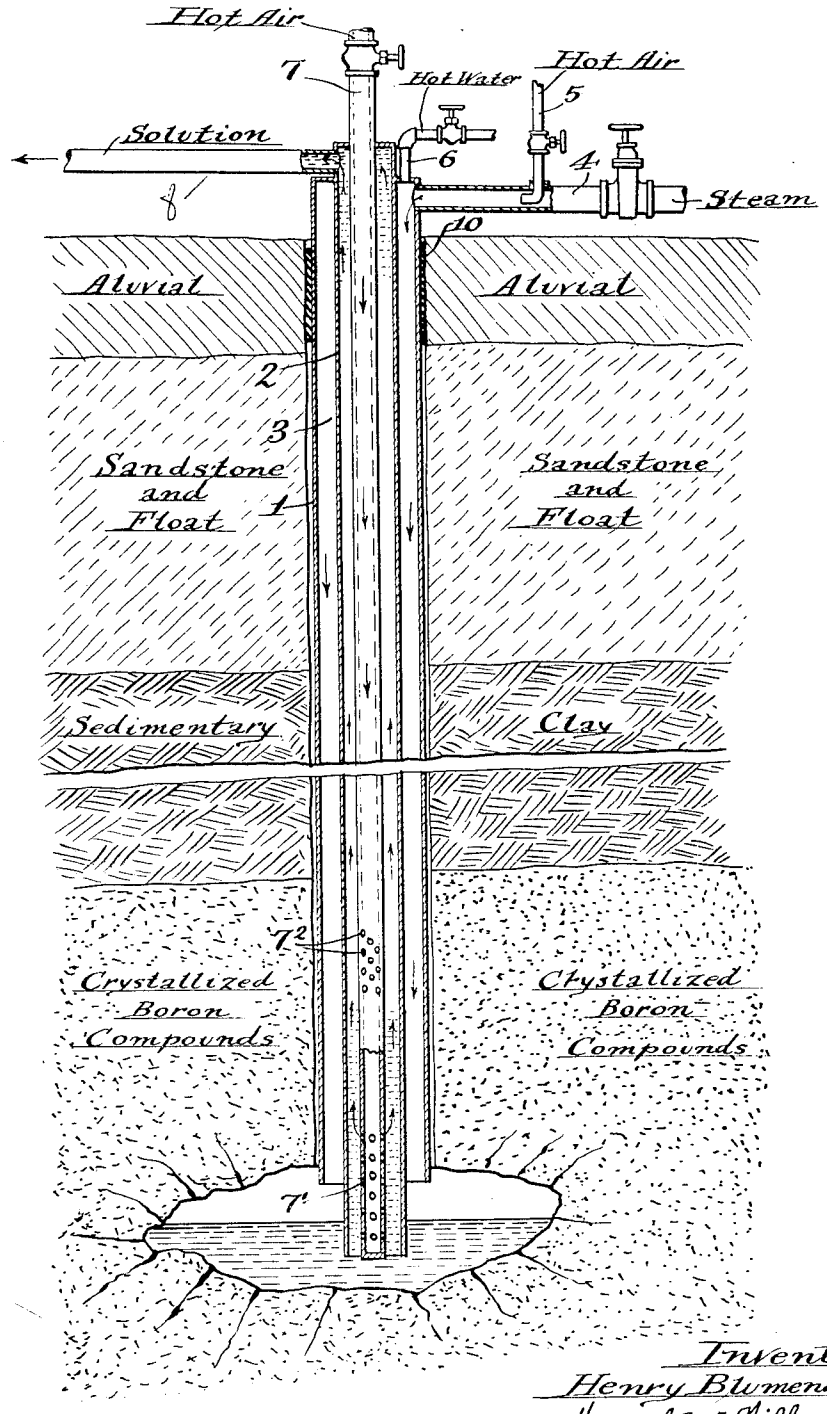

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METHOD OF MINING SOLUBLE BORON COMPOUNDS AND THE LIKE.

Application filed February 16, 1927. Serial No. 168,543.

My invention relates to a method of mining soluble boron compounds but is not limited thereto and may be used for the recovery of soluble minerals occurring under similar conditions.

Sodium borate $Na_2B_4O_7$ occurs occasionally in deposits in considerable depth from the surface of the ground and makes ordinary mining operations difficult and expensive.

It is an object of my invention to provide a method whereby the sodium borate or any other soluble boron compound may be economically and efficiently recovered.

As well known, the solubility of sodium borate increases greatly with the temperature of water. One gallon of water at 0° C. dissolves approximately 3 ounces, while at 100° C. approximately 250 ounces are dissolved. The use of hot water for leaching and dissolving minerals containing soluble boron compounds suggests itself. However, a slight cooling of the hot solution precipitates boron compound crystals which clog up the conduits and valves of the apparatus and are exceedingly difficult to handle.

My invention contemplates a method to overcome this difficulty by the joint use of steam and hot air, preferably using an air lift employing hot air for raising the borate solution and also for efficiently leaching out soluble borates which may occur at a considerable distance from the bottom of the shaft and located above them, the air being used to fill spaces caused by the removal of the soluble borates and the steam penetrating crevices in every direction on condensing, dissolving efficiently the borates and conducting them to the bottom of the shaft from which they are raised by means of hot air.

The claims of the present invention are limited to the method shown and described. The apparatus is claimed in my co-pending application, Serial No. 170,651, filed February 24, 1927.

My invention consists of the steps of the process hereinafter described and claimed.

In the accompanying drawings, which form a part of the specification, I have illustrated an apparatus suitable for carrying out my method and in which the figure is a vertical cross section of the apparatus for leaching out and recovering soluble borates.

Referring to the drawings, 1 indicates an outer casing which has been inserted in a hole drilled for the purpose in the formation containing soluble borates at or adjacent the bottom thereof. The earth strata have been indicated by legends on the drawings, such as alluvial, sandstone, sedimentary clays and the deposit at the bottom of crystallized boron compounds. Since the method is especially intended for use in connection with borax, the term borax for the sake of simplicity will be used throughout the specification.

Within the outer casing is an inner casing 2 which preferably projects somewhat beyond the bottom of outer casing 1. Into the annular chamber 3 formed between outer casing 1 and inner casing 2 I supply steam from any suitable source by valve controlled steam pipe 4 to which is connected a valve controlled hot air pipe 5. A valve controlled hot water pipe 6 also communicates with the chamber 3. An air lift pipe 7 is arranged within inner casing 2 closed at the bottom and provided near the bottom with perforations 7'. If desirable perforations 7^2 may be provided intermediate the upper and lower ends of the air lift pipe 7, or any other preferred construction of an air lift may be used, the particular structure thereof forming no part of my invention. The borax solution exit pipe 8 communicates with the top of the inner casing 2. 10 is a packer between the shaft and the outer casing 1 to confine the air or steam pressure within the shaft.

The operation is as follows:

Steam is conducted to the bottom of the shaft through steam pipe 4 and annular chamber 3. A portion of the steam will condense as it passes down into the shaft and to the ore deposit, the steam penetrating through the crevices and the hot water of condensation efficiently leaching out and dissolving the borax. Hot air is also introduced to the bottom of the shaft, passing from hot air pipe 5, steam pipe 4 and annular chamber 3. The hot air serves to fill the space and cavities caused by the leaching and removal of the borax and also in forcing the borax solution into the inner casing 2. Air, preferably hot, is now pumped through the air pipe 7 and passing through perforations 7' and 7^2 will lift the

borax solution and cause the same to flow through the exit pipe 8 to suitable borax solution containers, not shown.

The degree of temperature of the steam and hot air depends somewhat on conditions, on the depth of the shaft, a deeper shaft ordinarily requiring higher temperature, the aim being at all times to keep the borax in solution and to prevent the formation of crystals.

By my arrangement the steam is hottest at the upper part of the apparatus, being cooled gradually as it descends into the shaft, thereby progressively heating the borax solution ascending in the inner casing 2. The temperature of the steam may vary from 100 to 500 lbs. of pressure or more and the hot air from 100 to 300°.

It may be advisable where the boron compound is insoluble, such as calcium borate, to introduce an acid such as hydrochloric acid, to liberate the boron in the form of boric acid. It will be obvious, however, that when hydrochloric acid is used that the pipes must be made or lined with non-corrodible material.

I prefer to use hot air in air lift pipe 7 in order to prevent any crystallization of borax in the solution that is lifted from the bottom of the shaft. However, cold air may be used, provided that the temperature is maintained sufficiently high by means of the steam surrounding the casing 2 to prevent the formation of borax crystals.

In place of hot air being pumped to the bottom of the shaft cold air may be used periodically and also hot water through pipe 6 may be employed in place of steam. The object, however, is to efficiently leach the deposit about the bottom of the shaft by means of hot water which is conveniently supplied by the water of condensation of steam and to exert pressure upon the solution so as to cause it to rise within casing 2 so that the same may then be lifted to the surface of the ground by any convenient means, care being taken throughout that the borax is kept in solution until conducted to the storage tanks.

Various changes may be made by those skilled in the art without departing from the spirit of my invention as claimed.

I claim:

1. A method of recovering soluble minerals comprising sinking a shaft to the mineral deposit, conducting steam to the bottom of the shaft to leach out the soluble contents by means of the water of condensation and lifting the solution thus formed to the surface of the ground.

2. A method of recovering soluble minerals comprising sinking a shaft to the mineral deposit, conducting steam and air to the bottom of the shaft to leach out the soluble contents by means of the water of condensation and lifting the solution thus formed to the surface of the ground.

3. A method of recovering soluble minerals comprising sinking a shaft to the mineral deposit, conducting steam and hot air to the bottom of the shaft to leach out the soluble contents by means of the water of condensation and lifting the solution thus formed to the surface of the ground.

4. A method of recovering soluble minerals comprising sinking a shaft to the mineral deposit, conducting steam and hot air to the bottom of the shaft to leach out the soluble contents by means of the water of condensation, heating the upper portion of the shaft to a higher degree than the lower portion thereof in order to maintain the soluble contents in solution and lifting the solution thus formed to the surface of the ground.

5. A method of recovering soluble minerals comprising sinking a shaft to the mineral deposit, conducting steam and hot air to the bottom of the shaft to leach out the soluble contents by means of the water of condensation, heating the upper portion of the shaft to a higher degree than the lower portion thereof in order to maintain the soluble contents in solution and introducing a gas under pressure into the solution at the bottom of the shaft to lift the solution to the surface of the ground.

6. A method of recovering soluble minerals comprising sinking a shaft to the mineral deposit, conducting steam and hot air to the bottom of the shaft to leach out the soluble contents by means of the water of condensation, heating the upper portion of the shaft to a higher degree than the lower portion thereof in order to maintain the soluble contents in solution, introducing a reagent to react with any insoluble minerals to liberate a soluble compound, and introducing a gas under pressure into the solution at the bottom of the shaft to lift the solution to the surface of the ground.

In testimony whereof I have signed my name to this specification.

HENRY BLUMENBERG, JR.