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PROCESS AND APPARATUS FOR MINING SULPHUR

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This invention relates to a process of mining sulphur by the practice of so-called "underground fusion", and has for its object generally an improved procedure which increases the amount of sulphur produced per heat unit expended and facilitates the mining operation.

In the mining of sulphur by underground fusion, which was originally proposed by H. Frasch, a hole or well is drilled through the overlying strata to the bottom of the sulphur deposit. This hole is preferably provided with a suitable casing, for example, a 10-inch pipe, in which a system of concentric pipes is disposed. The mining operation is customarily carried out by passing a mining fluid, such as superheated water under pressure, down one of the annular spaces, and thence out into the sulphur-bearing formation. Such fluid is at a temperature such that sulphur is melted and flows in consequence by gravity downwardly to the bottom of the well. From thence the molten sulphur is forced upward through another of the annular spaces a certain distance by the hydrostatic pressure on the formation; then it is picked up in the well piping by a stream of compressed air, and raised to a point where it is discharged above the surface of the ground.

When mining sulphur by underground fusion from deposits which occur in rock strata over salt domes of the Gulf Coast type, certain difficulties are encountered due to the inherent nature of the geological formation encountered, which result in gradually increasing costs of operation as the mining progresses. A specific object of the present invention is to provide an improved procedure which is convenient in the salt dome region and effects a decrease in the cost of the mining operation.

The sulphur of deposits over salt domes is found both disseminated and in narrow veins in dense limestone. The formation itself, however, is often highly porous so that the mining fluid employed frequently passes away from the vicinity of the well through a system of connected cavities, without having given up its heat to the dense masses of limestone containing the sulphur. What is termed the "thermal efficiency of the process", i. e., the ratio of sulphur produced to heat units expended, is, in such cases, relatively low. In addition to this, the nature of the cavities and channels may be such that even though sulphur is melted, instead of running to the bottom of the well it may run off through a channel, heated by the flow of hot mining fluid, and not be recoverable in the particular area affected by the well under operation.

Another apparent cause for low thermal efficiency associated with this method of mining is the fact that the hot mining fluid, because of its high temperature, has a lower density than the natural waters which saturate the formation. Convection currents produced in the formation rapidly carry the hot mining water to the top of the formation, where little, if any, sulphur is located, and the heat is dissipated without useful results.

Various methods have been proposed from time to time for overcoming these difficulties. It has been proposed, for example, that the hot water which has found its way to the top of the formation be withdrawn and returned to the producing wells, after first being reheated to a point sufficiently high to melt sulphur. A principal difficulty in carrying out this proposal is that the mine waters are highly corrosive and also contain salts which sometimes form deposits in heating apparatus used to raise the temperature. A further difficulty is that these returned waters are still too low in density compared with the colder natural formation waters and tend to return directly to the point of withdrawal without having given up their heat content. Another specific object accordingly is to provide a method and means for utilizing the waste heat contained in the hot water from the upper portions of the sulphur formation while eliminating the difficulties with corrosiion and scale formation heretofore encountered.

The use of heated fluids of higher density than water has been suggested for the purpose of preventing convection currents and consequent dissipation of heat. Hot concentrated common salt solutions have been suggested to this end but no cheap and practical means have been proposed for carrying out the suggestions. One such previous suggestion is impractical to practice in a region where salt domes prevail, because of the fact that a dense layer of anhydrite invariably separates the sulphur formation from the body of salt and effectively prevents contact between the hot salt solution and the sulphur. No provision is made which would penetrate the anhydrite layer and bring the hot salt solution into effective contact with the sulphur; consequently no heat could be given up to the sulphur. Another object of this invention accordingly is to provide means for effecting such contact, when an anhydrite layer is present, in a convenient and inexpensive manner.