G. MOORE.

METALLURGICAL PROCESS.

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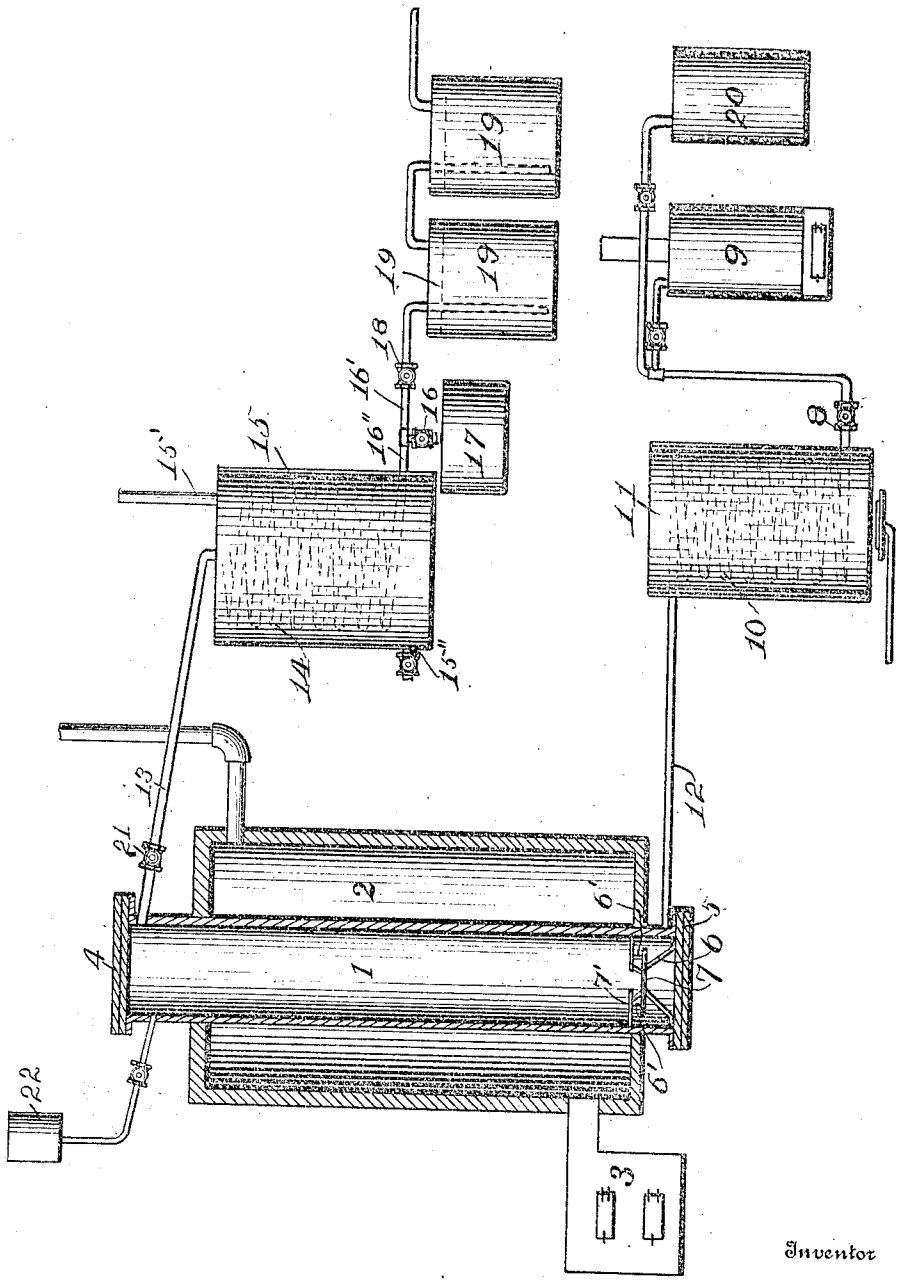

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METALLURGICAL PROCESS.

No. 913,535. Specification of Letters Patent. Patented Feb. 23, 1909.

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To all whom it may concern:

Be it known that I, GEORGE MOORE, citizen of the United States, residing at New York, in the borough of Manhattan and State of New York, have invented certain new and useful Improvements in Metallurgical Processes; 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 invention relates to improvements in the art of separating metals from their ores and it consists in certain novel processes set forth in the claims concluding this specification.

It is well known that metals in the form of suitable salts—say, chlorids, bromids, or other haloid salts, for example—may be separated from ores by vaporizing them at relatively moderate temperatures; but in all processes for effecting this result with which I am familiar, products of combustion, or atmospheric air, with or without the products of combustion, have been mixed during the vaporizing process with the vaporized metallic salts, diluting them with nitrogen and other gases to such an extent that it has been practically impossible to readily effect complete, or substantially complete, recovery of the metals.

The gist of my invention consists in vaporizing such metallic salts under conditions which exclude, or practically exclude, the presence of atmospheric air, or other dilutent or vehicle which cannot be readily condensed or absorbed. Of course, the presence of small quantities of nitrogen, while undesirable, would not be fatal to the practice of my invention, in substantial form.

In order to vaporize the metals at relatively low temperatures, it has long been common practice to convert them into haloid salts, such as chlorids or bromids. They may be converted into chlorids by being subjected to heat in the presence of common salt. Assuming, as an example, that the pulverized ore bearing a metal, or the metals to be recovered, intimately mixed with common salt, be heated in a closed retort, then the chlorid of the metal or metals will be given off. But it is evident that to conduct all of this gas out of the retort, a vehicle of some sort must be employed. If the vehicle be steam, for example, which may be readily condensed and in which the volatilized metallic chlorid is soluble, the result of the process will be aqueous solution of the metallic chlorids, and other soluble constituents, with such particles of metals as have been reduced to the metallic state and other soluble constituents. However, other gases than steam may be employed as a vehicle and will be readily suggested to those skilled in the art. As an example of such other vehicles, I may mention carbon dioxid, which can be readily absorbed by lime water. Again, instead of forming the chlorin or bromin gas within the retort, as above described, it will be readily understood that it may be generated elsewhere and introduced into the retort to act not only to convert the metals into the chlorids, but to act also as the vehicle for conveying the vaporized metallic salts away from the retort. On the other hand, instead of the vehicle employed being generated outside the retort, as above described, it may be generated within the retort itself. For example, an acid may be introduced therein which will act upon carbonates of lime or magnesia, which may be the constituent part of the ore treated or which may be added thereto, to liberate gases which will act as the vehicle for carrying the vapors of the metallic salts out of the retort.

The following is a description of the accompanying drawings, which show an apparatus capable of carrying out my improved processes, but it will be understood that my invention is in no wise limited to the form of apparatus illustrated and described.

The retort 1 may, of course, be constructed in any desired manner, and is preferably provided, at its lower end, with a plate 7 spaced above said lower end and supported upon suitable legs 6, 6 and also provided with plates 7′, 7′, carried by legs 6′, 6′ spacing the plates 7′ above plate 7 to exclude the ore from the cool portion of the retort. A tube 12 communicates with the bottom of the retort beneath the plate 7, and, when carrying out the process by the use of steam or gas, the said tube 12 is preferably in communication with a superheating coil 10 receiving a supply of steam or gas from any suitable boiler or gas generator.

In carrying out the process, ore with haloid salts—say, common salt—is introduced into the retort 1 surrounded by a heating chamber 2, and the said chamber is heated by any

suitable heating means 3. Before the volatilization of the metallic salts begins, however, I preferably remove the air from the retort by any suitable means, as, for example, by displacement with steam, or other vehicle employed. Said retort 1 is provided with a removable cover 4 for charging, and a removable bottom 5 for discharging ore, plates 7 and 7′ preventing the ore from filling the bottom of the retort, which is below the heating chamber and is, therefore, cool. When the air in the retort 1 is heated sufficiently the valve is opened and steam or other gas from boiler or gas generator 9 is admitted through coil 10 in heater 11 through pipe 12 into retort 1. As the steam or gas rises through the hot ore, it carries with it the volatile metallic bromids or chlorids in said retort, and they are passed out through pipe 13 into coil 14 within the cooling tank 15. The tank 15 is supplied with a cooling agent through pipe 15′, which agent flows through said tank and is discharged out pipe 15″, the supply through pipe 15 being continuous. If steam is used as the carrier of the metal haloids, the condensed water from such steam with the condensed metals is allowed to run through valve 16 in branch pipe 16′ of main discharge pipe 16″, communicating with coil 14, and said condensed products are discharged into receptacle 17. The flow of steam is continued until all of the vapors are removed from the retort. If other gases are used they are passed through valve 18 and into absorbing solutions: For example, if carbon dioxid is used as the carrier of the metal haloids, it is passed through calcium hydrate liquor which absorbs all of the gas and its accompanying metals.

Instead of mixing the salts of chlorin or bromin with the ore, the gas of these salts may be generated in chamber 20 and passed with or without additional carrying gas or steam from the gas generator or boiler 9, through the ore where the chlorin or bromin gas will unite with the metals and carry them through the condenser and absorber as described below.

During either of the operations hereinbefore described valve 21 in pipe 13 may be closed and a pressure developed in retort 1 to force the gases into all interstices of the ore. After the pressure in retort 1 has risen to the desired degree, the valve 21 may be opened and the relief of the pressure will cause a large expansion of the contained gases and steam, and a great percentage of the gases and metals immediately exhaust and pass out pipe 13. This supplying of pressure and expansion may be repeated until practically all of the metal gases are removed from said retort.

If desired, the carrier gas may be generated within the retort by allowing a chemical, such as acid, to pass from receptacle 22 through pipe 23 into the retort 1, where, by chemical action with constituents of ore, such as carbonates of lime or magnesia, gases will be liberated. These gases, by pressure and expansion, may be made to carry all the volatile metals out of the retort, as before described.

The combining of the metals with the chlorin or bromin is aided materially by first converting all the base metals into sulfates or sulfites before converting them into chlorids or bromids. This can be done, either by an oxidizing roast of the sulfids, or by contact of the oxids or carbonates with sulfuric acid gas, or by sulfurous acid gas with or without oxygen, or by these acid solutions; or oxygen gases of sulfur may be passed into the retort, to aid the reaction in the formation of sodium sulfate and the decomposition of the haloid salts.

The volatilization is aided by first mixing the pulverized ore with solutions of chlorid or bromid salts and then evaporating to dryness before treating in the retort. This gives intimate contact of every particle of ore with the chlorid or bromid.

It is obvious that the present improved process may be carried out by the utilization of various structures.

The present improved process may be carried out with certain essential steps variously related, the essential feature lying in the employment of a readily absorbed or condensed gas as a vehicle for volatilized metals,—such as nitrogen is not—, it being understood that steam is without question a gas, and the term "gas", employed in the claims of this application, is intended to cover steam under ordinary pressure or in a superheated condition, the superheated steam or other gas being preferable to steam or other gas of a lower temperature.

What I claim is:

1. The process of separating metals from their ores consisting in volatilizing salts of the metal in a suitable vessel, forcing a condensable gaseous vehicle through the subjected ores, and condensing the impregnated vehicle.

2. The process of separating metals from their ores, consisting in volatilizing salts of the metal in a suitable vessel, forcing steam upwardly through the subjected ores, and condensing the impregnated steam.

3. The process of treating ores in a suitable vessel with a salt capable of producing with the metal a volatilizable product, applying heat to the treated mass within the vessel, forcing a condensable gaseous vehicle through the heated mass and condensing the vehicle.

4. The process of treating ores with a salt in a suitable vessel, consisting in volatilizing the salt by the application of heat to the vessel, forcing a condensable gaseous vehicle

upwardly through the heated mass, and condensing the vehicle.

5. The process of treating ores in a suitable vessel with a salt capable of producing with the metal a volatilizable product, applying heat to the treated mass within the vessel, forcing steam upwardly through the heated mass, and condensing the steam.

6. The process of separating metals from their ores consisting in mixing pulverized ores with sodium chlorid in any suitable vessel applying heat to the vessel, forcing a condensable gaseous vehicle through the mass, and condensing the vehicle.

7. The process of separating metals from their ores consisting in mixing pulverized ores with sodium chlorid in any suitable vessel, applying heat to the vessel, forcing steam upwardly through the mass and condensing the steam.

8. The process of separating metals from their ores consisting in commingling the gas of a haloid salt with the ores, forcing a condensable vehicle through the ores and condensing the vehicle.

9. The process of separating metals from their ores consisting in commingling the gas of a haloid salt with the ores, forcing steam through the ores and condensing the steam.

10. The process of separating metals from their ores consisting in heating the ores, and forcing through them the gas of a haloid salt in combination with a condensable vehicle, and condensing the combined gases.

11. The process of separating metals from their ores consisting in heating the ores and forcing through them the gas of a haloid salt in combination with steam and condensing the combined gases.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE MOORE.

Witnesses:
L. H. MOORE,
CHAS. J. SHAW.