UNITED STATES PATENT OFFICE.

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PROCESS OF TREATING OXID ORES OF MANGANESE.

1,349,322. Specification of Letters Patent. Patented Aug. 10, 1920.

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To all whom it may concern:

Be it known that we, (1) GALEN HOWELL CLEVENGER, a citizen of the United States, and (2) MARTINUS HENDRICUS CARON, a subject of the Queen of Holland, residing at (1) Colorado Springs, county of El Paso, State of Colorado, and (2) Weltevreden, Java, Dutch East Indies, have invented certain new and useful Improvements in Processes of Treating Oxid Ores of Manganese, of which the following is a specification.

Considerable difficulty has been heretofore experienced in the preparation of marketable concentrates from low grade oxid ores of manganese. Water-concentration as ordinarily practised for the concentration of other ores is at best applicable only to certain types of manganese ores, and in general does not afford a very high recovery. Flotation as now practised is not applicable to ores of this type.

The present invention is a novel process whereby oxid ores of manganese (including water- or other partial concentrates derived from such ores) are readily and economically concentrated to a marketable grade. The process involves subjecting the ores or partial concentrates to a reduction treatment, whereby certain chemical and physical changes are brought about, followed by magnetic treatment of the modified ore to produce the manganese concentrate.

It is well known that simple application of heat to manganese dioxid results in the expulsion of a portion of the oxygen, yielding manganic oxid Mn_2O_3. This is generally more magnetic than the dioxid. We have discovered that when manganic oxid is further reduced, the resulting lower oxids, including the so-called manganous-manganic oxid Mn_3O_4, and more especially manganous oxid MnO are still more strongly magnetic, and can be more readily and completely separated from the gangue. Moreover the heat treatment under reducing conditions tends to consolidate the original fine amorphous material and to impart to it a more or less crystalline character. The physical changes undergone by the ore are of such nature that it breaks more freely from the gangue when crushed, and is decidedly more susceptible to treatment by magnetic separation.

It is not necessary in all cases to carry the reduction of the ore to the manganous oxid stage, as the invention may be practised when some or all of the ore is present as the manganous-manganic oxid Mn_3O_4. We prefer, however, to reduce the ore substantially to the manganous oxid condition, since this affords not only the best magnetic conditions but also the best physical conditions for the concentration.

Our preferred procedure in accordance with the invention is as follows, it being understood that the invention is not restricted to the details of the manipulative treatment:

The higher oxids of manganese present in the ore or partial concentrate are first reduced, either wholly or to a substantial extent, to the lowest or manganous oxid, MnO. The degree of subdivision of the ore necessary for proper reduction varies greatly: for example, some very porous ores require crushing only to pass a 2 or 3 inch ring, while certain denser ores may require crushing to 10 mesh or finer. Reduction is accomplished by heating the ore in presence of reducing gases, such for example as hydrogen, producer gas, or the like, to a temperature of 300° C. or higher. The higher the temperature the more rapidly the reduction takes place. A multiple-hearth circular roasting furnace of the MacDougal type; a straight line furnace of the Edwards' type; or rotary kilns either externally or internally fired; are all suitable for the purpose.

The ore is next cooled in such manner as to avoid material reoxidation. This may be accomplished by quenching the hot ore in water out of contact with air, or by cooling in a reducing atmosphere. The reduced and cooled ore is then crushed to whatever degree of subdivision may be necessary to liberate the particles of reduced manganese mineral from the gangue. This will vary with the particular ore, but in general any considerable portion of fines should be avoided.

The properly subdivided reduced ore is then passed through a magnetic separator, which may be either of the wet or dry type. We have found the Wetherill separator particularly well suited to this work, which in general requires a rather high magnetic intensity. There generally result three prod-

ucts, to wit: the concentrate which is sufficiently high-grade for marketing; the tailings which can be rejected; and the middlings which require further treatment. The middlings are re-crushed in order to free the mineral particles, and again passed through the magnetic separator.

A useful variation of the process, applicable to ores containing iron or other minerals more magnetic than the lower oxids of manganese, is to remove such minerals either before or after reduction as may be most readily accomplished, using for this purpose a magnetic field of lower intensity than that required for the lower oxids of manganese. This operation is then followed by the passage of the ore after reduction (in case the reducing treatment was not applied before the first operation), through a magnetic separator having a sufficiently high magnetic intensity to effect the separation of the lower oxids of manganese from the silica and other nonmagnetic gangue materials.

The process may also be combined with water-concentration, or other methods of concentration; and also with other processes for the recovery of any precious metal contained in the ore. One example of such application is the case of a very low-grade ore from which a substantial portion of a manganese mineral containing silver may be separated by water-concentration. The partial concentrate thus produced contains the major portion of the manganese and silver, and may be subjected to the reduction treatment, the silver being thereafter extracted by cyaniding or other method applicable to free-milling ores. The manganese content is brought to marketable grade, either before or after the recovery of the silver, by magnetic separation.

We claim:—

1. Process of treating oxid ores of manganese, comprising effecting reduction thereof to a state lower than the manganic oxid state, and then concentrating the manganese content by magnetic separation.

2. Process of treating oxid ores of manganese, comprising effecting reduction thereof to a state lower than the manganic oxid state, cooling the reduced ore under conditions to avoid reoxidation, and then concentrating the manganese content by magnetic separation.

3. Process of treating oxid ores of manganese, comprising effecting reduction thereof substantially to the state of maganous oxid, and then concentrating the manganese content by magnetic separation.

4. Process of treating oxid ores of manganese, comprising effecting reduction thereof substantially to the state of manganous oxid, cooling the reduced ore under conditions to avoid reoxidation, and then concentrating the manganese content by magnetic separation.

5. Process of treating oxid ores of manganese containing silver, comprising concentrating the manganese and silver contents thereof; subjecting the resulting partial concentrate to a reducing treatment; and thereafter extracting the silver and effecting a further concentration of the manganese content by magnetic separation.

6. Process of treating oxid ores of manganese containing minerals more highly magnetic than the lower oxids of manganese, comprising separating the more magnetic minerals by a magnetic field of relatively low intensity, and thereafter concentrating the manganese content of the ore, previously reduced to a lower state of oxidation, by a magnetic field of higher intensity.

In testimony whereof we affix our signatures.

GALEN HOWELL CLEVENGER.
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