

E. F. GOLTRA.
PROCESS FOR CLEANING IRON ORES.
APPLICATION FILED JAN. 4, 1910.

957,157.

Patented May 3, 1910.

Fig. 1.

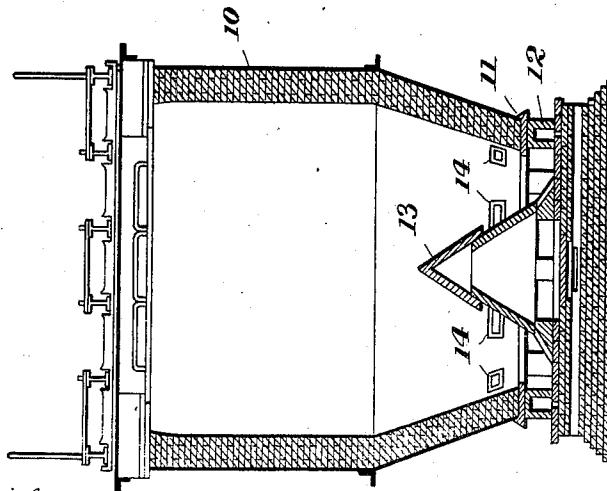
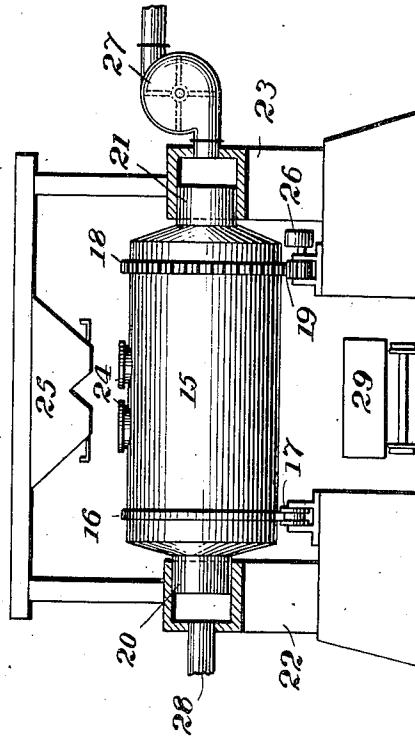


Fig. 2.



Witnesses

J. H. Brunning
J. H. Brunning

Inventor

Edward F. Goltra
By *Factor, Freeman, Watson & Co.*
Attorneys

UNITED STATES PATENT OFFICE.

EDWARD F. GOLTRA, OF ST. LOUIS, MISSOURI.

PROCESS FOR CLEANING IRON ORES.

957,157.

Specification of Letters Patent.

Patented May 3, 1910.

Application filed January 4, 1910. Serial No. 536,403.

To all whom it may concern:

Be it known that I, EDWARD F. GOLTRA, a citizen of the United States, and resident of St. Louis, State of Missouri, have invented certain new and useful Improvements in Processes for Cleaning Iron Ores, of which the following is a specification.

This invention relates to a process for cleaning iron ores and for preparing the same for the subsequent operations.

Some iron ores, as brown hematite, contain a large percentage of clay as a gangue, and this gangue must be separated from the ore before it can be used in the blast furnace. Heretofore the gangue in clayey ores has been separated from the ore by washing with water in the usual jigging or log washing operations. The ore and its gangue were also thrown on an inclined sidewise movable screen, or in a revolving screen or trommel and subjected to a spray of water, which washed out the dirt. The above washing processes are, however, open to many objections. The stream of water carries off much of the ore, and it is impossible to thoroughly clean the ore in this manner of all the gangue in the crevices and in and around the ore. In some ores the percentage of clay is very high; sometimes there is from five to seven times as much clay as ore. It will, therefore, be readily seen that in order to wash out this enormous quantity of clay by a stream of water, it will not only require enormous quantities of water, which is quite an item where water is scarce, but that these large quantities of water will carry with them a large percentage of the ore. The ore, after being washed with water, must be dried and calcined before it can be used in the blast furnace. There are thus great losses of ore, heat in drying the wet ore, and in water, and even then the ore contains a large percentage of gangue. Due to the above objections to prior processes, it has been impossible and uneconomical to use large quantities of existing ores.

One of the objects of this invention, therefore, is to devise a process whereby the ore is washed or cleaned of its gangue by a blast of air, and another object is to devise a process whereby the moisture and other volatile matter are driven off and the ore prepared for the blast furnace.

The invention generally stated consists in the operations as hereinafter fully described and claimed.

The process, and the apparatus for carrying out the process will be described in connection with the accompanying drawings in which—

Figure 1 is a section through a common form of roasting or calcining kiln, and Fig. 2 is an elevation of a tumbling apparatus.

Fig. 1, shows a common form of calcining kiln known as the Gjers calcining kiln. It is a circular kiln, the walls 10 of which are built of iron plates lined with fire brick, the lower part being conical in form. The walls rest upon a cast iron ring 11 which is supported by cast iron columns 12, leaving a clear space for the removal of the calcined ore. A cast iron cone 13 with its apex upward rests on the foundation in the center of the kiln, directs the descending ore outward, and renders its removal more easy through the clear spaces between the columns. The walls are provided with a series of openings 14 supplied with doors for the admission and regulation of the air. The ore is added at the top and removed at the bottom as calcined so that the process is continuous. Since this calcining kiln is of well known construction, further detailed description will be unnecessary.

Referring to Fig. 2, which shows a tumbling apparatus, 15 designates a tumbling barrel provided with a smooth ring 16 resting upon anti-friction rollers 17, and a toothed ring 18 resting upon and meshing with pinions 19. This tumbling barrel is provided with hollow cylindrical extensions 20 and 21 extending into and making an airtight connection with heads 22 and 23 respectively. The tumbling barrel or drum 15 is provided with manholes which are closed by removable manhole covers 24. A double hopper 25 is located above the tumbling barrel and supported by suitable frame-work so that when the tumbling barrel is moved to the position shown in Fig. 2, and the manhole covers 24 removed, the hopper will discharge into the barrel. The pinions 19 are driven by any suitable means, in this particular instance, one of the pinion shafts is provided with a belt pulley 26, by means of which it may be belted to any suitable motor. A centrifugal fan or blower 27 is connected to the head 23, while the other head 22 is provided with a suitable intake pipe 28. By means of this fan a strong blast may be passed through the tumbling barrel while it is rotated around

its axis, the blast entering the intake 28 and passing through the hollow extensions 20 and 21 and the tumbling barrel. The tumbling barrel is preferably elevated on its foundations so that a car 29 may be moved beneath the same, and in this way the contents in the tumbling barrel may be dumped into the car by rotating the former about its axis so that the manholes are below.

10 Having described one form of apparatus which is to be used in performing the process, the process will now be described.

The ore as mined is preferably crushed or reduced to a workable form. It is not 15 necessary to pulverize the ore, in fact it is preferable not to do so, but it is sufficient if it is crushed so it may pass through a two or two and one half inch mesh, or even to a larger size. In some cases it may not be 20 necessary to crush the ore at all. The ore and its gangue when crushed, or in the condition as they leave the mine are charged in at the top of the kiln shown in Fig. 1 and there subjected to a heating and calcining operation at a temperature and for a 25 period sufficient so as to thoroughly dry out the clayey gangue, and preferably so as to also drive off the free moisture, combined moisture if present and other volatile matter 30 in order to prepare the ore for the furnace. The temperatures and the duration of the heating operation will, of course, depend upon the condition of the ore as to the amount of gangue and volatile matter contained therein etc. In all cases, however, 35 the operation is continued until the gangue has been thoroughly dried out and rendered brittle. The heat will not only render the clayey gangue brittle but any hard stone contained in the ore will also be separated. 40 This stone gangue will sometimes occur in the ore in the form of layers; now the heat during the heating and calcining operations will cause the ore and stone to expand at different rates and thus the stone will be 45 broken and cracked off. A skilled operator can of course ascertain when the ore and gangue have been reduced to the proper condition, and when this condition is obtained 50 the ore and gangue are raked out of the kiln through the spaces between the columns 12. After the ore and its gangue have been thus prepared they are conveyed to the tumbling apparatus shown in Fig. 2 in any suitable 55 manner. The ore is dumped into the hopper 25 and from there discharged into the tumbling barrel through the manholes. After a sufficient quantity of the ore and its gangue have been discharged into the tumbling barrel, the manhole covers are replaced 60 and the tumbling barrel is started in operation. During the revolving action of the tumbling barrel the ore and its gangue will be thrown around and tumbled so as to 65 thoroughly shake loose the gangue from the

ore. As this tumbling action proceeds and the gangue is knocked off, the heavy lumps will pulverize the dried out gangue and reduce it to a powder but the ore itself will not be pulverized to any extent. During 70 the heating and calcining operation the heat will crack open the lumps of ore to expose all the gangue, and to dry and prepare the same. This cracking open will be completed during the tumbling operation, where the 75 gangue is shaken loose and pulverized. During the tumbling operation a strong blast is passed through the tumbling barrel and through the ore contained therein by means of the fan 27. This blast in passing over, 80 through and around the ore as it is thrown around in the tumbling barrel, will sweep and clean the ore of its gangue. The blast will seek out the dried out and loosened gangue in, around and clinging to the ore 85 and in the crevices and carry the gangue along with it leaving the heavier ore lumps in the tumbling barrel. It will thus be seen that the blast of air washes the ore of its gangue in the same manner that the water 90 does in the water washing operation. In this process, however, the blast of air can enter crevices in the ore where a stream of water cannot enter, and thus practically all of the gangue will be washed out. After the 95 ore has been washed of its gangue the blast is stopped and the cleaned and washed ore is discharged into the car 29.

The cleaned ore as it leaves the tumbling barrel is in a condition to be used in a blast 100 furnace immediately and no preliminary calcining is necessary. The water and other volatile matter have been driven off in the heating and calcining operation, and the ore is placed in a porous condition, which is 105 desirable for blast furnace operation. This process, therefore, dispenses with all water washing operations and its resultant losses in ore, heat, etc. and at the same time the ore is discharged after the air washing operation 110 in a condition to be immediately used in the furnace.

In the specific embodiment of this apparatus, certain types of apparatus have been selected for convenience. It is to be understood, however, that this invention is not 115 to be limited to the specific apparatus shown. Any other type of apparatus may be used for heating and calcining the ore so as to render the gangue easily separable therefrom, and any other apparatus may be used 120 for tumbling the ore and cleaning it by the air blast. The tumbling apparatus may consist of a long inclined rotary drum or tube in which the prepared ore and gangue 125 are fed in at one end while a blast passes through the drum in the opposite direction, the cleaned ore being discharged at the lower end. In all forms of apparatus, however, the essentials are that the ore be prepared 130

for loosening the gangue and that the prepared gangue be washed from the ore by the air blast.

5 In the specific apparatus shown, the heating and calcining apparatus and the tumbling apparatus are shown as separated and no connection is shown between them, the prepared ore being conveyed to the tumbling barrel in any suitable manner. It is
10 obvious, however, that any known form of conveyer may be used for conveying the ore and gangue, as discharged from the heating and calcining apparatus, to the hopper of the tumbling apparatus. Furthermore it
15 is possible to perform the entire process in a single apparatus; for instance, a heated blast may be passed through the long inclined tube or drum referred to, the heated blast preparing the gangue and sweeping
20 and washing it from the ore. This particular embodiment is described in my copending application Serial No. 523,091, filed October 18, 1909. All of these embodiments are within the scope of this invention; it,
25 therefore, is to be understood that this invention is not to be limited to the specific arrangement as shown and described.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

30 1. The herein described process of treating iron ores containing moist clay etc. as a

gangue, which consists in heating the ore and its gangue at a temperature and for a period sufficient to drive off the moisture 35 and to render the gangue easily separable from the ore, tumbling the ore and its gangue to shake loose the gangue from the ore and to pulverize the gangue by said tumbling action, and subjecting the ore and 40 gangue to a strong gaseous blast which sweeps, cleans and removes the gangue from the ore.

2. The herein described process of treating iron ores containing moist clay etc. as a 45 gangue, which consists in calcining the lumps of ore and its gangue at a temperature and for a period sufficient to expose and dry out the gangue and to render it easily separable from the ore, to drive off 50 the moisture and volatile matter, tumbling the ore and its gangue to shake loose the gangue from the ore and to pulverize the gangue by said tumbling action, of the lumps, and subjecting the ore and gangue to 55 a strong gaseous blast which sweeps, cleans and removes the gangue from the ore.

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

EDWARD F. GOLTRA.

Witnesses:

J. D. DANA,

FRANK LUCAS.