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W. KOEHLER.

PROCESS FOR THE REDUCTION OF ORES.

APPLICATION FILED AUG. 4, 1905.

Fig. 1.

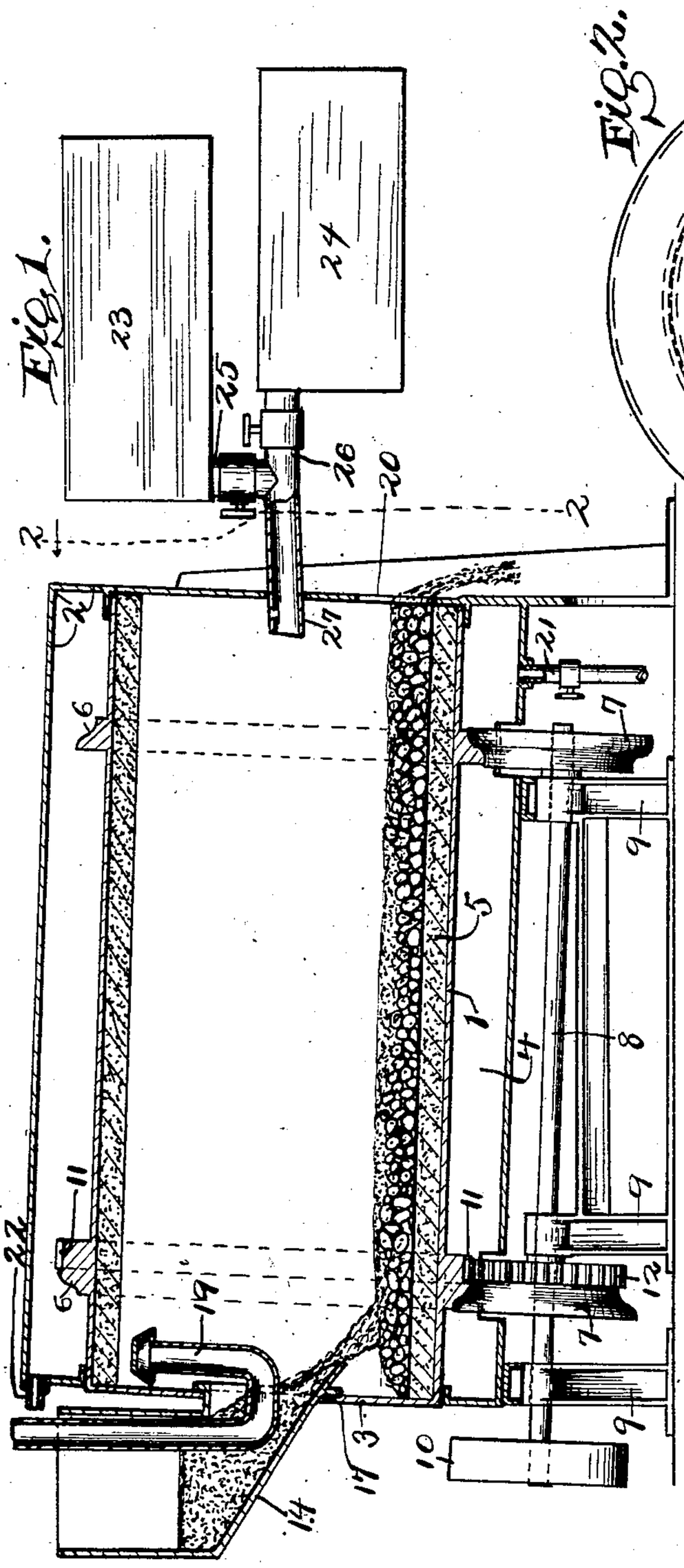
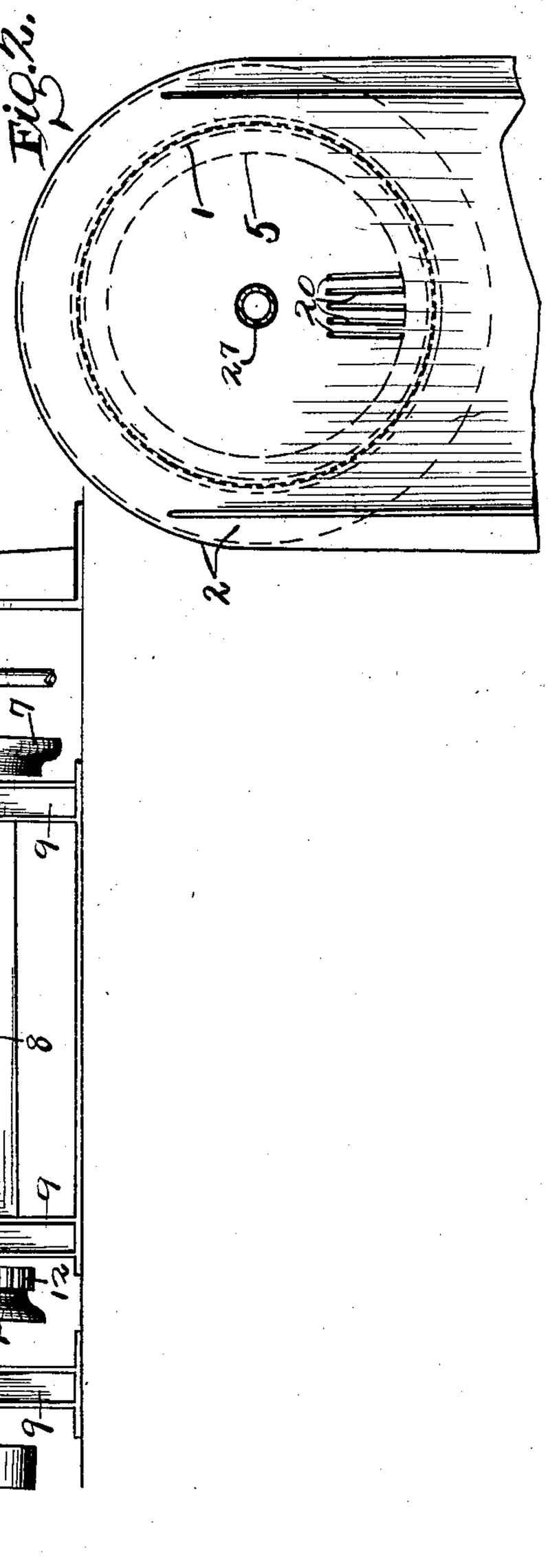


Fig. 2.



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PROCESS FOR THE REDUCTION OF ORES.

No. 824,663. Specification of Letters Patent. Patented June 26, 1906.

Application filed August 4, 1905. Serial No. 272,722.

To all whom it may concern:

Be it known that I, WILLIAM KOEHLER, a citizen of the United States of America, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Processes for the Reduction of Ores; and I 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 pertains to make and use the same.

This invention relates to a new process for the treatment of refractory or rebellious ores in order to bring them into such a condition that they may be easily worked according to well-known methods.

The object of this invention is to provide a cheaper and more economical method for securing the complete chlorination of ore than is now possible under the present methods of treating ores.

In carrying out my process the material or ore is subjected at a suitable temperature, which will vary according to the ore under treatment, to the action of a halogen-acid gas in an anhydrous condition, or in case of very refractory ore the ore is subjected to the action of a halogen-acid gas in an anhydrous condition in the presence of nitric acid in an anhydrous gaseous condition.

In carrying out my process I prefer to use hydrochloric-acid gas, owing to its comparative cheapness, and therefore I subject the material or ore which is to be treated to the action of anhydrous hydrochloric-acid gas or to a mixture of anhydrous hydrochloric-acid gas and nitric acid in an anhydrous gaseous condition. To secure the proper working of my process, the ore must be at a suitable temperature during the working, and this temperature will vary according to the ore which is being treated. In some instances the heat of combination will be sufficient to bring about decomposition of the material, and in such cases the application of external heat would be unnecessary, and in other instances the heat of combination will not be sufficient to carry out the reaction, and it will be necessary, therefore, to apply external heat.

The process can be carried out in any suitable metallurgical furnace or similar apparatus.

In the accompanying drawings, Figure 1 shows a central sectional view of such an apparatus; and Fig. 2 is a sectional view of the same on line 2 2, Fig. 1.

In the drawings, 1 represents a cylinder which is rotatably mounted in a frame 2. The cylinder 1 is closed at one end by the side of the frame and at its other end is provided with a head 3, formed integral with the said cylinder. Around the cylinder is arranged a chamber 4 for receiving the gases which are to heat the cylinder. The cylinder 1 is preferably provided with a lining 5, of cement or similar material, in order to protect the cylinder from the action of the gases used in carrying out the process. On the exterior surface of the cylinder are formed bearing-rings 6, which are arranged to rest on the drums 7, secured on a shaft 8, mounted in suitable supports 9. On one end of the shaft S is arranged a pulley 10. On the exterior surface of the cylinder 1 is formed a toothed ring 11, which is arranged to mesh with a gear-wheel 12, secured on the shaft 8. The cylinder 1 is preferably mounted so that the axis thereof inclines toward the front end thereof. A hopper 14 for holding the material to be treated is arranged at the rear end of the drum or cylinder, and the outlet of the hopper communicates with the interior of the drum through an opening 17, formed in the head of the drum. A flue-pipe 19 is arranged at the rear end of the drum in order to permit the escape of the spent gases, and this flue is preferably arranged to extend through the hopper, so that the heat from the escaping gases will be imparted to the material in the hopper. An outlet 20 is provided for the escape of the material after it has been treated. The chamber 4 is provided with an inlet-pipe 21 and an outlet-pipe 22. Gas-reservoirs 23 and 24 are arranged in proximity to the cylinder 1 and are connected therewith by means of valved pipes 25 and 26, respectively, and a nozzle 27.

In carrying out my process with an apparatus such as is shown in the drawings the material or ore to be treated is first reduced to the proper size and is then placed in the hopper 14. The cylinder is then rotated, and the ore is allowed to feed slowly into the cylinder.

The valve in the pipe 25, communicating with the reservoir 23, which has been previously filled with anhydrous hydrochloric-acid gas, is then opened, and the hydrochloric-acid gas is allowed to enter the cylin-

der 1. If the nature of the ore makes it necessary, the cylinder is heated by means of hot air, vapor, steam, or any other suitable agent introduced into the chamber 4, surrounding the cylinder, through the pipe 21. The continuous rotation of the cylinder will bring all particles of the ore into contact with the anhydrous hydrochloric-acid gas and by the time the ore has reached the outlet at the front end of the cylinder it will be completely chlorinated. The chlorinated product is then treated in any suitable manner to recover the metal and to regain all other valuable products contained therein. The spent gases will pass through the flue and can be conducted away and disposed of as desired. All oxids and carbonates will be completely chlorinated by subjecting them in this manner to the action of hydrochloric-acid gas in an anhydrous condition. It will, however, be advantageous in treating most sulfid, selenid, telurid, and arsenid ores, herein referred to collectively as ores containing a metal and a metalloid, to admit to the cylinder while the said ores are being treated a quantity of nitric acid in an anhydrous gaseous condition, and therefore when such ores are being treated while the hydrochloric acid is being admitted to the cylinder the valve in the pipe 26, which communicates with the reservoir 24, which has been previously filled with nitric acid in an anhydrous gaseous condition, is also opened and both gases are admitted to the cylinder at the same time. The nitric-acid gas and the hydrochloric-acid gas will combine and the reaction will give nitroxyl chlorid and chlorin gas just being liberated—that is, in a nascent condition, and therefore in condition to act most powerfully.

What I claim is—

1. The process of treating ores which consists in subjecting them to the action of a halogen-acid gas in presence of an oxidizing agent.

2. The process of treating ores which consists in subjecting them to the action of a halogen-acid gas in presence of a gaseous oxidizing agent.

3. The process of treating ores which consists in subjecting them to the action of gaseous hydrochloric acid in presence of an oxidizing agent.

4. The process of treating ores which consists in subjecting them to the action of a gaseous mixture containing hydrochloric acid and an oxidizing agent.

5. The process of treating ores consisting in subjecting the ores to the action of a halogen-acid gas in the presence of nitric acid in a gaseous condition.

6. The process of treating ores consisting in subjecting the ores to the action of a halogen-acid gas in the presence of nitric acid in an anhydrous gaseous condition.

7. The process of treating ores consisting in subjecting the ores while heated to the action of a halogen-acid gas in the presence of nitric acid in a gaseous condition.

8. The process of treating ores consisting in subjecting the ores while heated to the action of a halogen-acid gas in the presence of nitric acid in an anhydrous gaseous condition.

9. The process of treating ores consisting in subjecting the ores to the action of an anhydrous halogen-acid gas in the presence of nitric acid in a gaseous condition.

10. The process of treating ores consisting in subjecting the ores to the action of an anhydrous halogen-acid gas in the presence of nitric acid in an anhydrous gaseous condition.

11. The process of treating ores consisting in subjecting the ores while heated to the action of an anhydrous halogen-acid gas in the presence of nitric acid in a gaseous condition.

12. The process of treating ores consisting in subjecting the ores while heated to the action of an anhydrous halogen-acid gas in the presence of nitric acid in an anhydrous gaseous condition.

13. The process of treating ores consisting in subjecting the ores to the action of hydrochloric-acid gas in the presence of nitric acid in a gaseous condition.

14. The process of treating ores consisting in subjecting the ores to the action of hydrochloric-acid gas in the presence of nitric acid in an anhydrous gaseous condition.

15. The process of treating ores consisting in subjecting the ores while heated to the action of hydrochloric-acid gas in the presence of nitric acid in a gaseous condition.

16. The process of treating ores consisting in subjecting the ores while heated to the action of hydrochloric-acid gas in the presence of nitric acid in an anhydrous gaseous condition.

17. The process of treating ores consisting in subjecting the ores to the action of anhydrous hydrochloric-acid gas in the presence of nitric acid in a gaseous condition.

18. The process of treating ores consisting in subjecting the ores to the action of anhydrous hydrochloric-acid gas in the presence of nitric acid in an anhydrous gaseous condition.

19. The process of treating ores consisting in subjecting the ores while heated to the action of anhydrous hydrochloric-acid gas in the presence of nitric acid in a gaseous condition.

20. The process of treating ores consisting in subjecting the ores while heated to the action of anhydrous hydrochloric-acid gas in the presence of nitric acid in an anhydrous gaseous condition.

21. The process of treating ores containing a metal and a metalloid which consists in sub-

jecting the dry ore to the action of a halogen-acid gas.

22. The process of treating ores containing a metal and a metalloid which consists in subjecting the dry ore to the action of a halogen-acid gas in presence of an oxidizing agent.

23. The process of treating sulfid ores which consists in subjecting the dry ore to the action of a halogen-acid gas.

24. The process of treating sulfid ores which consists in subjecting the dry ore to the action of a halogen-acid gas in presence of an oxidizing agent.

In testimony whereof I sign the foregoing specification in the presence of two witnesses.

WILLIAM KOEHLER.

Witnesses:
VICTOR C. LYNCH,
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