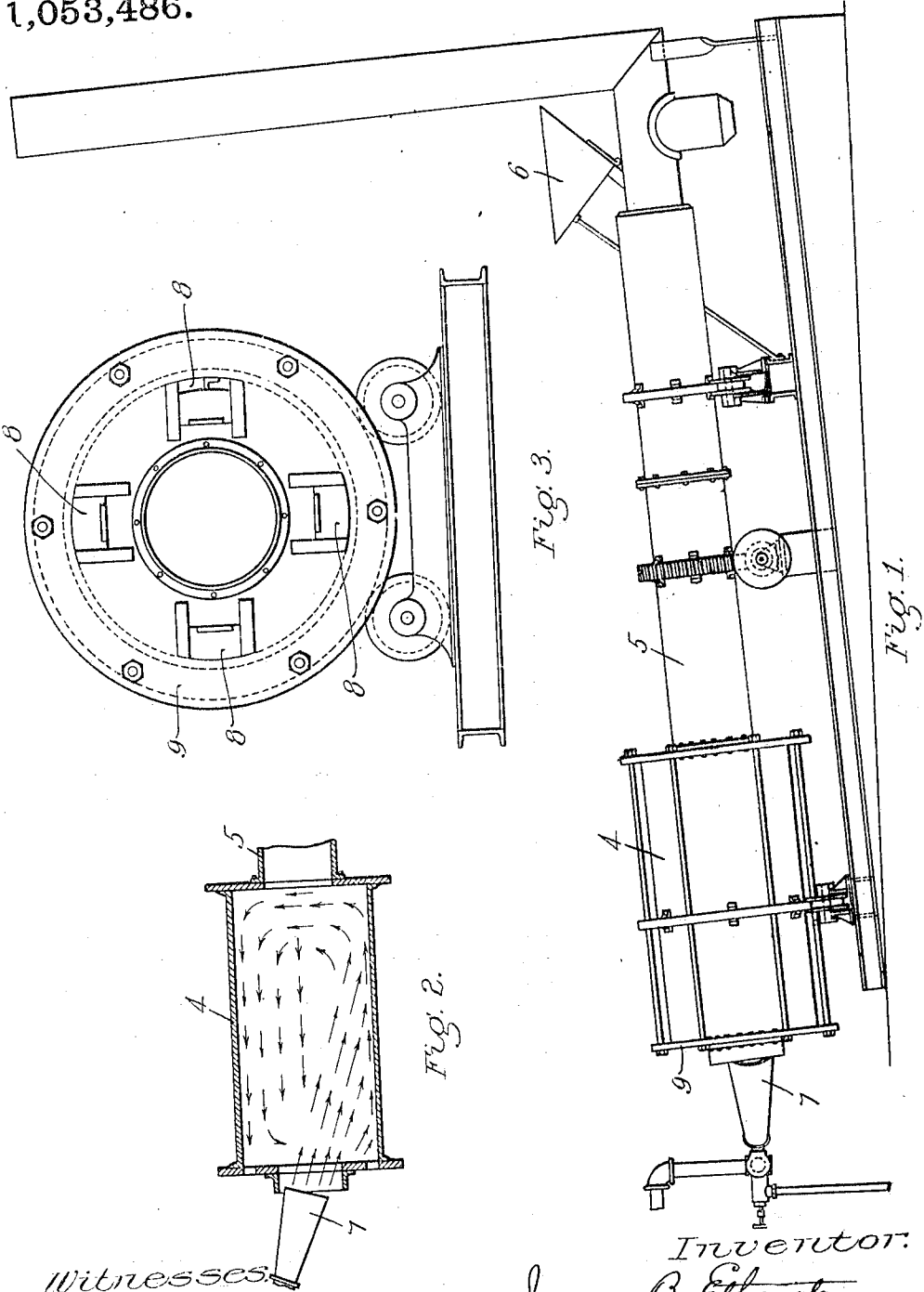


J. B. ETHERINGTON.
 PROCESS OF TREATING ORES PREPARATORY TO MAGNETIC SEPARATION.
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Patented Feb. 18, 1913.

1,053,486.



Witnesses:
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UNITED STATES PATENT OFFICE.

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PROCESS OF TREATING ORES PREPARATORY TO MAGNETIC SEPARATION.

1,053,486.

Specification of Letters Patent.

Patented Feb. 18, 1913.

Original application filed January 12, 1911, Serial No. 602,177. Divided and this application filed April 6, 1912. Serial No. 688,938.

To all whom it may concern:

Be it known that I, JAMES B. ETHERINGTON, a citizen of the United States, residing at Winthrop, in the county of Suffolk and State of Massachusetts, have invented new and useful Improvements in Processes of Treating Ores Preparatory to Magnetic Separation, of which the following is a specification.

This invention relates to the treatment of ferruginous ores containing sulfids, being a division of my copending application filed Jan. 12, 1911, Serial No. 602,177.

The invention consists in a process the object of which is to render such ores susceptible to magnetic or electrical influences without volatilizing or materially oxidizing the metallic constituents.

My process consists primarily in heating the ore in a furnace, containing a non-oxidizing atmosphere or an atmosphere possessing a minimum amount of free oxygen.

I have discovered that in order to get the best results in magnetizing non-magnetic ores by heat, it is desirable to admit only sufficient air to support the combustion of the fuel, without materially oxidizing the metallic constituents of the ore.

I am aware that, prior to my invention, it was discovered that the ferruginous constituent in non-magnetic pyritiferous ores containing in addition to the iron other base or precious metals could be magnetized by subjecting the same to heat for a brief time without removing substantial portions of any of the solid constituents of the ore; and that Letters Patent were granted for such process to Henry F. Campbell, No. 723,363, dated March 24, 1903, which invention I am utilizing, in the herein described process, to the greatest practical and commercial advantage.

Prior to my invention, it was the general practice to roast sulfid ores for a number of hours while freely exposed to oxidation, in order to render them magnetic, employing therefor costly and ponderous apparatus, and producing wasteful results. By means of my process, employing in the practice of the same comparatively light and inexpensive apparatus, I am able to treat non-magnetic pyritiferous ores commercially and economically so as to render the ferruginous

constituents magnetic by subjecting said ores to heat for a few minutes.

The principal feature of my process consists in conveying the ore through a furnace, into which is blown a flame created outside the furnace, and carrying with it into the furnace practically only sufficient air to support the combustion of the fuel in the blast, thereby preventing any considerable oxidation of the ore. This is contrary to the former methods. Heretofore it has been a common practice to roast the ore in a furnace or roaster with an abundance of air circulating through it, in order to oxidize fully and as rapidly as possible the sulfur of the ore, thereby converting the iron into an oxid. The fire was built and run inside of the roaster and depended upon a free draft of air through the roaster to maintain it. There were no means, nor any attempt to provide means, to limit the supply of air, but on the contrary, to furnish the maximum amount of oxygen to the ore, was considered indispensable to good results. The difference between the prior art methods and my process is radical in this respect.

My invention resides in heating the ore while exposed to the minimum amount of oxygen. The prior art consists in exposing the ore to the maximum amount of oxygen while roasting it.

My invention is not limited to heating in a strictly reducing or non-oxidizing atmosphere, but includes one that approximates it by possessing a minimum amount of oxygen which accomplishes the essential objects of my invention. Whenever I make use of the terms non-oxidizing or reducing atmosphere, they shall be understood to include conditions under which the ore while being heated is exposed to a minimum amount of oxygen.

In the methods of roasting ore, prior to my invention, the heat was not applied to the ore with such precision and uniformity that any reliance could be placed upon magnetizing the ore that passed through the furnace, without excessively roasting a large percentage of it, and actually fusing some of its constituents.

There were two serious evils in the apparatus and methods of the prior art, namely,

first, the dependence upon a natural draft of air through the roaster to support the fire within it; and secondly, the great length of time required to insure the roasting of all parts of the ore, owing to the inability to control the degree of heat, and to apply it to the ore with precision. The preservation of the sulfur in the ore during the magnetizing process increases the commercial value of both the zinc and iron sulfids after separation.

When sulfid ores, either low or high grade, containing iron sulfids and zinc sulfids alone, or combined with other metals, are treated by my process, and then subjected to magnetic separation, the products are a zinc sulfid containing a minimum amount of iron, and an iron sulfid containing a minimum amount of zinc. The iron sulfid retains such a large percentage of its original sulfur as to make it a valuable commercial product.

My invention is applicable to all kinds of ores containing iron and other base and precious metals which require treatment to make them susceptible or more susceptible to magnetic influences.

The means heretofore employed by me for practising my process, which have proved to be efficient are shown in the accompanying drawing in which—

Figure 1 is a side elevation of the same; Fig. 2 is a diagrammatic view illustrating the heat generators and the interior of the larger section of the furnace; and Fig. 3 is an elevation of the discharging end of the furnace.

Referring to the drawing, 4 is an unlined metallic cylinder mounted and rotated in any manner well known in the art for mounting and rotating roasters of various descriptions. This cylinder 4 may be made from 30 to 40 inches in diameter and of plate iron about $\frac{3}{8}$ of an inch thick.

5 represents a cylinder of similar material, but longer and of smaller diameter, which is bolted to the head of the cylinder 4, and connects it with the flue either directly or through any suitable dust arrester.

6 is a hopper for feeding the ore into the furnace, from which it is caused to travel through the furnace by reason of the inclination and rotary motion thereof. The ore is met in the cylinder 4 by the flame from a hydro-carbon burner 7, located outside of the cylinder 4, into which the flame and heat are projected by a blast of air supplied and regulated by said burner in the familiar way. For my purpose, I prefer to use the

type of burner shown in the United States patent to Barker, No. 825,290, issued July 10th, 1906. But any burner employing either fuel oil, coal gas, or the like, and capable of producing a jet of flame when projected by a blast of air into the retort, will suffice for my purposes. The small ports 8 for the discharge of the ore in the head 9 (see Fig. 3) are not of sufficient area to admit an appreciable amount of air, and no air enters them except as a result of the artificial blast of air from the burner, because without the latter, the pressure of air and gases is outward from the furnace. I find, therefore, that the construction shown enables the operator to predetermine the volume of air admitted to the furnace and to control and regulate it so as to maintain practically a reducing or non-oxidizing atmosphere in the furnace.

In Fig. 2 the arrows show the course of the flame and heat projected from the burner. While I have shown but one burner, two or more may be employed, as preferred. The means shown are only one of many that may be devised to practise my process, and they are shown simply to illustrate one way but not to limit in any manner the scope of the invention.

What I claim and desire to secure by Letters Patent is:

1. The process of treating ore, containing non-magnetic iron sulfids, consisting of subjecting the same to heat in a non-oxidizing atmosphere until the iron sulfids become magnetic, and then removing the same from the action of the heat.

2. The process of treating ore, containing non-magnetic iron sulfids, consisting of subjecting the same to heat in a reducing atmosphere until the iron sulfids become magnetic, and then removing the same from the action of heat before the iron sulfids are converted into oxids.

3. The process of concentrating ores, containing non-magnetic zinc and iron sulfids, consisting of subjecting the same to heat in a non-oxidizing atmosphere until the iron sulfids become magnetic, then removing the ore from the action of heat before the sulfids are converted into oxids, and then magnetically separating the same.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses, this 18th day of March 1912.

JAMES B. ETHERINGTON.

Witnesses:

JOHN F. PERKINS,
LOUIS ALLEN.