(No Model.)

C. M. ALLEN.

PROCESS OF SMELTING ORES AND REFINING METALS.

No. 496,032. Patented Apr. 25, 1893.

Fig. 1.

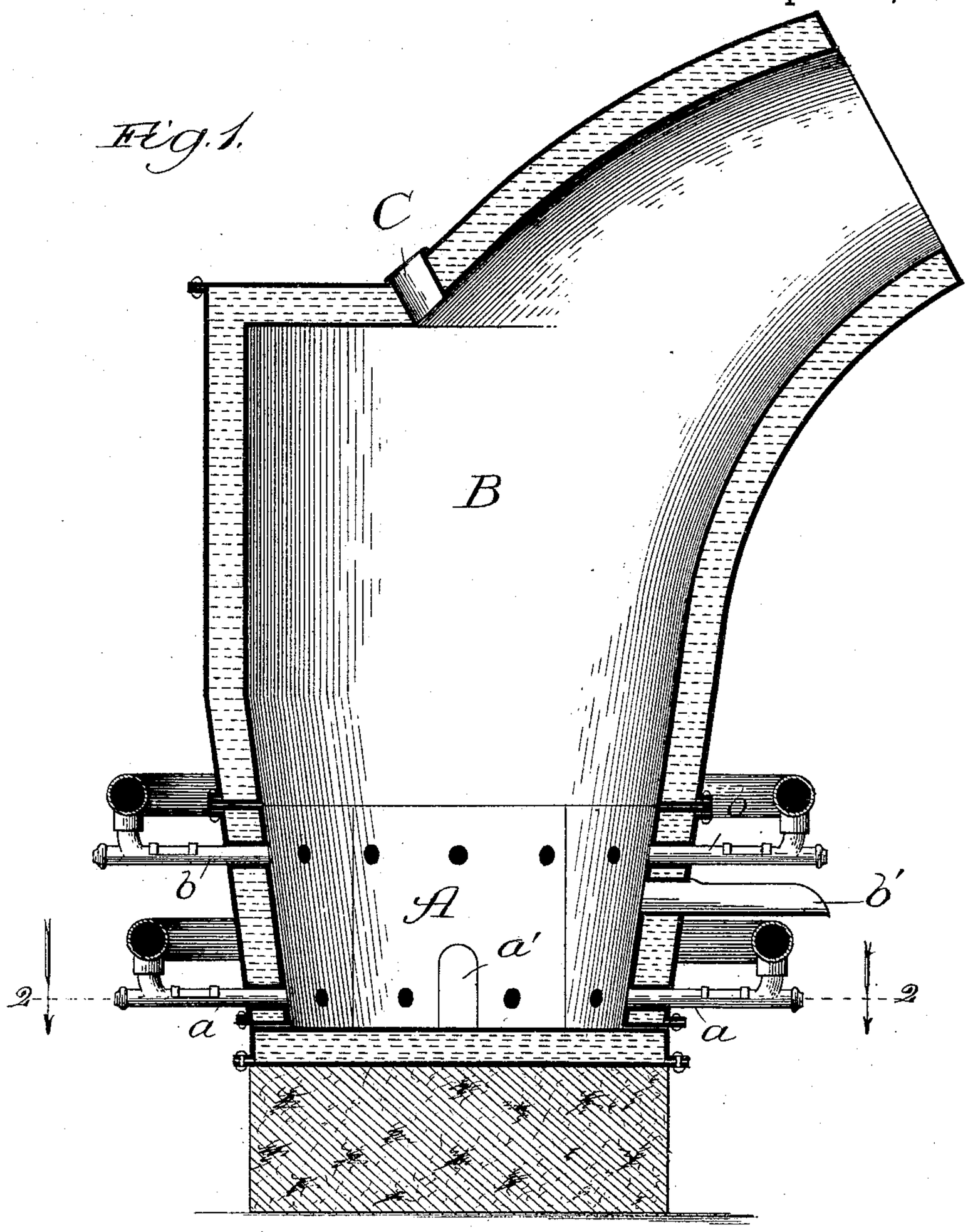
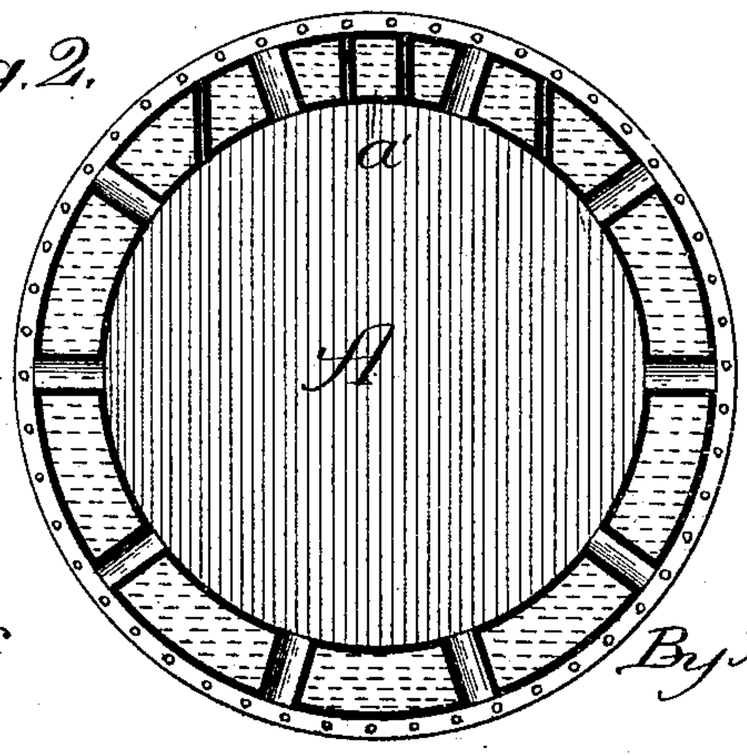


Fig. 2.



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UNITED STATES PATENT OFFICE.

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PROCESS OF SMELTING ORES AND REFINING METALS.

SPECIFICATION forming part of Letters Patent No. 496,032, dated April 25, 1893.

Application filed April 12, 1892. Serial No. 428,830. (No model.)

To all whom it may concern:

Be it known that I, CHARLES M. ALLEN, a citizen of the United States, residing at Butte City, in the county of Silver Bow and State of Montana, have invented a new and useful Process of Smelting Ores and Refining Metals, of which the following is a specification.

The object of my invention is to provide for smelting ores and refining metals in one operation, and for utilizing as fuel the sulphur in the ores to be refined or smelted; and the invention consists in the process hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a vertical sectional elevation, and Fig. 2 a cross section taken on line 2 of Fig. 1.

A is the converter, *a* the tuyeres, and *a'* the metal tap thereof; B the blast furnace, *b* the tuyeres, and *b'* the slag spout thereof; and C the opening for the introduction of concentrates, ore, matte, or other substances to be treated.

In carrying out my process, I use a combined converter and blast furnace, which, as shown, is circular in form, but which may be square, oval, rectangular, or in any shape desired. The sides of the converter and furnace are preferably made of steel, iron, or copper plates, with an intervening water space as in the usual form of water jacket blast furnace, the bottom being also water jacketed—although the water jacketing is not in all cases necessary. There are two rows of tuyeres, one above the other, the upper row being for the blast furnace and the lower row for the converter. The raw concentrates, ore, matte, or other substances to be treated, are introduced through a suitable opening in the top or sides as may be most convenient. The top of the furnace may be so shaped that the particles thrown upward by the force of the blast will strike against a covering, preferably water jacketed, after which they will be conducted, along with the fumes and gases, into dust chambers or flues, and thence through a stack or chimney to the outer air.

In operation a wood fire is built in the bottom of the converter, after which coke is added until a good coke fire is burning above the tuyeres. A gentle blast is then turned on through the upper row of tuyeres, the lower row being closed with plugs of the material to be treated, or with clay or metal, the metal tap held through the brick breast, and the slag tap being closed with a suitable plug or stopper. After the coke is all aglow, the raw sulphides are added and the blast increased, gradually adding sulphides and coke until the molten mass reaches the upper tuyeres. The plugs in the lower tuyeres being removed—if formed of the material to be treated, they may be simply driven in—and a blast of sufficient pressure, according to the height of charge, being turned on, the conversion of the sulphides to metals will immediately begin, the oxygen and sulphur uniting with the air to form SO_2, which escapes through the stack. The iron in the ore, present as a sulphide, which in this state refuses, even in the plastic condition, to unite with the silica, (SiO_2,) becomes an oxide, (FeO,) and unites with the silica to form a silicate of iron. By regulating the proportion of the pyrites to silica or quartz, which can be readily done by previous concentration with jigs and vanners or other concentrating machinery, or if necessary by the addition to the charge of lime rock, ($CaCo_3$,) any desired slag can be produced. As the presence of sulphides of iron always reduces the oxides of copper, and, as by the use of this continuous process fresh raw sulphides are constantly added, this operation is peculiarly adapted to make good clean slag. After the blowing has progressed sufficiently, the blast is stopped or checked and the material allowed to separate in the furnace, after which the slag tap is opened with a pointed bar or otherwise, as in other forms of blast furnace smelting, and a certain amount of slag allowed to run out, the amount being determined by measurement in suitable vessels and approximated to the weight of slag making material treated, which has been previously determined by the metallurgist in charge. Of course care should be taken not to remove all the slag, a certain amount being necessary to arrest the oxides formed in the converter below. These

oxides are arrested by coming in contact with the molten sulphides on top of the metallic bath, or by passing through slag above the molten sulphides. A certain amount of metal, say copper or lead, is now tapped out, during which process an equal weight of sulphides is added to the charge from above. The tuyeres being reopened and the blast again turned on, the molten mass that remains, being at a white heat, ignites the new charge immediately; and so the process goes on continuously, the slag and metal being drawn off and ore added as in other smelting processes. Of course a sufficient height of molten material to cover the tuyeres must be carried at all times during the operation of the furnace, and the blast must be strong enough to prevent the molten material from entering the tuyeres. In other words, the blast pressure must be greater during the smelting operation than the weight of molten material above the tuyeres. This strong blast necessarily keeps the molten mass in constant agitation while the smelting operation is in progress; but as soon as matte or metal of a desired grade is produced, the blast must be stopped or checked by closing some or all of the tuyeres, as above mentioned, to the extent necessary to stop agitation. This stopping or checking of the blast is an important step in my process, inasmuch as, by stoping agitation, it permits the different materials to separate in the furnace—say, as sand suspended in water by agitation settles when the agitation ceases—and thus allows slag to be drawn from one point, matte or metal from another, &c. It also dispenses with the necessity of tipping the furnace to raise the tuyeres above the charge, when it is desired to accomplish separation. It will thus be seen that I provide for continuously treating metals contained in raw sulphide ores by smelting, converting, refining and smelting at one operation, and also for using the sulphur contained in the metallic sulphides as fuel. In this way I avoid the preliminary calcining or roasting of the sulphide ores and the subsequent smelting to metallic matte, and also save much of the fuel necessary in smelting. In other words, I am able by this process to smelt ore by a blast heated by passing through molten material or matte, and also to smelt ore and convert the valuable metals contained in raw sulphides into a metallic state—as, for instance, "black" or "blister" copper—in one operation and without the use of any fuel except that necessary in starting and maintaining the blast. I am also able to dispense with the stove usually employed in heating the blast required for pyritic smelting.

I am aware that attempts have been made to separate matte, metal and slag in a converter by stopping the blast by the use of a movable tuyere adapted to be dipped into the molten material or withdrawn therefrom; but this method has not been found practicable because of the rapid destruction of the tuyere, the difficulty of keeping it open, and the impossibility of introducing it through a charge of ore. My process obviates all these objections, the tuyere being fixed and indestructible, easily kept open, and capable of use under any charge or weight of ore. I therefore disclaim any process in which the blast is checked or stopped by withdrawing the tuyere from the charge, and limit myself to a process in which a stationary tuyere is used, and the stopping or checking of the blast is effected by plugging the tuyeres.

As the essence of my invention consists in the process described, it will of course be understood that I do not intend to limit myself to minor features or details of operation, or in every case to the accomplishment of all the objects or benefits specified. Nor do I contemplate limiting the use of my process to the treatment of any particular kind of ores, it being my intention to use the same with any ores to which it may be applicable.

I do not herein claim a converter and blast furnace combined, the same being the subject of another application Serial No. 428,831 filed by me April 12, 1892.

I claim—

1. The process of smelting ores, which consists in subjecting them to a blast heated by passing through molten metal or matte in a furnace or converter, and checking or stopping the blast by plugging the tuyeres to permit slag, matte and metal to separate in the converter, substantially as described.

2. The process of smelting ores and refining metals, which consists in melting ores in a furnace or converter, forcing a blast through the molten material, checking or stopping the blast by plugging the tuyeres to permit slag, matte and metal to separate in the converter, and tapping the slag, matte and metal from the converter separately and at different heights, substantially as described.

3. The process of smelting ores and refining metals, which consists in feeding raw sulphides into a furnace or converter, subjecting them to a blast heated by passing through molten material, checking or stopping the blast by plugging the tuyeres to permit slag, matte and metal to separate in the converter separately and at different heights, and retaining sufficient molten material after each tap to ignite the next charge, substantially as described.

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