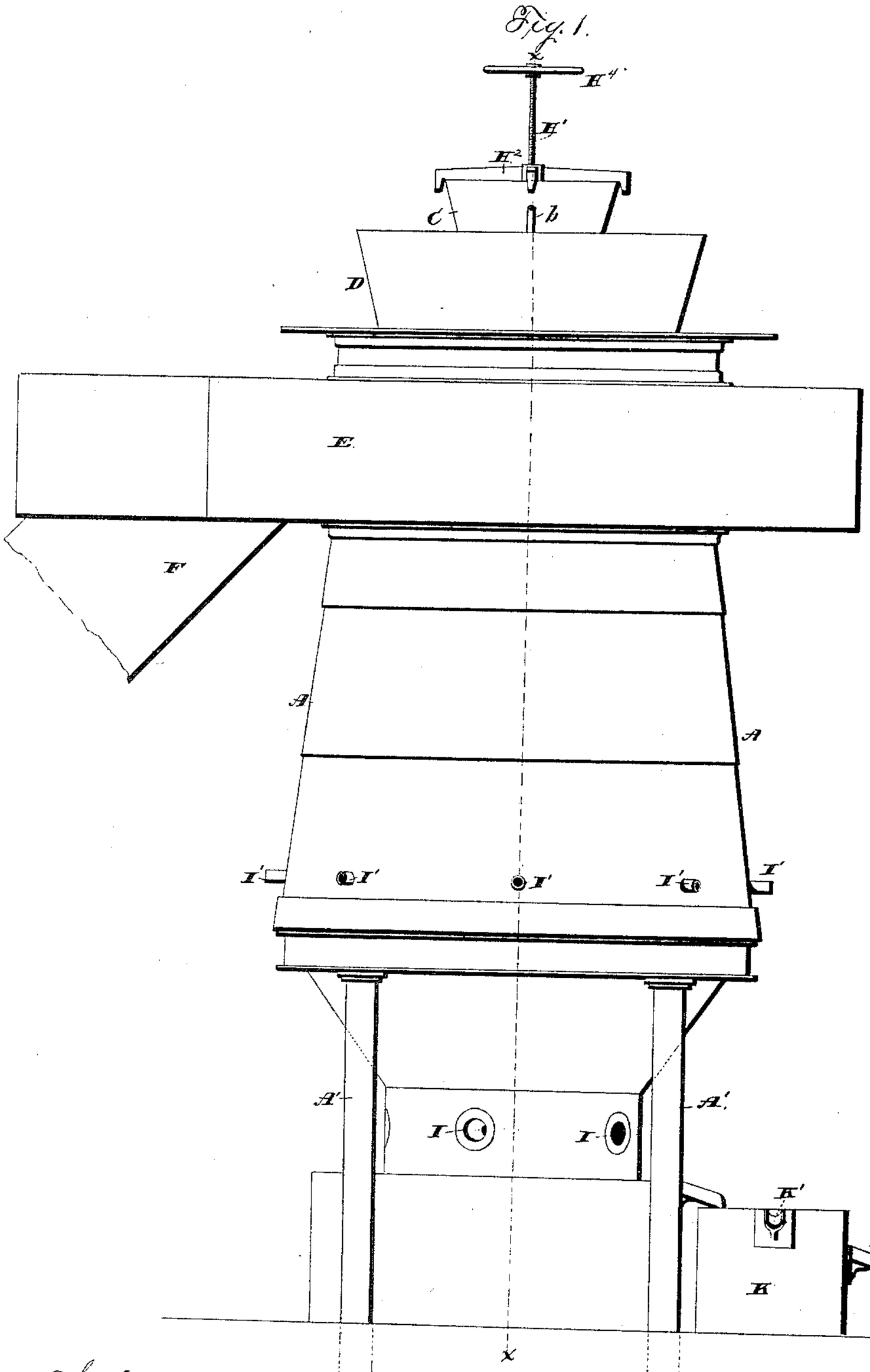
(No Model.) 3 Sheets—Sheet 1.

W. L. AUSTIN.

PROCESS OF SMELTING SULPHIDES.

No. 453,529. Patented June 2, 1891.

Fig. 1.



Witnesses
Chas. J. Williamson
Henry C. Hazard.

Inventor
William L. Austin.
by Prindle and Russell
his Attorneys

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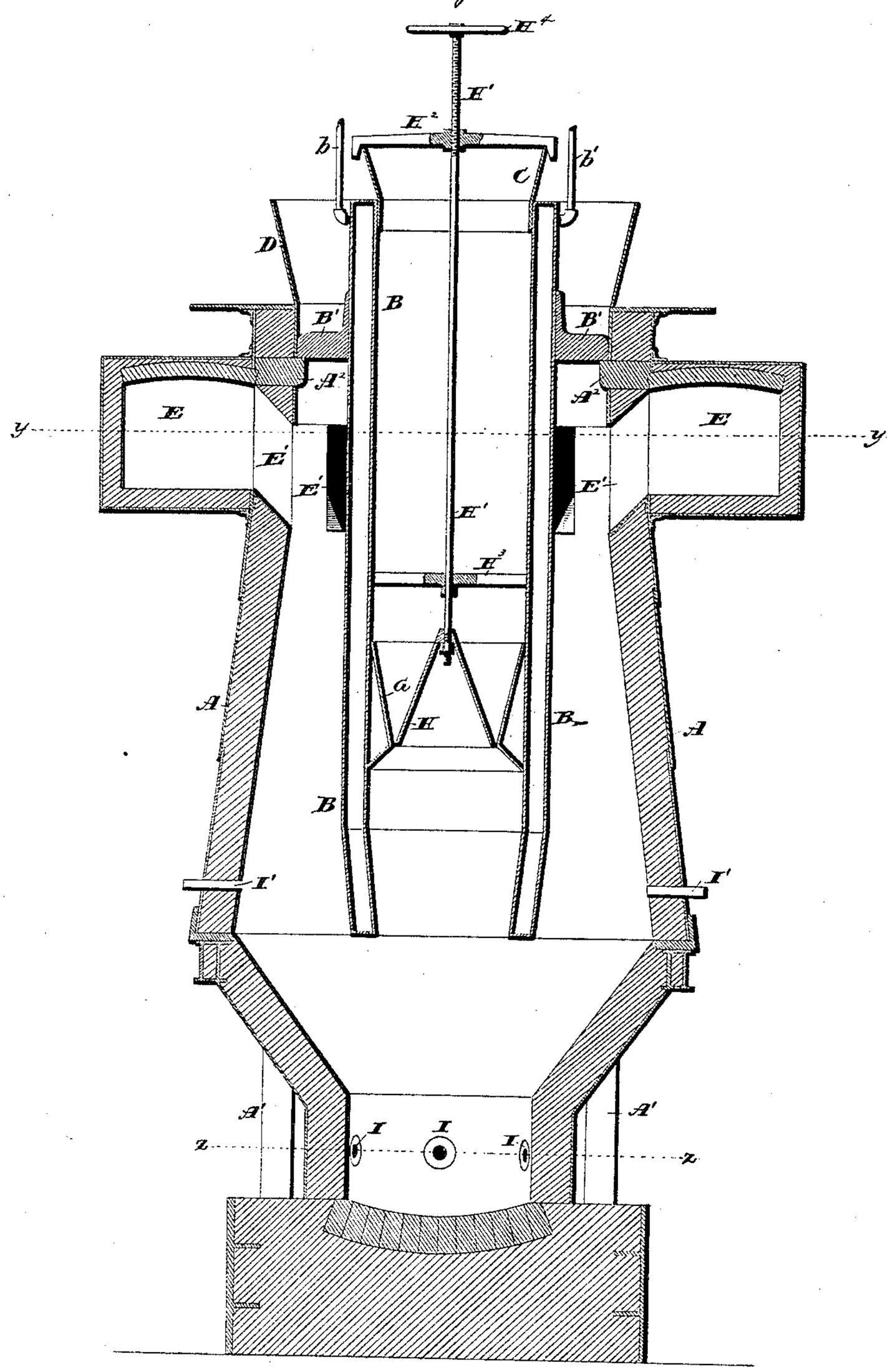
Fig. 2.



Witnesses
Chas. J. Williamson.
Henry C. Hazard

Inventor
William L. Austin
by Pindle and Russell
his attorneys

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Fig 3

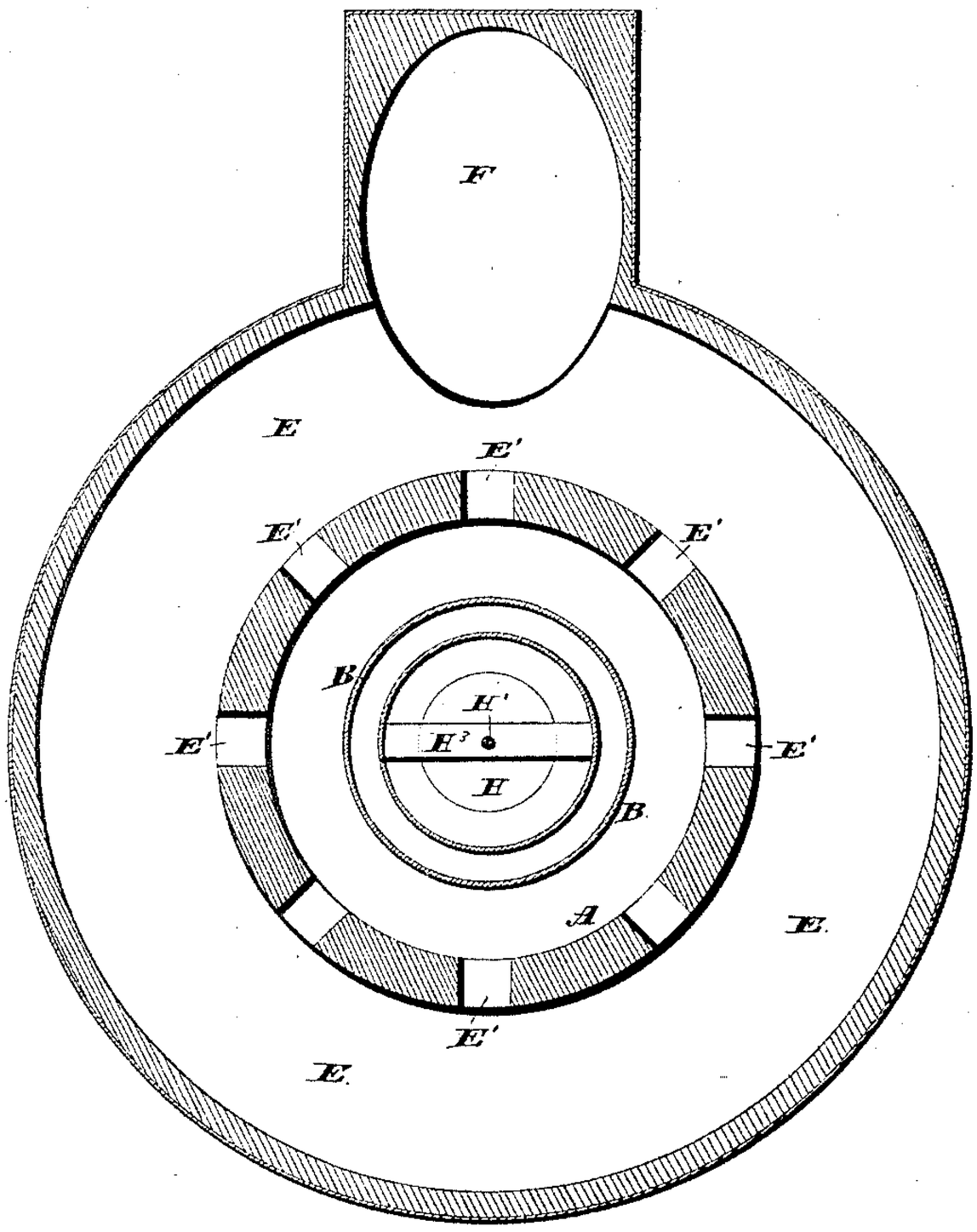
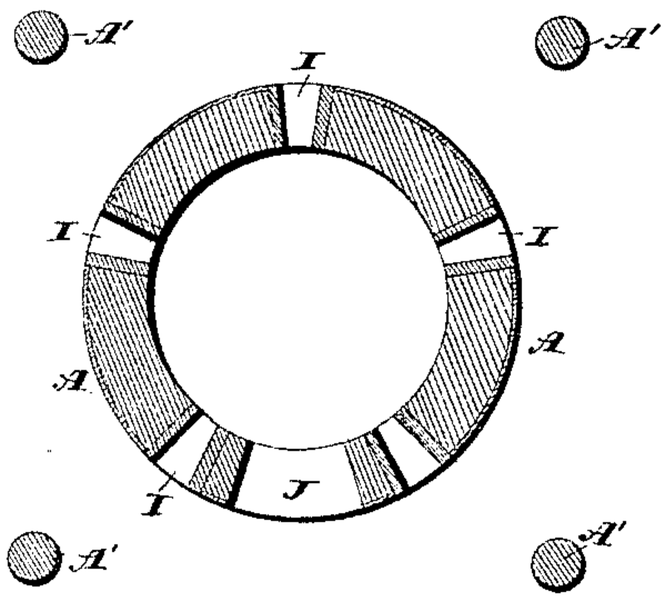


Fig 4.



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his attorneys

UNITED STATES PATENT OFFICE.

WILLIAM LAWRENCE AUSTIN, OF TOSTON, MONTANA.

PROCESS OF SMELTING SULPHIDES.

SPECIFICATION forming part of Letters Patent No. 453,529, dated June 2, 1891.

Application filed February 28, 1889. Serial No. 301,558. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM LAWRENCE AUSTIN, of Toston, in the county of Meagher, and in the Territory of Montana, have invented a certain new and useful Improved Process of Smelting; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which—

Figure 1 shows a view in side elevation of a form of furnace used by me in carrying out my process; Fig. 2, a vertical section of the same on line *x x* of Fig. 1; Fig. 3, a horizontal section of the same on line *y y* of Fig. 2. and Fig. 4 a similar section on line *z z* of Fig. 2.

Letters of like name and kind refer to like parts in each of the figures.

The object of my invention is to provide an improved process of smelting applicable to pyrites, sulphides, (natural and artificial,) sulphurets, arsenical and antimonical sulphurets, zinc-blende, and other ores or artificial compounds of a similar nature; and to this end my invention consists in the process and in the parts thereof, or sub-processes, as hereinafter specified.

My invention relates to the smelting of iron and copper pyrites, zinc-blende, natural or artificial sulphides, and sulphurets of useful metals. Its special object and purpose has been to provide a process of smelting such ores or compounds which, when started, can be maintained or kept up continuously to fuse the ores or compounds without the admixture of any carbonaceous fuel with the smelting charge or the application of such fuel during the process within the furnace. As will be seen, I attain the desired end of avoiding the use of carbonaceous fuel during the smelting operation without employing a bath of molten material, as applied and used in the Holloway and other kindred processes.

In carrying out my process of smelting all molten matter is drawn off out of the furnace as soon as formed, and is not used to generate heat for operating the process.

The furnaces which I make use of are similar in general construction to the ordinary blast smelting-furnaces used for treating copper, iron, and lead ores with certain modifications, as will appear hereinafter. Almost any blast-furnace such as is now used for lead or copper smelting can be easily adapted to my process.

In order to set forth my process most clearly, I will first describe one form of furnace as arranged for carrying it out and then specifically set forth the manner of operating the process.

In the drawings, A designates the main body of a blast cupola-furnace built on the general lines of an ordinary furnace of this kind. Four pillars A′ A′, with suitable foundations, serve to support the furnace-body. Within such body is an upright cylinder B, supported centrally within the furnace interior by means of suitable lugs or bracket-arms B′ B′ near its upper end, resting upon suitable abutments or bearings A^2 A^2 on the furnace-walls. This cylinder, which is open at both ends, is preferably made of cast or wrought iron, and adapted to be kept cool by water. For this purpose its walls are shown hollow to form a water-space into which water can be introduced at the top through pipe *b*. A second pipe *b′* at the other side of the top of the cylinder water-space serves to draw off the water, so that a cooling circulation can be kept up. The outside diameter of the cylinder is less than the diameter of the narrowest part of the furnace-space within which it stands, so that there is an annular space extending around between the cylinder and the furnace-walls.

While I prefer the form of cylinder shown adapted to be kept cool by water, I do not limit myself thereto. It can be made of any desired material adequate to resist destruction during the use of the furnace, and can be of any preferred shape or manner of construction without involving any departure from my invention. Of whatever form or material it may be it should extend from the top of the furnace, above where the gases are taken off, down to a point within the furnace near the zone of fusion. In its upper end is a hopper C for the reception of the sulphurets and such material as is to be fed into the furnace with them.

Upon the upper end of the furnace and surrounding the upper portion of the cylinder B is a second hopper D for receiving the balance of the charge and guiding it down into

the furnace through the annular space between the cylinder and furnace-walls. Surrounding the upper portion of the furnace, below hopper D, is an annular chamber or passage E for collecting gases, fumes, and products of combustion which reach it from the furnace through the series of openings E′ E′ E′ in the furnace-walls. From this chamber or passage opens the downtake F, of any desired form and construction.

Within the cylinder B, near its lower end, is a hopper-like contraction G, formed, preferably as shown, with the walls of its upper portion inclined inward at a slight angle, while those of its lower side flare outward abruptly. Also, within the cylinder and adapted to act in conjunction with the contracted passage to close and open the same is the conical bell H, attached to the lower end of rod H′, while its upper end is threaded and tapped through a supporting-spider H^2, resting upon the top of hopper C. For steadying the lower end of the rod which carries the bell, I provide within the cylinder B, just above the contraction G, a cross-bar H^3, having a central guiding-opening through which the rod passes. Fixed upon the upper end of the rod H′ is a hand-wheel H^4, by which the rod can be turned, as desired, to screw it up or down in the supporting-spider H^2, so as to raise or lower the bell H, to cause it to close or open the passage through contraction G, or to regulate the width of the space through which any material can pass by the bell to reach the lower end of the cylinder. Such end of the cylinder I prefer to make, as shown, with its walls extending inward at a slight angle instead of making it exactly cylindrical. The main tuyeres I I, for introducing the hot blast, are, as usual in blast-furnaces, situated so as to discharge into the lower contracted portion of the furnace just above the exit J for the molten products. Auxiliary tuyeres I′ I′ are provided by me, opening into the furnace-chamber on a plane above that of the lower end of the cylinder B. To receive the molten products flowing from exit J there is the usual receiver K, having the slag-overflow K′ and the exit-tap K^2 for matte.

While the manner of carrying out my process will be described in connection with the furnace, as shown and described, I desire it to be understood that such form of furnace is not necessary, and that I do not limit myself to it.

In preparing for my process the sulphides and combustibles are first fed into the hopper C, from which they pass down through the cylinder B into the body of the furnace, the rate of their flow being dependent upon the adjustment of the bell H with reference to the hopper formed within the cylinder by contraction G, or of some other desired regulating device. When this preliminary mingled charge of sulphides and combustibles has been fired and the furnace has become heated up in the ordinary way, the normal charge containing no carbonaceous fuel is gradually introduced into the hoppers C and D. Sulphurets and other compounds which are liable to fuse and stick together when exposed to heat and furnace-gases are fed into the hopper C, so as to be inclosed and kept away from the heat of combustion in the furnace by the cylinder B until they can reach the smelting-zone of the furnace. By this means and in this manner it is possible to introduce the sulphurets and said other compounds into the furnace and feed them continuously to the smelting-zone without danger of the sticking and clogging up of the furnace, which is sure to take place where it is attempted to feed them down in the usual way exposed to the furnace heat and gases before they reach such zone. Silicious ores, fluxes, and coarse material generally, which will not fuse, soften, or stick together, are fed into the outside hopper D and pass down into the body of the furnace. On the way down the annular space between the furnace-walls and the cylinder B they are subjected to the action of the escaping gases, heat, and products of combustion, so that they are beneficially prepared for the subsequent fusion upon reaching the smelting-zone and being subjected to the blasts from the tuyeres. They act, also, in their passage downward through the gases and vapors to catch and hold volatilized solids. The height of the furnace should be such that the gases and vapors rising from the combustion and smelting shall be in a comparatively cool state when they pass into the downtake F.

It will be observed that it is not my intent to divide up the charge as a whole, but to keep certain ingredients of the charge from the action of the heat and gases before they reach the smelting-zone, while allowing the other ingredients to be acted upon by the heat, vapors, gases, and products of combustion before they reach said zone. The two parts of the charge are kept separate until just before they enter the zone of fusion, when they commingle and descend together. The molten products pass the main tuyeres I I and immediately run out of the furnace through exit J into receiver K. They are not allowed to collect so as to form a bath in the furnace or to assist in keeping up or supporting combustion, but are continuously drawn off as soon as formed. Through the main tuyeres I I is introduced a hot blast, while through tuyeres I′ I′ air is admitted to consume any sulphur or other volatile product which tends to collect upon the furnace or cylinder sides. As the molten products are drawn off and collect in the receiver K, the slag, being the lightest, rises to the top and flows off by exit or spout K′, while the heavier matte or metal is drawn off from below by spout.

If desired, the furnace can easily be arranged to allow of the feeding of the sulphurets

and other compounds to be kept away from the heat and products of combustion until they reach the zone of fusion down around the outside of the cylinder and the feeding of the other parts of the charge down within such cylinder. In this case the gases and products of combustion can be allowed to escape from the top of the cylinder, which can be connected, if desired, with a suitable down-take. The sulphurets or sulphide ores can then be fed into hopper D and be caused to pass down around the outside of the cylinder.

With my process carried out, as set forth hereinbefore, by delivering the raw or artificial sulphurets or sulphide ores into the body of the furnace at a point about five feet above the plane passing through the centers of the tuyeres I I—that is, at the zone of fusion—and there mixing them with the other ingredients of the smelting-charge, and by forcing in through such tuyeres a hot blast, I am enabled to maintain the necessary heat and to make continuous oxidizing-fusion of the ore without the use or admixture of any carbonaceous fuel after the furnace has once been heated up. With the sulphurets or sulphide ores kept away from the heat and products of combustion until they mingle at or near the zone of fusion with the silicious ores, fluxes, and coarse material, which do not fuse, soften, and stick together, the feeding of the component parts of the charge down to the desired point within the furnace-body can be a continuous one without trouble or danger of stoppage and clogging.

In actual practice I have successfully used in the charge for the furnace forty-four per cent. of sulphide of iron, as contained in iron, copper, arsenical, magnetic, or other pyrites, carrying various percentages of the precious metals, and fifty-six per cent. of dry argentiferous ores varying in the amounts of silver carried by them. Such ores are mainly of silicates, slates, and quartz.

The resultant products of my smelting operation with a charge as described are small amounts of matte, from five per cent. to ten per cent. of the total charge, and slag containing silicates of protoxide of iron associated with silicates of whatever other bases there may be in the charge and which are not included in those forming the matte.

The charge described is, by my process, smelted without the use of coke or coal in the furnace after the preliminary heating, provided the blast of air is heated up to from 800° to 1000° Fahrenheit, while with blasts at the ordinary temperature of the atmosphere the charge cannot be smelted, but is only roasted.

As indicated hereinbefore, no particular form or shape of furnace is necessary to the successful carrying out of my invention. The furnace can be square, round, or rectangular, with the cylinder shaped to correspond. The cylinder, instead of being of metal, hollow, and water-cooled, can be of such material and construction, cooled by air, or can be formed of any substance capable of resisting a high temperature and of protecting the cylinder contents from a degree of heat sufficient to soften and fuse them, so that they will stick together and clog up the passage through the cylinder.

Having thus described my invention, what I claim is—

1. As an improvement in the art of smelting pyrites, blende, sulphurets, or sulphides, the method of securing continued combustion and smelting without the necessity of the continued use of carbonaceous fuel, which consists in first heating the lower part of a charge containing one or more of the substances or compounds up to a point where combustion can take place and then subjecting the charge to the action of a hot-air blast and continuously drawing the molten products as formed away from the path of the blast, substantially as and for the purpose specified.

2. As an improvement in the art of smelting pyrites, blende, sulphurets, or sulphides, the method of keeping up the combustion and smelting without the use of carbonaceous fuel, which consists in introducing such compounds or ores into the body of a heated furnace at or near the zone of fusion, subjecting them to a hot blast, and drawing off the molten products as formed, substantially as and for the purpose specified.

3. As an improvement in the art of smelting pyrites, blende, sulphurets, or sulphides, the method of keeping up the combustion and smelting without carbonaceous fuel, which consists in feeding such ores or compounds down within the furnace-body, keeping them out of contact with the heat and products of combustion until they reach the zone of fusion, subjecting them there to a hot blast, and drawing off the molten products as formed, substantially as and for the purpose shown.

4. As an improvement in the art of smelting pyrites, blende, sulphurets, or sulphides, the process which consists in feeding such ores or compounds down into a heated furnace, keeping them out of contact with the heat and products of combustion until they approach or reach the zone of fusion, feeding the other component parts of the charge down in contact with the gases or vapors from combustion, mingling the parts of the charge at or near the zone of fusion, subjecting them there to a hot blast, and drawing off the molten products of smelting as formed, substantially as and for the purpose set forth.

5. As an improvement in the art of smelting pyrites, blende, sulphurets, or sulphides, the method of securing the proper feeding of the charge down to the zone of fusion, which consists in feeding to the furnace separately the parts of the charge liable to fuse and stick together and those not liable to fuse, protecting the fusible parts from the heat of the furnace

until they reach a point at or near the zone of fusion, and then mingling the parts of the charge together, substantially as and for the purpose described.

6. As an improvement in the art of smelting pyrites, blende, sulphurets, or sulphides, the method of feeding the charge down to the smelting-zone, which consists in feeding the pyrites, blende, sulphurets, or sulphides down within the body of the furnace protected from the action of the heat and products of combustion until they approach or reach the zone of fusion, feeding the other parts of the smelting charge down within the furnace in contact with the heated gases and products of combustion from the zone of fusion, and mingling them at or near such zone with the sulphurets or other compounds, substantially as and for the purpose specified.

7. As an improvement in the art of smelting pyrites, blende, sulphurets, or sulphides, the process which consists in feeding separately the sulphuret or other compound and protecting it from the heat and products of combustion until it arrives at a point near the zone of fusion, feeding the silicious ores or fluxes and coarse material down within the furnace, so as to be subjected to the action of heat, gases, and products of combustion before they reach the zone of fusion, mingling the parts of the charge together at or near such zone, subjecting them to a hot blast, and drawing off the molten products as formed, substantially as and for the purpose shown.

8. As an improvement in the art of smelting pyrites, blende, sulphurets, or sulphides, the process which consists in feeding the sulphuret or compound protected from the heat and products of combustion down to the zone of fusion, feeding the other parts of the charge down within the furnace unprotected from heat and products of combustion, then subjecting the charge to hot blast, drawing off the molten products as formed, and introducing air at a point above the zone of fusion, substantially as and for the purpose set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 27th day of February, 1889.

WILLIAM LAWRENCE AUSTIN.

Witnesses:
WILLIAM M. STEWART, JR.,
FRAS. B. OWEN.