(No Model.) 3 Sheets—Sheet 1.

O. S. GARRETSON.

METHOD OF AND APPARATUS FOR SMELTING COMPLEX ORES.

No. 596,747. Patented Jan. 4, 1898.

Fig. 1.

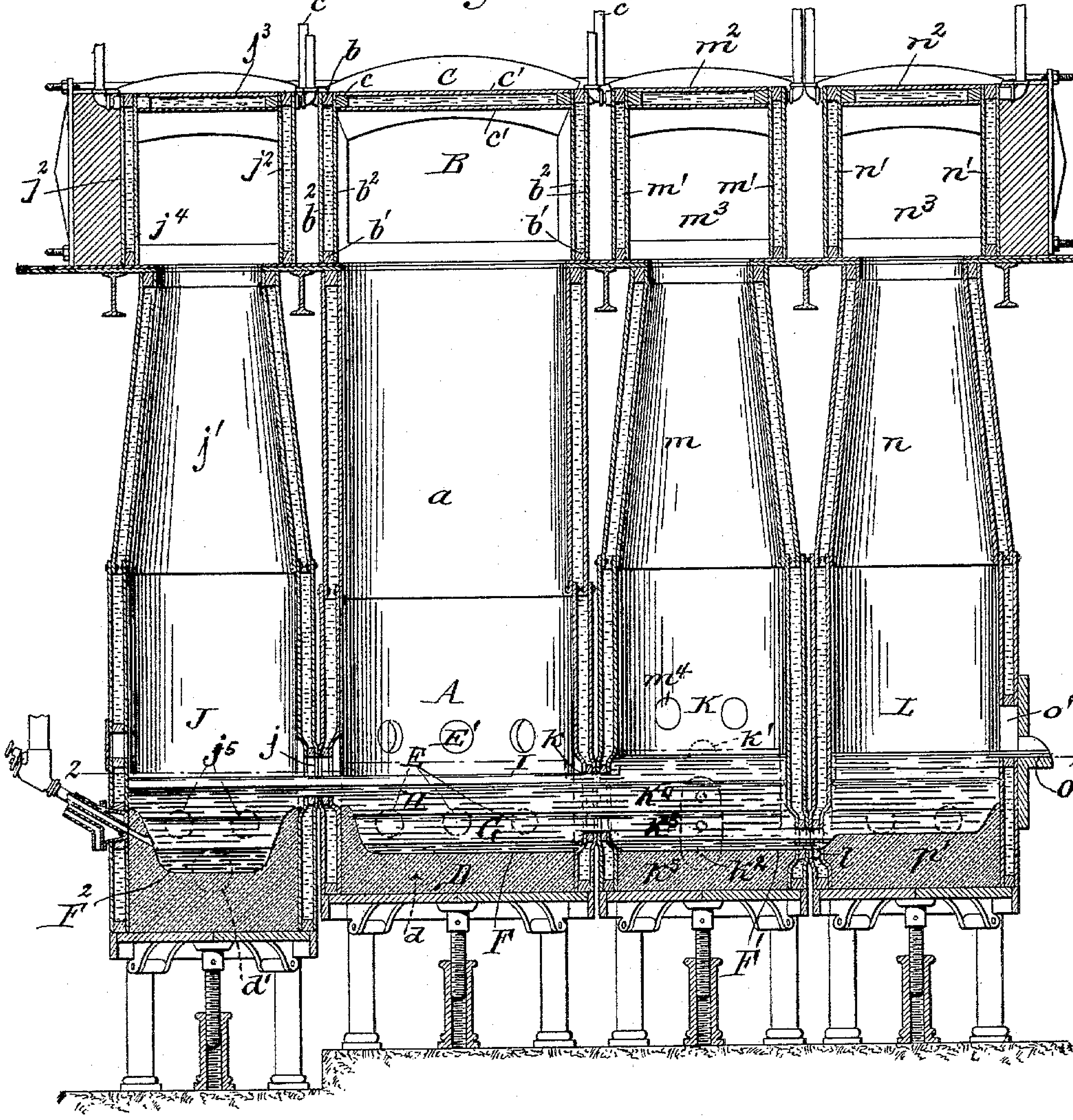

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Fig. 2.

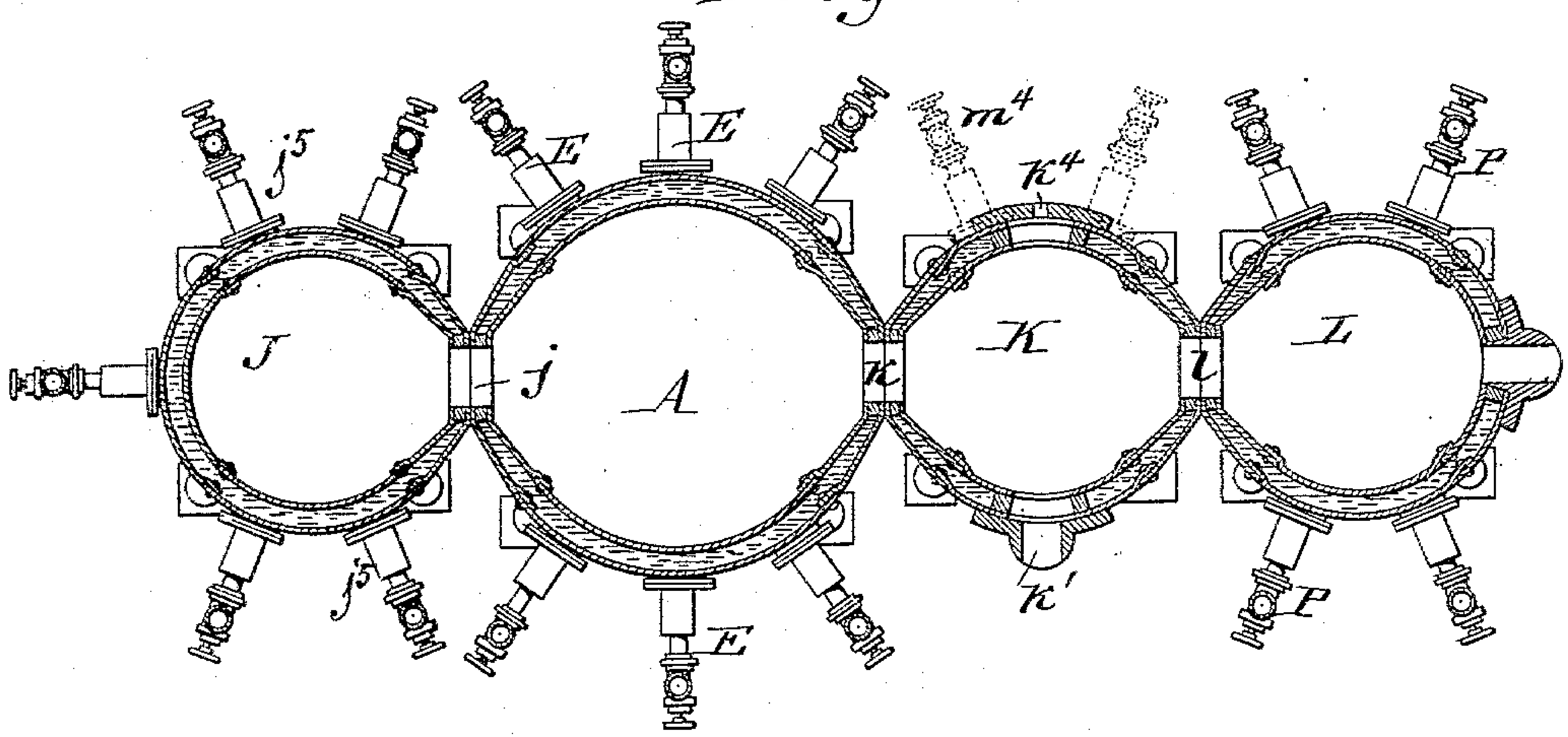
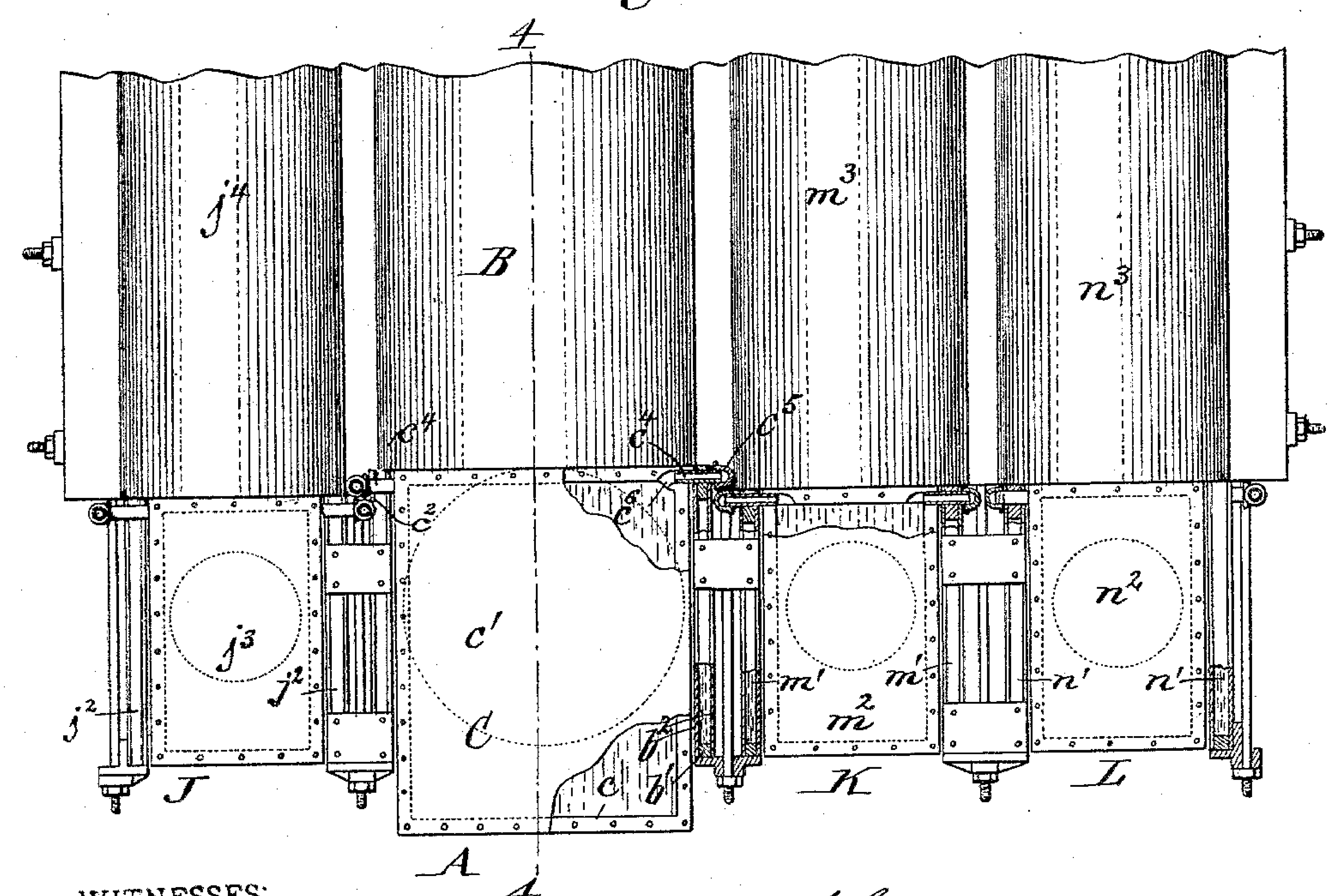


Fig. 3.



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(No Model.) 3 Sheets—Sheet 3.

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METHOD OF AND APPARATUS FOR SMELTING COMPLEX ORES.

No. 596,747. Patented Jan. 4, 1898.

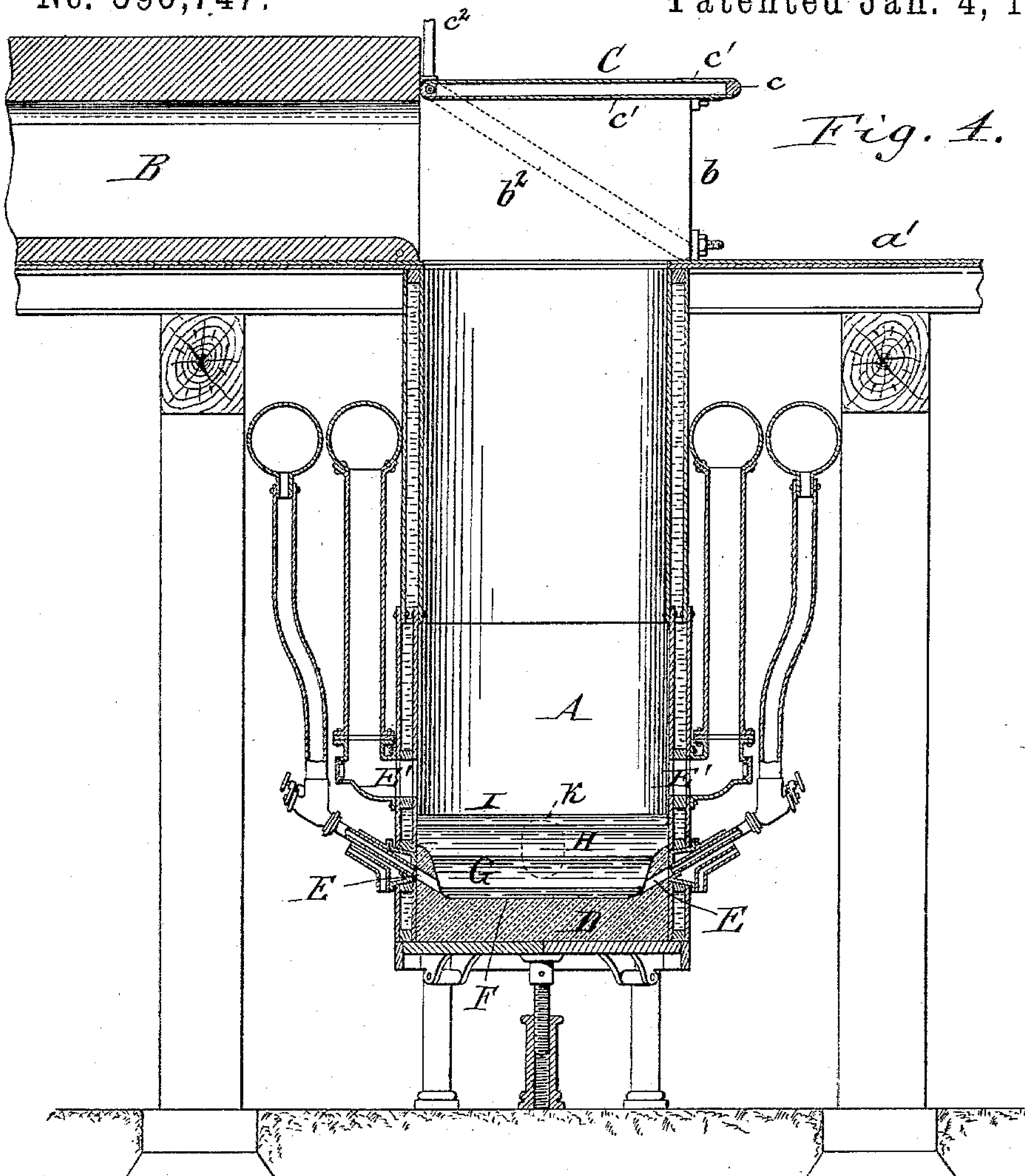

Fig. 4.

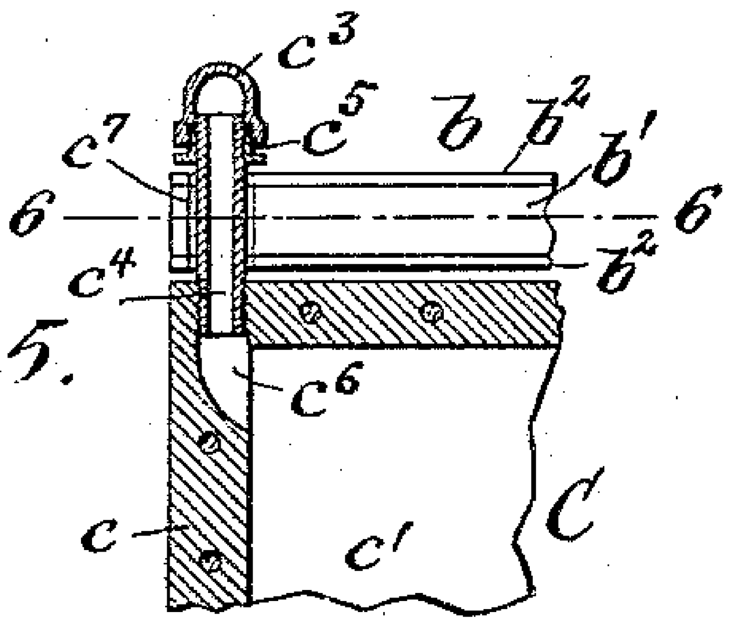

Fig. 5.

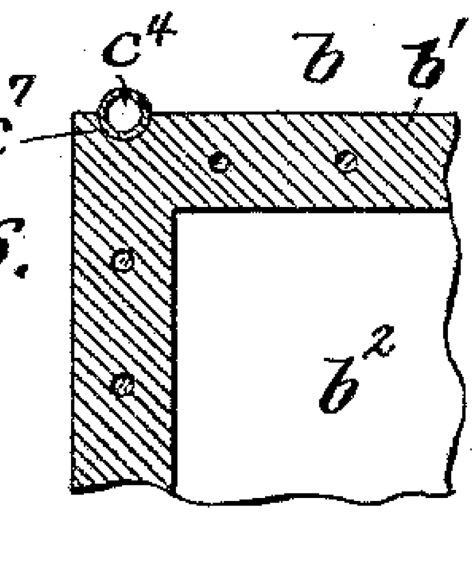

Fig. 6.

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UNITED STATES PATENT OFFICE.

OLIVER S. GARRETSON, OF BUFFALO, NEW YORK.

METHOD OF AND APPARATUS FOR SMELTING COMPLEX ORES.

SPECIFICATION forming part of Letters Patent No. 596,747, dated January 4, 1898.

Application filed March 6, 1897. Serial No. 626,256. (No model.)

To all whom it may concern:

Be it known that I, OLIVER S. GARRETSON, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Methods of and Apparatus for Smelting Complex Ores, of which the following is a specification.

This invention relates to the smelting of complex or mixed lead and copper ores, and has for its object to separate the molten copper and iron compounds from the compounds of lead and similar metals and treat each kind of compound separately in an appropriate manner for extracting the values contained therein.

It is well known that in lead-smelting the presence of copper compounds is objectionable, and that in such smelting the values contained in the copper compounds cannot be profitably extracted, while in copper-smelting the presence of lead compounds is equally objectionable. My invention is designed to overcome these difficulties and to separate and extract the values from both kinds of compounds at one operation in a simple and efficient manner.

In the accompanying drawings, consisting of three sheets, Figure 1 is a longitudinal vertical section of a set of smelting and converting or bessemerizing furnaces embodying my invention. Fig. 2 is a horizontal section in line 2 2, Fig. 1. Fig. 3 is a top plan view, partly in section. Fig. 4 is a vertical section of the smelting-furnace in line 4 4, Fig. 3. Fig. 5 is a horizontal section, on an enlarged scale, of one of the trunnions of the water-jacketed furnace-cover. Fig. 6 is a vertical section in line 6 6, Fig. 5.

Like letters of reference refer to like parts in the several figures.

A represents the primary or smelting furnace, having a water-jacketed stack a, which is charged with ore and fuel from the charging-floor a'. The latter is arranged on a level with the upper end of the stack, at the front side thereof, in the usual manner, as shown in Fig. 4.

B represents the uptake, which extends rearwardly from the furnace-top. This top is composed of two upright side pieces b b, each of which is composed of a frame b' and side plates b^2, forming a water-jacket, and a pivoted cover C, which is also water-jacketed. This cover is pivotally supported with its rear end above the front end of the uptake, Fig. 4, and swings down between the side pieces b, resting, when closed, in an inclined position, with its front end on the top of the stack, as shown in dotted lines in Fig. 4. For charging the stack the cover is raised and suitably supported in a horizontal position, as shown in full lines in Fig. 4. This cover is a flat hollow box or chamber composed of a rectangular frame c and top and bottom plates c', riveted thereto. The water flows to and from this chamber through vertical pipes c^2. Each of these pipes is stationary and provided at its lower end with an elbow c^3, Fig. 5, in which is fitted the outer end of a horizontal pipe c^4, which is secured to and projects laterally from the cover at the rear end thereof. A stuffing-box c^5 connects the horizontal pipe with the elbow. The inner end of the horizontal pipe is screwed into a passage c^6, which is formed in the frame c of the cover and which opens into the cavity of the latter, so that the water can pass from the stationary vertical pipe through the horizontal pipe into the cavity of the cover, or vice versa, and the cover can be swung on the horizontal pipes as trunnions. These trunnion-pipes rest and turn in recesses c^7, formed in the upper ends of the side pieces b, Fig. 6.

D represents the hearth of this furnace, and d represents the tap-hole through which the metal is drawn off which collects on the bottom of this hearth. E represents the bessemerizing-twyers, which open above the bottom and below the slag-level, and E' represents the smelting-twyers, which open into the furnace above the slag-level.

In smelting in this furnace complex ores containing sulfids of lead, bismuth, and similar metals, and copper and iron sulfids, the molten metallic compounds arrange themselves on the hearth of the furnace in superposed layers or strata in the order of their specific gravities. The metal, if any, is formed on the bottom, the next lighter compounds, which are mainly lead compounds, above the metal, the next lighter compounds, which are mainly copper and iron compounds, above the lead compounds, and the slag at the top.

In the drawings, F represents the bottom stratum of metal in the smelting-furnace; G, the stratum of lead compounds; H, the stratum of copper and iron compounds, and I the top stratum of slag.

The molten lead compounds and the molten copper and iron compounds flow separately from the smelting-furnace into bessemerizing or converting furnaces arranged on opposite sides of the smelting-furnace.

J represents the furnace for bessemerizing the copper matte, arranged on one side of the smelting-furnace A. This furnace communicates with the smelting-furnace by a passage j, formed in the adjacent side walls of these furnaces in such manner that the lead compounds are excluded from this passage while the copper and iron compounds or mattes flow through this passage from the smelting-furnace into the copper-bessemerizing furnace. For this purpose the bottom of the passage j is arranged above the level of the stratum G of lead compounds in the smelting-furnace and below the slag-level, as shown in Fig. 1. The passage extends, preferably, above the slag-level, so that the slag formed in the copper-bessemerizing furnace can flow through this passage into the smelting-furnace and the excess of gases can pass through this passage above the slag from one furnace to the other.

The copper-bessemerizing furnace has above its hearth a stack j', which preferably tapers upwardly and is filled with a column of flux, such as quartz, diorite, or other silicious material suitable for forming a fluid slag with the iron oxid. The top of this furnace consists of side pieces j^2 and a pivoted cover j^3, which are water-jacketed and otherwise constructed like the corresponding parts of the top of the smelting-furnace.

j^4 represents the uptake of the copper-bessemerizing furnace, and j^5 the bessemerizing-twyers of the same.

K represents a settling-well, and L a bessemerizing-furnace in which the lead compounds are treated. The settling-well K is arranged adjacent to the furnace A and communicates therewith by a passage k, formed in the adjacent side walls of this furnace and the settling-well in such manner that the lead compounds, the copper and iron compounds, and the slag flow through this passage from the smelting-furnace into the settling-well. The latter is provided with a slag-spout k', (shown in dotted lines in Fig. 1 and in full lines in Fig. 2,) a tap-hole k^2 for drawing off the metal, and preferably with auxiliary tap-holes k^3 k^4 at greater heights above the bottom of the hearth k^5 for drawing samples of the different compounds. This settling-well is provided above its hearth with an upwardly-tapering water-jacketed stack m and has a top composed of side pieces m' and a pivoted cover m^2 and an uptake m^3. These parts are in construction and arrangement like the corresponding parts of the matte-bessemerizing furnace J. The lower portion of the stack is preferably provided above the slag-level with twyers m^4. The stack of this furnace is preferably charged with charcoal or similar fuel, which acts as a filter in intercepting particles of matte or metal which may be floating in the slag and also to some extent operates to reduce metallic oxids.

The lead-bessemerizing furnace L is arranged on the outer side of the settling-well K and communicates with the latter by a passage l, formed in the adjacent side walls at such a height above the bottom that only the lead compounds can flow through this passage from the settling-well K to the lead-bessemerizing furnace L, while the lighter copper and iron compounds, which occupy a higher level, are prevented from entering this passage. This lead-bessemerizing furnace is provided above its hearth with an upwardly-tapering water-jacketed stack n and a top which is composed of side pieces n' and a pivoted cover n^2 and communicates with the uptake n^3, all of which parts are constructed and arranged like the corresponding parts of the settling-well.

o represents the slag-spout of the furnace L, which is fitted against the outer side of an opening o' in the side wall of the furnace and made vertically adjustable in a well-known manner, so that the spout can be adjusted to the slag-level which is maintained in this furnace. P represents the bessemerizing-twyers of this furnace, which open immediately above the bottom of the hearth p' thereof. This bottom is arranged slightly higher than the bottom k^5 of the settling-well K, so that the metal which is deposited on the bottom p' flows through the passage l upon the bottom of the settling-well, from which it is drawn off through the tap-hole k^2.

The slag-spout k' of the settling-well is arranged at a slightly-higher level than the slag-level in the smelting-furnace, as shown in Fig. 1, to adjust the spout to the slag-level which is maintained in the settling-well and which is proportionately higher than in the smelting-furnace by reason of the air-pressure which is maintained in the latter, because the blast cannot freely escape through the stack of the furnace, which is filled with a column of ore and fuel.

The smelting-furnace is kept filled with a charge of ore and fuel. Assuming that the ore contains mainly sulfids and other combinations of bismuth, lead, copper, and iron, the molten mass which collects on the hearth will become gradually enriched by the bessemerizing-blast burning out sulfur. This increases the difference in gravity between the sulfids and other compounds of lead and similar metal—such as bismuth, antimony, tin, &c.—and the iron and copper mattes, which are specifically lighter than the lead compounds. The lead compounds may consist mainly of sulfids, but may also contain arsenids and antimonids and other combinations of these metals, according to the composition of the ores used, and when arsenids are present in sufficient quantity they may form a distinct layer, which will take its place below the layer consisting mainly of lead sulfid, as it is specifically heavier. Metallic bismuth, probably mixed with some lead and other similar metals, being the heaviest ingredient, will form the lowest layer F, lead compounds, probably containing some bismuth and other metals, the next higher layer G, the iron and copper mattes the next higher layer H, and the slag the top layer I. The deposited metal is drawn off from time to time through the tap-hole *d*. The lead compounds and the copper and iron mattes flow through the passage *k* into the settling-well K. The lead compounds pass from the settling-well into the lead-bessemerizing furnace L, which is also filled with charcoal or other fuel and where the bessemerizing-blast causes the gradual enrichment of these compounds and the separation of metallic lead, probably mixed with some bismuth and other similar metals. This molten metal flows back into the settling-well, where it is joined by such metal as is deposited therein, and this layer of metal F', in which lead usually preponderates, is drawn off through the tap-hole of the settling-well.

The iron and copper mattes pass from the smelting-furnace into the copper-bessemerizing furnace J and are there subjected to the bessemerizing-blast underneath the column of flux or silica which is contained in the stack of that furnace. The copper and other metals combined therewith are deposited on the hearth of that furnace in a layer F^2 and are drawn off from time to time through the tap-hole *d*. The iron oxid combines with the silica and forms therewith a fluid slag, which flows into the smelting-furnace. This slag encounters in the latter the sulfur and poor sulfids, whereby the values contained in the slag are intercepted and returned to the mattes. The impoverished slag then passes into the settling-well, from which it is discharged. Comparatively little slag is formed in the lead-bessemerizing furnace L, and the slag there formed is discharged through the slag-spout of that furnace. In this manner the molten iron and copper mattes and the molten lead and similar compounds are separated and each is treated in an appropriate manner, the lead and similar compounds in the absence of a silicious flux, which would cause a loss of lead in the form of lead silicate, and the iron and copper mattes with a silicious flux which combines with the iron oxid and forms therewith a fluid slag, which is readily discharged and which can be caused to flow through the smelting-furnace in order to extract the values which may be contained in the slag. The bessemerizing of the separated ingredients proceeds simultaneously and while the smelting is going on, and the reheating of the products of the operation of smelting is thereby avoided, rendering the process simple, continuous, and economical. Low-grade mattes and other furnace products may be smelted in the same way, and I do not wish to limit myself to the smelting of ores, but wish to include the smelting of such metallic combinations.

I claim as my invention—

1. The herein-described continuous method of smelting complex ores or furnace products which consists in smelting the ore or furnace product, permitting the stratification of the molten mass according to the different densities of the ingredients, causing superposed layers of different ingredients to flow separately and continuously into bessemerizing-furnaces, and bessemerizing such ingredients separately, substantially as set forth.

2. The herein-described continuous method of smelting complex ores or furnace products containing lead compounds and iron and copper compounds, which consists in smelting the ore or furnace product, bessemerizing the molten mass and permitting the stratification thereof according to the different densities of the ingredients, causing the superposed layers of lead compounds and of iron and copper mattes to flow separately and continuously into bessemerizing-furnaces, bessemerizing the iron and copper mattes underneath a column of flux, and bessemerizing the lead compounds separately, substantially as set forth.

3. The combination with a smelting-furnace, of bessemerizing-furnaces having their hearths communicating with the hearth of the smelting-furnace by separate passages arranged at different levels, through which the layers of the molten mass collecting on the hearth of the smelting-furnace according to their densities flow separately to said bessemerizing-furnaces, substantially as set forth.

4. The combination with a smelting-furnace, of a matte-bessemerizing furnace having its hearth communicating with that of the smelting-furnace by a matte-passage, and a lead-bessemerizing furnace having its hearth communicating with that of the smelting-furnace by a passage which has its top arranged lower than the bottom of the matte-passage, substantially as set forth.

5. The combination with a smelting-furnace, of a matte-bessemerizing furnace having its hearth communicating with that of the smelting-furnace by a matte-passage, a settling-well having its hearth communicating with that of the smelting-furnace, and a lead-bessemerizing furnace communicating with the settling-well by a passage which has its top arranged lower than the bottom of the matte-passage, substantially as set forth.

6. The combination with a smelting-furnace, of a settling-well having its hearth communicating with that of the smelting-furnace, and a bessemerizing-furnace having its hearth communicating with that of the settling-well and having its hearth arranged higher than

that of the settling-well, whereby the molten metal which is deposited in the bessemerizing-furnace is caused to flow back into the settling-well, substantially as set forth.

7. The combination with a metallurgical furnace, of a top composed of water-jacketed side pieces and a pivoted cover arranged between these side pieces and composed of a water-chamber having an inlet for the cold water and an outlet for the heated water, substantially as set forth.

Witness my hand this 2d day of March, 1897.

OLIVER S. GARRETSON.

Witnesses:

JNO. J. BONNER,

ELLA R. DEAN.