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ART OF SMELTING ORES.

APPLICATION FILED MAR. 2, 1903.

959,484.

Patented May 31, 1910.

2 SHEETS—SHEET 1.

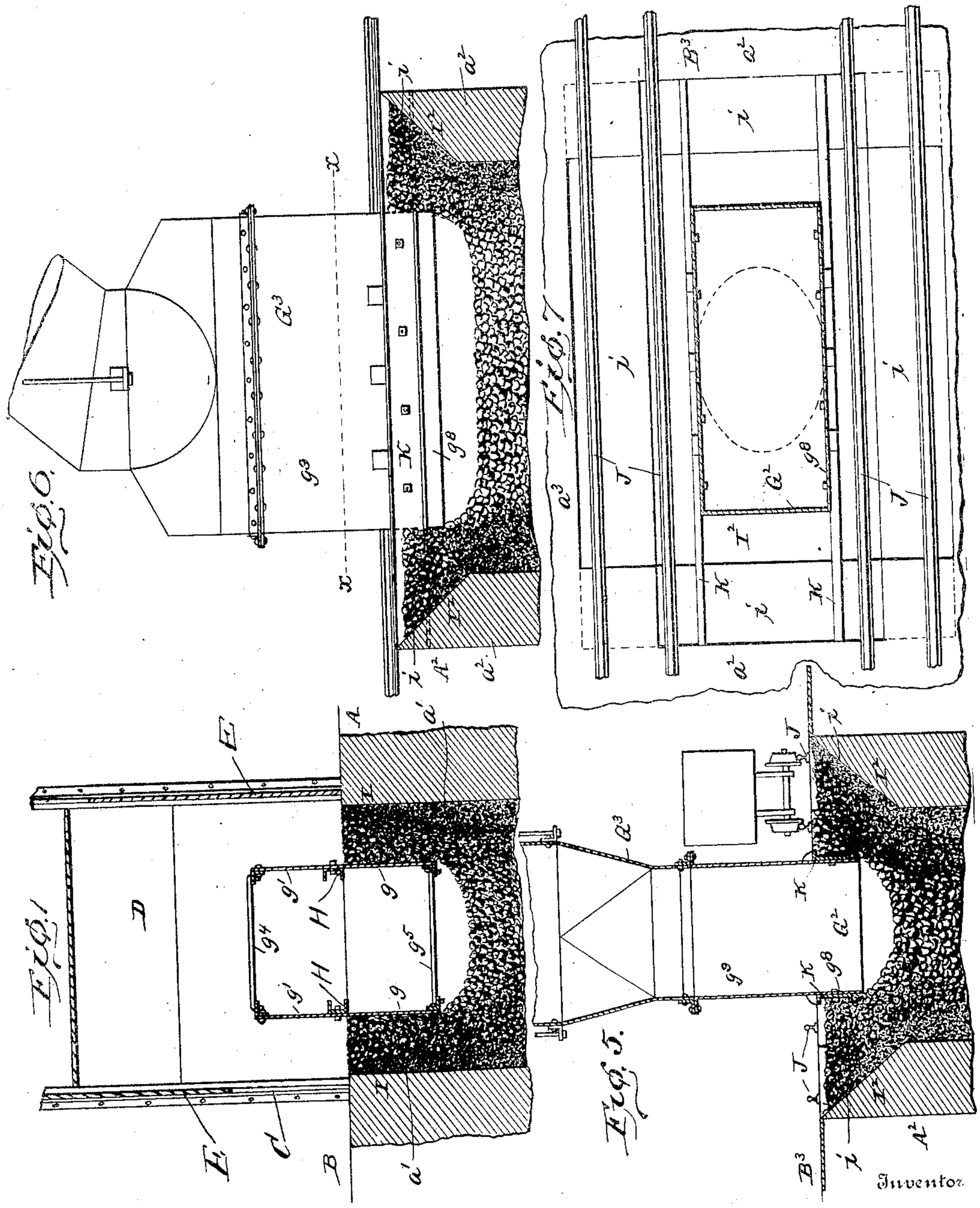

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Fig. 2.

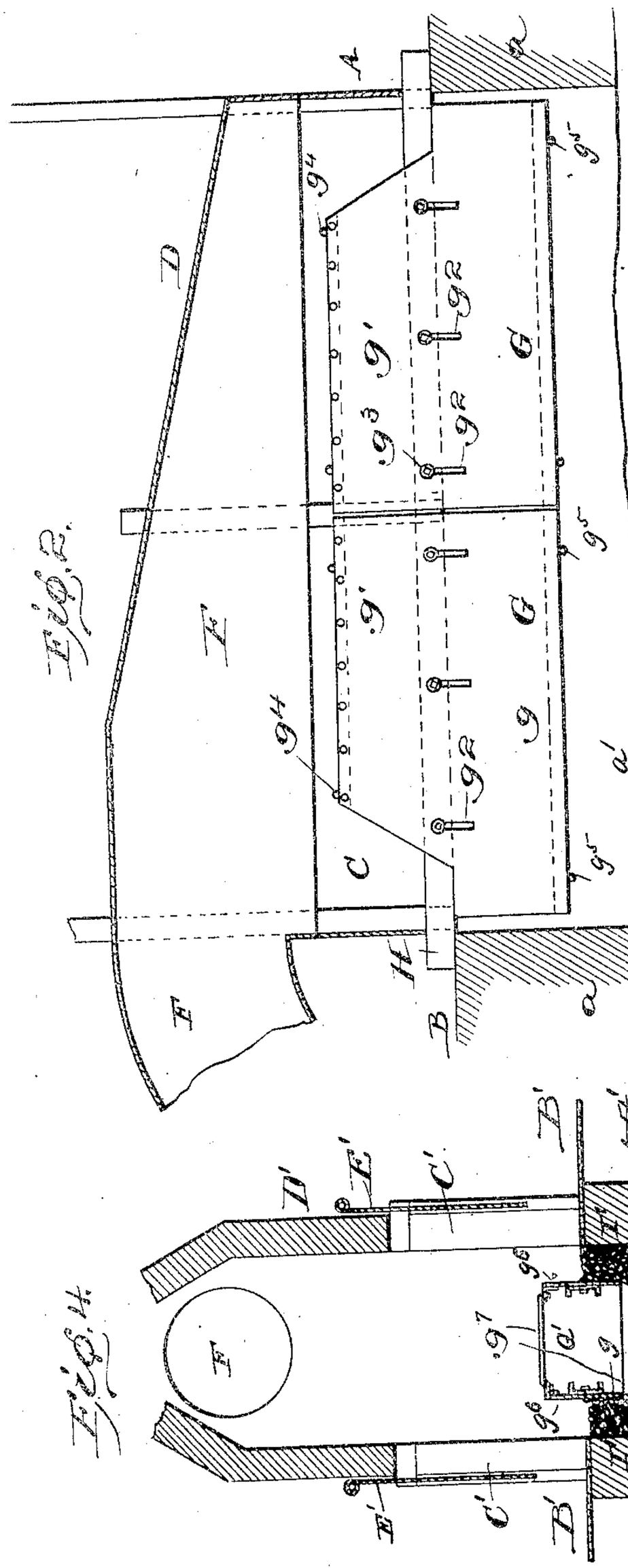

Fig. 3.

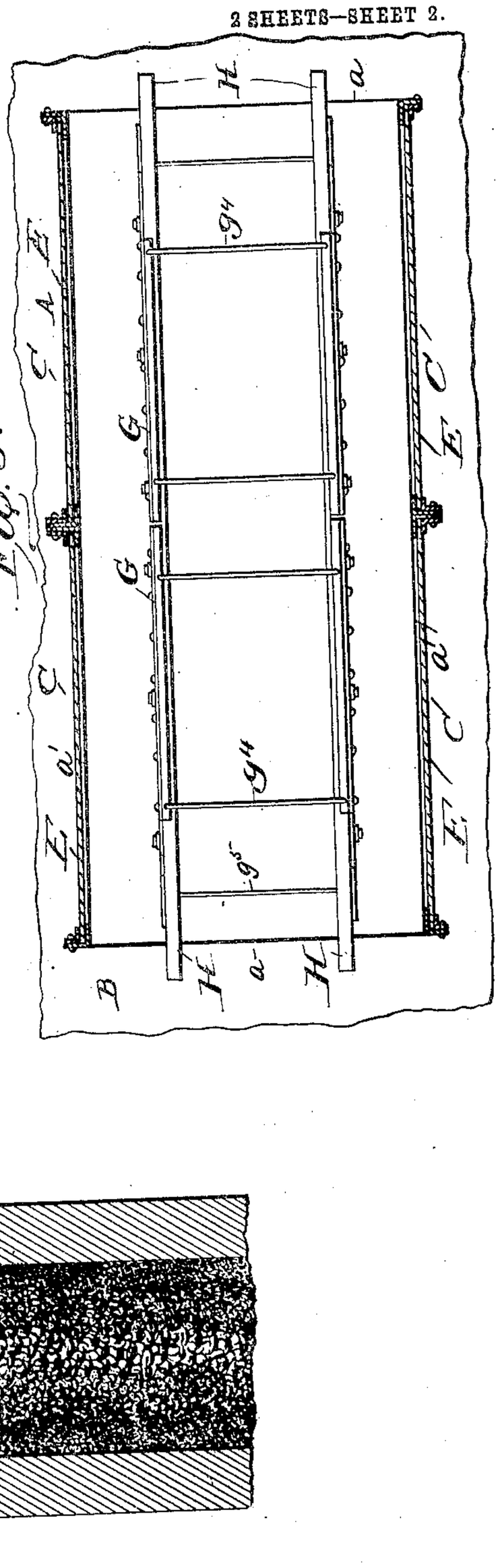

Fig. 4.

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ART OF SMELTING ORES.

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Application filed March 2, 1903. Serial No. 145,803.

To all whom it may concern:

Be it known that I, ARTHUR S. DWIGHT, a citizen of the United States, residing at San Luis Potosi, Mexico, have invented certain new and useful Improvements in the Art of Smelting Ores, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to improvements in the art of smelting ores of various sorts, it pertaining more particularly to a method of automatically feeding into the top of the furnace the masses of material which are to pass down through it and which are composed of bodies of fuel, ore and fluxes respectively.

The purposes aimed at and the results attained will be understood from the description given below.

Figure 1 is a transverse section of a furnace of one of the forms embodying my improvements. Fig. 2 is a longitudinal section showing the feeding device in side elevation. Fig. 3 shows the feeding device in plan. Fig. 4 is a cross section of a modified form of the furnace. Fig. 5 is a transverse section of another modified form of furnace. Fig. 6 is a side elevation of the parts shown in Fig. 5. Fig. 7 is a cross section on the line *x*—*x* of Fig. 6, looking downward.

A indicates as a whole the furnace structure which may be built of any suitable material and be of such size and proportions as are demanded by varying circumstances. I have selected for illustration a furnace having an interior chamber which is oblong in shape, that is to say, has a longitudinal dimension greater than its transverse dimensions. The end walls are shown at *a a* and the side walls at *a' a'*. At B are indicated the platforms or floors upon which are supported the operatives and the apparatus for carrying the material and delivering it to the upper part of the furnace. In the walls of the structure D above the furnace proper there are doorways C. These may be provided with doors of any suitable sort. As shown, doors are indicated at E adapted to slide vertically in suitable guide-ways. The structure at D is either shaped to constitute or is adapted to support an exhaust flue or chimney F. In the construction shown in Figs. 1, 2 and 3, this is a laterally extended duct which may communicate with a suction mechanism. Or as in the other constructions, it may be a chimney or stack through which natural exhaust is permitted. Through the door-ways at C, the fuel, the ore, and the fluxes are introduced to the upper part of the furnace. And during the operation, charges are delivered from time to time. The furnace is provided at or near the bottom with a blast mechanism for forcing air inward and upward through the heated material; but this part of the apparatus does not require any detailed description, as it is well known, and any one of the numerous forms can be employed.

It is well known that the gases in a furnace of this character in their ascent through the column of material in the shaft of the furnace tend to find paths of least resistance to their upward passage, and such paths they find along the walls of the furnace when the feeding is effected in the common way. But at the same time it has been well recognized that the best results, with relation to the primary heating and the chemical preparation of the descending masses, can be attained only when the gases permeate uniformly and evenly the whole of the contents of the shaft. And in order to accomplish this, there should be, through the vertical, central part of the shaft chamber, numerous path-ways for the gases, so that the resistance along such vertical central lines will be reduced, and the proper volumes of the gases will be induced to pass upward through the said central part of the mass. One method that has been followed in order to attain this has been to feed the finer or more reduced masses of the material downward at lines where it would tend to keep close to and follow the vertical walls of the furnace, and at the same time feed the larger, coarser or less reduced particles or masses in such way that they will tend to travel downward on the central vertical lines of the chamber. Hand labor has been generally depended upon for carrying this out; but it is constantly the case that either from carelessness or lack of skill on the part of the operatives, there is great unevenness in the feeding of the material; and consequently there is great irregularity in the action of the furnace; crusts or cross-walls from the partial melting of the bodies are formed, fuel is wasted, and metal is lost by volatilization.

The difficulties incident to and the in-

ferior results attained by the employment of hand labor has prompted the proposal of numerous methods and automatic mechanisms for furnace feeding to obviate them.

In all cases within my knowledge where use was made of automatic or mechanical feeders and where the ore, the fuel and the fluxes were initially fed to the furnace in a common mass, the materials instantly or rapidly moved downward into the shaft chamber to horizontal planes below the feeding devices, in contradistinction to having the materials checked or suspended in masses on their way to but before reaching the shaft chamber proper. As an example, I refer to the well known "bell and hopper" feed device used with the round blast furnaces employed in the smelting of iron. With these, the materials as they are dumped into the upper part of the furnace, are instantly permitted to move downward to points below the feeder. The bell in such constructions moves downward and upward frequently and with comparative rapidity at each movement. The parts are so related that the material is directed from the center of the furnace outward, giving it a tendency to strike against the wall of the shaft and then bound backward so that there is no assurance as to the vertical lines on which the particles of different classes shall move. A construction of the kind now being referred to is illustrated in the French Patent No. 106,301, to Brandon, dated January 2, 1875, in the use of which the purpose is to form in the upper part of the furnace a well-defined horizontal strata of the different components of the charge, such as the coke, the ore, etc., and the parts are so constructed and operated as to leave, in the upper part of the mass of material, cavities around which the charge is unsupported, and it tends to all slide rapidly and with frequent movements to the center of the shaft carrying the finer and coarser particles indiscriminately toward the vertical axis. But in following the process which I have devised, results of a materially different character are reached, in respect to disposing of the different classes of material at the upper end of the furnace shaft.

As will be seen from the further description to be given, I have devised a method and a feeding mechanism for preventing the material from thus suddenly dropping into the shaft chamber and also for permitting the successful feeding of furnaces which are of other shapes than round in horizontal section, particularly the furnaces of the sort found to be superior in lead and copper smelting and which are rectangular in horizontal section.

By referring to the drawings, it will be seen that I place at lines between the side walls of the chamber, partitions or wall-like parts G G, these being situated in vertical planes and preferably substantially parallel to the body part of the shaft chamber. They may be made of metal in sheet or other form, and are preferably vertically adjustable, as shown in Fig. 2. They may be supported in any suitable way, I preferring to employ light but strong angle-irons as shown at H, the ends of which can be rested upon or in the masonry of the furnace. These walls or aprons extend to horizontal lines some distance below the horizontal plane of the feeding door-ways, but should not extend too far downward, the distance being controlled by the dimensions of the furnace and the distance of these walls or aprons from the chamber walls. I also prefer to extend them somewhat above the bottom planes of the door-way, as shown at g', the depending parts being indicated by g. By forming slots as at g^2 in them and employing supporting devices such as bolts g^3, the aprons or partition walls can be placed at higher or lower positions as desired. They are braced together at the top by means of rods g^4 and also at the bottom as shown at g^5, these insuring that lateral pressure shall be properly resisted and the feeder kept in proper shape.

The operation of a furnace constructed in this way and provided with the devices described will be readily understood. It being assumed that it is in action, and that the shaft chamber is filled with material, new charges are brought in barrows or cars and dumped on the charging floor at B near the door-ways. After the mass in the furnace has sunk far enough, fresh charges are shoveled in until the spaces at I are full, the method properly carried out requiring that these spaces should be thus constantly substantially filled, new material being added as soon as the surface of the sub-masses in the side chambers at I I descends.

The tendency of the smaller particles of the more finely reduced portion of the mass is to sift directly downward under the jolting action as the entire mass settles from time to time, but the larger particles or lumps on the contrary tend to roll or crowd toward the central vertical lines of the furnace. This moving directly downward of the finer particles continues, but as soon as the larger particles or lumps reach the lower edges of the partition or apron G, they roll to the low place under the center of the feeder hood, that is, the vertical center of the shaft chamber. In this way there is produced a classification according to sizes of the different particles in the general mass, and the automatic placing of these particles in strict accordance with what is the most desirable arrangement for the action of the furnace.

The walls at G G not flaring outwardly

as they do in the devices of the "bell and hopper" sort, there is no tendency to crowd or throw the larger masses or lumps outward toward the shaft wall. I am not aware of the use of such cones or outward flaring guiding devices in feeding the material in the manner which I follow, that is to say, by slow and gradual settling past the feeder; and such device would be impracticable for the carrying out of my process, inasmuch as the slowly settling material would crowd into the gradually narrowing throat-way and there choke and bridge and either stop the action of the apparatus or cause an irregular feeding and require the frequent application of tools for the dislodging of the masses. The feeding hood is open vertically, that is, at top and bottom, and as the side chambers I I are kept constantly full of material, the waste gases that rise to the top of the mass are gradually drawn off through this as a guide-way. After escaping through it, they enter the stack or duct for the exhaust, either such as shown at F in Fig. 2, or such as illustrated in the modifications.

By keeping the furnace and the side chambers I I constantly full, the amount of cold air which can enter is reduced to a minimum, and the size and capacity of the chimney, stack or exhaust duct can be reduced to a great extent over that which is required with other forms of furnace.

It will be seen that the parts of the feeder are so arranged that they present no material impediment in getting access to the top parts of the furnace walls, as is frequently necessary. As above noted, crusts, bridges or "scaffolds" are formed in the furnace as the materials melt, and these can be broken up and the furnace walls can be cleaned without difficulty.

In Fig. 4 I have shown a form of furnace somewhat modified in comparison with that in Figs. 1 and 2, the difference, however, being merely in the construction and arrangement of the parts at the top, that is, those incident to the exhaust apparatus. A′ represents the furnace, D′, the chimney or exhaust flue, B′ the charging floor, C′, C′ the doorways, and E′, E′ the sliding doors. G′ is the feeding device having the vertical side walls g^6 and the staying devices g^7, I′ indicating the initial settling spaces for the commingled materials.

In Figs. 5, 6 and 7, another modification is illustrated. Here the chambers I^2, I^2 which initially receive the material are widened by flaring the upper part of the shaft chamber, the side walls being inclined outward and upward as shown at *i*. Car tracks as at J, J, are placed across the top of the furnace chamber and the materials can be passed directly from the cars to the chambers I^2 without requiring shoveling. Here the device which insures the proper feeding of the material also serves to collect the rising gases and fumes and conduct them away. The lower part of it is indicated by G^2 and the upper part by G^3. It is supported by beam K secured in the top part of the furnace A^2. The lower parts g^8 of the walls serve in the manner above described to effect separation of the larger particles or masses from the smaller ones. These walls in this construction are extended upward continuously as at g^9 to provide the exhaust flue or stack for the fumes and gases.

What I claim is:

1. The herein described improvement in the art of smelting ore, which consists in heating the ore in a vertically disposed body in a shaft, feeding to the top of the shaft near the walls thereof masses of material containing smaller particles and larger particles of the ore, fuel and fluxes mixed together, arresting the inward flow of the said masses of newly fed commingled material at the top of the shaft, causing them to slowly settle step by step and simultaneously causing the finer particles to separate from the larger ones of the commingled masses on vertical lines adjacent to the shaft walls, and after the material has been thus arrested for a predetermined distance in its downward travel releasing the larger particles and permitting them to roll toward the central vertical lines of the shaft.

2. The herein described method of treating ore and smelting it, it consisting in heating the ore in a vertically disposed body in a shaft, feeding to the top of said body near the walls of the said shaft a substantially continuous supply of masses of material containing smaller particles and larger particles of the ore, fuel and fluxes mixed together, causing the gases and fumes from the heated lower part of the body to pass upward substantially on the vertical central lines thereof, arresting the inward flow beyond a predetermined point of the said masses of newly fed commingled material at the top of said body and around the upward passage for said gases and fumes, causing them to settle slowly downward gradually toward the heating region, simultaneously causing the finer particles to separate from the larger ones of the commingled mass as it settles, and causing them to travel on vertical lines adjacent to the shaft walls, and then after the material has been thus arrested for a given distance in its downward flow releasing the larger particles of the commingled material at a horizontal plane below the plane of feeding and permitting them to roll toward those central vertical lines of the shaft along which the gases and fumes escape upward across the horizontal plane of feed.

3. The herein described method of initially supplying ore, fuel and fluxes to the

top of the shaft of a smelter, which consists in filling the said shaft with the said commingled materials to the horizontal line where the material will settle in accordance with natural flow under the action of gravity, feeding to the top of the body of material thus formed commingled masses of said material, temporarily restraining the upper piled portions of material from natural flow inward, causing them to settle step by step on lines near the side walls of the furnace and simultaneously causing the finer particles to separate from the larger ones and to move downward on said lines, and then after the material thus restrained has moved downward a given distance allowing the larger particles in accordance with natural flow under gravity and the pressure of the superincumbent mass to roll or move toward the central vertical part of the lower mass.

4. The herein described improvement in the art of smelting ore which consists in heating the ore in a vertically disposed body in a shaft, feeding to the top of said body near the walls of said shaft masses of material containing smaller particles and larger particles of the ore, fuel and fluxes mixed together, restraining the masses of newly fed material from inward flow beyond a predetermined point toward the central vertical lines of the shaft, causing them while thus restrained to settle slowly step by step and simultaneously causing the finer particles to separate from the larger ones of the commingled mass on vertical lines adjacent to the shaft walls, and then after the material thus restrained has traveled downward adjacent to the shaft walls a predetermined distance, releasing the larger particles thereof and permitting them to move under the action of gravity and the pressure of the superincumbent mass of material toward the central vertical lines of the shaft.

5. The herein described improvement in the art of smelting ore, which consists in heating the ore in a vertically disposed body whose central top portion is shaped by the natural flow of the material under gravity, feeding to the top of said body on vertical lines outside of the vertical planes surrounding said central top portion masses of commingled smaller and larger particles of ore, temporarily restraining the particles of said newly fed masses against inward flow while causing them to slowly settle step by step, simultaneously causing the finer particles to separate from the larger ones on vertical lines adjacent to the shaft walls and causing them to travel continuously downward on said vertical lines, and then when the particles of said newly fed masses have moved downward along the furnace walls a predetermined distance releasing the larger particles and permitting them to roll along the inclined lines of natural flow toward the central vertical lines of the shaft.

6. The herein described improvement in the art of smelting ores, which consists in heating the ore in a vertically disposed body whose central top portion is shaped by the natural flow of the material under the action of gravity, feeding to the top of said body on vertical lines outside of the vertical plane surrounding said central top portion masses of material containing smaller and larger particles of the ore, fuel and fluxes mixed together, temporarily restraining the inward flow beyond a predetermined point of the particles of said newly fed masses while causing them to slowly settle step by step adjacent to the shaft walls, simultaneously causing the finer particles to separate from the larger ones on vertical lines adjacent to the shaft walls, then when the particles of said newly fed masses have moved downward adjacent to said shaft walls a predetermined distance releasing the larger particles and permitting them to roll along the inclined lines of natural flow toward the central vertical lines of the shaft, causing the furnace gases to rise uniformly through the body of material in the said shaft, and then drawing them vertically upward from the top of said body of material in the shaft on vertical lines within the vertical lines beyond which the said masses of newly fed material are temporarily restrained against inward flow.

7. The herein described improvement in the art of smelting ore, which consists in heating the ore in a vertically disposed body in a shaft, feeding masses of material containing smaller particles of the ore, fuel and fluxes to the top of said body in vertical planes at the sides of the central top portion of said body, temporarily restraining the particles of said newly fed materials from inward flow beyond a predetermined point, causing them to slowly settle downward on lines adjacent to the shaft walls, simultaneously causing the finer particles to separate from the larger ones on said vertical lines, then after the particles thus restrained have moved downward a predetermined distance releasing the larger particles and allowing them to roll toward the central vertical lines of the shaft, and drawing off the furnace gases passing up through said body of material in the shaft on vertical lines within the innermost vertical line of the temporarily restrained masses of newly fed material at the top of the shaft.

In testimony whereof I affix my signature in presence of two witnesses.

ARTHUR S. DWIGHT.

Witnesses:
H. A. EYE,
W. G. FROST.