No. 824,485. PATENTED JUNE 26, 1906.

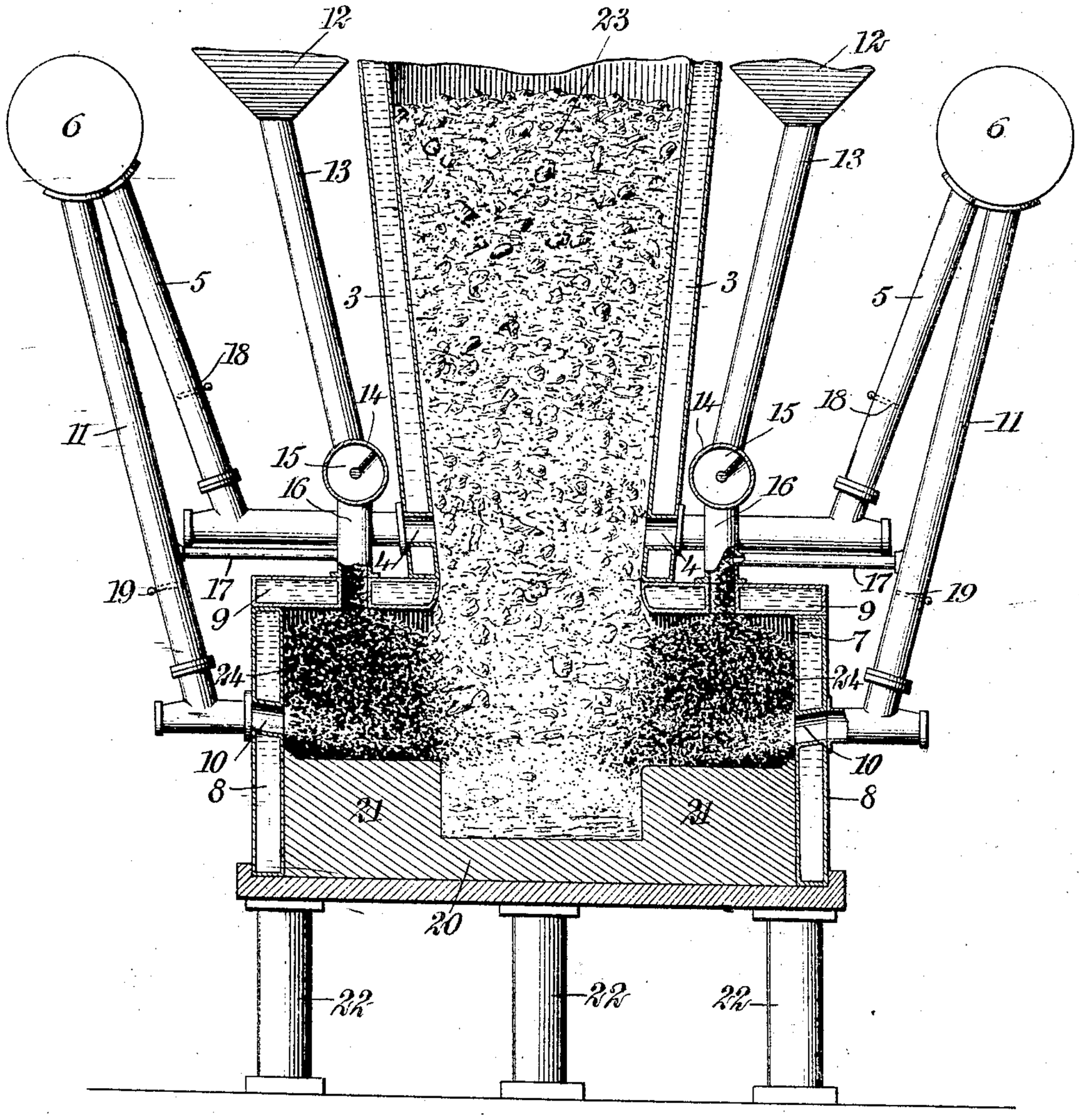
W. KEMP.

BLAST FURNACE.

APPLICATION FILED JUNE 30, 1905.

2 SHEETS—SHEET 1.

FIG. 1.



WITNESSES:

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2 SHEETS—SHEET 2.

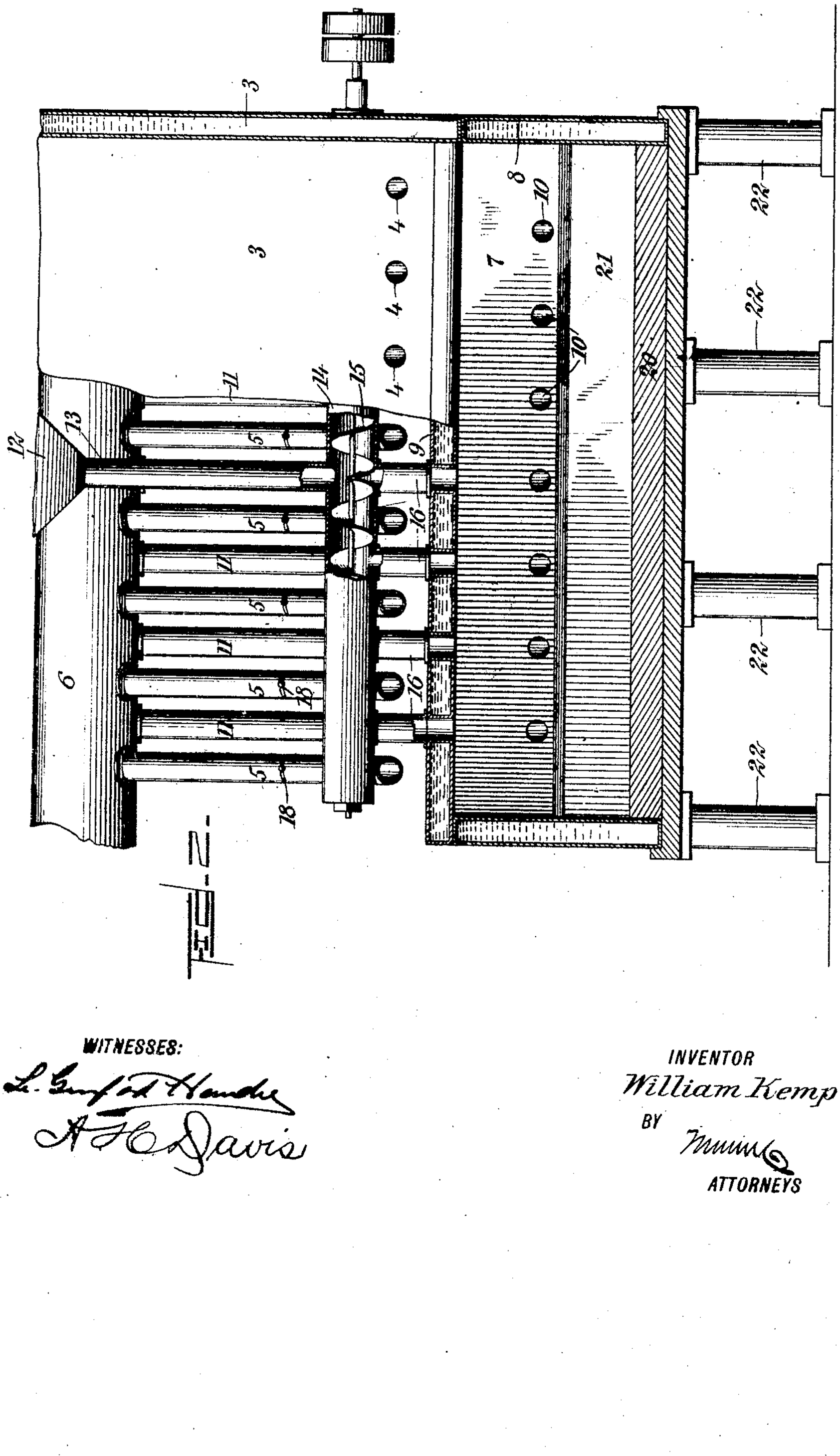

FIG. 2.

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BLAST-FURNACE.

No. 824,485. Specification of Letters Patent. Patented June 26, 1906.

Application filed June 30, 1905. Serial No. 267,741.

To all whom it may concern:

Be it known that I, WILLIAM KEMP, a citizen of the United States, and a resident of Tucson, in the county of Pima and Territory of Arizona, have invented a new and Improved Blast-Furnace, of which the following is a full, clear, and exact description.

My invention relates to furnaces for smelting ores, especially ores of copper and iron. Among the objects of my invention are the following: first, to economize the use of fuel; second, to rid the ore of sulfur should any of the latter be contained therein; third, to provide an effective fuel-chamber in which the fuel is fed directly to the smelting zone of the furnace before being heated; fourth, to provide special air-blasts for preventing the coal from being heated while in transit to the fuel-chamber; fifth, to provide the furnace with special twyers for the purpose of burning out sulfurous components of ores; sixth, to distribute the fuel uniformly along the fuel-chamber throughout the entire length of the furnace, and, seventh, to provide certain constructional improvements hereinafter described.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in both figures.

Figure 1 is a vertical cross-section through my improved furnace, and Fig. 2 is a longitudinal section through the same.

The ore-chamber is shown at 3, and consists of a water-jacket of substantially frusto-wedge shape, as indicated in Fig. 1. This ore-chamber is open at the top in the usual manner. At the bottom of the ore-chamber are disposed upon each side a series of twyers 4, connected by means of twyer-pipes 5 with the bustle-pipe 6. The fuel-chamber is shown at 7 and extends practically throughout the length of the furnace. This fuel-chamber is bounded by water-jacketed walls 8 9, forming an angle relatively to each other. A series of twyers 10 tap into the water-jacketed wall 8 for the purpose of supplying air to the fuel-chamber 7 at a plurality of points. These twyers 10 are supplied by air-pipes 11, which communicate directly with the bustle-pipe 6. Hoppers 12 are provided with chutes 13, which extend obliquely downward into conveyers 14, which are provided with spiral screws 15. The hoppers 12 are preferably of the self-feeding type; but this feature is old and forms no essential part of my invention. Each tubular conveyer 14 is, in effect, a conduit for carrying coal from the chute 13 and properly distributing it in the fuel-chamber 7. A number of branch conduits 16 are connected with the conduits 14 and are spaced equidistant throughout the general length of the furnace. Each branch conduit 16 is connected by a comparatively small air-pipe 17 with one of the air-pipes 11. By means of sliding valves 18 19 the respective pipes 5 and 11 may be opened and closed at will. The metal-well is shown at 20, and disposed upon each side thereof are walls 21 of refractory material, preferably quite thick, as indicated. These walls serve to support the fuel, and consequently constitute the bottoms of the respective fuel-chambers 7. The supports 22 and other parts shown are of ordinary construction. The ore is shown at 23 and the fuel at 24.

Preferably I start my furnace in the following manner: In the smelting-chamber I first put the wood and ignite the same and then feed through the branch conduits 16 in the manner above described coal on the burning wood and start up the blast through the twyers 10 until I have produced an incandescent mass in the fuel-chamber. Then I feed at the top of the ore-chamber the ores desired to be treated. The ore is fed into the ore-chamber 3 at the top in the usual manner. If the ore contains sulfur or its combustible compounds, the valves 18 are left open to a suitable extent. If the ore contains no sulfur, the valves 18 are generally closed. The spiral conveyers 15 being in action the coal is fed continuously from the hoppers 12, through the chutes 13, and through the several branch conduits 16, so as to fill the fuel-chambers 7. The coal does not stack up in the branch conduits 16, but falls upon the walls 21 and piles up, preferably, to a level somewhat below the lower ends of the branch conduits 16. Meanwhile the ore 23 feeds downward, and is thus sandwiched between the masses of fuel 24, being in actual contact, but not being commingled—that is to say, the ore-body as a whole is almost separate from the fuel-bodies. As the fuel is consumed more is supplied through the branch conduits 16,

the supply being so regulated that the branch conduits 16 are always kept free of burning fuel. Air is supplied from the pipes 11, and when the furnace is in operation the valves 19 are always open, at least to a greater or lesser extent. The air-pipes 17 are always open, and not only serve to keep up a circulation of air through the branch conduits 16 and downward by a downblast following the fuel-supply into the fuel-chamber, thereby preventing combustion of the fuel while passing through the branch conduits 16, but also serve to supply the fuel 24 with air delivered at a point somewhat difficult of access. The fuel 24 is thus supplied with an upblast from the bottom and a downblast from its top. In the case of ores containing sulfur when the air-blast is turned on passing through the twyers 4 the air comes directly into contact with the sulfur and iron in the heated ore, forming sulfurous gases and oxid of iron, thus generating a smelting-heat. This heat is due partly to oxidation of the iron, but mainly to the combustion of the sulfur. A great advantage is thus obtained, because the objectionable gases are expelled from the ore and the necessity of roasting as a distinct step is avoided, and the gases themselves in the process of expulsion actually serve the purpose of fuel, and therefore economize the use of coal.

It will be noted that the fuel-chambers 7 are comparatively wide. Each of these fuel-chambers has approximately the shape of an immense fireplace. A comparatively large volume of coal is thus caused to burn in immediate contact with the ore-body, and yet there is no danger of any part of the coal being ignited before actually entering the fuel-chamber. It should be borne in mind that the coal drops loosely from the conveyers 15 to the bottom of the fuel-chamber or to the level to which the fuel may be filled therein. It is of course impossible for the coal, whether in large lumps or otherwise, to ignite while falling this short distance so long as the air-pipes 17 are blowing a strong blast of cold air upon each separate piece of coal as it falls.

I prefer to feed the coal by dropping it loosely, as above stated, but do not limit myself to that manner of feeding, as it may sometimes be desirable to feed the coal downward upon the fuel as practically a solid feed from the conduits 14, and this may readily be done provided the downdraft through the branch conduits 16 is kept up with sufficient power to prevent combustion in those conduits, one important feature of my invention being the use of this downdraft to prevent an updraft through the branch conduits and the combustion of the fuel therein.

In order to stop the supply of coal, owing to the fuel-chambers being full, the rotation of the spiral conveyers 15 is simply stopped.

The fuel-chamber 7, together with the space intermediate thereof, constitute the smelting-chamber.

One of the main purposes of my invention is to feed the ore into the center of the smelting-chamber and to feed solid coal free from combustion into immediate contact with the ore-body without admixture therein, so that the coal after being thus placed is ignited—that is to say, the coal is first placed while comparatively cool in the smelting-chamber and is then heated and ignited in the first instance.

It will be seen that this furnace as compared with other furnaces affords quite a number of distinct advantages. For instance, a sulfid ore containing any percentage of sulfur can be smelted by the use of a comparatively small quantity of coal. If an ore contains no sulfur, it can be smelted at a much less cost in this furnace than in other furnaces, for the reason that the fuel used is coal and is consumed right at the smelting zone. In most of the ordinary furnaces considerable waste takes place, due to the fact that a large percentage of the heat is lost in the shape of unburned carbonic oxid, which passes through the ore-body and escapes from the top of the furnace. In my furnace no carbonic oxid can escape, as none is formed above the smelting zone.

I am aware that furnaces have heretofore been constructed in which the attempt was made to feed the ore and the fuel independently and continuously. I do more than this, in that while feeding the fuel to the ore continuously I also prevent the premature combustion from taking place in the fuel thus supplied.

I do not limit myself to the exact details above stated, for obviously the principles underlying my invention may be applied in various ways, depending upon the diversified needs of the art and the individual tastes and requirements of different operators. Neither do I limit myself to the use of coal, for under certain conditions coke or charcoal and other solid forms of fuel may be employed instead.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination of an ore-feeding chamber, a conveyer for supplying fuel to a point adjacent thereto, an air-pipe connected with said fuel-chamber at the point of entry of said fuel into said chamber so as to maintain said fuel at a lower temperature until after actually entering said fuel-chamber, and means for supplying a draft through said air-pipe sufficient to prevent combustion of the fuel before entering said chamber.

2. In a furnace, the combination of an ore-feeding chamber, means for supplying air directly thereto for the purpose of burning out sulfurous components contained within the ores, a fuel-chamber independent of said ore-

feeding chamber, means for supplying fuel to said fuel-chamber, and mechanism for supplying an air-blast to the fuel while in transit to said fuel-chamber and also for supplying air to said fuel-chamber.

3. In a furnace, the combination of an ore-feeding chamber, a horizontally-disposed wall located adjacent to the bottom of said ore-feeding chamber and of greater width than the same, vertically-disposed walls supporting said horizontally-disposed walls, means for feeding solid fuel through said horizontally-disposed walls, and a twyer for supplying an indraft of air to said fuel, said indraft being so arranged as to follow said fuel into said fuel-chamber, thereby preventing premature combustion of the fuel.

4. In a furnace, the combination of an ore-feeding chamber, a horizontally-disposed wall located adjacent to the bottom thereof and of greater width than the same, vertically-disposed walls supporting said horizontally-disposed walls, means for feeding solid fuel through said horizontally-disposed walls, and means for cooling said solid fuel as thus fed through said horizontally-disposed walls.

5. In a furnace, the combination of an ore-feeding chamber having its lower end open, a smelting-chamber communicating with said lower end and provided with portions serving as fuel-chambers, said smelting-chamber being further provided with comparatively thick walls serving as bottoms for said fuel-chambers, and with a space intermediate of said thick walls serving as a metal-well, mechanism for supplying solid fuel into said fuel-chambers immediately over said walls, and cooling devices for maintaining the temperature of said solid fuel comparatively low until said fuel enters said fuel-chamber.

6. In a furnace, the combination of an ore-feeding chamber, a fuel-chamber disposed adjacent to the lower end of said ore-feeding chamber and of greater width than the same, means for supplying coal directly into said fuel-chamber, and mechanism for maintaining said coal at a low temperature until actually delivered within said fuel-chamber.

7. In a furnace, the combination of an ore-feeding chamber, a horizontally-disposed wall located adjacent to the bottom thereof and of greater width than said ore-feeding chamber, vertically-disposed walls supporting said horizontally-disposed wall, means for feeding solid fuel through said horizontally-disposed wall, and twyers connected with said vertically-disposed walls for supplying air therethrough.

8. In a furnace, the combination of an ore-feeding chamber, fuel-chambers disposed at the lower ends thereof and spaced apart by a distance approximating the width of the lower end of said ore-feeding chamber, mechanism for feeding coal directly into said fuel-chambers, and means for supplying air to said coal while in transit to said fuel-chambers, thereby preventing premature combustion.

9. The combination with a furnace having a smelting-chamber and a contracted feed-chamber opening through the upper wall of the smelting-chamber, of a fuel-feed conduit extending into the upper wall of the smelting-chamber beside the feed-chamber, twyers delivering to the smelting-chamber, and pipes connecting the twyers and conduit.

10. The combination of a smelting-chamber, a plurality of branch conduits opening thereinto, means for supplying solid fuel to said branch conduits, twyers connected directly to said smelting-chamber, and branch pipes extending from said twyers to said branch conduits.

11. In a furnace, the combination of a smelting-chamber, twyers for delivering air thereinto, a conduit for feeding coal to said furnace, branch conduits connected with said conduit and opening directly into said smelting-chamber, spiral feed-screws mounted within said first-mentioned conduit and adapted to distribute said coal through said branch conduits, and separate pipes connected with said twyers and with said branch conduits.

12. The combination of a smelting-chamber, a main fuel-feeding conduit, a substantially horizontal conduit leading from said main conduit, branch conduits connecting said horizontal conduit with said smelting-chamber, a conveyer operating in said horizontal conduit, means for applying air continuously to said smelting-chamber below said conduits, and pipes for supplying air directly to said branch conduits.

13. The combination of a smelting-chamber, a twyer delivering thereto, a fuel-feeding conduit, a spiral conveyer mounted within said conduit, a pipe connecting the twyer and the conduit between the conveyer and the smelting-chamber, and means for feeding an uninterrupted supply of air through said twyer to said smelting-chamber.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM KEMP.

Witnesses:
L. W. WAKEFIELD,
J. W. BOGAN.