C. A. KUENZEL.

SMELTING FURNACE.

APPLICATION FILED AUG. 17, 1912.

1,067,481.

Patented July 15, 1913.

2 SHEETS—SHEET 1.

Fig. 1.

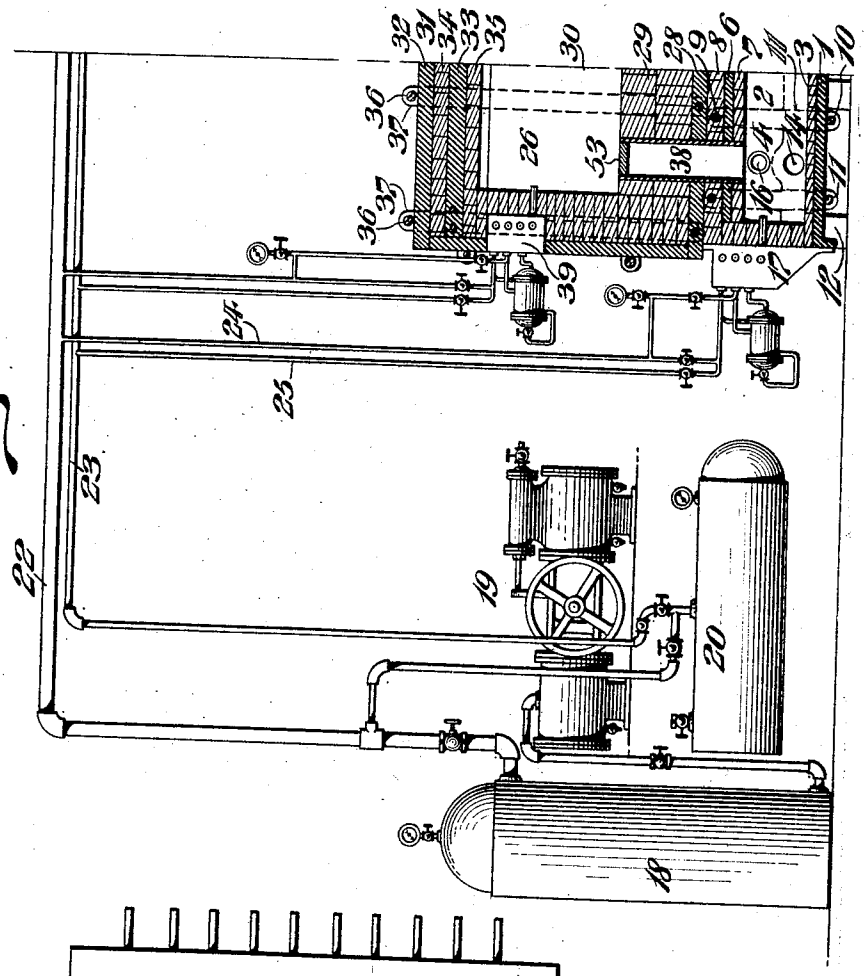
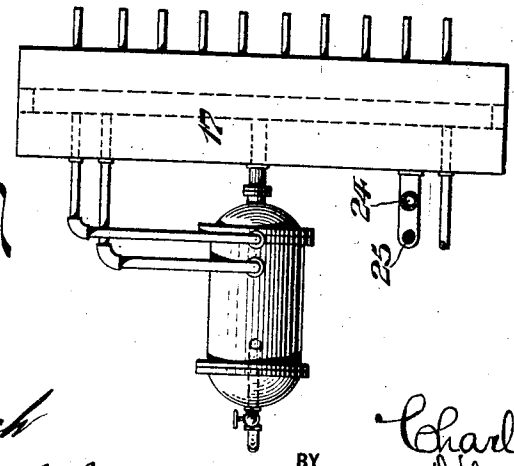


Fig. 3.



WITNESSES

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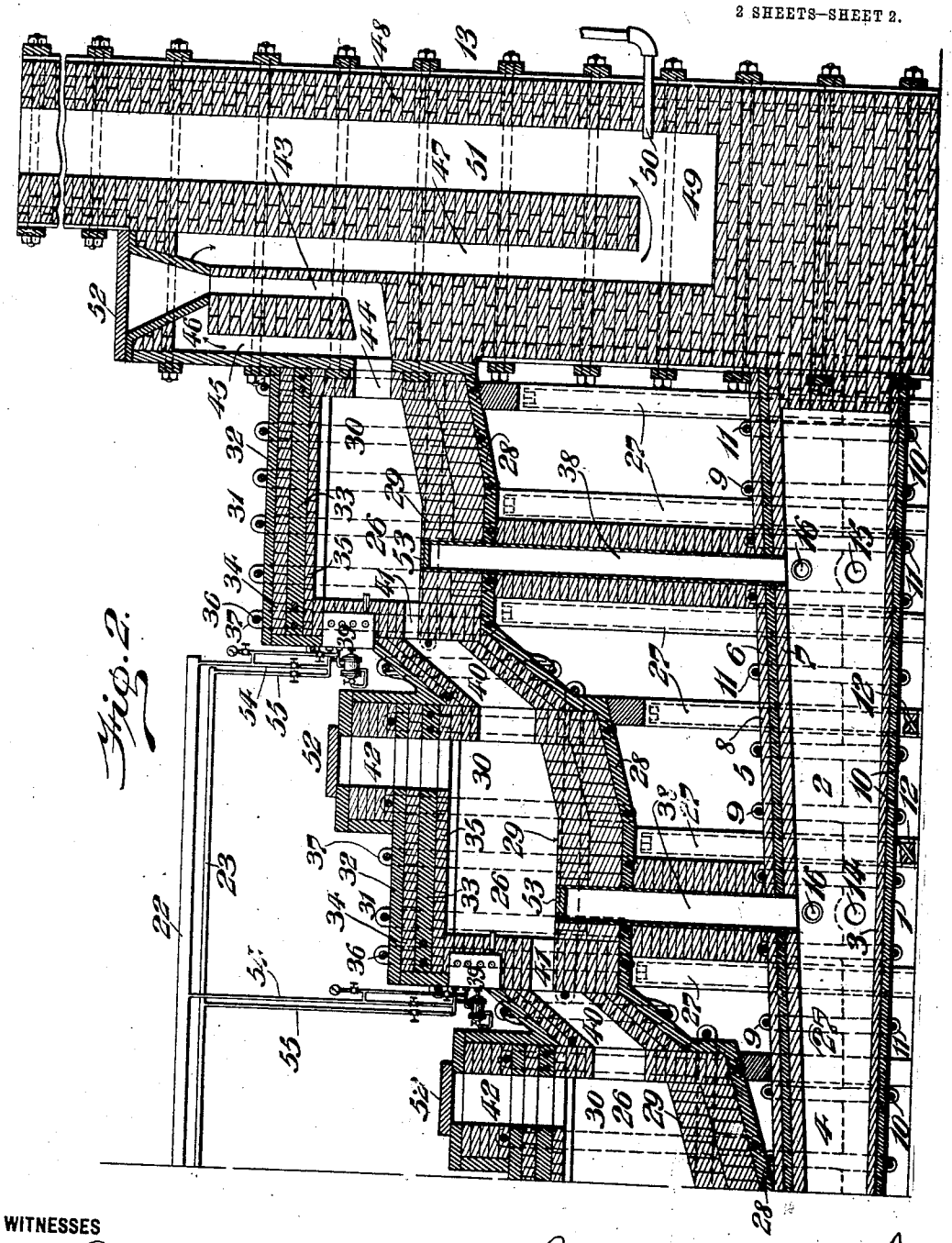

Fig. 2.

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UNITED STATES PATENT OFFICE.

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SMELTING-FURNACE.

1,067,481. Specification of Letters Patent. Patented July 15, 1913.

Application filed August 17, 1912. Serial No. 715,577.

To all whom it may concern:

Be it known that I, CHARLES A. KUENZEL, a citizen of the United States, residing at Buena Vista, in the county of Chaffee, State of Colorado, have invented a new and useful Smelting-Furnace, of which the following is a specification.

My invention consists of a furnace for smelting metallic ores in which gas is employed as a fuel, such gas being preferably generated from oil in individual retort-burners for each furnace-section, such as the gas generator for which I have filed a patent application, Serial No. 646,258, on August 26th, 1911, and patented September 24th, 1912, No. 1,039,549, or the gas generator for which I have filed a patent application, Serial No. 663,047, on November 29th, 1911.

It further consists of such a furnace in which ore is subjected to a preliminary roasting and smelting in chambers arranged stepwise and each having an individual retort-burner but communicating with each other, and in which the molten metal passes from such furnace-chambers into a chamber, also provided with a retort-burner, in which the molten metal is subjected to a final melting process.

It further consists of other novel features of construction, all as will be hereinafter fully set forth.

The invention is satisfactorily illustrated in the accompanying drawing, but the important instrumentalities thereof may be varied, and so it is to be understood that the invention is not limited to the specific arrangement and organization shown and described.

Figure 1 represents an elevation of the apparatus for generating the fuel gas and the lower end of the furnace structure in vertical section. Fig. 2 represents a vertical section of the remaining part of the furnace structure. Fig. 3 represents a top plan view of one of the retort-burners.

Similar numerals of reference indicate corresponding parts in the figures.

Referring to the drawings, the reference numeral 1 indicates a pan-shaped base of cast iron or similar metal, in which a long main furnace chamber 2 is supported, comprising a floor, 3, and side-walls, 4, of firebrick, and a top 5 resting upon said sides and formed by metal plates, 6, having a lining, 7, and covering, 8, of firebrick. Transverse stay-rods 9 and 10, extend across the top and beneath the base and have their ends secured in the upper and lower ends of stay-links, 11, by means of which rods and links the furnace-chamber is braced and held together. The base of the furnace-chamber is supported upon transverse girders, 12, to provide cooling ventilation for the bottom of the chamber, and the top of such chamber slopes upward to a chimney-structure, 13, which will be described later. Tap-holes, 14, are formed in the sides of the furnace chamber, and a slag tap-hole, 15, is formed in the side of the chamber near the highest end of the same, the level of said tap-holes preferably following the slope of the top. Peep-holes, 16, through which the condition of the metal may be examined, are formed in the side walls of the furnace-chamber, above the tap-holes. A retort-burner 17 of the construction disclosed in the above stated patent applications, or of any suitable construction to produce an intensely hot gas flame, is secured in the front or lower end-wall of the furnace chamber, and said structure receives air from an air-tank, 18, charged from a compressor, 19, and oil from a tank, 20, connected by a pipe, 21, to the compressed-air tank to have air pressure on the surface of the oil in the tank. A main air-pipe, 22, extends from the air-tank and along the entire furnace-structure, and a main-oil pipe, 23, extends from the bottom of the oil tank and along the furnace-structure. An air-pipe, 24, and an oil-pipe 25, extends from the mains to the retort-burner.

A plurality of primary furnace-chambers, 26, in the present instance three, are supported above the main furnace-chamber upon upright columns, 27, in stepwise arrangement each at a higher level than the other, and each of said chambers has a metal bottom formed by plates, 28, preferably of cast iron, and the rear plate of such bottom is preferably inclined while the forward plate is horizontal. Layers, 29, of firebrick rest upon the bottom-plates, and side-walls, 30, also of firebrick, rest upon the floor thus formed. A top, 31, composed of top-plates, 32 and 33, of cast-iron, and linings 34 and 35, of firebrick, rest upon the upper edges of said walls, and the bottom, walls, and top are tied together by stay-

rods, 36, and stay-links 37. Each furnace-chamber has a chute, 38, extending from its floor to and through the top of the main furnace. A retort-burner, 39, is secured in the front-wall of each furnace-chamber, to project its flame rearward across such chamber. An upwardly inclined flue, 40, extends from the rear end of the first and the second furnace-chamber and enters through the front wall of the subsequent furnace-chamber through a flue-opening, 41, in such wall and beneath the burner. The first and the second furnace-chamber has each a chute, 42, through its top, for the purpose of feeding ore into the chamber, and the third chamber has a feed-chute, 43, which opens into an opening, 44, in the rear wall of said chamber. Said opening communicates with a vertical flue, 45, for carrying off the fumes of the ore and the products of combustion, and said flue communicates by a horizontal flue, 46, with a vertical down-flue 47, in a stack, 48, which flue opens into a chamber 49, in the lower end of the stack, into which one or more nozzles, 50 open, which nozzles are suitably connected to a steam-generator. An up-flue 51, extends upward from this chamber and opens at the top of the stack. The feeding-chutes into the primary furnace chambers have suitable removable closures, 52, to confine the gases and other products of combustion, when said chambers are not being charged, and the chutes leading from said primary chambers to the main furnace chamber have removable closures, 53. The retort-burners and their accessories are each connected to the main air and oil pipes by pipes, 54 and 55.

When the furnace is started, the retort-burners are first started to heat the several furnace-chambers. When said chambers are suitably heated, ore and flux is charged into the primary furnace-chambers through the feed or charging chutes in their tops. When the metal begins to flow in the primary furnace-chambers, the downward chutes are opened and the molten metal and slag flows down into the main furnace-chamber, whence the slag may be run off through the slag tap-holes in its sides. When the metal in the main-furnace-chamber is in proper condition, it may be run through the tap-holes into pigs or whatever molds are desired. While the metal is cooking in the main furnace-chamber, it may be inspected through the peep-holes, so as to be run at the exact moment it is ready. The primary furnace-chambers may be charged while the metal is cooking in the main chamber, and said chamber and the metal therein will not be chilled by the charger. The flame, gases and other products of combustion from the lower chambers will ascend into the upper chambers and all the heat from each burner or set of burners will be fully utilized. When the ore is fed into the uppermost primary furnace-chamber, the roasted ore, molten metal and slag will gradually descend along the inclined bottoms of the chambers and through the inclined flues from one chamber to the next succeeding one, throughout the entire series of chambers, being successively subjected to the heat from the burners, so that the metal and slag will not chill the contents of the main furnace when let into the same through the chute from the lowermost primary furnace-chamber. The furnace will thus act continuously, maintaining a continuous downward flow through the primary chambers, and dispensing with the necessity of stirring the ore and slag in the primary chambers and entirely operating by gravity.

When the furnace is used for smelting zinc ores or ores of other volatile metals, the steam jets will condense and precipitate the metal in the vapor as it passes through the chamber in the lower end of the stack, and said jets will also precipitate other solid particles passing through the stack, so that nothing but waste gases will pass out of the stack. As the main-furnace-chamber is raised from the ground by the girders upon which it rests, and the primary furnace-chambers are supported upon the columns, all sides of said chambers are exposed to atmospheric temperature and kept comparatively cool. By the use of gas as a fuel and by avoiding cooling of the molten metal from fresh charges, employing the primary furnace-chambers to be charged while the molten metal is cooking in the main furnace-chamber, slag and cinders from fuel and chilled metal are avoided, thus resulting in the production of a superior grade of metal. The furnace may be employed for smelting any metallic ores tractable by a smelting process.

While I prefer to employ the gas generators and burners disclosed in either of the apparatus disclosed in my above applications, it is evident that other gas fuel, whether natural or produced from coal or hydrocarbons, consumed through other burners, may be employed in my improved furnace.

Gases and products of combustion from the main-furnace-chamber will pass up through the chutes into the primary furnace chambers, so that said main-chamber will be relieved of such products and the primary chambers will be heated by the same, and all fumes and gases passing up through the stack will be condensed by the steam-jets in the bottom of the same and such constituents as arsenic, sulfur or other noxious or poisonous substances will be precipitated in the bottom of the stack, whence they may

be removed. This will dispose of the serious objection to smelting furnaces, namely the injurious effects upon animal life and vegetation of the noxious and poisonous gases and fumes emanating from the stacks of such furnaces.

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

1. An apparatus of the character stated, comprising a long main furnace-chamber provided with a series of tap-holes and having a sloping top, a burner at the lower end of such chamber, a series of primary furnace-chambers arranged stepwise above said main chamber and formed with inclined bottoms and with chutes in their tops for charging them, inclined flues each connecting the lower end of one chamber with the upper end of the next-succeeding chamber, burners at the lower end of each chamber, and chutes extending from the lower end of each chamber to and through the top of the main chamber.

2. An apparatus of the character stated, comprising a series of primary furnace-chambers arranged stepwise and provided with means for charging them and with inclined floors, inclined flues each connecting the lower end of one chamber with the upper end of the next-succeeding chamber, individual burners at the lower end of each of said chambers, a main-furnace-chamber provided with tap-holes, a chute connecting the lowermost of said primary furnace-chambers with said main furnace-chamber, and a burner in said latter chamber.

3. An apparatus of the character stated, comprising a long main furnace-chamber provided with a series of tap-holes and having a sloping top, a burner at the lower end of such chamber, a series of primary furnace-chambers arranged stepwise above said main chamber and formed with inclined bottoms and with chutes in their tops for charging them, inclined flues each connecting the lower end of one chamber with the upper end of the next-succeeding chamber, burners at the lower end of each chamber, chutes extending from the lower end of each chamber to and through the top of the main chamber, means for controlling such chutes, and a stack communicating with the upper end of the uppermost primary furnace-chamber.

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Witnesses:
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