F. A. BURNS.

REVERBERATORY FURNACE.

APPLICATION FILED MAR. 10, 1910.

960,499.

Patented June 7, 1910.

3 SHEETS—SHEET 1.

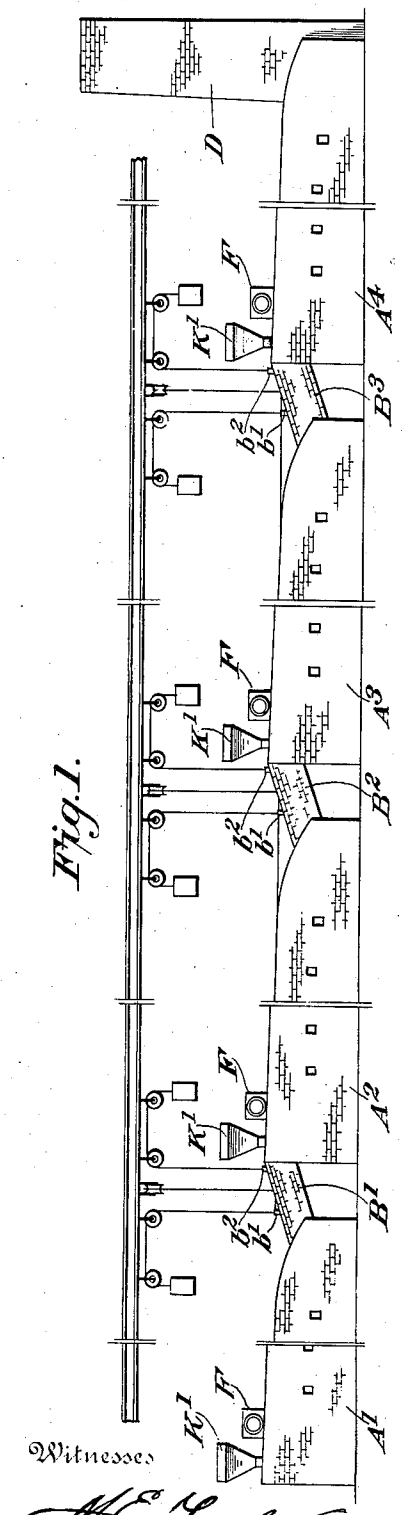

Fig. 1.

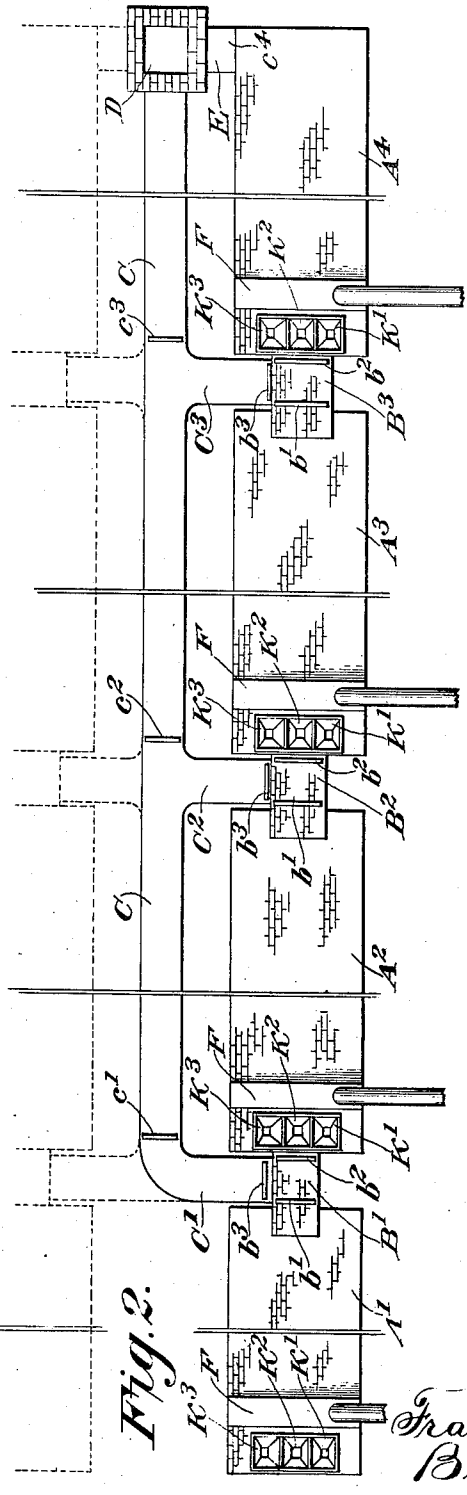

Fig. 2.

Witnesses

M. E. Fowler

James R. Mansfield

Inventor

Frank A. Burns

By Alexander Bovell

Attorney

F. A. BURNS.

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3 SHEETS—SHEET 2.

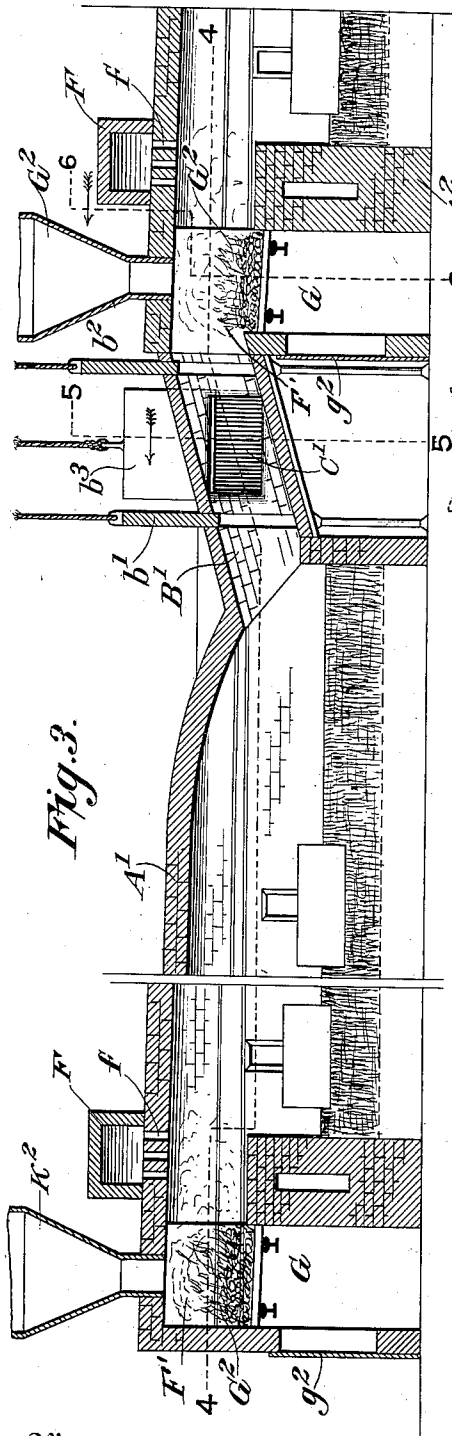

Fig. 3.

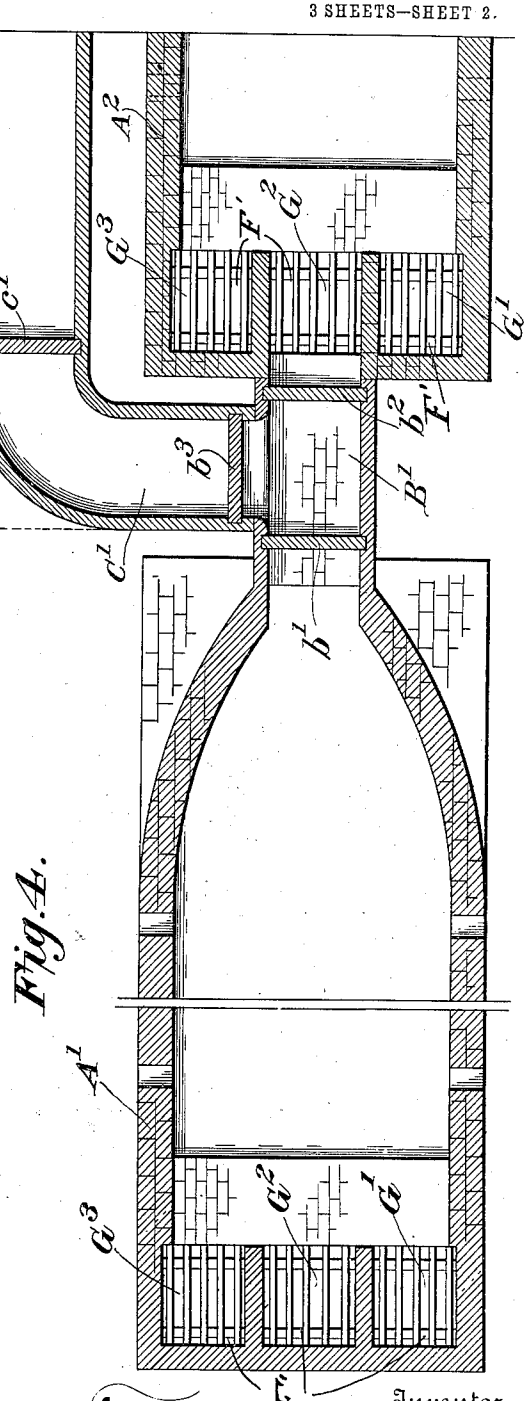

Fig. 4.

Witnesses

M. E. Fowler

James Mansfield

Inventor

Frank A. Burns

By Alexander & Fowler

Attorneys.

F. A. BURNS.

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3 SHEETS—SHEET 3.

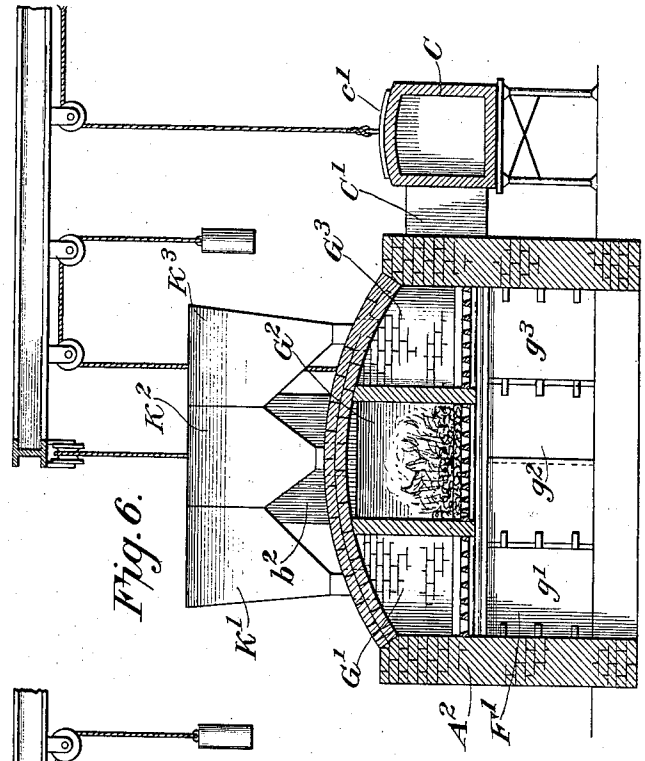

Fig. 6.

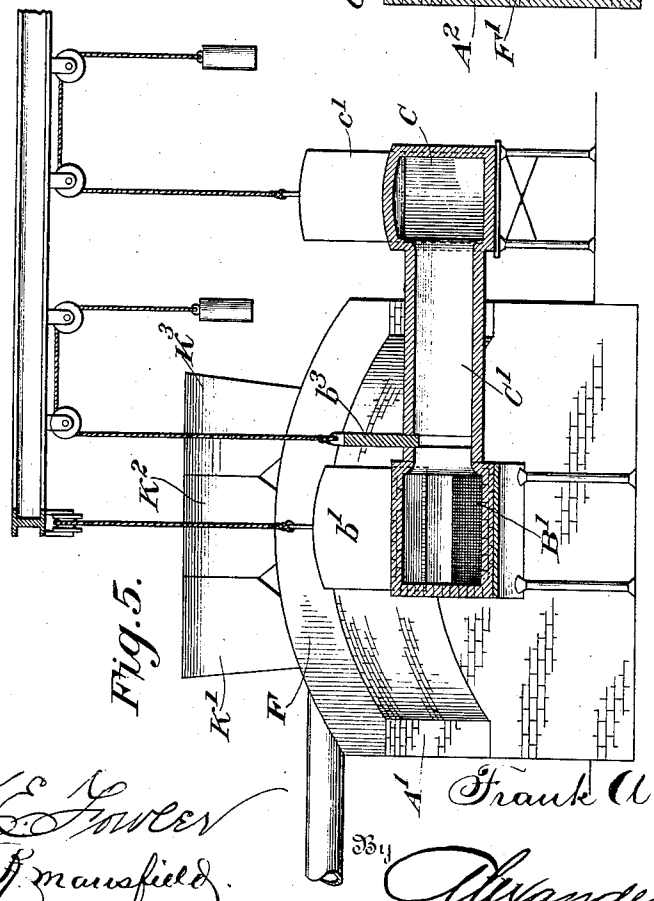

Fig. 5.

Witnesses

H. E. Fowler

James F. Mansfield.

Inventor

Frank A. Burns

By Alexander & Fowell

Attorneys

UNITED STATES PATENT OFFICE.

FRANK A. BURNS, OF ANACONDA, MONTANA.

REVERBERATORY FURNACE.

960,499. Specification of Letters Patent. Patented June 7, 1910.

Application filed March 10, 1910. Serial No. 548,383.

To all whom it may concern:

Be it known that I, FRANK A. BURNS, of Anaconda, in the county of Deerlodge and State of Montana, have invented certain new and useful Improvements in Reverberatory Furnaces; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

This invention is an improvement in smelting furnaces, and has particular reference to reverberatory furnaces used in matte smelting; and the object of the invention is to so arrange a number of matte smelting furnaces in a battery, or series, and so connect them that the, at present, waste hot gases derived from the smelting operation in one furnace is utilized for heating another furnace or furnaces, and the ore therein, in the series, so that by the consumption of a small amount of fuel in such latter furnace, or furnaces, I can complete the smelting of the matte therein; thereby greatly economizing fuel, and saving much time, in reducing the ores, and increasing the output of the furnaces in a given time.

In the smelting of copper sulfid and like ores in a reverberatory furnace a temperature of about 2800 degrees Fabrenheit is required, and the temperature of the waste gases leaving such furnace is about 2200 Fahrenheit. An ordinary reverberatory smelting furnace having a capacity of say 300 tons burns approximately 60 tons of coal in every 24 hours while in operation. By my invention when two or more furnaces are used approximately one-half of this amount of coal or other fuel will be saved; and in a battery of three furnaces such saving would amount to about 90 tons of coal per day; while with larger batteries of furnaces the saving in fuel would be proportionately increased.

My invention in brief consists in arranging a plurality of ordinary smelting furnaces in a battery or series and connecting them in such manner that the hot heretofore waste gases issuing from one furnace may be passed through any one, or more, of the other furnaces in the battery, so as to heat the same and its contents; and at the same time any one or more of such furnaces in which ore is to be smelted may be additionally and independently heated, by using a comparatively small amount of fuel therein, to the temperature requisite to smelt the ore, and the waste gases from such furnace can be in turn utilized in other furnaces in the battery to preliminarily heat the same.

Means are provided for passing the gases from one furnace to another, and for introducing additional hot gases from the fire-box or burner in the latter furnace, or furnaces; and for introducing additional air thereto to maintain combustion therein and raise the temperature thereof to that requisite for smelting ore in such furnace.

The furnaces may be heated by any suitable fuel such as coal, oil, gas or wood. Preferably I locate four or more reverberatory furnaces in a direct line and so connect them that the waste heat and gases from one furnace can be passed directly to and through the next without checking the draft; and for this purpose the flue passages connecting the successive furnaces are gradually increased in cross sectional area so that the draft through the flues and furnaces shall not be checked by reason of the increase in the volume of gases therein.

I will now describe the invention with reference to the accompanying drawings in which—

Figure 1 represents in side elevation a battery of four smelting furnaces arranged and connected so as to embody the invention. Fig. 2 is a plan view of Fig. 1. Fig. 3 is an enlarged sectional view showing the construction of the draft flues and connections between the furnaces; intermediate parts of the furnaces being broken away so as to enable the connections to be more clearly shown. Fig. 4 is a horizontal section on line 4—4, Fig. 3. Fig. 5 is a transverse section on line 5—5, Fig. 3. Fig. 6 is a section on line 6—6, Fig. 3 showing the preferred construction of the fire-box when hard fuel is used.

In the accompanying drawings A^1, A^2, A^3 and A^4, designate four reverberatory furnaces, each of any approved type and construction, arranged in a series or battery, in accordance with my invention. Each of said furnaces is provided with a fire-chamber G which is preferably constructed as hereinafter described with reference to Fig. 6 when hard fuel is used; but when gas or oil is used for fuel the furnace may be piped with burners of any suitable construction, many such being well known.

The outlet of furnace A^1 is connected by

a flue B^1 with the inlet or fire-chamber of furnace A^2; similarly the outlet of furnace A^2 is connected with the inlet or fire-chamber of furnace A^3 by a flue B^2; similarly the outlet of furnace A^3 is connected with the inlet or fire-chamber of furnace A^4 by a flue B^3. The flue B^2 is made of larger cross sectional area than the flue B^1; and the flue B^3 is similarly larger than flue B^2, for a purpose hereinafter explained. The outlet of the furnace A^4, or the last furnace of the series, is connected by a flue E with an uptake or chimney D.

Extending from a point adjacent the first furnace A^1 directly to the uptake D is a conduit C which should be of sufficient cross sectional area to accommodate all the hot waste gases which may be admitted thereto from the successive furnaces. This conduit is connected with the flues B^1, B^2, B^3 by branches C^1, C^2, C^3, and dampers or valves are provided, as hereinafter explained, so that the gases issuing from one furnace may be either passed directly into the next furnace, or diverted therefrom into the conduit C and passed through said conduit into any other of the furnaces, or direct to the flue.

A fire-box or burner F^1 is located at the inlet end of each furnace A^1, A^2, A^3, so that the necessary amount of fresh hot gases can be produced therein to raise the temperature of the waste furnace gases entering such furnace up to a smelting temperature. Fresh air can be admitted into the furnaces A^2, A^3, A^4, through apertures f in the roof of the furnaces, above the fire-chambers,—or at other convenient desired point—or points—said apertures connecting with wind boxes F to which air may be supplied by a pump or blower (not shown). This air furnishes a sufficient amount of oxygen to burn sulfur in the charge of ore in such furnaces, and to oxidize the gases admitted thereinto. Each of the furnaces A^2, A^3, A^4, is similarly constructed and connected to the preceding furnace—like parts being similarly lettered in the drawings.

It is an important feature of the construction, that the flues B^1, B^2, B^3, be of such relative cubical capacity that the gases passing into or through said flues will not be checked. The conduit C may be arranged at either side of, or above, the furnaces as may be most convenient.

The flues B^1, B^2, B^3, are each provided at opposite sides of the branches C^1, C^2, C^3, with valves b^1, b^2. The branches C^1, C^2, C^3 of conduit C are each provided with a valve b^3 adjacent the flues B^1, B^2, B^3. The conduit C is provided between the connections C^1, C^2, with a valve c^1; and between the connections C^2, C^3, with a valve c^2; and between the connections C^3 and the flue E with a valve c^3. By this arrangement of dampers or valves it will be observed that the waste gases from the furnace A^1 can be passed directly into any one of the other furnaces, or directly to the uptake D. The waste gases from furnace A^2 can be similarly made to traverse all the subsequent furnaces; and similarly the waste gases from furnace A^3 can be made to traverse furnace A^4. Also that any one of the battery of furnaces may be cut out of operation and no waste gases passed therethrough; each furnace being capable of use independently of the others, or may be cut out of operation for repairs.

To illustrate the method of using the furnaces, assuming that furnace A^1 is in operation, and that furnace A^2, for example, is to be shut down for repairs; valve b^2 in flue B^1, valve b^1 in flue B^2, and valve c^2 in conduit C are closed, and the other valves left open. The gases from furnace A^1 will then pass into the flue B^1, thence through branch C^1 into the conduit C, and thence through branch C^2 and flue B^2 into furnace A^3. After furnace A^3 is heated a fire is started in its fire-box (or burners) and fresh air is admitted at the points f and smelting is carried on in furnace A^3. In a similar manner any furnace can be put in operation or cut out without interfering with the smelting operations in the other furnaces. The gases from furnace A^1 could also be passed around furnace A^3 by closing valve b^3 in connection C^2, opening valve c^2, closing valve c^3 and valve b^1 in flue B^3, and opening valve b^2 in flue B^3 and valve b^3 in connection C^3, and opening valve c^2.

The number of furnaces used can be varied, and increased if desired, and a like series of furnaces could be arranged beside the first series, and connected with conduit C as indicated in dotted broken lines in Fig. 2.

To take down or repair a smelting furnace usually requires several weeks' time and costs several thousands of dollars and ordinarily necessitates the shutting down of all that part of the plant; but by my invention after properly adjusting the various valves, any unit of the battery of furnaces can be torn down, and the other furnaces can be run as usual, up to practically normal capacity.

When starting up a new furnace, or one having been shut down, it is necessary to bring such furnace up to smelting heat before it can be put into operation. This is now done at great expense and loss of fuel. With my invention the waste heat from another furnace unit of the battery (except the first) can be turned into the cold furnace, and it will be brought up to nearly smelting temperature without any expense for fuel.

Another advantage of my invention is the

reduction of flue and fuel dust which results from passing waste gases from one furnace into another; as by so doing a great deal of the dust which would ordinarily be carried to the uptake is deposited in the succeeding furnaces and reduced therein, which results in a great saving.

While I have described a battery of four furnaces it is obvious the number may be varied as may be found most economical in operation, and according to the requirements and capacity of the plant desired.

By my invention the largest smelting plants containing a number of reverberatory furnaces can be operated with economy and conservation of heat and fuel as above set forth; while each furnace may have a direct draft to one main stack, and may be put into or out of operation at will.

As shown in Fig. 6 the fire-box of the furnaces may be divided into three compartments G^1, G^2, G^3, to each of which fuel may be supplied from hoppers K^1, K^2, K^3, as shown. The flues B^1, B^2, B^3, may be connected with the central compartment G^2 of the fire-boxes of the respective furnaces A^2, A^3, A^4. On the first furnace A^1 all three compartments can be fired; on the following furnaces A^2, A^3, A^4, only the compartments G^2 need ordinarily be fired; and the doors g^2 under said compartments may be left open on the furnaces A^2, A^3, A^4, when such furnaces are being used for smelting.

What I claim is:

1. In a smelting plant, the combination of a plurality of smelting furnaces, an uptake, a flue connecting the outlet of one furnace with the inlet of the next following furnace, a conduit connected with the uptake and with the flues intermediate the furnaces, and dampers or valves whereby the waste gases from one furnace may be directed into the next furnace or through said conduit into another furnace in the series or to the uptake.

2. In a smelting plant, the combination of a series of smelting furnaces, an uptake connected with the outlet of the last furnace in the series, a flue connecting the outlet of each preceding furnace with the inlet of the next, a conduit connected with the uptake and with the said flues, and valves whereby the waste gases from one furnace may be directed into the next furnace or through said conduit into another furnace in the series or to the uptake.

3. In a smelting plant, the combination of a plurality of smelting furnaces, an uptake, a flue connecting the outlet of one furnace with the inlet of the next following furnace, a conduit connected with the uptake and with the flues intermediate the furnaces, and dampers or valves whereby the waste gases from one furnace may be directed into the next furnace or through said conduit into another furnace in the series or to the uptake; and means for reheating and for reoxygenating the waste gases introduced into the following furnaces.

4. In a smelting plant, the combination of a series of smelting furnaces, a flue connecting the outlet of a preceding furnace with the inlet of the next succeeding furnace, an uptake, a conduit connected with said uptake and with each connecting flue between adjacent furnaces, and valves whereby the waste gases from a preceding furnace may be directed to or through any of the following furnaces in the series, the flues between the furnaces being of successively greater capacity to prevent checking of the gases passing from one furnace to the next.

5. In a smelting plant, the combination of a plurality of smelting furnaces arranged in a series, a flue connecting the outlet of a preceding furnace in the series with the inlet of a succeeding furnace, an uptake, a conduit connected with said uptake and with each of the connecting flues between adjacent furnaces, valves whereby the waste gases from a preceding furnace may be directed to or through any one or more of the following furnaces in the series, and means for reheating and for reoxygenating the waste gases introduced into such furnaces, the flues between the furnaces being of successively greater capacity to prevent checking of the gases passing from one furnace to the next.

6. In a smelting plant, the combination of a series of smelting furnaces, a flue connecting the outlet of a preceding furnace with the inlet of a succeeding furnace, an uptake connected with the outlet of the last furnace of the series, a conduit connected with said uptake and by branches with each of the connecting flues between adjacent furnaces, valves in said conduit and flues whereby the waste gases from a preceding furnace may be directed to or through any one or more of the following furnaces in the series; means for introducing fresh fuel gases into the secondary furnaces to raise the temperature therein to the smelting point, and means for introducing air into said furnaces.

7. In a smelting plant, the combination of a series of smelting furnaces, a flue connecting the outlet of a preceding furnace with the inlet of the net succeeding furnace, the flues between the furnaces being of successively greater capacity to prevent checking of the gases passing from one furnace to the next; an uptake connected with the outlet of the last furnace of the series, a conduit connected with said uptake and with each of the connecting flues between adjacent furnaces, valves or dampers in said conduit, and flues whereby the waste gases from a preceding furnace may be directed to or through any

one or more of the following furnaces in the series; means for introducing fresh fuel gases into the secondary furnaces to raise the temperature therein to the smelting point, and means for supplying air to said furnaces.

8. In a smelting plant, the combination of a plurality of furnaces, a flue connecting the outlet of one furnace with the fire-chamber of the next furnace, the latter furnace having its fire-chamber divided into three compartments, and the said flue being connected with the central compartment thereof, substantially as and for the purpose described.

In testimony that I claim the foregoing as my own, I affix my signature in presence of two witnesses.

FRANK A. BURNS.

Witnesses:
JOHN WEISS,
ALFRED S. MINES.