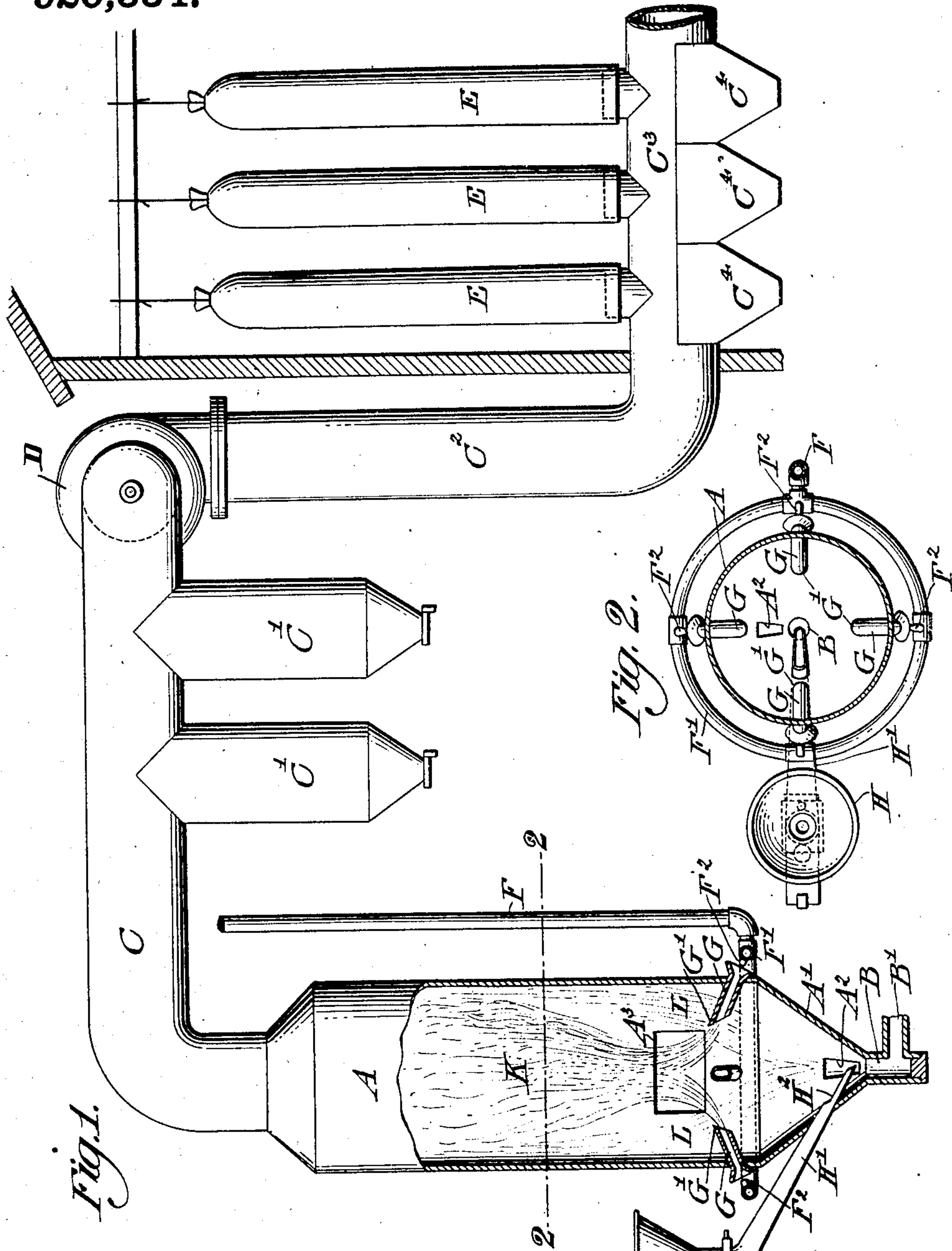


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**Patented May 4, 1909.**

**920,334.**



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# UNITED STATES PATENT OFFICE.

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## METALLURGICAL FURNACE.

No. 920,334.

Specification of Letters Patent.

Patented May 4, 1909.

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*To all whom it may concern:*

Be it known that I, LOUIS S. HUGHES, a citizen of the United States of America, residing in Joplin, in the county of Jasper, in the State of Missouri, have invented a certain new and useful Improvement in Metallurgical Furnaces, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My invention relates to furnace construction and particularly to the type of furnace described and claimed in my pending application for Letters Patent Serial Number 306,954 filed March 20th, 1906, my present invention being in the nature of an improvement in the construction of the furnace described in my said application. The purposes of my present invention being to provide for the protection of the gas burners against injury by flame or choking; to provide also for the more convenient and continuous extraction from the furnace of unburned particles; to provide also for an additional supply of air to the furnace in such a way as to at the same time insure a more energetic oxidizing flame and greater protection to the wall of the furnace.

Further objects of my invention are to provide for a better feed of air.

The various features constituting my improvements will be best understood as described in connection with the drawings in which they are illustrated, and in which—

Figure 1 is a side elevation, partly in central section, of my improved furnace with the cooling flues and screen system also indicated diagrammatically, and Fig. 2 is a cross-sectional view on the line 2—2 of Fig. 1.

A indicates the furnace, which has a vertical cylindrical body of unlined and comparatively thin sheet iron having by preference a cone shaped bottom, indicated at A', through the lower portion of which is formed one or more openings, indicated at A<sup>2</sup>, serving at the same time for the entrance of air and for the extraction of unburned and inert particles of the ore.

A<sup>3</sup> indicates a normally closed opening in the side of the furnace provided for access to the interior thereof.

B is an air jet pipe directed vertically upward from the furnace and fed by a compressed air pipe B'.

C is the flue leading from the top of the furnace having, by preference, settling chambers C', C', connected with it to receive heavy impurities which may separate from the gases by subsidence. The flue C connects with the flue C<sup>2</sup>, a draft fan D being inserted in the flues and the flue C<sup>2</sup> connects with the horizontal flue C<sup>3</sup> having hoppers C<sup>4</sup> at its bottom and connecting at top with screen bags indicated at E, E, etc.

F is a gas pipe connecting, as shown, with a burner ring F' which surrounds the body of the furnace at about the point where the hopper shaped bottom merges into it, the ring being provided with a series of burner nozzles, indicated at F<sup>2</sup>, F<sup>2</sup>, which project into burner tubes G, G, etc. These tubes, according to my present invention, are inclined upward so that the flame issuing from their ends will not impinge upon oppositely disposed tubes. Further the ends of the tubes G are formed or provided with overhangs, as indicated at G', so that in descending material will not enter the tube.

H is a hopper for pulverized ore connecting through a chute H' with the interior of the furnace and in accordance with my present invention, the chute H' is carried well into the furnace and formed with a trough like end H<sup>2</sup> which projects to or nearly to the center line of the furnace so as to deliver the ore directly into the air jet issuing upward from the blast pipe B.

I is a gate by which the feed of ore is regulated and J is a rapping or vibrating device which I attach to the hopper and chute in such a way that its rapping and vibration is communicated to both. Any convenient vibrator may be employed so long as it is of such a character as to keep the hopper and chute in a state of vibration but an electric rapping device of the kind familiarly known as a buzzer I have found to be specially well adapted for the purpose.

I have indicated at K the gas flames issuing from the burner tubes G' and filling the central portion of the furnace and I have indicated at L the flow of the air admitted through the opening A<sup>2</sup> and which, at least in the lower part of the furnace, incloses and jackets the flame K protecting the adjacent walls of the furnace from the direct action of the flame.

In operation the furnace is heated by the ignition of the mixed gas and air issuing



from the burner tubes G, a very considerable volume of air being permitted to enter through the opening A<sup>2</sup> at the bottom of the furnace and to rise around the burner flame

5 K. As indicated the overheating of the furnace is prevented by the rapid conduction away of the heat generated therein. Thin sheet iron walls form I believe the best way of keeping down the furnace temperature and also of maintaining the furnace heat at the comparatively low temperature desirable in order to prevent adherence of slag etc., to such walls. The heat of course passes rapidly through the thin wall and is dissipated both by radiation and by the contact with the outside of the wall by atmospheric air.

The furnace being in operation, the gate of the ore hopper is opened to the desired extent, the vibrator or buzzer set in operation and a continuous and regular supply of ore fed through the chute H' and through H<sup>2</sup> to the center of the furnace falling directly into the upwardly projected air jet which carries it in a fine state of separation into the heat zone of the furnace. The products of the furnace treatment which are sufficiently light or finely divided pass out with the furnace gases into flue C, heavier impurities being separated by subsidence in the chamber C' and the solid particles finally divided from the gases by the screens E, E, will settle into the hopper C<sup>4</sup>. Unburned particles of ore cinder or heavy impurities will separate by subsidence into the vertical furnace A, the unburned impurities finally settling down into the hopper bottom and issuing through the opening A<sup>2</sup>. I have found in practice that these particles may be withdrawn even during the normal action of the furnace and of course it is obvious that by a very short stoppage of the furnace a complete settlement of such impurities and their complete extraction through the opening can be at any time effected.

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

1. A metallurgical furnace having a vertical body and an outlet at its top in combination with a series of gas burners projecting into the furnace at a distance above its bottom, a jet pipe directed upward from the bottom of the furnace, an air opening formed in the bottom of the furnace and means for feeding finely divided ore to the furnace.

2. A metallurgical furnace having a vertical body, an outlet at its top and a hopper shaped bottom in combination with a series of gas burners projecting into the furnace at a distance above its bottom, a jet pipe directed upward from the bottom of the furnace, an air opening formed in the bottom

of the furnace and means for feeding finely divided ore to the furnace.

3. A metallurgical furnace having a vertical body and an outlet at its top in combination with a series of gas burners projecting into the furnace at a distance above its bottom, a jet pipe directed upward from the bottom of the furnace, and an ore chute extending through the wall of the furnace and terminating substantially above the jet pipe.

4. A metallurgical furnace having a vertical body, an outlet at its top and a hopper shaped bottom in combination with a series of gas burners projecting into the furnace at a distance above its bottom, a jet pipe directed upward from the bottom of the furnace, and an ore chute extending through the wall of the furnace and terminating substantially above the jet pipe.

5. A metallurgical furnace having a vertical body, an outlet at its top and a hopper shaped bottom in combination with a series of gas burners projecting into the furnace at a distance above its bottom, a jet pipe directed upward from the bottom of the furnace, an ore chute extending through the wall of the furnace and terminating substantially above the jet pipe, a hopper at the head of the chute and a vibrator arranged to act on the base of the hopper to facilitate the feed of the ore.

6. A metallurgical furnace having a vertical body, an outlet at its top and a hopper shaped bottom in combination with a series of gas burners projecting into the furnace at a distance above its bottom, a jet pipe directed upward from the bottom of the furnace, an air opening formed in the bottom of the furnace and an ore chute extending through the wall of the furnace and terminating substantially above the jet pipe.

7. A metallurgical furnace having a vertical body with an outlet at its top in combination with a series of burner nozzles projecting through the walls of the furnace, said nozzles being inclined upward and formed with their upper edges projecting over their lower edges, a jet pipe directed upward from the bottom of the furnace and means for feeding finely divided ore to the furnace.

8. A metallurgical furnace having a vertical body with an outlet at its top and a hopper shaped bottom, in combination with a series of burner nozzles projecting through the walls of the furnace said nozzles being inclined upward and formed with their upper edges projecting over their lower edges, a jet pipe directed upward from the bottom of the furnace and an ore chute extending through the bottom of the furnace to substantially the center thereof.

9. A metallurgical furnace having a verti-



cal body with an outlet at its top and a hopper shaped bottom with an air opening through its walls in combination with a series of burner nozzles projecting through the walls of the furnace, said nozzles being inclined upward and formed with their upper edges projecting over their lower edges, a jet pipe directed upward from the bottom of the furnace and means for feeding finely divided ore to the furnace.

10. A metallurgical furnace having a vertical body formed of thin unlined sheet metal and an outlet at its top in combination with a series of gas burners projecting into the furnace at a distance above its bottom, a jet pipe directed upward from the bottom of the furnace, an air opening formed in the bottom of the furnace and means for feeding finely divided ore to the furnace.

11. A metallurgical furnace having a vertical body formed of thin unlined sheet

metal, an outlet at its top and a hopper shaped bottom in combination with a series of gas burners projecting into the furnace at a distance above its bottom, a jet pipe directed upward from the bottom of the furnace and an ore chute extending through the wall of the furnace and terminating substantially above the jet pipe.

12. A metallurgical furnace having a vertical body formed of thin unlined sheet metal with an outlet at its top in combination with a series of burner nozzles projecting through the walls of the furnace said nozzles being inclined upward and formed with upper edges projecting over their lower edges, a jet pipe directed upward from the bottom of the furnace and means for feeding finely divided ore to the furnace.

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Witnesses:

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JERE. CHARLOW.