No. 625,912. Patented May 30, 1899.

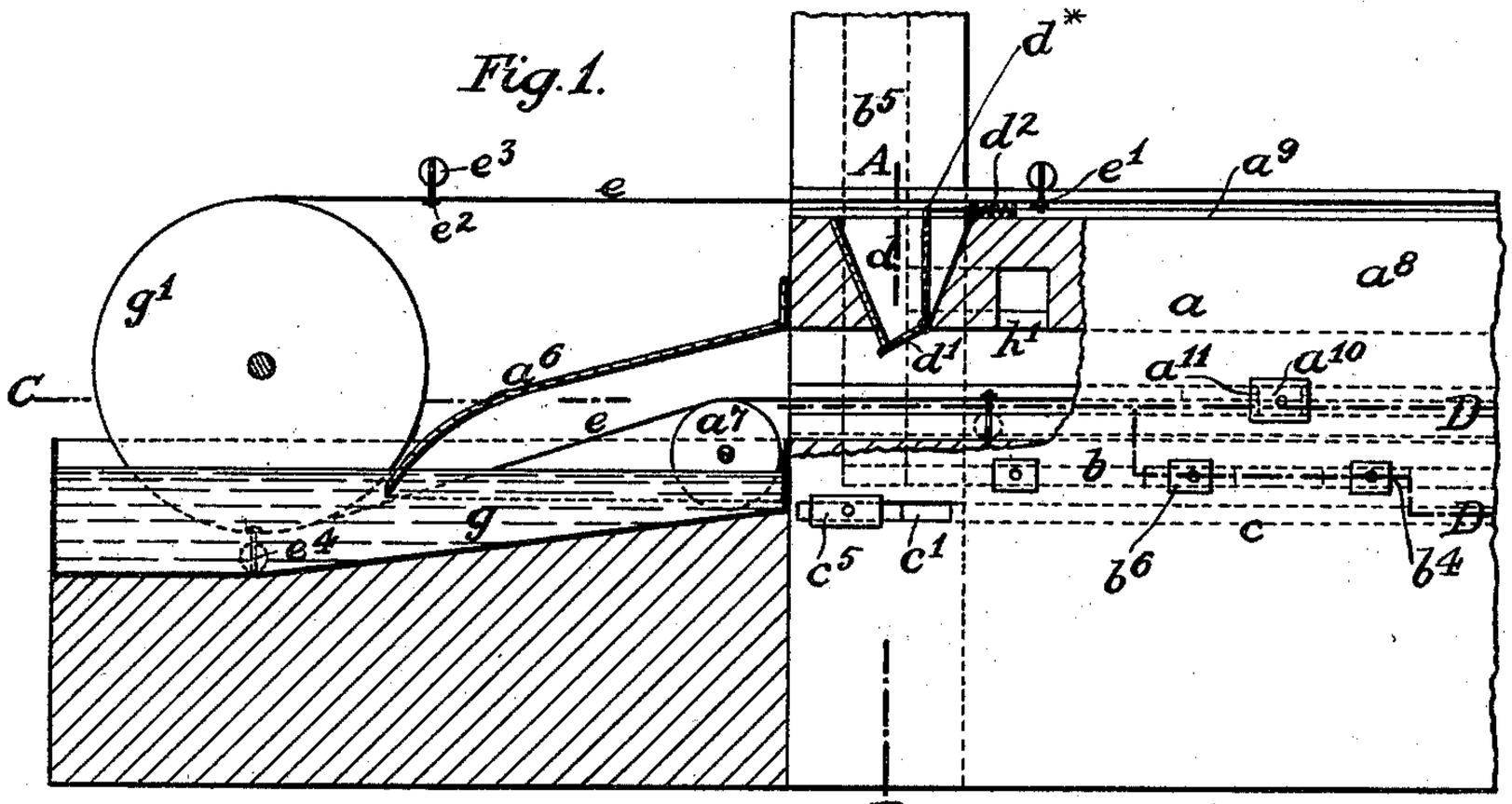
A. G. WELLS.

FURNACE FOR TREATING ORES.

(Application filed June 28, 1898.)

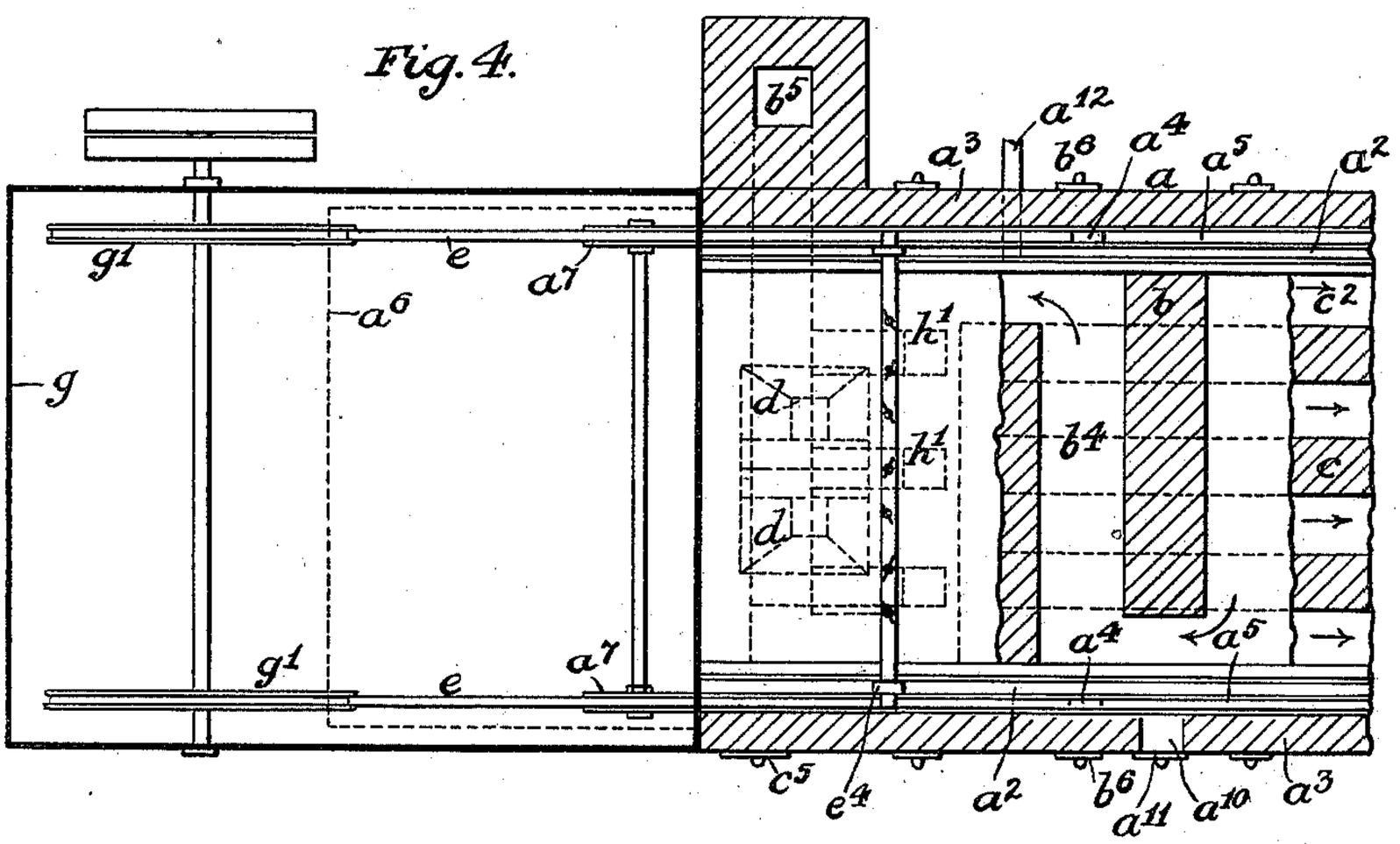
(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



B

Fig. 4.



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(No Model.) 3 Sheets—Sheet 2.

Fig. 1.

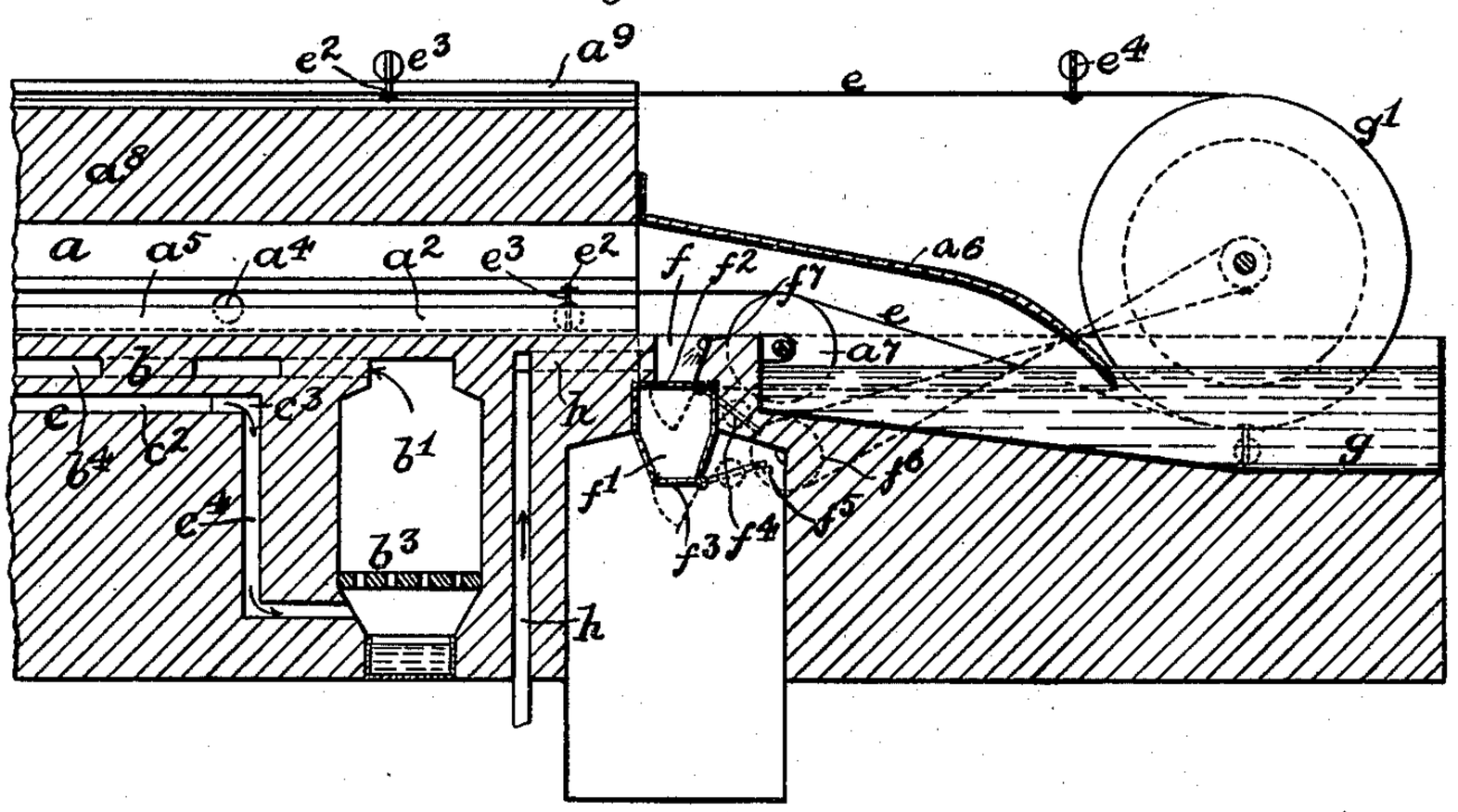
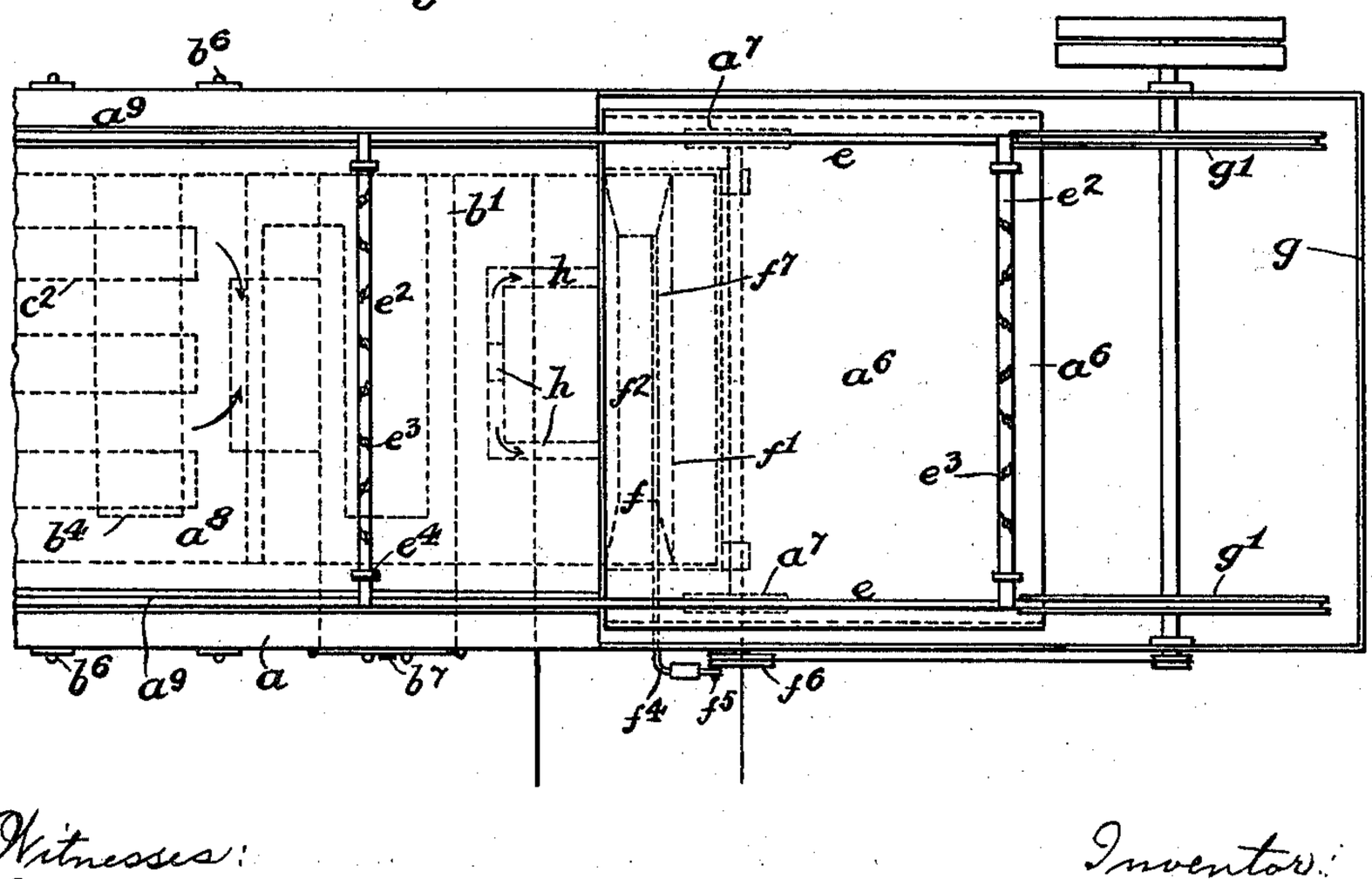


Fig. 3.



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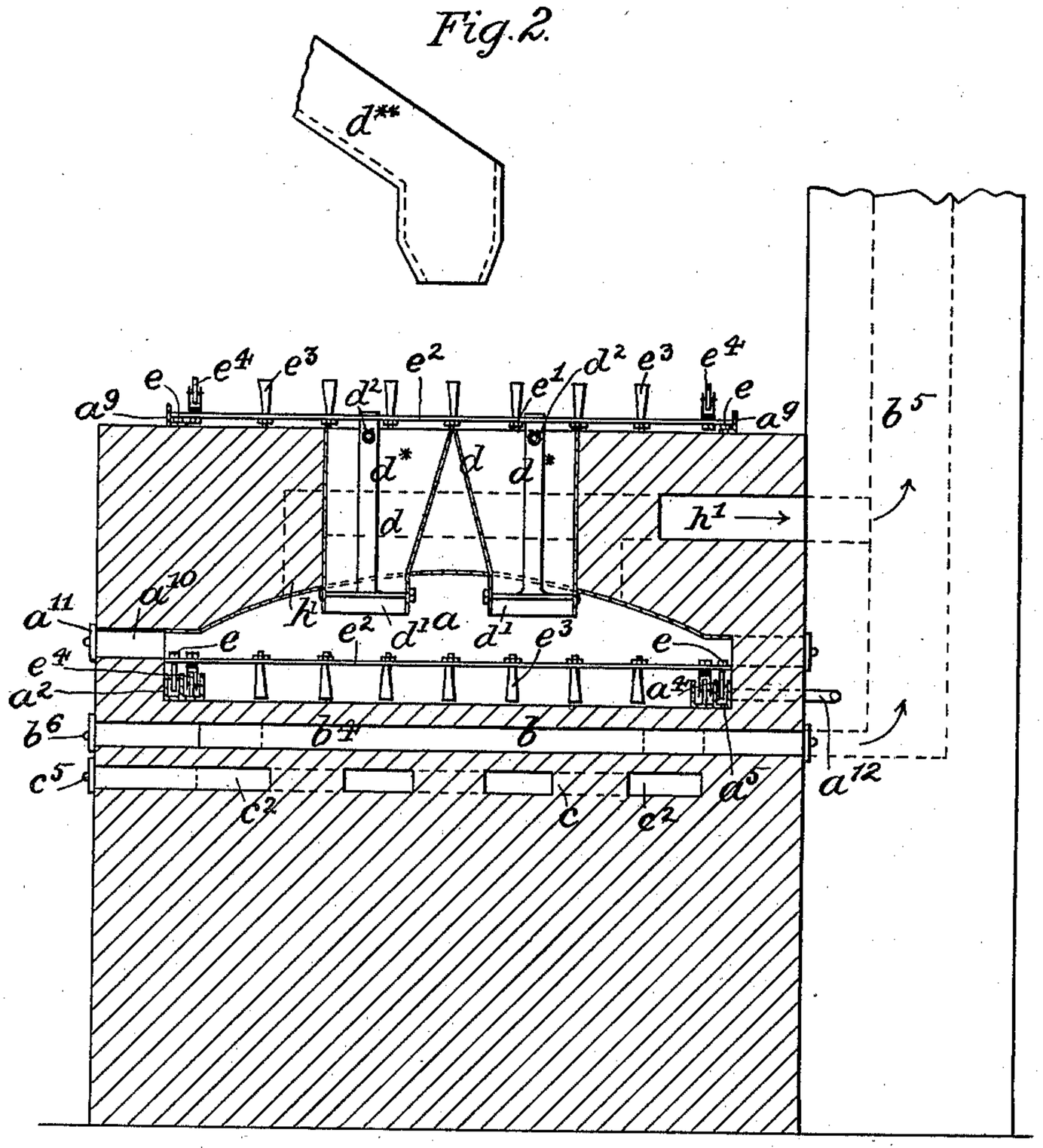
FURNACE FOR TREATING ORES.

(Application filed June 28, 1898.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 2.



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UNITED STATES PATENT OFFICE.

ALFRED GEORGE WELLS, OF LONDON, ENGLAND.

FURNACE FOR TREATING ORES.

SPECIFICATION forming part of Letters Patent No. 625,912, dated May 30, 1899.

Application filed June 28, 1898. Serial No. 684,669. (No model.)

To all whom it may concern:

Be it known that I, ALFRED GEORGE WELLS, engineer, a subject of the Queen of Great Britain and Ireland, residing at London, England, have invented certain new and useful Improvements in Furnaces for the Treatment of Ores, (for which I have filed an application for British Patent No. 28,894, dated December 7, 1897,) of which the following is a specification.

This invention relates to improvements in apparatus for roasting and reducing ores in a closed or air-tight chamber, and has reference both to an improved arrangement and construction of furnace and flues for heating the chamber externally and to an improved arrangement and construction of the chamber within which the ore is roasted by the heat imparted by the furnace and flues and is simultaneously reduced by the hot gases employed for such purpose, the improvements relating to the furnace being designed to effect a better heating of the reducing-chamber with a more economical consumption of fuel and those relating to the reducing-chamber being designed to enable the pulverized ore to be traversed therethrough by means which will be in continuous operation within the chamber, but will, nevertheless, pass into and out thereof and will not be continuously subject to the action of the ore-reducing gases traversing the chamber and which will consequently avoid the serious disadvantages incidental to the present means of manipulating the ore while under treatment in such apparatus, which means are either occasionally introduced by hand through side openings into the chamber, the disadvantage of which is that air obtains access to the chamber, which is not desired, or are arranged within the chamber and continuously operate therein and are continuously subject to the action of the ore-reducing agent within the chamber, the disadvantage of which is that they are so quickly destroyed as to necessitate such frequent interruption of working and expense of renewal as to render the treatment of ores in such apparatus impracticable and commercially unsuccessful.

The reducing-gas employed may, for example, be produced by passing superheated steam either through spongy iron ore or over incandescent limestone heated in a chamber from which atmospheric air is excluded, or may consist of superheated steam saturated with alkaline vapor or gas; but other reducing gases may be employed, as best suitable to the nature of the ore under treatment.

On the accompanying drawings, Figures 1 and 1ª represent a broken longitudinal section of the improved apparatus. Fig. 2 represents a transverse section through A B, Fig. 1. Fig. 3 represents a top plan of the ore-outlet end; and Fig. 4 represents a sectional plan of the ore-inlet end through C D, Fig. 1.

In carrying out the invention, the reducing-chamber *a* is built above the heating-flues *b*, through which the furnace-gases circulate from a fire-chamber *b'* to a chimney b^5, and the heating-flues are above the air-heating flues *c*, through which atmospheric air traverses from an inlet at the end of the apparatus farthest from the fire-chamber and in doing so is gradually heated up by the downwardly-radiating heat of the superposed heating-flues until it emerges in a highly-heated condition into the fire-chamber, and so tends to economize the consumption of fuel.

The air-heating flues are constructed with a transverse inlet-duct *c'*, from which branch a series of longitudinal ducts c^2, which extend under the heating-flues until they emerge into a transverse duct c^3 at the fire-chamber end of the apparatus, and which by one or more descending ducts c^4 leads the hot air into the fire-chamber *b'*, below the grate-bars b^3. The inlet *c'* is provided with an adjustable door c^5 to regulate the supply of air to the furnace.

The heating-flues are constructed with a zigzag flue b^4, which leads from the fire-chamber *b'* to and fro across the apparatus between the subposed air-heating flues and the superposed reducing-chamber, the transverse flues communicating at their alternate ends with each other, so as to make a continuous flue, which at the farther end of the apparatus emerges into the chimney b^5, by which the furnace-gases are carried off. The transverse flues b^4 are provided with end doors b^6 to facilitate their cleaning. The fire-chamber is also provided with an air-tight door b^7 to prevent access of air to the fire-chamber

otherwise than through the air-heating flues excepting when desired.

The reducing-chamber is built above the heating-flues and may be made of any required height, width, and length and is so adapted that the ore to be treated is automatically supplied thereto at the cooler end of the chamber and is automatically removed therefrom at the hotter end by means respectively serving when in operation to prevent access of air to the chamber and such that the ore is traversed along from end to end of the chamber by means which enter the chamber at one end and emerge therefrom at the other end and at each end dip into and pass through a water-tank by which the chamber end is closed air-tight (both ends of the chamber being similarly kept air-tight) and the ore-traversing means after emerging from the chamber are cooled before reëntering the same. The chamber is also provided with means by which the hot reducing-gases are admitted thereinto at the ore-exit end and are led therefrom at the ore-entry end either to the chimney by which the furnace-gases are led away or to any suitable condensing apparatus, wherein such of the products eliminated from the ore as are sufficiently valuable may be recovered as by-products in any suitable manner.

The ore is automatically and intermittently supplied to the chamber through hoppers d, (into which it may be fed by a chute d^{**},) each of which is fitted at its bottom with a hinged flap or door d', having an arm d^*, which is connected to a spring d^2 or to a weighted chain or the like means, which serves normally to keep the hopper-door closed, the doors d' being automatically and intermittently opened to discharge the contents of the hoppers onto the hearth of the chamber at any required intervals of time by traveling trippers e', hereinafter further referred to, which engage with the door-arms d^* and by overcoming the action of the springs d^2 open the doors, which are again closed by the springs when the trippers pass beyond their range of action on the door-arms.

The ore after having been traversed along the chamber, as hereinafter described, falls into a discharge-hopper, from which it is automatically discharged into trucks run thereunder without admitting air to the chamber. To this end the hopper is made in upper and lower parts $f\,f'$, the bottoms of which are normally closed by hinged counterweighted doors $f^2\,f^3$, respectively, having extending arms f^4, adapted to be alternately engaged at regular intervals by a stud f^5, projecting from a rotating part f^6, so as to cause the upper hopper part to discharge the ore therein into the lower hopper part while the outlet of the latter is closed and the lower hopper part to discharge its contents into the truck while the outlet from the upper hopper part is closed.

The hopper-door f^2 may be played on by a fine spray of water from a pipe f^7 to cool the hot ore which falls thereonto and prevent the door from buckling.

The ore is traversed from end to end of the reducing-chamber by chains e, fitted with cross-bars e^2, carrying adjustable rakes e^3, which are suspended just above the bed of the chamber and serve to traverse the ore under treatment from the inlet to the outlet end thereof. The bars e^2 are supported at their ends by runners e^4, guided in channels a^2, let into the side walls a^3 of the chamber, and the intervening slack portions of the chains e are supported by carrier-wheels a^4, arranged in other channels a^5, let into the chamber-walls.

The channels $a^2\,a^5$ are supplied by suitable inlets a^{12} with running streams of water, which outflow at each end into a water-tank g at the end of the chamber, the water in the channels serving to aid in keeping cool the runners and carriers $e^4\,a^4$ and the parts they respectively support while traversing the chamber.

At each end of the reducing-chamber is arranged a water-tank g, into which there dips a hood a^6, which incloses the open ends of the chamber and of the channels $a^2\,a^5$, so as to seal the same from communication with the outer air. The chains e as they enter the chamber and emerge therefrom are guided by carrier-wheels a^7, in alinement with which and with the chain-channels a^5 and so mounted as to partly rotate under water in the tanks g are arranged other carrier-wheels g', which, conjunctively with the wheels a^7, serve to deflect the portions of the chains respectively leaving and reëntering the chamber and to cause the same, together with the bars and rakes they carry, to pass under water, as represented in Fig. 1, whereby they are cooled and prevented from being so highly heated while in the chamber as to be rendered subject to the destructive action of the reducing-gases circulating therethrough. The chamber-roof a^8 is provided with rails a^9, which serve to support the bars e^2 and chains e while returning outside the chamber from the exit end to the reëntering end thereof.

The trippers e', by which the hopper-doors d' are opened, are carried by the chain-bars e^2 at any desired intervals apart to regulate the supply of ore as may be required.

The side walls of the chamber are formed at suitable intervals with inspection-openings a^{10}, closed by air-tight doors a^{11}.

The reducing-gases are caused to enter the chamber, at the ore-outlet end thereof, in a highly-heated condition by pipes or ducts h, leading from any convenient heating or superheating apparatus wherein they are or may be generated or heated to any desired degree, and after coursing through the reducing-chamber in a direction opposite to the travel of the ore under treatment they pass away from the chamber by outlets h', which may either lead to the chimney b^5, as represented,

or may lead to any suitable apparatus wherein they may be condensed and any contained valuable matters recovered, as aforesaid.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In apparatus for roasting ores, in combination, a closed roasting-chamber wherein the ores are roasted and reduced, a fire-chamber, means for supplying reducing-gases to said closed chamber and leading them therefrom, the roasting-chamber hearth, the transversely-arranged zigzag heating-flues below the bottom of the closed roasting-chamber serving to lead the furnace-gases from the fire-chamber to and fro under the roasting-chamber hearth, and air-heating flues below said heating-flues serving to lead atmospheric air from an inlet at the cooler end of the apparatus to the fire-chamber whereby it is heated, the fire-chamber being arranged adjacent to the ore-outlet end of the apparatus, as set forth.

2. In apparatus for roasting ores in a closed or air-tight chamber, in combination, a chamber wherein the ores are roasted and reduced, a hopper with a flap-bottom for supplying the ore to be treated to the chamber, a hopper with superposed flap-bottoms for removing the treated ore and preventing access of air to the chamber, means for supplying reducing-gases to the chamber and leading them therefrom, a water-tank at each end of the chamber, and a hood at each such end dipping into the water-tank and serving to seal and close the chamber end, and means for traversing the ore from end to end of the chamber adapted to emerge from and to reënter the chamber through said water-tanks and to be cooled thereby before reëntering the chamber, and to actuate both the ore-inlet and the ore-outlet hopper flaps, at regular intervals, as set forth.

3. In apparatus for roasting ores in a closed or air-tight chamber, the combination of a chamber wherein the ores are roasted and reduced, means for admitting ore to the chamber, an exit for treated ore, a gas-inlet and a gas-outlet communicating with the chamber, liquid seals at opposite ends of the chamber, and suitably-driven means passing through the liquid seals for moving ore longitudinally of the chamber.

4. In apparatus for roasting ores in a closed or air-tight chamber, the combination of a chamber wherein the ores are roasted and reduced, means for admitting ore to the chamber, an exit for treated ore, a gas-inlet and a gas-outlet communicating with the chamber, tanks g, g at opposite ends of the chamber and adapted to hold liquid, means for closing the ends of the chamber except through liquid in said tanks, wheels g', g', axles therefor, said wheels extending into the tanks below the liquid-level employed therein, endless chains passing around wheels g', one side of the endless chains passing through the chamber, the other side of the chain passing outside of the chamber, and means moved by said chains for moving ore longitudinally through the chamber.

Signed at London, England, this 30th day of April, 1898.

ALFRED GEORGE WELLS.

Witnesses:

CHARLES AUBREY DAY,

ALFRED CHARLES DAY.