No. 614,129. Patented Nov. 15, 1898.

L. PIETRASCHEWSKI.

METALLURGICAL FURNACE.

(Application filed Feb. 27, 1897.)

(No Model.) 3 Sheets—Sheet 1.

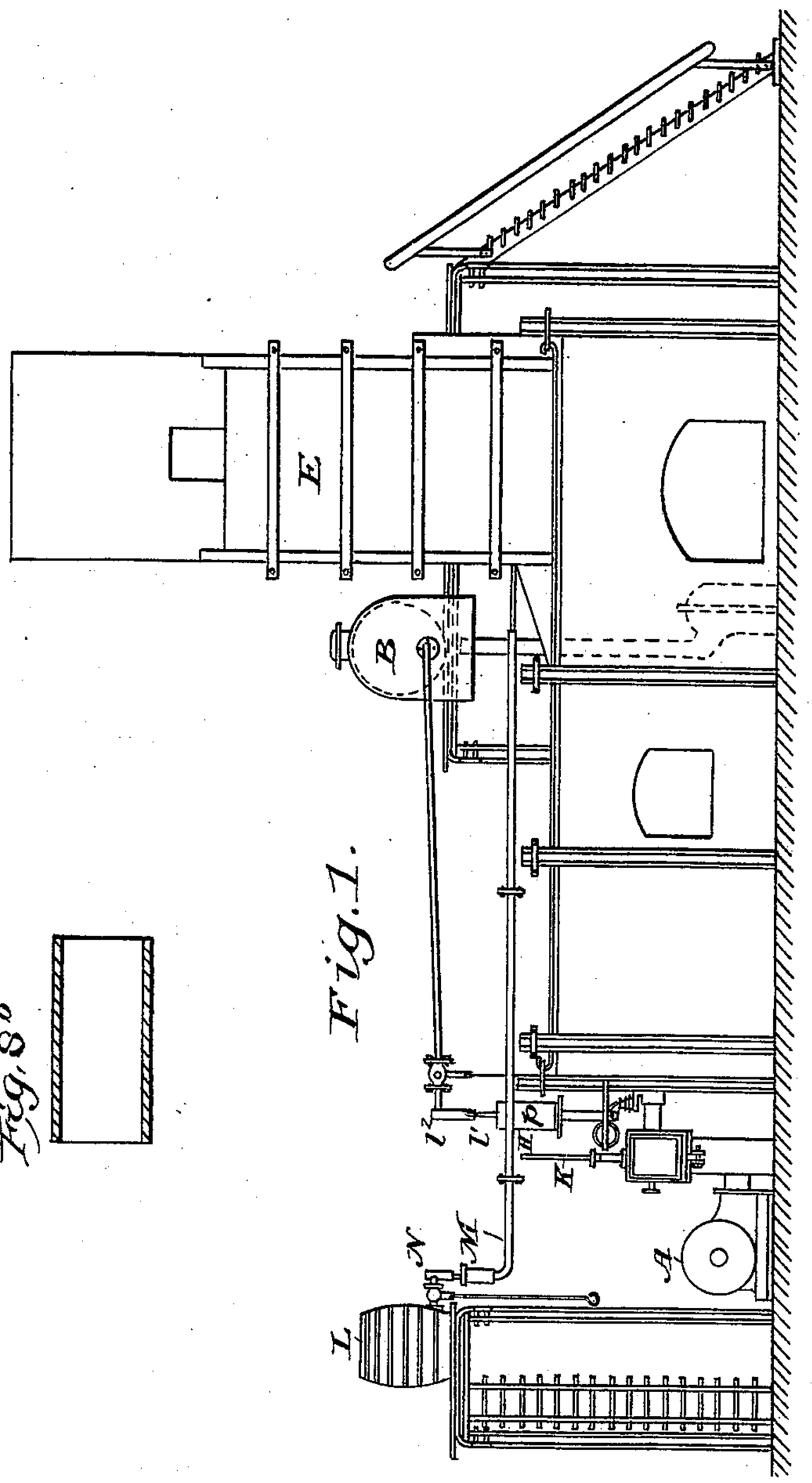

Fig. 1.

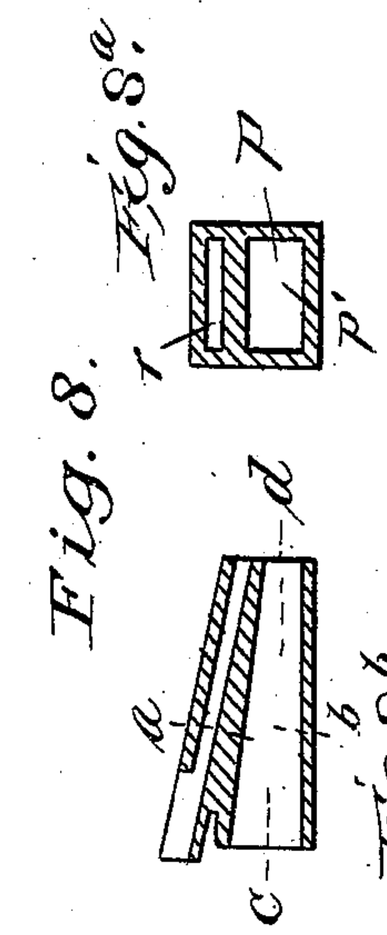

Fig. 8.

Fig. 8ª.

Fig. 8ᵇ

Fig. 6ª.

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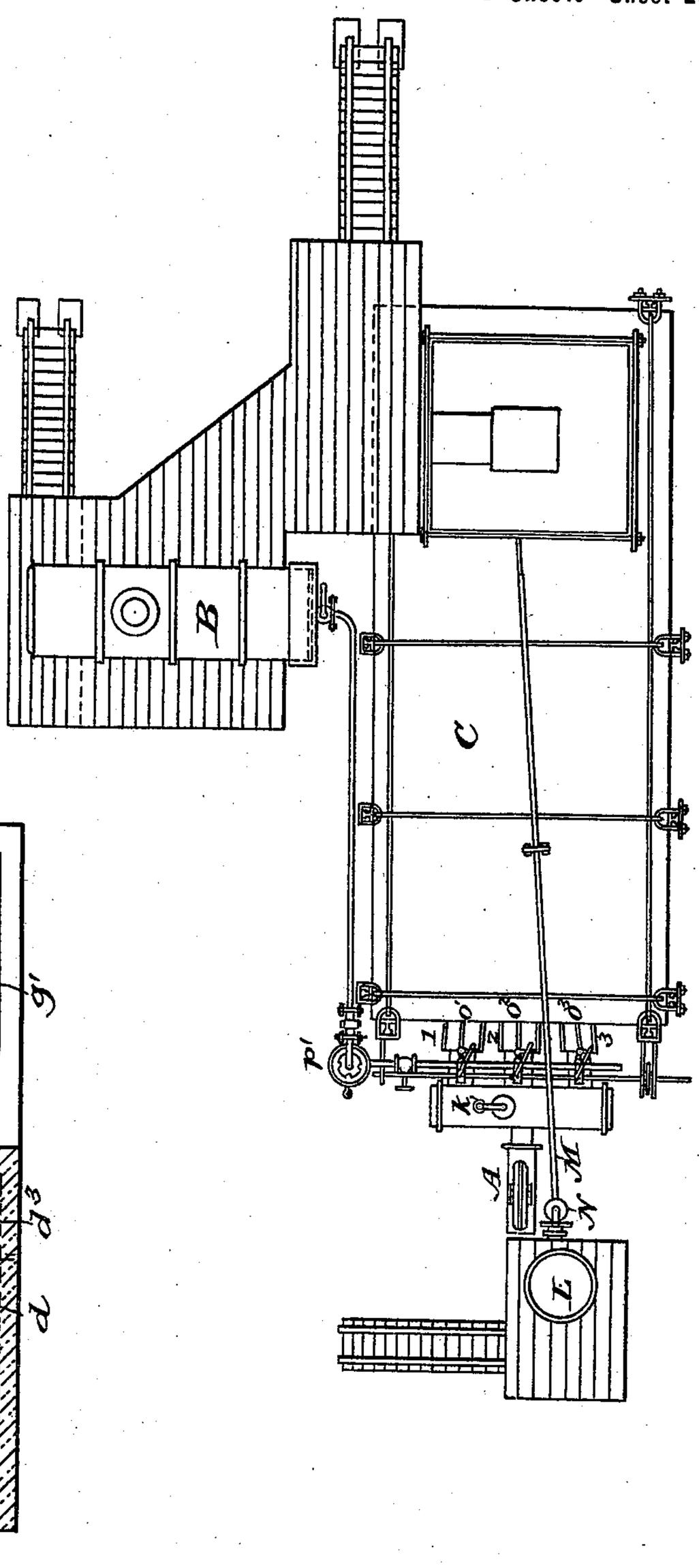

Fig. 2.

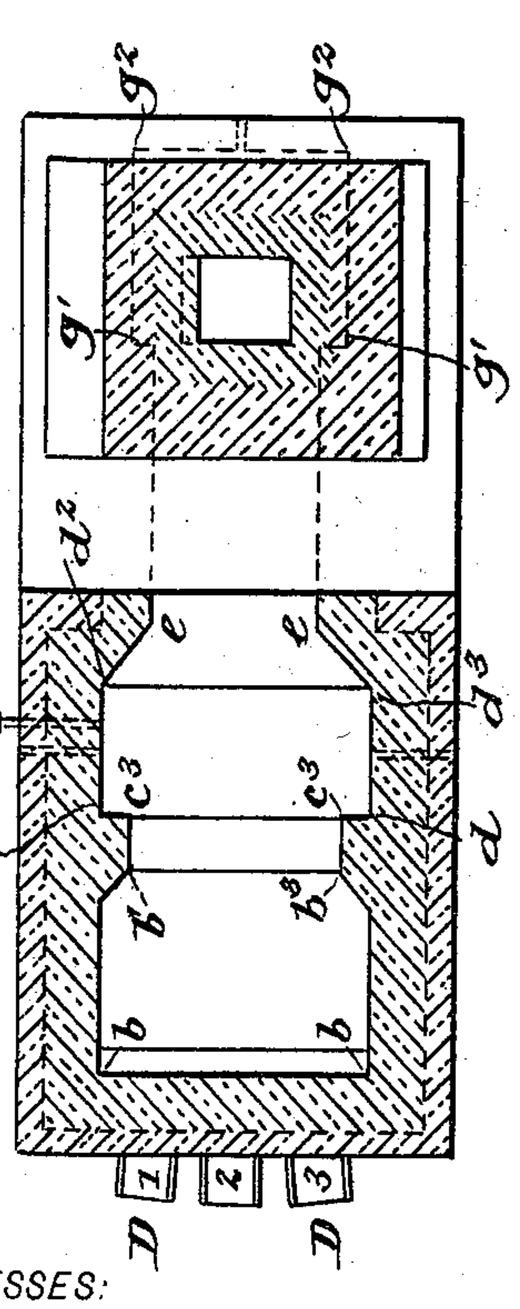

Fig. 5.

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(Application filed Feb. 27, 1897.)

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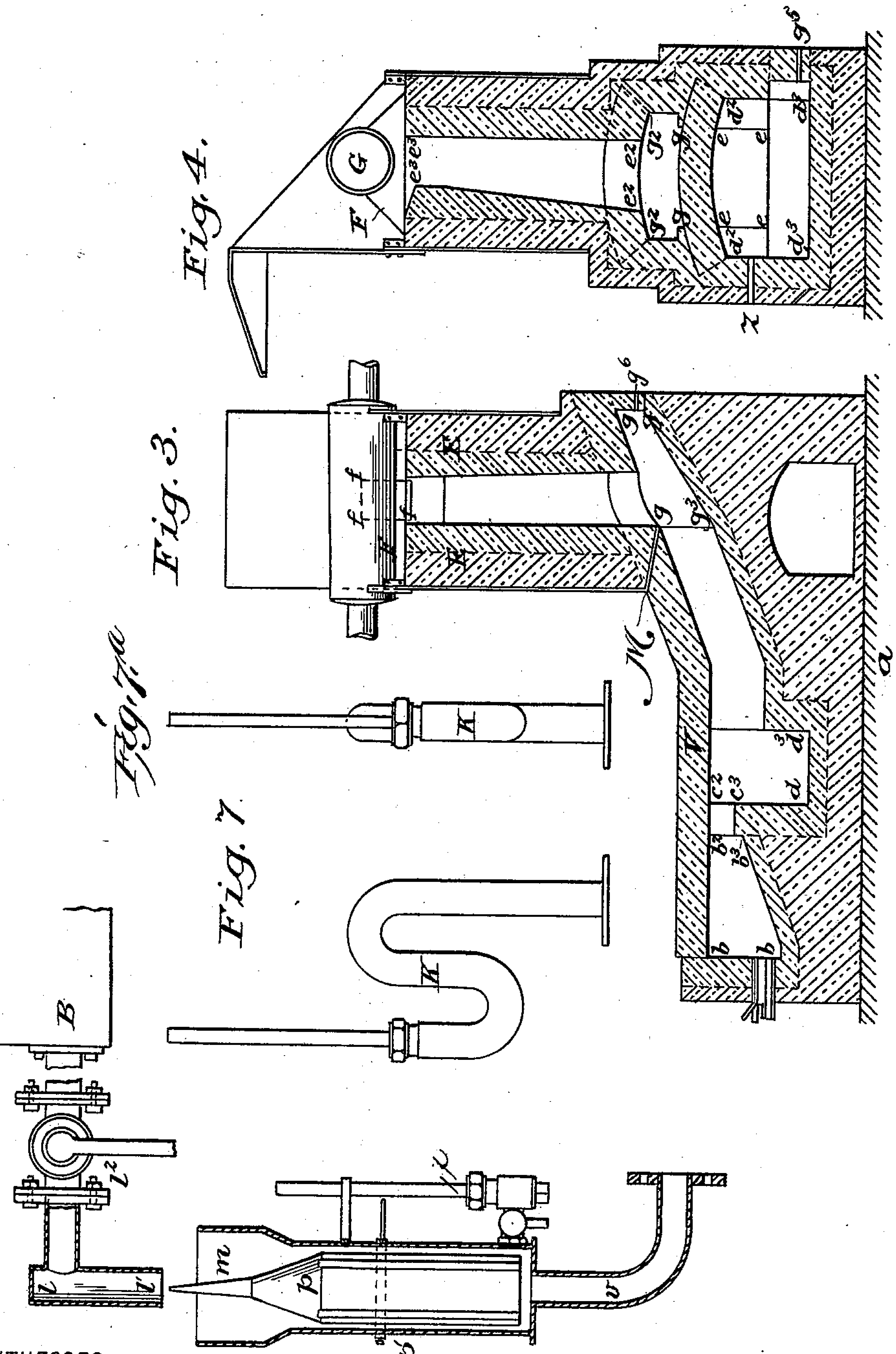
3 Sheets—Sheet 3.



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UNITED STATES PATENT OFFICE.

LEON PIETRASCHEWSKI, OF BORISSOGLEBSK, RUSSIA.

METALLURGICAL FURNACE.

SPECIFICATION forming part of Letters Patent No. 614,129, dated November 15, 1898.

Application filed February 27, 1897. Serial No. 625,429. (No model.)

To all whom it may concern:

Be it known that I, LEON PIETRASCHEWSKI, a subject of the Emperor of Russia, residing at Borissoglebsk, Russia, have invented certain new and useful Improvements in Metallurgical Furnaces, of which the following is a specification.

My invention has for its object a shaft-furnace heated with liquid fuel (crude petroleum-oil, naphtha residues, &c.) for melting metals (cast-iron, iron, steel, &c.) or for smelting ores.

In the accompanying drawings, Figure 1 represents a side view of my improved furnace. Fig. 2 is a plan view of the same. Fig. 3 is a longitudinal section of the chief part of the furnace. Fig. 4 is a vertical transverse section, and Fig. 5 a horizontal section thereof. Fig. 6 is a side view, partly in section, of a regulating apparatus for automatically controlling the flow of the liquid fuel to the burners. Fig. 6^a is the plan thereof. Figs. 7 and 7^a are respectively a side and end elevation of a device for measuring the pressure of the air. Figs. 8, 8^a, and 8^b represent one form of the burner, Fig. 8 being a transverse section, Fig. 8^a a longitudinal vertical section, and Fig. 8^b a longitudinal horizontal section.

The furnace (represented by Figs. 1 to 5 of the drawings) has a heat-generating chamber into which the fuel flows from an elevated tank or reservoir. The fuel is vaporized and mixed with air blown into the generating-chamber by a fan or other blower. The pulverized fuel is ignited and the flame and gaseous products pass into a vertical shaft, where ore is placed or any metal which is to be melted. The molten metal is stored in a receiver. The maintaining of the same temperature in the furnace during the process of melting is an indispensable condition of the satisfactory action of the furnace, and for this purpose the flow of the fuel into the furnace is regulated by means of a self-acting valve. Besides, the flow of the fuel is measured by the level of it in a glass cylinder. The liquid fuel flows into the generator under a constant pressure of the liquid in the glass cylinder, and consequently is fed always in the same desirable quantity. According to the quantity of the fuel, the fan or blower draws in a proportionate quantity of air, which is measured by a pressure-gage.

In order to economize the fuel, the air may be heated in some suitable apparatus placed at the upper end of the shaft.

Referring to Figs. 1 to 5, A is a fan or blower. B is a tank or other vessel for the liquid fuel. C is the furnace. D are the burners, (1, 2, and 3.) E is a shaft; F, a chimney; G, Figs. 3 and 4, an air-heating apparatus; H, Fig. 1, an apparatus for measuring the pressure of the liquid fuel; I, a self-acting apparatus for regulating the flow of the liquid fuel, Fig. 6; K, an apparatus for measuring the pressure of the air, Fig. 7.

The furnace, built on a suitable foundation *a*, consists of a heat-generating chamber $b\ b'\ b^2\ b^3$ of refractory bricks, having the form of a box with an inclined sole or bed $b\ b^3$. In the front wall of this chamber the burners 1 2 3 are tightly fitted, and in the opposite wall a passage $c^2\ c^3$ is made for the flow of the gases. The liquid fuel is let into the furnace by separate pipes $o'\ o^2\ o^3$ or through the burners, Fig. 8, opening inside the furnace. The construction of the burner is clearly illustrated in Figs. 8, 8^a, and 8^b, in which it will be observed that Fig. 8 is a longitudinal vertical section, Fig. 8^a a transverse section on line *a b* of Fig. 8, and Fig. 8^b a section on line *c d* of Fig. 8. The burner comprises a rectangular box P, having a narrow rectangular opening or channel above inclining downwardly and a rectangular channel beneath of greater height, but tapering toward its mouth or exit to give force to the blast. At the end of the heat-generating chamber there is arranged a receiver for the molten metal $d\ d'\ d^2\ d^3$. The heat-generator chamber and the receiver are covered with a vault V.

g^5, Fig. 4, is a tap-hole for the metal, and Z is a slag-hole. *l* is a pipe closed by glass or mica for observing the process of melting.

Over the receiver $d\ d'\ d^2\ d^3$ or at its side a shaft $e\ e'\ e^2\ e^3$ is built, in which the metal to be melted or a metallic ore is placed.

A charging-hole *f* with a door is provided in the side wall of the shaft for charging the ore or metal. At the bottom of the shaft is an enlarged space $g\ g'\ g^2\ g^3$, which affords a better access of the combustible gases to the metal or ore and their equal distribution. An opening g^6 on the extreme right of chamber $g\ g'$

g^2 g^3, Fig. 3, is provided for the inspection of the process in the furnace. The upper end of the shaft is prolonged by a chimney F, in which may be placed an apparatus or reservoir for heating the air. The whole furnace and the shaft are laid on their inside with refractory bricks and on the outside with iron plates and strengthened with ties.

The apparatus for measuring the pressure under which the liquid fuel flows into the furnace, Fig. 6, consists of a glass cylinder i i. The level of the liquid fuel in the glass, as indicated by a pointer i^2, determines the height of the pressure—for instance, n inches—under which the petroleum-oil flows into the furnace through the burners. The pressure of the blast is measured by a water or mercury gage K, Fig. 7.

A self-acting valve is arranged in the apparatus I, Fig. 6, in the following manner: At the end of a tube provided with a cock or valve l^2, which serves to control the flow of liquid fuel from the reservoir B, a vertical tube l l is provided. This tube has at its lower end a bearing-surface or a seat l' for the needle-valve m, fixed to a float p, freely arranged in a cylindrical vessel p', in which a constant level of the liquid fluid is maintained, as will be hereinafter described. From the vessel p' the liquid fuel is let to the burners by the pipe v.

The furnace operates in the following manner: The fan or blower being brought into action and a flow of a little quantity of the liquid fuel being let into the burners, this fuel is ignited and its flow is gradually increased in order not to let the furnace be heated at once, then some ore or metal will be thrown through the charging-hole into the shaft. After this the blast and the flow of fuel must be increased. When the molten metal has shown itself through the tap-hole, the latter must be closed with some clay, and as soon as slag begins to flow out of the slag-hole the tap-hole may be opened and the metal poured into forms. The quantity of metal in the shaft must be added gradually in proportion to its melting. If a new quantity of metal is no more wanted, the valve l^2 for the liquid fuel is closed and the blast ceased.

In this furnace cast-iron can be melted about twenty minutes after the charging and steel after about forty minutes. The action of the apparatus I for automatically regulating the pressure under which the liquid fuel flows to the burners is as follows: When the shaft is filled with ore or metal, the inner space of the furnace will be filled with gases under a certain pressure, according to the strength of the air-blast, which may be measured, (let it be, for instance, equal to n inches of a water-column.) The liquid fuel flows through the burners into the furnace. Consequently the pressure of the gases that fill the furnace will act upon the liquid at the inner ends of the burners. If the pressure of the liquid fuel is not sufficient to overcome the gaseous pressure in the furnace, no flow of the liquid into the furnace will take place. The condition for a satisfactory burning is that the pressure of the liquid fuel should be somewhat greater than the pressure of the air and of the gases in the furnace. This excess of pressure will be found in each case by experience, and being marked by the pointer i^3, Fig. 6, must be maintained during the whole process of melting. For this purpose a self-acting valve m, with a float p in a cylinder p', is employed. The cylinder p', which is in direct communication with the glass tube i, receives a constant flow of liquid fuel from the reservoir B. If the level of the liquid fuel in the glass tube and in the cylinder p' falls, the needle-valve m recedes and the opening l'' will be enlarged, and if the level of the liquid rises this opening will be partly closed, so that the quantity of the liquid fuel flowing into the apparatus and from it to the burners, and consequently the temperature in the furnace, will be constant. If another storage-tank of a greater capacity for the liquid fuel is employed besides the reservoir B, then the level of the liquid in this reservoir B may be maintained by the aid of a self-acting apparatus of the described character.

Every system of burners may be employed in this furnace. Fig. 8 illustrates one of such burners. The upper channel of this burner is for the liquid fuel and the lower for the air-blast.

The essential advantages and peculiarities of the furnace of my invention are—

First. The furnace works under a pressure of gases approximately equal to that of the air-blast.

Second. The burning in the furnace is quite constant. All the elements that constitute the process of burning and melting remain invariable. Consequently the metal will be got of the same quality during the whole melting process and during the whole service of the same furnace.

Third. The duration of the melting process and the temperature can be quickly and easily regulated, diminished, or increased.

Fourth. The processes of oxidation and deoxidation and other metallurgical processes are easily controlled.

Fifth. The liquid fuel being free of admixtures, such as sulfur, phosphorus, or any other obnoxious substances, produces metals in a pure state.

Sixth. The construction and the repairing of the furnace are cheap.

Seventh. There is no necessity to make the furnace clean of the residual products and of the residual of fuel.

Eighth. The heating and the charging of the furnace are easy; so, for instance, a furnace melting sixteen hundred kilograms during an hour needs only the aid of two workmen.

Ninth. In regard to the expense of fuel and

to the loss of heat this furnace is more economical than those that are heated with coal.

Tenth. There is no obstacle to employ an apparatus for heating the air-blast, which will give an additional economy of fuel.

Eleventh. In case a special decarburation of a metal is desired, (so, for instance, in order to get soft cast-iron out of hard one,) a stream of liquid fuel from a separate tank L, Figs. 1 and 2, may be let by a pipe M into the shaft. Its constant flowing will be regulated by means of a self-acting apparatus N of the form described, Fig. 6.

I claim as my invention—

In combination, the gas-generating chamber, the hydrocarbon-burners communicating therewith, a receiver for the molten metal in rear of said chamber and having a communication with said chamber near the top thereof, the inclined chamber extending rearwardly from the receiver, a vertical shaft connecting with the rear portion of the inclined chamber, and a hydrocarbon-pipe connecting with the inclined chamber at the base of the vertical shaft, substantially as described.

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

LEON PIETRASCHEWSKI.

Witnesses:

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J. BLAU.