(No Model.)

H. T. RUSSELL.

BURNING APPARATUS FOR LIQUID FUEL.

No. 585,792. Patented July 6, 1897.

Fig. 1.

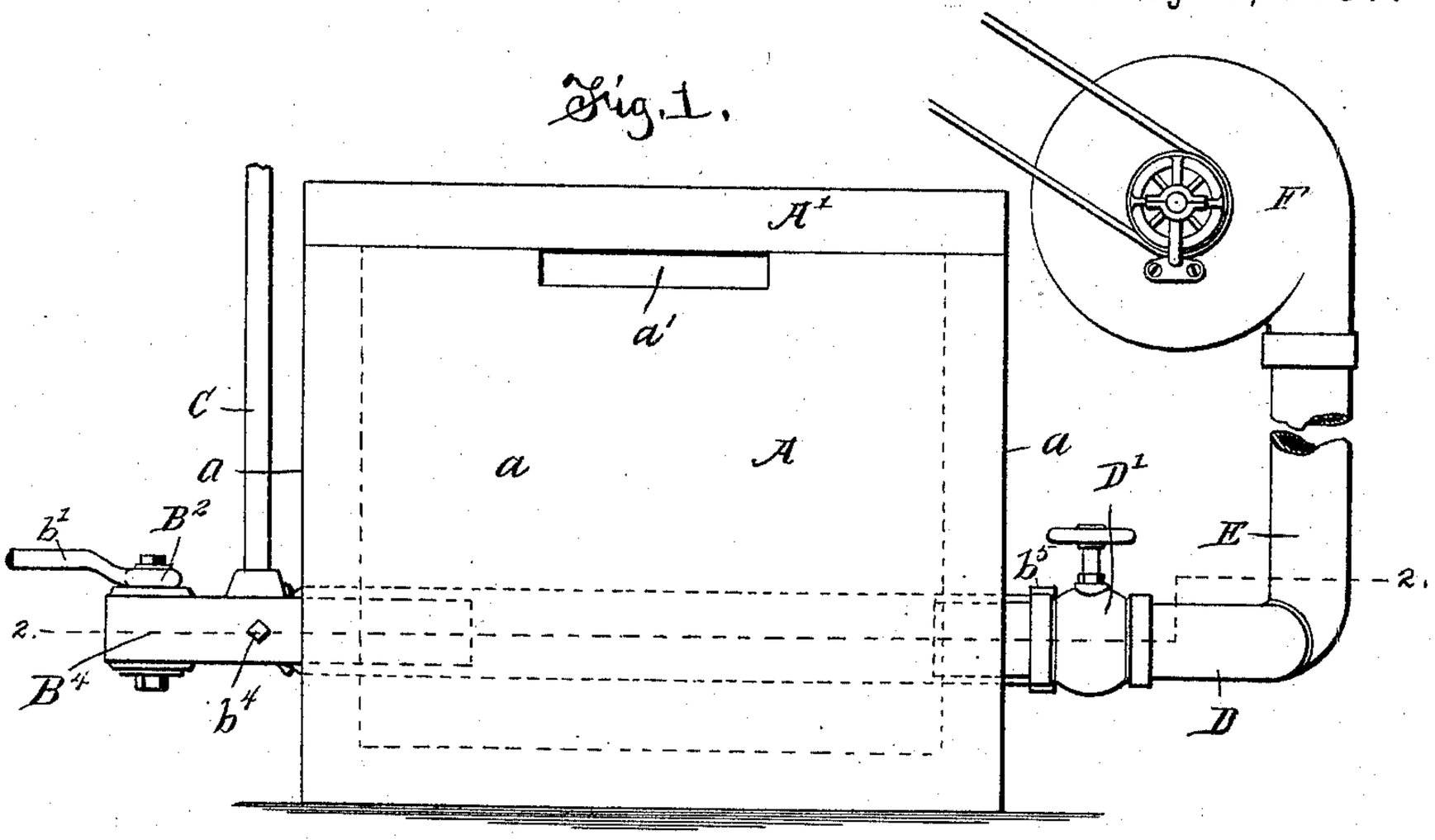


Fig. 2.

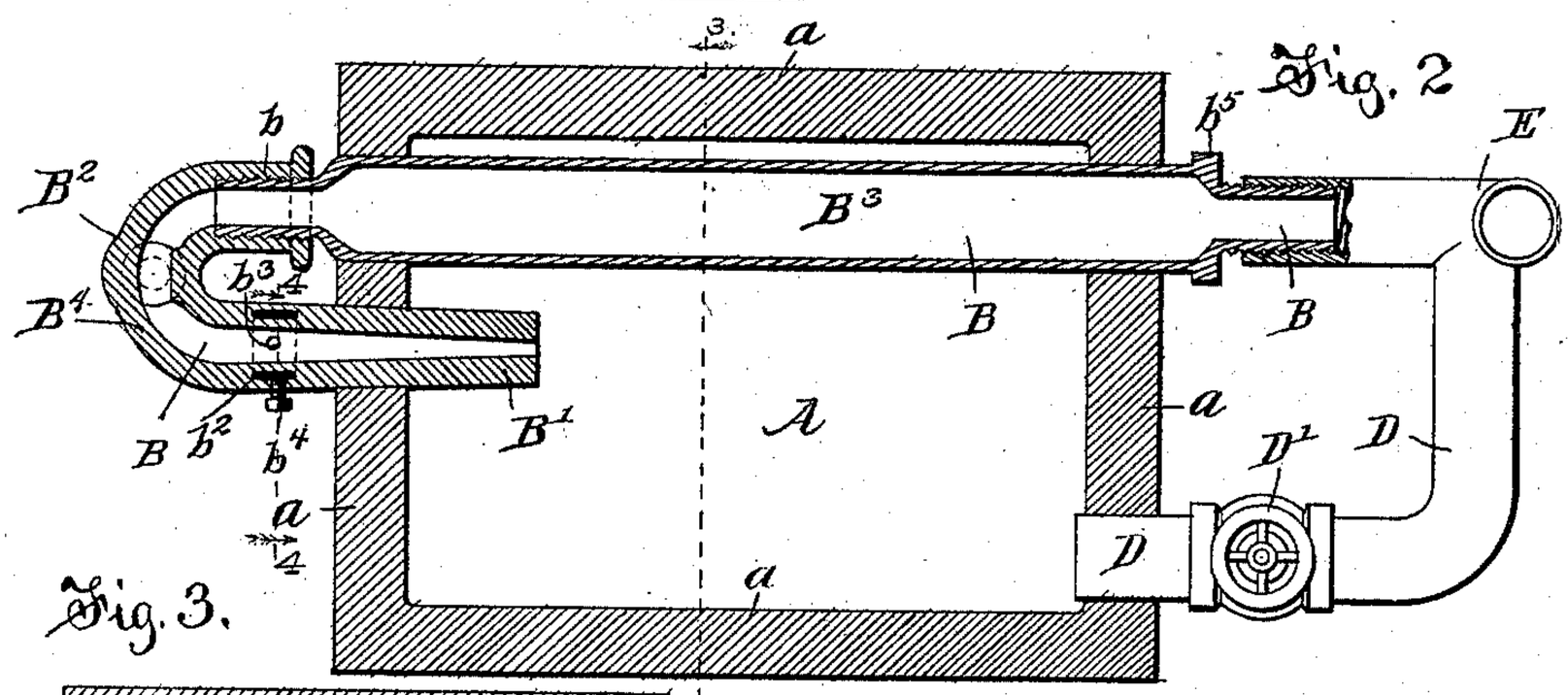


Fig. 3.

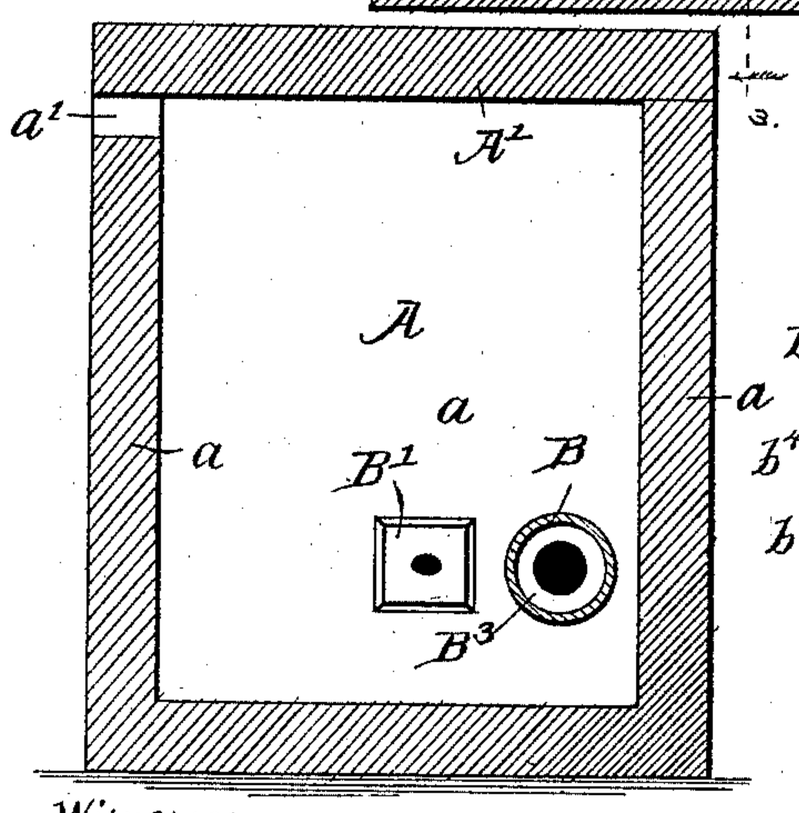


Fig. 4.

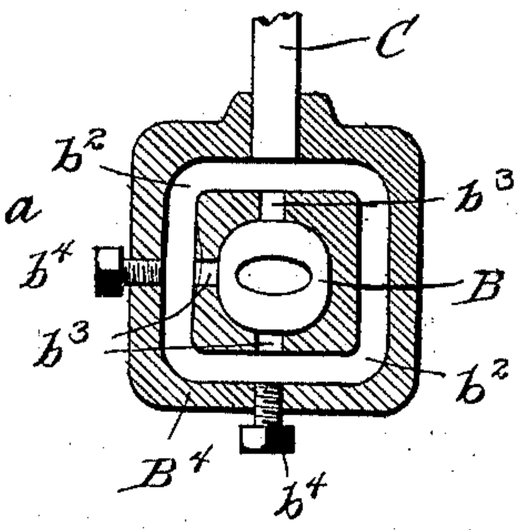
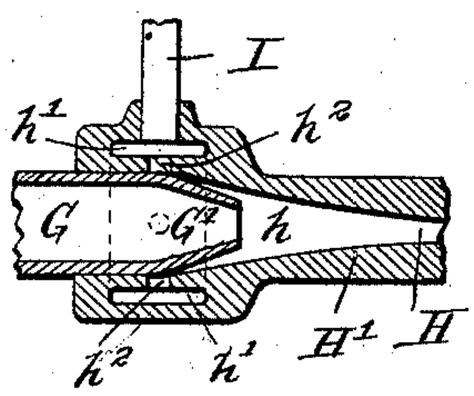


Fig. 5.



Witnesses:
Samuel Ker.
C. E. Goulinson.

Inventor,
Henry T. Russell,
Dayton, Poole & Brown.
Attorneys.

UNITED STATES PATENT OFFICE.

HENRY T. RUSSELL, OF CHICAGO, ILLINOIS.

BURNING APPARATUS FOR LIQUID FUEL.

SPECIFICATION forming part of Letters Patent No. 585,792, dated July 6, 1897.

Application filed January 26, 1892. Serial No. 419,280. (No model.)

To all whom it may concern:

Be it known that I, HENRY T. RUSSELL, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Burning Apparatus for Liquid Fuel; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improved apparatus adapted for burning liquid and gaseous fuels, such as oil or crude petroleum and natural or artificial gas, as well as solid fuel in a pulverulent or atomized state—such, for instance, as pulverized coal.

A burning apparatus embodying my invention embraces as its main or essential features an inclosed space or chamber in which combustion takes place, a duct communicating with a source supplying hot air under pressure and leading into said chamber, a supply-pipe discharging liquid fuel, gas, or pulverulent combustible matter into said air-duct, whereby the latter supplies an admixture of hot air and atomized or vaporized fuel or gas to the chamber, and a second air-duct which enters the side of the combustion-chamber opposite the opening or mouth of the said hot-air duct and which directs a forcible blast of air toward the flames produced by the burning of the admixture of fuel and air issuing from the mouth of said hot-air duct. Such air-blast acts upon the flame like a blowpipe to afford a rapid and abundant supply of oxygen to the flame, and owing to the opposite arrangement of the outlets of the hot-air duct and the said second air-duct the oxygen is mixed with and supplied to all parts of the flame, thereby producing rapid and complete combustion of the fuel and a most intense heat.

The invention is shown as embodied in an oil-burning apparatus and as applied to a furnace used for heating iron to be forged, but substantially the same features of construction may be employed for burning gas or pulverulent fuel and in heating apparatus used for other purposes—as, for instance, in steam-boiler furnaces.

In the accompanying drawings, Figure 1 is a side elevation of a furnace embodying my invention. Fig. 2 is a horizontal section of the same, taken upon line 2 2 of Fig. 1. Fig. 3 is a vertical section taken upon line 3 3 of Fig. 2. Fig. 4 is a detail section taken upon line 4 4 of Fig. 2. Fig. 5 illustrates a modified form of the device employed to produce an admixture of hot air and vaporized or atomized oil.

As illustrated in the said drawings, A is the combustion-chamber, having a bottom wall, four connected side walls *a a a a*, and a top A′. Said combustion-chamber is provided with an opening *a′* for the exit of the products of combustion. In the case of a heating apparatus or furnace used for heating iron or steel to be forged the bars of metal to be heated will be inserted through said opening *a′*. B is an air-duct for supplying hot air under pressure to said combustion-chamber. Said air-duct passes horizontally through the chamber A and is connected outside of the chamber with a nozzle B′, which passes through the end wall of the chamber and discharges within the same. C is an oil-supply pipe leading from a suitable tank or reservoir and communicating with the interior of the duct B at a point near the nozzle B′. D is a second air-supply pipe or duct discharging into the said chamber at the side of the latter opposite the nozzle B′. Said air pipe or duct D is herein shown as forming a branch of an air-supply pipe E, which is connected with the pipe D and with suitable means for supplying air under pressure—as, for instance, a blower F.

The pipe B is desirably provided with a valve B^2, by means of which the flow of air therethrough may be controlled, and the air-duct D is similarly provided with a valve D′.

The operation of the parts constructed as above is as follows: The air delivered under pressure to the pipe B passes through the latter and out of the nozzle B′ into the combustion-chamber A, taking with it a quantity of oil delivered through the pipe C in an atomized or vaporized state. The admixture of vaporized oil and hot air being ignited gives a flame which is directed horizontally into the combustion-chamber toward the opposite wall thereof. The burning of the vaporized or atomized oil within the combustion-

chamber retains the latter at a high temperature, so that the pipe B is kept very hot and the air is highly heated before making its exit from the nozzle B′. Such heating of the air causes the latter to more easily take up the oil and probably serves to partially vaporize the latter, while at the same time the high temperature of the air greatly promotes combustion within the chamber. As the admixture of hot air and vaporized or atomized oil issuing from the nozzle B′ is burning a continuous current or blast of air is projected forcibly from the second air-duct D into the chamber and toward the flame coming from the nozzle of the hot-air duct. The secondary air-blast thus introduced acts upon the flame like the blast from a blow pipe, affording a rapid supply of oxygen, which is thoroughly mixed with the flame and thereby produces perfect combustion and an intense heat. In practice I have found the admixture of hot air and vaporized or atomized oil, when forced under pressure into the closed chamber and when burning under the influence of the secondary blast, to burn with a blue and white smokeless flame, filling the combustion-chamber and affording very great heat therein.

The particular details of construction present in the device illustrated are as follows: That the part of the duct B located within the chamber A and supported in the walls of the same consists of a cylindric pipe B^3, somewhat larger in diameter than the air-supply pipe E and also larger than that part of the duct or passage adjacent to the nozzle B′. The nozzle B′, together with the parts of the duct embracing the valve B^2 and the connection of the oil-supply pipe C, is formed by a single casting B^4, Figs. 2 and 4, which is formed with a half-bend at its outer end in the manner illustrated, and is connected with the pipe B^3 by means of a screw-joint *b*.

The valve B^2 may be of any convenient kind, but, as herein shown, is a plug-valve having a transverse aperture and provided with a hand-lever *b*′, by which it may be turned. The oil-supply pipe C, instead of discharging directly into the passage of the casting B^4, desirably communicates with a passage b^2, which extends around the central passage of the casting B^4 and communicates with the said passage by means of a plurality of apertures or perforations b^3 b^3. Said apertures or perforations are herein shown as formed by boring from the outside of the casting through the inner wall thereof, the holes formed in the casting exterior to the passage b^2 being closed by screw-plugs b^4 b^4.

I have shown the nozzle B′ and adjacent parts of the casting B^4 as made of rectangular form for convenience in insertion in the brick wall of a furnace, but this particular shape of the nozzle is of course not essential.

The part of the interior passage of the casting B^4 between the valve B^2 and the end of the nozzle is preferably tapered, as shown, the opening at the end of the nozzle being much smaller than the other parts of the passage. By making the pipe B^3 which is within the furnace considerably larger than the other parts of the duct B said pipe acts as a reservoir, through which the air flows slowly and is thereby more thoroughly heated than would otherwise be the case. By making the exit-opening of the nozzle B′ relatively small the heated air is delivered therethrough to the combustion-chamber at a high velocity and under considerable pressure, whereby the diffusion or atomizing of the oil is greatly facilitated.

The pipe B^3 is herein shown as provided at its end remote from the casting B^4 and outside of the wall of the combustion-chamber with a flat-sided flange b^5, whereby the said pipe may be easily turned by means of a wrench to disconnect it from the said casting. Such construction is of advantage in assembling the parts and whenever it becomes necessary to renew said pipe by reason of the same becoming injured by the intense heat within the furnace.

The delivery of the oil to the duct supplying heated air in the manner above described obviously produces an admixture with said air of the oil in a finely-divided or vaporized state before the air is delivered to the combustion-chamber, but as far as the main features of the invention are concerned such mixing of the oil with the heated air may be accomplished in any well-known or preferred manner—as, for instance, a device similar to the well-known injector may be employed, and a device of this kind is illustrated in Fig. 5 of the drawings. In this case G is a a hot-air duct, and G′ the discharge thereof, which enters a conical recess *h*, terminating in an exit-passage H of a discharge-nozzle H′.

I is a supply-pipe which leads into a circumferential passage *h*′, which extends around the nozzle and communicates by openings h^2 with the recess *h* at the rear of the nozzle-openings. The air-blast issuing from said nozzle G′ tends to draw or suck the oil inwardly from the passage *h*′, so as to produce an admixture of the oil in an atomized form with the air in a manner heretofore well known and understood.

In cases where the combustion-chamber A is made proportionately smaller or of less height in proportion to its width than in the construction illustrated in Figs. 1 and 3 a flame of considerable length will be forced out of the exit-opening *a*′. In furnaces for use in forging, such as herein shown, the combustion-chamber will be desirably made of such size and so proportioned that the flame will be confined, mainly, within the chamber, but for use under steam-generators or in heating apparatus the chamber will be especially arranged to facilitate the exit therefrom of the flame, so that a flame of great length may be obtained for passing through boiler-flues or for heating extended areas or furnaces.

It will of course be understood that as far as the operation of the main elements constituting the apparatus herein shown is concerned the air by which the liquid fuel is taken up or vaporized may be heated by the passage of the supply-duct through the furnace or combustion-chamber in the manner shown or otherwise, as may be found convenient or desirable.

The heat of the flame can be easily and accurately regulated by means of the valve D′, located in the secondary air-pipe, an increase of the air-supply giving a more intense flame, while a diminution of the supply affords a flame having less heating effect.

The same apparatus above described may be obviously employed in the use of gaseous or vaporized fuel. In the case of natural or artificial gas the gas will be supplied through the supply-pipe C and, entering the air-duct through the perforations b^3 b^3, will become mixed with the hot air and will be carried therewith into the combustion-chamber in the same manner as are the atoms or particles of oil, as above described. It will of course be understood that a non-permanent gas or hydrocarbon vapor may be carried through the supply-pipe C into the air-duct in the same manner as gas.

In the use of pulverized solid fuel—such as coal, sawdust, or other combustible substance adapted for reduction to a granulated or powdered state—the pulverized substance will be conveyed to and discharge into the hot-air duct by a suitable pipe or passage in a similar manner, for example, to the introduction of liquid or gaseous fuel through the pipe C, and after entering the duct will be picked up by and diffused through the hot-air current, so that in entering the chamber it will be in condition to quickly ignite, it being well understood that finely-divided combustible material will ignite and burn as rapidly as gas and in some instances with such quickness as to produce an explosion. It is to be understood that when such pulverulent fuel is used it will be fed through the pipe C in such quantities and the force of the blast so proportioned thereto that the minute particles of fuel will all be carried in suspension in the current of air directly to the combustion-chamber.

The novel apparatus herein described and claimed is of special value for use in boiler-furnaces in cities and elsewhere for the reason that the flame produced is entirely smokeless, owing to the complete combustion which takes place within the air-chamber under the influence of the secondary blast of air supplied thereto in the manner above described.

I claim as my invention—

1. An apparatus for burning liquid, gaseous or pulverulent fuel, comprising an inclosure constituting a combustion-chamber, provided with an outlet for the products of combustion, a branched air-supply pipe, one branch of which passes through the said inclosure, and is provided outside of the same with a return-bend which projects through the wall of the inclosure to forcibly deliver hot air thereto, and the other branch of which enters the combustion-chamber through the wall which is opposite the open end of said hot-air pipe to forcibly deliver air into said inclosure, a fuel-supply pipe discharging into said hot-air pipe, and means for supplying air under pressure to said air-supply pipe.

2. An apparatus for burning liquid, gaseous or pulverulent fuel, consisting of a substantially rectangular inclosure, constituting a combustion-chamber, provided near its top with an outlet for the products of combustion, a branched air-supply pipe, one branch of which is provided with a detachable section which passes through the opposite walls of said inclosure, with a return-bend detachably connected with the end of said section outside of said inclosure and with a nozzle attached to said return-bend and projecting through the adjacent wall of said inclosure to forcibly deliver hot air thereto, and the other branch of which pipe enters the inclosure through the wall which is opposite the opening of said hot-air nozzle to forcibly deliver air to said inclosure, a fuel-supply pipe discharging into said hot-air nozzle, and means for supplying air under pressure to said air-supply pipe.

3. In combination with a furnace for burning liquid, gaseous or pulverulent fuel, and a pipe for supplying hot air under pressure thereto, of means for delivering fuel into said hot-air pipe, consisting of a space cast in said pipe between the outer circumference and the bore thereof and concentric with said bore, ports in the partition between said space and bore affording open communication therethrough, and a fuel-supply pipe for delivering fuel to said space.

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

HENRY T. RUSSELL.

Witnesses:
W. P. PREBLE,
W. S. HALL.