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W. P. THOMPSON.

FURNACE FOR HEATING OR MELTING MATERIALS.

APPLICATION FILED JUNE 11, 1901.

NO MODEL.

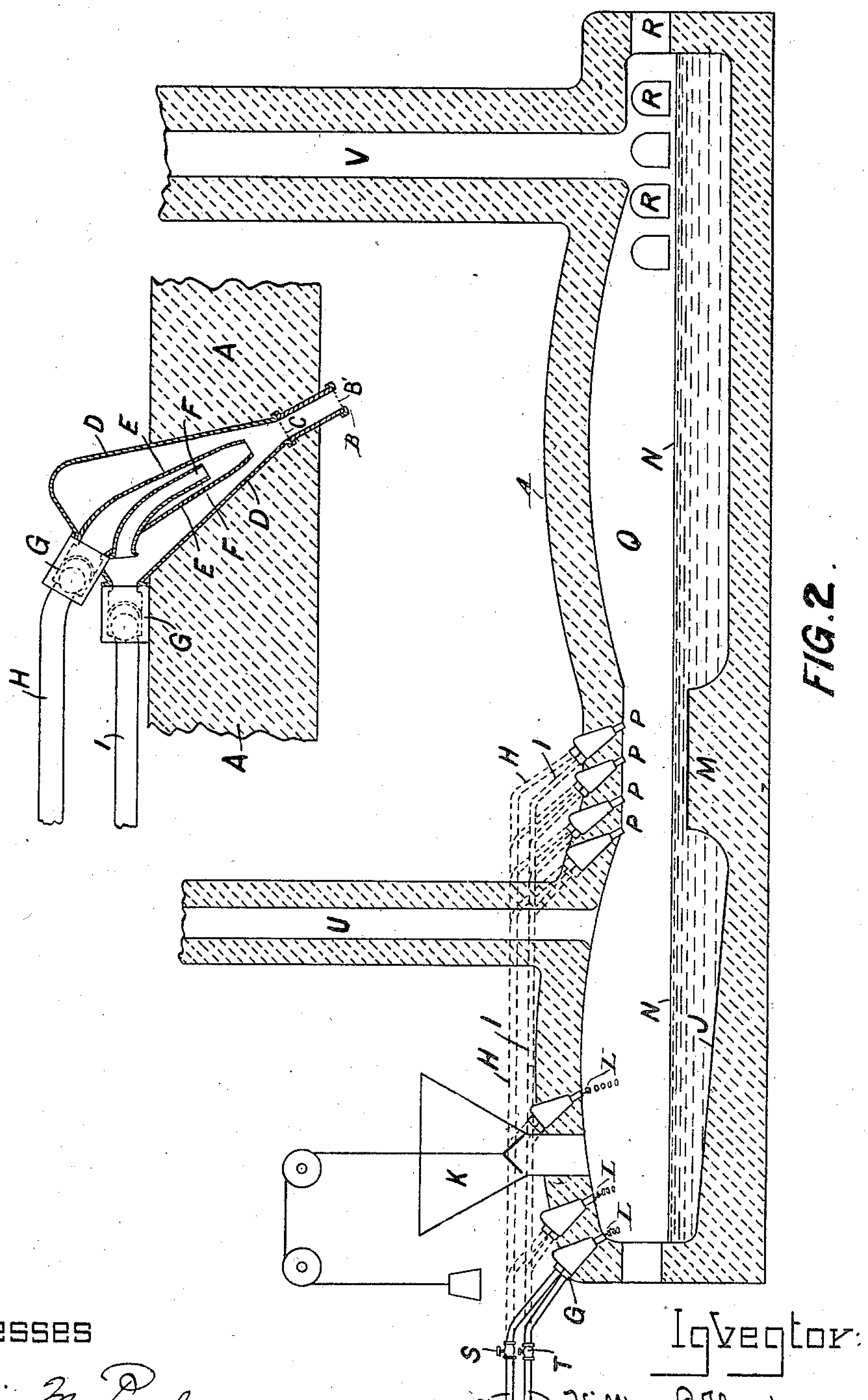

FIG. 1.

FIG. 2.

Witnesses
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UNITED STATES PATENT OFFICE.

WILLIAM PHILLIPS THOMPSON, OF LIVERPOOL, ENGLAND.

FURNACE FOR HEATING OR MELTING MATERIALS.

SPECIFICATION forming part of Letters Patent No. 725,173, dated April 14, 1903.

Application filed June 11, 1901. Serial No. 64,164. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM PHILLIPS THOMPSON, a subject of the King of Great Britain, residing at Liverpool, in the county of Lancaster, England, (whose full postal address is 6 Lord street, Liverpool, aforesaid,) have invented certain new and useful Improvements in Furnaces for Heating or Melting Materials, (for which application for patent has been made in England, where provisional protection has been obtained, under No. 7,821[A], May 25, 1901,) of which the following is a specification.

This invention has for its object a process for utilizing combustible gas more perfectly than heretofore.

In using gas at present for ordinary combustion a very considerable excess of air is used (and is consequently heated) beyond what is thoretically necessary, or smoke and soot in large quantities are the unfortunate result.

Now by my invention I am able to use almost the exact theoretical quantities of gas and air for producing perfect combustion, and also am able to get much more useful heat and power from a given amount of gas than has hitherto been found practicable.

In place of, as heretofore, mixing the air and gas in the furnace where they have to be burned, I mix them in the required quantities in a separate mixing-chamber, as close adjoining as possible to avoid danger of explosion, and when the gaseous materials are thoroughly mixed I bring them, through short nozzles or pipes or conduits made as short as possible and well provided with porous intercepting-diaphragms, so as to prevent back explosion, to the place where they eject their mixed gases into the furnace. By this means an absolutely perfect mixture is obtained, and consequently each carbon or hydrogen molecule is surrounded by the requisite molecules of oxygen for complete combustion, whereas where the gases are mixed in the furnace sufficient time is not given for a perfect mixture, and therefore a much larger percentage of oxygen has to be used in order that each molecule of combustible gas may come in contact with the requisite quantity of oxygen. I have also found that if such perfectly-mixed gas be projected against the article to be heated with such force and at such speed or with such excess of nitrogen or of neutral gas that the speed of exit from the orifice is greater than the speed at which the flame can travel (and consequently no combustion takes place until the gas strikes the hot surface of the article to be heated) a much more intense combustion takes place than in ordinary cases. Indeed, if a mixture comparatively poor in combustible gases be made thus to ignite only on the surface of the article to be heated and a much richer gas be caused to ignite at the burner and produce a vivid flame which plays on the article to be heated there is much more rapid heating of the article in the first case than in the second. This appeared to me for a considerable time contrary to science; but I attribute the cause of it to be as follows: Where the gas takes fire at the burner and flame is produced and that flame is projected against the article to be heated, the whole of the nitrogen in the mixture of gas and air is heated to the same degree as the actual products of combustion, and as the nitrogen is three times the volume of the products of combustion by the time the flame arrives at the object to be heated it is only at one-third the temperature that it would be if pure oxygen instead of air had been employed, two-thirds at least of the heat being employed in heating the nitrogen. Where, however, combustion takes place on the actual surface of the article, the oxygen unites with the carbon and the hydrogen at that surface with an intense heating effect and gives up its heat at once to the article to be heated instead of heating the nitrogen, so that the products of combustion including the nitrogen pass away from the object to be heated at a very much less temperature than the object itself, as the nitrogen is not heated largely until it and the products of combustion have escaped from the surface of the object to be heated, and I have found that if the jets of mixed gases be projected against the article to be heated at an angle of about sixty degrees a better result is obtained than at any other angle, which I believe to be owing to the greater ease at which the products of combustion are deflected, they being deflected also at this angle of sixty degrees, and therefore at an equal angle with the surface of the article itself and with the incoming jet. Owing to the great explosive force of my gas mixture at the high pressures used—fifty to two hundred pounds on the square inch—the minimum being dependent on the richness of the gas, it is very desirable to keep as little mixed at one time as possible. Accordingly I mix it as close to the burner as possible. The two pipes, preferably carrying the air and gas at substantially the same pressure, are brought to the mixing-chamber. Their terminals can be arranged on the injector plan, one—say the compressed-air-pipe end—being a jet or annulus surrounded by an annular jet and surrounding, perhaps, a central jet also, each delivering gas and pointing to the exit of the mixing-chamber. This latter is preferably a cylindrical pipe surrounding the jets. This chamber about two or three diameters from the jets has a finely-perforated transverse plate, and near the end of the cylinder or nozzle is preferably another similar perforated plate. Before reaching these perforated plates the pipe or chamber is contracted as a cone and then is parallel after the first plate for a slight distance to form a mouthpiece for the nozzle. Any other mixing-nozzle can be used that will thoroughly mix the gases. The compressed air and the gas pipe entering the mixing-chamber have each close to such chamber a back-pressure valve of any ordinary construction to prevent the mixed gases from the mixing-chamber reëntering the pipe.

Referring to the drawings, Figure 1 is a longitudinal section of nozzle and mixing-chamber; Fig. 2, a vertical central section of a furnace worked on my principle for glass, showing the positions of the nozzles or jets. Only one jet is shown and dotted lines added to indicate positions of other transverse lines of jets and the pipes leading thereto.

Referring first to Fig. 1, A is the brickwork of furnace-top; B, mouth of nozzle; B′, perforated plate with great numbers of fine perforations, too fine to allow flame to pass; C, a second plate of similar nature with mixing-space between it and plate B′; D, outer conical mixing-chamber open to air-pipe I; E, conical nozzle therein open to gas-pipe H; F, central nozzle open to air-pipe I; G G, back-pressure valves preventing the mixture from returning through pipes I and H. It is obvious that there might be several alternate injector-cones open alternately to air and gas instead of merely three, F E D; also, that any other combination of nozzle and mixing-chamber in which the air and gas are mixed in the requisite proportion and at the requisite pressure can be substituted for that shown.

Fig. 2 shows a glass-furnace made in accordance with my invention, in which J is the melting-hearth; K, charging-hopper of usual type; L L L, transverse lines of nozzles pointing down to the hearth at an angle of sixty degrees with the horizontal; M, dam; N, line of melted glass; P, transverse lines of nozzles supplying oxidizing-gas having a little more air than is theoretically necessary for the perfect combustion of the gas; Q, main furnace; R R, working holes; H gas-conduits, and I air-conduits to each nozzle; U, small chimney, not necessary but desirable to carry off most of the spent gases of nozzles L L L; V, main chimney for taking off spent or waste gases.

The mode of action is as follows: Glass material is inserted from time to time into furnace J by hopper K. Combustible gas and compressed air are forced at first with gentle pressure through nozzles L into the furnace. As the latter gets red-hot the pressure is increased till flame nearly or quite ceases, and the surface of the glass material grows rapidly white-hot. The exact quantities of gas and air, respectively, are regulated by cocks S and T, if required. The back-pressure valves G, Fig. 2, of any ordinary construction prevent gas entering the air-pipe, and, vice versa, in case by any chance the respective differences of the pressures are too great the glass being melted flows in a thin stream full of bubbles over sill M. Here it is blown upon by an extremely hot oxidizing mixture, (gas with excess of air, and so intensely heated and oxidized that the bubbles begin to escape and the glass to go white through oxidation of the protoxid of iron.) The glass slowly travels to the working holes, where it is free from bubbles, and unless the materials be very impure free from color also. In thus describing the injector-nozzles I wish it to be understood that I do not confine myself to these, as any other injector-nozzle in which the air and gas are thoroughly mixed in requisite proportions and injected at high pressure into the furnace will do.

I declare that what I claim is—

1. In a furnace, the combination of a heating-chamber, a series of nozzles pointing downward directly onto the material to be heated in said heating-chamber; means, such as pipes, for supplying air and gas in proportions substantially as described and under such high pressure that the effluent mixture hereafter mentioned shall be ejected against the material to be heated at a velocity greater than the speed of flame in such mixture, one set of pipes supplying air, and the other set of pipes supplying gas to each nozzle; and means for thoroughly mixing these gases in the nozzles.

2. In a furnace for heating or melting materials, the combination with a furnace-roof, of a series of nozzles pointing against the material to be heated or melted at an angle of approximately sixty degrees to the normal surface; and means for supplying separately to each nozzle air and combustible gas in self-burning proportions and at high pressure, whereby over the entire surface of the material to be heated gas in self-burning proportions is projected at a speed greater than that

of flame in the mixture, and in such manner that the products of combustion can escape with the least impediment, and the entire surface is made incandescent.

3. In a furnace for heating or melting substances, the combination of a heating-chamber; a series of nozzles pointing downward into said heating-chamber, and thus distributing the heat-producing supply over a large surface of the chamber; means for supplying separately to each nozzle combustible gas and air at high pressure and in requisite proportions for complete combustion; and means for thoroughly mixing the gas and air in the nozzles and delivering the same at the mouth of the nozzles at a speed very much greater than that of flame in the mixture supplied.

4. In a furnace for melting materials, the combination of a melting-chamber; a settling-chamber; a broad dam or bridge between said chambers; and two or more series of nozzles supplied with separate pipes for air and gas, one set capable of projecting an ordinary mixture of gas and air at high pressure against the materials in the melting-chamber, and another series capable of projecting an oxidizing mixture of air and gas at high pressure against the shallow layer of melted materials over the bridge, whereby great heat is obtained in the melting-chamber and oxidation with great heat is effected at the point where the melted materials pass to the settling-tank in a thin layer.

In witness whereof I have hereunto signed my name, this 1st day of June, 1901, in the presence of two subscribing witnesses.

WILLIAM PHILLIPS THOMPSON.

Witnesses:

ALBERT C. B. HENRI,

JOHN MCLACHLAN.