G. KEITH.

CRUCIBLE FURNACE.

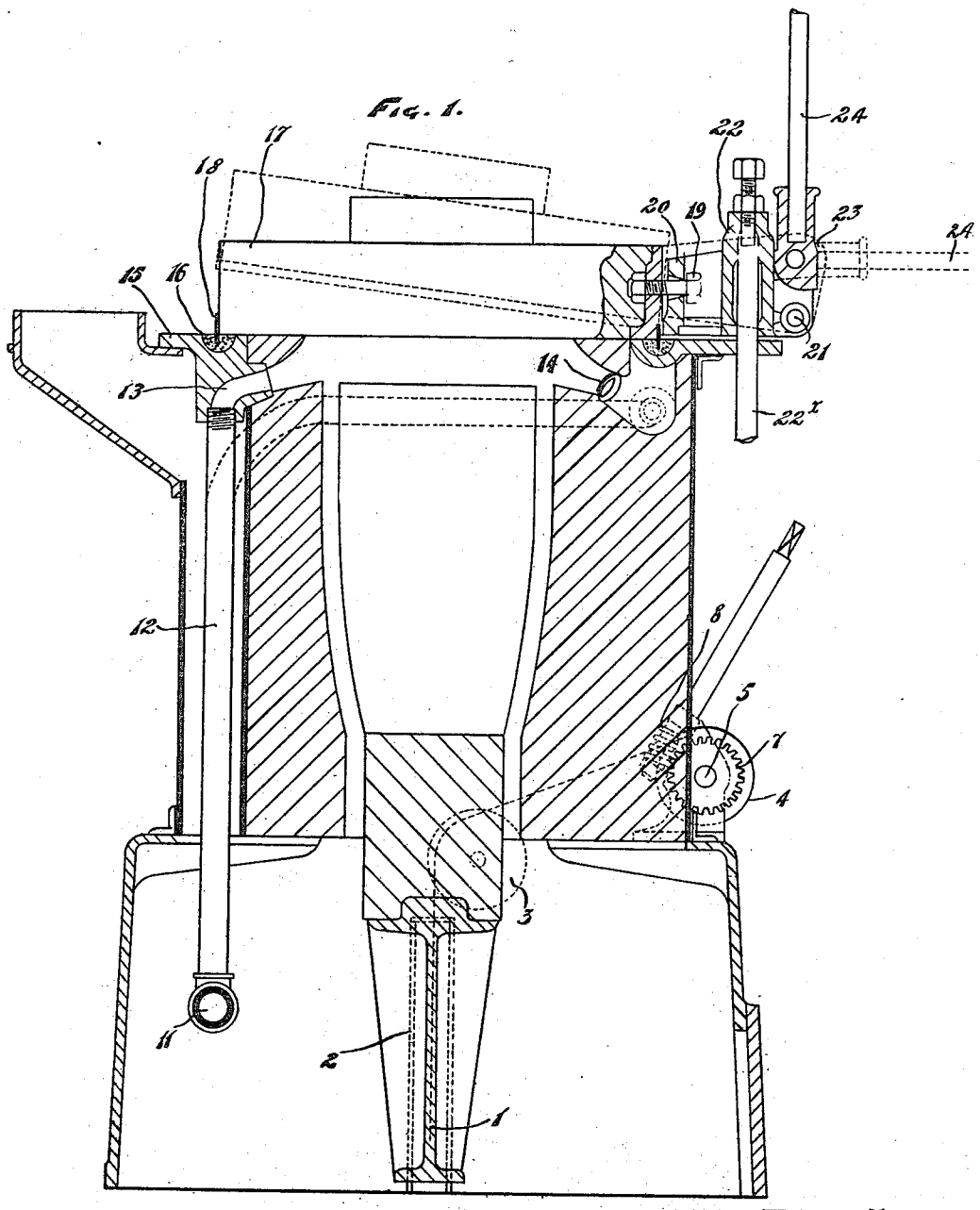
APPLICATION FILED OCT. 23, 1916.

1,241,397.

Patented Sept. 25, 1917.

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 2.

Fig. 4.

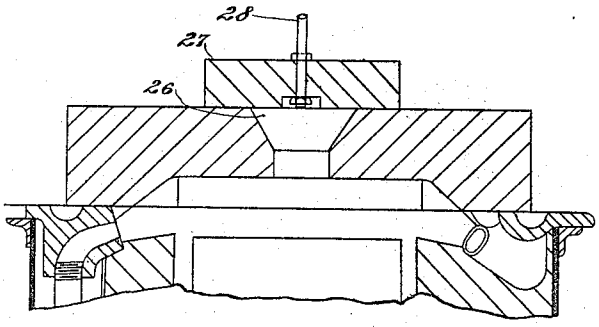
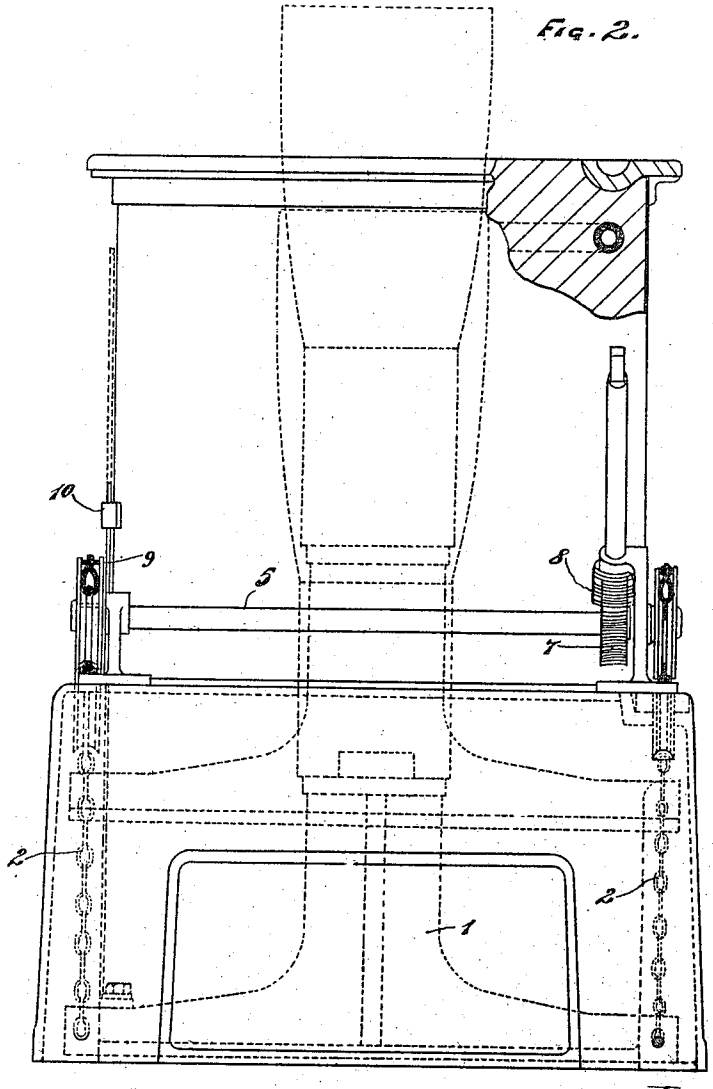


Fig. 2.



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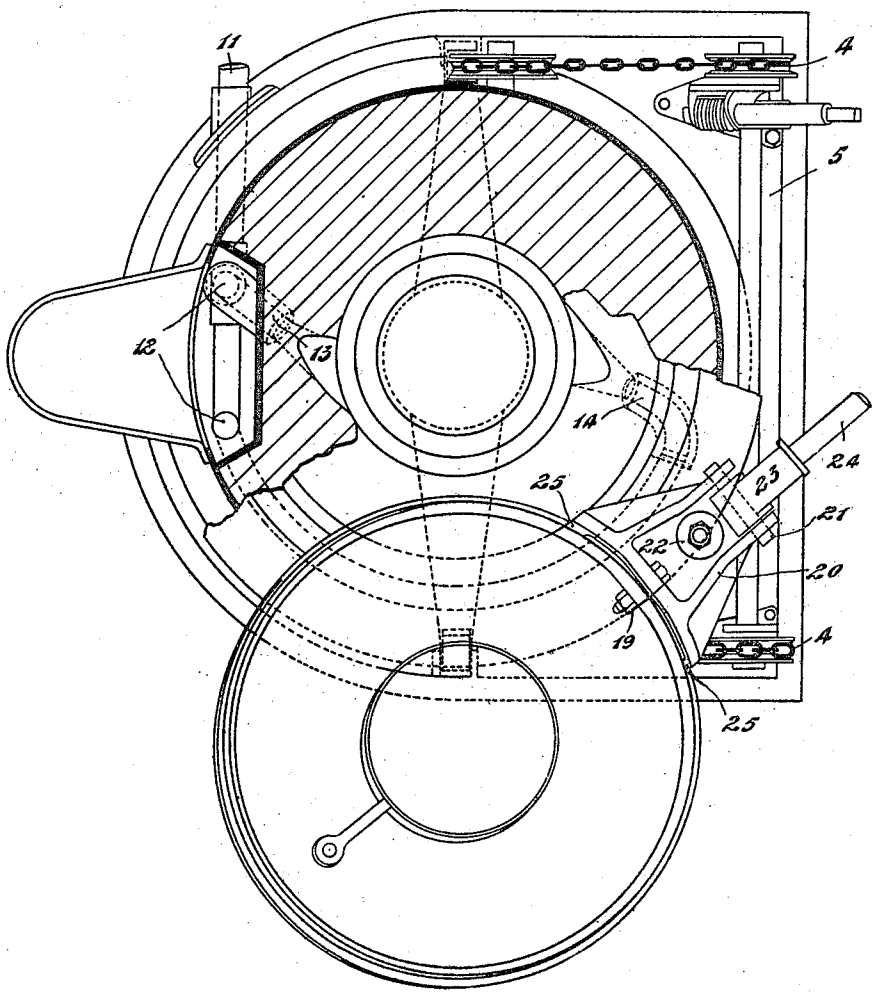
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4 SHEETS—SHEET 3.

Fig. 3.



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4 SHEETS—SHEET 4.

Fig. 5.

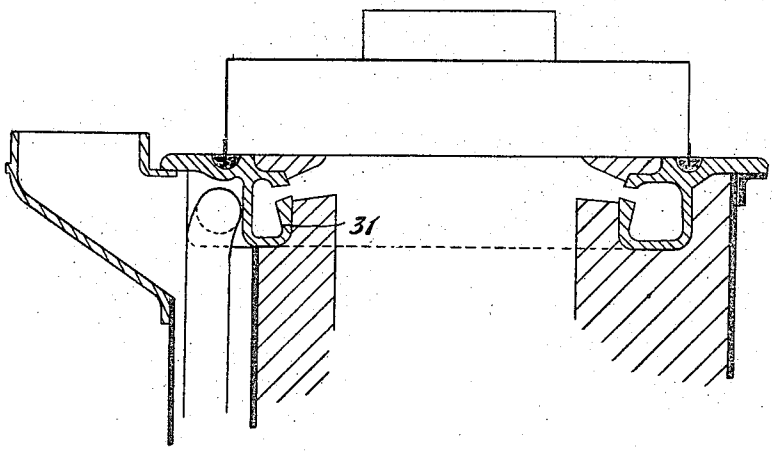
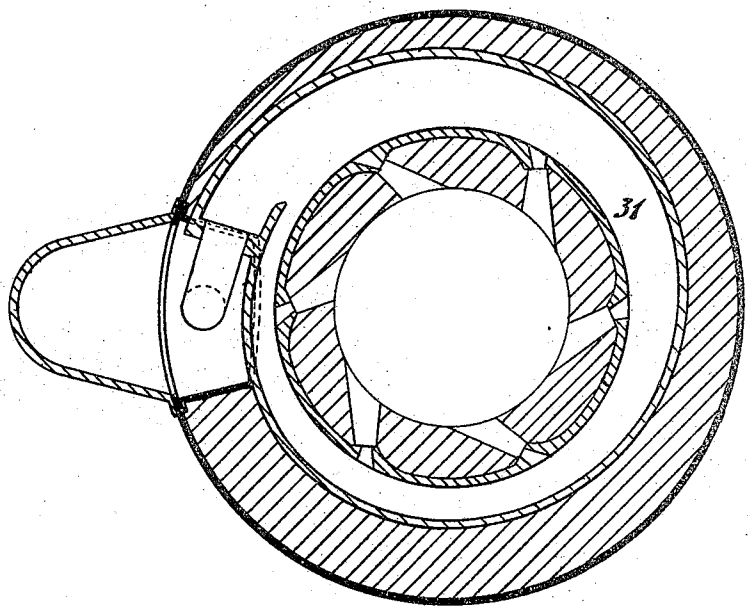


Fig. 6.



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UNITED STATES PATENT OFFICE.

GEORGE KEITH, OF LONDON, ENGLAND, ASSIGNOR OF ONE-HALF TO JAMES KEITH, OF LONDON, ENGLAND.

CRUCIBLE-FURNACE.

1,241,397. Specification of Letters Patent. Patented Sept. 25, 1917.

Application filed October 23, 1916. Serial No. 127,176.

To all whom it may concern:

Be it known that I, GEORGE KEITH, a subject of the King of the United Kingdom of Great Britain and Ireland, and residing at London, England, have invented a certain new and useful Improvement in Crucible-Furnaces, of which the following is a specification.

This invention relates to improvements in crucible furnaces.

In the use of crucible furnaces fired from below according to the practice at present most widely adopted it is found that the gas flame has a very serious destructive action on the material (plumbago, etc.,) of which the crucible is composed, the crucible deteriorating rapidly in consequence of the flaking off of large pieces from the lower end on which the flame first impinges.

Again, in the operation of existing gas-fired crucible furnaces, particularly when large crucibles are being dealt with, there is encountered the drawback that the provision of sufficient space around the crucible to permit the crucible tongs to grip the crucible securely and low enough down involves material reduction of the efficiency of the furnace from the point of view of consumption of gas.

In a crucible furnace according to the invention provision is made for introducing the mixture tangentially and with a slight upward inclination into a recess which may be formed in the cover of the furnace, such cover being composed of highly refractory material, the products of combustion being reflected downwardly by the cover and led downward between the crucible and the interior wall of the furnace—which wall preferably conforms to the contour of the crucible while being spaced therefrom sufficiently to leave a practicable working space for the downward passage of the hot products.

Due to this inversion of the usual firing operation, the refractory top cover of the furnace receives the first shock of the incoming jets, the action being in the nature of a reverberatory action, the metal to be treated being heated from the top. The importance of this characteristic will be appreciated if it be kept in view that, whereas when the contents of the crucible are heated from below in the usual manner the metal in the bottom of the crucible is melted and becomes thoroughly hot long before the metal floating on the top does, while the addition of solid metal to the molten or partially molten contents of the crucible has a chilling effect and even tends to cause solidification of already molten metal, when the contents of the crucible are heated from above the result is to improve the circulation, the metal flowing to the bottom as it becomes molten and heavier—it being understood that most of the metals treated in crucible furnaces contract on liquefaction.

In addition, the heating of the crucible by the hot currents passing down the side of the same is distributed over the surface of the crucible, there being, in general, no excessive local action—the severest action being at the upper edge which is exposed to the highest heat but which, unlike the bottom, can be allowed to become considerably worn before the crucible is rendered entirely useless.

To provide for accommodation of the tongs I arrange for effecting relative vertical displacement of the crucible and the inner wall of the furnace.

I prefer to provide for vertical displacement of the crucible-supporting pedestal, thus permitting reduction to a minimum of the space between the top of the crucible and the top of the furnace, while leaving it possible to heap unmelted ingots on the top of the crucible when it is first introduced into the furnace; it being understood that reduction of the internal dimensions of the furnace entails the attainment of a higher temperature for a given consumption of gas, and therefore of increased efficiency.

Alternatively, the inner wall of the furnace may be formed as a separate liner, between which and a crucible-supporting pedestal at the bottom is an annular space for the escape of combustion products, provision being made for lowering the liner temporarily to the base of the furnace so as to leave a substantial clear annular space around the crucible, sufficient to permit convenient adjustment of the tongs.

To provide for preheating of the mixture there is fitted in the furnace a pipe or passage through which the mixture on its way to the nozzles may be led, such passage being located in a high temperature zone so that the mixture passing therethrough may be highly heated. To protect the nozzles from injury due to excessive local heat, they

are desirably thermally connected with an annulus forming the upper part of the furnace casing proper, such annulus being exposed to the atmosphere and serving to dissipate excessive heat.

To insure more even distribution of the heating action, the nozzles may be supplied with mixture from an annulus coaxial with the crucible and thermally connected with the upper part of the furnace casing proper, the cross-sectional area of the annulus diminishing from the point or points at which it is connected to the source of supply so as to insure relative uniformity of delivery. The nozzles are cooled by reason of the continuous circulation of the mixture through the annulus and also by reason of the dissipation of heat to the atmosphere.

In the accompanying drawings Figure 1 is a vertical section showing the preferred construction of furnace in which the crucible is vertically movable. Fig. 2 is a side elevation. Fig. 3 is a part sectional plan, showing the lid swung into open position. Fig. 4 is a detail view showing an alternative construction of lid. Figs. 5 and 6 represent in vertical section and transverse section an alternative arrangement of the nozzles.

Referring to Figs. 1, 2 and 3, 1 denotes a T-shaped casting, the head of which extends to opposite sides of the base of the structure, and works in vertical channels. To the ends of the casting are attached chains 2, each of which passes over a pulley 3 fixed on the top of the base, and thence to another pulley 4 fixed on a cross shaft 5. The ends of the chains are attached to the pulleys 4, the diameters of which are such that less than one complete revolution will give the necessary lift to the pedestal. The cross shaft 5 is revolved by means of a worm wheel 7 and worm 8. The shaft of the latter may be carried upward to any convenient position for working. It will be seen that the chains 2 will lift the casting 1 bodily, and maintain it level in one plane.

The mixture of gas and air is introduced by way of the pipe connection 11 passing into the base, where the mixture is heated by the waste products. The pipe 11 branches into two vertical pipes 12 which pass through the uptake or chimney, the preheating of the mixture being thus continued until the mixture is almost about to enter the nozzles. To the branches 12 are connected the nozzles 13 and 14 which are in good thermal connection with, and are preferably cast in one piece with the annulus 15 constituting, as it were, a flange on the upper end of the furnace casing and serving to dissipate excess heat so that the temperature of the nozzles may be maintained within practical limits, having regard to the circumstance that a highly preheated mixture is employed, and that the surroundings are at a high temperature. The nozzles 13 and 14 are arranged substantially tangentially, with respect to the crucible, and at a slight upward inclination, whereby the products of combustion are reflected downwardly by the cover 17 into the space between the crucible and the interior wall of the furnace. A sand receiving groove 16 formed in the annulus 15 serves as a lute for effecting a tight closure of the furnace cover 17 which is shown fitted with a collar 18 arranged to dip into the lute. The cover 17 is arranged to tilt upward to swing clear of the lute and the top of the furnace in a manner which will best be understood from consideration of Figs. 1 and 3. As shown, the frame of the cover 17 is attached loosely by means of a bolt 19 to a casting 20, which is hinged at 21 to a casting 22 rotatable around the fixed spindle 22^x. For tilting the cover 17 there are provided the cam 23 and the lever 24. It will be seen that when the lever 24 is moved into horizontal position shown in dotted lines, the cover 17 will be tilted upward into a position such that it can be conveniently swung in horizontal direction by actuation of the lever 24. The arrangement is such that in the raised position of the cover the bolt 19 is in tension, and the lower part of the cover bears on the extensions 25 formed on the casting 20. It will be seen accordingly that when the cover is swung open it can easily be reversed by revolving it on the bolt 19, so that the refractory material of the cover can be repaired or renewed conveniently.

In the form shown in Fig. 4 the cover 17 is formed with a recess constituting a chamber into which the burner mixture from the nozzles is introduced. The cover 17 is also shown as provided with a sight hole 26 having a cover or lid 27 fitted with a connection 28 by means of which gas can be introduced to the top of the crucible, preferably when the latter is raised so as to touch the cover 17, for the purpose of reducing or preventing oxidation of the material being melted.

In Figs. 1 to 4 are shown arrangements employing only a pair of nozzles adapted to direct the mixture tangentially. It will be understood, however, that any convenient number of nozzles may be employed.

In Figs. 5 and 6 is represented an advantageous arrangement in which the nozzles 32 are arranged in a circular row and in communication with a hollow annulus 31 into which opens the upper end of the pipe 12^x supplying the mixture. The annulus 31 is flanged and extends over the upper part of the furnace proper, the cavity in the interior of said annulus being of gradually diminishing cross-sectional area.

It will be understood that the invention

is not limited to the details of construction above described. For example, means other than herein shown may be provided for effecting relative vertical movement of the liner and crucible, and other preheating arrangements may be adopted.

What I claim is:—

1. In combination, a gas-fired crucible furnace presenting a recess adjacent to the upper end thereof and constituting an initial combustion chamber, and means for introducing combustible mixture tangentially and with a slight upward inclination into said recess and for reflecting downward the heat and combustion products.

2. In combination, a gas-fired crucible furnace having a liner, said furnace presenting a recess adjacent to the upper end thereof and constituting an initial combustion chamber, means for introducing combustible mixture tangentially and with a slight upward inclination into said recess and for reflecting downward the heat and combustion products, a crucible within said furnace, and means for effecting relative vertical movements of said crucible and liner.

3. In combination, a gas-fired crucible furnace presenting a recess adjacent to the upper end thereof and constituting an initial combustion chamber, means for introducing combustible mixture tangentially and with a slight upward inclination into said recess and for reflecting downward the heat and combustion products and a pipe for leading the mixture to the upper end of the furnace, said pipe so arranged as to permit preheating of the mixture on its passage upward.

4. In combination, a gas-fired crucible furnace casing having its upper part exposed to the atmosphere and presenting a recess adjacent to the upper end thereof, and upwardly directed nozzles for introducing combustible mixture tangentially and with a slight upward inclination into said recess, said nozzles thermally connected to the upper part of said casing.

5. In combination, a gas-fired crucible furnace casing having its upper part exposed to the atmosphere, a hollow annulus of tapering cross section, said annulus thermally connected with the upper part of said casing, and a series of tangentially and upwardly directed nozzles arranged in a circular row, said nozzles being in communication with said annulus.

6. In combination, a crucible furnace casing, a cover for said casing, a vertical spindle fitted to said casing, a casting revoluble around said spindle, a second casting hinged to said first-mentioned casting, the axis of the hinge being horizontal, a horizontal bolt disposed diametrically of said cover and connecting said cover to said second casting and permitting movement of said cover around the axis of said bolt, and a lever pivoted to said second mentioned casting and formed with a cam surface engaging said first-mentioned casting, said lever and cam serving to impart tilting and horizontal movements to said cover.

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

GEORGE KEITH.

Witnesses:

WALLACE CRANSTON FAIRWEATHER,

HENRY MASON.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."