Sept. 2, 1958 JEAN-BAPTISTE GUILLAMON 2,850,374

CUPOLA FURNACE, AND PROCESS FOR ITS OPERATION

Filed May 31, 1956 2 Sheets-Sheet 1

Fig. 1

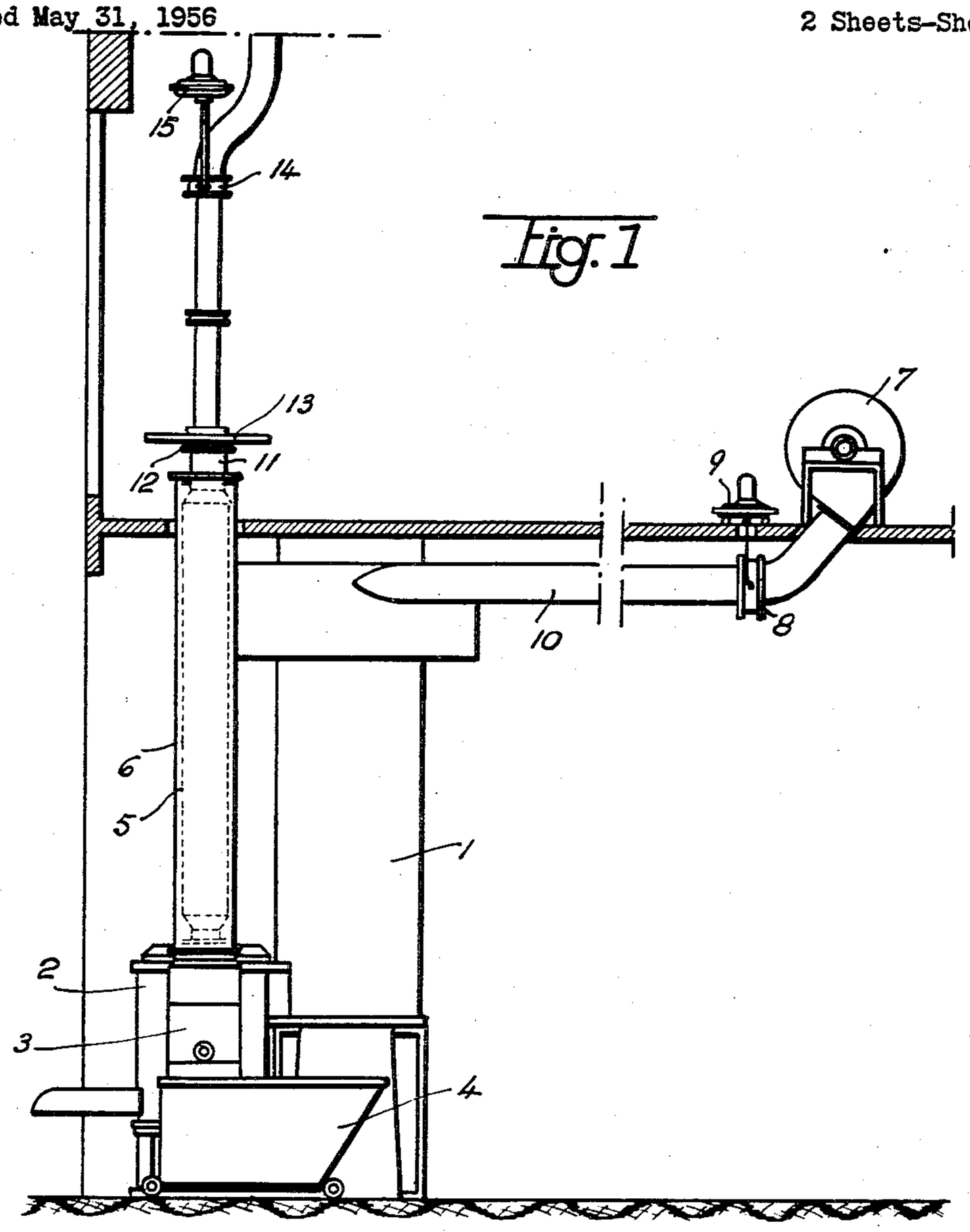

Fig. 2

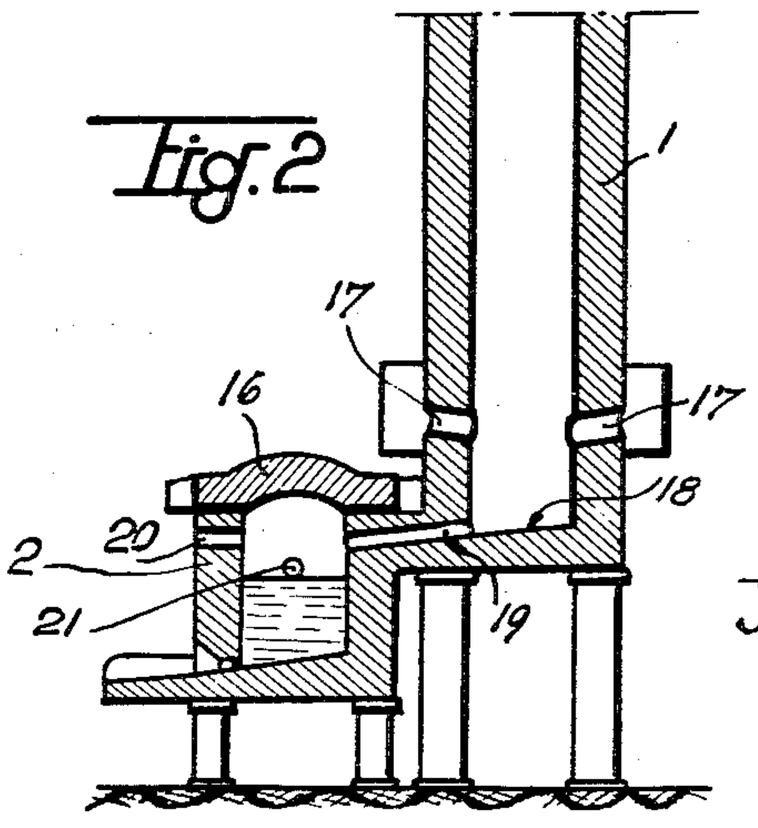

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Fig. 4

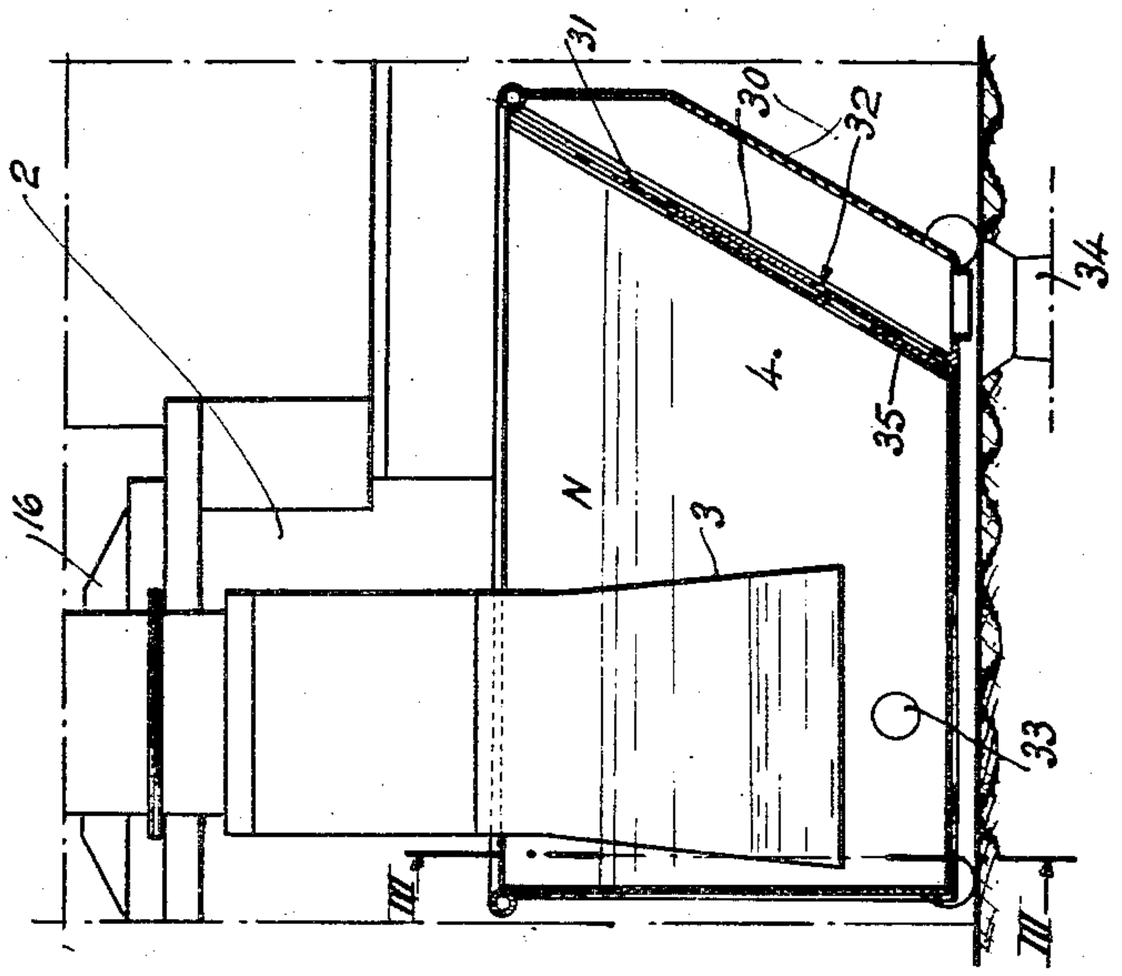
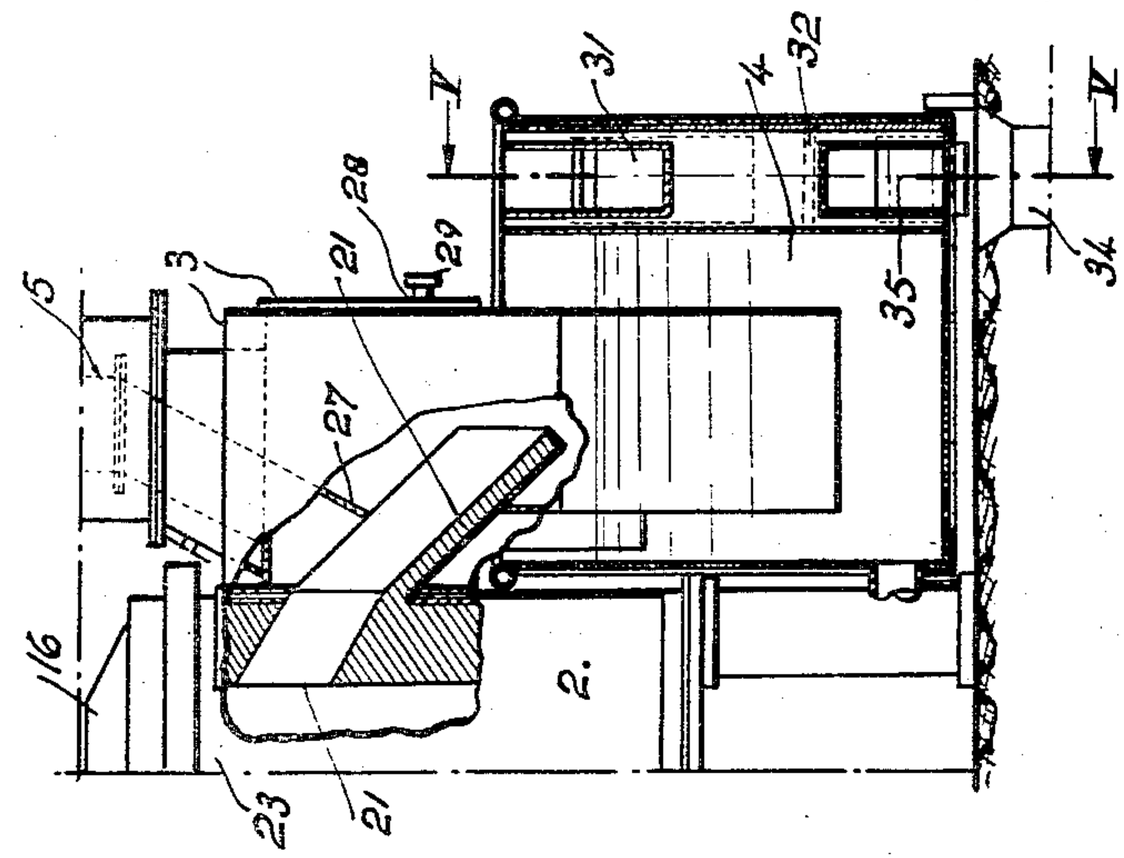


Fig. 3



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CUPOLA FURNACE AND PROCESS FOR ITS OPERATION

Jean-Baptiste Guillamon, Paris, France

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7 Claims. (Cl. 75—45)

It has already been proposed to operate cupola furnaces having a fore-hearth or of the continuous casting type by providing in the bottom of the cupola furnace a heating hearth with a maximum temperature area in register with said hearth as obtained through a suitable adjustment of the amount of air blown into the lower section of the cupola taking into account the distance between the air-blowing twyers and the hearth.

This leads to the obtainment of cast iron at a very high temperature which may be modified at will through special structural features of the cupola.

It is possible to adjust the flow of the combustion gases and their temperature with a view to defining the chemical composition of the gases which allows ascertaining the output of air blown at room temperature.

Now, it has been found that the combustion gases were subjected under the action of a same disturbance to modifications which are all the more important when their temperature is higher, which makes the adjustment of their flow very difficult, if not impossible.

Furthermore, the removal of the burnt gases at very high temperatures requires pipes of refractory material which are very expensive and this leads to problems of safety, working conditions and sanitation, the satisfactory solution of which requires a large expenditure of money.

In order to cut out these drawbacks and to allow uniformizing the throughput of combustion gases, I have conceived, in accordance with my invention, of the cooling of said gases through a circulation and/or spraying of water.

The temperature of the gases is thus reduced down to a value for which the amplitude of modification is sufficiently small for it to be possible to resort to automatic flow adjusting apparatus of a conventional type, with which may be incorporated any known thermometric or thermoelectric arrangement for the automatic correction of the flow as a function of temperature while taking as a reference the flow at 0° C. under an atmospheric pressure of 760 mm. of mercury.

The composition of the combustion gases is speedily stabilized as soon as the permanent conditions of operation of the cupola furnace are reached and consequently, assuming Q designates the constant flow from the blower feeding the air-blowing twyers, q designates the flow of the combustion gases corresponding to a volume q' blown towards the lower part of the cupola furnace, the volume of air blown into the upper part of the furnace is

$$Q-q'=\text{constant}$$

This double adjustment allows retaining substantial uniformity in composition for the case iron and the modifications of q alone allow modifying it as desired. The temperature is much less subjected to the action of this modification in the flow of the combustion gases and consequently my improved method allows modifying the composition of the cast iron while retaining a high temperature of casting.

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My invention has also for its object various improved structural modifications brought to cupola furnaces provided with a fore-hearth with a view to improving the execution of the method.

Among these modifications, I should mention more particularly:

The arrangement of a baffle plate at the upper end of the syphon serving for the exhaust of the combustion gases with a view to stopping the steam formed by the dropping of the dross into the water of the vat serving for the granulation of the slag.

The cooling of the wall of the syphon through circulation and/or spraying of water.

The adjustment of the level of water inside the slag-granulating or dross-containing vat together with the keeping of the slideways of the dampers associated with the latter in a constant state of cleanliness through the operation of a set of sliding dampers provided preferably on a same sloping wall of the vat.

I have illustrated in the accompanying drawings by way of example and by no means in a limiting sense various embodiments of my improved arrangements incorporated with cupola furnaces of the fore-hearth type for the execution of my method. In said drawings:

Fig. 1 is a diagrammatic elevational view of a cupola furnace provided with its fore-hearth.

Fig. 2 is a vertical sectional view of the lower part of the cupola furnace and of its fore-hearth.

Fig. 3 is a partial sectional view through line III—III of Fig. 4 of the vat containing the dross and serving for the granulation of the slag and the exhaust of the gases, the syphon being assumed to be removed.

Fig. 4 is a sectional view through line IV—IV of Fig. 3.

In Fig. 1, **1** designates the cupola furnace, **2** its fore-hearth, **3** the syphon for the vat **4** containing the dross and in which the slag is granulated, **5** the exhaust pipe for the combustion gases together with its jacket **6** forming the water circuit, **7** the fan or blower for blowing air into the furnace, **8** a gate for adjusting the flow of air blown into the furnace, which gate is controlled by the motor **9** and is inserted in the air-feeding pipe **10** leading to the blast box. The exhaust pipe **5** includes extension **11** of a reduced height assembled through flanges **12** providing for a sealing of the stream of gases. An expansion compensating packing may be provided at **13** for absorbing the modifications in length of the pipe elements under the action of temperature, **14** designates an adjusting throttle valve inserted in the gas exhaust pipe and controlled by an auxiliary motor **15**.

Fig. 2 also shows the cupola furnace **1** with its fore-hearth **2** provided with a cap **16** while **17** designates the air-blowing twyers. The air is directed partly towards the upper part of the cupola furnace and partly towards the hearth **18**. For a predetermined distance between said hearth and the twyers **17**, the cross-section of the channel **19** connecting the cupola furnace with the fore-hearth should be such that, taking into account the resistance formed in the upward direction by the stack of alternating coke and metal layers, the amount of air admitted into the fore-hearth **2** may be exactly that required for the formation of a maximum temperature area at the distance considered from the twyers i. e. on the hearth **18**. **21** designates the opening for the removal of the dross from the fore-hearth.

Each time the dross is to be removed, the dropping of the slag into the water of the granulating vat leads to the production of an amount of steam which varies with the mass and temperature of the slag. In order to prevent said steam from disturbing the adjustment performed through admixture with the combustion gases, a baffle plate **27** (Fig. 3) prevents said steam from entering the

upper section of the syphon **3** while simultaneously the walls of the syphon are cooled through water running and/or spraying over them so as to make the steam evolved condense on said walls. The combustion gases are thus simultaneously cooled. To allow the expansion under the action of heat to be performed freely, the syphon **3** is secured to the ferrule **23** of the fore-hearth independently of the slag-granulating vat **4** into which it dips.

The syphon **3** is provided at its front end with an inspection gate **28** secured to the actual body of the syphon with the interposition of a fluidtight packing. An inspection hole adapted to operate in two directions allows checking the flow of the slag and acting if required inside the syphon.

One of the walls **30** of the dross-containing and slag-granulating vat **4** has a sloping shape as shown in Fig. 4 so as to aid in the extraction of the granulated slag. This extraction may be performed mechanically through a chain of scrapers or of buckets.

The level of the water inside the vat varies with the adjustment and consequently, with a view to cutting out any loss of gases which might, in addition to a disturbance in the operation of the furnace, lead to a poisoning of the attendants, it is necessary to suitably adjust this level since if the lowering of the level due to the pressure of the gases inside the syphon **3** is small and if, at the same time, the adjusted level is too high, the slag is cooled too near the passage **19** so that it becomes solid and prevents the removal of the dross.

In order to allow a speedy adjustment of said level, the vat **4** is provided with a damper **31** sliding between two slideways with the level N of the water inside the vat being defined by the upper edge of the damper **31**.

To keep the slideways in a state of constant cleanliness, an opening **32** is formed at the lower end of the slideways so as to establish a permanent circulation of water which carries along with it the foreign particles which might foul the slideway. The water entering the vat at **33** collects in a chamber **34** engaging the bottom wall of the vat on the outside thereof and the lower opening of which allows the overflow water to be exhausted into a drain.

In the lower part of the sloping wall **30** is provided another damper **35** which may be controlled from a point above the vat and which provides for speedily emptying said vat **4**.

What I claim is:

1. In a cupola furnace the combination of a fore-hearth, a dross-containing and slag-granulating vat, a syphon connecting the fore-hearth with the vat, a channel for the exhausting of the combustion gases connected with said syphon and a cooling water-jacket surrounding said channel.

2. In a cupola furnace the combination of a fore-hearth, a dross-containing and slag-granulating vat, a syphon connecting the fore-hearth with the vat, a baffle plate at the upper end of the syphon adapted to prevent the steam passing out of the vat from mixing with the combustion gases, a channel for the exhausting of the combustion gases connected with said syphon and a cooling water-jacket surrounding said channel.

3. In a cupola furnace, the combination of a fore-hearth, a dross-containing and slag-granulating vat, a syphon connecting the fore-hearth with the vat, means for cooling the walls of the syphon, a baffle plate at the upper end of the syphon adapted to prevent the steam passing out of the vat from mixing with the combustion gases, a channel for the exhausting of the combustion gases connected with said syphon and a cooling water-jacket surrounding said channel.

4. In a cupola furnace, the combination of a fore-hearth, a dross-containing and slag-granulating vat, a set of parallel slideways along one wall of the vat, at least one damper slidingly carried between said slideways and the operation of which provides adjustment of the level of water in the vat by defining an overflow level for the water, a syphon connecting the fore-hearth with the vat, a channel for the exhausting of the combustion gases connected with said syphon and a cooling water-jacket surrounding said channel.

5. In a cupola furnace, the combination of a fore-hearth, a dross-containing and slag-granulating vat, a set of parallel slideways along one wall of the vat, at least one damper slidingly carried between said slideways and the operation of which provides adjustment of the level of water in the vat by defining an overflow level for the water, an exhaust opening being provided in register with the lower ends of the slideways for the removal of fouling material, a syphon connecting the fore-hearth with the vat, a channel for the exhausting of the combustion gases connected with said syphon and a cooling water-jacket surrounding said channel.

6. In a cupola furnace, the combination of a fore-hearth, a dross-containing and slag-granulating vat, a set of parallel slideways along one wall of the vat, at least one damper slidingly carried between said slideways and the operation of which provides adjustment of the level of water in the vat by defining an overflow level for the water, an exhaust opening being provided in register with the lower ends of the slideways for the removal of fouling material, a syphon connecting the fore-hearth with the vat, means for cooling the walls of the syphon, a baffle plate at the upper end of the syphon adapted to prevent the steam passing out of the vat from mixing with the combustion gases, a channel for the exhausting of the combustion gases connected with said syphon and a cooling water-jacket surrounding said channel.

7. Process of producing cast-iron of a desired composition in a cupola furnace having a fore-hearth consisting in creating an area of heat at a very high temperature in the bottom of said cupola, introducing air into said area, passing a portion of the gas of combustion and air mixture from said area into said fore-hearth maintaining the casting of the molten iron in said fore-hearth at a high temperature, regulating the flow of said gas and air mixture through said fore-hearth for obtaining in said fore-hearth a casting of a composition as desired while maintaining said casting at a very high temperature and cooling the gas leaving said fore-hearth.

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