Aug. 27, 1963 B. L. YDSTIE 3,102,091

AUTOMATIC ARRANGEMENT FOR MAINTAINING COMBUSTION IN GAS BURNERS FOR USE WITH ALUMINUM FURNACES

Filed March 9, 1961

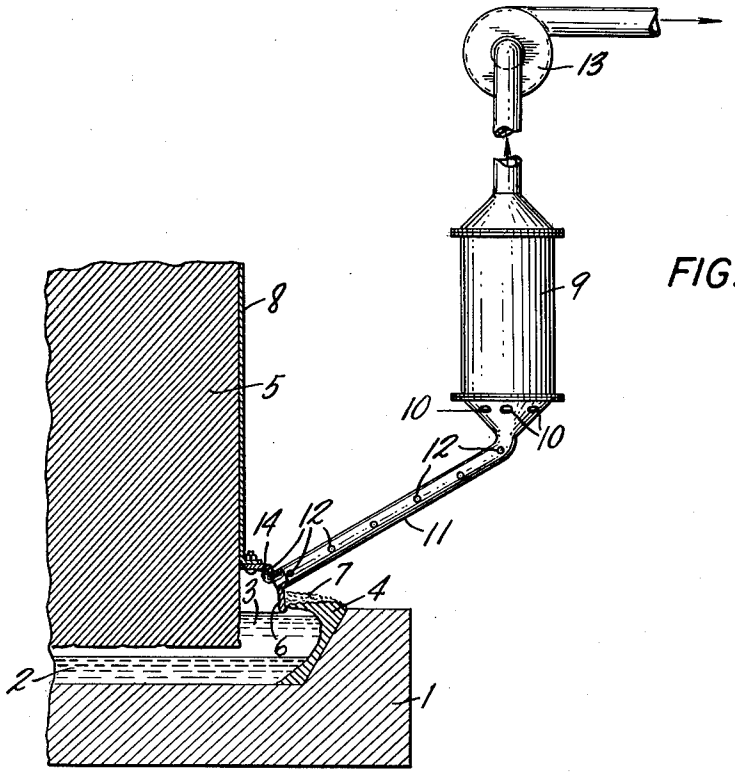

FIG. 1.

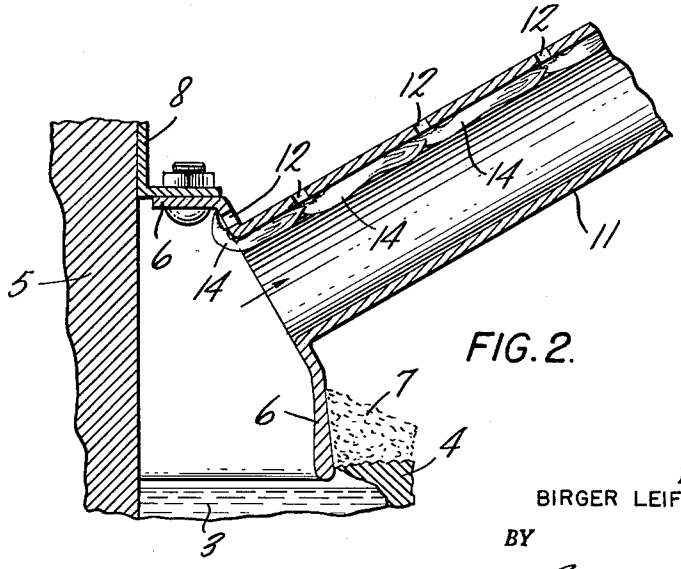

FIG. 2.

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United States Patent Office 3,102,091
Patented Aug. 27, 1963

3,102,091

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Filed Mar. 9, 1961, Ser. No. 94,470
Claims priority, application Norway Apr. 6, 1960
4 Claims. (Cl. 204—247)

In the aluminum industry so called Soederberg furnaces are now used extensively. In these furnaces the anode is suspended by means of vertical contact rods and the furnace gas is collected in a duct surrounding the anode near the bath surface. The general construction is illustrated for example in Jouannet U.S. Patent No. 2,526,875. The furnace gases contain carbon monoxide developed by the electrolytic reaction and in addition contain substantial quantities of tar fumes resulting from the carbonization of the binder used in the anode. In addition these gases contain fluorine which demands that they be purified before being released into the air.

The tar fumes are volatile at elevated temperatures but tend to condense when atmospheric temperatures are approached. This means that the tar fumes have to be eliminated from the gas before the gases are conducted to a central purifying point. This is done by supplying a burner adjacent each furnace and close enough so that the furnace gases will reach the burner before they cool off sufficiently to cause the tar fumes to condense. In this burner the carbon monoxide and the tar fumes are burned so as to produce a residual gas that can be conducted to a central station and handled at normal temperatures. It is very important that the tar fumes be removed before the gas is led to the central point where the gases are cleaned and the fluorine recovered, or otherwise the tar fumes would condense and precipitate on the walls of the gas pipes and gradually clog these pipes up.

In the commercial production of aluminum the furnaces are connected in series, each series comprising a large number of furnaces. Usually each furnace is provided with an individual burner for burning the fumes and the residual gases from all of the furnaces in the series is conducted to the central cleaning point. It is found, however, that in such a large series it frequently occurs that some of the gas burners go out and before this is noted the tar fumes from the furnace in question may enter the gas conduits and clog them up. This means that a complex and expensive cleaning of the gas collecting system is required.

The present invention relates to a system whereby the tar fume burners are automatically kept burning. I have found that this can be done by operating the gas burners at a pressure slightly below atmospheric and supplying a series of small holes in the pipe leading from the gas collecting duct to the burner. The first of these holes is located closely adjacent to the gas collecting duct or even in such duct and due to the fact that the gas pipe has a pressure below atmospheric a small amount of air will be drawn in through such hole. At the temperature of the pipe at this point this will result in the formation of what may be termed an "inverse flame" in the pipe. That is, the air will be consumed in causing combustion of a limited portion of the gas with propagation of a flame and due to the fact that the gas is moving in the pipe this flame will be carried forward. It should be large enough so that it will reach the next hole in the series. Here again the air coming into the second hole will cause limited combustion with an accompanying flame and in this way the flame will be carried forward from one hole to the next until it reaches the burner where sufficient air is introduced to burn all of the gas. In this way a

flame is initiated near the gas collecting duct and propagated all the way to the burner but very much less than all the combustible gas is consumed.

In carrying out this invention the holes in the pipe may be quite small relative to the diameter of the pipe so that the air admitted will be considerably less than required for total combustion. Ordinarily the pipe leading from the gas collecting duct to the burner will have internal diameter of at least 10 cm. or it may be very substantially larger than this. On the other hand the holes in the pipe may for example vary in size from a diameter of about 5 mm. up to a diameter of about 16 mm. From these figures it will be seen that the cross sectional area of each hole is less than $\frac{1}{150}$ of the cross sectional area of the pipe. As regards the spacing of the holes, this will depend in part upon the velocity of the gas in the pipe but ordinarily the space between the holes may range between 4 and 20 cm. I have found that, generally speaking, for good operating conditions the diameter of the holes should be between about 6 and 10 mm. and the spacing of the holes should be between 5 and 15 cm.

As an equivalent of sucking air into the pipe, air under pressure may be forced into it.

This invention may be readily understood by reference to the accompanying drawings in which:

FIG. 1 shows a side view partly in section of a portion of an aluminum pot with the device of this invention in place, and

FIG. 2 is an enlarged sectional view through the gas conducting pipe.

In the drawings, **1** is the furnace pot. **2** is the molten aluminum covered by the molten bath **3**. **4** is the crust formed on the surface of the bath and **5** is the anode surrounded by the gas duct **6**. The seal between the crust **4** and the gas duct **6** is formed by aluminum oxide **7**. **8** is the permanent casing holding the anode **5** and ordinarily the gas duct **6** will be bolted to this casing. **9** is the burner where the combustion air is supplied through the hole **10**. **11** is the connecting pipe between the gas duct and the burner. The pipe **11** should be of the usual length and diameter employed in aluminum furnaces and in such case the gases passing through this pipe will still be hot when they reach the burner **9** but the heat generated in the burner **9** will not be great enough to overheat the adjacent anode casing **8**, causing the electrode paste inside this casing to bake and stick. **13** indicates a fan located somewhere in the system to maintain a slight suction on the pipe **11**. Ordinarily, this fan will be operated in conjunction with the central gas collecting and purifying system and this whole system will be operated under a reduced pressure.

As indicated in FIG. 2 air will be drawn in through the first of the holes **12** adjacent the gas collecting duct and as shown in this figure one hole **12** may be actually formed in the gas collecting duct. The air passing in through these holes will be substantially less than that required to burn all the gas in pipe **9** so that in effect the air will burn with gas in the duct to form an "inverse flame," as indicated at **14**. This flame will be carried on by the stream of gas to the next hole **12** where additional air coming in will be ignited, and this will continue until the flame reaches the burner **9**.

The amount of suction necessary will vary with the size of the holes **12** and their spacing. To adjust the suction when this device is started up the suction can be gradually increased until the flame reaches the burner **9** and ignites the gas in it. Thereafter, if this amount of suction is maintained the device will operate so that if the flow of gas should be interrupted and a given burner **9** should go out, it will ignite as soon as the flow of gas is renewed. In other words, the maintenance of of combustion in each burner **9** is insured automatically.

It is understood that the example given is only by way of illustration and may be modified in any particular operation.

I claim:

1. An aluminum smelting furnace comprising a furnace pot, an electrode entering such pot, a gas collecting duct around the lower portion of the electrode for collecting gases evolved during smelting, a tar fume burner positioned at a point remote from said electrode to prevent overheating and baking of the electrode by the heat generated in such burner while burning tar fumes and combustible gases evolved during smelting, a pipe between the gas collecting duct and the tar fume burner for conducting the gases evolved during smelting away from the gas collecting duct to the tar fume burner, a plurality of holes of substantially smaller diameter than the pipe and spaced apart from each other along the entire length thereof, said holes permitting entry of limited amounts of air into the pipe for causing spontaneous combustion of a limited portion of the gases passing in the vicinity of each hole accompanied by propagation of a flame, the spacing of said holes being sufficiently close to cause successive spontaneous combustions and flame propagations along the entire length of the pipe from the end adjacent the gas collecting duct to the end adjacent the tar fume burner whereby ignition of the tar fume burner is maintained automatically during operation of the furnace.

2. The structure of claim 1 which includes pump means coupled to the tar fume burner for drawing the gases evolved during smelting through the pipe and the tar fume burner.

3. The structure of claim 1 wherein the cross sectional area of the pipe is at least 150 times the cross sectional area of the holes in the pipe.

4. The structure of claim 1 wherein said tar fume burner has holes for the admitting of sufficient amounts of air to permit the burning of substantially all the tar fumes and combustible gases evolved during smelting.

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