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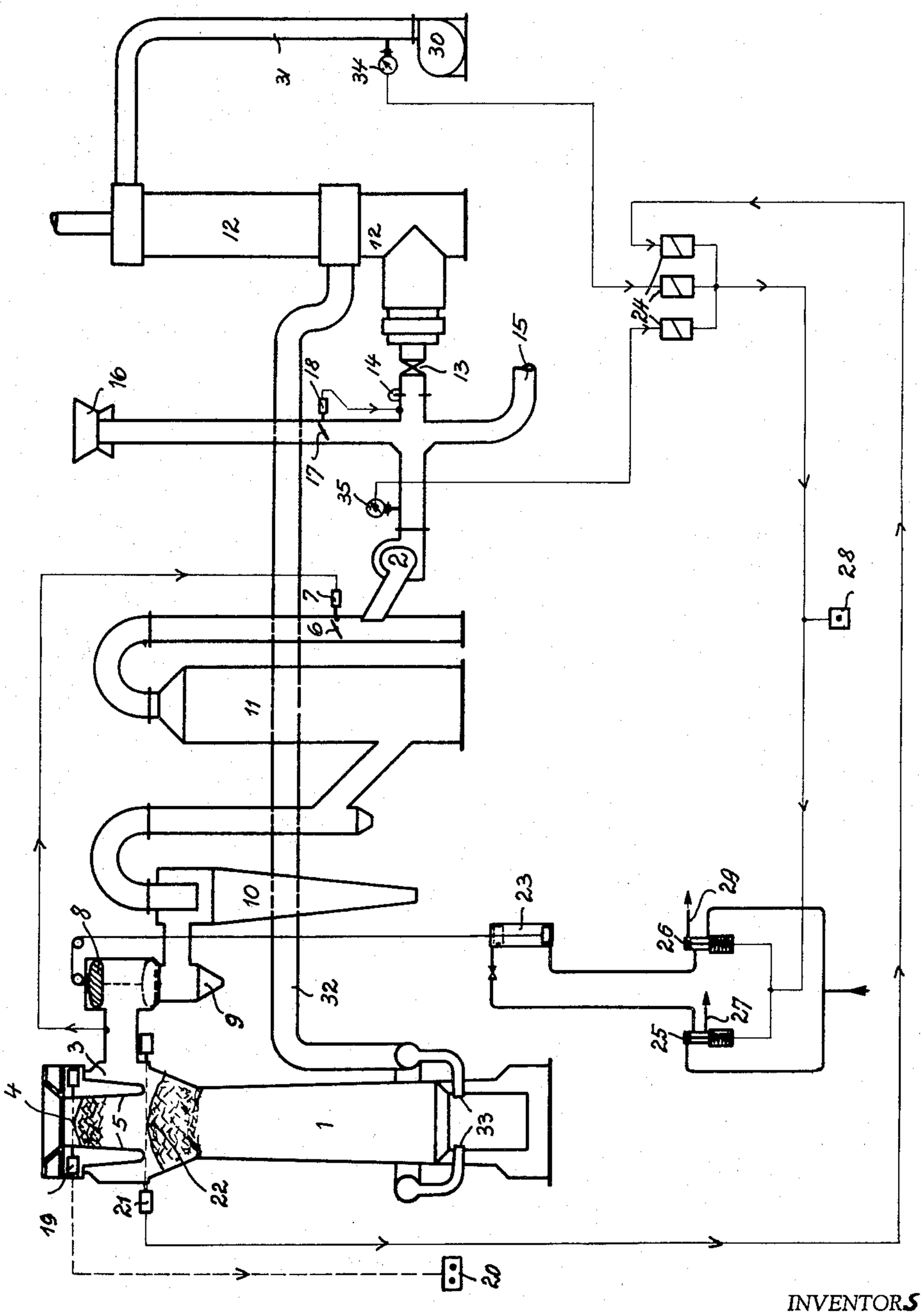

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APPARATUS FOR OPERATION OF CUPOLA FURNACES

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Unlike blast furnaces, cupola furnaces are operated with throat permanently open. This is firstly because a considerably shorter charge cycle is required in the latter case, and secondly because cupola furnace gases are generally hotter than blast furnace gas, a circumstance interfering with satisfactory operation of a charging mechanism. Furthermore, the short charge cycle of cupola furnaces would involve continual pressure fluctuations in the gas line, interfering with convenient utilization of the cupola furnace gas.

Now open-throat operation of cupola furnaces not only entails substantial gas losses, seriouly impairing economy of the process, but also constitutes a public nuisance. Consequently, the need for a "smokeless" cupola furnace has become acute. This remains true of what are known as hot-blast cupola furnaces, in which part of the exhaust gas is tapped off for recuperative preheating of the furnace blast, but a considerable portion of the gas escapes in the same manner as in cupola furnaces operated on cold blast.

The object of the present invention is to make possible the "smokeless" operation of open-throat cupola furnaces, and the efficient utilization of all of the furnace gas.

This object is accomplished in a hot-blast cupola furnace, with open throat from which the exhaust gas of the furnace is drawn off behind a steel plate baffle into an annular duct and used for recuperative preheating of the blast, by a process according to the invention wherein withdrawal of the furnace gases from the throat continually being filled with charge is effected by a draft such as to maintain suction in the duct opening into the throat of the furnace behind the baffle, which suction equilibrates the flow resistance of the charge within the baffle, and wherein the suction prevailing in the duct is automatically regulated to that condition by a throttling means in the gas line.

In a cupola furnace installation comprising a cupola furnace whose throat contains a water-cooled baffle surrounded by a chamber connected to the furnace gas line, and a shut-off means installed in the gas line in series with a purifier, a cooler, an exhaust blower and a recuperator, whence the preheated blast is forced by a blower into the bustle pipe and thence into the tuyeres of the cupola furnace, the process according to the invention is practiced by causing the shut-off valve in the gas line following the intake chamber to close automatically in response to signals from a level-indicating means in the throat of the cupola furnace and pressure-indicating means in the gas line behind the exhaust blower and in the blast line leading to the furnace.

The level-indicating means in the throat of the furnace, comprising a safety contactor controlling the gas shut-off valve in relation to the charge level in the throat, consists of means for transmission of radioactive beams, located on the periphery of the throat. These means act upon an indicator responding to deficiency of charge in the throat and actuating a hydraulically or pneumatically operated piston to close the shut-off valve via a relay from an electric contact. The piston may be replaced by an electric motor if desired.

The hydraulically, pneumatically or electrically operated shut-off valve is likewise subjected to control via pressure-indicating means and relays by safety devices in the gas line behind the exhaust and in the blast line.

The device according to the invention will now be more fully described with reference to the accompanying drawing, but it should be understood that this is given by way of illustration and not of limitation and that many changes in the details may be made without departing from the spirit of the invention.

The drawing shows a diagram of a cupola furnace installation for practicing the process according to the invention.

The entire exhaust gas of a cupola furnace **1** is withdrawn by an exhaust blower **2** from an annular gas chamber **3** opening into the throat of the furnace about two meters below the top charge level **4** behind a baffle **5** constructed of steel plate. To achieve smokeless operation of the cupola furnace, according to the invention, the following procedure is employed.

The furnace **1** is kept gastight by the column of charge within the baffle **5**. The charge gradually slides down through the baffle into the stack. However, the baffle is at all times kept sufficiently full so that the charge present in it will offer a flow resistance equilibrating suction in the gas exit chamber **3**. Since the cupola furnace must be charged intermittently, and the baffle **5** will therefore sometimes be only about half full, the suction in the exhaust chamber **3** must be kept regulated to this fluctuation. This is accomplished by a throttling means **6** in the gas line, controlled by a pressure regulator **7** receiving its signal from the pressure in the gas chamber **3**.

The cupola furnace gas is drawn through a slide or bell valve **8** and a cyclone **9** into a pre-purifier **10** and thence through a gas cooler **11**. The suction draft is generated by the exhaust blower **2**, which may optionally be combined with a disintegrator, thus at the same time purifying the gas.

The blower delivers the gas withdrawn from the cupola furnace to the recuperator **12** at a pressure of about 300 mm. of water or more, to the extent of about ⅓ of the output. The remaining gas is piped to other points of consumption, such as steam boilers or heating furnaces. The amount of gas required by the recuperator **12** can be proportioned by means of a preceding slide valve **13** and measured by means of a meter **14**, for example. The excess gas not required by the recuperator is carried off to points of consumption via line **15**. Since the latter will not always require the same quantities of gas, and the demand must be adapted to operating conditions, any waste gas should be burned off. This is the function of the flare **16**, to which gas is admitted via a throttling means **17**. The throttling means is controlled by the pressure regulator **18**.

In smokeless operation of such a cupola furnace installation, the invention further provides means for dependable elimination of hazards that might arise from failures of any kind.

A radioactive level-control device **19** of known construction is located in the hollow interior of baffle **5**, far enough below the hopper to indicate when there is enough space within the baffle to receive a fresh load of charge. Associated signal boxes **20** with red and green lights are installed on the furnace platform and in the charging station. When the green light shows, the furnace must be charged, while the red light indicates that the baffle has been filled up to the permissible level.

Another radioactive level indicator **21** of known construction is installed below the baffle, at the extreme periphery of the throat. If the furnace charge, owing to a failure in the charging process, should subside to a level below the baffle **5** and consequently down to the

intake of the gas chamber, namely down to level 22, then this level indicator closes the bell valve 8 by means of a compressed air cylinder 23 actuated by a relay system 24 and two magnetic valves 25, 26 controlled by the level indicator.

Specifically, response of the radioactive instrument 21 actuates the two magnetic valves 25, 26 via relay 24 in such manner that magnetic valve 26 admits compressed air to the under side of the piston of cylinder 23, while magnetic valve 25 allows the air over the compressed-air cylinder to escape through line 27. When the trouble has been removed and baffle 5 has been filled once more, the two magnetic valves 25, 26 are switched by means of a manually operated pushbutton arrangement 28. Compressed air will then pass from magnetic valve 25 to above the piston of cylinder 23, while the air under the piston of the cylinder will escape into the open via magnetic valve 26 and its vent 29. In this way, the shut-off valve 8 is reopened when the normal charging process has been restored.

If the blower 30 supplying hot blast to the furnace via line 31, recuperator 12, line 32 and tuyeres 33 should fail, the blast pressure in the line 32 leading to the furnace will drop from about 700 mm. H_2O to zero. A pressure regulator 34 in the pressure line 31 of the blower will in that case likewise actuate the relay system 24, and this in turn the magnetic valves 25, 26. The operation of the compressed-air cylinder 23 actuating the shut-off valve 8 will then be the same as in the case previously described.

In the event of failure of the exhaust blower and/or disintegrator 2, the signal closing the shut-off valve 8 will likewise be transmitted by a pressure or diaphragm control 35 in the furnace gas line. As before, the shut-off valve 8 will be closed upon occurrence and opened upon correction of the failure in the manner described.

What we claim is:

1. A system for operating a cupola furnace, comprising a cupola furnace having an open throat, a bustle pipe and tuyeres, a water-cooled baffle in said throat, a duct surrounding said throat, a gas line connected to said duct, a purifier connected to said gas line, a cooler connected to said purifier, a gas-exhauster connected to said cooler, adapted to withdraw the furnace gas from said open throat with an intensity which is in equilibrium with the flow resistance of the charge within the said baffle, a recuperator for recuperating the gas upon its passage from said gas-exhauster and connected to the latter, an exhaust blower in said recuperator for forcing the preheated blast into the bustle pipe and thence into the

tuyeres of the cupola furnace, shut-off valve means in said gas line and automatic safety means for closing said shut-off valve, said safety means comprising indicators in said open throat, pressure-indicating means in the blast supplying line arranged between said exhaust blower and said bustle pipe, and pressure-indicating means arranged between said cooler and said recuperator.

2. Apparatus for open-throat operation of a cupola furnace, comprising a cupola furnace having a bustle pipe and tuyeres, a throat in said furnace, a water-cooled baffle in said throat, a duct surrounding said throat, a gas line connected to said duct, a purifier connected to said gas line, a cooler connected to said purifier in the path of gas which is being exhausted, a recuperator for recuperating gas upon its passage from said cooler and connected to the latter, an exhaust blower in said recuperator for forcing the preheated blast into the bustle pipe and thence into the tuyeres of the cupola furnace, a hot blast line connecting said blower with said bustle pipe, pressure regulating means in said line, shut-off valve means in said gas line, automatic safety means for closing said shut-off valve, said safety means comprising level indicators located at the periphery of the throat of the furnace for transmitting radioactive beams capable of acting upon an indicator in response to a deficiency in the charge of said throat, said means further comprising a relay and magnetic valve system adapted to be actuated by said radioactive beams, power cylinder means actuable by said relay and magnetic valve system for closing said shut-off valve and pressure-indicating means arranged between said cooler and said recuperator.

3. Apparatus according to claim 2 and an additional level indicator arranged at a point higher than the said periphery of the throat of the furnace and signal lights connected with said additional level indicator for indicating charging operations.

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