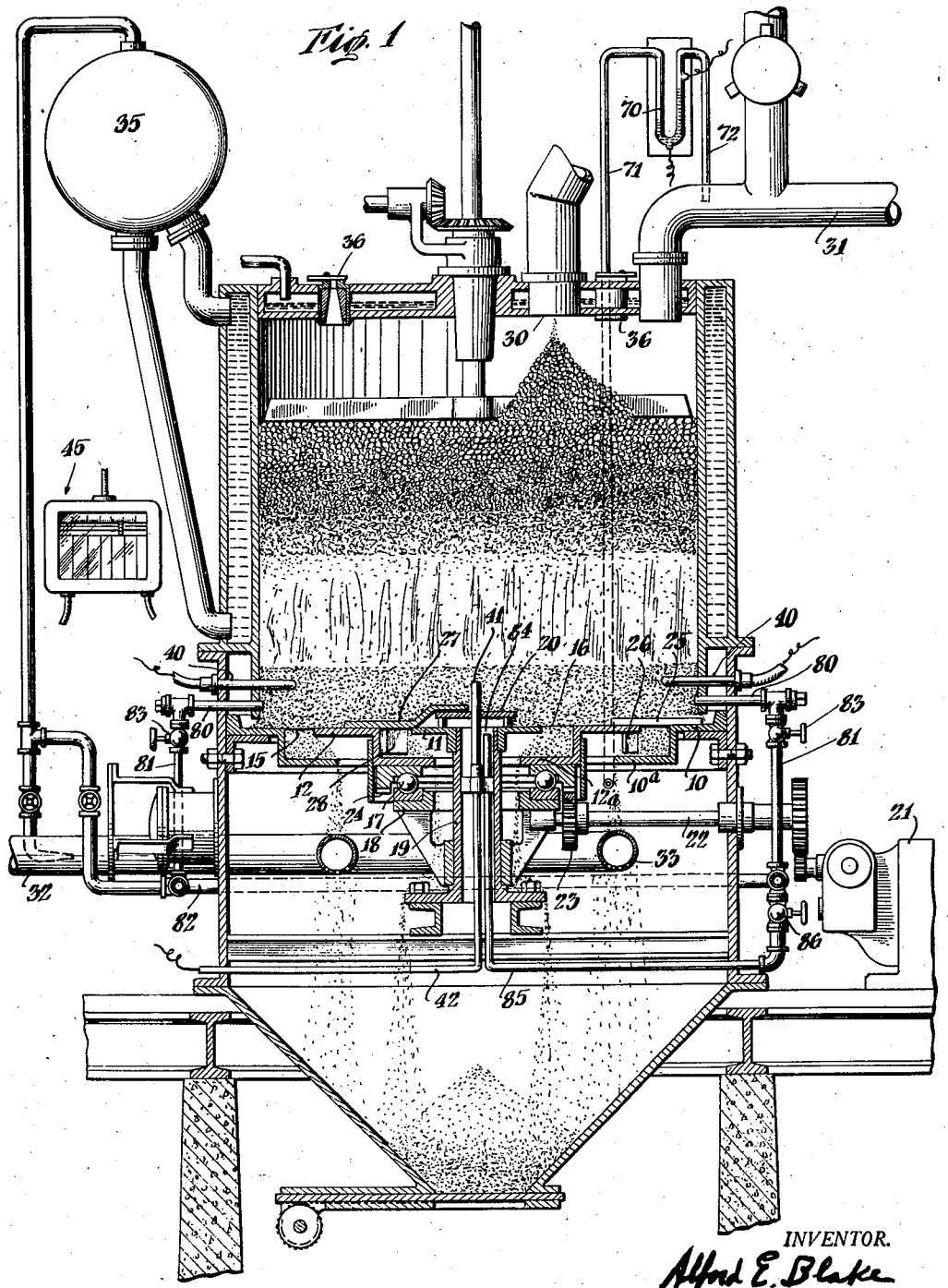
Aug. 7, 1945. A. E. BLAKE 2,381,200

GAS PRODUCER

Filed Jan. 22, 1943 2 Sheets-Sheet 1

Fig. 1



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Fig. 2

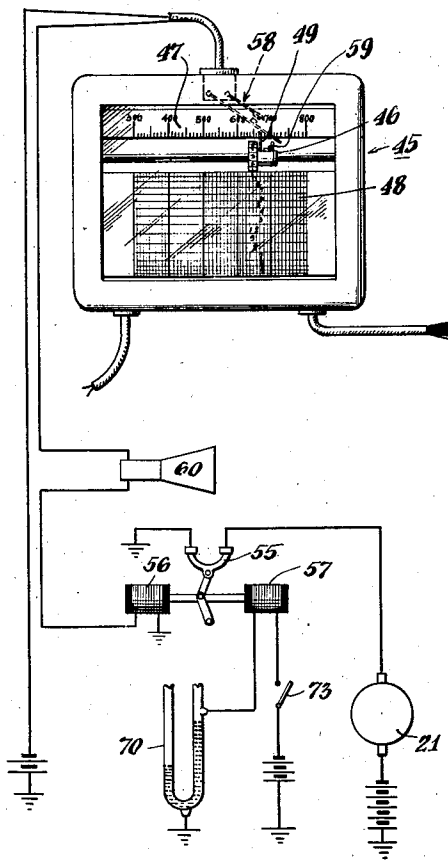
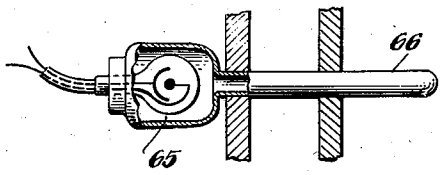


Fig. 5



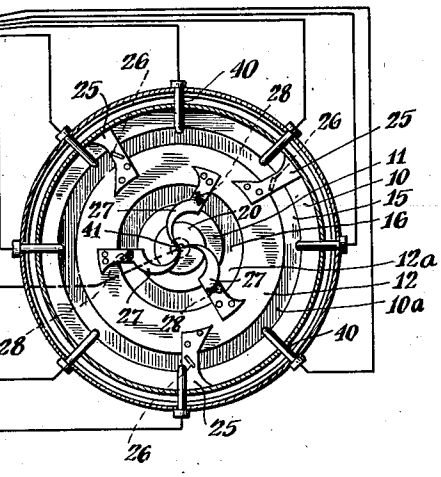


Fig. 4

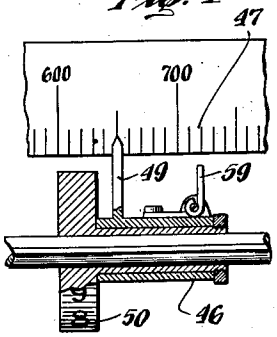
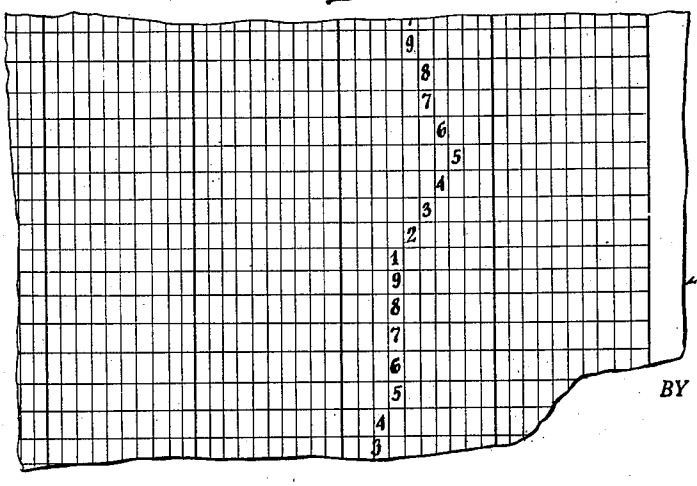


Fig. 3



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2,381,200

UNITED STATES PATENT OFFICE

2,381,200

GAS PRODUCER

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Application January 22, 1943, Serial No. 473,152

6 Claims. (Cl. 48—87)

This invention relates to gas producers. Objects of the invention are to avoid injury to the producer grate and to obtain a more uniform and continuous operation of the producer, to reduce the effects of carelessness and unreliability of operators, and to obtain maximum gas production with minimum fuel and power consumption and minimum labor.

The invention is especially intended for dry grate producers which use fuels of low volatile content, such as coke and anthracite coal, and which have mechanical grates, that is, grates which, or a part or parts of which, are movable for causing ashes to be discharged downward through the grate and are operated, either continuously or intermittently, by a suitable motor, usually an electric motor.

In the operation of such gas producers, it is necessary for best results and for protection of the grate that a layer of ashes of sufficient thickness be maintained on the grate between it and the hot burning fuel above. If the layer of ashes becomes too thin in any part, the grate is damaged by the excessive heat and may be so seriously damaged, even to the extent of being practically destroyed, as to allow uncontrolled flow of ash and fuel down through the grate, resulting in serious stoppage in the operation of the producer. It has been customary, therefore, in the operation of gas producers, to have the operator make tests at intervals to determine the thickness of the ash bed by opening poke holes in the top of the producer chamber and thrusting long pokers down through the poke holes and through the ash bed to the grate and leaving them there long enough for the portions in the combustion zone to become heated red hot. The thickness of the ash bed is then determined from the distance from the tip of the poker to the place where the poker has been heated red hot. If any part of the ash bed is found to be too thin, the grate motor is stopped for a time to permit the ash bed to increase in depth. This testing, heretofore necessary, takes considerable time and is an arduous operation, and it necessitates reducing the pressure in the producer chamber to a slight negative value before opening the poke holes to avoid gas leakage, and this results in contamination of the gas by partial combustion due to inflow of air.

The new invention provides means responsive to the temperature in the ash bed at a certain level above the grate whereby the operator is given information as to the thickness of the ash bed without having to make the poker tests, and whereby, if the temperature in any part of the ash bed at such level above the grate exceeds a certain maximum, the grate motor is stopped, and means whereby the motor is started again when the ash bed has been sufficiently increased. The invention includes the prevision of means for quickly cooling and at the same time increasing the thickness of a part of the ash bed which has become too thin, and means for giving an alarm to call the operator when the bed has a too thin part, and means for making a record of the temperature of different parts of the ash bed at the selected level.

A full understanding of the invention can best be given by a detail description in connection with drawings showing a gas producer embodying the various features of the invention, and such a description will now be given in connection with the accompanying drawings, in which—

Fig. 1 is a sectional view of a gas producer embodying the various features of the invention in the form now considered best;

Fig. 2 is a partly diagrammatic view showing a sectional plan of the furnace chamber of the producer taken on line 2—2 of Fig. 1, and the multiple record indicating and recording controller, and showing diagrammatically the motor stopping and re-starting means and the signal horn and the various electrical connections;

Fig. 3 shows a portion of a record sheet with suppositional record markings thereon;

Fig. 4 is an enlarged detail view, mostly in section, of a part of the multiple record controller; and

Fig. 5 is a detail view of an alternative temperature-responsive element.

Referring to the drawings, Fig. 1 shows a gas producer having a substantially flat stepped mechanical grate of the kind shown by Figs. 3 and 4 of my Patent No. 2,255,373. The grate has a stationary annular outer plate 10 which has a downwardly-offset inwardly-extending part 10*a*, a central plate 11 at the level of plate 10, and a concentrically revoluble annular plate 12 between and at the same level as and spaced from the plates 10 and 11, and which has a downwardly-offset inwardly-extending plate 12*a*. The width of plate 12 is less than the distance between plates 10 and 11, so that annular ash discharge openings 15 and 16 are left between the plates, and the lower plate 10*a* extends under the plate 12 and lower plate 12*a* extends under plate 11, so that ash dropping through the openings 15 and 16 will pile up on and remain on plates 10*a* and 12*a*. The plate 12 is mounted by means of a ball bearing 17 on an annular support 18 surrounding a central post 19 which carries the central plate 11. The post 19 is hollow, for a purpose which will be explained, and the opening at the top of the post is covered by a cap plate 20. The rotary plate 12 is driven by a small electric motor 21 through a shaft 22 and pinion 23 meshing with an annular rack 24.

Rotary plate 12 carries a plurality of circumferentially spaced arms 25 which extend over

the opening 15 and over the plate 10 and which carry each a rake, or plough, 26 extending down through opening 15; and plate 12 carries, also, a plurality of circumferentially spaced arms 27 which extend over the opening 16 and over plate 11 and over the cap plate 20 and which carry each a rake, or plough, 28 extending down through the opening 16. As explained in my Patent No. 2,255,373, the ploughs push ashes from the plates 10a and 12a and the arms act to move ashes on the plates 10, 11 and 12 toward the openings 15 and 16, so that by rotation of plate 12 the ashes are caused to be fed gradually downward through the grate to fall into the ash pit. The rate of ash discharge depends on the speed at which the plate 12 is rotated, and the rate of discharge determines the depth of the ash bed maintained on the grate.

The producer chamber has the usual water-jacketed walls, a fuel feed opening 30 in its top wall, a gas take-off pipe 31 leading from an opening in the top wall, and a pipe 32 through which a mixture of air and steam is supplied to be discharged into the ash pit from discharge holes in a circular pipe 33 mounted beneath the grate. A blast of heated air is supplied to the pipe 32 from a suitable source, and steam from a steam drum 35 connected to the top and bottom of the producer chamber water-jacket, or from other source, is supplied to the pipe 32 as usual to form the proper air-steam mixture. The top chamber wall is shown as having the usual normally closed poke-hole fittings 36.

The producer furnace is provided with a plurality of thermo-couple pyrometer tubes 40 mounted to extend through the furnace wall into the ash bed space at points spaced circumferentially and at a distance above the grate to be somewhat below the normal level of the top of the ash bed. If the ash bed is to be maintained with a thickness, or depth, of about 9 inches, the pyrometer tubes are most desirably set at about 7 inches above the grate, but the level above the grate of the tubes may be more or less than 7 inches within a considerable range according to the normal depth of the ash bed and the characteristics of the thermo-couple tubes or other temperature-responsive elements used. An additional pyrometer tube 41 is mounted within the hollow post 19 to extend up through the cap plate 20 to measure the temperature at a middle point of the ash bed. The conductors from this tube, extending down through the post into the ash pit and out through the side wall of the pit, are protected by a tube 42.

The conductors from each of the tubes 40 and from the tube 41 lead to a multiple indicating and recording potentiometer controller 45 having a member 46 which is moved along a temperature marked scale 47 and over a correspondingly marked record sheet 48 under control of each of the several pyrometer tubes in sequence in successive time periods. The member 46 carries a pointer 49 for indicating the temperature on a scale 47 and a printing wheel 50 which has numerals or other characters indicating the several pyrometer tubes and is turned for each movement of member 46 to bring into printing position the character indicating the tube under control of which member 46 has made that movement, a printing movement being then effected to press the positioned character against the chart. The temperatures measured by the several tubes are thus indicated by the pointer and recorded on the chart in sequence in each successive time period, the chart being given a suitable forward feeding movement. Such multiple indicating and recording controllers are well known instruments and are made by several established concerns. As the instrument in and by itself forms no part of the present invention, it needs no further description.

When any one of the pyrometer tubes is subjected to a temperature above a certain predetermined maximum, the circuit to the grate motor is opened by means actuated by the controller member 46 when the member is moved to a position corresponding to such maximum temperature. For this purpose, as shown by Fig. 2, the circuit to the grate motor includes a toggle-operated switch 55 which is opened by the energization of a solenoid 56 and is closed by the energization of a solenoid 57. The circuit to the switch-opening solenoid 56 includes a normally open switch 58 mounted on the controller 45 in position to be engaged by and closed by a finger 59 extending from the member 46 when the member 46 has been moved to the position corresponding to said maximum temperature. The finger 59 is a one-way trip finger, being pivotally mounted on the member 46 and free to turn to the right as viewed in Figs. 2 and 4, so that if it has been moved beyond the engaging member of the switch 58 it will when it strikes the switch member on return movement of member 46 swing away from the switch member and down so as to pass beneath it. The switch 58 is, as shown in Fig. 2, pivotally mounted so as to permit the finger 59 to pass on beneath it in its forward movement, and it is adjustable lengthwise of the scale for varying the temperature at which the operation of the grate motor is stopped.

An electrically operated horn or other sound signal device 60 is connected in the circuit to solenoid 56 so that a sound signal will be given whenever the circuit is closed to cause the motor circuit to be opened.

The ash bed temperature measured by the pyrometer elements at which the grate motor is stopped and the signal horn operated depends on the position of the switch 58. The normal operating temperature in the ash bed at the level of the pyrometer tubes is usually about 400° to 500° F., and the switch should be set for a temperature somewhat above the normal temperature of the ash bed at the level of the tubes but not above about 800° F.

There is thus provided means responsive to the temperature of the ash bed at a certain level above the grate for indicating both visually and audibly when the temperature at any one of a plurality of points within the ash bed at such level exceeds a certain maximum, and means for recording the temperatures at such points within the ash bed in successive time periods, and means for stopping the grate motor when the temperature at any one of such points within the ash bed exceeds a certain maximum. The operator will be notified by the sound signal or may see from the scale indicator or from the record sheet when the temperature at any of the measuring points in the ash bed has reached the predetermined maximum, which will indicate to him that the bed at and near some point in the bed is too thin, and the chart record will show him which particular part of the ash bed is too thin. The operator would then know that the operation of the grate should be stopped so that the ash bed would then build up in thickness. The apparatus operates, however, to stop the

grate motor automatically at the same time that the danger signal is sounded. If, therefore, the operator should for any reason not act promptly in response to the signal, the operation of the grate will nevertheless be stopped, thereby preventing further thinning of the ash bed and increase of its temperature toward the grate, and permitting the building up of the bed.

Heat responsive elements, or devices, other than thermo-couple tubes may of course be used, and in Fig. 5 there is shown an alternative current-generating device comprising a photo-electric cell **65** mounted at the outer end of a tube **66** of a suitable heat resisting material which may be mounted to extend through the furnace wall into the ash bed like and instead of the tubes **40** in Fig. 1. The cell developes a small electric potential when subjected to radiation from the closed inner end of the tube, which may become heated to low incandescence.

The invention includes, also, means whereby the grate motor will be again started in operation when the too thin portion of the ash bed has, because of non-operation of the grate, been built up to a suitable thickness. This restarting of the motor is effected by taking advantage of the difference between the pressure in the ash pit and the pressure in the upper part of the producer chamber or in the gas take-off, when there is no too thin portion of the ash bed. For this purpose, a manometer **70** is provided containing an electricity-conducting fluid such as mercury and having one arm connected to the producer ash pit as by tube **71** and the other arm connected by tube **72** to the gas take-off pipe **31**. The manometer tube has two electrical contact terminals extending through the tube wall, one at the bottom of the tube and one in its low pressure arm at a suitable height according to the pressure difference at which it is desired that the grate shall be started in operation. These contact terminals are connected in circuit with the switch closing solenoid **57**. The circuit to the grate motor will, therefore, by operation of this solenoid be closed when the ash bed has been built up sufficiently to cause a drop in pressure from the ash pit to the take-off pipe such as will raise the mercury to the contact terminal in the low pressure arm of the manometer. A hand switch **73** is desirably provided in the circuit to the solenoid **57** so that the operator can, if he desires, open this circuit to prevent the restarting of the grate motor.

It is sometimes desirable, if the overheating at any one or more stations in the ash bed is serious, or under a heavy load condition, to correct the condition of the ash bed quickly without waiting for the bed to build up following stopping of the grate. To provide for such quick reduction of excessive temperature in any part of the bed, the producer furnace is, in accordance with the invention, provided with a plurality of steam discharge nozzle pipes **80** mounted adjacent to the pyrometer tubes **40** to discharge steam jets into the ash bed. Each of these nozzle pipes **80** is connected by a pipe **81** to a steam header pipe **82** extending about the ash pit wall and to which steam is supplied from the steam drum **35** or from other suitable source, and each pipe **81** has a shut-off valve **83**. A nozzle pipe **84** is also provided extending up through the hollow post **19** to discharge a jet of steam into the middle portion of the ash bed adjacent the pyrometer tube **41**, and this nozzle **84** is connected to the header pipe **82** by a pipe **85** containing a control valve **86**. By opening one or more of the valves **83** or the valve **86**, steam may be discharged into a portion or portions of the ash bed where the temperature has been shown to be too high, and such selective application of steam, due to its endothermic reaction with the fuel, will result in a very rapid cure of the overheated condition.

It is to be understood that the invention is not to be limited to the illustrative apparatus shown, but that it includes changes in and modifications thereof within the claims.

What is claimed is:

1. In a gas producer having a flat grate of the dry, mechanical type and means to operate the grate to continuously discharge ashes therethrough, the improvement which comprises means to maintain an ash bed of determined thickness over the grate, said means comprising means to continuously measure the temperature of the ash bed at a plurality of points at the same horizontal level above the grate, means actuated by said temperature measuring means at a determined maximum temperature measured at any one of said plurality of points to de-energize said grate operating means, means continuously measuring the pressure differential between the ash pit space below the grate and the space above the fuel bed on the grate, and means actuated by said pressure differential measuring means at a determined maximum pressure differential measured thereby to re-energize the said grate operating means.

2. In combination with the improvement of claim 1, manually operative means to inject a cooling gas at any one of a plurality of points within the ash bed lying in the space between the temperature measuring means and the grate.

3. In combination with the improvement of claim 1, a signal means actuated by said temperature measuring means to audibly indicate operation of said means to de-energize the grate operating means.

4. In combination with the improvement of claim 1, a means actuated by said temperature measuring means to visually record the temperature being continuously measured at each of said plurality of points by said temperature measuring means.

5. In a gas producer, the combination of a flat mechanical grate, means actuating said grate to discharge ashes therethrough, means continuously measuring the temperature of the ash bed on the grate at a plurality of points at a determined horizontal level above the grate, means continuously recording the temperatures measured by said temperature measuring means, means actuated by said recording means at a predetermined maximum temperature at any one of said plurality of points to de-energize the said grate actuating means, means to simultaneously actuate an audible signal means, means continuously measuring the pressure differential between the ash pit space below the grate and the space above the fuel bed on the grate, and means actuated by said pressure differential measuring means on the measuring of a predetermined maximum pressure to re-energize said grate actuating means.

6. The combination of claim 5, wherein in combination therewith means to inject a cooling gas at any one of a plurality of points in the space gap between the grate and said temperature measuring means, are provided, said means being selectively operative manually.

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