Jan. 9, 1945. P. A. ASTRADSSON 2,367,165

COMBUSTION DEVICE FOR SOLID FUELS RICH IN GASES

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Fig. 1.

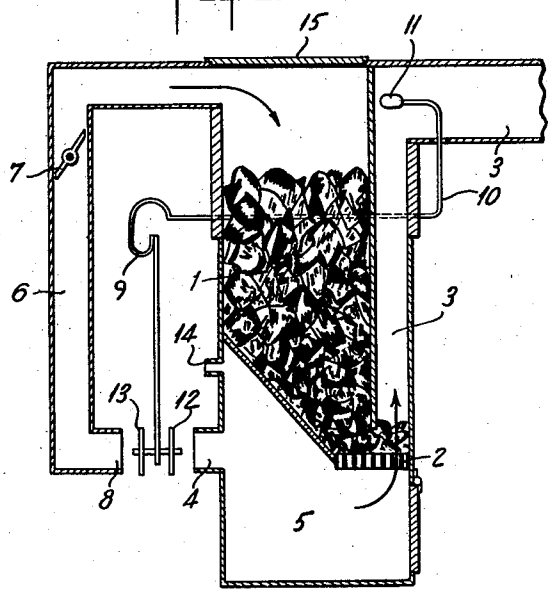


Fig. 2.

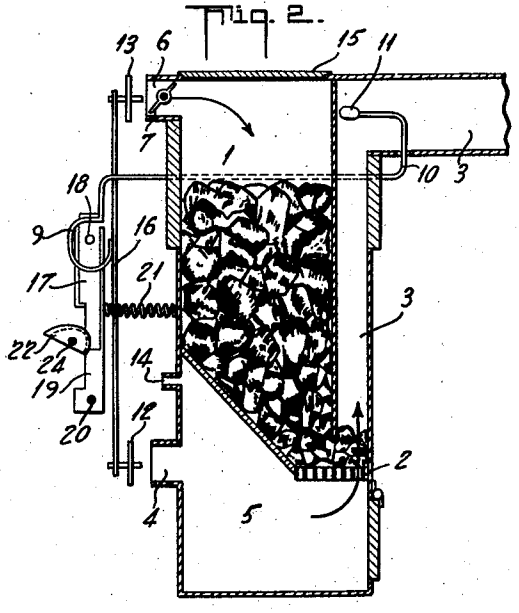
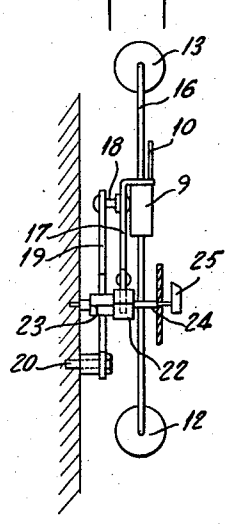


Fig. 3.



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COMBUSTION DEVICE FOR SOLID FUELS RICH IN GASES

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3 Claims. (Cl. 236—95)

This invention relates to a combustion device for solid fuel rich in gases and more particularly to a thermostatic regulating device for regulating the admission of secondary air in dependence of the temperature of the combustion gases.

In combustion of solid fuels rich in gases, the combustion air is generally conveyed partly to the solid fuel (primary combustion air) and partly to the gases escaping from the burning fuel (secondary combustion air). The amount of combustible gases generated from the fuel mainly depends on the production of heat from the layer of fuel, and a certain regulation of the production of gas in the furnace is therefore possible by regulating the primary air supply. There is some lag, however, so that the generation of gas goes on even after the primary air supply has been shut off. Since the reactions in the generation of gas are chiefly exothermic, the disaggregation of the fuel might even go on until entirely completed. These circumstances make the regulation of the combustion device difficult. If, for instance, the combustion device is continuously burning with a combustion corresponding to a certain heat requirement and a reduced production of heat is required, this cannot be carried out without difficulties. If the supply of primary and secondary air is reduced in proportion to the reduced heat requirement, then the amount of air supplied will not be sufficient for a complete combustion of the fuel gases which might still be produced in the same amount. If, on the other hand, only the primary air supply is reduced and the secondary air supply is unaltered, conditions for combustion will be suitable to begin with, but if the production of gas is gradually reduced there will be an excess of air and consequently an increase in the losses. In order always to obtain the most favourable combustion conditions, the supply of secondary air must be regulated in an intelligent way. This, however, means skilled people for attendance and care of the combustion device and expensive apparatus for controlling the firing.

The present invention refers to simple means for an automatic regulation of the secondary air supply, so that such air will always be supplied in suitable quantities. The invention is based on the idea of letting a tendency to alteration of the excess of air give an impulse to the air-regulating members to the effect that this alteration is counteracted. In practice there is always some excess of air. An alteration of the quantity of gas escaping from the fuel entails, at a constant supply of air, an alteration of the excess of air. If the quantity of gas increases, the excess of air will decrease, and conversely, if the quantity of gas decreases, the excess of air will increase. Further, if the excess of air increases, the temperature of the combustion gases decreases. The means by which the regulation of the air supply is attained according to the present invention, must thus influence the supply of air in such a way as to restore the original excess of air, that is a decrease of the air supply. For this purpose the combustion device according to the present invention is provided with a thermostatic device so arranged as to reduce the quantity of secondary air at a decreasing temperature of the combustion gases. It is also possible to use this thermostatic device for the purpose of regulating the primary air supply in an ordinary way, so that this increases when the temperature of the combustion gases decreases.

In the following the invention will be more fully described with reference to the accompanying drawing, diagrammatically illustrating two embodiments.

Fig. 1 is a cross section of a cooking stove, fragmentarily shown.

Fig. 2 is a similar cross section as Fig. 1 but with modified air regulating means.

Fig. 3 is the air regulating details in side view.

In Fig. 1 the fuel chamber 1 of the stove is provided at the bottom with a grate 2. The gases generated from the fuel leave the fuel chamber at its bottom part and pass into a flue 3 leading to a chimney. When entering into this flue, the gases meet secondary air which is sucked in by the draft, through an inlet 4, an ash pit 5, and the grate 2.

Primary air is supplied to the fuel chamber in its upper part through a duct 6, in which is arranged a damper 7. The inlet 8 of the duct 6 is situated in front of the inlet 4. A thermostatic device of well-known type is composed of a Bourdon tube 9 connected to a receptacle 11 by means of a tube 10. These parts form a closed system containing fluid. The receptacle 11 is located in the flue 3. The free end of the Bourdon spring tube carries two valve discs 12 and 13, located in front of the secondary and primary air inlets 4 and 8, respectively. The thermostatic device is arranged between the air inlets 4 and 8 in such a way that, when the Bourdon spring tube expands, the valve disc 12 withdraws

from the secondary air inlet 4 while the valve disc 13 approaches the primary air inlet 8.

The upper parts of the fuel chamber and the flue 3 are arranged in good heat-conducting connection with a hot plate 15. On the other hand, the bottom part of the fuel chamber should be in poor heat-conducting connection with the hot plate, or even surrounded by heat insulation, thus making it possible to maintain combustion in the bottom part of the fuel chamber with slight losses when the stove is idle. For this purpose, the grate 2 is arranged in such a way, that the secondary air also touches the fuel that is lying on the grate in the bottom part of the fuel chamber and which has evolved its gas. Further, a special opening 14 is arranged in the ash pit wall for the supply of a slight volume of secondary air even when the valve disc 12 completely closes the inlet 4.

When the stove is cold, the valve disc 12 is in the latter position that is, closing inlet 4. When lighting a fire in the stove, fuel, such as wood, is put in the fuel chamber and the damper 7 should be opened. When the fuel has been ignited, combustion is first sustained by the primary air entering through the inlet 6 and the slight amount of secondary air that enters through the opening 14. When the combustion gases have reached a certain temperature, the valve disc 12 is, however, moved by the thermostat from the orifice of the inlet 4, so that plenty of secondary air is supplied. The valve disc 13, however, still leaves the inlet 8 almost entirely open so that also plenty of primary air enters. The combustion is then rapidly increased and the temperature in the flue 3 rises, actuating the thermostat so that the valve disc 13 gradually closes the primary air inlet 8. If the temperature in the flue 3 increases too much, the inlet 8 will be substantially closed, thus diminishing the combustion in the fuel chamber and also the generating of gas. By means of the thermostat, the combustion will thus be so regulated that a certain temperature is maintained in the flue 3. When the evolution of gas is nearly completed, the combustion, then mainly limited to the fuel chamber, is unable to maintain this temperature in the flue 3. The valve disc then gradually opens the inlet 8 for the primary air, and the combustion of the fuel, void of gas, increases. At the same time the valve disc 12 approaches the inlet 4, thus reducing the supply of secondary air in proportion to the reduced evolution of gas.

If more fresh fuel is supplied, the evolution of gas from the fuel commences immediately, a rapid combustion of gases takes place again in the flue 3, and the temperature there will rise considerably. The thermostat will then again limit the supply of primary air to the value necessary for maintaining normal temperature in the flue 3, simultaneously increasing the supply of secondary air.

When the stove is no longer to be used, the damper 7 should be shut, so that the supply of primary air ceases. Secondary air will, however, still be supplied to the full extent, and the gases formed in the fuel chamber will thus still be completely consumed. The evolution of gas ceases gradually, however, and the temperature in the flue 3 falls. The consequence of this is that the thermostat reduces the air supply through the inlet 4. It is suitable to adjust the thermostat in such a way that the valve disc 12 completely shuts the inlet 4 when the evolution of gas has completely or nearly ceased. Air will then only enter through the orifice 14 and to such an extent that it is only just sufficient for maintaining combustion of the fuel in the bottom part in such a degree that the fuel is maintained at ignition temperature.

In the embodiment as shown in Figs. 2 and 3 the orifices of the inlets 4 and 6 face in the same direction and the valve discs 12 and 13 are supported by a thermostat rod 16. The Bourdon spring tube 9 is placed on a lever 17 journalled on a pin 18, which is fixed to one end of another lever 19, the other end of which is journalled on a bolt 20 firmly screwed into the stove. The free end of the lever 17 is urged by a spring 21 against an eccentric 22 and the said spring also presses the other lever 19 against an eccentric 23. The eccentrics 22 and 23 are firmly fixed to a turnable spindle 24, which may be turned by means of a handle 25 located on the outside of the stove to adjust the eccentrics. The dimensions of these eccentrics are such that when turning the eccentrics, the thermostat rod 16 and the valve discs 12 and 13 receive a parallel movement. By means of this construction an adjusting of the handle 25 alters the neutral position of the thermostat, that is the temperature at which the thermostat valve discs completely close the air inlets 4 and 6. This is impossible with the construction according to Fig. 1.

While I have shown my invention applied to a cooking stove, it is to be understood that this has been done for purposes of illustrating only, and that the scope of my invention is not to be limited thereby, but the invention is to be applicable to any combustion device.

What I claim is:

1. In a combustion device for burning solid fuels rich in gases, a combustion chamber, means for supplying primary air for supporting combustion of said solid fuel in said chamber, means for supplying secondary air for supporting combustion of gas evolved from said solid fuel, a flue for conveying products of combustion from said combustion chamber, and thermostatic means disposed in heat-exchange relation to said products of combustion responsive to a given decrease in the temperature of said flue gases for decreasing the quantity of secondary air while maintaining the quantity of primary air substantially constant and responsive to an increase in said temperature for decreasing the quantity of primary air while maintaining the quantity of secondary air substantially constant.

2. In a combustion device for burning solid fuels rich in gases, a combustion chamber, means for supplying primary air for supporting combustion of said solid fuel in said chamber, means for supplying secondary air for supporting combustion of gas evolved from said solid fuel, a flue for conveying products of combustion from said combustion chamber, thermostatic means disposed in heat exchange relation to said products of combustion and a controller actuated by said thermostatic means to increase the flow of secondary air as the temperature of the products of combustion increases while maintaining maximum flow of primary air and to decrease the flow of primary air while maintaining the maximum flow of secondary air after a predetermined temperature of the products of combustion has been released.

3. In a combustion device for burning solid fuels rich in gases, a combustion chamber, means for supplying primary air for supporting combustion of said solid fuel in said chamber, means for

supplying secondary air for supporting combustion of gas evolved from said solid fuel, a flue for conveying products of combustion from said combustion chamber, thermostatic means disposed in heat exchange relation to said products of combustion and a controller actuated by said thermostatic means to increase the flow of secondary air as the temperature of the products of combustion increases while maintaining maximum flow of primary air and to decrease the flow of primary air while maintaining the maximum flow of secondary air after a predetermined temperature of the products of combustion has been reached, said means being further operable to simultaneously increase primary air flow and decrease secondary air flow and to simultaneously decrease primary air flow and increase secondary air flow.

PER ANTON ÅSTRADSSON.