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(54) **Improvements relating to furnaces.**

(57) The invention relates to a solid fuel furnace having a fixed grate and a grate mounted within the furnace chamber to rake the ash and fuel mechanically to remove clinker from the grate.

The grate may be raked in strips by either one rake movable transversely or a plurality of separate rakes. Alternatively, the rake may be the full width of the grate and controlled to move the ash and live fuel by discreet increments.

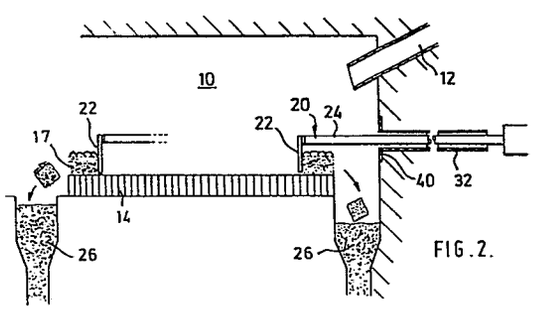

FIG.2.

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IMPROVEMENTS RELATING TO FURNACES

This invention relates to furnaces and in particular to the removal of ash from the grate of solid fuel furnaces.

At present, ash is removed from the grate of such a furnace either by manual raking or by using a travelling, reciprocating or vibrating grate to cause the ash to travel along or through the grate into an ash receiving space.

One known prior art device is the so-called travelling grate stoker. In this device, coal is fed on to a travelling grate and once the coal reaches the grate it is ignited from its top surface by radiation from above. The coal then burns down from the top surface and under ideal conditions, the coal is completely burnt when the end of the grate is reached. The ash then drops off the grate into an ash bed laying beneath the end of the grate. The ash is removed from the furance on a conveyor or by means of a screw.

Another known device is the so called drop tube or front spread fixed grate stoker. In this device, the grate is fixed and coal is fed from above. The burner system is automatic in operation for up to twelve hours, but after this time, the ash has to be removed manually from the grate.

A further known device which also requires the

manual removal of ash is a so called coking stoker. Coal is pushed into the furnace by a ram and is moved down the furnace by cam driven movement of the grate bars.

In accordance with a first aspect of the present invention, there is provided a solid fuel furnace having a fixed fuel grate, a mechanical rake and a control mechanism for moving the rake relative to the grate to displace the ash and fuel on the grate.

Preferably, the operation of the control mechanism is automatic and takes place periodically.

In accordance with a second aspect of the present invention, a solid fuel furnace comprises a grate, a mechanical rake for displacing the ash on the fuel bed or the grate and means for controlling the rake to displace a first section of the bed on the grate by an increment and subsequently to displace successive sections by a corresponding increment, each section thereby occupying a position on the grate vacated by the previously displaced section.

Various embodiments of the invention will now be described by example, with reference to the accompanying drawings, in which:

Figure 1 is a section through a furnace burning solid fuel;

Figure 2 is a section through a furnace embodying the present invention;

Figures 2a and 2b show plan views of modified rakes incorporating side blades;

Figure 3 is a schematic diagram showing air cooling of the mechanically operated rake;

Figure 4 is a section through a further embodiment of the invention; and

Figure 5 is a horizontal section through a furnace illustrating one method of operating the rake in an embodiment of the invention.

Figure 1 shows a typical firebed after some hours running without de-ashing. Solid fuel, usually coal, is fed into the furnace 10 by a feed tube 12 which may be in any position in the furnace wall but is illustrated as entering the furnace in the top right hand corner as viewed. The coal is fed onto a grate upon which it is mixed with combustion air and burnt. In Figure 1, it can be seen that if the firebed runs without de-ashing, a considerable layer 16 of ash builds up on the grate and a thinner layer 18 of coal rests on top of the ash layer 16. The ash builds up in depths at more or less the same rate over the entire length and width of the grate.

Figure 2 shows how a mechanical rake, generally designated 20 and comprising a rake blade 22 and a rake

boom 24 may be used to remove ash from the grate 14. The rake 20 may pull, as shown in the right hand portion of Figure 2, or push as shown in the left hand portion of Figure 2, the fuel and ash bed 17 along the grate into an ash receptacle 26. The ash may be subsequently removed from the receptacle 26 by manual, mechanical, hydraulic or pneumatic means.

The rake 20 may be operated in any of a variety of ways. In a first method of operation, the rake may simply move the fuel and ash bed 17 progressively down the grate. In a second alternative mode, the rake may be used to move the live fuel to the back or the front of the grate, then rake out the whole of the ash, and then redistribute the live fuel evenly on the grate.

In a further alternative, the whole of the ash and live fuel may be raked out. In this case, the rake may be arranged to rake the fuel and ash bed in strips longitudinally along the grate by subdividing the rake into small sections whereby when new fuel is placed on the grate it can be reignited from the adjacent sections.

The rake 20 may have a plane end as shown in Figure 2, or it may be bucket shaped to prevent sideways movement of the ash. Preferably, the rake blade 22 is pivoted along its length to provide a variable incidence or penetration into the ash and fuel bed and to allow the blade to be pivoted so as to pass above the fuel and ash bed without disturbing the bed when desired.

Such an arrangement of a pivoted blade is shown in Figure 4. The blade may be pivoted around pivot 30 to vary the angle of incidence of the rake blade on the fuel and ash bed.

Figure 2 also shows the guide system for the rake boom 24. The Figure shows a simple tubular guide system 30 and the boom 24 may be driven mechanically, pneumatically or hydraulically.

Depending upon the width of the grate, one, two or more rakes 20 may be employed in the furnace 10. Alternatively, the rake 20 may be driven or manually repositioned sideways to avoid the use of multiple rakes. The furnace 10 may be pressurised, or may operate at atmospheric or sub-atmospheric pressure.

The mechanical rake system may be air, gas or liquid cooled in order to be able to withstand the high temperatures within the furnace 10.

Figure 3 shows an air cooled blade and boom. A cooling air inlet 34 is provided in the boom 24 and the air runs along the boom, into the blade 22 and passes from the lower end of the blade 22 onto the grate 14. As an alternative to such cooling, the rake system may be made from heat resistant material.

It is an advantage if only a small part of the ignited fuel bed is removed from the furnace at one time,

since if most of the fuel bed remains, new fuel being deposited on the bed can be ignited.

A system for incremental removal of the ash from the furnace is illustrated in Figure 5. In this system the rake 20 periodically completes a cycle as follows:

(1) The last, thickest increment of ash, which is located in a burn out zone 36, is pulled into the ash receptable 26.

(2) The rake boom 24 advances and pulls the next increment of ash and fuel into the burn out zone 36.

(3) The rake 20 progressively works down the grate moving each increment of ash and fuel along the grate by one increment.

A variable incidence rake blade, as described above with respect to Figure 4, permits the blade to be lifted over ash undisturbed as the rake advances. It is to be noted that such an incremental system of ash removal could be used at the other end of the grate 14, in which case the rake will act upon the ash increment by pushing rather than pulling.

Another feature of the variable incidence blade described in respect of Figure 4 is that movement of the ash and feed bed 17 is permitted to produce desired movements and levels in the bed.

Alternative sequences of operation include lateral movement of the ash either by sideways movement of the whole rake and boom or the attachment of variable end fixed incidence side blades to the rake end fixed either to the blade 20 or boom 24. Such side blades (41) are shown in Figures 2a and 2b. In Figure 2b the side blades 41 are fluid cooled. By the adoption of these

variations it is possible to move some or all of the ash into a centre prior to longitudinal raking to remove the ash from the furnace.

Yet another variation would allow the rake to rotate on its axis by 90 degrees so that the incidence of the blade would provide a sideways component to the ash. By these methods the ash may be removed through a narrow exit which is advantageous in furnace applications.

The above described embodiments may be varied in a number of other ways within the scope of the invention. For example, the rake boom 24 may be telescopic to reduce the space requirements of the system.

Another feature is that the rake may be provided with a roller which keeps the rake at a prescribed distance above the grate.

Another feature of the invention is that the whole boom 24 could be pivoted at the entrance 40 to the furnace. Utilising this feature, the whole rake could be pivoted and raised above the ash and fuel bed 17.

CLAIMS

1. A solid fuel furnace comprising a fixed fuel grate, characterised by a mechanical rake (20) and a control mechanism for moving the rake relative to the grate to displace the ash and fuel on the grate.

2. A solid fuel furnace as claimed in Claim 1 wherein the rake comprises a boom (24) and a blade (22) connected to the end of the boom, the boom being reciprocable parallel to its longitudinal axis.

3. A solid fuel furnace as claimed in Claim 2 wherein the rake (20) comprising the boom (24) and blade (22) is additionally movable transversely of the longitudinal axis of the boom to enable the grate to be raked in parallel strips.

4. A solid fuel furnace as claimed in Claim 2 comprising a plurality of rakes (20) each comprising a boom and a blade and each operative to rake a respective strip of the grate.

5. A solid fuel furnace as claimed in Claim 2, wherein the blade extends across the width of the grate and the control mechanism is operative to control movement of the rake such that the blade advances the ash and live fuel on the grate by increments each increment being displaced to occupy the position vacated by the last increment to be moved (Figure 2).

6. A solid fuel furnace as claimed in any of Claims 2 to 5, wherein the blade (22) is flat.

7. A solid fuel furnace as claimed in any of Claims 2 to 5, wherein the blade (22) is bucket shaped.

8. A solid fuel furnace as claimed in any of Claims 2 to 7, wherein the blade (22) is pivotable relative to the boom (24) whereby to enable the height of the blade above the grate to be adjusted (Figure 4).

9. A solid fuel furnace as claimed in any of Claims 2 to 8 wherein the or each blade (22) is cooled by a flow of gas.

10. A solid fuel furnace as claimed in any preceding Claim, wherein the or each rake (20) is guided by rollers to remain at a prescribed height above the grate.

11. A solid fuel furnace as claimed in any preceding Claim, wherein the or each rake (20) is rotatable about its own axis to vary the degree of penetration of the blade into the ash and fuel.

12. A solid fuel furnace as claimed in Claim 2 wherein the boom arm (24) is pivoted to enable the blade to be raised and lowered relative to the grate.

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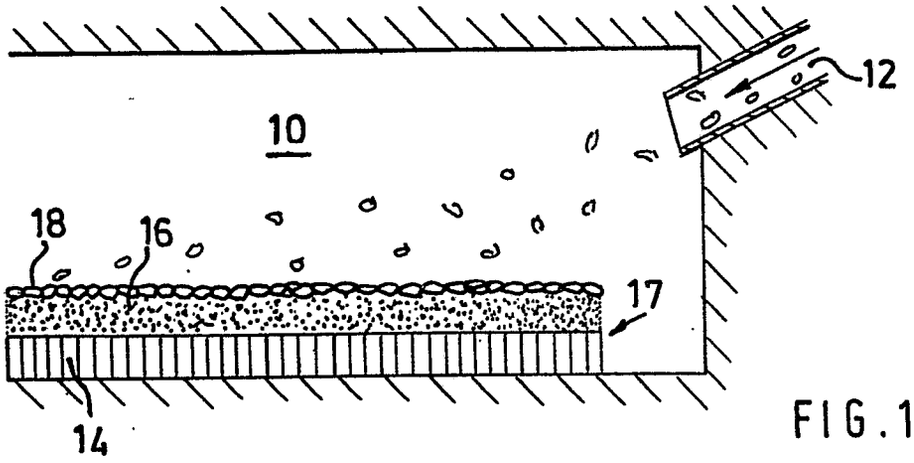

FIG.1.

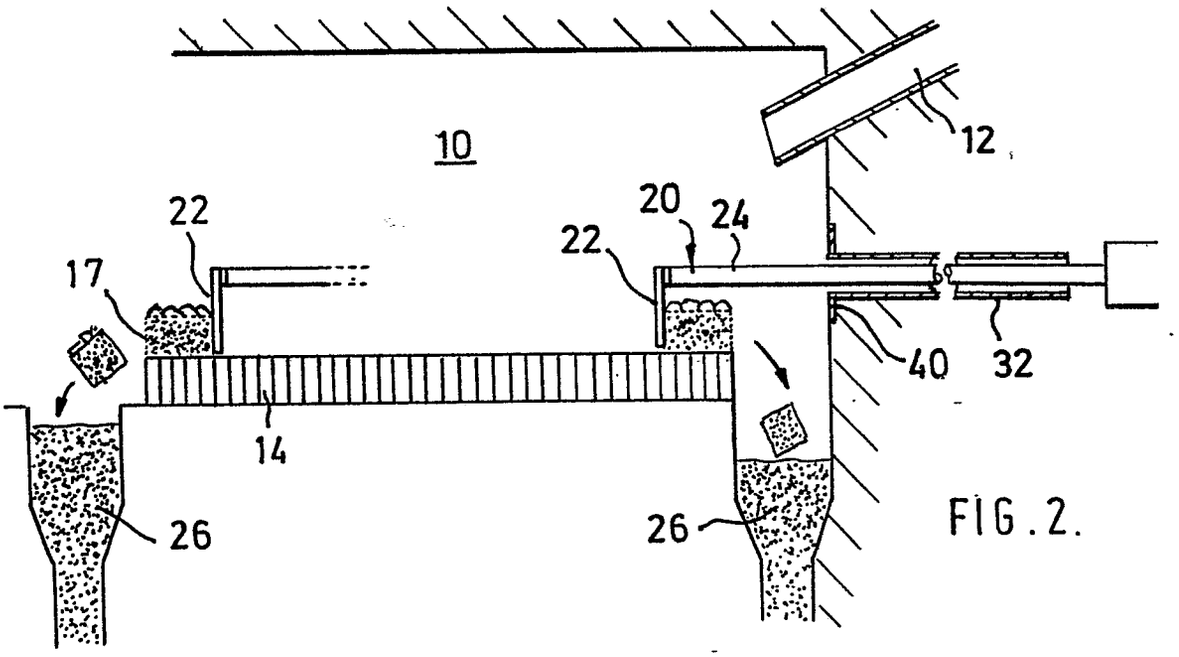

FIG.2.

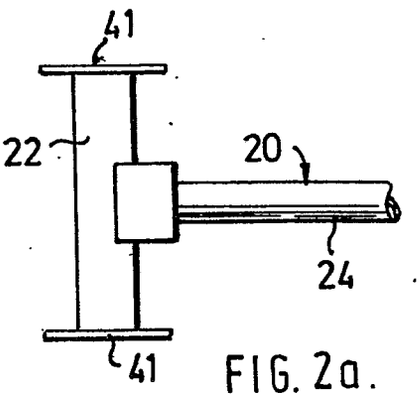

FIG.2a.

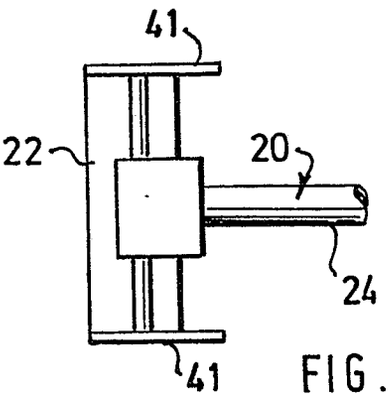

FIG.2b.

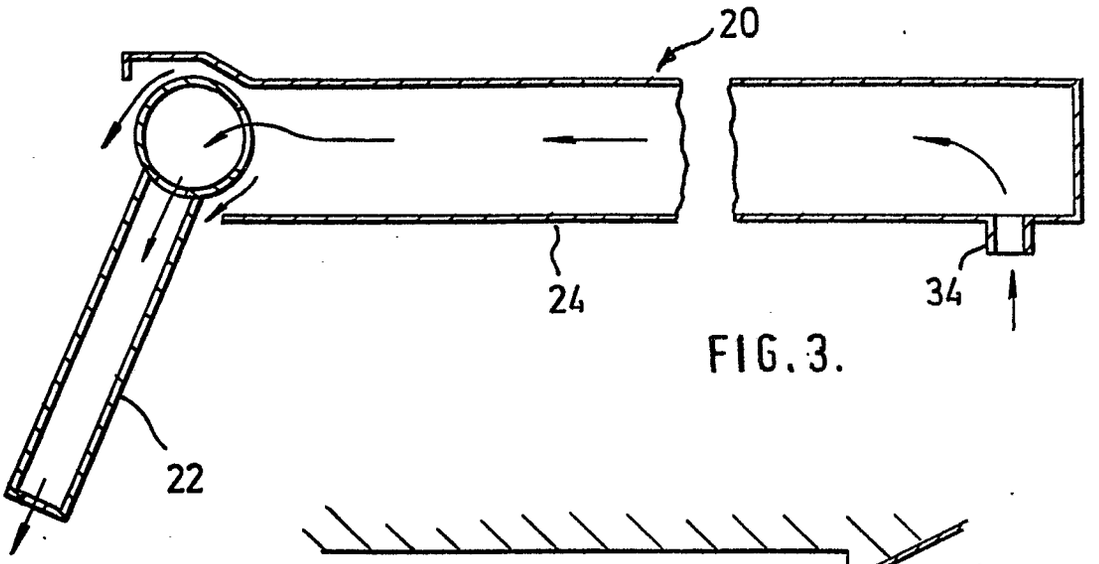

FIG.3.

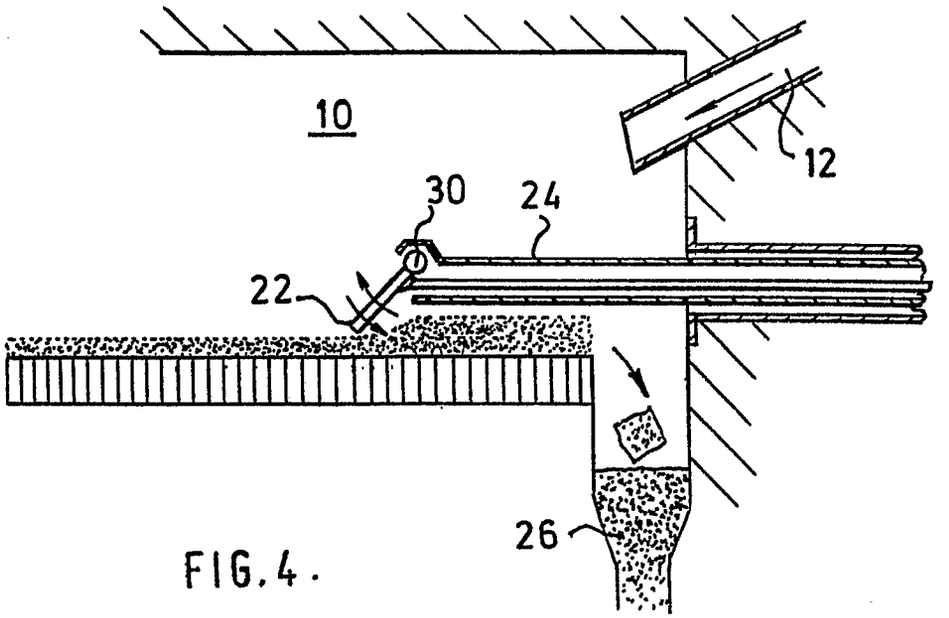

FIG.4.

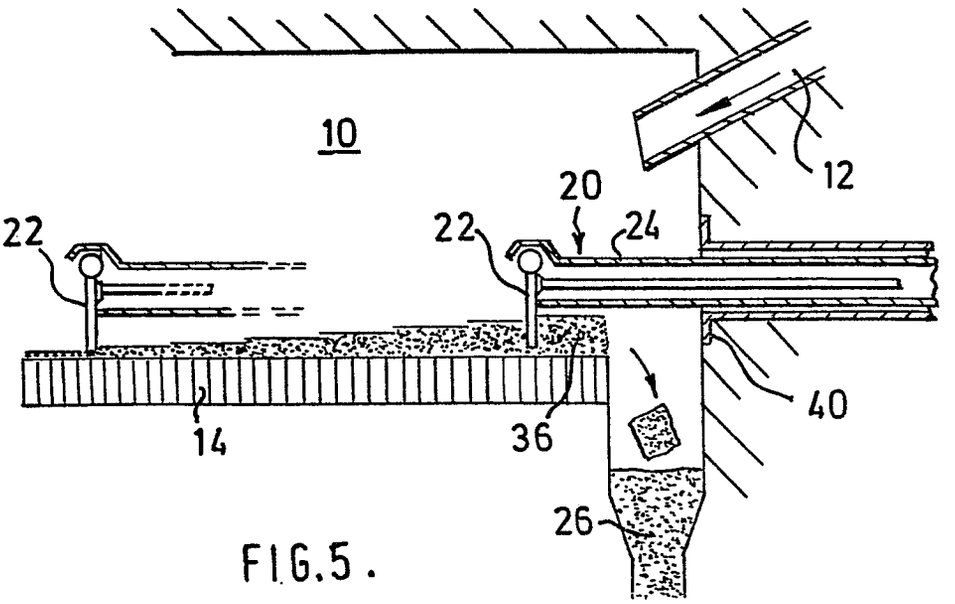

FIG.5.