Jan. 2, 1940. C. L. MYERS 2,185,865

STOKER FURNACE

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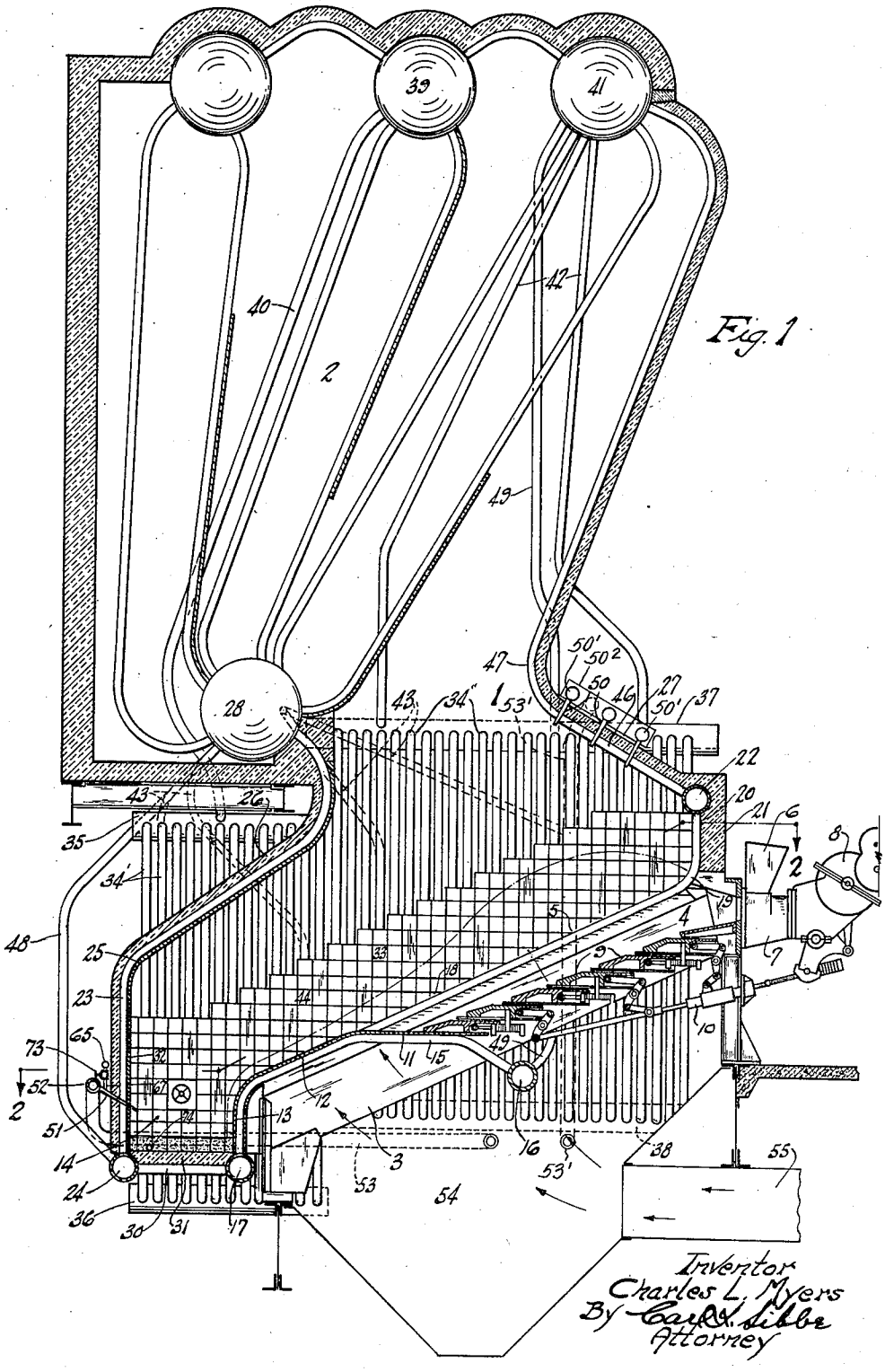


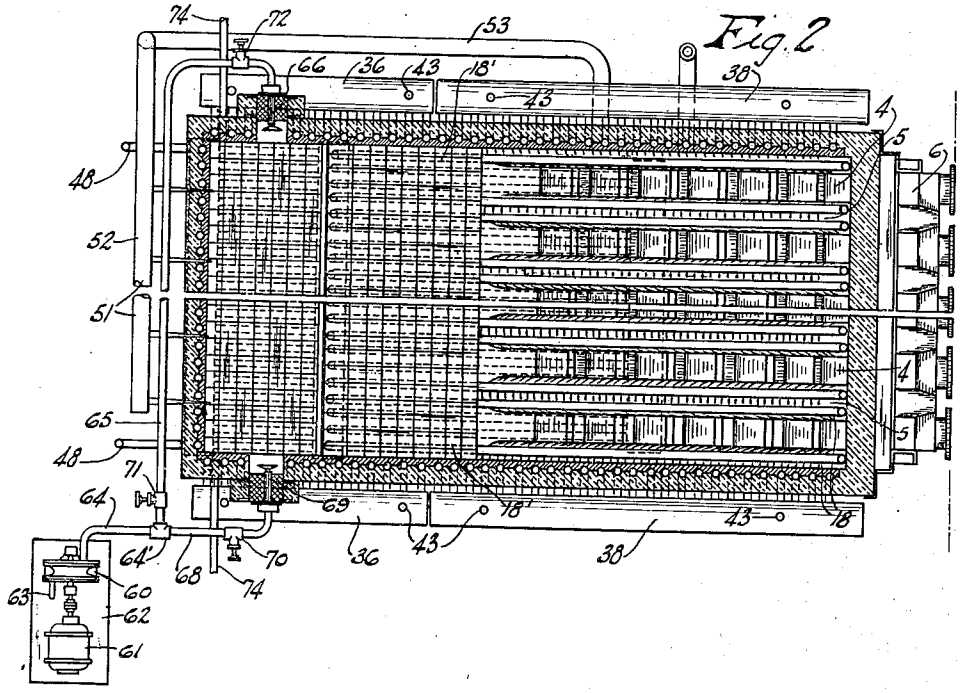
Fig. 1

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STOKER FURNACE

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Fig. 2



Inventor
Charles L. Myers
By Clark & Gibbs
Attorney

Patented Jan. 2, 1940

2,185,865

UNITED STATES PATENT OFFICE

2,185,865

STOKER FURNACE

Charles L. Myers, Philadelphia, Pa., assignor to American Engineering Company, Philadelphia, Pa., a corporation of Pennsylvania

Application June 3, 1936, Serial No. 83,281

3 Claims. (Cl. 110—44)

This invention relates to stoker furnaces, and more particularly to stokers of the inclined grate, multiple retort underfeed type.

One object of the present inventon is to provide a novel and highly improved stoker of the stated character, capable of functioning throughout the operating range of the furnace to effect complete combustion of the fuel with the use of a minimum of excess air, thereby insuring maximum furnace temperatures under all conditions of operation.

Another object is to provide an improved stoker construction which requires a minimum of headroom, and therefore is adapted for use in commercial plants of varied sizes.

Another object is to provide in a stoker of the stated character a novel ash disposal means for the refuse fed from the stoker.

A more specific object is to provide in a stoker of the stated character a slag pit for receiving the residue fed from the stoker wherein such residue is maintained in a liquid state, and any combustible matter contained in such residue separates therefrom and floats on top of the molten mass where it is brought into direct contact with a combustion supporting gas and completely burned before the molten residue is drawn from the furnace.

A further object is to provide in a stoker furnace, novel means for liquefying and maintaining in a liquid state the residue fed from the stoker to the slag pit, and to provide means for directing air over the top of the slag pit and into direct contact with the combustible matter separating from the refuse as the latter is liquefied to effect complete burning thereof, said air thereafter passing over the fuel bed of the stoker where it combines with the combustible gases driven from the fuel to insure complete combustion thereof.

Other and further objects will become apparent as the description of the invention progresses.

Of the drawings:

Fig. 1 is a longitudinal sectional view diagrammatic in part taken through a furnace showing the preferred embodiment of the present invention.

Fig. 2 is a sectional view taken substantially along line 2—2 of Fig. 1.

Referring more particularly to Figs. 1 and 2 of the drawings, the furnace 1 comprises a boiler 2, fired in the present instance by a multiple retort underfeed stoker 3. Stoker 3 consists of a series of alternately disposed retorts 4 and tuyère rows 5. Fuel is fed to the retorts from hoppers 6 by a series of fuel feeding rams operating in cylinders 7 and driven by any suitable power mechanism 8. Fuel is underfed along the retorts by a series of pushers 9 mounted in the bottoms thereof and operatively connected to the power mechanism 8 by a link and lever mechanism 10.

The lower end of the stoker has provided thereon dead plates, each of which consisting of a horizontal portion 11 within the lower end of a retort, and a downwardly inclined portion 12 extending rearwardly of the retort and terminating at its rearwardly disposed end in a substantially vertical portion 13, the latter of which forming a portion of the front wall of a slag pit 14. The portions 11, 12 and 13 of the dead plates are cooled in the present instance by fluid conducting tubes 15 mounted in cooling relation therewith, said tubes terminating at the upper ends thereof in a header 16 mounted beneath the stoker, and at their lower ends in a header 17 suitably mounted at the bottom of the slag pit 14. Each row of tuyère blocks 5 also has mounted thereon a pair of fluid conducting tubes 18, the upper ends of said tubes being bent as shown at 19, and terminate in vertical portions 20 which form a portion of the front wall 21 of the furnace. The upper ends of tubes 18 terminate in a header 22, while the lower ends of said tubes extend downwardly in substantially parallel relation with the lower ends of tubes 15 and terminate in header 17. The portions of tubes 18 adjacent tubes 15 may be provided with blocks 18' as shown in Fig. 2, or with any other suitable protective means whereby a smooth, continuous surface is presented to fuel and ash passing over the lower end of the stoker. The extensions 12 and 13 of plate 11 may also be of block construction if it is so desired. The extensions 12 and the adjacent block sections 18' form an extended overfeed section of the stoker which directs the refuse fed from the stoker into pit 14.

The rear wall of the furnace also consists of a series of vertically disposed tubes 23 connected at the lower ends thereof to a header 24 mounted at the bottom of slag pit 14. The tubes 23 are bent as shown at 25, and extend forwardly and upwardly, forming an arch 26 overlying slag pit 14 and the lower end of stoker 3, and terminate in the mud drum 28 of boiler 2. Headers 17 and 24 disposed at the bottom of the slag pit are connected by a series of substantially horizontal tubes 30 upon which are mounted a layer of refractory material, as shown at 31. The inner surfaces of tubes 23 have secured thereto a series

of protective blocks, or other protective means, as shown at 32.

The side walls 33 of the stoker and slag pit 14 comprise a series of vertically disposed tubes 34' and 34''. Tubes 34' are connected at their upper ends to a substantially horizontal header 35 and at their lower ends in a second header 36. Tubes 34'' are likewise connected at their upper ends to a horizontally disposed header 37 and at their lower ends to a second horizontally disposed header 38. Header 35 is connected to the steam drum 39 by risers 40, while header 37 is connected to steam drum 41 by risers 42. The lower headers 36 and 38 are connected to the mud drum 28 of boiler 2 by downtake connections 43. The portion of tubes 34' and 34'' adjacent stoker 3 and slag pit 14 are covered by a series of protective blocks 44.

It therefore is seen that the slag pit 14 is bounded on all sides by a fluid cooled construction. A certain quantity of the molten slag contained in pit 14 will adhere to the walls of the latter and thereby not only forming an insulating coating thereon, but also a seal for the various joints thereof. Other forms of sealing means obviously may also be employed, if it is so desired. As shown in Fig. 1, a series of fluid conducting tubes 46 extend upwardly and rearwardly from header 22 forming an arch 27 at the upper end of the combustion chamber. Tubes 46 are then bent as shown at 47, and extend upwardly and forwardly, and terminate at their upper ends in steam drum 41. The header 24 provided at the lower end of slag pit 14 is connected to mud drum 28 of boiler 2 by downtake connection 48, while header 16 may be connected by risers 49 to one of the steam drums of the boiler. The circulatory system is thus complete, and upon operation of the furnace the fluid cooled sections of the stoker and the walls of the furnace operate as a boiler to assist the boiler 2 proper in carrying the load, as well as effectively cooling the stoker and associated parts to prevent damage thereto.

The arch 27 has provided therein a series of nozzles 50, which direct at relatively high velocities, a combustion supporting gas such as air, downwardly and rearwardly over the top of the fuel bed, thereby driving the high temperature gases toward the slag pit 14. These high temperature gases so directed, as well as the heat deflecting arch 26, create a high temperature zone over the lower end of the stoker and slag pit and as a result liquefication of the ash is effected. When the ash is so reduced to a liquid state the combustible matter separates therefrom and floats on top of the molten mass.

The rear wall of the slag pit 14 also has provided therein a series of nozzles 51 which direct at relatively high velocities a combustion supporting gas downwardly and forwardly over the top of the slag pit, and thence over the lower end of the stoker. The air so introduced thus comes into direct contact with the combustible matter at the top of the slag pit and effects complete combustion thereof. The heat derived from the burning of this matter also assists in maintaining the ash in the pit in a molten state.

The air introduced through nozzles 50 and 51 also passes over the fuel bed and unites with the combustible gases rising therefrom to effect complete combustion thereof. The nozzles 51 are supplied with air by a duct 52 which extends transversely of the rear of the furnace and communicates with a second duct 53 which may be connected to the plenum chamber 54 disposed beneath the stoker, or to any other suitable source of supply. Plenum chamber 54 is supplied with air under pressure in the usual manner by any suitable fan or blower mechanism (not shown) through an inlet duct 55. Nozzles 50 are connected to transversely extending pipes $50'$, connected to a header 50^2, which in turn may be connected to plenum chamber 54 by a duct 53', or to any duct extending from the plenum chamber or by any other suitable air supply means. Draft air from plenum chamber 54 passes between the tuyères of the stoker in the usual manner and flows in the direction of the arrows shown in Fig. 1.

During operation of the furnace at the lower ratings it may be desirable to supply an auxiliary source of heat to the slag pit in order to maintain the refuse contained therein in a liquid state. To this end a pump 60 driven by an electric motor 61 is provided to supply an auxiliary fuel, such as oil or gas, to this portion of the furnace. As shown more particularly in Fig. 2, this auxiliary fuel is drawn from a reservoir 62 by pump 60 through a pipe 63, and is discharged by said pump through a pipe 64. A branch pipe 65 is connected to a coupling 64' provided at one end of pipe 64, the other end of which is connected to a burner 66 mounted in one of the side walls of the furnace above the slag pit 14. Pipe 65 also has connected thereto a series of substantially vertical branch pipes 67 which are connected at their lower ends to the nozzles 51. By this means a mixture of fuel and air is simultaneously introduced above the slag pit. A second branch pipe 68 is also attached to coupling pipe 64' which conducts fuel to a second burner 69 provided in the opposite side wall of the furnace above the slag pit 14. A control valve 70 is provided in pipe 68, while a pair of control valves 71 and 72 are provided in pipe 65 so that the amount of fuel introduced may be effectively controlled. When the furnace is operating at the higher ratings it is unnecessary to introduce heat from this auxiliary source, and under these conditions valves 70, 71 and 72 may be closed. A valve 73 may also be provided in each branch pipe 67 so as to enable independent operation of the various burners above described if it is so desired.

From the foregoing description it is seen that during operation of the furnace as the fuel approaches the lower end of the stoker the ash content thereof is liquefied and flows into slag pit 14, from which it may be drawn from time to time by pipe connections 74 extending through the side walls at the lower end of the ash pit. The slag so drawn from the pit may be conducted to a sluice (not shown) or to any other desired disposal means.

Upon liquefication of the ash as above described, the combustible matter container therein, having a density less than that of the molten ash, floats at the top of the slag pit. By separating the combustible matter from the ash in this manner it is apparent that less air is required to completely burn the same than would be required if such combustible matter were protected by an outer coating of ash. For this reason a minimum of excess air is required to effect complete combustion of the fuel, and as a result the chilling effect on the furnace gases produced by excess air is reduced to a minimum. The furnace gases are therefore maintained at maximum temperatures, and consequently the furnace op-

erates at high efficiencies throughout the operating range thereof. It is also seen that by the provision of air emitting nozzles of the character just described, it is unnecessary to introduce all of the air for combustion purposes through the grates of the stoker, but only a sufficient quantity to reduce the solid fuel to a gaseous state. Therefore, air may be introduced beneath the grates of the stoker at relatively low pressures, with the result that blowing of the fuel will not occur and the fuel bed will remain normally uniform. It is also seen that by liquefying the ash, a relatively shallow slag pit may be employed, and therefore the use of deep crusher pits, ash hoppers, and other equipment which require considerable headroom may be eliminated. A stoker constructed after this fashion therefore requires a minimum of headroom space, and may be installed in commercial plants of all sizes.

From the foregoing description of the present invention, it is seen that by reducing the ash content of the fuel to a liquid state, troublesome ash handling problems are completely eliminated. It is also seen that by treating the ash in this manner the fixed carbon and other combustible matter contained therein separates from the ash and floats on top of the molten mass. This combustible matter being directly exposed to incoming air is completely burned and as a result all of the combustible matter contained in the fuel fed to the stoker is consumed, with the use of a minimum of excess air. The furnace therefore operates at high efficiencies inasmuch as the gases generated therein are maintained at maximum temperatures. It is also seen that by passing a certain quantity of air over the fuel bed, as well as over the combustible matter floating at the top of the ash pit it is unnecessary to feed all of the air for combustion purposes through the grates of the stoker. Blowing of the fuel from the fuel bed is thus prevented, and as a result the fuel bed remains normally uniform throughout the operation of the furnace. By treating the ash in the novel manner set forth herein, it is also apparent that a relatively shallow slag pit may be provided, and consequently the headroom requirements of the unit as a whole are reduced to a minimum.

While the embodiment herein shown and described is admirably adapted to fulfill the objects primarily stated, it is to be understood that the invention is not to be limited thereto since it may be embodied in other forms, all coming within the scope of the claims which follow.

What is claimed is:

1. In a furnace, the combination with an inclined grate underfeed stoker, consisting of alternately disposed retorts and tuyère rows, of means for feeding fuel to and along said stoker, an overfeed section disposed at the lower end of said stoker, a slag pit adjacent said overfeed section, an arch provided over the upper portion of said stoker, having a series of nozzles provided therein for directing a combustion supporting gas over said fuel bed toward said slag pit, and a second arch for directing the furnace heat over said slag pit whereby the ash content of the fuel is converted into liquid form.

2. In a furnace, the combination with an inclined grate underfeed stoker, consisting of alternately disposed retorts and tuyère rows, of means for feeding fuel to and along said stoker, an overfeed section disposed at the lower end of said stoker, a slag pit adjacent said overfeed section, an arch provided over the upper portion of said stoker, having a series of nozzles provided therein for directing a combustion supporting gas over said fuel bed toward said slag pit, a second arch for directing the furnace heat over said slag pit whereby the ash content of the fuel is converted into liquid form, nozzle means for directing a combustion supporting gas over said slag pit to insure complete combustion of any combustible matter contained therein, and to maintain the slag in said pit in liquid form, and auxiliary heating means for said slag comprising one or more burners disposed above said slag pit.

3. In a furnace, the combination with an inclined grate underfeed stoker, consisting of alternately disposed retorts and tuyère rows, of means for feeding fuel to and along said stoker, an overfeed section disposed at the lower end of said stoker, a slag pit disposed adjacent said overfeed section, means for supplying a combustion supporting gas to said fuel bed to partially reduce the fuel from a solid to a gaseous state, means for completing the combustion of the combustible gases driven from said fuel and reducing the ash content of said fuel to a liquid state, said means comprising an arch disposed over the upper end of said stoker, a series of nozzles provided in said arch for directing a combustion supporting gas toward said ash pit to concentrate the heat in that vicinity of the furnace, a second arch extending over said slag pit for deflecting the heat of the furnace toward said slag pit, a series of nozzles provided in the upper portion of said slag pit for directing a combustion supporting gas over the same whereby any combustible contained in said ash is completely burned, and means for removing the slag from said pit.

CHARLES L. MYERS.