

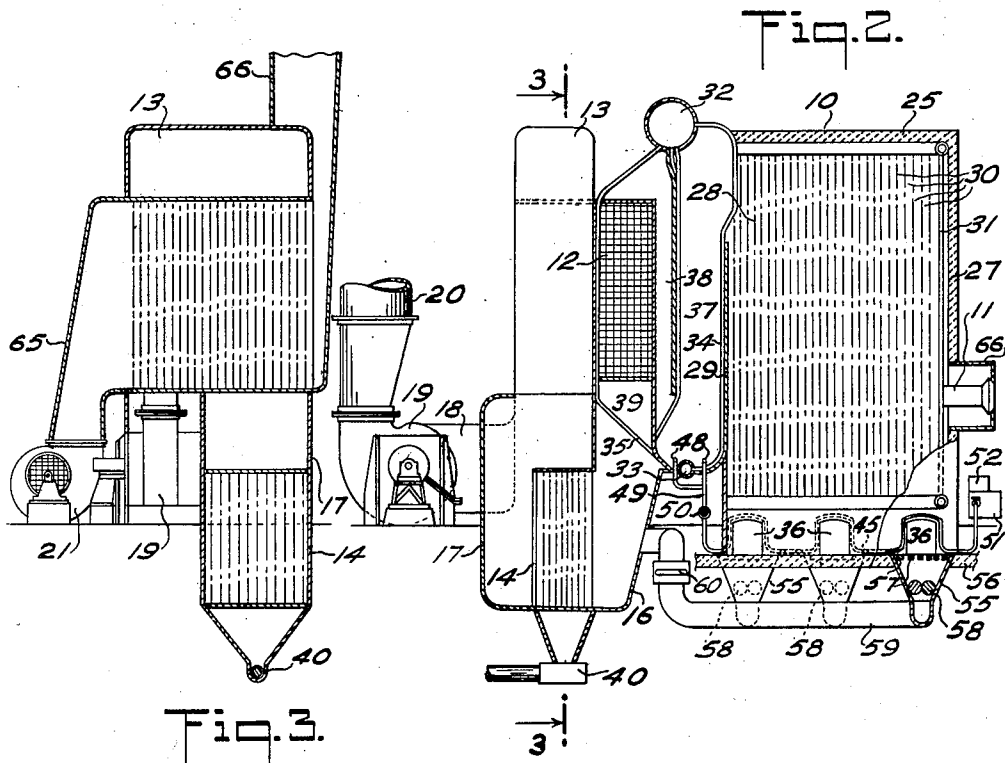
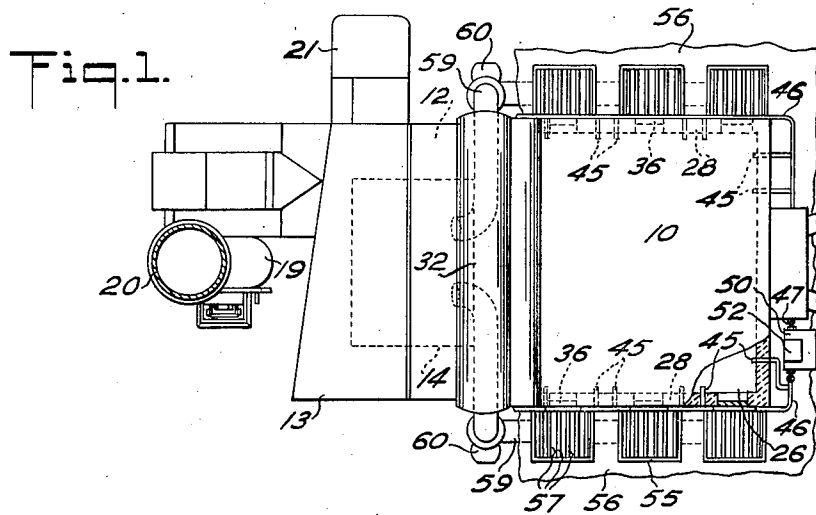
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STEAM GENERATOR FURNACE

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STEAM GENERATOR FURNACE

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8 Claims. (Cl. 110—165)

This invention relates to steam generator furnaces and more particularly to a steam generator having improved provisions for handling ash liberated by the combustion of the fuel.

In the generation of steam with pulverized fuel, and particularly pulverized bituminous coal, a considerable quantity of ash is released by the burning of the coal. The ash, upon continued operation, must be disposed of. A portion of the ash released is in finely divided form and other portions of the ash are in dry aggregated form in relatively large particle or lump sizes. It is the present practice to permit the major portion of the ash to collect on the floor of the steam generator and remove the same from time to time and when a sufficient pile has been collected by raking and shovelling. This mode of handling the ash is not satisfactory. The portions of the ash which are carried in the advancing stream of furnace gases are discharged into the atmosphere from the stack after passing through the induced draft fan. Not only is the discharge of ash into the atmosphere highly objectionable but frequent replacement of the blades or rotor of the induced draft fan is required because of the erosive action of the ash thereon.

It is the principal object of the present invention to provide for the removal of the ash from the pulverized fuel burned in a steam generator.

It is a further object of the present invention to provide for the removal of the ash in finely divided form and in larger aggregate sizes by the provision of apparatus which may be quickly and easily installed in the building of new steam generators or which may be readily applied to existing installations.

It is a further object of the present invention to provide, in a simple and reliable manner, for the removal of ash released in different forms by the burning of pulverized fuel in a steam generator.

Other objects of the invention will be apparent from the annexed specification.

The nature and characteristic features of the invention will be more readily understood from the following description, taken in connection with the accompanying drawing forming part hereof, in which:

Figure 1 is a top plan view of the apparatus in accordance with the present invention;

Fig. 2 is a vertical central sectional view through the apparatus in accordance with the present invention taken from front to rear; and

Fig. 3 is a transverse vertical sectional view taken approximately on the line 3—3 of Fig. 2.

It should, of course, be understood that the description and drawing herein are illustrative merely, and that various modifications and changes may be made in the structure disclosed without departing from the spirit of the invention.

The present invention is in part a continuation of my prior application for Letters Patent, Ser. No. 454,952 filed August 15, 1942, now Patent No. 2,364,044, issued December 5, 1944, for Steam generator furnaces and the specific improvements herein consist in the provision of suitable means for handling ash in aggregate form in addition to the ash in small particle sizes and in a manner not contemplated in my prior application and also in an improved arrangement of the ash collector or separator.

Referring more particularly to the drawing, the apparatus of the present invention includes a steam generator 10 of any preferred type having fuel burners 11 to which fuel, such as pulverized bituminous coal, is supplied from a pulverizer (not shown). An economizer 12 is preferably provided for receiving the hot gases of combustion from the steam generator 10 and for absorbing heat therefrom for further extraction of heat from the fuel. An air heater 13 is provided for receiving the hot gases of combustion after their passage through the economizer 12 for absorbing heat from the hot gases for preheating air for the delivery of fuel to the burners 11 and for the combustion of the fuel introduced through the burners 11.

An ash collector or separator 14 is provided, preferably interposed between the economizer 12 and the air heater 13, and preferably arranged on a lower level than the economizer 12 and the air preheater 13. The collector 14 is connected to the economizer 12 by a duct 16 and is connected by a hot gas duct 17 to the air heater 13. The air heater 13 has a gas outlet which is in communication, by means of a duct 18, with an induced draft fan 19, the induced draft fan 19 being connected to the stack 20 for the delivery thereto of the gases of combustion. A forced draft fan 21 is also provided for delivering air to the preheater 13 and therefrom to the steam generator 10 for supporting combustion.

The steam generator 10 may be of any preferred type but for the purposes of illustration a specific form of steam generator is illustrated. The steam generator 10 shown includes a combustion chamber having a top wall 25, a bottom wall or floor 26, a front wall 27, and side walls 28, with a rear baffle 29 forming the rear wall of the

combustion chamber. The rear baffle 29 is terminated at a suitable distance above the bottom wall or floor 26 for permitting the passage of gases therearound.

The walls of the combustion chamber are water cooled and provided with steam generating tubes extending upwardly therealong. The side walls 28 of the combustion chamber are water cooled and are provided with steam generating tubes 30 and the front wall 27 is provided with steam generating tubes 31, the tubes 30 and 31 being connected for the delivery of steam to an upper transverse steam and water drum 32 disposed rearwardly with respect to the combustion chamber. A lower transverse water header or drum 33 is provided, below the drum 32 to which the tubes 34 at the baffle 29 are connected. The drum 32 and the drum 33 have suitable downcomer tubes 35 extending therebetween for circulation.

The front wall 27 is provided with suitable burners 11 for the delivery of pulverized fuel and air to the combustion chamber for combustion.

The side walls 28 have a plurality of ash doors 36 therein for purposes to be explained.

The space to the rear of the combustion chamber is divided into a downward pass 37 and an upward pass 38 and may also have an additional downward pass 39 in which the economizer 12 is located.

In accordance with the present invention the economizer 12 is connected by the duct 16 to the dust collector 14. The dust collector 14 may be of any preferred type for the separation of the gases of combustion and the ash and may if desired be of the single or multiple cyclone type and is preferably constructed of suitable materials to withstand the effect of the temperature of the combustion gases upon their discharge from the economizer 12. For this purpose a collector of the type shown in the patent to Lloyd J. Hersh, No. 2,358,508, is suitable.

The lower part of the dust collector 14 has an ash conveyor connected thereto, the ash conveyor 40 preferably being of the screw conveyor type and driven by a conveyor motor. The gas outlet of the dust collector 14 is connected to the air heater 13 so that the particles of ash will be removed from the advancing stream of gases, as hereinafter pointed out, before the same are delivered to the air heater 13.

In accordance with the present invention the steam generator 10 is provided with suitable agitators as shown in my prior application for patent hereinbefore referred to at a plurality of locations and preferably at the places where ash particles entrained in the advancing stream of combustion gases would normally have an opportunity to collect, such as at the bottom floor 26 of the combustion chamber and at the space below the downward pass 37.

The agitators for the collecting space on the floor 26 of the combustion chamber preferably include small pipes or nozzles 45 at spaced intervals along each of the side walls 28 close to the bottom wall 26 and at spaced intervals along the front wall 27 close to the bottom wall 26. Pipes 46 having control valves 47 therein are connected to the small discharge pipes or nozzles 45 for supplying thereto fluid under relatively high pressure for high velocity discharge across the floor 26.

The agitators for the collecting space at the bottom of the pass 37 are similar to the other agitators and preferably include small discharge pipes or nozzles 48 at spaced intervals along the

side and are supplied with fluid under pressure by pipes 49, which have control valves 50 therein, connected to the discharge pipes or nozzles 48.

The pipes 49 and the pipes 46 are connected to a suitable source of fluid pressure such as a tank 51 to which air under pressure of the order of eighty or ninety pounds per square inch is supplied by a compressor 52. If desired, steam could be supplied to the pipes 46 and the pipes 49 in place of air particularly if the sulphur content of the fuel is at a low level.

In accordance with the present invention hoppers 55 are provided outside the ash doors 36 preferably beneath the operating floor 56 outside the steam generator 10. The upper part of the hoppers 55 have grills 57 thereover preferably consisting of parallel bars with their upper edges flush with the operating floor 56. In the lower part of the hoppers 55 crusher rollers 58 are provided for crushing the ash delivered thereto as hereinafter pointed out. The lower ends of the hoppers 55 are connected to ash delivery pipes 59. The ash delivery pipes 59 are provided with slidable dampers 60 and are connected to the duct 16 for the delivery of ash by suction as hereinafter explained. The forced draft fan 21 is connected by a duct 65 to the air heater 13 and the air heater 13 is connected by a duct 66 to the burners 11.

The mode of operation will now be pointed out.

The steam generator 10 is operated in the customary manner, the coal being supplied through the burners 11 in pulverized form together with air delivered through the duct 66. The coal is burned in the combustion chamber. The release of heat as radiant heat of combustion in the combustion chamber effects steam generation in the banks of wall tubes 30 and 31. The gases of combustion pass from the combustion chamber through the downward pass 37 to the rear of the wall or baffle 29, pass upwardly through the upward pass 38 and downwardly in contact with the tubes of the economizer 12 and to the collector 14. The gases in passing from the combustion chamber travel at a relatively high velocity of the order of two thousand to three thousand feet per minute. The velocity may decrease as the temperature decreases, to a velocity of the order of fifteen hundred feet per minute, but the design and operation of the steam generator 10 are preferably such that the gases move at a high velocity. The flow of gases is maintained by the induced draft fan 19, with which a suction of the order of six inches of water may be maintained at the inlet of the collector 14, the gases passing from the collector to the air heater 13 and thence through the induced draft fan 19 for discharge to the stack 20. Upon the combustion of the pulverized fuel in the combustion chamber the ash therein separates and tends in great part to fall towards the floor 26.

In accordance with the present invention fluid under pressure is supplied continuously or intermittently as desired and as required through the pipes 46 to the small pipes or nozzles 45 from which it is discharged at high velocity, to agitate the small particles of ash tending to collect on the floor 26. These smaller particles are swept from the floor 26 and from above the floor 26 and pass upwardly into the stream of gases flowing from the combustion chamber. The smaller ash particles are entrained and carried onward with the moving stream of combustion gases in its advance. The same character of agitation is

effected, continuously or intermittently, as desired, and as required, by the pipes or nozzles 48, at the bottom of the downward pass 37, so that any ash particles tending to settle at this location are agitated and blown into the path of the gases for delivery to the collector 14.

The stream of gases with the ash particles entrained therein and carried therewith by flotation passes into the dust collector 14 where the gases and the ash particles are separated. The ash is withdrawn at the lower part of the dust collector 14 and delivered by the conveyor 40 for disposal. The gases of combustion freed of the solid ash particles by the dust collector 14 are clean upon passing into the air heater 13 and upon their subsequent contact with the blades of the induced draft fan 19, and as discharged from the stack 20 are freed from ash which would otherwise be discharged into the atmosphere. The gases of combustion, freed of solid material, do not have any erosive action on the rotor of the induced draft fans 19. The larger particles of ash which are incapable of being elevated by the high velocity of the fluid discharged from the nozzles 45 and 48 or are incapable of being carried in the advancing stream of gases, are withdrawn from time to time through the doors 36 and are raked or otherwise moved onto the bars 57 where the same may be broken to sizes to pass through the openings between the bars 57. The ash falling into the hopper 55 is then crushed by the crusher rollers 58 to a suitable size for separation at the collector 14. The ash is then delivered through the duct 59 and to the duct 16, this delivery being effected by the suction prevailing in the duct 16. The ash is thus delivered to the separator 14 for removal from the stream of advancing gases. In this manner all the ash is collected in a convenient manner and at a convenient location.

I claim:

1. In combination with a steam generator having a combustion chamber with side walls and a flat bottom wall, means for supplying pulverized coal for combustion in said chamber, said combustion chamber having a combustion gas outlet conduit, said bottom wall providing an ash collecting space for collecting non-combustible ash released by the combustion of said coal, and means for collecting the non-combustible ash released by the combustion of said coal, said ash collecting means including members for agitating ash particles whereby the same are elevated from the bottom wall and entrained in the stream of gases generated in said combustion chamber for delivery from said steam generator with the combustion gases, ash doors in certain of said side walls, members outside said steam generator for receiving ash withdrawn through said ash doors, an ash collector in said gas outlet conduit for separating ash from the combustion gases, and a conduit connected to said ash receiving members and in communication with said ash collector for delivering thereto by suction for collection ash withdrawn through said ash doors.

2. In combination with a steam generator having a combustion chamber with side walls and a flat bottom wall, ash doors in certain of said side walls, means for supplying pulverized fuel for combustion in said chamber, said combustion chamber having a combustion gas outlet conduit, said bottom wall providing an ash collecting space for collecting non-combustible ash released by the combustion of said fuel, and an ash collector in said gas outlet conduit for separating

ash from the combustion gases, and means for delivering to said collector the non-combustible ash released by the combustion of said coal, said delivering means including nozzles spaced along said side walls for supplying air in a plurality of high velocity jets for agitating certain ash particles whereby the same are elevated from the bottom wall and entrained in the stream of gases generated in said combustion chamber for delivery to said ash collector with the combustion gases, ash receiving members outside said steam generator for receiving ash withdrawn through said ash doors, and a conduit connecting said ash receiving members to said ash collector for delivering thereto ash withdrawn through said ash doors.

3. In combination with a steam generator having a combustion chamber with side walls and a flat bottom wall, ash removal doors in certain of said side walls, means for supplying pulverized coal for combustion in said chamber, said combustion chamber having a combustion gas outlet conduit, said bottom wall providing an ash collecting space for collecting non-combustible ash released by the combustion of said coal, and means for collecting the non-combustible ash released by the combustion of said coal, said ash collecting means including nozzles spaced along said side walls for supplying air in a plurality of high velocity jets for agitating the ash particles whereby the same are elevated from the bottom wall and entrained in the stream of gases generated in said combustion chamber for delivery from said steam generator with the combustion gases, an ash separator in said gas outlet conduit for separating the ash particles from the combustion gases, hopper members outside said steam generator for receiving ash withdrawn through said ash doors, and a conduit in communication with the lower part of each of said hopper members and said ash separator for delivering to said ash separator ash withdrawn through said ash removal doors.

4. In combination with a steam generator having a combustion gas outlet conduit, an induced draft fan in said conduit and a combustion chamber with side walls and a flat bottom wall, ash doors in certain of said side walls, means in one of the walls of said combustion chamber for supplying pulverized coal for combustion in said chamber, said bottom wall providing an ash collecting space for collecting non-combustible ash released by the combustion of said coal, an ash separator in said gas outlet conduit, and means for delivering to said separator non-combustible ash released by the combustion of said coal, said delivery means including ash agitating nozzles spaced for supplying air in a plurality of high velocity jets for agitating falling ash particles whereby said ash particles are elevated from said bottom wall and entrained in the stream of gases generated in said combustion chamber for delivery from said steam generator with the combustion gases, said ash delivery means also including hoppers outside said combustion chamber and adjacent said ash doors, members mounted in said hoppers for reducing the size of the ash delivered thereto, and conduit members connecting the lower portions of said hoppers to said ash separator for delivery of ash thereto by suction from the induced draft fan.

5. In combination with a steam generator having a combustion gas outlet conduit, an induced draft fan in said conduit and a combustion chamber with side walls and a flat bottom wall, ash

doors in certain of said side walls, means in one of the walls of said combustion chamber for supplying pulverized coal for combustion in said chamber, said bottom well providing an ash collecting space for collecting non-combustible ash released by the combustion of said coal, and means for separating and removing the non-combustible ash released in the combustion chamber by the combustion of said coal, said means including nozzles spaced along the lower portions of certain of said walls for supplying air in a plurality of high velocity jets for agitating falling ash particles whereby said ash particles are elevated from said bottom wall and entrained in the stream of gases generated in said combustion chamber for delivery from said steam generator with the combustion gases, an ash separator in said gas outlet conduit beyond said combustion chamber for separating entrained ash from the discharged combustion gases prior to their passage to the induced draft fan, said means also including ash hoppers outside said combustion chamber and adjacent said ash doors for receiving ash particles incapable of entrainment, bar members interposed between said ash doors and said hoppers for limiting the size of the ash delivered to said hoppers, additional means for reducing the size of the ash delivered to said hoppers, and conduit members connecting the lower portions of said hoppers to said ash separator for delivery of reduced size ash thereto.

6. In combination with a steam generator having a combustion gas outlet conduit, an induced draft fan in said conduit, and a combustion chamber with side walls and a bottom wall, ash removal doors in certain of said side walls, means in one of the walls of said combustion chamber for supplying pulverized coal for combustion in said chamber, said combustion chamber having a combustion gas discharge outlet, said bottom wall providing an ash collecting space for collecting non-combustible ash released by the combustion of said coal, and means for removing non-combustible ash released by the combustion of said coal, said ash removing means including an ash separator in said gas outlet conduit, hoppers outside said combustion chamber and adjacent said ash removal doors, members for reducing the size

of the ash delivered to said hoppers, and conduit members connecting the lower portions of said hoppers to said ash separator.

7. In combination with a steam generator having a combustion gas outlet conduit, an induced draft fan in said conduit, and a combustion chamber with side walls and a bottom wall, ash removal doors in certain of said side walls, means in one of the walls of said combustion chamber for supplying pulverized coal for combustion in said chamber, said combustion chamber having a combustion gas discharge outlet, said bottom wall providing an ash collecting space for collecting non-combustible ash released by the combustion of said coal, and means for removing non-combustible ash released by the combustion of said coal, said ash removing means including an ash separator in said gas outlet conduit, hoppers outside said combustion chamber and adjacent said ash removal doors, bar members at the upper portions of said hoppers for limiting the size of the ash delivered thereto, and conduit members connecting the lower portions of said hoppers to said ash separator.

8. In combination with a steam generator having a combustion gas outlet conduit, an induced draft fan in said conduit, and a combustion chamber with side walls and a bottom wall, ash removal doors in certain of said side walls, means in one of the walls of said combustion chamber for supplying pulverized coal for combustion in said chamber, said combustion chamber having a combustion gas discharge outlet, said bottom wall providing an ash collecting space for collecting non-combustible ash released by the combustion of said coal, and means for removing non-combustible ash released by the combustion of said coal, said ash removing means including an ash separator in said gas outlet conduit, hoppers outside said combustion chamber and adjacent said ash removal doors, members for limiting the size of the ash delivered to said hoppers, members for reducing the size of the ash delivered to said hoppers, and conduit members connecting the lower portions of said hoppers to said ash separator.

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