

[72] Inventors **Samuel S. Blackburn, Jr.**
Avon;
Earl K. Rickard, East Granby, Conn.
 [21] Appl. No. **881,986**
 [22] Filed **Dec. 4, 1969**
 [45] Patented **May 25, 1971**
 [73] Assignee **Combustion Engineering, Inc.**
Windsor, Conn.

[50] Field of Search..... 122/235,
 478, 479; 110/49, 171

[56] **References Cited**
UNITED STATES PATENTS
 3,155,074 11/1964 Clayton 122/479X
 3,155,078 11/1964 Clayton, Jr. 122/479

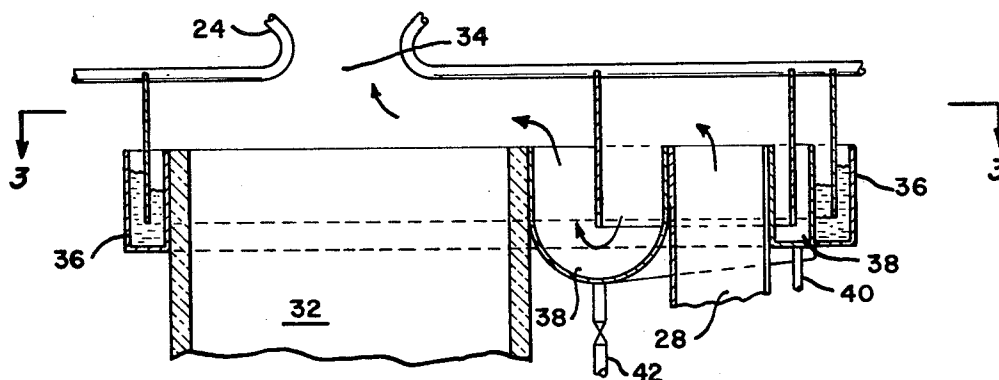
Primary Examiner—Kenneth W. Sprague
Attorneys—Carlton R. Bryant, Eldon H. Luther, Robert L.
 Olson, John F. Carney, Richard H. Berneike, Edward L.
 Kochey, Jr. and Lawrence P. Kessler

[54] **STEAM GENERATOR USING GAS
 RECIRCULATION**
 4 Claims, 3 Drawing Figs.

[52] U.S. Cl..... 122/235,
 110/49, 110/171, 122/479

[51] Int. Cl..... F22g 5/06,
 F23j 5/02

ABSTRACT: A steam-generating unit using gas recirculation for steam temperature control, where the recirculated gases are introduced into the furnace through the ash hopper. A liquid seal inside the ash hopper is used to control flow of recirculated gases.



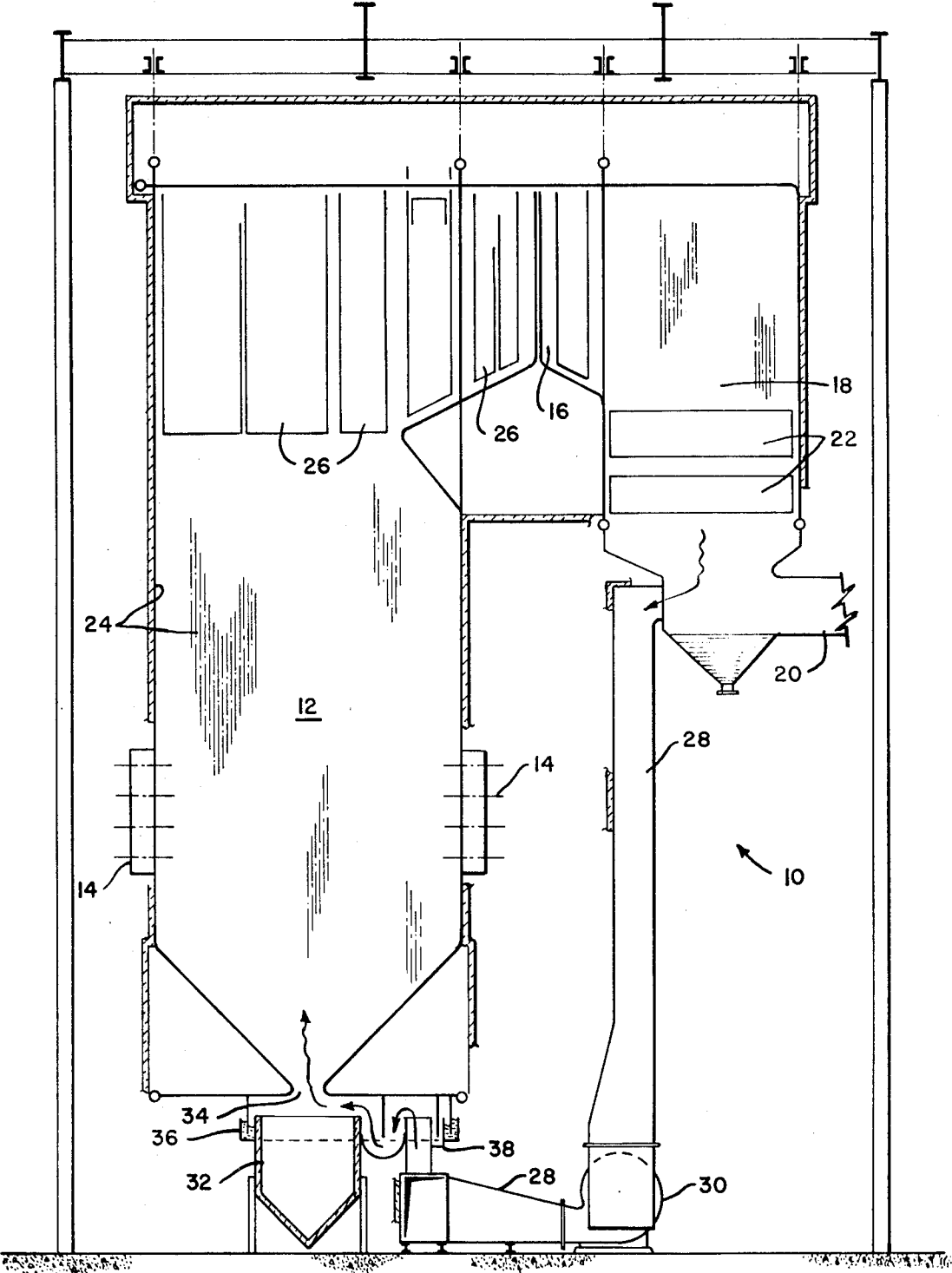
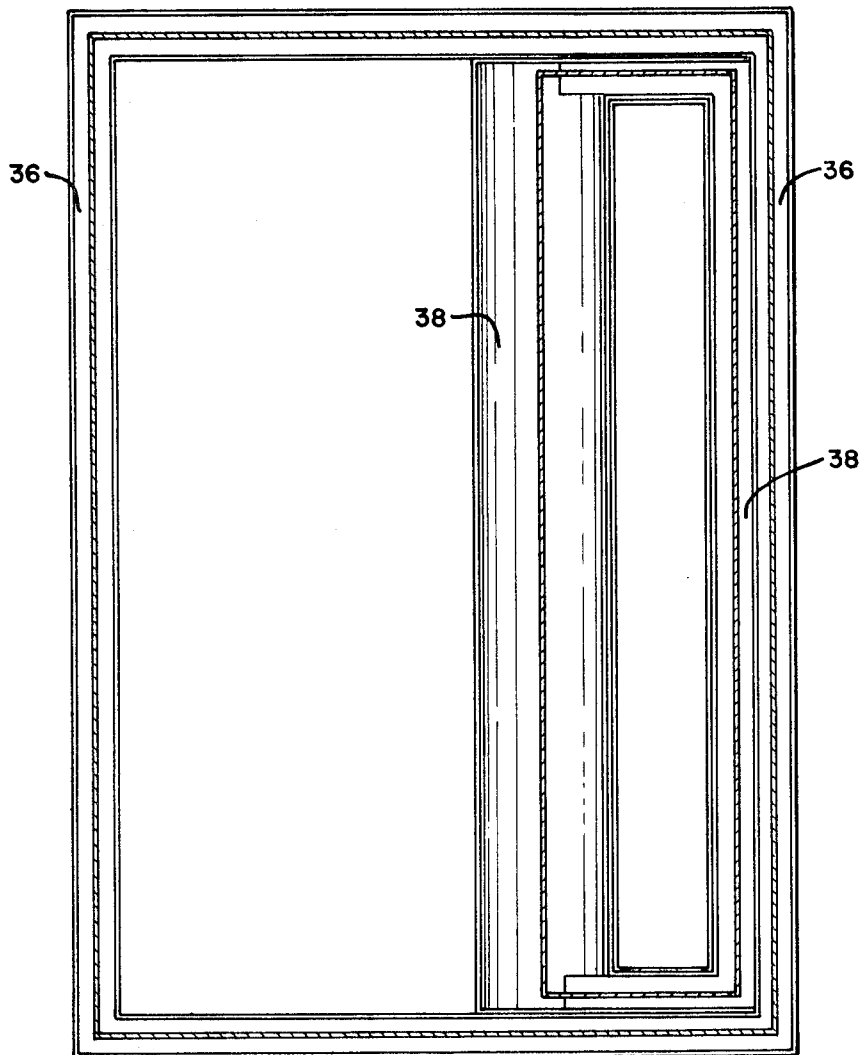
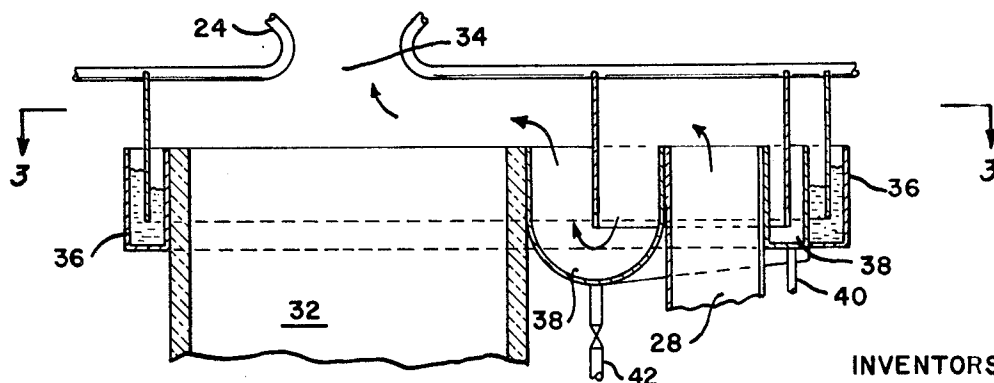


FIG. 1

INVENTORS
SAMUEL S. BLACKBURN JR.
EARL K. RICKARD
BY *Robert L Olson*
ATTORNEY



INVENTORS

SAMUEL S. BLACKBURN JR.

EARL K. RICKARD

BY *Robert L Olson*
ATTORNEY

STEAM GENERATOR USING GAS RECIRCULATION

BACKGROUND OF THE INVENTION

One manner of controlling steam temperature with varying load conditions of a steam generator is to recirculate gases from the rear gas pass of a furnace back to the furnace. In order to maintain superheat temperature constant regardless of what load the unit is operating at, the recirculation of gases back to the furnace is increased as the load decreases. Some problems encountered with present gas recirculation systems are (1) difficulty in getting dampers for the gas recirculation duct which close tightly enough to protect the gas recirculation fan from the hot furnace gases when no gas recirculation is required; and (2) providing large enough openings in the furnace wall to handle the large volume of recirculated gases required under certain operating conditions. Most furnaces today are lined with tubes, and in order to provide an opening therein a number of tubes have to be bent out of the plane of the wall.

SUMMARY OF THE INVENTION

In the gas recirculation system of this invention, recirculated gases are introduced into the furnace through the ash hopper. A liquid seal is provided inside the ash hopper to control the flow of recirculated gases.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic representation in the nature of a vertical sectional view through a vapor generator incorporating the present invention;

FIG. 2 is an enlarged view of the lower portion of the furnace shown in FIG. 1; and

FIG. 3 is a sectional view taken on lines 3-3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Looking now to FIG. 1 of the drawings, 10 is a steam generating unit having a furnace 12. Fuel is introduced into the furnace and burned therein by burners 14. The hot combustion gases rise and exit from the furnace through horizontal gas pass 16 and rear pass 18 before being exhausted to the atmosphere through duct 20 which is connected to a stack, not shown.

Steam is generated and heated by flowing through the various heat exchangers located in the unit. Water is heated in economizer 22 and then flows through the water tubes 24 lining the furnace walls, where steam is generated. From here the steam passes through the superheater sections 26, and thereafter goes to a turbine, not shown.

When the turbine is used for driving a generator for producing electricity, it is necessary to maintain the superheat temperature constant regardless of what load the unit is operating at. The superheat temperature in most units tends to decrease with decrease in load. To overcome this problem relatively cool combustion gases are recirculated back to the furnace in an increasing amount as the load decreases. This decreases the amount of heat transferred to the radiant steam-generating surface 24 lining the furnace walls while increasing the amount of heat transferred to the convection superheat surfaces located outside of the furnace, thus holding the superheat temperature substantially constant even though the load on the unit decreases.

In the illustrated unit, gases are recirculated back to the furnace through duct 28. A fan 30 is provided in the duct to provide for flow of gases when desired. The outlet of duct 28 is positioned inside of a liquid seal 36. From here the gases flow upwardly through the throat opening 34 into the furnace proper.

Most large steam generators are top supported so that they are free to contract and expand due to temperature changes of the structure. The ash hopper 32 is bottom supported. Since hot gases must be prevented from entering the boiler room through the ash hopper, a liquid seal 36 is provided between

the furnace 12 and the ash hopper. This allows relative movement between the furnace and ash hopper while preventing escape of the hot combustion gases therefrom.

The outlet end of the gas recirculation duct is also provided with a liquid seal 38 (see FIGS. 2 and 3). When gas recirculation is called for, the liquid seal is drained by means of outlet 42. When no gas is to be recirculated, the seal is filled by means of water line 40. The liquid valve is provided to keep fan 30 from being exposed to high temperature gas within the furnace when no gas recirculation is taking place. A liquid seal is used rather than some other type of valve, since other valves would not stand up to the high temperatures within the ash hopper. Since there will be constant evaporation from the liquid seals 36 and 38, predetermined levels should be maintained by use of any well-known apparatus; i.e. by letting water run into the seal continuously and providing an overflow line at the desired level. Duct 28 is attached to the ash hopper at some point below the wall of the liquid seal 36 so there will be no problem with thermal movement of the furnace. As shown, the duct 28 enters the bottom of the unit. Also, since the gas recirculation fan is not supported from the same means as the furnace on most units, expansion joints somewhere in the duct must generally be provided. In the present arrangement, this is not necessary. These expansion joints are typically sources of much maintenance.

With the organization of the invention it can be seen that a gas recirculation system has been provided which does not require any of the tubes in the furnace walls to be bent out of the plane of the wall to permit recirculated gases to enter the furnace; and it also provides positive fan protection by reason of the liquid seal. Also, no movable mechanical parts, such as dampers, have to be exposed to furnace temperatures as required in previous gas recirculation systems.

What we claim is:

1. In a steam-generating unit having a furnace and heat exchange means for generating steam therein, an ash hopper located beneath the furnace, opening means connecting the ash hopper to the furnace, first liquid seal means completely surrounding the ash hopper for preventing hot combustion gases from escaping therefrom, duct means, said duct means having an inlet end connected to the steam-generating unit downstream of the heat exchange means, and an outlet end positioned inside the first liquid seal means, means located in the duct means which when actuated will cause combustion gases to flow from the inlet end to the outlet end, and second liquid seal means surrounding the outlet end of the duct means, means for filling and draining the second liquid seal means, so that when the second liquid seal means is drained recirculated combustion gases can be introduced into the furnace through the ash hopper, and when the second liquid seal means is filled, no recirculation of combustion gases takes place.

2. In a steam-generating unit having a furnace and heat exchange means for generating steam therein, an ash hopper located beneath the furnace, opening means connecting the ash hopper to the furnace, water filled trough means surrounding the ash hopper, wall means extending down from the furnace into the trough means, which terminates below the water level so as to form a liquid seal for preventing hot combustion gases from escaping therefrom, duct means, said duct means having an inlet end connected to the steam-generating unit downstream of the heat exchange means, and an outlet end positioned inside the liquid seal, the outlet end being attached to the ash hopper at a location below the wall means terminating in the trough means, a fan located in the duct means which when actuated will cause combustion gases to flow from the inlet end to the outlet end, and valve means for the duct means located downstream of the fan which can be closed to protect the fan from hot furnace combustion gases when it is not operating.

3. The steam-generating unit set forth in claim 2, wherein the valve means is a liquid valve.

4. The steam-generating unit of claim 3, wherein the liquid valve is located within the ash hopper.