May 21, 1963 H. E. BURBACH ETAL 3,090,332

GAS RECIRCULATION DUCT

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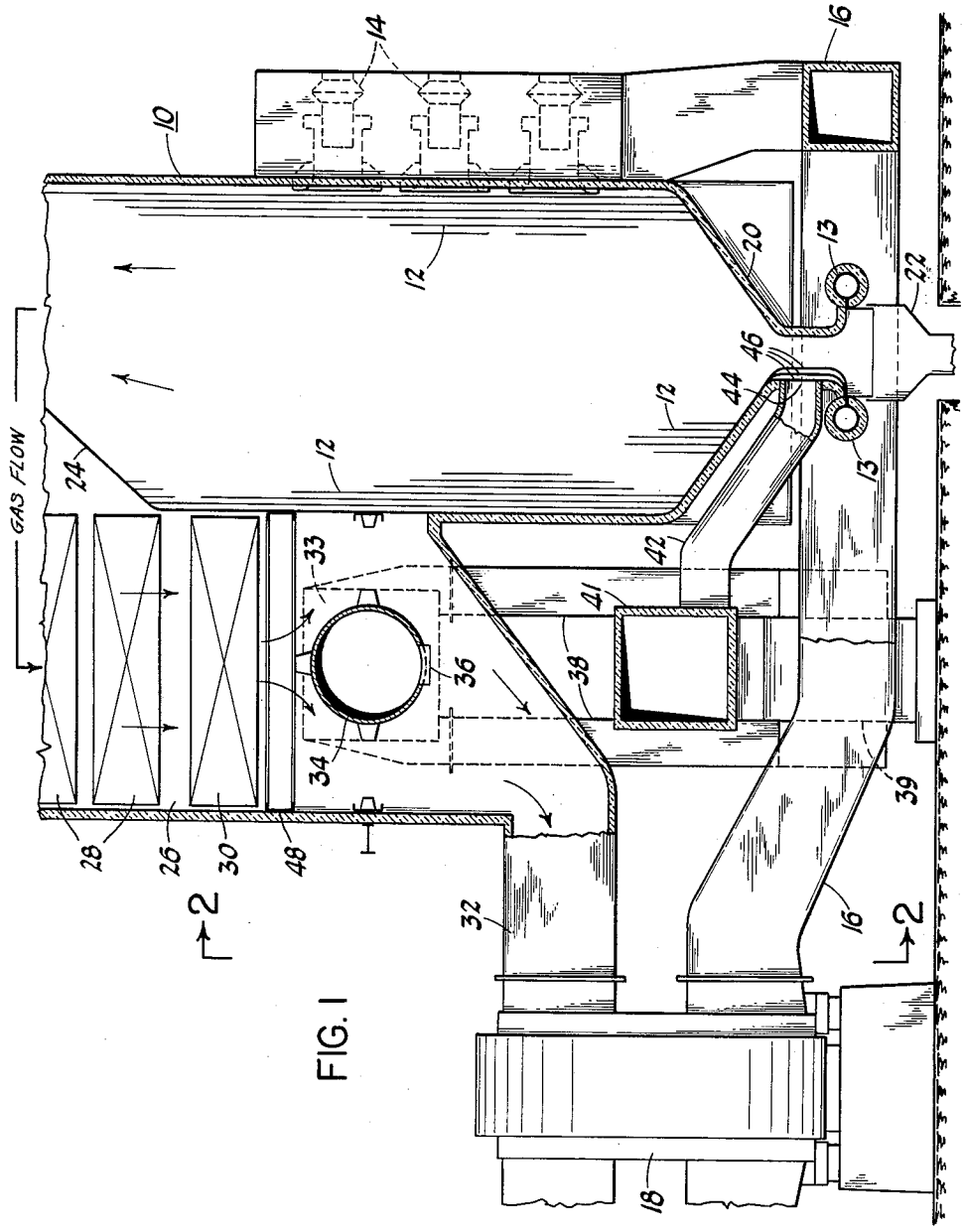


FIG. 1

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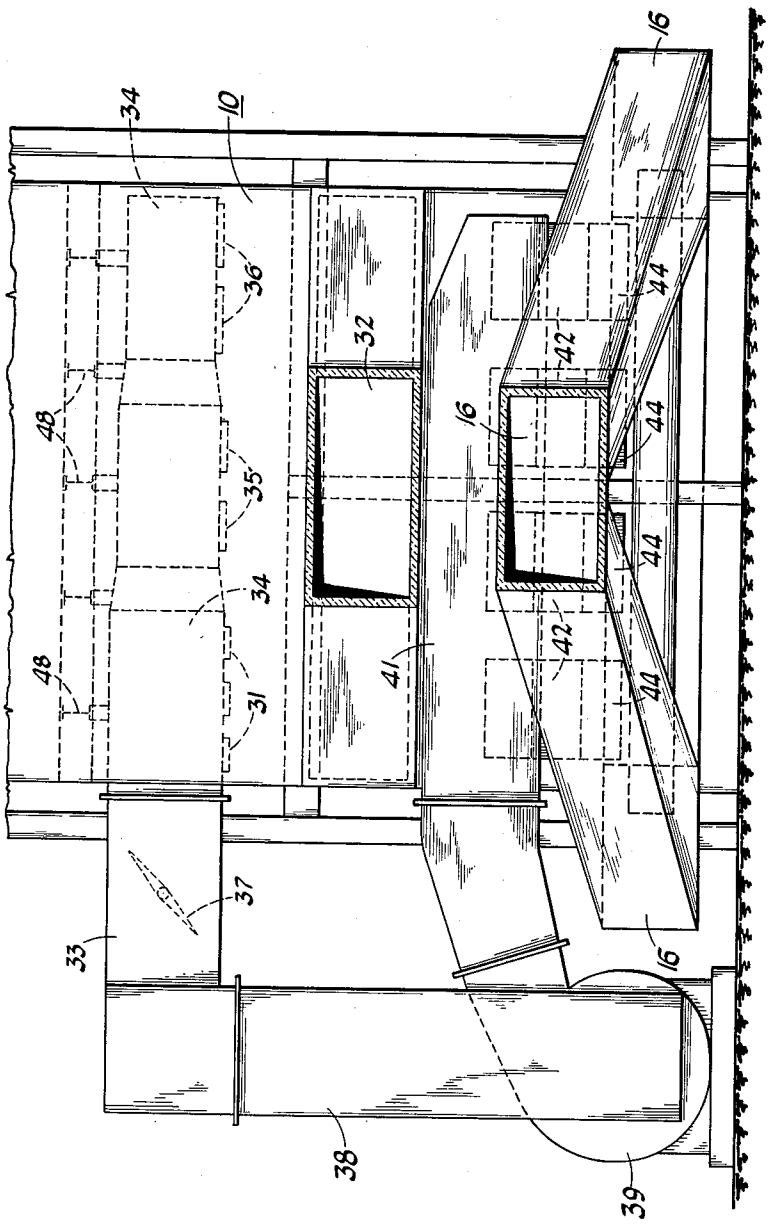


FIG. 2

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GAS RECIRCULATION DUCT

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This invention relates to steam generating units employing gas recirculation, where a portion of the gases leaving the furnace are recirculated back to the furnace for temperature control.

In modern steam generating plants, it is found that as the load requirements decrease, the steam temperature also decreases, and this is not desirable. To obtain greatest turbine efficiency, the steam should be kept at a constant temperature, regardless of the load requirements. One of the methods of maintaining constant steam temperature is by gas recirculation. As the load decreases, more combustion gas is recirculated back to the furnace. This prevents to a large extent the amount of heat that passes from the combustion gases within the furnace by radiation to the tubes lining the furnace walls, and hence leaves a greater amount of heat in the gases leaving the furnace outlet to be absorbed by the convection heat exchange members, such as the superheater and reheater. Also, a greater volume of gas leaves the furnace when recirculated gas is introduced into the furnace. In this manner, the steam temperature is maintained substantially constant, regardless of load changes.

This invention is particularly directed to the construction and position of the gas recirculation duct extending between the gas pass downstream of the heat exchange means and the furnace, and especially in a coal fired furnace. In a coal fire furnace, the hot combustion gases leaving the furnace contain a large amount of dust, fly ash and other foreign particles. In present steam generating units, dust collectors are usually installed in the recirculating gas ducts, on coal fired units, upstream of the fan to remove the dust and ash therefrom. If it is not removed, serious problems can result due to the large amount of such ash and dust being reintroduced into the furnace along with the recirculated gas.

In accordance with this invention, a portion of the recirculated gas duct is contained within the gas pass, and the openings thereto are on the underside, such that the gases entering must pass through a 180° turn. By such construction, a large portion of the fly ash, dust, and other foreign particles are prevented from entering the recirculated gas duct. This also gives protection to the fan in the recirculated gas duct, the abrasive action of the fly ash and dust on the fan being very damaging and costly.

Other advantages are that the duct within the gas pass need not be insulated. The temperature of the gases in the gas pass downstream of the heat exchange members is approximately 700° F., and normally the entire gas recirculation duct must be insulated. Also, positioning a portion of the duct within the gas pass results in a substantial saving of space. In large modern boilers this is of significance. Another advantage is that only one opening through the wall of the gas pass must be sealed, this being the opening through which the recirculated gas duct extends. In ordinary units utilizing gas recirculation, two or more openings are usually provided for attachment of gas recirculation ducts, which connections must be suitably sealed. The above listed advantages apply not only to a coal fired furnace, but apply equally well to any furnace, regardless of the type of fuel being burned.

Additional objects and advantages of the invention will appear from the following description of a preferred embodiment thereof when considered in conjunction with the accompanying drawings wherein:

FIGURE 1 is a sectional side elevation of a furnace employing gas recirculation;

FIGURE 2 is a view of the furnace taken along lines 2—2 of FIGURE 1.

Referring to FIGURE 1 of the drawings, 10 designates a horizontal cyclone fired furnace utilizing pulverized coal as a fuel. The walls of the furnace are lined with tubes 12, which absorb heat radiantly from the furnace gases to produce steam. These tubes 12 are supplied with water from lower headers 13. Pulverized coal along with air is introduced into the furnace through horizontal cyclone burners 14, the air being supplied by duct 16. This air is heated in air preheater 18 prior to introduction into the furnace. The furnace 10 contains a hopper bottom 20, the walls of which are also lined with tubes 12. Below the furnace is an ash compartment 22, into which the ash from the furnace is allowed to fall.

The hot combustion gases within the furnace rise upwardly past the narrow portion of the furnace formed by arch 24, then flow through a horizontal pass (shown schematically) and flow downwardly through vertical gas pass 26. Gas pass 26 contains convection steam heating means 28, such as a superheater and reheater, where a substantial portion of the heat of the hot combustion gases is withdrawn therefrom. The gases continue on past economizer 30, where more of the heat is utilized, and then flows on to air preheater 18 by means of duct 32.

A portion of the gases are withdrawn from gas pass 26 and are recirculated back to the furnace as the need arises. For this purpose a duct 34 extends into gas pass 26, and contains openings 31, 35, and 36 on the underside thereof by means of which the gases are allowed to enter the duct. The duct 34 is connected to duct 33 outside of the gas pass 26, which duct 33 passes recirculated gas to fan 39 by means of ducts 38. Manifold or duct 41 receives the discharge of fan 39. Extending transversely from manifold 41 are a plurality of ducts 42, which are connected to openings 44 in the bottom or throat of hopper 20. The tubes 12 are staggered, as shown at 46 in FIGURE 1, to allow entrance of the recirculated gas therebetween.

Duct 33 contains damper 37, by means of which the amount of recirculated gas passing back to the furnace can be regulated. This damper can be adjusted manually or automatically, as is well known in the art, to increase the amount of gas recirculation as the load requirements decrease, to thereby maintain a constant steam temperature.

As illustrated in FIGURE 2, the openings 31, 35, and 36 are substantially evenly spaced across the entire width of gas pass 26. Also, duct 34 is centrally located within the gas pass 26. This prevents an imbalance of gas flow through the heat exchange means 28 and 30 directly above duct 34, due to the suction created by fan 39 at openings 31, 35, and 36. Since the suction effect will be greatest near the left end, the openings can be made progressively larger, openings 36 being the largest. Duct 34 is supported directly beneath economizer 30 by means of I-beams 48, which can also be used to support the economizer. A circular or sloping contour at the top of duct 33 presents a streamlined surface, thereby insuring a minimum resistance to gas flow, and thus very little draft loss, as well as achieving a self-cleaning surface.

From the foregoing it can be seen that any gases to be recirculated back to the furnace must pass through a 180° turn to enter openings 31, 35, and 36 in duct 34. Due to the velocity of the flow through gas pass 26, and the force of gravity, very little fly ash, dust, or other foreign particles will be drawn into openings 31, 35, and 36 by the suction created by operation of fan 39. The sloping or cir-

cular top edge of duct 33 will tend to force the fly ash and dust impinging thereon away from the duct, thus preventing it from entering openings 31, 35, and 36. In summarizing, it can be seen that fly ash carryover to the gas recirculation system is reduced simply and efficiently, resulting in reduction of fan maintenance costs and reduction of reintroduction of such fly ash into the furnace. Also, the unit is compact and economical, there being no need for insulation of the duct within the gas pass.

While the preferred embodiment of the invention has been shown and described, it will be understood that such is merely illustrative and not restrictive.

What we claim is:

1. A steam generating unit comprising a furnace, fuel and air inlets for said furnace, an outlet leading from the upper portion of said furnace through which the hot combustion gases pass, vertical wall means forming a gas pass containing heat exchange means, said gas pass being connected to said furnace outlet such that the gases pass downwardly therethrough, a duct in communication at one end with the gas pass downstream of said heat exchange means, and in communication at its other end with said furnace, a fan in said duct, a portion of said duct contained within said gas pass, said portion of said duct extending across the center portion of the gas pass, a plurality of openings in said duct being evenly spaced across the width of the gas pass through which gases are allowed to flow from the gas pass into said duct, said openings being positioned on the underside of said duct, such that the gases flowing in the gas pass must make a 180° turn to enter said openings, said openings progressively decreasing in size, the smallest opening being located the closest to the fan, so there is no imbalance of flow of gases through the portion of the gas pass containing said heat exchange means due to the suction effect of said fan.

2. In a steam generating unit, a furnace, fuel and air inlets for said furnace, an outlet leading from said furnace through which the hot combustion gases pass, wall means forming a gas pass containing heat exchange means, said gas pass being connected to said furnace outlet, a duct in communication at one end with the gas pass downstream of said heat exchange means, and in communication at its other end with said furnace, a fan in said duct, a portion of said duct contained within the gas pass, said portion of said duct extending across the center portion of the gas pass, a plurality of openings in said duct through which gases are allowed to flow from the gas pass into said duct, said openings being positioned such that the gases flowing in the gas pass must make a 180° turn to enter such openings, thereby preventing ash or other foreign particles carried by said gases from entering the duct, said openings progressively decreasing in size, the smallest opening being located the closest to the fan, so there is no imbalance of flow of gases through the portion of the gas pass containing said heat exchange means due to the suction effect of said fan.

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