Dec. 28, 1965 R. T. BRADY ETAL 3,226,038

COMBUSTOR FOR A STEAM GENERATOR

Original Filed May 6, 1963 2 Sheets-Sheet 1

FIG.4

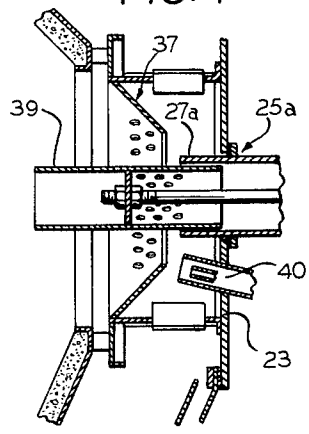

FIG.1

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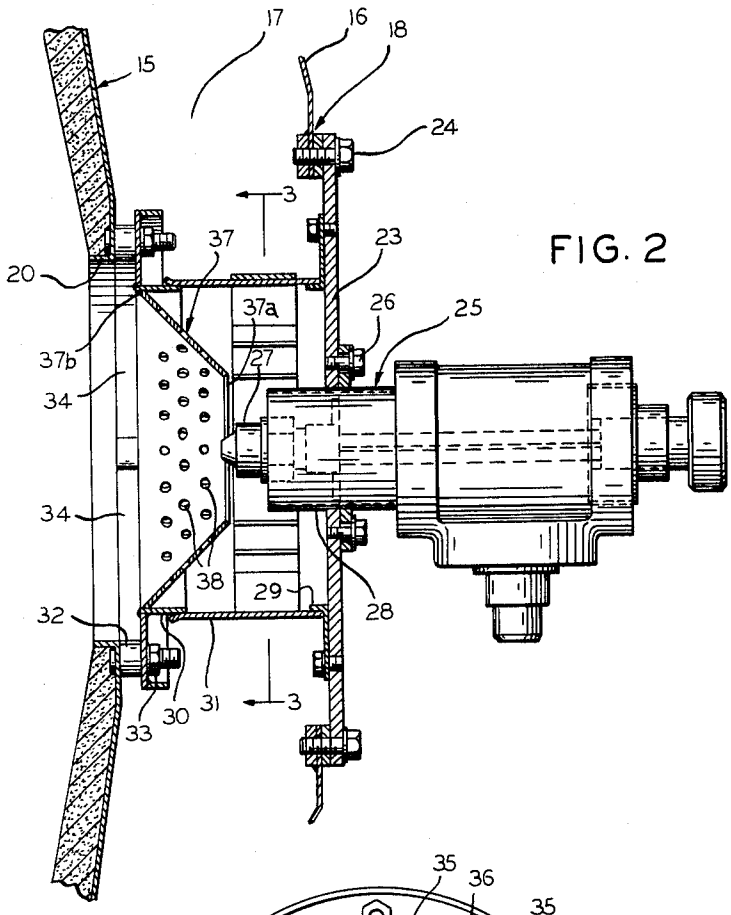

FIG. 2

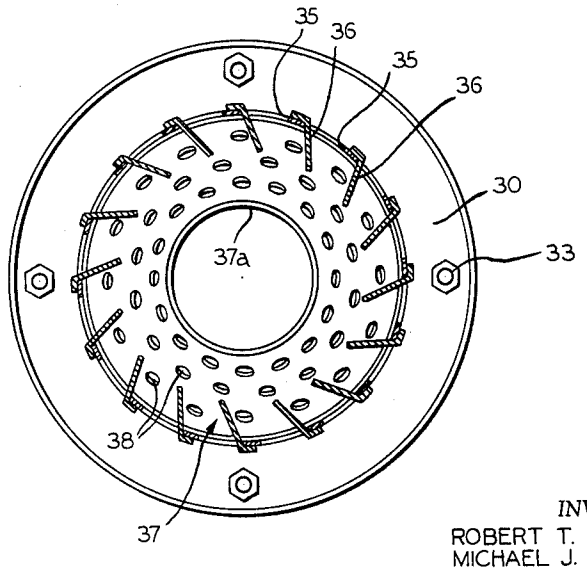

FIG. 3

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COMBUSTOR FOR A STEAM GENERATOR

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Continuation of application Ser. No. 278,329, May 6, 1963. This application Apr. 20, 1965, Ser. No. 456,597
4 Claims. (Cl. 239—405)

This is a continuation of application Serial No. 278,329, filed May 6, 1963, now abandoned.

This invention relates in general to a combustor or burner for a boiler or steam generator, and more particularly to a combustion system capable of keeping combustion within a chamber and aiding in balancing distribution of the resultant energy, and still more particularly to a burner assembly for providing an efficient combustion system.

The combustor of the present invention generally includes a fire pot arranged within a casing that defines therewith a plenum chamber. Air is supplied through the plenum chamber to a burner assembly which is mounted in association with a combustion throat of the fire pot. The burner assembly includes a fuel nozzle surrounded by an air register that controls the supply of air to the nozzle area from the plenum chamber, a stabilizing cone for stabilizing the flame front, and air passage means between the stabilizing cone and the combustion throat. Either oil or gas nozzles may be employed depending upon the desires of the user. Further, a choke is provided in the fire pot that is flared to direct the gases being discharged from the fire pot into the desired area of use.

It is therefore an object of this invention to provide an improved combustor or burner for a steam generator, wherein the combustor is compact and provides efficient and quite complete combustion which approaches stoichiometric combustion.

A further object of this invention resides in the provision of a combustor for a steam generator capable of producing high heat release rates with comparatively low air pressures.

A still further object of this invention resides in the provision of a combustor for a steam generator having a burner assembly capable of enabling substantially complete combustion within a combustion chamber and aiding balancing of the distribution of the resultant energy.

Another object of this invention is to provide a combustor for a steam generator having a burner assembly capable of inducing internal recirculation of the combustion products within the combustion chamber and thereby to contain the fire within the combustion chamber resulting in improved combustion.

Another object of this invention is the provision of a combustor in a steam generator of simplified construction capable of inducing internal recirculation for aiding the combustion process.

Other objects, features and advantages of the invention will be apparent from the following detailed disclosure, taken in conjunction with the accompanying sheets of drawings, wherein like reference numerals refer to like parts, in which:

FIG. 1 is an elevational view of a steam generator equipped with the combustor of the present invention, showing some parts in section and other parts broken away and still other parts diagrammatically for simplicity purposes;

FIG. 2 is a greatly enlarged side elevational view with some parts in section of a burner assembly having an oil nozzle according to the present invention;

FIG. 3 is a transverse sectional view taken substantially along line 3—3 of FIG. 2; and

FIG. 4 is a vertical sectional view taken through a burner assembly in accordance with the present invention and showing a gas nozzle.

Referring now to the drawings, and particularly to FIG. 1, a steam generator **10** includes a combustor or burner **11** according to the present invention that delivers hot gases to the heat transfer means or water tubes **12**. Water and steam are pumped through the water tubes **13** by means of a circulating water pump **13**, and the steam is separated from the water in the drum **14**. Since the details of the steam generator other than in the combustor **11** are not relavant to the present invention, the remainder of the application will refer only to the combustor **11**.

The combustor **11** includes generally a fire pot **15** surrounded by a casing **16** that defines therewith a plenum chamber **17**, and a burner assembly **18**. The plenum chamber **17** is annular and is supplied with air by means of a blower **19** so that the chamber remains pressurized during the operation of the combustor **11**.

The fire pot **15** is generally cylindrical in shape and consists of a refractory lined can having a combustion throat **20** at one end and a choke **21** at the other end. The combustion throat and choke are centrally located in the opposite ends of the fire pot. Moreover, the choke **21** is flared at **22** for enabling the heat energy, both radiant and convective, issuing from the fire pot to be appropriately distributed into the heat exchange area of the steam generator where the water tubes **12** are mounted.

Referring now particularly to FIGS. 2 and 3, the burner assembly **18** includes a mounting plate **23** secured to an opening in the casing **16** by means of a plurality of fasteners **24**. A central opening is provided in the plate **23** for receiving the burner nozzle unit **25**. In this illustration, an oil nozzle is shown, but it should be appreciated that a gas nozzle may be employed as shown in FIG. 4. A plurality of fasteners **26** mount the burner nozzle unit **25** in place on the mounting plate **23**, whereby easy removal of the burner nozzle assembly may be accomplished for cleaning or servicing thereof. The burner nozzle unit **25** includes an oil nozzle **27** and a hood **28** surrounding the nozzle for the purpose of directing cooling air to prevent the nozzle from varnishing. When using gas in the burner assembly **18**, it is not necessary to employ the cooling air.

The burner assembly further includes a flange **29** mounted on a mounting plate **23**, and a flange **30** in opposed spaced relation therewith for receiving a cylindrical air register **31**. The flange **30** is suitably mounted in spaced relationship from the entrance to the combustion throat **20** by means of spacers **32** and fasteners **33**. Air passage means **34** is provided between the flange **30** and the entrance to the combustion throat **20** as seen particularly in FIG. 2.

The air register **31** defines the intercommunication between the plenum chamber and the area about the nozzle **27**, and includes a plurality of circumferentially spaced openings **35**, each of which has associated therewith a louver or air deflector **36**. Each louver **36** extends inwardly from its associated opening **35** and at an angle to a radius drawn from the center of the air register to the point of entry within the register of each louver. Essentially, the air register may be considered a spinner louver.

Preferably, the louvered openings are in substantial alignment with the end of the fuel nozzle **27**. Also in substantial alignment with the end of the fuel nozzle **27** is the inlet end **37***a* of a stabilizing cone **37**. The outlet

end 37*b* of the stabilizing cone is adjacent to the combustion throat 20 and coplanar with the end of the flange 30 adjacent to the combustion throat. In fact, the diameter of the cone outlet 37*b* is substantially equal to the diameter of the flange 30 and is secured thereto by any suitable means such as by welding or the like. The stabilizing cone 37 is perforated and therefore provided with a plurality of holes 38. It may be noted that the cone 37 is coaxial with the fuel nozzle 27, the cylindrical air register 31 and the annular flange 30. Further, the air passage means or opening 34 is arranged between the outlet end of the stabilizing cone 37 and the fire pot 15.

The embodiment of FIG. 4, showing a burner assembly 25*a*, is the same in all respects as far as operation and general construction as the embodiment of FIGS. 2 and 3 with the exception that this assembly is constructed to employ gas as a fuel. A fuel nozzle 27*a* is shown having its outer end in substantial alignment with the louvered openings and the inlet end of the stabilizing cone. Additionally, a perforated gas pipe spreader 39 is mounted in the end of the fuel nozzle 27*a* for spreading the gas as it leaves the nozzle. This spreader may be of the type shown or a cone spreader of the usual type. A pilot burner 40 is provided to light the gases of the burner, and this pilot burner may be arranged in a suitable location such as where shown projecting through the mounting plate 23. It should also be understood that some pilot lighting device would be provided with the burner assembly unit 25 in the embodiment of FIG. 2.

In operation, air is introduced into the annular plenum chamber 17 surrounding the fire pot 15 in accordance with proper ratios. The air is heated as it passes over the outer surface of the fire pot 15, and thereby cools the fire pot. Then the air passes through the air-fuel mixing section of the burner assembly, wherein a predetermined amount enters the louvered openings of the air register and a predetermined amount enters through the openings 34 under the stabilizing cone. The spinner louvers of the air register swirl the air and provide turbulent air for thorough mixing with the fuel. Further, the spinner louver centrifuges or spreads the mixture throughout the combustion chamber of the fire pot. The refractory in the fire pot reflects radiant energy to the center of the fire pot thereby enhancing and improving combustion. Air is wiped against the stabilizing cone 37 to stabilize the flame front, and the cone acts as a vortex sieve providing localized recirculation for flame stabilization and aiding of combustion.

On oil fired burner assemblies, a single air atomizing nozzle of multi-port design imparts the necessary atomization and momentum to the fuel for delivery into the appropriate areas for combustion. On gas fired burner units, either a cone spreader or a perforated pipe as shown is used to distribute the gas. The multi-directional streams of air and fuel meet at the combustion throat 20 where intimate mixing of air and fuel takes place. This mixture then proceeds into the combustion chamber where the sudden enlargement decreases the velocity to that of the fuel burning rate. As the products of combustion proceed out of the combustion chamber of the fire pot, they are forced through the choke 21, which sets up a recirculation within the combustion chamber without the aid of any secondary air or apertures. This recirculation brings heat, ions, and radicals back into the mixing zone to aid combustion and stabilizaton. And as heretofore mentioned, radiation from the refractory and surface combustion on the refractory also aid the burning process. As the gases issue from the choke 21, they are distributed to their point of use with the aid of a flared choke surface 22. Radiant energy from the flare choke is also directed into the areas of use.

From the foregoing, it is appreciated that the combustor or burner of the present invention is capable of obtaining comparatively high heat release rates with low air pressure through the use of large air passages in the air-fuel mixing section.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention, but it is understood that this application is to be limited only by the scope of the appended claims.

The invention is hereby claimed as follows:

1. In a combustor having a fire pot with a combustion throat, a burner assembly for the combustion throat comprising, a mounting plate spaced from said throat and having an opening therethrough, a burner nozzle unit mounted on said plate and projecting through said opening toward and coaxially of said combustion throat, a cylindrical air register extending between said mounting plate and said fire pot and in coaxial alignment with said throat and said burner nozzle unit and terminating just short of said fire pot to define first air passage means between the area about said air register and said throat, means defining second air passage means between said area about said air register and the interior thereof for permitting air to enter the air register behind the discharge end of said burner nozzle unit, perforated frusto-conical shell having its small end in substantial coaxial alignment with the discharge end of the burner nozzle unit and its larger end terminating at the end of the cylindrical register positioned adjacent to the fire pot, and means for supplying air to said first and second air passage means.

2. The combination as defined in claim 1, wherein said second air passage means includes a plurality of circumferentially spaced and radially aligned openings in said air register.

3. The combination as defined in claim 2, wherein a louver is provided for each of said openings in the air register.

4. The combination as defined in claim 3, wherein each louver is angularly offset from a radius of said air register.

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