Nov. 2, 1965 C. E. NELSON 3,215,098

BURNER THROAT

Filed Sept. 26, 1963

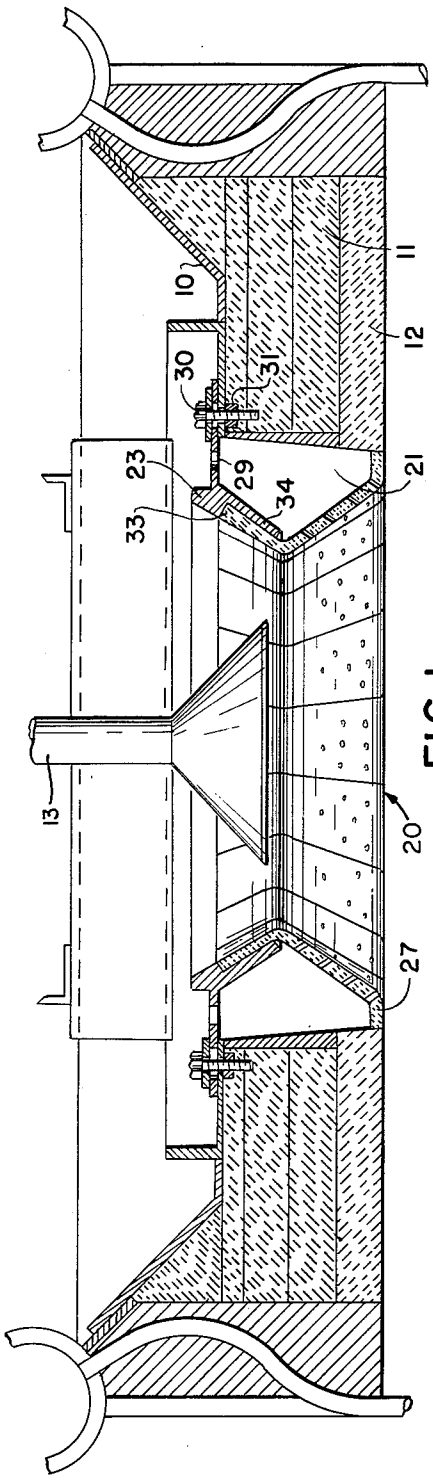

FIG. 1

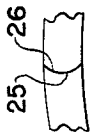

FIG. 4

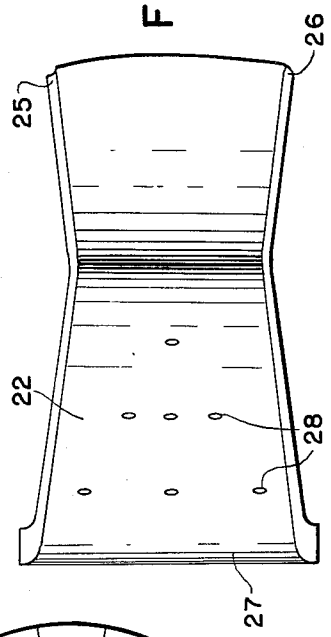

FIG. 2

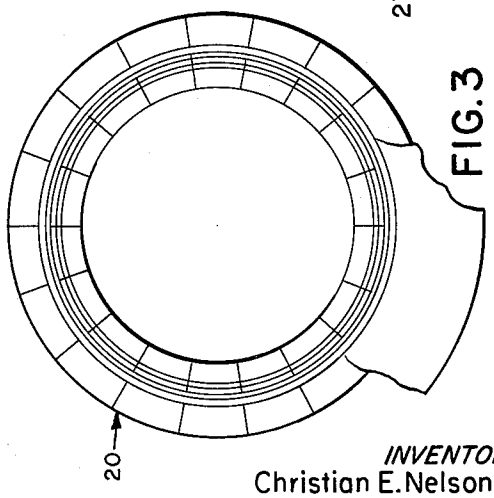

FIG. 3

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BURNER THROAT

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This invention relates to a refractory burner throat for boilers, steam generators, heat exchangers or similar combustion devices fired with fossil fuels or waste materials. The device of the invention is particularly suited for roof-fired applications where suspension of refractory materials is a requisite, but is also applicable to other forms of installations in these devices.

Among the objects of the invention is to provide a highly refractory burner throat which has an increased useful life-span, and low installation and maintenance costs.

Refractory burner throats employed in combustion furnaces are shaped like a venturi tube so as to provide a suction to draw air or other combustion supporting gases into the furnace and are subject to frequent failures which our investigation has shown to be due to a number of causes, such as insufficient anchorage for the relatively heavy mass, thermal spalling due in part to tensions set up by the anchoring means for the heavy refractory mass, and chemical attack by the fuel oil ash, etc., which results in slag formation.

Among other objects of the invention is to provide a refractory throat for roof fired boilers which is of relatively light weight and is easy to install.

Among further objects of the invention is to provide a "venturi" throat having controlled perforations or pores providing a positive flow of cooling air over the hot face thereof to provide hot face temperature control by transpiration cooling.

Another object of the invention is to provide a venturi throat of hollow construction for high temperature applications so as to provide an internal chamber into which air is piped from an adjacent wind box to provide internal cooling for the device.

Among further objects of the invention is to provide a burner throat construction in which the refractory material of the throat is placed under compressive stress so as to avoid failure due to unequal tensions such as may be set up by thermal gradients.

Among still further objects of the invention is to provide a burner throat which is highly refractory, highly resistant to chemical attack and which has relatively high thermal conductivity. The high thermal conductivity of the throat of the invention reduces the thermal gradient thereof and improves the thermal shock resistance of the body.

These and other objects of the invention are attained by constructing the throat of a plurality of separate sectors, so constructed that they can be placed under compression when assembled, said sectors being formed with relatively thin walls and shaped to cooperate with the wall to which they are attached to form a hollow chamber between the sectors and the wall.

Preferred materials for constructing the throat of the invention are oxide-metallic systems comprising sintered ceramic oxide particles bonded with the aid of metallic particle or metallic base materials such as metallic base sponge coated on both hot and cold faces with a refractory oxide. Thus the throat sectors preferably comprise an interior refractory metal reinforcement, for example, a sponge or expanded refractory metal, embedded in refractory oxide materials. Examples of the internal metal reinforcement are expanded sheets of stainless steels, nickel or nickelcobalt alloys, etc. Examples of the refractory oxide coating or embedding materials are the oxides of silicates of aluminum, zirconium, thorium, beryllium, etc. the spinels of the formula $M''O.Al_2O_3$ where M''O is a bivalent metal oxide such as MgO, MnO, CaO, NiO, CoO, etc. refractory carbides such as silicon carbide, and mixtures of such compounds.

Further objects and advantages of the invention will become apparent as the description proceeds.

In the accompanying drawing:

FIG. 1 is a side cross sectional view of a throat installation made according to the present invention.

FIG. 2 is a plan view of a single sector.

FIG. 3 is a top plan view of the completed throat.

FIG. 4 is a detail end view of a joint between two throat members.

FIG. 1 shows the roof of a boiler which includes a ring lining or supporting member **10**, a ring of fire clay with refractory tile lining **12** at the interior surface and the nozzle **13** for supplying the fuel. Said nozzle **13** is centrally located with respect to the throat **20** but there is considerable space therebetween to permit the passage of air into the boiler. Conveniently throats are made to substantially fill the space between the rings formed by fire clay **11** and tile **12**. The throat of the present invention is formed of thin sections so that, while retaining the venturi shape of the opening, a hollow space **21** is formed between the throat and the ring. A reduction in weight of about 90% is achieved by this thin wall construction.

The throat **20** is formed of a plurality of sectors **22** (18 in the one shown) which are fitted together and held within the metal supporting ring **23**. The ring **23** includes the interior annular abutment **33**, and the inwardly projecting annular flange **34** which supports and holds the throat pieces from the inlet side of the throat. The inner ends or sides **27** of the throat members contact the wall **12** to define the hollow region **21**. The 18 sectors **22** combined are large enough so that they fit tightly into the ring **23** and are under some compression at room temperature. Since such bodies have a positive index of thermal expansion, the compressive stress increases as the temperature increases during use. The separate sectors **22** are united by any suitable cement as they are assembled to form the complete throat. Epoxy resin has been found to be very satisfactory for cementing the sectors together. As shown in FIGS. 2 and 4, each sector **22** has a simple grooved edge **25** at one side and a tongue **26** adapted to interfit with the grooved edge **25** of the next sector, at the opposite edge.

The forward end **27** of each sector also includes a number of openings **28** and supporting ring **23** also contains a series of spaced orifices **29**. Thus air also passes through orifice **29** into the hollow region **21** and out through orifices **28** which in effect are transpiration cooling orifices.

The ring **23** is attached to the rings **10** and **11** by bolts **30** and nuts **31**. The entire throat of 18 sectors **22** and the ring **23** is assembled outside of the boiler and can then be lowered from the burner opening in the boiler roof, accurately positioned in the ring **10**, **11** and secured thereto by one man.

In an actual example, a burner throat constructed of 18 segments **22** made of the stainless steel reinforcement such as "Sicoride AM 38" embedded in a sintered mass of alumina, beryllia and zirconium oxide particles has a softening point of about 3700° F. (about 2040° C.), a density of about 3.9, a thermal expansion of 8.5×10^{-6}, relatively high thermal conductivity, compressive strength of 450,000 p.s.i. etc., and with a diameter of about 16" weighs about 45 lbs. This throat is resistant to thermal shock and to spalling and operates very satisfactorily although it weighs only about 10% of that of a solid throat.

Thus, in the construction shown, the venturi throat is internally cooled by passing combustion air through its hollow structure and the same air further cools the hot face through transpiration by way of the pores or holes **28** of the structure.

The features and principles underlying the invention described above in connection with specific exemplifications will suggest to those skilled in the art many other modifications thereof. It is accordingly desired that the appended claims shall not be limited to any specific feature or details thereof.

I claim:

1. In a combustion apparatus including a combustion chamber having one wall provided with a circular inlet opening and a concentrically positioned nozzle extending from the outer side of said wall for the injection of fuel through said circular opening, an improved throat construction comprising

a plurality of interfitting segments united to form a venturi throat extending radially inwardly from the periphery of said circular opening,

each of said segments being of relatively thin-walled construction defined by two outer, circumference-forming edges, sloping inwardly to form the venturi constriction in the assembled throat, one of said circumference-forming edges being adjacent the outer side of said wall and the other of said circumference-forming edges being adjacent the inner side of said wall,

a metal ring circumferentially held on the outer side of said wall with the interior portion of the ring extending radially within said circular opening,

said metal ring having an interior shoulder portion adapted to embrace that circumference-forming edge of the composite segments which is adjacent the outer side of said walls,

said metal ring also having a flange portion embracing a substantial portion of the outer circumferential surface of the composite segments which is adjacent the outer side of said wall,

the circumference-forming edges of the composite segments which are adjacent the inner side of said wall being constructed to contact said wall at the inner edge of said circular opening whereby the define a hollow region between the surface of the opening in said wall and the outer circumferential surface of the composite interfitting segments.

2. A combustion apparatus as defined in claim **1**, wherein

each of said segments has at least one opening extending therethrough in the region thereof nearest the inner side of said wall,

said ring member having at least one opening extending into the hollow region between the throat segments and the circular opening in said wall of the combustion apparatus

whereby said openings in said segments and said ring member constitute transpiration openings for cooling said throat.

3. A combustion apparatus as defined in claim **1** wherein said wall with the circular opening is the roof of a roof-fired boiler.

4. A combustion apparatus as defined in claim **1** wherein each of said sectors comprises one side edge portion in the form of a groove and one side edge portion in the form of a tongue interfitting with the side edge groove in the adjacent sector.

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