Aug. 4, 1953 S. A. SLOAN 2,647,568

BURNER THROAT

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Fig. 1.

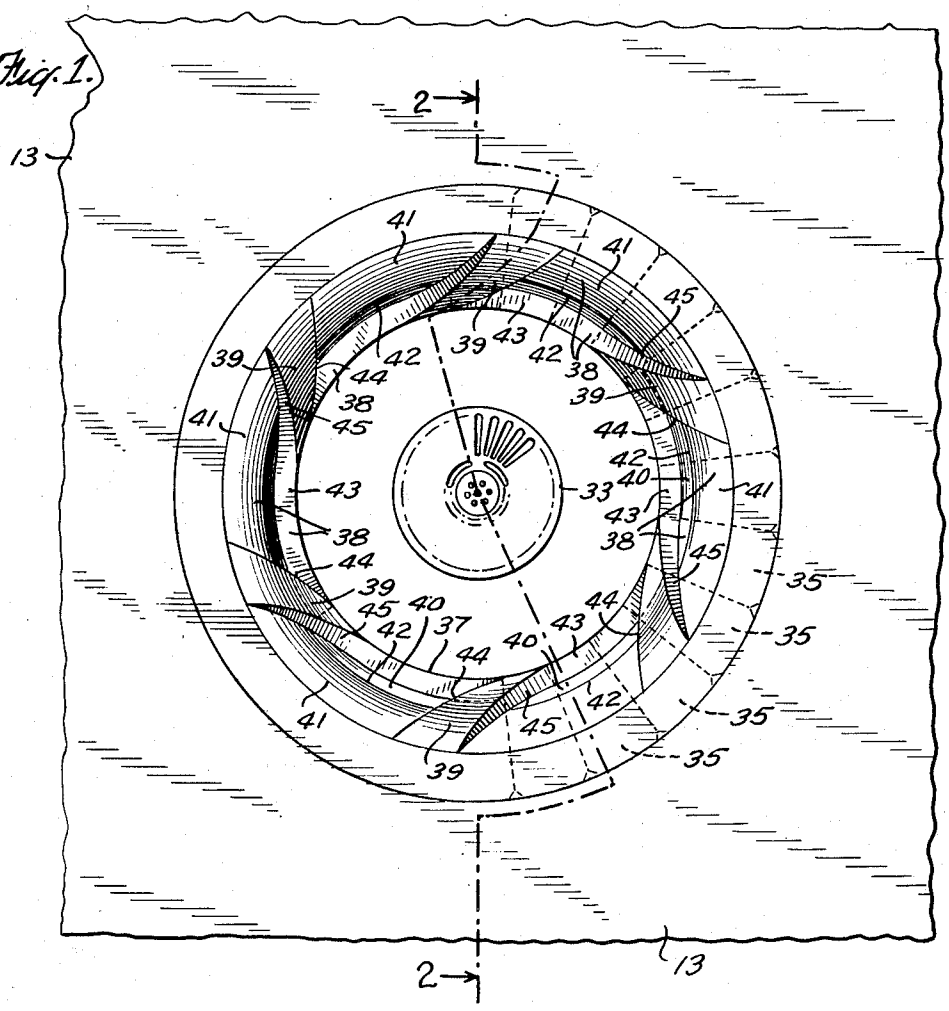
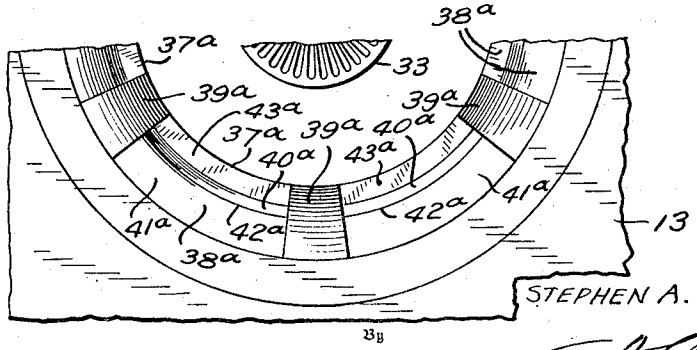


Fig. 3.



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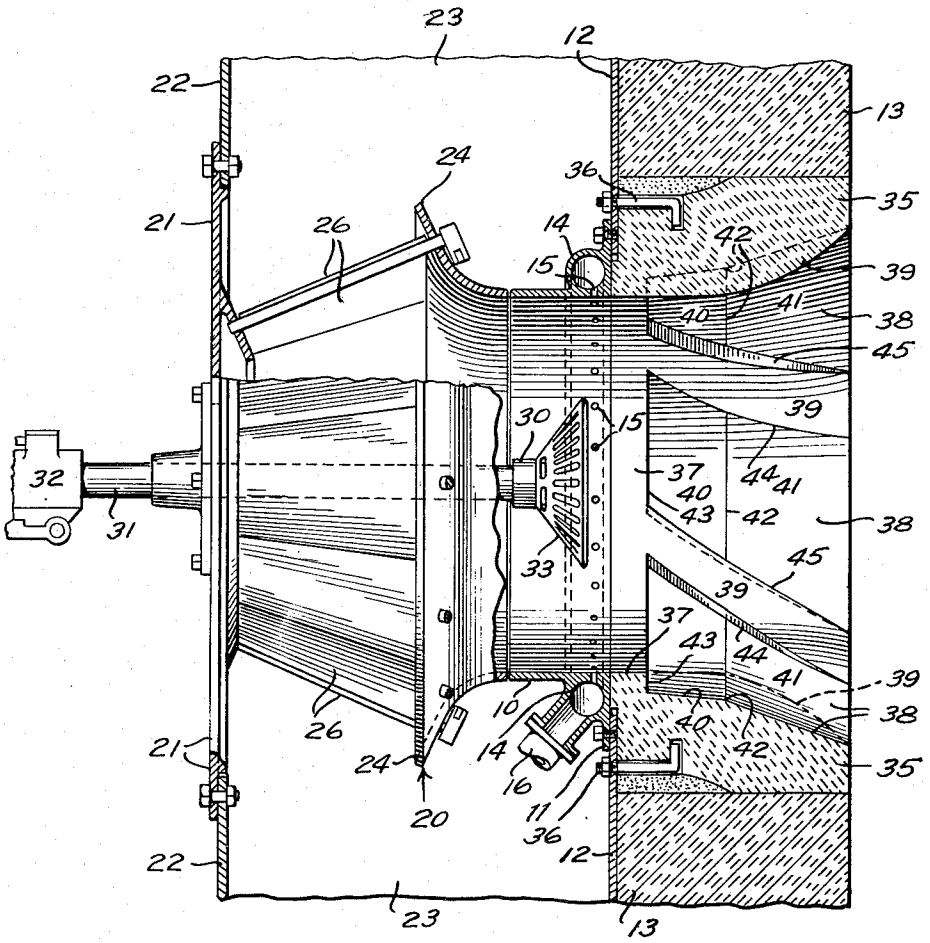
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Fig. 2.



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BURNER THROAT

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8 Claims. (Cl. 158—76)

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This invention relates to fuel burners and has for an object to provide a burner which is stable in operation.

Another object is to provide a burner which maintains ignition even in the presence of a large excess of air.

Another object is to provide a novel and improved burner throat having greatly improved stability.

Various other objects and advantages will be apparent as the nature of the invention is more fully disclosed.

In fuel burners of the type in which the fuel is burned in suspension there may be a tendency toward instability, particularly at extremely low burner capacities where a large excess of air is available. For example if the burner were set to operate at one-tenth of its maximum capacity, the air supply normally would be cut to one-tenth of its maximum. However, the fans would be capable of delivering ten times as much air as would be required to burn this reduced amount of fuel and if, due to some malfunctioning of the controls, the full amount of air were supplied even temporarily, it could cause the burner to blow out. Such conditions might also exist in normal plant operations when starting up a unit as well as under other circumstances.

The present burner throat obviates this difficulty and prevents the flame from being blown out under such conditions.

This is accomplished in general in accordance with the present invention by providing the burner throat with a short annular portion adjacent the fuel injection zone of the same diameter as the burner tube and forming an unimpeded continuation thereof.

Beyond this annular portion the throat diameter is increased to form an annular ledge which provides a sharp drop-off for the air-fuel mixture as it passes thereover to the zone of larger diameter. This drop-off produces eddy currents in the mixture which serve to retain combustion and prevent the flame from being blown out even by a large excess of air.

The portion of increased diameter may be formed by recessed segmental areas in the throat surface and extending from the ledge rearwardly to the furnace end of the throat. The recessed segmental areas may be spaced to leave raised ribs therebetween which extend either axially or in a direction inclined thereto and have radial sides adapted to form additional ledges with a sharp drop-off over which the rotating mixture passes and forms additional eddy currents. The

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ribs are preferably so formed that the upper surfaces thereof do not project above the normal burner throat contour so as to impede the normal rotation of the gases.

The nature of the invention will be better understood by referring to the following description, taken in connection with the accompanying drawing in which a specific embodiment has been set forth for purposes of illustration.

In the drawings:

Fig. 1 is a rear elevation of a burner throat as seen from the furnace end;

Fig. 2 is a broken side elevation, partly in section taken on the line 2—2 of Fig. 1 showing the complete burner; and

Fig. 3 is a partial rear elevation of a burner throat illustrating a different arrangement of ribs.

Referring to the drawings more in detail, the invention is shown as applied to a burner comprising a burner tube 10 having a flange 11 which is attached to the front plate 12 of a furnace wall 13 and has formed therein an annular gas ring 14 having exit orifices 15 extending around the periphery of the burner tube through which gas is supplied to the throat. The gas ring 14 is connected to a suitable supply pipe 16.

The burner tube 10 is mounted in registration with an air register 20 having a front plate 21 connected to a wall 22 which is spaced from the furnace wall to provide a plenum chamber or wind box 23, and having a back plate 24 provided with an opening which registers with the burner tube 10. The air register is provided with the usual peripheral air doors 26 which are mounted for relative rotation to vary the rotation of the air supplied therethrough to the burner tube.

The burner is also shown as including an oil atomizer tip 30 carried by a barrel 31 extending axially through the air register and having coupling means 32 at its forward end to provide for the supply of fuel to the burner. A diffusion plate 33 is positioned on the barrel 31 adjacent the atomizer tip 30. It is to be understood that the portion of the burner thus far described is of standard construction and only so much thereof has been set forth as is necessary to an understanding of the invention.

The furnace wall 13 is provided with a burner opening in which throat tile 35 are secured by suitable means as by angle bolts 36. The throat tile in the embodiments shown are formed with a cylindrical annular surface 37 which registers with and forms a continuation of the inner surface of the burner tube 10 and with a plurality

of segmental recessed portions 38 which extend toward the furnace end of the throat from the annular portion 37 and form therebetween a plurality of ribs 39. The recessed portions 38 are flared and are shown as comprising a forward slightly flared portion 40 and a rearward more highly flared portion 41 intersecting along a peripheral line 42 although it is to be understood that the recessed segments 38 may be flared along a smooth curve or a straight line if desired.

At the forward end the segments 38 terminate in a radial wall 43 which forms a sharp angle with the annular surface 37. The sides 44 to 45 of the ribs 39 are preferably formed along radial lines so that a sharp edge is formed with their upper surfaces. The upper surfaces of the ribs extend from the annular surface 37 in a gradual curve flaring outwardly to meet the flared surface 41 of the recessed portions 38 at the furnace end of the throat tile. Hence the ribs 39 taper in thickness from their formed end to the furnace end.

In the embodiment shown in Figs. 1 and 2 the ribs 39 are inclined with respect to the axis of the burner and are preferably inclined in the direction to cross the rotating air-fuel mixture so that the rotating mixture flows over the trailing edges of the ribs to form eddy currents which assist in retaining combustion. The throat may be formed of segmental tile in accordance with usual practice, as indicated by dotted lines in Fig. 2.

In the embodiment of Fig. 3 the ribs 39*a* extend in an axial direction. This may be preferred in certain instances and permits the rib to be formed on a single tile segment.

In this invention the annular ledge formed by the surface 37 and wall 43 and the ledge formed by the trailing sides of the ribs 39 produce eddy currents which serve to stabilize combustion. It has been found that burners embodying this invention are stable under the most adverse conditions encountered in commercial operations.

The greatest zone of eddy current formation is at the annular ledge formed by the wall 43 and at the forward ends of the ribs 39 where their thickness is greatest.

Under moderate conditions the ribs 39 may be omitted and increased stability obtained by means of annulus 37 and wall 43, although for maximum stability under most extreme conditions the ribs have been found essential. Likewise, the ribs may be employed without the annulus under certain conditions.

The wall 43 and the sides of the ribs have been shown as radial to provide sharp ledges over which the mixture flows with a sharp drop-off. Obviously the shape may be modified somewhat provided the ledge effect is retained as distinguished from a sloping surface which may change the direction of the mixture flowing thereover without producing substantial eddy currents.

The oil atomizer may be used in conjunction with or in place of the gas ring. The throat construction is not restricted to any specific burner construction although it is most effective in burners having peripheral fuel injection and rotating air-fuel mixtures at the throat.

What is claimed is:

1. A burner having air and fuel admission means and a refractory member having an imperforate annular surface flaring rearwardly to form a burner throat, said throat having a narrow peripheral surface and having an outwardly flared surface extending rearwardly therefrom, said outwardly flared surface being depressed radially beyond said peripheral surface to form an annular ledge adapted to produce eddy currents in the air-fuel mixture flowing thereover, and a plurality of ribs spaced peripherally around said flared surface and extending rearwardly from said peripheral surface to the rearward end of said throat, said ribs having a peripheral surface no portion of which extends radially inward beyond said first peripheral surface and having sides extending substantially normal to said peripheral surface of said ribs to form a ledge adapted to form eddy currents in the mixture passing thereover.

2. A burner having air and fuel admission means and a refractory member having an imperforate annular surface flaring rearwardly to form a burner throat, said throat having a narrow peripheral surface and having an outwardly flared surface extending rearwardly therefrom, said outwardly flared surface being depressed radially beyond said peripheral surface to form an annular ledge adapted to produce eddy currents in the air-fuel mixture flowing thereover, and a plurality of ribs spaced peripherally around said flared surface and extending rearwardly from said peripheral surface to the rearward end of said throat, said ribs having a peripheral surface no portion of which extends radially inward beyond said first peripheral surface and having sides extending substantially normal to said peripheral surface of said ribs to form a ledge adapted to form eddy currents in the mixture passing thereover, said ribs tapering in radial thickness from said first peripheral surface rearwardly and merging rearwardly in said flared surface.

3. A burner having air and fuel admission means and a refractory member having an imperforate annular surface flaring rearwardly to form a burner throat, said throat having a narrow peripheral surface and having an outwardly flared surface extending rearwardly therefrom, said outwardly flared surface being depressed radially beyond said peripheral surface to form an annular ledge adapted to produce eddy currents in the air-fuel mixture flowing thereover, and a plurality of ribs spaced peripherally around said flared surface and extending rearwardly from said peripheral surface to the rearward end of said throat, said ribs having a peripheral surface no portion of which extends radially inward beyond said first peripheral surface and having sides extending substantially normal to said peripheral surface of said ribs to form a ledge adapted to form eddy currents in the mixture passing thereover, said ribs tapering in radial thickness from said first peripheral surface rearwardly and merging rearwardly into said flared surface, said ribs being inclined to the axis of said throat in a direction to extend across the rotating air-fuel stream flowing therethrough.

4. A burner having air and fuel admission means and a refractory member having an imperforate annular surface flaring rearwardly to form a burner throat, said throat having a narrow peripheral surface and having an outwardly flared surface extending rearwardly therefrom, said outwardly flared surface being depressed radially beyond said peripheral surface to form an annular ledge adapted to produce eddy currents in the air-fuel mixture flowing thereover, and a plurality of ribs spaced peripherally around said flared surface and extending rearwardly from said peripheral surface to the rearward end of

said throat, said ribs having a peripheral surface no portion of which extends radially inward beyond said first peripheral surface and having sides extending substantially normal to said peripheral surface of said ribs to form a ledge adapted to form eddy currents in the mixture passing thereover, said ribs tapering in radial thickness from said first peripheral surface rearwardly and merging rearwardly into said flared surface, said ribs extending axially along said flared surface.

5. A burner having air and fuel admission means and a refractory member having an imperforate annular surface flaring rearwardly to form a burner throat, said throat having a narrow peripheral surface and having an outwardly flared surface extending rearwardly therefrom, said outwardly flared surface being formed by depressed segments spaced peripherally to leave raised ribs therebetween and defined by an annular front wall extending substantially normal to said peripheral surface and by side walls substantially normal to the inner surface of said ribs, said walls forming ledges adapted to produce eddy currents in the air-fuel mixture flowing thereover.

6. In a burner having fuel and air admission means, a refractory member having an imperforate annular surface flaring rearwardly to form a burner throat through which air flows from said air admission means, said throat surface having depressed portions forming raised ribs therebetween having peripheral and radial surfaces forming ledges adapted to produce eddy currents in the air flowing thereover, said ribs having their maximum radial thickness at their forward ends and tapering in thickness toward their rearward ends.

7. A burner, as set forth in claim 6, in which said ribs are inclined to the axis of said throat.

8. In a burner having fuel and air admission means, a refractory member having an imperforate annular surface flaring rearwardly to form a burner throat through which air flows from said air admission means, said throat surface having depressed portions forming raised ribs of rectangular cross section therebetween having peripheral and radial surfaces forming ledges adapted to produce eddy currents in the air flowing thereover.

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