July 27, 1948. R. C. VROOM ET AL 2,446,069

FUEL BURNER

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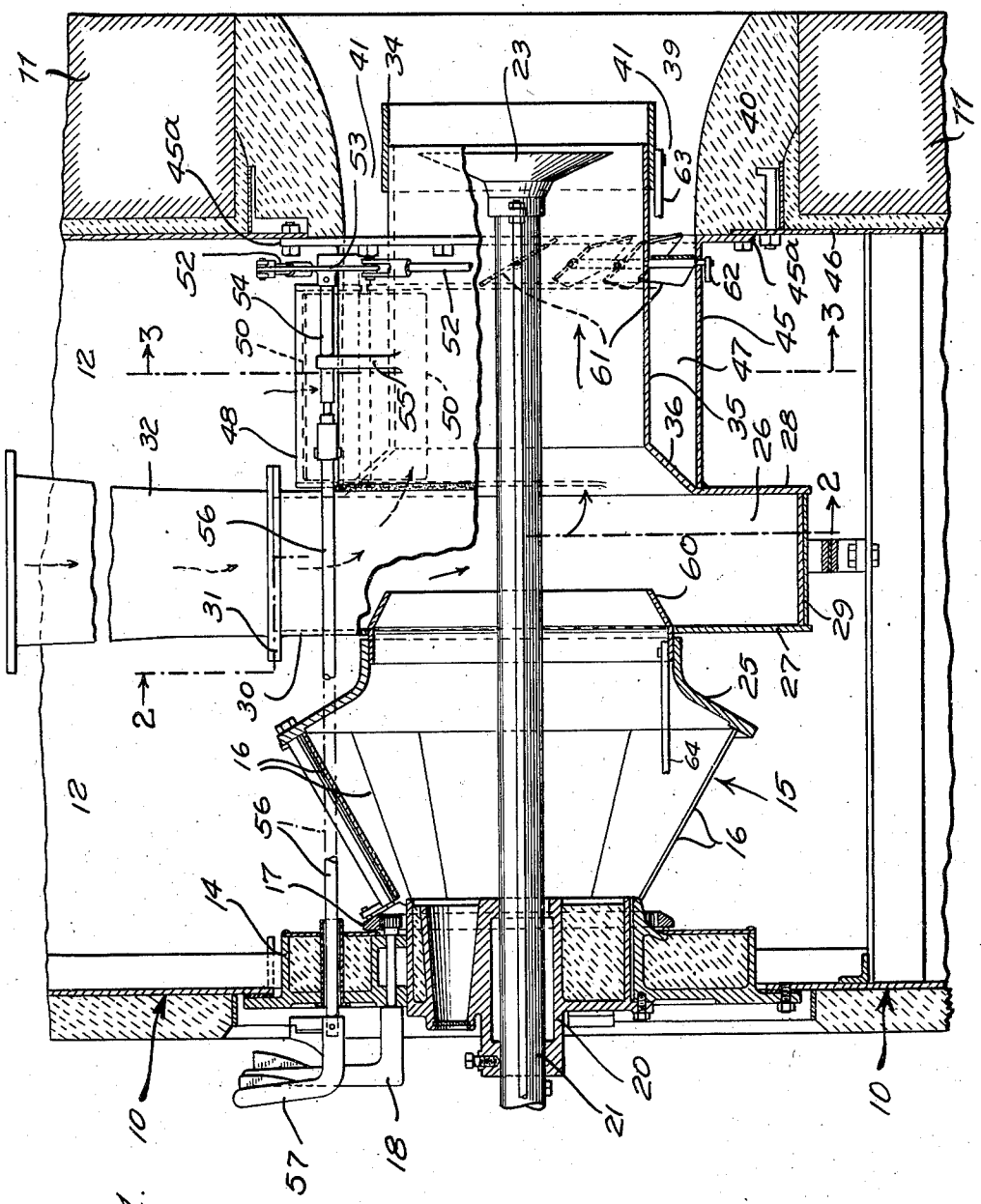



Fig. 1.

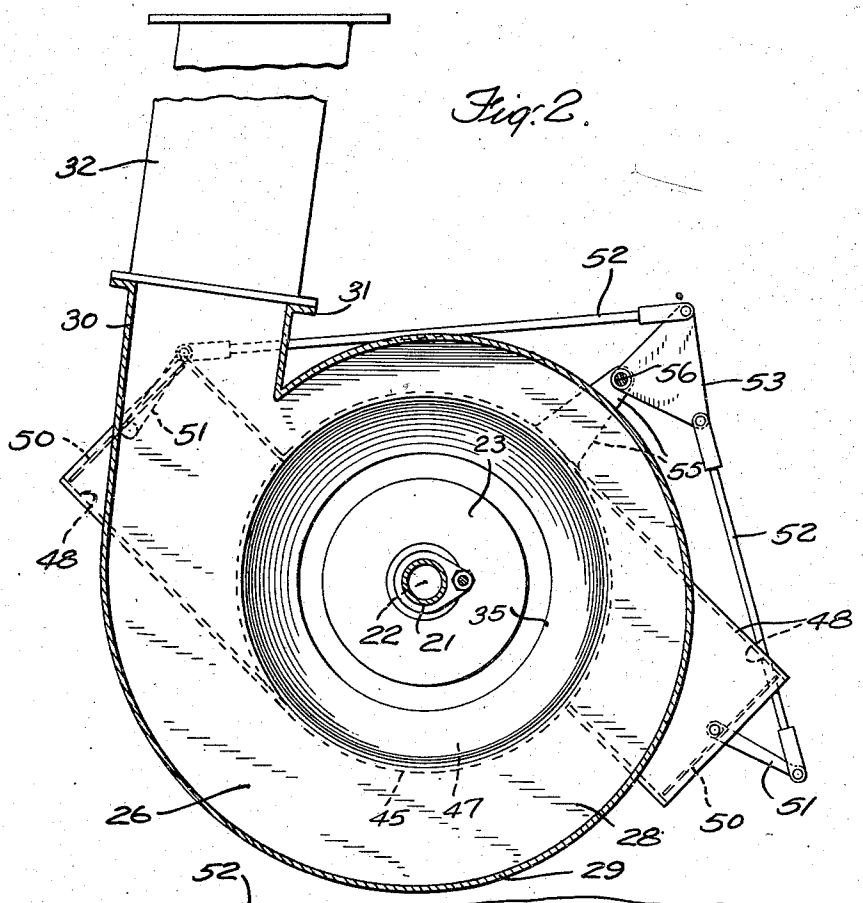
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Fig. 2.



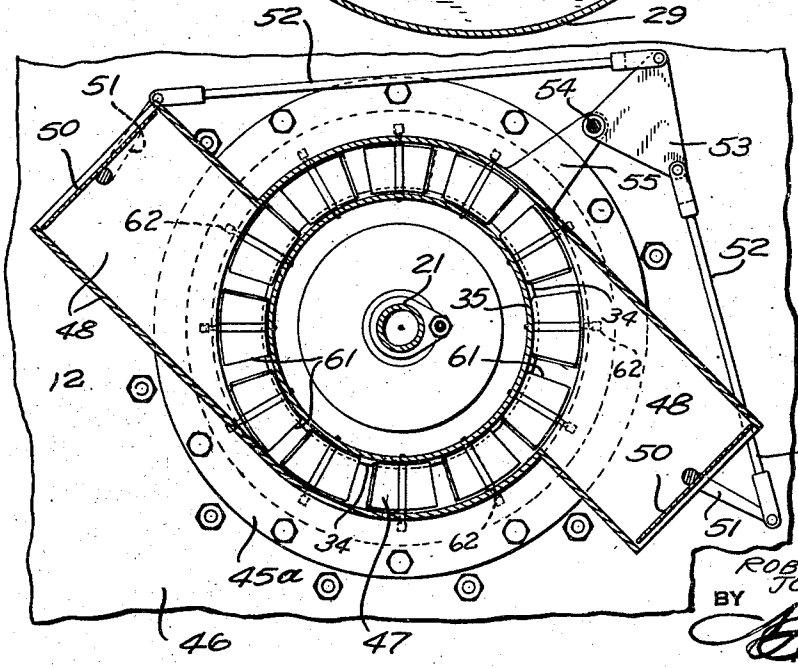




Fig. 3.

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## FUEL BURNER

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2 Claims. (Cl. 110—104)

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This invention relates to fuel burners and has for an object to provide a burner for fuels in suspension of novel and improved construction which is stable over a wide range of capacities.

In accordance with the present invention a portion of the air for combustion, or other gas, is supplied as a tertiary fluid around the periphery of the burner throat in such a way as to shield the tile of the throat from the fuel stream and means are provided for causing the tertiary fluid to rotate in a controlled manner so as to maintain the desired flame shape. When the tertiary fluid is air a richer mixture of fuel and secondary air is obtained than would be the case if all of the air for combustion were admitted through the burner tube, and more stable operation results, particularly at the lower burner capacities.

The invention further provides a fuel admission chamber of larger diameter than the burner tube and having an end wall extending entirely therearound which controls the fuel flow to the burner tube.

Although the novel features which are believed to be characteristic of this invention are pointed out more particularly in the claims appended hereto, the invention will be better understood by referring to the following description, taken in connection with the accompanying drawings in which a specific embodiment thereof has been set forth for purposes of illustration.

In the drawings,

Fig. 1 is a longitudinal section through a burner embodying the present invention; and

Figs. 2 and 3 are transverse sections taken on the lines 2—2 and 3—3 respectively of Fig. 1.

Referring to the drawings, the construction shown comprises a wind box front plate 10 which is separated from a furnace wall 11 to provide a wind box or plenum chamber 12 therebetween which may be closed or open, depending upon whether the combustion air is to be supplied under a positive pressure or at atmospheric pressure. The furnace wall 11 forms a part of a combustion chamber. To the wind box front plate 10 is attached as air register front plate 14 which carries an air register 15 of standard type having peripheral air doors 16 which are arranged to admit air from the wind box 12 to the interior of the air register. The doors 16 are shown as arranged conically about the periphery of the air register 15. It is to be understand, however, that they may be arranged cylindrically if desired. In the embodiment shown, the doors 16 are indicated as actuated in unison by a gear and pinion 17 which

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is controlled by a handle 18 accessible from the front of the register front plate 14. The air register front plate 14 is provided with a central boss 20 having a pipe 21 through which a fuel atomizer barrel carrying liquid fuel extends. The atomizer barrel is provided at the furnace end with a tip which is suited to discharge fuel for combustion. A diffuser plate 23 of the usual form is shown as attached to the pipe 21 and its position is controlled by an operating rod connected to the hub of diffuser 23 as shown in Fig. 1.

The air register 15 is provided with a throat piece 25 through which the rotating secondary air is discharged axially. The throat piece 25 opens into a pulverized fuel chamber 26 which is formed by a front transverse wall 27 and a rear transverse baffle wall 28 joined by a peripheral wall 29 which is arranged in the form of a curve of decreasing radius as shown more clearly in Fig. 2. A fuel supply duct 30 opens tangentially into the fuel chamber 26 so as to supply pulverized or suspended fuel to said chamber and to cause the same to pass around the chamber and then to advance axially into a burner tube 35. The wall 28 extends entirely around the burner tube 35 so that direct passage of fuel into the tube without first flowing over the wall 28 is prevented. The supply duct 30 is shown as attached by flanges 31 to a fuel supply pipe 32.

The burner tube 35 is provided at its forward end with a conical section 36 which is attached to the rear radial wall 28 of the fuel chamber 26 and extends at its furnace end into the burner throat 39 which is formed by a ring of tile 40 of standard construction. The free end of the burner tube 35 is spaced from the burner throat 39 to provide an annular fluid passage 41 therebetween. A ring 34 is adjustably secured to the end of the burner tube 35 for adjusting the admission passage 41. The ring 34 may be adjusted axially over the burner tube 35 for this purpose by a rod 63.

A cylindrical wall 45 extends between the wall 28 and a flange 45a attached to a furnace wall front plate 46 which in turn is attached to the wall 11 of the furnace. This cylindrical wall 45 is spaced from the burner tube 35 to provide an annular chamber 47 therebetween which connects with annular passage 41 at the burner throat.

A pair of fluid supply ducts 48 (Fig. 3), which are arranged in diametrically opposite positions, are connected to supply air or other fluid tangentially to the annular chamber 47. These ducts 48 may be open to the plenum chamber or wind box

12 as shown (or may be supplied separately) and are provided with suitable dampers 50 by means of which the amount of fluid supplied therethrough may be controlled. The dampers 50, as shown in Fig. 2, are connected to levers 51 and links 52 for operation in unison. The links 52 are pivotally connected to a plate 53 which is pivoted at 54 to an ear 55 on the cylindrical wall 45. Plate 53 is attached to a control rod 56 which extends through the air register front plate 14 and is provided with a handle 57. Other methods of fluid admission to chamber 47 either with or without rotation may be provided.

A conical member 60 is attached to the air register throat piece 25 and extends into the fuel chamber 26 to prevent fuel from entering the air register chamber. This member may be adjusted axially by an adjusting rod 64.

In addition, vanes 61 may be mounted between the burner tube 35 and the cylindrical wall 45 and adjusted by handles 62. These vanes 61 are adjustable through at least 180° so that the fluid supplied to the passage 41 from the chamber 47 may be caused to rotate in either direction or to flow without rotation as desired.

*Operation*

In the operation of this device, a stream of fuel suspended in carrier (primary) fluid is supplied through the pipe 32 and the duct 30 to the fuel chamber 26 which, being of spiral form, causes the fuel to be evenly distributed as it rotates and passes over the baffle wall 28 into the burner tube 35. At the same time, secondary air from the plenum chamber 12 enters the air register between the air register doors 16, which impart a whirling motion thereto and cause the air to rotate and to pass axially through the air register throat piece 25 and through cone 60 to be mixed with the fuel suspended in primary fluid from chamber 26 in the burner tube 35. This mixture of fuel with primary fluid and secondary air then passes through the burner tube 35 and is discharged from the open end thereof at the burner throat 39 where combustion takes place. Due to the tangential flow of fuel into the chamber 26 and to the rotation of the secondary air in the air register 15, the mixture of fuel and air rotates peripherally as it advances along the burner tube 35.

The fuel emerging from the burner tube 35 is ignited initially by suitable means such as liquid fuel from the atomizer tip 22 and thereafter burns in a flame extending outwardly from the end of the burner tube. It is to be understood that after ignition takes place, the fuel atomizer barrel may be retracted.

If air is the tertiary fluid a portion of the air in the plenum chamber 12 passes through the dampers 50 into the tertiary fluid chamber 47 wherein it is likewise caused to rotate due to the tangential position of the air admission ducts 48 and the position of dampers 50. Tertiary fluid other than air may be supplied from a separate source. The tertiary fluid may rotate in either direction or may be supplied without rotation. This rotating tertiary fluid then advances along the outside of the burner tube 35 and discharges through vanes 61 and the annular passage 41 at the burner throat where it is supplied to the mixture of fuel and secondary air.

The dampers 50 not only serve to throttle the tertiary fluid, but may also be used to vary the degree of rotation thereof, depending on the direction in which the dampers are rotated for closure purposes, and may be used without vanes 61.

The rotation is also controlled by the vanes 61 which, in conjunction with the tangential ducts 48 and dampers 50 may be adjusted to vary the degree of rotation concurrent with or counter to the fuel in the tube 35a according to the flame characteristics desired. It has been found that rotation of the tertiary fluid assists in maintaining a short flame and that the flame shape may be adjusted by varying the amount and direction of rotation of the tertiary fluid.

The use of air or the tertiary fluid also facilitates ignition by creating a richer mixture through the burner tube and thus permits the burner to be operated at a lower capacity. Hence, a wider range between maximum and minimum capacity is obtained than would be the case if all of the air from chamber 12 were supplied through the air register as secondary air. The proportion of tertiary to secondary air is variable to conform to the ignition characteristics of the fuel in such a way as to avoid either loss of ignition or back burning. The tertiary fluid also shields the tile surface of the burner throat from the pulverized fuel and prevents the accumulation of ash on the refractory throat.

Usually it is possible to set the tertiary air dampers and register doors 16 at predetermined positions and to vary the flow of secondary and tertiary air throughout the capacity range of the burner solely by varying the air pressure in the wind box or plenum chamber.

Air for combustion is supplied through the air register 15. The primary or tertiary fluid may, however, be inert or other than air depending upon the required conditions.

What is claimed is:

1. A fuel burner comprising a burner tube adapted to connect with a combustion chamber, means forming an annular fuel channel at the entrance end of said burner tube open throughout its entire inner periphery for the unrestricted flow of fuel radially into said burner tube and formed by a pair of similar spaced annular transverse walls one of which extends entirely around and radially outward from the end of said burner tube to form a continuous flat annular baffle of substantial radial extent around its entire periphery over which the fuel flows before entering said tube, said baffle having its inner edge substantially flush with said tube at the entrance end thereof, the other of said walls being spaced beyond the end of said burner tube, and a peripheral wall of progressively decreasing radius joining said transverse walls to form an outer closure for said chamber, said peripheral wall lying substantially beyond the periphery of said tube around the entire periphery thereof so as to provide a continuous annular fuel channel for the recirculation of fuel lying entirely beyond the periphery of the burner tube, a fuel inlet duct carrying a stream of fuel suspended in a carrying fluid communicating tangentially with said annular chamber at its point of greatest radial width to cause the fuel to rotate in said chamber and to pass radially inwardly therefrom into said burner tube, and air admission means located substantially entirely in advance of said fuel chamber to leave said chamber unobstructed and having means supplying a rotating air stream axially to said annular passage for mixing with the fuel as it flows therefrom into said burner tube.

2. A fuel burner comprising a burner tube adapted to connect with a combustion chamber,

burner tube and having means to supply a rotat- air admission means located in advance of said ing air stream axially to said burner tube, means forming an annular fuel channel between said burner tube and said air admission means open throughout its entire inner periphery to said rotating air stream, a fuel inlet duct carrying a stream of fuel suspended in a carrying fluid communicating tangentially with said annular channel, said annular channel decreasing progressively in radial extent from said inlet duct around its circumference, but having a substantial minimum radial extent so as to provide a continuous annular channel for the re-circulation of fuel around said channel entirely beyond said rotating air stream, said channel being adapted for the uniform admission of fuel around its periphery radially inwardly into said burner tube.

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