May 1, 1934. A. B. CUNNINGHAM 1,956,857

GAS BURNER

Filed Feb. 5, 1931

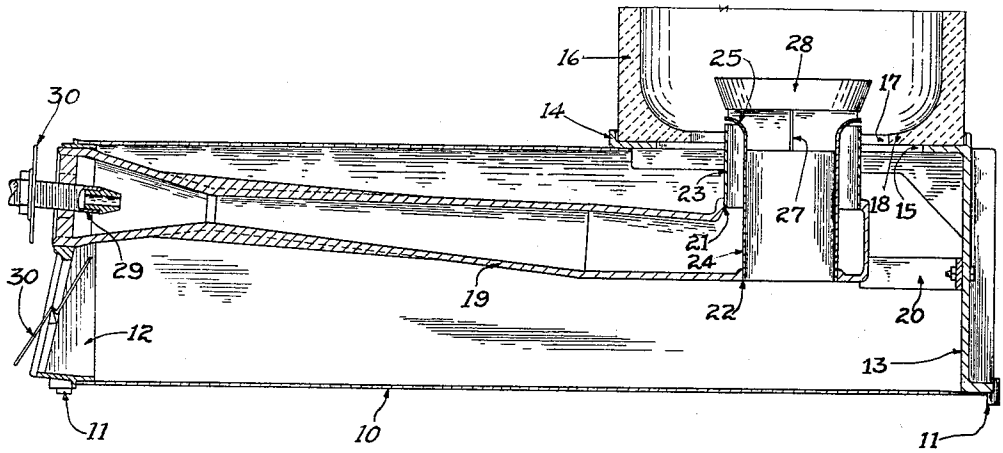


Fig. 1

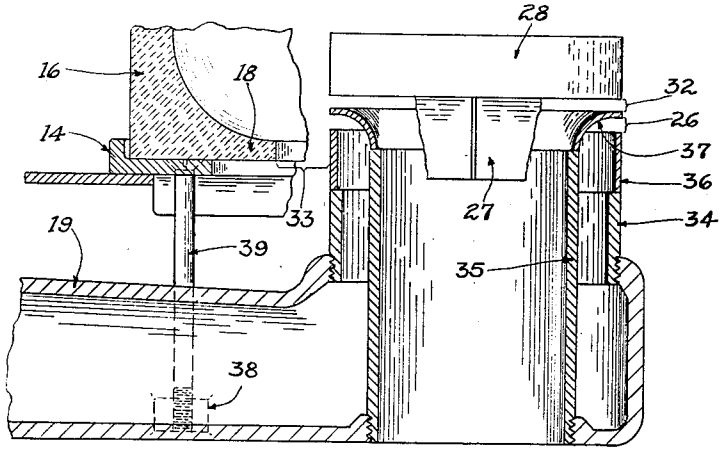


Fig 2

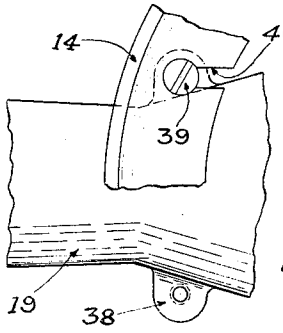


Fig. 3

Inventor

Arthur B. Cunningham

by James B Lewis

Attorney

Patented May 1, 1934

1,956,857

UNITED STATES PATENT OFFICE

1,956,857

GAS BURNER

Arthur B. Cunningham, Chicago, Ill., assignor to Autogas Corporation, Chicago, Ill., a corporation of Delaware

Application February 5, 1931, Serial No. 513,568

14 Claims. (Cl. 158—99)

This invention relates to gas burners and has to do particularly with burner structure of the character well adapted for use with gas heaters, furnaces, and boilers for heating systems, and wherein the gas flow to the burner may be controlled by thermostatic or hand operated means.

One of the objects of this invention is to provide a burner structure of maximum efficiency and universal application.

Another object of the invention is to provide a gas burner wherein the flame issuing therefrom is narrow in cross section and wherein secondary air is supplied to each side of such flame to effect complete and efficient combustion of the gases.

Still another object of the invention is to provide a burner wherein an unbroken sheet of flame, in contradistinction to a series of smaller flames issuing from separate ports, as in the multi-jet type, is emitted from the burner and wherein complete and efficient combustion is effected by the supply of a minimum amount of excess air to either side of said flame.

A further object of the invention is to provide a burner which will give an intense flame and which is so constructed that the flame is emitted laterally from the burner and in the form of a ring narrow in cross section.

A still further object of the invention is to provide a unitary burner head wherein the gas is emitted laterally from a narrow slit-like discharge orifice and wherein the secondary air is directed into intimate contact with the gases on either side of the flame thereby affecting an expeditious, complete, and efficient combustion of the gases, which enables the burning of a large volume of gas in a minimum of time.

A still further object of the invention is to provide a unitary burner structure wherein a combustible mixture is discharged laterally in a sheet-like ring narrow in cross section with a minimum of excess secondary air supplied thru means which directs the same into intimate contact with the sides of the flame.

Additional objects of the invention are to provide a unitary burner capable of installation in any form of heating plant, domestic or otherwise; of low operating and maintenance costs, of an enduring nature and virtually noiseless in operation.

The various features of novelty which characterize the invention will be well understood by reference to the following description of an illustrative embodiment of the invention shown by way of example in the accompanying drawing.

Fig. 1 is a sectional view thru the burner assembly illustrating its application to one type of combustion chamber.

Fig. 2 is a sectional view of a modified burner head and adjustable support therefor.

Fig. 3 is a broken view, with certain parts removed, illustrating details of the supporting means of Fig. 2.

The burner illustrated is particularly adapted for use with the burner illustrated in the application of Ashur U. Wetherbee, Serial No. 493,537, filed November 5, 1930. However, it is to be understood that this invention is not limited to that particular application, but that it may be applied generally wherever gas heating is desired.

The burner illustrated in the aforesaid application comprises a combustion chamber composed of a base with super-imposed rings placed thereon and defining a combustion zone, into which the primary mixture with an adequate, but not an excess amount of secondary air is introduced and burned. The flame and products of combustion passing up through this combustion chamber heat the chamber to a high degree of incandescence, which emits radiant heat. The present invention has to do with means for properly proportioning and introducing the combustible mixture to the zone of combustion, whereby large quantities of gas can be completely and efficiently burned with consequent development of intense heat.

Referring to the exemplary embodiment of the invention illustrated in Fig. 1, the numeral 10 designates an assembly casing particularly designed to be readily installed in a conventional domestic heating system or furnace and is of such size as to pass freely thru the ashpit door of such a heating system. This casing 10 is preferably made of sheet metal and is provided with suitable legs 11 adjacent its front and rear ends. A casting 12, provided with suitable openings therein, is detachably connected to the front end of the casing, while the rear end of the casing is closed by a casting 13 provided with a laterally extending top portion 14 adapted to form a support for a refractory cylinder which may be of the type illustrated in the prior application above mentioned. The laterally extending top portion is provided with an opening 15 and the base ring 16 is provided with an opening 17 of smaller diameter than the opening 15. By virtue of this arrangement a portion 18 of the bottom of the base ring overhangs the supporting structure of the top extension and thereby protects such ex-

tension and the casing from the intense heat developed within the burner.

Enclosed within the casing is a mixing tube 19 having a constriction in the form of a Venturi throat and supported at its forward end by casting 12 and at its rear end by a bracket 20 carried by the rear casting 13, the connection with the bracket being of a detachable character to facilitate removal and replacement of the tube.

The rear end of the tube 19 is expanded to form the lower portion of the burner head and contributory to that end, openings 21 and 22 are provided in the upper and lower walls respectively of the tube and said openings are preferably concentrically arranged. The concentric space between the short tube 23, fitted into the opening 21, and the longer tube 24, fitted into the lower opening 22, constitutes a continuation of the tube 19, and the upper end of the tube 24 is flared outwardly as at 25 to cooperate with the tube 23 to form therewith an opening 26 of narrow slit-like character thru which the primary mixture of gas and air is discharged. Tubes 23 and 24 are preferably made of heat resisting material and tube 24 carries a support 27 in the form of a spider which supports the cap 28. This cap is preferably made of a refractory material and its primary functions are to divert the secondary air discharged thru tube 24 into proximity to the flame emitted from the discharge slot 26 and to prevent excessive heating of the burner head. A spud or nozzle 29 is conveniently mounted in the forward end of the tube 19 for directing the gas into said tube and an air shutter 30 for regulating the flow of air into the end of the tube 19 is adjustably mounted upon the spud for adjustment to and from the end of the tube to regulate the flow of primary air into the mixing tube. A door 31 having a central offset portion pivotally mounted on a knife edge support carried by the casting 12 provides means for regulating the flow of secondary air to the burner.

In the operation of the device the gas discharged thru the inlet spud 29 aspirates primary air as it passes into the throat of the mixing tube 19 and the shutter 30 is adjusted so that the admixture of air and gas in the tube forms therein a combustible mixture which flows between the tubes 23 and 24 and out thru the discharge opening 26 where it is ignited by a suitable means, such as a pilot light, not shown, and burns in the form of a continuous flame, in the present instance, a thin sheet or ring of flame. This discharge of the combustible mixture coupled with a slight suction in the firebox, induces a flow of secondary air, thru the door 31, which divides into two flow paths, one of which is thru the tube 24 while the other is around the tube 23 and thru the opening 17 in the base ring 16. The secondary air passing up thru the tube 24 contacts with the cap 28 is preheated and diverted outwardly through opening 32 into intimate contact with the upper side of the flame, while the air passing thru the opening 33 defined by tube 23 and opening 17 in the base ring 16 is preheated by contact with the portion 18 and directed to the lower side of the flame. The secondary air inlet openings are proportioned so that a minimum of excess air is supplied to complete combustion. In practice, it has been found that for efficient operation under normal conditions, the areas of the primary discharge outlet 26 and the secondary air outlets 32, 33, respectively bear a certain relation to each other and this relationship is substantially in the ratio of 1:2:10, that is, the secondary air opening 32 has an area twice that of the primary mixture outlet opening 26, while the other secondary air opening 33 is ten times that of the primary mixture opening 26. These ratios have been found satisfactory on standard gas pressure of substantially two to three inches of water, and it is to be understood that other ratios may be worked out for different conditions of operation.

With the secondary air and gas proportioned as described, an intense heat is produced, while at the same time a large volume of gas may be completely and efficiently burned, because the flame is projected in the form of a thin sheet and the secondary air is supplied to each side of the flame in sufficient, but not excessive, quantities to support complete and efficient combustion of the gases.

Rapidity of combustion depends upon securing an intimate commingling of the combustible gas with the secondary air. This commingling is largely due to the diffusion of the air and combustible gas to secure actual contact between each molecule of the combustible gas and the necessary molecules of oxygen of the air. The thin sheet of flame accelerates the admixing of the molecules since there is a smaller initial distance between the molecules at the center of the flame and the required molecules of oxygen in the secondary air than would ordinarily be the case in a flame of the jet type.

The tubes 23 and 24 are securely fitted into the openings 21 and 22, respectively, in the tube 19 as by sweating or welding or they may be threaded therein, as in Fig. 2, to prevent the escape of the primary mixture as it flows through the tube to the combustion zone. Since the tubes, and particularly the portions adjacent the outlet end, are subject to high temperatures they may be made entirely of non-corrosive heat resisting material such, for example, as ascaloy metal, or if desired, they may be made in two or more parts as in Fig. 2, with the lower parts 34 and 35 secured in the openings in the tube 19 and the tips or extensions 36 and 37, of non-corrosive and heat resisting material welded or otherwise secured in place on the lower parts. A non-corrosive heat resisting material is preferable to maintain the characteristics of the burner by preventing corrosion of the parts during nonuse and the warping and burning away of the parts during constant use.

In Fig. 2, adjustable supporting means for the burner head is shown, in which the burner head may be adjusted both vertically and axially to properly position the same relative to the base 16. The mixing tube 19 is preferably provided, on opposite sides, with tapped lugs 38 into which the screws or bolts 39 are threaded and the extension 14 has a pair of spaced key-hole slots 40 for the reception of the screws 39. To insert the mixing tube and burner head the shanks of the screws are passed into the slots 40 and the tube lowered until the heads of the screws rest in the enlarged portion of the slots, likewise, to remove the burner head the tube is raised and the screws 39 passed out of the slots. The base 16 may be either removed or slightly raised to facilitate the insertion or removal operations. By collectively adjusting the screws 39 the burner may be raised or lowered to correctly position the discharge outlet 26 with respect to the interior end of the base 16, and by individually adjusting the screws 19, the burner head may be tilted laterally to bring the discharge outlet 26 into position, pref-

erably parallel with the inner edge of the opening 17, but sufficiently above the interior end of the base 16, so that the flame emitted from the discharge outlet 26 will pass into the bowl of the base without impinging against the walls of opening 17.

From the foregoing, it will be seen that with a burner arrangement of the type disclosed, a high degree of efficiency is obtained because of the complete and efficient combustion of the gases and a large volume of gas may be burned with a minimum of excess air, since the flame is narrow in cross-section and the secondary air is supplied to each side of the flame thereby accelerating complete combustion of the combustible constituents of the gas. This type of burner is well adapted to on and off control since it is practically noiseless in operation and may be started without popping or explosions and discontinued or stopped without puffing. Various changes in details of construction may be made without departing from the spirit of the invention.

What I claim is:

1. A burner assembly unit for insertion in the ash pit door of a furnace, comprising a casing closed at each end and provided with an opening in its top wall adjacent one end, a mixing tube provided with a burner head terminating in a flame discharge orifice, and means for adjustably and removably supporting said tube in said casing with said discharge orifice above the opening in said top wall.

2. A burner assembly unit for insertion in the ash pit door of a furnace, comprising a casing closed at each end and provided with an opening in its top wall adjacent one end, a mixing tube provided with a burner head terminating in a flame discharge orifice, and readily detachable means for removably supporting said tube in said casing with said discharge orifice above the opening in said top wall.

3. An assembly unit for insertion in the ash pit door of a furnace, comprising a casing having the top wall thereof cut away adjacent one end, an end casting for closing the latter end of the casing and provided with an extension covering the opening in said top wall, there being an opening in said extension, a casting for closing the other end of said casing and provided with an aperture, a burner head provided with a mixing tube mounted in said aperture, and means carried by the first mentioned end casting for detachably and adjustably supporting the burner head with the flame discharge orifice above the top extension.

4. A gas burner including a base having a restricted opening in one end thereof, a burner head comprising tubular elements positioned in said opening for discharging a combustible mixture outwardly of the base, the end wall of the base adjacent the discharge orifice being concave to direct the flame laterally and outwardly of the base, and supporting means for said burner head overlain and protected from said flame by said base.

5. A gas burner including a base having an opening in the end of less diameter than the interior diameter of the base, and the interior wall of the base converging towards said opening to form a flame directing surface, and means for supplying a combustible mixture to said base adjacent said curved wall whereby the flame is directed laterally and outwardly of said base and including an annular passage directed immediately above and substantially parallel to said directing surface.

6. A gas burner including a refractory base having side and end walls and there being an opening in the end wall of less diameter than the interior diameter of the base, and the end wall converging towards said opening to form a flame directing surface, and a burner structure comprising concentrically arranged tubes, defining a primary combustible mixture duct and the inner tube being flared outwardly into proximity to the outer tube to define with said tube a discharge orifice for directing the flame outwardly and along the flame directing surface, and means for directing a secondary supporter of combustion to each side of the flame whereby the flame is prevented from contacting directly with the directing surface.

7. A gas burner including a base having an opening in the end thereof with the interior wall of the base converging towards said opening to form a flame directing surface, and a burner structure comprising concentrically arranged tubes defining a primary combustible mixture duct with the inner tube flared outwardly into proximity to the outer tube to define with said tube an annular discharge orifice for directing the flame outwardly and along the flame directing surface, a deflector positioned above the outlet of the inner of said tubes, the outer of said tubes of smaller diameter than the opening in the end of the base whereby the secondary air in passing up and around the larger tube contacts with the underside of the flame and cushions the same against contact with the directing surface while the air discharging from the inner tube contacts with the deflector and is deflected into contact with the upper surface of the flame.

8. A gas burner including a base ring having the lower end thereof tapered inwardly to define an opening, a burner head including concentrically arranged tubes projecting through said opening, said outer tube defining with said opening a secondary air inlet and said inner tube defining a secondary air inlet, said inner tube flaring outwardly into proximity to the end of the outer tube to define therewith a primary gas and air mixture discharge nozzle for directing the flame outwardly along the tapered end wall, and a refractory deflector superimposed above the inner tube for directing the secondary air emitting therefrom into contact with the flame, the arrangement being such that the secondary air passing through the annular opening formed by the outer tube contacts with and shields the flame from the tapered wall of the base, while the secondary air emitting from the inner tube is directed against the upper surface of the flame whereby the flame is surrounded on each side by secondary air and complete and efficient combustion is obtained.

9. A burner comprising a flame-directing base, members defining an annular narrow discharge outlet through which a primary combustible mixture may be discharged in the form of a thin sheet paralleling said base and means for supplying a supporter of combustion to each side of said sheet in the ratio of substantially five times the volume on the side next said base as compared to the volume on the other side thereof.

10. A burner comprising in combination a base having an opening therethrough, inner and outer co-axial tubular members spaced apart to provide a gas passage therebetween and co-axially located in said opening to provide a secondary air inlet

between the outer member and the inner edge of the opening, the areas of gas discharge and secondary air inlet openings being substantially in the ratio of one to ten, respectively.

11. A burner comprising in combination a base having a circular opening therein, inner and outer tubular walls spaced apart to form a passage therebetween, the inner wall flared outwardly and coacting with the top of the outer wall to form therewith a narrow slit like discharge outlet for directing a combustible mixture in the form a thin sheet, outwardly therefrom, said walls positioned co-axially of the circular opening to define an annular secondary air inlet between the outer wall and the edge of the circular opening, and a deflector coacting with the flared portion of the inner wall to form therewith another secondary air inlet opening, said secondary inlet openings directing the air to either side of the gas discharge openings and the areas of gas and secondary air openings being substantially in the ratio of one for the gas opening to two for one of the air openings and ten for the other of the air openings.

12. A burner unit comprising a casing adapted to extend outwardly through the door of a furnace and having its rear end closed and an opening in its top wall adjacent said closed end, a primary air and gas mixing tube provided with a discharge outlet at its rear end, means adjacent the exterior end of the casing for supporting the forward end of said tube and means for adjustably supporting the other end of said tube with the discharge outlet thereof coordinated with the opening in the top wall of the casing.

13. A conversion burner unit comprising a conduit adapted to extend outwardly through the door of a furnace to provide a secondary air inlet to said furnace, said casing having an opening in its top wall adjacent the rear end thereof, a primary air and gas mixing tube in said casing and supported adjacent the outward end thereof and means for removably suspending the rear end of said tube from the top wall of said casing.

14. A burner apparatus comprising an air supply conduit for a furnace and adapted to extend outwardly therefrom and provided with an opening in its top wall adjacent the rear end thereof, a primary air and gas mixture tube provided with a discharge opening at its rear end, said tube disposed in said casing, and means for removably and adjustably supporting said tube from the top wall of the conduit with the discharge opening thereof in proper relation to the opening in the top wall of said conduit.

ARTHUR B. CUNNINGHAM.