Dec. 19, 1939. W. S. GORDON, JR. 2,183,836

FLUID FUEL BURNER

Filed Dec. 18, 1936 2 Sheets-Sheet 1

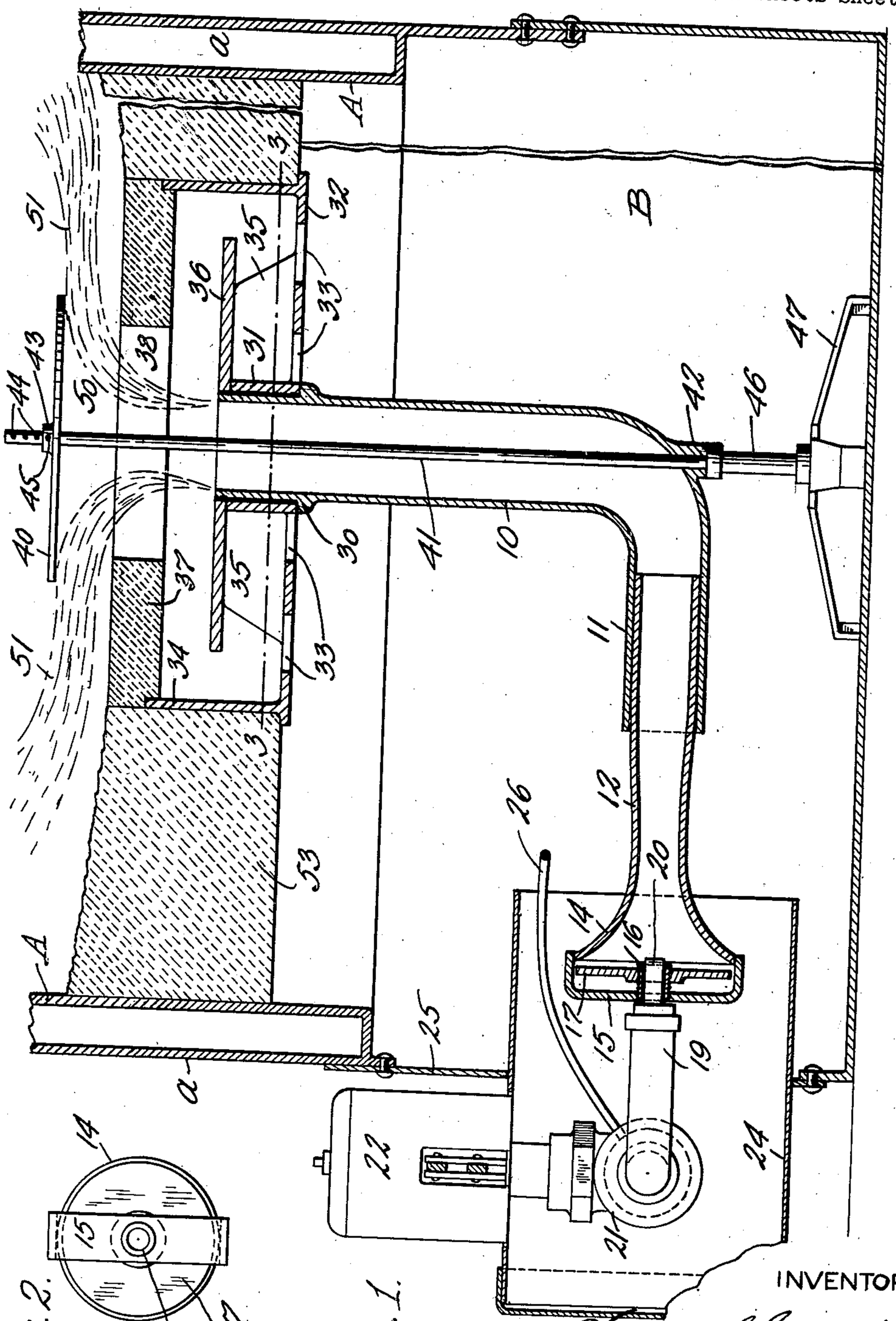

Fig. 1.

Fig. 2.

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2 Sheets-Sheet 2

Fig. 3.

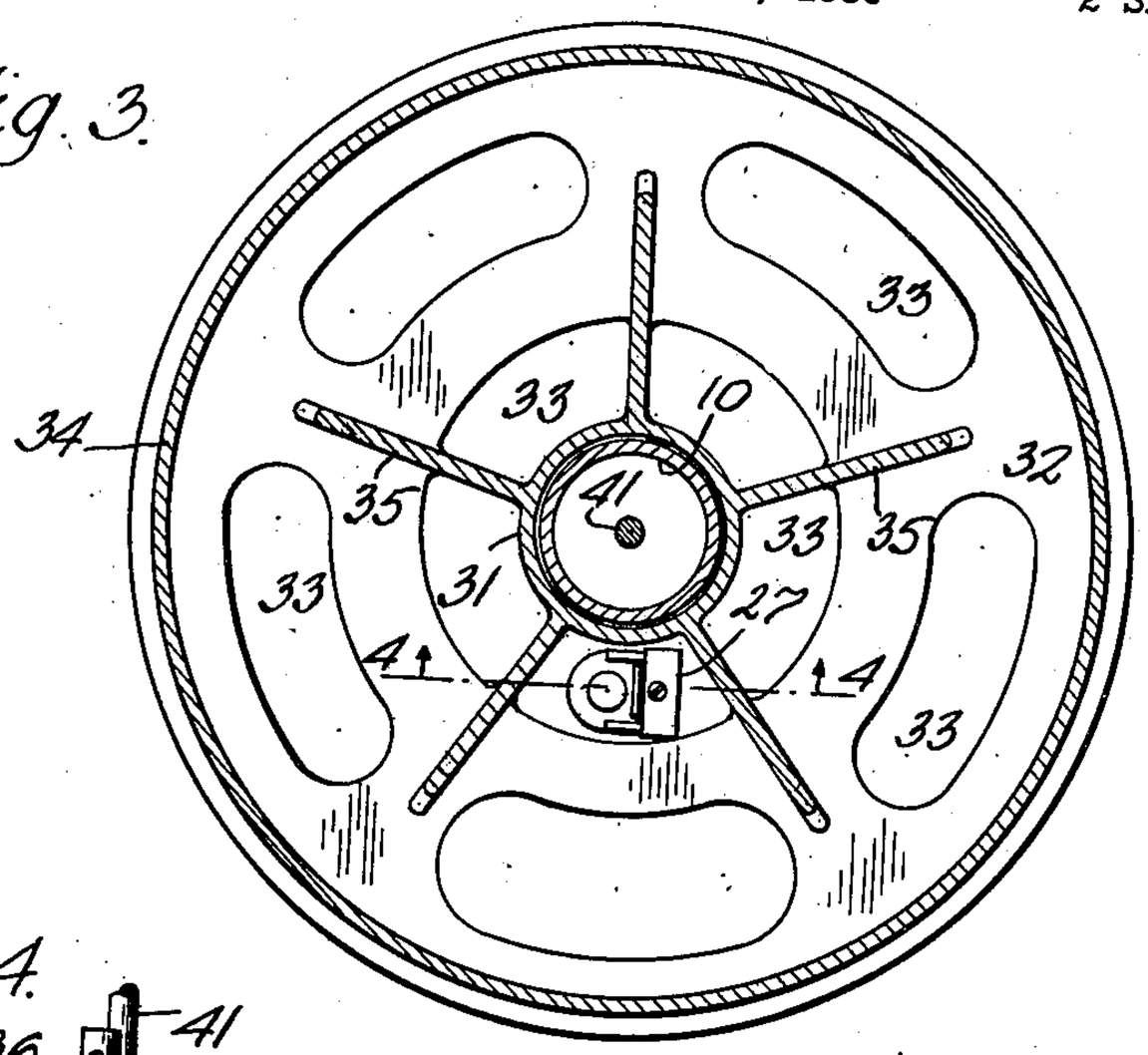


Fig. 4.

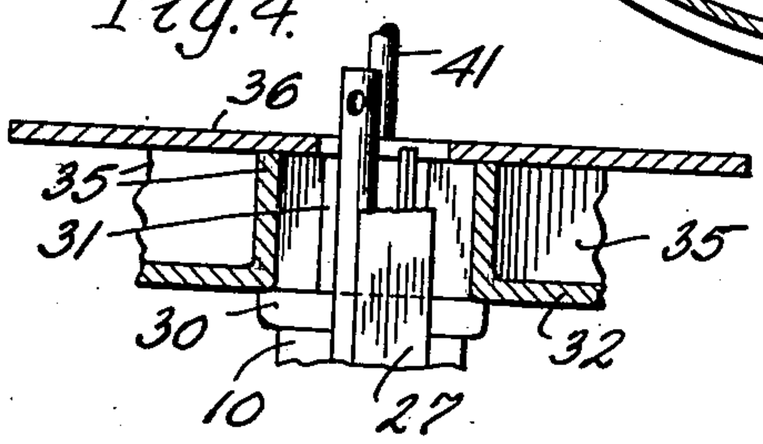


Fig. 5.

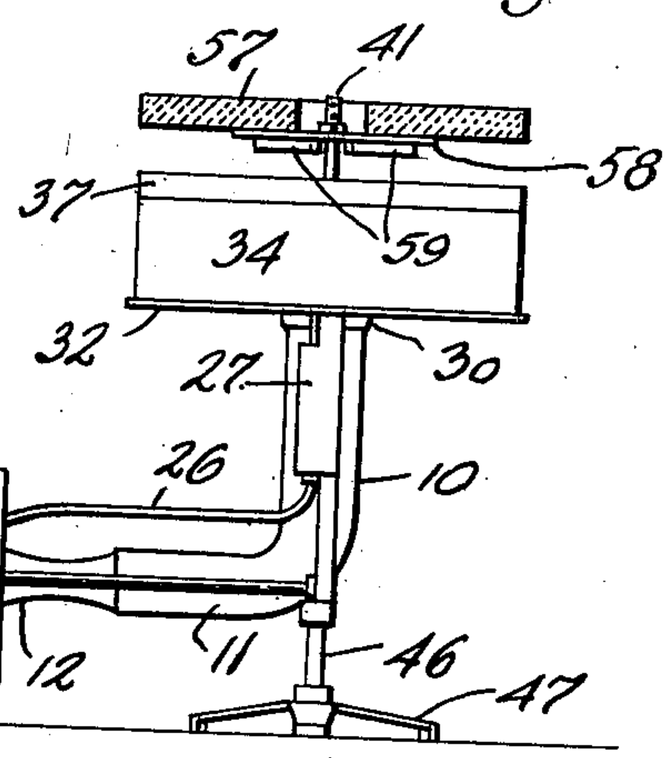


Fig. 6.

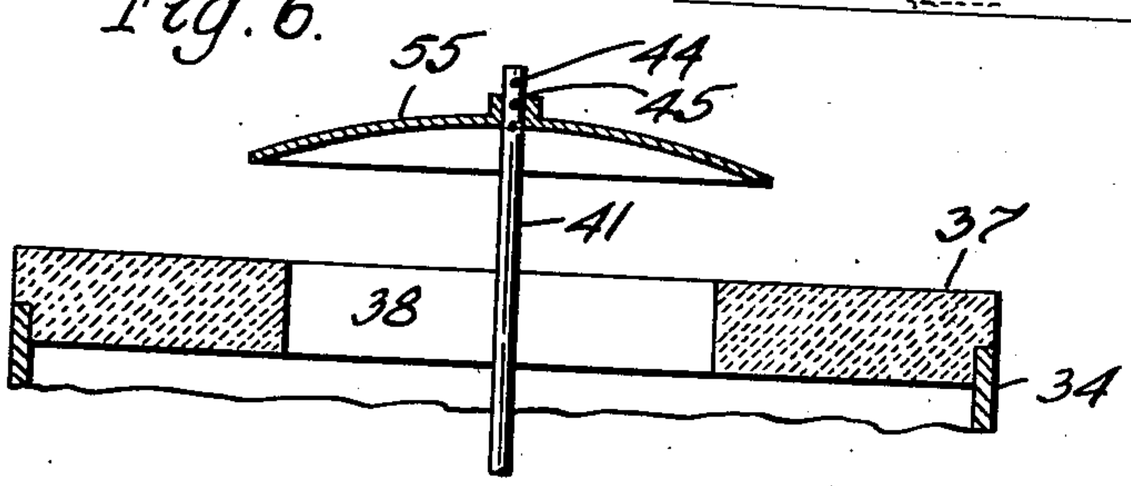
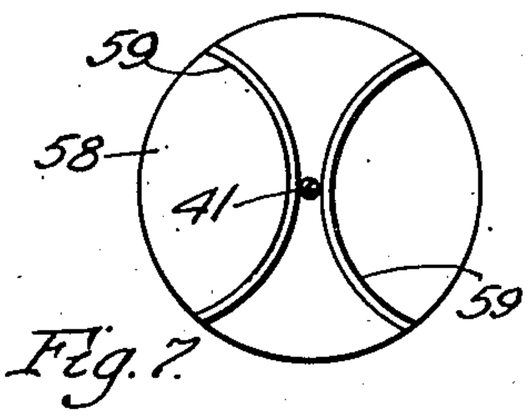


Fig. 7.



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FLUID FUEL BURNER

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Application December 18, 1936, Serial No. 116,590

15 Claims. (Cl. 158—99)

This invention relates to improvements in fluid fuel burners.

In burners of the conversion type intended to be installed in furnaces and heaters which were primarily constructed for use in connection with solid fuel, it has been customary to provide a burner having a number of orifices arranged adjacent to the walls of the combustion chamber of fire pot for the purpose of transmitting heat efficiently to such walls. In accordance with this invention, I provide a burner which may be arranged approximately in the middle of a combustion chamber, and which is constructed to deflect the products of combustion laterally against the walls of the combustion chamber to effect an efficient transfer of heat to such walls. It will be understood that my improved burner may be used for other purposes than as a conversion burner.

One of the objects of this invention is to provide a burner with novel means for deflecting a flame radially outward. Another object of this invention is to provide a burner with novel means of deflecting the flame radially outward against a lateral surface which will become hot and radiate heat to the firepot walls. Another object is to provide a burner which is so constructed that it can readily be applied to furnaces or heaters having fire pots of different sizes and shapes, and which can readily be adjusted to deflect the flame outwardly so as to impinge against fire pot walls located at different distances from the burner.

Another object of this invention is to provide a burner of this type with a telescopically arranged mixing tube whereby the burner can be readily located at different distances from fuel valves and the like. Another object of this invention is to provide a fluid fuel burner of simplified and improved construction in which the use of relatively heavy castings is eliminated, and which is, consequently, easy to install or remove. Another object of this invention is to provide a burner of high efficiency in which the noises or explosions resulting from the turning off of the fuel to extinguish the burner are materially reduced or eliminated. Another object of the invention is to provide a burner in which a very thorough mixing of gaseous fuel and air results. Still another object is to provide a burner of this kind in which secondary air is discharged at an angle to a jet of primary air and gas in such a manner as to improve the mixing of secondary air with the primary mixture.

Another object of this invention is to provide a burner in which a deflecting device is arranged mainly in the primary cone of the flame. Another object is to provide a burner of this type in which the deflecting device is supported by means of a rod or other supporting member extending from the interior of the duct carrying the primary mixture through the primary cone of the flame, so that the supporting member will not be subjected to the heat of the flame and will be cooled by the primary mixture flowing through the duct. Other objects of the invention will appear from the following description and claims.

In the accompanying drawings:

Fig. 1 is a sectional elevation of a fluid fuel burner embodying this invention, showing the same installed in a furnace or heater.

Fig. 2 is an end elevation of the primary fuel and air mixing device of the burner.

Fig. 3 is a sectional plan view thereof, on line 3—3, Fig. 1.

Fig. 4 is a fragmentary section thereof, on line 4—4, Fig. 3.

Fig. 5 is an elevation of my improved burner showing the same removed from a furnace or heater, and having a flame deflecting device of slightly modified form.

Fig. 6 is a fragmentary sectional elevation showing a deflecting member of another modified construction.

Fig. 7 is a bottom plan view of the deflecting device shown in Fig. 5.

In Fig. 1 a heater or furnace is shown having an inner wall A which forms the wall of the fire pot or combustion chamber of the furnace and *a* represents the outer wall of the furnace or heater, the space between the walls containing water, air, or other medium to be heated. In the lower portion of the furnace, the usual ash pit B is formed. While I have illustrated my improved burner as installed in a furnace or heater intended primarily for operation in connection with solid fuel, it will be understood that the burner may be used for other purposes if desired. I have also illustrated the burner as used in connection with gas, but other fluid fuels may be used, if desired.

My improved burner includes a tube or duct 10 for fuel or a mixture of fuel and primary air and this duct is preferably arranged approximately centrally with relation to the combustion chamber. When the burner is installed in such a manner that the tube or duct 10 extends vertically, the duct is preferably provided at its lower end with a laterally extending arm 11 into which a mixing tube 12 of approximately Venturi shape discharges fuel. Preferably the larger or flaring end of the mixing tube is telescopically arranged with reference to the arm 11 of the duct 10 and in the construction shown, the mixing tube extends into the arm 11. This permits adjustment of the gas receiving end of the mixing tube with relation to the discharge end of the duct 10 so that burners of this type can readily be installed in different types and sizes of fur-

naces and heaters, or with the fuel supply connections arranged at different distances from the discharge end of the burner.

The mixing tube 12 may be of any suitable or desired construction, that shown being provided at its receiving end with a bell-shaped mouth 14 having a strap or bracket 15 secured thereto which is provided with an externally threaded nipple 16 secured to the bracket 15 and extending coaxially with the mixing tube 12. An air adjusting plate or disk 17 is supported on the threaded nipple 16 and cooperates with the threads thereof in such a manner that by turning the plate or disk 17, it can be adjusted toward or from the bell-shaped mouth 14 of the mixing tube. A fuel discharge pipe 19 has a reduced portion 20 which extends through the nipple 16 and from which a jet of fuel is discharged into the mixing tube 12 so as to draw in primary air through the bell-shaped mouth 14 of the mixing tube. A thorough mixing of primary air with the fuel takes place during the movement of the mixture in the tube 12 and through the duct 10.

The flow of fuel in the pipe 19 may be controlled by means of a valve 21 of any suitable kind, which may be controlled by means of a motor or valve actuating device generally indicated at 22, the structure of which forms no part of this invention. The receiving end of the mixing tube and the pipe 19 may be arranged in a housing 24 which extends into the ash pit B through a suitable opening in the wall thereof. For example, the housing 24 may extend through the usual ash pit opening of a furnace or heater, which opening is closed about the housing 24 by means of a plate or partition 25. Air may be admitted into the ash pit through suitable openings (not shown) in the housing 24. 26 represents a small tube or duct for carrying fuel to a pilot burner generally designated at 27, which may be of any suitable or desired form to project a pilot flame to the fuel discharged from the pipe or duct 10.

Air may be supplied to the discharge end of the duct 10 in any suitable or desired manner and preferably the air is so directed with relation to the discharge end of the duct 10 as to impinge almost at right angles against the jet of fuel or primary mixture discharged from the duct 10. Air guide means of any suitable or desired construction may be employed, and in the particular embodiment shown in the drawing, I have provided an air directing housing about the duct 10, which may, for example, be supported upon projections or lugs 30 formed on the duct 10. The air housing shown includes a central cylindrical part 31 arranged about the discharge end of the duct 10 and having a laterally extending lower web or plate 32 preferably formed integrally therewith, this web being provided with suitable apertures or holes 33 for admission of air and near the outer portion of the lower web or plate 32 an upwardly extending enclosing wall or flange 34 is provided. The air directing housing also has a plurality of upwardly extending ribs or webs 35, which may also be formed integrally therewith, and a plate 36 which is preferably substantially imperforate, may rest upon the upper edges of the web 35 and on the central cylindrical part or sleeve 31. The plate 36 is so proportioned that its outer edges will be spaced at a distance from the outer wall or flange 34 of the air guiding housing, and consequently, air entering from the ash pit B through the openings 33 in the bottom plate 32 will be deflected by the lower surface of the plate 36 to flow outwardly and then upwardly through the space between the outer edges of the plate 36 and the flange or wall 34. Upon reaching this part of its path of travel, the air is deflected inwardly and horizontally or in a direction substantially at a right angle to the direction of flow of the jet of fuel discharged by the duct 10. This may, for example, be accomplished by means of a guide member or plate 37 supported on the upper edges of the flange 34 of the air housing. This plate is of annular shape, being provided with a central opening 38 of considerably larger diameter than that of the duct 10, and this opening is preferably arranged substantially concentric with the duct so that the primary mixture or fuel discharged by the duct together with the air delivered by the air guiding or directing housing will flow upwardly through the opening 38. Since the plate 37 is subjected to the heat of the flame, it is preferably made of suitable refractory material, such for example as a clay product.

If the burner is employed in a furnace or heater, it is desirable that the flame be deflected outwardly into contact with the walls A of the combustion chamber and when such a deflecting of the flame is desired, I provide a deflecting device 40 which may be in the form of a plate, and which will be located beyond the discharge opening 38 in the member or plate 37. This deflecting device may be supported in the position shown in Fig. 1 in any suitable or desired manner, and in the construction illustrated, I provide a supporting rod or member 41 which may be mounted within the duct 10 in any suitable manner. In the particular construction shown, the duct 10 is provided at the lower portion thereof with a lug or enlargement 42, into which the lower end of the rod or supporting member 41 may enter to support this rod approximately centrally within the duct 10. The upper end of the rod may pass through a lug or hub portion 43 formed on the deflecting device or plate 40. The upper end of the supporting member or rod 41 is also provided with a series of apertures 44 and a pin 45 may extend through apertures in the lug or hub 43 and one of the apertures 44 for holding the deflecting device or plate in the desired position with relation to the discharge aperture 38 of the burner. The lug 42 of the lower end of the duct 10 may also be employed to cooperate with a pedestal 46 which is secured to a suitable base 47 by means of which the burner may be supported from the bottom of the ash pit B. Any other suitable means for supporting the rod or deflector support in relation to the burner, and any other means for adjustably securing the deflector to the support may be provided.

In the operation of the burner described, the jet of primary mixture or other fuel will begin to burn at the discharge end of the duct 10, but complete combustion will take place only at the periphery or surface of the jet where the fuel has become mixed with air from the air housing 24. The interior of the jet which contains either fuel unmixed with air or a non-combustible primary mixture, will form within the flame a primary cone containing fuel which has not been mixed with enough air to burn. This primary cone will be deflected out of its truly conical form by means of the deflecting device or plate 40. In Fig. 1, I have represented the primary

cone as 50 and the flame as 51, and it will be noted that the deflecting device 40, as well as the supporting member 41 therefor are both located in the primary cone or mass of fuel which is not burning. Consequently, these parts may be made of metal and will not become corroded or excessively heated because of the fact that they are in contact mainly with non-burning gases, and not with an oxidizing part of the flame. Because of the fact that the deflecting device 40 directs the flame and fuel laterally, the plate or member 37 will, however, become highly heated by the flame of the burner and for that reason, this plate is preferably made of refractory material and preferably of material of this kind capable of effectively radiating heat such, for example, as a clay mixture. The upper surface of the plate 37, consequently, may be roughened or provided with projections of various forms to increase the radiation of heat from the outer surface of this plate.

By means of the construction described, it will be obvious that my improved burner is capable of operating at widely different capacities, depending upon the amount of fuel supplied to the same. If the burner is installed in a small furnace or heater a reduced amount of gas or other fuel is supplied to the same, which results in turn in the reduced velocity of the jet of fuel mixture and flame so that the same will readily be deflected laterally to a sufficient extent to impinge against the combustion chamber wall A, which in that case will be located rather closely to the burner. If, on the other hand, the burner is installed in a furnace or heater of a large size in which the walls of the combustion chamber A are located at a greater distance from the burner, the burner will also be required to operate at a higher capacity and consequently, a larger quantity of fuel will be discharged into the same, and the air opening (not shown) in the housing 24 may be opened to a greater extent. This will result in a higher rate of flow of the flame and combustible mixture, which will, consequently, be discharged laterally to a greater distance by the deflecting device or plate 40, so that the same will again impinge upon the walls of the combustion chamber of the larger furnace or heater. Furthermore, by adjusting the deflecting plate 40 with relation to the plate 37 as described, the extent to which the flame and products of combustion are projected laterally can further be controlled to suit furnaces or heaters of various kinds. The burner can be used successfully in connection with furnaces or heaters having combustion chambers of rectangular form, as well as those in which the combustion chamber is of circular form, for the reason that the flame and combustible mixture is deflected outwardly to a sufficient extent to cause the flame or hot combustion products to impinge against all portions of the combustion chamber wall of a furnace or heater of rectangular shape.

In order to prevent air from passing to the flame or into the combustion chamber of the furnace or heater except through the air supply housing, suitable means may be provided for forming a substantially air-tight seal between the burner and the furnace wall A and for this purpose, I have shown a partition or dividing wall 53, preferably of refractory material, which extends from the flange 34 of the air supply housing to the furnace wall A, and which separates the combustion chamber from the ash pit and, consequently, makes it possible to accurately control the amount of air supplied to the flame and prevents deflection of the outward movement of the flame by the interference of upward currents of air. The partition or divided wall 53 may be made with a roughened surface on its upper face which may become heated to incandescence by the flame being deflected against the surface and provide radiant heat to the walls of the furnace.

The burner described has in addition to the advantages which have already been stated, the desirable feature of making it readily adjustable to furnaces of different sizes and shapes because of the telescopic connection between the mixing tube 12 and the part 11 of the duct 10. The housing 24 and the parts associated therewith can, consequently, be arranged at all times to extend only to a limited extent beyond the exterior of the furnace or heater and the burner can be centrally located with reference to the fire box regardless of the position of the housing 24. The burner described is also made of parts of relatively light weight so that it is inexpensive to produce and easy to install. By bringing the air in laterally with reference to the jet of fuel discharged from the duct 10, a thorough mixture of the secondary air with the primary mixture results, and furthermore, this lateral impingement of air upon the jet issuing from the duct prevents raising the flame above the discharge end of the duct 10, which in turn results in an objectionable roaring noise. The fuel jet discharged from my burner starts burning at the edge of the duct 10 and the burning is substantially noiseless. The usual explosion or popping noise frequently experienced in burners of other types when the supply of fuel is extinguished is totally absent with this burner, for the reason that the fuel supply duct 10 is of such construction that no large body of mixture of fuel and air is contained within the duct and the opening at the end of the duct is of the same diameter as the duct so that any mixture of air and fuel within the duct is not confined. Consequently, when the burner is turned off, the gas remaining in the duct 10 and mixing tube 12, as it becomes gradually diluted with air, burns by having the flame pass downwardly into the duct until the gas is consumed, and this burning is gradual so that no explosion or popping sound results just before the burner becomes finally extinguished. The flame discharged from the burner passes into contact with the fire pot wall A and in passing upwardly along the wall, has a scrubbing effect upon the same which results in the most efficient transfer of heat from the flame to the wall. In addition to the heat transferred to the wall directly by the flame, the air guiding member or plate 37 and partition 53 of the burner also become heated, and some of this heat is radiated to the fire pot walls and thus increases the efficiency of the burner. The heating of the plate 37 and partition 53, furthermore, increases the efficiency of the burner in that some of the heat from this plate is transmitted to the air flowing to the burner in contact with the lower surface of this plate, and this heating of the air guiding member 37 is accomplished mainly by heat radiated downwardly from the lower part of the flame, which would otherwise be dissipated in the ash pit, where it would serve no useful purpose. The structure of the air directing housing described furthermore, has the advantage that because of the lateral flow of secondary air in the housing, this housing as well as the ash pit is kept cool and the heat taken up by the air in keeping

these parts cool increases the efficiency of the burner. The heat and air flow in opposite directions, so that the cooler air is exposed to a lesser amount of heat further from the flame and the partly warmed air there is exposed to greater heat at the lower surface of the disk or plate 37, and this counterflow principle ensures an efficient taking up of heat that would otherwise pass into the space below the burner.

The deflecting plate 40 as illustrated in Figs. 1 to 5 is substantially flat but it will be understood that this deflecting device may be of any other suitable form. For example, in Fig. 6 a deflecting plate 55 of modified form is shown which is slightly concaved or dished on its lower face, and consequently, this construction deflects the flame and unburnt gases toward the plate 37 to a greater extent than the flat plate 40, so that higher heating of and a larger amount of radiation from the plate 37 results. Still another form of heat deflecting device is shown in Fig. 5, which is particularly desirable when it is necessary to deflect the flame to a greater extent than possible by means of the metal deflecting plates 40 and 55 shown in the other drawings. When metal plates are used for deflecting the flame, the diameter of such plates must, of course, be limited in accordance with the diameter of the deflected primary cone or zone of unburnt gases of the flame. If this plate is made of greater diameter and extends into the oxidizing part of the flame, a rapid deterioration of those parts of the plate which are subject to this action of the flame will result, and the plate will also be heated to a high temperature. Consequently, if a greater lateral or radial projection of the flame is necessary, the metal deflecting plate 40 may be supplemented or replaced by a plate or disk 57 of refractory material, the diameter of which may be greater than the diameter of the deflecting plates 40 and 55, and which will, consequently, cause the flame to be projected radially to a greater extent. By using a plate of refractory material, the plate will not be damaged by the action of the flame. I have shown the refractory plate or disk 57 in Fig. 5 as supported upon a deflecting plate 58, but any other means for mounting the refractory plate 57 in correct relation to the burner may be employed, if desired.

The deflecting plate or device may, of course, be shaped in accordance with the shape of the jet of fuel projected toward the deflecting device. In the accompanying drawings, the burner is shown with a fuel discharge end or opening of substantially circular cross section and, consequently, a deflecting plate or device of substantially circular cross section is desirable. If, however, the flame discharge opening of the burner is of rectangular or other shape, the deflecting device is preferably also of rectangular or other shape corresponding in general to the shape of the fuel discharge opening of the burner and to the extent of the outward projection of the flame which may be desired.

In Figs. 5 and 7, I have shown additional means for controlling the manner in which the flame may be projected by means of the deflector. In this construction, the deflector plate 58 is provided on the lower surface thereof with downwardly extending ribs 59 which change the course of some of the gases impinging on the deflector plate. For example, when a round burner is employed in a rectangular furnace, the flame can be projected by means of the ribs 59 so that the portions of the wall of the combustion chamber farther removed from the burner will receive substantially as much heat and flame as those portions of the wall located more closely to the burner. The deflecting plate 58 with the downwardly extending ribs 59 may, of course, be used with or without the refractory plate 57.

The burner shown is formed in two parts, one part being arranged wholly within the furnace or heater and supported in the ash pit by the base 47, and the other part supported on the furnace wall 25 and including the air and fuel control valves or devices and the Venturi-shaped mixing tube 12. By providing a telescopic connection in the ash pit between the mixing tube 12 and the tubular end 11, the two parts of the burner can be installed in furnaces of different sizes so that the two parts of the burner can be correctly located with reference to the furnace. The spacing of the two parts at different distances to each other is compensated for by the telescopic connection between the parts. The two parts of the telescopic connection need not be fitted with great accuracy, since if there is any leak in the telescopic joint, air from the ash pit will pass into the pipe 11 and become mixed with the primary mixture, and there is no tendency for gas to escape through the telescopic connection. By locating the telescopic joint in the ash pit, any leak of air into the joint will not impair the proportion or ratio of air and fuel, since the air supplied to the burner is controlled at the housing 24.

I claim as my invention:

1. A gas burner including an open-ended duct for a mixture of primary air and gas, means for supplying secondary air to the discharge end of said duct for mixture with the primary mixture discharged therefrom, said means including a substantially imperforate plate arranged adjacent to the discharge end of said duct and extending outwardly about the same, and means arranged in spaced relation to said plate and beyond the discharge end of said duct for confining air flowing to the flame adjacent to the upper face of said plate.

2. A burner including an open-ended duct through which a jet of fuel is discharged, and a plate arranged beyond the discharge end of said duct and having an aperture through which flame and fuel discharged by said duct pass, the lower face of said plate serving to guide air toward the discharge end of said duct for mixture with the fuel and for cooling said plate, and a deflecting member arranged beyond said duct and said plate for deflecting flame toward the other face of said plate.

3. A burner including an open-ended duct for fuel, a member of refractory material arranged beyond the discharge end of said duct and having an aperture larger in diameter than said duct and through which fuel from said duct may pass, and a deflector arranged beyond said refractory member against which fuel from said duct is discharged and deflected backwardly against said refractory member.

4. A burner including an open-ended duct for fuel, a member arranged beyond the discharge end of said duct and having an aperture of larger diameter than said duct and through which fuel from said duct may pass, a deflector arranged beyond said member against which fuel from said duct is discharged and deflected outwardly over the outer face of said member, and means for conducting air for mixture with the fuel along the opposite face of said member to said aperture.

5. A burner including an open-ended duct for fuel, a plate arranged beyond the discharge end

of said duct and having an aperture of larger diameter than and substantially coaxially with said duct through which fuel discharged from said duct may pass, a deflector beyond said plate and of larger size than said aperture for deflecting fuel and flame outwardly over the outer face of said plate, and means for supplying air to the fuel discharged from said duct, said means including a second plate arranged in spaced relation to the inner face of said first plate and extending to said duct for causing air to flow between said plates to the jet of fuel.

6. A burner including a duct for the discharge of fuel and an air directing housing supported at the discharge end of said duct and including a plate extending outwardly from the discharge end of said duct, and means cooperating with said plate for causing air to flow outwardly along the under face of said plate and then inwardly along the upper face of said plate toward the discharge end of said duct, said means being spaced between said plate and the greater part of the flame to protect said plate against excessive heat from said flame.

7. A burner including a duct for discharging a jet of fluid fuel, an air guiding device arranged at the discharge end of said duct and including a sleeve arranged about the discharge end of said duct and supported thereby and extending lengthwise of said duct, a perforate web extending outwardly from said sleeve, an outer wall near the periphery of said web and extending lengthwise of said duct, a plate supported on said outer wall and extending toward said jet and having a central aperture substantially in alinement with said duct, a second plate extending outwardly from said sleeve and spaced between said web and the inner face of said first mentioned plate, the periphery of said second plate being spaced from said outer wall, whereby air will flow between said plates to said jets and around the periphery of said second plate.

8. A burner including an open-ended discharge duct for a jet of burning fuel, a substantially flat plate having a hole through which the jet passes, said plate extending about said jet beyond the discharge end of said duct and said hole being of larger diameter than said duct, and a flame deflecting device arranged beyond said plate and extending substantially parallel thereto and of approximately circular shape for deflecting fuel and flame in a direction substantially parallel to one face of said plate, and an air passage defined in part by the opposite face of said plate.

9. A burner including an open-ended discharge duct for a jet of burning fuel, a substantially flat plate having a hole through which the jet passes, said plate extending about said jet beyond the discharge end of said duct and said hole being of larger diameter than said duct, and a flame deflecting device arranged beyond said plate and having a concave face directed toward said jet for deflecting said jet and flame toward one face of said plate, and an air passage defined in part by the opposite face of said plate.

10. A burner including an open-ended discharge duct for a jet of burning fuel, a substantially flat plate having a hole through which the jet passes, said plate extending about said jet beyond the discharge end of said duct and said hole being of larger diameter than said duct, and made of refractory material, and a flame deflecting device arranged beyond said plate and extending substantially parallel to the same to form a restricted passage between said plate and said deflecting device through which flame may be discharged, a portion of said deflecting device arranged in the primary cone of the flame being made of metal and the portion of said deflecting device exposed to flame beyond said primary cone being made of refractory material.

11. A burner having an open-ended discharge duct for a jet of burning fuel, a plate arranged beyond the discharge end of said duct and having a hole therein beyond said duct and of materially larger diameter than said duct and through which said jet passes, a second plate extending outwardly from the discharge end of said duct and having a portion thereof which is arranged in spaced relation to said first plate and forms therewith an annular passage in which air may flow toward said jet, and means for supplying air to the outer portion of said annular passage.

12. A burner having an open-ended discharge duct for a jet of burning fuel, a plate arranged beyond the discharge end of said duct and having a hole therein beyond said duct and of materially larger diameter than said duct and through which said jet passes, a second plate extending outwardly from the discharge end of said duct and having a portion thereof which is arranged in spaced relation to said first plate and forms therewith an annular passage in which air may flow toward said jet, means for supplying air to the outer portion of said annular passage, and a deflector arranged beyond said first plate and of larger size than the hole therein to deflect said jet in a direction substantially parallel to said plate.

13. A burner including a duct, the discharge portion of which is of substantially uniform cross sectional area and through which a jet of fuel is discharged, a deflector arranged beyond the discharge end of said duct approximately perpendicular to the flow of fuel from said jet and which deflects the flame into a plane substantially perpendicular to said jet, means for supplying air to said jet, and means forming a restricted passage for air and fuel adjacent to said duct for limiting the quantity of air supplied to said fuel, said passage being of smaller transverse area than the area of said deflector.

14. A burner including an open-ended duct through which fuel is discharged in the form of a solid jet, which, when ignited burns adjacent to said duct at the peripheral portion only of said jet, a member arranged about said jet of fuel at a distance beyond the discharge end of said duct and extending at an angle away from said jet, and means arranged beyond said member for deflecting said burning jet out of the path in which it is projected by said duct and toward said member.

15. A burner including an open-ended duct through which a jet of combustible gas is discharged, and a member arranged around and beyond the discharge end of said duct and having an aperture through which flame and gas discharged by said duct pass, the inner face of said member serving to guide air toward the discharge end of said duct for mixture with the gas and for cooling said member, and a deflecting member arranged beyond said duct and said first member for deflecting flame to direct heat toward the other face of said first member.

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