

Oct. 10, 1950

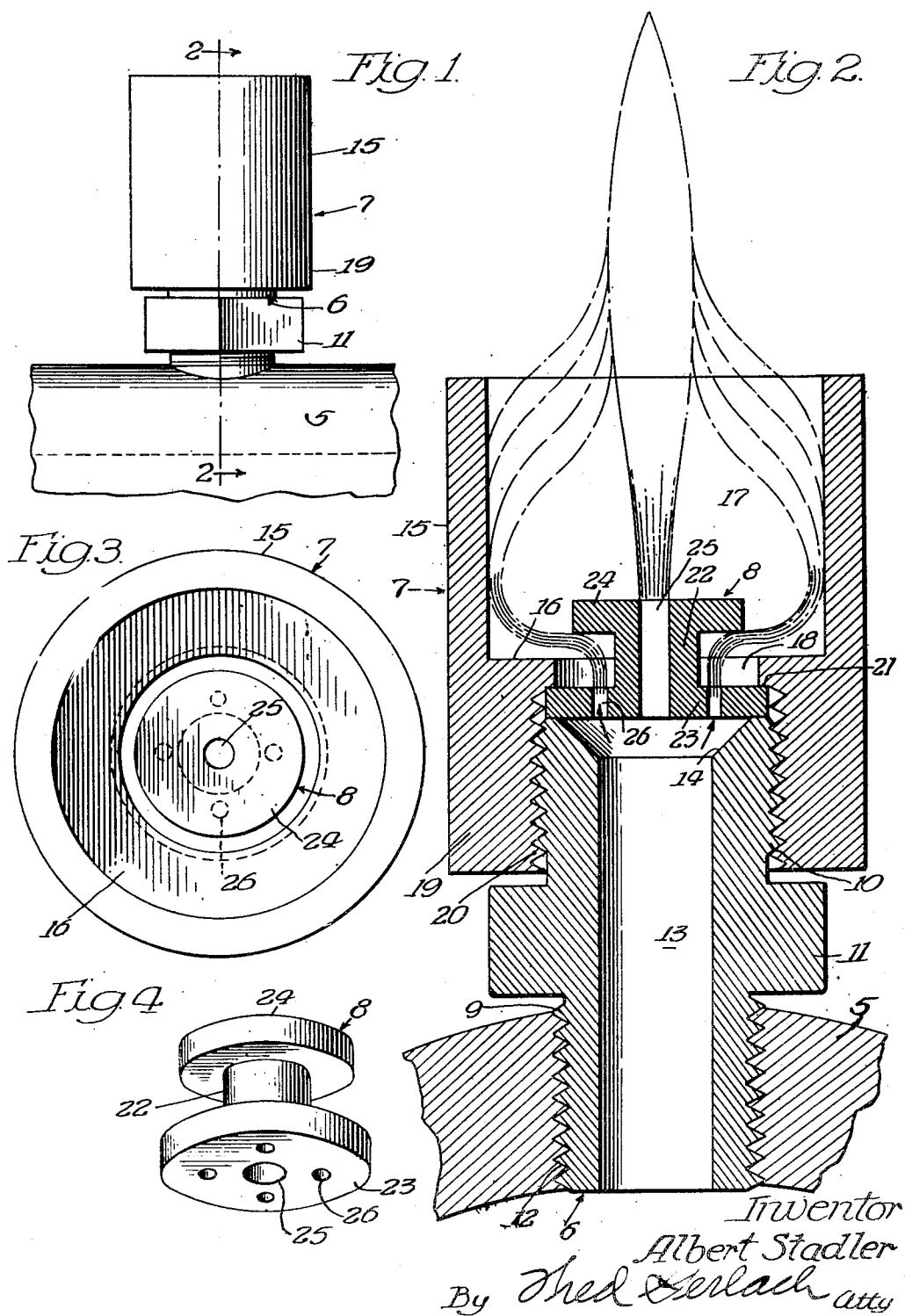
A. STADLER

2,525,432

GASEOUS FUEL BURNER, INCLUDING FLAME RETAINER

Filed Nov. 16, 1946

2 Sheets-Sheet 1



Oct. 10, 1950

A. STADLER

2,525,432

GASEOUS FUEL BURNER, INCLUDING FLAME RETAINER

Filed Nov. 16, 1946

2 Sheets-Sheet 2

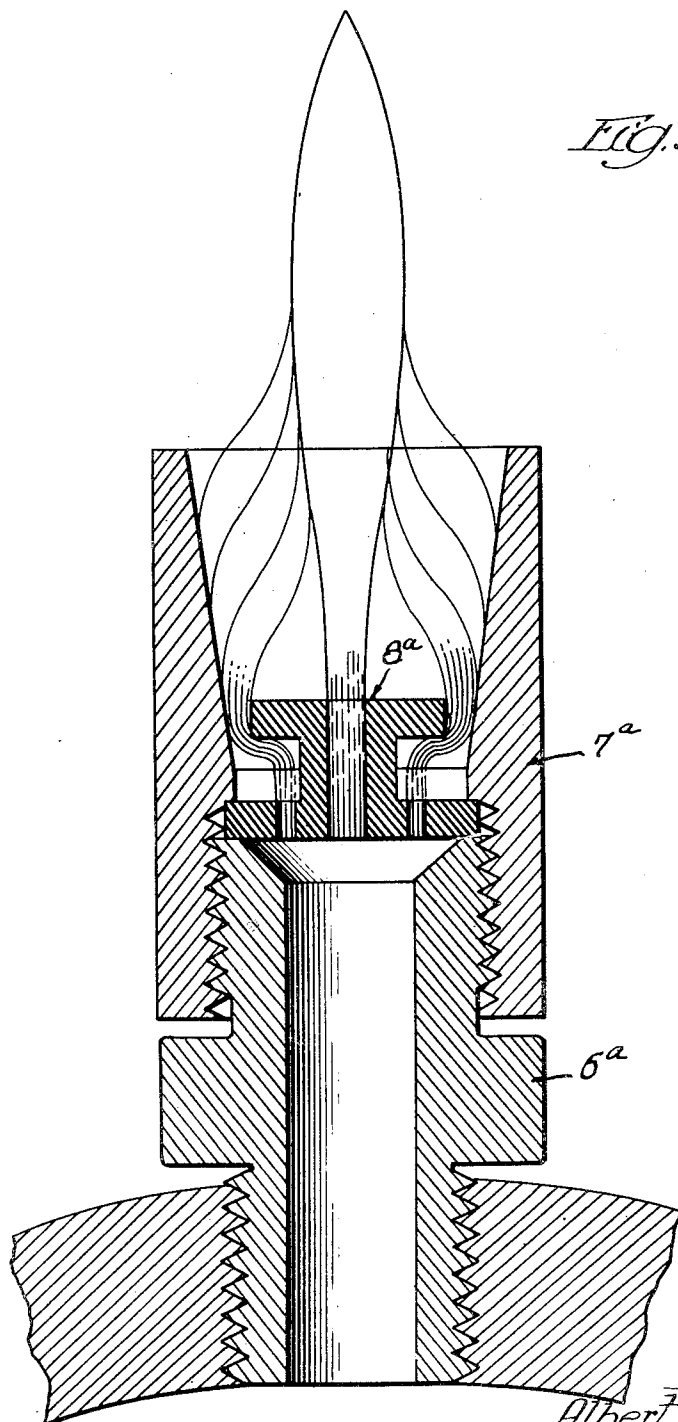


Fig. 5

Inventor
Albert Stadler
By: Fred Gulach Ally.

UNITED STATES PATENT OFFICE

2,525,432

GASEOUS FUEL BURNER, INCLUDING
FLAME RETAINER

Albert Stadler, Rockford, Ill., assignor to Eclipse
Fuel Engineering Co., Rockford, Ill., a corpo-
ration of Illinois

Application November 16, 1946, Serial No. 710,367

14 Claims. (Cl. 158—116)

1

The present invention relates generally to burners for gaseous fuel under pressure. More particularly the invention relates to that type of burner which is designed to effect burning of so-called slow burning gaseous fuel in the form of a mixture of air and a gas of high calorific value, such, for example, as natural gas, propane or butane, is associated and connected with a source of fuel to be burned, and as its essential or primary components comprises: (1) a cup shaped shell, the upper portion of the interior of which constitutes or forms a combustion chamber; (2) an insert member which is disposed for the most part in the lower central portion of the shell, embodies a vertically extending shank and an outwardly extending disc-like flange at the upper end of the shank, and has a vertical open ended duct extending centrally through the shank and flange and serving to deliver or introduce into the central portion of the combustion chamber from the source a main stream of gaseous fuel; and (3) means in the form of an annular series of vertically extending ports around the lower end of the shank of the insert member for introducing or delivering jets of pilot fuel from the source into the space beneath the disc-like flange at the upper end of the shank.

As evidenced by United States Patent No. 1,909,496, granted on May 16 1933, to Garnet W. McKee, it has heretofore been proposed in connection with a gaseous fuel burner of this type to provide vertically extending holes in the outer marginal portion of the disc-like flange of the insert member in order that a portion of the pilot fuel that is introduced into the space beneath the flange by way of the annular series of ports flows upwards into the combustion chamber in the form of streams around the main stream of gaseous fuel emanating from the vertical open ended duct in the insert member and the balance of the pilot fuel, after being deflected outwards by the flange, flows into the combustion chamber through the annular space between the flange and the adjacent portion of the side wall of the shell. It has also been proposed so to dimension or proportion the shell side wall that its inner periphery is spaced but a small distance from the flange with the result that the thickness of the annular space through which the balance or remainder of the pilot fuel is delivered or introduced into the combustion chamber is extremely small. In practice it has been found that when a burner like that of Patent No. 1,909,496 is operated while the fuel is under

2

comparatively high pressure, say a pressure in excess of 4 inches of water column, the flame leaves the combustion chamber and becomes extinguished. This is directly attributable to the fact that the velocity of the pilot fuel entering the combustion chamber is not reduced to the point where it is less than the rate of flame propagation of the gaseous fuel.

One object of the invention is to provide a gaseous fuel burner of the type under consideration which is an improvement upon, and eliminates the disadvantages of, previously designed burners of the same general character by reason of the fact that it is so designed and constructed that in connection with operation thereof there is little, if any, likelihood of isolation or extinguishment of the flame even through the fuel, i. e., the mixture of air and gas, is under comparatively high pressure. The improved burner is characterized by the fact that the disc-like flange at the upper end of the shank of the insert member is imperforate except for the upper end of the duct for the main stream of fuel and hence all of the pilot fuel is deflected laterally outwards against the side wall of the shell. It is further characterized by the fact that the side wall of the shell is so proportioned or dimensioned that the inner periphery thereof is spaced from the disc-like flange such an appreciable distance that the pilot fuel, due to expansion prior to entry into the combustion chamber and entrainment with the main stream of fuel, has its velocity reduced to a point where it is materially less than the rate of flame propagation of the fuel.

Another object of the invention is to provide a gaseous fuel burner of the type and character under consideration in which the side wall of the shell is extended above the flange of the insert member a sufficient distance to prevent the ambient or surrounding air that is drawn into and entrained with the main stream of fuel at a point above the shell from mixing with the pilot fuel prior to entrainment or mixing of the latter with the main fuel stream.

Another object of the invention is to provide a gaseous fuel burner of the aforementioned type in which the bottom wall of the shell has a centrally disposed hole which is of greater diameter than the shank of the insert member and through which the shank extends, and the lower end of the shank is provided with a disc-like flange which is of greater diameter than said hole, underlies and fits against the hole defining portion of the bottom wall of the shell and has in it the

3

annular series of vertically extending ports for delivering the pilot fuel from the source into the space beneath the disc-like flange at the upper end of the shank.

Another object of the invention is to provide a gaseous fuel burner of the last mentioned character in which the lower end of the side wall of the shell is extended downwards beyond the bottom wall to form a cylindrical skirt which is internally threaded and has the upper end thereof in surrounding relation with the port equipped disc-like flange on the lower end of the shank of the insert member.

A further object of the invention is to provide a gaseous fuel burner of the type and character last mentioned which comprises a tubular vertically extending externally threaded adaptor which serves to connect the burner as a whole to a manifold or other source of gaseous fuel under pressure and has the upper end thereof shaped to fit within the internally threaded skirt and of such length that when it is screwed fully into place it serves to clamp the port equipped disc-like flange on the lower end of the shank of the insert member upwards against the hole defining portion of the bottom wall of the shell.

A still further object of the invention is to provide a gaseous fuel burner which is generally of new and improved construction and is characterized by high efficiency and the fact that it may be manufactured or produced at a comparatively low cost.

Other objects of the invention and the various advantages and characteristics of the present gaseous fuel burner will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a side view of a gaseous fuel burner embodying one form of the invention;

Figure 2 is an enlarged vertical or longitudinal section taken on the line 2—2 of Figure 1 and illustrating in detail the manner in which the insert member is secured in place within the lower portion of the shell and showing the proportioning or dimensioning of the shell side wall;

Figure 3 is an enlarged top or plan view of the burner of Figure 1;

Figure 4 is a perspective of the insert member of the burner of Figure 1; and

Figure 5 is a vertical or longitudinal section of a burner embodying a second or modified form of the invention.

The burner which is shown in Figures 1 to 4, inclusive, of the drawings constitutes one form or embodiment of the invention. It is primarily designed and adapted to effect burning of slow burning gaseous fuel in the form of a mixture of air and a gas of high calorific value, such, for example, as natural gas, propane or butane. As hereinafter described more in detail, the burner is so designed and constructed that, even though the fuel is under comparatively high pressure, it effects burning of the fuel without isolation or extinguishment of the flame resulting from

4

combustion of the fuel. It is contemplated that the burner will be supplied with gaseous fuel under pressure from any suitable source of supply such, for example, as a manifold 5. The latter extends horizontally and is in the form of a pipe or like tubular element. As its component parts the burner comprises a tubular adaptor 6, a shell 7, and an insert member 8.

The adaptor 6 extends vertically, embodies an external screw thread 9 at its lower end and an external screw thread 10 at its upper end, and has at its central portion and between the two screw threads 9 and 10 a polygonal enlargement 11 whereby it may be gripped and turned by a wrench or similar tool. As illustrated in Figures 1 and 2, the lower end of the adaptor is adapted to extend through, and fit within a screw threaded hole 12 in, the upper portion of the manifold 5 which, as heretofore pointed out, constitutes the source of supply of the gaseous fuel under pressure. The inner periphery of the adaptor defines a vertically extending open ended fuel duct 13. The upper end of the adaptor is countersunk in order that the upper or discharge end of the fuel duct 13 is flared as at 14. When the burner is in operation the gaseous fuel under pressure, after flowing through the manifold 5, flows upwards through the vertically extending duct 13 in the central portion of the adaptor 6.

The shell 7 is located for the most part above the adaptor 6 and is cup shaped so far as contour or configuration is concerned. It is of one-piece character and consists of a cylindrical side wall 15 and a circular bottom wall 16. Steel, brass, a heat resisting alloy, a refractory substance or any other suitable material may be used to form the shell 7. The upper portion of the interior of the shell constitutes or forms a combustion chamber 17. As shown in the drawing, the shell is arranged in coaxial relation with the tubular adaptor 6. The bottom wall 16 of the shell has a flat upper surface and embodies in its central portion a comparatively large circular hole 18 which, as best shown in Figure 2, is of slightly less diameter than the external diameter of the upper end of the adaptor 6. The lower end of the cylindrical side wall 15 of the shell is provided with an integral, depending cylindrical skirt 19. The latter projects beneath the shell bottom wall 16 and has an internal screw thread 20 for receiving the external screw thread 10 on the upper end of the adaptor. The interfitting screw threads 10 and 20 serve removably to connect the depending cylindrical skirt 19 to the upper end of the adaptor. The portion of the lower surface of the bottom wall that is directly outwards of the circular large sized hole 18 defines a downwardly extending annular shoulder 21 and this overlies and is spaced above the upper end of the adaptor 6.

The insert member 8 is located centrally within and surrounded by the hole equipped bottom wall 16 of the shell 7. It is formed of a single piece of steel or other suitable material and consists of a vertically extending shank 22, a circular or disc-like flange 23 on the lower end of the shank and a circular or disc-like flange 24 on the upper end of the shank. The two flanges are flat and extend horizontally. The lower flange 23 is slightly larger in diameter than the circular hole 18 in the central portion of the shell bottom wall 16 and has the outer marginal portion thereof in underlying and abutting relation with the

5

annular downwardly facing shoulder 21. The upper end of the tubular adaptor 6 bears against the marginal portion of the lower flange 23 and serves when the adaptor is tightened to its fullest extent with respect to the depending cylindrical skirt 19 to clamp said marginal portion of the lower flange against the shoulder 21. The diameter of the shank 22 of the insert member 8 is approximately one-half that of the circular hole 16 in the shell bottom. The upper disc-like flange 24 is of slightly less diameter than said hole 18 and is spaced a comparatively small distance above the upper surface of the shell bottom wall 16. The insert member 8 is provided with a vertical open ended duct 25 and this extends through, and is centrally disposed within, the shank 22 and the disc-like flanges 23 and 24. It is arranged in coaxial relation with the duct 13 in the adaptor 6 and serves to deliver or introduce into the central portion of the combustion chamber 17 a main stream of gaseous fuel. Preferably the duct 25 is of uniform diameter from end to end and is circular in cross section. It is contemplated, however, that if a comparatively long flame is desired the duct will be formed so that it is upwardly tapered. The main stream of fuel that emanates from the duct 25 flows upwards through the combustion chamber 17 at a velocity which generally is in excess of the rate of flame propagation of the gaseous fuel, it being understood that the rate of flame propagation of the fuel depends upon the type of gas that is mixed with the air and the proportion of gas to air. When the fuel is under comparatively high pressure, such as a pressure between 15 and 40 inches of water column, and as contemplated in connection with normal operation of the burner, the velocity of the fuel in transit through the vertically extending duct 25 in the insert member will be in excess of the rate of the flame propagation of the fuel. As soon as the main stream of fuel enters the combustion chamber where it is permitted to expand the velocity of the fuel is materially reduced. In order further to reduce the velocity of the main stream of fuel and also to maintain the main stream of fuel ignited without likelihood of isolation of the flame from the burner low velocity pilot fuel is introduced into the outer portion of the combustion chamber 17 by way of means consisting of an annular series of vertically extending open ended ports 26 in the lower disc-like flange 23 of the insert member 8. These ports are located directly outwards of the shank 22 and underlie the upper disc-like flange 24. The lower ends of the ports receive fuel under pressure from the vertically extending duct 13 in the adaptor 6 by way of the flared upper end of such duct. Preferably the ports are of uniform diameter from end to end and the diameter of the ports is materially less than the vertically extending duct in the insert member 8. The pilot fuel passes upwards through the ports 26, impinges against the lower surface of the upper flange 24, is then deflected laterally outwards against the lower end of the inner periphery of the shell side wall 15, and then flows upwards into the outer portion of the combustion chamber 17. After entry of the pilot fuel into the outer portion of the combustion chamber it is entrained and mixed with the main stream of fuel as illustrated in Figure 2 of the drawing. The upper disc-like flange 24 is imperforate except for the upper end of the duct 25 with the result that all of the pilot fuel is deflected outwards against the side wall 15 of the shell. Pref-

6

erably the total cross sectional area of the ports 26 is less than the cross sectional area of the duct 25. The shell side wall is so proportioned or dimensioned that the inner periphery thereof is spaced from the axis of the duct 25 such a distance that the pilot fuel in connection with lateral and outward deflection thereof against the lower end of the shell side wall so expands that its velocity is reduced to a point less than the rate of flame propagation of the fuel. As a result of this the pilot fuel burns within the combustion chamber 17, mixes with the main stream of fuel when it is entrained therewith, and precludes isolation or extinguishment of the flame resulting from burning of the main stream of fuel that emanates from the centrally disposed duct 25 in the insert member 8. It is to be noted in the drawing that the internal diameter of the side wall of the shell is approximately twice that of the upper disc-like flange 24 of the insert member. As the result of this the annular space between the outer periphery of the flange 24 and the adjacent portion of the inner periphery of the shell side wall is pronouncedly wide and permits of substantially unlimited expansion of the pilot fuel prior to passage of the latter into the combustion chamber 17. The height of the side wall 15 of the shell 7 is such that the ambient or surrounding air that is drawn into and entrained with the main stream of fuel at a point above the combustion chamber is prevented from mixing with the pilot fuel prior to entrainment and mixing of the latter with the main fuel stream. In other words, the height of the shell side wall 15 is such that the pilot fuel is entrained with the main fuel stream while it is substantially all within the combustion chamber and hence the ambient or surrounding air that is entrained with the main fuel stream at a point above the combustion chamber does not augment or increase the velocity of the pilot fuel so that it is in excess of the rate of flame propagation of the fuel. In practice it has been found that if the shell side wall 15 extends upwards to such an extent that the height of the combustion chamber is in excess of the radius of the combustion chamber the desired results are obtained inasmuch as with such proportioning of the shell side wall so far as its height is concerned there is substantially complete entrainment of the pilot fuel with the main fuel stream while it is within the combustion chamber.

The operation of the burner is as follows:

When the gaseous fuel under pressure is supplied to the manifold 5 the fuel, after passing through the manifold, flows upwards through the vertically extending open ended duct 13 in the tubular adaptor 6. After reaching the upper end of the duct 13 a portion of the fuel flows upwards through the vertically extending open ended duct 25 in the insert member 8 and the balance of the fuel flows upwards through the vertically extending open ended ports 26 in the horizontally extending disc-like flange 23 at the lower end of the shank 22. The portion of the fuel that emanates from the duct 25 constitutes the main stream of fuel, as hereinbefore pointed out, and flows upwards through the central portion of the combustion chamber 17 at a velocity that is in excess of the rate of flame propagation of the fuel. The portion of the fuel that passes upwards through the ports 26 constitutes the pilot fuel for the burner and flows upwards against the lower surface of the upper disc-like flange 24 at the upper end of the shank 22 and then is deflected

7

laterally outwards against the lower end of the shell side wall 15. During outward flow of the pilot fuel such fuel expands to such an extent that its velocity is reduced to a point less than the rate of flame propagation of the fuel. After striking against the lower end of the shell side wall 15 the pilot fuel flows upwards into the outer portion of the combustion chamber 17 and then, while within the combustion chamber, flows inwards into entrained relation with the main stream of fuel that emanates from the duct 25. In connection with upward flow of the pilot fuel in the outer portion of the combustion chamber the velocity of the fuel is further reduced with the result that the pilot fuel maintains a constant ignition ring where the pilot and main fuels unite to the end that the flame resulting from combustion is not subject to extinguishment or isolation from the burner.

The herein described gaseous fuel burner effectively and efficiently fulfills its intended purpose and, due to its design and construction, is capable of burning high pressure slow burning fuel without likelihood of extinguishment of the flame. It consists of but three parts and is capable of being manufactured at a low and reasonable cost as well as assembled with facility. In practice it has been found that a burner which is proportioned as shown in Figure 2 of the drawing produces most satisfactory results and is capable of burning slow burning high B. t. u. gaseous fuel while at a pressure as high as 40 inches of water column.

The burner which is shown in Figure 5 of the drawings constitutes a second embodiment or modified form of the invention. It is adapted like the burner of Figures 1 to 4, inclusive, to burn slow burning high B. t. u. gaseous fuel and comprises as its component parts a tubular adaptor 6a, a shell 7a and an insert member 8a. The adaptor and insert member function in the same manner as, and are exactly like, the corresponding parts of the burner of Figures 1 to 4, inclusive. The shell 7a is, however, different from the shell 7 of the burner heretofore described in that the inner periphery of the side wall, instead of being cylindrical, is gradually and uniformly upwardly flared. The lower or small end of the inner periphery of the shell side wall is disposed beneath and but slightly outwards of the upper disc-like flange of the insert 8a. Because of this and the fact that the inner periphery of the shell side wall is upwardly flared the ignition ring resulting from burning of the pilot fuel is closer to the main flame than is the case in the burner of Figures 1 to 4, inclusive. The burner of Figure 5 operates in the same manner as that of Figures 1 to 4, inclusive. It is, however, due to the upwardly flared inner periphery of the shell side wall, designed to be used when the pressure of the gaseous fuel is comparatively low, i. e., less than 15 inches of water column. Because of the fact that the inner periphery of the shell side wall is upwardly flared and arranged as shown in the drawings there is no likelihood of the ignition ring resulting from burning of the pilot fuel becoming extinguished when the pressure of the fuel in the manifold or supply pipe is reduced to an extremely low point, such, for example, as 1/2 inch of water column.

It is contemplated that the burner of Figures 1 to 4, inclusive, will be used where the normal pressure of the gaseous fuel runs between 15 and 40 inches of water column and that the burner of Figure 5 will be utilized when the normal pres-

8

sure of the gaseous fuel is 15 inches of water column or less.

The invention is not to be understood as restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall and a continuous open top side wall extending upwardly from the bottom wall and having the upper portion of its interior constituting a combustion chamber, an insert member disposed centrally within the lower portion of the shell and embodying a vertical shank and an enlarged outwardly extending flange connected to the upper end of the shank, spaced directly above the shell bottom wall and inwards with respect to the shell side wall, and positioned materially closer to said shell bottom wall than to the upper end of the shell side wall, said insert member having a vertical open ended duct extending centrally through the shank and flange and serving to deliver upwards into the central portion of the combustion chamber from the source a main stream of fuel, and means forming an annular series of truly vertically extending ports around the lower end of the shank for delivering jets of pilot fuel upwards into the space beneath the flange, said flange being imperforate except for the upper end of the duct and serving with the shank to deflect all of the pilot fuel laterally against the lower end of the shell side wall, said shell side wall being spaced outwards of the ports such an appreciable distance that the velocity of the pilot fuel is materially reduced as said pilot fuel flows laterally towards said side wall and serving together with the bottom wall to deflect all of the pilot fuel upwards past the flange, around the flange and into the outer portion of the combustion chamber where it is subject to entrainment with the main fuel stream.

2. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall and a cylindrical open top side wall extending upwardly from the bottom wall and having the upper portion of its interior constituting a combustion chamber, an insert member disposed centrally within the lower portion of the shell and embodying a vertical cylindrical shank and an enlarged circular flange connected to the upper end of the shank and spaced directly above the shell bottom wall and inwards with respect to the shell side wall, and disposed materially closer to the shell bottom wall than to the upper end of the shell side wall, said insert member having a vertical open ended duct extending centrally through the shank and flange and serving to deliver upwards into the central portion of the combustion chamber from the source a main stream of fuel, and means forming an annular series of truly vertical ports around the lower end of the shank for delivering jets of pilot fuel from the source upwards into the space beneath the flange, said flange being imperforate except for the upper end of the duct and serving with the shank to deflect all of the pilot fuel laterally against the lower end of the shell side wall, said shell side wall being so dimensioned with respect to its internal diameter that its

lower end is spaced outwards from the ports such a distance that the velocity of the pilot fuel as the latter flows outwards laterally towards said side wall is reduced to a point less than the rate of flame propagation of the fuel, and serving together with the bottom wall to deflect all of the low velocity pilot fuel upwards around the flange and into the outer portion of the combustion chamber for entrainment with the main fuel stream.

3. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall and a continuous open top side wall extending upwardly from the bottom wall and having the upper portion of its interior constituting a combustion chamber, an insert member disposed centrally within the lower portion of the shell and embodying a vertical shank and an enlarged outwardly extending flange connected to the upper end of the shank, spaced directly above the shell bottom wall and inwards with respect to the shell side wall, and disposed materially nearer the shell bottom wall than to the upper end of the shell side wall, said insert member having a vertical open ended duct extending centrally through the shank and flange and serving to deliver upwards into the central portion of the combustion chamber from the source a main stream of fuel, and means forming an annular series of truly vertical ports around the lower ends of the shank for delivering jets of pilot fuel from the source upwards into the space beneath the flange, said flange being imperforate except for the upper end of the duct and serving with the shank to deflect all of the pilot fuel laterally against the lower end of the shell side wall, said shell side wall being spaced outwards from the ports an appreciable distance in order that the velocity of the pilot fuel is materially reduced as said pilot fuel flows laterally towards said side wall, said shell side wall serving together with the bottom wall to deflect all of the pilot fuel upwards around the flange and into the outer portion of the combustion chamber for entrainment with the main fuel stream and being of such height that the pilot fuel after upward deflection thereof is substantially all entrained with said main fuel stream while within the combustion chamber.

4. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall and a continuous open top side wall extending upwardly from the bottom wall and having the upper portion of its interior constituting a combustion chamber, an insert member disposed centrally within the lower portion of the shell and embodying a vertical shank and an enlarged downwardly extending flange connected to the upper end of the shank, spaced directly above the shell bottom wall and inwards with respect to the shell side wall, and disposed materially nearer the shell bottom wall than to the upper end of the shell side wall, said insert member having a vertical open ended duct extending centrally through the shank and flange and serving to deliver upwards into the central portion of the combustion chamber from the source a main stream of fuel, and means forming an annular series of truly vertical ports around the lower end of the shank for delivering jets of pilot fuel from the source upwards into the space beneath the flange, said ports having a total cross sectional area less than the cross sectional

area of said duct, said flange being imperforate except for the upper end of the duct and serving with the shank to deflect all of the pilot fuel laterally against the lower end of the shell side wall, said shell side wall being spaced outwards from the ports such an appreciable distance that the velocity of the pilot fuel is materially reduced as said pilot fuel flows laterally towards said side wall and serving together with the bottom wall to deflect all of the pilot fuel upwards around the flange and into the outer portion of the combustion chamber where it is subject to entrainment with the main fuel stream.

5. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall and a cylindrical open top side wall extending upwardly from the bottom wall and having the upper portion of its interior constituting a combustion chamber, an insert member disposed centrally within the lower portion of the shell and embodying a vertical cylindrical shank and an enlarged circular flange connected to the upper end of the shank, spaced directly above the shell bottom wall and inwards with respect to the shell side wall, and disposed materially nearer the shell bottom wall than to the upper end of the shell side wall, said insert member having a vertical open ended duct extending centrally through the shank and flange and serving to deliver upwards into the central portion of the combustion chamber from the source a main stream of fuel, and means forming an annular series of truly vertical ports around the lower end of the shank for delivering jets of pilot fuel upwards into the space beneath the flange, said ports having a total cross sectional area less than the cross sectional area of said duct, said flange being imperforate except for the upper end of the duct and serving with the shank to deflect all of the pilot fuel laterally against the lower end of the shell side wall, said shell side wall being spaced outwards from the ports such an appreciable distance that the velocity of the pilot fuel is materially reduced as said pilot fuel flows laterally towards said side wall and serving together with the bottom wall to deflect all of the pilot fuel upwards around the flange and into the outer portion of the combustion chamber where it is subject to entrainment with the main fuel stream.

6. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall and a cylindrical open top side wall extending upwardly from the bottom wall and having the upper portion of its interior constituting a combustion chamber, an insert member disposed centrally within the lower portion of the shell, embodying a vertical cylindrical shank and an enlarged circular flange connected to the upper end of the shank and spaced directly above the shell bottom wall, inwards with respect to the shell side wall an appreciable distance beneath the upper end of the latter, and having a vertical open ended duct extending centrally through the shank and flange and serving to deliver upwards into the central portion of the combustion chamber from the source a main stream of fuel, and means forming an annular series of vertically extending ports around the shank for delivering jets of pilot fuel from the source into the space beneath the flange, said flange being imperforate except for the upper end of the duct and serving

11

with the shank to deflect all of the pilot fuel laterally against the lower end of the shell side wall, said shell side wall being so dimensioned that its internal diameter is substantially twice the diameter of the flange, and serving together with the bottom wall to deflect all of the pilot fuel upwards around the flange and into the outer portion of the combustion chamber where it is subject to entrainment with the main fuel stream.

7. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall and a cylindrical open top side wall extending upwardly from the bottom wall and having the upper portion of its interior constituting a combustion chamber, an insert member disposed centrally within the lower portion of the shell, embodying a vertical cylindrical shank and an enlarged circular flange connected to the upper end of the shank and spaced directly above the shell bottom wall, inwards with respect to the shell side wall and an appreciable distance beneath the upper end of the latter, and having a vertical open ended duct extending centrally through the shank and flange and serving to deliver upwards into the central portion of the combustion chamber from the source a main stream of fuel, and means forming an annular series of vertically extending ports around the shank for delivering jets of pilot fuel from the source upwards into the space beneath the flange, said flange being imperforate except for the upper end of the duct and serving with the shank to deflect all of the pilot fuel laterally against the lower end of the shell side wall, said shell side wall being so dimensioned with respect to its internal diameter that its lower end is spaced outwards from the ports such a distance that the velocity of the pilot fuel as the latter flows laterally towards said side wall is materially reduced, said shell side wall serving together with the bottom wall to deflect all of the low velocity pilot fuel upwards around the flange and into the outer portion of the combustion chamber for entrainment with the main fuel stream and being of such height that the height of the combustion chamber is greater than the latter's radius.

8. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall with a comparatively large circular hole in its central portion and a continuous open top side wall extending upwards from the bottom wall, having the upper portion of its interior constituting a combustion chamber, and provided at its lower end with a depending skirt extending below the bottom wall and having means for connecting it to receive fuel from the source, and a separately formed insert member disposed partly within the central lower portion of the shell and embodying a vertical shank of less diameter than, and extending through, the hole in the shell bottom wall, an enlarged outwardly extending upper flange connected to the upper end of the shank and spaced above the shell bottom wall and inwards with respect to the shell side wall, and an enlarged outwardly extending lower flange connected to the lower end of the shank and underlying and abutting against the hole defining portion of said shell bottom wall, said insert member having a vertical open ended duct extending centrally through the shank and flanges and serving to deliver upwards into the central portion of the combustion chamber from the skirt

12

interior a main stream of fuel, the lower flange being provided with an annular series of truly vertical ports for delivering jets of pilot fuel upwards from the skirt interior into the space beneath the upper flange, said upper flange being imperforate except for the upper end of the duct and serving with the shank to deflect all of the pilot fuel laterally against the lower end of the shell side wall preliminary to upflow of said pilot fuel into the outer portion of the combustion chamber.

9. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall with a comparatively large circular hole in its central portion and a continuous open top side wall extending upwards from the bottom wall, having the upper portion of its interior constituting a combustion chamber, and provided at its lower end with a depending skirt extending below the bottom wall, a vertically extending tubular adaptor having the lower end thereof adapted for connection to and to receive fuel from, the source of fuel supply and its upper end fitting part way into the skirt, and a separately formed insert member disposed partly within the central lower portion of the shell and embodying a vertical shank of less diameter than, and extending through, the hole in the shell bottom wall, an enlarged outwardly extending upper flange connected to the upper end of the shank and spaced above the shell bottom wall and inwards with respect to the shell side wall, and an enlarged outwardly extending lower flange connected to the lower end of the shank and interposed between the upper end of the adaptor and the hole defining portion of said shell bottom wall, said insert member having a vertical open ended duct extending centrally through the shank and flanges and serving to deliver upwards into the central portion of the combustion chamber from the skirt interior a main stream of fuel, the lower flange being provided with a plurality of vertically extending ports for delivering jets of pilot fuel from the skirt interior into the space beneath the upper flange, said upper flange serving with the shank to deflect the pilot fuel laterally against the lower end of the shell side wall preliminary to upflow of said pilot fuel into the outer portion of the combustion chamber.

10. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall with a comparatively large circular hole in its central portion and a continuous open top side wall extending upwards from the bottom wall, having the upper portion of its interior constituting a combustion chamber, and provided at its lower end with a depending cylindrical skirt extending below the bottom wall and having an internal screw thread, a vertically extending tubular adaptor having its lower end adapted for connection to, and to receive fuel from, the source of fuel supply and its upper end externally threaded and fitting part way into the skirt, and a separately formed insert member disposed partly within the central lower portion of the shell and embodying a vertical shank of less diameter than, and extending through, the hole in the shell bottom wall, an enlarged outwardly extending upper flange connected to the upper end of the shank and spaced above the shell bottom wall and inwards with respect to the shell side wall, and an enlarged outwardly extending lower flange connected to the lower end of the shank

and interposed and clamped between the upper end of the adaptor and the hole defining portion of said shell bottom wall, said insert member having a vertical open ended duct extending centrally through the shank and flanges and serving to deliver upwards into the central portion of the combustion chamber from the skirt interior a mainstream of fuel, the lower flange being provided with an annular series of truly vertical ports for delivering jets of pilot fuel from the skirt interior upwards into the space beneath the upper flange, said upper flange serving with the shank to deflect the pilot fuel laterally against the lower end of the shell side wall preliminary to upflow of said pilot fuel into the outer portion of the combustion chamber.

11. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall with a comparatively large circular hole in its central portion and a continuous open top side wall extending upwards from the bottom wall, having the upper portion of its interior constituting a combustion chamber, and provided at its lower end with a depending cylindrical skirt extending below the bottom wall and having an internal screw thread, a vertically extending tubular adaptor having its lower end adapted for connection to, and to receive fuel from, the source of fuel supply and its upper end externally threaded and fitting part way into the skirt, and a separately formed insert member disposed partly within the central lower portion of the shell and embodying a vertical shank of less diameter than, and extending through, the hole in the shell bottom wall, an enlarged outwardly extending upper flange connected to the upper end of the shank and spaced above the shell bottom wall and inwards with respect to the shell side wall, and an enlarged outwardly extending lower flange connected to the lower end of the shank and interposed and clamped between the upper end of the adaptor and the hole defining portion of said shell bottom wall, said insert member having a vertical open ended duct extending centrally through the shank and flanges and serving to deliver upwards into the central portion of the combustion chamber from the skirt interior a main stream of fuel, the lower flange being provided with an annular series of vertically extending ports for delivering jets of pilot fuel from the skirt interior upwards into the space beneath the upper flange, said upper flange being imperforate except for the upper end of the duct and serving with the shank to deflect all of the pilot fuel laterally against the lower end of the shell side wall preliminary to upflow of said pilot fuel into the outer portion of the combustion chamber.

12. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall with a comparatively large circular hole in its central portion and a cylindrical open top side wall extending upwards from the bottom wall, having the upper portion of its interior constituting a combustion chamber, and provided at its lower end with a depending cylindrical skirt extending below the bottom wall and having an internal screw thread, a vertically extending tubular adaptor having its lower end adapted for connection to, and to receive fuel from, the source of fuel supply and its upper end externally threaded and fitting part way into the skirt, and a separately formed insert member disposed partly within the central lower portion of the shell and embodying

a vertical shank of less diameter than, and extending through, the hole in the shell bottom wall, an enlarged outwardly extending upper flange connected to the upper end of the shank and spaced above the shell bottom wall and inwards with respect to the shell side wall, and an enlarged outwardly extending lower flange connected to the lower end of the shank and interposed and clamped between the upper end of the adaptor and the hole defining portion of said shell bottom wall, said insert member having a vertical open ended duct extending centrally through the shank and flanges and serving to deliver upwards into the central portion of the combustion chamber from the skirt interior a main stream of fuel, the lower flange being provided with an annular series of vertically extending ports for delivering jets of pilot fuel from the skirt interior upwards into the space beneath the upper flange, said upper flange being imperforate except for the upper end of the duct and serving with the shank to deflect all of the pilot fuel laterally against the lower end of the shell side wall, said shell side wall being so dimensioned that its internal diameter is substantially twice the diameter of the upper flange, serving together with the bottom wall to deflect the pilot fuel upwards into the outer portion of the combustion chamber where it is subject to entrainment with the main fuel stream, and being of such height that the height of the combustion chamber is greater than the latter's radius.

13. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall and a continuous open top side wall extending upwardly from the bottom wall having the inner periphery thereof gradually and uniformly upwardly flared and having the upper portion of its interior constituting a combustion chamber, an insert member disposed centrally within the lower portion of the shell and embodying a vertical shank and an enlarged outwardly extending flange connected to the upper end of the shank, spaced directly above the shell bottom wall and inwards with respect to the shell side wall, and disposed materially nearer the shell bottom wall than to the upper end of the shell side wall, said insert member having a vertical open ended duct extending centrally through the shank and flange and serving to deliver upwards into the central portion of the combustion chamber from the source a main stream of fuel, and means forming an annular series of truly vertical ports around the lower end of the shank for delivering jets of pilot fuel from the source upwards into the space beneath the flange, said flange being imperforate except for the upper end of the duct and serving with the shank to deflect all of the pilot fuel laterally against the lower end of the shell side wall, said lower end of the shell side wall being spaced outwards an appreciable distance from the ports and serving together with the bottom wall to deflect the pilot fuel upwards into the outer portion of the combustion chamber where it is subject to entrainment with the main fuel stream.

14. A burner adapted to burn gaseous fuel under pressure from a source of supply and comprising a cup shaped shell embodying a bottom wall and a continuous open top side wall extending upwardly from the bottom wall having the inner periphery thereof gradually and uniformly upwardly flared and having the upper portion of its interior constituting a combustion chamber,

15

an insert member disposed centrally within the lower portion of the shell and embodying a vertical shank and an enlarged outwardly extending flange connected to the upper end of the shank, spaced directly above the shell bottom wall and inwards with respect to the shell side wall, disposed materially closer to the shell bottom wall than to the upper end of the shell side wall, said insert member having a vertical open ended duct extending centrally through the shank and flange and serving to deliver upwards into the central portion of the combustion chamber from the source a main stream of fuel, and means forming an annular series of vertically extending ports around the lower end of the shank for delivering jets of pilot fuel from the source upwards into the space beneath the flange, said flange being imperforate except for the upper end of the duct and serving with the shank to deflect all of the pilot fuel laterally against the lower end of the shell side wall, said lower end of the shell side wall being spaced an appreciable distance outwards from the ports and serving together with

16

the bottom wall to deflect the pilot fuel upwards into the outer portion of the combustion chamber for entrainment with the main fuel stream, said shell side wall being of such height that the pilot fuel after upward deflection thereof is substantially all entrained with said main fuel stream while within the combustion chamber.

ALBERT STADLER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,600,712	Buttner	Sept. 21, 1926
1,750,616	McCoy	Mar. 11, 1930
1,884,764	Lonergan	Oct. 25, 1932
1,909,496	McKee	May 16, 1933
1,943,859	Fisher	Jan. 16, 1934
2,365,945	Ferguson	Dec. 26, 1944
2,402,045	Hess	June 11, 1946