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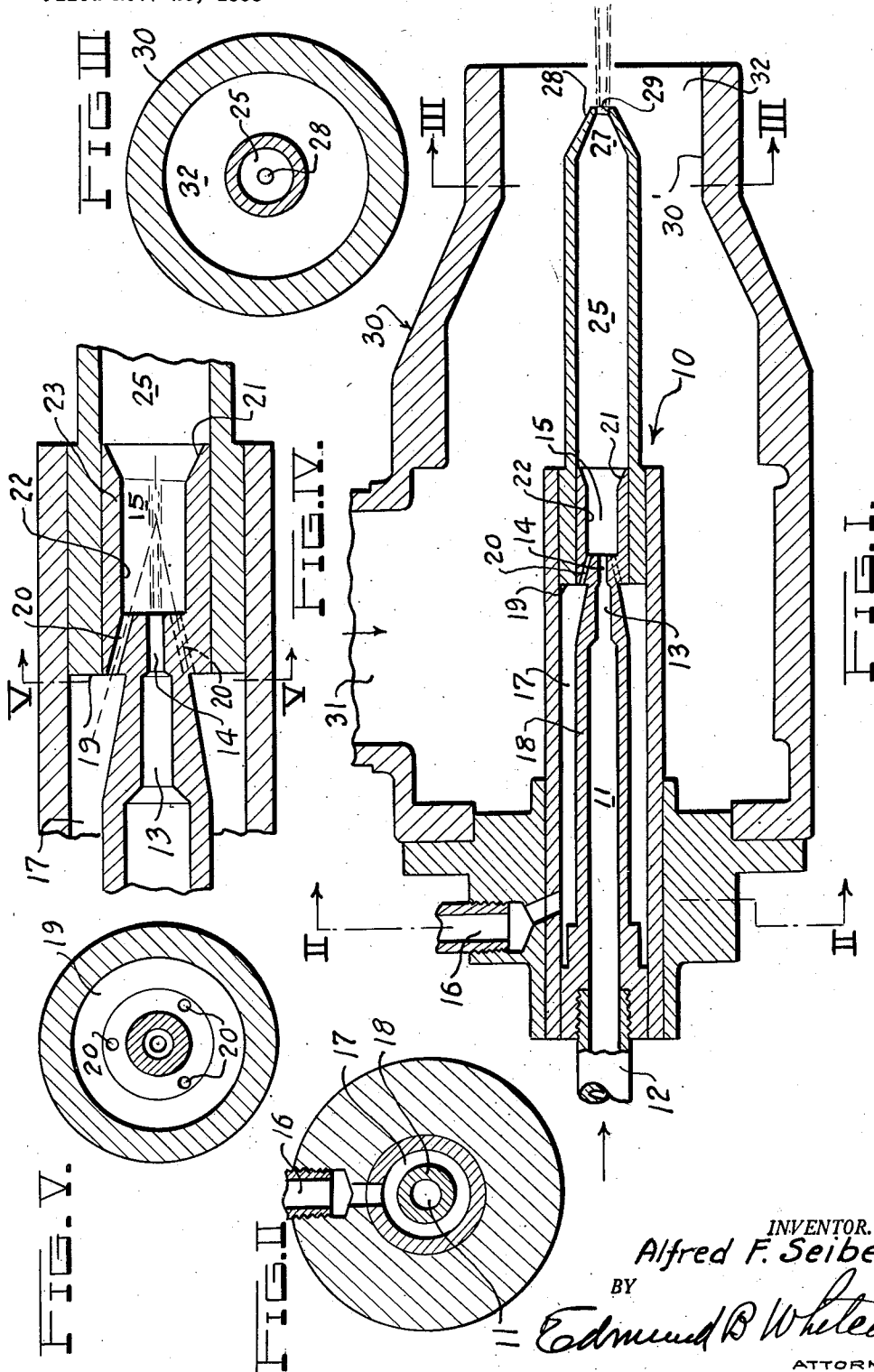
A. F. SEIBEL

2,764,455

VAPORIZING AND MIXING UNIT

Filed Nov. 23, 1953

3 Sheets-Sheet 1



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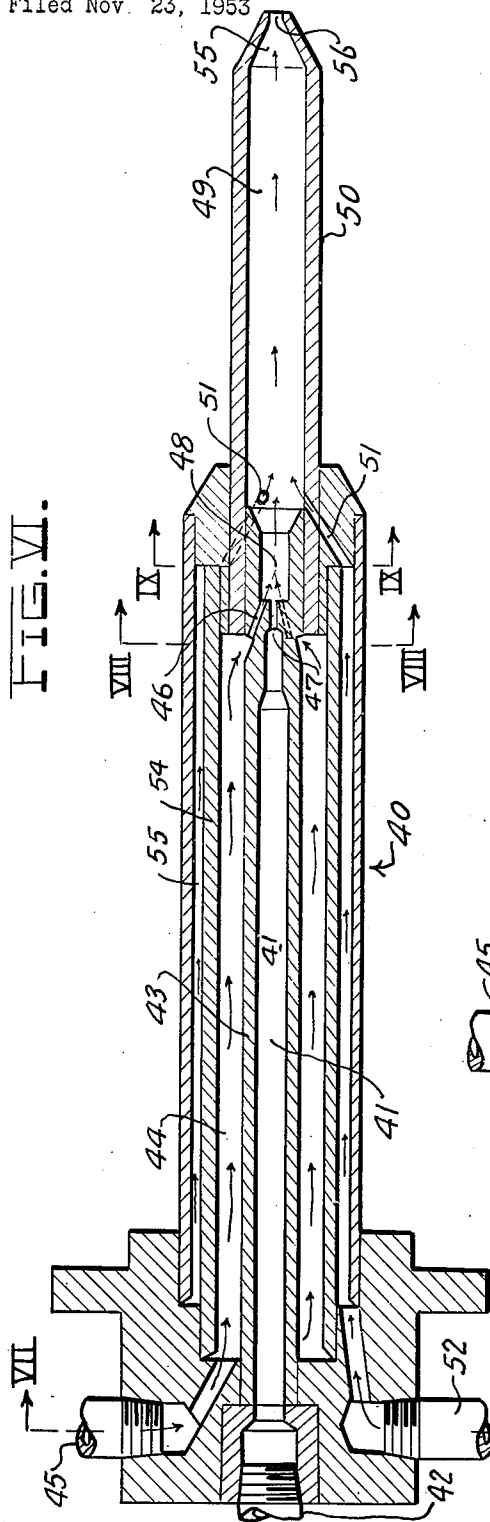
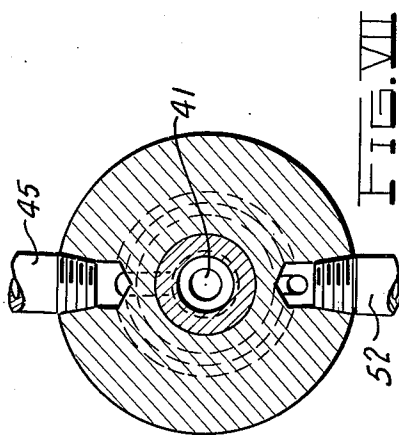
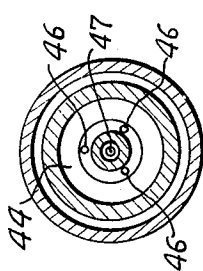
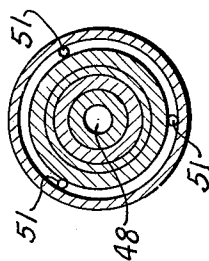
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3 Sheets-Sheet 2



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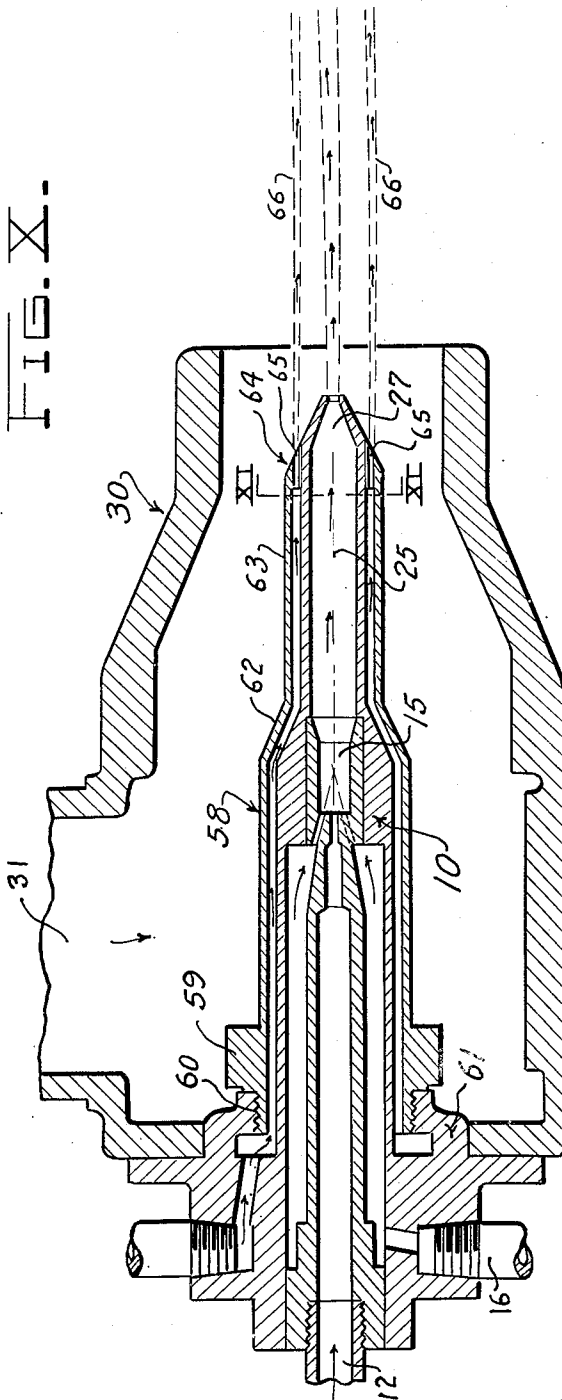
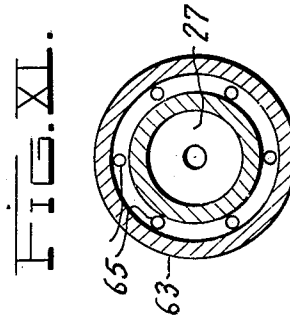
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VAPORIZING AND MIXING UNIT

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3 Sheets-Sheet 3



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2,764,455

VAPORIZING AND MIXING UNIT

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7 Claims. (Cl. 299—140)

This invention relates to a fuel and gaseous mixing unit in which a liquid fuel such as oil, for example, is mixed with one or more gaseous fluids such as compressed air, steam or other gases and comprises such arrangement of passages therefor together with specially constructed mixing, vaporizing, expansion and turbulizing chambers and compression means as to produce a highly satisfactory combustible mixture for use in a furnace, for example, with a greatly reduced requirement of fuel supply, thereby making a very efficient unit of the type indicated.

Further objects and advantages are within the scope of this invention such as relate to the arrangement, operation and function of the related elements of the structure, to various details of construction and to combinations of parts, elements per se, and to economies of manufacture and numerous other features as will be apparent from a consideration of the specification and drawing of a form of the invention, which may be preferred, in which:

Figure I is a sectional elevation through a burner illustrating one embodiment of my invention;

Figure II is a section taken on the line II—II of Figure I;

Figure III is a section taken on the line III—III of Figure I;

Figure IV is an enlarged sectional elevation of the atomizing portion of the burner illustrated in Figure I;

Figure V is a section taken on the line V—V of Figure IV;

Figure VI is a sectional elevation through a burner illustrating an alternate form of my invention;

Figure VII is a section taken on the line VII—VII of Figure VI;

Figure VIII is a section taken on the line VIII—VIII of Figure VI;

Figure IX is a section taken on the line IX—IX of Figure VI;

Figure X is a longitudinal sectional elevation of a still further modification; and

Figure XI is a cross section thereof taken on line XI—XI of Figure X.

In the drawings and particularly in Figure I, I have illustrated my invention in the specific embodiment shown as including a burner unit designated generally as 10 located in a suitable housing and adapted to be mounted for use with a furnace, particularly of the industrial type, not shown.

The burner unit itself forming the essential basis of the invention in the embodiment illustrated, comprises a vaporizing member 10, the oil or other liquid fuel supply to which is admitted under pressure to a central cylindrical passage 11 from a supply line 12. The discharge end of the passage 11 is reduced in diameter to form a passage 13 and terminates in a still further restricted outlet 14 adapted to discharge a fine stream of liquid fuel to be united with air, steam or other gas in a mixing or "first stage" treatment chamber 15.

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Air or other suitable gas, steam, or the like, under pressure, for example, 45 to 50 pounds per square inch, is admitted from a source 16 through an annular chamber 17 surrounding the wall 18 of the passage 11 and discharges into chamber 15. The annular passage 17 is closed as at 19 except for a plurality of ports 20 inclined at a suitable angle, preferably substantially at such an exact angle as to converge in the line of the axis of the passage 11 or into the center of the stream of liquid fuel issuing from the outlet 14. The arrangement and inclination of these ports 20 is such that the impingement of the air on the fuel stream takes place slightly forward of the center of the mixing chamber 15, the oil and gas extremely divided up, vaporized and interunited as will hereinafter appear. Moreover, it will be noted from the drawing that I prefer to use three ducts spaced 120 degrees circumferentially around the axis of the unit since I have found that by using an odd number of ducts, as shown, the meeting of the stream of compressed gaseous fluid centrally of the axis of the unit has a very desirable effect in furthering the mixture, since there is no tendency of the contact of one of the streams to counterbalance the other but the gases and fuel are the more intimately mixed when an odd number of compressed gaseous fluid ducts are employed. The chamber 15 has an outwardly flared wall 21 and the proportions of the mechanism herein illustrated I have found to be very satisfactory in operation.

As forming means for providing a "second stage" of fuel expansion, turbulizing and intimately mixing means, I provide a relatively long cylindrical chamber 25 aligned with the chambers 11 and 17, said chamber 25 being united at its outer end with a conically-shaped "third stage" or compressing chamber 27, formed as shown by providing the conical-shaped end wall 28.

It will be noted that the special outlet in the wall 28 of the compression chamber 27 is formed with a "land" indicated at 29, the outlet nozzle thus arranged to suitably form a relatively long narrow stream of vaporized fuel for the combustible mixture.

In the embodiment shown in Figure I, I have shown a suitable housing 30 surrounding the entire burner unit 10 and adapted to conduct combustion or "blower" air under low pressure from a source 31 to an area 32 surrounding the vaporized fuel stream issuing from the unit 10 to form the combustible mixture for passage into a furnace.

This housing 30 is provided, as shown, with a cylindrical outlet section 30', the length thereof from the extreme outlet wall being varied as desired. Making this section 30' longer cooperates with the issuing stream of combustible mixture to confine the flame into a relatively long narrow stream, whereas, making this cylindrical section 30' shorter permits this stream to widen out more.

As will be seen from examination of Figure IV, the air jets from the passage 20 strike the stream of oil forming an extremely intimate mixture at the same time that expansion of the combined charge is taking place in its first stage. This rapidly moving mixture is restricted in movement by the cylindrical wall 22 of the mixing chamber 15, the relatively high pressures for the gases and the manner of engagement thereof with the fuel stream effecting, it is believed, a violent intermixing and interuniting or such change of the atomic pattern of the elements to form a highly combustible fuel mixture.

This stream now enters the second expansion chamber 25 which is relatively long and in the form shown further breaks up and unites the air and fuel particles to an increased degree.

Thereupon, the mixed fuel and gas enters the compression chamber 27 at the extreme outer end of the unit and since there is a non-restricted connection between the

turbulence chamber 25 and the compression chamber 27, no hard, fast plane of division occurs. The tapered and reduced shape of the chamber 27 is proportioned as shown, since I have found with this burner unit constructed to the proportions or dimensions illustrated has formed a very efficient burner effecting a saving of a large per cent of fuel, even starting with heavy fuels. It is extremely desirable to cause the mixed fuel to emerge from the burner into the stream of combustible air in a long narrow formation from the burner unit and this land 29 which for this embodiment should not be more than $\frac{1}{16}$ or less than $\frac{1}{32}$ inch in length, causes the necessary limited divergence of the issuing fuel stream, along lines approximately indicated as X and Y on Figure I.

In the embodiment shown in Figures VI to IX, I have illustrated a further embodiment of my invention. Here, two gases are mixed with the fuel before it emerges from the burner. The burner unit indicated generally at 40 has a central fuel admitting chamber 41 receiving liquid fuel from a source 42. Surrounding the chamber 41 is a wall 43 and external to this is an annular chamber 44 adapted to receive air or other gas under pressure from a source 45. A plurality of inclined passages 46 conduct the pressure air to impingement on the fuel stream issuing from the orifice 47 into the first stage expansion and mixing chamber 48. The action of this mixing and expansion is to this point exactly the same as has been described in connection with burner 10 (Figure I).

A cylindrical chamber 49 is mounted adjacent chamber 48, the wall 50 of which is provided with a plurality of ports 51 inclined toward the center of the chamber 49 and adapted to receive air or other gas from a source 52 through an annular chamber 55 surrounding the wall 54 of the chamber 44. The chamber 49 now acts as a second stage expansion and mixing chamber for the atomized air and fuel, plus the second gas entering through the ports 51 and is compressed in the area 55 and ejected from the orifice 56 in the same manner as previously described for burner 10.

In Figure X, I have illustrated a still further embodiment of my invention in which I use the central unit 10 substantially identical with that illustrated in Figure I, together with the outer housing 30. These parts are substantially identical in dimensions and proportions as illustrated in connection with the invention shown in Figure I. However, in Figure X, I provide means for supplying a second gaseous fluid emerging at the outlet end of the unit 10 rather than entering the second expansion chamber illustrated in Figure VI, where two gases are there mixed with the liquid fuel. In Figure X, as shown, I surround the unit 10 with an annular enlarged tube 58 having a base portion 59 provided with a screw-threaded extension 60 adapted to be screw-threaded into a threaded end wall portion 61 which carries centrally thereof the unit 10. As indicated at 62, the outer wall 58 of the innermost section of the annular tube 58 converges at a plane adjacent the forward portion of the first expansion chamber 15. As shown, in Figure X, this converging section 62 merges into a tubular portion 63 surrounding and spaced from the second expansion chamber 25. This section 63 is of smaller diameter than the portion 58 and preferably integral therewith and extends to adjacent the outer end of the unit 10 as shown. The outer end of section 63 terminates in an inclined face 64 merging with the outer surface of the "compression" chamber 27 of the unit 10 shown in Figure I. As more clearly shown in Figure XI, the outer end portion of the tube section 63 is provided through the face 64 with a series of openings 65. I illustrate six such longitudinally arranged passages 65 which direct the stream of the second gas substantially parallel to the axis of the unit 10 as indicated at 66 in Figure X.

It is apparent that, within the scope of the invention, modifications and different arrangements may be made other than is herein disclosed, and the present disclosure is

illustrative merely, the invention comprehending all variations thereof.

What I claim is:

1. In a fuel and gaseous fluid vaporizer unit for a furnace, a central passage having a fuel inlet at one end and an outlet at the other end; an annular gaseous fluid passage surrounding said central passage having means to admit a gaseous fluid thereto at the end thereof adjacent the inlet of said central passage; a relatively short longitudinally extended mixing and expanding chamber fixed to the outlet end of said central passage and forming a closure for said surrounding passage, said chamber being provided with a plurality of annularly arranged diagonal gaseous fluid ducts from said surrounding passage into said mixing chamber, said diagonal ducts arranged to converge in a plane forwardly of the central portion of said mixing chamber; and a relatively long enlarged extension fixed to the outer end of said mixing chamber, said extension forming an expansion section for extremely finely atomizing and turbulizing the mixture; a restricted wall at the outer end of said expansion chamber forming a compression chamber at the emerging end of said extension, said compression chamber having an outlet for the combustible mixture.

2. In an oil and air vaporizer unit for a furnace, a central tube having an oil inlet at one end and a restricted outlet at the other end; an annular compressed air tube surrounding said central tube having means to admit compressed air thereto at the end adjacent said oil inlet of said central tube; a relatively short longitudinally extended mixing and expanding chamber fixed to the outlet end of said central tube into which said oil outlet opens; a plurality of annularly arranged diagonal air ducts from said compressed air passage into said mixing chamber with said oil outlet, and said diagonal air ducts arranged to converge in a plane adjacent the central portion of said chamber, a relatively long tubular extension fixed to the outer end of said mixing chamber, said extension forming an extremely finely atomizing and turbulizing section; a restricted outlet forming a compression chamber at the emerging end of said extension; and means to deliver a combustible mixture from said unit in a narrow long stream.

3. In a fuel and gaseous fluid vaporizer unit, a central passage having a fuel inlet at one end and a restricted passage at the outlet end thereof; an annular gaseous fluid passage surrounding said central passage having means to admit gaseous fluid thereto at the end thereof adjacent the inlet of said central passage; a relatively short longitudinally extending mixing and expanding chamber fixed to the outlet end of said central passage and having an end wall forming a closure for said surrounding passage, said chamber being provided with a plurality of annularly arranged diagonal gaseous fluid inlet ducts from said surrounding passage extending through said end wall into said mixing chamber, the outlet surfaces of said ducts arranged in the plane of the outlet surface of said restricted fuel outlet, said diagonal ducts arranged to converge in a plane forwardly of the central portion of said mixing chamber and a relatively long enlarged extension fixed to the outer end of said mixing chamber, said extension forming an expansion section for extremely finely atomizing and turbulizing the mixture; a restricted wall at the outer end of said expansion chamber forming a compression chamber at the emerging end of said extension, said compression chamber having an outlet for the combustible mixture.

4. In a fuel and gaseous fluid vaporizer unit, a central passage having a fuel inlet at one end and a restricted passage at the outlet end thereof; an annular gaseous fluid passage surrounding said central passage having means to admit gaseous fluid thereto at the end thereof adjacent the inlet of said central passage; a relatively short longitudinally extending mixing and expanding chamber fixed to the outlet end of said central passage

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and having an end wall forming a closure for said surrounding passage, said chamber being provided with a plurality of annularly arranged diagonal gaseous fluid inlet ducts from said surrounding passage extending through said end wall into said mixing chamber, the outlet surfaces of said ducts arranged in the plane of the outlet surface of said restricted fuel outlet, said diagonal ducts arranged to converge centrally in the stream of fuel issuing from said central restricted outlet end in a plane located forwardly of the central portion of said mixing chamber; and a relatively long enlarged hollow extension fixed to the outer end of said mixing chamber; an expanded opening outlet from said mixing chamber to said extension chamber, said extension chamber forming an expansion section for extremely finely atomizing and turbulizing the mixture, and a compression chamber connected with said extension chamber, said compression chamber being provided with an outlet for the combustible mixture.

5. In a fuel and gaseous fluid vaporizer unit for a furnace, a central passage having a fuel inlet at one end and an outlet at the other end; an annular gaseous fluid passage surrounding said central passage having means to admit a gaseous fluid thereto at the end thereof adjacent the inlet of said central passage; a relatively short longitudinally extended mixing and expanding chamber fixed to the outlet end of said central passage and forming a closure for said surrounding passage, said chamber being provided with a plurality of annularly arranged diagonal gaseous fluid ducts from said surrounding passage into said mixing chamber, said diagonal ducts arranged to converge in a plane forwardly of the central portion of said mixing chamber; and a relatively long enlarged extension fixed to the outer end of said mixing chamber; another annular passage surrounding said first-mentioned annular gaseous fluid passage connected at one end with an inlet and provided at its other end with diagonally arranged ducts for connecting said second annular passage with the inlet end of said extension chamber, said extension chamber forming an expansion section for extremely finely atomizing and turbulizing the mixture; a restricted wall at the outer end of said expansion chamber forming a compression chamber at the emerging end of said extension, said compression chamber having an outlet for the combustible mixture.

6. In a fuel and gaseous fluid vaporizer unit for a furnace, a central passage having a fuel inlet at one end and an outlet at the other end; an annular gaseous fluid passage surrounding said central passage having means to admit a gaseous fluid thereto at the end thereof adjacent the inlet of said central passage; a relatively short longitudinally extended mixing and expanding chamber fixed to the outlet end of said central passage and forming a closure for said surrounding passage, said chamber being provided with a plurality of annularly arranged diagonal gaseous fluid ducts from said surrounding passage into said mixing chamber, said diagonal ducts arranged to converge in a plane forwardly of the central

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portion of said mixing chamber; and a relatively long enlarged extension fixed to the outer end of said mixing chamber; another annular passage surrounding said first-mentioned annular gaseous fluid passage connected at one end with an inlet and provided at its other end with a reduced annular passage surrounding said extension chamber, said reduced extension of said second annular passage being provided with a plurality of outlet ducts surrounding said expansion chamber, said ducts arranged substantially parallel to the axis of said central fuel passage, said extension forming an expansion section for extremely finely atomizing and turbulizing the mixture; a restricted wall at the outer end of said expansion chamber forming a compression chamber at the emerging end of said extension, said compression chamber having an outlet for the combustible mixture, the ducts of said second annular passage arranged to discharge a gaseous fluid annularly around the discharge of said combustible mixture.

7. In a fuel and gaseous fluid vaporizer unit for a furnace, a central passage having a fuel inlet at one end and an outlet at the other end; an annular gaseous fluid passage surrounding said central passage having means to admit a gaseous fluid thereto at the end thereof adjacent the inlet of said central passage; a relatively short longitudinally extended mixing chamber fixed to the outlet end of said central passage and forming a closure for said surrounding passage, said chamber being provided with a plurality of annularly arranged diagonal gaseous fluid ducts from said surrounding passage into said mixing chamber, said diagonal ducts arranged to converge in a plane forwardly of the central portion of said mixing chamber; and a relatively long enlarged extension fixed to the outer end of said mixing chamber, said extension forming an expansion section, the volume of said expansion chamber being several times greater than the volume of said mixing chamber to cause rapid expansion of any fuel particles into the gaseous fluid and for extremely finely atomizing and turbulizing the mixture; a restricted wall at the outer end of said expansion chamber forming a compression chamber at the emerging end of said extension, said compression chamber being of substantially less volume than the volume of said expansion chamber to unify and condense said turbulized mixture, said compression chamber having an outlet for the combustible mixture.

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