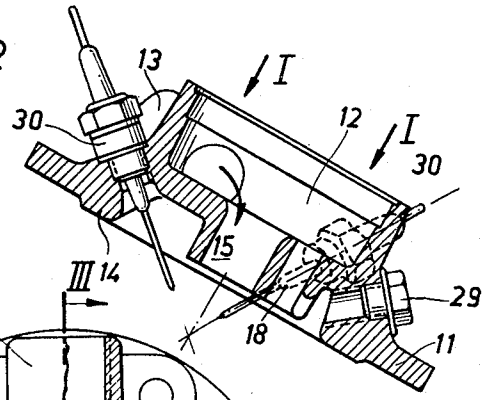
March 8, 1966 R. VON LINDE ETAL 3,238,990

BURNER

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Fig. 2



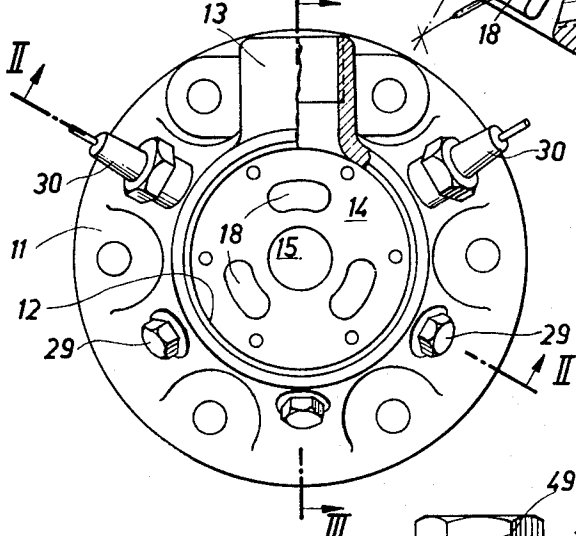
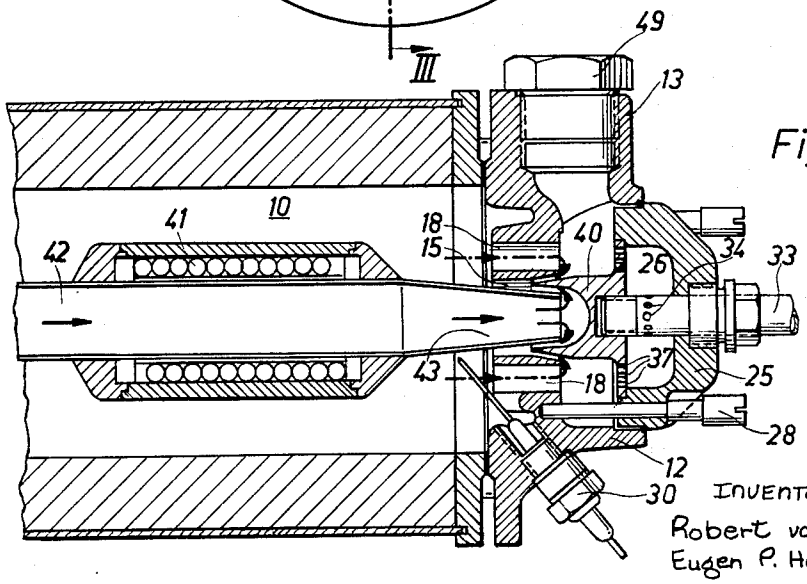


Fig. 1

Fig. 5



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BURNER

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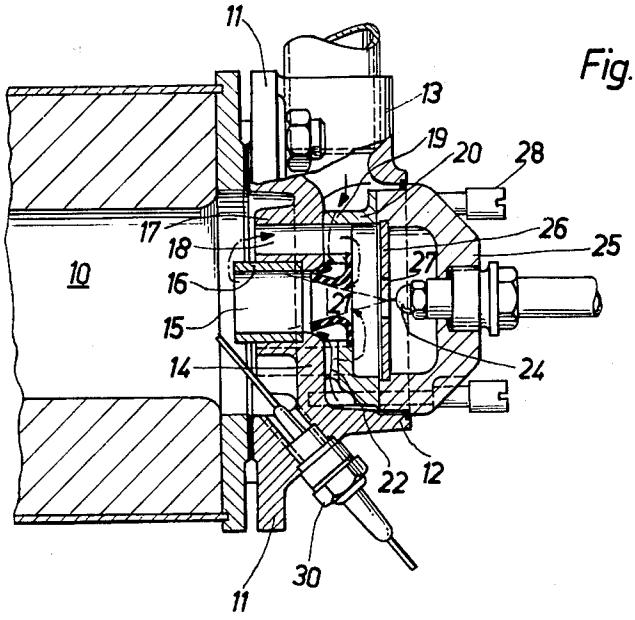


Fig.3

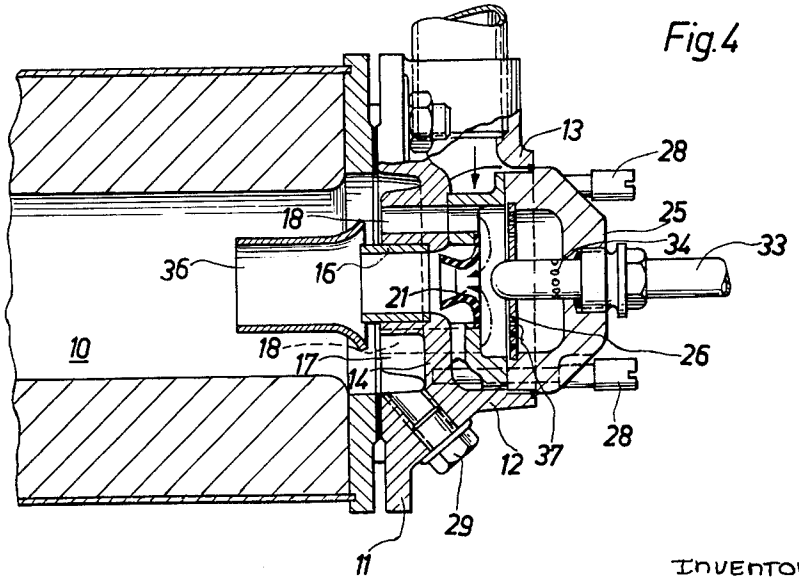


Fig.4

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United States Patent Office 3,238,990 Patented Mar. 8, 1966

3,238,990

BURNER

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Filed Mar. 13, 1964, Ser. No. 351,704
Claims priority, application Germany, Mar. 29, 1963, L 44,496
12 Claims. (Cl. 158—1)

The present invention relates to a burner provided with a driving or operating nozzle by means of which the combustion air supplied under pressure sucks out of the combustion space through return channels a partial quantity of combustion gas to which is added on its way to the inlet connection of the driving nozzle a fuel with flow characteristics.

It has been found that the returned hot combustion gas mixture is a valuable endothermic gasification medium which, by reason of its contents of carbonic acid and water vapor, prepares the fuel injected into the returned gas mixture and/or finely distributed therein, that is, converts or transforms the same into a readily combustible gas mixture which now burns with the combustion air added thereto completely free of soot and smoke and with a clear, short flame. Furthermore, it has been found that the burners of this type are not only useful for the generation of heat in furnaces with stoichiometric supply of combustion air or with slight air excess by reason of the superior flame formation thereof, but can be operated even under considerable air shortage and therewith can be used for the production of mixtures effective as reducing agents which, by reason of the high content in carbon monoxide and/or hydrogen may be used, for example, as protective gases or similar purposes in industrial ovens or furnaces of all types. Thus, strongly reducing exhaust gases could be produced from heating oils and also from propane and butane. The burner is equally suited for the preparation of powdered fuels. The return ducts or channels needed in the burners of this type, which discharge into a special mixing chamber separate from the air supply and are provided with means for the distribution and possibly also for the atomization of the fuel capable of flowing, render difficult the manufacture of such burners. In particular, it has not been possible heretofore to so construct burners of this type that they can be easily manufactured and readily disassembled for purposes of cleaning and exchanging individual component parts thereof.

These difficulties are avoided by the present invention in that the burner consists of several structural parts arranged one behind the other and sealed with respect to one another by seating surfaces, which structural parts complement one another, on the one hand, forming channels or ducts for the returning gases and, on the other, forming passages for the supply of combustion air. A particularly appropriate embodiment of the burner in accordance with the present invention essentially consists in that a housing part to be flangedly connected to the combustion chamber and serving as bearing socket, the bottom of which forms the forward end wall of the combustion chamber and which is provided with a central aperture for the accommodation of a driving or mixing nozzle as well as with lateral apertures for the sucked-back partial quantity of the combustion gas mixture, is closed by a cover which carries the fuel supply, and in that a further hollow structural part is accommodated within the hollow space defined by this cover and the housing part serving as bearing socket, which further hollow structural part divides or separates with respect to each other the hollow space chambers needed for the mixture components to be returned and for the supply of the combustion air. It is achieved by this construction that only a single sealing gap is present on the outside of the burner.

Accordingly, it is an object of the present invention to provide a burner of the type described hereinabove which eliminates by extremely simple means the shortcomings and disadvantages encountered in the prior art constructions.

It is another object of the present invention to provide a burner of the type described above and constituted by several separately made parts, which may be readily manufactured and easily assembled as well as disassembled when necessary.

Another object of the present invention resides in the provision of a burner construction of the type described above which is not only relatively inexpensive as regards the manufacture and assembly, but also minimizes difficulties with respect to the sealing of the various parts thereof.

These and other objects, features and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, several embodiments in accordance with the present invention, and wherein

FIGURE 1 is an elevational view of a housing part serving as bearing socket, taken in the direction of the arrows I in FIGURE 2;

FIGURE 2 is a cross-sectional view through the bearing socket of FIGURE 1, taken along line II—II of FIGURE 1;

FIGURE 3 is a partial cross-sectional view through the complete burner taken along line III—III of FIGURE 1, whereby a spark plug **30** has been inserted in the place of the plug or stopper **29**;

FIGURE 4 is a partial cross-sectional view, similar to FIGURE 3, through a modified embodiment of a burner in accordance with the present invention, and

FIGURE 5 is a partial cross-sectional view, similar to FIGURES 3 and 40, through still a further modified embodiment in accordance with the present invention.

Referring now to the drawing wherein like reference numerals are used throughout the various views to designate like parts, reference numeral **10** designates in the illustratetd embodiments a conventional combustion chamber which is closed off at the front end thereof (FIGURES 3 to 5) by a housing part **12** provided with a flange **11**, which housing part **12** forms a bearing or support socket for the remaining parts of the burner. The bottom **14** of this socket **12** which forms the forward end wall of the combustion chamber **10**, contains a centrally arranged hollow space **15** forming an aperture which is constituted by a short tubular member or short piece of pipe **16**. Laterally of this short piece of pipe **16**, the bottom **14** is provided with several projections or raised portions **17** which are provided with hollow spaces or apertures **18** open on both sides thereof. These hollow spaces or passages **18** each form a first section of the return channels or ducts which discharge in a plane sealing surface within the housing **12**.

Stub-like raised portions **19** are sealingly supported against this sealing surface; these raised portions **19** are seated at the bottom of a cap-like housing insert **20** and contain ducts or channels corresponding to the channels **18** which form each a further section of the return ducts or channels terminating in the hollow space of the housing insert **20**. The combustion air which is introduced into the housing **12** through a lateral connecting nipple **13** is able to flow or pass through between the raised portions **19** into the relatively shallow, hollow space or passage **22** defined by the bottom **14** of the bearing socket **12** and by the bottom of the housing insert **20** and from there

along the outer wall of a mixing nozzle **21**, which is seated at the bottom of the housing insert **20**, into the hollow space **15**. A pressure drop occurs thereby at the orifice of the nozzle **21** which effects that hot combustion gas mixture is sucked out of the combustion chamber **10** by way of return channels **18** and the hollow space of the cap-shaped housing insert **20** into this nozzle **21** along the path indicated in the drawing in dash and dot lines.

In the embodiment according to FIGURE 3, liquid fuel is injected into this mixture in a finely distributed condition by an atomizer nozzle **24** of conventional construction which is inserted axially into a cover **25** tightly closing the housing socket **12**. In this cover **25**, which is constructed in a cap-like manner and is secured at the socket **12** by screws **28**, is arranged a partition wall **26** provided with a central aperture **27** through which is supplied the atomized liquid fuel to the combination gas mixture flowing toward the mixing nozzle **21**. This aperture **27** thus also offers the possibility to displace the burner stock discharging into the atomizer nozzle **24** toward the mixing nozzle **21** and thus to adjust the quantity of returned combustion gas mixture flowing toward this nozzle **21** to the prevailing requirements.

Spark plugs **30** of conventional construction may be utilized for the ignition of the supplied mixture of fuel and combustion air, as illustrated in the drawing. For the installation of these spark plugs **30**, several threaded bores are provided within the conical housing part of the bearing socket **12** which discharge obliquely into the combustion chamber **10**. It is thereby recommended, as may be seen particularly from FIGURE 1, to arrange more threaded bores distributed over the housing circumference than are needed for the spark plugs. The location and arrangement of the ignition places can then be readily matched and adapted to the existing structural conditions. The threaded bores not needed in a given case for the insertion of spark plugs can then be closed off by simple threaded plugs or stoppers **29** insofar as they are not to be used for the accommodation of measuring and observation devices.

The burner according to the present invention may, of course, also be operated with gaseous fuel. For that purpose, as may be seen from FIGURE 4, the atomizer nozzle **24** is replaced by a suitable gas distributor, preferably by a pipe or tubular piece **33** closed at the end face thereof and provided with outflow apertures **34** discharging laterally into the cap-shaped hollow space of the cover **25**. In order to achieve a good mixture formation, the partition wall **26** preferably now provided in the rim zone thereof with sieve-like perforations **37**. As further shown in FIGURE 4, it may be desirable to connect a mixing pipe **36** to the rear, that is, downstream of the tubular piece **16**.

As already mentioned above, the burner according to the present invention is also suitable for the manufacture of reducing gas mixtures. The mixture conversion thereby has to take place under a shortage or lack of air. However, under such operating conditions, the quantities of heat necessary for the conversion or reaction are not liberated by the supplied fuel, particularly if strongly reducing utilization gases are to be obtained under correspondingly large air shortage. In these cases, it is therefore necessary to supply additional heat to the process.

An arrangement particularly suitable for this operation is illustrated in FIGURE 5. In that case, the combustion air is supplied to the burner, in which the main structural parts **12** and **25** are again utilized as in connection with the other embodiments, by means of a line **42** extending centrally through the combustion space **10** and provided with an electric heating system **41** jacketing or surrounding the same. The conically shaped end face **43** of the line **42** discharges or terminates in a bucket or cup-shaped insert body **40**. This insert body **40**, which is arranged at the partition wall **26**, firstly serves for the deflection of the produced warm air stream. The internal wall surfaces of this hollow body **40** form together with the external surfaces of the pipe end **43** an annularly-shaped driving nozzle, whereas the outer wall surfaces of the hollow insert **40** form, together with the central hollow space **15** within the housing socket **12**, an annularly-shaped mixing nozzle for the supply of the mixture consisting of the returned combustion gas components and fuel. In this application, the connecting nipple **13** may be utilized either for the supply of a further working medium having flow characteristics and useful for the operation of the installation or, as illustrated, may be closed off by a closure plug **49**.

While we have shown and described several embodiments in accordance with the present invention, it is understood that the same is not limited thereto, but is susceptible of numerous changes and modifications as known to a person skilled in the art, and we, therefore, do not wish to be limited to the details shown and described herein, but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

We claim:

1. A burner assembly, comprising

combustion chamber means,

nozzle means having an inlet portion and an outlet portion,

air channel means to deliver combustion air adjacent to said outlet portion of said nozzle means to produce a substantial suction within said nozzle means at said outlet portion,

return channel means to conduct combustion gases from said combustion chamber means to said inlet portion of said nozzle means in response to the suction,

fuel supply means to deliver fuel to the combustion gases and mix the fuel with the combustion gases prior to the fuel and gases reaching said outlet portion of said nozzle means,

and a plurality of structural parts arranged serially with respect to one another and sealed with respect to each other, and provided with complementary means constituting in part said return channel means and said air channel means.

2. A burner assembly comprising:

combustion chamber means,

nozzle means having an inlet portion and an outlet portion,

air channel means to deliver combustion air adjacent to said outlet portion of said nozzle means to produce a substantial suction within said nozzle means at said outlet portion,

return channel means to conduct combustion gases from said combustion chamber means to said inlet portion of said nozzle means in response to the suction,

fuel supply means to deliver fuel to the combustion gases and mix the fuel with the combustion gases prior to the fuel and gases reaching said outlet portion of said nozzle means,

a plurality of structural parts arranged serially with respect to one another and sealed with respect to each other, and provided with complementary means constituting in part said return channel means and said air channel means,

a first one of said parts being a housing part serving as a bearing socket and flangedly connected with the combustion chamber means, said first part being provided with a bottom forming the forward end wall of said combustion chamber means and being provided with a central aperture for the accommodation of said nozzle means and with lateral apertures comprising in part said return channel means for the return of the combustion gases,

a second one of said parts being formed by a cover closing said first housing part and carrying said fuel supply means,

and said cover and said first housing part defining therebetween a second chamber, and a further hollow structural part constituting a third one of said parts

accommodated in said second chamber, which divides said second chamber to form in part therein said air channel means and said return channel means.

3. A burner assembly, comprising

combustion chamber means,

nozzle means having an inlet portion and an outlet portion,

air channel means to deliver combustion air adjacent to said outlet portion of said nozzle means to produce a substantial suction within said nozzle means at said outlet portion,

return channel means to conduct combustion gases from said combustion chamber means to said inlet portion of said nozzle means in response to the suction,

fuel supply means to deliver fuel to the combustion gases and mix fuel with the combustion gases prior to the fuel and gases reaching said outlet portion of the nozzle means,

a plurality of structural parts arranged serially with respect to one another and sealed with respect to each other, and provided with complementary means constituting in part said return channel means and said air channel means,

a first one of said parts being a housing part serving as a bearing socket and flangedly connected with the combustion chamber means, said first part being provided with a bottom forming the forward end wall of said combustion chamber means and being provided with a central aperture for the accommodation of said nozzle means and with lateral apertures comprising in part said return channel means for the return of the combustion gases,

a second one of said parts being formed by a cover closing said first housing part and carrying said fuel supply means,

said cover and said first housing part defining therebetween a second chamber,

a further hollow structural part in the form of a cap-like insert and constituting a third one of said parts accommodated in said second chamber, which divides said second chamber to form in part therein said air channel means and said return channel means,

said cap-like insert member having a bottom facing said bearing socket,

said nozzle means being carried by the bottom of said cap-like insert in communication with said central aperture in said bearing socket,

the bottom of said cap-like insert being provided laterally of said nozzle means with hollow raised portions which adjoin in a sealing manner with a bottom of said bearing socket in alignment with said lateral apertures to form a further section of said return channel means communicating with said inlet portion of said nozzle means, while leaving therebetween passages crossing said return channel means and comprising in part said air channel means.

4. A burner assembly, comprising

combustion chamber means,

nozzle means having an inlet portion and an outlet portion,

air channel means to deliver combustion air adjacent to said outlet portion of said nozzle means to produce a substantial suction within said nozzle means at said outlet portion,

return channel means to conduct combustion gases from said combustion chamber means to said inlet portion of said nozzle means in response to the suction,

fuel supply means to deliver fuel to the combustion gases and mix the fuel with the combustion gases prior to the fuel and gases reaching said outlet portion of said nozzle means,

a plurality of structural parts arranged serially with respect to one another and sealed with respect to each other, and provided with complementary means constituting in part said return channel means and said air channel means,

a first one of said parts being a housing part serving as a bearing socket and flangedly connected with the combustion chamber means, said first part being provided with a bottom forming the forward end wall of said combustion chamber means and being provided with a central aperture for the accommodation of said nozzle means and with lateral apertures comprising in part said return channel means for the return of the combustion gases,

a second one of said parts being formed by a cover closing said first housing part and carrying said fuel supply means,

said cover and said first housing part defining therebetween a second chamber,

a further hollow structural part in the form of a cap-like insert and constituting a third one of said parts accommodated in said second chamber, which divides said second chamber to form in part therein said air channel means and said return channel means,

said cap-like insert member having a bottom facing said bearing socket,

said nozzle means being carried by the bottom of said cap-like insert in communication with said central aperture in said bearing socket,

the bottom of said cap-like insert being provided laterally of said nozzle means with hollow raised portions which adjoin in a sealing manner with a bottom of said bearing socket in alignment with said lateral apertures to form a further section of said return channel means communicating with said inlet portion of said nozzle means, while leaving therebetween passages crossing said return channel means and comprising in part said air channel means,

said nozzle means having a venturi shape,

and an annular gap between said central aperture of said bearing socket bottom and said nozzle means to form the terminal end of said air channel means and distribute the air around said outlet portion of said nozzle means to produce the suction.

5. A burner assembly, comprising

combustion chamber means,

nozzle means having an inlet portion and an outlet portion,

air channel means to deliver combustion air adjacent to said outlet portion of said nozzle means to produce a substantial suction within said nozzle means at said outlet portion,

return channel means to conduct combustion gases from said combustion chamber means to said inlet portion of said nozzle means in response to the suction,

fuel supply means to deliver fuel to the combustion gases and mix the fuel with the combustion gases prior to the fuel and gases reaching said outlet portion of said nozzle means,

a plurality of structural parts arranged serially with respect to one another and sealed with respect to each other, and provided with complementary means constituting in part said return channel means and said air channel means,

a first one of said parts being a housing part serving as bearing socket and flangedly connected with the combustion chamber means, said first part being provided with a bottom forming the forward end wall of said combustion chamber means and being provided with a central aperture for the accommodation of said nozzle means and with lateral apertures comprising in part said return channel means for the return of the combustion gases,

a second one of said parts being formed by a cover closing said first housing part and carrying said fuel supply means,

said cover and said first housing part defining therebetween a second chamber,
a further hollow structural part in the form of a cap-like insert and constituting a third one of said parts accommodated in said second chamber, which divides said second chamber to form in part therein said air channel means and said return channel means, mean,s
said cap-like insert member having a bottom facing said bearing socket,
said nozzle means being carried by the bottom of said cap-like insert in communication with said central aperture in said bearing socket,
the bottom of said cap-like insert being provided laterally of said nozzle means with hollow raised portions which adjoin in a sealing manner with a bottom of said bearing socket in alignment with said lateral apertures to form a further section of said return channel means communicating with said inlet portion of said nozzle means while leaving therebetween passages crossing said return channel means and comprising in part said air channel means,
and the outer walls of said first housing part being provided with a connecting nipple communicating with said passages and adapted to be used for the supply of combustion air.

6. A burner assembly, comprising
combustion chamber means,
nozzle means having an inlet portion and an outlet portion,
air channel means to deliver combustion air adjacent to said outlet portion of said nozzle means to produce a substantial suction within said nozzle means at said outlet portion,
return channel means to conduct combustion gases from said combustion chamber means to said inlet portion of said nozzle means in response to the suction,
fuel supply means to deliver fuel to the combustion gases and mix the fuel with the combustion gases prior to the fuel and gases reaching said outlet portion of said nozzle means,
a plurality of structural parts arranged serially with respect to one another and sealed with respect to each other, and provided with complementary means constituting in part said return channel means and said air channel means,
a first one of said parts being a housing part serving as a bearing socket and flangedly connected with said combination chamber means, said first part being provided with a bottom forming the forward end wall of said combustion chamber means and being provided with a central aperture for the accommodation of said nozzle means and with lateral apertures comprising in part said return channel means for the return of the combustion gases,
a second one of said parts being formed by a cover closing said first housing part and carrying said fuel supply means,
said cover and said housing part defining therebetween a second chamber,
and said cover being constructed in a cap-like manner,
a partition wall subdividing said second chamber and provided with a least one aperture.

7. A burner assembly, comprising
combustion chamber means,
nozzle means having an inlet portion and an outlet portion,
air channel means to deliver combustion air adjacent to said outlet portion of said nozzle means to produce a substantial suction within said nozzle means at said outlet portion,
return channel means to conduct combustion gases from said combustion chamber means to said inlet portion of said nozzle means in response to the suction,
fuel supply means to deliver fuel to the combustion

gases and mix the fuel with the combustion gases prior to the fuel and gases reaching said outlet portion of said nozzle means,
a plurality of structural parts arranged serially with respect to one another and sealed with respect to each other, and provided with complementary means constituting in part said return channel means and said air channel means,
a first one of said parts being a housing part serving as a bearing socket and flangedly connected with the combustion chamber means, said first part being provided with a bottom forming the forward end wall of said combustion chamber means and being provided with a central aperture for the accommodation of said nozzle means and with lateral apertures comprising in part said return channel means for the return of the combustion gases,
a second one of said parts being formed by a cover closing said first housing part and carrying said fuel supply means,
said cover and said first housing part defining therebetween a second chamber, and a further hollow structural part constituting a third one of said parts accommodated in said second chamber, which divides said second chamber to form in part therein said air channel means and said return channel means,
the outer walls of said first housing parts, serving as said bearing socket, being provided with a connecting nipple communicating with said passages and adapted to be used for the supply of combustion air,
said cover being constructed in a cap-like manner,
and a partition wall subdividing said second chamber and being provided with at least one aperture.

8. A burner assembly, comprising
combustion chamber means,
nozzle means having an inlet portion and an outlet portion,
air channel means to deliver combustion air adjacent to said outlet portion of said nozzle means to produce a substantial suction within said nozzle means at said outlet portion,
return channel means to conduct combustion gases from said combustion chamber means to said inlet portion of said nozzle means in response to the suction,
fuel supply means to deliver fuel to the combustion gases and mix the fuel with the combustion gases prior to the fuel and gases reaching said outlet portion of said nozzle means,
a plurality of structural parts arranged serially with respect to one another and sealed with respect to each other, and provided with complementary means constituting in part said return channel means and said air channel means,
a first one of said parts being a housing part serving as a bearing socket and flangedly connected with said combustion chamber means, said first part being provided with a bottom forming the forward end wall of said combustion chamber means and being provided with a central aperture for the accommodation of said nozzle means and with lateral apertures comprising in part said return channel means for the return of the combustion gases,
a second one of said parts being formed by a cover closing said first housing part and carrying said fuel supply means,
said cover and said housing part defining therebetween a second chamber,
said cover being constructed in a cap-like manner,
a partition wall subdividing said second chamber and provided with at least one aperture,
said partition wall being axially between said nozzle means and said fuel supply means,
said fuel supply means including an atomizer nozzle means,
and said aperture in said partition wall being centrally

located for the passage of the fuel mist discharged from said atomizer nozzle means.

9. A burner assembly, comprising

combustion chamber means,

nozzle means having an inlet portion and an outlet portion,

air channel means to deliver combustion air adjacent to said outlet portion of said nozzle means to produce a substantial suction within said nozzle means at said outlet portion,

return channel means to conduct combustion gases from said combustion chamber means to said inlet portion of said nozzle means in response to the suction,

fuel supply means to deliver fuel to the combustion gases and mix the fuel with the combustion gases prior to the fuel and gases reaching said outlet portion of said nozzle means,

a plurality of structural parts arranged serially with respect to one another and sealed with respect to each other, and provided with complementary means constituting in part said return channel means and said air channel means,

a first one of said parts being a housing part serving as a bearing socket and flangedly connected with said combustion chamber means, said first part being provided with a bottom forming the forward end wall of said combustion chamber means and being provided with a central aperture for the accommodation of said nozzle means and with lateral apertures comprising in part said return channel means for the return of the combustion gases,

a second one of said parts being formed by a cover closing said first housing part and carrying said fuel supply means,

said cover and said housing part defining therebetween a second chamber,

said cover being constructed in a cap-like manner,

a partition wall subdividing said second chamber and provided with at least one aperture,

and a plurality of gas discharge apertures provided in the rim zone of said partition wall for the passage therethrough of a gaseous fuel.

10. A burner assembly comprising

combustion chamber means,

nozzle means having an inlet portion and an outlet portion,

air channel means to deliver combustion air adjacent to said outlet portion of said nozzle means to produce a substantial suction within said nozzle means at said outlet portion,

return channel means to conduct combustion gases from said combustion chamber means to said inlet portion of said nozzle means in response to the suction,

fuel supply means to deliver fuel to the combustion gases and mix the fuel with the combustion gases prior to the fuel and gases reaching said outlet portion of said nozzle means,

a plurality of structural parts arranged serially with respect to one another and sealed with respect to each other, and provided with complementary means constituting in part said return channel means and said air channel means,

a first one of said parts being a housing part serving as a bearing socket and flangedly connected with the combustion chamber means, said first part being provided with a bottom forming the forward end wall of said combustion chamber means and being provided with a central aperture for the accommodation of said nozzle means and with lateral apertures comprising in part said return channel means for the return of the combustion gases,

a second one of said parts being formed by a cover closing said first housing part and carrying said fuel supply means,

said cover and said first housing part defining therebetween a second chamber,

a partition wall between said first housing part and said cover, and a substantially cup-shaped insert carried by said partition wall,

and said air channel means including conduit means within said combustion chamber means and terminating in said cup-shaped insert member which deflects the combustion air stream, the rim portions of said insert member forming with the external surfaces of said conduit means, an annular driving nozzle and with the central aperture of the bearing socket an annularly shaped suction gap forming said nozzle means.

11. A burner assembly comprising:

combustion chamber means,

nozzle means having an inlet portion and an outlet portion,

air channel means to deliver combustion air adjacent to said outlet portion of said nozzle means to produce a substantial suction within said nozzle means at said outlet portion,

return channel means to conduct combustion gases from said combustion chamber means to said inlet portion of said nozzle means in response to the suction,

fuel supply means to deliver fuel to the combustion gases and mix the fuel with the combustion gases prior to the fuel and gases reaching said outlet portion of said nozzle means,

a plurality of structural parts arranged serially with respect to one another and sealed with respect to each other, and provided with complementary means constituting in part said return channel means and said air channel means,

and one of said parts being a housing part serving as a bearing socket, apertures distributed over the housing circumference being arranged within said housing part, said apertures including to the housing axis, extending in substantially radial planes and terminating in the combustion space, one of said apertures serving for the insertion of a spark plug and the others being adapted to be closed.

12. A burner assembly, comprising

combustion chamber means,

nozzle means having an inlet portion and an outlet portion,

air channel means to deliver combustion air adjacent to said outlet portion of said nozzle means to produce a substantial suction within said nozzle means at said outlet portion,

return channel means to conduct combustion gases from said combustion chamber means to said inlet portion of said nozzle means in response to the suction,

fuel supply means to deliver fuel to the combustion gases and mix the fuel with the combustion gases prior to the fuel and gases reaching said outlet portion of said nozzle means,

a plurality of structural parts arranged serially with respect to one another and sealed with respect to each other, and provided with complementary means constituting in part said return channel means and said air channel means,

one of said parts being a housing part serving as a bearing socket and flangedly connected with said combustion chamber means, said housing part being provided with a bottom forming the forward end wall of said combustion chamber means and being provided with a central aperture for the accommodation of said nozzle means and with lateral apertures comprising in part said return channel means for the combustion gases to be returned,

another of said parts being formed by a cover closing

said first housing part and carrying said fuel supply means, and a third one of said parts being accommodated between said first and second parts and serving to effect a crossing of said air channel means and said return channel means.

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