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3,304,987

APPARATUS FOR HEATING WITH NATURAL GAS

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Fig. 1

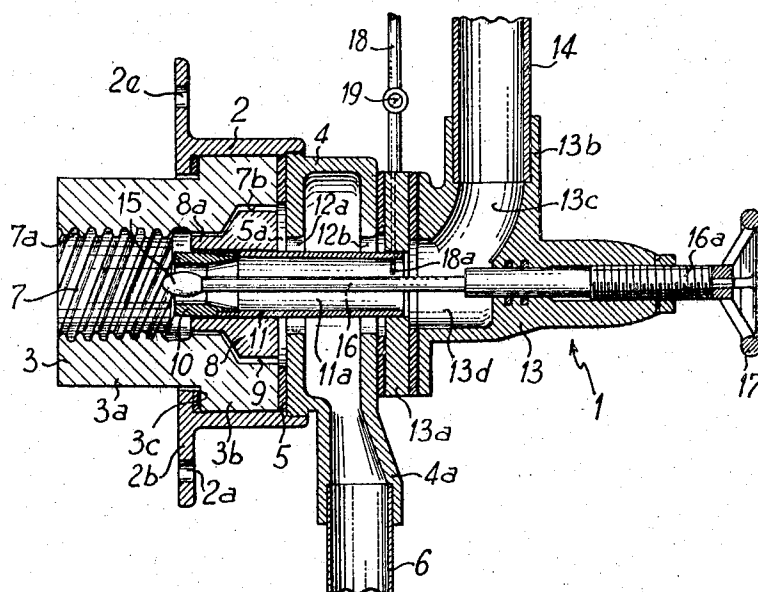
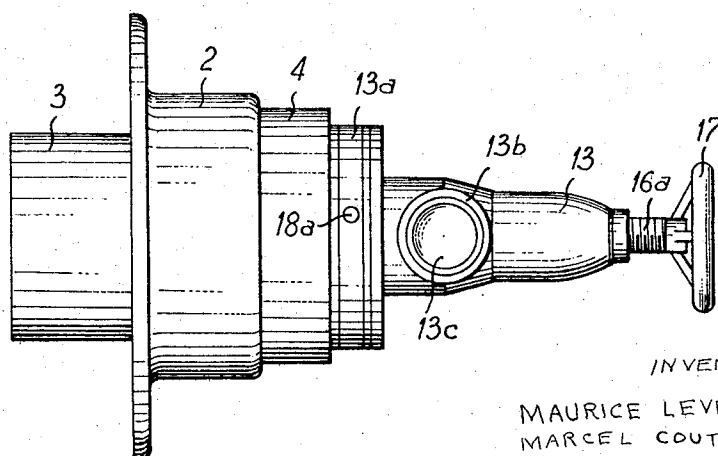


Fig. 2



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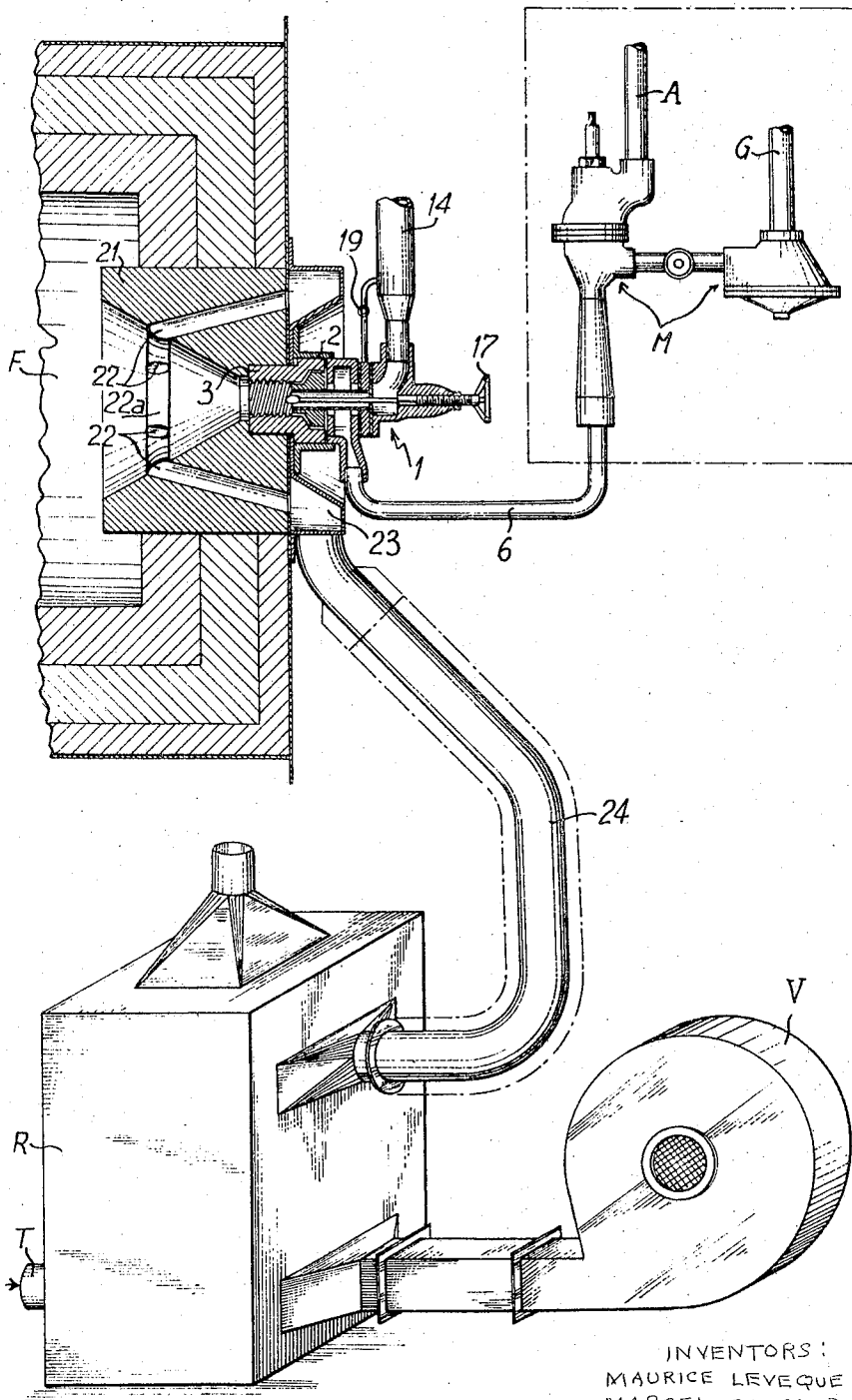
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Fig. 3



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APPARATUS FOR HEATING WITH NATURAL GAS
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The present invention relates in a general way to the heating of industrial furnaces, ovens and like enclosures by means of natural gas and more particularly gas having a high content of methane or other hydrocarbons.

The flame of a natural gas normally comprises carbonic gas and steam whose radiation factors are low. Further, the proportion of dry smoke per unit volume of natural gas is very distinctly greater than that of town gas. Consequently, owing to these factors, the substitution of natural gas for town gas in gas heating units results in a marked drop in the efficiency of these units.

The object of the invention is to provide an improved process of putting natural gas in combustion which increases the radiation power of the flame and consequently affords an improved transmission of the heat to the cold source. One of the objects of the invention is in particular to obtain, by the application of this improved process, an improved total energetic efficiency of a heated enclosure in permitting substitution of natural gas for town gas or fuel oil for the heating of this enclosure without need to modify the geometric characteristics of this enclosure.

For this purpose, the invention concerns imparting the necessary luminosity to the flame and obtaining a flame having the dimensional characteristics appropriate to the enclosure in which the flame must be developed.

It is known that hydrocarbons, such as methane, can be disassociated by thermal cracking with formation of particles of carbon and soot which, when they are in suspension in a flame, impart high luminosity to the latter.

The process for improving the characteristics of a natural gas flame which is one of the objects of the present invention comprises producing a jet of natural gas and subjecting said jet of natural gas on the upstream side of the mixing point of said jet with a jet of comburent gas, to the action of a high temperature resulting in at least a partial cracking of the peripheral zone of said jet of natural gas.

This high temperature is of the order of at least 900° C. and is obtained by the heating of a hollow refractory body through which the jet of natural gas travels, said heating being obtained by means of an auxiliary jet formed by drawing off a small proportion of natural gas which is mixed prior to its ignition with a comburent gas or mixture (which is not necessarily oxygen and can be for example air) in accordance with the necessary theoretical proportion for the combustion of this auxiliary jet bearing in mind the composition of said natural gas.

The amount of natural gas drawn off can be of the order of 3% of the main jet flow.

Another object of the invention is to provide an improved burner adapted for the use of natural combustible gas, said burner comprising in combination a main axial

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conduit adapted to be connected to a natural gas supply conduit, the main conduit communicating with a refractory jet in the form of a cylindrical sleeve coaxial with the main conduit, an annular auxiliary conduit coaxial with the main conduit and communicating with the sleeve in an annular zone which is contiguous with the inner face of the sleeve and with the end of the main conduit, the auxiliary conduit being adapted to be connected to a supply conduit supplying a mixture of natural gas and comburent gas (for example air), said burner being adapted to be mounted axially in the entrance of a radiating opening with which communicate the conduits supplying air and preferably hot air.

Another object of the invention is to provide a heating unit for a furnace or like enclosure said unit comprising an air injection opening, a burner of the type defined hereinbefore mounted axially in the entrance of said opening, a natural gas supply conduit connected to the main conduit of the burner and to a source of natural gas, a mixer of air and natural gas connected, on the one hand, to sources of air and natural gas and, on the other hand, to the annular conduit of the burner, and a device supplying air to said opening, said device preferably comprising an apparatus heating air by direct heating or by recuperation which preheats said air supply.

Further features and advantages of the invention will be apparent from the ensuing description, with reference to the accompanying drawings to which the invention is in no way limited.

In the drawings:

FIG. 1 is an axial sectional view of a burner according to the invention;

FIG. 2 is an elevational view of said burner taken at 90° to FIG. 1, and

FIG. 3 is a view, partly in perspective and partly in section, of a heating unit for a furnace which employs the process according to the invention.

In the embodiment shown in FIGS. 1 and 2, a natural gas burner according to the invention, generally designated by the reference character 1, comprises a generally annular shaped metal collar 2 which has fixing holes 2a and in which is disposed a jet 3 composed of a refractory material and constituting a sleeve having two cylindrical portions 3a, 3b separated by a shoulder 3c, the portion 3a which is of smaller diameter extending forwardly of the mounting face 2b of the collar. This sleeve is held in position by a cylindrical case 4 secured to the collar 2 by a screwthreaded engagement, welding or other means. The jet 3 and case 4 are separated by an insulating gasket 5. The case 4 comprises a pipe 4a adapted to be connected to a conduit 6.

The jet or sleeve 3 has an axial cylindrical chamber 7 whose wall comprises deep grooves, for example helical grooves 7a. This chamber comprises an upstream portion 7b of larger diameter in which is disposed a ring 8 whose end 8a of smaller diameter extends into the chamber 7. Formed between the outer face of this ring and the wall of the chamber 7, 7a, is a space 9 constituting an annular conduit coaxial with the chamber 7, 7a. The ring 8 has an axial conduit in which is disposed a nozzle 10 composed of a refractory material and secured to the end of a tube 11 which extends through the case 4 through circular coaxial openings 12a, 12b.

A space 5a formed between the ring 8 and the case 4 permits the annular conduit to communicate with the opening 12a and consequently with the inner chamber of the case 4.

Secured to the case 4 by screwing, welding or other means, is a head 13 carrying a base 13a and a pipe 13b adapted to be connected to a conduit 14. The inner passage 13c of this pipe communicates with a chamber 13d which communicates with the inner cavity 11a of the tube 11. The cavities 13c, 13d, 11a and the cavity of the nozzle 10 form a main conduit communicating with the conduit 14 and the axial part of the chamber 7 of the jet 3. The cavity of the pipe 4a, the cavity of the case 4, the opening 12a, the space 5a, and the annular conduit 9 constitute an auxiliary conduit which communicates with the conduit 6 and the peripheral part of the chamber 7, since the outer wall of the annular conduit is constituted by a portion of the wall of the chamber 7 of the jet 3.

The assembly is completed by the following accessories. The size of the end passage section of the nozzle 10 is adjusted by a member 15 of oval or like shape disposed axially in said nozzle and secured to the end of a rod 16 which is screwed at 16a in the head 13 and is provided with a regulating wheel 17. A pipe 18 independent of the conduit 14 communicates with the latter and tangentially at 18a with the cavity 11a of the tube 11. A tap 19 regulates the flow through this pipe. The conduit 14 and pipe 18 have been omitted from FIG. 2 for the sake of clarity.

This burner (FIG. 3) is secured through the medium of its collar 2 to the outer face of an element 21 of refractory material closing the opening in a heating furnace F and provided with air inlet conduits 22 which communicate by way of an annular passageway 22a with the mouth of the element 21 at a certain distance inward of the end of the jet 3 of the burner, the conduits 22 communicating with an annular chamber 23 connected to a heat-insulated pipe 24 which is connected to a recuperation device or regenerator R fed with air by a fan V and with heat by a smoke pipe T.

Further, the conduit 14 is connected to a source of natural gas (not shown) which constitutes the heating fuel of the furnace; the conduit 6 is connected to an air and gas mixer M fed with air by a conduit A and with natural gas by a conduit G connected to said source of natural gas.

The apparatus operates in the following manner;

Whereas the major part of the natural gas to be burnt is supplied by the conduit 14 to the main conduit and reaches the nozzle 10, a small proportion of this gas (for example 3% of the total supply) is supplied to the mixer M where it is mixed with air in proportions corresponding to the theoretical combustion, bearing in mind the composition of the gas. This mixture is supplied through the conduit 6 and the auxiliary annular conduit 9 to a region in the vicinity of the end of the nozzle 10 of the main conduit. This mixture is combustible and ignited, but is supplied under such pressure that, firstly, its circulation velocity is higher than the velocity of propagation of the flame in this gaseous mixture and, secondly, the flame is stabilized in a position in the vicinity of the end of the auxiliary conduit. This auxiliary combustion performs a double function:

(1) This auxiliary combustion heats at high temperature—of the order of at least 900° C—the peripheral zone of the gas jet which issues from the nozzle and thus results in a partial cracking of this gas; consequently, there are created in the flame in the opening of the element 21 when the gas is mixed with the air issuing from the passageway 22a, particles of carbon and soot which impart intense luminosity to the flame and thus increase the transmission of heat by radiation.

(2) Said auxiliary combustion insures a preheating of, for example, 300° C. of the whole of the gas jet before its ignition.

It will be observed that:

(a) In the course of its passage through the jet 3 the annular flame is driven in a helical direction by the rubbing of its peripheral zone against the helically ribbed wall of the chamber 7.

(b) The regulating device, constituted by the control wheel 17 and tap 19, imparts to the flame dimensional characteristics appropriate to those of the enclosure F to be heated. The setting of the oval valve member 15 by means of the wheel 17 regulates the length of the flame. The setting of the valve 19 regulates the flow of the tangential jet supplied by the pipe 18 and consequently the magnitude of the rotary component given in this region to the gas jet in the main conduit; consequently the flame can be made more or less turbulent or soft.

It will be understood that it is also possible to adjust by means (not shown) the supply of the gas-air mixture to the auxiliary annular conduit, the velocity of this mixture in the supply conduit and thus the stabilized position of the auxiliary flame. Consequently it is possible to adjust the degree of the localized high cracking temperature and the degree of preheating of the flame; this degree depends also on this adjustment of the temperature of the hot air supplied by the pipe 24.

Although specific embodiments of the invention have been described, many modifications and changes may be made therein without departing from the scope of the invention as defined in the appended claims.

Having now described our invention what we claim as new and desire to secure by Letters Patent is:

1. A burner intended to be mounted axially in the entrance of a radiating opening which is provided in an enclosure to be heated and communicates with air supply conduits, the burner comprising means defining a body in which are provided, a main axial conduit means for supplying raw natural gas to said main conduit, said conduit means having an outlet end and inlet end, a jet composed of refractory material and in the form of a sleeve which is coaxial with and communicates with the main conduit, an annular auxiliary conduit coaxial with the main conduit and communicating with the sleeve in an annular zone which is contiguous with the inner face of the sleeve and with said outlet end of the main conduit, means for supplying a mixture of natural gas and an oxidant to said auxiliary conduit, the burner further comprising a main pipe having one end for connection to a source of natural gas and another end communicating with said inlet end of the main conduit, a secondary pipe having one end connected to the main pipe and another end communicating with the interior of and being connected to said inlet end of the main conduit in such manner as to be tangent with the main conduit, whereby a portion of said natural gas is supplied tangentially in the inlet end of the main conduit.

2. A burner intended to be mounted axially in the entrance of a radiating opening which is provided in an enclosure to be heated and communicates with air supply conduits, the burner comprising means defining a body in which are provided, a main axial conduit, means for supplying natural gas to the main conduit, said means having an outlet end and an inlet end, a jet composed of refractory material and in the form of a sleeve which is coaxial with and communicates with the main conduit, an annular auxiliary conduit coaxial with the main conduit and communicating with the sleeve in an annular zone which is contiguous with the inner face of the sleeve and with said outlet end of the main conduit, means for supplying a mixture of natural gas and an oxidant to the auxiliary conduit; the burner further comprising a main pipe having one end for connection to a source of natural gas and another end communicating with said inlet end of the main conduit, a secondary pipe having one end connected to the main pipe and another end communicating with the interior of and being connected to said inlet end of the main conduit, whereby a portion of said

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natural gas is supplied tangentially in the inlet end of the main conduit, and means inserted in the secondary pipe for adjusting the gas flow therethrough.

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