Jan. 20, 1959 P. BORNKESSEL 2,869,632

PRESSURE GAS BURNERS

Filed Feb. 9, 1953 2 Sheets-Sheet 1

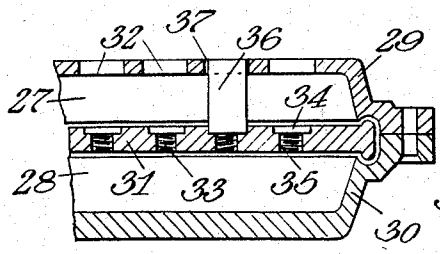


Fig. 1.

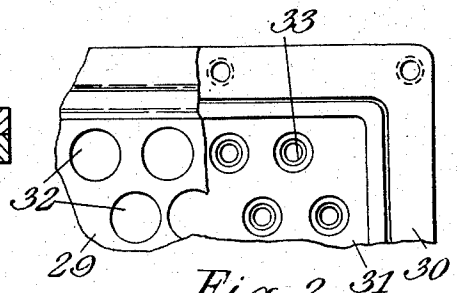


Fig. 2.

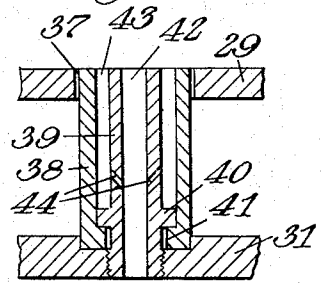


Fig. 3

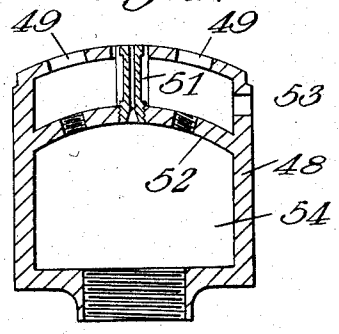


Fig. 5.

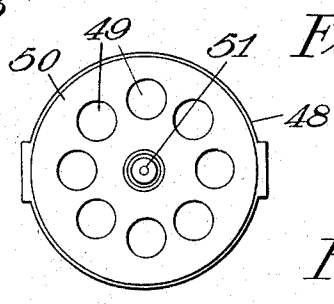


Fig. 6.

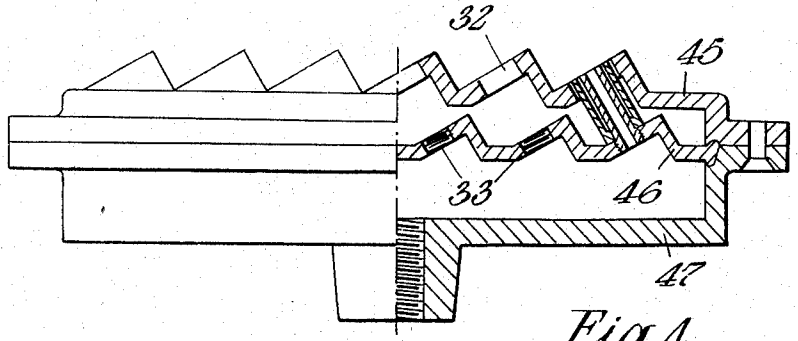


Fig. 4.

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PRESSURE GAS BURNERS

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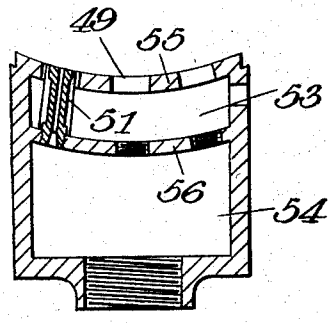


Fig. 7.

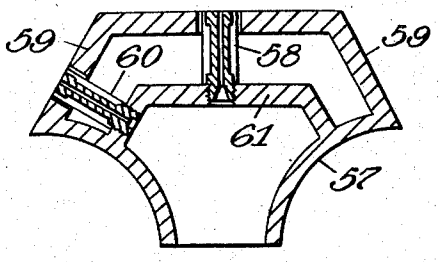


Fig. 8.

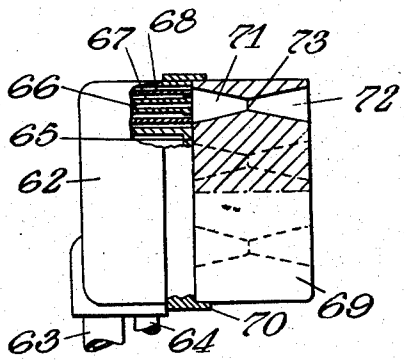


Fig. 9.

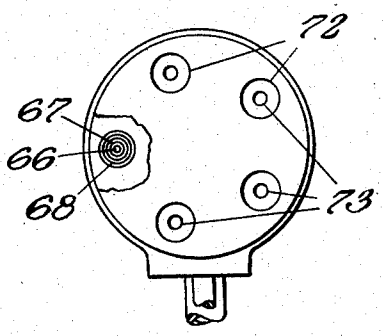


Fig. 10.

United States Patent Office 2,869,632
Patented Jan. 20, 1959

2,869,632

PRESSURE GAS BURNERS

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Application February 9, 1953, Serial No. 335,750

5 Claims. (Cl. 158—116)

This invention relates to gas burners which, for obtaining a long burner flame, are fed with a gas-air mixture of high press. Whilst the words "high pressure gas" and "low pressure gas" are used in the following specification, combustible mixtures of gas and primary air are meant.

In burners operating with high pressure gas, there is a risk that the flames under the action of the high speed of issue of the gas will pull off from the nozzles of the burner and will be extinguished, the gas then escaping from the burner without being burnt. For avoiding this, it has already been proposed to provide the nozzles of such burners beyond their central exit opening for the high pressure gas with one or several additional annular outlets which are arranged concentrically around the main exit opening for the high pressure gas and have the purpose to supply the flame with low pressure gas for insuring an uninterrupted combustion of the high pressure gas. In burners of this kind the low pressure gas is fed into the annular outlet by small throttling bores provided in the duct of the high pressure gas.

Moreover, it has already been proposed in gas burners of this type, which simultaneously are operated with high pressure gas and with low pressure gas to provide an additional supply to the burner flame of secondary compressed air. The compressed air is fed to the flame by means of an outer annular outlet opening which coaxially surrounds the ducts for high pressure gas and low pressure gas. Burners of this type have been constructed as three-chamber burners and have been provided with individual chambers for high pressure gas, low pressure gas and compressed air, from which the individual nozzles of the flame hole have been supplied by means of individual ducts.

The invention has for its object to simplify the construction of burners of this type, the flame holes of which are supplied by coaxial ducts with high pressure gas, low pressure gas and secondary compressed air, and to construct these burners as two-chamber burners which are provided only with separate chambers for high pressure gas and for compressed air. According to the present invention the burner comprises two chambers, namely one for high pressure gas and one for compressed air, which are separated by a partition, the three coaxial outlet openings of the flame holes being formed by a double nozzle inserted into the partition between the two chambers for gas and air, said double nozzle comprising a central duct for the high pressure gas and a coaxial annular duct which is supplied from the central duct with low pressure gas by means of small wall bores, said double nozzle extending across the compressed air chamber and projecting into an outer wall opening of the compressed air chamber in such way that the wall opening forms the additional annular outlet for the secondary compressed air.

By using double nozzles of the prescribed kind the manufacture of the burners is essentially simplified, particularly the manufacture of burners which are provided

with an increased number of flame holes. Moreover, the pressure gas chamber is insulated by the compressed air chamber from the burner flames and thereby protected against excessive heating.

Preferably, the double nozzles are threaded into the partition between the chamber for high pressure gas and compressed air, this construction allowing the removal of the double nozzles individually for the purpose of cleaning their ducts and bores without dismounting the entire burner casing.

The fitting, insertion and removal of the nozzles and their manufacture are particularly simple when the inner nozzle tube contains the high pressure gas is provided at its input end with an external thread and with an external flange, which fits over an internal flange of the outer nozzle tube and clamps the latter to the partition between the chambers of the burner casing.

The burners according to the invention may be constructed as flat surface burners with flames which are parallel to or inclined to the axis of the burner casing or cross one another, also as ring burners with radially inwardly directed flames or as pot burners with radially outwardly directed flames.

According to a further feature of this invention, the casing surfaces of such a burner, which contain the flame holes and the gas nozzles, may have a convex or a concave curvature or inclination. By this means it is possible to obtain a converging or diverging inclination of the burner flames with any desired angle of inclination or also a conical flame arrangement. The converging inclination of the burner flames will preferably be such that all the flames of one burner will have their ends lying together in a point or along a line, thereby ensuring an intense heating effect at this place. However, also a diverging position of the flames may be chosen if it is desirable that, with a burner casing of small dimensions, the heating effect is spread over a large surface.

For increasing the heat radiation, the pressure burners according to the invention may be provided with a known ceramic nozzle piece, the ducts of which are composed in their longitudinal direction of two sections separated by a constriction, which sections are preferably of conical form. In this arrangement the ceramic nozzle piece is fixed to the outer wall of the compressed air chamber containing the flame holes, the compressed air chamber thus protecting the pressure gas chamber against the radiation heat. Such a pressure burner with a ceramic nozzle piece is a favourable substitute for the ceramic jet burners hitherto in use and is particularly suitable for the heating of industrial furnaces operating at high temperatures.

Examples for the construction of pressure gas burners according to the invention are illustrated in the accompanying drawings, in which show

Figs. 1 and 2 a longitudinal section and plan view of a multi-flame pressure burner of the two-chamber kind, only a portion of the burner being shown,

Fig. 3 the nozzle construction for such two-chamber burners to a larger scale,

Fig. 4 a flat surface inclined burner, partly in elevation and partly in section,

Figs. 5 and 6 a vertical longitudinal section through and the plan view of a two-chamber burner with an outwardly diverging flame cone,

Fig. 7 a vertical longitudinal section through a burner of the same kind for the production of a converging flame cone,

Fig. 8 the vertical section of a two-chamber burner the head of which in the plan view (not shown) may be of circular shape or may extend with straight-lined side edges over a certain length, and

Figs. 9 and 10 a pressure gas burner constructed as a jet burner with a ceramic nozzle piece in side elevation, partly in section, and in front elevation.

Figs. 1 and 2 show a flat surface burner the casing of which has two chambers, namely an upper chamber 27 for compressed air, and a lower chamber 28 for high pressure gas. The casing consists of two flat hollow members 29, 30, between which is a partition 31. The member 29 and the partition 31 are provided with coaxial apertures 32, 33. The latter may, as shown in Fig. 1, comprise a countersunk part 34 and a threaded hole 35. The apertures 32 of the casing member 29 act as flame holes and are reduced in cross sectional area by nozzle insertions 36 so as to form annular ports 37 for compressed air. The nozzle insertions 36 are screwed into the openings 33 in the partition 31 and consist, as shown in Fig. 3, of double nozzles formed by a sleeve 38 and a nozzle tube 39. The nozzle tube is screwed at the bottom with an external thread into the partition 31 and is provided with an outer flange 40 which engages over an internal flange 41 of the sleeve 38 and clamps the latter to the partition 31. The bore 42 of the nozzle tube 39 conveys the pressure gas. Between 38 and 39 there remains an annular gap 43 which is connected by fine openings 44, which throttle the gas pressure, with the pressure gas supply and serve the purpose of conveying expanded low pressure gas to the flame holes.

In the burner casing according to Fig. 4 the upper casing member 45 and the partition 46 are serrated in cross-section, so that both parts have roof-like steps which in the direction perpendicular to the plane of the drawings extend throughout the entire length of the burner casing. In this case as well the upper casing member and the partition are provided with coaxial apertures 32, 33 which are, however, at an inclination to the base surface of the burner casing, formed by the lower casing member 47. This results in an inclined position of the burner nozzles and consequently also of the burner flames. This is of advantage for many technical purposes. If required, the other sides of the roof-like formations may also be provided with burner nozzles, so that the burner will operate with inclined flames crossing one another.

Figs. 5 to 7 show modified constructions for a two-chamber pressure burner with conical clusters of flames. In the burner according to Figs. 8 and 9 the cylindrical casing 48 is provided with a convex end surface 50 containing the flame holes 49. Parallel to this end surface is a partition 52 for supporting the burner nozzles 51, which partition is between the compressed air chamber 53 and the pressure gas chamber 54. The burner nozzles 51 are of the construction described with reference to Fig. 3. By the convex curvature of the walls 50, 52 the gas nozzles near the edge of the burner are given an inclined position and will form an outwardly diverging cone of flames. Similarly in the case of the burner according to Fig. 7 the concave curvature of the walls 55, 56 will produce a cone of flames, which converges towards the points of the flames. By a greater or less curvature or inclination of the walls containing the flame holes and the nozzles the burner flames will be given a greater or smaller inclination.

In the burner according to Fig. 8 the casing 57 has a mushroom-shaped cross-section and is provided in its end surface with a central nozzle 58 and at the inclined side walls 59 with nozzles 60 which are fixed to a partition 61 which is parallel to the external surface. The nozzles 60 fixed to the inclined walls have an inclined position, so that they enclose an acute angle with the main axis of the burner head. When the burner head is circular in plan view, the result will be a conical flame burner with widely outwardly diverging burner flames.

The two-chamber casings may in the cross-sections shown extend for instance perpendicular to the plane of the drawing in a straight line or annularly, so that they will provide corresponding long or ring burners. With an annular casing the flame nozzles may be arranged around the inner periphery of the annular casing in such a manner that the flames will extend radially and have their points converging in a point in the centre of the ring.

Figs. 9 and 10 show a pressure gas burner according to the invention which operates as a heat radiation burner. The burner casing 62 is of the two-chamber type as described for the preceding constructions, and is provided with separate supply pipes 63, 64 for pressure gas and compressed air. It is provided in its end surface 65 with five flame holes distributed over the circumference, each of which consists of a central nozzle 66 for pressure gas, an annular nozzle 67 for expanded gas and an outer nozzle 68 for compressed air. On the end surface 65 of the compressed air chamber of the burner casing is placed a ceramic nozzle piece 69, which is fixed to a flange 70 of the burner casing. In the region of the flame holes the ceramic nozzle piece is provided in known manner with ducts composed of two conical sections 71, 72 which taper from the ends inwards. At the narrowest place 73 these ducts similar to a Venturi nozzle are equal in cross-sectional area to about the total cross-sectional area of the gas and air outlets of the associated flame hole or somewhat smaller, in order that there will be a pressure in the inlet portion 71. The flames burn only beyond the narrowest place 73 in the outlet part 72. The inlet part 71 acts only as a mixing chamber, whilst the outlet part 72 acts as a combustion chamber. The length of the latter is so dimensioned, preferably, that the ceramic nozzle piece will, when the burner is in operation become incandescent at the outer end surface and with its uniform radiating heat increase the heat of the flame. In this construction the metal nozzles and the pressure gas chamber of the burner are insulated from the glowing ceramic nozzle piece by the compressed air chamber of the burner casing.

The inlet section 71 of the ducts of the ceramic nozzle piece, which faces the burner head, may be of other than conical shape. Several inlet sections 71 may be united to form a single mixing chamber, from which several conical outlet sections 72 are branched off.

The pressure burners in accordance with the invention which are operating with a long flame, are suitable for all manner of purposes, more particularly for industrial purposes, for heating, drying, boiling, roasting, baking, annealing, tempering, smelting and the like. The long flame also makes the burner particularly suitable for use in hot air producers.

What I claim is:

1. In a multi-flame pressure gas burner, more particularly for industrial purposes, the combination of a casing provided with a plurality of circular openings in one of its walls, a partition within the casing disposed opposite of and substantially parallel to said casing wall containing the circular openings, said partition being provided with bores coordinated to said circular openings and lying in axial alignment therewith, each of said bores having a double nozzle tightly inserted therein from the side directed towards the circular openings of the burner casing and extending with its free end into the associated openings of the casing, each of said double nozzles comprising a central duct extending up to the end of the nozzle and a small annular duct surrounding the central duct up to its end and communicating therewith by means of small bores provided in the wall of the central duct at a substantial distance from its outer end, said partition dividing said casing into two chambers, the one of which containing said circular wall openings and said double nozzles and serving as a chamber for compressed air to be supplied thereto, the other chamber serving as a chamber for compressed gas and being provided with means for supplying a gas-air-mixture under high pressure thereto, said circular wall openings of the burner casing embracing the outer ends of said double nozzles with a small annular orifice therebetween and forming the flame

holes of the burner casing, each flame hole thus comprising a central hole for supply of the flame with high pressure gas-air-mixture, a small coaxial inner annular slit surrounding the central hole and serving for the supply of the flame with low pressure gas-air-mixture, and a coaxial outer annular slit for supply of the flame with secondary compressed air by means of a cylindrical air stream surrounding the low pressure flame, said double nozzles comprising an outer sleeve-like nozzle tube provided at its end adjacent to the partition with an internal flange surrounding the inner nozzle tube, the latter being provided at its inner end with an external thread and with an external flange fitting into said outer nozzle tube, said external thread of the inner tube extending through the internal flange of the outer tube and into said partition of the burner casing, and said external flange of the inner tube overlying the internal flange of the outer tube when the external thread of the inner tube is screwed into the bore of the partition for clamping the tubes together to the partition of the burner casing with sealing clamping pressure.

2. In a multi-flame pressure gas burner, more particularly for industrial purposes, the combination of a casing provided with a plurality of circular openings in one of its walls, a partition within the casing disposed opposite of and substantially parallel to said casing wall containing the circular openings, said partition being provided with bores coordinated to said circular openings and lying in axial alignment therewith, each of said bores having a double nozzle tightly inserted therein from the side directed towards the circular openings of the burner casing and extending with its free end into the associated openings of the casing, each of said double nozzles comprising a central duct extending up to the end of the nozzle and a small annular duct surrounding the central duct up to its end and communicating therewith by means of small bores provided in the wall of the central duct at a substantial distance from its outer end, said partition dividing said casing into two chambers, the one of which containing said circular wall openings and said double nozzles and serving as a chamber for compressed air to be supplied thereto, the other chamber serving as a chamber for compressed gas and being provided with means for supplying a gas-air-mixture under high pressure thereto, said circular wall openings of the burner casing embracing the outer ends of said double nozzles with a small annular orifice therebetween and forming the flame holes of the burner casing, each flame hole thus comprising a central hole for supply of the flame with high pressure gas-air-mixture, a small coaxial inner annular slit surrounding the central hole and serving for the supply of the flame with low pressure gas-air-mixture, and a coaxial outer annular slit for supply of the flame with secondary compressed air by means of a cylindrical air stream surrounding the low pressure flame, the outer wall of said burner casing containing the flame holes and the partition within the burner casing supporting the double nozzles being provided with parallel serrations roof-shaped in cross section, the flame holes of the outer wall and their coaxial nozzle-receiving bores of the partition being disposed at parallel opposite inclined faces of these serrated walls, and the axes of the flame holes and of the double nozzles thus being disposed at an inclination to the base surface of the burner casing to form a burner with a plurality of parallel flames inclined to the base surface of the burner casing.

3. In a multi-flame pressure gas burner, more particularly for industrial purposes, the combination of a casing provided with a plurality of circular openings in one of its walls, a partition within the casing disposed opposite of and substantially parallel to said casing wall containing the circular openings, said partition being provided with bores coordinated to said circular openings and lying in axial alignment therewith, each of said bores having a double nozzle tightly inserted therein from the side directed towards the circular openings of the burner casing and extending with its free end into the associated openings of the casing, each of said double nozzles comprising a central duct extending up to the end of the nozzle and a small annular duct surrounding the central duct up to its end and communicating therewith by means of small bores provided in the wall of the central duct at a substantial distance from its outer end, said partition dividing said casing into two chambers, the one of which containing said circular wall openings and said double nozzles and serving as a chamber for compressed air to be supplied thereto, the other chamber serving as a chamber for compressed gas and being provided with means for supplying a gas-air-mixture under high pressure thereto, said circular wall openings of the burner casing embracing the outer ends of said double nozzles with a small annular orifice therebetween and forming the flame holes of the burner casing, each flame hole thus comprising a central hole for supply of the flame with high pressure gas-air-mixture, a small coaxial inner annular slit surrounding the central hole and serving for the supply of the flame with low pressure gas-air-mixture, and a coaxial outer annular slit for supply of the flame with secondary compressed air by means of a cylindrical air stream surrounding the low pressure flame, the outer wall of said burner casing containing the flame holes, and said partition within the burner casing supporting the double nozzles being of concentrical spherical configuration, the flame holes of the burner casing and their coordinated coaxial bores of the partition being disposed in these curved walls on coaxial circles around a common main axis of the burner to form a burner with inclined double nozzles and inclined flames radially distributed on a circle around the common main axes of the burner casing.

4. In a multi-flame pressure gas burner, more particularly for industrial purposes, the combination of a casing provided with a plurality of circular openings in one of its walls, a partition within the casing disposed opposite of and substantially parallel to said casing wall containing the circular openings, said partition being provided with bores coordinated to said circular openings and lying in axial alignment therewith, each of said bores having a double nozzle tightly inserted therein from the side directed towards the circular openings of the burner casing and extending with its free end into the associated openings of the casing, each of said double nozzles comprising a central duct extending up to the end of the nozzle and a small annular duct surrounding the central duct up to its end and communicating therewith by means of small bores provided in the wall of the central duct at a substantial distance from its outer end, said partition dividing said casing into two chambers, the one of which containing said circular wall openings and said double nozzles and serving as a chamber for compressed air to be supplied thereto, the other chamber serving as a chamber for compressed gas and being provided with means for supplying a gas-air-mixture under high pressure thereto, said circular wall openings of the burner casing embracing the outer ends of said double nozzles with a small annular orifice therebetween and forming the flame holes of the burner casing, each flame hole thus comprising a central hole for supply of the flame with high pressure gas-air-mixture, a small coaxial inner annular slit surrounding the central hole and serving for the supply of the flame with low pressure gas-air-mixture, and a coaxial outer annular slit for supply of the flame with secondary compressed air by means of a cylindrical air stream surrounding the low pressure flame, said burner casing having a mushroom-like cross section formed by a horizontal upper surface bordered by an upwardly converging conical rim, and a partition within the burner casing equally provided with a horizontal inner surface and an upwardly converging conical rim, the flame holes of the burner casing and their coaxial nozzle-receiving bores of the partition being disposed at the inclined rims of said casing wall and said partition.

5. In a multi-flame pressure gas burner, more particularly for industrial purposes, the combination of a casing provided with a plurality of circular openings in one of its walls, a partition within the casing disposed opposite of and substantially parallel to said casing wall containing the circular openings, said partition being provided with bores coordinated to said circular openings and lying in axial alignment therewith, each of said bores having a double nozzle tightly inserted therein from the side directed towards the circular openings of the burner casing and extending with its free end into the associated openings of the casing, each of said double nozzles comprising a central duct extending up to the end of the nozzle and a small annular duct surrounding the central duct up to its end and communicating therewith by means of small bores provided in the wall of the central duct at a substantial distance from its outer end, said partition dividing said casing into two chambers, the one of which containing said circular wall openings and said double nozzles and serving as a chamber for compressed air to be supplied thereto, the other chamber serving as a chamber for compressed gas and being provided with means for supplying a gas-air-mixture under high pressure thereto, said circular wall openings of the burner casing embracing the outer ends of said double nozzles with a small annular orifice therebetween and forming the flame holes of the burner casing, each flame hole thus comprising a central hole for supply of the flame with high pressure gas-air-mixture, a small coaxial inner annular slit surrounding the central hole and serving for the supply of the flame with low pressure gas-air-mixture, and a coaxial outer annular slit for supply of the flame with secondary compressed air by means of a cylindrical air stream surrounding the low pressure flame, said burner casing having a ceramic nozzle, said ceramic nozzle piece being provided with flame passage holes communicating with the burner casing flame holes, said flame passage holes of the ceramic nozzle piece being composed in the direction of flow by a converging inlet duct and a diverging outlet duct, said ducts being of substantially same length and meeting each other in the midst of the flame passages with a contracted cross section of substantially smaller width than the outer annular air exit slit of the burner flame holes.

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