

STOVE BURNER AND GAS STOVE

BACKGROUND OF INVENTION

Field of the Invention

5 [0001] The present invention relates to a stove burner including vertically stacked two rows of ports, and to a gas stove including the stove burner. The stove burner burns an air-gas mixture at the lower ports in a low heat mode, and burns the air-gas mixture at the lower ports and also at the upper ports in a high heat mode and detects a flame formed at the lower ports.

Background Art

10 [0002] The gas stove burns a fuel gas to cook food in cookware. The gas stove includes stove burners to burn the fuel gas. Each stove burner includes a hollow burner body and a burner head with a cylindrical outer circumferential surface on the burner body. The burner body is connected to a mixture path. The burner head has, in its outer circumferential surface, multiple ports as openings arranged in the circumferential direction. The mixture path has an
15 open end opposite to the end connected to the burner body. A fuel gas ejected toward the open end flows into the mixture path together with air and mixes with air in the mixture path to form an air-gas mixture, which then flows into the burner body. The air-gas mixture flowing into the burner body is supplied to the burner head and flows out through the ports that are open in the outer circumferential surface of the burner head. The air-gas mixture flowing out through
20 the ports is ignited with, for example, a spark emitted from a spark plug to start burning the fuel gas in the stove burner.

[0003] The stove burner also includes a flame sensor that detects flames formed at the ports. The flame sensor produces electromotive force in response to a temperature rise. The flame sensor is located for heated by flames formed at the ports and can detect the flames formed at
25 the ports. When combustion fails to start due to an ignition failure or a flame goes out during combustion, ejection of the fuel gas into the mixture path is stopped to prevent leakage of the air-gas mixture through the ports.

[0004] A flame formed at each port changes its size with heat output by the stove burner,

and is smaller with lower heat output. To reliably detect a small flame, a flame sensor may be located for heated by an outer flame that is a higher-temperature portion of the flame. In contrast, a flame formed at each port is larger with higher heat output. For a larger flame, the flame sensor located to reliably detect a small flame is heated by an inner flame that is a lower-
5 temperature portion of the flame. Thus, the flame sensor may produce insufficient electromotive force and cannot reliably detect the flame.

[0005] For reliable detection of flames with any level of heat output by a stove burner, the stove burner has a burner head having an outer circumferential surface with multiple ports, and a portion of the outer circumferential surface facing a flame sensor is recessed inward in the
10 radial direction of the burner head (Patent Literature 1). In this stove burner, a port facing the flame sensor (hereafter referred to as a flame detection port) is at a position deeper than other ports (hereafter referred to as normal ports). Thus, the air-gas mixture flowing out through the flame detection port lacks air to be used for combustion than the air-gas mixture flowing out through the normal ports, and a flame is located farther from the flame detection port than
15 a flame from the normal ports. This reduces the difference between the positions at which a small flame is formed and at which a large flame is formed. The flame sensor can thus reliably detect flames irrespective of whether the flame size changes with a change of the heat level of the stove burner.

CITATION LIST

20 PATENT LITERATURE

[0006] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2017-020705

[0007] However, in the stove burner including the vertically stacked two rows of ports to burn the air-gas mixture at the lower ports to output low heat and to burn the air-gas mixture
25 both at the lower ports and at the upper ports to output high heat (hereafter referred to as a vertically stacked double burner), the flame detection port simply recessed from the normal ports may have difficulty in reliably detecting flames in a high heat mode.

[0008] One or more aspects of the present invention are directed to a stove burner and a

gas stove that can reliably detect a flame formed at a port with any level of heat.

SUMMARY OF INVENTION

[0009] In response to the above issue, a stove burner according to one or more aspects of
5 the present invention has the structure described below.

A stove burner includes a burner body to which an air-gas mixture containing a fuel gas and air is supplied, a burner head mounted on the burner body to form a plurality of ports in a cylindrical outer circumferential surface to allow the air-gas mixture flowing from the burner body to flow out through the plurality of ports, an ignitor that ignites the air-gas mixture flowing
10 out through at least one port of the plurality of ports, and a flame detector facing a port of the plurality of ports different from the at least one port at which the ignitor ignites the air-gas mixture to detect a flame at the port facing the flame detector. The burner head includes a plurality of first ports included in the plurality of ports and arranged in a circumferential direction of the cylindrical outer circumferential surface, and a plurality of second ports
15 included in the plurality of ports and arranged in the circumferential direction above the plurality of first ports. Adjacent first ports of the plurality of first ports are spaced by a distance allowing a flame at one of the adjacent first ports to spread to the other of the adjacent first ports. Each of the plurality of first ports is spaced from a second port of the plurality of second ports above the first port by a distance allowing a flame at the first port to spread to the
20 second port above the first port. The ignitor ignites the air-gas mixture flowing out through the at least one first port of the plurality of first ports instead of the plurality of second ports. The flame detector detects a flame at a first port of the plurality of first ports facing the flame detector instead of the plurality of second ports. The plurality of first ports include at least one flame detection port at which the flame detector detects a flame. The at least one flame
25 detection port is located more inward than another first port of the plurality of first ports in a radial direction of the burner head. The plurality of second ports include at least one detection upper port located above the at least one flame detection port. The at least one detection upper port is located more inward than another second port of the plurality of second ports in the

radial direction of the burner head.

[0010] The stove burner according to the above aspect of the present invention can detect a flame with the flame detector after igniting at least one first port with the ignitor, and allow a flame formed at the first port to spread to other first ports to start combustion at all the first
5 ports. After combustion starts at all the first ports, the stove burner allows the flames at the first ports to spread to second ports formed above the first ports to start combustion also at all the second ports. A flame detection port in the multiple first ports at which the flame detector detects a flame is located more inward in a radial direction of an outer circumferential surface of the burner head than the other first ports. Thus, the flame detector can stably detect a flame
10 irrespective of whether the flame formed at the flame detection port changes its size. Although the flame detector does not detect a flame at a detection upper port in the multiple second ports located above the flame detection port, the detection upper port is located more inward in the radial direction of the outer circumferential surface of the burner head than other second ports.

[0011] When the detection upper port is located at the same position as the other second
15 ports in the radial direction of the outer circumferential surface, the flame formed at the flame detection port is shifted outward in the radial direction due to the flame formed at the detection upper port, although its detailed mechanism will be described later. In this case, the flame detector cannot stably detect a flame. When the detection upper port is located more inward in the radial direction of the outer circumferential surface than the other second ports, the flame
20 formed at the detection upper port is also shifted inward in the radial direction, reducing shifts of the flame formed at the flame detection port outward in the radial direction. In this case, the flame detector can stably detect a flame formed at the flame detection port irrespective of whether flames are formed at the detection upper port and the second ports.

[0012] In the stove burner according to the above aspect of the present invention, the plurality
25 of first ports may include a plurality of the flame detection ports located adjacent to each other. The plurality of second ports may include a plurality of the detection upper ports located adjacent to each other above the plurality of flame detection ports. The plurality of detection upper ports is included in a detection upper port array that may be wider than a flame detection port

array including the plurality of flame detection ports in the circumferential direction of the cylindrical outer circumferential surface.

[0013] This structure maintains a distance between a flame at the flame detection port and a flame at the second port, and thus can reduce a failure in stable detection of a flame with the flame detector due to the flame at the second port shifting the flame at the flame detection port outward in the radial direction.

[0014] In the stove burner according to any one of the above aspects of the present invention, the cylindrical outer circumferential surface may include a protrusion protruding in a radial direction from the cylindrical outer circumferential surface between a portion of the cylindrical outer circumferential surface including the at least one flame detection port and a portion of the cylindrical outer circumferential surface including the at least one detection upper port.

[0015] This structure including a protrusion blocking a flame at the detection upper port is less likely to affect a flame at the flame detection port. Thus, irrespective of whether flames are formed at the detection upper port and the second ports, the flame detector can stably detect a flame formed at the flame detection port.

[0016] In the stove burner according to any one of the above aspects of the present invention, the burner head may be divided into an upper burner head and a lower burner head. The lower burner head may be mounted on the burner body. The upper burner head may be mounted on the lower burner head. The lower burner head and the upper burner head may have the shapes described below to form the plurality of first ports and the plurality of second ports. The lower burner head may include a bottom cylindrical wall protruding downward from an outer periphery of a bottom surface of the lower burner head, and a lower cylindrical wall protruding upward from an outer periphery of an upper surface of the lower burner head. The upper burner head may include an upper cylindrical wall protruding downward from an outer periphery of a bottom surface of the upper burner head. The bottom cylindrical wall of the lower burner head mounted on the burner body may include a plurality of first port grooves in a lower end surface of the bottom cylindrical wall to form the plurality of first ports. The

lower cylindrical wall receiving the upper burner head may include a plurality of lower second port grooves to form the plurality of second ports. The upper cylindrical wall mounted on the lower burner head may include a plurality of upper second port grooves to form the plurality of second ports. The plurality of upper second port grooves in the upper burner head mounted
5 on the lower burner head may be staggered relative to the plurality of lower second port grooves in the lower burner head in the circumferential direction of the cylindrical outer circumferential surface.

[0017] In this structure, each second port includes two separate portions including a portion formed between a lower second port groove and the upper cylindrical wall and a portion
10 between an upper second port groove and the lower cylindrical wall. A flame formed at the second port also includes two separate portions. This structure can stabilize combustion at the second ports while stably detecting a flame at the flame detection port.

[0018] In the stove burner according to the above aspect of the present invention divided into the lower burner head and the upper burner head, a first port groove of the plurality of the
15 first port grooves forming the at least one flame detection port with the lower burner head being mounted on the burner body may have a greater height than another first port groove of the plurality of first port grooves. A sum of a height of a lower second port groove of the plurality of lower second port grooves and a height of an upper second port groove of the plurality of upper second port grooves forming the at least one detection upper port with the upper burner
20 head being mounted on the lower burner head may be less than a sum of a height of another lower second port groove of the plurality of lower second port grooves and a height of another upper second port groove of the plurality of upper second port grooves.

[0019] This structure can form a large flame at the flame detection port, and thus can stably detect a flame with the flame detector.

25 [0020] The stove burner according to any one of the above aspects of the present invention may be included in a gas stove.

[0021] The gas stove with this structure can stably detect a flame.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] FIG. 1 is a perspective external view of a gas stove 1 including stove burners 10 according to an embodiment.

FIG. 2 is a perspective view of one of the stove burners 10 according to the embodiment,
5 showing a rough shape.

FIG. 3 is an exploded view of the stove burner 10 according to the embodiment showing its internal structure including a burner head 20 and a burner body 11b.

FIG. 4 is an enlarged view of a portion of the burner head 20 viewed obliquely from below including flame detection ports 27.

10 FIGs. 5A and 5B are diagrams of a flame detection port 27a in a lower burner head 22 located more inward than a small port 22u in the radial direction, and a detection upper port 26 in an upper burner head 21 located more inward than an upper main port 21f in the radial direction.

FIGs. 6A and 6B are diagrams describing the positional relationship between a flame sensor
15 32 and a flame formed at the flame detection port 27 when the upper main port 21f above the flame detection port 27 would not be shifted inward in the radial direction of the burner head 20.

FIGs. 7A and 7B are diagrams describing stable detection of a flame at the flame detection port 27 by the flame sensor 32 in the stove burner 10 according to the embodiment with any
20 flame formed at the detection upper port 26.

FIGs. 8A and 8B are diagrams of a stove burner 10 according to a modification.

DETAILED DESCRIPTION

[0023] FIG. 1 is a perspective external view of a gas stove 1 including stove burners 10
25 according to an embodiment. The gas stove 1 shown in FIG. 1 is a built-in gas stove 1 fitted in a countertop of a system kitchen (not shown), and includes a body case 2 that is rectangular and has an open top, and a cooktop 3 covering the upper surface of the body case 2.

[0024] The body case 2 accommodates two stove burners 10 that are laterally arranged side

by side. Each stove burner 10 includes a primary burner and a secondary burner stacked vertically. The primary burner and the secondary burner will be described later. These stove burners 10 have upper portions protruding from through-holes in the cooktop 3. The cooktop 3 receives trivets 4 surrounding the protruding upper portions of the respective stove burners 10. Cookware such as a pot is placed on each trivet 4 for heating by the corresponding stove burner 10 from below.

[0025] Each stove burner 10 also includes a temperature sensor 5 extending through its center. The temperature sensor 5 is urged upward by an urging spring (not shown). The upper portion of the temperature sensor 5 protrudes from the upper surface center of the stove burner 10. When cookware is placed on each trivet 4, the bottom surface of the cookware depresses the corresponding temperature sensor 5, which has its upper end coming into contact with the bottom surface of the cookware to detect the temperature of the cookware.

[0026] The gas stove 1 also includes a grill door 7 on its front surface. Behind the grill door 7, a grill chamber and a grill burner (not shown) are located. On the right side of the grill door 7, two stove operation buttons 8 are located corresponding to the two stove burners 10. A user of the gas stove 1 operates any of the stove operation buttons 8 to turn on or off the corresponding stove burner 10 or adjust the heat level. On the left side of the grill door 7, a grill operation button 9 is located. The user operates the grill operation button 9 to turn on or off the grill burner or adjust the heat level.

[0027] FIG. 2 is a perspective view of one of the stove burners 10 according to the present embodiment, showing a rough shape. As illustrated, the stove burner 10 includes a burner unit 11 including an assembly of sheet-metal components and a substantially cylindrical burner head 20. The burner unit 11 includes a substantially cylindrical burner body 11b, a primary mixture path 12 connected to the burner body 11b, and a secondary mixture path 13 connected to the burner body 11b. The secondary mixture path 13 has a smaller diameter than the primary mixture path 12. The burner head 20 is mounted on the burner body 11b. The burner head 20 has a through-hole 20h at its center. The through-hole 20h receives the temperature sensor 5 described above with reference to FIG. 1.

[0028] The burner head 20 includes two separate members stacked vertically, and is formed from an aluminum alloy or brass by casting or die casting. The upper member of the burner head 20 will be referred to as an upper burner head 21, and the lower member of the burner head 20 will be referred to as a lower burner head 22. As shown in an enlarged manner in FIG. 2, when the upper burner head 21 is mounted on the lower burner head 22, the outer circumferential surface of the upper burner head 21 has multiple upper main ports 21f, and the outer circumferential surface of the lower burner head 22 has multiple lower main ports 22f. The upper and lower burner heads 21 and 22 are assembled together to have the upper main ports 21f staggered relative to the lower main ports 22f.

[0029] When the burner head 20 is mounted on the burner body 11b, multiple small ports (hereafter referred to as small ports 22u) are formed between the lower burner head 22 and the burner body 11b. As described later, the inside of the burner body 11b includes a space connected to the primary mixture path 12 and a space connected to the secondary mixture path 13. The small ports 22u formed between the lower burner head 22 and the burner body 11b are continuous with the space connected to the secondary mixture path 13. The upper main ports 21f in the upper burner head 21 and the lower main ports 22f in the lower burner head 22 are continuous with the space connected to the primary mixture path 12. Thus, as described later, a fuel gas supplied to the secondary mixture path 13 flows out through the small ports 22u, and a fuel gas supplied to the primary mixture path 12 flows out through the upper and lower main ports 21f and 22f. The small ports 22u in the present embodiment correspond to “first ports” in one or more aspects of the present invention, and the upper and lower main ports 21f and 22f in the present embodiment correspond to “second ports” in one or more aspects of the present invention.

[0030] The fuel gas is supplied to the primary and secondary mixture paths 12 and 13 in the manner described below. First, the primary mixture path 12 has an open end 12o opposite to the end connected to the burner body 11b, and the secondary mixture path 13 has an open end 13o opposite to the end connected to the burner body 11b. A gas ejection nozzle 43p is located to face the open end 12o of the primary mixture path 12. A gas ejection nozzle 43c is

located to face the open end 13o of the secondary mixture path 13. The gas ejection nozzle 43p located at the primary mixture path 12 may be referred to as a primary gas ejection nozzle 43p, and the gas ejection nozzle 43c located at the secondary mixture path 13 may be referred to as a secondary gas ejection nozzle 43c. The primary gas ejection nozzle 43p is connected to a connection pipe 40p, and the secondary gas ejection nozzle 43c is connected to a connection pipe 40c. These two connection pipes 40p and 40c branch from a gas supply pipe 40.

[0031] When a fuel gas is supplied to the gas supply pipe 40, the fuel gas is split into the connection pipes 40p and 40c, and supplied to the primary and secondary gas ejection nozzles 43p and 43c. The fuel gas is then ejected toward the open end 12o of the primary mixture path 12 from a nozzle hole 44p at the end of the primary gas ejection nozzle 43p. The ejected fuel gas flows into the primary mixture path 12 together with ambient air with the ejector effect, mixes with the air in the primary mixture path 12, and then flows out through the upper and lower main ports 21f and 22f. Similarly, the fuel gas is also ejected toward the open end 13o of the secondary mixture path 13 from a nozzle hole 44c at the end of the secondary gas ejection nozzle 43c. The ejected fuel gas flows into the secondary mixture path 13 together with ambient air with the ejector effect, mixes with the air in the secondary mixture path 13, and then flows out through the small ports 22u.

[0032] The nozzle hole 44p in the primary gas ejection nozzle 43p has a larger diameter than the nozzle hole 44c in the secondary gas ejection nozzle 43c. Thus, the primary gas ejection nozzle 43p can eject a larger amount of fuel gas than the secondary gas ejection nozzle 43c. Thus, the primary mixture path 12 has a larger diameter than the secondary mixture path 13. A gas-flow control valve 41 for adjusting the flow rate of the fuel gas is attached to a portion of the gas supply pipe 40. An open-close valve 42 that opens or closes the connection pipe 40p is attached to a portion of the connection pipe 40p through which the fuel gas is supplied to the primary mixture path 12.

[0033] The burner unit 11 includes a spark plug 30 and a flame sensor 32 near the outer periphery of the burner body 11b. The spark plug 30 in the present embodiment corresponds to an ignitor in one or more aspects of the present invention, and the flame sensor 32 in the

present embodiment corresponds to a flame detector in one or more aspects of the present invention. Above the spark plug 30, an ignition target (not shown) protrudes from the outer periphery of the burner head 20, and a spark plug guard 31 larger than the ignition target protrudes from the outer periphery above the ignition target to block liquids boiling over from
5 spilling on the spark plug 30. When the gas-flow control valve 41 is open while the open-close valve 42 is closed off and the spark plug 30 discharges a spark to the ignition target below the spark plug guard 31, the fuel gas flows out through the small ports 22u, and the fuel gas is ignited to start combustion.

[0034] Each pair of small ports 22u adjacent to each other are spaced by a distance that
10 allows a flame formed at one of the small ports 22u to spread to the adjacent small port 22u. After combustion starts at the small port 22u near the spark plug 30, the flame successively spreads to the adjacent small ports 22u, and thus combustion of the fuel gas starts at all the small ports 22u. The flame sensor 32 can detect flames formed at the small ports 22u.

[0035] When the open-close valve 42 is open while flames are formed at the small ports
15 22u, the fuel gas also flows out through the upper and lower main ports 21f and 22f. The small ports 22u and the lower main ports 22f above the small ports 22u are spaced by a distance that allows flames formed at the small ports 22u to spread to the lower main ports 22f above the small ports 22u. Thus, the flames at the small ports 22u start combustion of the fuel gas also at the lower and upper main ports 22f and 21f.

[0036] The stove burner 10 according to the present embodiment includes the spark plug
20 30 to ignite the fuel gas flowing out through the small ports 22u, but does not include a spark plug to ignite the fuel gas flowing out through the lower and upper main ports 22f and 21f for the reasons described below. As described above with reference to FIG. 2, the upper and lower main ports 21f and 22f have a larger opening area than the small ports 22u. The primary
25 mixture path 12 continuous with the upper and lower main ports 21f and 22f inside the burner unit 11 has a larger diameter than the secondary mixture path 13 continuous with the small ports 22u. In addition, the gas ejection nozzle 43p can eject a larger amount of fuel gas than the gas ejection nozzle 43c. Thus, the upper and lower main ports 21f and 22f enable combustion of

a larger amount of fuel gas than the small ports 22u to output high heat. Thus, the stove burner 10 burns the fuel gas at the small ports 22u to output low heat, and burns the fuel gas also at the upper and lower main ports 21f and 22f to output high heat. To return to low heat, the stove burner 10 ends combustion at the upper and lower main ports 21f and 22f while retaining
5 combustion at the small ports 22u.

[0037] Thus, when the stove burner 10 according to the present embodiment starts combustion at the upper and lower main ports 21f and 22f, the fuel gas is always burned at the small ports 22u. Thus, ignition of the fuel gas flowing out through the small ports 22u with the spark plug 30 can start combustion at the lower and upper main ports 22f and 21f through
10 spreading of the flames from the small ports 22u. The spark plug 30 that ignites the small ports 22u can thus eliminate the use of a spark plug for igniting the lower and upper main ports 22f and 21f. A portion of the stove burner 10 with the small ports 22u may be referred to as a secondary burner, and a portion of the stove burner 10 with the upper and lower main ports 21f and 22f may be referred to as a primary burner.

15 [0038] FIG. 3 is an exploded view of the stove burner 10 according to the present embodiment showing its internal structure including the burner head 20 and the burner body 11b. As illustrated, the substantially cylindrical burner body 11b has an annular mount surface 11a that receives the burner head 20. The mount surface 11a is formed by folding the upper end of the burner body 11b inward. Inside the burner body 11b, a center cylinder 14 extends
20 vertically. An annular mixing chamber 16 that receives the air-gas mixture is formed between the burner body 11b and the center cylinder 14.

[0039] A substantially cylindrical partition cylinder 15 is located between the burner body 11b and the center cylinder 14. The partition cylinder 15 divides the mixing chamber 16 into spaces inward and outward from the partition cylinder 15. The space inward from the partition
25 cylinder 15 serves as a primary mixing chamber 16p described later, and the space outward from the partition cylinder 15 serves as a secondary mixing chamber 16c described later. The partition cylinder 15 is formed from a sheet-metal component as in the burner body 11b. The partition cylinder 15 has its cylindrical upper end folded inward, and the folded portion has an

inner rim folded downward to form a short cylindrical fitting surface 15a.

[0040] As described above, the burner head 20 includes the upper and lower burner heads 21 and 22, the lower burner head 22 is mounted on the mount surface 11a of the burner body 11b, and the upper burner head 21 is mounted on the lower burner head 22. As illustrated, the lower burner head 22 is a substantially annular component, and a wall cylinder 22a extends vertically downward from the annular inner rim. A bottom cylindrical wall 22b shorter than the wall cylinder 22a extends vertically downward from the bottom surface of the periphery of the lower burner head 22. The bottom cylindrical wall 22b has multiple small port grooves 22c in its lower end surface (surface in contact with the mount surface 11a of the burner body 11b). The small port grooves 22c are recessed upward and located radially from the center of the lower burner head 22. A lower cylindrical wall 22d taller than the bottom cylindrical wall 22b extends upward from the upper surface of the periphery of the lower burner head 22. The lower cylindrical wall 22d has multiple lower main port grooves 22e in its upper end surface. The lower main port grooves 22e are recessed downward and located radially from the center of the lower cylindrical wall 22d. The spark plug guard 31 protrudes from the outer circumferential surface of the lower cylindrical wall 22d in the lower burner head 22 to the above position over the spark plug 30. The small port grooves 22c in the present embodiment correspond to “first port grooves” in one or more aspects of the present invention. The lower main port grooves 22e in the present embodiment correspond to “lower second port grooves” in one or more aspects of the present invention.

[0041] The upper burner head 21 is annular, and has an inner rim from which an inner cylinder (not shown) extends vertically downward. From the periphery of the upper burner head 21, an upper cylindrical wall 21a extends downward. The upper cylindrical wall 21a has multiple upper main port grooves 21b in its lower end surface. The upper main port grooves 21b are located radially from the center of the upper cylindrical wall 21a. The upper main port grooves 21b in the present embodiment correspond to “upper second port grooves” in one or more aspects of the present invention.

[0042] The upper burner head 21 with the above shape is mounted on the lower burner

head 22 without the upper main port grooves 21b in the upper burner head 21 overlapping the lower main port grooves 22e in the lower burner head 22. Thus, the upper surfaces of the lower main port grooves 22e in the lower burner head 22 are closed by the lower end surface of the upper cylindrical wall 21a in the upper burner head 21. Thus, the lower main ports 22f (refer to FIG. 2) are formed at the openings of the lower main port grooves 22e in the outer circumferential surface of the lower cylindrical wall 22d. The bottom surfaces of the upper main port grooves 21b in the upper burner head 21 are closed by the upper end surface of the lower cylindrical wall 22d of the lower burner head 22, and the upper main ports 21f (refer to FIG. 2) are formed at the openings of the upper main port grooves 21b in the outer circumferential surface of the upper cylindrical wall 21a. Thus, as shown in FIG. 2, the upper and lower main ports 21f and 22f are staggered relative to each other (shifted from each other in the circumferential direction).

[0043] To mount the burner head 20 on the burner body 11b, the burner head 20 is lowered while the wall cylinder 22a extending vertically downward from the inner rim of the lower burner head 22 is being placed on the inner side of a fitting surface 15a of the partition cylinder 15, and an inner cylinder (not shown) extending vertically downward from the inner rim of the upper burner head 21 is being placed on the inner side of the center cylinder 14. The bottom cylindrical wall 22b protruding downward from the periphery of the lower burner head 22 then comes into contact with the mount surface 11a of the burner body 11b. Thus, the burner head 20 is mounted on the burner body 11b.

[0044] When the burner head 20 is mounted on the burner body 11b, the wall cylinder 22a in the lower burner head 22 fits to the fitting surface 15a of the partition cylinder 15, and the inner cylinder (not shown) in the upper burner head 21 fits to the inner peripheral surface of an upper portion of the center cylinder 14. Thus, the secondary mixing chamber 16c defined by the partition cylinder 15, the burner body 11b, and the lower burner head 22 is formed on the outer side of the partition cylinder 15. The secondary mixing chamber 16c is continuous with the secondary mixture path 13. The primary mixing chamber 16p defined by the center cylinder 14, the partition cylinder 15, the wall cylinder 22a, and the upper burner head 21 is

formed on the inner side of the partition cylinder 15. The primary mixing chamber 16p is continuous with the primary mixture path 12.

[0045] In the stove burner 10 with the above structure according to the present embodiment, the igniting the fuel gas flowing out through at least one of the small ports 22u to allow the flame formed at the small port 22u to spread to all the small ports 22u and also to the lower and upper main ports 22f and 21f arranged above the small ports 22u. Thus, the spark plug 30 in the stove burner 10 according to the present embodiment may ignite the fuel gas from any small port 22u, and the flame sensor 32 may detect any flame formed at the small port 22u. Thus, the spark plug 30 and the flame sensor 32 may be at any position each facing one or more small ports 22u. To reliably detect flames with any size at the small ports 22u with the flame sensor 32, the small ports 22u facing the flame sensor 32 are to have shapes different from the shapes of the small ports 22u at other positions. The small ports 22u facing the flame sensor 32 will be referred to as flame detection ports 27.

[0046] FIG. 4 is an enlarged view of a portion of the burner head 20 viewed obliquely from below including the flame detection ports 27. FIG. 4 shows the profiles of the flame sensor 32 and the spark plug 30 with broken lines. As illustrated, when mounted on the burner body 11b, the lower burner head 22 forms the small ports 22u in the bottom cylindrical wall 22b. At a position facing the flame sensor 32, the bottom cylindrical wall 22b is recessed inward in the radial direction, and multiple (three in the present embodiment) flame detection ports 27 are arranged in the recessed portion. In FIG. 4, the flame detection ports 27 are finely hatched. Of these three flame detection ports 27, the middle flame detection port 27 forms a flame detection port 27b with a smaller height than the small ports 22u. The flame detection ports 27 on both sides of the flame detection port 27b form flame detection ports 27a with a greater height than the small ports 22u. An array of the flame detection ports 27 may also be referred to as a flame detection port array 27L.

[0047] In the stove burner 10 according to the present embodiment, the spark plug 30 is adjacent to the flame sensor 32, and a portion of the bottom cylindrical wall 22b facing the spark plug 30 is recessed inward in the radial direction to be aligned with the portion of the

bottom cylindrical wall 22b facing the flame sensor 32. In the recessed portion, multiple (five in the present embodiment) ignition ports 28 are arranged. Thus, the ignition ports 28 are formed in the bottom cylindrical wall 22b with the same radius as the flame detection ports 27. Above the ignition ports 28, an ignition target 31t protrudes from the lower cylindrical wall 22d.

5 [0048] The lower main ports 22f are formed in the lower cylindrical wall 22d above the small ports 22u. However, the lower main ports 22f are not formed above the flame detection port array 27L. This is because the flame detection ports 27a has a greater height than the small ports 22u, and thus the lower cylindrical wall 22d has no space for the lower main ports 22f. The flame detection ports 27a may have a smaller height to form the lower main ports

10 22f above the flame detection port array 27L. The flame detection ports 27a have a greater height than the small ports 22u. Thus, in the case the lower main ports 22f are formed above the flame detection ports 27a, the sum of the height of the lower main ports 22f formed above the flame detection ports 27a and the height of detection upper ports 26 is less than the sum of the height of the lower main ports 22f formed above the small ports 22u and the height of the

15 upper main ports 21f. In the present embodiment, no lower main ports 22f are formed above the flame detection ports 27a, and thus the lower main ports 22f have a height of zero.

[0049] The stove burner 10 according to the present embodiment has no lower main ports 22f in the lower cylindrical wall 22d above the ignition ports 28. This is because the ignition target 31t is located above the ignition ports 28, and thus the lower cylindrical wall 22d has no

20 space for the lower main ports 22f. The height of the ignition target 31t may be reduced to form the lower main ports 22f with a smaller height above the ignition ports 28.

[0050] The upper main ports 21f are formed in the upper cylindrical wall 21a in the upper burner head 21 mounted on the lower burner head 22. At a position above the flame detection port array 27L in the lower burner head 22, the upper cylindrical wall 21a has a portion recessed

25 inward in the radial direction, and multiple (five in the present embodiment) detection upper ports 26 are arranged in the recessed portion. In FIG. 4, the detection upper ports 26 are roughly hatched. The detection upper ports 26 have the same shape as the upper main ports 21f but are located more inward in the radial direction than the upper main ports 21f. An array

of the detection upper ports 26 may be referred to as a detection upper port array 26L. As shown in FIG. 4, the width (the dimension of the upper burner head 21 in the circumferential direction) of the detection upper port array 26L in the upper burner head 21 is larger than the width (the dimension of the lower burner head 22 in the circumferential direction) of the flame detection port array 27L in the lower burner head 22.

[0051] FIGs. 5A and 5B are diagrams of one of the flame detection ports 27a located more inward than the small ports 22u in the radial direction, and the corresponding detection upper port 26 located more inward than the upper main ports 21f in the radial direction. FIG. 5A is a cross-sectional view of the stove burner 10 taken along the plane including the flame detection port 27a and the detection upper port 26. FIG. 5B is a reference cross-sectional view of the stove burner 10 taken along the plane including one of the small ports 22u.

[0052] FIG. 5A shows the profile of the flame sensor 32 with a thin broken line. For purpose of reference, FIG. 5A also shows the positions of the small port 22u, the lower main port 22f, and the upper main port 21f with thick broken lines (also refer to FIG. 5B). As illustrated, the flame detection ports 27 (flame detection ports 27a and 27b) of the lower burner head 22 are located more inward in the radial direction of the lower burner head 22 than the small port 22u indicated with a broken line. The detection upper ports 26 of the upper burner head 21 are located more inward in the radial direction of the upper burner head 21 than the upper main port 21f indicated with a broken line. Between the flame detection ports 27 (flame detection ports 27a and 27b) and the detection upper ports 26, a protrusion 29 protrudes more outward in the radial direction than the flame detection ports 27 and the detection upper ports 26.

[0053] Thus, in the stove burner 10 according to the present embodiment, the flame detection ports 27 (flame detection ports 27a and 27b) facing the flame sensor 32 are located more inward than the small ports 22u in the radial direction of the burner head 20, and the detection upper ports 26 above the flame detection ports 27 are located more inward than the upper main ports 21f in the radial direction of the burner head 20. This structure can reduce combustion interruption due to a failure of the flame sensor 32 in flame detection when the

mode of burning the fuel gas at the small ports 22u alone (hereafter referred to as a low heat mode) is shifted to the mode of burning the fuel gas also at the upper main ports 21f and the lower main ports 22f in addition to the small ports 22u (hereafter referred to as a high heat mode). The reasons for this will be described below.

5 [0054] FIGs. 6A and 6B are diagrams describing the positional relationship between the flame sensor 32 and flames formed at the flame detection ports 27 in a known stove burner 10 (more specifically, in the stove burner 10 in which the upper main ports 21f above the flame detection ports 27 are not shifted more inward than other upper main ports 21f in the radial direction of the burner head 20). FIG. 6A shows the state of no flame formed at the upper
10 main port 21f (more specifically, flames formed at the small port 22u and the flame detection port 27 alone). FIG. 6B shows the state of a flame also formed at the upper main port 21f (and the lower main port 22f).

[0055] FIG. 6A shows a flame formed at the flame detection port 27 in a minimum heat mode with a solid line. As described above, the flame detection ports 27 are located more
15 inward than the other small ports 22u in the radial direction of the burner head 20, and thus air used for combustion less easily reaches the positions of the flame detection ports 27. Thus, as indicated with an outlined arrow in FIG. 6A, also in the minimum heat mode, a flame at the flame detection port 27 is formed away from the flame detection port 27 (outward in the radial direction of the burner head 20). The broken line in FIG. 6A indicates a flame formed at the
20 flame detection port 27 when the heat level is increased within the range of a low heat mode (more specifically, within the heat range for burning the fuel gas at the small ports 22u and the flame detection ports 27 alone). The flame formed at the flame detection port 27 increases with the increase in the heat level. However, the position of the flame is not significantly shifted with the increase in the heat level because the flame in the minimum heat mode is
25 already formed away from the flame detection port 27. Thus, as shown in FIG. 6A, irrespective of an increase in the heat level from that in the minimum heat mode, the flame sensor 32 is similarly heated by the flames at the flame detection ports 27 and thus can stably detect the flames.

[0056] FIG. 6B shows flames also formed at the upper main ports 21f (and the lower main ports 22f) with a more increase in the heat level (more specifically, a high heat mode). FIG. 6B shows a flame formed at the upper main port 21f with a dot-dash line. Large flames formed at the upper main ports 21f are located immediately above the flames at the flame detection ports 27, and thus combustion lacks air for the flames at the flame detection ports 27. Thus, as indicted with a solid arrow in FIG. 6B, the flame at the flame detection port 27 shifts farther away (outward in the radial direction of the burner head 20) from the flame detection port 27 for air for combustion. Thus, as shown in FIG. 6B, the flame sensor 32 is heated by an inner flame with a lower temperature at the flame detection port 27 and thus cannot stably detect the flame.

[0057] FIGs. 7A and 7B are diagrams describing the positional relationship between the flame sensor 32 and a flame formed at one of the flame detection ports 27 in the stove burner 10 according to the present embodiment. FIG. 7A shows the state of no flame formed at the detection upper port 26 (more specifically, a low heat mode). FIG. 7B shows the state of a flame also formed at the detection upper port 26 (more specifically, a high heat mode).

[0058] FIG. 7A shows a flame formed at the flame detection port 27 in a minimum heat mode with a solid line, and a flame formed at the flame detection port 27 with heat increased within a low heat mode with a broken line. FIG. 7A showing no flame formed at the detection upper port 26 is the same as FIG. 6A. More specifically, as indicated with an outlined arrow in FIG. 7A, a flame formed at the flame detection port 27 in the minimum heat mode is located away from the flame detection port 27 (outward in the radial direction of the burner head 20). Thus, irrespective of an increase in the heat level within the range of the low heat mode from that in the minimum heat mode, the flame sensor 32 is similarly heated by the flames at the flame detection ports 27 and thus can stably detect the flames.

[0059] FIG. 7B shows a flame also formed at the detection upper port 26 (more specifically, a high heat mode). The flame indicated with a dot-dash line in FIG. 7B indicates a flame formed at the detection upper port 26. As described above, the detection upper ports 26 are located more inward than the upper main ports 21f in the radial direction of the burner head 20,

and thus the flames formed at the detection upper ports 26 are located more inward than the flames at the upper main ports 21f in the radial direction. Thus, the flames formed at the flame detection ports 27 are also located more inward in the radial direction than in the known structure described above with reference to FIG. 6B. This structure reduces shifts of the flames at the flame detection ports 27 outward in the radial direction when flames are formed at the detection upper ports 26. Thus, the stove burner 10 according to the present embodiment can keep the flame sensor 32 heated by the flames at the flame detection ports 27 without a large change in heated condition when flames are formed at the detection upper ports 26. Thus, the flame sensor 32 can stably detect the flames.

[0060] The stove burner 10 according to the present embodiment includes the protrusion 29 protruding outward in the radial direction between the detection upper ports 26 and the flame detection ports 27. The protrusion 29 separates the flame formed at the detection upper port 26 from the flame formed at the flame detection port 27 at the bases of the flames. Thus, the flame at the detection upper port 26 is guided not to spread downward, and is less likely to affect the flame at the flame detection port 27. Thus, the stove burner 10 according to the present embodiment can keep the flame sensor 32 heated by the flame at the flame detection port 27 without a large change in heated condition when flames are formed at the detection upper ports 26. Thus, the flame sensor 32 can stably detect the flames.

[0061] In the above embodiments, the detection upper ports 26 are located more inward than the upper main ports 21f in the radial direction of the burner head 20. Instead of the detection upper ports 26 being located inward in the radial direction, the bottom surfaces of the detection upper ports 26 may be more steeply inclined than the upper main ports 21f (more specifically, the bottom surfaces may be located higher as they extend more outward in the radial direction).

[0062] FIGs. 8A and 8B are diagrams of a stove burner 10 with such a structure according to a modification. FIG. 8A is a cross-sectional view of the stove burner 10 according to the modification taken along a plane including the flame detection port 27a and the detection upper port 26. FIG. 8B is a diagram of the stove burner 10 according to the modification showing

flames formed at the flame detection ports 27 and the detection upper ports 26 (more specifically, a high heat mode).

[0063] As shown in FIG. 8A, in the stove burner 10 according to the modification, the flame detection ports 27 are located more inward than the small ports 22u in the radial direction, but the detection upper ports 26 are not located inward. Instead, each detection upper port 26 includes a slope 26a in a radially outer portion of the bottom surface. The slope 26a is more steeply inclined than the upper main ports 21f. Although the slope 26a is located in a radially outer portion of the bottom surface of each detection upper port 26 in FIG. 8A, the slope 26a may extend over the entire bottom surface of the detection upper port 26 to be more steeply inclined than the upper main ports 21f (the bottom surface may be higher as it extends more outward in the radial direction).

[0064] In the stove burner 10 according to the modification, the slope 26a allows the flames formed at the detection upper ports 26 to extend more upward (more specifically, farther away from the flames at the flame detection ports 27) than the flames formed at the upper main ports 21f. As shown in FIG. 8B, this structure reduces a shift of flames formed at the flame detection ports 27 with any flames formed at the detection upper ports 26. Thus, the flame sensor 32 can stably detect flames at the flame detection ports 27.

[0065] The stove burner 10 and the gas stove 1 according to the present embodiment have been described. However, the present invention is not limited to the above embodiments and may be practiced in various manners without departing from the spirit and scope of the invention.

[0066] For example, the above stove burner 10 according to the present embodiment includes the burner head 20 separable into the upper and lower burner heads 21 and 22. The upper main port grooves 21b in the upper burner head 21 and the lower main port grooves 22e in the lower burner head 22 are staggered to form separate ports when the upper and lower burner heads 21 and 22 are assembled together. Instead, each upper main port groove 21b in the upper burner head 21 and the corresponding lower main port groove 22e in the lower burner head 22 may be vertically combined to form an integrated port.

[0067] The above stove burner 10 according to the present embodiment has the upper and lower burner heads 21 and 22 each including main port grooves (the upper main port grooves 21b or the lower main port grooves 22e). Instead, either of the upper burner head 21 or the lower burner head 22 may have main port grooves to form main ports when the upper burner head 21 is mounted on the lower burner head 22.

[0068] In the above stove burner 10 according to the present embodiment, to form the small ports 22u between the burner body 11b and the lower burner head 22 when the lower burner head 22 is mounted on the burner body 11b, the small port grooves 22c are formed in the lower surface of the lower burner head 22. Instead, small port grooves may be formed in the upper surface of the burner body 11b to form small ports when the lower burner head 22 is mounted on the burner body 11b.

[0069] The above stove burner 10 according to the present embodiment emits a spark from the spark plug 30 to ignite the air-gas mixture. Instead, the stove burner 10 may ignite the air-gas mixture with heat using a heater.

[0070] The above stove burner 10 according to the present embodiment includes the annular burner head 20 having the through-hole 20h at its center. Instead, the stove burner may include, for example, a disk-shaped burner head with a closed portion corresponding to the through-hole 20h.

REFERENCE SIGNS LIST

- [0071]
- 1 gas stove
 - 2 body case
 - 3 cooktop
 - 4 trivet
 - 5 temperature sensor
 - 7 grill door
 - 8 stove operation button

- 9 grill operation button
- 10 stove burner
- 11 burner unit
- 11a mount surface
- 5 11b burner body
- 12 primary mixture path
- 12o open end
- 13 secondary mixture path
- 13o open end
- 10 14 center cylinder
- 15 partition cylinder
- 15a fitting surface
- 16 mixing chamber
- 16c secondary mixing chamber
- 15 16p primary mixing chamber
- 20 burner head
- 20h through-hole
- 21 upper burner head
- 21a upper cylindrical wall
- 20 21b upper main port groove
- 21f upper main port
- 22 lower burner head
- 22a wall cylinder
- 22b bottom cylindrical wall
- 25 22c small port groove
- 22d lower cylindrical wall
- 22e lower main port groove
- 22f lower main port

- 22u small port
- 26 detection upper port
- 26L detection upper port array
- 26a slope
- 5 27 flame detection port
- 27L flame detection port array
- 27a flame detection port
- 27b flame detection port
- 28 ignition port
- 10 29 protrusion
- 30 spark plug
- 31 spark plug guard
- 31t ignition target
- 32 flame sensor
- 15 40 gas supply pipe
- 40c connection pipe
- 40p connection pipe
- 41 gas-flow control valve
- 42 open-close valve
- 20 43c gas ejection nozzle
- 43p gas ejection nozzle
- 44c nozzle hole
- 44p nozzle hole

CLAIMS

1. A stove burner, comprising:
 - a burner body to which an air-gas mixture containing a fuel gas and air is supplied;
 - a burner head mounted on the burner body to form a plurality of ports in a cylindrical outer
 - 5 circumferential surface, the burner head allowing the air-gas mixture flowing from the burner
 - body to flow out through the plurality of ports;
 - an ignitor configured to ignite the air-gas mixture flowing out through at least one port of
 - the plurality of ports; and
 - a flame detector facing a port of the plurality of ports different from the at least one port at
 - 10 which the ignitor ignites the air-gas mixture, the flame detector being configured to detect a
 - flame at the port facing the flame detector,
 - wherein the burner head includes
 - a plurality of first ports included in the plurality of ports and arranged in a
 - circumferential direction of the cylindrical outer circumferential surface, and
 - 15 a plurality of second ports included in the plurality of ports and arranged in the
 - circumferential direction above the plurality of first ports,
 - adjacent first ports of the plurality of first ports are spaced by a distance allowing a flame
 - at one of the adjacent first ports to spread to the other of the adjacent first ports, and each of the
 - plurality of first ports is spaced from a second port of the plurality of second ports above the

first port by a distance allowing a flame at the first port to spread to the second port above the first port,

the ignitor ignites the air-gas mixture flowing out through the at least one first port of the plurality of first ports instead of the plurality of second ports,

5 the flame detector detects a flame at a first port of the plurality of first ports facing the flame detector instead of the plurality of second ports,

the plurality of first ports include at least one flame detection port at which the flame detector detects a flame, and the at least one flame detection port is located more inward than another first port of the plurality of first ports in a radial direction of the burner head, and

10 the plurality of second ports include at least one detection upper port located above the at least one flame detection port, and the at least one detection upper port is located more inward than another second port of the plurality of second ports in the radial direction of the burner head.

2. The stove burner according to claim 1, wherein

15 the plurality of first ports include a plurality of the flame detection ports located adjacent to each other and forming a flame detection port array,

the plurality of second ports include a plurality of the detection upper ports located adjacent to each other and forming a detection upper port array, and

the detection upper port array is wider than the flame detection port array in the

circumferential direction of the cylindrical outer circumferential surface.

3. The stove burner according to claim 1 or claim 2, wherein

the cylindrical outer circumferential surface includes a protrusion protruding in a radial direction from the cylindrical outer circumferential surface between a portion including the at

5 least one flame detection port and a portion including the at least one detection upper port.

4. The stove burner according to any one of claims 1 to 3, wherein

the burner head includes

a lower burner head mounted on the burner body, and

an upper burner head mounted on the lower burner head,

10 the lower burner head includes

a bottom cylindrical wall protruding downward from an outer periphery of a bottom surface of the lower burner head and mounted on the burner body, and

a lower cylindrical wall protruding upward from an outer periphery of an upper surface of the lower burner head,

15 the upper burner head includes an upper cylindrical wall protruding downward from an outer periphery of a bottom surface of the upper burner head and mounted on the lower cylindrical wall of the lower burner head,

the bottom cylindrical wall mounted on the burner body includes a plurality of first port grooves in a lower end surface of the bottom cylindrical wall and forms the plurality of first

ports between the bottom cylindrical wall and the burner body,

the lower cylindrical wall receiving the upper burner head includes a plurality of lower second port grooves in an upper end surface of the lower cylindrical wall and forms the plurality of second ports between the lower cylindrical wall and the upper burner head,

5 the upper cylindrical wall mounted on the lower burner head includes a plurality of upper second port grooves in a lower end surface of the upper cylindrical wall and forms the plurality of second ports between the upper cylindrical wall and the lower burner head, and

the plurality of upper second port grooves in the upper burner head are staggered relative to the plurality of lower second port grooves in the lower burner head in the circumferential
10 direction of the cylindrical outer circumferential surface.

5. The stove burner according to claim 4, wherein

a first port groove of the plurality of the first port grooves forming the at least one flame detection port with the lower burner head being mounted on the burner body has a greater height than another first port groove of the plurality of first port grooves, and

15 a sum of a height of a lower second port groove of the plurality of lower second port grooves and a height of an upper second port groove of the plurality of upper second port grooves forming the at least one detection upper port with the upper burner head being mounted on the lower burner head is less than a sum of a height of another lower second port groove of the plurality of lower second port grooves and a height of another upper second port groove of

the plurality of upper second port grooves.

6. A gas stove, comprising:

the stove burner according to any one of claims 1 to 5.