Aug. 6, 1940. W. A. BECKETT 2,210,228

GAS HEATING APPARATUS

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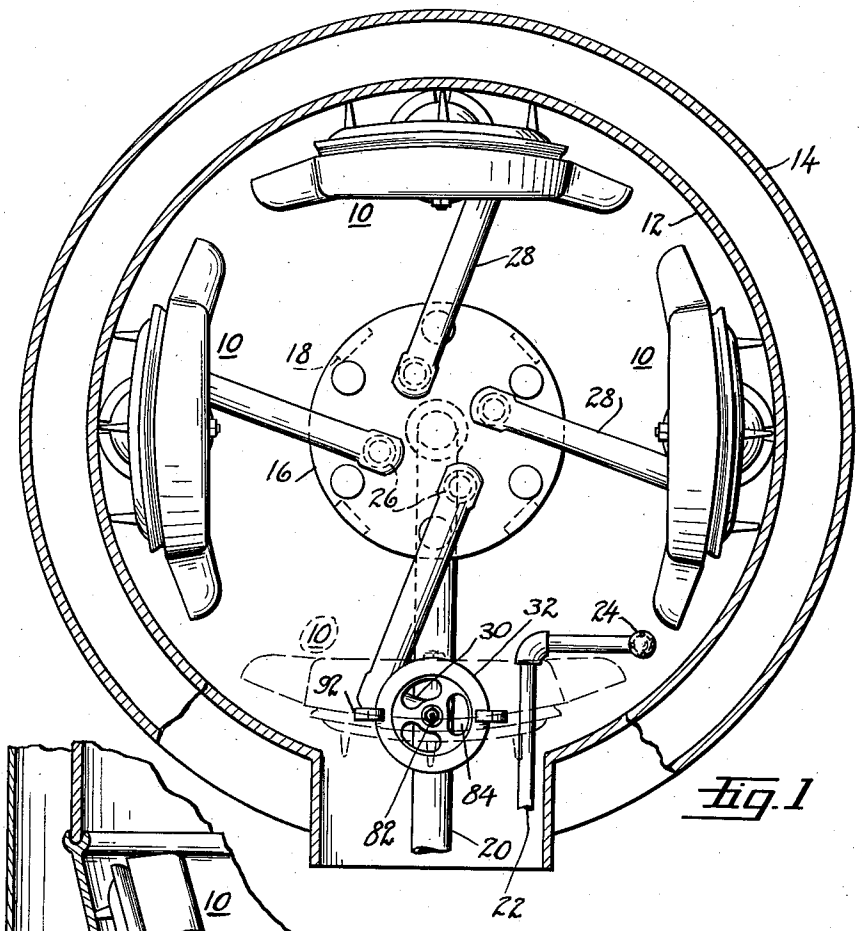


Fig. 1

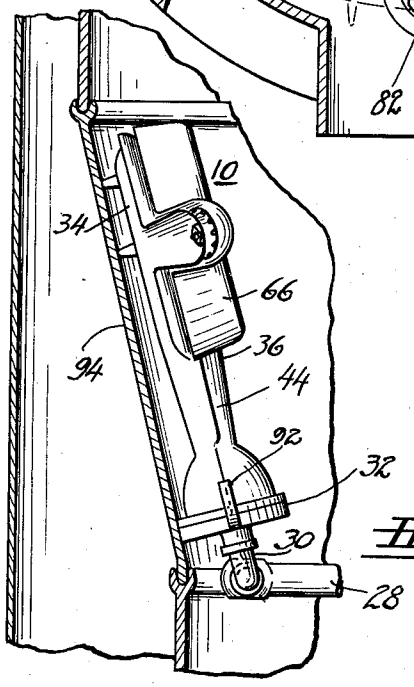


Fig. 10

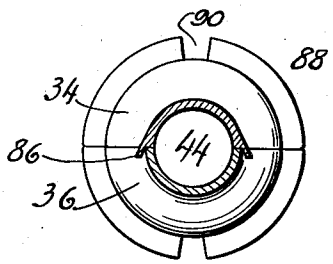


Fig. 9

INVENTOR.
William A. Beckett
BY
Parker & Burton
ATTORNEYS.

Aug. 6, 1940. W. A. BECKETT 2,210,228

GAS HEATING APPARATUS

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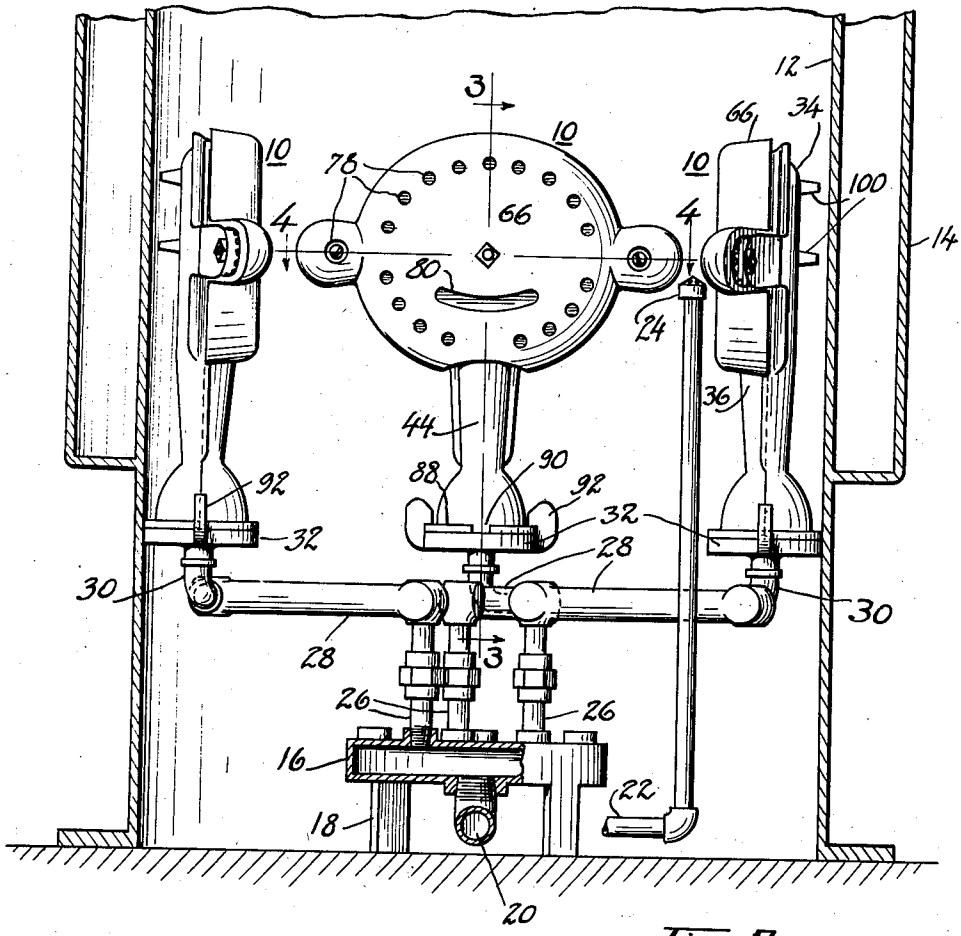


Fig. 2

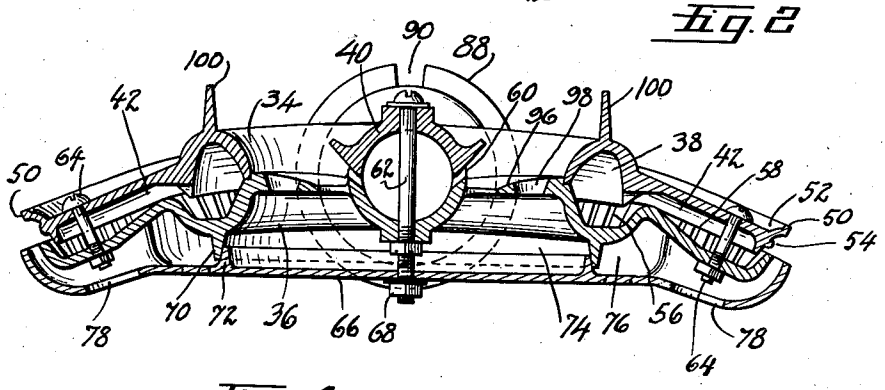


Fig. 4

INVENTOR.
BY William A. Beckett
Parker & Burton
ATTORNEYS.

Aug. 6, 1940. W. A. BECKETT 2,210,228

GAS HEATING APPARATUS

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Fig. 5

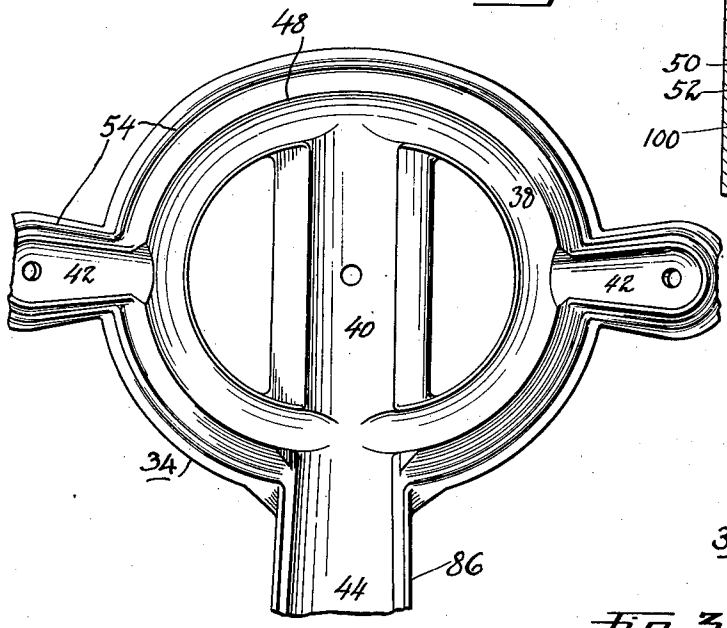


Fig. 3

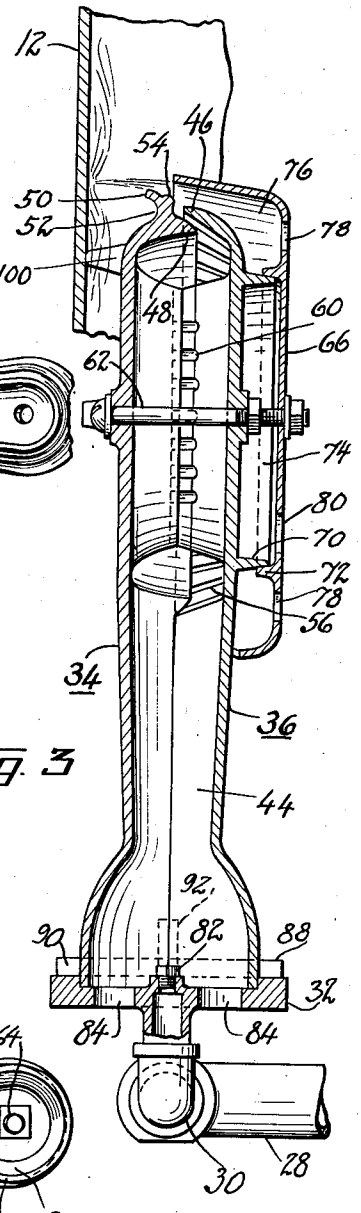
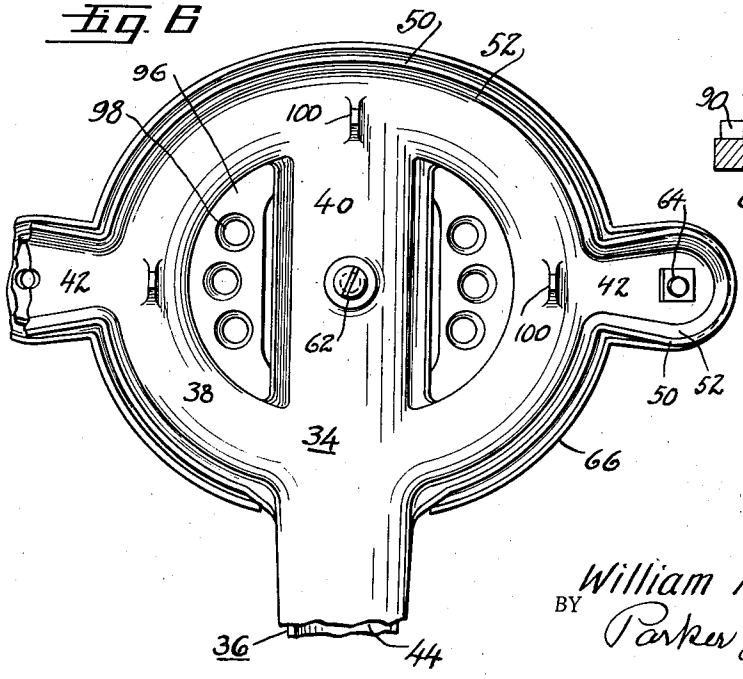


Fig. 6



INVENTOR.
William A. Beckett
BY Parker & Burton
ATTORNEYS.

Aug. 6, 1940. W. A. BECKETT 2,210,228

GAS HEATING APPARATUS

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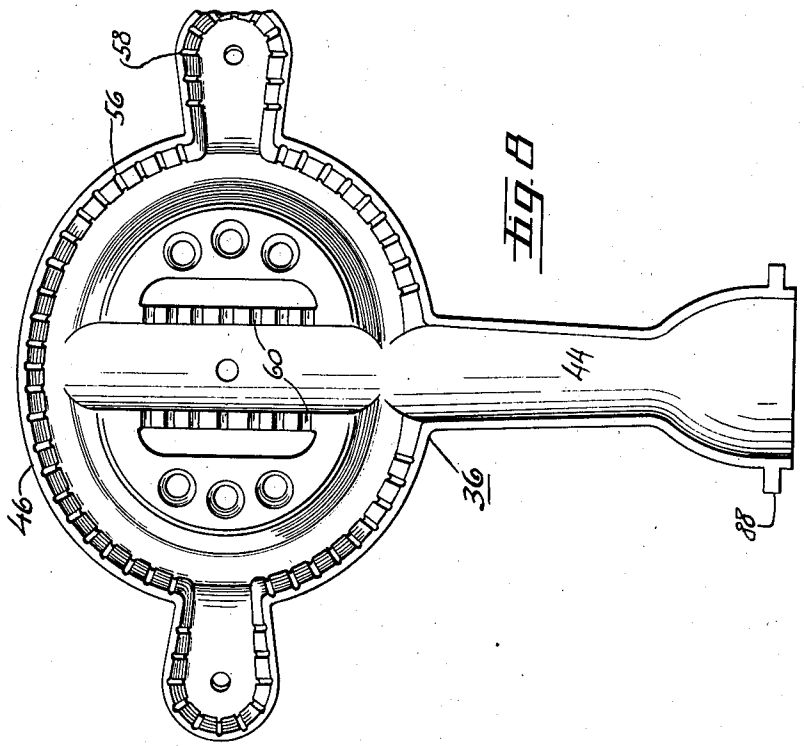


Fig. 8

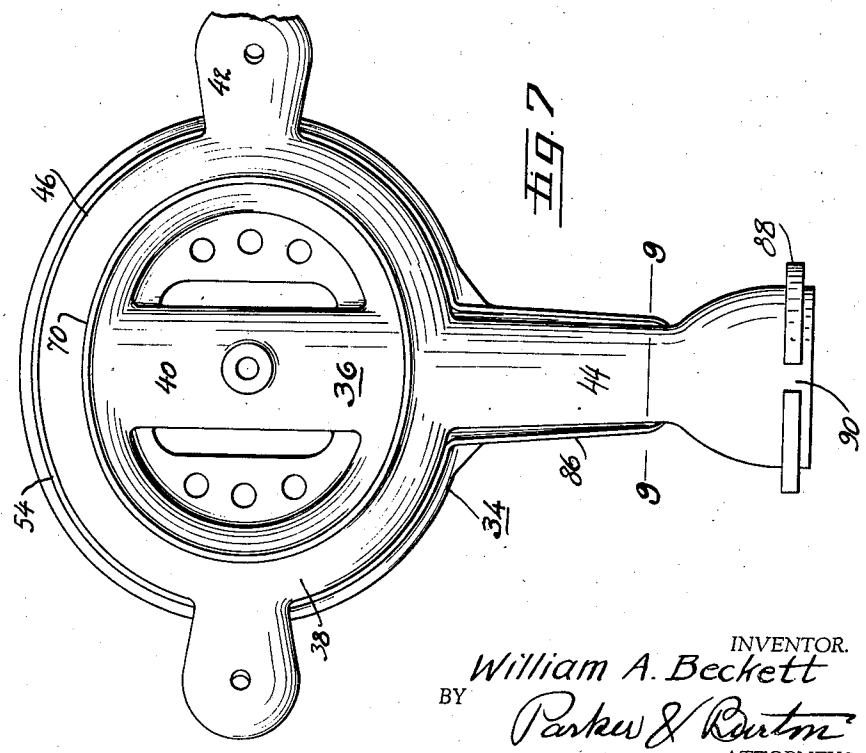


Fig. 7

INVENTOR.
William A. Beckett
BY
Parker & Burton
ATTORNEYS.

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UNITED STATES PATENT OFFICE

2,210,228

GAS HEATING APPARATUS

William A. Beckett, Kingsville, Ontario, Canada, assignor of one-half to Frederick K. Jasperson, Windsor, Ontario, Canada

Application October 5, 1936, Serial No. 104,050

10 Claims. (Cl. 158—116)

This invention relates to gas heating apparatus and more particularly to improvements in the construction, operation and association of such devices.

An important object of this invention is to improve the efficiency and effectiveness of gas heating apparatus or burners both individually and collectively. This is accomplished by the invention described herein by the provision of improvements in the construction and operation of gas burners and the manner of associating them together in a furnace or other object to be heated.

It has been the practice in the past to associate relatively large baffle plates with the gas burner for the purpose of deflecting the flames of combustion toward the object to be heated such as the wall of a furnace. This was necessary because the burning fuel was usually directed above the burner unit and the baffle was employed to deflect the burning fuel upon the wall of the furnace. This indirect method of applying the heat of the burner reduced the efficiency of the burner and wasted the hottest parts of the flames upon the baffle plates. In addition, it has been the practice to discharge the burning fuel from orifices arranged substantially in a horizontal line for the purpose of preventing any part of the burning fuel interfering with the combustion of any other part of the burning fuel. Obviously, this practice tended to disperse or scatter the combustion of each burner over a wide area and reduce the effectiveness of the burner.

It is an object of this invention to overcome the disadvantages of the practices hithertofore made in this art by providing an improved gas heating apparatus which throws a direct, concentrated fire upon the object to be heated, such as the wall of a furnace. The apparatus or burner is constructed in a novel way to discharge the burning fuel directly upon the heating surface of a furnace and in such a way that the hottest parts of the burning fuel jets impinge upon the surface to be heated. This preserves the heat which otherwise would be lost if the flames of combustion impinged upon the heating surface in an indirect manner by first striking a baffle and being deflected thereby toward the heating surface.

The manner of applying the burning gaseous fuel to the heating surface is likewise a meritorious feature of this invention. The apparatus comprehended by this invention operates to throw a concentrated, intensely heated flame upon the wall of the furnace. The apparatus is constructed in a novel way to discharge a ring of burning fuel upon a wall of a furnace in such a way that the hottest sections of all the jets effectively strike the heating surfaces while sufficient air is provided to insure proper combustion at all parts of the ring of the fire. In contradistinction to the usual practice in the art, the combustion may be directed from the burner on two or more closely related levels. This is accomplished by the novel construction of the burner which provides proper combustion for the different levels regardless of the tendency of the combustion on one level to affect that on another.

More specifically, the invention comprehends a gas heating apparatus having a manifold arranged generally in the shape of a ring and provided with discharge orifices therearound adapted to throw a ring of burning fuel. Novel means is provided for supporting the apparatus in an upright or substantially vertical position so that the ring of fuel jets is disposed in substantially a vertical plane. When in such position novel means is provided for insuring sufficient secondary air for all the fuel jets so that the operation of one section of the ring will not be affected by the operation of another section. At the same time the secondary air is so distributed over the apparatus that no overheating of parts will occur.

An important feature of the invention is the ability of the apparatus of the type described herein to employ heated air as well as the flames of combustion to accomplish its purpose. Not only are the hottest and most effective parts of the burning jets played upon the heating surface, but air in highly heated condition is also employed to heat the furnace walls and to maintain the furnace in a highly heated condition. The apparatus is arranged in a novel manner to draw air into the center of the ring of burning fuel where not only does it provide proper combustion but also is heated to a high temperature before it impinges upon the walls of the furnace. This action is continuous. Air is constantly syphoned in this manner—heated within the ring of burning fuel and used as an additional agent for heating the walls of the furnace.

Another important feature of the invention resides in the provision of means for supporting one or more gas burners in a furnace and permitting adjustment of the same for different sizes and shapes of furnaces. All the burners are supported from a centrally located element or manifold in the furnace. Each burner is supported by an arm extending from this element and relative adjustment of this arm will permit the burn-

er to assume different positions in the furnaces. A meritorious feature is found in the fact that these arms may be employed for conducting fuel to the burners as well as performing their function as burner supports. In the embodiment illustrated herein, an assemblage of gas burners are shown supported upon the ends of fuel delivery conduits which are adjustable to permit radial movement of the burners from the center of the furnace and to permit angular adjustment of the same in any radially adjusted position.

Another meritorious feature of the invention resides in the construction of the various individual parts or elements comprising the gas burner. These elements are preferably cast into the desired shape and assembled together to form the burner. The burner in the embodiment of the invention illustrated herein comprises an assembly of three cast parts or elements, two of which when fitted together form the manifold sections of the burner and the fuel inlet thereto. The third element is in the form of a baffle plate and is assembled upon the rear side of the manifold sections where it forms in combination with the manifold sections a plurality of passages through which secondary air is drawn to aid the combustion.

More specifically, the manifold sections of the burner are formed by providing channels in two of the cast elements. When these elements are fitted together the channels in each element cooperate with one another to form an interconnected series of manifold sections in which gas and air mix prior to combustion. An important feature of the structural embodiment illustrated herein is the circular or ring-shaped character of one of the manifold sections thus provided. This manifold section discharges a circular or ring-shaped band of fire upon a heating surface as previously described. Secondary air is drawn or syphoned through the center of the annular manifold section and provides a proper quantity of oxygen in the middle of the ring of fire. In the embodiment of the invention illustrated herein, the ports for discharging jets of burning fuel are provided by forming a series of grooves on the inner side of one of the elements along the peripheral edges of the aforementioned channels. Due to the fact that the peripheral edges of one of the elements forming the manifold sections overlap that of the other, these grooves function to permit the escape of gaseous fuel from the manifold sections wherever they may be provided. The discharge parts thus provided are arranged to discharge the gaseous fuel in a direction substantially normal to the plane of the burner.

An important detail feature of the invention resides in the novel construction of the burner adjacent the discharge ports. The structure around the discharge ports is so arranged as to cause the jets of burning fuel issuing therefrom to be directed in a perpendicular manner against the heating surface. In addition, novel means is provided adjacent the discharge orifices which causes the production of an even flame all around and prevents any part of the combustion from blowing out or floating lazily and ineffectively.

Various other objects, advantages and meritorious features will be found in the following specification, appended claims, and accompanying drawings wherein:

Figure 1 is a top cross-sectional view of a furnace showing an assemblage of burner units and the manner of supporting the same from the center of the furnace,

Fig. 2 is an interior view of a furnace showing the gas burner assemblage of Fig. 1 in elevation with one of the burners removed for clarity,

Fig. 3 is a cross-sectional view along line 3—3 of Fig. 2,

Fig. 4 is a cross-sectional view along line 4—4 of Fig. 2,

Fig. 5 is an inside view of one of the complementary halves of the burner assembly,

Fig. 6 is an outside view of the element shown in Fig. 5 but with the same in assembled position in the burner,

Fig. 7 is an outside view of the other complementary half of the burner assembly showing the same in assembled condition on the burners,

Fig. 8 is an inside view of the element shown in Fig. 7 illustrating the arrangement of the fuel discharge orifices,

Fig. 9 is a cross-sectional view along lines 9—9 of Fig. 7, and

Fig. 10 is a fragmentary interior view of a hot air furnace showing the adaption of the burner to inclined heating surfaces.

In the embodiment of the invention illustrated herein, the gas burners are shown assembled in the fire pot of a furnace. In Figs. 1 and 2 a plurality of these burners **10**, four in number, are shown assembled in a circle adjacent the wall **12** of the furnace. The furnace shown in these figures is a steam heating furnace and is provided with an outside jacket **14** in which water may be disposed. Centrally located in the bottom of the furnace is a manifold **16** supported spacedly above the floor of the furnace by suitable legs **18**. Gas is delivered to this manifold through a pipe **20**. A pipe conduit **22** delivers gas to a pilot light **24**.

From the top of the manifold **16** extends a plurality of vertical pipe sections **26** joined at their upper ends to horizontal pipe sections **28**. These last sections are each in turn connected to angle pipes **30** each of which carries a circular plate **32** on its upper end. As shown in these figures, these plates support the gas burners **10** in upright position. The unions or connections between the pipe sections **26** and **28** and the pipe sections **28** and **30** are such that upon loosening these connections the pipe sections can be swivelled relative to one another. When the union connecting a pipe **28** to a pipe **26** is loosened, the former may be rotated in a horizontal plane about the pipe **26** as an axis. Since the pipe sections **26** are eccentrically mounted relative to the center of the manifold as shown in Fig. 1, the outside ends of the pipe **28** will swing in a path from a minimum distance from the center of the manifold to a maximum distance from the center thereof. This will permit radial adjustment of any one or all of the gas burners connected to the manifold so that the assembly of the gas burners can be varied in diameter to accommodate the size of the furnace. The union connecting a pipe section **28** to a pipe section **30** will permit the later to be rotated about a horizontal axis at the end of the pipe section **28**. This will permit the gas burner to assume a plurality of inclined positions as well as a vertical position shown in Figs. 1 and 2.

Referring in detail to the construction of the gas burner, the gas mixing and discharge part thereof comprises a two-part assembly forming an annular or ring-shaped manifold and a tubular inlet for conducting gas and primary air

thereto. The two-part character of this portion of the burner is probably best shown in Figs. 3 and 4. In these figures, the gas burner is formed by associating together two cast elements 34 and 36. These elements by themselves form complementary halves of the assembly. When joined together they form a manifold of general ring-shaped formation, a plurality of subsidiary manifold sections, and a tubular inlet leading thereto.

Figs. 5 and 6 show the interior and exterior construction of the element 34 respectively. Figs. 7 and 8 show the exterior and the interior construction of element 36 respectively. These elements are channeled to provide the complementary halves of the manifold sections. When the elements 34 and 36 are assembled together, the channels form the manifold sections of the burner which in the embodiment of the invention illustrated herein comprise the ring manifold section 38, the diametrically extending manifold section 40 and the pair of laterally extending manifold sections 42 on opposite sides of the burner. All these manifold sections communicate with one another. The elements 34 and 36 likewise form, when assembled together, a tubular inlet 44 through which gas and primary air is fed to the manifold sections. It will be noted that the diametrical manifold section 40 extends in substantial alignment with the tubular inlet and this insures delivery of sufficient fuel to the opposite side of the ring manifold section.

Element 36 is provided with a curved peripheral edge 46 which overlaps a similarly curved peripheral edge 48 on element 34 as shown in Fig. 3. Upon the curved peripheral edge of element 34 is provided a flange or lip 50 which is curved to provide a recess 52 along the outside of the element 34. As shown in Fig. 6, both the lip and recess extend substantially around the outer edge of the ring manifold and the subsidiary manifold sections extending laterally from opposite sides of the ring manifold. Upon the outer surface of the lip 50 is a raised portion or ridge 54 spaced slightly from the outer edge 46 of element 36. The function of the lip, recess and ridge is important and is more particularly described hereinafter in connection with the operation of the burner.

To provide the necessary orifices or ports for discharging jets of burning fuel, element 36 is grooved on the inside surface along the outer edges of the channels which form part of the manifold sections. As clearly shown in Fig. 8, grooves 56 are formed on the inside surface of the peripheral edge of element 36. Grooves 58 are provided on the inside edges of those parts of element 36 which forms part of the projecting manifold sections 42. Grooves 60 are arranged on the inside surface along opposite sides of that part of element 36 which will cooperate to form the central manifold section 40.

When the two elements 34 and 36 are properly assembled together, the curved edge 46 of element 36 overlaps the curved edge 48 of element 34, and the grooves 56 and 58 are arranged to discharge the gaseous fuel in a direction substantially perpendicular to the plane of the burner. The fuel thus discharged forms a circle or ring of burning fuel conforming in outline to the arrangement of the discharge ports 56 and 58 on the inside of element 36. The ports 60 on either side of the diametrically extending manifold section 40 discharge burning gaseous fuel into the center of the ring of fire. As will be more fully explained hereinafter, the lip 50 performs the important function of drawing or bending the flame jets toward the center of the ring of fire so that the jets strike the heating surface in a substantially perpendicular manner as illustrated in Fig. 3.

The elements 34 and 36 are secured together by any suitable means such as by a bolt 62 in the center of the burner and bolts 64 across the subsidiary manifold sections. Secured to the back of the burner is a baffle plate 66 which is of a formation similar in outline to the formation of the manifold sections of the gas burner. Suitable means such as a nut 68 may be arranged to secure the baffle plate upon the bolt 62. The baffle in retained in spaced relationship from the element 36 by the provision of overlapping abutting flanges 70 and 72 on the element 36 and the baffle plate 66 respectively. These flanges provide an air space between the back of the member and the baffle plate. The flanges 70 and 72 are circular in outline and continue their overlapping relationship completely around the center of the burner so that the air space 74 on the inside of the midsection of the baffle plate is completely separated from the air space 76 surrounding the same adjacent the outer edges of the baffle plate. A series of openings 78 is provided adjacent the peripheral edge of the baffle plate through which secondary air may be admitted to the air space 76. An opening 80 may be likewise provided for admitting air to the secondary air space 74. As shown in Figs. 3 and 4 the baffle plate 58 is curved at its outer extremity so as to partially enclose or embrace the manifold sections of the gas burner. The curved edge of the baffle plate terminates substantially in spaced relationship opposite the discharge ports of the manifold sections.

As previously mentioned, the complementary halves 34 and 36 of the gas burner assembly form a tubular inlet 44. This inlet is bellmouthed at its end remote from the manifold sections of the gas burner and may rest upon a plate 32 for support. Gas is delivered through the swivable pipe sections 26, 28 and 30 to the center of the plate 32 where a suitable nozzle 82 may be provided for injecting the gas into the bellmouth of the inlet 44 as shown in Fig. 3. A series of openings 84 are provided in the plate 32 through which primary air is admitted to the bell mouth of the inlet 74. This primary air as readily understood mixes with the gas and the mixture rises in the inlet 44 and enters the manifold sections of the gas burner. To prevent leakage of gas from the inlet 44, it is preferred that one of the elements forming the assembly be provided with lips 86 which partially overlap the other element along the crack separating these two elements as shown in Fig. 9. The pocket formed by this lip formation is filled with furnace cement which, when dry, seals the cracks of the tubular inlet 44.

Each of the elements 34 and 36 is provided with flanges 88 which, when the elements 34 and 36 are assembled together, substantially encircle the bellmouth with the exception of a pair of slots 90 arranged diametrically opposite one another as shown in Fig. 9. These flange sections 88 are adapted to cooperate with any suitable means provided on the plate 32 for locking the gas burner against removal. This locking provision may be accomplished by providing a pair of ears or dogs 92 arranged diametrically opposite one another on the plate 32. These dogs are constructed so that they will fit through the slots 90 and overlap the

flanges 88 upon slight rotation of the burner relative to its seat 32. Such a position is shown by the central burner in Fig. 2. The overhanging character of the dogs 92 releasably lock the burners against removal.

In Fig. 10, a gas burner is shown in combination with an inclined section of a fire pot 94. This clearly demonstrates the adaptability of the gas burner to various positions and insures that all the burning jets of fuel impinge upon the surface to be heated.

It is preferred that the element 36 be provided with web-sections 96 between the ring manifold and the diametrically extending manifold 40. These web-sections are apertured at 98 to permit air to flow through the center of the ring manifold. The presence of these web-sections reduces the amount of air admitted so that proper combustion of the burning fuel is obtained. If no such provision were made it was found in practice that too much air was admitted to the center of the combustion and this adversely affected its operation.

The gas burners are intended to be positioned in parallel, slightly spaced relationship to the surface which they are intended to heat. In order to obtain the proper distances from the surface, lugs 100 are provided on the element 34 which are adapted to bear upon the heating surface and space the burner therefrom.

In operation, gas is delivered to the adjustable pipe sections 26, 28 and 30 to the base of the tubular inlet 44 where it mixes with primary air admitted to openings 84 in plates 32. This gaseous mixture arises in the tubular inlet 44 and divides itself between the various manifold sections of the gas burner. The central manifold section 40 conveys some of this mixture to the upper portion of the ring manifold and insures sufficient delivery of gas to that section. The gaseous mixture then flows out from the discharge ports 56, 58 and 60, where it is ignited as it leaves these ports. Secondary air is admitted through the openings 78 in the baffle plate and this air flows, as indicated by the arrows, through the air space 74 and contacts the gas mixture as the latter leaves the discharge ports. It is clearly seen that secondary air is delivered to the gas jets issuing from the burner. Considering the discharge of the gaseous mixture as a whole, it will be appreciated that a ring of burning fuel will be directed by the gas burner upon the heating surface. The secondary air admitted through the holes 78 in the baffle plate is conveyed to the outer edge of such a ring of burning fuel.

If no provision were made for admitting secondary air to the center of the ring of burning fuel, the jets of fuel discharged at the top of the burner would not receive sufficient oxygen for proper combustion due to the fact that the burning fuel issuing from the lower part of the burner would consume a considerable amount of the oxygen which would otherwise rise up to feed the jets at the top of the burner. In other words, the jets along the top of the burner would burn lazily indicating incomplete combustion and heat loss. Secondary air which is admitted through the opening 80 in the baffle plate travels through the apertures in the webs 96 and enters the center of fire where it overcomes the objection previously referred to. Due to the heat of combustion and the syphoning action of the gas jets the air is drawn through the opening 80 in a considerable volume and in addition to providing sufficient secondary air for the burning jets along the top of the burner also becomes a medium for assisting the heating operation. That is, the secondary air thus admitted enters the hottest part of the combustion zone and being heated to a high temperature by the combustion rises into contact with the walls of the furnace and assists the burning jets in maintaining a high temperature in the furnace.

The swiveling character of the delivery pipe sections 26, 28 and 30 permit adjustment of the gas burners for different size furnaces. Obviously, if the furnace in Figs. 1 and 2 was of different diameter, the pipe sections 28 could be swung to a different position to dispose the gas burners at a different radial distance from the center of the furnace. If the furnace should contain a fire pot having an inclined wall section such as that illustrated in Fig. 10, the angle pipe 30 may swivel to position the gas burner on an inclination. This enables the hottest part of all the burning gas jets to impinge upon the heating surface. The fire pot construction shown in Fig. 10 is intended to illustrate a hot air furnace.

As previously mentioned the lips 50 perform an important service in directing the burning jets upon the heating surface in a perpendicular manner. The burning jets as they pass over and beyond the lips are bent toward the center of the fire ring so that the tips of the bluish sections of the jets impinge vertically upon the heating surface. Such an action is illustrated in Fig. 3 and is best explained by the fact that the presence of recess 52 under the lip 50 produces a suction or area of sub-atmospheric pressure, which suction tends to draw the jets into the desired direction.

The raised portion or ridge 54 on lip 50 obstructs the discharge of gaseous fuel from the manifold sections as is clearly apparent in Fig. 3. This slows down the speed at which the jets of fuel leave the burner and slightly deflects the jets into the path of secondary air syphoned through the passage 76. If the jets discharge from the burner at a too great rate of speed they will blow out or burn incompletely, necessitating the use of shutters at the primary air entrances 84 to reduce the quantity of primary air admitted and thus control the blowing action. In practice it was found that a very desirable short peppy flame of gas was produced by the structure of the lip 50 and the ridge 54. The structure eliminates the necessity of shutters at the primary air entrances.

In certain circumstances it may be found necessary to mount one or more gas burners in horizontal position and if such is the case the gas burner will readily operate in such a position. In certain circumstances, such as in a steam boiler furnace, it may be desirable to provide a pipe of considerable dimension which will fit the back of the baffle plate and be of a size to enclose the secondary air openings 78 and 80. Secondary air can then be fed through this pipe from some source, for example, from outside the furnace if so desired. Usually, in such cases, the gas burner will be laid in horizontal position and the secondary air pipe thus described would rest on the grate of the furnace. Secondary air would be conveyed only through the grate at those sections where the pipe rests thereon.

What I claim:

1. A gas burner unit for furnaces comprising, in combination, a manifold of general annular shape having a series of fuel discharge ports ar-

ranged substantially therearound and adapted to discharge a ring of burning fuel from one side of the manifold in a direction substantially perpendicular to the plane of the manifold, means for supporting said manifold in a substantially vertical plane, means for delivering gas and primary air to said manifold, means cooperating with the side of said manifold opposite to that from which the ring of burning fuel issues to form an air passage through which secondary air is delivered to the outer edge of the ring of burning fuel, and an air passage for conducting secondary air through the hole in the center of the annular manifold to deliver secondary air to the inner edge of the ring of burning fuel.

2. A gas burner comprising, in combination, a ring-shaped manifold provided with fuel discharge ports extending substantially around its outer peripheral edge from which burning jets of fuel issue, a baffle plate secured to one side of said manifold in spaced relationship to the side wall of the manifold and provided with a curved peripheral edge partially enclosing the manifold, said plate provided with openings through which air is admitted to feed the burning jets of fuel issuing from said ports.

3. A gas burner comprising, in combination, an annular shaped manifold having spaced orifices around the outer periphery arranged to discharge burning jets of fuel from one side of the manifold, a plate member of substantially the size of the manifold secured in spaced relationship to the side of said manifold opposite to that from which the burning jets of fuel issue, said plate having an opening in the midsection thereof and an opening spaced therefrom through which air may be admitted to the burning jets of fuel, and means between said manifold and said plate preventing intermixture of the air admitted through the opening in the midsection of the plate and the air admitted through the opening in the plate spaced therefrom.

4. A gas burner comprising, in combination, a manifold having a ring-shaped manifold section and a manifold section extending substantially diametrically across the ring section and communicating at opposite ends with the ring section of the manifold, means for conveying gas and primary air into said ring section in substantial alignment with said diametrically extending manifold section, said ring section provided with a plurality of ports along its outer peripheral edge arranged to discharge burning jets of fuel laterally from one side of the ring-shaped manifold section, a baffle plate of substantially the same size as said ring-shaped manifold section secured in spaced relationship to the side of said manifold opposite that from which the burning jets of fuel are directed, said baffle plate provided with a curved peripheral edge partially enclosing said ring section and overhanging said discharge ports to assist in directing the fuel jets laterally from the manifold in the given direction, said baffle plate further provided with a series of openings opposite to the ring-shaped manifold section through which secondary air is admitted to feed the burning jets of fuel and an opening in the mid-section thereof for admitting secondary air to the center of said ring-shaped manifold section and around said diametrically extending manifold section.

5. The invention described in claim 4 further characterized by the fact that means is provided between said baffle plate and the side of the manifold to which it is secured for preventing the air admitted through the opening in the mid-section of the baffle plate from mixing with the air admitted through the openings in the baffle plate opposite to the ring-shaped manifold section.

6. A gas burner comprising, in combination, a manifold having a ring-shaped manifold section and a manifold section extending substantially diametrically across the ring section and communicating at its opposite ends with the interior of the ring section, said ring-shaped manifold section provided with subsidiary manifold sections projecting laterally from opposite sides thereof and communicating with the same to receive gaseous fuel therefrom, said manifold provided with discharge ports along the outer peripheral edge of said ring-shaped manifold section and said subsidiary manifold sections and along the opposite sides of said diametrically extending manifold section, said ports arranged to discharge burning jets of fuel from one side of the manifold in a direction substantially perpendicular to the plane of said ring-shaped manifold section, a baffle plate of slightly larger size than said manifold and similarly shaped including laterally extending sections corresponding to the laterally extending subsidiary manifold sections of said ring section, and means for securing said baffle plate in spaced relation to the side of said manifold opposite to that from which the burning jets of fuel issue so as to provide an air space between the manifold and the baffle plate at substantially all points along the manifold.

7. A gas burner having a fuel inlet and a series of fuel discharge orifices from which the fuel issues in jets of burning fuel, a lip on said burner adjacent said series of orifices across which the jets of burning fuel are discharged, said lip directing the jets as they leave the orifices in a given direction, and a ridge on said lip projecting into the path of the jets of burning fuel and acting to decrease the speed at which the jets discharged from the orifices.

8. A gas burner comprising, in combination, a manifold having a fuel inlet and a plurality of discharge orifices arranged closely together in a line, a lip projecting from said manifold along one side of said line of discharge orifices and disposed in such a position that the jets of burning fuel issuing from said orifices cross over the lip and are directed thereby in a given direction before leaving the burner, a member disposed in spaced relation to the manifold on the other side of said line of orifices and forming in conjunction with the manifold an air passage through which secondary air is delivered to the jets of burning fuel, and a ridge projecting from said lip in the path of said jets of burning fuel and acting to reduce the speed at which the burning fuel emerges from the orifices and to deflect the burning fuel into the secondary air delivered by said air passage.

9. A gas burner including, in combination, a series of discharge ports from which ignited jets of fuel are adapted to issue, said gas burner provided with a surface projecting beyond said series of discharge ports over which the ignited jets of fuel travel, means for delivering secondary air from a point in the rear of said discharge ports to a point in front of the same but on the side of said fuel jets opposite to said surface over which jets are directed to travel, said surface provided with a raised portion in front of each of said discharge ports but in spaced relation thereto

acting to deflect the ignited jets of fuel into the path of the secondary air.

10. A gas burner comprising, in combination, a ring-shaped manifold in which gas and air is mixed prior to ignition formed of two complementary channeled half sections brought into edge abutting relationship, one of said halve sections having a series of radially directed grooves formed on the inside surface along its outer peripheral edge and cooperating with the abutting edge of the other half section of the manifold to provide orifices for the discharge of burning jets of fuel, said grooves arranged substantially around the manifold so that a ring of burning fuel issues from the manifold when the burner is in operation, and a lip on the outer peripheral edge of the other half section forming a surface across which the burning jets of fuel must pass, said lip provided with a raised portion in front of each of said orifices acting to retard the burning jets of fuel as they issue from the orifices.

WILLIAM A. BECKETT.