July 24, 1951 A. A. FURCZYK 2,561,793

INCANDESCENT GAS BURNER FOR FURNACE WALL

Filed Oct. 26, 1948 4 Sheets-Sheet 1

FIG. 1

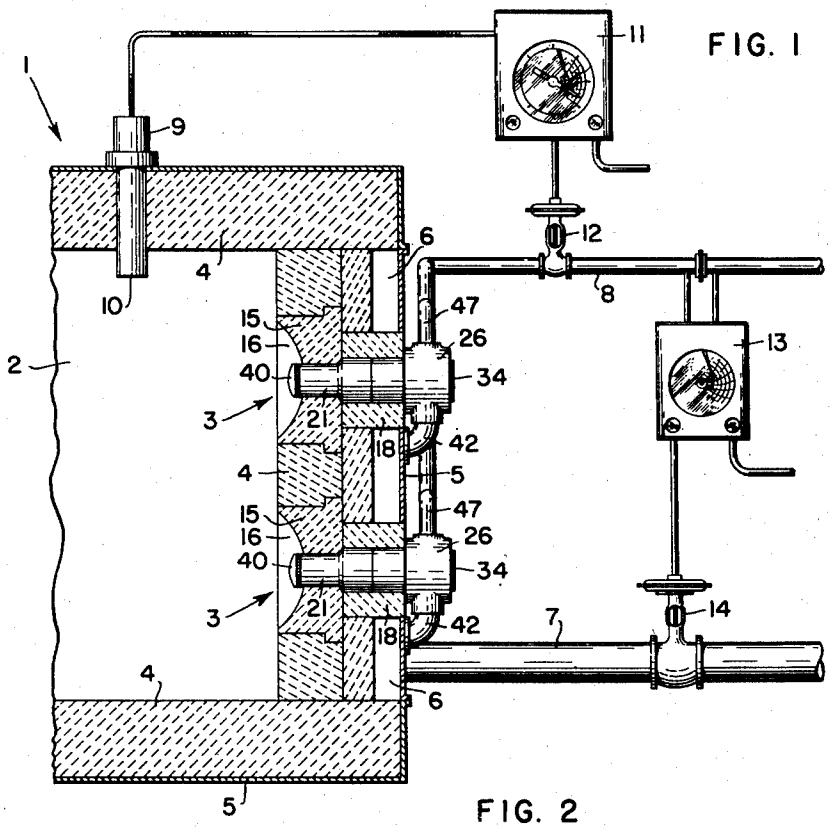

FIG. 2

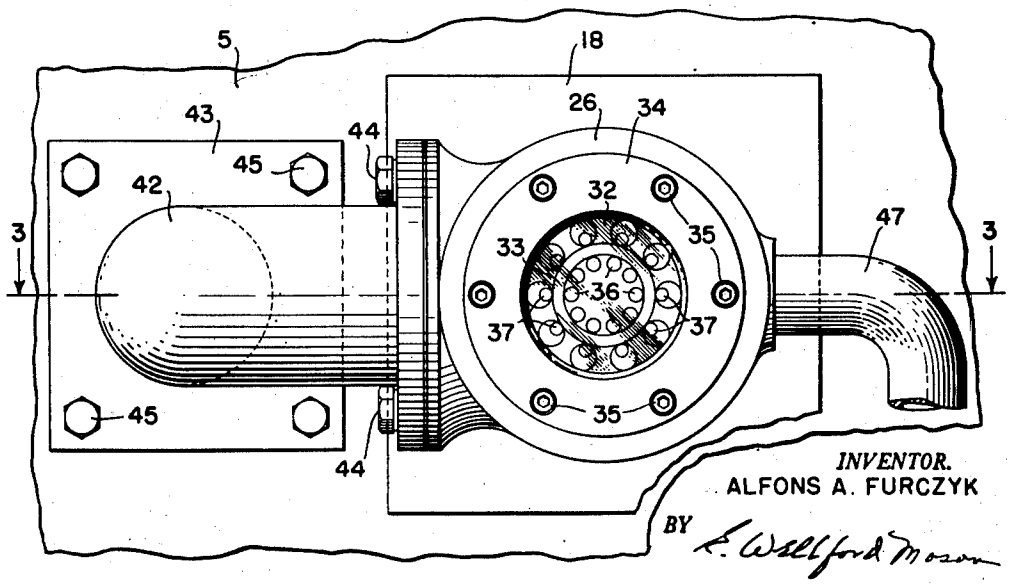

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FIG. 3

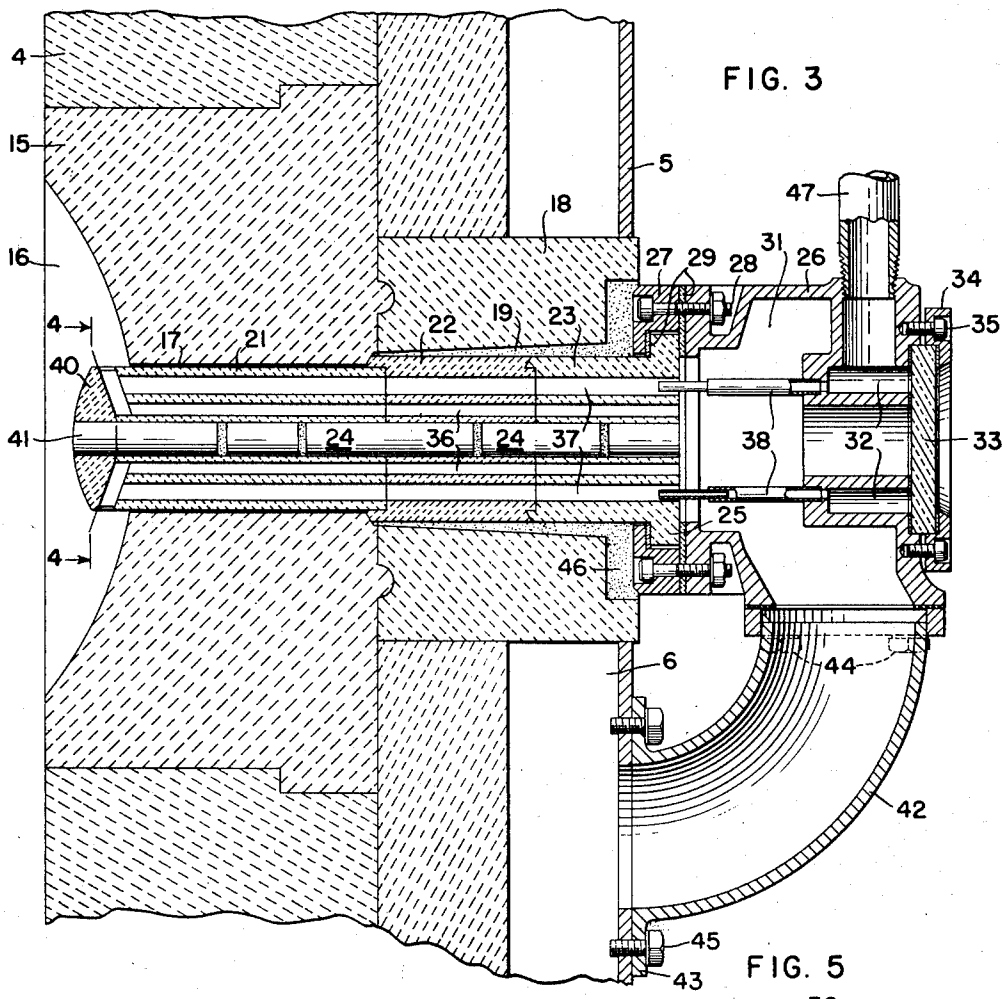

FIG. 4

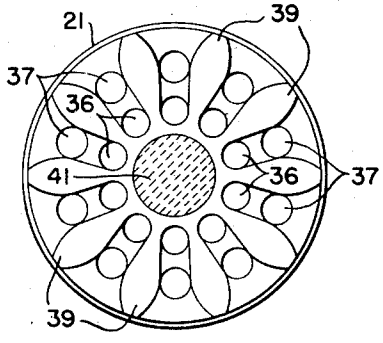

FIG. 5

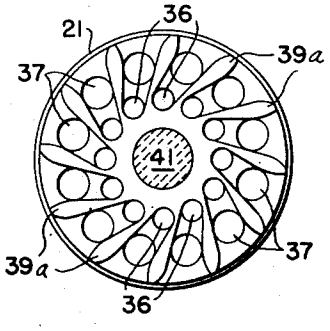

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FIG. 6

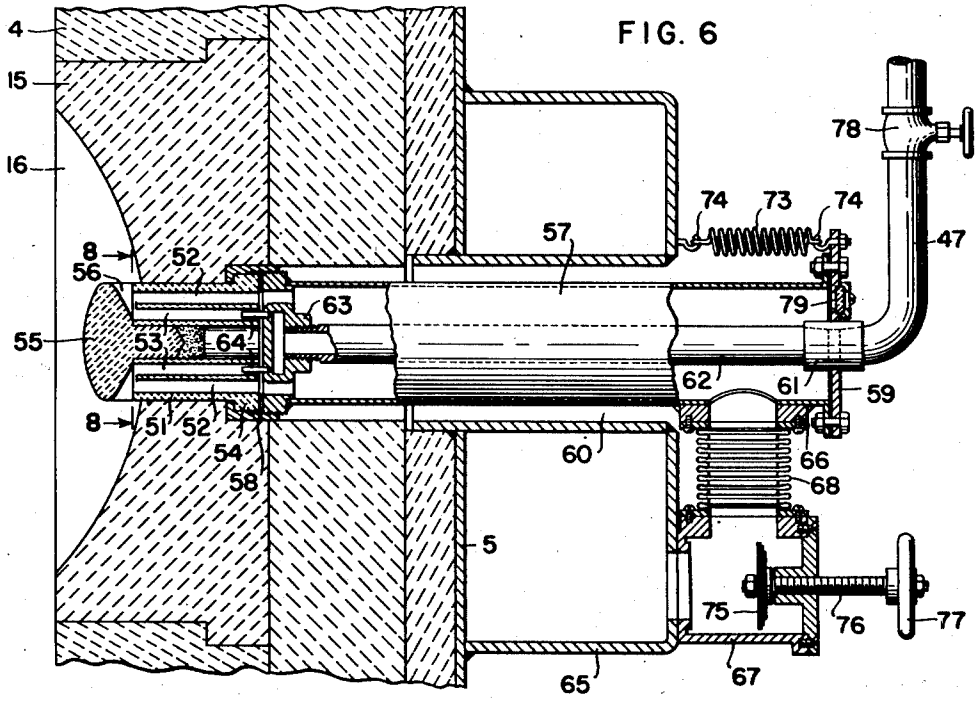

FIG. 7

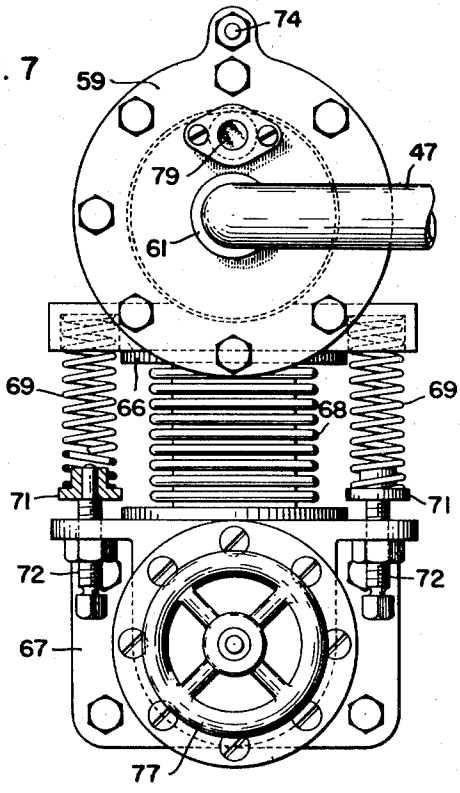

FIG. 8

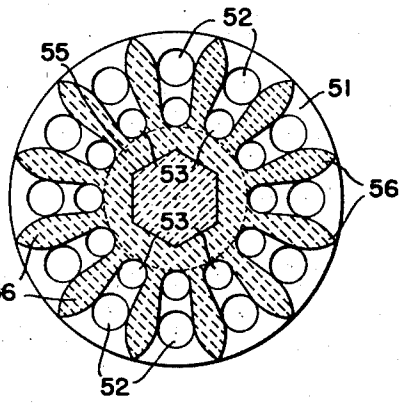

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FIG. 9

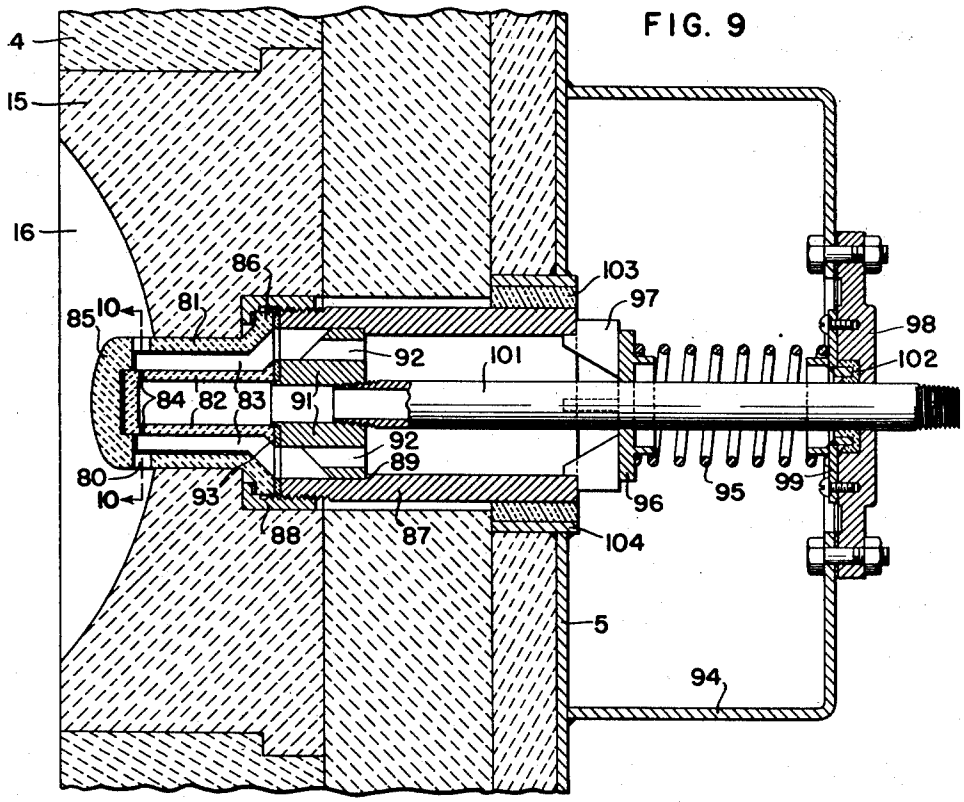
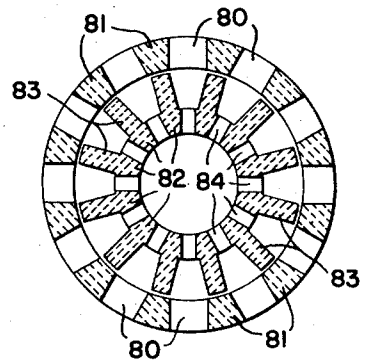


FIG. 10



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Patented July 24, 1951

2,561,793

UNITED STATES PATENT OFFICE

2,561,793

INCANDESCENT GAS BURNER FOR FURNACE WALL

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Application October 26, 1948, Serial No. 56,616

13 Claims. (Cl. 158—99)

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The present invention relates to burners that are used in large industrial installations, and more particularly to high temperature radiant type burners that are formed of ceramic material and burn a mixture of a fluid fuel and air.

Burners of a type generally similar to those of the present invention using a mixture of fuel and air are well known. All of those burners, however, are supplied from mixing machines with a combustible fuel mixture. When a large number of high capacity burners is required the amount of mixing equipment necessary is almost prohibitive. Also, since a combustible mixture is being supplied from the machines to the burner, certain other equipment, such as firechecks, is also required to reduce the explosion hazard.

The burners of the present invention have all of the highly desirable characteristics of the previously known radiant burners, but do not require the mixing machines and other auxiliary equipment needed by them.

It is an object of the invention to provide a burner of high capacity which can be used in various types of furnaces that require high temperatures. It is a further object of the invention to provide a ceramic burner that burns predetermined proportions of fuel and air to produce high temperature radiant and convection heat without flame impingement upon the work being heated.

The burner includes a ceramic cup which is heated to incandescence by flames that sweep across its surface to supply radiant heat to the furnace. Combustion takes place completely within the cup so that only the high temperature products of combustion move into the furnace chamber proper. A means is provided to supply measured proportions of fuel, which is usually gas and air, to the burner. The fuel and air are initially mixed in a distributing portion of the burner prior to the time they are forced under pressure to the cup in which combustion takes place.

The fuel is supplied directly to the burner, while the air needed for combustion is supplied first to a space formed in the furnace wall for preheating prior to the time it goes to the burner. It is, therefore, a further object of the invention to provide means for preheating the air prior to the time it is supplied to the burner.

It is a further object of the invention to provide a system of combustion in which predetermined proportions of fuel and air are supplied to a burner unit in which they are mixed and burned. The system is so designed that combustion takes place at a speed that is higher than the theoretical speed of flame propagation. Therefore, the system has a tremendous heat producing capacity for the size of the burner units.

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The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

In the drawings:

Figure 1 is a sectional view showing a furnace with the burners of the invention installed therein, and a control system therefore;

Figure 2 is a view of a single burner from the right of Figure 1;

Figure 3 is a section through a burner on line 3—3 of Figure 2;

Figure 4 is a section on line 4—4 of Figure 3;

Figure 5 is a view similar to Figure 4 showing a modified port arrangement;

Figure 6 is a sectional view of a modified type of burner;

Figure 7 is a view from the right of Figure 6;

Figure 8 is a section on line 8—8 of Figure 6;

Figure 9 is a view of another type of burner according to the invention; and

Figure 10 is a section on line 10—10 of Figure 9.

Referring first to Figure 1 there is shown a furnace 1 which can take any form that is necessary for the type of heating being performed. This furnace has a chamber 2 which is heated by any necessary number of burner units 3. The furnace is shown herein as being made in accordance with conventional furnace practice. The roof and floor of the furnace are formed of a refractory material and similar refractory is placed between the various burner units, in order to space them properly for the heat pattern that is desired. The refractory material is backed up by sheet metal 5 which can be supported by structural steel members of any desired or necessary shape. Behind the wall in which the burners are located the refractory and the sheet metal are so spaced relative to each other that a duct or air chamber 6 is formed from which air is supplied for combustion purposes to each of the burner units. This air for all of the burners in a furnace, or for groups of burners, is supplied through a pipe 7 from a suitable blower.

Gas is supplied under pressure to all of the burners of the furnace, or to groups of burners, by a pipe 8.

In the operation of the furnace the gas and air supplies may be adjusted manually in order to provide the proper ratio of air to gas for combustion to take place. As shown herein, however, there is provided a temperature responsive device 9, which may either be a radiation pyrometer or a thermocouple, that is protected from the furnace atmosphere by a protecting tube 10 which is extended into the furnace chamber. The temperature responsive device is connected to a pneumatic control instrument 11 that operates to vary the pressure applied to the diaphragm of a valve 12 in the gas line in response to the temperature of the furnace and therefore to vary the valve opening. In order to obtain the proper portions of gas and air, the flow of the gas is measured by a conventional flow ratio controller 13 which serves to adjust the air pressure applied to the diaphragm of a valve 14 in the air line and therefore the flow through the valve. This type of control system is well known and the details form no part of the present invention. It is sufficient to say that the gas is supplied in accordance with the temperature of the furnace, and the air is automatically adjusted to maintain the proper proportions thereof with respect to the amount of gas that is supplied. This proportion can be predetermined, and will be set to a value depending upon the type of gas, whether it is natural or manufactured, and upon the type of atmosphere that is to be produced in the furnace. If an oxidizing atmosphere is to be maintained in the furnace chamber a larger percentage of air will be used whereas if a reducing atmosphere is to be maintained in the furnace chamber a smaller proportion of air will be used. In either case the air and gas are mixed in the burner units in a manner to be described so that combustion takes place to heat the furnace chamber. The control system that is used may be electric, hydraulic or pneumatic. It is shown herein as being pneumatic for purposes of illustration only.

The details of the preferred form of burner are shown in Figures 2, 3 and 4. The burner unit includes a burner block 15 that is embedded in the wall of the furnace and which is provided with a cavity or cup 16 in its surface facing the interior of the furnace. The block has an opening 17 through it at the base of the cup which is coaxial with an opening 19 formed in a wall block 18 that lies back of the burner block and extends through the outer wall 5 of the furnace. Extending through the openings 17 and 19 of the burner block and the wall block are a plurality of ceramic distributing members 21, 22 and 23 which are fastened together as a single member by means of pins 24 that extend through and are cemented to central openings in the distributing members. The distributing members 21, 22 and 23 could be made in a single piece if it was so desired, but for purposes of convenience in the manufacture of these members which are of a ceramic material, it is more feasible to make them in sections and join these sections together. The outer member 23 has a flange 25 on its end that is attached to a casting 26 which projects beyond the wall of the furnace. This casting is fastened to the flange 25 by means of a retaining ring 27 and bolts 28 which hold the retaining ring and the casting together. Suitable gaskets 29 are provided between the parts so that a pressure tight connection is obtained between the distributing members and the casting.

The casting forms an outer chamber 31 to which air is supplied, and an inner, annular chamber 32 to which gas is supplied. The right ends of the chambers are closed by a window 33 which may be made of some temperature resisting glass or which may be made of metal. This window is provided so that the action of the burner during operation may be observed without disturbing the same. The window is held in position by a retaining ring 34 which engages its outer edge and which ring is fastened to the casting by bolts 35. Suitable gaskets are provided on each side of the window so that a pressure tight connection is obtained, and so that the chambers 31 and 32 will be separated.

The distributing members each have formed in them an inner row of axially aligned openings 36 that, as shown in Figure 3, extend in a circle around the member, and an outer row of axially aligned openings 37 which are radially displaced with respect to the openings 36. Air is supplied through the openings 36 to the cup 16 from chamber 31. Gas is supplied through the outer row of openings 37 by means of tubes 38 which extend from the annular chamber 32 inwardly a short distance into the ends of openings 37. The end of the distributor member 21 which projects into the cup 16 is formed with a series of partitions 39 that extend as shown in Figure 4 between each of the radially aligned pairs of openings 36 and 37. These partitions are so shaped that a series of channels or compartments is made in the end of the distributor, each channel at its inward end being of a width equal to the diameter of openings 36, and flaring outwardly toward the periphery of the member as shown in the drawing. The upper end of each partition is closed off by a cap 40 also of ceramic material so that gas and air are directed in a jet that is substantially parallel to the surface of the cup 16. The cap 40 is held in place by a pin or rod 41. All of the parts of the distributor assembly including the distributor members, the cap and the various rods are fastened together with high temperature cement to form a single unit.

After the distributor members have been assembled with the casting 26 they are moved from the right in Figure 3 into position in the burner block. It will be seen that distributor member 22 is slightly larger in diameter than distributor member 21 so that a shoulder is formed on its left end which engages tightly against a cooperating shoulder formed on the right side of the burner block 15. The entire assembly consisting of the distributor members and the casting is held in place in the furnace wall by means of a connection formed between the casting and an elbow 42 that extends to and is fastened to the metal backing 5 of the furnace. Bolts 44 are provided between the casting 26 and the elbow member 42 to hold these parts rigidly together. The lower left end of the elbow is welded to a plate or flanged to form a flat portion 43 provided with openings through which bolts 45 can extend into the the metal backing of the furnace. Suitable gaskets are provided between flange 43 and the metal backing and between elbow 42 and the casting 26 if necessary, so that pressure tight connections are formed between these two parts. Just before the distributor member is moved into the openings of the burner block a body of cement 46 is placed in a cut-out portion provided therefore in the wall block. This cement is for

the purpose of making an air tight joint between the distributor and the wall of the furnace. If the furnace was operated with its chamber at a sub-atmospheric pressure there would be no need to provide any means for holding the distributor member in the burner block. Since, however, most furnaces are operated with a pressure slightly higher than atmospheric some means is necessary to hold the distributing member in place and to prevent the leakage of gases from the furnace except in exhaust openings provided for this purpose. It is for this reason that it is necessary to have a rigid support to hold these parts in the burner block. It is noted that gas is supplied to chamber 32 from the gas main 8 by means of a pipe 47 extending from the chamber to the gas main.

In the embodiment just described, the openings 36 and 37 were located radially so that the gas and air mixture which is discharged from the compartments formed by the partition 39 would be discharged radially into the cup 15. A slightly different manner of forming the partitions is shown in the drawing at Figure 5. In this drawing the openings 36 and 37 instead of being radial with respect to each other are displaced circumferentially so that partitions 39a formed in the end of distributor member 21 extend at an angle to a radial direction. When the partitions are formed in this manner the gas and air mixture will be discharged into the cup 16 in a spiral direction rather than radially. This is a matter of choice and will depend somewhat upon the type of gas that is being used as a fuel. The operation of the two types of distributing members will be described in detail below.

In operation, gas is supplied from main 8 to the individual pipes 47 leading to chamber 32 of the burner. Air is supplied from main 7 to the duct 6 formed between the refractory wall of the furnace and the metal backing 5. Here the air is preheated by any heat which is lost through the refractory wall of the furnace, and the preheated air passes through elbow 42 to chamber 31. Gas passes from chamber 32 through tubes 38 to passages 37. Since the tubes are smaller than the passages some air will be drawn into the passages with the gas, but not enough to form a combustible mixture. The remaining air needed for combustion will pass through the passages 36.

At the tip end of the distributor the individual streams of gas-air mixture in passages 37 will be mixed with the radially displaced streams of air in passages 36 to form a combustible mixture that may be burned in cup 16. The flame formed by the mixture issuing from each pair of passages will sweep the surface of the cup, rather than impinge upon it. In this fashion the hottest portion of the flame will be used to heat the surface of the cup to a high degree of incandescence. This incandescence which is above the flash point of the mixture helps to accelerate the combustion process so that a larger amount of fuel may be burned within a given time than would otherwise be possible. The burning of the jets of the mixture in cup 16 is similar to the type of burning that is described in Hess Patent 2,215,079 issued September 17, 1940. Combustion is completed within the cup so that there is no flame impingement on the work. Heating of the furnace is accomplished by high temperature radiant heat directed from the cup into the furnace chamber, and the high temperature products of

combustion that move through the furnace chamber to a point of exhaust.

As an example of one size of burner that has been built and its capacity for releasing heat, the following figures are given. Other burners of different sizes will be comparable in capacity. A burner having a cup diameter of twelve inches can burn enough manufactured gas of 530 B. t. u. per cubic foot to liberate 710,000 B. t. u. per hour. This is accomplished by supplying to the burner 6100 cubic feet of air per hour at 33 inches W. C. and 1340 cubic feet of gas per hour at 46 inches W. C. When the burner is being fired in the open the cup temperatures will be from 2200° F. to 2700° F., and this temperature will increase if the burner is fired in a closed chamber.

When operating the burner air is supplied through the holes or passages 36 and gas is supplied through tubes 38 to the holes or passages 37. By dimensioning these tubes properly with respect to passages 37 a mixture of approximately two parts air and one part gas is supplied through them. The limitation imposed on this mixture is that it should be rich enough so that it will not burn. Danger of a backfire in the tubes is therefore avoided. It is noted that enough air should be mixed with the raw gas so that cracking of the gas in the high temperature zone at the tip of the distributor is avoided. In other words the gas should have as much air mixed with it as possible without running into the danger of backfiring.

By premixing the gas with air in passages 37 the time element for final mixing with air from passages 36 is reduced. This results in the creation of a flame near the distributor tip with better combustion and higher cup temperatures. The spaces between the partitions 39 and cap 40 are so constructed that each pair of passages 36 and 37 exhaust into an individual compartment. Air is directed across the primary air-gas mixture at substantially 90°. The flaring sides of the compartment also tend to slow down the velocity of the mixture so that combustion can be speeded up. It is noted that by the use of compartments the mixture is more complete than it would be possible to obtain if, for example, the inner row of passages was made an annular opening.

The velocity of the mixture and its volume are so great at the exit of the compartments that theoretically complete combustion cannot take place within the cup. Such combustion does take place, however, and is probably due to the fact that the temperature of the cup is well above the flash point of the mixture. Instead of each flame burning only on its surface, there are an infinite number of points over the area of the cup where combustion is progressing.

Another form the invention may take is shown in Figures 6, 7 and 8. In this case a short distributor sleeve 51 is inserted through an opening corresponding to the opening 17 in Figure 3 provided in the burner block 15. The distributor sleeve 51 is provided with an outer row of openings 52 and an inner row of openings 53 which extend axially thereof in a manner similar to the openings formed in the previously described embodiment. A cap 55 having radial partitions 56 formed on it is attached to the outer end of the sleeve as shown. The partitions separate pairs of openings 52 and 53 into individual compartments as is best shown in Figure 8 of the drawing. Therefore the air and gas which are supplied to the burner will be distributed from compartments in a manner similar to that de-

scribed in connection with the previous embodiment of the invention.

The distributor sleeve is attached at its inner end to a pipe 57 extending through the furnace wall by means of a collar 58 that engages a flange on the distributor sleeve. This collar is threaded into engagement with a suitable collar fastened to the end of the pipe. The rear end of the pipe or tube 57 is closed by a plate 59, that has a fixture 61 welded permanently in the center thereof, thus forming a chamber similar to chamber 31. Air is supplied to the distributor through tube 57, and gas is supplied through a tube or pipe 62 that is fastened to the fixture 61. The left end of pipe 62 has a cap 63 threaded to its end to form a chamber similar to chamber 32. The cap is provided with a plurality of short tubes 64 that extend into the inner row of openings 53 of the distributor sleeve. Gas flows from pipe 62 through tubes 64, where it is mixed with air that is drawn from the tube 57 so that an air-gas mixture is passed through openings 53 to the compartments at the end of the distributor.

In this case air is supplied to the burner through an air duct 65 that is formed of sheet metal work which is attached to the outside rather than the inside of the metal sheathing 5 of the furnace. It is intended that the duct will extend either vertically or horizontally across the furnace so that a single duct will supply the air necessary for a group of burners. The distributor assembly passes through an opening 60 provided in the duct. The outer end of tubes 57 is attached to the air duct 65 so that air may flow from the duct through the tube to the burner tip. To this end an opening is formed in the lower portion of tube 57, and has a flange 66 suitably welded around its edges. There is also provided a casting 67 that is attached by bolts or otherwise to the air duct 65.

In this case the entire distribtuor unit may move with respect to the burner block and furnace wall. Accordingly, a flexible connection 68 is provided between flange 66 and casting 67. In order to hold the air tube 57 concentric with the opening formed in the duct, and in order to hold the distributor member concentric to and tightly in the opening provided in burner block 15 there is provided a pair of springs 69, the upper ends of which are received in sockets provided in the flange 66, and the lower ends of which engage seats 71 that are mounted on the ends of adjusting screws 72 threaded in the upper portion of the casting 67. By adjusting the screws 72 the tube 57 may be raised or lowered until it is axially aligned with the opening in the burner block. The tube and the distributor are biased normally toward the left in Figure 6 of the drawing so that the flange of collar 58 will be held tightly against a cooperating shoulder formed on the burner block, to maintain the distributor member in the burner block. This bias is obtained by means of a spring 73 that extends between a pair of hooks 74, one of which is fastened to the outside of the air duct and the other of which is adjustably held in plate 59. By adjusting the hook in the flange the tension of spring 73 may be varied so that the burner may be held in position with the proper amount of force.

In this case there is provided a valve in both the air line and the gas line to the burner so that the individual burners may be shut down if it is desired. To this end a valve 75 is used to cover the opening between the air duct and the casting 67. This valve is mounted upon a stem 76 that can be adjusted by a hand wheel 77. The gas line 47 extending to the burner is attached to fixture 61 and has a valve 78 in it. Also an inspection window 79 may be provided in plate 59 if it is so desired.

This embodiment of the burner operates in a manner similar to the burner first described, and the parts are proportioned in the same way. In this case, however, the rich air-gas mixture is formed in the inner row of passages 53 and is directed substantially at right angles to the flow of air through passages 52 to form the combustible mixture. In the first described form of the invention the ceramic distributor member extended all of the way through the furnace wall. But with this form of burner only a short distributor is used. The metal tube 57, while being subjected to the heat in the furnace wall, is, nevertheless, cooled by the air and gas flowing through it. Air in tube 57 is also given a greater amount of preheat than could be obtained from duct 65 alone.

In Figures 9 and 10 there is shown an embodiment in which the air and gas are not mixed until just prior to the time that they are blown into the cup 16 to be burned. In this case the distributor takes the form of a pair of concentrically located cylinders 81 and 82 made of a high temperature ceramic material. The inner cylinder 82 is provided with flanges 83 to form passages through which the air is supplied. Gas is supplied through the interior of cylinder 82 and is discharged through openings 84 provided in the outer end of that cylinder to mix with the air coming through the passages between cylinders 81 and 82. This mixture passes through openings 80 in cylinder 81 to the cup 16. A cap 85 is placed over the end of cylinder 81 so that individual compartments will be formed for each stream of the gas-air mixture as it moves to the cup. The three parts 81, 82 and 85 are assembled into a single unit with suitably high temperature cement between them. The inner end of the ceramic cylinder 81 is provided with a flange 86 to which is attached one end of a sleeve 87 by collar 88 that is threaded thereto. This collar has a flange which bears against the outer surface of flange 86 to hold the parts together in a pressure tight relation. Suitable gaskets 93 are placed between the flanges. Pipe 87 has a shoulder 89 on it that receives the end of cylindrical member 91 through which the gas is supplied; the left end of member 91 tightly engaging gasket 93 and cylinder 82. Member 91 has a series of openings 92 in it through which the air can pass.

In this case there is also shown an air duct 94 that is to supply a series of burners. The air is supplied directly from the duct through tube 87 to the burner. In this case the distributor member and the pipe 87 attached thereto are held in position in the burner cup by a spring 95, one end of which bears against a plate 96 that is fastened to tube 87 by spacer members 97. The other end of the spring is held by a disc 98 that closes an opening formed in the air duct through which the entire burner assembly can be inserted or can be removed. The spring actually bears against a spring seat and packing holder 99 that is fastened to the plate 98. Gas is supplied to the cylinder 82 by a pipe 101 which extends through and is concentric with pipe 87. The right end of pipe 101 passes through a central opening formed in plate 98 and is sealed with re-

spect to this opening by a gasket 102 held in position by member 99. There is also provided a seal in the form of asbestos rope, or other heat resisting material, 103 that is forced between the outer surface of pipe 87 and a flange 104 fastened to the metal work 5 around the outside of the furnace.

In this form of burner the air is forced into the air duct 94, and gas is passed into pipe 101 from a suitable control means such as that described in connection with Figure 1. As gas issues from openings 84 it is mixed with air in the passages between flanges 83. The complete air-gas mixture passes through openings 80 into the cup 16 where it is burned. Combustion in the cup takes place in exactly the same fashion as in the previously described embodiments of the invention.

From the above it will be seen that I have devised a high capacity radiant type burner. Since the mixing of the gas and air takes place in a controlled manner just prior to the time combustion takes place there is no question of an explosive mixture being formed in the apparatus. By forming a plurality of compartments in which the mixing takes place it is insured that each unit of gas will be mixed with the proper amount of air to obtain complete combustion. No auxiliary equipment other than conventional blowers is required with the burners. For automatic operation a standard air-gas ratio control system may be used if desired.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me it will be apparent to those skilled in the art that changes may be made in the form of the apparatus described without departing from the spirit and scope of the invention, as set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. A gas burner including a burner block having a cup formed in one surface thereof and an opening extending from the base of the cup to an opposite surface of said block, a stationary distributor member extending through said opening and projecting into said cup, said member being formed with a plurality of substantially radially extending jet producing compartments in the projecting portion thereof substantially adjacent to the cup surface, said member having a plurality of axially extending passages terminating at one end in said compartments, means to supply air through some of said passages, means to supply gas through other of said passages, the air and gas mixing in said compartments to issue in a plurality of substantially radially directed jets as a combustible mixture from said compartments into said cup, and means to control the ratio of air and gas supplied to said passages.

2. A gas burner having a burner block formed with a cup therein and a stationary distributor member projecting into said cup, said member being provided with a first ring of axially extending passages, and a second ring of axially extending passages, the passages of the first ring being spaced radially inward from the passages of the second ring, said member also being formed with a plurality of compartments into each of which a passage of each row terminates, each compartment opening from the side of said member substantially adjacent to the cup surface into said cup, means to supply air to each of said passages, and means to supply gas to the passages of the second ring to form an air-gas mixture therein, the mixture being diluted by air in said first row of passages as the air and mixture move into said compartments and cup.

3. In a gas burner, the combination of a burner block adapted to be located in a furnace wall, said block being formed on one surface with a cup and an opening extending from the base of the cup to an opposite surface thereof, a stationary distributor member extending through the block and into said cup, means having a pair of chambers in it attached to said member, said member being formed with a plurality of passages terminating at one end in said cup and at the other end in one chamber, tubes extending from the other chamber into the ends of some of said passages, means to supply air to said one chamber, and means to supply gas to said other chamber, an air and gas mixture being formed in the passages into which said tubes extend.

4. In a gas burner, the combination of a burner block having a cup formed in one surface thereof and an opening extending from the base of the cup to an opposite surface of the block, a stationary distributor member extending through said opening and having its end projecting into said cup, said distributor member having formed near its end a plurality of compartments opening from the side thereof into said cup substantially adjacent to the cup surface, said distributor member also being formed with a plurality of rows of axially extending passages, one end of a passage in each row terminating in each compartment, means to supply air through each of said passages, means to supply gas through the passages in one row, the air and gas in said last-mentioned passages forming a mixture that is mixed in said compartments with the air from the remaining passages to form a combustible mixture that is burnt in said cup.

5. In a gas burner, the combination of a burner block having a cup formed in one surface thereof, and an opening extending from the base of the cup to an opposite surface of the block, a distributor member formed with air passages and gas passages and extending through said opening and projecting into the cup, a plurality of radially disposed compartments formed in the projecting end of said distributor and opening into said cup substantially adjacent to the cup surface, said compartments communicating with passages, means to supply air and gas through said passages to said compartments for mixing therein into a combustible mixture, the mixture issuing from said compartments to be burned in radially directed jets in said cup.

6. In a gas burner, the combination of a refractory block having a cup formed therein with an opening extending through the block from the base of the cup, a distributor extending through the opening with its end projecting into the cup, said distributor being formed with a plurality of enclosed axially extending passages and with a plurality of radially extending compartments open at the periphery of the distributor within said cup substantially adjacent to the cup surface, the passages terminating in said compartments, means to supply air through said passages, and means to supply fuel through said distributor to said compartments where it mixes with the air to form a combustible mixture, the mixture passing into the cup where it is burned.

7. In a burner, the combination of a distributor member formed with annular rows of radially displaced passages, means on said distributor communicating with each pair of radially displaced passages to form separate compartments opening outwardly at the periphery of said distributor member, means to supply air to each of said passages, means to supply gas to the passages in one annular row thereof, and a burner block having a cup formed therein into which the air and gas passing through said passages flows in radial jets to be burnt the exit of said compartments being substantially adjacent to the cup surface.

8. In a gas burner the combination of a burner block having a cup formed in one face thereof and an opening extending from the base of said cup to an opposite face thereof, a distributor member in said opening with an end thereof projecting into said cup, said member being formed with a central, axially disposed opening and a plurality of axially extending passages spaced around the periphery of said opening, said distributor member being formed with ports between said opening and each passage adjacent to the end projecting into said cup, said member being formed with radial holes extending to said passages substantially aligned with said ports and substantially adjacent to the cup surface, means to supply air to said passages, means to supply gas to said opening, the gas exhausting through said ports to mix with the air and the mixture exhausting through said holes into said cup where it is burned.

9. In a gas burner, a cylindrical distributor member having a plurality of axially extending passages so arranged that pairs of said passages are radially located with respect to each other, said member being formed near one end thereof with a plurality of compartments in each of which a pair of radially displaced passages terminates, one side of each compartment opening at the periphery of said member, the walls of each compartment flaring outwardly toward said periphery, means forming a chamber attached to the other end of said member with said chamber being in communication with each of said passages, means forming a second chamber, tubular means connecting the interior of said second chamber with some of said passages, and means to supply air to said first chamber and gas to said second chamber.

10. The combination of claim 9 in which said tubes extend into the inner ones of said radially displaced pairs of passages so that a gas-air mixture is formed therein.

11. The combination of claim 9 in which said tubes extend into the outer ones of said radially displaced pairs of passages so that a gas-air mixture is formed therein.

12. The combination of claim 9 including a furnace wall, a burner block in said wall, said block having a cup formed in the surface thereof

extending toward the interior of the furnace and having an opening at the base of the cup extending through the block and furnace wall, and means to hold said member in place in the opening in the furnace wall with the end of said member having the compartments projecting into said cup.

13. In a burner, the combination of a solid refractory block having a substantially conical depression formed in one surface thereof and an opening having a substantially cylindrical portion extending from the apex of said depression through said block to an opposite face thereof, a stationary distributing member extending through and snugly received in said cylindrical portion of said opening with the end thereof projecting into said depression, means in said member forming a passage therein extending into the portion of said member received in said opening, through which air may be supplied to said end, means in said member forming a separate passage therein extending into the portion of said member received in said opening through which a fluid fuel may be supplied to the end of said member, said member including means forming a space adjacent to said end communicating with said passages wherein the air and fuel flowing through said passages will mix to form a combustible mixture, and said member being provided with a radially extending port connecting said space with the periphery of said end in said depression substantially adjacent to the surface thereof whereby the combustible mixture will be discharged into said depression in a substantially radially directed jet to be burned therein.

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