

Dec. 5, 1950

C. E. GOLDEN ET AL

2,533,104

HIGH PRIMARY TYPE GAS BURNER WITH RADIANT SCREEN

Filed June 27, 1947

5 Sheets-Sheet 1

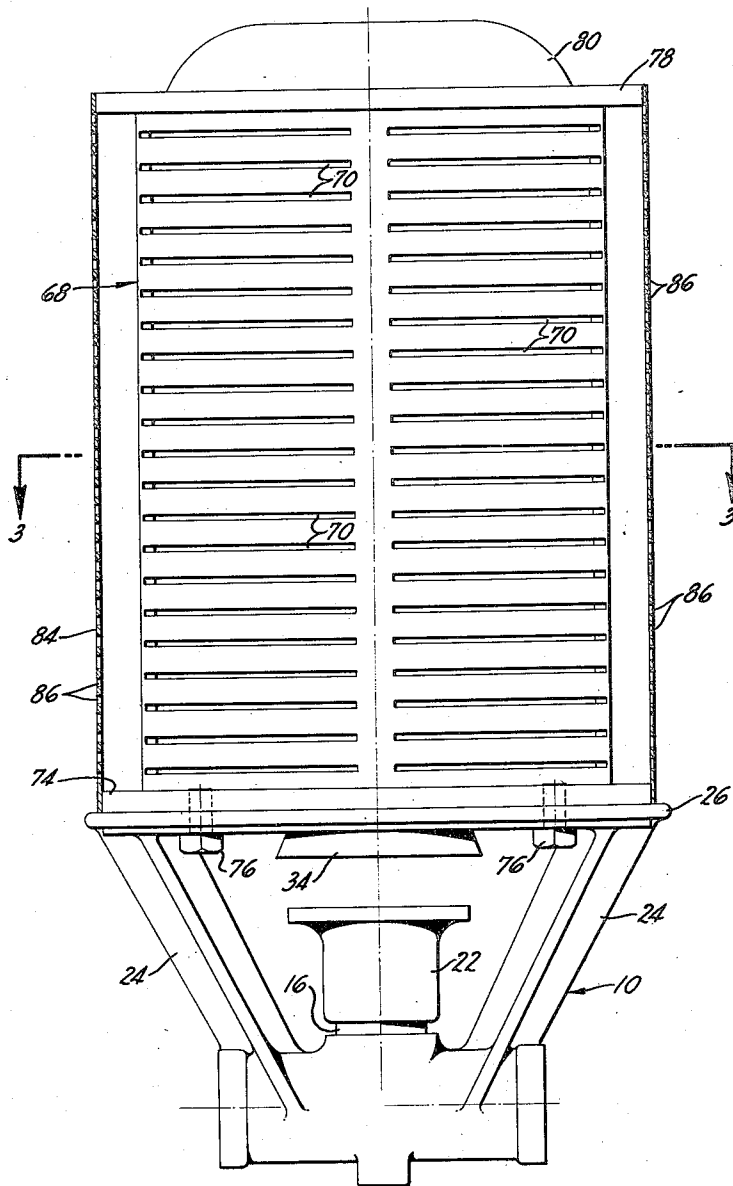


FIG. 1

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5 Sheets-Sheet 2

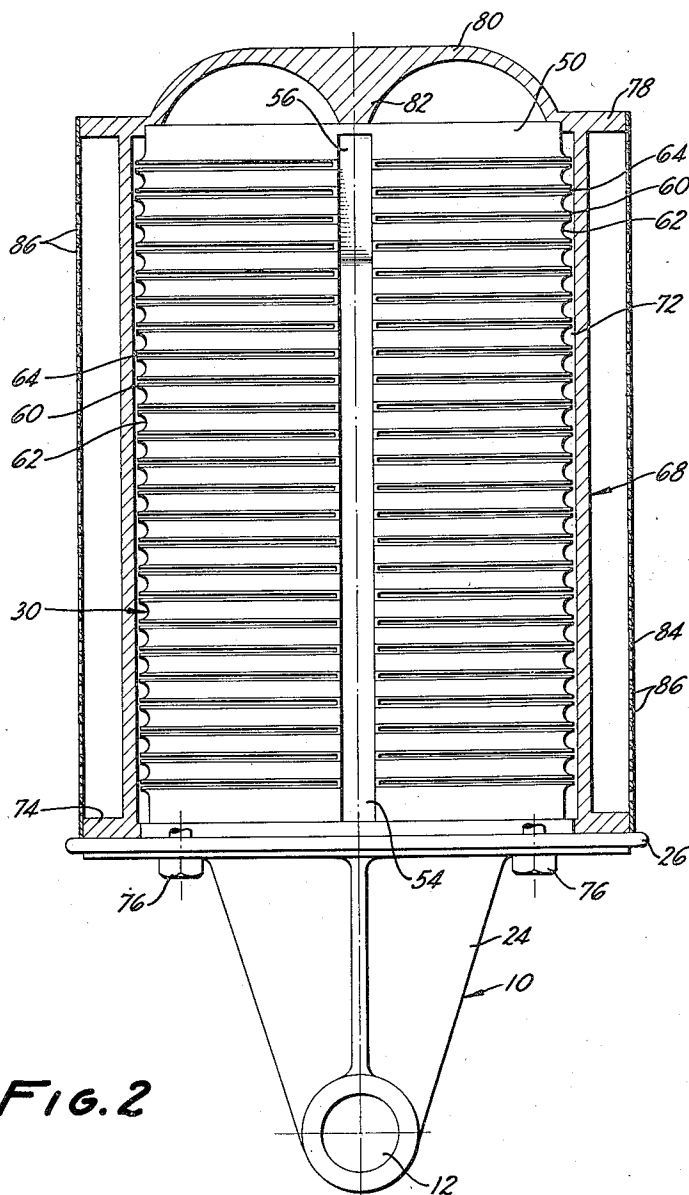


FIG. 2

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FIG. 5

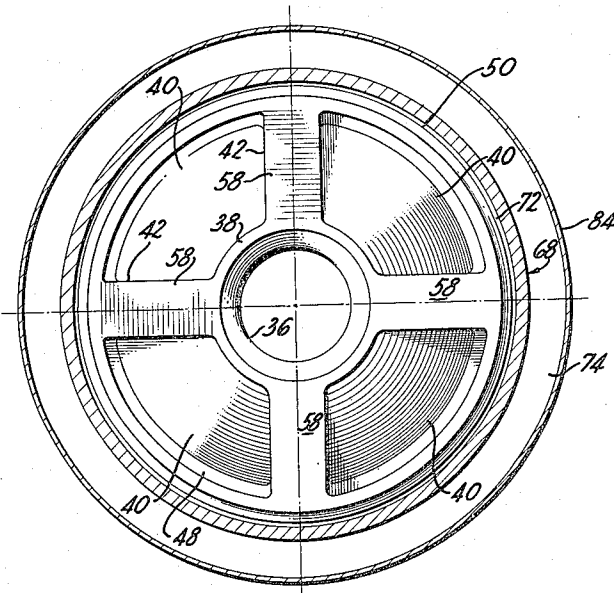
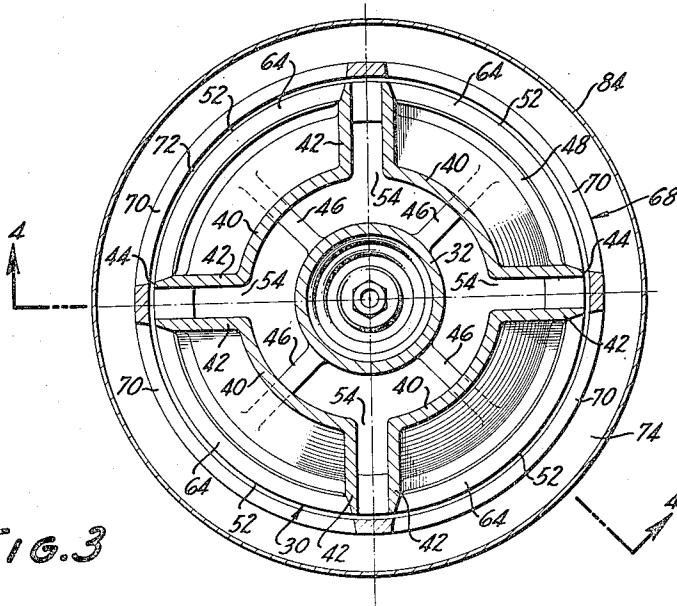


FIG. 3



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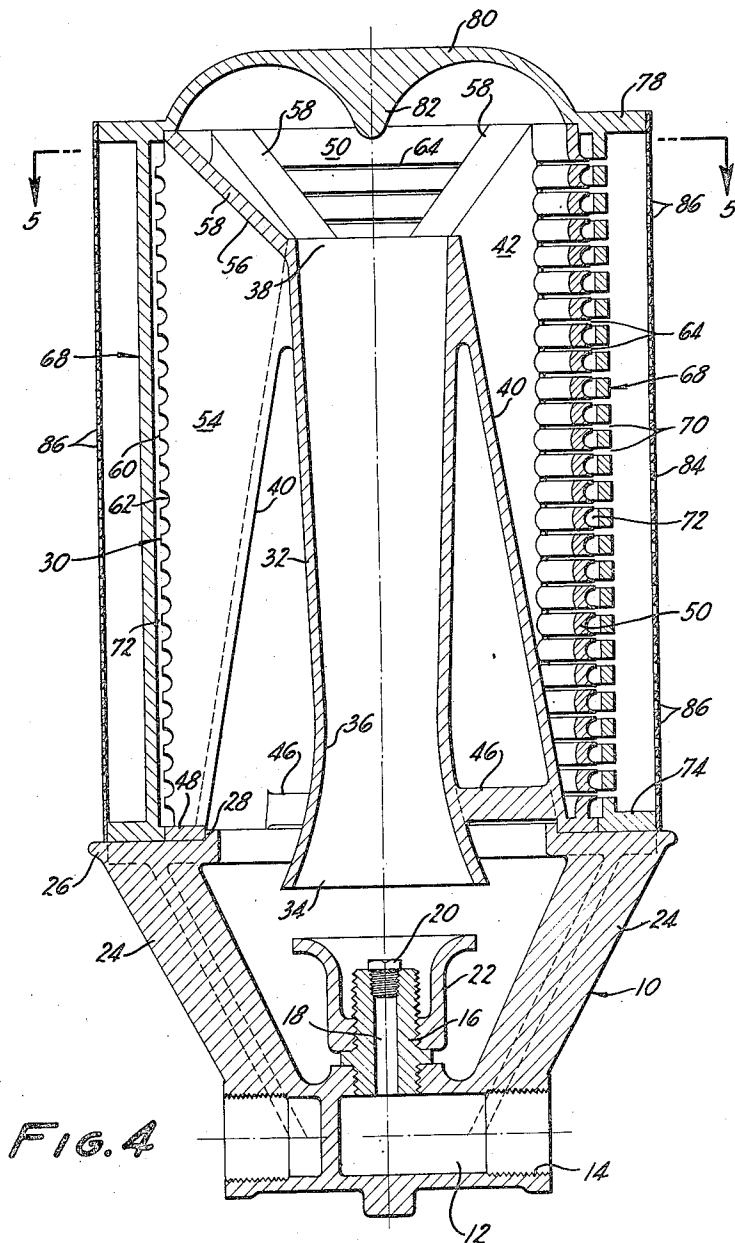
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HIGH PRIMARY TYPE GAS BURNER WITH RADIANT SCREEN

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5 Sheets-Sheet 4



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5 Sheets-Sheet 5

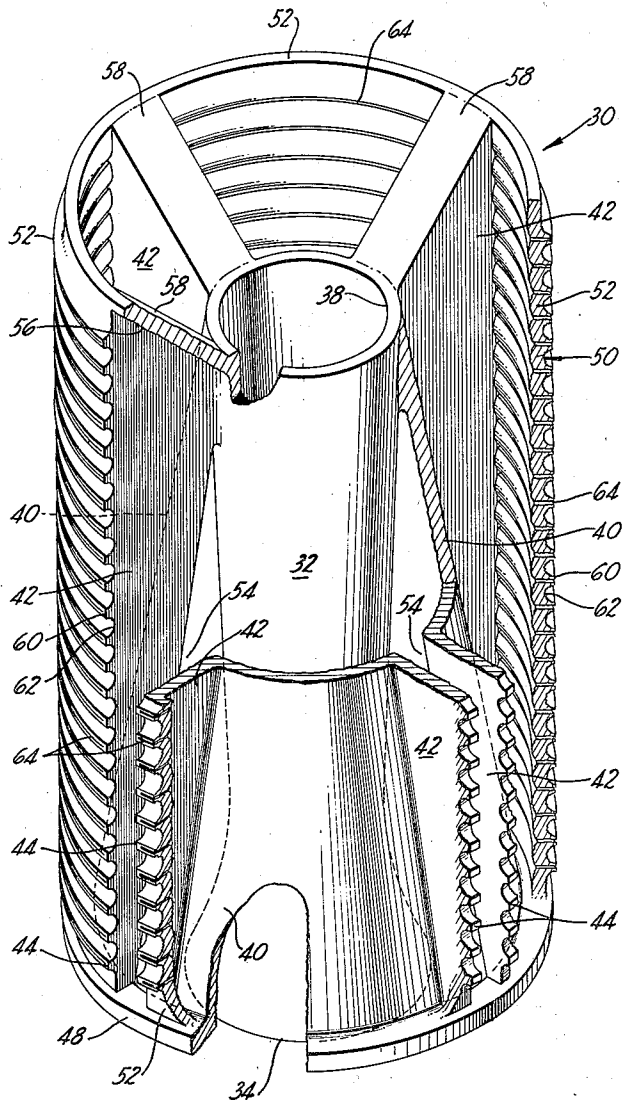


Fig. 6

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UNITED STATES PATENT OFFICE

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HIGH PRIMARY TYPE GAS BURNER WITH RADIANT SCREEN

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9 Claims. (Cl. 158—99)

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This invention relates to gas burners, and more particularly to a burner of the high primary air type.

One of the main difficulties encountered in the use of various types of gas burners is that of obtaining an air-gas mixture containing an adequate amount of air to support efficient combustion. The optimum richness of the primary air constituent of the mixture necessary to support substantially complete combustion of the gas constituent is very difficult, if not impossible, to obtain with conventional burner structures, especially when the gas is being fed to the burner under comparatively low pressures. Incomplete combustion results in a waste of heating potential, and, frequently, in the production of noxious gaseous compounds, with a proportionate decrease in burner efficiency.

An object of this invention is to provide a novel type of burner in which a substantially fully combustible mixture of primary air and gas is fed to the locus of combustion.

Another object of this invention is to provide a gas burner having high radiant heat characteristics.

A further object of the invention is to provide a burner structure which is effective to inhibit the tendency of "flash backs" to occur upon a reduction in the input of the gas constituent, or a reduction of the gas pressure.

Additional objects of the invention are to provide a gas burner of a shape and size adaptable to a wide variety of applications; to provide a compact burner structure; and to provide a burner having a relatively high thermal unit input capacity in relation to the volumetric size of the burner.

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with the drawings forming part of this specification, and in which:

Figure 1 is a view in elevation of the burner embodied in the invention, with the radiant cylinder, or outer screen, shown in section;

Figure 2 is a view in side elevation of the burner of Figure 1, with both the radiant cylinder and the adjacent temperature screen being shown in section;

Figure 3 is a view in section taken along lines 3—3 of Figure 1;

Figure 4 is a view in section taken along lines 4—4 of Figure 3;

Figure 5 is a view in section taken along lines 5—5 of Figure 4, and Figure 6 is a view in perspective, partly broken away, showing the burner head structure.

Referring to the drawings for further details of the invention, the burner is provided with an open base indicated generally at 10 and including an inlet conduit 12 having an internally threaded

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end portion 14 for connection with gas lines, not shown; a nipple 16 threadably engaged with the conduit 12 and having a passage 18 in communication with the inlet conduit, an orifice nozzle 20 threadably engaged in the upper end of nipple 16, a cup-like control shutter 22 threadably engaged on the nipple 16 and adjustably positionable thereon, bracket members 24 connected to the inlet conduit member and supporting a mounting ring 26 having an internal annular shoulder 28.

A burner head, indicated generally at 30, includes a Venturi tube 32 having a mouth 34 in spaced alignment with the cup-like control shutter 22, a throat 36, and an outlet 38 supported by four baffles 40 in the form of frusto-conical segments, each of said baffles having at each end thereof radial vertical partitions 42 having vertical outer edges 44, while the venturi 32 is further supported by four radial webs 46 interconnecting the lower part of the venturi and the lower portions of the baffles 40.

The baffles 40 and partitions 42 are connected to a ring 48 supported on the mounting ring 26 in abutting relation to the shoulder 28, said ring 48 also having secured thereto an elongated cylindrical shell, indicated generally at 50, and comprising four segments 52 in radial alignment with the four baffles 40 and terminating at the leading edges 44 of the partitions 42, said partitions 42 defining four radial passageways 54 providing for communication between the annular space defined by the venturi 32 and the baffles 40 and the exterior of the cylindrical shell 50. Each of the partitions 42 defining the four passageways 54 have angularly inclined upper edges 56 extending from the upper edge of the venturi 32 to the upper edge of the cylindrical shell 50, the upper edges 56 of each pair of adjacent partitions 42 being bridged by upper wall strips 58 which prevent communication between the vertical passageways 54 and the upper end of the venturi 32.

Each of the segments 52 of the cylindrical shell 50 are provided with a corrugated surface defining a plurality of spaced ridges 60 and depressions 62, said ridges 60 being provided with slots 64 extending substantially the full peripheral distance of each of the segments 52. Four spaced banks of parallel and equi-spaced slots 60 are thus provided in the cylindrical shell 50.

A second elongated cylindrical shell, or temperature screen 68 having four spaced banks of parallel, equi-spaced slots 70 is fitted over the burner head and shell 50 so that the slots 70, slightly greater in width than the slots 64, are in registration with the slots 64 and so that it is spaced therefrom to provide the narrow annular free space 72 between the shell 50 and the temperature screen 68. The screen 68 is provided with a bottom annular flange 74 supported by

the mounting ring 26 and secured thereto, as by bolts 76. The temperature screen is further provided with an upper annular flange 78 carrying a dome member 80 having a deflector 82 depended therefrom. A radiant cylinder 84 having a plurality of apertures 86 may be placed over the assembly so as to be supported on the mounting ring 26 and by the flange 74 and 78 of the temperature screen.

The burner is operative in the following manner. The gas stream passes into the conduit 12 and through the passageway 18 in the nipple 16 to issue from the orifice 20 and pass into the mouth 34 of the venturi 32. First stage primary air is drawn into the mouth of the venturi by the moving gas stream, and this aspiration of the air is further augmented by an increase in the velocity and consequent pressure drop of the air gas stream in the throat 36 of the venturi. A certain amount of mixing of the air and gas components takes place in the throat of the venturi, and the mixture stream passes upwardly to issue from the top 38 of the venturi and impinge the deflector 82 of the dome 80, said deflector and dome causing a turbulent mixing of the stream and serving to direct the mixture downwardly into the four spaces defined by the inner surfaces of the segments 52 of the cylindrical shell 50, the outer surfaces of the four baffles 40 and partitions 42, as thus shown in Figure 5. As the gas and air mixture enters these four spaces and travels downwardly therein, it passes through each slot 64 in the four banks of slots of the cylindrical shell 50 of the burner head, and, due to the fact that the cross-sectional area of the path of travel of the air and gas mixture is steadily decreased by the angularity of baffles 40, the rate of flow of the mixture through each of the slots 64 is substantially constant.

As the first stage primary air and gas mixture passes through the slot 64, a Venturi action is caused by each of the slots 64 and its adjacent slot 70 in the temperature screen 68, thus providing a large number of Venturi throats in the annular free space 72 between the burner head and the screen 68. The reduced pressure in this annular space causes an aspiration of second stage primary air passing from the open base through the annulus between the mounting ring 26 and the mouth 34 of the venturi and into the space defined by the outer wall of the venturi 32, the inner walls of the baffles 40, and the partitions 42 forming passageways 54, said passageways communicating with the annular space 72. As air is drawn into this described space, it is fed throughout the vertical lengths of the passageways 54 to the annular space 72 where it is deflected by the unslotted vertical strips of the temperature screen between the banks of slots 70. The deflected air is distributed throughout the annular space 72 to mix with the low pressure streams issuing into this space from the slot 64. A second stage primary air condition is thus caused to provide an intimate mixture of air and gas which is substantially fully combustible as it issues from the slot 70 into the annular space between the temperature screen 68 and the radiant cylinder 84. This annular space is the locus of combustion. It will be noted that the decreasing cross-sectional area of the path of travel of a portion of the second stage primary air between the baffles 40 and the venturi 32 is effective, as air is constantly metered out progressively from the bottom to the top of the passageways 54, to provide a substantially constant

rate of second stage primary air feed throughout the vertical length of the mouths of passages 54, thus providing for the second stage primary air what the same baffles 40 provide for the first stage primary air and gas mixture in its downward travel along the outside surfaces of baffles 40. In each case a substantially constant feed is provided throughout the height of the burner head.

It will be noted from Figure 1 that some 21 slots are provided in each of the four banks of slots in both the burner head and the temperature screen. These slots, therefore, constitute some 84 secondary venturis, which, in conjunction with the primary venturi 32, provide for the very high degree of entrainment of air due to the kinetic energy of the gas-air stream to obtain a mixture which is substantially fully combustible. The combustion taking place in the annular space between the temperature screen 68 and the radiant cylinder 84 causes the latter to attain a degree of incandescence, thus providing a high degree of radiation. If this high degree of radiation is not desired for some uses, the radiant cylinder 84 may be removed. The burner will then provide a flame characteristic somewhat similar to that provided by conventional burners having slotted ports, provided said burners utilize a high percentage of primary air.

The elevated temperature of the radiant cylinder 84 may be controlled by a variation of the heat transfer area of such a cylinder, as well as by reducing the amount of first stage primary air aspirated into the venturi 32, such reduction in primary air being achieved by an adjustment of the cup-like shutter 22 to bring this member into closer relation with the mouth 34 of the venturi.

It is to be pointed out that the temperature screen 68 serves to protect the burner head from the high degree of radiant heat emanating from the surfaces of the radiant cylinder 84, and, further, that the flow of second stage primary air up through the passageways 54 serves to dissipate heat absorbed by the burner head to thereby continually maintain satisfactory operating temperatures at the critical point of slots 64. Inasmuch as the occurrence of "flash backs" in general is more prevalent as the burner head temperature is increased, it will be readily seen that the temperature screen and the heat dissipating characteristics of the passageways 54 serve to maintain the burner head at a low temperature and, thus, reduce the possibility of "flash backs."

An important operating characteristic of the burner of the invention is that "flash backs," due to a turning down of the gas flow, caused either by a valving off of the gas inlet conduit or by a passing of the gas through a smaller outlet orifice, are substantially eliminated. This is considered to be due in part to the fact that the slots 64 and 70 are quite evenly loaded so that a fairly uniform velocity through these ports is obtained. A further aspect of the burner structure and operation which tends to inhibit "flash backs" is that the air and gas mixture is reversed in direction after passing through the venturi, thus producing a balanced draft effect so that when the flow of gas is reduced upon turn down there is no tendency for an abnormal amount of primary air to flow through the venturi. Due to the absence of "flash backs," even to the point of complete turn down, the described burner can be successfully used in conjunction with a throt-

tioned type of thermostat, thereby achieving results not obtainable with conventional burners.

While the preferred embodiment of the invention has been shown and described, it is to be understood that the embodiment is subject to modification within the spirit of the invention and the scope of the appended claims.

What we claim as new and desire to secure by Letters Patent is:

1. A gas burner comprising an annular base member, concentric inner and outer shells supported on the base member in narrowly spaced relation and providing a free space therebetween, each shell being provided with a plurality of ports, a Venturi tube axially disposed within said inner shell, means on the base member for supplying gas and aspirated air to the inlet end of the tube, a closed covering member on the upper end of said shells disposed in spaced relation to the outlet end of the tube, said member comprising deflecting means for directing the gas mixture issuing from said outlet toward the ports of the inner shell to issue therefrom, and conduit forming means between the tube and inner shell and defining second stage air passageways between the base member and the space between the shells.

2. A gas burner as set forth in claim 1, wherein angularly inclined baffle members extending from the upper portion of the Venturi tube outwardly and downwardly toward the inner shell define in conjunction with said inner shell a discontinuous annular space of decreasing cross-sectional area for downward travel of the deflected air-gas mixture.

3. A gas burner as set forth in claim 2, wherein said inner shell is comprised of a plurality of spaced segments, and wherein a plurality of spaced baffle members constituting the discontinuous surface of a hollow conic frustrum surround the Venturi tube, each baffle member being in radial alignment with an inner shell segment, the aligned lateral edges of said baffle members and shell segments being connected by partition members, said second stage air passageways being defined by the outer wall of the Venturi tube, the inner surfaces of the baffle members, and said partitions.

4. A gas burner as set forth in claim 3, wherein the ports of said inner shell segments are horizontal elongated slots extending substantially the arcuate width of said segments, said ports of said outer shell being elongated slots of slightly larger size than said inner shell slots and arranged in spaced banks in radial alignment with said inner slots.

5. A gas burner as set forth in claim 4, wherein a perforate radiant cylinder surrounds said outer shell in spaced relation therewith.

6. A gas burner as set forth in claim 5, having means for supporting the inlet end of the Venturi tube in spaced alignment with a gas supply orifice member carried by the base, and a member carried by said orifice member and movable thereon to and from said inlet end to control the amount of air aspirated into said Venturi tube.

7. In a gas burner, a burner head comprising a Venturi tube, a cone-shaped skirt depending from and surrounding the upper portion of said

tube and comprised of a plurality of laterally spaced sections, radial partition members extending outwardly from the lateral edges of said sections, a cylindrical shell concentric with the Venturi tube and formed in segments connecting the outer edges of the two partition members on each skirt section, each segment being formed with a plurality of vertically spaced ports, closure members for the upper ends of the passageways between the spaced skirt sections as defined by the adjacent radial partitions on successive skirt sections, a second cylindrical shell enclosing the segments of the first shell and passages therebetween in spaced relation and formed with a plurality of vertically spaced ports in radial alignment with the ports in the segments, and an imperforate cover on the upper end of both shells extending above the outlet of the Venturi tube and the closed upper ends of the passageways between the skirt sections thereby directing the flow from the Venturi tube to the ports in the segments of the inner shell.

8. A burner head comprising a central Venturi tube, elongated inner and outer shells surrounding the tube in narrowly spaced relation to each other and formed with circumferentially spaced banks of radially aligned ports disposed in vertically spaced relation from end to end of the respective shells, an imperforate cover connected to the upper ends of the shells and extending above the tube outlet, means comprising circumferentially spaced channels of gradually decreasing cross sectional area from top to bottom extending from the upper portion of the tube to the respective banks of ports in the inner shell for delivering primary gas-air mixture to said banks of ports in graduated amount, and means, including the spaces between said channels, for admitting secondary air to the space between the shells.

9. A burner head comprising a central Venturi tube, elongated inner and outer shells surrounding the tube in narrowly spaced relation to each other and formed from end to end with vertically spaced ports, an imperforate cover connected to the upper ends of the shells and extending above the tube outlet, means between the tube and the inner shell for delivering primary gas-air mixture from the tube to the ports of the inner shell in graduated amount from top to bottom thereof, and means for admitting secondary air to the space between the shells.

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