

Aug. 9, 1966

H. T. CHILDREE

3,265,114

IGNITOR-BURNER ASSEMBLY

Filed July 20, 1964

2 Sheets-Sheet 1

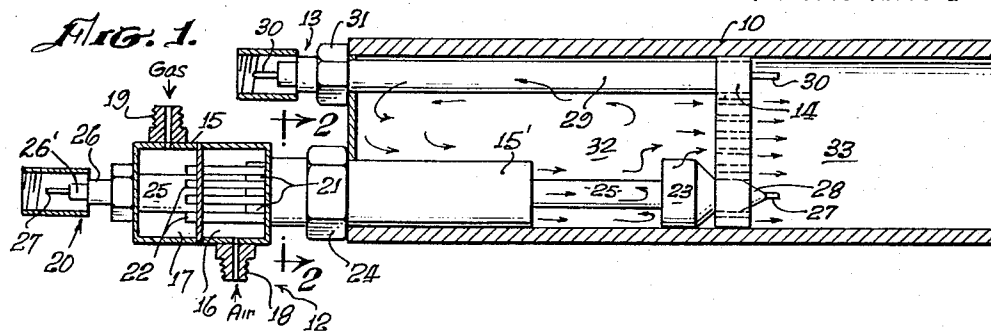


FIG. 3.

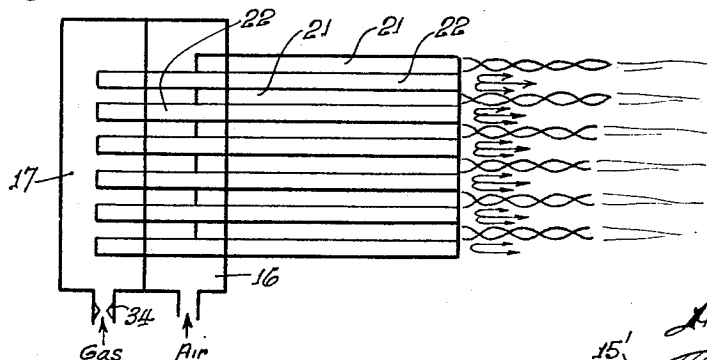


FIG. 2.

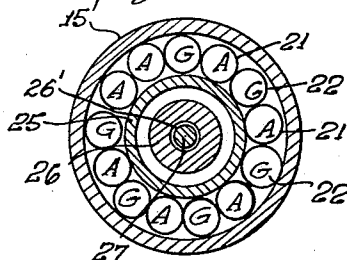


FIG. 4.

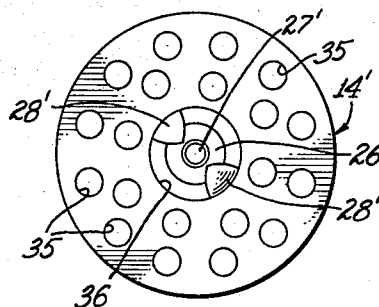
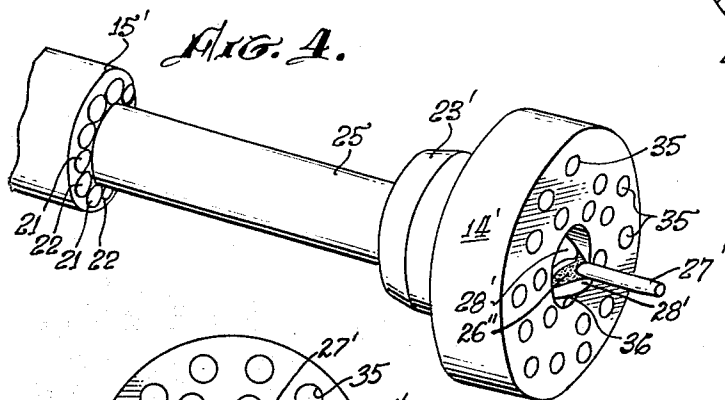


FIG. 4A.

HERMAN T. CHILDREE,
INVENTOR.

BY

John M. Hazelwood

ATTORNEY.

Aug. 9, 1966

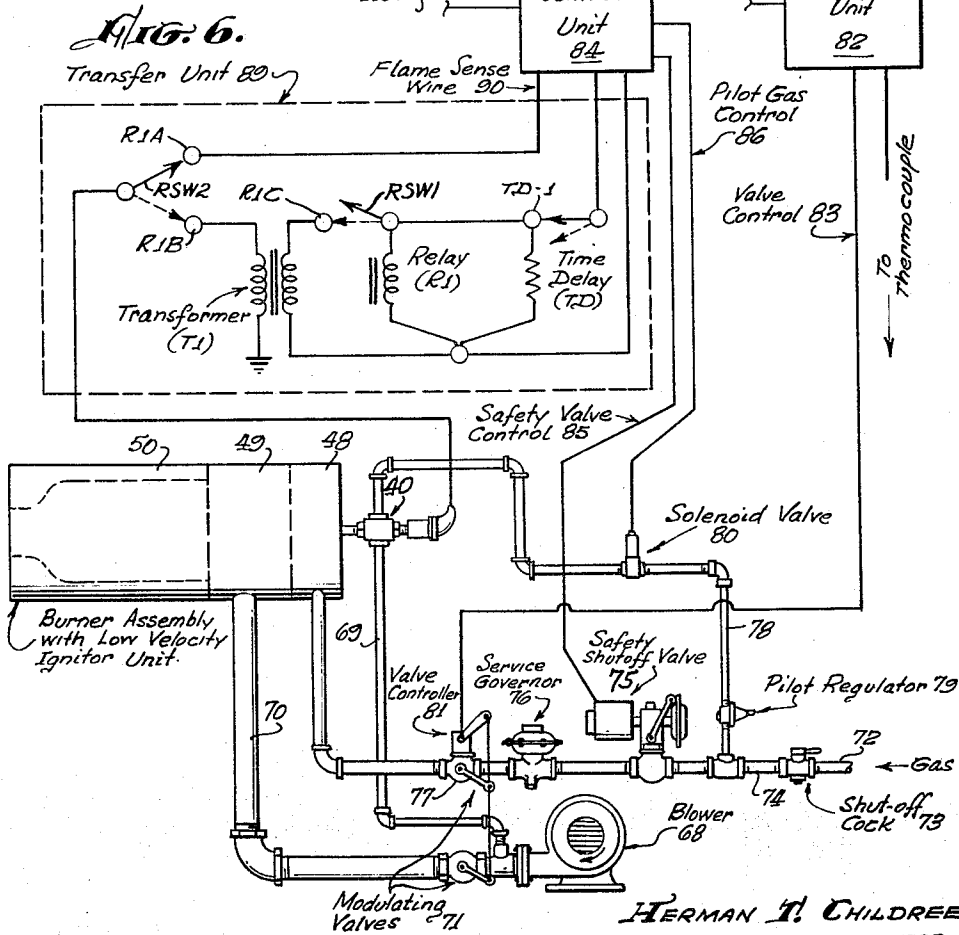
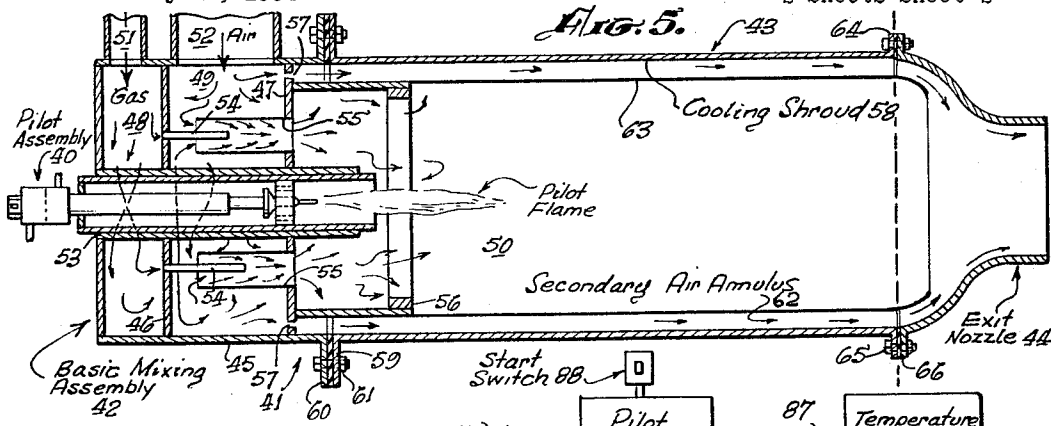
H. T. CHILDREE

3,265,114

IGNITOR-BURNER ASSEMBLY

Filed July 20, 1964

2 Sheets-Sheet 2



HERMAN T. CHILDREE,
INVENTOR.

BY

John W. Hazelwood

ATTORNEY.

1

3,265,114

IGNITOR-BURNER ASSEMBLY

Herman T. Childree, Cason, Tex., assignor to General Dynamics Corporation, Pomona, Calif., a corporation of Delaware

Filed July 20, 1964, Ser. No. 383,602

11 Claims. (Cl. 158-123)

This invention relates to burners, particularly to pilot ignitor-burners, and more particularly to natural gas pilot ignitor-burners which have the ability to operate under adverse conditions.

One of the problems that has always confronted users of gas burners is backfire. A backfire occurs when the rate of flame propagation exceeds the velocity of the combustible gas mixture issuing from the burner. Another problem is so-called flame out or flame blow away. When the velocity of the stream of combustible gas mixture issuing from the burner exceeds the rate of burning of the gas mixture, in whatever state of dilution has been caused by the surrounding air, the flame recedes or flows away from the burner orifice and is usually extinguished altogether. The burner flame remains stationary or sealed at the discharge orifice of the burner, or a very small distance from it, only when the velocity of the stream of combustible gas mixture issuing from the orifice is substantially equal to the rate of burning of the gas in the stream.

Heretofore, but without full success, many attempts have been made to develop a pilot ignitor-burner that would effectively operate under adverse conditions. The basic design and operation of these prior art devices depends on the mixing of air and gas in a suitable mixing chamber with an exit whose purpose is to direct the air-fuel mixture to a point at which it is discharged in the vicinity of a high voltage spark.

Several disadvantages are inherent in the prior art devices and deleterious effects result therefrom. The maximum and minimum air-fuel mixtures of gas and air which can be ignited by a low intensity high voltage spark are narrow. Therefore, it is necessary that the amount of gas and air be closely controlled so that the air-fuel mixture that is discharged in the vicinity of the spark plug is ignitable. In most cases in the prior art there are no provisions made to hold the flame at a specific point. There are some devices which depend upon a diverging exit that permits the air-fuel mixture to establish a flame front at the most acceptable condition for sustained burning. In either case, an upset or change in pressure at the exit will, in most instances, cause a flame out. Any change in the supply pressures of gas and air will correspondingly change the air-fuel mixture. It has been noted that variations of as little as one-half pound in gas pressure will result in no ignition or a flame out. Variations in air pressure will produce the same undesirable results.

The flame sensing installations on most of these basic devices consist of a high temperature metal rod that is positioned at a point which will sense the presence of the flame and initiate a signal or indication. On some prior art devices the flame rod is exposed to the flame at such a point which will permit the flame rod to droop or sag and ground out. The prior devices produce a flame temperature that ranges from 1200 degrees F. to 1500 degrees F. Observations show that the flame in most operating conditions is detached or blown away from the end of these ignitor-burners and is very easily blown out.

This invention provides an ignitor-burner assembly capable of operation under a very wide range of pressures and environmental conditions.

Therefore, it is an object of this invention to provide an ignitor-burner assembly.

2

A further object of the invention is to provide a gas pilot ignitor-burner assembly.

A still further object of the invention is to provide a gas pilot ignitor-burner having the ability to operate under adverse conditions.

Another object of the invention is to provide a pilot ignitor-burner capable of operation under a very wide range of pressures and environmental conditions.

Another object of the invention is to provide an ignitor assembly that produces a homogeneous mixture of air and gas by internal supersonic nozzle principle turbulence which results in a high velocity, high temperature flame which is immune to most external variations.

Another object of the invention is to provide an ignitor assembly that results in the proper mixing of the gases by internal turbulence in the event of low velocity or low pressure requirements.

Another object of the invention is to provide an ignitor assembly that contains a turbulating method that provides the necessary turbulence to hold the flame within the combustor section.

Another object of the invention is to provide an ignitor-burner which utilizes an ignition device and a flame sensing device.

Another object of the invention is to provide a burner assembly having a flame sensor positioned in a relatively low temperature area which permits the presence of a flame which is sensed by the control unit.

Other objects of the invention, not specifically set forth above, will become readily apparent from the following description and accompanying drawings wherein:

FIG. 1 is a view of one embodiment of the invention with portions cut-away to illustrate the internal elements;

FIG. 2 is a cross-sectional view of the FIG. 1 device taken on the line 2-2 of FIG. 1;

FIG. 3 is a schematic view of the gas and air mixing of the FIG. 1 device;

FIG. 4 is a perspective view of another embodiment of the invention;

FIG. 4a is an end view of the FIG. 4 embodiment;

FIG. 5 is a view partially in cross section of a combustor unit incorporating the invention; and

FIG. 6 is a schematic view showing the control system of the FIG. 5 unit.

This invention is directed to an ignitor-burner which incorporates means to mix air and gas in such a manner as to produce a high velocity, high temperature flame which is immune to most environmental variations. More particularly, the device comprises a conventional flame rod unit and a burner assembly comprising a pair of manifolds, one for air and the other for natural gas; a plurality of tubular elements; a high voltage electrode; a spark baffle; combustor grid; and various casings and insulating elements. The ignitor assembly and the flame rod may be mounted adjacent to or concentric with each other with terminal portions thereof extending through bores provided in a multiple-apertured flame holding or turbulator plate. The tubular elements are positioned in an annular arrangement surrounding the spark plug casing, the terminal portion of which functions as a negative electrode for the above mentioned electrode, and adjacent this location is mounted the spark baffle. Alternative tubes of said annular arrangement are adapted to convey the air and gas respectively. The flow emitting from the air tubes may or may not be supersonic, while the flow emitting from the gas tubes is subsonic. Due to the particular arrangement of the tubes there exists a supersonic jet of air on each side of a subsonic jet of gas, which results in a homogeneous mixture thereof. Due to the inability of natural gas, for example, to maintain a flame if its velocity is high, the flow of the result-

ing mixture is turbulated or decelerated before reaching the spark gap by the above mentioned baffle and combustor grid.

Instructions issued by the manufacturers of natural gas burners pertaining to the maintenance of the natural gas pilots make a point in stressing the importance of the flame rod circuit. In most cases their instructions state that the flame rod should be removed and cleaned. In some cases the flame rod needs to be replaced due to foreign material being imbedded in the surface of the insulator, either at the end which has been subjected to the flame or at the connector end which may be contaminated by atmospheric conditions. There have been some improvements in the type of ceramic material used and the method of protecting the connector point but the major problems in the flame rod assembly of the prior art devices still exist. These problems are very apparent to those who have the responsibility of maintaining natural gas pilot systems. The inability of the flame rod in the prior art devices to supply satisfactory results was the main reason why the infra-red and the ultra-violet systems have been developed and by using these types of flame detection, the problem of the flame rod has been eliminated although the overall cost of the system has been increased.

The ignitor-burner assembly of this invention utilizes a conventional flame rod assembly and sensing control unit. One unique feature of this invention is the placement of the flame rod. As the homogeneous mixture of gas and air exhausts through the flame holder or combustor grid and ignites, a relatively low temperature area is established in and around the flame rod end creating the presence of a flame which is sensed by the control unit. This flame rod of the sensor unit will remain relatively cool.

Referring now to the drawings, the ignitor-burner assembly as shown in FIGS. 1 and 2 comprises a housing 10, an ignitor unit generally indicated at 12, a flame rod unit indicated generally at 13, and a combustor grid or turbulator plate 14 operatively positioned in housing 10.

Ignitor unit 12, in this embodiment, comprises a housing 15 defining an air manifold 16 and a gas manifold 17; an inlet passage 18 connecting air manifold 16 to an air supply source (see FIG. 6); an inlet passage 19 connecting gas manifold 17 to a gas supply source; an electrode assembly generally indicated at 20; air and gas conduits 21 and 22, respectively, positioned around a separator 25 which is located around an electrode assembly 20, conduits or tubes 21 and 22 being operatively attached to their respective manifolds. A combustor grid baffle plate 23 is positioned around said separator 25, and means such as nut 24 for attaching the ignitor unit housing 15 within an aperture in housing 10 is placed around a portion of housing 15. As shown in FIG. 2, gas conduits 22 are positioned intermediate air conduits 21 except in applications where housing portion 15' is of such diameter as to require an odd number of conduits due to the external diameter of separator 25, the internal diameter of the housing 15', and the external diameter of the conduits, as in this embodiment, wherein an extra air conduit 21 is positioned between gas conduits 22. Electrode assembly 20 consists of a casing 26 operatively located within separator 25, and a positive electrode 27 is insulated at 26' from casing 26, casing 26 terminating in a pair of points 28 (only one shown) which serve as the negative electrode (see FIG. 1). The insulator material should be of the type which exhibits a good dielectric constant at high temperatures, good mechanical strength, and good thermal shock capabilities. Housing portion 15' terminates a predetermined distance from baffle plate 23 to provide homogeneous mixture of the air and gas flowing from conduits 21 and 22 which will be presently described.

Flame rod unit 13 comprises a casing 29 and a flame

sensor rod or electrode 30 insulated from casing 29 by material having the same qualities as set forth above with respect to the insulator material of the ignitor unit 12, and means such as retainer nut 31 for holding casing 29 with respect to housing 10. The material used for the rod 30 should exhibit good high temperature capabilities. The action of flame rod unit 13 is identical with the present state of art in sensing the presence of a flame. However, the manner of installation of the flame rod unit 13 in housing 10 greatly reduces the existing problems presently encountered in flame sensing. The main problem with the flame rod installation of the prior art assemblies is not the flame rod itself, but arises from the necessity of using this type of sensing where an inefficient pilot and/or burner is used that results in a condition which causes carbon or other foreign substance to build up on the flame rod creating a low resistance to ground. Various prior known pilots require that the flame rod be inserted deep into the flame, thus if rough burning occurs, the insulation of the flame rod unit will break or the rod itself becomes hot enough to permit it to bend and touch the metal housing, shorting out the flame sensing circuit. The flame rod unit 13, when utilized as illustrated and described herein, does not suffer the same effects as the prior art approaches because (1) it is an integral part of the pilot system and is not mounted separate from the pilot, thus requiring only one mounting hole, (2) it is mechanically strong and securely mounted, (3) it is not subjected to any high temperature flame, (4) it is installed in a manner so that it cannot become contaminated with carbon build-up or any foreign matter, and (5) it has a connection to the flame sensing circuit which is protected in the same manner as the spark connection of unit 12 and results in a compact unit.

Combustor grid 14 is provided with a plurality of apertures extending therethrough as indicated by the dotted lines in FIG. 1 to allow the mixture of air and gas to flow from mixing chamber 32 to combustion zone 33 where the mixture is ignited by the electrode assembly 20 which extends through a passageway in grid 14 and into combustion zone 33 a predetermined distance. Flame rod unit 13 is mounted in a passageway in grid 14 so that flame sensor rod 30 extends a predetermined distance into combustion zone 33. The apertures in combustion grid 14, through which the air and gas mixture passes, may have various configurations, for example, straight or angled holes, straight or angled slots which extend from the center outwardly, or horizontal or vertical slots. The specific aperture configuration is dependent on the flow pattern desired.

Referring now to FIGS. 1-3, the basic operation of the invention is as follows. Pressurized air is supplied to air manifold 16 through inlet 18. This pressurized air is directed from manifold 16 through conduits or tubes 21 and discharges from these conduits into the mixing chamber 32. If the pressure is great enough, conduits 21 will choke, resulting in a high velocity flow of air. Gas under pressure is supplied through inlet 19 to manifold 17, an orifice 34 may be positioned in gas inlet passage 19 if desired. This pressurized gas is directed from manifold through the conduits or tubes 22 and discharged into the mixing chamber 32. As described above, and shown in FIGS. 2 and 3, conduits 21 and 22 are so positioned that there is a gas flow each side of a high velocity air flow. This high velocity air tends to pull the gas discharging from conduits 22 along with it as it enters the mixing zone 32. This is produced by the aspiration effect of the high velocity air discharging from conduits 21. The remaining gas flow is forced by the manifold pressure into the very turbulent area at the point where the high velocity air expands or becomes subsonic. In this extremely turbulent area a homogeneous mixture is produced. This resulting mixture or a portion thereof impacts against baffle 23 which prevents the mixture from flowing into combustor grid 14 and slows the flow of

5

the mixture to a low velocity. Baffle 23 directs the mixture or changes its flow direction thus providing more turbulence within mixing chamber 32 thus assisting in providing a complete homogeneous mixture of the gas and air. As the flow of air and gas continues from conduits 21 and 22, the static pressure increases slightly in the mixing chamber 32 behind combustor grid 14, thereby causing it to flow through the apertures in grid 14 into combustion zone 33. As this homogeneous mixture reaches the area within zone 33 of ignitor assembly 20 it is at a low velocity and easily ignited by the spark across electrodes 27 and 28. The effective area of the combustion grid 14 is such that the resulting flame is slightly detached from the surface of the grid which keeps the electrodes 27 and 28 and combustor grid 14 very cool and provides a very long electrode life. The flame within combustion zone 33 causes the flame rod 30 to operate in an identical manner as the flame rod units of the present state of the art. Note that the flame rod 30 does not necessarily extend into the high temperature flame within zone 33 and due to the efficient mixing and ignition of the ignitor unit 12, the flame is clean and does not deposit any foreign substance on the sensing portion of flame rod 30 which is within combustion zone 33, thus providing trouble-free operation of flame rod unit 13.

Referring now to FIGS. 4 and 4a, the ignitor unit has been modified to incorporate the flame rod sensor and comprises essentially all of the elements of the FIG. 1 ignitor unit 12 except the center electrode 27' functions both as the positive electrode and as the flame sensor rod and is extended further into combustion zone 33. Only the discharge and ignition end of the unit has been shown in that the external electrical connections are described hereinafter in the description of FIG. 6. As shown in FIG. 4, the modified ignitor unit consists of housing 15' having air and gas conduits 21 and 22 discharging therefrom against combustor grid baffle plate 23' which is mounted on electrode casing 26 as in the FIGS. 1 and 2 embodiment. Combustor grid 14' is provided with a plurality of apertures 35 which function to transfer the air and gas mixture to the combustion zone as described above. However, grid 14' is provided with a central passage 36 through which the modified ignitor unit extends. As in the FIG. 1 embodiment, the end of electrode casing 26 is pointed to define the negative electrodes 28' as shown in FIG. 4a. Also, as in the FIG. 1 embodiment, the electrode 27' is separated for the pair of electrodes 28' by insulator material indicated at 26''. The advantages of the FIG. 4 device are in compactness wherein the overall size of the ignitor-burner assembly can be reduced to approximately 75 percent of that of the FIG. 1 embodiment.

The operation of the FIG. 4 modification is identical to the previous description of the FIG. 1 device except that the control system has a time delay and transfer relay to provide switching of the electrode 27' from flame sense to spark sense to flame sense, the details of the control system being presently described.

The type of material used in the FIGS. 1 and 4 embodiments is dependent on the particular application thereof but should have a thermal expansion coefficient near that of the insulator material utilized in the ignitor and flame rod units.

Referring now to FIG. 5, the ignitor-burner assembly described above and indicated generally at 40 is mounted in a burner generally indicated at 41 which comprises a mixing and combustion assembly 42, a cooling section 43, and an exit nozzle section 44.

Mixing and combustion assembly 42 comprises a housing 45 having plates or partitions 46 and 47 defining a gas manifold 48, an air manifold 49, and a combustion chamber 50. Gas is supplied to manifold 48 through inlet passageway 51 from a source (see FIG. 6), while air is supplied to manifold 49 through inlet passageway 52 from a source such as a blower shown in FIG. 6.

6

Housing 45 is provided with a central passageway 53 within which the ignitor-burner assembly 40 is operatively positioned. Gas manifold 48 is provided with a plurality of tubes 54 (two being shown) mounted in partition 46 each tube 54 extending approximately $\frac{1}{3}$ of the way through an associated mixing tube 55 positioned in air manifold 49, attached to partition 47, and discharging into combustion chamber 50, there being an air tube 55 for each gas tube 54. A semi-swirl or turbulator plate 56 is positioned in combustion chamber 50 adjacent the partition 47. Partition 47 is provided with a plurality of apertures 57 through which air from manifold 49 passes into the cooling section 43 which consists of a shroud 58 having a flanged portion 59 which is attached to a flanged portion 60 of housing 45 by means such as bolts 61, shroud 58 defining an annular air passage or cooling annulus 62 around the wall 63 of combustion chamber 50 for cooling thereof by air flowing from manifold 49. The downstream end of shroud 58 is provided with a flange 64 which is attached by means such as bolts 65 to a flanged portion 66 of exit nozzle section 44.

The basic operation of the FIG. 5 burner assembly is extremely simple. There can be any number of air tubes 55 and corresponding number of gas tubes 54 placed equally around a circumference within partition or front plate 47 to provide adequate mixing of the air and gas flowing into combustion chamber 50. Pressurized air is supplied to manifold 49 through inlet 2. Manifold 49 is pressurized and air flow is established through the mixing tubes 55 and the apertures 57 connected to the cooling annulus 62. The former air flow enters the combustion zone of chamber 50 and continues down the combustor and exhausts through the exit nozzle 44. The air flow from apertures 57 flows down the cooling annulus 62 and exhausts through the exit nozzle 44. Gas under pressure is supplied through inlet 51 to manifold 48. The manifold 48 is pressurized and gas flow is established through the gas tubes 54. The gas is discharged into the turbulent air stream flowing through and from mixing tube 55 and the mixture is discharged into the combustion chamber 50. At this point the gas and air mixture comes in direct contact with the pilot flame generated by ignitor-burner assembly 40 which is easily ignited. The combustion takes place primarily around the barrel of assembly 40. The semi-swirl or turbulator plate 56 creates further turbulence at higher flows and holds the flame in this area by turbulence only. The combustion continues down the combustion section 43 until it exhausts from the exit nozzle section 44.

The cooling air may be injected into the cooling annulus 62 in an alternate method by using a separate air inlet which may be directly connected between the air supply source and cooling annulus 62. This alternate method would eliminate the cooling air apertures 57 in partition 47 and would require a balancing valve mechanism to control the air flowing to the annulus 62.

Referring now to FIG. 6, the control set-up for the FIG. 5 assembly comprises an air supply source such as blower 68 which supplies air to the ignitor-burner assembly 40 through conduit 69 and to the air manifold 49 of the burner assembly through a conduit 70 having a modulating valve 71 positioned therein to control the supply of air therethrough. Gas under pressure from a source as indicated by legend is directed into a supply line 72 having a shut-off cock or valve 73. A conduit assembly 74 interconnects valve 73 with the gas manifold 48 of the burner assembly. Positioned in conduit assembly 74 are a safety shutoff valve 75, a service governor 76, and a modulating valve 77. A conduit assembly 78 is connected to conduit assembly 74 between shutoff valve 73 and safety valve 75 and directs gas to the ignitor-burner assembly 40. A pilot regulator 79 and a solenoid valve 80 are positioned in conduit assembly 78. A valve controller mechanism 81 is mounted on modulating valve 77 and controls modulating valves 71 and 77.

Controller mechanism 81 is operatively connected to a temperature control unit 82 via a valve control connection 83, while safety valve 75 and solenoid valve 80 are operatively connected to a pilot control unit 84 via a safety valve control connection 85 and a pilot gas control connection 86. Temperature control unit 82 is electrically connected to a power source 87 and to a thermocouple indicated by legend, while pilot control unit 84 is electrically connected to power source 87, a start switch 88 and a transfer unit 89.

The pilot control unit 84 is a conventional unit that is generally used with a burner setup, the details thereof being deemed unnecessary since it is not part of this invention. The unit will sense the flame by either a flame rod, such as rod 30 of FIG. 1, or a photo-cell (not shown) through a flame sense wire 90. Unit 84 is a self-contained unit that attempts to light the pilot 40 for a length of time and if a flame is not sensed, the unit will lock itself out and will need to be manually reset. There can be no main gas flow signal to supply gas to manifold 48 unless a flame is sensed.

The temperature control unit 82 is also a conventional unit, the operation thereof being such that it positions the valve controller mechanism 81 with respect to the temperature set point. The air and gas modulating valves 71 and 77 are linked to controller 81 and the amount that these valves are opened depends on the position of the control linkage of controller 81. When properly adjusted, a constant air/fuel ratio is obtained in the mixing and combustion section 42 of the burner assembly over the entire range of firing.

The transfer unit 89 consists of a time delay unit (TD) and a relay (R1). A high voltage transformer (T1) may be part of this unit, as shown, or mounted externally. If the ignitor-burner assembly 40 is of the FIG. 1 embodiment, which contains separate spark and flame rod units, the transfer unit 89 will not be required; thus the flame sense wire 90 would be connected directly between the pilot control unit 84 and the ignitor-burner assembly 40.

Where the ignitor-burner assembly 40 is of the FIG. 4 embodiment the operation sequence of the FIG. 5 burner assembly is illustrated in FIG. 6 as follows:

- (1) Blower 68 is placed into operation.
- (2) Main gas cock 73 is opened.
- (3) Temperature control unit 82 and pilot control unit 84 are turned on.
- (4) The required temperature control point (not shown) is set on the temperature control unit 82.
- (5) After a suitable time has elapsed to insure that the control units 82 and 84 have warmed up, the start switch 88 is actuated.
- (6) Actuation of start switch 88 sends a signal to pilot gas solenoid valve 80 to direct gas to assembly 40.
- (7) Simultaneous with item 6, power is applied to transfer unit 89. This voltage appears across the time delay (TD) and the relay (R1). TD starts its delay immediately. Also R1 energizes immediately operating its switch blades and contacts in the following manner: Switch blade RSW1 is moved to engage contact R1C as shown in dotted line, while switch blade RSW2 moves from contact R1A to contact R1B as shown in dotted line thus breaking the circuit via flame sense wire 90 between pilot control unit 84 and pilot assembly 40.
- (8) The spark/flame rod 27' (see FIG. 4) is transferred from the flame sense input of the pilot control unit 84 to the secondary of the high voltage transformer T1 by the operation of contacts R1A and R1B.
- (9) When item 7 is complete, a voltage is applied through contact R1C to the primary of T1. The high voltage is applied to the spark/flame rod 27' through the contact R1B.
- (10) After a delay of 2 to 3 seconds the delay of TD is over and the contact TD-1 opens by moving the

switch blade thereof as shown in dotted line, thus removing the voltage from TD and R1.

- (11) The switch blades RSW1 and RSW2 of R1 operate in the reverse order to that set forth in item 7, namely:

- (a) R1C opens.
- (b) R1B opens.
- (c) R1A closes.

- (12) After the operation of item 11, the spark/flame rod is connected to the flame sense circuit of the pilot control unit 84.

If the pilot control unit 84 did not sense a flame, the operation is repeated when the time delay (TD) cools down to a point where contact TD-1 closes. It continues to ignite and sense until the delay of the pilot control unit is over. At this time the pilot control locks itself out, removing voltage from the transfer unit input, closing the pilot gas valve 80 and remaining in this position until the interlock is manually cleared after which the above operation will be repeated.

If the pilot control unit 84 did sense the presence of a flame in the pilot section, the voltage is immediately removed from the transfer unit input. An operating voltage or signal is applied to the safety shutoff valve 75 allowing the gas to be directed to the manifold 48 of the burner assembly.

As the temperature of the heated device approaches the set point of the controller, the valves 71 and 77 begin to position themselves thereby reducing the air and gas supplied to the burner assembly. These valves will allow an amount of air and gas to be supplied to the burner assembly to regulate and hold the temperature on the required set point.

If at any time the pilot control unit 84 fails to sense a flame, the signal is immediately removed from the safety shutoff valve 75 and it immediately closes. The voltage is again applied to the transfer unit input and the pilot ignite/sense repeats. Again when the flame is sensed, the operation of the safety shutoff valve 75 may be initiated.

It has thus been shown that the ignitor-burner assembly as illustrated by the FIGS. 1 and 4 embodiments has the following advantages: (1) its operation will not be affected by varying air and/or gas pressures, (2) it produces a high temperature, high velocity flame to produce easier and smoother ignition of a main burner, (3) it is immune to varying environmental conditions, (4) the flame rod is protected in such a manner that it does not suffer the deleterious effects that plague the prior art units, (5) the air and gas mixing is accomplished in such a manner that it produces a mixture which is easily ignited and very efficient, while eliminating flash back, (6) any gas pressure may be used with excellent results provided that the gas inlet be provided with orifice means at high pressures, and (7) any air pressure may be used assuming that it provides an adequate amount of air to satisfy the ratio of air to gas.

While the ignitor-burner assembly has been illustrated as a pilot ignitor for a main burner assembly, it is not intended to limit its application to this area, and the ignitor-burner may be effectively used in any application requiring a high temperature flame such as water heating systems or steam generation systems by directing water through appropriate tubing which is in contact with the flame of the ignitor-burner.

While not shown, the ignitor-burner assembly of the invention may be modified to provide efficient burning of other mixtures such as oxygen-natural gas, oxygen-hydrogen, oxygen-acetylene, air-hydrogen, and air-acetylene.

Although particular embodiments of the invention have been illustrated and described, modifications thereof will be readily apparent to those skilled in the art, and it is intended to cover in the appended claims all such modifications as come within the true spirit and scope of the invention.

What I claim is:

1. In combination with a combustion chamber, an ignitor assembly comprising: air supply means, gas supply means, and ignition means; said air supply means including means for providing a supersonic air flow; said gas supply means including means for providing a subsonic gas flow; said air and gas supply means being constructed and arranged to provide a homogeneous mixture thereof, said air supply means and said gas supply means being positioned in a concentric arrangement with respect to said ignition means.

2. The combination defined in claim 1 additionally including a flame rod assembly.

3. An ignitor-burner assembly comprising a combustion chamber, an ignitor assembly, a flame rod and sensor assembly, a flame holder, means for supplying air and fuel to said combustion chamber, and means for supplying fuel and air to said ignitor assembly; said ignitor assembly including fuel manifold means, air manifold means, a plurality of fuel conduits operatively attached to said fuel manifold, a plurality of air conduits operatively attached to said air manifold, and ignition means, said fuel conduits being positioned intermediate said air conduits; said ignition means including positive and negative electrodes and baffle means positioned a predetermined distance from one end of each of said electrodes; said fuel and air conduits being concentrically located around said ignitor means and having the terminal ends thereof spaced from said baffle means of said ignition means.

4. The ignitor-burner assembly defined in claim 3, wherein said flame rod and sensor assembly is located in a spaced relationship to said ignitor assembly.

5. The ignitor-burner assembly defined in claim 3, wherein said flame rod and sensor assembly is incorporated into said ignitor assembly whereby said positive electrode of said ignitor assembly functions as the flame rod of said flame rod and sensor assembly.

6. The ignitor-burner assembly defined in claim 3, wherein said ends of said electrodes and one end of said flame rod and sensor assembly extend through said flame holder, said flame holder additionally including a plurality of passageways therethrough.

7. A natural gas pilot burner comprising a housing, an ignitor assembly, a flame rod assembly, and a flame holder having passages therethrough and operatively mounted in said housing; said ignitor assembly including gas and air manifolds, a plurality of conduit means hav-

ing one end thereof operatively connected to said gas manifold, a plurality of conduit means having one end thereof operatively connected to said air manifold, said gas conduit means being positioned intermediate said air conduit means, ignition means including positive and negative electrode means and baffle means positioned a predetermined distance from one end of said electrode means, said one end of said electrode means extending through said flame holder, said gas and air conduit means being positioned concentrically with respect to said ignition means and having the other ends thereof terminating in a spaced relationship with respect to said baffle means.

8. The natural gas pilot burner defined in claim 7, wherein said flame rod assembly includes a flame rod and insulating means for said flame rod, said flame rod having one end thereof extending through said flame holder.

9. The natural gas pilot burner defined in claim 8, wherein said flame rod is positioned in said ignition means of said ignitor assembly and additionally functions as the positive electrode means of said ignition means.

10. An ignitor comprising a gas manifold, an air manifold, ignition means, a plurality of conduits operatively connected to said gas manifold, a plurality of conduits operatively connected to said air manifold, said conduits being coaxially aligned with said ignition means with said gas conduits being positioned substantially intermediate said air conduits, said ignition means including positive and negative electrode means with insulation means therefor and baffle means positioned a predetermined distance from one end of said electrodes, said gas and air conduits terminating in a spaced relationship to said baffle means.

11. The ignitor defined in claim 10, wherein said gas manifold includes means for determining the flow of gas thereinto.

References Cited by the Examiner

UNITED STATES PATENTS

1,647,675	11/1927	Vedder	158—109 X
2,402,763	6/1946	Tongini	158—115
2,784,553	3/1957	Corso et al.	60—39.82
2,794,620	6/1957	Arnold et al.	158—27.4
2,970,178	1/1961	Braconier et al.	158—118
3,002,351	10/1961	Sloan	60—39.82

FREDERICK KETTERER, *Primary Examiner.*