United States Patent

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[54] **IGNITING DEVICE**
8 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **431/158,** 431/202
[51] **Int. Cl.** **F23r 1/02**
[50] **Field of Search** 431/1, 158, 202; 23/277

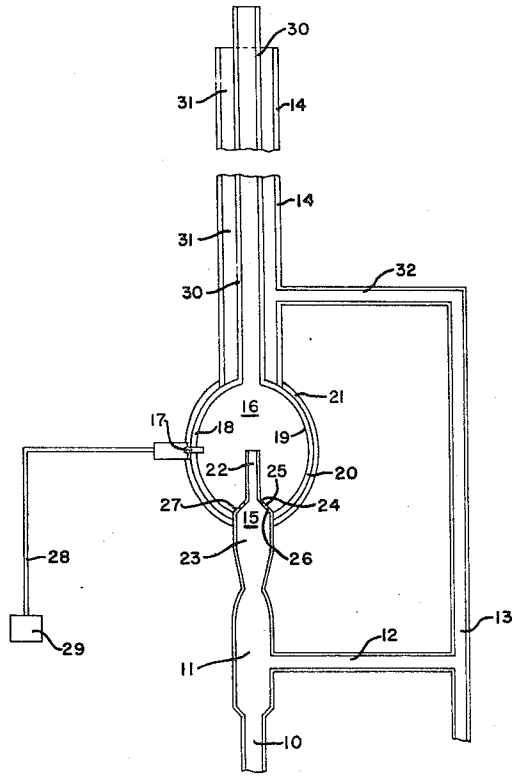
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ABSTRACT: An apparatus comprising (1) a mixing zone in open communication with a source of an oxygen-containing gas and a source of a combustible gas, (2) a combustion chamber having a substantially symmetrical internal configuration and having at least one electrically generated spark-producing means in the sidewall thereof, (3) a tubular injection jet extending from said mixing chamber into said combustion chamber to a point just above said spark-producing means, said injection jet being in open communication at one end thereof with said mixing zone at at the other end thereof with said combustion chamber, the upper end of said injection jet having a diameter less than that of said lower end, at least one minor opening through the sidewall of said injection jet into said combustion chamber, said opening being adjacent the lower end of said jet and having a diameter substantially less than the diameter of said tubular injection jet, and the plane of said opening being in angular relation to the axis of said injection jet, (4) a first conducting tube in open communication at one end thereof with said combustion chamber and opening at its other end adjacent the upper end of the flare stack combustion tip, said combustion chamber and said first conducting tube being in relation such that said combustion chamber bears a volume ratio per unit length of said first conducting tube within the range of 1.7:1 to 2.25:1, (5) a second conducting tube coaxially aligned with and of greater diameter than said first conduction tube, said second conduction tube being in open communication adjacent its lower end with the source of a combustible gas and being open at its upper end to the atmosphere, said upper end terminating adjacent but below the upper end of said first conducting tube, and (6) means for causing said spark-producing means to create a spark.



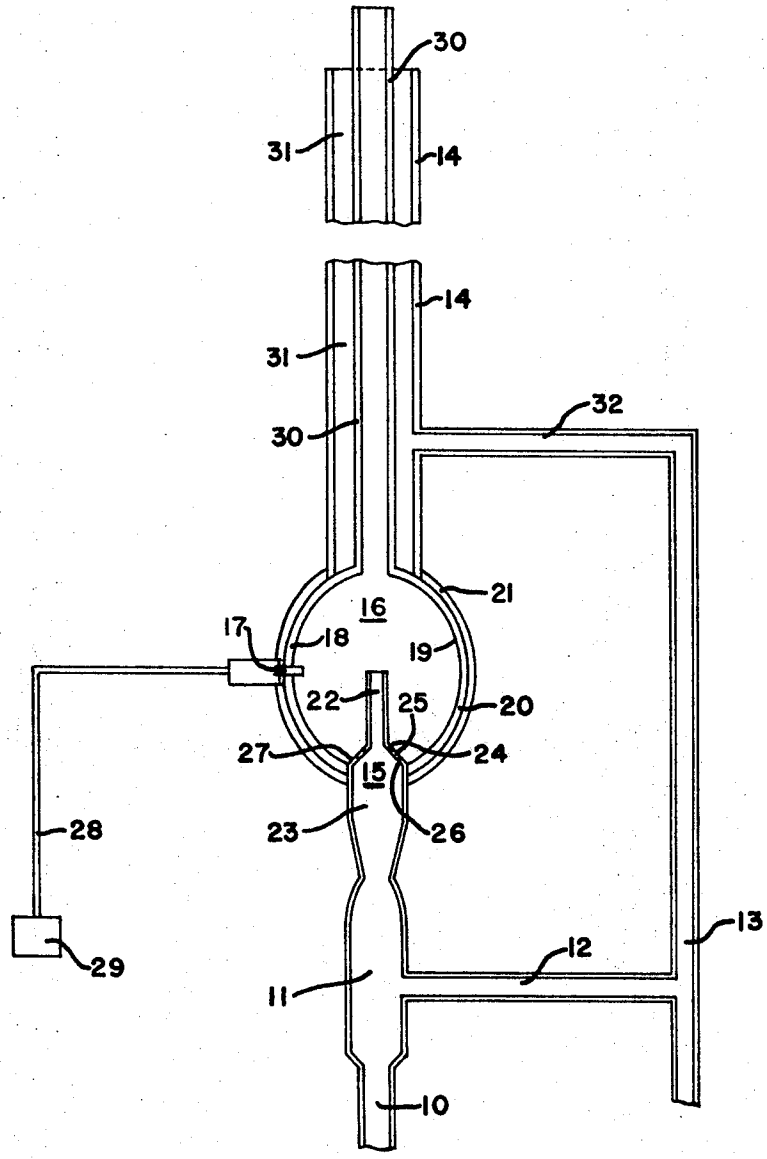


FIGURE 1

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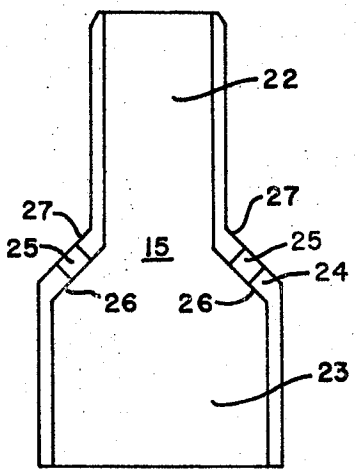


FIGURE 2

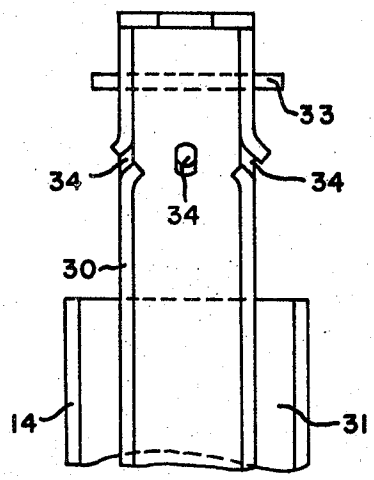


FIGURE 3

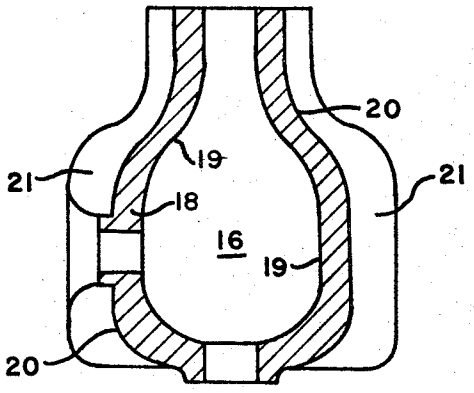


FIGURE 4

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IGNITING DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to a pilot-type ignition device. More particularly, the present invention relates to an igniting device having particular utility for igniting gases at the top of the combustion tips of flare stacks.

Because of the intermittent and variable character of the gas flow through and from many flare stacks used in the chemical and refining industries, a continuous burning of such gases in many instances cannot be maintained. In such instances, it is customary to provide one or more pilot lights or flares adjacent the upper end of such flare stacks to insure ignition and burning of gases passing therefrom. The most used conventional pilot flares are provided with a continuous flow of a combustible gas and under stable conditions maintain a continuous flame at the head thereof. However, in periods of high winds or variable gas pressure and the like, this type of pilot light may be extinguished and if so, generally requires an operator to scale the flare stack to manually relight the pilot.

As an alternative to the continuous pilot flare and, in some instances, as an accessory thereto, the so-called flame front generation pilots were developed. With such apparatus, a combustible mixture of gases are ignited in a combustion area away from the upper end of the flare stack by means of an electrically generated spark and a flame front from such ignition is conducted by means of a tubular conduit to the top of said flare stack. Upon exiting the upper end of this tubular conduit, the flame front is expected to ignite any combustible gases adjacent the upper end of said conduit. This type of apparatus does not require an operator to climb the flare stack and manually relight the flare in the event it is blown out. However, the flame front generators heretofore known for igniting gases adjacent the upper end of flare stacks have suffered several deficiencies. First, some of these known flame front generators have been somewhat undependable in producing an ignition flame at the top of the flare stack. In many instances, the flame generated by the known pilots of this type is frequently inadequate to ignite the gases adjacent the top of the flare stack. Others have been found to overheat in the combustion areas and to quite often either fail to ignite in the combustion area or to over ignite in such area, either being undesirable.

It is an object of the present invention to provide a new and improved ignition device.

Another object of the present invention is to provide a new and improved ignition device of the flame front generating type.

Another object of the present invention is to provide a new and improved ignition device for igniting gases in areas away from and remote to said device.

An additional object of the present invention is to provide a new and improved ignition device particularly useful for igniting combustible gases adjacent the upper end of flare stacks.

A remaining object of the present invention is to provide a new and improved flame front-generating pilot for igniting gases adjacent the upper end of flare stacks, which pilot is dependable in operation.

Additional objects will become apparent from the following description of the invention herein disclosed.

SUMMARY OF THE INVENTION

The present invention, which fulfills these and other objects, is an apparatus comprising (1) a mixing zone in open communication with a source of an oxygen-containing gas and a source of a combustible gas, (2) a combustion chamber having a substantially symmetrical internal configuration and having at least one electrically generated spark-producing means in the sidewall thereof, (3) a tubular injection jet extending from said mixing chamber into said combustion chamber to a point just above said spark-producing means, said injection jet being in open communication at one end thereof with said mixing zone and at the other end thereof with said combustion chamber, the upper end of said injection jet having a diameter less than that of said lower end, at least one minor opening through the sidewall of said injection jet into said combustion chamber, said opening being adjacent the lower end of said jet and having a diameter substantially less than the diameter of said tubular injection jet, and the plane of said opening being in angular relation to the axis of said injection jet, (4) a first conducting tube in open communication at one end thereof with said combustion chamber and opening at its other end adjacent the upper end of the flare stack combustion tip, said combustion chamber and said first conducting tube being in relation such that said combustion chamber bears a volume ratio per unit length of said first conducting tube within the range of 1.7:1 to 2.25:1, (5) a second conducting tube coaxially aligned with and of greater diameter than said first conduction tube, said second conduction tube being in open communication adjacent its lower end with the source of a combustible gas and being open at its upper end to the atmosphere, said upper end terminating adjacent but below the upper end of said first conducting tube, and (6) means for causing said spark-producing means to create a spark.

The ignition device of the present invention provides a dependable means of igniting combustible gases in remote and difficultly accessible areas. Also, the present igniting device will produce a continuous pilot flame which is virtually unextinguishable by external forces such as wind, rain, external pressure, etc. Particularly, the igniting device of the present invention is useful in providing a dependable means of producing a continuous pilot for the ignition of gases adjacent the upper end of the combustion tip of a flare stack. By means of the present apparatus, an extremely rapid rate of firing, i.e., up to 1,000 times per minute and higher, may be obtained. In addition, this device will allow optimum utilization of the combustible gases used as feeds thereto. Further, the flame produced by the ignition device of the present invention is adequate to ignite the gases exiting the combustion tip of the flare stack. Still further, the apparatus of the present invention is less susceptible to under ignition or over within the combustion area than are most conventional pilots of the flame front generating type. Additionally, should the flare adjacent the upper end of said pilot be blown out, turned off during periods when not needed, or otherwise extinguished, it may be immediately relit upon demand and need without manual lighting or scaling the flare stack.

DESCRIPTION OF THE DRAWINGS

FIG. 1 of the drawings is a cross-sectional view of the ignition device of the present invention in a particularly useful embodiment thereof;

FIG. 2 of the drawings is a cross-sectional view of the injection jet of the apparatus of the present invention;

FIG. 3 of the drawings is a cross-sectional view of the upper terminating ends of the coaxially aligned first and second conducting means;

FIG. 4 of the drawings is a cross-sectional view of the combustion chamber of the present invention in a particularly useful embodiment thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE PRESENT INVENTION

Reference is made to the accompanying drawings or for description of the preferred embodiments of the present invention. In the drawings, the same characters are used throughout to denote like features of the apparatus of the present invention.

Referring to the drawings, an oxygen-containing gas, generally air or an oxygen enriched air, is introduced by means of line **10** into mixing zone **11**. Concurrently with the introduction of the oxygen-containing gas through line **10**, a combustible gas such as low molecular weight hydrocarbon, i.e., methane, ethane, etc., also is introduced into mixing zone **11** by means of line **12**. In the embodiment illustrated in FIG.

1, line 12 is shown in open communication at one end with a combustible gas header line 13 which is in open communication with a gas source (not shown) and with a second conducting tube 14 which will be more fully discussed below. As shown in FIG. 1, the combustible gas and oxygen are brought together in substantially perpendicular relationship to one another, however, other arrangements might be employed if desired without departing from the spirit and scope of the present invention.

Above mixing zone 11 and in open communication therewith by means of injection jet 15 is combustion chamber 16. Within combustion chamber 16, the combustible mixture of the oxygen-containing gas and the combustible gas from mixing zone 11 are ignited. Ignition within combustion chamber 16 is provided by means of spark-generating means 17. Generally, spark-generating means 17 is an ordinary spark plug. Combustion chamber 16 may be provided with only one spark-generating means 17 or with a plurality of such means. Such spark-generating means 17 extend into combustion chamber 16 through a sidewall 18 thereof.

In accordance with the present invention, combustion chamber 16 has a substantially symmetrical internal configuration. Preferably, the internal walls 19 of the combustion chamber 16 form a circle in any given horizontal plane though the diameter of such circle may vary along the vertical length of combustion chamber 16. It is desirable that the upper surfaces of the internal walls of the combustion chamber be converging surfaces converging toward the opening in the upper end of such combustion chamber, the convergence of such surfaces being such as to permit relatively smooth flow of gases there across without inducing any significant turbulence or backmixing of such gases. To aid in dissipating heat generated within combustion chamber 16, it is frequently desirable to provide the outer surface 20 of combustion chamber 16 with a plurality of spaced-apart baffles or fins 21 perpendicular to such outer surface 20.

The injection jet 15 which permits open communication of mixing zone 11 with combustion chamber 16 extends within such combustion chamber to a point at or above the level in said combustion chamber at which spark-generating means 17 extends through wall 18 thereof. The upper end 22 of injection jet 15 is of reduced diameter as compared to the lower segment 23 of injection jet 15. Between upper section 22 and lower section 23 of injection jet 15 is a flared section 24 which acts as a reducing section between upper section 22 and lower section 23 of injection jet 15. Within flared section 24 is one or a plurality of small passages 25 opening from the interior of injection jet 15 to the lower portion of combustion chamber 16. These passages 25 are of a diameter significantly reduced from that of the upper section 22 of injection jet 15. Preferably, passages 25 slant upwardly through flared section 24 from the inner surface 26 to the outer surface 27 of the flared section 24 of injection jet 15. In a particularly preferred embodiment of the present invention two passages 25 are provided with said passage being on opposite sides of flare section 24. In such embodiment, the two openings of passages 25 into combustion chamber 16 lie on a line perpendicular to a line from spark-generating means 17 through the vertical axis of combustion chamber 16.

Spark-generating means 17 may be any conventional means for generating a spark such as an ordinary spark plug. Connected to spark-generating means 17 is an electrical conduit 28 connecting said spark-generating means to an electrical source (not shown) through a control means 29. Through control means 29, the flow of electrical energy to spark-generating means 17 is regulated and thereby the rate of firing of spark-generating means 17 may be controlled to provide the desired rate of flame front generation.

The upper end of combustion chamber 16 opens into a first conducting tube 30 which extends from such combustion chamber to adjacent the waste gas effluent exit area. It is up through this conducting tube 30 that the flame front generated by ignition of gases within combustion chamber 16 passes upward to the waste gas effluent area. Conducting tube 30 generally is substantially straight for the greater part of its length though quite frequently it is bent slightly at its upper end in order to better extend into the exit area of the waste gas effluent from the flare stack combustion tip. The relationship of first conducting tube 30 and combustion chamber 16 generally is such that the combustion chamber volume ratio per unit length of first conducting tube 30 is within the range of 1.7:1 to 2.25:1.

A second conducting tube 14 surrounds and is coaxially aligned with first conducting tube 30 to thereby provide an annular space 31 around first conducting tube 30. The lower end of second combustion tube 14 generally will extend to adjacent the upper end of combustion chamber 16. However, if desired it need not extend to such point by may terminate further up the length of first conducting tube 30. Such lower end of second conducting tube 14 is in open communication with header 13 by means of gas line 32. In such manner a combustible gas is fed through line 32 into annular space 31 about first conducting tube 30.

The upper end of second conducting tube 14 terminates at a point adjacent to but below the upper end of first conducting tube 30. By passing a combustible gas up through the annular space 31 surrounding first conducting tube 30 to adjacent the upper end of first conducting tube 30, such upper end of first conducting tube 30 is surrounded by combustible gas at all times thereby providing for a constant flame at the upper end of the igniting device of the present invention. Should such flame be extinguished, ignition of gas within combustion chamber 16 is initiated to create a flame front which passes up through first conducting tube 30 to thereby again ignite the gas surrounding the upper end of first conducting tube 30. Second conducting tube 14 and annular space 31 created thereby also provide insulation for first conducting tube 30. Such insulation aids in preventing the flame front generated in combustion chamber 16 from being extinguished during passage through conducting tube 30.

In a preferred embodiment of the present invention, first conducting tube 30 is provided with a circular baffle 33 adjacent its upper end and above the upper end of second conducting tube 14. Such baffle 33 lies in a plane substantially perpendicularly aligned with the axis of first conducting tube 30. Baffle 33 has a diameter substantially similar to the internal diameter of second conducting tube 14. Thereby such baffle acts to deflect gases passing upwardly through annular space 31. Such deflection of the gases passing upward through annular space 31 creates an area of turbulence in the area adjacent the upper end of first conducting tube 30 which in turn provides for an increased concentration of the combustible gas in such area. This concentration permits easier ignition and upon ignition provides for a large, more stable flame.

To aid in igniting the gases passing through and out of annular space 31, a preferred embodiment of the present invention includes spiral openings 34 in the wall of first conducting tube 30. Such spiral openings 34 cause a portion of the flame front passing upward through first combustion tube 30 to be discharged outward into the concentration of combustible gas just above the upper end of second conducting tube 14. During periods when no flame front is passing upward through first conducting tube 30 but only a continuous gas flow is passing upward therethrough, this gas is discharged in a spiralar movement into admixture with the gases concentrated above the second combustion tube 14 and adjacent to the first conducting tube 30 thereby imparting a spiralar motion to the entire gas mass. Such spiralar motion aids in stabilizing and concentrating the flame and in the induction of atmospheric oxygen into the flame. The spiral openings 34 may be formed in any manner which will provide an opening through which the gases are discharged in a spiralar manner. Such may be accomplished by means of the shape of the opening, the angle of the passageway of the opening between the internal and external surfaces of the wall of first conducting tube 30, spiral baffles either on the inner or outer surfaces of the first conducting tube 30 adjacent openings 34, and like means.

While the gas supplied to mixing zone **11** by combustible gas line **12** and that supplied to second conducting tube **14** by a gas line **32** are shown in the drawings as coming from a single header **13**, obviously the present invention is not so narrowly restricted. Gas lines **12** and **32** may be in communication with different gas sources and in fact, may actually deliver different combustible gases.

In operation, an oxygen-containing gas and a combustible hydrocarbon gas are fed into mixing zone **11** by lines **10** and **12** respectively. Within mixing zone **11**, the gases are intimately mixed into a combustion mixture which passes upwardly into the lower section **23** of injection jet **15**. As the gases pass up through injection jet **15**, a small portion of the combustion mixture passes through passages **25** in the flared section **24** of injection jet **15** to thereby enter the lower portion of combustion chamber **16**. The portion of the combustion mixture entering the lower portion of combustion chamber **16** by means of passages **25** is that ignited by spark-generating means **17**. The positioning, diameter and number of passages **25**, with respect to spark-generating means **17** may be used as a means of controlling the frequency of ignition of gases within chamber **16**. The closer the passages **25** open to spark-generating means **17**, the more rapid is the ignition frequency assuming a substantially constant spark generation by spark-generating means **17**. Also, the larger the diameter of passages **25** and number of such passages, the more rapid is such ignition frequency. The portion of the combustion gas not passing through passages **23** continues up through the upper section **22** of injection jet **15** and passes into the upper portion of combustion chamber **16** and into first conducting tube **30**.

Through control means **29** and a power source (not shown) a spark is created in spark-generating means **17**. This spark ignites the combustion mixture within combustion chamber **16** thereby creating a flame front which passes upwardly through first conducting tube **30** and out the upper end of such tube. The flame created by ignition of the gases entering combustion chamber **16** by passages **25** is propagated upward through conducting tube **30** by the combustion of that portion of the gases passing from the upper section **22** of injection jet **15** into first conducting tube **30**.

To maintain a constant flame, a combustible gas in continuously introduced into the annular space **31** surrounding first conducting tube **30** and passed upwardly through said annular space **31** to adjacent the upper end of first conducting tube **30**. At this point, the gas passing from the annular space **31** is ignited to provide a continuous flame at the upper end of the igniter. Once a flame is so established at the upper end of the igniter, no further ignition of gases within combustion chamber **16** is necessary and the spark-generating means **17** may be inactivated by turning off the power source. However, generally it is desirable to allow the combustion gas mixture to continue to flow through combustion chamber **16**. Such continued flow aids in maintaining a stable, compact flame at the upper end of the igniter and maintains the combustion chamber **16** and conducting tube **30** in instant readiness for ignition of combustion gases in the event such flame is blown out or otherwise extinguished.

We claim:

1. An apparatus comprising (1) a mixing zone in open communication with a source of an oxygen-containing gas and a source of a combustible gas, (2) a combustion chamber having a substantially symmetrical internal configuration and having at least one electrically generated spark-producing means in the sidewall thereof, (3) a tubular injection jet extending from said mixing chamber into said combustion chamber to a point just above said spark-producing means, said injection jet being in open communication at one end thereof with said mixing zone and at the other end thereof with said combustion chamber, the upper end of said injection jet having a diameter less than that of said lower end, at least one minor opening through the sidewall of said injection jet into said combustion chamber, said opening being adjacent the lower end of said jet and having a diameter substantially less than the diameter of said tubular injection jet, and the plane of said opening being in angular relation to the axis of said injection jet, (4) a first conducting tube in open communication at one end thereof with said combustion chamber and opening at its other end adjacent the upper end of a flare stack combustion tip, said combustion chamber and said first conducting tube being in relation such that said combustion chamber bears a volume ratio per unit length of said first conducting tube within the range of 1.7:1 to 2.25:1, (5) a second conducting tube coaxially aligned with and of greater diameter than said first conduction tube, said second conduction tube being in open communication adjacent its lower end with the source of a combustible gas and being open at its upper end to the atmosphere, said upper end terminating adjacent but below the upper end of said first conducting tube, and (6) means for causing said spark-producing means to create a spark.

2. The apparatus of claim **1** wherein said injection jet includes a flared section between the ends thereof and adjacent the lower end of said combustion chamber.

3. The apparatus of claim **1** wherein two minor openings are provided through said flared section of said injection jet, said two minor openings being on opposite sides of said flared section and being positioned such as to lie in a vertical plane perpendicular to a line from said spark-producing means to the vertical axis of said combustion chamber.

4. The apparatus of claim **1** wherein said combustion chamber has a substantially symmetrical internal configuration.

5. The apparatus of claim **4** wherein the internal walls of said combustion chamber form a circle in any given horizontal plane and provide for the upper surfaces thereof to converge toward the upper end of said combustion chamber.

6. The apparatus of claim **1** wherein the outer surface of said combustion chamber is provided with a plurality of baffles perpendicularly arranged with respect to such surface.

7. The apparatus of claim **1** wherein said first conduction tube is provided with a circular baffle adjacent its upper end and above the upper end of said second conducting tube.

8. The apparatus of claim **1** wherein said conducting tube is provided with spiral openings adjacent its upper end and above the upper end of said second conducting tube.