

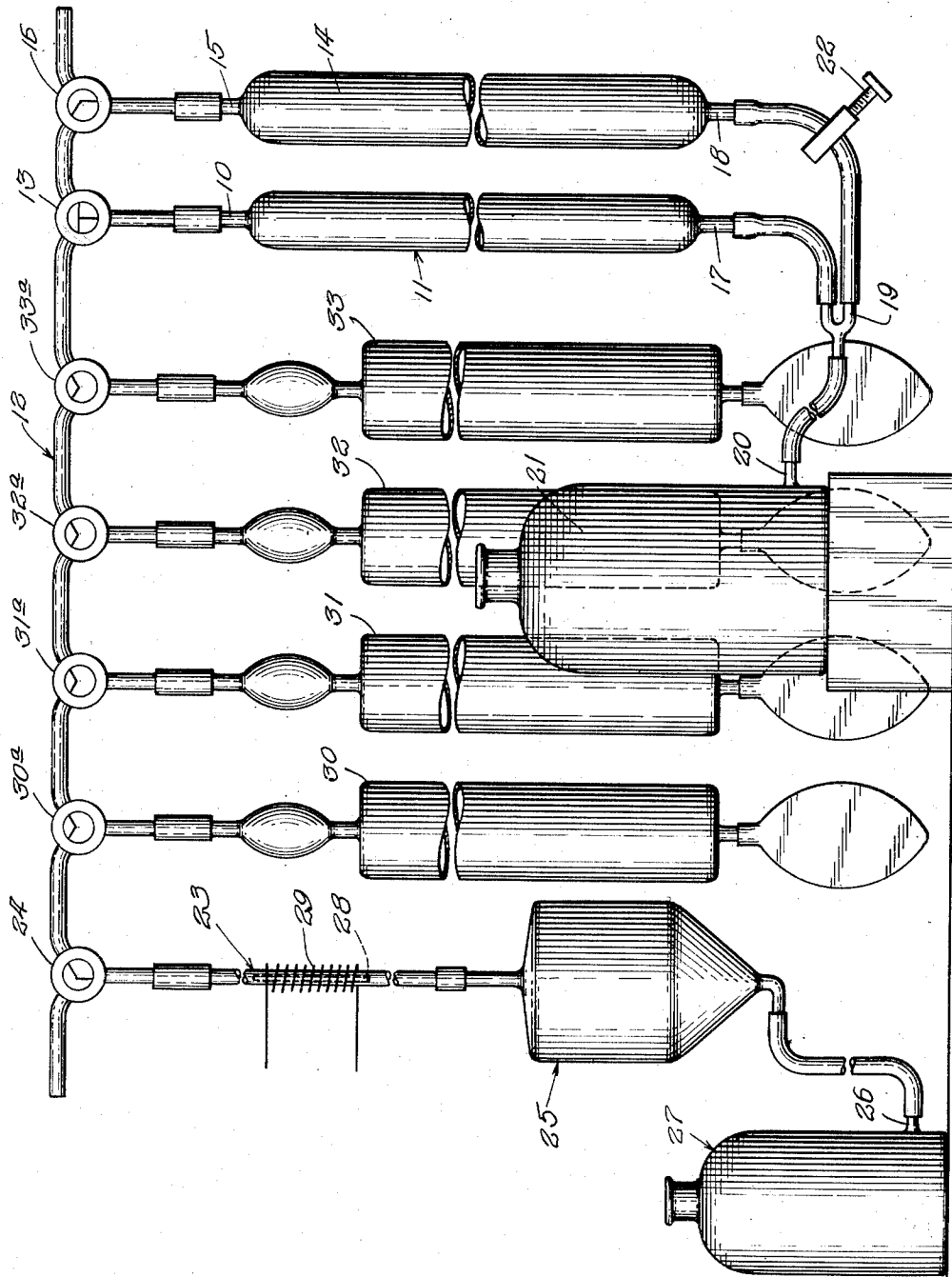
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APPARATUS FOR IGNITING COMBUSTIBLE FUEL GASES

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APPARATUS FOR IGNITING COMBUSTIBLE FUEL GASES

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2 Claims. (Cl. 23—254)

This invention relates to apparatus for igniting combustible fuel gases for chemical analysis.

In making a chemical analysis of combustible fuel gases it is common laboratory practice first to ignite a mixture of predetermined, measured amounts of an oxidizing gas and fuel gases. Following this reaction, the resulting volume contraction of the ignited gases, the production of carbon dioxide, and the consumption of oxygen are determined by well known measurement techniques in a burette and by absorption in specific kinds of well known selective liquid or solid absorbing agents.

A number of problems arise in igniting the combustible fuel gases for chemical analysis, particularly when conducting large volumes of the work. Since a major portion of the apparatus is constructed of glass, it is important to avoid an explosive mixture of fuel gases and an oxidizing gas in quantities large enough to shatter the glass portions of the apparatus in case of an accidental detonation. In addition, it is most advantageous to prevent or minimize ignition failure resulting from an improper mix of the oxidizing gas with the fuel gases as this results in loss of time and increases the cost of testing. Furthermore, the efficiency of combustion should be both uniform and high.

I have discovered apparatus for and a method of igniting combustible fuel gases which overcomes these problems. In the apparatus of this invention it is impossible for any "flash backs" to cause an explosion severe enough to shatter the glass portions of the apparatus; the efficiency of combustion is uniform and high; and any possibility of reaction failure during ignition due to improper mixing of the oxidizing gas with the fuel gases is eliminated.

Other features and advantages will be apparent from the following description of the drawing illustrating a preferred embodiment of my invention, in which is illustrated a partial schematic, side elevational view of the apparatus with the supporting structure omitted for purposes of clarity.

In the particular embodiment of the invention as illustrated, the upper end or outlet 10 of a gas container 11, here shown as a gas measuring burette in an upright position, is connected to one end of a horizontally positioned tube 12 through a three-way glass stopcock 13. This burette is used to store a predetermined amount of the fuel gases to be ignited and chemically analyzed.

A second burette 14 for storing the oxidizing gas such as air or oxygen which is to be mixed with the fuel gases is here shown positioned alongside and parallel to the gas measuring burette 11. The upper end or outlet 15 of this burette is connected to the same end portion of the tube 12 through a three-way stopcock 16.

The bottom ends or inlets 17 and 18 of the burettes 11 and 14, respectively, are connected through a manifold 19 to the outlet 20 in the bottom portion of an open top levelling bottle 21 by means of rubber tubing. This rubber tubing is sufficiently long so that when the levelling bottle 21 is filled with water, it can be raised substantially above the level of the inlets 17 and 18 causing gradual,

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simultaneous filling of the burettes with the water from the levelling bottle 21, or lowered sufficiently below the level of the inlets 17 and 18 so as to empty the two burettes of any water. A screw clamp 22 is here shown engaging that portion of the rubber tubing between the manifold 19 and the outlet 13 of the oxidizing gas storage burette 14 and enables one to regulate the flow of water either into or out of the storage burette as desired.

It is preferred that the cross-sectional area of the storage burette 14 be sufficiently larger than that of the gas measuring burette 11 so that the displacement of gas volume per unit length of the storage burette 14 provides at least a sufficient quantity of oxidizing gas from the storage burette 14 to complete the combustion of the amount of fuel gases displaced from an equal length of the gas measuring burette 11. Thus, when predetermined amounts of oxidizing gas and fuel gases are stored in the gas storage burette 14 and the gas measuring burette 11 respectively, and the levelling bottle 21, filled with water, is gradually raised to its uppermost position, the water from this levelling bottle simultaneously flows into the two burettes. The rising water levels in the two burettes are the same. Consequently, the amounts of fuel gases and oxidizing gas delivered from the two burettes as a result of this water displacement into the tube 12 are constantly in the required proportions for complete combustion of the fuel gases without any prior mixing.

It is to be noted that excess amounts of oxidizing gas are not harmful and it is only necessary in determining the proper ratio of cross-sections between the gas measuring burette 11 and the storage burette 14 that the storage burette be larger than would be needed to supply the calculated amount of oxidizing gas necessary for complete combustion of the fuel gases on ignition.

An ignition capillary tube 23, preferably of the Drehschmidt type and connected to the other end of the tube 12 through a three-way stopcock 24 is used to ignite the mixed gases flowing from the tube 12. The bottom end of the ignition capillary tube 23 is connected to a container 25 for storing the ignited gases and the outlet at the bottom of this container is connected by means of rubber tubing to the outlet 26 of a second water levelling bottle 27 similar in construction and operation to that of the first water levelling bottle 21.

As here shown, the ignition capillary tube 23 contains a cylinder of platinum 28 extending therethrough and has an electrical high resistance heating coil 29 therearound, the ends of which lead to an electrical source not shown. This heating coil 29 is used to heat the ignition tube 23 to a temperature sufficiently high to ignite the mixed gases flowing from the tube 12.

A number of absorption pipettes 30, 31, 32, and 33 are connected to the tube 12 along its center portion through three-way stopcocks 30a, 31a, 32a, and 33a. These pipettes contain selective absorption agents for measuring the production of carbon dioxide in the ignited gas and for measuring oxygen, carbon monoxide and "illuminants" comprising higher hydrocarbons.

A general method of operating the apparatus is as follows:

A predetermined amount of the fuel gases to be analyzed is stored in the gas measuring burette 11 while a predetermined amount of an oxidizing gas such as oxygen or air sufficient to cause complete combustion of the fuel gases to be analyzed is stored in the storage burette 14. The stopcocks 13 and 16 are in the closed position and the levelling bottles 21 and 27 are in their lowermost positions. The ignition capillary tube is heated to the ignition temperature of the gas mix which is to be flowed therethrough. The various stopcocks are then positioned so that a through passageway exists from the outlets of both burettes through the tube 12, the ignition tube 23

and into the container 25. The levelling bottle 21, filled with water, is then raised gradually. As this bottle is raised, the water therein flows into both burettes simultaneously and at the same level causing the fuel gases in the gas measuring burette 11 and the oxidizing gas in the storage burette 14 to be driven out of their respective burettes, through the tube 12 wherein they are mixed, and into and through the heated ignition capillary tube 23 where the mixed gas is ignited. The ignited fuel gases from the capillary ignition tube 23 flow into the container 25 where they are stored.

It is to be noted that the rate of supply of oxidizing gas at the point of ignition is necessarily and automatically adjusted to the rate of supply of the fuel gases at the point of ignition. Burning occurs smoothly and very efficiently and the operation may be carried out with great rapidity.

In the event that the levelling bottle 21 is raised too fast so that the gases supplied to the ignition capillary tube 23 exceeds a practical maximum, "flash back" will occur. However, these "flash backs" cannot ignite a large volume of explosive mixtures since the two separate burettes containing the reactable gases are isolated.

After substantially the entire volume of fuel gases to be analyzed and oxidizing gas have passed through the ignition tube 23 and into the container 25, i. e., when the water level in the two burettes reaches the stopcocks 13 and 16, the water levelling bottle 21 may be lowered, thus emptying the two burettes.

The volume contraction of the ignited gases can readily be determined by moving the gases in the container 25 into the gas measuring burette 11. This is accomplished by closing stopcock 16 to the tube 12 and raising the levelling bottle 27 filled with water to its uppermost position. As a result, the water in the levelling bottle 27 flows into and gradually fills the container 25 causing the gas therein to flow back through the ignition tube 23 and the tube 12 into the gas measuring burette 11. The residual trace of fuel gases that have not been ignited which remains in the tube 12 is so slight as to constitute no possible explosive mixture and may be burned by repetitive passages of the mixture through the hot tube.

By proper adjustment of the stopcocks in the system and raising of the levelling bottle 21, the ignited gases in the gas measuring burette 11 can then be moved into the desired selective adsorbents contained in pipettes 30, 31, 32, and 33.

The foregoing detailed description has been given for clearness of understanding only and no unnecessary limitations should be understood therefrom as modifications will be obvious to those skilled in the art.

We claim:

1. Apparatus for igniting and analyzing combustible fuel gases, comprising: a first burette for storing a predetermined amount of the fuel gases to be ignited having an inlet and an outlet; a second burette for storing a predetermined amount of an oxidizing gas having an inlet and an outlet, the cross-sectional area of said second burette being larger than that of the first burette whereby the displacement of gas volume per unit length in the second burette provides at least a sufficient quantity of oxidizing gas to complete the combustion of an amount of the fuel gases displaced from an equal length of the first burette; an ignition capillary tube; means for heating said ignition tube; a mixing tube having one end connected to one end of the ignition tube and the other end connected to the outlets of both the first and second burettes; a storage container connected to said ignition tube for receiving the ignited gases from said ignition tube means for causing liquid to flow simultaneously into the inlets of the two burettes, whereby the liquid level in the first burette being at all times substantially the same as that in the second burette and the fuel gases and the oxidizing gases are caused to flow out of the first and second burettes through the mixing tube, being mixed therein and into and through the ignition tube and into said storage container and means for chemically analyzing the ignited gases.

2. Apparatus as set forth in claim 1 wherein the analyzing means includes means connected to said mixing tube for chemically analyzing the ignited gases; and means for moving the ignited gases from the ignition tube to the chemical analyzing means.

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