WFC 421 - Quenching Circuit Technology

Rendering Hydrogen Safer Than Natural Gas

The **Quenching Circuit Technology** is a combination and integration of several **Gas-Processes** that uses noncombustible gases to render hydrogen safer than Natural Gas.

The, "**Non-Burnable**" gases are used to adjust hydrogen "**Burn-Rate**" to **Fuel-Gas** burning levels

> ... recycled to stabilize **Gas-Flame** temperatures

> ...intermixed to sustain and maintain a Hydrogen **Gas-Flame**

> ... and used to prevent **Spark-Ignition** of supply gases.

The utilization and recycling of the non-combustible gases allows the **Water Fuel Cell** to become a **Retrofit Energy System**.

The **Quenching Circuit Technology** is systematically activated and performed in the following way:

Spark-Ignition Tube

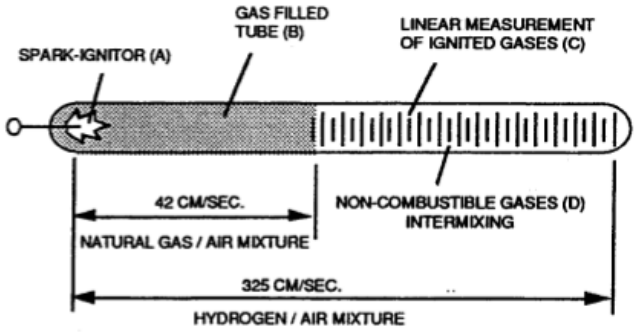

FIGURE 2-1: SPARK IGNITION TUBE

Spark-Ignition Tube (B) is a tubular test apparatus (1/8 diameter) that determines and measures the "**Burn-Rate**" of different types of **Burnable Gases** intermixed with Ambient Air, as illustrated in Figure (2-1).

Spark-Igniter (A) causes and starts the **Burnable Gas-Mixture** (B) to undergo **Gas-Ignition** which, in turns, supports and allows **Gas Combustion** to take place ... forming and sustaining a **Gas-Flame**.

The expanding and moving **Gas-Flame** travels (away from spark-igniter) the linear length of the **gas filled tube** (C) and is "**detected**" and "**measured**" (length between spark-igniter and light-detector) in one second after gas-ignition. The Gas-Ignition Process, now, establishes the "**Burn-Rate**" of a **Burnable Gas-Mixture** in centimeters per second (cm/sec.), as illustrated in Figure (2-2).

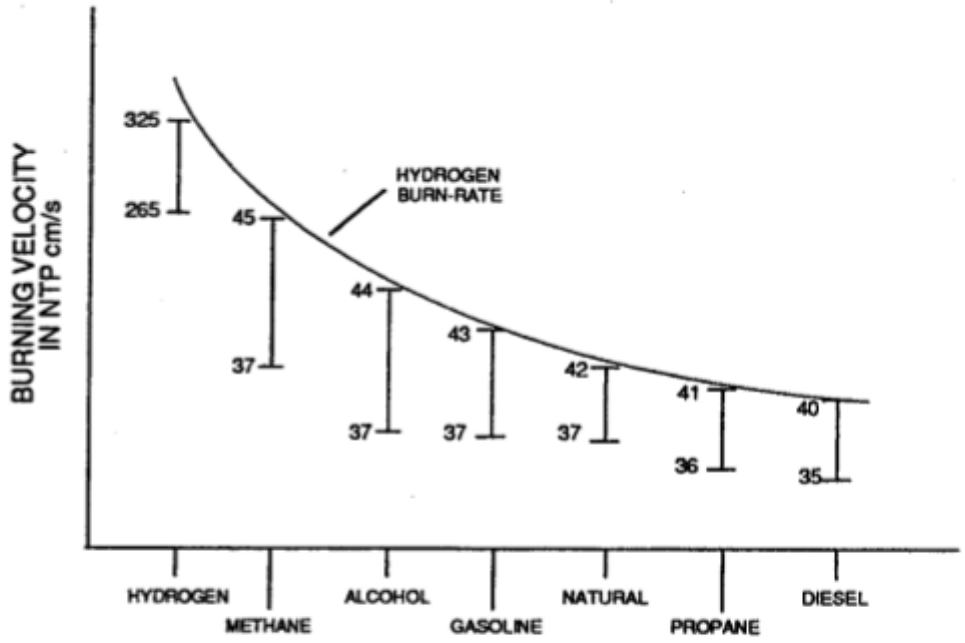

FIGURE 2-2: HYDROGEN BURN RATE

Different types of "**Burnable**" **Gas-Mixtures** exposed to the **Gas-Ignition Process** were tested, measured, recorded and systematically arranged as to cm/sec. length, see vertical bar Graph (2-2) again.

The **Gas-Ignition Process** was performed several times to establish the "average" **Burn-Rate** of the **Fuel-Gases** which, in turn, establishes the length of the vertical bars.

Gas Injection Process

Injecting and intermixing an **Non-Combustible Gas** (D) (non-burnable gas) with the ' **Burnable Gas-Mixture** (B) "changes" or "alters" the gas-mixture "**Burn-Rate**".

Ir **Gas** (D) diminishes and/or lowers th r.

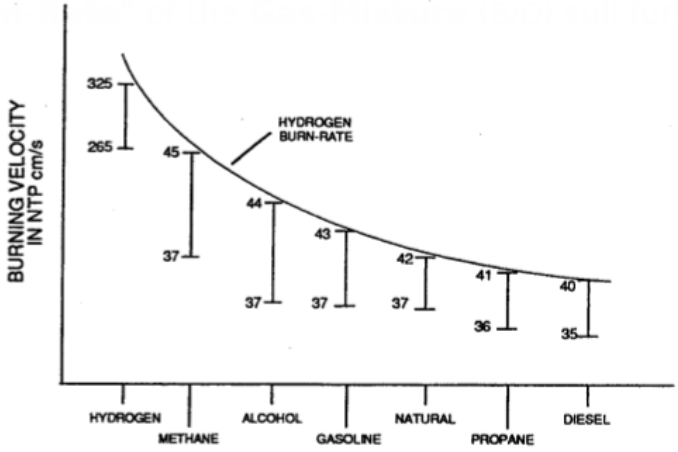

FIGURE 2-2: HYDROGEN BURN RATE

Progressive and controlled

intermixing of the non-combustible gases (B/D) allowed the "Burn-Rate" of Hydrogen to be "lowered" or "adjusted" to "match" or ... co-equal the "Burn-Rate" of other **Fuel-Gases**, see curve line in Figure (2-2).

In terms of operational performance, the **Non-Burnable** gas (D) does "Not" support the **Combustion Process** since the **Non-Burnable Gas** (D) "restricts" or "retards" the speed at which the **Oxygen Atom** unites with **Hydrogen Atoms** to cause **Gas Combustion**.

> The "**Gas Retarding Process**" is, of course, applicable to any type or combination of **Burnable Gases** or **Burnable gas-mixture**.

Gas Mixing Regulator

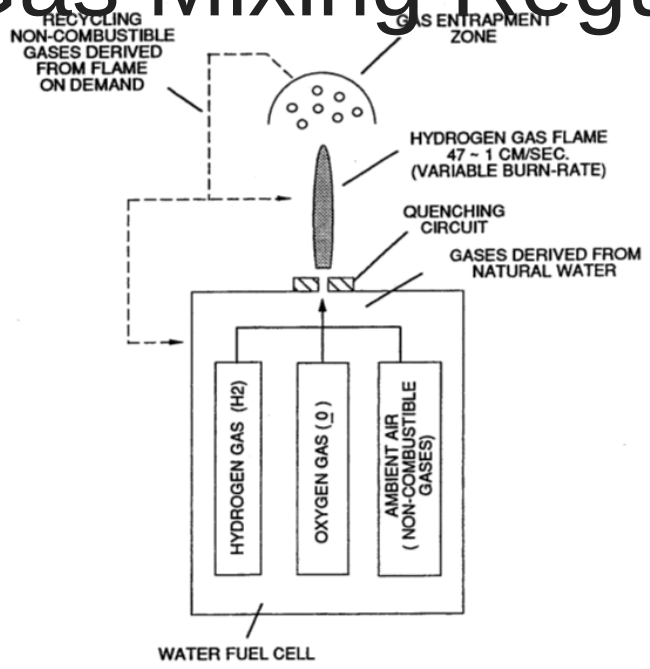

FIGURE 2-3: GAS MIXING REGULATOR

Inherently, the **Water Fuel Cell** allows the "**Burn-Rate**" of **Hydrogen** to be "Changed" or "adjusted" from 325 cm/sec. to 42 cm/sec.

(Co-equalling Natural Gas Burning levels) since **Non-Combustible Gases** (such as Nitrogen, Argon, and other non-burnable gases) derived from **Ambient Air** dissolved in natural water performs the **Gas Retarding Process**

> ... sustaining and maintaining an **Open-Air Flame** beyond 5000-degrees F, as illustrated in Figure (2-3)

Natural water acts and performs as a "**Gas-Mixing Regulator**" when the **Fuel-Cell** is electrically energized by way of voltage stimulation (Electrical Polarization Process)

... producing a uniform gas-mixture (B/D) regardless of the **Gas Flow-Rate** of the **Fuel-Cell**

... producing a uniform gas-mixture (B/D) only when needed.

> In quiescent-state, the supply of gases (BID) being released from the water bath is "terminated" and "stopped" when the **Fuel-Cell** becomes "de-energized".

The unused water, of course, remains as a non-burnable liquid.

> The gases (B/D) above the water bath is "vented" for safety purposes.

Flame Temperature Adjustment

By capturing and recycling the expelled non-combustible gas (D) (derived from and supplied by the water bath) back into the sustained hydrogen gas-flame or **Fuel-Cell** causes the gas-flame temperature to be "changed" or "altered" by way of the **Gas Retarding Process**, as illustrated in Figure (2-4) as to Figure (2-3).

Gas Retarding Process, as illustrated in Figure (2-4)

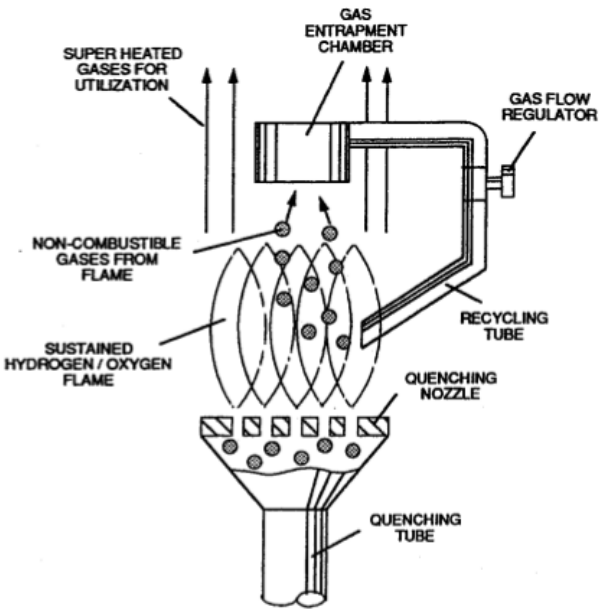

FIGURE 2-4: ADJUSTING FLAME TEMPERATURE

Figure (2-3)

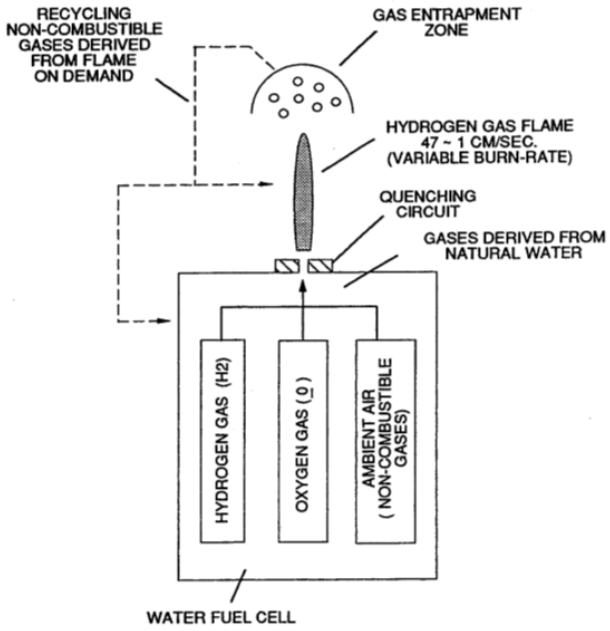

FIGURE 2-3: GAS MIXING REGULATOR

The recycling gases (D) controlled by an **Gas Flow Regulator** allows the gas flame-temperature to be "adjusted" or "calibrated" to any gas burning level (S), as so illustrated in Figure (2-2).

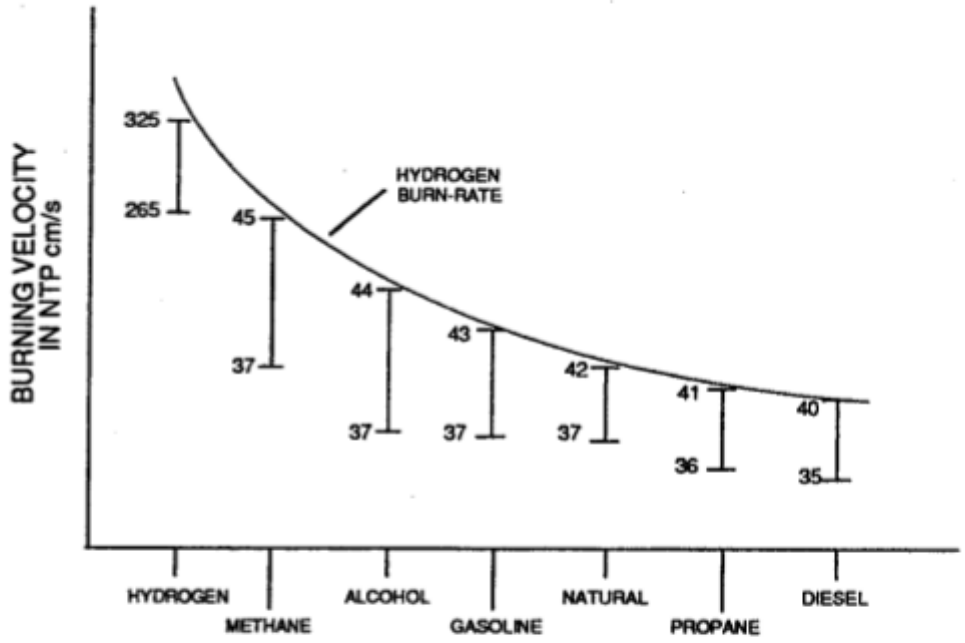

FIGURE 2-2: HYDROGEN BURN RATE

The "newly" formed and established gas flame-temperature remains constant regardless of the gas flow-rate of the Fuel-Cell.

> Continual feedback of non-combustible gases (D) is, hereinafter, called "**The Gas Combustion Stabilization Process**".

Automatically, the **Gas Combustion Stabilization Process** changes the "**Burn-Rate**" of the **Fuel Cell** gases (B/D) when obtaining the desired gas-flame temperature.

Quenching Circuit

Spark-Ignition of the **Fuel-Cell** gases (B/D) is prevented when the "**Gas Retarding Process**" is used in conjunction with a "**Quenching Circuit**", as illustrated in Figure (2-3), (2-4), (2-5) and (2-6).

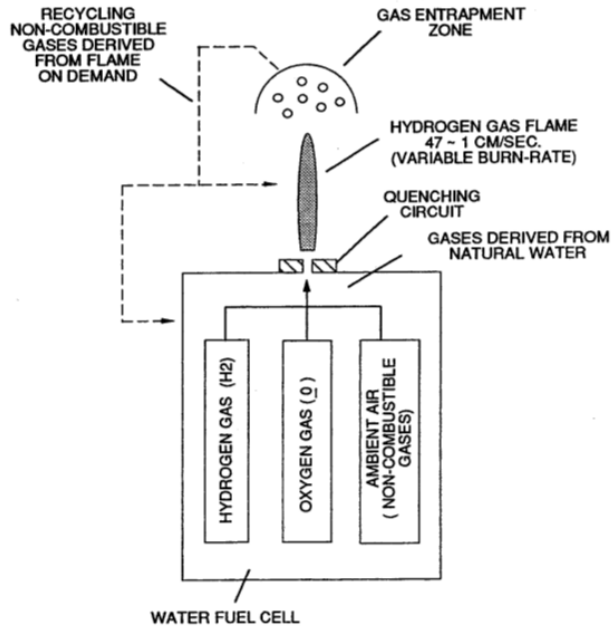

FIGURE 2-3: GAS MIXING REGULATOR

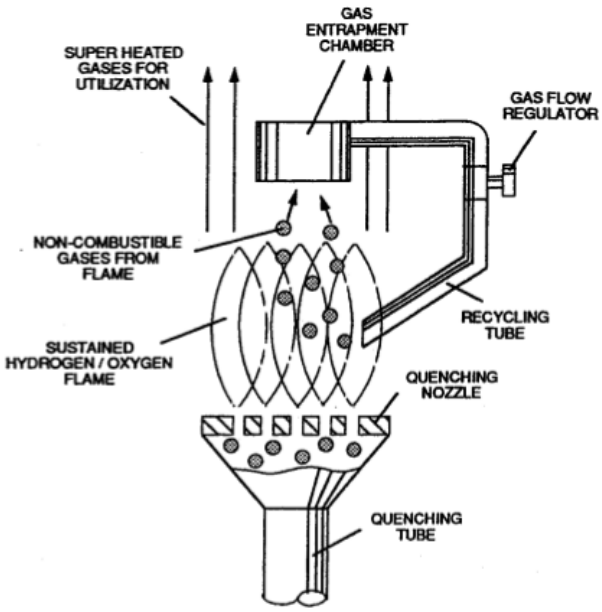

FIGURE 2-4: ADJUSTING FLAME TEMPERATURE

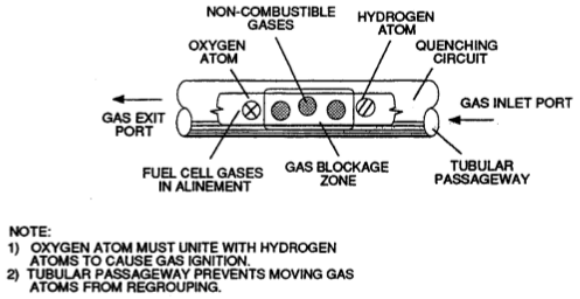

FIGURE 2-5: PREVENTING GAS IGNITION

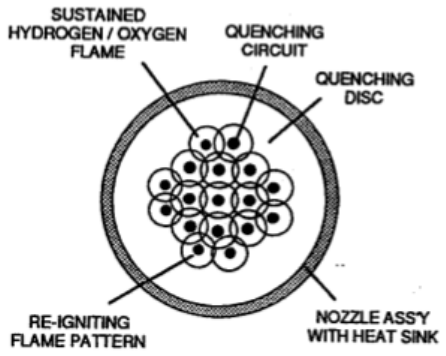

FIGURE 2-6: QUENCHING NOZZLE

The non-combustible gases (D) separates and prevents the hydrogen atoms to unite with oxygen atoms to "bring-on" or "initiate" **Gas-Ignition**.

> The narrow passageway (at least *1/8* inch long and having a .015 diameter) prevents the moving gas atoms from "Re-Grouping".

The alignment of the Fuel-Cell gases *(BID)* inside the tubular-passageway is, hereinafter, called "**The Quenching Circuit**".

> The **Quenching Circuit** "Anti-Spark technique" is "independent" of both **Gas-Velocity** and **Gas-Pressure**.

Quenching Nozzle

> Additional Quenching Circuits arranged in a Disc-shape configuration forms a "Quenching Nozzle" when attached to an "Quenching Tube", as illustrated in Figure (2-4) as to Figure (2-6).

Figure (2-3)

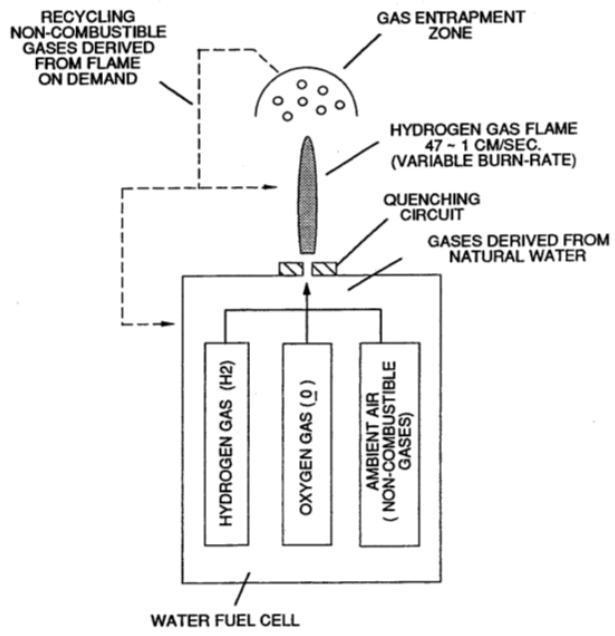

FIGURE 2-3: GAS MIXING REGULATOR

Figure (2-6)

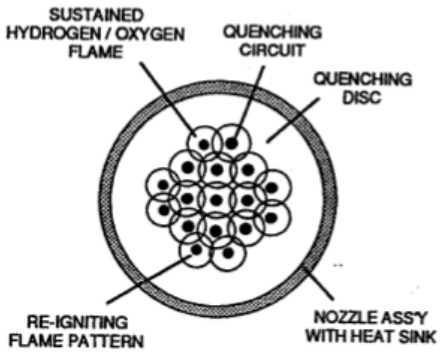

FIGURE 2-6: QUENCHING NOZZLE

The **Multi Gas-Port Disc** compensates for increased **Gas-Velocity** while "preventing" spark-ignition of the **Fuel-Cell** gases.

The overlapping **Flame-Pattern** re-ignites the expelling hydrogen gas-mixture (B/D) should **Flame-Out** occur.

Ceramic material is used to form the "**Quenching Disc**" to "prevent" hole-size enlargement due to gas-oxidation.

The non-combustible gases (D) keeps the **Ceramic Material** "cool-to-the-touch" by projecting the **Gas-Flame** beyond and away from the disc-surface ... the **Quenching Disc** remains "cool" even if the Gas-Flame Temperature exceeds the melting-point of the disc-material.

Quenching Tube

The **Quenching Disc** is extended into a **Flexible Tube** to transport the **Fuel-Cell** gases safely over long distances, as illustrated in Figure (2-7).

The **Spark-Arresting Gas-Line** is, hereinafter, called "**The Quenching Tube**."

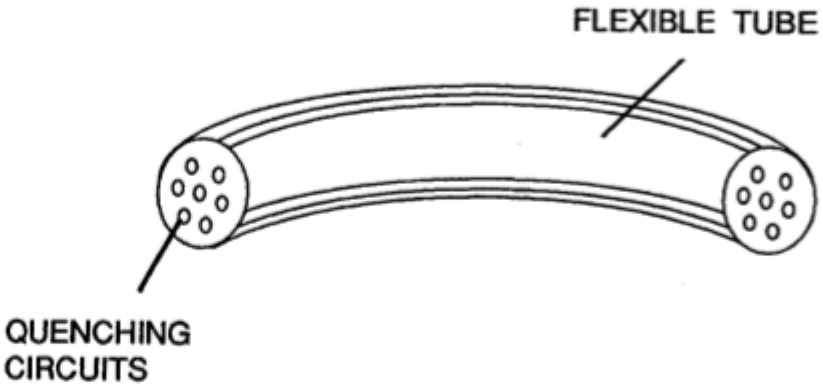

FIGURE 2-7: QUENCHING TUBE ALLOWS HYDROGEN TO BE DISTRIBUTED WITHOUT SPARK-IGNITION

Catalytic Block Assembly

An inverted hemispherical cavity placed on top. of and in space relationship to the "**Quenching Disc**" insures total gas-combustion by recycling any "escaped" or "unused" burnable gases back into the gas-flame for **Gas-Ignition**

> ... preventing **Gas-Oxide** formation, as illustrated in Figure (2-8) as to Figure (2-4).

Figure (2-8)

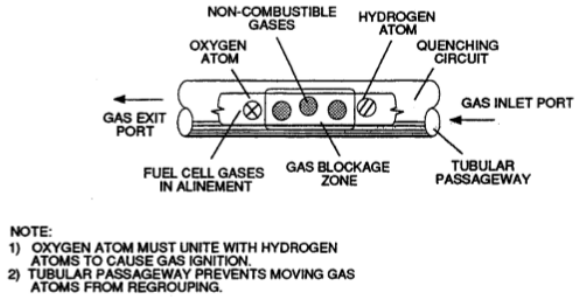

FIGURE 2-5: PREVENTING GAS IGNITION

Figure (2-4)

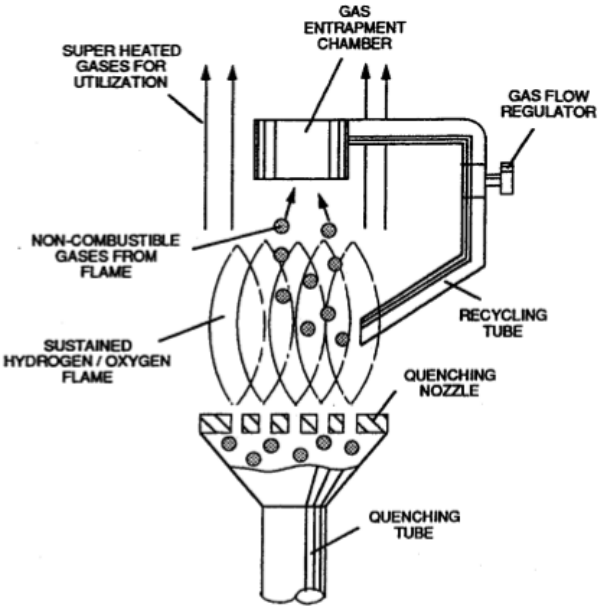

FIGURE 2-4: ADJUSTING FLAME TEMPERATURE

Internal Combustion Engine

The **Gas Combustion Stabilization Process** (recycling non-combustible gases) is also applicable to operating an **Internal Combustion Engine** without changing **Engine-Parts** since the **Gas Retarding Process** allows the hydrogen "**Burn-Rate** to "equal" the "**Burn-Rate**" of Gasoline or Diesel-Fuel, as illustrated in Figure (2-2).

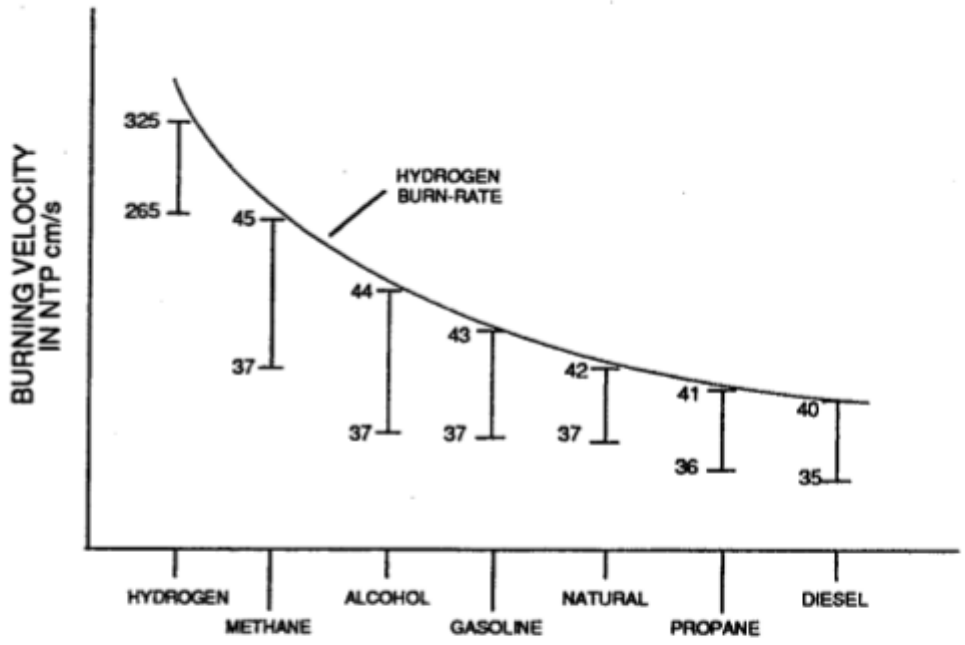

FIGURE 2-2: HYDROGEN BURN RATE

The engine provides its own non-combustible gases derived from **Ambient Air** undergoing the gas-combustion process.

> Engine temperature remains the same since **The Gas Stabilization Process** is used.

Gas Grid System

Ambient Air is the prime source of **Non-Combustible Gases** when the **Air-Gases** are exposed to and passes through an **Open-Air Flame**, as illustrated in Figure (2-10).

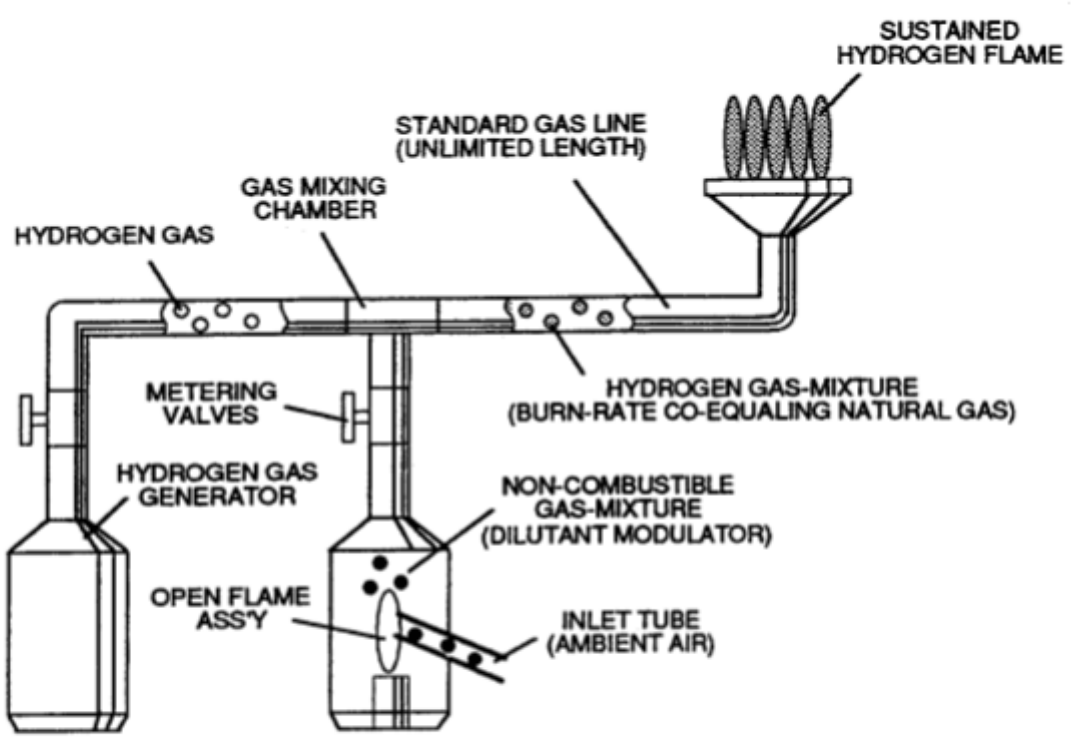

FIGURE 2-10: UTILIZING STANDARD GAS LINE TO TRANSPORT HYDROGEN GAS SAFER THAN NATURAL GAS

The **Gas Combustion Process** of the **Gas-Flame** eliminates oxygen and burnable gas atoms from the expelling gases ... producing an endless supply of non-combustible gases.

Mixing the "processed" **Air-Gases** with an **Hydrogen Supply Source** sets up **The Gas Retarding Process** ... allowing the **Hydrogen Gas-Mixture** to be transported safely through existing **Gas-Grid System**.

Operational Parameters

The utilization and recycling of non-combustible gases, now, renders hydrogen gas as safe as **Natural Gas** or any other **Fuel-Gas** ... allowing the **Water Fuel Cell** to become a **Retrofit Energy System**.

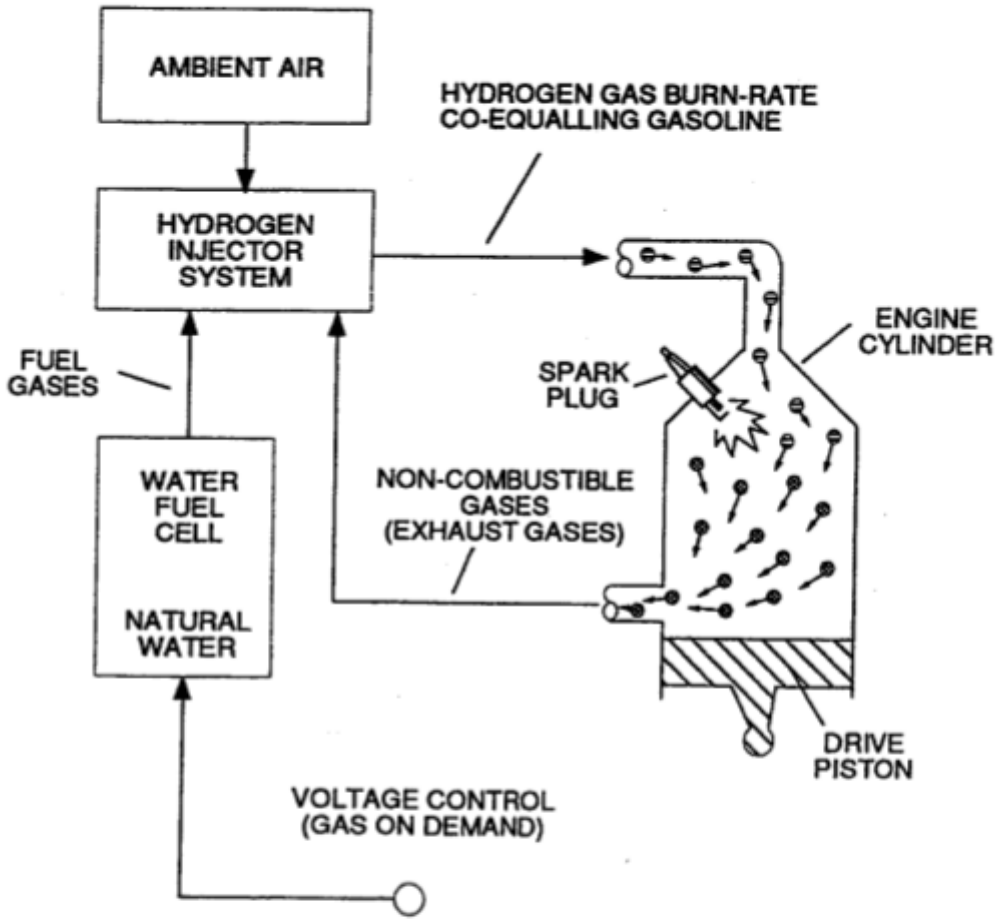

FIGURE 2-9: WATER FUEL CELL RETROFITTED TO A INTERNAL COMBUSTION ENGINE

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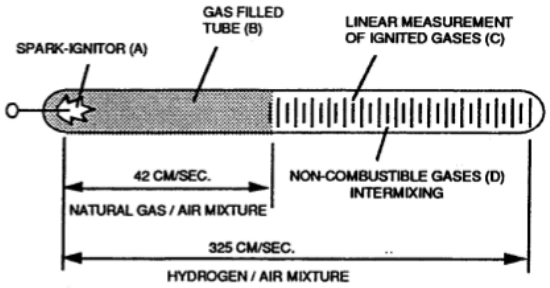
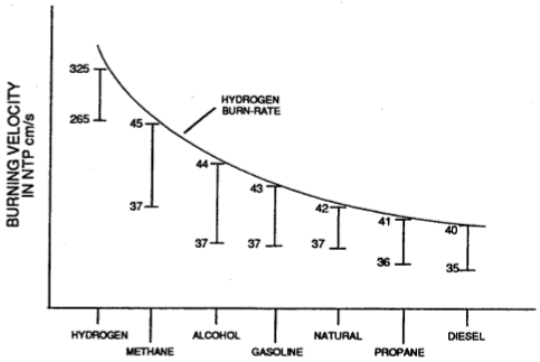


FIGURE 2-1: SPARK IGNITION TUBE



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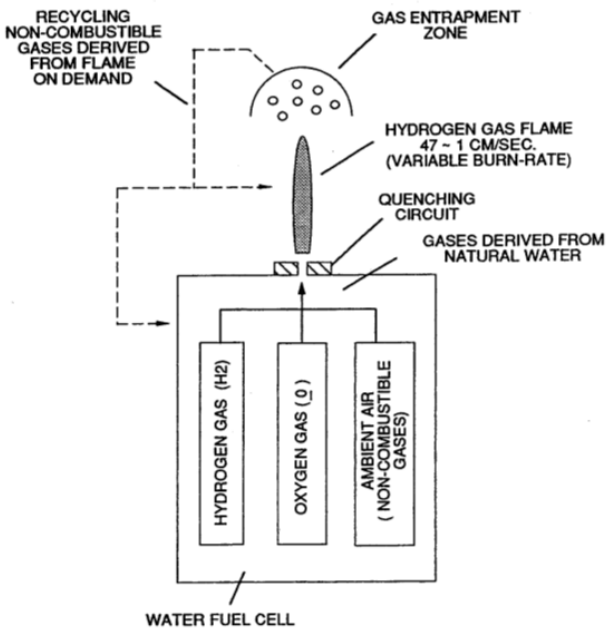


FIGURE 2-3: GAS MIXING REGULATOR

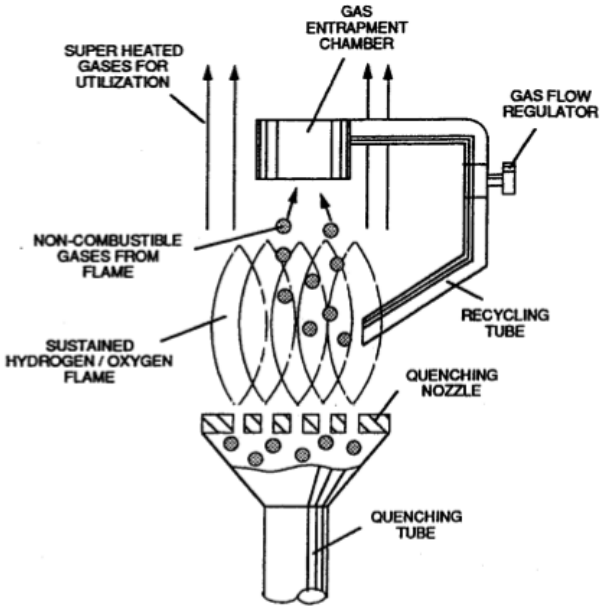
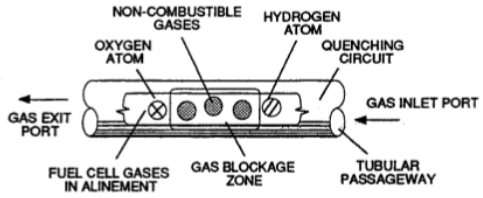


FIGURE 2-4: ADJUSTING FLAME TEMPERATURE



NOTE:
1) OXYGEN ATOM MUST UNITE WITH HYDROGEN ATOMS TO CAUSE GAS IGNITION.
2) TUBULAR PASSAGEWAY PREVENTS MOVING GAS ATOMS FROM REGROUPING.

FIGURE 2-5: PREVENTING GAS IGNITION

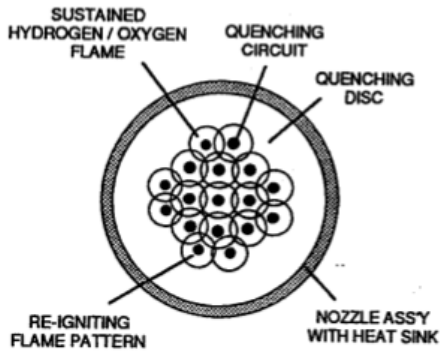


FIGURE 2-6: QUENCHING NOZZLE

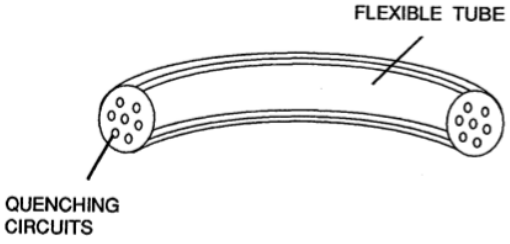


FIGURE 2-7: QUENCHING TUBE ALLOWS HYDROGEN TO BE DISTRIBUTED WITHOUT SPARK-IGNITION

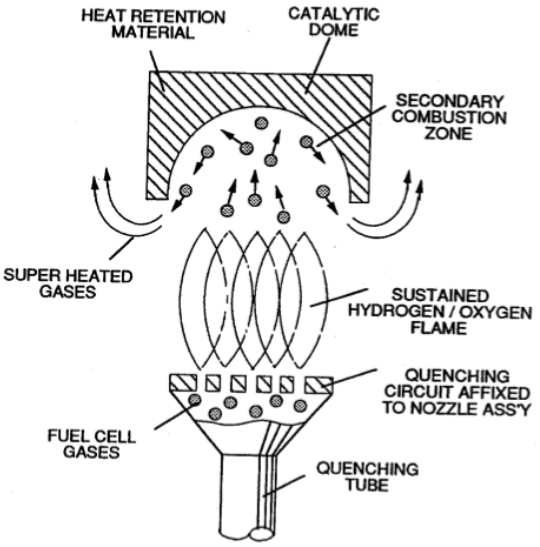


FIGURE 2-8: CATALYTIC BLOCK ASS'Y

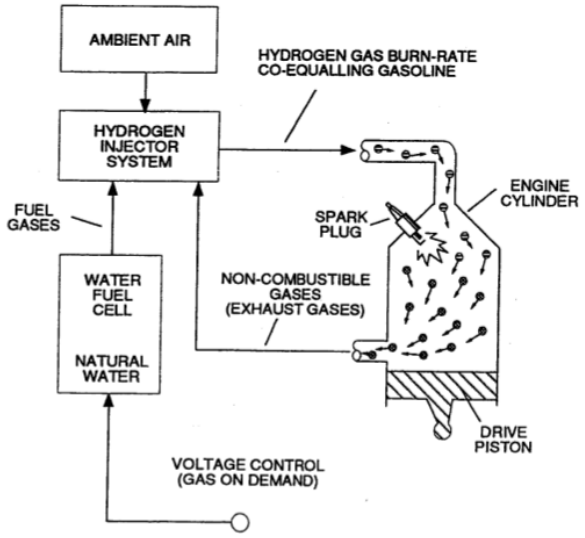


FIGURE 2-9: WATER FUEL CELL RETROFITTED TO A INTERNAL COMBUSTION ENGINE

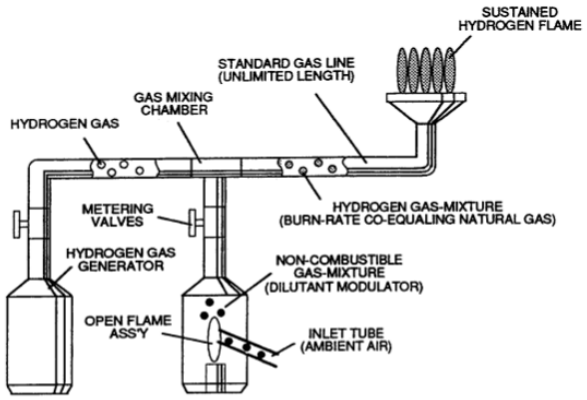


FIGURE 2-10: UTILIZING STANDARD GAS LINE TO TRANSPORT HYDROGEN GAS SAFER THAN NATURAL GAS

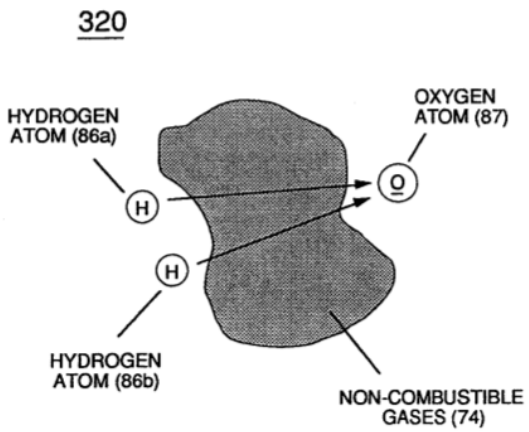


FIGURE 2-11: GAS MODULATOR