

# *A Practical Guide to 'Free Energy' Devices*

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Please note that this is a re-worded excerpt from this patent application. If the content interests you, then a full copy can be obtained from <http://www.espacenet.com>. It describes a method which it is claimed is capable of operating an internal combustion engine from a mixture of steam and hydrogen gas.

**Patent Application EP0405919 1st February 1991 Inventor: Juan C. Aguero**

## WATER-PROPELLED INTERNAL-COMBUSTION ENGINE SYSTEM

### ABSTRACT:

This is an energy-transforming system for driving, for instance, an internal combustion engine which uses hydrogen gas as its fuel. The gas is obtained by electrolysing water on board and is then injected into the combustion chambers. The electrolysis is carried out in an electrolytic tank **15**, energised with electric current generated by the engine. The hydrogen passes from a reservoir **23**, via collector cylinder **29**, to carburettor device **39**. The hydrogen is then fed into the engine together with dry saturated steam and at least part of the hydrogen may be heated **51** prior to admission. A cooler and more controlled combustion is achieved with the steam and furthermore relatively lesser amounts of hydrogen are required. This is probably caused by the steam acting as a temperature moderator during admission and combustion of the hydrogen and additionally expanding during the expansion stroke.

### FIELD OF THE INVENTION:

The present invention refers to energy-converter systems, in particular related to an internal combustion engine fuelled by hydrogen gas, i.e. wherein the main propellant admitted to the combustion chambers is hydrogen. More particularly still, the present invention refers to method and means for obtaining hydrogen gas in an efficient and reasonably economical manner, and for supplying the gas to the combustion chambers under conditions for controlled ignition and optimum energy conversion. The present invention also refers to means and method for running an internal-combustion engine system from an available, cheap and non-contaminant hydrogen containing matter such as water as a fuel supply.

In general, the invention may find application in any system employing internal combustion principles, ranging from large installations such as electricity works to relatively smaller automobile systems like locomotives, lorries, motor-cars, ships and motor-boats. In the ensuing description, the invention is generally disclosed for application in the automotive field, however its adaptation and application in other fields may also be considered to be within the purview of the present invention.

### BACKGROUND:

Dwindling natural resources, dangerous contamination levels, increasing prices and unreliable dependence on other countries are making it increasingly necessary to search an alternative to fossil fuels like oil (hydrocarbons) and oil derivatives as the primary energy source in automobiles. To date, none of the attempted alternatives appears to have proved its worth as a substitute for petrol, either because of inherent drawbacks as to contamination, safety, cost, etc. or because man has not yet been able to find a practical way of applying the alternative energy forms to domestic motor cars.

For instance, electricity is a good alternative in the ecological sense, both chemically and acoustically, however it appears to be the least efficient form of energy known, which together with the high cost of manufacture of electric motors and the severe storage limitations insofar capacity and size have stopped it

from coming into the market at least for the time being. The same is generally true even when solar energy is concerned.

Nuclear power is efficient, available and relatively cheap, but extremely perilous. Synthetic fuels may certainly be the answer in the future, however it appears that none practical enough have been developed. Use of gases such as methane or propane, or of alcohol distilled from sugar cane, has also been tried, but for one reason or another its marketing has been limited to small regions. Methanol for instance is a promising synthetic fuel, but it is extremely difficult to ignite in cold weather and has a low energy content (about half that of petrol).

The use of hydrogen gas as a substitute for petrol has been experimented lately. The chemistry investigator Derek P. Gregory is cited as believing that hydrogen is the ideal fuel in not just one sense. Hydrogen combustion produces steam as its only residue, a decisive advantage over contaminating conventional fuels such as petrol and coal. Unfortunately, hydrogen hardly exists on earth in its natural free form but only combined in chemical compounds, from which it must be extracted using complicated, expensive and often hazardous industrial processes. In addition, if this obstacle were overcome, it would still be necessary to transport and store the hydrogen in service stations and moreover find a safe and practical way of loading and storing it in motor vehicles. Mercedes-Benz for one is experimenting with a vehicle equipped with a special tank for storing hydrogen gas and means for supplying the gas to the injection system, instead of the conventional petrol tank and circuit, without however yet achieving a satisfactory degree of safety and cost-efficiency. The use of dry hydrogen gas as a propellant has heretofore been found to produce a generally uncontrolled ignition, a large temperature excursion upwards which proved too destructive for the chamber walls. The engine life was limited to less than 10,000 km (about 6,000 miles).

#### **DISCLOSURE OF THE INVENTION:**

The invention is based on the discovery of an energy-converter system to run an internal combustion engine and particularly is based on the discovery of a method and means for reliably, economically, safely and cleanly fuel an internal combustion engine with hydrogen, and obtaining the hydrogen in a usable form to this end from a cheap and plentifully available substance such as water. The hydrogen may be generated in optimum conditions to be fed into the engine.

According to the invention, hydrogen is obtained on board from a readily available hydrogenous source such as ionised water which is subjected to electrolysis, from whence the hydrogen is injected in each cylinder of the engine on the admission stroke. The hydrogen gas is mixed with water vapour (steam at atmospheric temperature) and surrounding air, and when this mixture is ignited within the combustion chamber, the steam (vapour) seems to act as a temperature moderator first and then assist in the expansion stroke. Preferably, the steam is dry saturated steam which, as a moderator, limits the maximum temperature of the combustion, thus helping to preserve the cylinder, valve and piston elements; and in assisting the expansion, the steam expands fast to contribute extra pressure on the piston head, increasing the mechanical output power of the engine. In other words, the inclusion of steam in the hydrogen propellant as suggested by the present invention moderates the negative effects of hydrogen and enhances the positive effects thereof in the combustion cycle.

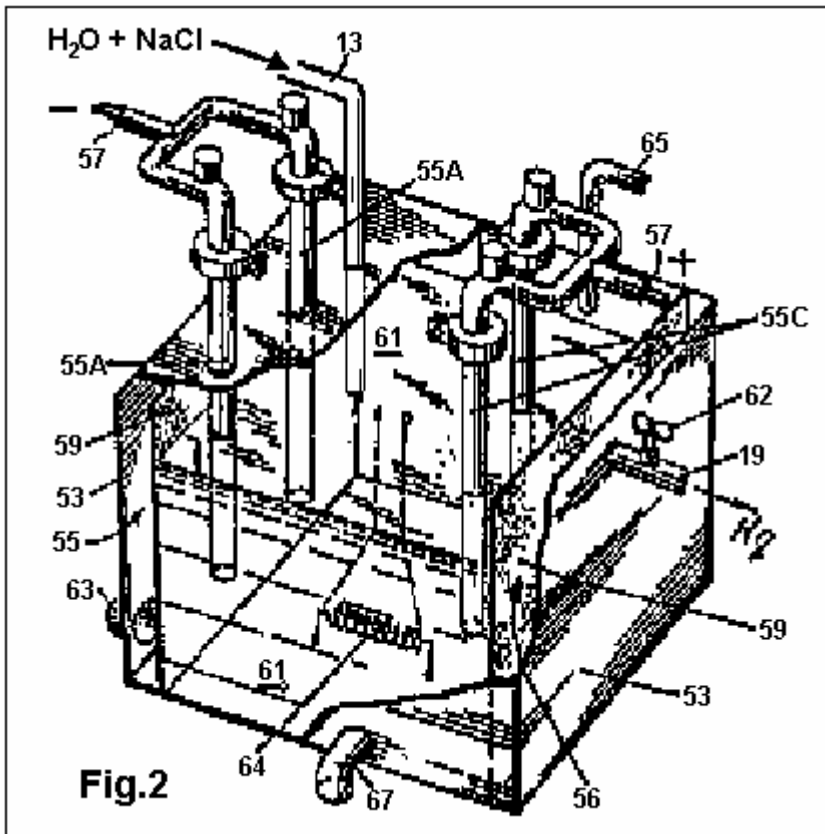
As a result of this discovery, the amount of hydrogen required to drive the engine is lower than was heretofore expected, hence the electrolysis need not produce more than 10 cc/sec (for example, for a 1,400 cc engine). Thus the amount of electricity required for the electrolysis, a stumbling block in earlier attempts, is lower, so much so, that on-board hydrogen production is now feasible.

The invention includes an apparatus comprising a first system for generating hydrogen and a second system for conditioning and supplying the hydrogen to the admission valves on the cylinder caps. The hydrogen-generating system basically consists of an electrolysis device which receives electrolytically adapted (i.e. at least partially ionised) water or some other suitable hydrogenous substance. An electric power supply is connected to the electrodes of the electrolysis device for generating the hydrogen, and the electricity requirements and the device dimensions are designed for a maximum hydrogen output rate of about 10 cc/sec for a typical automotive application.

The second system comprises means such as a vacuum pump or the like to draw out the hydrogen from the first system, means for supplying the hydrogen gas to the admission valves, means for conditioning the moisture content of the hydrogen, carburettor means or the like for mixing the hydrogen with atmospheric air or some other combustion enabling substance, and means to control and maintain a specified gas pressure valve or range for the hydrogen supplied to the mixing means.



Figure 2 is an elevational view of the electrolysis device of figure 1.



**DETAILED ACCOUNT OF AN EMBODIMENT:**

**Fig.1** shows a system **11** for obtaining hydrogen front water piped from a reservoir or tank (not illustrated) to an inlet **13** of an electrolysis cell **15**. The water is salted by adding sodium chloride to ionise it and enable electrolysis when electric power is applied to a pair of terminals **17**. As disclosed in more detail later, the power applied to the terminals **17** is in the form of a DC pulse signal of 65 Amps at 87 Volts, generated via a suitable converter from, in the event that the present system is applied to an automobile, the standard automotive 12 Volt DC level. The device **15** has various outlets, one of which is the hydrogen gas outlet **19** which is connected through a solenoid valve **21** to an accumulator or reservoir cylinder **23**. Other outlets of the electrolysis device **15** are for removing electrolysis effluents such as sodium hydroxide and chlorine gas, to which further reference is made below.

A vacuum pump **25** or similar, extracts gas from the reservoir **23** and channels it through a hydrogen circuit system **27**. Thus the reservoir **23** acts as a pressure buffer of a systems interface between the electrolysis device **15** and the pump **25**. The reservoir **23** may be a 2,000 cc capacity, stainless-steel cylinder with the valve **21** metering the passage of gas through it, so that the reservoir is initially filled with about 1,500 cc of hydrogen at normal pressure and temperature (NPT) conditions. To this end, the cylinder **23** may be provided with a gauge **28V** which controls the state of valve **21** electronically. Valve **21** may be a Jefferson Model SPS solenoid valve, available from OTASI, Santa Rosa 556, Córdoba, Argentina. Vacuum pump **25** is a diaphragm pump with a pulley drive and it is coupled by means of a transmission belt to the engine's crankshaft output. Such a device **25** may be a Bosch model available in Germany. The pulley drive is decoupled by an electromagnetic clutch when the pressure read by a gauge **28P** screwed into the outlet side of pump **25** exceeds 2Kg/sq. cm.

Pump **25** sends hydrogen through tubing **26**, which also includes a by-pass **24** provided for inspection and safety purposes together with a two-way valve **28**, and into a second cylinder **29** which contains means **31** which cause a turbulence or a labyrinthine movement in the gas, in order to condense the heavy mixture, schematically shown as droplets **32**, present in the gas stream. The condensed mixture collects in the form of distilled water **33** at the bottom of cylinder **29**. Near the top of the cylinder, there is an outlet **35** through which hydrogen gas, laden with a good amount of steam, is transported to mixer **37**. Also at the top of

collector cylinder **29**, there is a temperature sensor **38** which is connected to an electronic digital thermometer circuit (not shown).

Mixer **37** comprises a carburettor device **39** for mixing hydrogen with air prior to feeding the mixture to the combustion chambers. The hydrogen is piped through a 3/8" diameter tube **41** from dryer cylinder **29** and then into the venturi section **43** of the carburettor **39** through a pair of 5/16" diameter tubes or hydrogen injecting nozzles **45**. The venturi section **43** is a section of the intake air passage which narrows to increase the air speed at the point where hydrogen is drawn out for mixing. The venturi intake **42** may be covered by a mesh **46**. However, it appears that no air filter is needed for the mixer to operate well. The carburettor device **39** may be a simplified form of a conventional carburettor, since the propellant, i.e. hydrogen gas, is fed directly to the venturi **43**. A butterfly valve, or the like, connected to an accelerator pedal (not illustrated) of the motor-car, controls the air intake rate and therefore the speed of the engine. This mixer device **39** is mounted as is a conventional carburettor, such that its outlet at the bottom communicates with the admission valves in the cylinder caps.

At the bottom part of the carburettor there is a supplementary hydrogen intake **47** connected to another 3/8" diameter pipe **49** which shunts part of the hydrogen through a heater **51**. This heater comprises a serpentine tube **51** of a chromium/cobalt alloy, mounted in close heat-exchange relationship with the body of the exhaust manifold **50** (schematically illustrated) in order to add a portion of heated gas to the fuel mixture before it is drawn into the combustion chambers through the corresponding admission valves on the cylinder caps. This pre-admission heating step, takes the hydrogen mixture to a near critical temperature for detonation. It has been found that this improves performance (e.g. the engine smoothness) at some speed ranges, and it works like a supercharger.

In practice, the engine of the present invention has shown a high efficiency when using three-electrode sparking plugs and an electronic ignition system (not illustrated).

**Fig.2** shows the electrolysis cell **15** outlined in **Fig.1** in more detail. It is comprised of a rectangular prism reservoir **53** with a pair of spaced-apart vertical electrodes **55**. The reservoir may measure, for instance, 24 cm long by 20 cm wide and 28 cm high. Both the anode and cathode **55** may each comprise double electrodes of carbon having a spacing between the electrodes **55** of the same polarity of about 10 cm. Alternatively, the anode **55A** may be a ring made of carbon while the cathode **55C** is an iron-mesh cylindrical electrode. Each electrode **55** has a terminal **57** at the top for inputting electric power as mentioned earlier. At each outer side of the electrodes **55** there is a porous membrane **59** made from a sheet of amianto (asbestos) for holding the water solution **61** in whilst at the same time letting the electrolysis products, i.e. hydrogen and oxygen, pass through. Thus, the hydrogen gas passes through the membrane **59** into a gas collector chamber **56** and exits out through pipe **19** to fuel the combustion engine. The hydrogen pipe **19** may have a proportioning valve **62** for regulating the flow of hydrogen. The oxygen on the other hand may be vented out into the atmosphere through an outlet **63**.

There is a heater element **64**, immersed in the salted water **61** fed through a resistor connected to a 12 Volt DC supply. This heats the water to about 85 degrees C (185 degrees F) to enhance the galvanic action of the electrolysis current on the aqueous solution **61**. A thermostat with a solid state silicon thermal sensor may be used to control the water temperature via a threshold comparator driving a relay which controls the current in the heater element **64**.

The electrolysis of the heated salted water solution **61** further produces, as effluents, chlorine gas (Cl<sub>2</sub>) and sodium hydroxide (NaOH). The chlorine gas may be vented through an opening **65** at the top of the reservoir **53** or else stored in an appropriate disposal tank (not shown). The sodium hydroxide precipitates and may be removed periodically through tap **67** at the bottom of the electrolysis cell.

It is important to note that the practice of the present invention requires practically no modifications in the engine itself. That is, existing petrol engines may be used with hardly any adjustments. Ignition is initiated at the dead top of the compression stroke or with a 1.5 degree lag at the most, and it has been found convenient to widen the gaps of the admission and exhaust valve pushers and use tri-electrode spark plugs. However it is advisable to use some rust-resistant compound such as plastics for the exhaust pipe and silencer, bearing in mind that the combustion residue is hot steam.

**Fig.1** also shows schematically, the electric power supply **71** connected to the terminals **17** of the cube **15**. Electrical current is obtained at 12 volt DC from the car battery/alternator system **73** and processed by an inverter device **75** for generating DC pulses of 65 Amps at 87 Volts. Pulse energisation of the electrolysis appears to maximise the ratio of hydrogen output rate to electric power input.

## **CLAIMS:**

1. A method of providing propellant to an internal combustion engine wherein combustion is fuelled on the basis of hydrogen gas admitted into at least one combustion chamber of the engine during the intake stroke, characterised in that the hydrogen is injected into the combustion chamber together with vapour.
2. The method of claim 1, characterised in that the surrounding air enters the combustion chamber, together with the hydrogen and vapour.
3. The method of claim 2, characterised in that the hydrogen gas is obtained from water which is continuously subjected to electrolysis energised by the engine.
4. The method of claim 2 or 3, characterised in that the hydrogen is generated at a rate of not more than 10 cc/sec.
5. The method of any of the preceding claims, characterised in that the engine drives a motor-car.
6. The method of any of preceding claims, characterised in that the vapour is added to the hydrogen prior to entering the combustion chamber.
7. The method of any of claims 1 to 5, characterised in that the vapour is contained in the hydrogen when generated.
8. The method of any of the preceding claims, characterised in that the vapour is dry saturated steam.
9. A method of driving a internal combustion engine with water as its primary source of energy, characterised by the steps of subjecting the water to hydrolysis thereby producing gaseous hydrogen, and controllably supplying the hydrogen produced by the hydrolysis to the engine combustion chambers during the admission stroke of each cylinder together with a proportion of steam.
10. The method of claim 9, characterised in that the steam is dry saturated steam.
11. The method of any of claims 9 or 10, characterised in that the hydrolysis driven by electric power to produce not more than 10 cc/sec of the hydrogen gas.
12. The method of any of claims 9 to 11, characterised in that the engine drives a motor-car including a water tank as its main propellant supply.
13. The method of any of claims 9 to 12, characterised in that at least part of the hydrogen is heated before injecting it into the chamber.
14. The method of any claims of 9 to 13, characterised in that steam is obtained together with the hydrogen gas from the electrolysis and then subjected to a drying cycle up to a predetermined point of saturation before being passed into the chambers.
15. The method of claim 11, characterised in that the hydrolysis means is supplied with about 5 kW pulsed electrical power.
16. A method of injecting propellant into an hydrogen-driven internal combustion engine cylinder during the admission stroke thereof, characterised in that dry steam is passed into said cylinder during the intake stroke to moderate temperature generation of the hydrogen ignition and enhance expansion after ignition has begun to increase the power of the pistons.
17. A method of obtaining hydrogen capable of being used to fuel an internal combustion engine, characterised by dissociating hydrogen gas from a hydrogenous compound, and admitting the hydrogen gas into each cylinder of said engine together with an amount of dry steam.
18. The method of claim 17, characterised in that the hydrogen gas is admitted to the engine cylinders at a rate of not more than 10 cc/sec.

19. The method of claim 17 or 18, characterised in that the compound is slightly salted water and the steam is saturated steam.

20. A system for obtaining and providing hydrogen propellant to an internal combustion engine including at least one cylinder containing a piston which is subjected to successive combustion cycles and injection means for admitting fuel into the cylinder on the intake or admission stroke of the cycle, characterised by comprising: fuel source means for containing a hydrogenous compound, electrolysis means (15) having at least one pair of electrodes (55) for receiving electric power and intake means (13) connected to the source for supplying the compound to the electrolysis means, a means (27, 37) for extracting hydrogen gas from one of the electrodes and supplying it to the cylinder injection means, and control means (25, 28, 29) for controlling the supply of hydrogen gas to the cylinder injection means whereby the rate of gas consumption in the engine is not more than 10 cc/sec.

21. The system of claim 20, characterised in that the means supplying hydrogen gas to the cylinder injection means further include means (37) for mixing said hydrogen gas with steam.

22. The system of claim 20 or 21, characterised in that the compound is water and the source means includes a water tank, the water including salt to facilitate electrolysis.

23. The system of claim 20, 21 or 22, characterised in that the control means include means (29) for removing the excessive moisture from the hydrogen gas extracted from the hydrolysis means.

24. The system of any of claims 20 to 23, characterised in that the electrolysis means is energised by the engine.

25. An internal combustion engine operating on hydrogen and having a water tank as its primary source of combustion fuel, a cylinder block containing at least one cylinder chamber, each chamber, having an associated piston, fuel intake means, ignition means, and exhaust means, and crankshaft means coupled to be driven by the pistons for providing mechanical output power from the engine, and characterised by further comprising: electrolysis means (15) connected to the water tank for electrolysing water to obtain hydrogen, electrical means (17) connected to supply electric power to at least one pair of electrodes (55) of the electrolysis means for carrying out the electrolysis of the water, and hydrogen circuit means (27) for extracting the hydrogen gas from the electrolysis means and passing it onto said intake means in a manner enabling controlled ignition and expansion of the fuel in the chamber.

26. The engine of claim 25, characterised in that said hydrogen circuit means passes hydrogen gas to the intake means at a rate of not more than 10 cc/sec.

27. The engine of claim 25 or 26, characterised by further comprising means for adding steam into each chamber before ignition of the hydrogen.

28. The engine of claim 27, characterised in that the steam adder means comprises means (25) for extracting steam from the electrolysis means, and means (29) for subjecting said steam to a drying process up to a pre-determined point.

29. The engine of any of claims 25 to 28, characterised by further comprising means (49, 51) for heating at least part of the hydrogen gas before it is passed into the chambers.

30. The engine of claim 29, characterised in that said heating means is a serpentine (51) inserted in a shunt (49) of the hydrogen circuit means and mounted in heat-exchange relationship on a manifold exhaust of the engine.

31. The engine of any of claims 25 to 30, characterised in that said electrical means include pulse generator means for supplying electrical pulses to said at least one pair of electrodes.

32. The engine of claim 31, characterised in that said pulse generator means supplies electrical DC pulses of between 50 and 75 Amps at between 60 and 100 Volts.

33. The engine of any of claims 25 to 32, characterised in that said hydrogen circuit means includes drying means (33) for removing excess moisture from the hydrogen extracted from the electrolysis means.

34. The engine of any of claims 25 to 33, characterised in that said crankshaft means drives a water-fuelled automobile.

35. The engine of any of claims 25 to 34, characterised in that the electrolysis means is driven by electricity derived from the engine.