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(54) **SYSTEM FOR PRODUCING MECHANICAL ENERGY FROM ELECTRICAL ENERGY**

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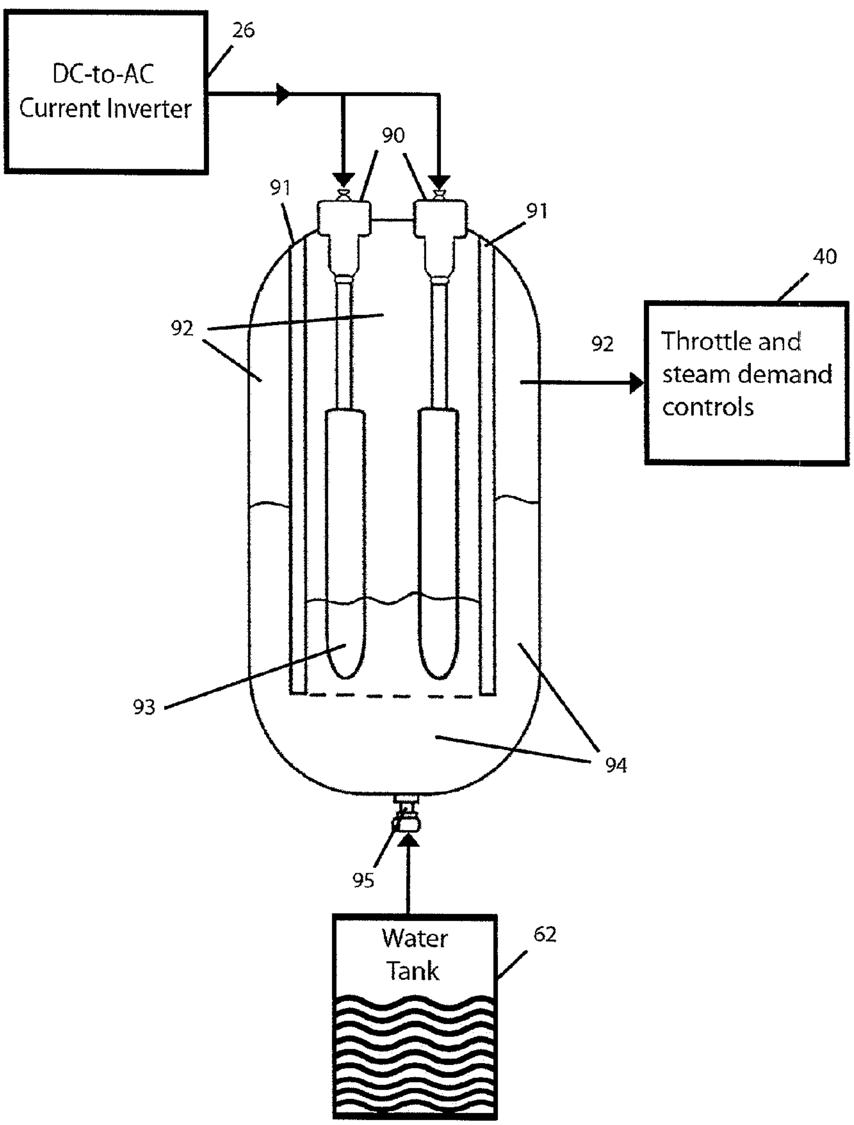
(57) **ABSTRACT**

A system for producing mechanical energy from electrical energy. The system has a source of electrical current, a boiler device for producing hot vapor from an electrically-conductive liquid directly from the electrical current, the boiler device comprising at least two electrodes that are electrically coupled to the source of electrical current and boil the liquid into a vapor by passing the current between the electrodes through the liquid, and an engine that produces mechanical energy from the hot vapor.



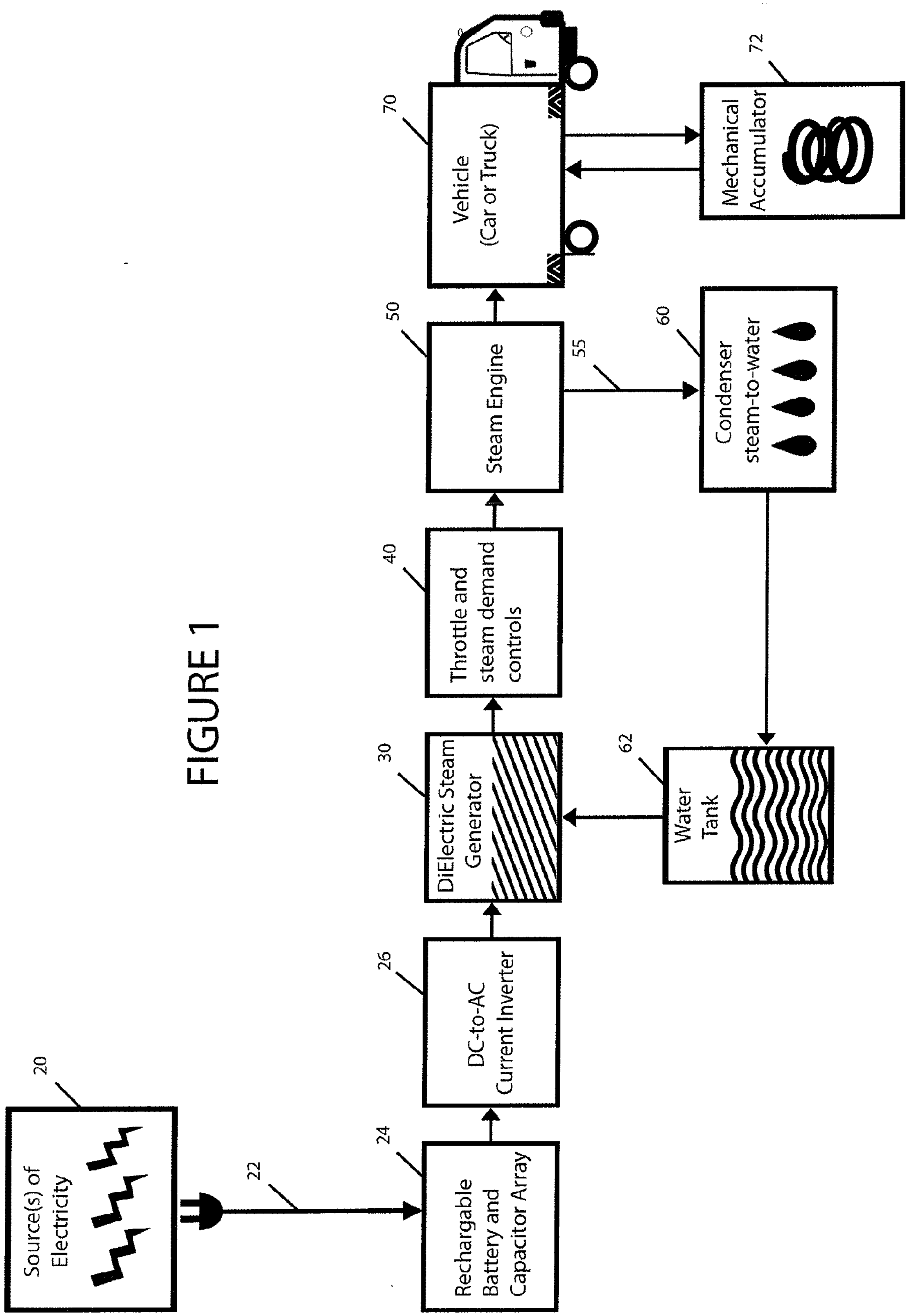

Source(s) of Electricity
20
22
Rechargable Battery and Capacitor Array
24
DC-to-AC Current Inverter
26
DiElectric Steam Generator
30
Water Tank
62
Throttle and steam demand controls
40
Steam Engine
50
55
Condenser steam-to-water
60
Vehicle (Car or Truck)
70
Mechanical Accumulator
72

FIGURE 1

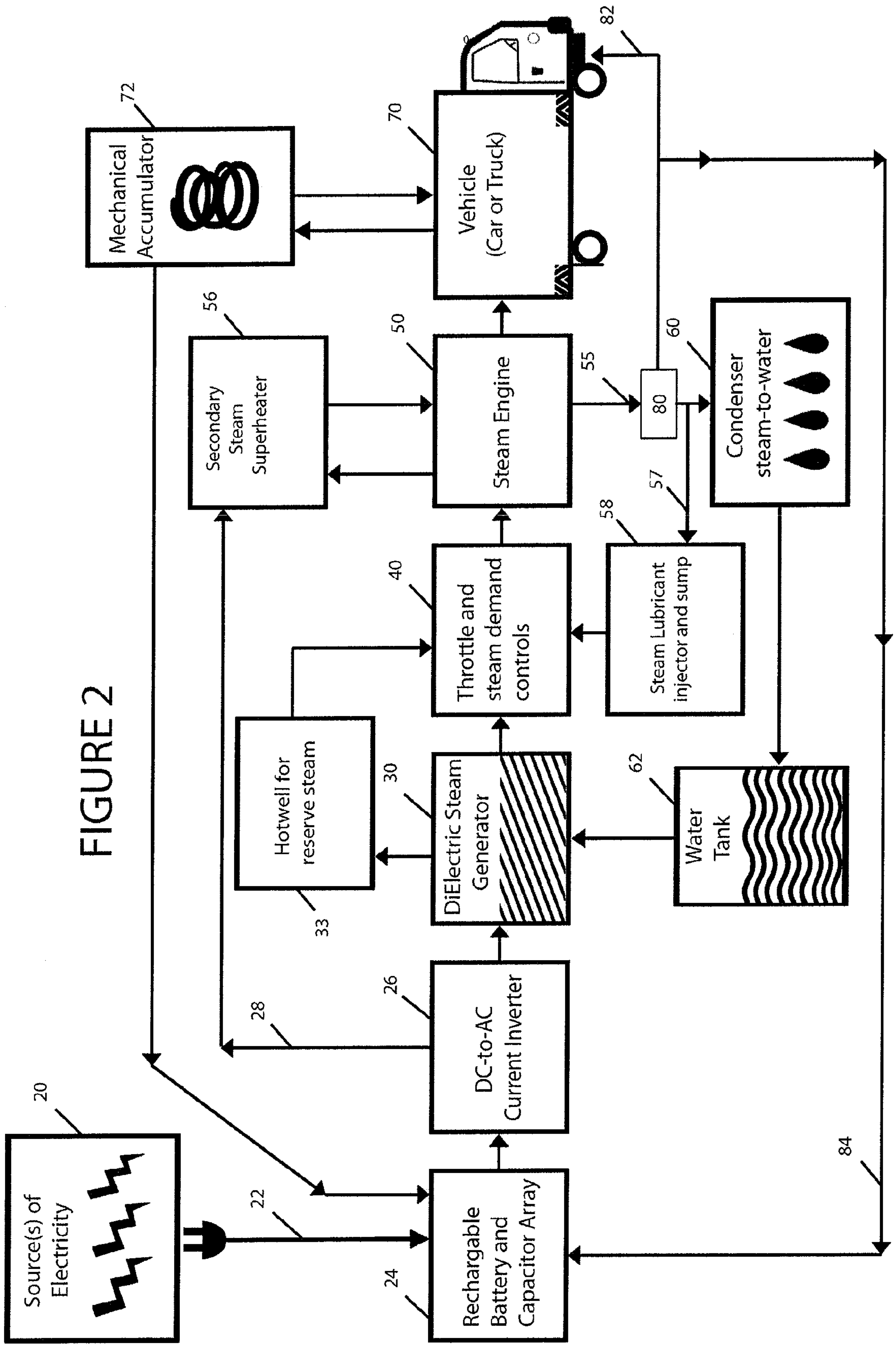

Source(s) of Electricity
20
22
Rechargable Battery and Capacitor Array
24
DC-to-AC Current Inverter
26
28
DiElectric Steam Generator
30
Hotwell for reserve steam
33
Throttle and steam demand controls
40
Steam Engine
50
55
80
57
Steam Lubricant injector and sump
58
Secondary Steam Superheater
56
Condenser steam-to-water
60
Water Tank
62
Vehicle (Car or Truck)
70
Mechanical Accumulator
72
82
84

FIGURE 2

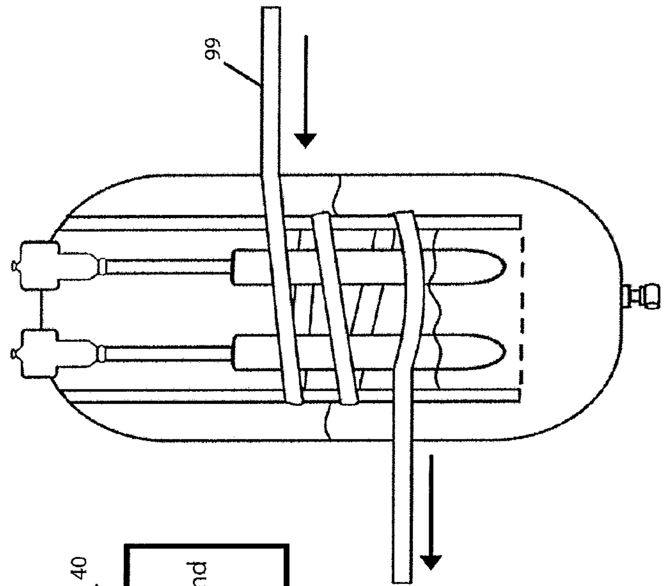

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FIGURE 3B

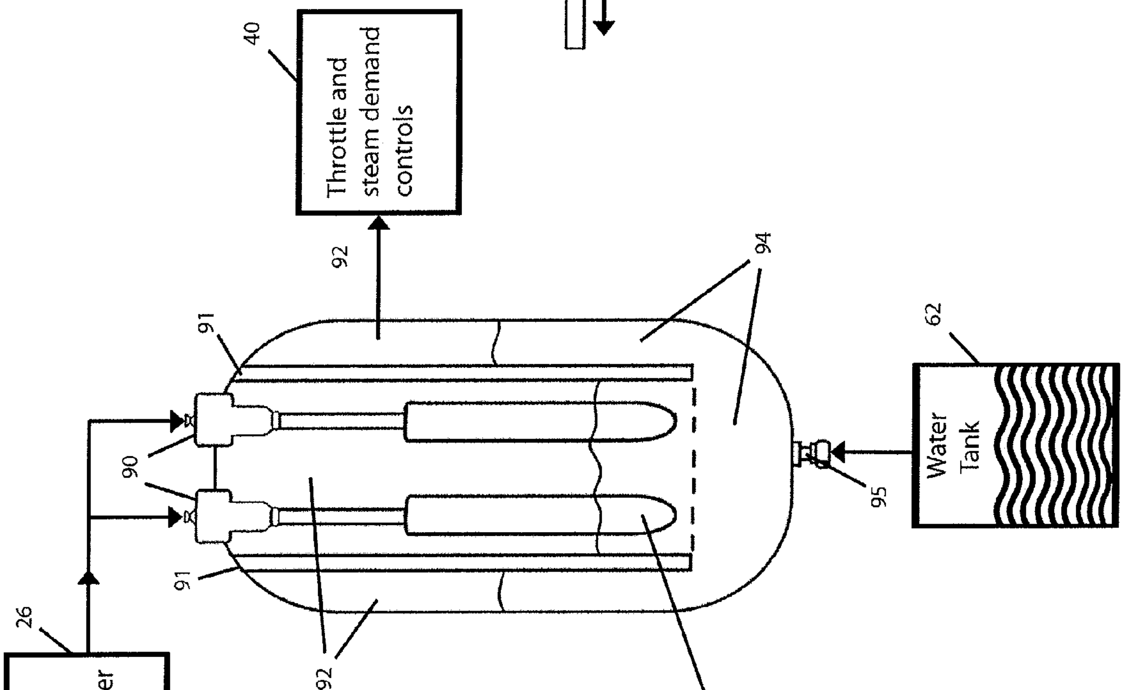
DC-to-AC
Current Inverter
26
90
91
92
93
94
95
Throttle and
steam demand
controls
40
Water
Tank
62

FIGURE 3A

SYSTEM FOR PRODUCING MECHANICAL ENERGY FROM ELECTRICAL ENERGY

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority of Provisional application Ser. No. 61/134,834 filed on Jul. 14, 2008. The entire contents of the Provisional application are incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to the field of engine power, specifically to a dielectric steam hybrid engine system.

BACKGROUND OF INVENTION

[0003] Steam engines capable of meeting and even exceeding modern automotive performance requirements have been known since at least the mid-1920s and early 1930s, when Abner Doble developed innovations for the mechanisms (boilers, blowers, pistons, gears, valves, etc.) for operating several automotive steam engines. He also worked for several years in the early 1950s on the "Paxton Phoenix Project" steam sports car that was developed by the McCulloch Motors Corporation (known today for chainsaws and the like). However, the emphasis in Project Phoenix—which also used gasoline as its fuel source—was to produce a high performance sports car that could out-race existing internal combustion engine designs; work that involved much higher engine pressures and temperatures than the 1930 cars, much greater even than would be necessary to produce vehicles generally useful today.

[0004] Blau, U.S. Pat. No. 6,397,962, describes a steam engine where the steam is produced by high-frequency radio wave energy and a battery electric drive system for a motor vehicle. It is described that the motor vehicle drive system comprises, in part, a steam engine, non-combustion high-frequency radio wave generation means, principally radio microwaves from a magnetometer, for heating water to create steam to supply said steam engine; an electric supply means for providing power to said non-combustion high-frequency radio wave heating means; and an additional electric engine drive means providing initial propulsion for said motor vehicle prior to propulsion by said steam engine. The method proposed by Blau has significant time lags between its start-up and the point where it can provide sufficient "working steam" to the steam engine and so it requires the use of the supplemental electric motor to fill those gaps.

[0005] Fasanello, US patent application publications 2003/0230446A1 and 2004/0065499A1, describes an electric-steam propulsion system. Fasanello employed what he referred to as a 'flash'-type heating element boiler for boiling liquid. The 'flash'-type boilers described by Fasanello comprise a coiled tube system, and have inherent limitations and hazards that are not limitations of the present invention. For example, these 'flash'-type boilers rely entirely upon the use of resistive heating elements, which must utilize heat transfer surfaces at a temperature substantially higher than the desired steam temperature, which is undesirable. The efficiency of such units depends on the efficiency of heat transfer, which is in turn highly dependent on heat transfer surfaces and decreases sharply as the flow of water increases which in turn requires enormous amounts of electricity to continue the heating process. With increased usage, minerals are left behind and deposited on the hot heat transfer surfaces in the form of baked on "scale" as the water flashes into steam. These deposits further reduce heat transfer efficiency.

[0006] Engine experts have long recognized that steam engines were simpler than gasoline engines, and superior in automobiles when it comes to performance characteristics—including tremendous on-demand torque from rest, much lower engine revolution speeds, much less heat, almost no noise, high cruise speeds, more power and traction at slow speeds, rapid and smooth acceleration that dispenses with the need for gears or a transmission, far fewer moving parts, far simpler design, less expensive materials, and far less exacting tolerances. However, even when a major effort was made to revive and develop a steam-powered sports car in the 1950s, steam car engine designs—elegant as they undoubtedly were—simply could not overcome fundamental issues associated with their complicated gasoline burners and boilers. The bottom line of steam car engine designs for the past 90 years has been that they still required gasoline to power their high-temperature flame burners and every attempt at modernizing them has foundered on the boiler mechanism.

[0007] Accordingly, a need exists for systems in which steam engines that do not use gasoline nor other fossil fuels can be made more practical, affordable and efficient to serve to power modern vehicles, such as automobiles and trucks, as well as other uses that are presently being carried out by internal combustion engines.

SUMMARY OF THE INVENTION

[0008] Accordingly, the present invention provides systems by which the superior characteristics of the steam engine—updated with modern materials, manufacturing techniques, and the engine innovations of the intervening years—can be harnessed and used in an energy efficient and practical manner to serve to power modern vehicles, such as automobiles and trucks. By switching the power source to rechargeable electric batteries and replacing the antique burner and boiler approach with an electric steam generator that boils a dielectric liquid to produce the steam and maintain the working steam reserve, while keeping the simplicity, raw power and high-performance of the steam engine, the present invention provides a unique combination of the advantages to provide a practical and efficient dielectric-steam hybrid engine.

[0009] The present invention involves a novel and unobvious design, which combines elements of three disparate technologies in order to produce a dielectric-steam hybrid engine with improved properties over earlier automotive steam engine designs. The present invention eliminates pollution from vehicles because it does not require the use of fossil fuels, is highly efficient, and is highly versatile.

[0010] The present invention provides a solution to the main problems that confounded steam car development in the 1920s and early 1930s: the inherent fuel inefficiencies and the technical maintenance difficulties associated with both the "burner" and "boiler" assemblies in steam vehicles. In addition, the present invention provides a dielectric-steam hybrid engine, which is vastly improved over the approach described by Fasanello, providing safer, cleaner and more efficient means for generating steam. By overcoming these difficulties, the present invention makes possible for the first time the practical use of steam engine assemblies to power useful modern vehicles, such as automobiles, transit buses, heavy commercial trucks, and construction equipment.

[0011] The engine design of the present invention is intended to replace existing internal combustion engines in a wide variety of different applications, but the primary commercial value is most likely its use for automotive engines. The dielectric-steam hybrid described in the present invention will allow most or all of the normal performance characteristics of a regular car or truck to be maintained, yet eliminate the need for gasoline or other fossil fuels to run the engine.

[0012] In the present invention, the elimination of fossil fuels can be accomplished by putting a closed-loop water condensing and recirculating automotive steam engine (for example, an engine of the Doble-type, which were briefly but very successfully manufactured in the late 1920s and 1930s) into a vehicle powered by a rechargeable battery or battery array (such as is used to power a "plug-in hybrid" like the latest modified Toyota Prius). Open-loop steam engines could also be used. Then, rather than using the fossil-fuel-fired burner and boiler arrangements that have been utilized previously to generate steam, or the 'flash'-type heating element boilers envisioned by Fasanello—which require heating elements that boil the water utilizing electrical resistance generated by "Joule heating" or "Ohmic heating"—the present invention inserts an electrical current inverter (converting battery DC-to-AC) and an electric steam generator device between the battery pack and the steam engine. The electric steam generator employs the principle of using AC passed directly through a dipolar conductive liquid (dielectric heating) to rapidly boil water in order to produce working amounts of steam by causing rapid molecular dipole rotation amongst individual molecules of water, or any other dipolar molecular fluid capable of producing working "steam-like" hot vapor, such that steam is instantly available and continuously produced in a manner capable of sustaining the operation of a practical steam engine.

[0013] Dielectric heating is caused by dipole rotation. When using water in an electric steam generator, an electrolyte must be added because pure water does not conduct electricity. Molecular dipole rotation occurs in materials containing polar molecules having an electrical polar moment, which align themselves in the presence of an electric field by rotating. As the electric field caused by the AC alternates, the molecules reverse direction and further accelerate the motion of individual molecules. Heat is quickly created by the friction of the molecules rotating against each other.

[0014] The preferred example of a dielectric heating device at present is the device immediately contemplated in the scheme of this invention, which is any dielectric electrode-electrolyte-type "electric steam generator" unit, which produces steam using "dielectric heating" based upon electric current alternating between electrodes immersed in water that has been saturated in electrolytes such as minerals salts or other dipolar working fluids, to heat the working fluid to the boiling point. The dielectric electric steam generator is run from the electrical power provided by the vehicle's rechargeable battery pack.

[0015] With the traditional burner/boiler arrangement eliminated by a dielectric electrode-electrolyte type electric steam generator, heat is generated directly at the molecular level so no part of the boiler needs to be heated to a temperature higher than that of the steam being produced. The lower operating temperature greatly reduces the tendency for scale formation and eliminates the problem of thermal shocking. It also reduces the likelihood of an explosive or dangerous occurrence resulting from the presence of super-heated surfaces or from exposed heating elements if water levels become reduced.

[0016] Using a dielectric heating device such as a dielectric electrode-electrolyte type "electric steam generator" allows the dielectric-steam hybrid system of the present invention to solve major design and efficiency issues that have plagued this otherwise excellent automotive engine concept for the past 90 years.

[0017] The electric steam generator used in a preferred embodiment of the invention has several inherent characteristics which improve on the boiler safety, efficiency, and suitability for vehicular steam engines.

[0018] For one, the steam output for any given voltage is proportional to the current flow between the portions of the electrodes that are immersed in the water. So, if the water level is raised so that twice as much electrode is covered by water, the amount of steam being produced at that moment will double as well.

[0019] Also, the ESG is a complete water-and-steam handling pressure vessel system that not only generates the steam but also contains that steam in a safe standby reserve situation until the steam engine needs it (in other, older designs of automotive engines this function was performed by a separate piece of equipment called a "hot well"). The ESG accomplishes this because its pressure vessel contains two inner chambers—one nested inside the other but open on the bottom—known as the "generating chamber" and the "regulating chamber". Through a series of valves, pipes, gauges, electrical sensors and relay switches, the ESG automatically balances the amount of steam being generated and the amount of water being fed to the electrodes and keeps the situation in equilibrium even as it constantly adjusts to the increases and decreases in demand for steam on the output side. Thus, the ESG automatically maintains a constant self-regulating steam pressure, stable temperature, and automatically balanced electrical input to the unit.

[0020] Because of the relatively low temperature inside the ESG, scale formation is far less likely to occur in an ESG than in resistive flash boilers which have internal surfaces with extremely high temperatures. No part of the ESG is ever hotter than the water or the steam itself.

[0021] In flash boilers such as that used in Fasanello, the rapid formation of scale greatly reduces heat transfer efficiency and thus the efficiency of the system employing this means of generating steam for the steam engine. By contrast, even when limited amounts of scale do eventually form on the electrode tips in an ESG, it does not result in a loss of boiler efficiency nor does it present a danger to personnel or equipment. Unlike the baked-on scale found in flash boilers, this scale that does form in ESGs can quickly and easily be removed from the electrode tips with a wire brush during periodic maintenance.

[0022] Also, in the ESG if the electrode tips (which descend downward from the top of the unit towards the water—which fills from the bottom up) for some reason become uncovered by a sudden drop in the water level, then current can no longer pass between the electrodes. Hence, no low water damage can occur.

[0023] The ESG cools and restarts faster than other boiler types, reducing maintenance downtime.

[0024] ESGs are simpler than other boiler types and minimize the number of controls and safety devices required.

[0025] ESGs are quick to react to sudden load changes as there is no delay, like in flash boilers, in transferring the heat to the water to produce additional steam.

[0026] With ESGs there is no possible "cold water" shock danger, whereas conventional fuel-fired boilers and electric flash boilers of the immersed resistive heating element type are subject to failure with potentially disastrous results if the water level falls below some minimal point. There is no unsafe water level in an ESG because, if for any reason the water supply is interrupted, causing the water in the pressure vessel to fall below normal levels, the electrode tips will become completely exposed. As soon as that happens current will cease flowing between the electrodes and no steam will be produced so no hazardous temperature climbs can occur.

[0027] In an ESG, essentially 100 percent of the electrical energy is converted to heat. There are no exhaust stacks, no flames, no soot, no pollution, no heating elements to burn out, and no energy is used to handle fuel or air. Heat is lost in only two ways: through thermal radiation or deliberate blowoff of the steam for use.

[0028] Unlike the flash-type boilers specified in Fasanello, ESGs are designed to be inherently self-regulating and have several redundant safety features to insure that sudden changes to water or steam pressure—or even catastrophic breaches of the pressure vessel itself—result in the immediate cut-off of electricity, heating of surfaces, and steam generation.

[0029] Although the present invention has a great many potential uses, it is contemplated that the most significant advantage of the present invention lies in the elimination of the need for gasoline, or any other liquid fuel, from vehicle engines. The value of reducing or eliminating the dependence upon fossil fuels for power and transportation is impossible to overstate under existing geopolitical, economic and environmental conditions.

[0030] The unique combination of elements in the present invention produces a dielectric-steam hybrid engine system without any internal combustion and eliminates the need for fossil fuels to drive automobiles or other vehicular systems that use internal combustion engines. Therefore, it also eliminates the deadly threat of carbon monoxide poisoning associated with all fossil fuel internal combustion engines.

[0031] The ESG or other steam generator for the invention can be powered by any source of electrical energy, such as a combination of on-board batteries, shore power charging (for example, overnight charging, as utilized in the "Prius Plus" available through www.CalCars.org), and newly developed power generation technologies (for example: solar cells on the car or truck roof). Vehicles using the inventive system may also be equipped with accumulator devices to recover additional mechanical energy and regeneratively feed it back to the batteries, a scheme which is readily available to those who are skilled in the art of automotive engineering, and presently such devices can be installed in existing gasoline-electric hybrid vehicle designs. Due to the high price and limited supply of gasoline and fossil fuels, there is presently a great incentive for the development of such new power generation technologies, and the present system is versatile enough to accommodate the use of many such technologies, as long as they are capable of running a dielectric heating device such as the dielectrical steam generator, as described herein.

[0032] This invention allows a relatively lightweight and small engine system to replace the comparatively large and heavy engine, transmission and exhaust systems associated with internal combustion. It also provides tremendous amounts of torque in a small package. Those factors serve to overturn the current design paradigm that has been trending toward smaller and smaller vehicles in order to take advantage of "alternative fuel" sources. Even as the world's cars have been getting smaller and smaller, it is clear that when given the chance the public has consistently shown a strong preference for larger vehicles—large cars, SUVs, and pickup trucks. This public preference has drawn a lot of criticism from parts of the environmental movement in recent decades but studies have shown that larger cars are safer cars and that when vehicles get smaller a disproportionate amount of injuries and deaths occur. The smaller the car, the more likely the occupants are to be maimed or killed when a collision occurs. The inventive dielectric-steam hybrid engine system makes it possible to once again build large cars, SUVs, and trucks with real desirable road power characteristics without having to worry about damaging the immediate environment. The invention will facilitate a return to full-size vehicles in terms of both driver and passenger space and trunk and cargo capacity.

[0033] The present invention thus provides technology which is extremely versatile and can be scaled from small engines, such as those which might be used to power a push-type lawn mower or snow blower, to automotive vehicles, right up to trucks, tractor trailers, construction vehicles, lawn tractors, buses, motorcycles and scooters, farm machinery, forklifts, industrial and mining equipment, military vehicles, and even to train locomotives, light rail trolleys, boats and beyond by simply increasing the number and/or size of the steam engine cylinders and/or the number and/or size of the electric steam generator, and/or increasing the capacity of electrical input—for example, by increasing the number or size of batteries, capacitors, fuel cells, or other sources of electrical input. The electrical input can include newly developed technologies such as solar power in some embodiments, especially for those vehicles which have large surface areas that would lend themselves to being covered with solar cells such as large trucks, trains, ships, and some types of manned or unmanned aircraft, such as drones or dirigibles.

[0034] In addition to eliminating the need to use internal combustion engines in vehicles, this invention also allows for the elimination from vehicles of some or all of a host of gasoline-associated systems such as the ignition, timing system, carburetor, cooling system, clutch, transmission, muffler and catalytic converter. Thus, the need for manufacture of and repairs to these costly and complicated systems will be greatly reduced or eliminated.

[0035] Also, since automotive steam engines operate at much lower RPM than internal combustion engines—even at speeds of up to 120 mph—vehicles powered by the dielectric-steam hybrid engine system of the present invention would be easier to design, since the potential problems of vibration dampening, noise reduction, and hot fumes would be greatly reduced or eliminated. Because of the lower RPM required to operate steam engines, the present invention is likely to reduce the wear and tear of operation on an engine, and hence extend the useable life of both vehicle and engine.

[0036] In addition to producing brand new vehicles using the invention, it is envisioned that the present invention will be useful for retrofitting many existing vehicles and many other systems of varied uses that presently use internal combustion engines. The inventive dielectric-steam hybrid engine system of the invention is sufficiently small that it can be accommodated within the body and chassis of many existing vehicles. Such retrofitting would be relatively simple to perform, and such a retrofitting process could be performed using tools, methods and knowledge that are readily available to one skilled in the art. In order to perform such retrofitting, one would remove the internal combustion systems, fuel tanks, etc. and install the steam engine with its unique drive mechanisms, a dielectric steam generator to run it, and the electrical system and/or battery packs necessary to run the dielectric steam generator. In some cases, adaptation of the vehicle's chassis and/or body may be necessary to accommodate the different retrofitted system. Again, methods, tools and knowledge to perform such adaptations are readily available to one skilled in the art.

[0037] One other clear advantage of the present invention is that steam engines, such as Doble-style steam engines are quite small, simple, relatively light weight, and extremely durable (Doble engines have been known to last for several hundred thousand miles, often with only normal engine maintenance). The technology and materials useful in the present invention can be accommodated so that the engines of the present invention may be capable of being manufactured in relatively standard facilities or manufacturing plants, such as those manufacturing plants presently operated by car manufacturers, with relatively modest adaptations and modifications.

[0038] Accordingly, it is presently possible to produce cars with great durability, and this would add the ability to produce engines of the present invention using essentially modular components that can be salvaged, swapped out, and moved from vehicle to vehicle. With a steam engine that is essentially a separate component, in some cases, about the size of a carry-on suitcase, it would be much easier and less expensive to maintain existing engines and to upgrade either the engine or the vehicular body and/or interior every few years.

[0039] Accordingly, the present invention may provide significant economic and ecological advantages in allowing the re-use and re-cycling of engines, bodies and other components, rather than the current practice of replacing entire vehicles, oftentimes ultimately resulting in the entire vehicle body and/or engine being sent to a scrap yard all at once, when one or the other is still useable.

[0040] In some applications where internal combustion engines are being replaced, the present invention can be applied to systems where the power input is directly connected to a live electrical source—such as a steam-electric hybrid motor running some piece of equipment on a factory floor. Accordingly, the present invention can be used in non-vehicular applications, such as providing mechanical torque to factory and industrial equipment or related compressed air or hydraulically powered systems.

[0041] This invention features a system for producing mechanical energy from electrical energy, comprising a source of electrical current, a boiler device for producing hot vapor from an electrically-conductive liquid directly from the electrical current, the boiler device comprising at least two electrodes that are electrically coupled to the source of electrical current and boil the liquid into a vapor by passing the current between the electrodes through the liquid, and an engine that produces mechanical energy from the hot vapor.

[0042] The engine preferably takes in the hot vapor from the boiler device and discharges vapor at a lower temperature. The engine may be a steam engine. The steam engine may be used to power a vehicle. The vehicle may be an automobile or a truck. The system may further comprise an accumulator system that recovers mechanical energy from the vehicle. The system may be part of a device of the type that can use an internal combustion engine. The system may further comprise a recirculating condenser that takes in the lower temperature vapor that has been discharged by the engine, condenses the vapor into liquid, and stores the liquid so it can be returned to the boiler device.

[0043] The electrically-conductive liquid may define an electrolytic conductor. The electrolytic conductor may comprise water containing an electrolyte. The electrically-conductive liquid may comprise dipolar molecules. The source of electrical current may comprise an electrical power storage system. The source of electrical current may further comprise a device for creating alternating current (AC) from the stored power. The electrical power storage system may comprise one or more of rechargeable batteries and capacitors. The source of electrical current may provide alternating current (AC).

[0044] The inventive system may further comprise a system that recovers energy from the vapor or the engine; this system may generate electricity. The inventive system may further comprise a secondary heater for heating the vapor to a higher temperature. The secondary heater may be electrically operated.

[0045] The system may further comprise a system for adding lubricant to the hot vapor, in which case the system may further comprise a system for removing lubricant from the vapor that is discharged by the engine. The system may further comprise a tank for holding the liquid that is supplied to the boiler device. The system may further comprise a hot well for holding hot vapor before it is supplied to the engine. The system may further comprise a liquid heater comprising a pipe or tube carrying the liquid, the pipe or tube exposed to the hot vapor.

[0046] Also featured is a system for powering a vehicle using electrical energy, comprising one or more of rechargeable batteries or capacitors for storing power, a device for creating alternating current (AC) from the stored power to accomplish a source of AC, an electrically-conductive liquid comprising water containing an electrolyte, a boiler device for producing hot vapor from the electrically-conductive liquid directly from the AC, the boiler device comprising at least two electrodes that are electrically coupled to the source of AC and boil the liquid into a vapor by passing the current between the electrodes through the liquid, and a steam engine that produces mechanical energy from the hot vapor, wherein the engine takes in the hot vapor from the boiler device and discharges vapor at a lower temperature, wherein the steam engine is used to power a vehicle.

[0047] Further featured is a system for powering a vehicle using electrical energy, comprising one or more rechargeable batteries or capacitors for storing power, a device for creating alternating current (AC) from the stored power to accomplish a source of AC, an electrically-conductive liquid comprising water containing an electrolyte, a boiler device for producing hot vapor from the electrically-conductive liquid directly from the AC, the boiler device comprising at least two electrodes that are electrically coupled to the source of AC and boil the liquid into a vapor by passing the current between the electrodes through the liquid, a steam engine that produces mechanical energy from the hot vapor, wherein the engine takes in the hot vapor from the boiler device and discharges vapor at a lower temperature, wherein the steam engine is used to power a vehicle, a recirculating condenser that takes in the lower temperature vapor that has been discharged by the engine, condenses the vapor into liquid, and stores the liquid so it can be returned to the boiler device, an accumulator system that recovers mechanical energy from the vehicle, and a system that recovers energy from the vapor or the engine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0048] Other objects, features and advantages will occur to those skilled in the art from the following description of certain preferred embodiments of the invention, along with the accompanying drawings, in which:

[0049] FIG. **1** is a schematic diagram of a simplified version of an embodiment of a hybrid electric-steam engine system of the invention;

[0050] FIG. **2** is a more detailed schematic diagram of an alternative embodiment of a hybrid electric-steam engine system of the invention; and

[0051] FIGS. **3**A and **3**B are simplified schematic cross-sectional views of electric steam generators for certain embodiments of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0052] As described above, in an earlier type of steam-powered automobile, steam was produced by such fossil fueled means as a gasoline-powered Venturi burner. The Venturi burner blasted flames right onto a coiled tube-type boiler in which circulating water was immediately turned into steam to power the steam engine. The steam engine converted the heat energy into mechanical energy to provide power for propelling the automobile. Steam exhausted out from the piston cylinders of the steam engine, was condensed and collected in a water tank to be returned to the boiler for re-use.

[0053] In a preferred embodiment of the present invention, initial power is provided by electrical means, such as shore power and/or solar energy and used to charge a rechargeable battery and/or capacitor array. The stored DC power is fed through an inverter which converts it to AC current in order to power a dielectrical heating means, such as a dielectric steam generator. The dielectric steam generator provides hot pressurized steam to power the steam engine, which in turn produces mechanical power to propel the automobile. Excess mechanical energy may be used to provide some regenerative power for the electrical means, and/or may be stored in an optional mechanical energy accumulator and used later. Steam from the steam engine is condensed, and then either collected as water in a holding tank for return to the dielectric steam generator for re-use or immediately piped back to the steam generator.

[0054] In certain embodiments, the present invention comprises an electric-steam hybrid engine system comprising an electrical heating means comprising two or more electrodes submerged in electrolyte-containing fluid, with electric current passed between electrodes. The current rapidly boils liquid to produce steam.

[0055] A source of electricity provides the initial energy used to provide power for running the dielectric-steam hybrid engine of the present invention. Power sources useful in the present invention may comprise any known system which is capable of generating and/or storing sufficient electric power to provide initial energy to the steam generator. Thus, one or more batteries, capacitors, fuel cells, fly wheels, generators, electrical catenaries, shore power connections, solar cells or other systems, including combinations of the above, may be used, so long as the power sources are capable of providing sufficient energy to operate the steam generator used in the invention. In addition, the power source may comprise any direct input, such as an AC or DC electrical connection, or other generation source. After the steam generator has begun operation, energy generated from the engine itself or the steam leaving the engine, or mechanical energy captured from the moving vehicle, may be used to partially maintain the operation of the steam generator, to recharge the power storage source, and/or to run auxiliary systems. Also, excess energy produced by the engine may be stored. It is presently contemplated that rechargeable batteries provide the best mode for supplying power to the steam generator in the invention.

[0056] The invention further comprises an externally powered device or system for dielectrically producing working steam. Preferably, the device is electrically powered. In a preferred embodiment, the device produces steam by energizing water molecules (or another working fluid comprising dipolar molecules), to instantly produce and continuously sustain working steam sufficient to power the steam-utilizing engine. The dielectrical device for the present invention preferably comprises an electrode-electrolyte electric steam generator. In certain preferred embodiments, the dielectrical device will rapidly heat water or other fluid to produce steam. The dielectrical device of the present invention must be capable of rapidly producing enough steam to power the steam-utilizing engine.

[0057] Examples of preferred dielectric devices include electric steam generators, such as those manufactured by the Electric Steam Generator Corporation of Buchanan, Mich., such as an ESG Automatic Balance SPEEDYLECTRIC™. (See, e.g., www.esgcorp.com).

[0058] In certain preferred embodiments, the source of electricity, such as batteries or capacitors, may be positioned such that it or they may be easily removed and replaced with newly charged batteries or capacitors. In these preferred embodiments, it will be useful for an automobile to be equipped with a spare electrical source, such as additional batteries or capacitors, which can be carried with the automobile in transit, as one might maintain a spare tire or a can of gasoline. In such preferred embodiments the dielectrical device or steam-utilizing engine may be equipped with a closed loop circuit which can be used to re-charge the spare electrical source.

[0059] The steam-utilizing engine useful in the invention may comprise any engine which is capable of being powered by steam or another hot vapor. Steam engines are remarkably versatile and powerful, and can be produced in a wide range of sizes and arrangements including reciprocating and turbine configurations. Some examples of steam engines that have been used to power automobiles and vehicles are further described in the book *Oldtime Steam Cars,* by John Bentley; Arco Handi-Books Publishing/Fawcett Publications, Inc., New York (1953). The disclosure of this publication is incorporated herein by reference.

[0060] In 1894, Stephen Roper of Boston had perfected a normal size bicycle with a 150 psi steam engine measuring only 16×6×6 inches that would propel it along at 60 mph. Several companies successfully manufactured city buses that ran on steam, including Baker Motors of Cleveland which in 1926 produced a 24-passenger bus that weighed 7,800 pounds and used a five-cylinder rotary steam engine that developed 90 horsepower at 1,600 rpm and put out 1,800 foot-pounds of torque at stalling load. It had a working steam pressure of 600 psi and a maximum speed of 50 mph.

[0061] In 1928, the Curran Steam Commercial Vehicle Company produced a test truck that used a three-cylinder horizontal uniflow steam engine working at 600 psi which lugged 11-ton loads right up hills outside of New York. However, they were not able to get production sufficiently funded.

[0062] The 1926 Convertible Doble had a four-cylinder, double-acting, compound, horizontal engine with two high-pressure cylinders (two-and-five-eighths inches by five inches) and two low-pressure cylinders (four-and-a-half by five inches) with 3,490 cc of displacement putting out 120 hp at 937 rpm. Working pressure in the boiler was 710 psi and that would send a car that weighed 4,256 pounds down the road at 60 mph at just 900 rpm. The engine was geared directly to the rear axle and the maximum speed was over 95 mph. At the time a reviewer wrote of the 1926 Doble, "What a boon it would be to city life, and how pleasant our cities would be, if all mechanically operated road transport could be driven by some prime mover (such as this steam engine) that made no noise in starting, had no roaring engine, had no gearbox, and could move off with scarcely a sound!" They added, "The low engine speed of this steam car gives a freedom from wear and an ease of maintenance which are great advantages."

[0063] The Doble steam engine itself was described in great detail in *The Model Engineer and Practical Electrician,* Feb. 6, 1930, pps. 123-127; the disclosure of this publication is incorporated herein by reference.

[0064] Advantages of steam engines over internal combustion engines include the following: There is no minimum idle speed needed to keep a steam engine going as long as the water remains heated (something which should be even easier today with modern insulating techniques and materials).

[0065] When a steam car stops, the engine goes to zero rpm but it retains full torque (over a thousand foot pounds of it in the case of the Doble) that is instantly available when the driver is ready to go again—even hours later.

[0066] Furthermore, that torque is delivered in a smooth analog flow of increasing speed to the axle, either reducing or completely eliminating the need for transmissions, automatic or otherwise; rendering obsolete shifting and grinding down gears.

[0067] Steam engines are truly reversible. They can run backwards at full speed as well as they can forwards just depending on which end of the piston the steam is directed into and thus they don't require any kind of complicated clutch mechanisms.

[0068] Steam engines are silent. Although a common impression is that of noisy steam train locomotives which expel steam, the automobiles that recirculate their steam through condensers do not require any mufflers or baffles on their engines because essentially no noise is produced in the first place.

[0069] As John Bentley, author of "Old Time Steam Cars," pointed out, the thermal efficiency of the internal combustion engine may reach 35 percent, whereas that of the steam engine tops 90 percent. This means that only a small proportion of every gallon of gasoline does any actual work in propelling an internal combustion engine powered automobile; the bulk of that gallon is transformed into useless heat that in turn makes necessary a complex and power-consuming cooling system in order to prevent overheating.

[0070] In addition, the low-speed torque (hauling power) even of the multi-cylinder gas engine is very inefficient; and for this reason it became necessary first to evolve sliding gear and synchromesh transmissions, and later—by way of "improvement"—various expensive, complicated and heavy torque converters which compensate (to some extent) for this shortcoming by transforming speed into energy and vice versa, as the occasion demands.

[0071] By contrast, a two-cylinder, double action steam engine with fewer than forty moving parts provides as many power impulses per crankshaft revolution as an eight-cylinder combustion engine cluttered with a mass of bewildering gadgets; and the steam engine requires neither clutch nor torque converter of any kind. It can be geared direct to the axle of an automobile or vehicle.

[0072] In assessing the efficiency of today's automobile—particularly where this refers to sports or racing cars—two highly desirable criteria usually come to mind. The first is the magic figure of 300 bhp per ton weight, and this (with an unsupercharged engine) is rarely achieved with combustion engines. The second is an output of 100 bhp per liter (61 cu. in.) displacement, not so far attained by any normally aspirating internal combustion engine.

[0073] With a properly designed steam engine, neither of these objectives would present any difficulty; indeed, in 1906, Fred Marriot's Florida Stanley Racer, a so-called "freak" which set a new world's record at 127.66 mph, came very close to these ideals. It developed 250 bhp for a weight of less than 2,200 pounds and a displacement of 206 cu. in. This was almost a century ago, and the steam powered automobile did not require numerous cylinders, overhead camshafts, trains of driving gears, multiple carburetors or a tricky ignition system.

[0074] With respect to everyday motoring needs, such as pick-up, flexibility, speed, reliability, running economy, silence or maintenance/upkeep costs, a modern steam automobile could outperform the conventional internal combustion automobile under virtually any conditions. Furthermore, with efficient production methods, the automobiles powered by the dielectric-steam hybrid engine systems according to the present invention can be manufactured and sold in quantities at prices significantly below those of the average gas-powered automobile.

Additional Optional Elements of the Invention Utilized in Preferred Embodiments.

[0075] As discussed further herein, there are a large number of available designs for elements of the present invention, particularly for the electrical source and for the steam-utilizing engine. The present invention contemplates that many of these designs may be combined in a novel and inventive manner together with the dielectrical steam source system of the present invention, in order to provide many different forms of dielectric-steam hybrid engine systems of the invention that are useful to power a large array of tools, vehicles and systems, including newly designed automobiles, as well as retrofitted automobiles which formerly utilized internal combustion engines running on liquid fuel. A few of the many optional elements are described in further detail below.

[0076] Condenser and/or Condensing means: In most preferred embodiments, the present invention will further comprise condensing means such as a steam condenser to harness the steam after it powers the engine and cools, so that the fluid can be re-used. All of Doble's steam engine designs from 1918 onward had a recirculating steam condenser and so the term "Doble-type" engine as used may comprise condensing means as an optional element which is present in preferred embodiments of the present invention. Condensing means may also include insulation as a method for retaining the engine heat and keeping it in the steam cycle (with certain early engine designs, insulation may have been ineffective or, as with a Venturi gas burner, it would have been pointless overkill). With modern materials, however, insulating means may be used effectively at several points throughout the steam cycle and contribute to making the system of the invention more efficient.

[0077] Electrolyte-Containing Media for Steam Generation: In preferred embodiments, the present invention may comprise one or more containers or chambers containing water and/or other fluids for steam generation. In certain preferred embodiments, one or more single chambers comprising electrolyte-containing media may be used, especially electrolyte-containing fluid. In such a single-chamber embodiment, the electrolyte-containing fluid will be dielectrically energized within the chamber, such that at least some of the fluid will rapidly and continuously be converted into steam. The steam will provide energy for operation of the steam engine. In preferred embodiments, the steam will be condensed and will be returned for re-use within the chamber. In other preferred embodiments, the chamber may be continuously supplied with new fluid to replace any fluid lost as steam. In such embodiments, it will be preferred to monitor the electrolyte levels and maintain such levels by adding fluid with or without electrolytes. In other embodiments, the electrolyte-containing media may comprise non-liquids, such as viscous gels, gases and solids, suspensions and mixtures of liquid, gas and solid media, in addition to or in place of the fluid as the electrolyte-containing media.

[0078] In other preferred embodiments, multiple containers or chambers will be used, including: (a) at least one first container or chamber containing electrolyte-containing fluid which is dielectrically energized, and will generate heat or energy that is provided to (b) at least one second container or chamber containing water or other fluid which will be converted into steam. In an embodiment of such a multi-chamber steam generator, a first chamber will contain electrolyte-containing fluid, which is dielectrically energized and will thereby become hot. The heated electrolyte-containing fluid (or its hot vapor) will contact the surface of a second chamber of fluid, preferably distilled or pure water or a working solution with a lower boiling point such as water mixed with ammonia, which will thereby be converted into the steam that is provided to the steam engine. Typically, the steam would then be condensed and returned to the second chamber for re-use. In preferred multi-chamber embodiments, one or more second chambers with distilled or pure water may be 'nested' within one or more first chambers such that the pure water will pass continuously through the second chamber(s). In other embodiments, a coiled tube of pure water may run through the electrolytic chamber. Many variations and permutations of containers and chambers of various sizes and configurations are possible and will comprise part of this invention.

[0079] Re-Heating or Pre-Heating Using the Steam Generator:

[0080] In some embodiments it may be desirable to route either the steam or the water (or any other working vapor or chemical solution being utilized in a particular system design) into a pipe that sends it back through the interior of the dielectric steam generator in order to boost the temperature of the vapor or liquid prior to it performing some other function in either the engine, the auxiliary turbines, or other alternator like devices.

[0081] Something similar was done in antique steam cars where the steam being exhausted from a larger cylinder would be looped out in a small pipe that was routed through the red hot interior of the Venturi burner in order to add superheat to the steam before it was used by the next smaller cylinder in the compound engine arrangement.

[0082] Using this principle, the temperature of steam or water being utilized by different stages of the overall electric-steam hybrid engine system could be selectively raised at certain points in the loop by passing the pipe through either the steam or the water zones of either the regulating or the generating chambers within the dielectric steam generator in order to pick up the additional heat energy. The pipe or pipes could also be coiled or bent into different configurations that would allow it to pass through some or even all of the different zones and chambers within the steam generator's interior.

[0083] Depending on the particular design embodiment being undertaken, this method could also be used to pre-heat water that was about to be returned either to the optional water holding tank or directly to the interior of the dielectric steam generator itself.

[0084] Ancillary Hydraulic Motors and other Accumulators: In other preferred embodiments, the steam engine, instead of connecting directly to a driveshaft which is directly putting mechanical power out to the vehicle, could instead employ its pistons to pressurize hydraulic fluid or similar accumulator schemes which could in turn employ hydraulic motors to power the actual driveshaft or other mechanical output of the engine as demand requires. This staged accumulator technique using methods like hydraulics and compressed air to power either the main propulsion means of a vehicle and/or other on-board equipment is well known to those skilled in the art of heavy vehicle and construction equipment manufacture and would be desirable in certain embodiments.

[0085] Auxiliary turbines and other Alternator-like Devices: In some embodiments it may be desirable to place small motors or turbines in the path of the steam between the point where it is generated and the condenser that turns it back into fluid in order to provide power to ancillary devices. This was done in the antique steam cars with small turbines to provide power to feed water pumps and run alternator-like devices to power headlamps and other functions of the vehicle. Although it is likely that such functions will largely be engineered to run directly from the large battery supply on the vehicles that are envisioned in embodiments of this invention, it is anticipated that in some configurations it would be desirable to power such auxiliary turbines and other devices using the steam in the steam loop.

[0086] Although not ideal, in certain embodiments, it may be preferred that a small amount of combustible fuel may be useful in order to provide additional energy to the engine; for example as an auxiliary power generating means. In other embodiments, the present invention may comprise one or more back-up electrical/capacitance systems, such as a spare battery, which may be utilized if the initial energy means runs low. Other embodiments may comprise means for attaching the electrical and/or dielectrical means of the present invention to an external power source, such as an AC electrical outlet, or a DC voltage source such as an external battery or generator. These components may be used to allow for more efficient or rapid start-up of the engine or for recharge of the power means of the present invention.

[0087] Turning to the drawings, FIG. **1** schematically depicts a simplified version of an embodiment of a hybrid electric-steam engine system of the invention. In this embodiment, the main input to this hybrid electric-steam engine system is electricity which can come from any source of electricity **20** supplying power now or in the future. A power cord **22** or similar charging means is plugged into the electricity source **20** and electricity flows in and charges the rechargeable batteries and/or capacitors in the power storage array **24** and in some embodiments that could include swapping batteries or capacitors that have already been separately charged into the array—such as in an emergency or other situation requiring an immediate quick change of battery.

[0088] Once the electrical power is onboard the vehicle and stored in the power storage array **24** it flows to the inverter **26** which converts it (with a slight loss) from direct current to alternating current that can be used by the dielectric steam generator **30**. The dielectric steam generator **30** utilizes the AC current to rapidly boil water by sending the electric current from one submerged electrode directly through the water that has been mixed with an electrolyte (usually a mineral salt) to a receiving electrode. The electrical field between the two (or more) electrodes causes the molecules of water, due to the presence of the electrolyte and the dipolar nature of the water molecules themselves, to react in an excited manner that creates molecular friction and heat to the point that the water—or other suitable dipolar working chemical solution with a lower boiling point—boils into steam or a similar working vapor. The dielectric steam generator **30** also uses the AC current supplied by the inverter **26** to operate its small water feed pump and any other auxiliary electrical equipment depending on the model and design.

[0089] Once generated in the dielectric steam generator **30**, the working steam is piped out through at least one valve **40** that is operated in response to throttle inputs from the driver of the vehicle **70** and is also regulated according to vapor pressure safety and the demand conditions of the automotive steam engine **50** depending on how it is being driven at the moment. The steam engine **50** can be any of the previous, existing, and potential designs of steam engines reciprocating, turbine, hybrid-hydraulic or otherwise that would be capable of providing mechanical motive power directly to any type of vehicle **70** especially those which currently use internal combustion engines.

[0090] Whether the steam engine design is one cylinder, twelve cylinder or no cylinder at all—once the prime movers in the engine **50** have made use of the hot steam or other working vapor it is exhausted out a pipe **55** to a condenser unit **60** which accomplishes the remaining temperature drop to bring it back to a liquid which is then routed either to an optional water holding tank **62** or directly back to the dielectric steam generator **30**.

[0091] It is also possible to add an optional mechanical accumulator system **72** to this embodiment in order to recover some of the mechanical and inertial energy expended by braking, cornering, going down hills, etc. that vehicles expend while driving. There are many different kinds of these systems and more are being invented every year ranging from relatively simple springs, pistons, and flywheels to sophisticated computer-controlled hydraulic and compressed air accumulator systems for large trucks.

[0092] FIG. **2** expands on some of the options and different embodiments that are contemplated as examples of how this fundamental improved hybrid electric-steam approach can be customized and enlarged in the coming years.

[0093] For instance, in some embodiments it might be advantageous to add additional superheat to the steam or hot chemical vapor as it loops through the individual cylinders or turbine sections of a steam engine. This could be accomplished by routing some of the available electrical power **26** through to an electrically powered superheater **56** either right before the steam initially reaches the engine **50** or in reheating stages when it is exhausted from individual cylinders before it reaches the next cylinder or turbine.

[0094] In some embodiments it might be advantageous to have a reserve amount of hot steam available that might be more than that normally provided by the dielectric steam generator **30** in real time. To accomplish that a "hot well" **33** steam tank could be added to the system to allow extra working steam to be built up for immediate use when demanded by whoever is operating the throttle valve **40** or other engine controls. The ability to have this contingency steam available in the hot well **33** could also allow vehicle designers to use smaller more efficient dielectric steam generators in some designs without sacrificing safety margins in an emergency.

[0095] Although the preferred embodiment operates at relatively low temperatures using saturated steam, it might be advantageous in some embodiments to operate the steam engine at higher pressures and temperatures in order to gain certain power and performance efficiencies. Past the point of saturated steam, when sufficient superheat is added to the working vapor, it will be important to be able to add lubricant to the steam loop so a lubrication injection device **58** will have to be added and a lubrication sump device **57** will also have to be added in order to remove the lubricant before the steam or vapor is re-condensed into a liquid.

[0096] In some embodiments it may be desirable to recover more of the remaining residual energy that is still contained in the steam or working vapor after it has been exhausted from the steam engine **50** and is on its way to the condenser **60**. This can be accomplished by intercepting the flow of returning steam with small turbines **80** or a similar means of extracting residual energy which can then immediately be turned back into electricity and used to power auxiliary systems **82** on the vehicle **70** itself or it can be returned **84** directly back to the power storage array.

[0097] FIGS. **3**A and **3**B are cut-away views showing the core functions of the dielectric steam generator—a number of the pipes, valves, gauges, safety devices, and the pressurized water feed pump that make up the actual commercial versions of these devices have been removed for the sake of clarity.

[0098] In the scheme of the preferred embodiment of the inventive hybrid electric steam engine system, AC electric current **26** is supplied to the electrodes **90** which are contained within a nested interior chamber **91** that is partially filled with re-circulating water **62** mixed with electrolytes **94** or some similar chemical solution that will directly boil into a working vapor in the presence of an electric field when current passes between the submerged tips of the electrodes **93** and causes the fluid to boil into steam or vapor **92**. That working vapor is then contained in the upper sections of the various nested chambers **92** until it is piped off at the demand of the throttle **40** system and other inputs from the driver and engine.

[0099] The embodiment shown in FIG. **3**B is the same dielectric steam generator with a pipe **99** or pipes passing completely through the vessel in order to allow steam or liquid water (or vapor of another working fluid depending on the particular design embodiment) to be re-heated before either continuing on to some stage within the engine (for instance, steam being looped back and reheated as it passes between cylinders or exhaust steam being briefly re-heated before it passes through the auxiliary turbines **80** shown in FIG. **2**) or as a pre-heating method for the re-condensed water or other working fluid being returned to the optional water tank **62** or directly to the inlet of the dielectric steam generator **30** itself as part of the re-circulating water or fluid loop embodied in this system.

[0100] The pipe **99** or pipes in these embodiments could be run straight through either the steam or water zones of just one interior chamber of the dielectric steam generator **30** or through both the inner and outer chambers or it could be coiled even more densely than in shown in FIG. **3**B through both the steam and water zones of multiple interior chambers depending on the re-heating requirements and the particular design being undertaken.

[0101] The present invention has been described according to certain preferred embodiments. However, as is evident from reading the specification and description herein, the present invention is remarkably versatile, and it will be readily apparent to the skilled person that the methods and materials of the present invention are capable of being changed, adapted and modified in many ways and for a wide variety of uses without varying from the essence of the invention as described. Such changes, adaptations and modifications are envisioned and are considered to be a part of the present invention, within the scope and teaching of this invention as defined by the claims appended hereto.

[0102] All of the documents and all of the websites referred to in the present specification are hereby incorporated herein by reference, and the information for which the documents or websites are referenced shall be considered part of the specification as if it were fully reproduced herein.

What is claimed is:

1. A system for producing mechanical energy from electrical energy, comprising:
- a source of electrical current;
- a boiler device for producing hot vapor from an electrically-conductive liquid directly from the electrical current, the boiler device comprising at least two electrodes that are electrically coupled to the source of electrical current and boil the liquid into a vapor by passing the current between the electrodes through the liquid; and
- an engine that produces mechanical energy from the hot vapor.

2. The system of claim **1** in which the engine takes in the hot vapor from the boiler device and discharges vapor at a lower temperature.

3. The system of claim **1** in which the engine is a steam engine.

4. The system of claim **3** in which the steam engine is used to power a vehicle.

5. The system of claim **4** in which the vehicle is an automobile or a truck.

6. The system of claim **4** further comprising an accumulator system that recovers mechanical energy from the vehicle.

7. The system of claim **2** in which the system is part of a device of the type that can use an internal combustion engine.

8. The system of claim **2** further comprising a recirculating condenser that takes in the lower temperature vapor that has been discharged by the engine, condenses the vapor into liquid, and stores the liquid so it can be returned to the boiler device.

9. The system of claim **1** in which the electrically-conductive liquid defines an electrolytic conductor.

10. The system of claim **9** in which the electrolytic conductor comprises water containing an electrolyte.

11. The system of claim **1** in which the electrically-conductive liquid comprises dipolar molecules.

12. The system of claim **1** in which the source of electrical current comprises an electrical power storage system.

13. The system of claim **12** in which the source of electrical current further comprises a device for creating alternating current (AC) from the stored power.

14. The system of claim **12** in which the electrical power storage system comprises one or more of rechargeable batteries and capacitors.

15. The system of claim **1** in which the source of electrical current provides alternating current (AC).

16. The system of claim **1** further comprising a system that recovers energy from the vapor or the engine.

17. The system of claim **16** in which the system that recovers energy generates electricity from the recovered energy.

18. The system of claim **1** further comprising a secondary heater for heating the vapor to a higher temperature.

19. The system of claim **18** in which the secondary heater is electrically operated.

20. The system of claim **2** further comprising a system for adding lubricant to the hot vapor.

21. The system of claim **20** further comprising a system for removing lubricant from the vapor that is discharged by the engine.

22. The system of claim **1** further comprising a tank for holding the liquid that is supplied to the boiler device.

23. The system of claim **1** further comprising a hot well for holding hot vapor before it is supplied to the engine.

24. The system of claim **1** further comprising a liquid heater comprising a pipe or tube carrying the liquid, the pipe or tube exposed to the hot vapor.

25. A system for powering a vehicle using electrical energy, comprising:
- one or more of rechargeable batteries and capacitors for storing power;
- a device for creating alternating current (AC) from the stored power to accomplish a source of AC;
- an electrically-conductive liquid comprising water containing an electrolyte;
- a boiler device for producing hot vapor from the electrically-conductive liquid directly from the AC, the boiler device comprising at least two electrodes that are electrically coupled to the source of AC and boil the liquid into a vapor by passing the current between the electrodes through the liquid; and

a steam engine that produces mechanical energy from the hot vapor, wherein the engine takes in the hot vapor from the boiler device and discharges vapor at a lower temperature;

the steam engine used to power a vehicle.

26. A system for powering a vehicle using electrical energy, comprising:

one or more of rechargeable batteries or capacitors for storing power;

a device for creating alternating current (AC) from the stored power to accomplish a source of AC;

an electrically-conductive liquid comprising water containing an electrolyte;

a boiler device for producing hot vapor from the electrically-conductive liquid directly from the AC, the boiler device comprising at least two electrodes that are electrically coupled to the source of AC and boil the liquid into a vapor by passing the current between the electrodes through the liquid;

a steam engine that produces mechanical energy from the hot vapor, wherein the engine takes in the hot vapor from the boiler device and discharges vapor at a lower temperature, wherein the steam engine is used to power a vehicle;

a recirculating condenser that takes in the lower temperature vapor that has been discharged by the engine, condenses the vapor into liquid, and stores the liquid so it can be returned to the boiler device;

an accumulator system that recovers mechanical energy from the vehicle; and

a system that recovers energy from the vapor or the engine.

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