

Analysis on the Principle and Performance of the Electric-Driven Water Engine(Hydrogen-Oxygen Deflagration Type)

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Abstract

This paper proposes a new type of prime mover based on hydrogen-oxygen deflagration and closed-loop energy recovery: the electric-driven water engine (hydrogen-oxygen deflagration type). The system uses a DC battery as the initial power input, with a water-based composite working medium containing antifreeze, anti-coagulant and high-efficiency conductive salt (sodium hydroxide is selected as the basic experimental material and can be replaced by other suitable electrolytes according to working conditions). Through electrolysis, hydrogen-oxygen mixture with a precise stoichiometric ratio of 2:1 is rapidly generated, which is naturally in the optimal deflagration range. Relying on a single-spindle core roller structure, self-sustaining chain deflagration is realized to output power. The engine spindle module is integrated inside the liquid storage tank, and high-efficiency heat recovery is realized through a thin, high-thermal-conductivity isolation shell. The system achieves ultra-high electric-to-mechanical energy conversion efficiency, low vibration, extremely low mechanical loss, near-zero substance emission and strong multi-scenario adaptability.

This paper conducts a full-link comparison with traditional internal combustion engines and pure electric drive systems, and verifies the significant advantages of the device in power density, energy efficiency, operational stability, manufacturing cost and application scope through accurate efficiency calculations. The power supply system, structural adaptability and other dimensions have been fully optimized to form a complete and implementable technical solution, with only a small amount of supplementary research required in the future.

Keywords

electric-driven water engine; hydrogen-oxygen deflagration; chain deflagration transmission; single-spindle prime mover; closed-loop energy recovery; high energy conversion efficiency; vibration-free power

1. Introduction

The current global power system is mainly composed of traditional fuel internal combustion engines and pure electric drive systems, both of which have insurmountable fundamental defects.

Traditional fuel internal combustion engines suffer from low thermal efficiency (25%–40%), severe vibration, serious mechanical fatigue, significant pollutant emissions and massive energy dissipation in the form of waste heat, representing a typical high-loss, high-pollution and high-maintenance power scheme.

Although pure electric drive systems are advertised to have high peak motor efficiency, the actual comprehensive efficiency from grid to wheel is only about 25%–32%. Restricted by multiple irreversible losses including charging loss, internal resistance loss, thermal management power consumption and transmission loss, pure electric vehicles completely rely on external power supply and cannot achieve energy self-circulation. Essentially, they only act as "energy transporters" and cannot solve the core problem of power supply.

Against this background, the electric-driven water engine (hydrogen-oxygen deflagration type) proposed in this paper is not a partial optimization of existing schemes, but a reconstruction of the power system from the underlying logic. The

system still requires batteries to provide initial electric energy, but achieves higher power output with less power consumption and long-term high-efficiency operation with lower loss through the ultra-high energy density of hydrogen-oxygen deflagration, self-sustaining chain deflagration structure and the original closed-loop heat and working medium recovery mechanism.

Meanwhile, the system can be adapted to different power scenarios by adjusting the number of deflagration points, roller structure, groove depth, deflagration density, multi-spindle configuration and other parameters, showing strong engineering flexibility and scalability.

This paper has completed the full-system core design of the technology, covering structural principles, working medium selection, power supply logic, efficiency optimization, scenario adaptation and all other core contents, forming a complete and engineerable technical solution. No further serial main papers are required, and only a small amount of supplementary research and parameter optimization will be carried out later.

2. Core Structural Design and Working Principle

2.1 Water-Based Composite Working Medium and Electrolysis Efficiency

The system abandons pure water and adopts a water-based composite medium added with antifreeze, anti-coagulant and high-efficiency conductive salt. Sodium hydroxide (NaOH) is selected as the basic experimental conductive salt in this paper. It features high conductivity, low cost and easy availability, which can significantly increase electrolysis speed, reduce electrolysis energy consumption and ensure stable operation in both low and high temperature environments, laying a foundation for rapid gas production and high-efficiency deflagration.

Important note: Sodium hydroxide is only one of the basic experimental materials proposed herein and is not the only mandatory option. According to actual working conditions, environmental requirements and cost constraints, it can be flexibly replaced by other suitable electrolytes such as potassium hydroxide or sodium carbonate. The core system architecture remains unchanged, and only working

medium parameters need to be adjusted for different applications.

2.2 Hydrogen-Oxygen Generation and Optimal Deflagration Characteristics

The electrolysis of water follows the reaction: $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$. The resulting hydrogen-oxygen mixture has a strict volume ratio of 2:1, which is naturally within the optimal hydrogen-oxygen deflagration range. It features rapid ignition, extremely high combustion velocity and high deflagration pressure. Its calorific value and thrust density are significantly higher than those of conventional fuel combustion, enabling ultra-high power density output and providing far greater instantaneous thrust and continuous power than traditional power systems.

2.3 Single-Spindle Core Roller Structure

The core of the engine is a single-spindle structure. The spindle is covered with a solid roller, on the surface of which unidirectional concave deflagration grooves are arranged obliquely in a honeycomb pattern. Micro gaps between grooves form chain deflagration transmission channels. This structure provides three core advantages:

- Single ignition triggers continuous self-sustaining chain deflagration without frequent ignition, greatly reducing system energy consumption;
- Uniform circumferential force realizes zero-vibration and symmetric power output;
- Integrated single-spindle rotation delivers extremely high operational stability and extremely low mechanical fatigue, fundamentally reducing structural loss.

2.4 Four-Core Initial Deflagration Points and Expandable Multi-Tangent Design

To achieve high-power and highly symmetric startup, the engine adopts an initial four-core chain deflagration structure:

- Four evenly distributed deflagration tangents are located at symmetric tangent points of the roller circumference, and the geometrically symmetric layout ensures fully balanced output;
- No eccentricity, no vibration and no dynamic imbalance, ensuring stable operation from the startup phase;
- Establishes a standardized structural foundation for subsequent multi-tangent expansion.

In later stages, the number of tangents can be flexibly adjusted according to power

requirements to achieve full-scenario adaptation:

- Increasing the number of tangents improves deflagration frequency and power density for heavy-duty and high-power scenarios;
- Reducing the number of tangents lowers energy consumption for low-power and lightweight applications;
- Multi-roller or multi-spindle combinations enable modular and multi-power-level expandable designs to meet diverse engineering requirements.

Meanwhile, the system structure is fully adjustable: roller size, groove depth, single deflagration volume, deflagration density, spindle length and multi-spindle configuration can all be adaptively regulated according to application scenarios. The design is not fixed but can be flexibly matched to applications ranging from micro power to large-scale heavy-duty power.

2.5 Spindle Built-In Liquid Storage Tank and High-Thermal-Conductivity Thin Shell

The engine spindle module is fully integrated inside the liquid storage tank. A hard, ultra-thin, high-thermal-conductivity metal isolation shell is arranged outside the roller to provide dual structural and functional protection:

- Physically isolates deflagration vapor from the spindle to prevent erosion and extend service life;
- Does not hinder heat transfer, enabling rapid conduction of deflagration waste heat to the electrolyte;
- Fully isolates from the working medium to avoid structural corrosion and medium contamination.

This design achieves two core values:

1. Waste heat is directly returned to the electrolysis process, significantly reducing the electric energy required for electrolysis and greatly improving overall system efficiency;
2. Closed-loop vapor reflux realizes zero substance emission and infinite recycling of the working medium, forming a complete energy closed loop.

2.6 Overall Working Flow

1. The battery provides initial electric energy and activates the electrolysis module;
2. Electrolysis rapidly generates hydrogen-oxygen mixture, which enters the deflagration grooves of the roller;
3. The four-core tangents ignite and trigger chain deflagration, driving the spindle to rotate at high speed;
4. The spindle outputs ultra-high power to complete energy conversion;
5. Pure water vapor after deflagration cools and refluxes to the liquid storage tank;
6. Deflagration waste heat heats the electrolyte through the high-thermal-conductivity shell, reducing subsequent electrolysis energy consumption;
7. The system enters a self-sustaining high-efficiency cycle and maintains operation with minimal electric energy.

3. Efficiency and Performance Comparison with Existing Power Systems

3.1 Accurate Calculation and Comparison of Energy Conversion Efficiency

3.1.1 Efficiency Calculation of Traditional Fuel Internal Combustion Engines (Gasoline)

The conversion of gasoline chemical energy to effective mechanical power at the wheel involves full-process irreversible losses, calculated as follows:

1. Basic calorific value: the low heating value of gasoline is 44 MJ/kg, representing total chemical energy;
2. Loss items: mechanical friction loss ~18%, exhaust heat loss ~30%, coolant heat loss ~25%, incomplete combustion loss ~5%;
3. Overall efficiency under regular working conditions: $100\% - (18\% + 30\% + 25\% + 5\%) = 22\%$;
4. Optimized efficiency of high-performance engines: $100\% - (12\% + 25\% + 20\% + 3\%) = 40\%$.

In summary, the real efficiency range of traditional fuel engines is 22%~40%, with more than 60% of energy wasted as waste heat or friction.

3.1.2 Full-Link Three-Condition Efficiency Calculation of Pure Electric Drive

System (Battery to Wheel)

Manufacturers only publicize the peak motor efficiency (96.8%). Actual full-link efficiency deducts all real losses, calculated by working conditions:

1. Fixed losses: battery charge-discharge internal resistance loss 8%~11%, inverter/electronic control loss 6%, gearbox mechanical loss 4%;
2. Variable loss: high-voltage accessories (air conditioner, thermal management, BMS) 12%~18%;
3. Urban commuting (normal temperature): $0.89 \times 0.94 \times 0.96 \times 0.96 \times 0.86 \approx 28.7\%$;
4. High-speed long-distance + air conditioning: $0.89 \times 0.92 \times 0.96 \times 0.96 \times 0.82 \approx 23.9\%$;
5. Low-temperature winter (-10°C): $0.85 \times 0.90 \times 0.96 \times 0.96 \times 0.78 \approx 19.2\%$.

In summary, the real full-link efficiency range of pure electric drive systems is 19.2%~28.7%, significantly reduced by multiple losses.

3.1.3 Efficiency Calculation of the Proposed Electric-Driven Water Engine

Based on physical constants and actual engineering losses, the efficiency is accurately calculated as:

1. Basic energy values: theoretical power consumption for electrolyzing 1 mol water is 237 kJ, total heat release from hydrogen-oxygen deflagration is 286 kJ, with a chemical energy net gain of 20.7%;
2. Engineering losses: electrolysis efficiency 90%, deflagration-to-mechanical efficiency 85%, heat recovery efficiency 98%, spindle transmission efficiency 90%;
3. Final efficiency under standard conditions: $0.90 \times 0.85 \times 0.98 \times 0.90 = 67.5\%$;
4. Efficiency with ordinary materials: $0.85 \times 0.85 \times 0.98 \times 0.85 = 60.2\%$.

In summary, the electric-to-mechanical conversion efficiency of the system ranges from 60.2%~67.5%, far exceeding both existing power systems.

3.1.4 Comparison of Calorific Value and Power Multiplier Between Hydrogen-Oxygen Deflagration and Gasoline Combustion

The system presents absolute advantages in energy density and explosive force:

1. Per-unit-mass calorific value: gasoline 44 MJ/kg, hydrogen 142 MJ/kg. The

calorific value of hydrogen is 3.2 times that of gasoline;

2. Burning velocity: hydrogen-oxygen combustion speed is 5~8 times that of gasoline, with more concentrated energy release;

3. Deflagration pressure and thrust: hydrogen-oxygen explosion pressure is 1.8~2.5 times that of gasoline. Under the same combustion chamber volume, the power output of the system is 2~3 times that of gasoline engines.

3.2 Power Output Characteristics

- Fuel engines: high power but high vibration, low efficiency and serious pollution;
- Electric vehicles: relatively high efficiency but limited power density, external energy dependence and range anxiety;
- Proposed system: calorific value and thrust exceed gasoline, efficiency is much higher than electric vehicles, with stable high-power output through a single spindle. It perfectly combines the high power density of fuel vehicles and the high efficiency of electric vehicles while avoiding all their defects.

3.3 Vibration and Mechanical Loss

- Fuel engines: reciprocating structure causes strong vibration and high mechanical fatigue, fast component wear and high maintenance cost;
- Electric vehicles: motors and transmission systems still suffer from continuous mechanical loss and structural fatigue during long-term operation;
- Proposed system: single-spindle and symmetric deflagration structure achieve nearly zero vibration, no mechanical impact and no fatigue loss. Component service life is exponentially improved with extremely low maintenance cost.

3.4 Environmental Performance and Emissions

- Fuel vehicles: massive exhaust emissions, environmental pollution and prominent carbon emissions;
- Electric vehicles: essentially energy transfer with no direct substance emissions;
- Proposed system: no combustion by-products, only recycled water-based working medium, no exhaust gas or pollution. It has overwhelming environmental advantages over fuel vehicles and stronger environmental friendliness than electric vehicles due to higher efficiency and partial energy self-sufficiency, truly achieving full-lifecycle

environmental protection.

3.5 Manufacturing and Maintenance

- Extremely simple structure, core components limited to spindle, roller, electrolysis module and liquid storage tank, without complex precision parts;
- Low-cost and easily available materials, manufacturable in ordinary small-scale workshops, greatly reducing production costs;
- Almost no wearing parts, extremely simple maintenance, only requiring periodic replenishment of a small amount of composite working medium.

3.6 Multi-Scenario Adaptability

The system can be adapted to full scenarios by flexibly adjusting:

- Number of tangents
- Roller size
- Groove depth
- Single deflagration volume
- Deflagration density
- Multi-spindle and multi-module combinations

It can be widely applied in almost all power scenarios including land vehicles, engineering machinery, aerospace equipment, submersible devices, precision instrument drives and field operation equipment. It operates stably in conventional environments as well as extreme low-temperature, high-temperature and sealed environments, with a wider application range than all existing power systems.

4. Originality and Intellectual Property Statement

The structural design, chain deflagration method, built-in spindle liquid storage tank scheme, high-thermal-conductivity isolation shell, four-core symmetric deflagration logic, multi-tangent regulation mechanism, working medium selection and optimization scheme proposed in this paper are all independently original achievements of the author.

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5. Conclusion

The electric-driven water engine (hydrogen-oxygen deflagration type) proposed in this paper subverts the traditional power system at the principle level, perfectly integrating the high power density of fuel power and the high efficiency of electric drive while avoiding all their defects. Accurate efficiency calculations verify that the system's electric-to-mechanical conversion efficiency reaches 60.2%~67.5%, far exceeding traditional fuel engines (22%~40%) and pure electric drive systems (19.2%~28.7%). The calorific value of hydrogen-oxygen deflagration is 3.2 times that of gasoline, with overall superior power output and explosive force.

Its core advantages include:

- Ultra-high energy conversion efficiency, far exceeding traditional fuel and electric power systems;
- Near-zero substance emissions and full-lifecycle environmental protection;
- Nearly zero vibration and mechanical loss, extremely high structural stability and long service life;
- Multi-scenario modular adaptation, flexibly adjustable parameters for full-range power demands;
- Low-cost manufacturing and maintenance, capable of mass production in small factories with extremely low operating costs;
- Self-sustaining cycle and low power demand, reducing external grid dependence and supporting partial energy self-sufficiency.

This system is not an iterative optimization of existing power devices but a new generation of prime mover. This paper has completed the full-system core design covering structure, working medium, power supply, efficiency and adaptation, forming a complete and implementable technical solution. Only a small amount of supplementary research and parameter optimization is needed in the future without further serial papers. The technology possesses high scientific, commercial and social

value, representing a core direction for the future development of global power technology.

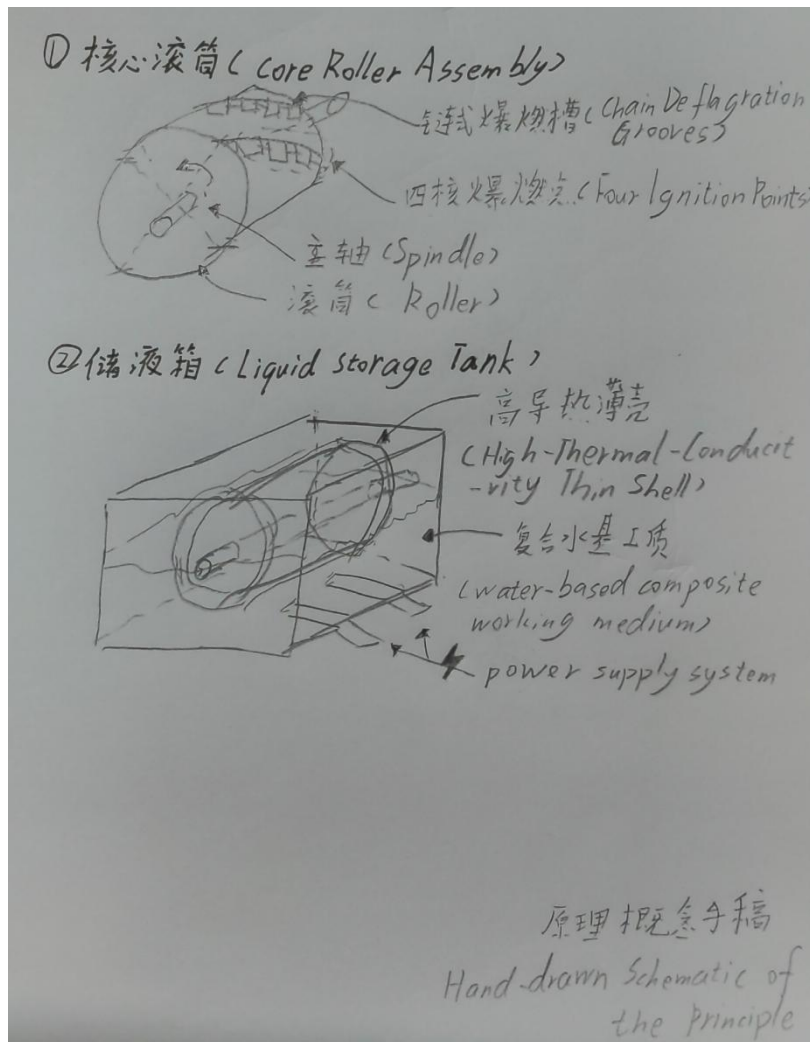
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Appendix A:



Hand-drawn Schematic of the Principle