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FREE PISTON LINEAR GENERATOR COMPARED TO ELECTRIC GENERATOR ON REGULAR INTERNAL COMBUSTION ENGINE

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Currently, interest in electric vehicles is growing stronger and stronger; however, due to the underdeveloped battery technology, they are not yet able to replace internal combustion engine (hereinafter referred to as "ICE") vehicles. Hybrids may serve as a compromise.

In hybrid vehicles, the powertrain consists of an internal combustion engine combined with a generator. A potential alternative to this configuration could be a generator-engine in a single housing. A free-piston linear generator is a type of device that generates electrical energy and is considered a potential solution to the problem of limited range in electric vehicles. The proposed engine has a number of advantages compared to a "conventional" one. The free-piston linear generator does not have a crankshaft mechanism, which increases efficiency, allows for dynamic changes in compression ratio, and results in a more compact unit [1]. In a conventional generator, electrical energy is generated using a wire frame that rotates in a magnetic field and is driven by an external engine. In the proposed generator, the wire frame remains stationary while the magnetic field moves linearly relative to it. This change allows for a reduction, simplification, and cost reduction of the design, especially when using an internal combustion engine [2].

The operating principle of the free-piston linear engine is similar to that of a conventional internal combustion engine. A connecting rod, designed as a metal rod, transmits the reciprocating motion to the linear generator. The connecting rod will be situated in sliding bearings and will be able to move not only linearly but also rotate within the generator housing. This engine will operate on a two-stroke cycle. As a result, the cylinder scavenging will be performed by the fuel-air mixture through scavenging ports in the cylinder, driven by the vacuum created during

the engine's working cycle. An electromagnet or permanent magnet will be positioned on the connecting rod. If an electromagnet is used, an excitation winding will also be added to create an initial magnetic field. Since the magnets are fixed on the connecting rod, during its reciprocating movements, the magnetic induction lines will move along with it, crossing the fixed wire frame in the housing and thereby inducing an electric current and voltage in it [2].

The main difference between the free-piston linear generator and a conventional internal combustion engine is the absence of a crankshaft mechanism. This simplification of design makes it lighter, simpler, and consequently more reliable than a conventional ICE. It will also allow for dynamic changes in the combustion chamber volume by varying the engine's compression ratio. Such an engine could operate alternately on various types of fuel without interrupting its operation, making it even more versatile. Additionally, the absence of a crankshaft mechanism will reduce mechanical losses due to fewer moving parts and increase the efficiency of the piston engine. The efficiency of modern gasoline internal combustion engines reaches 20–25%, while the theoretical efficiency of the proposed engine could reach up to 70%. One section of this installation will contain two horizontally positioned cylinders and one generator, making it more compact than “ordinary” internal combustion engines. Additionally, due to its sectional design, the configuration of the generator can be adjusted based on the available space and the required power characteristics of the free-piston linear generator.

However, the free-piston linear generator also has its drawbacks. One of these is the high vibrational load on the engine compared to “traditional” internal combustion engines [2]. This is related to its structural features as well as the operating principle of the free-piston engine. To solve this issue, it is recommended to use two sections that work separately.

References

1. Engine Building // Issuu. – URL: https://issuu.com/borov665/docs/nit012021/s/11654806 (date of access: 30.03.2025).

2. Skoromets, Yu.G. Linear engine on a vehicle / Yu.G. Skoromets // Modern technology and technology. – 2012. – № 8. – URL: https://technology.snauka.ru/2012/08/1307 (date of access: 30.03.2025).