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Efficiency of using internal combustion engines

One of the most effective ways to increase the productivity of social labor is to improve the quality of products. The production of high quality products compensates for their quantity with significantly less labor and cost. In improving the quality of engineering products, an important place is given to power plants - internal combustion engines, which are the most massive energy means of various machines and mechanisms and largely determine their reliability and efficiency. Requirements for power plants installed on mobile objects: efficiency of functioning as part of a car, a tractor and other machines, ensuring the safety of work, minimal negative impact on humans and the environment, minimizing the consumption of operating materials and energy during operation. Work to further improve the reliability of engines, their reliability and durability should be carried out by ensuring the uniform strength of parts and assemblies (in the extreme case, the multiplicity of the resource in relation to the basic parts of increased durability). These tasks are solved by improving the design and manufacturing technology of engines, improving the quality of materials used and products of related industries, improving activities in the field of operation and repair. High reliability of engines gives a great economic effect in the national economy by reducing equipment downtime, increasing machine productivity, reducing repair costs, and reducing the need for spare parts. An increase in the service life of engines is equivalent to an increase in their output.

The operation of machines reflects three aspects - their use for their intended purpose, maintenance in a working condition and ensuring their functioning.

The first aspect - intended use - implies organizational measures to ensure the efficient use of machines.

The second is keeping it in good working order - ensuring operability through maintenance and storage of machines.

The third - ensuring the functioning - providing operational materials (fuels and lubricants, spare parts, etc.).

To ensure the functioning of machines, the first place is the issue of energy supply. The energy source for mobile technology is mainly internal combustion engines.

Many enterprises are engaged in the production of engines, especially for vehicles. Domestic engine manufacturers have to compete in this area and with foreign firms, and not always successfully. This necessitates a systematic increase in the technical and economic efficiency of the produced engines.

Some experts consider reliability to be the main indicator of engine efficiency. At the same time, the technical and economic efficiency of engines can be expressed by an integral quality indicator.

The efficiency of using working machines (vehicles) is greatly influenced by productivity (amount of work per unit of time). An increase in vehicle productivity is associated with an increase in travel speed and an increase in carrying capacity. And this requires an increase in the power-to-weight ratio of the vehicle by increasing the absolute power of the engine and increasing the engine power per unit of the total mass of the vehicle. Increase in vehicle weight and travel speeds led to a significant increase in engine power.

If in the middle of the last century the power of engines of trucks ranged from 40 to 120 hp, now for some cars it reaches over 1000 hp. According to forecasts for heavy (off-road) vehicles, engines with a capacity of up to 2000 hp are advisable.

The increase in vehicle engine power to increase speed and payload is accompanied by an increase in fuel consumption per kilometer. This has caused the urgency of the problem of fuel efficiency of vehicles.

Increasing the power of gasoline engines in trucks and buses requires an increase in cylinder bore, which, due to the tendency to detonation, necessitates the use of high-octane gasolines, or a decrease in the compression ratio, leading to a decrease in fuel efficiency. This limited the increase in cylinder bore of carburetor engines to just over 100 mm.

The transition to the use of diesel engines on trucks instead of gasoline engines caused a decrease in operating fuel consumption by 25 ... 30%, and in tense urban conditions up to 40 ... 50%. On four-wheel drive vehicles in off-road conditions and especially with trailers, the savings are sometimes more than 2 times.

With a fleet of cars of 1 million units with a carrying capacity of 8 tons, the annual fuel savings from replacing gasoline engines with diesels can be up to 4.4 million tons. At the same time, transport and storage costs are reduced. Other advantages of diesel engines are:

- less toxicity of exhaust gases;
- the best suitability for pressurization;
- less demanding fuel grades;
- great suitability for creating multi-fuel modifications;
- great ability to brake the car with the engine;
- less fire hazard;
- less heat transfer to the cooling system;
- the best dynamic qualities.

There are also disadvantages. Including:

- more severe combustion process;
- increase in massiveness and cost of the engine up to 25%;
- the cost of manufacturing a transmission when switching from a gasoline engine to a diesel is higher up to 10 ... 20%;

- 1.5 ... 2 times higher cost of storage batteries (a starting engine is installed on tractors);

- more difficult to start, especially at low temperatures and others.

At the same time, fuel efficiency makes the above disadvantages to be neglected and pushes production towards the use of diesel engines, even in light duty vehicles and passenger cars.

The high mass of diesel engines for tractor engines not only does not worsen the technical characteristics of the tractor, but, on the contrary, increases its coupling weight, which is necessary to increase the tractive effort, reduce slipping.

The decrease in the cost of the engine is associated with an increase in their mass production. In this regard, it is advisable to create unified families of multi-purpose engines with a wide design and technological unification of parts and assemblies of engine models with different numbers of cylinders.

Practice shows that the cost of maintaining an engine in working order is many times higher than the cost of manufacturing (production). The cost of maintenance and repair compared to the cost of manufacturing is up to 7 times higher, and labor intensity - up to 60 times.

The costs of maintaining the operability of the engine with losses associated with machine downtime due to its failures largely determine its technical and economic efficiency.

To ensure high reliability of the engine, it is necessary to ensure the minimum permissible amount of maintenance in operation, up to its exclusion for individual components and assemblies while maintaining their reliability and durability and the engine as a whole.

The high reliability of the engine, inherent in the creation, ensured during manufacture and realized during operation, can reduce the cost of maintaining the engine in a working condition and the losses associated with downtime of the car due to the fault of the engine.

Hence, the reliability of the engine is the basis of its technical and economic efficiency, a reserve for saving social labor and the basis for increasing its productivity.

High engine reliability is provided by: increasing reliability by ensuring the same durability (resource), or its multiplicity for assembly units relative to the basic part with high durability; an increase in the engine resource before overhaul by increasing the resource of limiting assembly units; increase in secondary engine overhaul life; reducing the cost of overhaul by improving repair methods, restoring parts and reducing the cost of spare parts; a decrease in the labor intensity of maintenance and an increase in maintainability due to design and technological measures, and others. To perform reliable work, it must be ensured that their influence on the occurrence of failures is reduced. In this case, it is necessary: improvement of the design and manufacturing technology (restoration) of parts; increasing the level of operation of products; improving the quality of major repairs (restoration of the resource); widespread use of technical diagnostics and others.

High reliability of engines gives a great economic effect in the national economy by reducing equipment downtime, increasing machine productivity, reducing repair costs, and reducing the need for spare parts. An increase in the service life of engines is equivalent to an increase in their output.

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