gas turbine engines, which is calculated by the formula

$$\Delta m_v = \frac{m_v - m_v^{'}}{m_v} \cdot 100.$$

The fifth and sixth columns show fuel consumption before and after the transition to gas turbine engines, respectively. The seventh column shows the percentage of reduction of fuel consumption ΔQ_s as a result of the replacement, which is calculated by the formula:

$$\Delta Q_s = \frac{Q_s - Q_s^{'}}{Q_s} \cdot 100.$$

Table 4. Total mass and fuel consumption before and after replacement.

m_v [kg]	R [W/kg]	$m_v^{'}$ [kg]	Q_s $\left[\frac{l}{100km}\right]$	$Q_s^{'}$ $\left[\frac{l}{100km}\right]$	ΔQ_s %
1000	40	877	3.65	2.75	24.7
	55	831	3.62	2.59	28.5
	70	785	3.62	2.46	32.0
4000	20	3755	14.37	11.40	20.7
	25	3693	14.23	11.17	21.5
	30	3622	10.73	10.87	-1.3
10000	8	9755	38.96	34.75	10.8
	11.5	9647	32.00	32.42	-1.3
	15	9540	28.00	29.98	-7.1

Figure 2 illustrates the effect of replacement of diesel engines by gas turbine engines on fuel consumption, which depends on total mass and power -to -weight ratio.

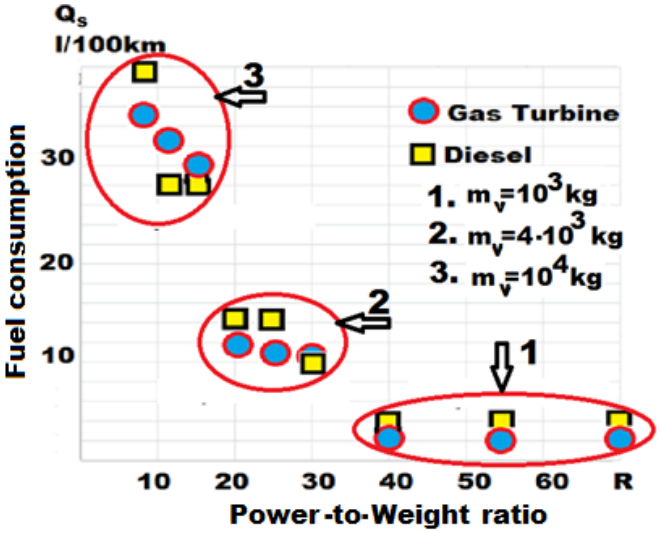

Fig. 2. Fuel consumption of hybrid vehicles with diesel and gas turbine engines

The obtained results allow for the following analysis:

1. When the mass of the vehicle is small (1000 kg), replacement of diesel engines by gas turbines leads to a very significant reduction in fuel consumption for any R. This is due, firstly, to the fact that for vehicles with such total mass the power of the heat engine does not exceed 50 kW, and accordingly the effective efficiency does not exceed 0.3 [23], and, secondly, to the fact that the relative reduction in the mass of the vehicle after the transition to gas turbines for any R is very significant: 12.3, 16.9 and 21.5% for R = 40, 55 and 70, respectively.
2. For mid-sized buses and trucks with mass of 4000 kg and R in the range of 20-25 the replacement of diesel engines by gas turbines also leads to a decrease in fuel consumption. This is due firstly to the fact that the effective efficiency of diesel engines in this case does not exceed 0.3, secondly, to the fact that γ_m in vehicles with diesel engines is 2% greater than in vehicles with gas turbines, and thirdly, that the relative reduction in the mass of the vehicle after the transition to gas turbines is quite significant: 6.1 and 7.7% for R = 20 and 25, respectively. When R = 30 for vehicles of this class fuel consumption after the transition to gas turbines increases slightly due to the fact that the power of the heat engines for this subclass is greater than 50 kW, and therefore the effective

efficiency of diesel engines equals 0.4. The 9.5 % reduction in the mass of the vehicle as a result of the transition to gas turbines leads to a decrease in fuel consumption, but this is offset by a decrease in effective efficiency from 0.4 to 0.35.

3. When the mass of the vehicle is 10,000 kg (large buses and trucks), reduction in fuel consumption after replacing diesel engines by gas turbines occurs only if $R \leq 10$. This is due to the fact that in this case the power of the heat engine is no greater than 50 kW, and therefore the effective efficiency of diesel engines does not exceed 0.3. When $R > 10$, the effective efficiency of the diesel engine is higher than that of the gas turbine, and this outweighs the influence of the slight (3-4%) mass reduction which results from replacing the diesel engine by a gas turbine.

4. CONCLUSIVE REMARKS

Let us summarize the main conclusions.

Remark 4.1. When assessing the feasibility of replacing diesel engines by gas turbines for different classes of vehicles, the most important design parameters of the vehicle that should be considered are: effective efficiency, mass and power of the heat engine.

Remark 4.2 Calculations show that for all light vehicles with mass of 1000 kg and mid-sized vehicles with R in the range between 20-25 W/kg, replacing diesel engines by gas turbines leads to a very significant (more than 20%) reduction of fuel consumption. For heavy trucks with mass of about 10 tons whose R = 8, transition to gas turbines will also lead to a reduction in fuel consumption, although a less significant one (about 10%). Thus, the widespread transition to gas turbines in such vehicles is highly desirable, since it will lead to a very significant reduction in the total fuel consumption in transportation, given that these classes represent a large percentage of all vehicles.

Remark 4.3. Even though for vehicles with mass of 4000 kg whose R = 30 and those with mass of 10000 kg whose R = 15 transition to gas turbines will result in a slight (approximately 1%) increase in fuel consumption, this transition is nonetheless advisable in view of the important advantages of gas turbine engines compared to diesel engines in terms of emissions, noise and vibration [8, 24], compactness and operating costs

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