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IMPROVING THE COOLING SYSTEM OF THE DAMAS VEHICLE

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Abstract: The Damas vehicle, widely used in Uzbekistan for both commercial and personal purposes, relies on a traditional liquid cooling system. While functional, the current mechanical fan system consumes engine power unnecessarily and leads to inefficiencies in fuel consumption, especially in varying climate conditions. This study proposes a redesign of the cooling system through the implementation of an electric fan controlled by a thermostat, synchronized with engine temperature. The new system aims to reduce fuel consumption, increase engine efficiency, and improve environmental performance. The research involved analysis of the existing system, prototyping, real-world testing, and economic evaluation. The results demonstrate that the redesigned system significantly improves thermal management and fuel efficiency.
Keywords: Damas vehicle, cooling system, electric fan, thermostat control, engine efficiency, thermal management

1. Introduction. Automotive engineering continues to evolve with the growing demands for fuel efficiency, environmental responsibility, and improved vehicle performance. In this context, engine thermal management plays a crucial role, especially for light commercial vehicles such as the Damas, which are prevalent throughout Uzbekistan. The Damas vehicle's original cooling system, while effective for baseline conditions, exhibits limitations in dynamically responding to varying thermal loads and environmental factors. Particularly, the use of a mechanically driven cooling fan, constantly engaged with the engine's crankshaft, results in unnecessary energy consumption, delayed engine warm-up, and increased emissions during cold starts.

The Damas vehicle, produced by UzAuto Motors, is based on the Suzuki Carry platform and is powered by a compact F8CV 0.8L engine. Its simplicity and affordability make it highly popular for small businesses, taxis, and family transportation. However, in extreme climates — where temperatures can vary from -20°C in winter to +40°C in summer — the existing cooling system struggles to maintain optimal engine temperature efficiently. This inefficiency negatively impacts fuel economy, engine wear, and cabin heating performance during cold conditions.

This study investigates the shortcomings of the current Damas cooling system and proposes a modified design incorporating an electric radiator fan managed by a thermostatic control. The research explores the theoretical basis, practical implementation, and testing outcomes of this modification.

2. Methods. The first phase of the study involved a technical assessment of the Damas vehicle's existing cooling system. The configuration includes a belt-driven mechanical fan, a conventional radiator, a water pump, thermostat, expansion tank, and rubber hoses. The fan operates continuously when the engine runs, regardless of thermal demand, resulting in constant power draw.

The key limitations identified are:

Inefficient warm-up during cold starts, especially in winter.
Unnecessary mechanical load on the engine.
Elevated fuel consumption (estimated increase of 0.5–1.0 L/100 km).
Delayed cabin heating due to slower temperature rise.
Inability to adjust fan operation based on real-time thermal needs.

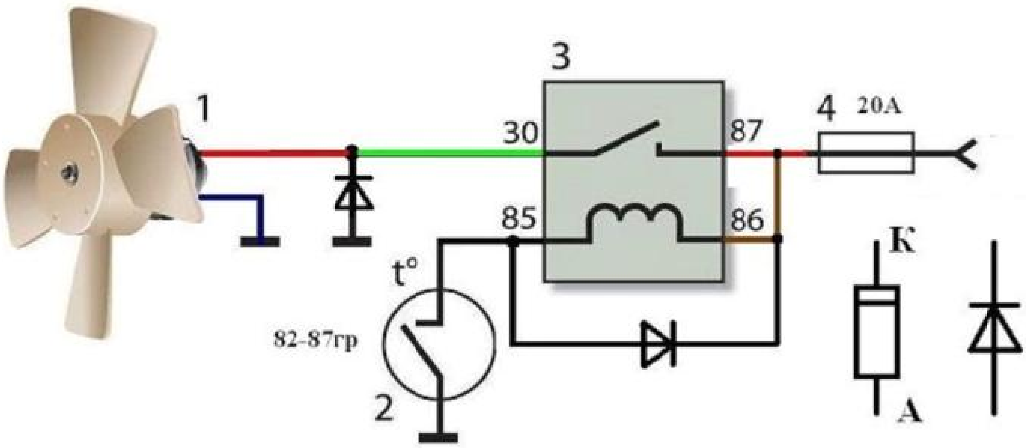

Fig 1. Thermostatically controlled electric fan wiring diagram

The proposed solution replaces the mechanical fan with a 12V electric fan, activated via a temperature sensor and controlled through a relay system. The fan operates only when coolant temperature exceeds a threshold (typically 85–90°C), thereby eliminating parasitic losses during low-load or cold conditions.

Components used:

12V electric radiator fan (100–120W)

Engine temperature sensor

30A automotive relay

15A fuse

2.5 mm² copper wires

Manual override switch (optional)

Installation Procedure

1. The original fan assembly was removed.
2. The electric fan was mounted behind the radiator using universal brackets.
3. A temperature sensor was inserted into the lower radiator hose using a brass T-joint.
4. The relay circuit was connected to the battery, sensor, and fan.
5. System was tested with and without engine load.

Testing and Evaluation

The modified system was evaluated over multiple operating cycles, including city and highway driving. Engine temperature, fan activation time, fuel consumption, and cabin heating response time were recorded and compared with the stock configuration.

3. Results. The electric fan engaged consistently at approximately 88°C and deactivated at 82°C. The engine reached optimal temperature 25–30% faster than with the mechanical fan.

Fuel consumption decreased by an average of 0.7 L/100 km in urban driving. This corresponds to a savings of roughly 140–180 liters of fuel annually for a vehicle traveling 20,000 km/year.

Faster warm-up improved cabin heating performance, with noticeable warmth available within 4–6 minutes of engine start during winter conditions, compared to 8–12 minutes previously.

The total cost of modification (including parts and labor) was approximately 1,100,000 UZS (\~\$90). Break-even based on fuel savings alone was projected at under 10 months of regular use.

No overheating incidents were observed. Electrical components remained stable under real-world driving conditions, with proper fusing preventing overload.

4. Discussion. The findings of this study demonstrate that substituting a mechanical fan with an electric, thermostat-controlled alternative in the Damas vehicle yields measurable improvements in fuel efficiency, thermal regulation, and overall user comfort. The faster engine warm-up not only improves fuel economy but also reduces engine wear during cold starts. Additionally, improved cabin heating contributes to driving safety and comfort, particularly important in

Uzbekistan’s winter conditions.

Environmental implications are also notable. Reducing fuel consumption by up to 7% lowers CO_2 emissions, contributing to national goals of energy efficiency and pollution reduction. From a manufacturing standpoint, introducing such modifications into production models would involve minimal redesign while offering long-term benefits to consumers.

While the project focused on a single vehicle model, the methodology and benefits are transferable to other vehicles with similar engine configurations and operating environments.

Future work could include integration with ECU-based controls, variable fan speeds, or hybrid-electric cooling systems to further optimize performance.

5. Conclusion. The modernization of the Damas vehicle’s cooling system through the integration of an electric, thermostat-regulated radiator fan proves to be a viable and cost-effective upgrade. It significantly enhances thermal efficiency, reduces operational costs, and aligns with broader environmental goals. This improvement exemplifies how targeted technical interventions can address practical inefficiencies in widely used vehicles without extensive overhaul. The implementation of this system is recommended not only for private owners but also for fleet operators and manufacturers seeking to enhance the Damas model’s performance profile.

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