

## METHOD OF OBTAINING ADDITIONAL ELECTRICAL ENERGY FROM MODERN TRUCKS

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**Abstract:** This article discusses the procedure for obtaining electrical energy from modern trucks (KamAZ, Ural, MAN, Isuzu), their utilization, and proposals for supplying electricity to practical shooting exercises during field deployments and organizing training sessions.

**Key words:** generator, storage battery, starter, voltage regulator, relay regulator.

In recent years, within the framework of reforms carried out in the Armed Forces of the Republic of Uzbekistan, special attention has been paid to modernizing the Armed Forces, improving their combat readiness, and developing the capability to deliver an adequate and timely response to any aggression directed against the country.

The combat effectiveness of any equipment and weapons depends on their rational and proper use. This, in turn, is determined by the high level of knowledge and professional competence of automotive service personnel.

Efficient operation of vehicles depends on the quality, productivity, durability, and proper maintenance of all structural components used in them (Figure 1).



**Figure 1. Modern trucks**

The increase in the number and power of electrical consumers in modern vehicles has led to an increase in generator capacity. As generator power increases, the excitation current also rises, which must be interrupted by voltage regulator contacts. However, when the interrupted current power increases, the contacts overheat and fail quickly. To prevent this, contact-transistor regulators have been developed, where the transistor performs the function of interrupting the excitation current, while the regulator contacts only control its operation (Figure 2).



**Figure 2. Three-dimensional view of the generator**

The generator is the main source of electrical power in vehicles. The generator shaft is driven by the engine crankshaft via a pulley using flat or V-belts. The transmission ratio of V-belt drives is 1.5–1.7 for DC generators and 2.0–2.5 for AC generators.

During vehicle operation, the crankshaft rotation frequency in modern engines ranges from 500–800 rpm at idle to 4000–6000 rpm at maximum speed. Therefore, variations in engine speed may cause generator shaft speed to vary up to 8–10 times.

Generator voltage depends on shaft rotation frequency: the higher the speed, the higher the voltage. However, vehicle electrical equipment, especially lighting and measuring instruments, is designed to operate at constant voltages of 14 V or 28 V.

Alternating current (AC) generators are widely used in vehicles because they offer several advantages over DC generators: lower weight at equal power, longer service life, reduced copper consumption (2–2.5 times less), and the possibility of increasing the transmission ratio. At higher transmission ratios, even at idle speed, the generator can supply 25–50% of its rated current, improving battery charging conditions and extending battery life.

Maintaining generator voltage at a specified value regardless of changes in rotation speed, load (consumer connection), or temperature is performed by a special device called a voltage regulator.

When crankshaft speed decreases to idle level, generator voltage may become lower than battery voltage. If the battery is not disconnected, it will begin discharging into the generator, overheating the windings and discharging the battery. When engine speed increases again, the generator must be reconnected to the electrical system. This function is performed by a reverse current relay (Figure 3).



**Figure 3. General structure of the generator**

The generator is designed for a specified maximum current. In case of malfunctions (discharged battery, short circuit, etc.), it may supply excessive current, leading to overheating and failure. To prevent overload, a current limiter is used.

All three devices (voltage regulator, reverse current relay, and current limiter) are combined into a single unit called a relay-regulator.

#### Starting System

The starting system consists of a starter, battery, starter circuit, and auxiliary starting devices. The battery and starter capacities are closely matched. Therefore, during engine starting, battery voltage significantly changes depending on the starter current.

Battery condition (temperature, charge level, wear), starter circuit condition, and auxiliary starting aids significantly affect engine starting (Figure 4).



**Figure 4. General view of the starter**

In AC generators, reverse current relays and current limiters are not used separately, but equivalent protective functions are integrated into the design.

When generator voltage exceeds the regulated value, regulator contacts open, excitation current decreases through resistors, magnetic flux reduces, and generator voltage drops. As voltage decreases, contacts close again, and excitation current increases. This process repeats periodically.

To increase contact vibration frequency and reduce voltage fluctuation amplitude, a 13-ohm resistor is connected in parallel (Figure 5).



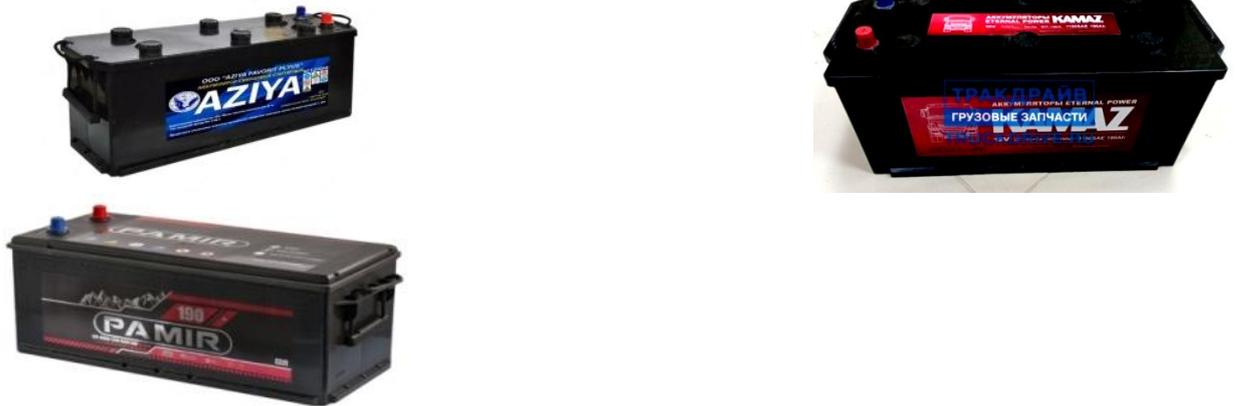
**Figure 5. Voltage regulator**

#### Battery System

The battery supplies electrical power to the starter during engine start and to electrical devices when the generator is not operating or insufficient (e.g., at idle).

If consumer demand exceeds generator output, the battery discharges to support the load. As battery voltage drops, starter speed and power decrease.

A lead-acid battery is a secondary chemical source of DC power. It must be charged before use. Starter batteries allow discharge currents 3–5 times higher than nominal capacity (Figure 6).



**Figure 6. Storage batteries**

Starter batteries are classified by:

- Nominal voltage (6V and 12V)
- Design (terminal placement)
- Maintenance type (maintenance-free, dry-charged, pre-filled)

Battery charging is monitored by an ammeter, voltmeter, or warning lamp. The voltmeter provides the most complete information, allowing monitoring of regulated generator voltage and battery condition.

Relays and Control

Relays are used for:

- Starter activation
- Signal systems
- Headlights (high/low beam)
- Cooling fan
- Rear window heater
- Generator excitation winding disconnection (KamAZ)
- Pre-heating systems

Practical Proposals for Military Trucks

- Monitoring battery charging режим
- Installing additional batteries on military trucks
- Installing additional generators when necessary
- Extracting surplus electrical energy from military trucks
- Proper use of electrical energy in extreme conditions

Monitoring charging ensures proper functioning of the generator and relay-regulator. Charging current indicates battery charge level, while overcharge current indicates correct voltage regulation adjusted for temperature.

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