USE OF GREEN ENERGY IN THE DOMAIN OF RAILWAY TRACTION

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Abstract: This paper aims to introduce the concept of energy in the Romanian railway vehicles. Thus, the possibility of using the solar energy, namely photovoltaic energy, was for the Desiro SR 20 D vehicle, manufactured by Siemens.

Keywords: energy, automotive, railway, photovoltaics.

1. Introduction

In this paper, a topical issue was addressed, namely, the possibility of using green energy, ie renewable and non-polluting energy, which comes directly from the environment, to the railway vehicles in the park of Romanian operators.

Thus, it was studied and experimented on a diesel engine type Desiro SR 20 D, manufactured by Siemens - Germany, how to implement a photovoltaic installation, for charging the battery batteries with which this car is equipped.

The technical solution for the use of green energy on the Desiro SR 20 D motor vehicle, proposes the use of *„green"* energy for Desiro SR 20 D motor vehicles. In this sense, within the Iasi depot, the author tested a *„green"* energy, namely solar energy, using photovoltaic panels and specialized controllers to charge the batteries of the Desiro SR 20 D.

2. Green energy sources for railway vehicles

At present, the world economy uses mostly energy from non-renewable resources, the most important of which are: coal, oil and natural gas. All these non-renewable resources lead through their use to increase the greenhouse effect, pollution and finally global warming.

Given that these resources are not endless, there is an increasing emphasis on increasing the share of renewable energy use.

Non-renewable energy leads to increased pollution, the appearance of acid rain, things that can no longer be neglected.

In recent years, humanity has consumed (fig. 1):

- 27% of electricity produced from the operation of coal-fired thermal power plants;
- 35.3% of electricity produced by burning oil (gasoline, diesel, etc.);
- 20.5% electricity produced by burning natural gas;
- 5% electricity produced in nuclear power plants;
- 13.2% electricity produced from renewable sources (hydro, biomass and others).

The current trend is to increase the amount of electricity produced from renewable sources and decrease the production of electricity produced by burning fossil fuels.

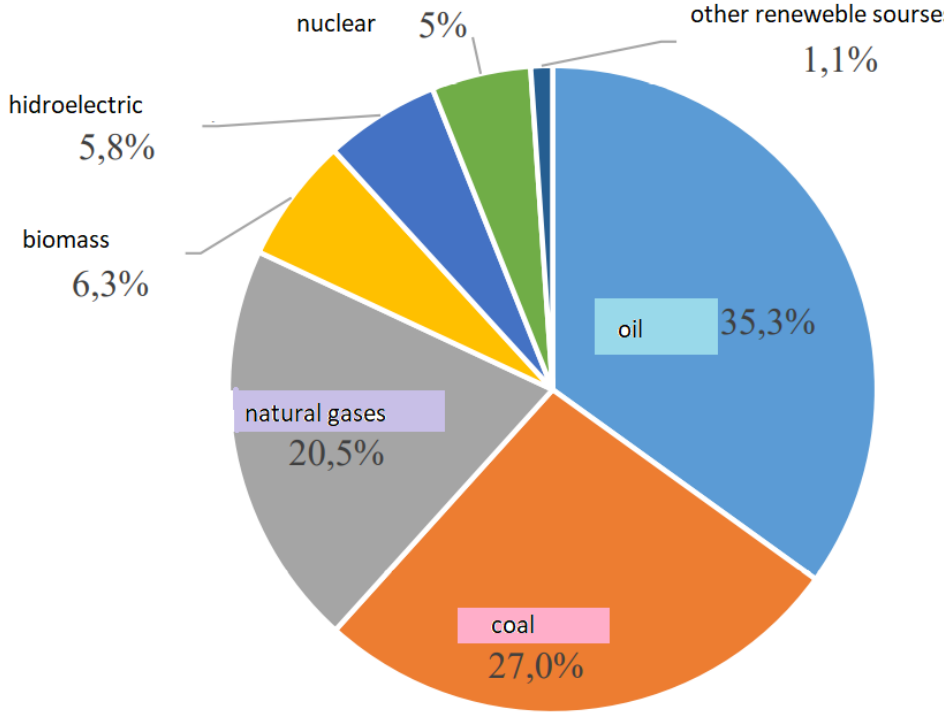

Fig. 1. *The current level of energy consumption depending on the source [1].*

We distinguish the following types of renewable energy:

- energy from the Sun;
- wind energy;
- thermal energy of groundwater;
- moving water energy;
- energy given by biomass.

Photovoltaic cells can be used in railway vehicles, which directly convert light into electric current using the photoelectric effect.

3. The technical solution for using green energy on a railway vehicle

The diesel engine type Desiro SR 20 D (fig. 2) is a railway vehicle that has the following equipment:

- Electronically monitored MTU type diesel engines;
- Knor Bremsse type brake, electronically controlled;
- Kovecta type air conditioning system, controlled by microcomputer;
- Ecological toilet;
- Electronic surveillance and control.

Fig. 2. *Side view of the Desiro car.*

3.1 The purpose of the technical solution

In order to optimize the operation of the installations on the diesel engine type Desiro SR 20 D, we sought to find viable technical solutions that are technically easy to achieve and have a number of advantages;

- Use of green energy;
- Improving the operation of accumulator batteries;
- Decreasing the motor vehicle's dependence on external energy source;
- Low realization costs;
- Decreasing fuel consumption;
- Reducing the consumption of electricity from the external source;
- Increasing the life of batteries;
- Increasing safety in operation;
- Reducing the costs of railway operators

3.2 Proposed technical solutions

The proposed technical solution is the use of green energy for charging batteries - solar energy, energy that is converted by electrical equipment into electricity.

Description of the technical solution. The block diagram of this installation is given in figure 3.

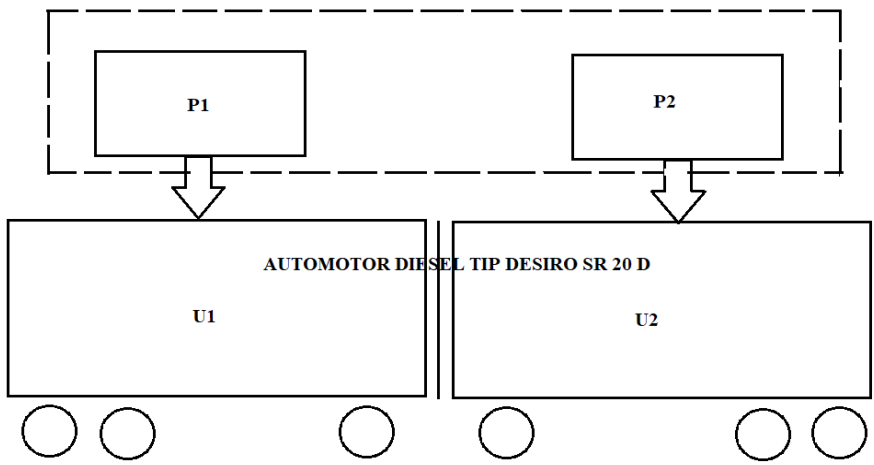

Fig. 3. *Block diagram of the installation on the Desiro car engine.*

În fig. 3 the following elements can be observed:

- Diesel car engine type Desiro SR 20 D, consisting of two engine units, marked U1 - unit number 1 and U2 - unit number 2;

- The solar energy conversion system, consisting of two elements (photovoltaic sources), P1 and P2, corresponding to the two motor units of the car fig. 4.

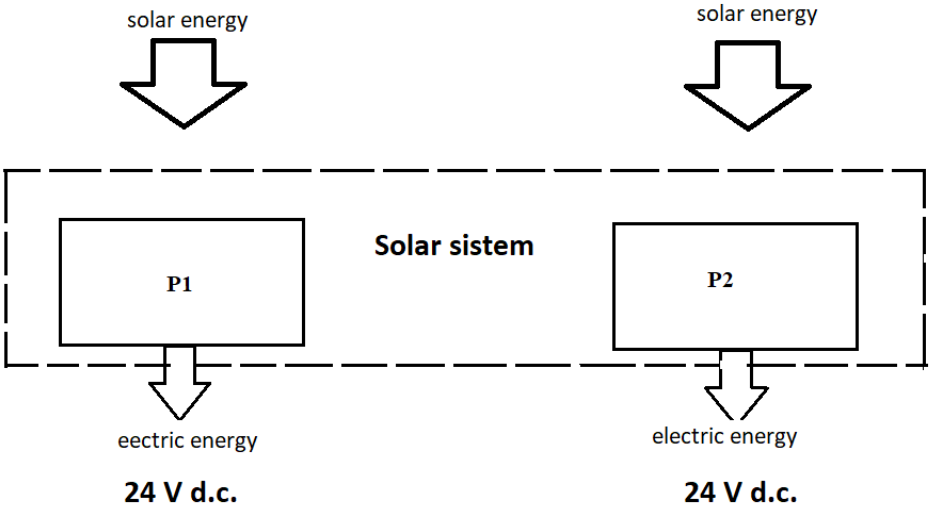

Fig. 4. *Solar system.*

Photovoltaic panels

Photovoltaic panels are the elements that convert green energy into electricity, energy that can then be easily used in the electrical system of the railway vehicle.

Green energy, in the case of photovoltaic panels, is solar energy, namely, energy received from the sun.

In this case, two solar panels with the following technical characteristics were used:

- Wurth Solar Manufacturing;
- Panel type WSG0036E080;
- Pmax = 80 W;
- Isc = 2.5 A;
- VMPP = 35 V;

- VCC = 44 V;
- Max. 1000 Vdc system voltage;
- Product tolerance + 5% -2%;
- Dimensions 1205 x 605 x 6 mm.

In figure 5 you can see the location of the solar panels on the roof of the Desiro SR 20 D diesel engine, the photovoltaic panels with the instruments for measuring electricity.

Fig. 5. *View with photovoltaic panels placed on the roof.*

Battery charging controller

The controller has the role of adapting the electrical energy delivered by the solar panels to the requirements of the system in which we use it. In this case, an inverter is used - solar controller type PWM type controller (pulse wave modulation).

Technical characteristics of the inverter - solar controller:

- Taiwan Mean Well Manufacturing:
- Type TN 3000-224B:

Inverter:

- Power: 3000 W;

- Voltage: 220 V;
- Frequency: 50 Hz;
- Waveform: sinusoidal;

Controllers

- PWM type;
- Maximum output voltage: 29 Vdc;
- Maximum charging current: 30 A.

A block diagram of this solar inverter-controller is given in figure 6.

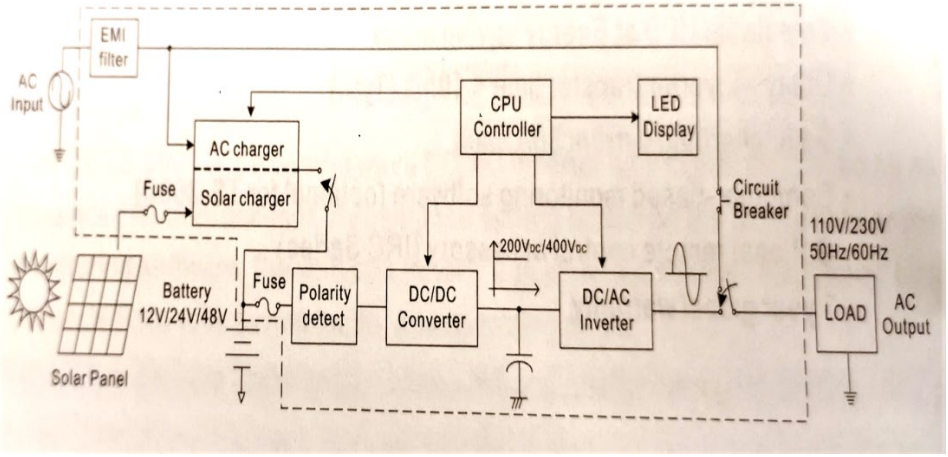

Fig. 6. *Block operation diagram of the controller inverter type TN-3000-224B, according to its technical book.*

Functional checks of the battery charging installation

In order to verify the operation of the proposed technical solution, the following types of electrical measuring devices were used:

- Ammeter pliers type 374 FC manufactured by Fluke, capable of measuring continuous current of maximum 600 A;
- Electronic multimeter, type UT 133A.

For functional checks, the electrical diagram from figure 6 was made, in which the measuring devices presented above were also connected.

The solar panels were connected in parallel and in series and current and voltage measurements were performed.

The following determinations were made (fig. 7,8):

Fig. 7. *View from the appliance block with the controller connected to the solar panels.*

Fig. 8. *Measuring the charging current of the battery pack with the ammeter clamp measuring device.*

Table 1. Measured values of voltage and current.

Voltage charged by the solar panel (V)		**Current produced by the solar panel (A)**
Serial mounting	28,2	2,4
Parallel mounting	28,1	4,4

Installation proposals

On the roof of the Desiro car there is the possibility of mounting in the conditions of maximum security of several solar panels, as can be seen in figure 9.

Fig. 9. *View with the surfaces available for the placement of solar panels*

Thus, photovoltaic panels with powers of up to 2 kW can be mounted on the roof surface, enough for efficient use - charging the batteries.

The advantages of the proposed solution

- Increased mobility for this railway vehicle;

- Increasing the life of electric batteries;
- Decreasing fuel consumption;
- Decreasing the consumption of electricity from the external source;
- Reducing maintenance costs.
- Low costs.

Disadvantage

- Requires investments in the proposed system;
- The efficiency of the system decreases during the night and in cloudy weather.

4.Conclusions

At present, the issue of reducing pollution and consuming fossil fuels, and implicitly maintenance costs, is becoming more and more aggressive.

The European Union has continuously developed rail transport and promoted subsidies that reduce the amount of greenhouse gases emitted into the Earth's atmosphere.

In this dissertation I considered a study on the implementation of equipment for capturing and converting green energy - solar energy, its use to charge battery batteries at the diesel engine type Desiro SR 20 D, in the fleet of SNTFC operator „*CFR Calatori"* TO.

The technical solution proposed and tested on the Desiro car engine brings the following:

- Increased mobility for this railway vehicle;
- Increasing the life of electric batteries;
- Decreasing fuel consumption;
- Decreasing the consumption of electricity from the external source;
- Reducing maintenance costs;
- Low investment costs.

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