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AUTOMATIC CONTROL SYSTEM OF VOLTAGE AND CURRENT FOR ELECTRIC CAR CHARGING STATION

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The efficiency of energy use in industry is assessed by the distribution of specific costs based on the construction and analysis of the energy balance of industrial and economic facilities. The main goal is to provide appropriate services for achieving high energy efficiency of economic activity, optimal use of all types of resources and ensuring the functioning of facilities during planning, organization, coordination, accounting and management [1, 2].

In recent years, there has been a steady transition from vehicles equipped with internal combustion engines to electric motors. Given the potential to reduce air pollution caused by cars, especially in large cities, the spread of electric cars is very promising. The technology of hybrid electric vehicles has made it possible to obtain effective economic solutions with higher characteristics and a lower level of emissions compared to traditional vehicles. Electrification of road transport is currently one of the main trends in the development of the global automotive industry. According to forecasts, by 2040 the share of electric cars in the world fleet will be about 30 % [3].

Manufacturers and researchers pay a lot of attention to the development of electric vehicles. Another important issue is the creation of energy efficient charging stations with the highest parameters of efficiency, power factor and other system parameters that satisfy the power grid and do not have a negative impact on it. Also, a rather important parameter of a charging station is the time and method of charging the battery of an electric vehicle [4, 5].

In Figure 1 shows the concept of an external DC charging station based on a three-phase active rectifier with power factor correction. In this case, the active rectifier performs the function of regulating the output voltage and charging current, and the input transformer provides galvanic isolation.

Automatic control system of the active rectifier is based on a built-in control device followed by pulse-width modulation (Figure 2). The developed automatic control system ensures the specified dynamics of voltage and current changes in the CC–CV (constant current – constant voltage) mode. The sub-model of the battery voltage and current regulator unit contains a built-in regulator. A feature of the developed regulator is that different integral coefficients are used for the current and charge voltage assignment modes, which improves the regulation dynamics compared to when the same coefficient is used in the CC and CV modes.

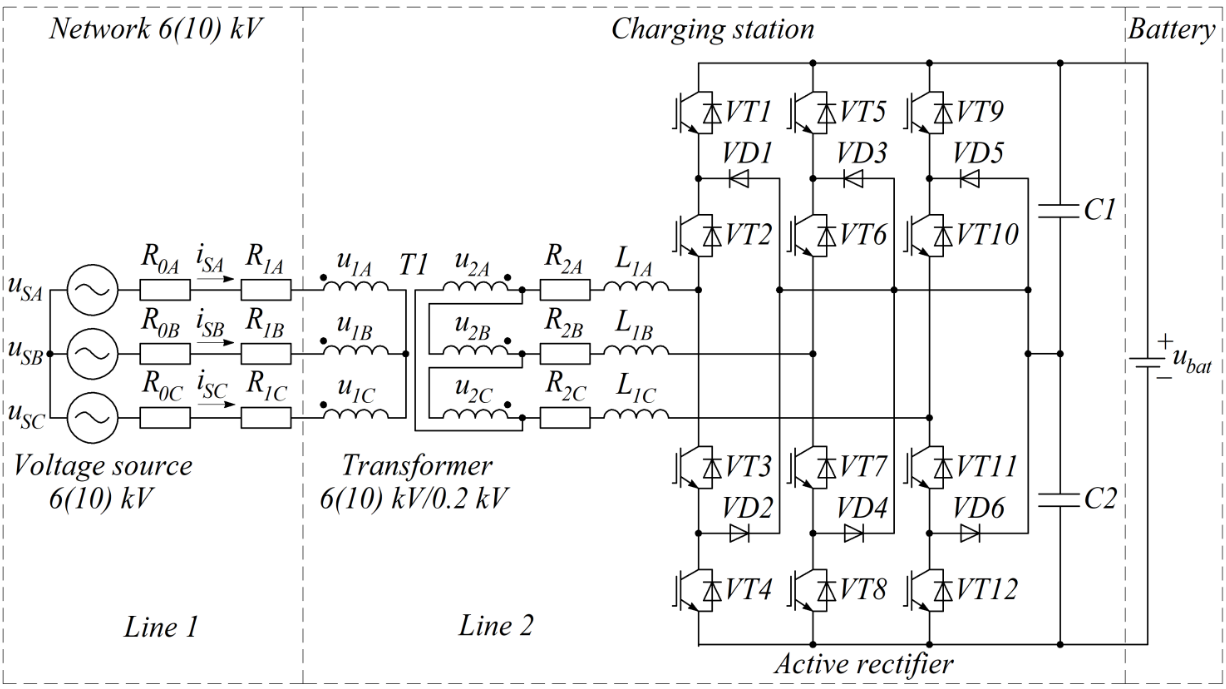

Figure 1 – Charging station system for electric vehicles with one-stage energy conversion

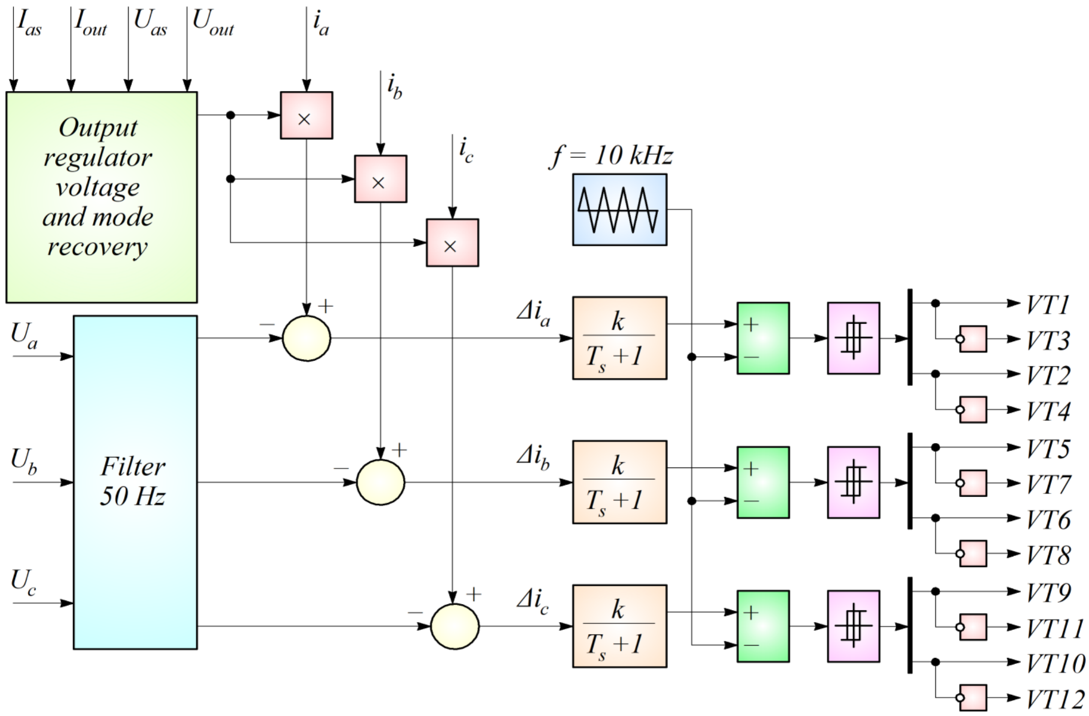

Figure 2 – Automatic control system of voltage and current

In Table 1 shows the values of power factor, efficiency and harmonic distortion factor of the charging station system at charge current in CC mode and pulse width modulation frequency.

Table 1 – Parameters of energy indicators of the charging station

PWM frequency, kHz	Charge current in CC mode, A	Efficiency, %	Charging time, min	Power factor	THD, %
5	150 (0.6C)	95.6	109.2	0.985	11.8
	200 (0.8C)	94.8	86.3	0.987	9.8
	250 (1.0C)	93.9	73	0.989	7.2
	300 (1.2C)	93.1	64	0.991	6.0
	350 (1.4C)	92.2	57.8	0.992	5.1
	400 (1.6C)	91.4	53.3	0.992	4.5
10	150 (0.6C)	95.4	109.2	0.987	6.1
	200 (0.8C)	94.5	86.5	0.99	4.6
	250 (1.0C)	93.7	73	0.991	3.7
	300 (1.2C)	92.9	64.2	0.992	3.1
	350 (1.4C)	92.1	58	0.992	2.7
	400 (1.6C)	91.3	53.3	0.993	2.5

Based on the research conducted, it can be seen that the efficiency of the proposed structure of the charging station is quite high. The dynamics is such that the higher the charge current, the lower the efficiency. At the same time, a decrease in the charge current leads to an increase in the duration of the charging process, as well as a slight deterioration of the power quality parameters.

It is worth noting that the specified topology of the charging station converter can also be used when using alternative power sources, such as solar panels or energy storage.

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WAYS OF DISPOSAL AND SECONDARY PROCESSING OF POLYMER MATERIALS

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Currently, the problem of waste disposal of polymeric materials has become relevant not only from the point of view of environmental protection, but also due to the fact that in the conditions of shortage of polymer raw materials, plastic waste