Chapter 14

Resonant Power System for Electric Transport

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ABSTRACT

Noncontact electric power supply with the use of cable line is an innovative trend in the development of electric transport. Work to develop such systems is carried out in the USA, South Korea, Germany, Israel, the Russian Federation. The VIESH researchers have developed and patented experimental models of a car and a tramway of the future without accumulators, which receive energy from external energy system through air gap from a single wire cable laid under the surface of road pavement. Noncontact systems for electric power supply to transport are developed at VIESH on the basis of resonant methods of electric power supply through a single-wire cable. This is a basic difference of the technology under consideration from similar ones. This technology makes it possible to realize at the new technological level the need for electric roads with minimal costs. Given that all the world’s automakers are working on the production of an electric vehicle for mass production, the need for creating a motorway in the city and on inter-urban autobahns is even more topical.

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INTRODUCTION

Noncontact electric power supply with the use of cable line is an innovative trend in the development of electric transport. Work to develop such systems is carried out in the USA, South Korea, Germany, Israel, the Russian Federation.

N. Tesla patented the contactless method of electric power supply to rail vehicles from single-conductor cable laid in ground (Tesla, N. 1894, Tesla, N. 1999, Tesla, N. 1978, Tesla N. Lectures 1956, Tesla, N. 2008, Sarbon S., M.Sc. 2013). In his letters dated June 14 and 17, 1905 N. Tesla wrote: «...by the use of a generator [transmitter] of stationary waves and receiving apparatus properly placed and adjusted in any other location, however remote, it is practicable to transmit intelligible signals or to control or actuate at will any one or all of such apparatus for many other important and valuable purposes... [or] other features or property of disturbances of this character.

Electricity is displaced by the transmitter in all directions, equally through the earth and the air; that is true, but energy is expended only at the place where it is collected and used to perform some work.

Although the electrical oscillations would manifest themselves all over the earth, at the surface as well as high in the air, virtually no power would be consumed.

Electromagnetic energy of the transmitter is sent to any place on Earth or its atmosphere where there is a receiver with resonant frequency, tuned to the transmitter’s frequency».

BACKGROUND

Resonant Single Trolley and Cable Systems for Supplying Power to Electric Vehicles

The scheme of the resonant system, used to power a mobile mechanism, is shown in Figure 1 (Strebkov, D.S., Nekrasov, A.I., Avramenko, S.V., & Sakharov, D.N. 2002; Strebkov, D.S., Avramenko, S.V., & Nekrasov, A.I. 2000; Strebkov, D.S., Avramenko S.V., Nekrasov A.I., & Roshchin, O.A. 2002; Strebkov D.S., Avramenko S.V., & Nekrasov, A.I. 1999). The power source 1 is connected to the frequency converter 2, whose output frequency ranges from 1 to 20 kHz. The converter powers the resonant step-up Tesla transformer 3, containing the low-voltage and high-voltage windings 4, 5, mounted on the common core. One terminal of the transformer secondary winding 5 is coupled to the contact system 6, the second terminal is open or grounded. The trolley 7 is connected to the contact system 6, whose voltage ranges from 1 to 35 kV. This voltage is applied to the high-voltage winding 9 of the step-down Tesla transformer 10. Its low-voltage winding 10 is connected to the inverter 12 through the diode unit 11. The inverter output voltage (with the required frequency) is applied to the traction motor 14 via the control unit 13; the motor is joined to the driving wheels 15 of the mobile mechanism.

The use of the resonant power supply system enables enhancement of the mechanism efficiency and reliability, as well as reduction of energy loss in the transmission line. The considered method may be used to power a group of mobile vehicles through contact systems of various structures (for example, a grid of conductors). In an alternative version, a thin insulated conductor with a high mechanical strength may be used instead of the conventional contact system.

Freight transportation inside farms may be carried out using ecologically pure electric vehicles powered through a trolley or a flexible single-wire conductor.