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Mende Parametric Electric Generator

By F. F. Mende

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I. Introduction

Energy electrical systems include the generator of electrical energy (further generator) and electric power line (EPL). Since the electric transmission up to the great distances is accomplished with the aid of high-voltage EPL, and generators have low output voltage, the intermediate component between the generator and EPL is the high-voltage step-up transformer. All elements indicated have energy losses, and their calculation shows that into these losses they can reach 10% the percentages. Consequently, a question of reduction in these losses is very important.

In essence, EPL are used for the transfer of alternating current; however, the lines of direct current have smaller losses to capacitive and inductive components. Therefore EPL on the direct current build when necessary to betray the separately large volumes of electric power. IN the USSR were built several electric power lines of the direct current: High-voltage line of direct current Moscow- Kashira(project Elba); High-voltage line of direct current Volgograd- Donbass ; High-voltage line of direct current Ekibastuz- Center and other.

The absence of the high-voltage generators, which directly generate constant voltage of the assigned magnitude with the necessary level of power, is the essential problem of the creation of power systems on the direct current. Therefore it is necessary to at first manufacture electric power on alternating current with the low voltages, then, using high-voltage transformers, to increase voltage and with the aid of the high-voltage rectifiers to further manufacture direct current. All these intermediate components have energy losses, what is the basic problem of such systems. Moreover they are very complex from a design point of view.

From the aforesaid it follows that the creation of the high-voltage direct-current generators, which immediately can generate the voltage of the assigned magnitude with the necessary levels of power, is the key problem of contemporary electro-energetics. Up to now such generators are not created.

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II. Operating Principle of Parametric Direct-Current Generator

If there is a capacitor, who'scapacity C, and this capacitor it is charged to a potential difference U, that the energy, accumulated in it, is determined by the relationship

$$W_C = \frac{1}{2} C U^2 \tag{1.2}$$

But charge Q, accumulated in the capacity, is equal

$$Q_{C,U} = CU. \tag{2.2}$$

From relationship (1.2) it is evident that if the charge, accumulated in the capacity, remains constant, then voltage on it can be changed by changing the capacity. In this case is fulfilled the relationship

$$Q_{C,U} = CU = C_0 U_0 = const,$$

where C, U - instantaneous values, and C_0, U_0 - initial values of these parameters.

The voltage on the capacity and the energy, accumulated in it, will be in this case determined by the relationships:

$$U = \frac{C_0 U_0}{C} = K U_0, \tag{2.3}$$

$$W_C = \frac{1}{2} \frac{(C_0 U_0)^2}{C}. \tag{2.4}$$

Coefficient

$$K = \frac{C_0}{C}. \tag{2.5}$$

It can be named the multiplication factor (transformation) of constant voltage.

The schematic of voltage transformer realizing the principle examined, is represented in Fig. 1.

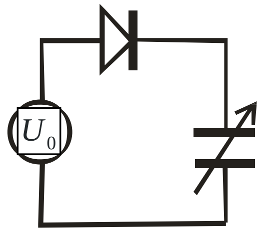

Fig. 1: Schematic of the transformer of constant voltage

In this diagram to the variable capacitor by means of the diode the dc power supply is connected U_0.

The incremental voltage, which can ensure this transformer, is determined from the relationship.

$$\Delta U_C = \left(\frac{C_0}{C} - 1\right) U_0 \ . \tag{2.6}$$

As follows from the relationships (2.3) and (2.4) with the decrease of capacitance of capacitor on it increases not only voltage, but also the energy stored in it.

It should be noted that this transformer can work only in the regime of an increase in the voltage, since. With the attempt to obtain the decrease of voltage across capacitor this cannot be made for that reason that the diode ensures the straight connection of the voltage source to the capacitor and therefore voltage across capacitor decrease cannot.

An increase in the energy, accumulated in the capacitor, with a change in its capacity is determined from the relationship.

$$\Delta W_C = \frac{1}{2}(C_0 U_0)^2 \left(\frac{1}{C} - \frac{1}{C_0}\right) \tag{2.7}$$

With a mechanical change in the capacitance of capacitor, the increase in the energy indicated ensures the spring mechanical energy source.

Properties of the transformer of constant voltage can be used for creating the high-voltage source of the direct current, whose diagram is given in Fig. 2.

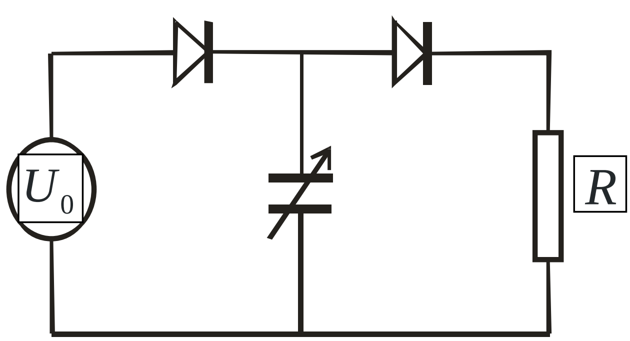

Fig. 2: Diagram of the high-voltage source of direct current

In this diagram is present still one diode and load resistance R.

In the initial state the capacitance of capacitor is equal C_0 and voltage on it equally U_0. At this time through the load resistance the current flows.

$$I_0 = \frac{U_0}{R} \ .$$

In this case the energy, obtained by capacitor from the voltage source, comprises.

$$W_0 = \frac{1}{2} C_0 U_0^2 \tag{2.8}$$

As soon as capacitance of capacitor will begin to decrease, the secondary voltage, assigned by the relationship will appear on it (2.5). This secondary voltage through the right diode enters on the load resistance R. The additional energy, isolated in this case during the load resistance, is determined by the relationship (2.7). For computed efficiency's of this process, it is necessary to compare the energy, spent by the right voltage source on the charging of capacitor and the energy, isolated during the load resistance. In this case efficiency it is defined as the relation of relationships (2.8) and (2.7).

$$EF = \frac{\Delta W_C}{W_0} = \left(\frac{C_0}{C} - 1\right) 100\% \tag{2.9}$$

In the following cycle proceeds an increase in the capacitance of capacitor from the values C to the values C_0. But voltage on it cannot be less than U_0 therefore the left voltage source begins to charge the being increased capacity. And up to the moment, when capacitance value reaches value C_0 voltage on it will be equal U_0. During this cycle the left voltage source will repeatedly consume the energy, determined by the relationship (2.8). In this case complete cycle to be completed and the system will return to the initial state.

The operating principle of the generator examined is such to the operating principle of the valve water pump, whose schematic is represented in Fig. 3.

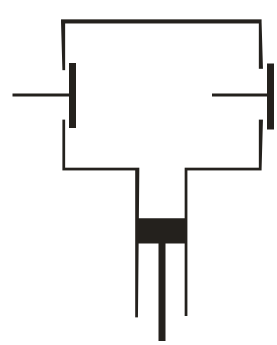

Fig. 3: Schematic of the valve water pump

With the displacement of piston downward left release valve is opened, and water is sucked in into the cavity of pump. With the displacement of piston upward the water through the right release valve is ejected outside.

The role of valves in the schematic of the described generator diodes play, while the role of cylinder with the being moved piston performs variable capacitor.

Hence it follows that the basic problem of the creation of the proposed generator is the development of the capacitor, whose capacity changes with mechanical method. In this case the capacitor must have the great significances of initial and final capacity, also, with the large relation of these values. This question can be solved by the way of using the technology of the creation of the ceramic capacitors, when titanate of barium, which has very large dielectric constant, is used as the dielectric between the capacitor plates. The construction of the generator, in which is used the principle indicated, it is shown in Fig. 4.

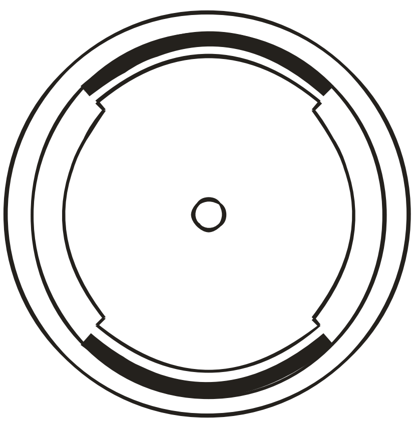

Fig. 4: The mechanical oscillator circuit, in which the inserts from titanate of barium are located on the internal surface of stator

In the given construction there is a figured rotor, and inserts from titanate of barium are located on the internal surface of cylindrical stator.

Let us calculate the practical construction of generator with the following parameters: the voltage of the voltage source $U_0 = 200 \ \ V$; the diameter of the rotor $D = 0.5 \ \ m$; clearance between the inserts of titanate of barium and the stator $d = 10 \mu m$; the thickness of the inserts $25 \ \ mm$; the depth of turnings on the rotor $25 \ \ mm$; the speed of rotation of the rotor $n = 500 \ \ \frac{1}{s}$ (this rotational speed it is characteristic for the gas turbines); the length of the generator $L{=}1m$.

The power, manufactured by generator will comprise

$$P = \frac{\pi \varepsilon n K D L U_0^2}{2d} \qquad (2.10)$$

During the record of this formula are taken into account the fact that in one revolution of rotor it occurs two cycles of a change in the capacity between the rotor and the stator.

The substitution of the assigned parameters into the formula (2.10) gives the power $34 \ \ kW$.

Efficiency generator, calculated according to the formula (2.9), comprises 50000%. This means that practically entire mechanical energy, spent on the rotation of the rotor of generator, is converted into the electrical energy.

The output voltage, which manufactures generator, calculated according to the formula (3.3) it will comprise $1 \ \ MV$. This voltage will be developed between the stator-rotor units, when the capacity between them is minimum. In order in this case to avoid electrical breakdown, the internal cavity of generator must be filled with air or another gas under the high pressure.

The optimal mode of operation of such a generator is the case where the RC time constant of the circuit, which is the load resistance and the maximum capacitance between the rotor and the stator, will be less than half the rotor rotation period. Then for the specified time the capacity will be discharged through the resistance, giving all its energy to the load.

None of the existing generators can ensure this high efficiency such high voltage without the use of the step-up transformers and rectifiers. Large simplicity of construction is the very great advantage of this generator.

The type of generator in the section is shown in Fig. 5.

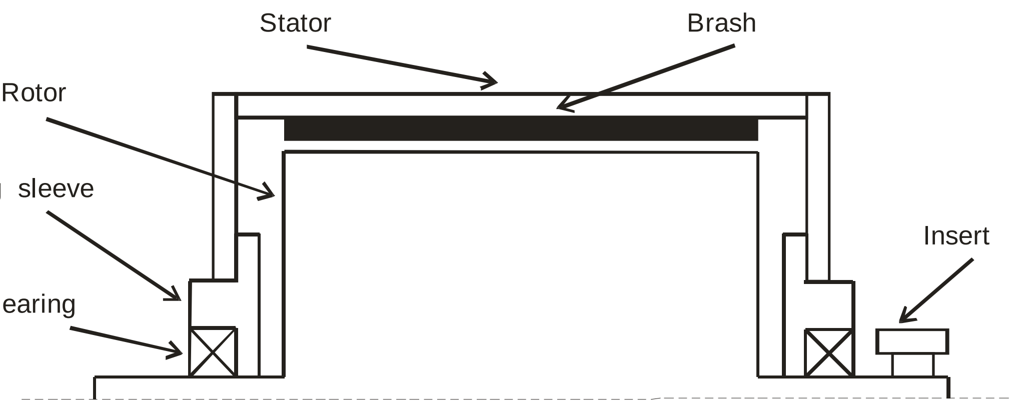

Fig. 5: Type of generator in the section

The insulating bush is located between the axis of rotor and the housing of stator. In this bushing the bearing is located. By lower its edge bushing slides along the axis of shaft, ensuring the vacuum seal between the internal cavity of generator and the atmosphere. The insert from titanate of barium is located on the internal part of the stator. The electrical contact between the axis of rotor and the external circuits brushes ensure.

III. Conclusion

In the article the operating principle is examined and is given the construction of the parametric electric generator, which gives the possibility to generate high constant voltage with the high level of power. The name of generator the production of constant voltage is connected with the fact that produced by the way of a mechanical change in the capacitance value of capacitor. The generator examined possesses large simplicity in comparison with the existing generators.

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