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THE ROLE OF GENERATORS IN ELECTRICITY PRODUCTION

Abstract: According to the method of generating the magnetic field necessary for the operation of an electric machine, AC machines are divided into electromagnet and permanent magnet machines. Permanent magnet machines are also called magnetoelectric machines. Such machines are very rare, they are mainly used only as tachogenerators and similar special machines.

Keywords: AC generators, indicator, electric machine, AC generators

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РОЛЬ ГЕНЕРАТОРОВ В ПРОИЗВОДСТВЕ ЭЛЕКТРОЭНЕРГИИ

Аннотация: По способу создания магнитного поля, необходимого для работы электрической машины, машины переменного тока подразделяются на электромагнитные и машины с постоянными магнитами. Машины с постоянными магнитами также называются магнитоэлектрическими машинами. Такие машины встречаются крайне редко и используются в основном в качестве тахогенераторов и подобных специальных машин.

Ключевые слова: генераторы переменного тока, индикатор, электрическая машина, генераторы переменного тока

Introduction

Alternating current generators mainly consist of two parts, the first part of which, which generates a magnetic flux, is called the indicator, and the second part, which generates the E.U.K., is called the armature.

The indicator, in turn, consists of a frame 1 and main poles 2, and the armature consists of an armature core 3, a collector 4, a shaft 5, a bearing 6, a bearing shield 7 and a fan 8 (Figure 1).

Figure 1 shows a structural diagram of an alternating current generator. In this case, the frame is a fixed part of the machine, and in high-power machines it is made of steel, and in low-power machines it is made of cast iron[1].

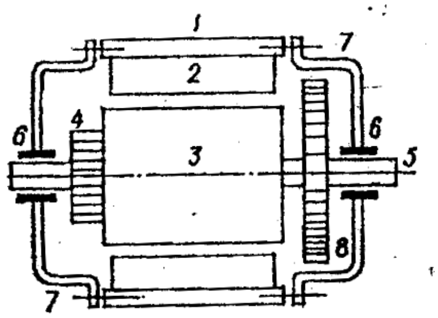

Figure 1. Construction scheme of DC machines

Electromagnetically driven machines are classified as independent and self-exciting according to the connection diagram of the starting winding. are divided into constant current generators[2]. If the excitation winding of the generator is supplied from an external current source, it is an independent generator, and if it is supplied from its own armature, then a self-excitation generator is obtained. Self-excitation generators, in turn, are divided into parallel (pair), series (series) and compound (compound) excitation generators. In a parallel excitation generator, the excitation winding is connected in parallel to the armature winding, while in a series generator there are two windings, one of which is connected in parallel to the armature winding and the other in series. Figure 2 shows the schematic diagrams of the connection of generators with excitation with: a-independent; b-parallel; c-series; d-compound; and d-permanent magnet excitation[3].

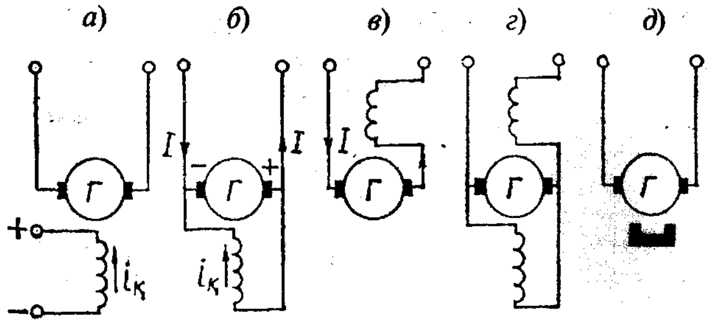

Figure 2. Electric circuits on connections of direct current generators.

Since the generator circuit in Fig. 2 d does not have an excitation coil, a permanent magnet is used instead.

Alternating current generators consist mainly of electrical machines called synchronous and asynchronous[4].

Three-phase current produced in power plants is generated in synchronous generators. Synchronous generators consist of a stationary stator and a rotating rotor. The stator, in turn, consists of a cast iron housing and a steel core fixed to it, in the slots of which a three-phase alternating current winding is placed. In order to reduce the power loss caused by eddy currents in the stator core, it is assembled from steel sleeves insulated from each other. (Figure 3)

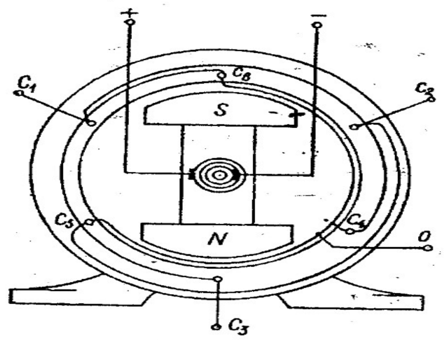

Figure 3. Electrical scheme of a synchronous generator

The rotor of a synchronous generator is made in two types, namely with a spring and a non-spring pole. Small and medium-power hydrogenerators, which are rotated at low frequencies by hydroturbines, are made with a spring, and large-power turbogenerators, which are rotated at high speeds by steam turbines, are made with a non-spring pole. The rotor itself is usually made of steel, and a starter coil is installed on it[5].

This starter coil in the rotating rotor is supplied with a constant current by means of brushes and rings, and a main magnetic flux is generated. Therefore, if the rotor coil supplied with a constant current is rotated by a primary motor, then, according to the law of electromagnetic induction, a variable E.U.K. is generated in the stator coil.

In order for this E.U.K. to change according to the law of a sinusoid, the magnetic induction generated in the poles must be distributed along a sinusoid.

Research method

Three windings are placed on the stator of a three-phase synchronous generator. These windings differ from each other by 1200 in phase, they are connected in a star or delta circuit. Each winding is called a phase of the generator, and in these phases, E.U.K.s differ from each other by 1200. If a three-phase load is connected to this three-phase E.U.K. system obtained from windings connected in a star or delta circuit, then a three-phase load current flows through the stator windings of the generator. The constant current required to start the synchronous machine is obtained from a starter or a rectifier with a shunt winding.

Synchronous generators with a capacity of up to 400 kVA are usually made with a voltage of 400/230 V, and those larger than 400 kVA with a voltage of 6300 V and more[6].

Generators of the STD type for diesel engines with power up to 1000 kVA are also produced.

The stator of an asynchronous machine is almost the same as that of a synchronous machine, but the coil in their rotor is not supplied with any current from an external source.

It should be noted that synchronous generators are mainly used to generate electricity. Their schemes are shown in Figure 3.

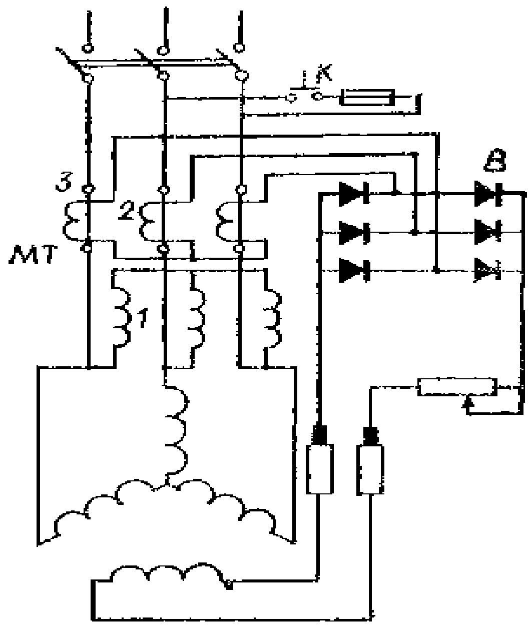

Figure 3. Connection diagram of a self-excited synchronous generator
Primary winding connected in parallel to the stator winding of MT-;
Primary windings of MT 3 connected in series to the stator winding and
secondary winding (voltage reducing winding) of MT 2;

Analysis and results

The diagram of a self-excited synchronous generator is shown, where I is the primary winding connected in parallel to the stator winding of the three-winding transformer MT; the primary windings of MT 3 are connected in series to the stator winding and the secondary winding (voltage-reducing winding) of MT 2; the principle of self-excitation of the generator is implemented in the usual operating mode, in which, under the influence of Eqal, formed in the stator winding from residual magnetism, a current flows in winding I of the stabilizing transformer. The magnetic flux formed by this current produces an emf in the secondary winding. This emf The valve (rectifier) is connected to V, and the constant current obtained from it is supplied to the excitation winding of the synchronous generator, and as a result, its voltage automatically increases to the nominal value. When the generator is loaded, the winding of the stabilizing transformer also begins to carry current from 3. Using the magnetic flux generated by the load current passing through this winding, it is possible to completely eliminate the effect of the demagnetizing effect of the armature reaction and the decreasing voltage in the generator winding. Thus, the given value of the voltages of the stabilizing transformer and the generator is automatically maintained unchanged[1-5].

Conclusion

To accelerate the self-excitation process, when starting a synchronous generator, its two phases are short-circuited with the button K. In this case, the short-circuit current generated by Eqal passes through the 3rd winding of the MT and increases the value of E.Y.K. generated in its second winding, and therefore the generator's starting current also increases rapidly and it starts faster. With the beginning of the self-excitation process, that is, with an increase in the generator voltage, the button K is immediately returned to its original state[5-6].

To adjust the generator voltage, it is enough to change the resistance of the resistor in the starting circuit. In such a scheme, with a change in the load, the generator voltage will change by no more than 5% compared to the given one. Synchronous generators with a power of not more than 30÷50 kVA can also be started with mechanical rectifiers. The principle of operation of a mechanical rectifier is almost no different from the principle of operation of a DC machine collector. In addition to the main winding 1, auxiliary excitation winding 2 is also installed on the generator stator itself. E.U.K generated in Yodramchi Chulgam is fed to the mechanical rectifier. This coil is connected in a triangular scheme, each phase of which consists of 5 ÷ 8 windings. The mechanical rectifier consists of a contact copper ring divided into 12 parts, 6 of these ring parts installed on the rotor shaft are considered working, and the rest are auxiliary parts. When working parts with even numbers are interconnected, they are connected to one end of the excitation coil on the rotor, and current numbers are connected to its 2 ends.

The electric currents generated in the auxiliary coils are fed to the mechanical rectifier by means of brushes. The brushes are spaced 120 electrical degrees apart, and their number is three times the number of pairs of poles. The width of the auxiliary part of the copper ring in the mechanical rectifier is made slightly larger than the width of the brushes. This prevents the brushes from shorting each other when they pass from one working part of the ring to another[5-6].

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