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Intellectual computer-aided design system of wind turbine axial generator

The intellectual computer-aided design system of wind turbine axial generator is developed.It is separeted the basic parameters of axial generators. The development of intellectual computer-aided design system of wind turbine axial generator is based on Simulink modelling.It is represented the modellingsceme of Simulink and giving result of modelling.

Introduction. Wind power is a form of energy conversion when turbines convert the kinetic energy of wind into mechanical or electrical energy. Wind power is considered as a renewable energy source.As we know world's wind power generation capacity has reached 435 GW at the end of 2017, around 7% of total global power generation capacity. A record of 64 GW was added in 2017.

China has once more underpinned its role as the global wind power leader, adding 33 GW of new capacity. This represents a market share of 51.8%. The US market saw good performance with 8.6 GW of added capacity, the strongest growth since 2012. Germany, in anticipation of changes in legislation, installed 4.9 GW. Brazil was the fourth largest market for new turbines with a market volume of 2.8 GW. India saw 2.3 GW of new installations by November 2015.

Global wind power generation amounted to 950 TWh in 2017, nearly 4% of total global power generation. Some countries have reached much higher percentage: Denmark produced 42% of its electricity from wind turbines in the 2016 year; wind power contributed a new record of 13% of the country's power demand in 2015.

Topwindpower capacity bycountry is represented in the table:

Table 1.

Power capacity by country

Country	Total Capacity (MW)	Added Capacity in 2017 (MW)
China	148 000	32 970
USA	74 347	8 598
Germany	45 192	4 919
India	24 759	2 294
Spain	22 987	0
United Kingdom	13 614	1 174

Wind power plant generator types. One of the basic element of all Wind Power Plant is an electrical generator. Any types of the three-phase generator can connect to with a wind turbine. Several different types of generators, which are used in wind turbines, are as follows: asynchronous (induction) generator and synchronous generator.

Induction machines are also known as Asynchronous Machines, which is they rotate below synchronous speed when used as a motor, and above synchronous speed when used as a generator. So when rotated faster than its normal operating or no-load speed, an induction generator produces AC electricity.

The synchronous generator is a synchronous electro-mechanical machine used as a generator and consists of a magnetic field on the rotor that rotates and a stationary stator containing multiple windings that supply the generated power. The rotors magnetic field system (excitation) is created by using permanent magnets either mounted directly onto the rotor or energized electro-magnetically by an external DC current flowing in the rotor field windings (fig.1.).

For our wind power plant was considered various generators of different types and sizes, but we chose the axial generator.

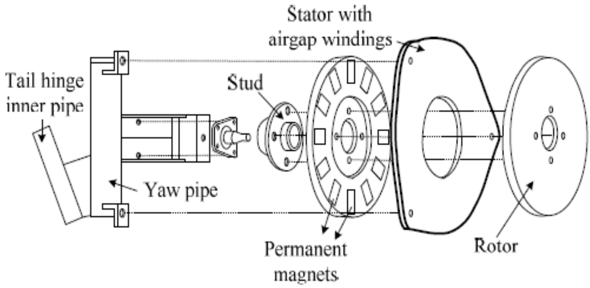

Fig. 1. Construction of axial generator

The advantage of axial generators is that they do not have a magnetic sticking, which allows them to start at a relatively small speed of wind (about 2 m / s). Because this generator was designed for a low wind speed, and goes to work power already in low winds (3-3.5m / sec.).

The advantages of the axial generator are related:

- minimal losses in friction;
- long service life;
- no noise and vibration when working;
- low cost of installation;
- no need for constant maintenance of the installation;

The axial generator differs from ordinary generators through a different path of the magnet flux. In ordinary generators, the current flows radially through the air gap between the rotor and the stator. However, in this generator flows flow parallel to the generator's axis. This type of rotor is often called a rotary pancake, and it can be made much thinner and lighter than other types.

THE NOMINAL PARAMETRS OF AXIAL GENERATOR

Generatorsrelease for a specified long-term mode of operation. If the generator works without fail in the conditions for which it was designed, then its operating mode is called nominal.The nominal operating mode of the generator is characterized by the values specified in its paper and are called nominal. In addition, to the frequency of rotation, the generator is characterized by the following basic nominal parameters:

- nominal voltage;
- nominal current;
- nominal full power;
- nominal active power;
- nominal rotor current;
- nominal power factor;
- nominal ratio of generator.

The nominal voltage is the linear voltage of the statorwinding.

The nominal current of the rotor is the maximum excitation current of the generator, in which it gives the network a nominal power in case of deviation of the stator voltage within ± 5%.

The nominal ratio is determined for each generator at nominal load and nominalpower factor. The value of the ratio coefficient for modern generators is 96.65- 98.75%.

Intellectual axial generator in Matlab / Simulink model. The approach used to build the Simulink model in this paper is a block type or modular approach. The approach is based on the idea presented the Simulink model can now be constructed by creating Simulink. The system is constructed using basic Simulink blocks such as the integrator, gain, sum, etc. The basic Simulink blocks are standard on all versions of MATLAB.

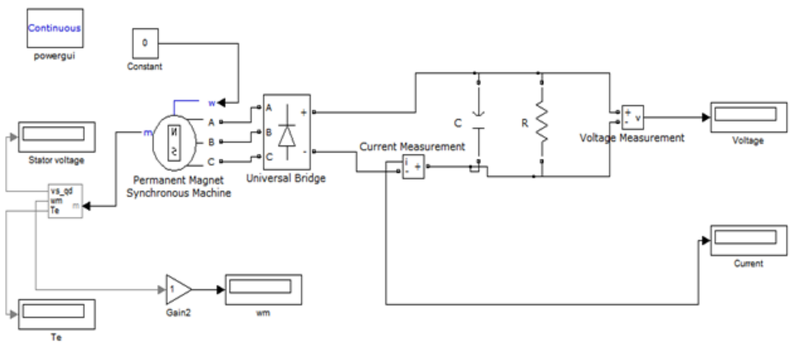

Fig. 2. Simulation model of the generator

The Simulink model presented can also be thought of as being built in layers. With the help of the Simulink system, we can automate the search for optimal parameters of our generator. The Simulink model of axial generator shown in Figure 2.

In the simulation modeling of the generator, using the specified parameters, voltage indices (Fig.3.), current (Fig. 4.), power (Fig. 5.) and their plotting dependencies on the rotational speed of the shaft of the generator were obtained.

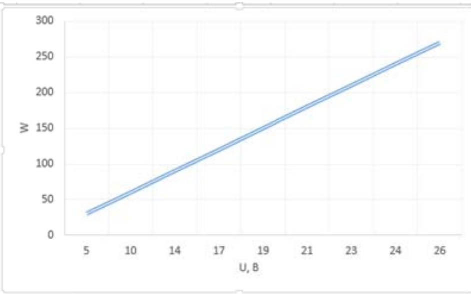

Fig. 3. Dependence w(U)

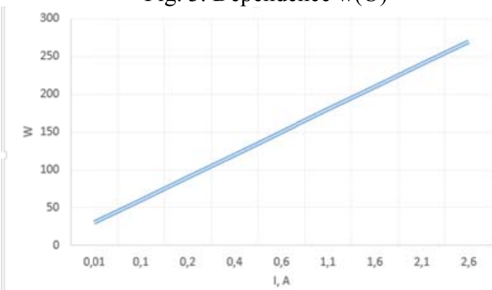

Fig. 4. Dependence w(I)

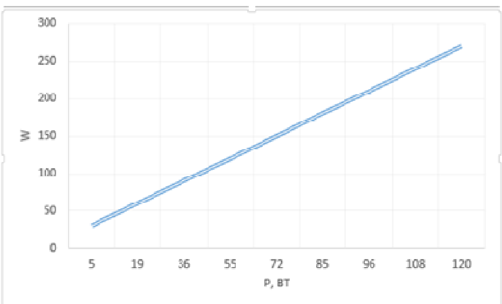

Fig. 5. Dependence w(P)

Conclusion. Thanks Simulink modeling we can determinate the optimal values of axial generator. Using this approach we can provide the increasing of the efficiency of such generators and in the turn the wind plant.

References

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