Improvement of Gear Box Structure for Large Wind Turbine

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Abstract

In recent years, with the continuous development of the economy, China has become the second energy consumer in the world.With the emergence of environmental problems, the concept of green development has become more and more popular.Vigorously developing wind power generation and actively promoting the development of wind energy has become a hot spot in recent years.In the context of today's wind power generation, the increasing number of large wind turbines, followed by the problem that the efficiency of wind power generation still needs to be improved, which has seriously affected the further development of wind power system.Starting from the structural system of large wind turbines, this paper will study the transmission system of large wind turbines, and study the structural improvement of wind power growth gear box of the growth mechanism for the transmission device, so as to improve the operation efficiency of wind turbines.

Keywords

Increase, Gear box structure.

1. Research background of wind power generation

China is a large country, land border area more than 20000 km, the total length of more than the total length of 18000 km coastline, according to the national meteorological department related survey data shows, accumulate abundant wind energy resources in our country, which is available for land air volume of more than 260 GW wind power resources, while the Marine wind energy resources available land part of the more than three times higher than that of more. Throughout the entire western China, the northwest region has unlimited wind energy resources. According to statistics, the areas with average annual wind speed above 6m/s in China now account for 1.2% of the total land area, which is the third place in the world after the United States and Russia.

China's wind energy industry is just emerging, with the wind power industry gradually on the right track, it is necessary to further improve the efficiency of wind turbines in technology. This requires improvements in wind power equipment to further improve the efficiency of power generation.

2. Existing problems with large wind turbines

Wind turbine can be divided into blade system, power system, transmission system and control system.

At present, the design of fan drive system mainly adopts the methods of reliability design and optimization design. The gearbox is the main component of the fan drive system and one of the main parts of the fan. Because the wind turbine is installed in the field, the natural environment changes greatly, and the maintenance is inconvenient, so the life and stability requirements of the gearbox are much higher than the general machinery. In order to realize the localization of fan equipment, the technical problems in the design and manufacture of these main components must be solved.

Compared with other industrial gearboxes, since the wind power gearbox is installed in a small engine room dozens of meters or even more than 100 meters above the ground, its own volume and weight have an important impact on the tower, foundation, wind load, engine room, installation and maintenance costs, etc., therefore, it is particularly important to reduce the external size and weight. At the same time, due to the inconvenience of maintenance, maintenance cost is high, usually the reliability of the gearbox is extremely demanding.

Due to the irreconcilable contradiction between size and weight and reliability, the design and manufacture of wind power gearbox is often in a dilemma. On the premise of satisfying the requirements of reliability and working life, the transmission schemes should be compared and optimized with the minimum volume and weight as the objectives. The structure design should be based on the premise of satisfying the transmission power and space limitation, and consider the simple structure, reliable operation, convenient maintenance as far as possible, and ensure the operation efficiency of the generator[1].

3. System structure system diagram of a large wind turbine

The structural system diagram of the transmission system of large wind turbine is as follows:

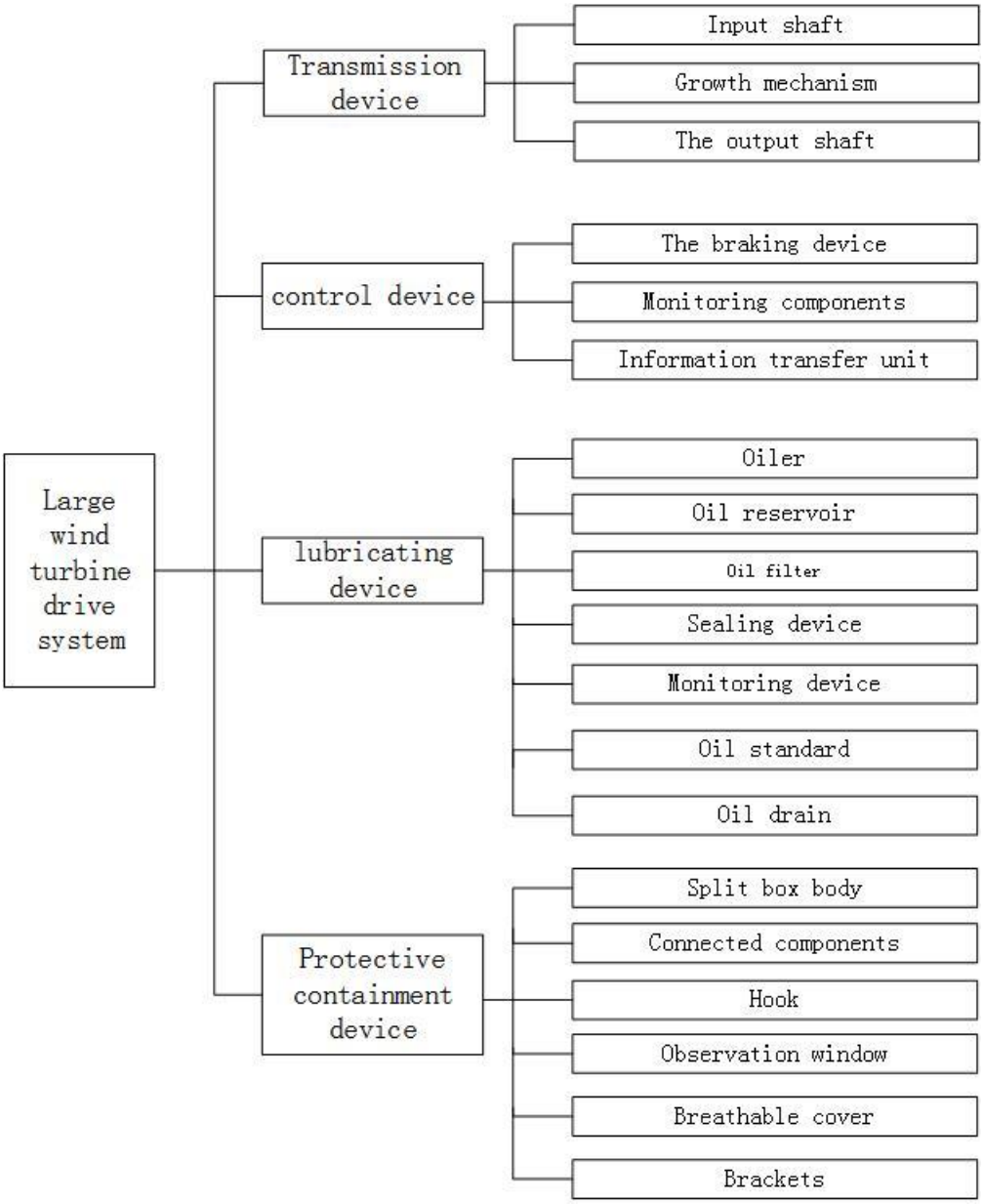


Figure 1. Structural system diagram of large wind turbine drive system

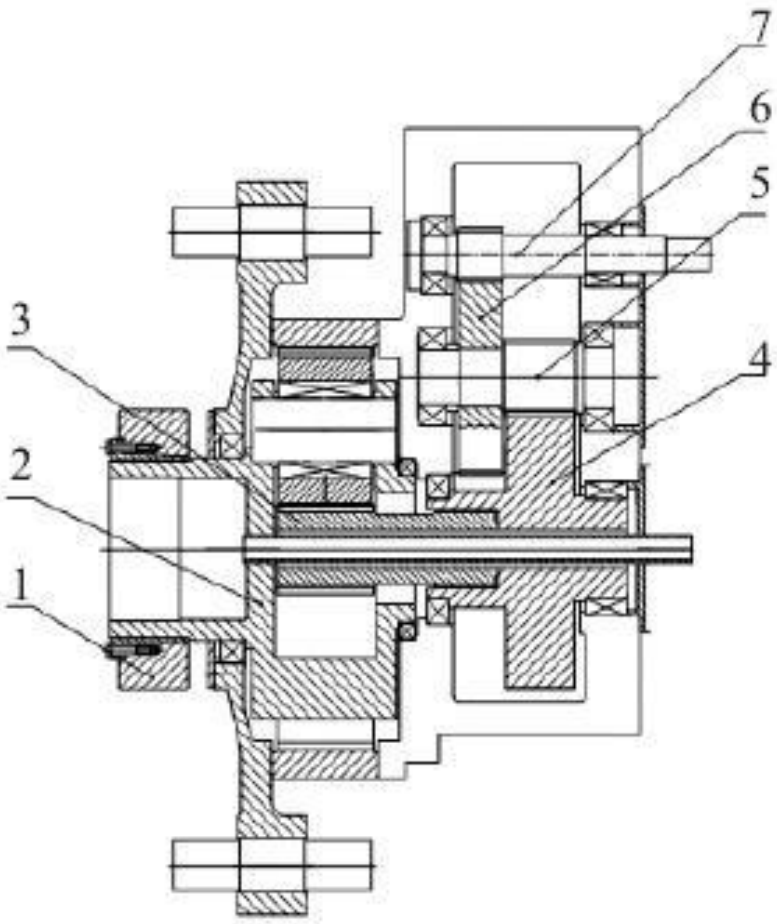
From the point of view of the system, if the large wind turbine is regarded as a production system, then its transmission system is a constituent element of the product. At the same time, from the perspective of the hierarchy of the system, the constituent elements can also be regarded as a self-contained subsystem, and the constituent elements of the system are the four devices mentioned above.

As a subsystem of wind turbine, the transmission system has a certain degree of independence. Similarly, its constituent elements also have a certain degree of independence, but they are closely related to each other, so it cannot be treated as a completely isolated individual in the design. For example, the lubricating device and the containment protection device have their respective functions, but there are common parts in the structure. The components used for oil injection, oil storage and oil discharge need to be integrated with the protective containment box, and these factors must be taken into account when designing the box. In the whole structure system, the transmission device is the most important, and the most important part of the transmission device is the growth mechanism. Therefore, this design focuses on the design of the growth mechanism [2].

4. Optimization of gear box structure of wind turbine generator

In high-power wind turbines, there are mainly the following types of traditional wind power growth gearbox:

(1) structural gear box with planetary frame input into the first planetary and second parallel axes (type 1) which is as follows：

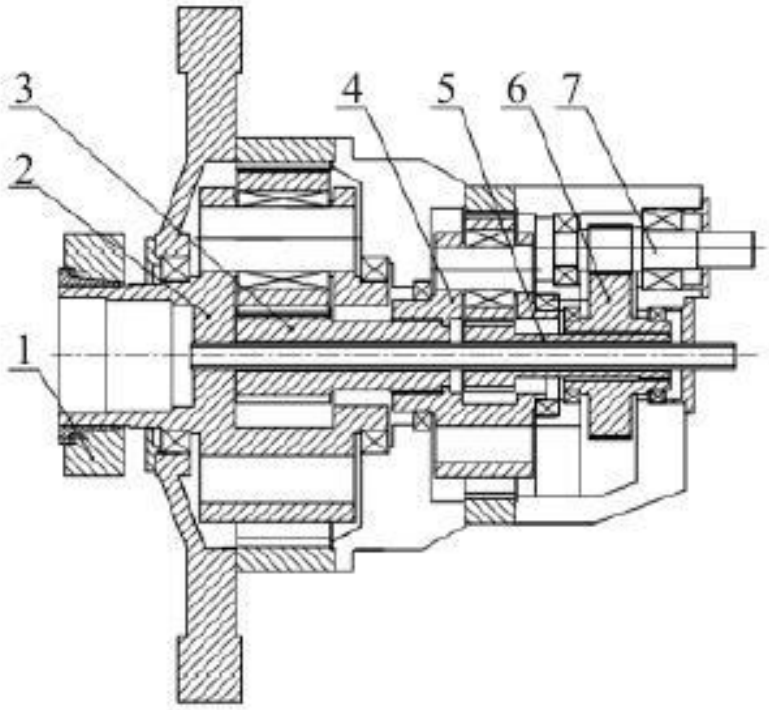


1.Tightening disc; 2. Planetary shelf; 3. Solar axis;4. Low-speed shaft; 5. Intermediate shaft;

6. Intermediate gear; 7. Input gear shaft

Figure 2. The planetary frame is fed into a structural gearbox of the first planetary and second parallel axes

(2) structural gear box with planetary frame input into the second planetary and first parallel axes (type 2) which is as follows：



1.Tightening disc; 2. Planetary shelf; 3. Solar axis; 4. Intermediate planetary racks;

5. Intermediate solar wheel axle; 6. High speed gear; 7. Input gear shaft

Figure 3. The planetary frame is fed into a structural gearbox of the second planetary and first parallel axes

(3) Optimized design

Improved variant of structural gear box with planetary frame input into the second planetary and first parallel axes (type 3) which is as follows：

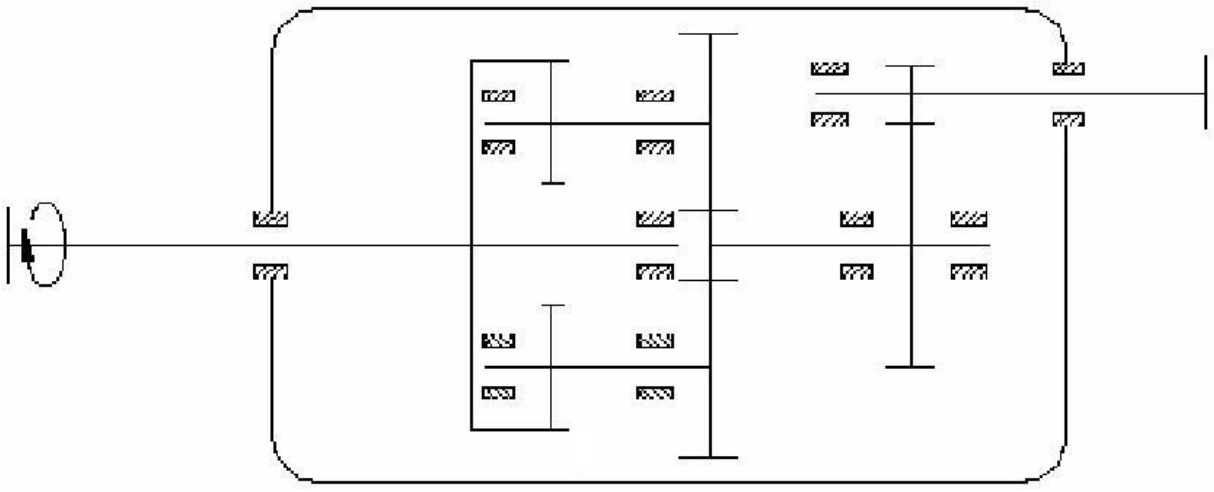


Figure 4. Improved variant of structural gear box with planetary frame input into the second planetary and first parallel axes

Based on the structure of two planets and one parallel axis, the improved structure type is obtained as shown in the figure. This structure the comprehensive level of planets and two levels of parallel axis parallel axis structure and two-stage planetary and level structure, the advantages of the planetary gear train in the two-stage planetary structure change, the planet carrier is fixed, the low speed shaft directly driven gear ring, as a result, the original planet into a fixed axis gear transmission, the gear system structure is simplified, the rational use of internal meshing, running in the process of energy loss and noise is also reduced. This can greatly improve the efficiency of large wind turbines [3].

5. Optimization structure evaluation

The following is the specific data comparison of the three wind power gearboxes：

Table 1. The specific data comparison of the three wind power gearboxes

The serial number	project name	Structure form		
		type 1	type 2	type 3
1	Planet carrier	rotating	rotating	fixed
2	Friction loss	medium	big	small
3	Transmission efficiency	medium	low	high
4	noise	Big	Big	small

Through the above comparison, the improved structure gearbox has reduced the friction loss, improved the transmission efficiency and reduced the noise, so it is better suited to the selection of wind turbine, greatly improve the operation efficiency of wind power generation, and make better use of wind energy.

6. Conclusion

Transmission system of the safe and stable operation for large wind turbines running plays an important role in this article, focusing on the growth mechanism of transmission device, based on the growth mechanism of wind power growth gear box structure improvement study, through experimental verification, found that the structure of the modified gear box, less friction loss, transmission efficiency, lower noise, can be better suited to wind generating set is chosen, and greatly improve the efficiency of wind power, better use of wind power.

References

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