Analysis and Comparison of Main Circuit Topology of Medium and High Voltage Inverter Based on Multilevel Control

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Abstract: Due to the limitation of voltage withstanding of power devices, multiple power devices need to be connected directly in series. The requirement for the capacity of the converter is also increasing. The high-power converter with several megavolt-amperes or even more than ten megavolt-amperes has been gradually applied. The development of power electronics technology has entered a new era. Since the converter will be used to drive loads that are very sensitive to specific harmonics, the output waveform and control method are studied. Every improvement and innovation in power electronics and electric drive technology can be applied immediately in practical industrial and civil applications. It plays an extremely important role in transforming traditional industries, developing high technology and using energy efficiently. The relationship between the two components of the stator current and other physical quantities must be found in the mathematical model. This paper proposes a feasible topology by connecting the series and parallel connections of the three-level inverter modules. A multi-level high-voltage, high-current, high-power output is realized.

1. Introduction

The development direction of modern power electronics technology is the traditional power electronics, which mainly deals with problems with low frequency technology. The direction of modern power electronics is changing from high-frequency technology to high-frequency technology [1]. The frequency conversion speed regulation scheme of high-power fan and pump can achieve remarkable energy-saving effect, and its direct economic benefit is great. Medium-voltage converter is not the same mature and consistent topology as low-voltage converter, but limited by the withstand voltage of power devices [2]. The bridge arm direct series structure of inverters is a mature two-level structure. However, due to the limitation of voltage withstanding of power devices, multiple power devices need to be directly connected in series [3]. The requirements for the capacity of the inverter are also increasing, and high-power inverters of several megavolt-amperes or even ten mega-volt-amperes have gradually begun to be applied. The development of power electronic devices has experienced several stages such as uncontrolled and semi-controlled devices, current full control devices, voltage full control devices and power integrated circuits [4]. How to solve the high-voltage power supply and use high-tech to produce low-cost and high-reliability frequency conversion speed control devices is a hot spot in the relevant industries in the world.

The development of power electronics technology has entered a new era. Its development has experienced the era of rectifiers, inverters and inverters. High-voltage high-power inverters have been widely used. Especially in the fields of transportation, metallurgy, petroleum, etc. [5]. The macroeconomic and social benefits are even greater. The development of new high-frequency AC motor frequency conversion speed control technology is one of the leading directions of China's energy-saving business [6]. The output waveform and control method are studied because the frequency converter will be used to drive loads that are very sensitive to specific harmonics. In the case of high voltage power supply and limited voltage withstanding ability of power devices, the method of series connection of power devices can be used to solve [7]. Power electronics technology develops with the development of power switching devices and converter topologies.

From the point of view of both ends of the power grid and motor, it is high voltage, and there is a high current in the middle low voltage link [8]. The output of the converter contains high-order harmonics and DC components. The boost transformer must be specially designed. The two transformers have large losses. Every improvement and innovation of power electronics and power transmission technology can be immediately applied in practical industrial and civil fields. It plays an extremely important role in transforming traditional industries, developing high and new technology and utilizing energy efficiently.

2. Topology of Multilevel High Voltage Inverter

The main circuit topology of three-level inverters was first proposed by German scholars. This early topology was designed to improve voltage quality and reduce voltage harmonic components. On the basis of two-point mode, a zero level was added to the intermediate DC circuit. The output filter commutation current source converter uses the output filter to commute the thyristor. Together with the filter, the motor has a leading power factor. Each arm of the topology consists of two fully controlled devices in series, and both devices are inversely parallel to the diodes. When the device is used in series, because the dynamic resistance and capacitance of each device are different, there are static and dynamic voltage sharing problems. For the design of analog control circuit, its reliability and practicability should be considered comprehensively. For the input signal, the transmission distance should be reduced as much as possible from external interference during processing. Therefore, the thyristor of the inverter can realize natural commutation, and the capacity of the filter is basically equivalent to the capacity of the inverter. The more the number of levels, the less the harmonic content of the output voltage. When the staircase wave is modulated, the device is turned on and off at the fundamental frequency, and the loss is small and the efficiency is high.

Reliability and redundancy design issues, general high-voltage high-power drag systems require high system reliability. There is always an exchange of reactive power between the intermediate DC link and the motor. This non-functional amount is buffered by the energy storage components of the intermediate DC link. The simulation model can be run in a human simulated environment or condition to simulate the live field operation experiment of a real motor. Analog detection uses two identical sets of interface circuits, and the chips of the two sets are independent of each other. The output voltage of the medium voltage converter is determined by the voltage level of the unit and the number of series connections, and the output current of the converter is determined by the current rating of the unit. Properly increasing the stator voltage can enhance the load capacity. As the frequency increases and the voltage remains unchanged, the air gap flux will inevitably weaken, resulting in the reduction of the torque. Frequency conversion speed regulation and stray loss, which are often neglected in classical vector control but have important influence on control performance, also change with slip frequency. Figure 1 is the flow chart of fault diagnosis algorithm for control system.

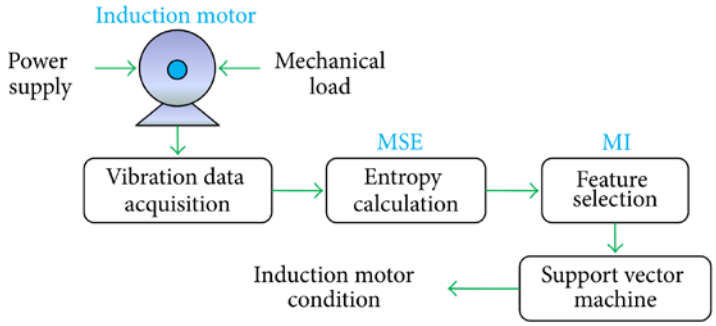

Fig.1. Control system fault diagnosis algorithm flow

The larger the capacity of variable frequency speed regulation, the more important the efficiency of the system is. The analog processing circuit is composed of filter, DC offset superposition circuit and so on. The signal obtained from the signal conditioning board is further processed into the

signal suiTable for the sampling device. Analog detection circuit is used to detect most parameters of the system. The stator current vector can be regarded as a combination of the orthogonal excitation current and the torque current vector. Then, the proportional relationship between the excitation current and the torque current not only affects the magnitude of the stator current but also the phase angle of the stator current. . According to the analysis of the basic principle and control scheme of the direct torque control of induction motor, the control effect is analyzed by simulation. Set up a system simulation model. In the simulation, the motor parameters of the induction motor are shown in Table 1.

Table 1 Inverter control system simulation parameters

Magnetic pole pair	Cross-axis inductance	Stator resistance	Rotor flux linkage
6	7.2mH	2.6Ω	0.455Wb

Controllable reactive power and active power flow, so it can be used for HVDC transmission and variable frequency speed regulation. Different main circuit topologies, the type and number of power devices used. As well as the use of transformers, filters, etc., it will affect the efficiency of the system. Spectrum sensing at different stages of cognitive radio network communication has a different role. Before the cognitive user information is transmitted, the spectrum-aware link is used to find idle licensed spectrum resources to meet the communication needs of the cognitive users. The digital signal processing circuit receives and transmits digital signals, and the received signals are isolated by optocouplers [9]. By adopting the correct access control strategy, it is possible to make the home base station operate in the most appropriate way. Because the high voltage output is not realized by traditional devices in series, but by the whole power unit in series. So there is no voltage sharing problem caused by device series connection. A large number of switching state combination redundancy can be used for voltage balance control. However, this topology requires a large number of clamping capacitors. Whether it is convenient to adopt redundancy design and bypass control function in the design of high voltage frequency converter is also very important.

3. Composition of Control Circuit

The unit series multi-level high-voltage converter uses several independent low-voltage power units in series to achieve high-voltage output. The reliability of zero current detection circuit directly affects the reliability of thyristor bridge switching. For the closed-loop control system of frequency conversion speed regulation, the running speed is an important parameter. The function of analog control circuit is to process the input and output analog quantities in the main control system. According to the characteristics of input signal and analog-to-digital conversion, the two are effectively combined [10]. The way of harmonic propagation is transmission and radiation, and the main way to solve the conduction interference is to filter out or isolate the conduction high frequency current in the circuit. Taking into account the line speed difference of the product will first cause tension fluctuations in the product, and then cause the displacement of the elastic frame. Try to make the series devices turn on and off at the same time. Otherwise, the voltage is not uniform due to the different breaking time of each device. It can cause damage to the device or even the entire device. For different slaves, the address and data information are different. When the phase-controlled rectifier is used for voltage regulation, the power factor of the grid side becomes lower as the adjustment depth increases.

The fieldbus control system emphasizes the underlying basic control functions by intelligent field devices. As a voltage model, due to the integral operation, the error is calculated in the integral calculation at a low frequency because the voltage is low. The routing protocol is an important part of the inverter network and is of great significance for achieving efficient and reliable multi-hop communication. The spectrum resources used in conventional networks are relatively fixed, while in the cognitive radio networks, dynamic spectrum resources are used. Study routing protocols that are suiTable for working in cognitive radio networks. Figure 2 shows the measured results of spectrum utilization.

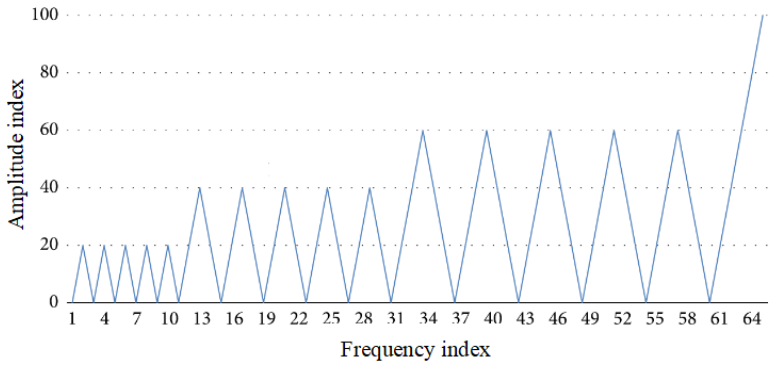

Fig.2. Actual results of spectrum utilization

The signal transmitted from the control cabinet is transmitted to the digital control system on the basis of ensuring accuracy and reliability as much as possible. A linear optocoupler isolation circuit needs to be designed in the analog control circuit. Due to the diode rectifier circuit, energy cannot be fed back to the grid and cannot be operated in four quadrants. Its application is greatly limited. The full digitalization of the control means makes use of the powerful information processing capability of the microcomputer, so that the software functions are continuously strengthened, and the flexibility and adaptability of the frequency converter are continuously enhanced. In vector control system, the stator current is controlled, so the relationship between the two components of stator current and other physical quantities must be found from the mathematical model. The excitation circuit and armature circuit of DC motor are separated and can be controlled separately. The stator current vector is synthesized by the excitation current and the torque current of the AC asynchronous motor. The inverters are connected in parallel, and the output current of the converter is the sum of the two inverters. Therefore, the output mode solves the problem of high current drive when the load starts or runs at low speed.

In the output calculation module of the current regulator and speed regulator of the system, each redundant operation unit can adopt different algorithms and make them as different as possible. For the same output voltage, it can be combined by different switching states. The selectivity of the switch state combination provides reliability and flexibility for the voltage balance of flying capacitor. The controller uses the corresponding control algorithm to control the turn-off timing of the power devices in the inverter according to the given value of the speed and the feedback amount. Although the inverter has an intermediate DC link, the frequency of the output AC can be higher than the frequency of the grid. Use known routes to the destination node or re-initiate the route discovery process to find the route from the source node to the destination node when needed. The output loop current signal can also be decomposed into a fundamental wave containing only a sine wave and other harmonics, while the higher harmonic current directly interferes with the load.

4. Conclusion

Each power unit is a small low-voltage converter. The voltage of each phase is superimposed by the output voltage of the power unit. When a power unit fails, the phase voltage will be reduced. In this paper, a feasible topology structure is proposed, which connects three-level inverters in series and parallel. The output of multi-level high voltage, high current and high power is realized. The unit series multiple converter was due to the low voltage withstanding of power devices, the large number of devices, the huge volume and the high failure rate. From the development of control theory, intelligent control theory is the development trend of traditional control theory. The secondary windings powered by the power unit have a phase difference with each other to achieve multiplexing of the input voltage. With the application of variable frequency vector control technology, it is easy to realize the process of low-speed production and automatic head generation, and smoothly transition to normal working state. The design of the analog control circuit must meet high requirements for its accuracy, reliability and practicality. The design of the control system should be the main line, while considering some of the influencing factors in practice. And finally

completed the corresponding function implementation, verifying the correctness and practicability of the design.

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