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Design and Implementation of a New Circuit Maintenance Training Platform

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Abstract. This paper designs a circuit maintenance platform for the artillery system. It can read or simulate the important node data of the artillery system in real time online or offline, and provide the basis for the artillery maintenance inspection. It can also be used as a daily teaching operation demonstration platform; analog data detection read and fault demonstration process.

1. Introduction

The artillery can achieve fast, accurate and stable tracking and aiming of moving targets, and can not be separated from the follow-up system. The follow-up system can accept the target elements from the fire-controlled radar in the form of electrical signals, compare the target elements with the muzzle elements, and then perform a logical operation to generate a driving signal, which is driven to amplify the gun position or The high and low execution motors drive the artillery to rotate quickly to continuously track the target. It is not only a signal amplifying circuit for the artillery to automatically track the aiming target, but also an important part of the signal logic processing. The real-time performance state of the follower system plays a decisive role in the normal tracking, aiming and shooting of the artillery.

At present, the system of signal detection and status monitoring of the follow-up system, which is used for equipment inspection and maintenance and teaching training, needs to be designed. In view of this, combined with the actual needs, based on a full understanding of the working principle of the equipment and the logical control relationship, a solution for the maintenance and training platform of the artillery system of the artillery system is proposed. By developing a training system for the artillery follow-up system, it is able to meet the teaching requirements of equipment testing and maintenance, it can also avoid human faults caused by improper operation and save equipment maintenance costs.

2. Circuit Maintenance Training Platform Design Requirements

A new type of artillery tracking system circuit maintenance training platform is a comprehensive system suitable for signal detection and condition monitoring of various types of artillery follower systems. It must meet the following basic conditions: First, the maintenance training platform must have a certain structure. The strength meets the requirements for carrying in outdoor harsh environments under field conditions, and the structural size should be as small as possible to meet the requirements of the electrical interface parameters of the artillery, which is convenient for teaching and training. Second, because the electrical devices of the artillery have different requirements for electrical parameters such as power supply current, voltage, power, etc., and have a certain range, in order to meet the power requirements of different devices, the maintenance training platform must have certain flexibility, that is, according to Different device inputs of different types of guns require

adjustment, detection, output and display of electrical parameters within a certain range. Third, the maintenance training platform is required to be modularized, combined installation, easy to carry and store, and suitable for various tasks in different environments.

In order to improve the maintenance efficiency, this paper designs a circuit maintenance platform for the artillery system. It can read or simulate the important node data of the artillery system in real time online or offline, and provide the basis for the artillery maintenance inspection. Daily teaching operation demonstration platform, simulation data detection reading and fault demonstration process.

With the follow-up control box, DC bus measurement and control box, azimuth/high and low receiver, azimuth/high and low drive, bleed box, joystick, angle limiter, azimuth/high and low execution motor, follow-up DC power box, etc. Simulated inspection and maintenance functions for 9 components;

It has the function of setting simulation fault, which is used for maintenance training demonstration and evaluation;

It has the working principle and control simulation function of the follow-up system, and the joint control system has the function of joint control;

It can detect analog signals such as power supply and signal with a multimeter, and can display digital signals such as the position of the gun and the target position;

It has control functions such as starting, stopping, automatic/semi-automatic switching of the follow-up system;

It has the function of detecting the detection hole of each monomer and component and the principle display function of the road; having a protection function for each monomer detection panel;

It has good operability and maintainability;

It has a grounding protection function, which is safe and reliable.

3. Design of the Console Training Platform

The circuit maintenance of a new type of artillery follower system is mainly composed of a system bench, a detection control unit, a detection indicating unit and a connecting cable.

3.1. System Gantry

The system gantry serves as the carrier of the entire maintenance training platform, including the gantry, analog follow-up control box, analog azimuth/high and low receiver, analog azimuth/high and low execution motor, analog azimuth/high and low drive, analog joystick, and analog angle limiter. 9 analog components such as analog DC bus measurement and control box, analog follow-up DC power supply box and analog bleed box. The test pedestal body is constructed of solid wood panels, and the analog component box is processed by aluminum alloy material, and the body is mounted with casters for convenient movement.

The gantry is constructed of solid wood panels, semi-enclosed open design, consisting of countertops, fences, cabinets, etc. The countertops are mainly used to install simulated follow-up control boxes, analog joysticks and other analog components, two bins. Used to install the inspection display computer and control box.

The analog follow-up control box is used to complete the input/output signal test, receiver indication and control functions of the follow-up control box. The analog follow-up control box can receive the position feedback signal of the analog receiver and display it; receive the combined speed signal of the azimuth/high and low analog tachometer and measure in the detection hole; receive the analog power driver signal and perform measurement; can pass the control switch, Control system working methods, etc. The box structure is adopted, and the internal circuit is redesigned and developed according to the working principle and function of the mounting; the panel part leads the detection signal for testing.

Simulated azimuth/high-low receiver device, using the same two-group revolving function as the installation principle, adding a coaxial motor, under the control of the joystick or automatic control signal, driving the rotation through the motor, and electricity The signal is connected to the test panel and the signal is sent via the internal cable to the follow-up control box for display. The azimuth/high and low analog receiver detection panel is shown in Figure 1. The voltage signal of each phase

winding of the receiver can be tested on the azimuth/high and low analog receiver detection panel, and the static resistance can be detected by switching the switch.

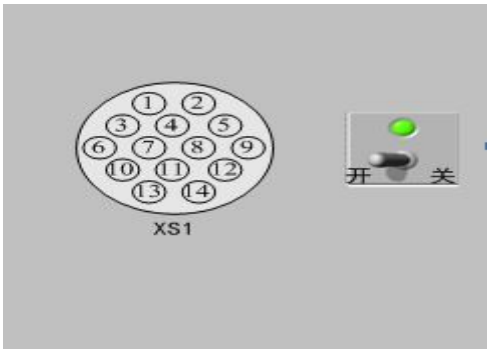

Figure 1. Schematic Diagram of the Receiver Test Panel

The analog azimuth/high-low execution motor uses a stepper motor that rotates under the control of the joystick control signal. Three-phase power signals and control signals can be tested on the test panel. Azimuth/high and low performs the motor detection panel as shown in Figure 2.

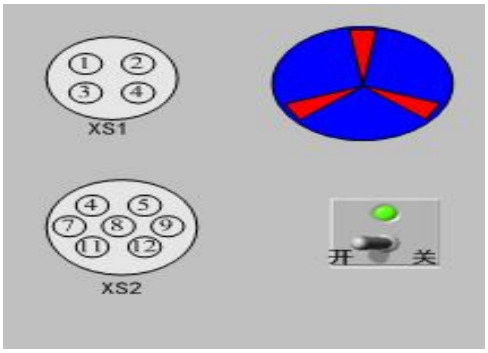

Figure 2. Schematic Diagram of the Executed Motor Detection Panel

The voltage signal of each phase winding of the receiver can be tested on the detection panel, and the static resistance can be detected by switching the switch, which is basically the same from the motor and the high and low motor detection panels.

Analog azimuth/high and low power driver for testing and controlling the input and output signals of the power driver. The box structure is adopted, and the internal circuit is redesigned and developed according to the working principle and function of the mounting; the panel part takes out the detection signal for testing, and the panel design is shown in Fig. 3 and Fig. 4.

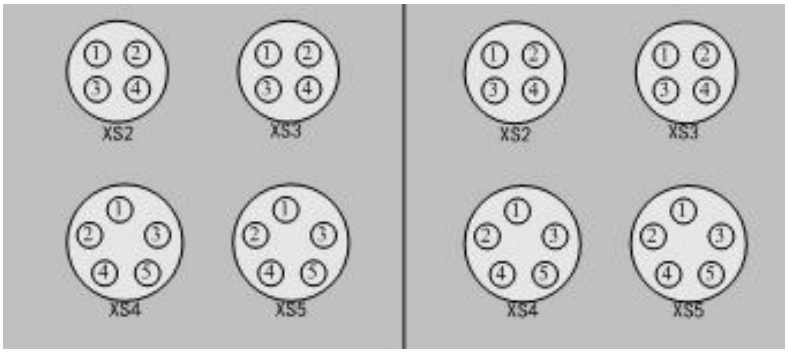

Figure 3. Schematic Diagram of the Analog Azimuth Power Driver

The shape of the analog joystick is designed according to the actual shape and is processed and welded with aluminum alloy material. The joystick body is customized according to the function and operation mode of the original joystick, and its functional shape is consistent with the actual installation. The joystick is developed with imitation components. The control and control functions are similar to the actual installation. By pulling the joystick, the output signal of the joystick can be detected in the detection hole. The analog joystick test panel is shown in Figure 5.

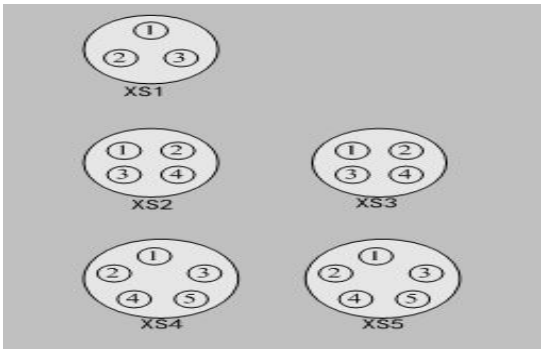

Figure 4. Schematic Diagram of the Analog High and Low Power Driver

Figure 5. Schematic Diagram of the Analog Joystick Test Panel

The analog angle limiter is functionally imitated in the internal structure. The control function is divided into high angle/low angle limit function. The control function is completed by the combination of the mechanical structure part and the control switch. The structure part is coaxially connected to the motor, the motor is controlled by the joystick or automatic signal, and the position feedback is positioned by the receiver to realize the control. Function, while detecting holes can measure input/output signals. The simulated angle limiter is shown in Figure 6.

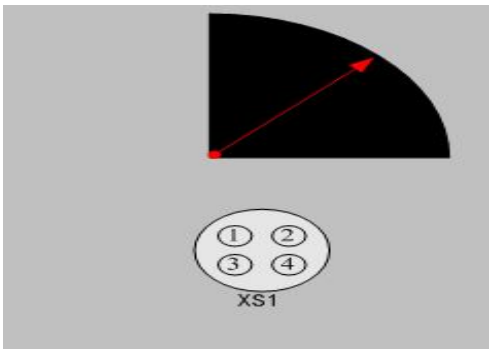

Figure 6. Schematic Diagram of the Analog Angle Limiter

The analog DC bus measurement and control box is used to generate the 325V DC bus voltage and 27V working voltage required for system operation, and adopts switching power supply technology for functional design.

The analog follow-up DC power box is used to generate the DC working voltage required for the operation of the servo system, and the analog power conversion technology is used for functional design.

Analog bleeder resistor box, with built-in resistance, power equivalent resistance, analog impedance test, bleeder current test, etc.

3.2. Detection Control Unit

The detection control unit is used for managing and controlling the correlation between the various analog components, giving the power, control signals and display signals of each unit during operation, simulating the fault setting and the like, so as to realize the simulation between the individual components. Mutual control function. It mainly consists of control box, power supply and signal board, control and display board, management logic board and connecting cable.

3.3. Detection and Control System

The detection control system is the core of the entire maintenance training platform, and completes the power management, control and display, logic management and other functions of the entire detection system. It consists of a cabinet, a power supply and signal board, a control and display panel, a management logic board, and a fault setting unit.

The box body is designed with aluminum alloy structure, and the sub-mother board plug-in structure is adopted inside, and each extension part is installed. The outer shape of the box body is shown in Fig. 7.

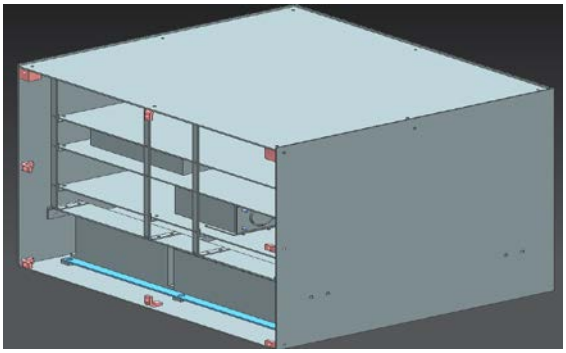

Figure 7. Schematic Diagram of the Box Shape

The power supply and signal board are used to convert the mains into 26V/400Hz AC signal power supply, 24VDC, ±15VDC, +5VDC signal power supply for the test platform.

Control and display panels perform various types of signals required to generate a system for impedance matching, amplification, and logic control processing of various power sources and signals. In addition, the circuit board also generates a digital signal that can communicate with a single unit such as a follow-up control box through a single-chip microcomputer system to realize functions such as control and data interaction.

The management logic board is composed of an ARM microcontroller and a logic matrix unit for completing the logic control function of the control system. Fault setting unit As a manual setting function, each fault function can be controlled by the fault selection control. The system sets 1 to 2 fault modes for each analog component.

3.4. Detection Instruction Unit

The detection indication unit is composed of a computer, instruction software, etc., and is mainly used to indicate the circuit structure principle of each single machine component, each input/output

channel/detection hole position, signal type, amplitude, etc., to facilitate detection and maintenance training. The detection indication system is mainly used for testing, which is convenient for querying the connection direction of each connector part, signal definition, and the operation principle of the unit and system. It mainly consists of detection indication platform and detection indication software. The detection indicator platform uses a professional touch computer to facilitate query operations. The instruction software is developed by LABVIEW software, which is convenient for manipulation and query. The detection indication system is shown in Figure 8.

The circuit maintenance training platform adds independent motion functions to the azimuth/high-low receiver, azimuth/high-low execution motor, and the angle limiter based on the components of the simulated mounting system, and moves it through the control system. The action is associated with the control signal; the control signal correlation simulation is performed on the follow-up control box, the joystick, the DC bus measurement and control box, and the DC power box of the follower system, thereby realizing the system working state of the simulation installation. In order to facilitate the inspection and maintenance, the detection holes and input/output plug-in signals of each single unit and component are led to the panel for display and detection. At the same time, reference can be made to the detection indication system for the circuit structure principle, pin definition, signal type/amplitude and so on.

The appearance of the circuit maintenance training platform is shown in Figure 9. The specification size is 2000mm × 2000mm × 1500mm, and the total weight is about 200kg. The input voltage is single phase 220V/50Hz or three phase 380V/50Hz. The measurement voltage range is 0 to 325V for DC DC and 0 to 220V for AC. The detection signal coverage is not less than 80%. The number of simulated fault set points is greater than eight. Operating temperature -10 ° C ~ 45 ° C. Continuous working time is greater than 8h.

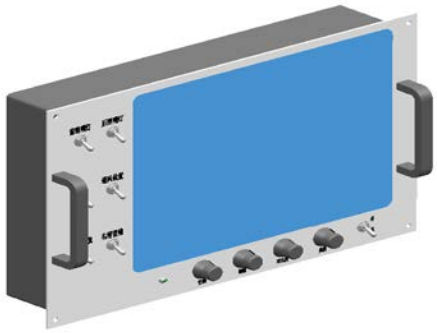

Figure 8. Schematic Diagram of the Detection Indication System

4. Acknowledgments

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