Fault Setting and Treatment Based on ZPW2000a Frequency-shift Track Circuit

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ABSTRACT: ZPW2000a frequency-shift track circuit is widely used in railway, and the routine maintenance of the equipment is particularly important. This paper introduces the fault setting based on the training platform of ZPW2000a frequency-shift track circuit as well as the fault treatment methods of typical faults, and provides solutions for students to examine and repair ZPW2000a system.

KEYWORDS: ZPW2000a; Fault; Treatment

1 GENERAL INSTRUCTIONS

The application of ZPW-2000A frequency-shift automatic block training system has become increasingly widespread. Railway signalman has to master installation and maintenance skills of ZPW-2000A automatic block system while engaged in the repair and maintenance of railway signaling equipment. The hardware principle of the training system based on ZPW2000A frequency-shift track circuit is exactly the same with that of the signal equipment actually used in railway system, which is qualified with stable performance and low cost, mainly aiming at the corresponding teaching resources of training teaching development.

Training system of frequency-shift track circuit includes frequency-shift automatic block training platform and intelligent training control device. Wherein the principle of frequency-shift automatic block training platform is in consistency with that of the field devices, its technical specifications and standards apply that of ZPW-2000A frequency-shift automatic block system, and after appropriate function modification, this intelligent training system can meet the requirements of railway related professions for rail traffic signal control teaching and training. Wherein the intelligent training control device fulfills the function of fault point setting and recovery in the training, the device allows the teacher to set up training assessment questions through the computer, the setting and recovery of the fault are automatically completed by hardware, no manual wire welding of the teacher is required, and automatic block basics of the sections can also be assessed. The training system, equipment failures and treatment methods of frequency-shift track circuit are introduced in the following part.

2 INTRODUCTION OF ZPW2000A FREQUENCY-SHIFT TRACK CIRCUIT

ZPW-2000A jointless track circuit is divided into the main track circuit and the small track circuit in tuning area, and small track circuit is considered as the “continuation segment” of the main track circuit in front of train operation. Controlled by the encoding conditions, the transmitter of the main track circuit generates frequency-shift signals of low-frequency modulation indicating different meanings, and the signals are transmitted to matching transformer and tuning unit through the cable channel (the actual cable and analog cable). As the rail is uninsulated, the signals are transmitted to both the main track and the small track in tuning area, and the main track signals are sent to the receiving end of track circuit through the rail, and then to the receiver of this section through tuning unit, matching transformer and cable channel. The small track signal in tuning area is processed by adjacent track circuit receiver in front of the operation, the execution condition of small track circuit relay formed by the result is sent to the receiver of this section, and the receiver of this section simultaneously receives the frequency-shift signal of main track and the execution condition of small track circuit relay, and drives the absorption of track circuit relay after correct verdict, to determine the vacancy or occupancy of the section. The checking principle of the main track and the small track in tuning area is shown in Figure 1.
3 INTRODUCTION OF THE TRAINING SYSTEM BASED ON ZPW2000A FREQUENCY-SHIFT TRACK CIRCUIT

The training platform is mainly set for ZPW-2000A frequency-shift automatic block training teaching and related railway professional training and competition.

3.1 Transmission of jointless track circuit

Low frequency is: $10.3 + n \times 1.1 \text{ Hz}$, $n = 0\sim17$, total of 18 species, and intelligent training system of frequency-shift automatic block (based on ZPW2000A) uses the low frequency of 11.4Hz, 13.6Hz, 16.9Hz, 26.8Hz and 27.9Hz.

Carrier frequency: the main track of intelligent training system of frequency-shift automatic block (based on ZPW2000A) uses the carrier frequency of 2300Hz, and the small track uses the carrier frequency of 1700Hz.

Frequency deviation: $\pm 11\text{Hz}$.

3.2 Receival of jointless track circuit

The adjustment status of track circuit is: voltage received by the main track is no less than 240mV; the voltage of the main track relay is no less than 20V (1700Ω load, under the state of no access to parallel machine); the voltage received by the small track is no less than 42mV (taking into account the amplitude difference between the upper and lower side frequency, the adjustment range applied is: 42mV $\sim$ 48mV); the voltage of small track relay or execution condition is no less than 20V (1700Ω load, under the state of no access to parallel machine).

3.3 Integral cabinet of frequency-shift training of sections

Each equipment cabinet installs a set of track circuit equipment, including a transmitter, a receiver, an attenuation plate, five 3x18 column terminals, two network disks of lightning protection analog, four 32-column connectors, an analog / rail change-over switch, a combination of relays, fifteen relays, a RC box and a resistance box. Panel of attenuation plate has test jack, which can measure the supply voltage of the transmitter, supply voltage of the receiver, voltage of track relay, output voltage of the transmitter, input voltage of the main track, input voltage of the small track and so on.

Adjustment of the main track circuit: the adjustment of the main track circuit is realized by conducting line crossing on the rack terminal behind the attenuation plate in accordance with the track circuit adjustment table.

Adjustment of the small track circuit: first, special frequency selection table is used to test the input signal of the small track on the input taphole of the attenuation plate’s panel, and then line crossing is conducted on the rack terminal behind the attenuation plate in accordance with the small track circuit adjustment table.

3.4 Fault setting points of training system

83 fault points are set throughout the entire training platform, the red circle in Figure 2 indicates the numbered fault point, open-circuit faults are mainly set, hardware and software are combined, teacher’s computer can arbitrarily set one or more fault points from the 83 faults of the students’ computers, and students can use multimeter and frequency meter as the main tools for finding faults, so as to train students’ ability of analyzing and dealing with problems, and skillfully using instruments.
4.1 Three-layer alarming design of the faults of ZPW2000A automatic block device

First layer: for station attendant

The loss of excitation of the total frequency-shift alarm relay indicates the existence of the faults in frequency-shift transmission and reception equipment within the station, and sound and light are used to alarm on the console.

Second layer: for the maintenance staff in the work area of the station

The “transmitting work” and “receiving work” of the attenuation plate of each section of track circuit denote fault transmitter and receiver. Meanwhile,
skilled maintenance personnel can quickly conduct judgment on the comprehensive faults of the system by combining with fault locating indicator light, security and gate output indicator light within the device.

Third layer: for the maintenance personnel of maintenance department
Fault searching method: the fault locating indication and flashing frequency within the transmitter and receiver indicate the maintenance personnel about the range of device fault.

Analytical judgment:
1) From the indicator light of attenuation box, only the unlighted receiver light indicates that the work of the transmitting box is regular, and it is proved regular from the test on transmission power; receiver box does not work, and test receiver box has no access.
2) That both the device side and cable side have voltage is measured from the test hole of the transmitting analog network disk of the comprehensive cabinet in section; that both the device side and cable side have no voltage is measured from the test hole of the receiving analog network disk.
3) And then from the connection terminal between the zero layer of comprehensive cabinet in section (equivalent to noseplate) and outdoor area, it is measured that the voltage of the transmitting end is normal, the receiving end has no voltage, and the outdoor cable has no voltage regardless of receiving end, which indicate the faults are outdoors. (For ZPW-2000A section equipment, comprehensive cabinet in section is also case-hardened and one-to-one corresponding. Location of the analog network plate is directly corresponding to the location of the terminal board, the corresponding number of layers is corresponding to the respective terminal board, the location is corresponding to the respective terminal number, the singular is the transmission terminal, and the even number is the receiving terminal).
4) Outdoor fault should be timely tested and judged according to the first reach to the transmission end or receiving end. No voltage on the track surface can be sent to the transmission side. The matching transformers E1, E2 of the transmitting side are tested to have no frequency-shift voltage, and the cable still has no voltage regardless of the terminal, indicating the cable has some problems. The location of the corresponding terminal of the cable box in front of the transmission end is tested to have frequency-shift voltage, indicating cable break between the two.

4.2 Specific fault treatment of the training platform
Check direction: sequentially checking transmitter, track circuit, receiver and lighting circuit.

1) Transmitter: check sequence of transmitter: 65, 66, 1, 67, 2, 68, 3, 69, 4 and 70 are divided into five groups, the first group is reverse 65 and 66; the second group occupies 1GJ, and is 1 and 67; the third group occupies 2GJ and is 2 and 68; the fourth group occupies 3GJ, and is 3 and 69; the fifth group is the case of no car occupation, and is 4 and 70; and then that of reverse occupancy and 1GJ occupancy are compared to find the fault points, if the indicator light of the reverse occupancy is not normal and the indicator light of 1GJ occupancy is normal, the fault point of 66 can be determined, and so on; but if both combinations occupying adjacent tracks are in red, relays occupying these two groups of adjacent tracks need to be tested. If FBJ has not been absorbed, points 02-4 and 02-16 are required to be tested, if there are numbers, the fault point is 83, otherwise, the fault point is 82, and if it still has not been absorbed after the restoration of 82, 83 also has fault.
2) Track section: in the forward direction, it is divided into upper and lower parts.
   The normal voltage of the upper part is 33-38V, if the voltage is too large (larger than 38V), the fault point is in its back (the distance can be far or near), and if the voltage is too small (0.5V or so, less than 1V), the fault point is on the left (unrelated to distance).
   The normal voltage of the lower part is about 1.7V, if the voltage is too large (around 5.9V), the fault point is on the left, and if the voltage is near 0V, the fault point is on its right.

QGJ measurement: if there is a fault, directly measure whether there is a number from 03-7 to 05-10. 79 is normal while there is a number, and 79 has fault when there is nothing; if there is no number after the fault solution, 78 also has fault, which is the same with FBJ.

3) Test of positive and negative indicator test:
   (1) First point to the positive and negative sides, one bright light can determine one way, and then test another one.
   (2) If the positive and negative lights are not bright, ① fix a probe in 02-11, ② fix another probe in QZF31, then direct the negative side to the positive side, and determine which of 77, 60, 61 and 76, 22 is normal (existence of number is normal), ③ if there is no number, these two probes use counterclockwise method (until QZFJ) to measure the number, ④ after the fault is excluded, another probe is fixed on 03-13, to judge 21,73.

5 CONCLUSION
Focusing on ZPW2000A training platform, this paper introduces the searching method of the fault points set inside. Students can complete combination wiring training, combination of wiring can replace training platform combination, and software test is applied to measure combination conduction. In the measurement process, if a step fails, it will be
The final conduction result requires the pass of all steps, which will be displayed in red, otherwise, in green. Combination wiring and testing are used to train students’ ability to identify the images and install equipment. The actual site conditions are varied and complex, requiring students’ diligent training and practice, so as to quickly locate the fault.

REFERENCES