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An Introduction to the Principles and Composition of 25hz Phase Sensitive Orbital Circuits 3V

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Abstract

At present, the number of China's railway mileage has exceeded 159,000 kilometres, electrification mileage is soaring, more than 90% of the stations use 25hz phase-sensitive track circuits,and, in practical application, the 97-type 25hz phase-sensitive track circuits as well as the JXW25 microelectronic track circuits occupy an important position, and they have many significant characteristics, such as: stable operation, easy maintenance, low failure rate. It also has strong impact resistance, which makes the railway development in China achieve remarkable results. Due to its effectiveness and reliability, it has been commonly used in practical situations. China's railways are moving towards greater standards and sophistication, which has led to an increase in traffic and an expansion of stations. Where there are cross crossings, there are unenergised branches in the track circuits, and here the trains on the track are very sparse. Due to oxidation of the track surface, the track circuits in these places are prone to poor branching leaving white light band faults. To solve these problems, we used a 25hz phase sensitive track circuit measurement software system and by analysing the data, we determined that raising the 25hz impedance of the choke transformer could help the track voltage. By changing the voltage, we were able to dramatically improve the superposition of the codes, so we chose the BG3(3)-L130/25 lightning protection track transformer to replace the original track transformer. In addition, we also chose the BGK-130/25 type reactance track transformer. In this way, we are able to ensure the safety of track circuit work and avoid accidents. By introducing QT-25 type phase regulator, we can significantly improve the phase performance of the track relay coil so as to achieve good stability. At the same time in the field of daily maintenance and centralised maintenance, does not affect the original 25hz phase-sensitive track circuit testing and maintenance methods, conducive to the field maintenance personnel daily maintenance and test data.

Keywords

Track Circuit; Bad Tap; 3visation.

1. Preface

1.1 3v to 25hz Phase Sensitive Orbit Circuit Overview

The 25Hz phase-sensitive track circuit has high operating efficiency and low power consumption, and it also has good low bed ballast resistance characteristics, which enables it to complete theoretical calculations more accurately and also supports signal superposition with locomotives such as the UM71 and the ZPW-2000, which enables it to meet the requirements of 10,000-tonne tractive effort while resisting external interference, and has thus gained a great deal of popularity. Despite the many advantages of 25Hz phase-sensitive rail circuits, however, the historical unavailability of efficient high-power crossover power supplies and the outdated power electronics technology meant that the original rail surface voltage was too low and the choice of termination impedances was too limited, resulting in susceptibility to shunt failures where there was no regular travelling. Today, 25 Hz phase-sensitive rail circuits are being used more and more widely, and the number of shunt failures is increasing every year.

When a vehicle wheelset is split, the receiving equipment (e.g. track relay) cannot accurately reflect the actual condition of the track circuit due to the 2.5 tonne pressure and 0.06Ω impedance, resulting in a poor split.

Poor tap conditions in rail circuits are common due to declining environmental quality, weakened traffic flow, and corrosion of rail surfaces. This condition is mainly due to corrosion of railway lines, weakened traffic flow of vehicles, and oxide layers on railway lines. There are three types of contacts between rails and wheelsets on railway lines: semiconductor thin-layer contacts, oxide thin-film contacts, and resistive contacts. The first two types of joints are generally poorly tapped, while the latter are better tapped because of the lower tapping resistance and the ability of the rail relays to operate correctly, thus ensuring the safe operation of the railway line. However, the inter-rail voltage that enables the semiconductor film to conduct is 1.2 V to 1.4 V or more, and when the ballast resistance becomes very large, the voltage across the double rail face of the Type 97 25 Hz phase-sensitive rail circuit may drop to 0.4 to 0.8 V, which affects the conductivity of the wheel-to-semiconductor film contact, thus causing a tapping problem for the rail circuit.

Figure 1. four turnouts

In Japan, there are many places where railway lines are experiencing severe poor railway splitting. By observing data from some locations, we have concluded that the residual voltage between railway lines is usually around 1V. We propose measures to deal with these situations, such as setting the relays of railway lines to a state where the relays can be dropped when the residual voltage between the railway lines is 1V, to ensure the safe operation of the railway lines. After numerical simulation, we found that most of the problems of poor tap faults were effectively dealt with when the voltage on the rail surface increased from 2V to 5V. We also further investigated these changes and found that increasing the 25Hz impedance of the choke transformer can improve the rail-face tap faults. As the 25Hz impedance is increased, the voltage of the relays goes out of the normal range due to the increase in the resistance of the roadbed and the rise in the cable currents, which can jeopardise the operation of the electronic components, and it is therefore necessary to use a transformer device which is capable of keeping the trend of the change in the current on the I side of the transformer device smooth while the voltage on the II side rises. In order to improve the performance of the 25hz rail

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circuit, we have adopted a new type of transformer equipment, i.e. BGK-130/25 type reactance rail transformer equipment. It can work with the choke transformer and tuner to greatly improve the splitting accuracy of the track circuit, and also can measure the end point of the track circuit more accurately, so as to better control the voltage of the track relay, as well as inhibit the harm of the track line current. In addition, we have added QT-25 phase regulator to ensure that the overall phase of the track relay can be well controlled. At the same time in the field of daily maintenance and centralised maintenance, does not affect the original 25hz phase-sensitive track circuit testing and maintenance methods, conducive to the field maintenance personnel daily maintenance and test data.

1.2 3Vised 25hz Orbital Circuits Used in the Field

Table 1. Application in 2009

order number	project name	place	Quantity (section)	unit type
1	Sub-road adverse remediation	Chengdu bureau	740	3V chemical equipment
2	Sub-road adverse remediation	Zhengzhou bureau	1234	3V chemical equipment
3	Sub-road adverse remediation	Wuhan bureau	402	3V chemical equipment
4	Sub-road adverse remediation	Nanning bureau	101	3V chemical equipment
5	Sub-road adverse remediation	Jinan bureau	450	3V chemical equipment
6	Sub-road adverse remediation	Lanzhou bureau	299	3V chemical equipment
7	Sub-road adverse remediation	Taiyuan bureau	18	3V chemical equipment
8	Sub-road adverse remediation	Nanchang bureau	387	3V chemical equipment
9	Sub-road adverse remediation	Guangzhou Railway Group	430	3V chemical equipment
10	Sub-road adverse remediation	Qinghai-Tibet Company	105	3V chemical equipment
11	Sub-road adverse remediation	Wu bureau	32	3V chemical equipment
12	Sub-road adverse remediation	Ha bureau	13	3V chemical equipment
13	Sub-road adverse remediation	Asustek Railway Company	18	3V chemical equipment
14	Sub-road adverse remediation	Xiang-yu railway	44	3V chemical equipment
15	Sub-road adverse remediation	Zheng Xi guest	32	3V chemical equipment
amount to			4305	

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Table 2. Application situation in 2008

order number	project name	place	Quantity (section)	unit type
1	Sub-road adverse remediation	Xian bureau	8 71	3V chemical equipment
2	Sub-road adverse remediation	Zhengzhou bureau	195	3V chemical equipment
3	Sub-road adverse remediation	Kunming bureau	359	3V chemical equipment
4	Sub-road adverse remediation	Chengdu bureau	56	3V chemical equipment
5	Sub-road adverse remediation	Nanning bureau	4	3V chemical equipment
6	Sub-road adverse remediation	Nanchang bureau	8	3V chemical equipment
7	Sub-road adverse remediation	Taiyuan bureau	3	3V chemical equipment
8	Sub-road adverse remediation	Hohhot bureau	8	3V chemical equipment
9	Sub-road adverse remediation	Wuhan bureau	12	3V chemical equipment
10	Sub-road adverse remediation	Guangzhou Railway Company	3	3V chemical equipment
11	Sub-road adverse remediation	Lanzhou bureau	2	3V chemical equipment
12	Sub-road adverse remediation	Su ning	1	3V chemical equipment
13	Sub-road adverse remediation	Taiyuan	2	3V chemical equipment
amount to				3V chemical equipment

The 25hz phase-sensitive track circuit proposed by UIC Technical Researchore (now ERRIA174 Committee) has good stability, energy saving and adaptability to low roadbed ballast resistance, so it has been widely used in our electrified sections, this is a voltage value to ensure the safety and reliability of track circuit operation:

1)50V (peak) : The surface of the rail has developed severe corrosion and ageing, making it fragile;

2)10V (peak) : the rail surface has a layer of silicon oxide film contamination of the section;

3)6V: the surface of the rail is not too badly rusted;

4)1.1V (peak): a section where the surface of the rail is usually clean.

In order to solve the serious rust problem, we recommend the standards 1) and 2). In these standards, high voltage pulse track circuits should be included. And in ordinary cases, we suggest choosing the standards of 3 and 4. In addition, in order to increase the voltage on the rail surface, we suggest that 3Vised 25hz rail circuits will be used[1].

For the busy trunk line and general trunk line, mainly for the station cross the ferry section, due to the cross the ferry section, track circuit without receiving branch not often go train, rail surface rust is easy to form an oxidised film, once the train is poorly split, leaving a white band, the train has a large impact on the scope of the need to use 3v 25hz track circuit, to alleviate the impact of poor split on the line, improve transport efficiency.

On 11th December 2007, this advanced track circuit has been generally adopted by the Ministry of Railways after strict inspection, and successfully completed the transformation of 5829 3v track sections, of which the compliance rate is more than 85%, which greatly improved the quality of the turnouts, and this system is easy to operate and reliable, which has gained the unanimous approval of the customers[2].

2. Principles and Composition

2.1 Circuit Principle

It has been learnt that increasing the 25hz rail impedance improves the rail surface voltage, and by putting the rail surface voltage it is possible to improve the problem of poor tapping. On the basis of not changing the original circuit structure, by changing the structure of some of the equipment, the problem can be achieved.

1) Resonant Choke Transformer

By modifying the original choke transformer and adding a third coil, not only can its original function be fulfilled, but also the impedance of the 25hz track circuit can be significantly increased, thus effectively enabling the superposition of the station's electrical coding.

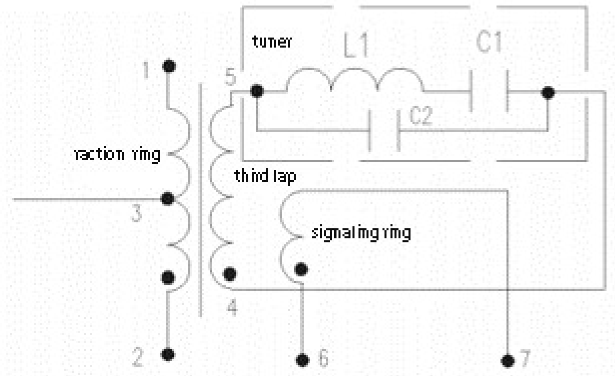

Figure 2. Resonant-type choke transformer

The third coil is actually a L1, C1 series resonance and parallel C2 resonance, and zpw2000A track circuit type electrical insulation section BA2 principle is similar to adjust the parameters of L1, C1, for 50hz traction signal, his impedance is very low (pole impedance), if there is an imbalance of traction current on the traction coils, it will be induced on the third coil, due to the design of the already good L1, C1 Parameters of L1 and C1 are designed to short-circuit the traction current, which will not interfere with the signal coil and protect the track circuit equipment from being affected.L1, C1 and C2 are connected in parallel, and the third coil forms a parallel resonance, which is equivalent to increasing the impedance of the 25hz signal in the circuit, and enhances the transmission of the 25hz circuit in the track[3].

By mounting the resonant choke transformer on the rail, the 25hz impedance can be significantly increased, the roadbed resistance can be effectively reduced, and the relay terminal voltage overrun due to the low roadbed resistance in the conventional rail circuit can be reduced, and the operation of the rail circuit components can be effectively safeguarded. Therefore, it is necessary to develop a transformer that can increase the voltage on the secondary side of II while the voltage change on the secondary side of I becomes smoother, and it is called a new generation of reactance transformer.

2) BGK-123/25 type reactor rail transformer

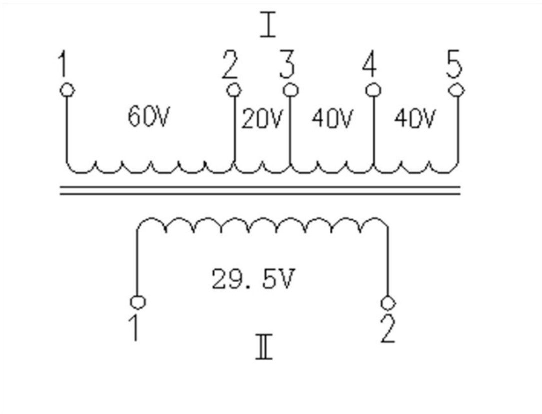

Figure 3. BGK-123 / 25 type electric resistance track transformer

By using a reactance rail transformer system, we are able to achieve isolation of the receiving end in a 3vised rail line. This transformer system can be combined with choke transformers and regulators to enhance the tapping capability of the rail line. It also maintains the terminating impedance of the rail circuit for better monitoring of taps and rail breaks. In addition, it is capable of effectively suppressing overloads on track relays and is capable of suppressing outside interference.

3) BG2(3)-L130/25 lightning protection rail transformer

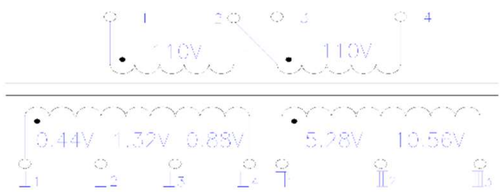

Figure 4. BG 2 (3) -L130 / 25 lightning protection track transformer

This track transformer is designed to provide power in circuits with frequencies of 3V and 25hz. Depending on the type and length of the circuit, it is able to provide different signals to ensure reliable operation of the rail relay[3].

4) QT type-25 phase regulator.

This technique is specifically used for 3v-ised 25hz phase-sensitive track circuits, which improves the phase difference of the voltages in the circuit by adjusting the voltage of the track coils, thus improving the performance of the system.

5) HPT-ZD type phase adjustment and matching box

The phase adjustment part of the 3v 25hz track circuit is designed to increase the overall power density as well as to reduce the power loss in some parts; while the matching part adopts the precise matching of the track circuit with the signal cable at the transmitter side, which ensures the safety, reliability and high-efficiency operation of the locomotive.

2.2 Diagram of the 3vised Track Circuit

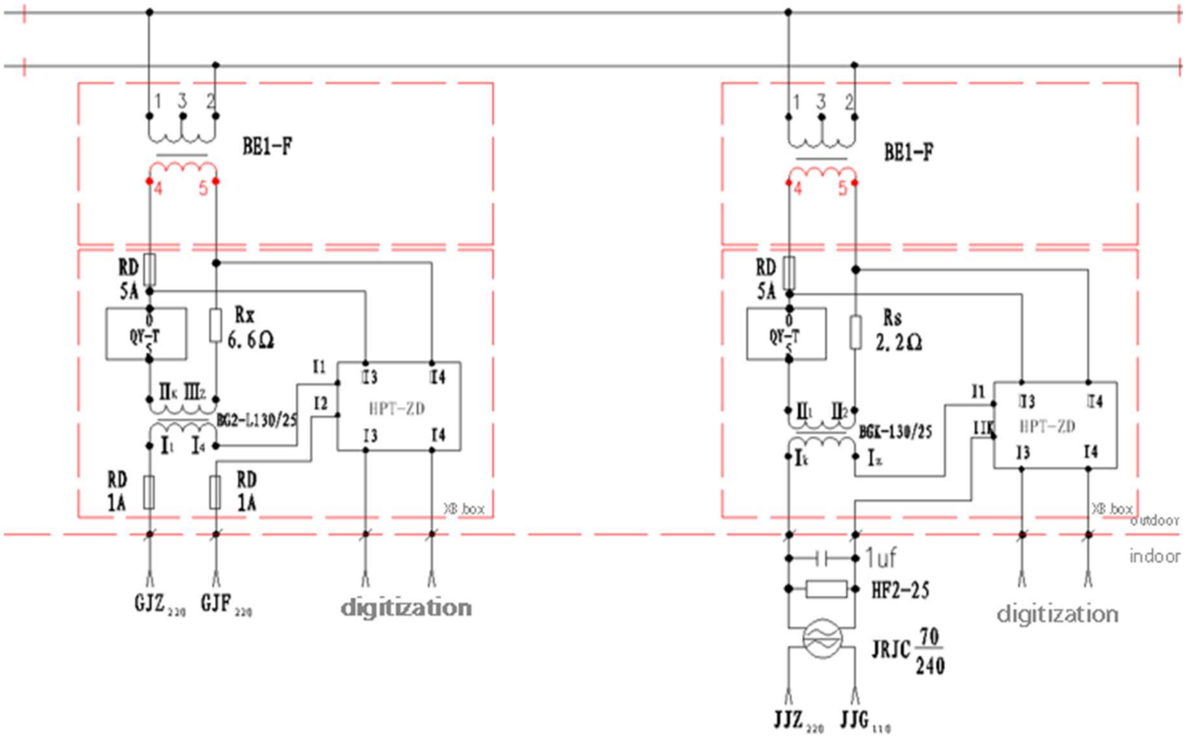

Figure 5. Circuit diagram of existing line 3v 2 5 hz in station

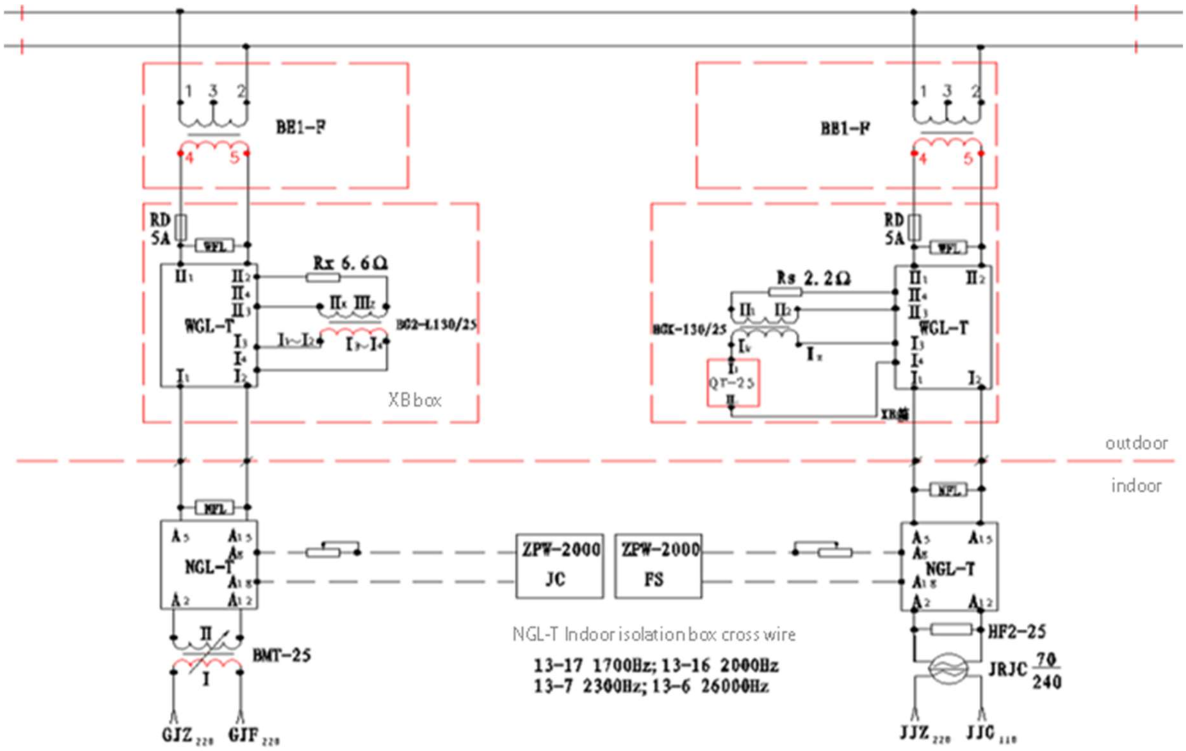

Figure 6. 3v 2 5 hz track circuit superimposed zpw 2000A type coded track circuit in the station

3. Engineering Design and Construction Guidelines

3.1 Construction Preparation for 3Vised Track Circuits

1) On-site tapping test

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The use of split residual voltage tester in the rail surface of the most serious locations to measure the track circuit split residual voltage, when the adjustment state and the split state binary two (microelectronic receiver) voltage difference between the two ends is greater than 3V, 3V can be used to 25hz phase-sensitive track circuits.

2) Equipment testing:

Before use, it should be checked in strict accordance with the prescribed standards to ensure that no adverse consequences will occur during transport.

3.2 Construction and Commissioning of 3Vised 25Hz Phase Sensitive Rail Circuits

1) Modification of electrified non-electrical coded section

Adopt new type of resonant choke transformer, replace the outdoor choke transformer with BE2-F type; replace the relay transformer with BGK-130/25, and connect the QT-25 phase regulator in series on the I-side; adjust the current limiting resistor on the output side to 6.6Ω, and adjust the current limiting resistor on the input side to 2.2Ω; in addition, it is necessary to give full consideration to the flow rate of the rail traffic, temperature and humidity, etc., so as to ensure the safety of the rail traffic. According to the adjustment table, if the required voltage exceeds 18.48V (fully considering the voltage drop of the cable transmitted from indoor and outdoor to indoor and outdoor), the transformer parameter of BG-L260/25 should be changed, and at the same time, the parameter of the phase regulator of I1 II1 should be taken in the section of one sending and one receiving, and connected with II1 II2; moreover, the parameters of the phase regulator of I1 In addition, I1 and I2 phase regulator parameters should be adopted in a send-multiple-receive zone, and at the same time, the indoor HF2-25 protection box and JRJC binary two-phase relay should be maintained unchanged[4].

2) According to the structure of the 3V-ised 25hz phase-sensitive track circuit, connect the components in an orderly manner so as to form a complete track circuit loop for information transmission.

3) accurately control the sending transformer, and other necessary signals such as relay status, phase and polarity by comparing the values in the regulation table to achieve optimum operation.

4) perform polarity crossover tests to ensure correct polarity crossover

5) Perform a tap test with a 0.06 ohm constant voltage tester.

3.3 Electrified Four-wire Overlay ZPW2000A Electrocoderised Retrofit

1) Replace the indoor choke transformer with BE1-F type resonant choke transformer, replace the wiring transformer with BGK-130/25 resistance transformer, replace the indoor shielding adjustment box with HPT-ZD phase matching and (phase regulator and matching equipment combined, terminal number and QT-25 to keep the same), adjust the resistance value of the feeder current limiter to 6.6 ohms, adjust the resistance value of the wiring transformer to 2.2 ohms, according to the required voltage of the II secondary side of the feeder transformer, decide whether to replace the wiring transformer with BGL260/25. Adjust the resistance of the feeder current limiter to 6.6 ohms, adjust the resistance of the wiring transformer to 2.2 ohms, and depending on the required voltage on the secondary side of the feeder transformer, decide whether or not to replace the wiring transformer with a BGL260/25. outdoors, install 110 V on the secondary side of the secondary side so that the voltage can be adjusted to the required value. At this point, steps should be taken to ensure that the BMT-type transformer, the Type 2 protection box, and the JRJC binary two-position relay are mounted in such a way as to ensure that they can effectively receive the new, more stable power supply.

2) Use a combination of a 3V-enabled 25Hz phase-sensitive track circuit and a ZPW2000 electrocoderised circuit to link all the equipment in sequence to form a complete track circuit system.

3) By checking the input voltage of the internal BMT-type power transformer, as well as the operating status, phase and polarity of its corresponding frequency converter, we can effectively control it so as to ensure that it achieves the best operating effect.

4) Test the outlet and inlet currents of sending and receiving power coding.

5) Ensure the accuracy of the measurement results by performing a polarity crossover test.

6) Do the split experiment with 0.06Ω split residual voltage tester[5].

3.4 Electrification of Two-wire System Superimposed 8 Information, 18 Information Electrocoderisation Section Modification

1) The outdoor choke transformer is converted into BE1-F type resonant choke transformer, and the relay transformer is converted into BGK-130/25 resistance transformer equipment, and the HPT-ZD type phase-matching box is newly installed in the outdoor box box, and the current-limiting resistor is converted into 6.6 ohms, and the current-limiting resistor is converted into 2.2 ohms, and the power transformer is newly installed at the earth grounding and the voltage is regulated to 110V. , to ensure the grounding quality. When the voltage of II secondary side reaches the maximum value, BMT type power transformer should be used to control the voltage of the transmission line; at the same time, the original DGL2-F sending end isolation box should be used, as well as the original DGL2-R junction box; indoor BMT power transformer, 2-type protection box and the position of the JRJC relay remain unchanged.

2) The integrity of the track circuit is achieved by adopting a 2-wire 3V-enabled 25Hz phase-sensitive track circuit, electrically coding the 8-signal and 18-signal signals, and connecting the various devices in accordance with simple steps.

3) By checking the input voltage of the internal BMT-type power transformer, as well as the operating status, phase and polarity of its corresponding inverter, we can effectively control it to ensure that it achieves optimum operation. ,

4) Test the outlet and inlet currents of sending and receiving electrocoderisation.

5) Ensure the accuracy of the polarity crossing by performing rigorous tests.

6) Do the split experiment with 0.06Ω split residual voltage tester[6].

3.5 Modification of Non-electrified 25hz Track Circuits

By developing the tuned rail transformer system BGT, we can effectively replace the resonant choke transformer in the 25Hz phase-sensitive rail circuit, which has good mechanical properties and reliable stability, and can effectively improve the reliability and operability of the rail system. By comparing and contrasting, we have achieved an effective integration of the circuit principle, circuit parameters, parametric converter and electrically coded superimposed circuits of the 25 Hz phase-sensitive rail circuit[7].

After the use of the tuned rail transformer BGT, the resonant choke transformer of the 25 Hz phase-sensitive rail circuit will be effectively replaced, thus realising the technical transformation without electrification. In the actual construction process, effective tuning and replacement of the choke transformer should be carried out in conjunction with the characteristics of the electrification technology[8].

3.6 Adjustment Method for 3Vised Orbital Circuits

1) How to adjust 3V to 25hz phase sensitive track circuit?

A.By evaluating the length and rust condition of the track circuit and combining it with the adjustment table, we can determine the ratio of the reactance transformer at the receiving end;

B. For better phase control, we can connect II1-II2 of the QT-25 phase regulator (which contains 12uF of capacitance) to the phase changer, and increase it if the phase is below 90º, or decrease its capacitance if the phase is above 90º, thus controlling the phase of the phase changer in the region of 60º to 120º;

C.To control the operation of relays (rise or fall) by changing the voltage of the transformer at the input, as well as to monitor and record the voltage/position of bi-directional relays;

D. testing the joints and rail surfaces of track circuits using the CFG-D series of tap residual voltage testers (0.06Ω) to determine the accuracy and reliability of their tap data;

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E. Check for polarity crossings with adjacent track circuits.

To ensure accurate phasing of the track circuit, do not use a resonant choke transformer for regulation and do not install jumpers inside the choke transformer as this will affect its electrical characteristics![9].

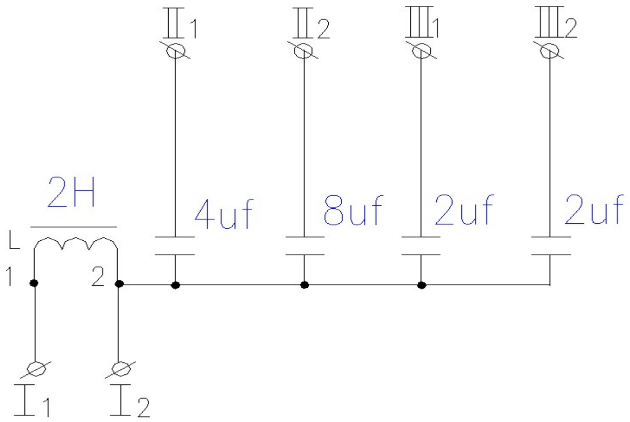

Figure 7. Phase modulator

4. Routine Maintenance and Overhaul

4.1 Routine Maintenance and Overhaul

4.1.1 Daily Maintenance

1) External maintenance of the box at the sending (receiving) end.

a) The box is intact, the locking device is intact, and the numbering is accurate and reliable.

b)All bolts have been lubricated, tightened, smooth surface, without any debris accumulation.

c) The basic inclination of the box should be less than 10mm, and the distance between the bottom of the box and the ground should be less than 150mm to ensure the drainage effect.

2) the sending (receiving) end of the lead wire maintenance

a) Use double lead connection, fix it on sleepers or other special equipment, never bury it in the soil or stone, and ensure that the surface remains smooth and rust-free, broken strands shall not be more than 1 / 5

b) Items such as anti-climbers and gauge bars must be avoided on connecting wires. When passing through the rails, it should be ensured that the clearance with the bottom of the rails is not less than 30mm and isolated.

c) The choke transformer lead wires, centre connecting wires and return wires shall be securely fastened together by means of strict connections to ensure anti-mixing[10].

4.1.2 Centralised Maintenance Access Equipment Maintenance

a) To ensure the integrity of the rails, it is necessary to ensure that they, the channel insulation and the fishtail plates are perfectly matched. In addition, in order to ensure the stability of the rails, it must be placed continuously and ensure that the gap between the two ends is less than 6-10mm. at the same time, in order to avoid impact, it is necessary to ensure that both ends of the rails of the sleeper firmly compacted, and to ensure that the roadbed of the tamping situation is up to standard.

b) In order to ensure the quality of the joint line, we use a double set of plug nails. The depth of the spigot must be flush with the rail waist, not exceeding 5mm at most, and the spigot and spigot holes must be in full and close contact with each other and coated with anticorrosive paint. The strand must be kept smooth and rust-free, with no more than 1/5 of the strands broken.

c) Anti-corrosion wires are well nailed and turnout jumpers for track circuits should be double-jumpered. When crossing the rails, it should be ensured that it is at least 30mm from the bottom of the rails and effective insulation measures should be taken to avoid contact with metal parts that may cause short circuits.

d) Gauge bars and ground anchor ties are installed and tested well.

e) When installing contact network towers, it should be ensured that the spark gap is intact and that the grounding reinforcement does not collide with other rails. In addition, the earthing reinforcement should not be buried in soil or rocks. Also, the lead wires of empty choke transformers should be in good condition.

f) Capacitors are well installed and tightened, and the tested capacity is in accordance with the regulations[11].

4.2 Centralised Maintenance

4.2.1 Box Box Foundation and Appearance

a) The foundation soil structure is solid, no cracks, no tilting, no offset of more than 10 mm, no weeds around, the clearance between the bottom of the box and the ground is not less than 150 mm, and the drainage is good.

b) In rail transformer cases, the inner edge of the choke transformer case shall be kept at least 1350 mm from the rails;

c) In this case, the track transformer and the choke transformer are arranged in a ‘one’ shape with their centres at the rail joints.

d) The distance between the two choke transformer boxes is approximately 650 mm and their centres are spaced apart from the track transformer.

e)The distance between the centres of the boxes is 700mm;

f) The installation is precise and free from any cracks, with locking and latching equipment intact and with excellent internal dust and water resistance[15].

4.2.2 Insurance and Wiring

a) The wiring must be perfect, the wire ends tight and secure without any damage, the wire loops or rings, and the broken strands must not exceed 1/5;.

b) In order to protect cables and flexible cords, they must be equipped with auxiliary toroids and protected by heat-shrinkable tubes;

c) Various nameplates in the box are complete and correct;

d) The installed terminal blocks are firm and reliable, without any cracks, and the screws and washers are ready;

e) Through the cable through the correct, and marked;

f) When filling the glue chamber with glue, ensure that the thickness of the glue does not exceed the protective layer of the cable and that the cable in the glue chamber does not sink.

4.2.3 Transformers

a) The transformer is installed flat and has fixing measures;

b) Transformer is not rusted, no noise and overheating phenomenon.

4.2.4 Current Limiting Resistor

According to the requirements of the ‘dimensional regulation’ (technical standards), the resistance value of the current-limiting resistor must be kept stable and must not be adjusted arbitrarily, nor can it be adjusted to zero.

4.2.5 Original Lightning Protection Components

The installed lightning protection components should be in accordance with the standards and should be free of breakdowns, and their numbers should be consistent with the ledger.

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4.3 Test

4.3.1 Receiving End

Table 3. Maintenance test record card for 3 V section of the 25 hz phase-sensitive track circuit

dates	
climatic	
Rail surface voltage	
Choke Transformer	Rail coil voltage
	Signal Loop Voltage
	current resisting
	Adapter Voltage
Current Limiter Voltage	
Suppressor Voltage	
Railway Transformer	secondary insulation
	primary voltage
	secondary voltage
Phase Regulator Voltage	
Phase Matching Box Voltage	
Orbital voltage after phase regulation	
Rail insulation test	
Cryptographic calibration	Inlet current
	low frequency
	frequency of carrier wave
beta tester	
dates	

A. Test Methods

Figure 8. Internal diagram of power transmission box

a) Rail surface voltage: Measured about 0.5m in front of the insulated connector at the receiving end, the voltage range is about 3v

b)Rail coil voltage: Measured on the six column terminals of the choke transformer, the voltage is comparable to the rail surface voltage, slightly decreasing, the

c)Signal coil voltage: Measured on the internal terminals 4 and 5 of the choke transformer, 3 times the track coil voltage

d) Anti-current line voltage: test the current of the lead line, generally the difference between the current of the long and short lines should not be too big, and the unbalance rate should not be more than 0.5%.

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e) adapter voltage: measured inside the choke transformer, adapter 1, 3 terminals, the voltage is generally about 60v.

f) Current limiter voltage: measured on the current limiting resistor.

g)Suppressor voltage: measured on the suppressor terminals.

h)Secondary insulation: the secondary insulation of the transformer shall not be less than 1 megohm.

i)Primary voltage and secondary voltage are measured on the corresponding terminals, but the terminals for primary voltage cannot be changed, and the transformer ratio is fixed at 1:13.89.

j)Phase regulator voltage: measured on the corresponding terminals.

k) Electrical coding calibration: meet the train hair code position, with a standard branch line occupied track circuit, with frequency shift table, frequency shift search block, current clamp stuck branch line, you can read out the data. Entrance current 1700, 2000, 2300hz for 500mA ~ 1200mA; 2600hz for 450mA ~ 1100mA.

l) rail insulation test: with online tester, in the insulation at the measurement, two pens were hitched to the two rail insulation joints measured rail end insulation resistance, and then a pen placed on the rail end of a section does not move, the other pen on both sides of the plywood were measured. Measurement is completed after the cross-pen (data requirements: rail end of the splint resistance greater than 50Ω for good, 50Ω to 20Ω need to focus on inspection and observation, less than 20Ω need to be replaced immediately, the two rail-end insulation resistance is greater than 20Ω for good (turnoff after the polarity of the insulation is greater than 15Ω good), 10Ω to 20Ω (turnoff after the polarity of the continued insulation 7-15Ω) need to focus on the inspection and observation, less than 10Ω (turnoff after the polarity of the insulation is less than 7Ω). Polar insulation less than 7Ω) need to be replaced immediately[15].

4.3.2 Delivery Side

Table 4. Maintenance test record card of 3 V section of 25 hz phase-sensitive track circuit

dates	
climatic	
Supply voltage at the sending end	
Phase Matching Box Voltage	
Railway Transformer	primary voltage
	secondary voltage
	secondary insulation
Current Limiter Voltage	
Suppressor Voltage	
Choke Transformer	Signal coil voltage
	Rail coil voltage
	current resisting
	Adapter Voltage
Rail surface voltage	
Rail insulation test	
coding test	Inlet current
	low frequency
	frequency of carrier wave
beta tester	
dates	

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B.Test Methods

Figure 9. Internal diagram of the receiver box

a) Power supply voltage at the sending end: measured on the corresponding terminal board of the box, the voltage is about 220v

b) Phase adjustment matching box voltage: measured on the corresponding terminal of the phase adjustment matching box.

c) secondary insulation: transformer secondary insulation shall not be less than 1 megohm.

d)Primary voltage and secondary voltage are measured on the corresponding terminals.

e)Current limiter voltage: measured on the current limiting resistor.

f)Suppressor voltage: Measured on the suppressor terminals.

g)Rail coil voltage: Measured on the six-post terminals of the choke transformer, the voltage is comparable to the rail voltage, with a slight drop in the

h)Signal coil voltage: measured on the choke transformer internal terminals 4, 5, three times the track coil voltage

i)Anti-current line voltage: test the current of the lead line, generally the difference between the current of the long and short lines should not be too big, and the unbalance rate should not be more than 0.5%.

j) Adapter voltage: measured inside the choke transformer, adapter 1, 3 terminals, the voltage is generally about 60v.

k)Rail surface voltage: measured about 0.5m in front of the insulated connector at the receiving end, the voltage range is about 3v

l)Electric coding calibration: meet the train to send code position, occupy the track circuit with the standard division line, use the frequency shift table, shift frequency searching block, current clamp stuck on the division line, you can read out the data. Entrance current 1700, 2000, 2300hz for 500mA ~ 1200mA; 2600hz for 450mA ~ 1100mA.

m) rail insulation test: with online tester, in the insulation at the measurement, two pens were hitched to the two rail insulation joints measured rail end insulation resistance, then a pen placed on the rail end of a section does not move, another pen were measured on both sides of the cleat. Measurement is completed after the cross-pen (data requirements: rail end of the splint resistance greater than 50Ω for good, 50Ω to 20Ω need to focus on inspection and observation, less than 20Ω need to be replaced immediately, the two rail-end insulation resistance is greater than 20Ω for good (turnoff after the polarity of the insulation is greater than 15Ω good), 10Ω to 20Ω (turnoff after the polarity of the continued insulation 7-15Ω) need to focus on the inspection and observation, less than 10Ω (turnoff after the polarity of the insulation is less than 7Ω). Polar insulation less than 7Ω) need to be replaced immediately.

5. Conclusion

Due to the rapid economic and social development in China, the increase in traffic flow and the development of the logistics industry, the quality of railway track circuits in stations has been greatly challenged. Especially during peak hours, the flow rate of trains is faster and there are more trains, all these will bring great pressure on the environment, which will cause the problems of the railway track lines, especially the 25Hz phase-sensitive track circuits, which are widely recognised for its high efficiency, stability and reliability, however, in the past, due to the lack of advanced high-power frequency division power supply and the backwardness of the power electronics technology, this kind of highly efficient rail lines still cannot be fully utilised. Due to the poor quality of the rail lines at the stations, one of the most serious problems is the semiconductor film contact between the rail lines. This situation can make maintenance on site very difficult. A number of techniques have been developed that can further improve the performance of the track circuits and can effectively reduce the failure rate of the track circuits. For example, in the case of the Type 97 25Hz phase-sensitive track circuit, if the ballast impedance is high, the voltage on the rail surface at its receiving end may drop to 0.4 to 0.8 V, which is not sufficient to break through the semiconductor film, thus reducing the safety and reliability of the track circuit. As a result of the study, several areas in Japan have experienced failures in train splits that originated primarily from semiconductor films. Data from Japan shows that in some places, the residual voltage between the rails reaches 1V, which causes failures. The contingency measure we propose for such cases is to set the voltage of the track relay to 1V to ensure its stable operation, thus effectively resolving the malfunction. After analysing the data, we found that most of the track circuit fault problems are effectively improved when the track surface current is adjusted from 2 to 5V RMS to an appropriate level. To better understand these changes, we also investigated their role in the rail integrated circuits and found that increasing the 25Hz impedance of the choke transformer improved the rail current. With the improvement of the 25hz rail ICs, the increase in the resistance of the roadbed as well as the rise in current leads to voltages in the relays that are out of the normal range, which will affect the normal operation of the rail IC devices. Therefore, to solve this problem, we used a transformer which is capable of keeping the voltage change on the secondary side of transformer I smooth as the current rises on the secondary side of transformer II at the receiving end. In order to improve the performance of the rail circuit, we modified the 25hz rail transformer system by adopting the BGK-130/25 type reactance rail transformer system, which is capable of cooperating with the choke transformer and the tuner to greatly improve the separation accuracy of the rail circuit; at the same time, it is also capable of stabilising the end impedance of the rail circuit, which makes it easier to realise the detection of the broken rails of the road; in addition, it is also capable of effectively controlling the pressure of the track relay, and at the same time suppresses the external interference and contributes to the phase change of the track relay. At the same time in the field of daily maintenance and centralised maintenance, does not affect the original 25hz phase-sensitive track circuit testing and maintenance methods, conducive to field maintenance personnel daily maintenance and test data.

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