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The design of over travel of automobile relay and its automatic control

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Abstract: with the development of the automobile industry, more and more general electrical parts are used in automobiles, and the quality of platform and standardized electrical products is also paid more and more attention. Relay plays an important role in auto regulation, safety protection and conversion circuit, so it is widely used in the whole vehicle. Over travel is one of the important parameters of automobile relay, and its consistency affects the life of relay and other main performance. In traditional manual assembly production or semi-automatic assembly line, due to the inherent errors in parts and assembly, a large number of manual adjustment relays are often needed to over travel.

Key words: automobile, Relay, Overstroke design, Automation control

According to the different systems of automobile relay, the environmental factors are different, such as high temperature, high current, humidity, etc. If the use of relay is not emphasized, the failure of automobile relay may occur, which may affect the function of the relay system and may endanger the safety of driving. Therefore, in the design of automobile relay and the test of vehicle model, it is necessary to fully analyze and demonstrate the factors and performance requirements of its working environment, and verify the reliability of the working performance of automobile relay. Most of the relay structures used in the automobile are clapping types, which are not very different from the ordinary clapping type electromagnetic relay. However, the automobile relay needs to meet the requirements of shock, vibration, high temperature, high humidity, salt fog dust and strict electromagnetic compatibility due to its worse environment. Therefore, the performance parameters of the relay are different.

1. The use environment of automobile relay

(1) Temperature

The individual installation position of automobile relay is close to the heat source of automobile engines, and it bears a high temperature environment. The plastic shell aging is fast, and the inner coil is easy to short circuit and open circuit.

(2) Silicon environment

Some silicon system gum can not be used around the automobile relay, otherwise, silicone gas will be directly generated, which will cause silicon to attach to the contact, which will lead to poor contact and failure.

(3) NOx production

If the humidity of the environment is too high, the arc will be generated directly. Under the action of the arc, N2 and O2 in the air will produce NO2 and react with the moisture in the air, so as to produce nitric acid and nitric acid which has great corrosiveness, and will corrode the metal parts inside the relay, which will bring great damage to the work of the machine and electrical equipment. Therefore, the humidity should not exceed 85% RH.

(4) External magnetic field

For cars, relays cannot be placed in an environment with speakers, then the magnetic field will affect the relay and

hinder its normal operation.

2. The relevant matters needing attention in the correct use of automobile relay

First, in order to ensure the normal use of automobile relay, then it is necessary to have a comprehensive understanding of the relay and analyze its characteristics, so as to understand the use conditions and environmental conditions of the relay, and to formulate the relevant use plan for these conditions. Meanwhile, attention should be paid to in the use: to avoid the relay falling and being impacted, to ensure the normal use of the relay, if there is a large dust in the use environment, it is necessary to place corresponding protective cover on the relay to avoid dust penetration into the relay; Resin and preservative containing silicon cannot be used, otherwise contact failure will be caused, which will affect the use of relay; It is necessary to connect coil power supply and contact power supply according to the correct regulations. For the service life and load of relay, it is mainly specified under relative standard conditions, but it will still be affected by relevant environmental conditions and external factors in actual use, and the ambient temperature of relay must meet relevant standards. The relay should be used correctly and reasonably.

Secondly, for the attention of coil input, to ensure the stable and reliable operation of relay, the rated voltage must be ensured. If the voltage of the coil exceeds the rated voltage, it will directly cause the coil to drop and finally burn back. And the resistance value of relay will change with the temperature. If the temperature of the coil is too high, the voltage will rise accordingly. After that, the automobile relay is mainly driven by battery, so that the maximum load will directly lead to the voltage reduction of the power supply, and also affect the service life of the relay. Therefore, it is necessary to pay attention to the influence of the fluctuation of the power supply voltage on the reliability of the relay. If the coil is pressurized for maximum continuity, the stability of relay operation will be affected, mainly because of the limitation of insulation performance, so we should know the insulation performance of the product enameled wire and correctly pressurize it. After the automobile relay works for a long time, the coil will be broken due to the influence of the environment and other factors. Therefore, it is necessary to ensure that the coil of relay and the positive pole of power supply are disconnected.

Finally, the attention to the use of contacts, the most important part of relay, is. Contact, contact working condition will be affected by factors such as sub chat, voltage and current. For contact voltage, if the energy of voltage is too large, it will accelerate the contact electrical corrosion, so pay attention to it. For the current of the contact, the current of the contact in the combination and disconnection has a greater impact on the contact. If the impact current is larger when the contact is in group, the greater the impact on the contact will be, which will cause great loss of the contact. Therefore, the protection of contact should be done well. Some contact protection elements and protection circuits should be used to reduce the reverse voltage of contacts, so as to protect the work. At the same time, some contact materials against transfer should be selected to protect the circuit.

3. Over stroke design

Over stroke is the distance from the armature center to the horizontal plane of yoke and armature hinge contact when the contact is just contacted. It is defined as the “structural over stroke” of relay, which is obtained by the combination of parts, namely the structure; Similarly, over travel B is the distance from the horizontal surface of yoke and armature hinge contact to the core when the contact is just contacted. It is defined as “magnetic circuit over travel” - this over stroke is obtained when the relay rivets the magnetic circuit. Why should the over travel be divided into two parts? This is mainly considered that the over travel of automobile relay is designed to obtain greater contact pressure according to different load requirements: between 0.15-0.30mm, some special relays even require more, so it is impossible to get all the over travel from magnetic circuit riveting, so some of the over travel needs to be designed into the structural dimension. The over stroke of the structure is obtained by the combination of relay parts; The other

part is obtained by riveting the iron core and yoke iron during production and assembly. That is, the magnetic circuit is over stroke. How much is the magnetic circuit over stroke appropriate? The general recommendation is as follows: small relay: 0-0.05 mm; Medium relay: 0.05-0.10 mm; Large relay: 0.08-0.13mm. We know from the magnetic field circuit that magnetic circuit efficiency is the highest when yoke iron and armature are parallel to armature (i.e. when the magnetic circuit overstroke is zero). Therefore, it is at the expense of magnetic circuit efficiency to increase the magnetic circuit overshoot. Therefore, it is recommended to add the value of small value in design. When the relay over stroke exceeds the above recommended value, it is recommended to increase it to the structure over travel. The following factors should be considered when selecting the ratio between the structure over travel and magnetic circuit: small magnetic circuit overshoot can increase the magnetic circuit efficiency, so the magnetic circuit overstroke should be small and not large; For relay with high over travel requirement, the over stroke of magnetic circuit may cause contact at the back half of the contact and affect the contact clearance. Therefore, the appropriate proportion should be selected in the design to achieve both.

The design of the structure over stroke is better, mainly due to the control of the machining accuracy of the later parts. The long dimension chain like over stroke (the typical snap in relay involves about six parts and the size of more than seven gears). However, due to the function of probability, tolerance will always offset one part of each other, so the actual results must be better than “extreme cases”, which also conforms to the normal distribution law. Therefore, the correct way to design the structure over stroke should be: do not lengthen the dimension chain artificially during design; Improve the precision of key dimensions of parts; Monitor the feed parts and so on. The over travel of magnetic circuit needs to be controlled in the later production and assembly. In the manufacturing process, the existing automobile relay, except for the structure over travel, can obtain the magnetic circuit overstroke by controlling the difference of riveting height between the iron core and yoke iron. Because the height of the hinge surface between yoke and armature has a certain tolerance; The setting height of the iron core is of certain tolerance when riveting the iron core by punch, and the core is of three section type, which has the disadvantages of difficult riveting, large force on the core and easy deformation; The position height of static contact has a certain tolerance after assembly; Armature, reed, dynamic contact three have certain tolerance after riveting; Because of the superposition of the above factors, the over travel consistency is poor, so the over stroke of traditional relay needs manual correction to ensure its consistency after assembly. In order to ensure the effective control of the over stroke of each relay in production, we improved the design of the coordination of relay core and yoke iron. See Figure 4. The two drawings clearly show the difference between the improved core and yoke iron in structure: the core is changed from three-stage to two-stage; The end of the core is designed with a taper of about 3 degrees; The yoke riveting hole and the cone table at the end of the core are interference fit, which is designed to match the over stroke control in production and assembly.

4. automatic control in relay over stroke production

In manual production line or semi-automatic assembly line, the calibration work is still the main type of relay assembly. Due to the improvement of the quality requirements of relay and the substantial increase in labor cost, automatic production is the only way for the development of the relay industry. Here, how to realize the automatic control of relay over stroke is the top priority of relay automation production.

In order to realize the automatic production and control of relay over stroke, the automatic production line is equipped with computer, high-precision punch, two displacement sensors and two hydraulic riveting machines in this station to realize simultaneous riveting of two stations to improve production efficiency and reduce manufacturing cost.

The main working flow of relay over stroke automatic control station is as follows: core insertion pre pressing → armature assembly → over stroke control and measurement → riveting of iron core → over stroke recheck → qualified blanking.

The whole operation process is detailed as follows:

First, the core is pre pressed. The specific steps are as follows: the core is inserted into the core (coil) center hole;

Press the cone table at the end of the core into the riveting hole of yoke iron; When the end face of the iron core is flush with the yoke end, the pressing shall be stopped. The riveting hole between the core and yoke is interference fit, and the core will not loose and move; At this time, the distance between armature and core center is “structural overstroke”, which is inconsistent due to the tolerance factors of parts and assembly.

Secondly, the manipulator installed the armature assembly into the yoke assembly, and the assembly was not completed, and the iron core and yoke were still in the pre riveting state.

Thirdly, relay over stroke automatic control and measurement and riveting of cone table at the end of core are as follows: the mechanical press head is equipped with displacement sensor, and the press head moves downward and pushes the reed, armature and moving contact to move synchronously; When the dynamic contact and the static contact moment, the displacement sensor begins to calculate the armature displacement distance, that is, the relay over travel measurement; The press head continues to move downward, and pushes the reed and armature to move downward. When the armature contacts the end face of the core, the displacement distance a, namely the structure over stroke, is pushed down; The press head continues to move downward, and pushes the reed, armature and iron core to move downward. The moving distance is B. The moving distance is the magnetic circuit over travel. When a + B is equal to the design over travel of relay, the feedback signal of displacement sensor is sent to the computer, and the press head stops pushing; Repeat the above process to measure the over stroke according to the programming instruction and ensure consistency with the design data.

Then, the press head is held still, and the hydraulic riveter at the other end of the iron core rivets the cone platform extending out of the yoke iron to the yoke iron.

Finally, the press head returns to the original position and measures the over stroke. The qualified products are unloaded and entered the next station. The relay over stroke automatic control, measurement and riveting assembly are completed.

Concluding remarks

In a word, the design and improvement of the relay for vehicle should focus on the adjustment of product structure, the change of production process and the improvement of production conditions.

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