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Design of a Comprehensive Test System based on Vehicle Mass Center

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Abstract: The position of the center of mass of a special vehicle has a great influence on all aspects of the special vehicle. The measurement speed and accuracy of the vehicle's centroid position affect the design and detection speed of the vehicle. Therefore, the purpose of this paper is to improve the detection speed and accuracy of special vehicles. This paper designs and designs the special vehicle centroid position comprehensive detection device according to the characteristics of the tested vehicles, which can meet the requirements of high detection speed and accuracy. According to the requirements of rapid and high precision detection, this paper decided to adopt the platform support reaction method and designed the overall hydraulic system.

Keyword: *Armored vehicle, Controid, Measure, Hydraulic system*

I. PURPOSE AND SIGNIFICANCE OF THE STUDY

The center of mass of the special vehicle has a great influence on all aspects of the special vehicle, including the flexibility and stability of the vehicle, safety, etc. It is also related to shooting and handling, so it is an important parameter of special vehicles. Because of the development of technology and the improvement of technology, we have greatly improved the design and standards of vehicles, but the measurement speed and accuracy of the vehicle's centroid position affect the design and detection speed of the vehicle. And because of the problems of the detection system, there are still many problems such as large errors in the measurement process, so China urgently needs a measurement system that can quickly and accurately measure the centroid position of special vehicles.

II. THE STATUS QUO OF CENTROID POSITION MEASUREMENT

Because the center of mass of a special vehicle is an important indicator of a special vehicle, it is related to the overall performance of a special vehicle. Therefore, we need to measure the centroid position of special vehicles in the design and testing process. However, there are few fast and accurate measurement methods for the center of mass of special vehicles. Due to the confidentiality of special vehicles, there is very little information in this area at home and abroad. Since the centroid position measurement of a special vehicle has two aspects; one is the exact position of the centroid position in the horizontal direction of the vehicle, including the exact position in the four directions of front, rear, left and right; the other is in the vertical direction[1].

At present, there are many specialities in the measurement of special vehicles: high quality, high measurement requirements, and increased requirements for equipment; the structure of special vehicles is complex, the theoretical position of the center of mass cannot be determined; the accuracy of measurement is high.

III. DESIGN CONTENT AND TECHNICAL REQUIREMENTS OF THIS PAPER

A. Main design content

The main research contents of this paper are as follows:

1. Study and master the requirements for vehicle testing such as vehicle roll, rollover, and centroid position measurement (GB14172 GB17578 GB/T 12538);
2. Research on the measurement method of the mass center of the armored vehicle body, and establish a mathematical model of the centroid measurement;
3. Complete the design and technical design of the inspection platform;
4. Complete the design of the hydraulic system of the test bench;

B. Technical requirements

Measurement system requirements:

1. Measurement range of vehicle weight: ≤ 5mm
2. Measurement of the centroid position in the X and Y directions: ≤5mm
3. Measurement error of centroid position in Z direction:≤10mm;
4. Platform size: 15000mm*5000mm;
5. Platform weight:22t;
6. Maximum inclination of the platform roll:45^{O}C

IV. OVERALL DESIGN OF THE SYSTEM

A. Overall system design theory

The system will be controlled by a computer to support the special vehicles we measure through a steel structure platform and hydraulic system. The measurement and control system is used to measure the position of the vehicle and the relative position of the steel structure platform. In the process of measurement, we can get the pressure received by the system by using the measurement and control system. The total pressure is the gravity of the vehicle. By substituting the obtained data into the formula of the centroid level, we can get the centroid position coordinates of the horizontal position of the center of the special vehicle. Then use the hydraulic system to make the steel structure platform produce a certain tilt angle. At this time, the measurement and control system can get a set of data again. We substitute this set of data into the centroid vertical position formula, and the coordinates of the vertical position of the special vehicle centroid can be obtained by the formula. So that you can measure the centroid position of a special vehicle [2]。

B. Overall structure of the system

Because the special vehicles we measure have some characteristics that are difficult to measure, we need to overcome the characteristics of the vehicle with high weight and large volume, and the system's measurement speed and accuracy. Therefore, the main components of our entire special

vehicle centroid position measurement system are as follows:

(1) Mechanical system consisting of steel structure platform, weighing unit, support structure assembly, positioning device, etc. The steel structure platform is used to carry special vehicles, because the special vehicles we measure are very important,

Therefore, our steel structure platform also needs special strength and deformation resistance. The weighing unit is used to measure the quality of special vehicles. The support structure is used to support our steel structure platform. The positioning device is used to measure the relative position of the special vehicle to the steel structure platform, and the positioning device is only a mounting pressure and inclination sensor.

(2) Hydraulic system

The main function of the hydraulic system is to support the steel structure platform and the vehicle under test, to lock the steel structure platform, and also to make our steel structure platform have a certain inclination. The main components of the hydraulic system are the supporting hydraulic cylinder, the supporting base, the front and rear locking hydraulic cylinders and the hydraulic source and the cooling system. The supporting hydraulic cylinders can also support the steel structure platform and the vehicle under test as well as the special vehicle. The vertical position of the center of mass causes the steel structure platform to have a certain inclination; the function of the support base is to support the steel structure platform together with the supporting hydraulic cylinder, and can also provide a rotation for the steel structure platform when measuring the vertical position of the center of mass of the special vehicle. The center of the front and rear locking hydraulic cylinder can lock the steel structure platform when driving on the special vehicle and leaving the steel structure platform, so as to prevent the supporting hydraulic cylinder and the supporting base from being subjected to some relatively large impact loads; The role is to provide a hydraulic source; the cooling system can cool the entire hydraulic system.

(3) Protection system

The protection system can prevent the dangerous situation caused by the displacement of the armored vehicle when the armored vehicle is opened and the steel structure platform is opened, and the armored vehicle is prevented from being displaced.

(4) Measurement and control system, etc. The system consists of a measurement system and a control system.

First of all, the main components of the measurement system are the pressure sensor, the tilt sensor and the corresponding positioning mechanism, which play the role of measurement data.

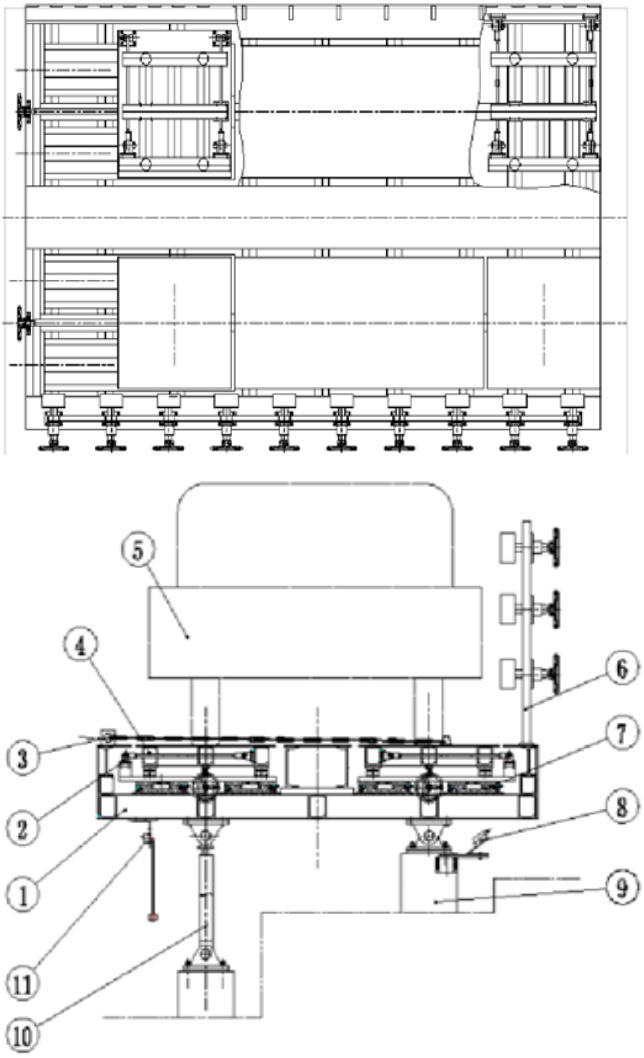
The pressure sensor is mounted on a steel structure platform. In the process of measurement, only the reading on the pressure sensor is read, and then the obtained data is input into a computer for data processing, so that the centroid position of the special vehicle can be measured.

The tilt sensor is mounted on a steel platform. The function of the tilt sensor is to measure the angle at which the steel structure platform is tilted when measuring the vertical position of the center of mass. It is also possible to measure whether the steel structure platform is tilted when the steel structure platform is leveled, so that it can be determined whether the steel structure platform has been leveled.

The control system consists of a computer and a data acquisition card. The computer performs data processing and control. The data acquisition card is used to collect data.

During the measurement process, the hydraulic system is controlled by the computer to complete the leveling of the steel structure platform and form a certain angle of inclination; the data acquisition card is used for data acquisition; then the data calculation is performed by using the piece calculation instrument; thus the center of mass of the tested vehicle can be obtained. Location, then print out our centroid position.

So the structure of this system is shown in Figure 2 below:



1-bracket, 2-pull rod assembly, 3-skid device, 4-weighing platform assembly, 5-belt vehicle, 6-turn-proof device, 7-weighing platform mobile device, 8-safe limit device, 9-hinge mount assembly, 10-lift device, 11-angle measuring device

Figure 2: Overall structure of special vehicle centroid testing system

First of all, the steel structure platform is a major component of our entire measurement system, and the steel structure platform needs to carry our special vehicles. Since our measuring objects are special vehicles, our steel structure platform needs sufficient area and strength to carry our heavy and bulky special vehicles. If the steel structure platform does not have a large enough area and sufficient strength, it is not easy to carry the vehicle under test, and the overall safety of our measurement system cannot be guaranteed; and our steel structure platform cannot be oversized, the steel structure

platform The large mass will put more pressure on our hydraulic system and increase the pressure of the hydraulic system. At the same time, we should try to increase the rigidity of the steel structure platform, which will reduce the systematic error caused by the steel structure platform.

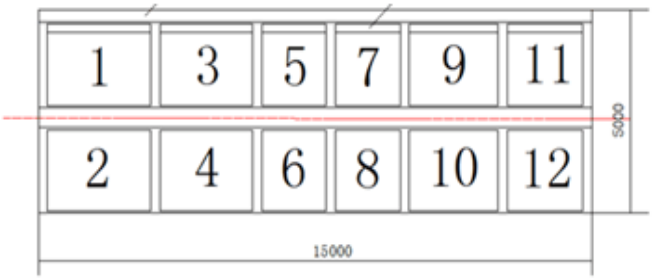


Fig.3 Sketch map of steel structure platform

Table 1: Weighing board specification

Weighing board number	Size (Length x width, mm)
1、2	2800x2000
3、4	2500x2000
5、6	1750x2000
7、8	1750x2000
9、10	2400x2000
11、12	2050x2000

Summary

In this paper, the measurement system designed by the platform supporting reaction method can combine various scientific techniques, which can accurately measure the position of the center of mass, ensure the accuracy of measurement, and quickly measure the position of the center of mass, ensure the measurement speed, and measure large scale. The vehicle, and this design can also be used for ordinary civilian vehicles to measure the centroid position of ordinary large vehicles, so this design is more widely used. Based on the characteristics of the system and the requirements of the measurement, we carried out the overall design of the hydraulic system on the basis of safety and convenience.

References

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