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Tractors Hydraulics System Stress Testing Design and Experiment

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Abstract. This paper aims to research and analysis the tractor hydraulic suspension system stress. The hydraulics system was hooked on the latest developed hillside tractor chassis, this experiment used load test method and portable hydraulic testing instrument to test the cylinder movement process and force process. It can be concluded from the drawn curve that when the system loads 2940 Newton, the maximum working pressure is 4.4Mpa. When the system loaded 3920 Newton, the maximum load is 4.8Mpa. The pressure difference between the left and right levers is 2Mpa. The conclusion can provide data validation for the simulation analysis of tractor suspension system as well as an effective reference for the design scheme of tractor suspension system.

1. Introduction

The method of hooking agricultural implements on tractors can be divided into 3 kinds: traction, semi-suspension and suspension. The suspension method is the most commonly used. The control suspension device can adopt mechanical device, pneumatic device, electric device and hydraulic transmission device. The three-point suspension device of hydraulic control device was used since 20th century. The tractor hydraulic suspension system agriculture is used to adjust the agricultural machinery according to special requirements or the external condition of farmland, like soil, straw, moisture content. The commonly used adjustment methods include: resistance regulation, position adjustment, force comprehensive regulation as well as rapid rise and fall regulation in the case of non-farming agricultural implements ^[1].

Agricultural wheeled tractors mainly rely on hydraulic suspension hoisting device carrying other agricultural machinery to implement the field operation. the main inspection indicators of wheeled tractor hydraulic suspension hoisting device is the rear-mounted three-point suspension hoisting capacity, so the hoisting capacity test is critical for the performance of the suspension system. the conventional testing methods are in accordance with the standard and test methods of "belt drive wheel tractor general technical conditions", "agricultural wheeled and tracked tractor general technical conditions" and "agricultural tractor test procedures part 4: rear-mounted three-point suspension hoisting capacity". In the recent years, test bench was adopted to the load simulation in order to improve the automation level and testing accuracy of hydraulic suspension system test ^[2]. While this design scheme adopts an automatic-manual combination method, directly conducted the stress tests, collected data, analyzed and processed to provide verification for the simulation analysis, which has reference value to the system design.



2. Experimental Condition

2.1. Agricultural Implements

The hydraulics system was hooked on the latest developed hillside tractor chassis, the suspension control valve group controlled the lifter movement. See figure 1.

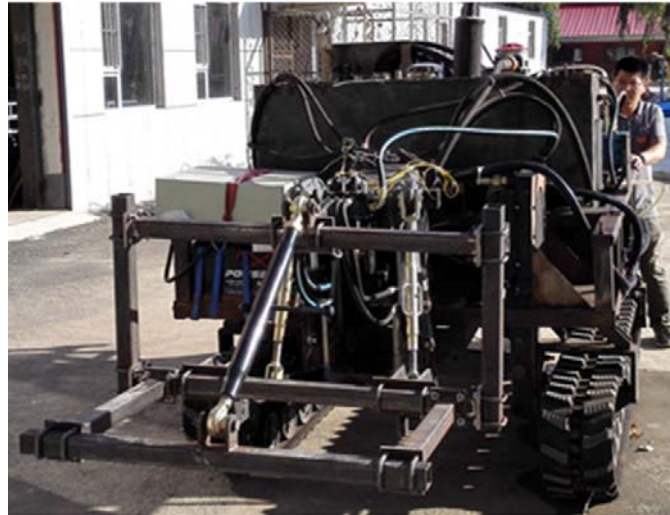


Figure 1. Agricultural wheeled tractor hydraulic suspension system

2.2. Main Components and Parameters

Power of diesel engine: 29kw, rated speed: 2200rpm;

Hydraulic pump rated working pressure 16Mpa, displacement 63ml/rev, speed 2200rpm;

The maximum stroke of the hydraulic cylinder is 130mm, the rated work pressure is 16Mpa, and the piston rod diameter is 32mm;

Using Parker pressure sensors, measuring range: 0-40 MPA, the maximum measure 80 MPA, measuring temperature range from -25°C to + 105°C;

There were two hydraulic cylinder on each side, they were connected to the left and right pull rod to realize the rise and fall of the lifter.

2.3. Loading Method

At present, two kinds of loading devices of the lifter are commonly used: Heavy block loading and oil cylinder loading.

This experiment adopted heavy block loading, which loaded 2940 newtons and 3920 newtons respectively.

3. Tests and Analysis

3.1. Result

The experiment carried out the exercise testing of the tractor lifting in whole process, the motion curve of 2940 Newtonian force is shown in figure 2, and the motion curve of 3920 Newtonian force is shown in figure 3.

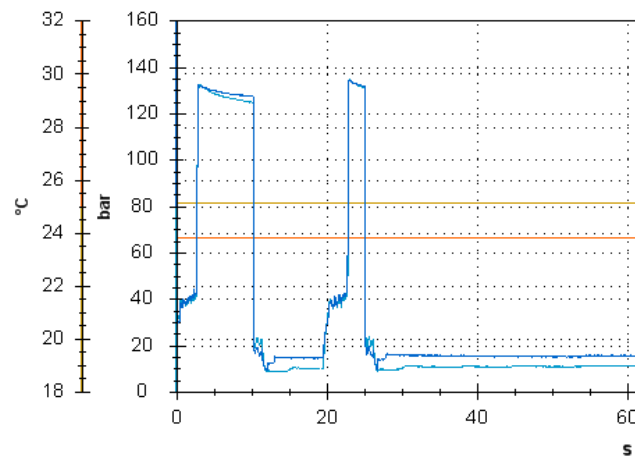


Figure 2. Tractor moving curve

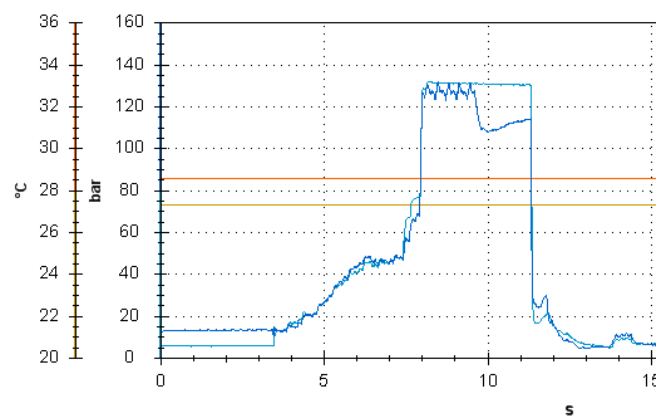


Figure 3. Tractor moving curve

3.2. Analysis

It can be concluded from the experiment that when the system loaded 2940 newtons, the maximum working pressure was 4.4mpa and the maximum working pressure was 4.8 MPA, if the data goes beyond this range, the oil will overflow and flow back to the cylinder.

It can be seen from figure 3 that if the force was loaded to 3920 newtons nonuniform, the deviation phenomenon would occur and the pressure difference between the left and right levers is 2Mpa.

When the lifter was rising, the pressure shows a jagged rise, in the descent process, the pressure slowly decreased.

4. Conclusion

From the above experiment, it comes to the conclusions that first, the dynamic performance of the left and right levers needs to be improved. Second, there is an irrational phenomenon in the design of the left and right levers, and it has been found that there is interference in the position of the left pull rod, and the mechanism is adjusted in time. Third, except the overflow part, the load cylinder holds steady in the process of rise and fall, which indicates that test method is feasible. Fourth, due to the inertia of the suspension system, the begin of the rising time of suspension system is late then the oil cylinder reaction time.

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