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The improved design and manufacture of JCCD-II Innovation

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Abstract: *This paper made a comparison and analysis of the present situation of the innovation experimental existed in our universities, and analyzed the problems existed in the practice of the innovative experimental course to get an further improvement to the platform. Firstly, this paper analyzed the functions and current situation of those experiment platforms existed in universities, and came up with some improvement plans aimed to the defects of the platform based on the course practice which was based on the JCCD-II innovation experimental platform. Then we used Solid works to simulate the 3-D model of the new part we designed, and analysis the rationality and advantages of the new parts; finally, we machined the material objects and assembled in the platform. The improvements to the innovation experimental platform in this paper enriched the functions it owned, increased the kinds it can provide and would enhance the teaching effects of lessons which based on the platform.*

Keywords: *experimental platform, improvement, simulation, manufacturer, innovation*

I. INTRODUCTION

The innovation experiment platform is an important tool for teaching in Colleges and universities, types of innovative experimental platform is also rich and varied, but there still exist many deficiencies and improvements. Comparing with a lot of innovative experimental platform and experimental practice based on function, JCCD-II innovation experimental platform is a further improvement of the experimental platform, which achieves more experimental function, and meet the experimental requirements of more innovative solutions [1].

By analyzing the classification and application status of innovative experimental platform in contrast, we find out the existing problems of JCCD-II innovation experimental platform and improvement, and through software simulation to verify the feasibility after manufacture of a prototype, we puts forward several improvement schemes [2].

The innovation and movement of the mechanical system JCCD-II lap test platform is based on the design of the experimental platform. Mechanical Engineering College of Shanghai University of Engineering Science, purchase the experimental platform in 2012, and opened "simulation and testing" mechanical system innovation experiment Elective course since 2013 to February, for all undergraduate students majoring in mechanical.

We found many problems in the practice of teaching platform. Based on the practice the experimental platform, 2 research papers has been published, which are "Application of 3D modeling and motion simulation function of PROE in mechanism innovation experiment", "Improving JCCD-II Experimental Platform Design Based on Innovative Experiment course". The experimental platform of the physical picture is shown in figure 1.2.

Figure 1 the experiment platform motion system before improving

Figure 2 the experiment platform of the transmission system before improving

The improved test system can drive by changing the motor speed to verify the transmission stability of different type. Through verification, in the belt drive process, the vibration of the driven shaft is impacted by different belt type; toothed belt has the best vibration absorption ability, followed is the V type belt, and the joint belt is the worst. At the same time, we found that in the belt drive, vibration amplitude is independent to the speed, but vibration frequency is proportional to speed [3-4].

II. ANALYSIS OF THE PRESENT SITUATION OF THE INNOVATION EXPERIMENT PLATFORM

Our country has put forward that before 2020, China will be built into the "innovative country", achieve the goal of the task is arduous in the "eleven five year" period. The university, especially in local colleges, the scientific research and teaching resources are not sufficient; and there still need a lot of effort to cultivate more high-quality talents.

At present, the experimental platform mainly has 3 level, laboratory experimental center, school of professional public basic experiment center and the provincial ministerial. But in the implementation process, there are still scattered experimental content, unreasonable arrangements. There are a lot of defects in equipment design itself, how to improve its function is a serious issue to study.

To build the innovation experiment platform is very important for the cultivation of creative talents. How to make good use of all colleges and universities play an important role of these devices, and it is what we need to think about. Comprehensive experimental design is an important link through improving students' practice ability and innovation ability, the comprehensive innovation experiment platform of higher education are being developed and produced.

Through innovation experiment, we found that there are still some problems need to be improved in the teaching practice, the problems we encountered in the practice of innovative experiment shows that the necessity of the transformation on the experimental table. In order to adapt teaching practice better, we improved the experimental platform aiming at some problems we found in the practice. There is countless possible combination of movable performance of the whole platform, it is expected to create institutions or new type of drive mechanical parts for a variety of practical and realistic problems of the combination [1].

III. DISADVANTAGES AND THE APPLICATION STATUS OF INNOVATIVE EXPERIMENTAL PLATFORM JCCD-II

The innovative experiment course based on JCCD-II innovation experiment platform is a school opened branch for undergraduate students. Its main function is to provide manual assembly of complex mechanical system training platform for students, to give the opportunities to the students to design and assemble the complex mechanical system which can realize different movement requirements. The installation of various types of sensors in the main component is equipped with detection system and data processing software, which students can understand the law of motion and kinematic characteristics of different components in complex mechanical system through the motion parameters change curve.

In order to overcome the current lack of the existing mechanism equipment in the school, we developed a kind of creative design of mechanism simulation platform technology, with secondary development tools and parameters provided by Pro/Engineer and SolidWorks software, we built a belt drive mechanism, single crank double rocker mechanism and Geneva mechanism to realize the parametric modeling, loading, solving. He results provide various view and curve animation.

The mechanical part mainly includes test and motion system transmission system testing.

The transmission system comprises a motor as a power source, and ensures the sensor can measure the rotational speed of the motor through a pair of gear which turns to another shaft. Then through the connecting shaft, it transmit to the gear which could transform transmission ratio, after connecting to a drive shaft to

transform belt or chain transmission, it will turn to another connecting shaft. Finally, it is connected to the shaft which tests the influence of the coupling device, and there is speed sensor at another angle.

The motion part of the testing system is composed of a motor as the power source, and transmits through belt drives to another shaft drive, which led to another group of eccentric cam to rotate, drive a group of rocker slider system, according to the analysis of the influence of various parameters on the motion of the system change of different parameters and the velocity information collected. We hope that through the purchase module and improved design of JCCD-II experiment platform, it could be more perfect and reasonable of the components.

Transmission such as helical gear can make the experiment more abundant; increase the brake loading device, compress the screw and sliding bearing to get the friction torque, enhance the stability by loading with magnetic powder brake; add force and torque device, the flexibility of the experimental data can be reduced, and can gain more compared to more; in the motion system, only the roller cam device is not relates to force closed system, lead to the accuracy of the data is greatly reduced, we can only measure a single distance data; and the software interface is not easy to operate, it is too complicated; besides, in motion device, the slider is designed to response data can change load or friction can be better; design a module combines t terminal transmission device, and processed into objects, assembling and debugging.

IV. ANALYSIS AND DESIGN OF INNOVATIVE EXPERIMENTAL PLATFORM

4.1 INNOVATION EXPERIMENT DESIGN AIM AT THE JCCD-II INNOVATION EXPERIMENTAL PLATFORM

4.1.1 Increase the Geneva mechanism

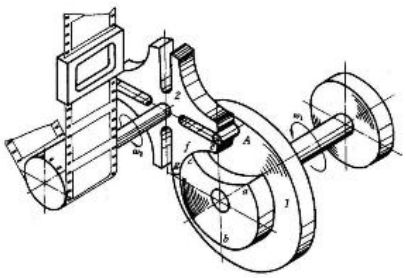

Figure 3 3D Schematic diagram of Geneva mechanism

When the cylindrical pin tumbler continuously rotating to the radial groove, the groove wheel turned an angle, the film will page down, when the cylindrical pin goes out the radial groove, groove wheel stops rotating. Rotary arm has a whole rotation, the groove complete a transfer stop motion [5-6]. In figure 3, the groove mechanism is applied in low speed intermittently rotates a certain angle devices, such as turning lathe tool turning mechanism. It is also often used in film projectors with intermittent moving film [7].

4.1.2 The increase of sliding gear

In the transmission, there are most ordinary transmission gear, and some planetary gear transmission. Ordinary gear drive transmission mechanism transmits with gear and clutch slip, slip gear is divided into multiple slip gear and gear of slip. From the structure of sliding gear transmission, the [8] center distance is too small in many cases.

Sliding gear is moving on the shaft, the transmission torque is transmitted to the shaft, connected by a sliding key or spline gear meshing to realize transmission. Helical gear cannot use as slip gear. In the process of helical gear meshing in axial movement, it would rotates itself because of tooth is inclined to produce rotation design, which increases the difficulty in axial movement mechanism. In addition, the helical gear force is not perpendicular to the axis of the gear transmission, it is easy to cause the gear get away [9].

We can change the speed through the gear sliding (applicable to automobile gear box, Machine Tool Headstock inside the shift gear shifting mechanism, etc.) the main reason of the sliding gear get off gear is that spline fit clearance and spline point deviates from the center [10] spline. In the design process, in order to make the safe operation mechanism, the inner hole sliding gear is to ensure good lubrication, and reduce friction. We choose a reliable fixed axial spline gear, to make it slide on the shaft, and drive the shaft to rotate together. The tooth side clearance degree reservation is larger than the ordinary gear. At the same time, considering the slip gear shifting fork (similar to automobile gear shifting fork) position, it should not interfere with the rotation of the gear in the limit position.

4.1.3 The increase of helical gear

Ordinary gear goes along the tooth width, and comes the vibration and noise, the transmission is not smooth. Helical gear transmission is better than that kind of straight teeth, and it can close the center distance in high

speed and heavy load cases. Helical gear reducer is novel. The optimization of module combination system, advanced design idea, has the advantages of small volume, light weight, large transmission torque, stable starting, the transmission ratio grading fine, can be arbitrary connection and a variety of installation position according to user requirements [7].

4.2 ANALYSIS OF THE RATIONALITY AND ADVANTAGES OF IMPROVED DESIGN AND 3D MODELING

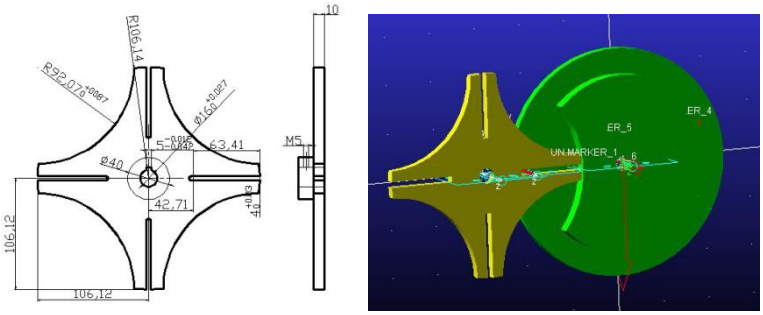

Figure 4 the Geneva Mechanism of 3D model and size

As shown in Figure 4, the Geneva mechanism has the advantages of simple structure, easy processing, reliable, accurate angle, high mechanical efficiency. But the lift is not adjustable, angular acceleration cannot be too small, Geneva has high accelerated speed in start and stop, and increased with the speed and the decreasing of the sheave groove number, so it is not suitable for high speed. It is mostly used to achieve movement without frequent adjustment of transposition angle indexing.

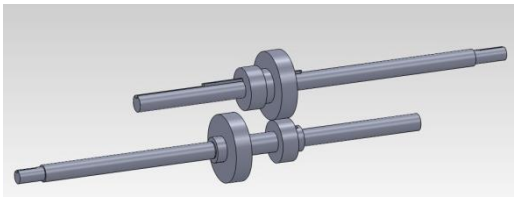

Figure 5 the 3D model of sliding gear

Sliding gear (Figure 5) has the advantages of simple structure, reliable operation, so it is widely used in general machinery. At the same time, the combined use of apparatus which is also often associated with other types, the manipulation is easy that can ensure accurate, precise displacement.

When machining the slender shaft, due to its poor rigidity, and affected by cutting force, cutting heat and other factors, deformation is large, and it is difficult to ensure processing quality. We use the appropriate clamping method of loading, and take the auxiliary supporting reasonable and advanced processing methods, and choose the reasonable cutting parameters and tool, in order to ensure the quality of the slender shaft processing requirements.

In addition, the increase of helical gear which transmission experiment platform lacks, increase the elastic belt wheel test function and purchase experiment platform tools, to further enrich the functions of the platform. Experimental platform of improved transmission system, is shown in figure 6, 7, 8.

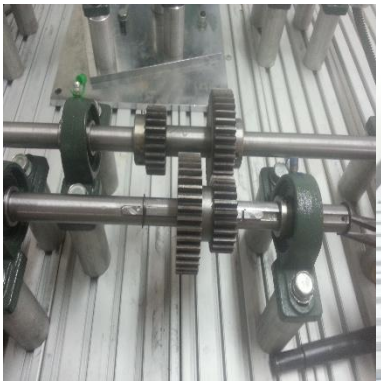

Figure 6 improved object A

Figure 7 improved object B

Figure 8 improved object C

V. CONCLUSION

This paper have analyzed the defects exited in the JCCD-II experimental platform, by making comparison and analysis to the functions and service conditions of the experimental platforms existed in the universities, and combined the problems existed in the practice lessons. We used software to design the impromental plan and 3-D modeling to verify the feasibility of our design. The improvement design enriched the variable experimental schemes and the functions on practice lessons. The maltase mechanism we added showed the theory of the projector, and the shifting solid gears let the principle of speed variator visually display on the platform. The simulation before practical manufacture provided more safeguards to the rational design, and the added parts or mechanisms all meet the improvement requirements well, and enriched the schemes the platform provided. The improvement to JCCD-II experimental platform provides more options for the innovation of experimental course, and it not only enriched the theory of innovative experimental platform in the function and content, but also provide a practical basis for the innovation of experimental courses.

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