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Design of Stepper Conveyor and Kinematics Simulation

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Abstract: A conveying machine that intermittently conveys materials or workpieces on a continuous fixed line is called a step conveyor. This paper first selects the transmission scheme of the stepper conveyor according to the design requirements of the stepper conveyor. Then, the main parts of the crank rocker mechanism, the first stage worm gear and the open gear were designed, and the overall design of the stepper conveyor was completed. Then design the linkage mechanism according to the requirements of the quick return feature. Finally, the virtual prototype software ADMAS was used to simulate and simulate, so that the quantitative data of the stepper conveyor could be quantitatively analyzed accurately, thus providing a theoretical basis for further improving the transmission structure.
Keywords: Conveyor, Connecting rod mechanism, Worm gear drive, Simulation.

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1. INTRODUCTION

Stepper conveyors are machines that can transport goods intermittently, stably, and evenly along a certain delivery route. Because the step conveyor is very convenient for use in various industries or other mechanical machines, it can increase production and life efficiency and save labor [1]. The design and manufacture of high-performance stepper conveyors is critical to the development of China's heavy industry and economy. This design is based on kinematics simulation with the help of virtual prototype software. The simulation results compare the uncertain data to make it more accurate.

2. WORKING PRINCIPLES AND ANALYSIS

The conveyor can intermittently convey the workpiece during operation. The electric motor drives the carriage to reciprocate through a deceleration device and a linkage mechanism. When the conveyor is working, the pushing claw on the carriage pushes the workpiece to advance

one step. When the carriage returns, there is a torsion spring between the pusher and the shaft. The pusher can slide past the bottom of the workpiece and the workpiece can still remain in its original position. When the carriage is pushed forward again, the slider has been reset, driving the new workpiece to advance, and the front pusher also pushes the workpiece in the previous station forward.

3. THE DEVELOPMENT OF THE OVERALL EXERISE PROGRAM

The main mover of the stepper conveyor is the crank; the follower is the pusher and there is a snapback feature in the stroke; the mechanism has good dynamic characteristics, and the speed requirement is low and stable during the work process. As shown in Fig. 1, the rocker slider mechanism is formed in series with the crank rocker mechanism. This scheme has made progress in the transmission performance and the speed change of the actuator. It is more reasonable to select the working mechanism system according to the movement characteristics of the guide rod mechanism.

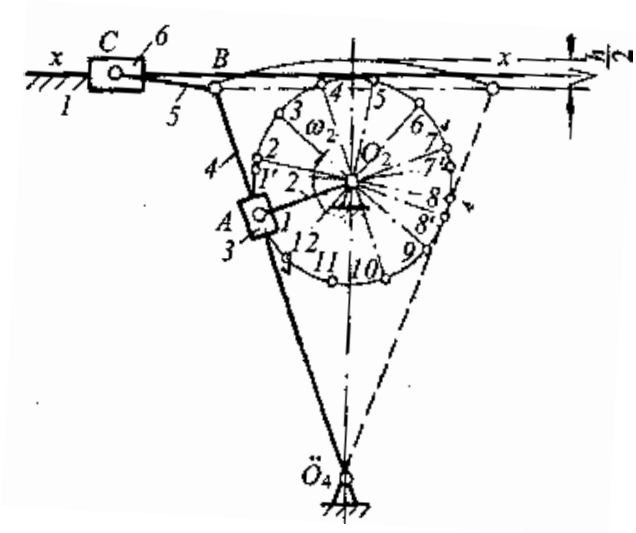


Fig 1. Slider rocker mechanism

4. DECELERATION TRANSMISSION PROGRAM

Motor → Double-stage Conical Cylindrical Gear Reducer → Open Gear Drive

As shown in Fig. 2, the worm drive can realize larger transmission ratio, uniform movement and compact structure. The worm drive is installed on the high-speed stage, and the smaller size can be obtained, and the lubricating oil film can be formed to improve the transmission efficiency and the carrying capacity. Therefore, it is more reasonable to choose this solution.

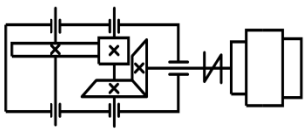


Fig 2. The project for retarder

5. ADAMS SOFTWARE OVERVIEW

ADAMS software is virtual prototyping software developed by U.S. MDI (Mechanical Dynamics Inc.).

On the one hand, ADAMS is an application software for virtual prototyping. The software solver uses the Lagrangian equation in dynamic theory. Therefore, ADAMS simulation is more intuitive, easier to measure, and has a powerful data post-processing module [2]. Therefore, ADAMS simulation is more intuitive, easier to measure, and has a powerful data post-processing module.

On the other hand, the virtual prototype analysis and development tool is also another function of this software, because it has many types of interfaces and open program structures that can be used by special industry users as a platform for auxiliary development tools.

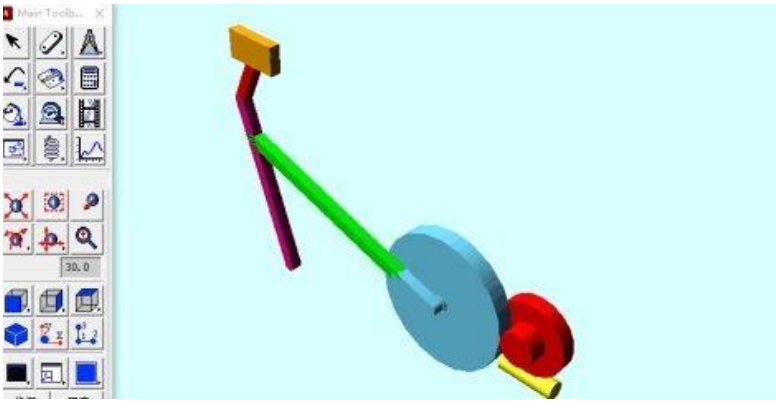


Fig 3. The ADAMS module interface

6. BASIC FLOW OF ADAMS SIMULATION

The basic flow of ADAMS prototype simulation is firstly to model the mechanism. By defining the parameters of the model, adding constraints and applying force and driving to it, the measurement is established, the mechanism is simulated, and finally the analysis results are processed and the conclusions are drawn [2].

7. SIMULATION OF CRANK AND ROCKER MECHANISM

According to the previously calculated structural parameters such as the length and the included angle of each rod, the rods are constructed in the ADAMS/View module, and the rotation constraints are defined at the connecting parts of the rods. In order to perform the motion simulation, it is necessary to install the racks. On the ground, the crank drive is finally defined on the crank and the model of the crank rocker mechanism is established, as shown in Fig. 4.

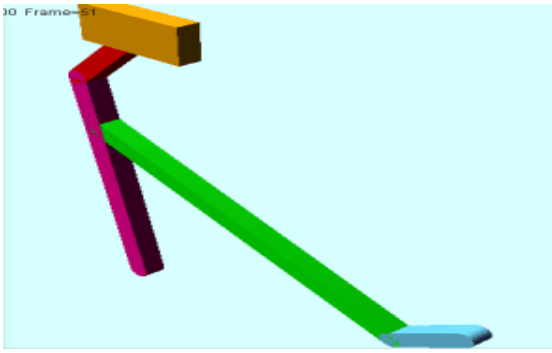


Fig 4. Crank rocker mechanism model

8. WORM GEAR KINEMATICS ANALYSIS

8.1 Modeling of worm gear mechanism

First, start ADAMS, set up a good working environment, create worm gears and worms from the parts library based on the calculated parameters, and then create a worm gear and a worm gear mesh in the drive library to create the meshing point of the worm gear and the worm gear. Shaft rotation. The basic model is shown in Fig. 5.

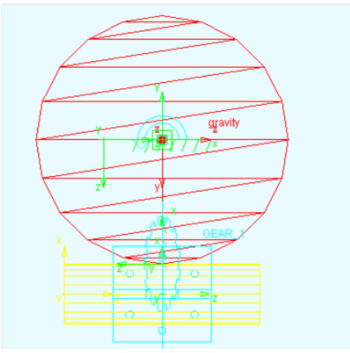


Fig 5. Worm gear mechanism model

8.2 Dynamic simulation of worm gear mechanism

First click the simulation button, set the simulation termination time to 60s, the simulation work step number is 80, and then simulate, observe the motion simulation of the worm and worm model. As shown in Fig. 6.

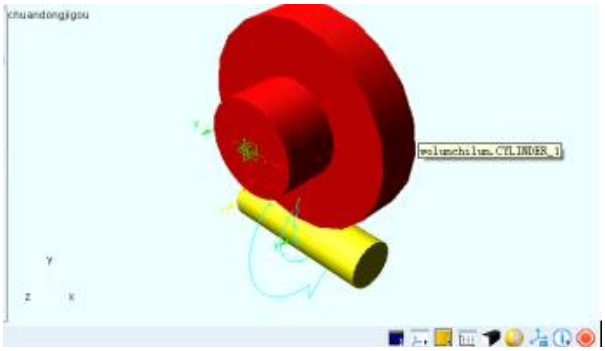
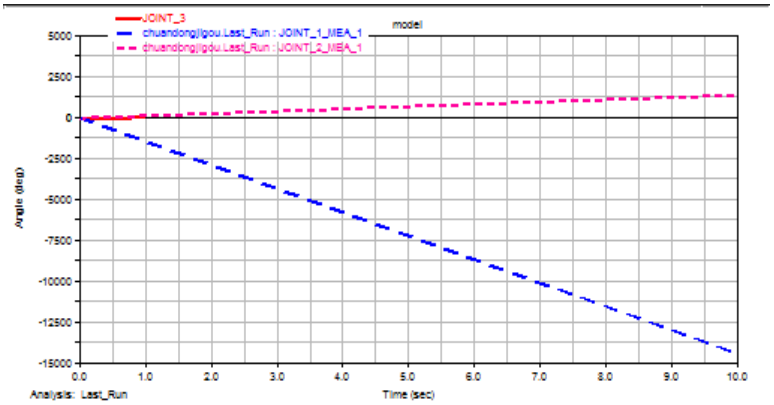


Fig 6. Phase analysis of arrangement

8.3 Output worm gear mechanism motion parameter curve

Open the worm gear model file in ADAMS/Postcessor and add a curve to observe the angular velocity of the worm gear Fig. 7.



JOINT_2 - worm gear angular velocity; JOINT_1 - worm gear angle change; DIFFERNT - worm angular velocity;

Fig 7. Comparison of angular speed of worm gear

9. CONCLUSION

The model is created in the virtual prototyping software and the kinematics simulation is performed. The proportional relationship between the worm and the worm gear speed is obtained. It can be further compared with the theoretical calculation value to verify the accuracy in the above calculation. The optimization design and strength check of the reducer drive system and other systems have contributed to a more reliable and accurate basis.

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