

Design and Manufacture of Carbon-free Car

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ABSTRACT

Based on oscillating mechanism of cam, we design a kind of "8" carbon free car which drive by gravitational potential. The car in the forward process can automatically walk around obstacles in 8-shaped track, without other forms of power. This paper designs the overall structure of the car, energy conversion mechanism, transmission and steering mechanism. Simulate and assembly the car through Three-dimensional software for the maximum repeatability and stability in the car running. It provides reference for the design of carbon free car.

Keywords - carbon-free car , 8-shaped track , cam mechanism

I. INTRODUCTION

The fifth national contest of College Students Comprehensive Ability Training requires requirements of a car without carbon as shown in Fig.1. The car needs to run around two obstacles of a distance of 450mm along the 8-shaped track in half a standard table tennis table. It uses the gravitational potential energy of 1kg weight. The new contest sets the second round in three obstacles into "L", as shown in fig.2. It requires the car running in 8-shaped track around two obstacles on the midline, ensuring that every obstacle in a closed loop in Figure 8 and not knocking down the third obstacles. The judges give the final evaluations on the basis of the number of the completed effective circle.

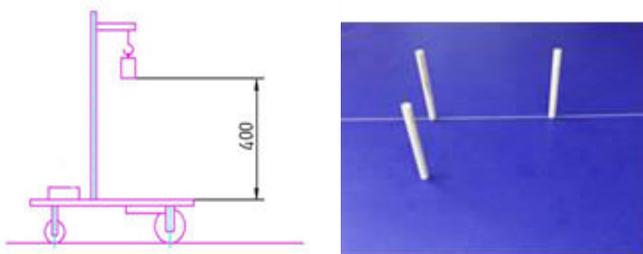


Fig.1 the schematic diagram of carbon free car (unit : mm)

Fig.2 the table tennis table and obstacle

II. Running track analysis

As shown in Fig.3 and Fig.4, AB section and CD section of cam radius match to the linear part of the "8". BC section and DA section match to the circular section. The cam revolving corresponds to a complete "8" is a stroke cycle. When they match well, the car is not easy to shift^[1].

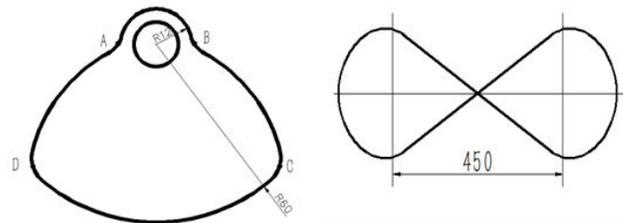
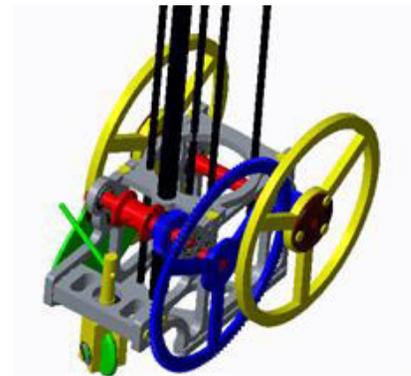
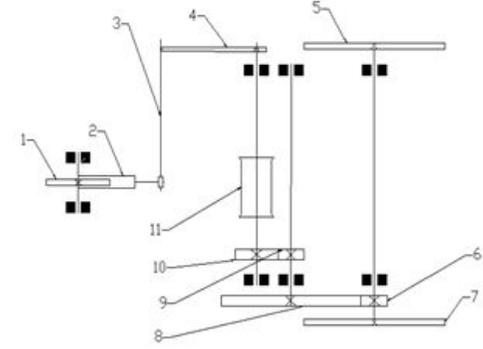


Fig.3 cam diagram (unit : mm)

Fig.4 8-shaped track (unit : mm)

III. Structure design



1 front wheel, 2 front fork, 3 oscillating bar, 4 cam, 5 rear wheel, 6/8 first grade gear, 7 rear wheel, 9/10 gear, 11 winding reel

Fig.5 structure diagram of carbon-free car

3.1 Design of overall mechanism

According to the requirement of the contest, the overall structure of the car takes front wheel as the guide pulley and rear wheel as the unilateral drive. This structure imitates the tricycle.

In order to the compactness of overall structure of car and facilitate steering, three pieces of transmission shafts are distributed in space. As shown in Diagram 5, the front shaft is winding shaft, the gravitational potential energy of heavy object is passed to the front shaft through winding reel, the second grade gear 9 and 10 drive the intermediate shaft to rotate so as to drive the first grade gear 6 and 8 and thus drive the rotation of rear shaft and advance of rear wheel 5 and 7. Hereinto, 7 is the driving wheel and 5 is the driven wheel. In the steering mechanism, the rotation of front shaft drives the rotation of cam 4 and thus drives the rotation of oscillating bar 3, front fork 2 and front wheel 1 so as to achieve periodic steering.

3.2 Energy conversion mechanism

The driving energy of car is from the gravitational potential of heavy object after direct conversion. The simply and reliable method is to realize it by using fine line with abrasion resistance and high strength and fixed pulley mechanism. One end of fine line is fastened to the hook of weight, and the other end is wound on the winding shaft. In addition, five pieces of carbon pipes are fixed on the periphery of heavy object to guide it drop and prevent swing. In this way, during the dropping of weight, gravitational potential can be converted into the torque on the driving wheel shaft so as to drive the driving wheel to realize walking^[2].

3.3 Transmission mechanism

In the transmission mechanism, considering the correctness and stability of transmission, the car adopts gear transmission. In order to make full use of energy, the second grade gear transmission is used, because its transmission is correct and transmission efficiency is high. The first grade gear module of rear wheel shaft and cam shaft shall be 1 and teeth shall be 120 and 20^[3]. The module of second gear of cam shaft and winding shaft shall be 1 and teeth shall be 17 and 35^[4].

3.4 Steering mechanism

8-shape steering mechanism of car can adopt cam mechanism, maltese mechanism, crank and rocker mechanism and incomplete gear mechanism. These structures have their own advantages and disadvantages. However, in consideration of the simple structure, facilitating processing and adjustment, the car adopts oscillating mechanism of cam. It drives the rotation of front wheel through oscillating mechanism of cam so as to realize automatic steering of car^[5].

3.5 Fine tuning mechanism

When the carbon-free car moves forward, fine tuning mechanism must be designed to ensure the repeatability of track and eliminating the impact of processing and assembly errors on the track. The fine tuning can be designed by using screw pitch.

IV. Making and debugging

Taking into account the stability of the car, accuracy of the position, the repeatability of the disassembly and so on. The overall of the whole use the cabinet structure while the rear axle use the stepped shaft. And the bearing use the flanges bearing. The stick what used to Support heavy objects are mainly composed by carbon. The aluminum is used to make up the sideboard the baseboard and the cover board and hollow to reduce the weight of the car. The material of the axis use aluminum and the cam use organic glass. The car is mainly made by the CNC milling machine and the CNC lathe. In the process of production, we try to improve the accuracy to reduce the error, and improve efficiency.

In debugging, we use the simple and reliable method for trajectory tracking. And continually revise the edge shape of the cam. We gradually improve the coincidence degree and stability of the trajectory.



Fig.6 the carbon-free car

V. CONCLUSION

We design the carbon-free car has many advantages, such as: start with the method of unilateral drive; flexible steering; uniform load distribution and compact structure; low center of gravity; light weight; high stability; etc. In the design manufacture and commissioning of carbon-free car, there is a rigorous scientific spirit that will combine the theory and practice perfectly. The design, manufacture and commissioning of a car is a long and arduous process that examines the perseverance of our team and the ability to continually sum up experience and innovation in practice.

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