



The research and application of Speed synthesizer

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ABSTRACT

This article is in view of the speed (speed/torque) synthesis of the practical engineering problems, through the analysis of the problem, the movement principle of mechanical design and mechanical structure design, principle of theoretical analysis, the methods of design and calculation, 3 d modeling and simulation verify its correctness. Finally, based on the principle of the speed synthesizer designed speed synthesis double leisure bike mock-ups, verify the feasibility of theory principle of reality.

Key Words: composition of velocities; torque; differential mechanism

Problem description

How can the two different sizes of speed (speed/torque) to synthesize into one speed, and make converting speed output?

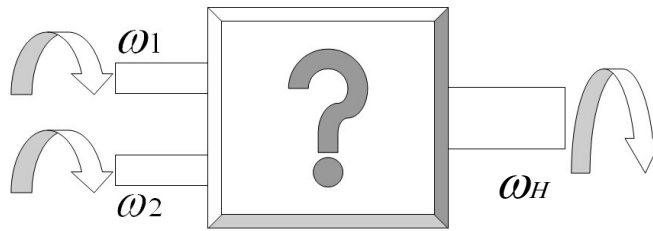


Fig. 1 Speed synthesis structure diagram

As shown in fig. 1, the input (left side), there are two different sizes of speed ω_1 and ω_2 , after middle speed synthesis device synthesis, the right end output for a synthetic and speed ω_H

Problem analysis

Which institutions in mechanical principle, which can realize the function of mechanism combination, or? In refer to professional books and literature, finally learned that gear train can be realized. In the gear train, an important part of the application is differential, which is a device for the motor output torque is split in two and allowed to output two different speed. its diagram is shown in fig. 2.

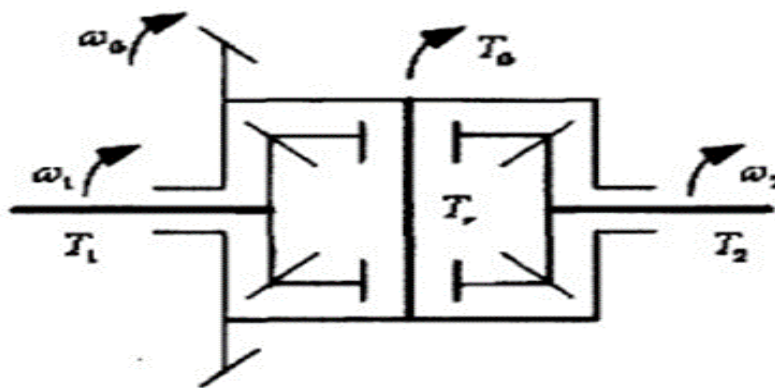


Fig.2 The principle diagram of the differential structure

If the differential input, output and input into the output end, respectively to achieve speed synthesis this function? Below will be through the theoretical derivation and modeling and simulation to verify whether can realize this function.

Speed synthesizer movement principle analysis

(1) Synthesis speed

This work in the design of speed synthesizer of differential gear train has two degrees of freedom, can be independent input two active movement, the output motion is the synthesis of two motion. Speed on both ends of the synthesizer is incorporated in the input speed of the device, allowing two different input speed. The schematic diagram is shown in figure 3. The

output of the angular velocity diagram for speed synthetic devices. ω_1 , ω_3 , ω_H is respectively about two input axle shaft angular velocity, as shown in figure 3 speed synthesizer.

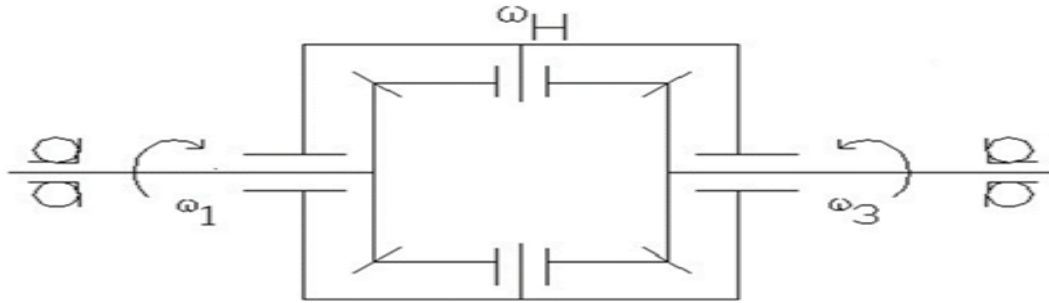


Fig. 3 Ordinary bevel gear type speed synthesis mechanism schematic diagram

According to the calculation formula of institutions degrees of freedom:

$$F = 3n - (2p_1 + 2p_h)$$

Have to $F = 2$ [n as active component, p_1 as low vice, p_h as high vice]

Institutional freedom to 2, agencies to determine movement.

According to the formula of epicyclic train transmission ratio:

$$i_{mn}^H = \frac{\omega_m^H}{\omega_n^H} = \frac{\omega_m - \omega_H}{\omega_n - \omega_H}$$

[m, n of epicyclic train gear, planet carrier for H]

$$i_{13}^H = \frac{\omega_1^H}{\omega_3^H} = \frac{\omega_1 - \omega_H}{\omega_3 - \omega_H} = -\frac{Z_2 Z_3}{Z_1 Z_2} = -\frac{Z_3}{Z_1} = -1$$

(equals the number of teeth gear 1 and 3)

Have to $\omega_1 - \omega_H = -(\omega_3 - \omega_H)$

$$\omega_1 + \omega_3 = 2\omega_H$$

Namely $n_1 + n_3 = 2n_H$ The speed synthesizer input speed of synthesis on both ends.

(2) Torque synthesis

Speed in synthetic agency about the number of teeth on the gear 1, 3, the same radius, when two different input axle shaft torque around, there is always a torque output. Assumptions on each axis input torque for T_1 and T_3 , synthesis of output torque for T_H .

According to the moment balance formula available:

$$T_1 + T_3 = T_H$$

The both ends of the planet carrier equal the sum of the input torque of the output torque.

The modeling and simulation

CREO is the PTC company launched in October 2010, CAD design software packages. CREO is to integrate the three software Pro/Engineer of PTC company of parameterized technology, CoCreate direct modeling technology and ProductView 3 d visualization technology of new CAD design software package, PTC is lightning plans to launch the first products of the company.

In March 2012, PTC company announced CREO 2.0 listed, CREO2.0 software is easy to operate, speed and quick; Provide a new modular product design function and function more conceptual design application, improve user in CREO Parametric in work efficiency, and many other advantages. In this paper measurements CREO2.0 software is adopted to establish the model.

CREO2.0 modeling general process is as follows:

- 1). To establish or select baseline characteristics as a benchmark model space positioning: such as datum, the datum axis and datum coordinate system. Every entity characteristic, establish using baseline characteristics as a reference;
- 2). To establish a basic physical features: stretching, rotating, scanning, mixing, etc.;
- 3). Establish engineering characteristics: holes, chamfering, rib, draft, etc.;
- 4). The characteristics of the modified: features array, editing operations such as copy;
- 5). To add texture and rendering process .

The established 3 d simulation model as shown in figure 4.

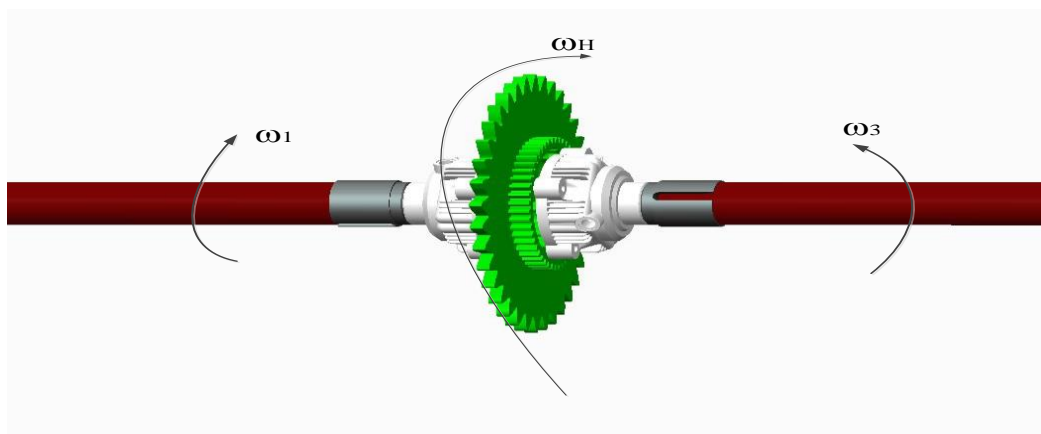


Fig. 4 Speed 3 d simulation model of the synthesis mechanism

In this paper, the research and analyze speed synthesizer, completed the speed synthesizer all structure parts of 3 d modeling, assembly speed synthesis mechanism.

Finally in the CREO2.0 software simulation, mechanism motion animation motion demonstrate the validity of the movement principle.

Test and application

The movement principle of speed synthesizer has been successfully applied to the double bicycle, in the actual experiments show good speed synthesis performance. As shown in figure 5 for speed synthetic mechanism in the 3 d model of double bicycle, figures 6 and 7, respectively for speed synthesizer physical figure and synthetic double leisure bike real figure, has been completed in the laboratory. Double bicycle speed synthetic principle and the principle of speed synthesizer is the same, its simple structure, light quality, conform to the actual situation, can be in the actual synthesize two people through the pedal speed device called a resultant force output and driver.

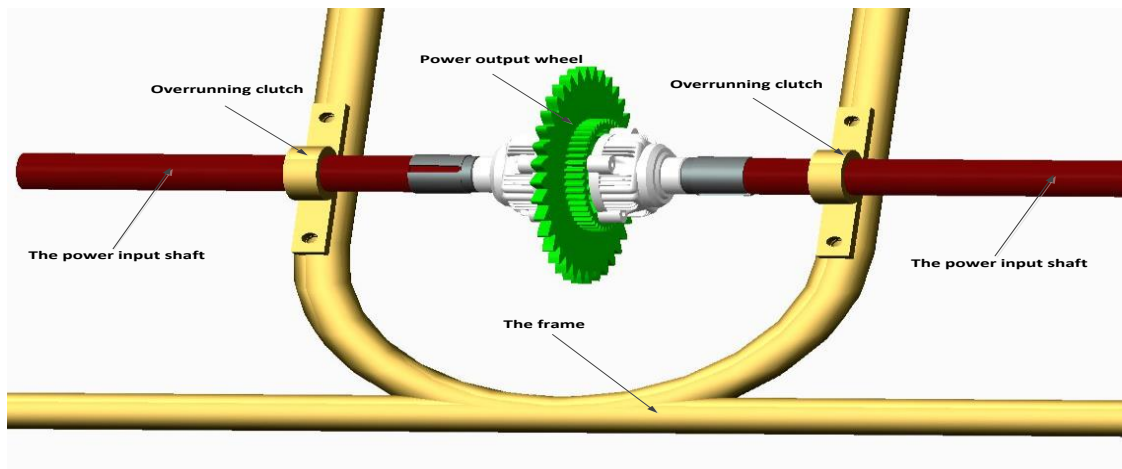


Fig.5 Applied to speed double the speed of leisure bike synthesis device model for the 3 d



Fig. 6 The speed synthesizer mock-up



Fig. 7 Synthetic double leisure bike physical speed

The conclusion

- (1) The synthesis of the practical engineering problem for speed, speed synthesis device was developed. Both ends of the device through the input speed, intermediate output and speed, can realize speed (RPM) and the synthesis of torque.
- (2) The software simulation and physical model experiment results show that the device has good speed synthesis ability, can meet the requirements of speed synthesis.
- (3) The successful design of the speed synthesizer synthesis function provides the technical support for the realization of the speed, the technology has good application prospect.

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