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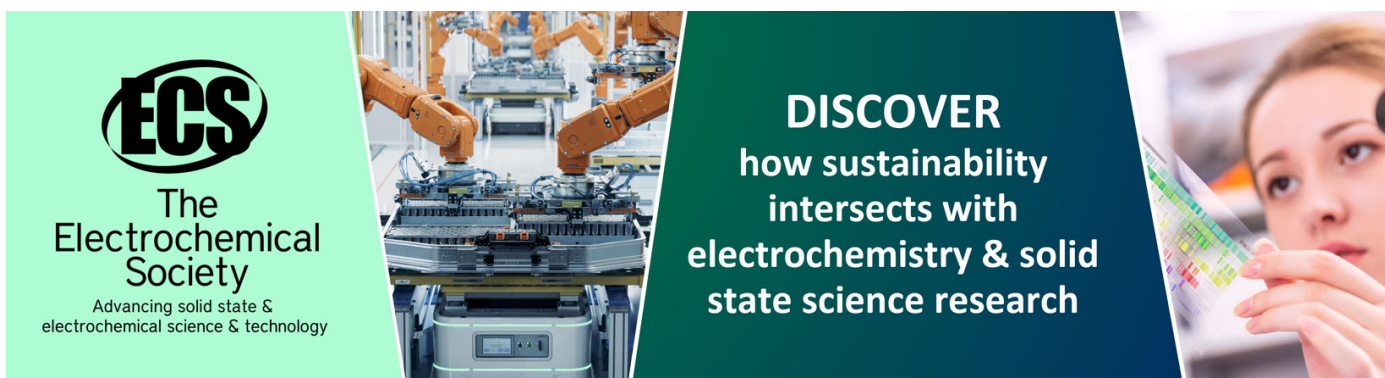
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Design and Application of Automatic Falling Device for Different Brands of Goods

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Abstract. The Goods- Falling device is an important device in the intelligent sorting goods sorting system, which is responsible for the temporary storage and counting of the goods, and the function of putting the goods on the conveyor belt according to certain precision requirements. According to the present situation analysis and actual demand of the domestic goods sorting equipment, a vertical type Goods - Falling Device is designed and the simulation model of the device is established. The dynamic characteristics such as the angular error of the opening and closing mechanism are carried out by ADAMS software. The simulation results show that the maximum angular error is 0.016rad. Through the test of the device, the goods falling speed is 7031/hour, the good of the falling position error within 2mm, meet the crawl accuracy requirements of the palletizing robot.

1. Introduction

Goods sorting for large department stores of the logistics distribution is an important work, the traditional manual sorting needs a lot of manpower, and low efficiency, high error rate[1], in order to reduce artificial labor intensity, to overcome the low efficiency of manual, goods sorting machine is used in different goods sorting operation. Fully automatic intelligent goods sorting is the mainstream development direction, full automatic intelligent sorting goods can according to the order requirement. This device can automatically take different brands and different types of goods and do not require manual participation. It can reduce human consumption and improve the efficiency of sorting. In the automatic intelligent goods sorting system, automatic falling commodity equipment is one of the important link, it can realize the function of the goods on the conveyor belt according to the quantity and the location accuracy, the purpose is to convenient feature identification and the fetching of the stacking robot.

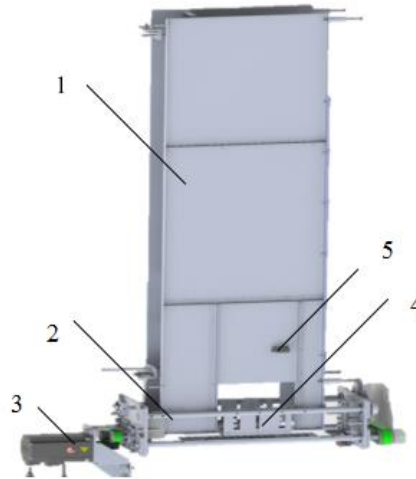
In literature 2, a sorting machine such as vertical channel sorting machine, object attitude shaping machine, synchronous belt conveyor is mentioned. Fall in this paper, design of the automatic equipment of various commodities, can complete different goods sorting, counting function, moreover, it is not necessary to add the additional item posture shaping machine, which greatly improves the efficiency of sorting and reduces the cost of the equipment. Domestic goods sorting equipment is relatively backward, compared with foreign countries, Japan, Italy, Americancigarette sorting equipment automation level is high. So our country should attach importance to the independent equipment research and development,



from the point of tobacco logistics mode in our country [3], prefecture level of goods logistics distribution center, to the demand of automatic sorting machine in different goods is big, make it has good application prospect.

2. Design and working principle of automatic falling commodity device

2.1. Structural components



1 storage device;2 transmission device;3 power device;4 position adjusting device;5 counting device

Figure 1 Automatic falling goods device

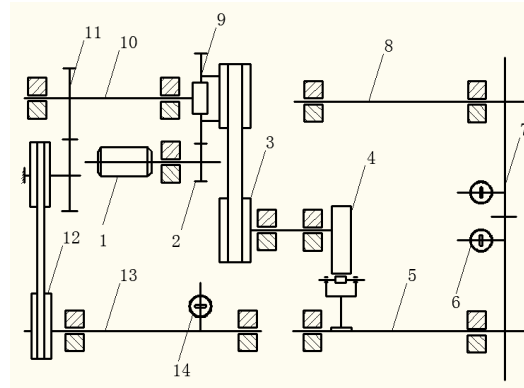
The automatic falling commodity device mainly completes the functions of storing, counting and ensuring the accuracy of the falling commodity. It shall consist of storage device, position adjusting device, power device, transmission device and counting device. Figure 1 shows that Automatic falling goods device, in actual, several groups or dozens of groups are used together. storage device 1: goods can be filled with different brands and specifications by hand or machine; transmission device 2: complete the falling function of the goods through the control system; power device 3: control motor, position adjusting device 4: according to different goods purpose to adjust the size of the goods, to avoid the problem of goods being stuck; counting device 5: complete the counting function for the photoelectric or laser sensor.

Table 1 Size requirements

Cosmetic requirements	long(mm)		wide(mm)		high(mm)	
	max	min	max	min	max	min
Commodity packaging	345	87	233	75	105	19

It can be seen from table 1 that this device is suitable for many different brands of goods and has a strong universality.

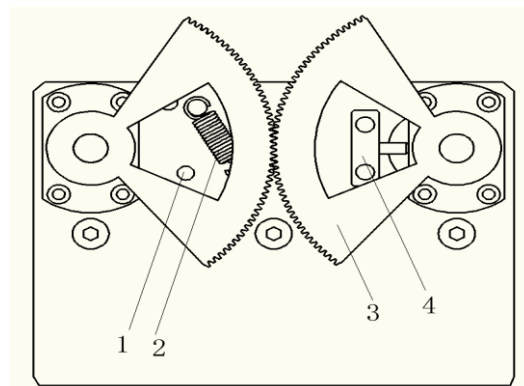
2.2. Structure and working principle of transmission device



The motor 2 pinion 3 Toothed belt and pulley 4 CAM mechanism 5 Axis - I 6 Reset spring - I 7 Synchronous gear - I 8 Axis - II 9 Large gear with a ratchet inside, 10 Axis-III 11 Synchronous gear - II 12 Synchronous belt and wheel 13 Axis - IV, 14 Reset spring - II

Figure 2 Schematic diagram of transmission device

The schematic diagram of the transmission device is shown in figure 2. The layout of the actual shaft is shown in figure 1. When it is working time, motor 1 through the gear 2 drives the big gear 9 and connected to the big gear wheel rotation, large teeth through internal ratchet drive axis-III forward, axis-III by synchronizing gear - II 11 and synchronous belt 12 and pulley 13, because of the synchronous belt and the synchronous gear drive, Axis - III and Axis - IV turning point of view, when the two axes rotate, the plates on the shaft move together and complete the opening of the tray, a commodity falls on the conveyor belt below, at the same time, the motor starts to reverse, The ratchet can only be selected in one direction, wheel will not drive axis - III reversal, However, under the reset spring - II role, axis - III 10 will follow big gear 9 inversion, in rear axle position - III stop running, and then the big gear will continue to rotate, drive the CAM 4 rotation and so it starts to rotate axis-1, Axis-I 5 through the synchronous gear- I 7 drive axle II 8, complete the location of the goods in the warehouse, fall down to the bottom board, motor continues to reverse, drive the CAM device 4 movement, in conjunction with the reset spring machine- I 6, complete axis - I 5 and axis - II 8 the closing of the action, prevent the above smoke from falling, then the motor is turning to complete the same job cycle.

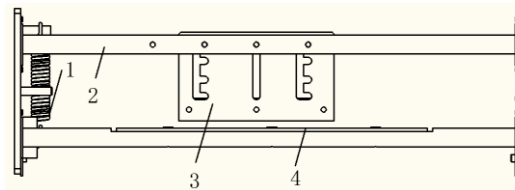


1 Limit pin; 2 Reset spring; 3 Synchronous gear; 4 Adjusting device

Figure 3 gear synchronous reset device

Figure 3 shows the gear synchronous reset device, the gears are the same gear as the number and the number of teeth in the figure, the Angle of rotation of the two axes is guaranteed, the he position

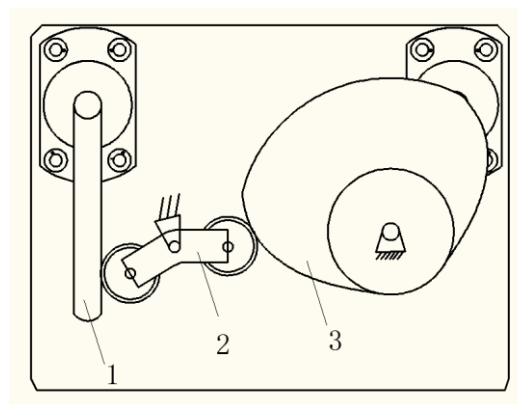
deviation will not occur because of the different Angle of the shaft, As the motion of the shaft is a two-way movement, and the Angle of rotation is small, the gear design is the pattern shown in figure 3. The structure of the transmission device is more compact, and the characteristics of small space and light weight are designed according to the movement characteristics of the parts, which can be used for reference to other institutions. After the gear is rotated to a certain Angle, the reposition spring 2 and the CAM mechanism can make the gear return to its original position. In order to prevent the overpower of the gear, set the limit pin 1, the adjusting device 4 can adjust the clearance of the gear, so that the movement is more stable.



1 Reset spring;2 axis;3 Adjusting device;4 plate

Figure 4 The falling commodity adjustment device

As shown in figure 4, the distance between the adjusting device 3 and the plate 4 can be applied to different brands and sizes of goods. If there is no such adjustment device, when changing to different sizes of goods, it is easy to have the problem of goods in the process of operation. In order to make the adjustment easier, in regulating hole on the left side of the design of the chute, in regulating without will tighten nut screw down, only to loosen can adjust, save time, improve the efficiency of the regulation.



1 Turn the baffle;2 rocker;3 CAM;

Figure 5 CAM mechanism

Is the most mature application of high speed CAM mechanism of automotive engine with the use of valve mechanism, and put forward a lot of new design method, 4 and 5 are put forward through reverse engineering or optimization method for CAM design, this paper a new design method, and combined with the actual application for the design of CAM, in order to reduce wear of the CAM mechanism, the small roller is designed at the 2 ends of the rocker.

3. Motion simulation analysis

Using ADAMS software to analyze the kinematics and dynamics of the mechanism, understand the dynamic characteristics of the institution.

Using SolidWorks to set up the 3d model of the shaft and the pallet and then import ADAMS [6],

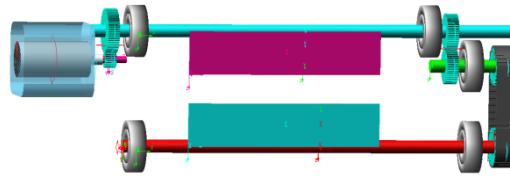
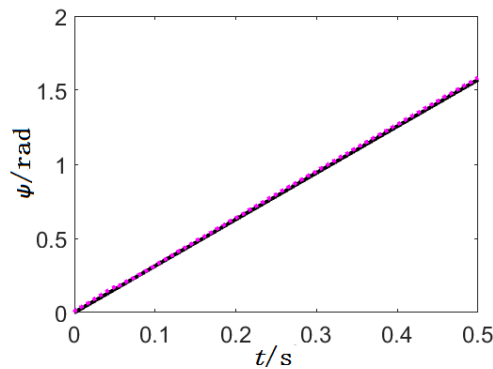
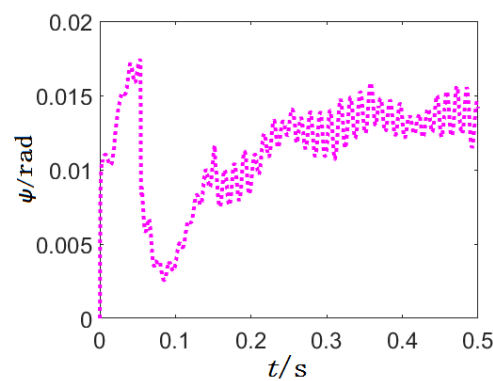


Figure 6 The simulation model

In order to make the result of simulation is more accurate, 3-d gear contact model is established in ADAMS, 3-d cog belt model, in the traditional modeling method, general rotation vice or flexible connection was used to simulate the bearing, the more accurate bearing model is established for simulation. In transmission device, the above two shaft is established by module and the same number of synchronous gear synchronous, gears can ensure the accurate transmission ratio, the following two shaft is to rely on synchronous cog belt, in the process of high-speed operation of the cog belt may have vibration and elastic deformation, to understand the dynamic characteristics, established in the Adams simulation model is shown in figure 6 on the dynamics and kinematics simulation.



a) Two axis Angle



b) The angular deviation of the two axes

Figure 7 The simulation results

Due to the cog belt has certain flexibility, so as shown in figure 7 in the movement of the inception phase change is bigger, the Angle between the two axis deviation Angle deviation of the maximum value appeared in 4.03 e-002 s moment, a maximum of 1.64 e-002 rad.

4. Test

4.1. Work efficiency test

Experiment with the method of continuous work, namely a fill smoke to make the device continuously work continuously, until all the smoke down, record the time used, smoke cigarettes used in the test for nanjing 26, just can accommodate the number of falling into a single device. During the experiment, there was no smoke, and the operation was smooth.

Table 2 Time for each group of tests

Test serial number	Commodity brand	Time t/s	Test serial number	Commodity brand	Time t/s
1	Yunyan	13.23	6	Nanjing	13.25
2	Yunyan	13.31	7	Nanjing	13.33
3	Yunyan	13.37	8	Nanjing	13.28
4	Yunyan	13.29	9	Nanjing	13.31
5	Yunyan	13.41	10	Nanjing	13.35

The average time spent was: 13.313 s, and the efficiency of the work was calculated to be 70,30.7 per hour.



Figure 8 A field test

4.2. Position accuracy test

The test adopts the continuous working method, the speed of the conveyor belt under the falling smoke device is 1.2 m/s, and the position error of the smoke on the conveyor belt is measured.

Table 3 Merchandise position error

Test serial number	Commodity brand	The position error(mm)	Test serial number	Commodity brand	The position error(mm)
1	Yunyan	1.35	6	Nanjing	1.41
2	Yunyan	1.42	7	Nanjing	1.62
3	Yunyan	1.5	8	Nanjing	1.56
4	Yunyan	1.89	9	Nanjing	1.73
5	Yunyan	1.65	10	Nanjing	1.56



Figure 9 A field test

5. Conclusion

According to the requirements of practical application designed for automatic special article automatic sorting system of goods falling device, and by using ADAMS, the dynamics simulation software of gear transmission mechanism kinematics and dynamics analysis, and then confirmed the feasibility of the scheme, through the experiment and practical application are obtained.

The rate of falling goods reaches 7031 / h, and the error of the falling position of a goods is within 2mm, which is very effective.

Acknowledgments

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