

Design of a New Carrying Device Based on the Stair Handrail

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Abstract. This paper describes a power assisting device with the help of the stair handrail. The slope of the stair handrail not only changes the forced direction of the objects, but also changes the ways of putting strength. The adjustable clamp system can adapt to different types of stair handrails. The fixed device can prevent it from tilting. The brake mechanism can control the gliding speed of the device. And the ratchet wheel can prevent the device from sliding down. In addition, the device is foldable, not only can it transport with the help of the stair handrail, but also it can transport on the ground, so the course of the transit is more convenient and fluent.

Introduction

In recent years, with the rapid development of economy and the rise of e-commerce, express delivery industry works up as an emerging service industry. However, the distribution form of the express company is still manpower, so couriers' workload is heavy. Most delivery companies adopt "door-to-door" service mode, however, most of the old residential buildings are no elevators at present. A portable power device is needed especially when couriers need to transport large commodities upstairs. The most widely applicable delivery device nowadays is planetary wheel dolly. This kind of stair climbing dolly has high noise, large vibration amplitude, unstable performance, low efficiency and so on, which has inevitable shortcomings to deliver large commodities.

In view of this, I design a new carrying device based on the stair handrail to help courier express goods, this device can not only lighten the working strength of couriers when transport goods upstairs, but also can ensure the safety of the goods. Couriers send the goods to people who live upstairs conveniently. In addition, this device can also be used to transport goods on the ground.

The Design Principle

The device contacts with the stair handrail by means of the side wheels and the top wheel. The side wheels fix with the stair handrail tightly by means of the spring. Select the spring with appropriate stiffness factor which can fix with different types of the stair handrail. The top wheel connects to the ratchet wheel which can prevent the device from sliding down. The clamping mechanism connects to the fixed device can prevent the goods from sliding off the device. The reliability of the delivery is ensured. Simultaneously, the brake mechanism can control the gliding speed of the device. And the ratchet wheel which is on the handle can prevent the device from sliding down. The device is foldable on account of the hinge and the connecting rod.

The three-dimensional diagram and the real picture of the device are as follows:

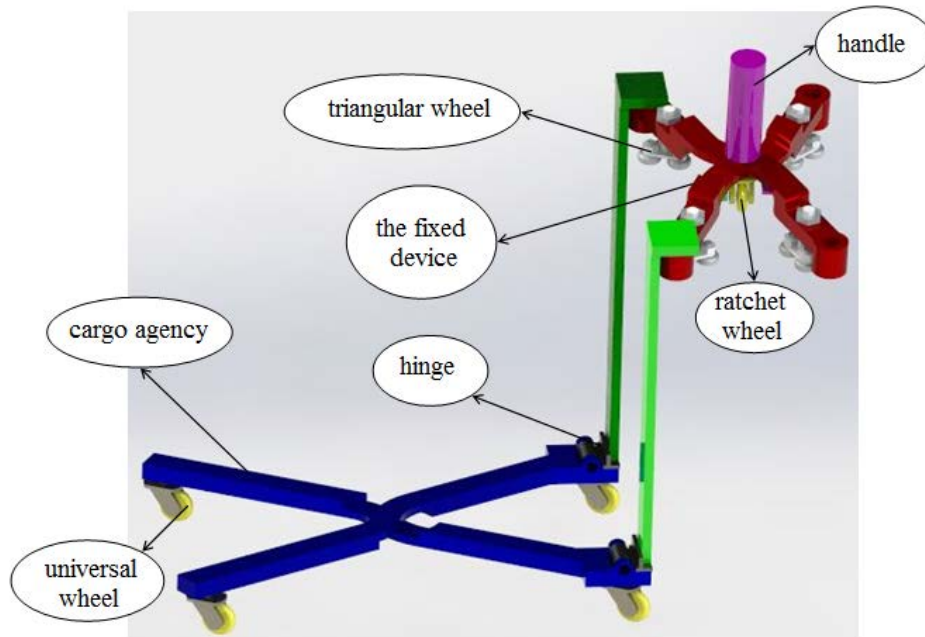


Fig.1 The three-dimensional diagram of the device



Fig.2 The picture of the device

Principal Organs of the Device

The Cargo Agency of the Device. The component 1 and the component 2 are connected by the rotating shaft. When the device works, the angle of the two components can reach 90degrees. The cargo device is similar to a parallelogram when deliver goods. When the device is during the non-working state, the angle can reach 0 degree to save space, so couriers can carry it easily. The cargo agency is shown in Fig.3.

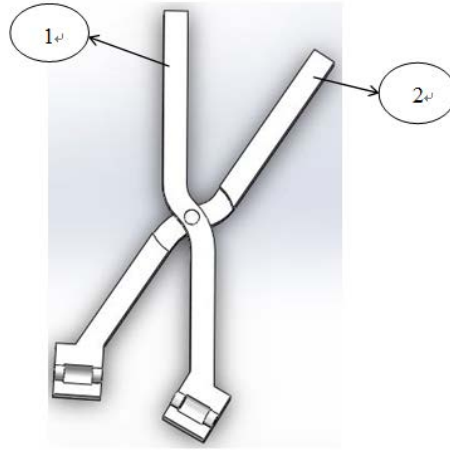


Fig.3The cargo agency

The Vertical Suspension Mechanism. On account of the gradient of the stair handrail is fixed. In order to ensure that goods which are shipped on the cargo agency still in level state,the length of the two vertical connecting rods are different. The top of the two rods are parallel to the stair handrail. The mechanical structure is shown in Fig.3.

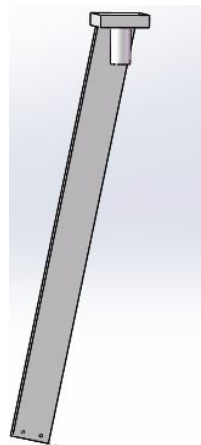


Fig.4The vertical suspension mechanism

The hinge Connecting Mechanism. The cargo agency and the vertical suspension mechanism are connected by the hinge. When the device is in working state, the angle between the two mechanisms is ninety degrees. When the device is in a state of non-working, they can be folded together. It is convenient for couriers to carry, and it can save a lot of space. The hinge connecting mechanism is shown in Fig.5.

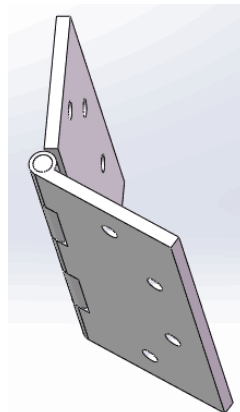


Fig.5The hinge

The Fixed Device. The fixed device can be fixed on both sides of the stairs. In the middle of the device there is the ratchet mechanism. What's more, couriers drive the whole device by the handle. The fixed device is shown in Fig.7.

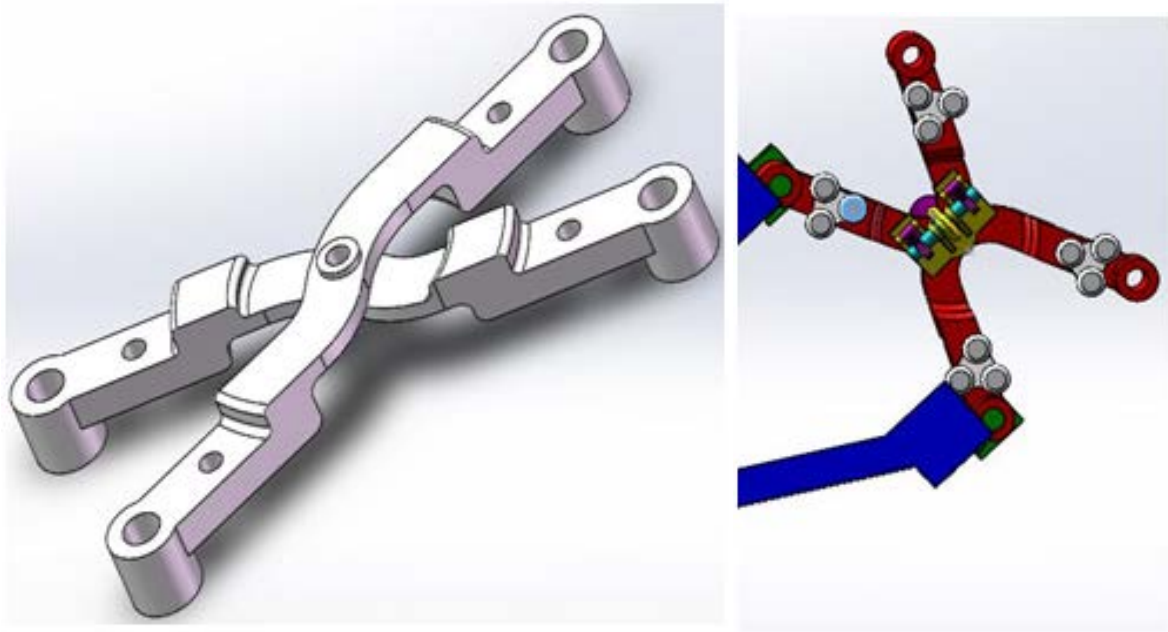


Fig.6 The fixed device

The ratchet and the Brake Mechanism. To avoid the device slipping off the stair handrail, the ratchet wheels which move unidirectional are fixed under the fixed device. The pawl and the rack are fixed on the ratchet wheels. When the couriers move the goods upward, the pawl is flicked, so the pawl and the ratchet are connected to prevent the device from sliding off. When the couriers move the goods upward, the pawl and the ratchet are not connected. The device can slide along the stair handrail easily. In addition, the brake mechanism can stop the device at any time. The ratchet mechanism is shown in Fig.7.

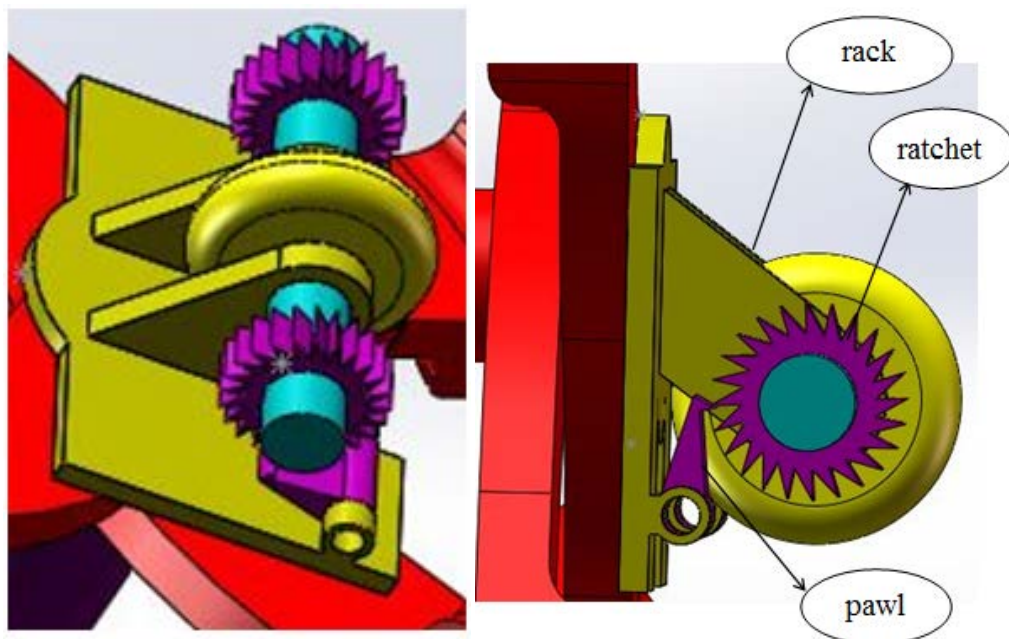


Fig.7 The ratchet mechanism

The Theoretical Arithmetic. The stress analysis of the device is necessary to judge the stability of the device. When the cargo is 20 kilos or 33 kilos, the stress of the device is analyzed by SolidWorks, the stress analysis diagram is as follows:

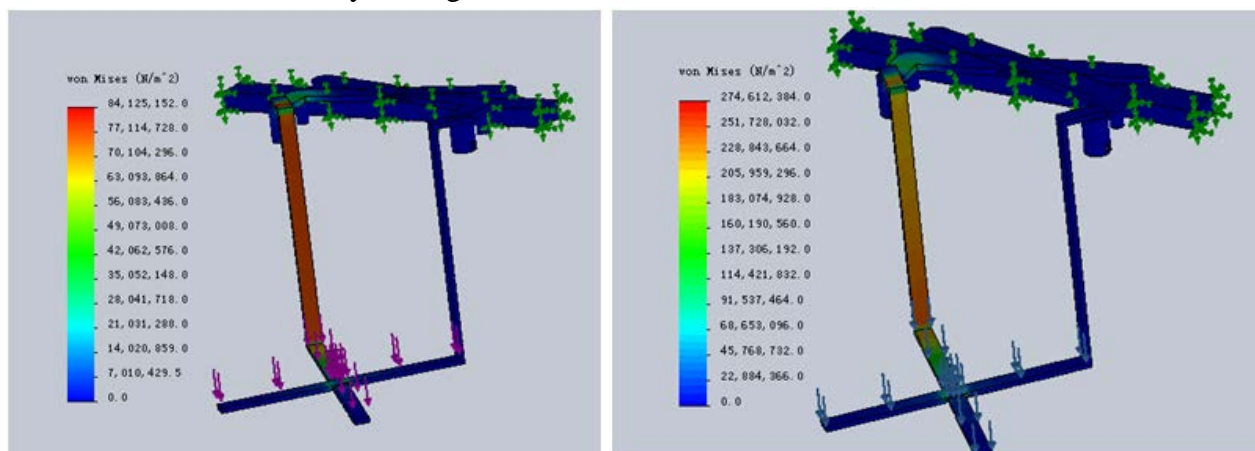


Fig.8 The stress analysis of the device

From Fig.8, we can easily draw the conclusion that the tension strength is about 246347265 N/m^2 . The tension strength of the alloy steel from the datasheet is 723825600 N/m^2 . So, we can conclude that the device meets the requirements of strength.

Conclusion

The device has the following innovation points:

Lighten the working strength of couriers by means of the device based on the stair handrail.

The device can not only transport goods on the playground, but also transport based on the stair handrail.

The fixed device, the ratchet and the brake mechanism enhance the safety.

The device is of great portability, and the price is cheap. So it has greatly popularized value.

References

- [1] Yang Kezhen, Cheng guangyun, Li Zhongsheng, Basis of Mechanical Designing, Higher Education Press. 2013;
- [2] Editorial board machine design manual, Machinery Handbook. China Machine Press, 2004;
- [3] Fan Chongluo, Mechanical Processing Technology, Southeast University Press. 2009;
- [4] Zou Huijun. Mechanical Principle, Higher Education Press, 2006;

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