Feasibility study of longitudinal transportation

Zhejun Shu, Haojie Mu
Zenith Steel Group Company Limited (Nantong), Nantong 226000, China

Abstract. The research in this paper relates to the technical field of light load transportation, in particular to an electric upstairs car, which includes a frame, the top of the frame is fixedly equipped with a handle, the bottom of the frame is rotationally equipped with a group of wheels, the side wall near the bottom of the frame is fixedly equipped with a carrier plate, the support plate is fixedly arranged between the frames, and the box is fixedly arranged on the side of the support frame away from the carrier plate, A support rod is rotated on the opposite side of the box. The length of the support rod is larger than the diameter of the wheel. An arc surface is set on the support rod. A drive component is set in the box. The drive component is used to drive the support rod to rotate. This kind of electric car that can be transported longitudinally can reduce labor.

Key words: Direction; Transport; Rotating support; Electric trolley.

1. Introduction
In industrial production, goods moved in a short distance and a small range are transported by trolleys. The well-known double-sided trolley includes a frame. The bottom of the frame is rotated and set with a set of wheels, the top of the frame is fixed with a handle, and the side wall near the bottom of the frame is set with a bottom movable baffle. Place the goods on the bottom interactive baffle. The bottom movable baffle supports the goods and pushes the handle. The wheels roll on the ground to drive the frame to move. The frame movement drives the bottom movable baffle to move, and then the movable baffle drives the goods to move. [1] Many times, goods need to be moved from low to high or from high to low, but many industrial buildings are not equipped with elevators and only stairs. Because the wheels are not easy to go up and down the stairs, so it is necessary to carry goods manually, resulting in an increase in labor.

2. Technical proposal for electric upstairs trolley
This electric upstairs trolley includes a frame. The top of the frame is fixed with a handle. The bottom of the frame is rotated with a set of wheels. The side wall near the bottom of the frame is fixed with a load plate. The support plate is fixed between the frames. The box body is provided with a drive component, which is used to drive the support rod to rotate. [2] By adopting the above technical scheme, the goods are placed on the loading plate and tied with the frame by ropes. When the car moves on the flat ground, the support rod has an arc surface on the surface, which makes the center of gravity of the support rod change in an inclined state. The end wall of the support rod is not easy to contact with the ground, thus facilitating the staff to push the car on the ground. When the car needs to go up the stairs, start the drive assembly, The drive assembly drives the support rod to rotate forward. The rotation of the support rod makes one end of the support rod contact with the upper step first, and then makes the support rod drive the frame to move upward. When the car needs to go down the stairs, start the drive assembly, and the drive assembly drives the support rod to reverse. One end of the support rod contacts with the lower step, and then the support rod drives the frame to move downward, so as to achieve the effect that the car is convenient for going up and down the stairs,
then facilitate the goods handling, Reduce the labor intensity of the staff.

The drive assembly includes a drive motor, a drive gear and a long pin shaft. The drive gear rotates and is arranged in the box. The long pin shaft penetrates the drive gear and is fixedly connected with the drive gear. The long pin shaft penetrates the box and is rotationally connected with the box. One end of the long pin shaft is fixedly connected with one of the supporting rods, the other end of the long pin shaft is fixedly connected with the other supporting rod, and the drive motor is fixedly arranged outside the box. The drive motor is used to drive the drive gear to rotate.

Start the drive motor, the drive motor drives the drive gear to rotate, the drive gear rotates to drive the long pin shaft to rotate, and the long pin shaft rotates to drive the support rod to rotate synchronously, so as to achieve the effect that the drive component drives the support rod to rotate.

The drive assembly also includes a drive gear and a reduction gear. The drive shaft of the drive motor runs through the side wall of the box and is rotationally connected with the drive gear. The reduction gear is rotationally arranged in the box. The end wall of the reduction gear is rotationally connected with the inner wall of the box. The drive gear and the reduction gear mesh with each other. The reduction gear and the transmission gear mesh with each other.

Start the drive motor, the drive motor drives the drive gear to rotate, the drive gear rotates to drive the reduction gear to rotate, and the reduction gear rotates to move the drive gear to achieve the effect of driving the drive motor to drive the drive gear to rotate.

Because the size of the drive gear is larger than the size of the reduction gear and the size of the reduction gear is larger than the size of the drive gear, when the size of the drive gear, the reduction gear and the linear speed of the drive gear are the same, the angular speed of the drive gear is greater than the angular speed of the drive gear, and then the rotational speed of the drive motor is greater than the rotational speed of the support rod. By setting the reduction gear, the rotational speed of the support rod is reduced. Reduce the difficulty of staff to control the trolley due to the fast rotation of the support rod.

The handle is provided with a start/stop switch, a reverse switch and a forward switch. The start/stop switch is used to control the start/stop of the drive motor, the forward switch is used to control the forward rotation of the motor, and the reverse switch is used to control the reverse rotation of the motor.

When the staff pushes the trolley up the stairs, the staff presses the start/stop-switch and the forward switch to drive the motor forward to drive the support rod forward. When the staff pushes the trolley down the stairs, the staff presses the start/stop switch and the reverse switch to drive the motor reverse to drive the support rod reverse.

The handle is fixedly provided with an anti-skid layer. The anti-skid layer increases the friction between the handle and the hands of the staff to facilitate the staff to push the trolley. The end walls of the support rods are fixedly provided with rubber layers. The rubber layer on the end wall of the support rod increases the friction between the end wall of the support rod and the step, which is convenient for the support rod to drive the trolley up and down the stairs.

Several reinforcing plates are fixedly arranged between the frames. The reinforcing plate increases the support force of the frame to the goods, reduces the breaking of the frame during the process of goods going up the stairs, reduces the breaking of the frame during the process of goods going down the stairs, and improves the strength of the frame.

3. Electric trolley operation theory and implementation plan

The implementation principle of this electric upstairs car is: when the car moves on the flat ground, the staff pushes the handle, the handle drives the wheel to roll, and then the wheel drives the frame, load plate and goods to move. When the car needs to go up the stairs, the staff presses the start-stop switch and the forward switch to drive the motor to drive the support rod forward. The rotation of the support rod makes one end of the support rod contact with the upper step first, and then the support rod drives the frame to move up. When the car needs to go down the stairs, the staff presses the start/stop switch and the reverse switch, and the drive motor drives the support rod to reverse. One end of the support rod contacts the lower steps, and then the support rod drives the frame to move downward.

![Fig. 2 Structure diagram of electric upstairs trolley](image)


This electric car for going upstairs. Referring to Figure 2, it includes a frame, which is welded by round steel pipe. A handle is installed on the top of the frame, and a group of wheels are set symmetrically at the bottom of the frame. A load plate is installed horizontally on the side wall near the bottom of the frame, and one end of the load plate is
welded with the frame. The support plate is installed on the load plate along the height direction. The bottom end of the support plate is welded with the top wall of the load plate, and the side wall of the support plate is welded with the frame. The box is installed on the side of the support frame away from the load plate, and the support rod is rotated on the back of the box. The length of the support rod is greater than the diameter of the wheel. The supporting rods are symmetrically arranged, and arc surfaces are set on the supporting rods. The supporting rods are S-shaped. The box body is equipped with a drive component, which is used to drive the support rod to rotate. Place the goods on the loading plate and bind the goods with the frame by ropes. When the car moves on the flat ground, the staff pushes the handle, which drives the wheel to roll, and then the wheel drives the frame, load plate and goods to move. Since the surface of the support rod is provided with an arc surface, the center of gravity of the support rod is changed to be inclined, and the end wall of the support rod is not easy to contact the ground when the trolley moves on the flat ground, which is convenient for the staff to push the trolley on the ground. When the car needs to go up the stairs, start the drive assembly. The drive assembly drives the support rod to rotate forward. The rotation of the support rod makes one end of the support rod contact with the upper step first, and then the support rod drives the frame to move upward. When the car needs to go down the stairs, start the drive assembly. The drive assembly drives the support rod to reverse. One end of the support rod contacts the lower step, and then the support rod drives the frame to move downward. To achieve the effect that the car is easy to go up and down the stairs, thus facilitating the goods handling and reducing the labor intensity of the staff.

In order to drive the support rod to rotate, refer to Figures 2 to 4. The drive assembly includes a drive motor, a drive gear, a reduction gear, a drive gear and a long pin shaft. The drive motor is installed on one side of the box, and the drive shaft of the drive shaft runs through the side wall of the box. One end of the drive gear is welded with the drive shaft of the drive motor, and the other end of the drive gear is rotationally connected with the inner wall of the box through the bearing. Both ends of the reduction gear are installed with bearings, which are rotationally connected with the inner wall of the box. The transmission gear is set in the box through the rotation of the long pin shaft. The long pin shaft runs through the transmission gear and is welded with the transmission gear. The long pin shaft runs through the box and is connected with the box through the rotation of the bearing. One end of the long pin shaft is connected with the central thread of one of the support rods and is fixed by nuts. The other end of the long pin shaft is connected with the central thread of the other support rod and is fixed by nuts. The reduction gear and the drive gear mesh with each other, and the reduction motor and the drive gear mesh with each other. Start the drive motor. The rotation of the drive motor drives the rotation of the drive gear. The rotation of the drive gear drives the rotation of the reduction gear. The rotation of the reduction gear drives the rotation of the drive gear. The rotation of the drive gear drives the rotation of the long pin shaft. The rotation of the long pin shaft drives the rotation of the support rod.

Referring to Figure 4, the size of the transmission gear is larger than that of the reduction gear, and the size of the reduction gear is larger than that of the drive gear. Because the size of the drive gear is larger than the size of the reduction gear and the size of the reduction gear is larger than that of the drive gear. Therefore, the angular speed of the drive gear is greater than the angular speed of the drive gear, and the rotational speed of the drive motor is greater than the rotational speed of the support rod. By setting the reduction gear, the rotation speed of the support rod is reduced, and the situation that the staff can not easily control the trolley due to the fast rotation of the support rod is reduced.
In order to facilitate the staff to control the rotation of the support rod, refer to Figure 2 and Figure 5. A control box is installed on the box. The battery, forward relay K1 and reverse relay K2 are installed in the control box. The positive end of the battery is connected with the positive connector of the drive motor, and the negative end of the battery is connected with the negative connector of the drive motor. The forward relay K1 and the reverse relay K2 are interlocked. The handle is equipped with a start-stop switch, a forward switch and a reverse switch. The start-stop switch, a forward switch and a reverse switch are connected in the circuit through wires, and the wires are routed through the round steel pipe of the frame. The start-stop switch is used to control the on-off of the drive motor and the battery, the forward switch is used to control the on-off of the forward relay K1, and the reverse switch is used to control the on-off of the reverse relay K2. When the staff pushes the trolley up the stairs, the staff presses the start/stop switch and the forward switch, the forward relay K1 is connected and the reverse relay K2 is disconnected, thus driving the motor forward to drive the support rod forward. When the staff pushes the trolley down the stairs, the staff presses the start-stop switch and the reverse switch, the reverse relay K2 is connected and the forward relay K1 is disconnected, which drives the motor to reverse and drives the support rod to reverse. [4] In order to facilitate the staff to push the trolley up and down the stairs, refer to Figure 1. The handle surface is pasted with anti-slip layer, which is made of rubber material. The anti-skid layer increases the friction between the handle and the hands of the staff to facilitate the staff to push the trolley. The end wall of the support rod is pasted with a rubber layer. The rubber layer on the end wall of the support rod increases the friction between the end wall of the support rod and the step, which is convenient for the support rod to drive the trolley up and down the stairs. A group of stiffening plates are installed between the frames, and the end wall of the stiffening plate is welded with the opposite side of the frame. The reinforcing plate increases the support force of the frame to the goods, reduces the breaking of the frame during the process of goods going up the stairs, reduces the breaking of the frame during the process of goods going down the stairs, and improves the strength of the frame.

4. Conclusion

To sum up, this kind of electrically driven car that can be transported longitudinally has a simple structure. By setting the drive motor, drive gear, drive gear, reduction gear and long pin shaft, the drive component drives the support rod to rotate, which is convenient for going up and down the stairs, thus facilitating the goods handling and reducing the labor intensity of the staff.

References