

Design and research of a kind of Compact Intelligent Stereo Garage for Battery Bicycle

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Abstract

A three-dimensional lifting and rotating electric garage is designed, including external frame, lifting device, rotating device, propulsion device and parking device. The garage is a steel frame structure on the ground. The shape of the garage is a hexagonal steel frame structure. The lifting and rotating device of the garage is installed in the center of the garage. It consists of motor, motion mechanism and motion platform. The propulsive device is equipped with a propulsive fork, which is driven by a motor and a propulsive motion mechanism. The parking plate is transversely mounted on the parking plate bracket of the frame, and the bracket is welded on the frame, which are distributed on all sides of the hexagonal frame. The garage has low cost, high storage density, high automation and complete functions.

Keywords: Intelligent Stereo Garage, Simultaneous Lift Rotation, Battery Bicycle Parking.

1. Introduction

Fig 1 is a survey of traveling mode choice of contemporary people. Electric vehicles play an extremely important role in it. Under the background of energy saving and emission reduction, reducing energy consumption and emission of vehicles has become an urgent social problem. The emergence of electric vehicles, especially the emergence of shared electric vehicles, has effectively solved this problem, and has incomparable advantages over other modes of transportation.

At present, there are three-dimensional garages for automobiles and bicycles, but there is no relevant technology for battery whose field is relatively blank. With the popularity of various electric vehicles, the proportion of parking area in residential areas and other public places is increasing. Speaking of parking problems, we must remember all kinds of persecution experienced by shared bicycles, which were popular all over the country now. And in our country, electric vehicles are also repeating the same problem on this issue. At the same time, buildings such as advertising booths and advertising racks in public places also cause different degrees of waste of land area.

In view of the above problems, we urgently need a kind of intelligent three-dimensional garage with reasonable design, low cost, high storage density, and high automation and complete functions urgently, which is convenient to use and popularize, to solve the problem of large parking area for electric cars and disorderly waste of land in the layout of advertising buildings.

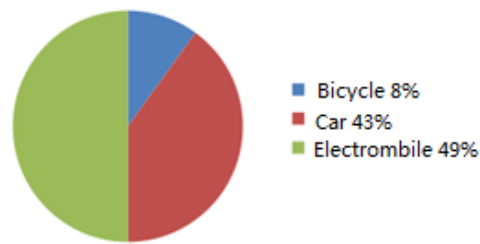


Fig1. Contemporary Travel Choice

2. Overall scheme flow

2.1. Problem Exposition

The development of mechanical three-dimensional garage in China has its own characteristics and the market has formed a fixed form, but watching the reality, it is still not optimistic. According to the current situation, the utilization rate of three-dimensional garage in the market in China has not achieved the desired results, and the investment and return of most cities are not proportional, resulting in most of the three-dimensional garage parking spaces idle. The main reasons are as follows:

(1) Low promotion. For the new parking mode of three-dimensional garage, people are not clear about its significance, and don't know its convenience, besides, they don't know its method of application and don't rest assured of its safety;

(2) It takes a long time to access the car. The design of the garage has drawbacks, and the time of accessing the car is limited. It cannot complete the accessing action in two minutes according to the design requirements. In places with high population density and large parking and picking-up capacity, it is more difficult to achieve a three-dimensional garage for the problem of centralized picking-up.

(3) The economy of access vehicle. Because of the garage's large floor area, it need pay high land purchase fees, resulting in the general cost of three-dimensional garage;

(4) The location of the three-dimensional garage is unreasonable. It is often hidden behind buildings and other concealed places, the location is not obvious, and propaganda work is not in place, all of these lead to the garage are hard to be noticed.

2.2. Overview of Overall Design Scheme of Stereo Garage

Our design is a compact intelligent three-dimensional garage for household battery car, which is used in the mechanical technology field of parking garage. It mainly solves the problems of large parking area of electric car in residential area and other public places, disorderly layout of advertising buildings and waste of land. It include external frame, lifting device, rotating device, propulsion device and parking device. The garage is made of polygonal multi-layer welded steel frame. The welding steel frame is directly poured on the ground, each layer of the steel frame is equipped with transparent wallboard for advertising. The lifting device of the garage is installed in the center of the bottom of the garage. The rotating device is locked and fixed on the fixed seat of the upper platform of the lifting device by four locking screws. The propulsion device of the consignment parking plate is installed on the rotating device. And the parking plate is transversely installed on the frame. On the parking plate bracket, brackets are welded on the frame and distributed on all sides of the polygonal frame. The parking plate is equipped with front wheel clamping device, front body restraint structure, rear wheel restraint groove and contact charging device of the electric vehicle. The garage described in this design has compact structure,

reasonable design, low cost, high storage density, high automation, complete functions and is easy to use and popularize.

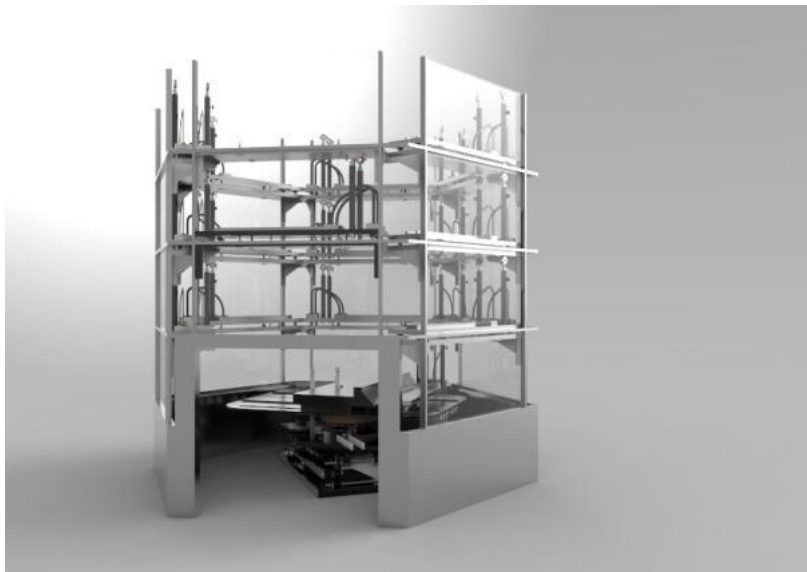


Fig 2. Intelligent Stereo Garage for Compact Household Battery Car

2.3. Advancement of Program

The three-dimensional garage of electric vehicle adopts the method of layered parking, fixed electric vehicle and parking plate, and pushing into the garage as a whole. The design is simple, the space utilization rate is high, and has great practicability. Specific advancement is as follows:

- (1) Electric vehicle has high storage density. The garage frame is a polygonal multistory structure, which reduces the space occupied by the garage.
- (2) The structure compatibility of our garage is good, which solves the placement problem of different types and models of electric vehicles.
- (3) The fixed frame structure of the electric vehicle is simple, reliable and shock-resistant, which ensures the stability of the mechanism.
- (4) Each parking plate has its charging interface, and the locking mechanism is simple and reliable.
- (5) Long service life and low maintenance cost.
- (6) A wide range of people. Operate easily. Saving and pick-up time does not exceed 50 seconds.
- (7) Working noise is lower and only part of lighting is needed. Noise and light pollution will not be caused in densely populated areas such as residential areas.

3. Scheme Design

3.1. Garage Integral Design

As shown in Fig 3, the overall design of the garage is a compact intelligent three-dimensional garage for household battery cars, including garage frame (1), lifting device (2), rotating device (3), propulsion device (4) and parking device (5). The garage frame (1) is directly fixed to the ground by concrete pouring, and the bracket (5-3) of the parking device (5) is bolted to each layer of the welded steel frame (1-2) of the frame (1), while the transparent wallboard (1-1) is installed between the layers of the welded steel frame (1-2), and the lifting platform (2-3) of the lifting device (2) is also laid on the ground and

placed in the garage frame by concrete pouring. (1) In the center, the rotating device (3) is fixed on the bearing box fixed seat (2-5) of the lifting platform (2-1) by four locking screws through the rotary bearing box (3-8), and the propulsion device (4) is installed on the rotating box body (3-5) by multi-bolt connection.

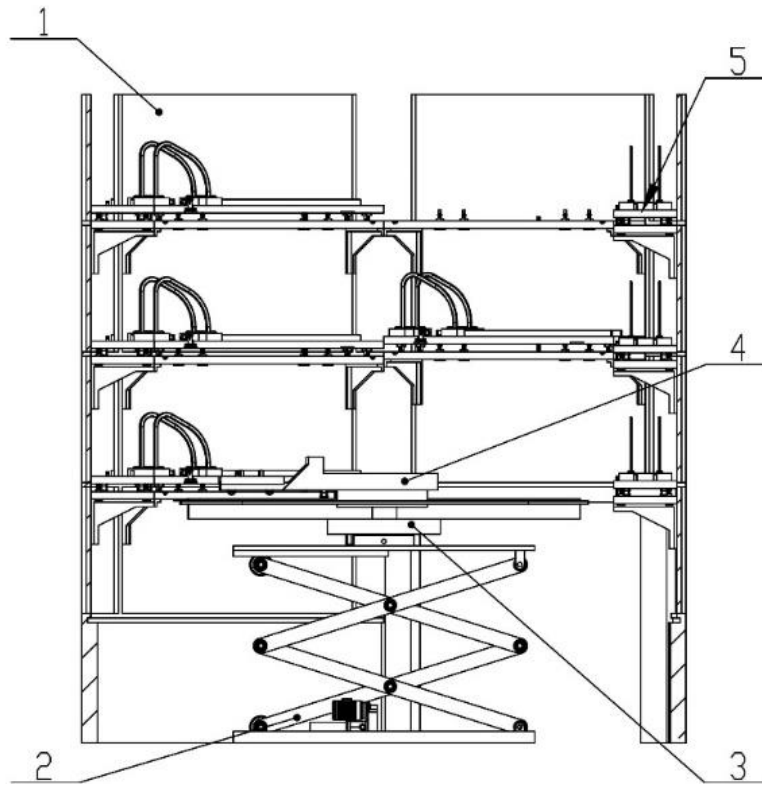


Fig 3. Garage Overall Design

3.2. Garage Part Design

3.2.1. Garage Frame Design

The garage shape is shown in Fig 4. The garage frame (1) consists of welded steel frame (1-2) and transparent wallboard (1-1). The welded steel frame (1-2) is a polygonal multi-layer structure. The transparent wallboard (1-1) for advertisement and the bracket (1-4) for placing the parking plate are installed on each side of the steel frame. Four cylindrical pins with fixed parking plate on the bracket and charging of the electric vehicle are installed. Interface. The frame shape of the garage uses regular hexagon, which makes it more adaptable to the site and occupies less space. There are four storeys in the garage. Six battery cars can be parked in each storey, and the number of storeys and edges can be expanded according to the area of the garage. Transparent wallboard can be used as billboards to advertise, which solve the problem of large parking area for electric vehicles and the waste of land in the layout of advertising buildings.

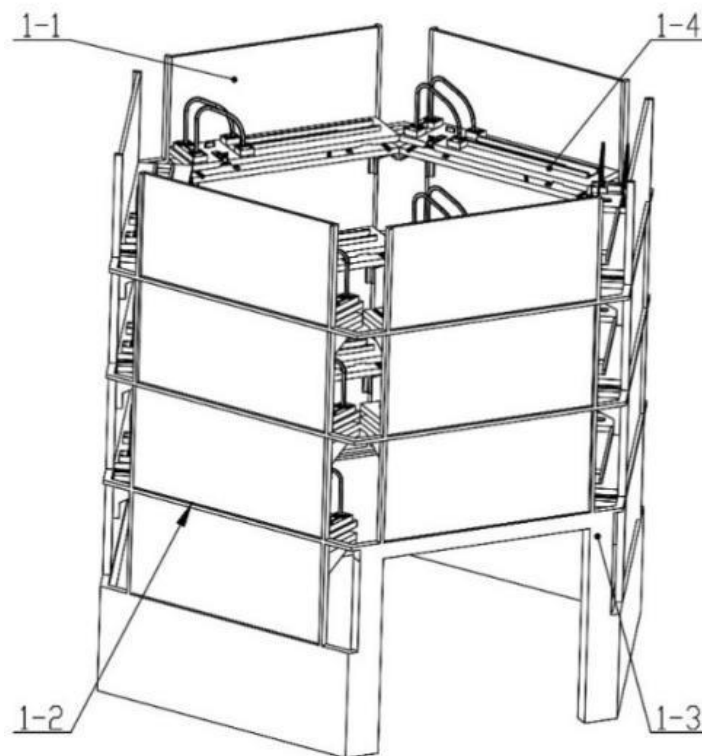


Fig4. Garage Profile

3.2.2. Garage Lifting Device Design

As shown in Fig 5, the garage lifting frame (2) includes lifting platform (2-1), scissors lifting frame (2-2), lifting platform (2-3) and hydraulic push rod (2-4). The scissors lifting frame (2-2) is driven by hydraulic push rod (2-4) and connected with lifting platform (2-3) and upper platform (2-1). The lifting platform (2-1) is equipped with bearing box fixed seat (2-5). In the lifting device, hydraulic scissors lifting platform is chosen as the main lifting mechanism, because of its mature and reliable technology, low failure rate, large bearing capacity, making the lifting device can provide stable lifting movement.

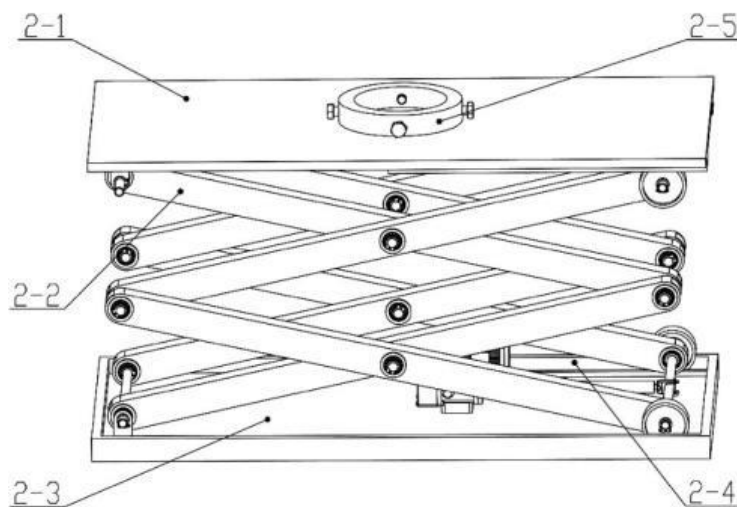


Fig 5. Garage Lift

3.2.3. Garage Rotary Device Design

The garage rotating device is shown in Fig 6. The rotating device (3), the rotating device reducer (3-6) is installed on the rotating box body (3-5) through the foot screw, the motor is connected with the input shaft of the reducer (3-6), the output shaft of the reducer (3-6) is connected with the worm wheel (3-7) through the coupling, and the worm wheel is installed on the rotating vertical shaft (3-10) through the key connection, and the rotating vertical shaft (3-6) is rotated. - 10) Fixed between the rotating box body (3-5) and the rotating upper platform through multi-bolt connection, large tapered roller bearings (3-9,) with auxiliary rotation are installed at the bottom of the rotating vertical shaft (3-10), and tapered roller bearings (3-9) are fixed in the rotating bearing box (3-8). When the motor starts to work, the worm motion is driven by the coupling, and the rotating vertical axis connected to the worm wheel is rotated by the transmission of the worm wheel and worm, thus fulfilling the rotating requirement of the whole device.

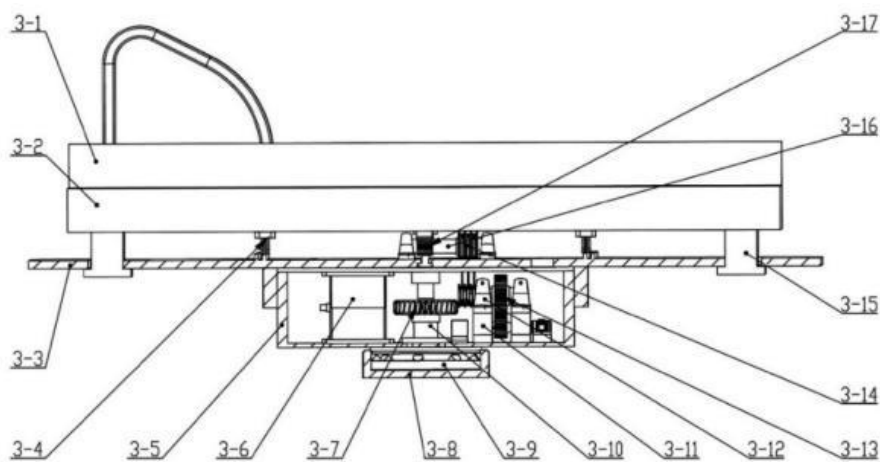


Fig 6. Rotating gear and parking rack

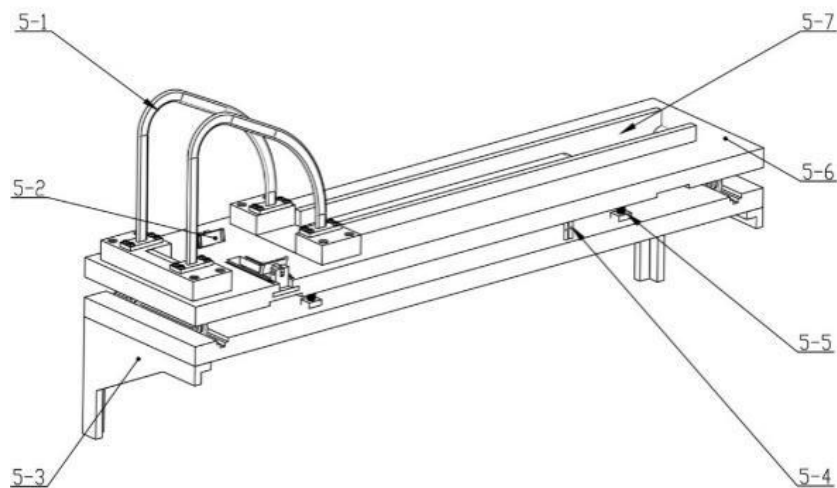


Fig 7. Battery Car Parking Device

3.2.4. Garage Propulsion Device Design

The garage propulsion device is shown in Fig 7. The propulsion device (4), the rotary box (3-5) are

equipped with the bearing seat mounting seat (3-11), the bearing seat (3-12) of the propulsion device is mounted on the mounting seat (3-11) through the foot screw, and the propulsion deceleration gear set (3-13) is supported by the bearing seat (3-12) and connected with the propulsion deceleration belt wheel set (3-14) to form a secondary deceleration device. The gear shafts (3-16) with large pulleys are matched with the propelling racks (3-17). The racks (3-17) are fixed on the propulsive fork rack (3-2). The propulsive platform (3-3) is strengthened by the reinforcement rib plate (4-2) and fixed on the rotary box (3-5) through multi-bolt connection. The propulsive fork rack (3-2) on the propulsive platform (3-3) is driven by the gear racks, four propulsive travel wheels (3-4) and the fork. The frame restraint foot (3-15) ensures stability, and the propulsion fork (3-4) is equipped with four electromagnets.

4. Control System Design

4.1. Control System

The garage model is divided into five layers, while has 28 storage parking spaces. The structure frame, motion, control and safety parts are controlled by automatic and manual methods. Specifically, the garage uses Siemens S7-200 series as the control core.

Tab.1 Input Address Assignment Table

Input Address Assignment Table		
Serial number	Address	Function
1	I0.0	Start button
2	I0.1	Stop button
3	I0.2	Emergency stop button
4	I0.3	Reset button
5	I0.4	Left Limit of Car Plate
6	I0.5	Right Limit of Car Plate
7	I0.6	Plate Limit
8	I0.7	Lower limit of car plate
9	I1.0~I4.3	Location Selection Button

Tab.2 Output Address Assignment Table

Output Address Assignment Table		
Serial number	Address	Function
1	Q0.0	Working indicator
2	Q0.1	Failure indicator
3	Q0.2	Alarm alarm
4	Q0.3	Lift motor forward rotation
5	Q0.4	Lift motor inversion
6	Q0.5~Q1.2	Rotating motor
7	Q1.3	Forward rotation of translation motor
8	Q1.4	Translation motor inversion

4.2. Control Flow Chart

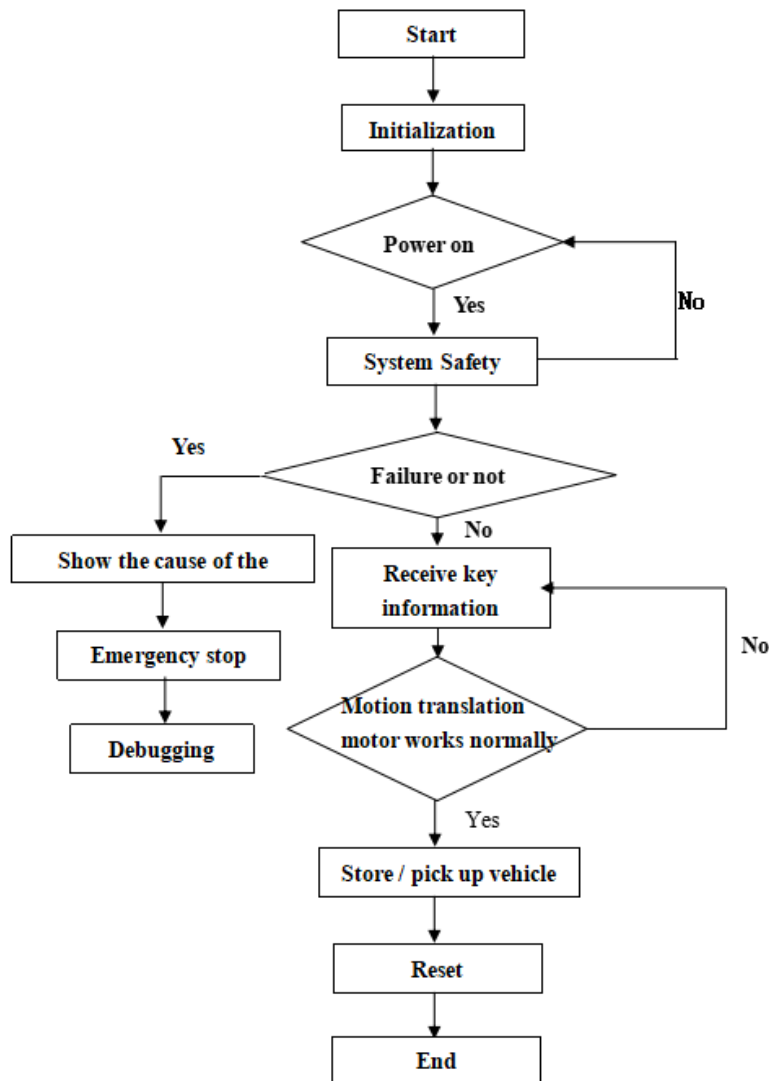


Fig 8. Control Flow Chart

5. Use method of electric garage.

5.1. Parking Method

(1) The parking user first logs his identity into the garage control system. The central controller records the user information and calculates the optimal path. The parking plate is taken out by the garage rotating elevator and placed at the ground entrance.

(2) The user pushes the electric vehicle onto the parking board at the ground entrance, and locks the front wheel clamping device of the electric vehicle. The parking plate of the electric vehicle is automatically conveyed to the empty parking plate bracket by the lifting and rotating propulsion device of the garage.

5.2. Car Collection Method

The central controller processes the information and outputs the parking position. According to the parking position, the garage rotating lifting system takes out the parking plate for the battery car and sends it to the garage entrance. The user can take back the electric car by loosening the front wheel clamping device of the electric car.

In addition, every transparent wall panel of garage frame can be installed with LED display screen. Advertiser users can advertise the advertisement on each LED display screen.

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