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Design of Slideway Device for Emergency Rescue Vehicle

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Abstract. With the rapid development of the country's economic construction, the number of motor vehicles has increased sharply, and traffic jams caused by urban and rural traffic congestion often occur.This subject relates to a slideway device suitable for urban road rescue vehicle, the system is composed of an electrical control device, a small hydraulic station, a quick hook device, a wire rope reel car, a hydraulic jacking device, an automobile limiting device, a backing plate, etc., and the system can make the accident vehicle quickly transfer to the road rescue vehicle, shorten the rescue time, and improve the congestion problem caused by road rescue.

Keywords. Traffic jams; Slide device; Quick transfers; Improve congestion

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1. Introduction

In recent years, the state attaches great importance to disaster prevention and mitigation and public safety, and China's road car rescue system and vigorously develop the road rescue industry has become an important part of China's social security undertakings. The development of the emergency industry ushered in new opportunities, but the overall development level of China's rescue industry lagged behind, rescue services are far from meeting the requirements of the majority of car owners, and the existing rescue agencies are small, chaotic and poor, and need to be further integrated to improve efficiency and resource utilization. China's professional rescue agencies account for only 3%, and the level of insufficient funds, practitioners' skills, rescue equipment and other hardware is backward.

The development status of roadside rescue vehicles in foreign countries shows the characteristics of continuous expansion of market scale, increasingly fierce competition, accelerated technological innovation, continuous improvement of service models and standards, attention to environmental protection and sustainable development, and the coexistence of challenges and opportunities.In response to different accidents and disasters, foreign rescue vehicles have formed rescue vehicles with different modules. For example, earthquake module rescue vehicle, traffic accident module rescue vehicle, rear support module rescue vehicle, etc. These professional rescue vehicles can meet the rescue needs in different scenarios and improve rescue efficiency.In the choice of rescue vehicles, Europe and the Americas present different characteristics. The main development direction of European rescue vehicles is to reduce the size and mass of the whole vehicle, so as to make the rescue vehicles lighter and more flexible; The American rescue vehicle pays more attention to the curb quality of the vehicle and the comprehensiveness of the equipment, so that the rescue vehicle has a wider range of applications.

With the rapid development of China's economic construction, the number of motor vehicles has increased sharply, and traffic jams caused by urban and rural traffic congestion often occur. The products studied in this project are installed in urban road rescue vehicles, which are used to quickly realize the traction and consignment of rescued vehicles, greatly shorten the rescue time of accident vehicles, effectively reduce the problem of urban congestion caused by traffic accidents, and have social and economic benefits.

2. General overview of the installation

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This product relates to a slideway device suitable for urban road rescue vehicles, the system is composed of an electrical control device, a small hydraulic station, a quick hook device, a wire rope reel, a hydraulic jacking device, a car limiting device, a backing plate, etc., the system can make the accident vehicle quickly transfer to the road rescue vehicle, greatly shorten the rescue time, and improve the congestion problem caused by road rescue.The vehicle has a certain height with the ground, and the backing plate is used as the ground slideway, which is convenient for the rescued vehicle to enter the slideway more smoothly; The vehicle sliding device includes the vehicle lifting plate and the roller device. The electrical control device is fixed near the front of the car, and an electric winch is fixed above the device.

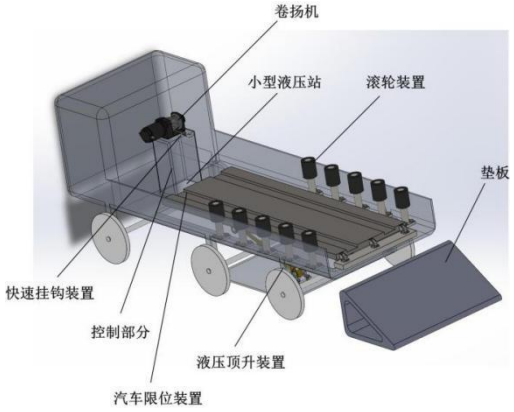

Figure 1: Conceptual diagram of the installation

3. Device workflow

The workflow of this product is as follows:(1) After the rescuer gets off the rescue vehicle, remove the backing plate and place it on the ground (the rear of the rescue vehicle);(2) manually click the button on the control box, the oil cylinder jacks up the lifting plate on the vehicle, releases the wire rope of the electric winch, and the rescuer hooks the rescued vehicle with the wire rope below;(3) start the winch, the rescued vehicle in the process of contact with the roller device, the roller will be corrected and rebounded, the traction direction of the rescued vehicle will be corrected, and the vehicle body will be pulled into the slideway;(4) After the positioning of the rescued car is completed by the automobile limiting device, the rope reel automatically stops, the oil cylinder is recycled, and the loading vehicle plate is flattened as far as possible, and the human wire rope is fixed with the rescue vehicle and the vehicle-containing plate.(5) Manually start the quick hook device to complete the fixation of the rescued car.

4. The main components of the device

4.1. Hydraulic jacking device

The hydraulic oil is pressurized by a vane pump and flows through a filter, an explosion-proof solenoid directional control valve, a throttle valve, a hydraulic one-way valve, and a balance valve to enter the lower end of the cylinder. This pressure drives the piston of the cylinder to move upwards, lifting the loading plate. The oil returning from the upper end of the cylinder passes through the explosion-proof solenoid directional control valve and returns to the oil tank. To ensure reliable braking and prevent accidents, a hydraulic one-way valve, also known as a hydraulic lock, is added to ensure safe self-locking in case of unexpected rupture of the hydraulic pipeline. This system is used for lifting and lowering the loading plate. When the rescue vehicle is in operation, the hydraulic rod extends, lifting the loading plate to form a certain angle with the horizontal plane, facilitating the traction of the vehicle onto the loading plate. After the vehicle is properly positioned, the hydraulic rod retracts, lowering the loading plate to the horizontal position. Then, the fixing device is released, completing the loading of the vehicle.

4.2. The pad

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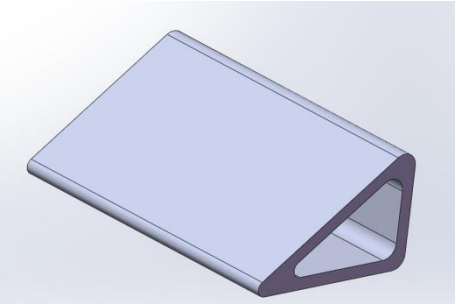

Figure 2. Backing plate

The backing plate is made of lightweight nylon, with strong bearing capacity and light weight, because the vehicle has a certain height with the ground, and the backing plate is taken by the rescuer to connect the ground with the vehicle-containing plate on the vehicle, so as to facilitate the vehicle to be towed onto the rescue vehicle.

4.3. Automotive limit device

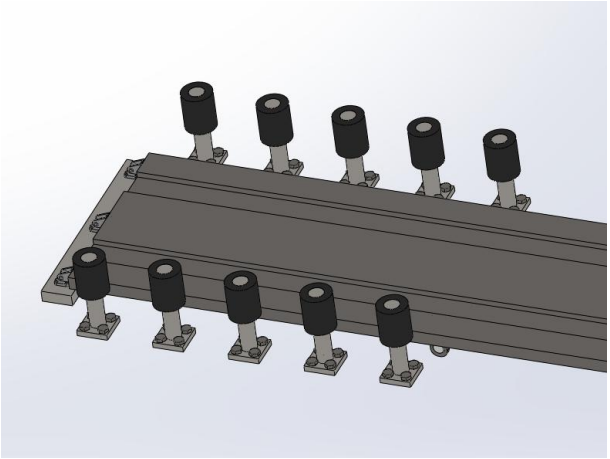

Figure 3. Automobile limiting device

The car limit is completed by the roller device, and the material is made of new MC nylon, which has good comprehensive performance, high strength, stiffness and hardness, creep resistance, wear resistance, heat aging resistance, low friction coefficient and smooth surface. It can be combined well with the rescue vehicle to play a role. This device is suitable for the vehicle traction direction deviation from the track, to correct the vehicle traction direction, when the vehicle surface is in contact with the roller, the roller will be in the right position of the vehicle by rebounding and turning to the traction, so as to avoid the secondary accident caused by rollover.

4.4. Quick hook device

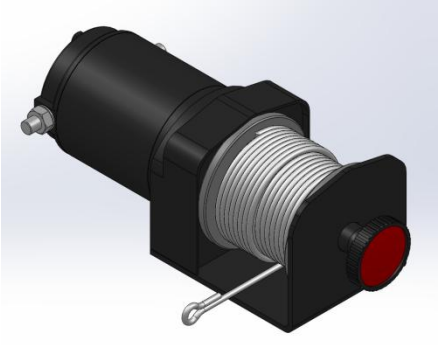

Figure 4. Quick hook device

Quick hook device, using a P2000 electric winch as a power source,The operating voltage of the p2000 electric winch (ATV DJ): 380V, 220V, 110V is high voltage. 36V, 24V, 12V is low voltage (12V is direct current, 220V is

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alternating current), by the winch body, box shell, coupling plate, slewing ring bearing with internal ring gear, vertical conical cylindrical gear reducer, etc., the winch has the characteristics of simple structure, high transmission efficiency, light weight, small footprint, etc., especially suitable for vehicle operation, the winch structure is simple, durable, easy to operate. The traction force can reach 12-30 kN, which is enough for towing vehicles. In order to place the winch, a casing is buried, and after the winch is inserted into the casing, it can be rotated arbitrarily according to the direction of the towed vehicle.

4.5. Small hydraulic station

The small hydraulic station is mainly composed of piston pump, cooling pump system, filter, electromagnetic relief valve, two-position two-way reversing valve, throttle valve, manual ball valve, pressure gauge, one-way stop valve, relief valve, thermostat, pressure sensor, heater, disc gate, accumulator, proportional control valve, globe valve, remote thermostat, oil level relay, etc.

The working principle of the small hydraulic station:The hydraulic pump consists of an overload protected shaft piston variable variable pump and a single-speed motor that provides pressure to the hydraulic control elements. When the brake is released, the accumulator reaches its maximum pressure. After the brake is released, the hydraulic pump only needs to provide pressure to compensate for the loss of system energy. The variable hydraulic pump automatically reduces the flow output and maintains the system pressure.

4.6. Electrical controls

There are three main parts of the electrical control device: the input part (such as sensors, switches, buttons, etc.), the logic part (such as relays, electric shocks, etc.) and the execution part (such as solenoid coils, indicator lights, etc.). It is used to realize the control of the rescued vehicle, so as to ensure that the rescued vehicle can safely and accurately enter the slideway.

The relay is used to control the motor, the auxiliary contact of the relay KM is connected in series in the main circuit of the motor control in the main circuit, as shown in the figure, because the motor power is not large, the motor start-up protection can be temporarily disregarded, the auxiliary circuit of the single-chip microcomputer is shown in the left figure, VCC, Y, GND, I0 are the power port, crystal oscillator, grounding, output port of the single-chip microcomputer, and the program is written into the I0 port of the single-chip microcomputer, and the function of timing the relay KM is realized to realize the simple control of the motor start and stop.

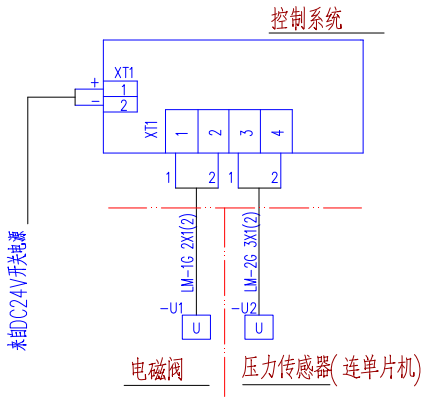

Figure 5 Electrical control diagram

4.7. The main features of the device

(1) This product uses a quick-lowered slideway device to complete the rescue work of the rescued vehicle, replacing the process of lifting and grabbing the vehicle by the conventional crane, and only one rescue worker is required to operate next to the machine to improve work efficiency;

(2) This product can realize the rapid recovery and decentralization of the rescued vehicle, compared with the conventional crane grasping and lowering, greatly shortening the rescue time and avoiding traffic jams;

(3) Compared with the crane hoisting rescue system, the main executive components of the system are composed of a hydraulic station, a hydraulic jacking device and a traversing device, which has high reliability, silence and good safety, and can effectively avoid the secondary traffic accident caused by the unstable center of gravity in the crane hoisting process.

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5. Application prospects, social value and parts to be improved of the device

With the frequent occurrence of natural disasters and man-made accidents around the world, the demand for emergency rescue equipment is increasing day by day. As an efficient and rapid evacuation and evacuation equipment, the slideway device will occupy an important position in the future emergency rescue. The slideway device has the characteristics of high safety, flame retardant, anti-static, etc., which can ensure the safe evacuation of personnel in an emergency. At the same time, its evacuation speed is fast and the sliding speed is adjustable, which improves the rescue efficiency. This device has the characteristics of fast and convenient, and is bound to be widely used in highway emergency rescue.

In the next step, we will focus on "the working range is not large, and the performance and structure of the vehicle are difficult to meet the needs of a variety of vehicle rescues." According to the existing process assembly level, a reasonable and perfect design is carried out, and the rescuers as the most important users of the emergency rescue vehicle can also provide the most valuable user opinion information.

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