Research on adjustable intelligent speed retarder

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Abstract: The existing speed bumps can reduce the number of traffic accidents, but it will reduce the comfort of drivers and reduce the service life of passing vehicles. In order to reduce the number of traffic accidents at the same time, to ensure the driver's comfort according to the provisions of the driving, to prevent the service life of the vehicle to reduce, put forward a lifting speed belt, the speed belt by measuring subsystem, lifting power subsystem and deceleration plate device composed. The experimental results show that the device can maximize the driver's comfort while reducing the speed of passing vehicles, reduce the number of traffic accidents, improve traffic safety, and protect people's life and property safety.

Key words: adjustable speed retarder; Driver comfort; Vehicle service life; Traffic safety; Life safety

Introduction

In modern traffic management, as an important traffic safety facility, speed bumps are widely used in roads, parking lots and other traffic areas to control the speed of vehicles and reduce the occurrence of traffic accidents. Studies have shown that on the same road, the speed reducer can reduce the speed of most vehicles by about 30%, which can reduce the number of accidents on the road by about 70%, and the number of accidents on the surrounding road is also reduced accordingly. However, the traditional static speed bumps lack of "humanized" design, and their fixed height leads to bumps regardless of whether the vehicle is speeding, and even impacts on the vehicle's suspension system and site, reducing the service life of the car. Based on this, a design according to the actual speed of the vehicle to achieve automatic lifting type speed bump, improve the flexibility and adaptability of the speed bump, minimize the negative impact of the speed bump, to achieve the humanized design of obstacle speed limit facilities.

1. Research overview

1.1 Domestic and foreign related research

In the 1920s, California was the first to install speed bumps, and China began to start in the late 1970s, initially to facilitate truck deceleration or parking, China's speed bump technology started late. In 1975, Steven Wright invented a "tongue" speed bump, also known as a "V" speed bump, which was designed to tilt at the bottom and sides to improve the comfort of vehicles passing through. In 2020, Deokjae Heo and Jihoon Chung, among others, investigated the feasibility of speed bumps as a solution to traffic congestion and road accidents, using them as self-powered sensors in ITS. A Hakan Lav and Ertugrul Bilgin et al. created a 1:6 scaled model to simulate the interaction between car wheels and speed bumps, demonstrating that speed bumps reduce vehicle speed while also reducing vehicle service life to some extent.

Wang Hongyan and Xie Jincheng from Qiqihar University established a simplified model of 1/2 vehicle system by using SimMechanics module in MATLAB software, which confirmed that the vehicle will be damaged when passing the speed bump, and the speed bump will affect the smooth running of the vehicle without difference. Tang Li and Wang Yuhang of Chongqing Jiaotong University designed a kind of induction-type hydraulic lifting speed bump, but the application scope is limited to long steep slope, and the application scope is narrow.

With the increase of vehicle ownership and the increasing complexity of roads, it is inevitable that the number of traffic accidents will gradually increase, and people's life and property safety will be seriously damaged. However, the existing speed bumps are usually fixed, can not be adjusted according to the need to adjust the height, regardless of speed, will cause bumpy feeling, not only reduce the ride comfort, but also reduce the service life of the vehicle. Therefore, it is necessary to design a lifting speed bump, which can control the lifting of the speed bump when the vehicle is detected speeding. The research of this project includes the speed measurement subsystem, the lifting power subsystem and the deceleration plate device, which is a joint speedometer and the deceleration plate device as one of the speed can be associated with the lifting speed belt. With accurate control and rapid response as the goal, with intelligent accurate control, the speed of vehicles can be more effectively limited, which is in line with the concept of green development, and helps to promote the construction of smart cities and the modernization of traffic management, improve road traffic safety, and effectively guarantee the safety of people's lives and property.

2. Structure principle

2.1 System structure and function

The lifting speed belt is composed of a speed measuring subsystem, a lifting power system and a decelerating plate device. The speed measuring subsystem is composed of a speed measuring device and an electrical signal transmission device, which has the function of vehicle speed acquisition and signal import and export. The tachometer device is set on the side of the road, in the preset distance range of the vehicle real-time speed acquisition, and through the electrical signal transmission device will collect the speed information into the speed measurement subsystem, the tachometer device collected speed information and the preset speed value is compared, through analysis and judgment, give real-time feedback to the lifting speed belt, issue lifting instructions.

The lifting power subsystem includes an electrical signal receiving device, a motor, a push rod pillar, a push rod, a push rod flange, a

lower box, a stroke switch and a limit block, which has the function of receiving signals and controlling the rise and fall of the deceleration plate, and is the core power part of the lifting deceleration belt. After the electrical signal receiving device receives the overspeed signal, the motor can be controlled to lift the push rod and the push rod flange, the push rod and the push rod flange will then lift the gear plate device, while the stroke switch and the limit block will lock the push rod and the push rod flange, after the rise time set by the speed reducer, the stroke switch and the limit block release control, the push rod pillar control the push rod unloading force decline. Thus making the deceleration strip down. The structure of the control device that can raise and lower the speed reducer is shown in Figure 1. The deceleration plate device is composed of the deceleration motherboard and the deceleration side plate. It can ensure the smooth passage of the vehicle without lifting, and the lifting can effectively control the speed. The structure of the liftable speed reducer can be seen in figure 2.

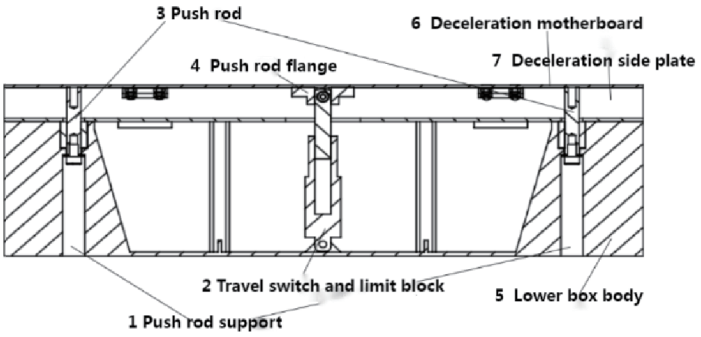

Figure 1 Structure diagram of the control device

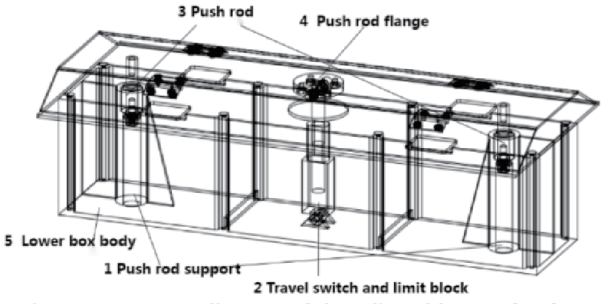

Figure 2 Structure diagram of the adjustable speed reducer

2.2 Working principle of the system

The adjustable speed reducer intelligently adjusts the speed of the speed reducer to limit the speed within the safe range, and ensures the safety of vehicles and pedestrians in the speed limit section. The speed detector device is installed to L meters away from the speed reducer, which can detect the vehicle speed v in front of M meters, the speed of the site is compared with the speed limit v0 of the current section, if less than the speed limit of the section, the speed reduction does not rise, the vehicle can gently pass; If it is greater than the speed limit of the road section, the speed bump rises, reminding the driver to slow down, and according to the speed limit of the road section and the location of the speed measurement point and the speed bump set a reasonable speed bump rise detention time t0, if the vehicle passes within the set time, it will be jolted, and the reverse will not be jolted.

2.3 Determine the speed measurement site and the rising time

The vehicle speeding over the speed measurement point, slow down to raise to remind the driver to slow down, in order to make the driver have enough distance to slow down and play a better deceleration effect, it is necessary to accurately determine the speed measurement point and speed bump rise time. According to the kinematic model, the distance calculation model between the speed reducer and the speed measurement point is proposed, the formula is. $L = v_2 + (v_c^2 - v^2) * 2a_0$ Where L is the distance from the deceleration belt to the measuring point, v is the speed measured by the speed detector, vc is the speed at the arrival of the deceleration belt (if you want to gently drive over, vc should be less than or equal to v0), t is the total reaction time and braking coordination time 0.7s; a0 is the safe braking acceleration, and the dry asphalt surface is 6.5m/s2. If the limit speed of a road section is known, the distance from the speed measurement point to the deceleration strip can be obtained according to the above formula. The speed bump rising time can be determined by the speed limit of the road and the desired S, if a vehicle in the speed limit of v0 on the road to v0 uniform speed from the speed measurement point through the speed bump, then through the speed bump, the speed bump just fall, The time used by the vehicle to travel from the speed measurement point to the speed bump (t=L/v0) can be used as the speed bump rising time, so the speed bump lifting or falling time needs to be controlled within L/2v0.

3 Substantive technical features and significant progress

Ordinary road speed bumps have disadvantages such as non-standard setting, poor driver comfort, and easy damage to vehicles. The lifting speed belt is composed of the speed measuring subsystem, the lifting power subsystem and the deceleration plate device. The speed measuring subsystem has the function of information import and signal output. The speed information collected by the tachometer device is compared with the preset speed value. The lifting speed belt adopts mechanical structure, which has high transmission efficiency, reliable work and compact structure, rather than the traditional hydraulic or pneumatic system, which reduces the maintenance cost and energy consumption, and considers the recyclability of materials in the design process, which is in line with the concept of energy saving and environmental protection. The electrical signal transmission device and the tachometer in the speed measurement subsystem are unified as a whole. The tachometer device directly sends the electrical signal to the electrical signal transmission device after measuring the vehicle speeding, and transmits the speeding signal to the electrical signal receiving device in the lifting power subsystem, so as to realize the flexible switching of the deceleration belt in the rising and steady state.

4 Application prospect

4.1 Improving traffic safety

In recent years, traffic accidents occur frequently in areas with dense personnel, many intersections and high road uncertainty in China. The future application prospects of the adjustable speed belt in such areas are broad, its overall adaptability is good, it can be applied in a wide range, it can be set in most sections, and intelligent regulation can be carried out according to the actual situation and changes in traffic flow, so as to achieve accurate quality control and sustainable development. Improve the level of traffic safety in the city and ensure the safety of people's lives and property. Although the existing ordinary speed bumps have been applied in life, they cannot achieve accurate quality control and are not intelligent. This project has a broad prospect in terms of demand application.

4.2 Improve the urban traffic environment

The speed belt can be lifted to comprehensively consider the relationship between the safety of local sections and the level of road service, so that the two can achieve machine coordination, for the vehicle speed within the speed limit range, the speed belt will be lowered to reduce the environmental pollution caused by frequent vehicle start-stop. High comprehensive benefits, conducive to improving the overall traffic environment, combined with the theme of sustainable development, to achieve green traffic.

5 Epilogue

This research deeply discusses the design and application of a lifting speed belt, which integrates speed measurement subsystem, lifting power subsystem and speed plate device, aiming at ensuring traffic safety while ensuring the driver's comfort. Traditional speed bumps can effectively reduce the speed of vehicles and reduce the possibility of traffic accidents. However, traditional speed bumps can not identify vehicles driving according to regulations, and will reduce the driver's comfort and vehicle service life without difference. The device can accurately identify speeding vehicles and only force speeding vehicles to slow down, which can reduce the number of traffic accidents while ensuring the driver's comfort. However, this study is only the beginning of exploration, and there are still many shortcomings and research directions. This device needs to be buried underground, has certain damage to the ground, and is greatly affected by extreme weather, which are the directions of future research. In addition, the formulation of relevant policies and regulations will also play a key role in promoting the popularization and specification of this technology.

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