Innovative Design of Speed Control Bump Based on SolidWorks

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Abstract

Human society consumes a lot of energy in the long process of development. Nowadays, as the foundation of economic and social development, energy has become a top priority for social development. It has become an urgent research focus how to collect, utilize and save energy. Through the analysis and research of the road speed reducer, a power generation device based on deceleration zone was designed and developed by using SolidWorks. The device utilizes the contact process of the car and the speed control bump to collect energy and store it in the form of electricity, thereby achieving the purpose of energy recycling.

Keyword---Energy-saving, Speed control bump, Innovative design

I. THE STATUS OF SPEED CONTROL BUMP IN CHINA

Power generation is a production process that converts other energy sources such as fossil energy, hydro energy, and geothermal energy into electrical energy. Nowadays, fossil fuels are used for power generation, but the resources of fossil fuels are limited and non-renewable. Therefore, with the massive use, fossil resources are depleted, and at the same time, the use of fossil energy is brought environmental problems such as smog, greenhouse gases and acid rain. Humans have gradually used more renewable energy (solar, hydro, geothermal, tidal, etc.) to generate electricity to meet the needs of people's lives and the economic sectors of the country.

The power generation methods that we usually find are including hydroelectric power generation, thermal power generation (also the most common for fossil energy consumption), nuclear power generation and other energy generation methods. Whether it is hydroelectric or thermal power or even nuclear power, it drives steam or liquid water or air to drive the generator to generate electricity.

With the large use of automobiles in China, the use of speed control bumps has begun to be widely used, as shown in Figure 1. However, in the face of so many vehicles and vehicles in China, the overload situation is serious and the overtaking of vehicles is more frequent. China has a hump-type speed control bump that has a long service life, is cheap and has a

deceleration effect. However, there are various problems. For example, because the material of the speed control bump is hard, the car is rigidly impacted when it is over the speed control

Figure 1 General speed bump

bump, and the driver is more shocked. It affects the driver's driving feeling seriously, at the same time, such a drastic force to change the speed of the car, so that all parts of the car will be strongly shaken, and the service life will be reducing. The rigid impact of the car and the speed control bump not only damages the car, but also the speed control bump is seriously damaged. More importantly, the driver will instinctively avoid the speed control bump, when the speed control bump is damaged. It is easy to form multiple cars. The phenomenon of cars occupying the gap could cause traffic accidents.

It is very possible to design a power generation device based on the speed reducer. The existing speed reducer has a single function but widely used, and there is a large space for product redesign. By designing the speed control bump to expand the function of the speed control bump, the speed control bump can generate additional economic value on the existing basis, and it can also generate considerable economic benefits through the multiplication effect. You can consider first from the structure and use characteristics of the product to design the speed control bumper. The working process of the speed control bump: when the vehicle comes in and drowned the speed control bump, the stripe and height on the speed control bump decelerate the vehicle. According to the use process of the speed reducer, we can know that the speed reducer needs to bear the heavy pressure of the vehicle, and the speed reducer itself has a certain height and elasticity. The speed reducer is deformed due to the pressure of the vehicle during the work. In this process, a part of the chemical energy generated by the burning of gasoline in the vehicle is converted into the elastic potential energy of the speed control bump. Finally, the elastic potential energy of the speed control bump is wasted.

The car will have a number of energy consumption after passing through the speed control bump. China has 160 million vehicles[1], and the roads extend in all directions. If this energy could be collected and reused, it can save a considerable amount of energy.

In order to achieve this goal, a new type of road speed reducer for power generation and illumination is designed by means of SolidWorks 3D modeling tool, which includes stroke amplification mechanism, energy conversion device and power generation storage device.

II. INTRODUCTION OF SOLIDWORKS

SolidWorks is a 3D design software developed by Dassault, France. It has powerful parts modeling, assembly entities and automation engineering drawings, and develops various application plug-ins for different design objects, which can be applied to all aspects of product development. And because of its friendly graphical interface, simple and convenient operation, it has been widely used in the field of mechanical design[2][3].

III. INNOVATIVE DESIGN OF THE SPEED REDUCER

A. The overall of design idea

The energy storage speed control bump can collect the energy of the car without having effect on the

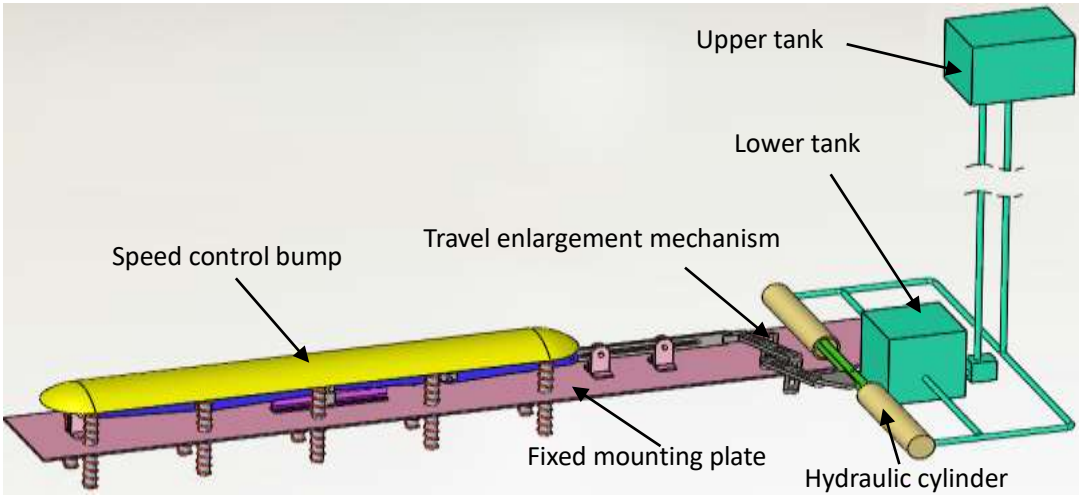

Figure2. the structure of the new speed bump

function of the speed control bump itself, shown in Figure 2. And because the spring buffer under the speed reducer reduces the bumps in the car, and the device is slowing down. Energy can storage when it is compressed and resets, with featuring high energy efficiency[4].

B. Main structure of the travel enlargement mechanism

After the opening installation groove of the road surface, the speed control bump is embedded in the ground. When the vehicle passes, the speed control bump is pressed downward and the spring is compressed and deformed, and the sliding rail fixed to the speed control bump is simultaneously moved downward[5].

Correspondingly, the slider is forced to slide under the action of the link, and its displacement is amplified by the multi-link mechanism and output to the Scissors mechanism. The end of scissors mechanism is connected to the piston rod of the energy conversion device and is displaced by the scissors mechanism, zoomed in again. By the spring, the speed control bump is displaced upward to return to the original position after the vehicles pass.

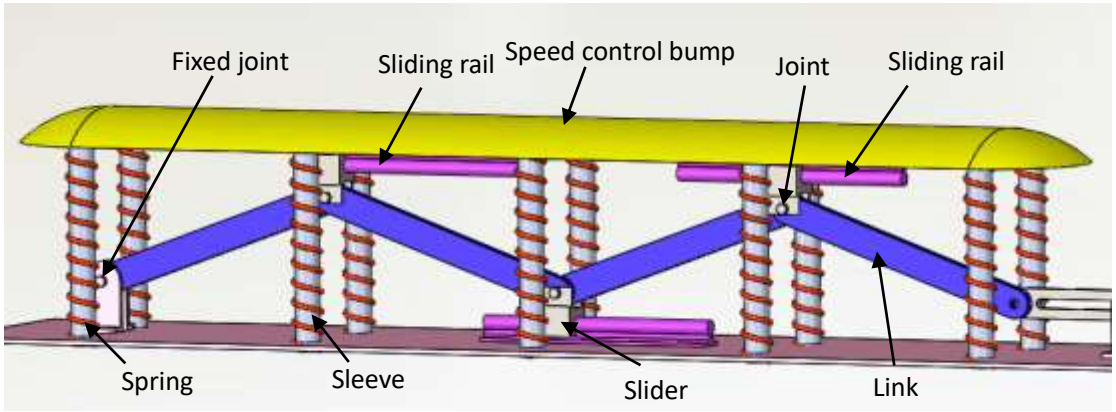

Figure3. Multi-link mechanism

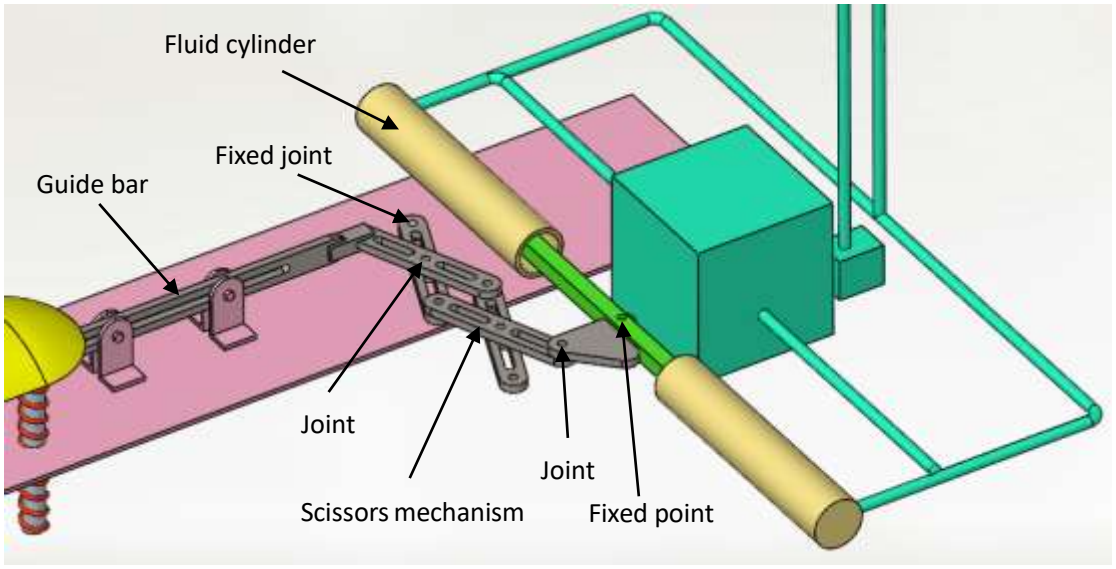

Figure4. Scissors mechanism

C. Main structure of the Energy Conversion Device

The energy conversion device comprises two oppositely arranged hydraulic cylinders, the pistons of the two hydraulic cylinders are connected with the same push rod, and the push rod is connected with the output of end of the scissor mechanism. The ends of the two hydraulic cylinders are connected to the lower water tank and the upper water tank through the pipeline. Among, through the pipeline 1 and the pipeline 2, water can only flow from the lower tank to the hydraulic cylinder; the water passing through the pipeline 3 and the pipeline 4 can only flow from the hydraulic cylinder to the upper tank (Directions of flow as shown in Figure 5, the blue arrow in Figure 5 illustrates the direction of water flow in the pipeline).

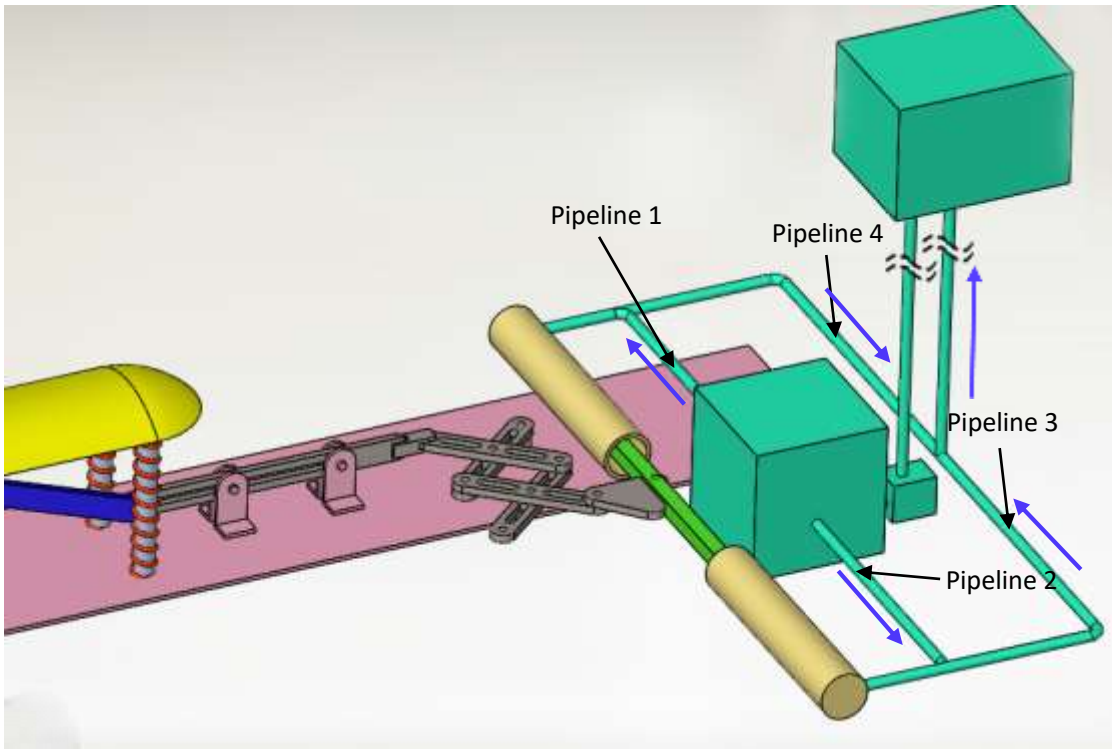

Figure5. Directions of water flow in pipelines

When the car passes the speed control bump, the speed control bump is pressed by the sleeve to compress the spring downwards and pushed by the four-bar linkage mechanism to push the guide rod. By the fork mechanism is pushed, the hydraulic rod is displaced, and at this time, the one-way valve of the pipeline 2 and the pipeline 4 closes the pipeline, and the one-way valve of the pipeline 1 and the pipeline 3 is turned on, so that the water in the cylinder 2 is pressed to the upper tank through the pipeline, and the water in the lower tank is sucked into the cylinder through the pipeline 1.

Conversely, after the car drives away from the speed control bump, the speed control bump moves upward under the action of the spring restoring force, and the hydraulic rod is pulled by the intermediate mechanism to press the water in the cylinder 1 through the pipeline to the upper water tank. At the same time, the water in the lower tank is drawn into the cylinder 2 via the line 2. Each time the water is sent to the upper tank through the pipeline is an energy harvest, and the speed control bump completes the energy conversion process twice per work[6].

D. Structure of the energy recovery device

After the liquid level in the upper tank reaches the set height, the water will be released to the lower tank. In this process, the water flows through the power generating device to complete the energy conversion process, and the generated electricity is stored in the battery.

When the car passes the speed control bump, the water in the lower tank will be pressed to the upper tank again and again, and then the power will be generated when flowing back to the lower tank.

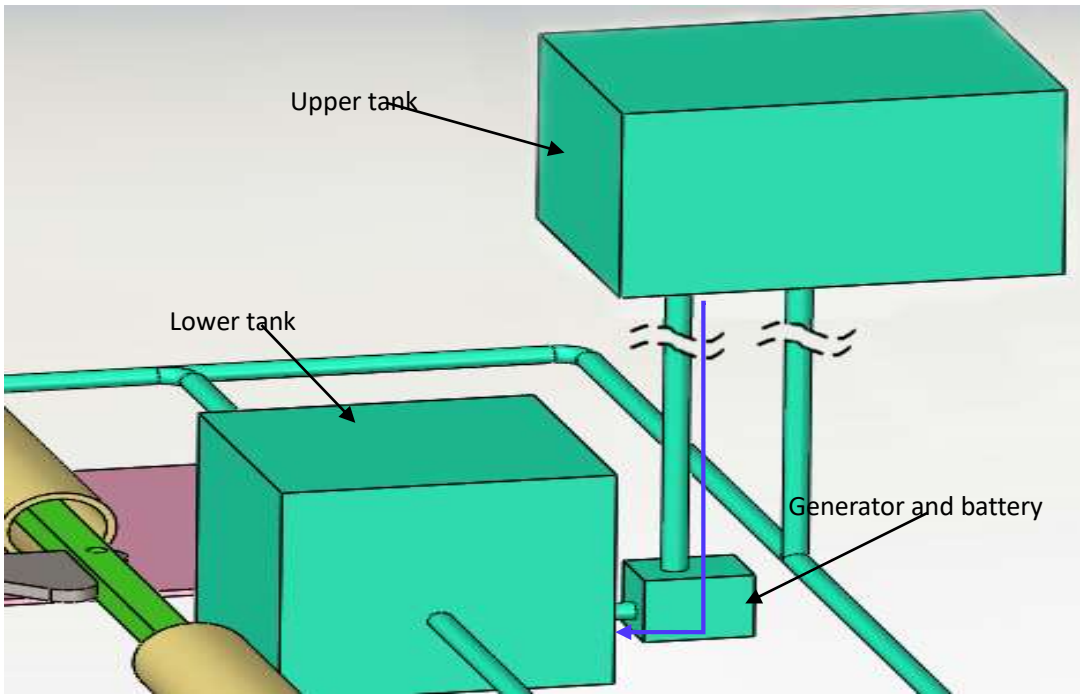

Figure6. Generation and storage devices

IV. CONCLUSION

After analysis and calculation, if there are about 300 vehicles enter and exit in a medium-sized community per day, there will be 600 vehicles entering and exiting each time in each speed control bump, each vehicle has two speed reduction belts. If there are three speed control bumps, then it can generate electricity 3,600 times. Through the rolling of three speed control bumps can send 18 degrees of electricity a day, which can be used for 60 40-watt street lights for 7.5 hours by calculating. That greatly improves energy efficiency, and environmental protection. In addition, the speed control bumper can also be used in highway toll stations, parking lots in shopping malls, etc. In such places, the number of vehicles entering and leaving each day will be several times that of a medium-sized community, and the electricity generated is several times that of a medium-sized community. You can't imagine that only one expressway with only three toll stations in Beijing can generate 52.5 degrees of electricity per day.

The novel power generation speed reduction belt described herein has the following advantages:

1. The structure is simple and novel, and the whole device is hidden underground and does not occupy the road surface.

2. The energy release mode that first converts the energy of the car through the speed control bump into the potential energy of the water and then releases it stably which is stable and reliable. And we can adjust the displacement of the speed control bump up and down by the adjustment of the spring force. The operability and adaptability are high.

3. Due to the simple structure, the stroke of the speed control bump in both directions is used to generate power for the hydraulic cylinder, and the stiffness coefficient of the spring determines the bearing capacity of the limit position of the speed control bump. The generated electric energy is proportional to the weight of the vehicle, and the energy conversion rate is higher.

4. By using of springs and hydraulic piston cylinders, the resistance is effectively increased, and the sinking movement of the speed control bump can reduce the vibration of the car and protect the people inside of the car.

5. The energy conversion part is stabilized because it first raises a amount of water and then released stably, so that the entire power generation process is stable and the damage to the device is small.

6. The energy conversion process uses water as a medium for transfer, with low loss and high efficiency. The whole process is green, pollution-free, sustainable, safe and reliable without manual assistance.

7. A plurality of speed control bumps adopt parallel hydraulic circuits, share a set of water supply mechanism, water storage mechanism and power storage part, which saves more energy, saves cost and space, and improves efficiency.

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