Design of the Downhill Automatic Liquid Damping Reduction Mechanism on the carbon-free car

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Abstract: The carbon-free car is driven by gravity potential energy, through the mechanism to complete the specific direction control and avoid obstacles, to achieve the driving purpose of the car. The event is a national science and technology innovation activity project organized by relevant departments. It is a competition that demonstrates the engineering training and comprehensive ability of college students. Based on the "S" and "8" glyphs around the pile competition, a new circular track was added, and the track was randomly set with intermittent barrier walls and up and down ramps. Small cars that do not have the ability to climb and do not have speed control on the upper and lower ramps make it difficult to complete the race. To this end, for the content of the new project, the automatic speed reduction mechanism for the carbon-free car downhill is developed. Under the condition that the gravitational potential energy of the carbon-free car on the downhill is constant, the stall phenomenon at the time of downhill is effectively solved, the safe driving speed is adjusted, avoid the problem of out of control when escaping the intermittent barrier wall on the circular track.

Key words: carbon-free car, reduction mechanism, damping.

1. Design content

1.1. Target requirements
It adopts the characteristics of liquid self-flow and self-leveling as the automatic damping power, which effectively solves the phenomenon that the carbon-free car in the downhill driving suddenly accelerates and continues to accelerate. When circumventing the intermittent barrier wall on the circular track below the ramp, if the carbon-free car exceeds the safe driving speed, it will cause problems such as out of control or rollover. The liquid automatic damping deceleration method is novel, simple structure, automatic flexibility, timely automatic performance and so on.

1.2. Specific programmes
The liquid automatic damping reduction mechanism is mainly composed of a frame support body, a water storage part and a damping deceleration part.
Figure 1. Schematic diagram of a preferred embodiment. 1 sub-tank port; 2 sub-tank; 3 water pipe; 4 frame; 5 V-shaped groove plate; 6 support; 7 water; 8 Crescent pad cover; 9 ejector; 10 main water tank; 11 convex ring; 12 first spring; 13 rod cover; 14 axle; 15 roller; 16 sub tank cover; 17 limit screw; 18 second spring; 19 damper rod; 20 main tank cover; 21 countersunk head screw; 22 runway; 23 main tank mouth; 24 drain port.

The frame support body is a part of the bearing structure of the carbon-free car, and the top rod sleeve, the V-shaped groove plate and the limit screw are respectively installed in the front, middle and rear of the left edge of the frame. The V-shaped groove plate is horizontally disposed on the left side edge of the frame to form a frame support body; Balanced water storage part of the water pipe is connected and fixed to the bottom cover of the main water tank and the auxiliary water tank respectively, wherein the main and auxiliary water tank ports are as shown in Fig. 2.

Figure 2. Water tank port schematic

The main and auxiliary water tanks are screwed to the two tank covers, and the main tank cover is provided with a drain port. The crescent pad cover is placed on the drain port and can be freely moved. The middle part of the water pipe is provided with a vertical support body and is placed on the V shape of the support body. In the tank, the water pipe at the auxiliary tank end is suspended at the top end of the frame limit screw to form a balanced water reservoir; For the damping deceleration part, first insert the small spring and the damper rod into the circular holes provided in the end surface of the fulcrum end of the ejector pin respectively, and press the damper rod with the outer diameter of the roller to shrink the small spring; Then, the wheel is positioned on the fork of the ejector by the axle. When the damper wheel rotates, the small spring generates moderate resistance, and then the cylinder in the middle of the ejector is placed in the inner hole of the ejector sleeve; Then use the axle to position the damper on the fork of the ejector pin. When the damper wheel rotates, the small spring generates moderate resistance, and then the cylinder in the middle of the ejector pin is placed in the inner hole of the ejector sleeve. Finally, a large spring is placed on the outer screw diameter of the upper end of the ejector pin.
and is positioned between the nut and the sleeve by a nut, and the ejector is free to move in a vertical shape. The outer diameter of the roller wheel and the distance of the runway should not be in contact.

2. Working principle and process

When a carbon-free car is driven on a runway with flatness requirements, the water pipes are relatively parallel to the runway. Since the water pipe and the main and auxiliary water tanks communicate with each other, the water level of the main and auxiliary water tanks is relatively uniform, so the main and auxiliary water tanks are balanced in weight. When the small car starts or uphill, the horizontal state of the water storage assembly changes, the main water tank is higher than the secondary water tank, the longitudinal horizontal state changes, so that the water level of the main secondary water tank is out of balance, resulting in the control of the main tank flow to the secondary water tank, so that the secondary water tank height drop. At this time, the limit screw restricts the down position of the water pipe and maintains the state of the auxiliary water tank relative to the frame. The basic process is shown in Figure 3.

When the car goes downhill, the horizontal state of the water storage component changes, the limit screw of the auxiliary water tank rises with the frame, the auxiliary water tank is higher than the main water tank, and the water in the auxiliary water tank flows to the main water tank through the water pipe in a controlled manner, so that the water body increases. The amount of the main tank is lowered, and the formation of gravitational potential energy provides kinetic energy for the automatic damping of the liquid. At this point, the ejector pin on the top of the ejector pin is inserted into the drain port to lift the crescent pad cover, as shown in Figure 5. At the same time, the main tank cover exerts a downward pressure on the ram to force it to descend, causing the damper wheel to contact with the runway. Under the constant force of the second spring and the damper rod, the damper wheel forms an adhesion force with the runway to generate a rolling friction, generating a certain amount of damping deceleration force. On the other hand, since the cover plate is jacked up by the ejector pin, the water in the main water tank is discharged from the water discharge port, and the weight of the main water tank is reduced to reduce the pressure on the ejector pin, to maintain the main water tank to the ejector pin when the car is going downhill. With constant pressure, the carbon-free car runs smoothly with damping and deceleration. When the carbon-free car is driving down the slope, the frame and the water pipe are parallel to the runway. Under the action of self-balancing force, the main and auxiliary water tanks can recover the corresponding horizontal state in time, and the ejector pin loses the pressure of the main water tank. Resetting and lifting the damper wheel to disengage from the runway under the action of the first spring, thereby releasing the deceleration function of the car, Figure 2 shows an enlarged view of the brake section. The deceleration mechanism solves the problem that the running carbon-free car will quickly generate the stall phenomenon of unit time when it goes downhill, resulting in exceeding the safe driving speed of the carbon-free car. Effectively avoid the problem of out of control or running instability when circumventing the intermittent barrier wall on the circular track.
3. Summary
Compared with similar cars, this design pays more attention to the stability of the car body structure, energy utilization and conversion, friction adjustment accuracy, etc.; the use of the balance flow mechanism involves the application of the mechanics principle; the car control friction is more precise, so that the speed at which the car avoids obstacles is easier to control. In addition, the overall structure of the car is simple, there are not many combined parts, the friction loss is small, the efficiency is high, and it is easier to manufacture and install.

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