Research on a New type of Wiper Assembly Based on New Energy Vehicle Electrical System

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Abstract. This paper analyzes the research status of commonly used wiper assembly. It proposes a wiper assembly which is applied to new energy vehicles. Moreover, a new set of wiper assembly device is developed and the hardware design and software programming of the device has been accomplished. This device is used to test the cleanliness and noise of the front windshield of a car. And the test results are presented. The test shows that the device has stable performance, simple operation and it meets the cleaning requirements of new energy vehicles. This paper provides technical support and technical reference for the research and development work of new energy vehicles and electronic parts enterprises.

1. Introduction
New energy vehicles refer to the use of unconventional vehicle fuels as power sources (or the use of conventional vehicle fuels and the use of new type of on-board power devices), integrating advanced technologies in power control and driving aspect. It forms a car with advanced technical principles, new technologies and new structures [1]. New energy vehicles are the same as regular cars, which have wipers to wipe off the rain on the front windshield or clean the front windshield on rainy days [2].

At present, when cleaning the front windshield of a car, the water spray handle is generally activated, the water spray motor works, and the cleaning liquid in the cleaning liquid tank is sprayed to spray water, and then the wiper motor starts to drive the wiper to swing left and right. The front windshield of the car can clean by this method. Since the existing water spray motor sprays water through two nozzles fixed under the front windshield on the left and right, the nozzles are hidden on the front cover (that is, at the bottom end of the front windshield) for aesthetic reasons. Due to the location, especially for the low power of the water spray motor, the spray range is mainly concentrated in the small area under the front windshield, which causes most of the front windshield area to be unable to spray. However, when the sprayed water is wipe to different places by the wiper, uneven water spraying within the swinging range of the wiper will appear, and the cleaning effect is not ideal. Therefore, the new wiper assembly developed in this paper not only takes into account the aesthetics, but also provides a safer and optimized cleaning method for the front windshield cleaning of new energy vehicles [3], which is of great significance to promote the development of the new energy vehicle industry.

2. Design scheme
The new type wiper assembly is composed of seven parts: the control console, the hydraulic motor, the nozzle, the liquid storage bottle, the wiper motor, the reducer and the wiper. The console controls the sprinkler motor and wiper motor and a connected on-board battery powers it. The console has an integrated controller and touch screen. The hydraulic motor is connecting to the cleaning liquid storage
bottle while connecting to the nozzle on the top of the front windshield. The wiper motor is connected to the reducer. The reducer plays the role of reducing speed and increasing torque. And then it is connected to the wiper with the mechanical structure. The two wipers are connecting with the mechanical structure of the connecting rod to realize the swing in the same direction and at the same frequency.

Figure 1 Working principle block diagram

On rainy days, when the driver needs to scrape the rainwater from the front windshield of the car, clicks the console screen and selects the corresponding mode to start the wiper. Moreover, when the driver needs for automobile front windshield cleaning, starts the hydraulic motor. The hydraulic motor transmits the cleaning liquid in the cleaning liquid tank to the connecting pipe. Then the cleaning liquid enters into the water spray pipe through the connecting pipe and sprays out from the top nozzle to the front windshield of the car. The wiper starts in 0.5s to clean the front windshield [4]. The working principle block diagram is shown in Figure 1.

3. Software architecture
The software flow chart is as follows: First, as the new energy vehicle starts, the Android system control program of the centre console completes automatic initialization and waits for the driver's instructions. When the driver issues an instruction for intermittent mode or low-speed mode or high-speed mode through the touch screen, the control system instructs the wiper motor to switch to the corresponding working mode. When the driver triggers the water spray command, the nozzle on the top of the front windshield starts the hydraulic motor. Thereafter, the central control system will immediately control the wiper motor to enter the high-speed mode after 0.5second, and automatically stop after running for three second [5]. The wiper will automatically return to the initial position and enter the waiting command mode. System software diagram as shown in Figure 2.
4. Test Results
In order to verify the effect of the wiper assembly developed in this article, we conducted a standardized test on the front windshield of the same car. Before each experiment, thoroughly remove the stains on the inner and outer surface of the front windshield with methanol-alcohol detergent. After it is dry, wipe it with 5% ammonia water and wipe it with a cotton cloth. Then evenly sprinkle a layer of dry talcum powder on the front windshield. Using a fixed-length, intact boneless wiper blade to start the water spray to perform a low-speed mode and high-speed mode respectively. Visually checking the wiper effect, repeat 10 times and monitor the wiper assembly in the high-speed mode and the low-speed mode whether the noise exceeds the QC/T 44-2009 standard requirements [6]. The noise measurement adopts A-weighting.

The results of 10 scrubbing cleanings as shown in Table1 below. The results show that the spray water is evenly sprayed on the glass surface from top to bottom. The wiper can spray water evenly within the swing range, which does not affect the driver's line of sight. In addition, a smaller power spray motor can be used to achieve the water spraying requirements. After each scrubbing cleaning, the glass surface should not exceed 1 strip with a width of 1mm and 3 strips with a width of 0.5mm, and there should be no fuzzy scratches. The noise test is carried out in an anechoic chamber, with adequate waterproof measures. The sound level metering apparatus is set to A-weighting and placed in the co-driver's seat in the car, 1 meter away from the window. Turn on the hydraulic motor to trigger the wiper assembly low-speed mode and high-speed mode 10 times each. The test results as shown in Table2.

| Count(int.) | 1 | 2 | 3 | 4 | 5 |
|-------------|---|---|---|---|---|
| Test Result | No traces of hanging brushes | No traces of hanging brushes | No traces of hanging brushes | No traces of hanging brushes | No traces of hanging brushes |
| Count(int.) | 6 | 7 | 8 | 9 | 10 |

Figure2 Software flow chart
### 5. Conclusion

This paper analyzes the status quo of the wiper assembly of new energy vehicles, presents the working principle diagram and software design ideas of wipers for new energy vehicles, and develops corresponding devices. The test results have been given in the first few chapters of this paper. The results show that the device can clean the front windshield of new energy vehicles well and meet the requirements of standard scraping degree and noise level. In addition, the device is simple to operate and highly flexible and it provides technical guidance for the product upgrading of automotive electronics enterprises.

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| Test Result | No traces of hanging brushes | No traces of hanging brushes | 1 residual trace, width 0.3mm | No traces of hanging brushes | 0.3mm and 0.5mm residues each |
|-------------|-----------------------------|-----------------------------|-------------------------------|-----------------------------|-------------------------------|

| Test mode      | A weighting(A) | Limit dB(A) |
|----------------|----------------|-------------|
| Low speed mode | 22 23 22 22 22 22 23 22 23 23 | ≤50         |
| High speed mode| 28 28 27 29 28 27 28 28 27 27 | ≤60         |