Design of the blow-drying device for gearbox housing based on stm32 microcomputer

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Abstract: Based on STM32 microcontroller, the design scheme of the gear box shell drying device is proposed, and the design framework and software design flow of the device are given. On the basis of high-performance MCU, the device can automatically complete the intelligent drying of the gearbox shell, and can carry out the secondary recovery of cutting fluid. At the same time, the device is equipped with a monitoring system, which can monitor the internal influencing factors according to the specified requirements, so as to achieve the goal of safety and efficiency.

1. Introduction
Automobile industry is the pillar industry of a country's economic development, which has a strong pulling effect on the development of the national economy. The automobile gearbox is one of the important components which decide the automobile quality and the running performance[1]. The shell is the basic part of the gearbox. It assembles the relevant parts of the gearbox, such as the axle, the gear, the control part, the shift part and so on, so as to keep the correct relative position between them, and in accordance with a certain transmission relationship to coordinate the transfer of motion and input and output power[2-4]. Therefore, the processing quality of the case will directly affect the accuracy, performance and life of the gearbox[5]. The capacity of the shell will also directly affect the ability of the enterprise to produce the gearbox.

After the gearbox shell is finished, the grooves on the shell and the processing part will have the residue of the cutting fluid which is sprayed during the processing. The blow-drying of the workpiece is mainly done by using the traditional Compressed air air gun and Manual Air Gun, blow away the remaining chips and blow-dry cutting fluid on the surface of the workpiece. The efficiency of manual cleaning is low, and the cutting fluid is corrosive. The splashing cutting fluid will do harm to human body, and it is disadvantageous to automatic processing, causing environmental pollution and serious waste of resources. In order to overcome the shortage of drying and recycling of cutting fluid, this paper designs a drying device for transmission case, which can realize the function of automatic and manual drying in closed environment.

2. Overall Scheme Design
This device is mainly aimed at the problem of drying the gearbox shell and fully recovering cutting fluid. The 360 degree round air dryer can effectively improve the production automation level and better guarantee the product quality. Meanwhile, it can avoid the operators from contacting the spatter cutting fluid directly, which provides guarantee for safety production.

The device mainly consists of device shell, power supply, main control, air flow control, cutting fluid
collection pipeline, monitoring, display and other parts. The block diagram of structural unit is shown in Figure 1.

![Figure 1 structural unit block diagram of gearbox shell drying device](image)

The MCU of the device uses stm32f103rbt6 microcontroller based on ARM® Cortex® M processor core as the core processor to complete signal acquisition, communication, control and other functions. Stm32f103rbt6 is a 32-bit processor product with lqfp64 package and 128KB built-in flash. The clock frequency can reach up to 72MHz; It has two 16 bit monitor timers, systick timer and 24 bit decrement counter. There are 9 communication interfaces, 2 I2C interfaces, 3 USART interfaces and 2 SPI interfaces. With the characteristics of rich resources and low cost, it can meet the needs of cost saving.

The display part of the device uses eight digital tubes to display the working state of the device, which can effectively display the current running state of the device, save the cost and achieve the effect of simplicity and beauty. The device is equipped with wireless communication function, which can read data freely and is easy to use.

3. Device Shell Design
The shell of the device has the function of sealing the environment and is composed of a bottom support, a box body and a control box. The bottom bracket is embedded in four wheels to facilitate the movement of the device. There are three cushion blocks at the bottom of the box body, which are used to place the gearbox housing. There are several air ducts and monitoring units inside, which are used for the monitoring of air drying and temperature in the box. There are three cushion blocks at the bottom of the box to place the gearbox housing. The control box is located at the back of the box, where the control circuit is placed.

The cutting fluid collection pipe is designed at the bottom of the device, which can collect the cutting fluid for secondary use and maximize the resources. The outline structure is shown in Figure 2.
4. Hardware Circuit Design

4.1 Blow Dry Function
After the gearbox housing is processed, there will be residual cutting fluid splashed in many grooves of the housing. The traditional drying method is manual. The manual drying causes the cutting fluid splash, which easily causes the operator to inhale a large amount of cutting fluid air mist, and damage the operator's body, and also causes the operator to very conflict with the job position. There are two preset drying modes: manual drying mode and automatic drying mode. Based on different parts, the two modes can be freely switched. At the same time, the use of the device can effectively improve the level of production automation. The device is equipped with four gas paths, which can be fully opened or partially opened to realize multi angle drying.

4.2 Control Unit
The control panel of the device consists of two parts: key control and relay control. The key control is 4 * 4 membrane switch matrix key. The hardware connection circuit is shown in Figure 3. Using the function keys to send different commands, complete the control of drying mode, drying time, fan start and stop and running speed and other parameter settings, realize the switching between manual drying and automatic drying, uniform drying and variable speed drying and other functions. The relay is an isolation relay module with optocoupler to control the gas circuit on and off. At the same time, the device is also equipped with emergency stop and start functions. In case of equipment failure, press the emergency stop button, the system will stop working, the display system will display err, and give an audible and visual alarm. Three seconds after the alarm, the display system will return to the interface before the emergency stop. After the fault is repaired and the start key is pressed, the system will continue to operate in the state before the emergency stop.

Figure 2 Outline structure drawing
4.3 Monitoring Unit
The device is equipped with an internal monitoring unit to monitor the internal environment of the device in real time. When the internal temperature is too high, the system automatically stops drying. At the same time, the collection of cutting fluid can be monitored. When the maximum collection quantity is reached, the system will send an alarm to remind the user to collect the cutting fluid in the device in time.

4.4 Data Storage Function
The data storage system adopts I2C serial communication memory cat24c02, which is used to store the serial number of gearbox housing, drying time, cutting fluid collection time, fault and other information, so as to facilitate later reading, analysis, adjustment of drying time and mode, and provide effective data for later improvement of production process.

5. Software Function Realization
The software design is an important part of the device to realize its function, and the hardware works together under the control and scheduling of the software. This design uses modularization to write the whole software, enhances the reliability and portability of the program, and is easy to test and maintain. After the device is powered on, the initialization setting is carried out first, including clock, i/o port, timer, serial port, etc. Then read some important parameters from EEPROM to enter the main cycle. In the main cycle, wait for the start command, and after getting the start command, enter the blow drying process until new command or blow dry time is obtained. In the process of drying, the monitoring unit always monitors the temperature and drying degree. When the monitoring data reaches the specified standard, it realizes the functions of alarm, automatic stop, manual intervention and so on. The processing flow is shown in Figure 4.
6. Conclusion
The device uses high-performance MCU and high-precision detection chip, which can realize intelligent drying of gearbox shell. By making the prototype for simulation test, the shell can be dried normally, the cutting fluid can be collected effectively, and the results can be displayed and reported, and the information can be stored. The use of the device improves the processing quality and production efficiency, reduces the labor cost and enhances the competitiveness of the enterprise.

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