

Research and application of engine electronic control training bench based on Changan Ford

Quanyou Fu

Foshan Vocational and Technical College, Foshan 528137, China

Abstract: Whether it is responsible for the professional teaching of vehicle vocational college teachers, or the students who study auto repair on campus, they should master the structure, principle and fault maintenance of the latest automobile circuit control system to different degrees, otherwise it is difficult to match the development of modern automobile new technology. In the actual teaching process found, first of all, for the real car is difficult to set idle or start the fault demonstration process, students are difficult to understand the principle of these failures, must use the engine electronic control training platform to meet the teaching needs. Secondly, most of today's automotive companies recruit college graduates who require talents with specialized brand service skills. Therefore, higher vocational colleges must cooperate with enterprises to train specialized automobile service talents.

Key words: automobile circuit control system; Fault; Electronically controlled training bench

Introduction

Efi engine and carburetor engine than more complex, thanks to the development of modern technology, EFI engine in the working process of the probability of mechanical failure is low, once the occurrence is basically the EFI control system or other related control system failure. Therefore, the personnel engaged in automobile maintenance should also have a higher diagnostic technology improvement for the corresponding control systems. In order to enable maintenance personnel to truly understand the causes of faults and to continuously improve and develop diagnostic technology, various higher vocational colleges and universities have set up majors such as automobile detection and maintenance technology one after another, and purchased the engine electronic control training platform researched by the development enterprises of teaching instruments.

In the past teaching process, vocational college teachers mainly set up some bench faults, including eight sensors or related executive components on the engine, so that the engine shows the corresponding fault characteristics. However, with the rapid development of electronic control technology, the current electronic control training platform is invented by the teaching instrument development enterprises, the information they use about electronic control technology is automobile companies have been or are being eliminated, open on the Internet, such as pull wire throttle and accelerator pedal has long been replaced by electronic throttle. Pressure sensor in addition to the absolute pressure sensor of the intake manifold also added a four-line booster pressure sensor, etc., automotive students have to re-learn the latest knowledge after working in the enterprise. Therefore, it is very necessary to research and develop an engine electronic control training platform jointly participated by automobile enterprises, higher vocational colleges and teaching instrument development companies, so that students can learn the latest fault diagnosis knowledge to adapt to future job needs.

1. The overall design of the training platform

1.1 Basic principles of the platform

Designed and developed this electronically controlled engine training platform based on Changan Ford can intuitively analyze the structure of the electronic control system of Changan Ford in-cylinder direct injection motor, find out the possible faults during operation, determine the fault types of engine sensors and actuators and the engine operation characteristics caused by the faults; Set the sensor and actuator fault characteristics, the use of microcontroller design has obvious human-machine interaction function of the fault setting function of the control system, so as to achieve the engine ignition, start, fuel injection, high and low pressure oil pump control, idle control and other processes of the fault setting. Finally, the troubleshooting process and points of attention need to be shown with the help of cameras and human-machine interfaces.

1.2 Engine selection

Ecoboost series 2.0T direct injection engine produced by Changan Ford Company is selected for the electronic control engine training platform, which adopts the latest three key technologies: in-cylinder direct injection, dual independent variable valve timing and turbocharging.

The electronic control system of Ecoboost series of 2.0T direct injection engine is mainly to control the fuel injection and ignition process. In the control of fuel injection and ignition process, the two control systems are not completely separated, forming closed-loop feedback control with each other, and also with system fault self-diagnosis system.

1.3 Safety device

The weight of Changan Ford 2.0T engine itself is large enough, and the fan and the fixed bracket and panel of the platform on the training platform will lead to greater weight of the assembly platform, so students are very likely to have safety accidents due to improper operation in the process of handling the platform. In addition, the engine bench may be in the working process for a long time in the teaching process, and safety accidents such as burns and front-end belts are exposed, and sleeves are easily rolled up when the coolant temperature

is high. For this, the platform must be made corresponding protection devices. For the engine support, the original support of Changan Ford Escape is used, and the structure is optimized with CATIA to make it portable, convenient for students and teachers to use; The platform moving wheel is the same as the normal platform moving wheel, which is a moving wheel with locking device to fix and move the platform; The square tube frame welded by 40×80 channel steel is used to cover both sides of the engine; For the phenomenon that the temperature of the coolant is too high, it is easy to cause the platform user to burn, and the heat shield is used to separate the water tank above, and the heat dissipation can still be carried out below; At the same time, in the actual teaching process, a set of additional safety protection device -- power-on switch is set up on the bench assembly. Under normal circumstances to use the bench must be turned on the power switch before ignition operation, this set of safety protection device will greatly reduce the probability of safety accidents. The electronic control training bench fault setting will appear in the relevant sensors, actuator components and the connection line between the ECU, usually the direct control signal on and off to set up the corresponding fault, in the traditional training bench clock is the use of manual switch on and off to achieve the occurrence of simulated faults. The obvious disadvantage is that the repeated use of the switch in the teaching process is more likely to cause damage to the bench and panel terminals. In order to avoid such shortcomings, the control terminal of Changan Ford engine electronic control training platform adopts intelligent control mode, abandoning the shortcomings of traditional manual terminals, which can greatly extend the service life of the platform.

2. Problems that can be solved by the training platform

2.1 Do quantitative analysis to provide corresponding data support when the engine fails

One of the functions of the electronic control engine training platform is to require that the engine fault phenomenon in the real car can be displayed in real time, and the fault is analyzed and processed to a certain extent, and finally compared with the original data, we can get the cause of the fault and the corresponding troubleshooting operation. The design of this electronic control training platform is mainly for the sensor actuator fault Settings, using the engine for the Changan Ford Company Ecoboost series 2.0T direct injection motor, the technology involved, sensors, actuators, etc. are the latest in the market, the most widely used knowledge, can be well adapted to the needs of scientific research.

2.2 Ensure the reliability and diversity of electric control system signal fault Settings

Some states or failures of automobile electronic control engine are difficult to reproduce, and the causes of occasional failures are strange. The engine electronic control training platform designed in this project adopts intelligent electronic control device for fault setting. For the sensor and actuator fault setting part, in addition to the on-off circuit, but also simulate the resistance increase, decrease and short circuit to the ground, the situation of open circuit, you can truly reproduce all kinds of accidental failures of the car, from the bench to learn the car on this non-replicable fault diagnosis method.

2.3 Reduce the harm caused by noise and exhaust gas to users

The noise caused by the artificial setting of the engine electronic control training platform and the harm caused by the exhaust gas to the user have not been paid attention to, but the setting of the fault in the detection process is inevitable. Therefore, by adding PCS (equipped with IDL diagnostic software provided by Changan Ford Company), cameras and other equipment beside the electronically controlled engine training platform, the diagnostic data can be transmitted to the multimedia host, and video signals can be collected and displayed on the large screen to achieve remote measurement and control. Whether it is used in teaching or scientific research, it can greatly reduce the number of use of the platform and reduce the harm.

3. Practical training platform design method

3.1 Intelligent fault setting

The fault setting in the teaching process is mainly the on-off control of the signal terminal feedback signal, short circuit control and iron control and so on. The control switch in series in the line can realize the line on-off control, and cut off the sensor or actuator line before or during the engine operation. The switch can be connected in series between the control panel and the sensor, between the sensor and the actuator and between the control panel and the actuator on the line, the student can check the on-off situation by checking the resistance between the terminals, if it is open, the resistance will be infinite, and conversely the resistance will be within about 0.5Ω. In the teaching process, when the engine failure needs to be set, the connector should be unplugged in time, and the fault setting device should be connected to the circuit operation control device for fault setting. The students should read the voltage, resistance and waveform again after reading the data under normal operation to eliminate the related line fault. The fault setting device, the choice is to use single-chip microcomputer control relay to set the fault.

3.2 Design of control panel

In the troubleshooting process, the checked resistance, voltage and waveform data should be compared with the standard data of Changan Ford maintenance manual. The electronically controlled training bench can feedback the real car condition because it directly uses the engine of Changan Ford. On the centralized control panel of the training platform, the original combination instrument panel of Changan Ford Escape is installed on the top, and the detection port of the corresponding sensor and actuator with annotations is arranged around it. In addition, it is necessary to increase the pressure gauge for fuel supply system detection and the vacuum pressure gauge for intake system detection. In the design of Changan Ford engine electronic control training platform, the ECU is also taken as the core, and placed in the center of the control panel, which is conducive to the use of the platform and beautiful. The circuit design is connected around the panel with

sensors and actuators port, finally concentrated in the middle, for the detection process of voltage, resistance and other data can be directly used multimeter or oscilloscope in the detection port to detect, the circuit diagram all use color drawing, drawing sensor graphics and the model on the engine is completely consistent, such as the crankshaft position sensor is magneto-electric, Camshaft position sensor is Hall type, etc., which is conducive to explaining the principle of components in the teaching process.

3.3 Remote desktop control technology implementation

The remote test of Changan Ford engine electronic control training bench mainly consists of electronic control training bench, related diagnostic lines, vertical computer (with Ford special diagnostic software inside), projector and screen components, etc. After the diagnosis line is connected to the platform, the data and fault diagnosis information on the platform will be transmitted to the vertical computer in time, and a series of fault Settings and data reading operations can be carried out on the platform on the computer equipped with IDL software. The information can be directly displayed in the classroom of the training platform through the projector and screen components, or the data can be downloaded into the PDF version and analyzed in other classrooms. In addition, there is also a high-definition camera beside the vertical computer, which can not only record the whole process of teachers' teaching and troubleshooting, but also record the operation process of students at the same time, which can be used for mutual evaluation between students and promote students' learning communication and progress.

References

- [1] Xiaojun Zhang, Enguo Dong. Design of Electronic Control Engine Teaching Experimental Bench [J]. *Wireless Internet Technology*, 2018, 15(01):69-70.
- [2] Xiangjun Zeng. Discussion on the application of Electronic control engine platform in Practical Training Teaching [J]. *Heilongjiang Science and Technology Information*, 2015(24):121.
- [3] Jiakai Mu. Practice Research on the construction of Professional group of Automobile Detection and Maintenance Technology [J]. *Times Automobile*, 2021(16):68-69.
- [4] Gaohui Han, Zhijie Sun. Design and Application of Experimental Device based on Automobile Electronic Control Engine [J]. *Shandong Industrial Technology*, 2014(10):10.
- [5] Jingfeng Gao, Guoxin Zhang, Min Li. Design and Research of K24A4 Engine Electronic Control System Integrated Training Platform [J]. *Transportation Standardization*, 2009(13):210-213.
- [6] Wenbin Wan. Design and Test Analysis of Electronic Control Engine Fault Diagnosis Platform [D]. Jiangsu University, 2005.

About the author: Fu Quanyou (1993-), male, born in Longyan, Fujian Province, master, full-time teacher in School of Automotive Engineering, Foshan Vocational and Technical University. His research interests include engine electronic control and intelligent network connection.