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The causes of unstable engine idle speed and their solutions

Fan Yang^{a)}

Guangdong University of Science & Technology, Dongguan, 523083, China.

^{a)}344653720@qq.com

Abstract. There are many types of engines. The most commonly used engine for automobiles is the internal combustion engine. Internal combustion engines use a four-stroke combustion cycle to convert gasoline into motion. The four-stroke approach, also known as the "Ototo cycle," commemorates Nicklaus Otto, who invented it in 1867. The working cycle of a four-stroke engine consists of four piston strokes, ie, intake stroke, compression stroke, power stroke, and exhaust stroke. This article focuses on the cause of the instability of the four-stroke engine and its solution. There are many reasons for the instability of the engine, so this article will be divided into four areas: intake system, fuel system, ignition system and mechanical structure. Based on the above reasons, the corresponding solution is proposed.

Keywords: Engine; four-stroke; intake system; fuel system; ignition system; mechanical structure.

INTRODUCTION

Intake systems, fuel systems, ignition systems, and mechanical engine failures all contribute to the instability of the engine's idle speed. Therefore, the cause of engine idle instability is a relatively wide-ranging and difficult task. It is easy to change parts. The method is not desirable. There are various reasons for the unstable idling failure. Correct judgments should be made based on test results, theoretical analysis, and maintenance experience. Therefore, it is legal to solve the problem of idling instability [1].

HOW THE ENGINE WORKS

The reason why the engine is continuously powered by energy sources is thanks to the orderly circulation of the four strokes of intake, compression, power, and exhaust in the cylinder. Intake stroke: When the piston moves from top dead center to bottom dead center in the cylinder, the intake valve opens and the exhaust valve closes. Fresh air and gasoline are drawn into the cylinder. Compression stroke: When the intake and exhaust valves are closed, the piston moves from bottom dead center to top dead center, and the gas mixture is compressed to the top of the cylinder to increase the temperature of the gas mixture in preparation for the power stroke. Work stroke: The spark plug ignites the compressed gas, and the mixed gas "explodes" inside the cylinder to generate a huge pressure, pushing the piston from top dead center to bottom dead center and pushing the crankshaft through the connecting rod. Exhaust stroke: When the piston moves from bottom dead center to top dead center, the intake valve closes and the exhaust valve opens, exhausting the burned exhaust gas outside the cylinder through the exhaust manifold. Figure 1 below shows the internal structure of the engine [2].



FIGURE 1. Internal structure of the engine

CAUSES OF ENGINE IDLING

Intake system

Intake Manifold or Various Valve Leaks

When the air, gasoline vapor, and combustion exhaust gas that should not enter into the intake manifold cause the mixture to be too rich or too lean, the engine will not burn properly. When the air leakage position only affects individual cylinders, the engine will experience more severe vibrations, which will have a greater impact on cold vehicle idle speed. Common causes are: intake manifold loose or broken hose; intake manifold gasket leakage; intake manifold damage or other parts of the intake manifold grind hole; injector O-ring leak; The vacuum tube plug is detached and broken; the crankcase forced ventilation (PCV) valve opening is large; the activated carbon tank valve is always open; the exhaust gas recirculation (EGR) valve is not closed tightly.

Excessive throttle and intake fouling

Excessive carbon deposition and dirt on the throttle and surrounding air intake passages change the cross-sectional area of the air passage, making it impossible for the control unit to precisely control the idle air intake amount, causing the mixture to be too concentrated or excessively lean and causing the combustion to be abnormal. Common causes include: Throttle oil or coke; Throttle around the intake port with oil, coke; Idle stepper motor, duty solenoid valve, rotary solenoid valve oil, carbon deposition.

Idle Air Actuator Failure

Ignition air actuator faults cause inaccurate air control. Common causes are: throttle motor damage or hairpin; idle stepper motor, duty solenoid valve, rotary solenoid valve damage or issuing.

Misaligned intake air

The control unit receives an error signal and issues an incorrect command, causing the engine to be inaccurate in control of the idle air intake, causing the engine to burn abnormally, which is an indirect cause of the unstable idle speed. Common causes are: air flow meter or its circuit failure; intake pressure sensor or its line failure; engine control unit plug due to poor water contact or internal computer failure.

Injector failure

Injector fuel injection is not uniform, the mist is not good, resulting in unbalanced power emitted by each cylinder. Common causes include: clogged injectors, poor seals, spitting fuel lines, etc.

Fuel System

Fuel Pressure Failure

When the oil pressure is too low, the atomization of the fuel from the injector is poor or the injected fuel is in a linear shape. In severe cases, only the oil droplets are ejected. The fuel injection volume is reduced to make the mixture too thin. The oil pressure is too high. The increase in fuel injection makes the mixture too rich. Common causes include: fuel filter plugging; fuel pump filter plugging; fuel pump pump capacity is insufficient; fuel pump safety valve spring force is too small; oil inlet pipe deformation; fuel pressure regulator failure; return pipe pressure clogging.

Inaccurate Injection Quantity

The failure of each sensor or line causes the control unit to issue an incorrect command to make the fuel injection amount incorrect, causing the mixture to be too rich or too lean, which is an indirect cause of idling instability [3]. Specific reasons are: air flow meter (or intake manifold pressure sensor) failure; throttle position sensor failure; throttle idle speed switch failure; coolant temperature sensor failure; intake air temperature sensor failure; oxygen sensor failure; There are open circuit, short circuit, and ground fault; the engine control unit plug is in poor water contact or internal computer failure.

Ignition system

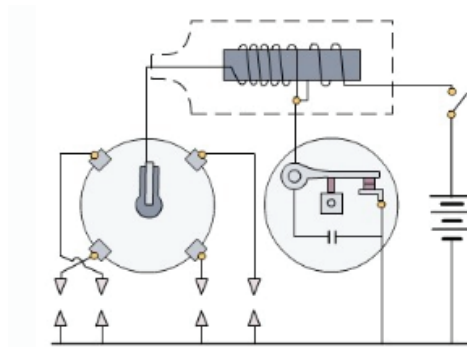


FIGURE 2. Schematic diagram of the engine ignition system

Ignition Module and Ignition Coil

In recent years, many models have integrated the ignition module with the ignition coil. The failure of the ignition module or the ignition coil is mainly manifested as weak high-pressure sparks or spark plug ignition. Common causes are: missing ignition trigger signal; faulty ignition module; loose connection of ignition module power supply or ground wire, bad contact; failure of primary coil or secondary coil.

Spark plugs and high-voltage lines

Spark plugs, high-voltage line failures cause spark energy to drop or misfire. Common causes are: spark plug gap is incorrect; spark plug electrode ablation or damage; spark plug electrode carbon deposition; spark plug magnetic insulator crack; high voltage wire resistance is too large; high voltage wire insulation skin or plug leakage; sub-burner electrode ablation or poor insulation [4].

Misalignment of ignition advance angle

Since the sensor and the line fault are the indirect causes of the idling instability, the control unit issues an incorrect command to make the ignition advance angle incorrect, or cause the ignition advance angle to fluctuate widely. Common

causes are: Air flow meter or intake pressure signal failure; Hall sensor failure; Coolant temperature sensor failure; Intake air temperature sensor failure; Knock sensor failure; The above sensor circuit has open circuit, short circuit, ground fault; Engine control Poor contact or internal circuit damage caused by water entering the unit.

Mechanical Structure

Air distribution mechanism

The failure of the valve train causes the power of individual cylinders to drop too much, thereby unbalancing the power of each cylinder. The common causes are: the timing belt installation position is wrong, so that the cylinder valve opening and closing time changes, resulting in inaccurate valve timing, each cylinder combustion is not normal. The valve work face and the valve seat ring have too much carbon deposition and the valve seal is not strict, so that the compression pressure of each cylinder is inconsistent. Cam wear of the camshaft causes inconsistent wear of the cylinder cams, resulting in inconsistent air intake from each cylinder. Valve related parts are faulty, such as worn or bent valve stems, worn rocker arms, stuck or leaking valves, broken valve springs, etc.

Engine body, piston linkage mechanism

These faults will cause the individual cylinders to drop in power too much, thereby unbalancing the power of each cylinder. Common causes are: ablation or damage to the cylinder liner, resulting in single cylinder leakage or air leakage between the two cylinders; piston ring end gap is too large, the counterpart or fracture, the piston ring loses its elasticity; too much carbon deposit in the piston ring groove; Piston and cylinder wear, cylinder roundness, cylindricity excess; due to cylinder bending caused by the water inlet, change the compression ratio; combustion chamber carbon deposition will change the compression ratio, carbon deposition seriously lead to idling instability.

THE SOLUTION TO THE UNSTABLE ENGINE SPEED

Ask the owner

After the engine has appeared idling, the owner should clearly clarify the following conditions: 1 the time when the idling is unstable at the earliest; 2 the temperature of the engine when the idling is unstable; 3 the mileage of the vehicle; 4 the road and habits of the driver; The maintenance of the car; 6 the history of the car repair; 7 whether the car is equipped with equipment [5]. Through the above understanding, it is possible to make a preliminary judgment on the instability of idle speed, shorten the inspection time, and avoid doing no useful work during maintenance.

Visual inspection

Open the hood inspection: observe the engine operating conditions, the degree of jitter, while observing the swing of the engine tachometer pointer, whether the deviation from the idle expected value; observation is normal idle jitter, or load idle jitter (open air conditioning, lighting, into the gear, hit Steering wheel, etc.); whether there is abnormality in the external parts of the engine; whether the vacuum tube is detached or damaged; whether the wire connector is loosened; whether there is a four-leakage phenomenon of oil leakage, water leakage, air leakage, and leakage; if the exhaust pipe is "sudden, "Abrupt" (indicating bad combustion), black smoke, raw petrol smell, etc.; normal throttle throttle cable is adjusted properly.

Query Analysis Failure Code

Reading code (permanent, occasional trouble code must be recorded) clear code operation (condition of failure to be reproduced at this time) re-reading code. Read the trouble code list in the service manual to check the cause of the trouble code, its effect, and how to troubleshoot it. The accidental code can't be neglected, and often the idling instability moment is when the accidental fault code appears. After analysis to determine the next maintenance work. If there is no fault code storage, it is considered that there may be a fault in the components that the control unit does not monitor.

Reading Analysis Data Block

The data block can provide real-time data of the engine's operation. The correct analysis can also represent the technical level of our diagnosticians. All are reading blocks of data. Some people can say the problem. Some people do not see it. I think that when we read it, we look at the data block table and look at its out-of-range content. For example, the Gold Pentium color measurement will immediately change color. In addition, for idling instability, we have to read the content of the idling data, one is the throttle opening, the normal value is 2 to 5 degrees, after the big is certainly dirty, then you need to clear the throttle. There is the engine operating conditions, there is no display idle speed, if there is no display, indicating the throttle is not closed in the switch contact [6]. There is also idle air flow learning value, idle air conditioning value, learning value is based on the previous period of the flow of the central value, point a central value, due to dirty throttle or load changes, flow needs to be adjusted, so a Learning value. Then, there is an adjustment value at each moment, which is a range in the fault code table, and normal is within this range.

Detection

According to the fault phenomenon, fault code content, data block value to determine the test content. According to the test object selection multimeter, diode test pen, exhaust gas detector, fuel pressure gauge, vacuum gauge, cylinder pressure gauge, oscilloscope, analog signal generator, fuel injector inspection and cleaning instrument. It can be performed in the order of electronic control system, ignition system, air intake system, fuel system, and engine mechanical parts.

Troubleshooting

Based on the above inspection results and the troubleshooting guide in the service manual, the diagnostician formulates a method for troubleshooting the vehicle. Exclusion methods generally include cleaning the throttle and the air intake, cleaning and checking the fuel injector, replacing the electrical components, checking the fault point of the wiring harness, cleaning the grounding point, and repairing the mechanical structure of the engine.

Examination of completion

After troubleshooting, we must use a diagnostic instrument and an exhaust gas analyzer to test it again. The exhaust gas analyzer can directly measure the idling instability and can determine the direction. Now we use four exhaust gases and five exhaust gases. We can also judge the bake ratio of carbon dioxide and oxygen. The direction.

CONCLUSION

All in all, it is the imbalance of the gas in the engine block that the engine is unstable. In solving the problem of engine idle instability, it is necessary to first determine the external causes and then repair the internal causes, and then have a targeted balance of engine cylinder pressure. This can quickly solve problems in a short period of time and improve work efficiency.

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