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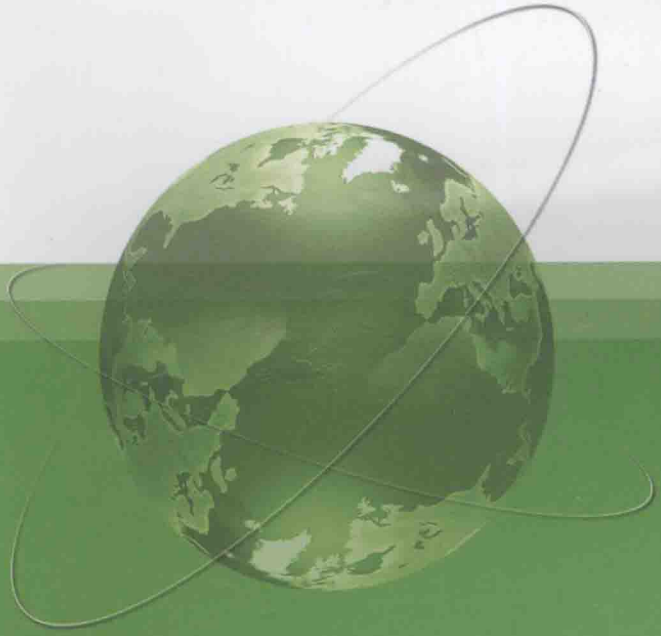
21世纪高职高专规划教材

（汽车类）

汽车专业实用英语



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汽车专业实用英语

主　编　陈晟闽
副主编　宋　震　黄红惠
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机械工业出版社

本书以汽车结构为主线，全面介绍了汽车各部分的组成、结构和原理及常用检测方法，特别是对进气系统、电控燃油喷射、电子点火系统、排放控制系统、自动变速器、防抱死制动系统、牵引控制系统、电子稳定性控制、巡航控制、安全气囊等新技术也进行了详细阐述。本书共分21个单元，每个单元包含一篇课文、翻译注释和相应的读图分析题和选择题。书末附有专业词汇总表，以方便查阅。本书可作为交通运输（汽车运用工程方向）、车辆工程和汽车服务工程等汽车类高职专业的教材，亦可供有关工程技术人员学习参考。

本书配有电子教案，凡一次性购书30本以上者免费赠送一份电子教案。请与本书策划编辑余茂祚联系（联系电话010-88379759，邮箱 yumaozuo@163.com）。

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前 言

近几年来，汽车产业飞速发展，汽车技术日新月异，因此对汽车行业的维修、销售、服务、管理人才的专业英语阅读及运用能力有较高的要求。

本书从高职学生的实际情况出发，深入浅出地介绍了汽车各主要系统的构造和工作原理，并将一些汽车新技术融入其中，使学生能够比较系统地掌握汽车方面的英语知识，为他们以后阅读汽车英语资料打下一个坚实的基础。

本书内容丰富，实用性强，共有21个单元，内容涉及发动机电控喷射系统、发动机冷却和润滑系统、发动机点火和充电系统的构造原理和检测；汽车底盘行驶系统、悬架和传动轴、转向系统、汽车变速器的构造与工作原理及零部件检测；汽车辅助电器、汽车空调、汽车巡航控制系统的构造原理和检测。本书具有以下特点：

1. 内容紧密结合当今最新的汽车技术，读者不仅可以学到最新的汽车技术知识，同时还可以从中学到常见的专业词汇。

2. 根据文章内容设置了相应的问题作为阅读和理解的导引。

3. 注重实用性，内容结合生产实践，对汽车维修和检测具有指导作用。

4. 图文并茂，通俗易懂。

5. 书后附有文中出现的汽车技术词汇，方便学生集中查询和学习。

6. 本书配有相关课件，供教师教学参考。

通过学习本书，学生既能掌握一定量的专业词汇，又能熟悉汽车专业外文资料，对以后查阅英文维修资料做了很好的铺垫。

本书由无锡职业技术学院陈晟闽担任主编，无锡职业技术学院宋震、无锡广播电视大学（江苏城市职业学院无锡办学点）黄红惠担任副主编。本书第3单元、第5单元、第6单元、第8单元、第9单元、第10单元、第19单元由陈晟闽编写，第7单元、第12单元、第17单元、第18单元由宋震编写，第1单元、第4单元、第13单元、第14单元、第15单元由黄红惠编写，第16单元、第20单元、专业词汇汇总由钱燕编写，第2单元由陆超编写，第11单元、第21单元由刘步丰编写。本书在编写过程中得到了相关汽车制造商、维修站的大力支持，在此一并感谢。

本书内容全面、概念清楚、图文并茂、实践操作性强，理论阐述由浅入深，适合大中专院校汽车修理行业相关专业及师生使用，也适合汽车维修技术人员以及汽车爱好者参考阅读。

由于编者水平有限，不足之处在所难免，敬请各位读者批评指正。

编 者

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CONTENTS

SECTION 1

Engine Operation

1.1 Internal Combustion Engines

Automotive engines are internal combustion engines. See Fig. 1-1. An engine is a machine that turns heat energy into mechanical energy. An internal combustion engine burns fuel internally. The heat produced from burning a fuel creates the power that moves the vehicle.

Most automotive engines are called reciprocating engines because their pistons move up and down inside the cylinders. It receives and transmits motion as a result of pressure changes applied to it.

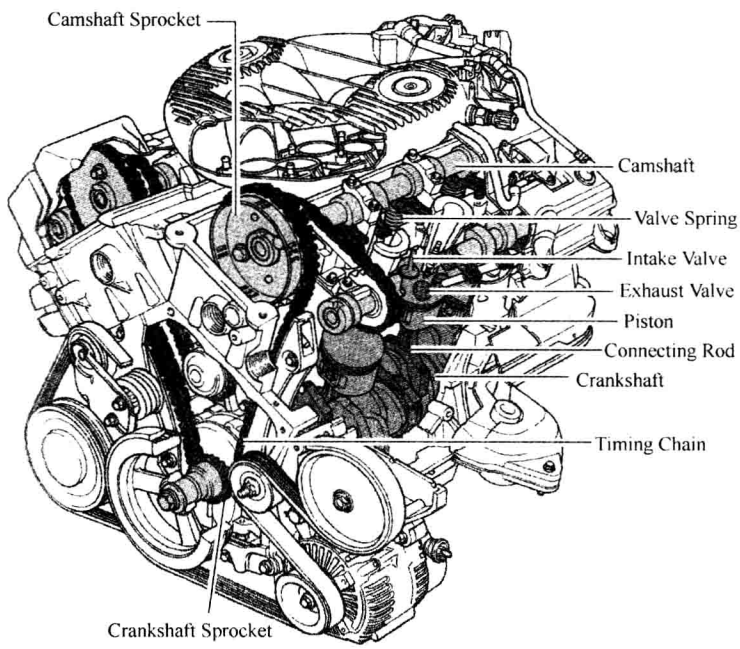

Fig. 1-1 A V-6 engine with dual overhead camshafts

There are two types of internal combustion piston engines: spark-ignition (gasoline) and compression-ignition (diesel). Internal combustion piston engines differ in.

* The type of fuel they use;
* The way ignition of the air/fuel mixture occurs;

Answer the following questions according to the article.

1. Define internal combustion engine.

2. What fuel does a spark ignition engine run on?

3. What's the meaning of "reciprocating"?

4. Describe the function of a piston.

5. What are the types of the internal combustion piston engines?

6. Which type of engine involves the ignition of fuel by heated air?

1.1.1 Spark-ignition Engine

Most spark-ignition engines run on liquid fuels, such as gasoline, alcohol, or a gasoline/alcohol blend. Some spark-ignition engines run on gaseous fuels, such as propane or natural gas.

Air and fuel enter the engine cylinders to create a combustible mixture. The pistons compress (squeeze) the mixture to about one-eighth of its original volume. The ignition system produces a spark at the spark plug, igniting the compressed mixture. As the mixture burns, temperature and pressure increase in the cylinder. The high pressure forces the piston down in the cylinder. This causes the crankshaft to rotate. Gears and shafts carry this motion to the wheels that drive the vehicle.

7. How is the fuel ignited inside the cylinder of gasoline engine?

1.1.2 Compression-ignition Engine

A diesel (compression-ignition) engine runs on a light fuel oil similar to kerosene. In this type of engine, the piston compresses only air. Compressing air to about one-twentieth of its original volume raises its temperature to 1,000℉ [538℃] or higher. The fuel is injected (sprayed) into the cylinder, where it is ignited by the heated air. As the mixture burns, the pressure forces the piston down in the cylinder.

8. What's the meaning of "compression-ignition"?

1.1.3 Conversion of Energy

An engine converts energy, from the form of a fuel, to motion. The fuel is burned and converted into heat. The heat develops pressure, which applies force to the engine's pistons. The pistons transfer this force, as reciprocating motion, to the engine's crankshaft. The crankshaft converts the reciprocating motion to rotary motion. The rotary motion is transferred through the drive train to provide motion to the vehicle's drive wheels.

9. Define "stroke".

1.1.4 Piston Action

The actions of the piston are divided into four strokes. "Stroke" refers to piston movement. A stroke is piston movement from TDC (top dead center) to BDC (bottom dead center) or from BDC to TDC. The upper limit of piston movement is called TDC (top). The lower limit of piston movement is called BDC (bottom). In other words, the piston completes a stroke each time it changes its direction of motion. See Fig. 1-2.

10. What are the four strokes of the engine?

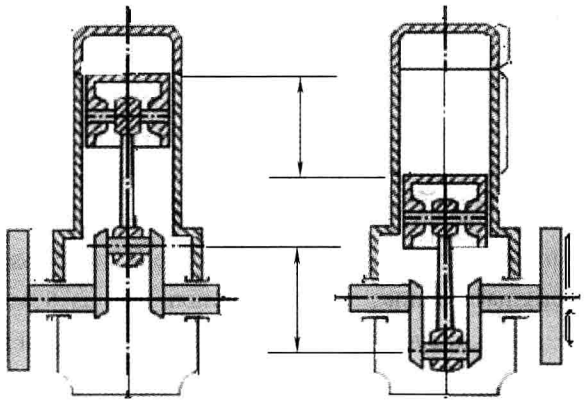

Fig. 1-2 Terms of an Engine

11. Please write down the terms "stroke, TDC, BDC, clearance volume" in Fig. 1-2.

The complete power cycle requires four piston strokes. See Fig. 1-3:

* Intake;
* Compression;
* Power;
* Exhaust.

12. Please write out the four strokes in Fig. 1-3.

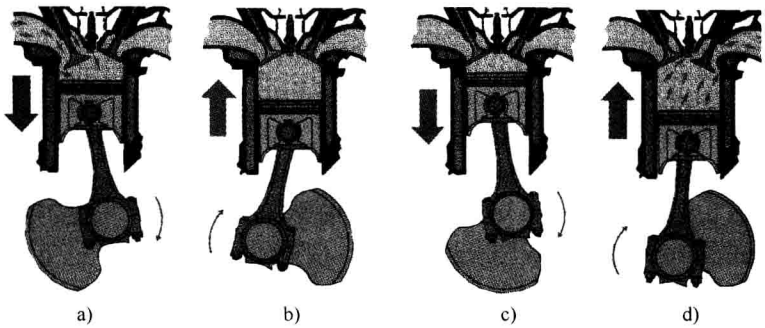

Fig. 1-3 Four strokes of the engine

a) Intake b) Compression c) Power d) Exhaust

13. Describe one piston stroke.

This progress makes the engine a four-stroke, or four-cycle engine. One complete four-stroke cycle requires two complete revolutions (720°) of the crankshaft.

Intake Stroke: During the intake stroke, the piston moves down in the cylinder. The intake valve is open. The downward movement of the piston creates a partial vacuum in the cylinder. Atmospheric pressure forces the air/fuel mixture into the cylinder to fill the vacuum. As the piston moves from TDC to BDC, the crankshaft rotates through 180°, or one-half turn.

14. On the intake stroke, which valve is closed? Describe the moving direction of the piston.

Compression Stroke: After the piston moves past BDC on the intake stroke, the compression stroke begins. The intake and exhaust valves are closed. As it moves up, the piston compresses the air/fuel mixture in the

15. What happens at the end of the compression stroke?

16. What is the measure of how much the air/fuel mixture is compressed during the compression stroke?

space between the top of the piston and the cylinder head. This space is the combustion chamber. The piston compresses the air/fuel mixture into about one-eighth of its original volume.

The compression ratio is the volume in the cylinder with the piston at BDC divided by the volume in the cylinder with the piston at TDC. It is the measure of how much the air/fuel mixture is compressed during the compression stroke. For example, if the mixture is compressed into one-eighth of its original volume, the compression ratio is 8 to 1 (written 8∶1). As the piston moves from BDC to TDC, the crankshaft rotates through 180°.

The compression ratios above 9.5∶1 may create enough heat to self-ignite the air/fuel mixture without the aid of a spark. In a spark-ignition engine, such detonation can damage the pistons, piston rings, spark plugs and valves.

17. How much is the mixture compressed?

Power Stroke: As the piston nears TDC at the end of the compression stroke, both the intake and exhaust valves are closed. An electric spark jumps the gap at the spark plug. As the mixture burns, high temperatures and pressures are created in the combustion chamber. The force of the expanding combustion gases pushes down on the top of the piston. The connecting rod transmits this force to the crankshaft, which rotates through another 180° from TDC to BDC.

Exhaust Stroke: As the piston approaches BDC on the power stroke, the exhaust valve opens. After the connecting rod journal passes through BDC, the piston moves up, forcing the burned gases out through the open exhaust port. As the piston moves from BDC to TDC, the crankshaft rotates through 180°.

18. What is the danger of high compression ratios in spark-ignition engine?

1.2 Engine Construction

19. What is the motion of the valves during the power stroke?

Spark-ignition and compression-ignition engines are similar in construction. Both have engine blocks and cylinder heads. Both have pistons that move up and down in the cylinders. The cylinders, or cylinder bores, are machined openings through the engine block. A cylinder head covers the top of the cylinders. The bottom of each cylinder is open. The pistons are connected through this opening to the crankshaft.

20. How do the burned gases go out of the cylinder?

1.2.1 Engine Block

The engine block, also called the cylinder block, is a precision metal casting. See Fig. 1-4. The block contains the:

* Cylinders or cylinder bores;

* Pistons and connecting rod assemblies;
* Camshaft, for engines that do not have an overhead camshaft design;
* Crankshaft.

21. Explain the rotation of the crankshaft during the power stroke.

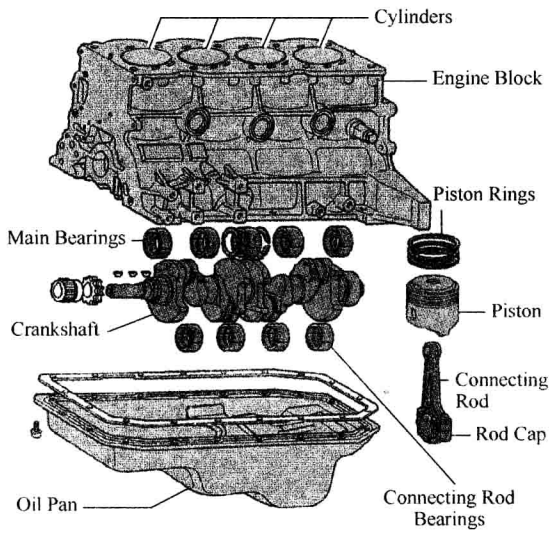

Fig. 1-4 Engine block and lower end part

22. What are the basics of engine construction?

23. What makes up the engine block?

1. 2. 2 Pistons and Piston Rings

Fig. 1-5 shows a piston and piston rings. Pistons are usually made of an aluminum alloy, which is aluminum mixed with other metals. They are slightly smaller than the cylinders so that they can move up and down freely.

24. Which part connects the piston to the crank-shaft?

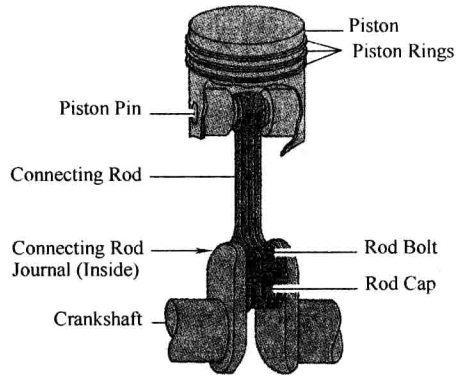

Fig. 1-5 Piston and piston rings

The small gap between the piston and cylinder wall is known as piston clearance. See Fig. 1-6. Piston clearance provides the sliding fit. If not properly sealed, this gap allows some of the compressed air/fuel mix-

25. What's the material of the piston?

ture and combustion gases to leak past of the piston. This leakage is called blow-by. Blow-by reduces power, wastes fuel, and pollutes the air. The piston rings seal the gap between the piston and the cylinder wall. Each ring fits into ring grooves cut into the piston.

26. What attaches the piston to the connecting rod?

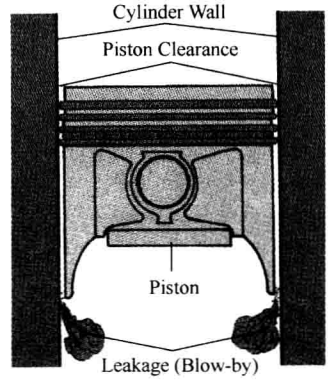

Fig. 1-6 Blow-by occurs between the piston and cylinder

27. What reduces the amount of blow-by?

There are two types of piston rings:

* Compression rings form a sliding seal between the piston and the cylinder wall. They reduce or control blow-by of combustion gases;

* Oil rings, or oil-control rings, scrape excess oil from the cylinder wall and return it to the crankcase.

28. Name the two types of the piston rings.

1.2.3 Crankshaft

The reciprocating motion of the pistons must be changed to rotary motion. Rotary motion is what turns the vehicle's drive wheels. The connecting rods and the crankshaft make this conversion possible. A piston pin connects each piston to the small end of the connecting rod. The connecting rod connects the piston to the crankshaft. See Fig. 1-7.

29. What's the job of the oil rings?

The rod cap and rod bolts attach the connecting rod to the connecting rod journal. The journal holds a split bearing (two halves), or connecting rod bearing, in place in the cap and rod. A slight clearance allows the connecting rod journal to turn inside the bearing. Oil fills this clearance to lubricate the bearing and prevent metal-to-metal contact. As the crankshaft turns, the connecting rod journal moves in a circle.

30. What's the function of the crankshaft?

As the piston moves up and down in the cylinder, its connecting rod journal moves in a circle around the centerline of the crankshaft. On the down stroke the connecting rod moves to one side, as its lower end follows the movement of the crankshaft rod journal. As the piston reaches BDC, the connecting rod journal continues to move in a circle. As the journal begins to move up, the connecting rod pushes the piston up on the

next stroke. In this way, the crankshaft changes the reciprocating motion of the piston to rotary motion at the drivetrain.

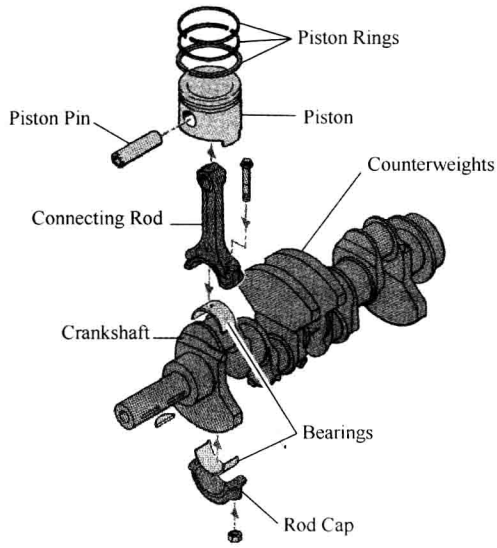

Fig. 1-7 Crankshaft and piston

31. Which part converts the reciprocating motion of the pistons to rotary motion?

32. How many complete revolutions does the crankshaft make during a whole four-stroke cycle?

1.2.4 Cylinder Head

The cylinder head is bolted to the top of the engine block. The cylinder head contains the:

* Intake valves, exhaust valves and connecting parts;
* Camshaft for engines with overhead camshaft design;
* Combustion chamber (the upper portion of the cylinder located in the head).

33. Which part of the engine contains the valve train, intake valves, exhaust valves, and combustion chamber?

1.3 Valve Action

The valve train is a series of parts that open and close the valves by transferring cam-lobe movement to the valves. One four-stroke cycle requires two revolutions of the crankshaft. This requires only one revolution of the camshaft. The crankshaft drives the camshaft through gears, sprockets, and a chain or through sprockets and a toothed timing belt. The sprocket driving the camshaft has twice as many teeth as the crankshaft sprocket.

34. Write out the two types of valves.

The valve action starts at the camshaft. Each cam is a round collar with a high spot, or lobe. The timing of valve opening and closing will vary with engine design. The intake valve opens before the intake stroke begins and closes after it ends. The exhaust valve opens before the ex-

haust stroke begins and closes after it ends. This valve overlap improves engine "breathing", or the flow of air/fuel mixture and exhaust gases into and out of the cylinders.

In an overhead-camshaft engine, the camshaft mounts in the cylinder head. One end of a rocker arm contacts the tip of each valve stem. A rocker arm is a pivoted lever that transfers cam or pushrod motion to the valve stem. The other end of the rocker arm contacts the valve lifter. Valve lifters may be either solid metal or hydraulically operated. In either case, the lifter is used to maintain the desired clearance between the rocker arm and the valve stem. When the rotating camshaft moves a cam-lobe in contact with a lifter, the rocker arm pivots to push the valve open. As the camshaft continues to rotate, the lobe moves away from the lifter. Spring tension now closes the valve.

35. What does "overhead camshaft" mean?

1.4 Power Flow

36. Describe valve overlap.

A single-cylinder four-cycle engine has one power stroke for every two rotations of its crankshaft. During the other three strokes—exhaust, intake, and compression, the piston does not deliver power. A single-cylinder engine produces power only one-fourth of its running time. The crankshaft increases its rotational speed on the power stroke. It loses speed on the non-power strokes.

37. How many times does the crankshaft turn for one turn of the camshaft?

In general, an engine with multiple cylinders runs more smoothly. Automotive engines have four or more cylinders to provide a more even and smooth power flow. A complete engine cycle requires two complete rotations of the crankshaft. In a four-cylinder engine, a power stroke occurs every 180° of crankshaft rotation. A six-cylinder engine provides a power stroke every 120°. An eight-cylinder engine provides a power stroke every 90°. With six or more cylinders, the power strokes follow each other very closely. Before the completion of a power stroke in one cylinder, a power stroke starts in another cylinder. This overlap results in a smoother-running engine.

38. During which stroke does the engine deliver power?

Even when the power bursts overlap, the flow of power from the pistons to the crankshaft is not completely smooth. The crankshaft tends to speed up on each power stroke and slow down between power strokes. Without a way to store the energy from each power stroke, the engine still runs unevenly.

39. Why isn't single cylinder engine used in cars?

A flywheel is mounted on one end of the crankshaft. The device on the other end of the crankshaft is known as the damper. The flywheel and damper store the energy produced by each power stroke. Between power

strokes, the flywheel and damper transfer the stored energy back to the crankshaft. This action balances the energy between the power strokes. The flywheel and damper work together to produce a smoother-running engine.

40. What is the purpose of the flywheel and damper?

1.5 Basic Engine System

A spark-ignition, fuel-injected engine requires six basic systems:

* Air induction system;
* Fuel system;
* Ignition system;
* Lubricating system;
* Cooling system;
* Exhaust system.

41. What are the basic systems of an engine?

1.5.1 Air Induction System

The function of the air induction system is to direct clean, filtered air to the intake manifold. The intake manifold is a set of tubes, or a casting with several passages. Air or an air/fuel mixture flows through these passages from the throttle valves to the intake ports in the cylinder head. See Fig. 1-8. Air entering the engine contains particles of dirt, which can damage the engine. An air filter in the air filter housing cleans the air. A throttle body contains a throttle blade that controls the engine speed by varying the

42. What's the purpose of the air induction system?

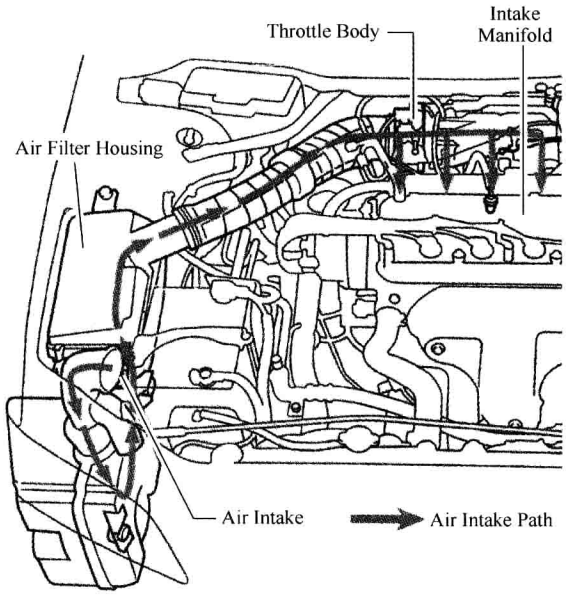

Fig. 1-8 Air intake path

43. What's the purpose of the air filter?

44. Which part of the AIS controls the engine speed?