高等学校教材

汽车工程专业英语

张金柱　韩玉敏　石美玉　主编

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前　言

教育部颁布的“大学英语教学大纲”要求学生在完成基础阶段的学习任务，达到四级或六级后，都必须修读专业英语。学生应能顺利阅读有关专业的原版教科书、参考书及其他参考资料，能借助词典将有关专业的英语文章译成汉语。据此作者编写了这本《汽车工程专业英语》教材，以满足高等学校汽车工程、交通运输及其他有关专业学生的专业英语教学的需要，也可满足从事与汽车相关专业的工程技术人员学习英语的要求。

本书课文内容比较新颖，选取的原文资料反映现代汽车所具有的典型结构。主要文章选自汽车专业网站“icarumba.com”，“howstuffworks.com”等。为了适应专业英语教学的要求，书中内容既对学生学过的课程进行了必要的覆盖，又有所拓宽和延伸，既可提高读者英语阅读水平，又能使读者学到一些汽车专业知识。

全书共分七章。第一章为发动机基本结构和工作原理；第二章为底盘和车身的结构和原理；第三章为汽车电器结构和原理；第四章为发动机故障诊断与修理；第五章为底盘故障诊断与修理；第六章为汽车电器故障诊断与修理；第七章为汽车保养。

本书由黑龙江工程学院张金柱，韩玉敏，石美玉主编。参加编写的还有黑龙江工程学院齐晓杰，王悦新，东北林业大学张锦生，哈尔滨工程大学王立权。

由于作者水平所限，疏漏和不当之处在所难免，敬请读者批评指正。

编　者

2005年5月

内 容 提 要

本书是按照教育部颁布的“大学英语教学大纲”，为高等院校汽车工程、交通运输及其他相关专业学生的专业英语课程编写的教材。

全书共分七章。第一章为发动机基本结构和工作原理，如发动机曲柄连杆机构、配气机构、燃油系、润滑系、冷却系和排放控制等。第二章为底盘和车身的结构和原理，如离合器、手动变速器、自动变速器、万向节、差速器、车架、悬架、转向系和制动系等。第三章为汽车电器结构和原理，如点火系、起动系、充电系、车用计算机控制系统、巡航控制系统、防抱死制动系统、空调系统、安全气囊、电动助力转向、汽车导航系统、汽车通讯技术等。第四章为发动机故障诊断与修理。第五章为底盘故障诊断与修理。第六章为汽车电器故障诊断与修理。第七章为汽车保养。

本书可供高等院校汽车工程专业、交通运输及相关专业学生使用，也可作为从事与汽车相关专业的工程技术人员学英语的参考书。

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Chapter 1 Engine Construction
发动机结构

Lesson 1

Internal Combustion Engine Basics
内燃机基础

1.1 The Basics 基本结构

The engine is, of course, the heart of every car. At the most basic level, the engine develops the power to move the car. This section discusses the different types of engines in use, as well as the fundamental concepts behind internal combustion engine.

There are many types and variations of automobile engines. The most common type is the internal combustion engine. It is named so because combustion takes place inside the engine.

The engine is mounted to the car frame. An internal combustion engine is like a container into which we put air and fuel and then start them burning. The air and fuel is burned in the engine container, or cylinder. A cylinder is a metal tube closed at one end. A movable plug, called a piston, is installed inside the cylinder. There is a small space between the piston top and the top of the cylinder. This space, called the combustion chamber, is where the burning takes place. If several drops of gasoline are placed into this space, and the piston is pushed up in the cylinder, the gasoline and air in the combustion chamber will be tightly squeezed together. When the mixture is squeezed as tightly as possible, it is ignited by an electric spark. The burning, or combustion, increases the pressure in the combustion chamber and pushes the piston down the cylinder with great force.

In order to use the power developed by the moving piston, the connecting rod is connected to the bottom of the piston. When the piston moves downward, this rod will move downward. The downward movement of the piston and connecting rod is changed to circular or rotary movement by a part called the crankshaft. The crankshaft is a shaft with its ends mounted in such a way that it can be rotated. The middle of the crankshaft is offset, and the lower end of the connecting rod is connected to the middle of the offset. The upper end of the connecting rod is joined to the piston by a pin called the wrist or piston pin. This pin allows the connecting rod to follow the motion of the crankshaft.

One additional part is required to complete a basic engine. Because it is necessary to push the piston down the cylinder more than once, in between down strokes it must be returned to the top of the cylinder. To do this, a heavy flywheel is mounted to the end of the crankshaft. When the piston is forced down, the crankshaft turns, and the flywheel turns with it. Because the flywheel is heavy, it does not slow down easily. Its momentum keeps the crankshaft turning. The rotation of the crankshaft then pushes the

piston back up to the top of the cylinder.

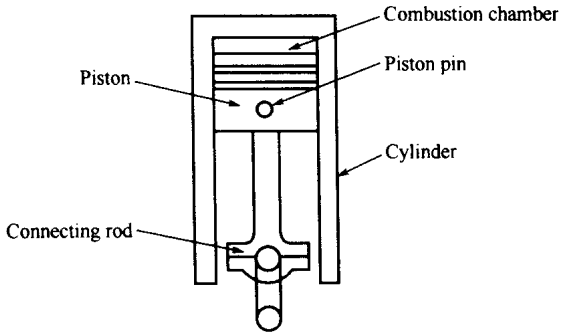

Figure 1-1 Combustion takes place in the cylinder.

1.2 Engine Design 发动机设计

Automotive engines may be classified in several different ways according to these design features:

Valve arrangement. Engines may be classified according to the location of the valves and the number of valves per cylinder. Many engines have the valves located in the cylinder head, and these engines are referred to as overhead valve engines. The majority of engines have two valves per cylinder, but engines with four valves per cylinder have become increasingly popular in recent years.

Camshaft location. Engines with a single camshaft positioned above the valve train on the cylinder head may be referred to as single overhead camshaft (SOHC) engines. Other engines have two camshafts located above the valve train in the cylinder head, and these engines are called dual overhead camshaft (DOHC) engines. V-type engines may have dual camshafts located above each cylinder head. Some SOHC engines, or DOHC engines have the camshaft located in the cylinder head rather than above the valve train. Other engines have the camshaft positioned in the cylinder block.

Ignition type. Engines may be classified as spark ignition (SI), and compression ignition (CI). In an SI engine, the air-fuel mixture in the combustion chamber is ignited by a spark at the spark plug electrodes. The air-fuel mixture in a CI engine is ignited by the heat of compression. Diesel engines use the CI principle, and these engines have much higher compression than SI engines.

Cylinder arrangement. The most common arrangements of engine cylinders are in-line, V-type, and opposed. An in-line engine has the cylinders mounted vertically and positioned in a line directly behind each other. V-type engines usually have 6 or 8 cylinders located in a V formation with an angle of 60 degrees or 90 degrees between the sides of the block. Other V-type engines have been used too; for example, one manufacturer is now marketing a V10 engine. In an opposed engine, the cylinders are positioned horizontally across from each other.

Number of cylinders. Engines are designed with 3, 4, 5, 6, 8, 10, or 12 cylinders.

Cycles. Most automotive engines operate on the four-cycle principle. Since the two-stroke engine is lighter and may be designed to produce more power than an equivalent

size four-stroke engine, the two-stroke engine may experience widespread use in the near future. All of the big-three automotive manufacturers have two-stroke engines under development.

[词汇]

combustion	*n*.燃烧	cylinder head	气缸盖
fundamental	*adj*.基础的，基本的	overhead valve	顶置式气门
automobile	*n*.汽车	camshaft	*n*.凸轮轴
cylinder	*n* 气缸，柱面	valve train	气门组
piston	*n*.活塞	single overhead camshaft	单顶置式气门
combustion chamber	燃烧室	dual overhead camshaft	双顶置式气门
connecting rod	连杆	cylinder block	气缸体
crankshaft	*n*.曲轴	ignition	*n*.点火，点燃
piston pin	活塞销	spark plug	*n*.火花塞
stroke	*n*.冲程	electrode	*n*.电极
flywheel	*n*.飞轮	equivalent	*adj*.相等的，相当的，同意义的
momentum	*n*.动量		
valve	*n*.气门		

[注释]

1. Internal combustion engine　内燃机：燃料在气缸内燃烧的能量直接推动活塞，转子或透平运动的内燃机，如汽油机、柴油机、三角活塞旋转式发动机和燃气轮机等。

2. The big-three automotive manufacturers...　三大汽车制造厂。这里指通用、福特和克莱斯勒汽车厂。

[问题]

1. How does the internal combustion engine work?
2. How are the automotive engines classified?
3. What is the main difference between the SOHC and DOHC?
4. What is the characteristic of the opposed engine?

Lesson 2

Engine Block
发动机缸体

2.1 Engine Block Types 发动机缸体类型

In-Line Blocks. In an in-line block, the cylinders are positioned in a direct line behind each other, and the cylinders are mounted vertically. This type of engine usually has four or six cylinders, and one cylinder head mounted on top of the block. Since the cylinders are mounted vertically, the engine requires more underhood space. Therefore, the hood and front fenders must be mounted higher above the in-line engine. This body design reduces the aerodynamic qualities.

V-Type Blocks. V-type engine blocks usually have six, eight, or ten cylinders arranged in two rows with an angle of 60 degrees or 90 degrees between the cylinder banks. This type of engine block has one crankshaft and a cylinder head mounted on top of each side of the V-block. Since the cylinders are mounted in a V configuration, a vehicle with this type of engine may be designed with a lower hood and improved aerodynamic qualities compared with a vehicle with an in-line engine.

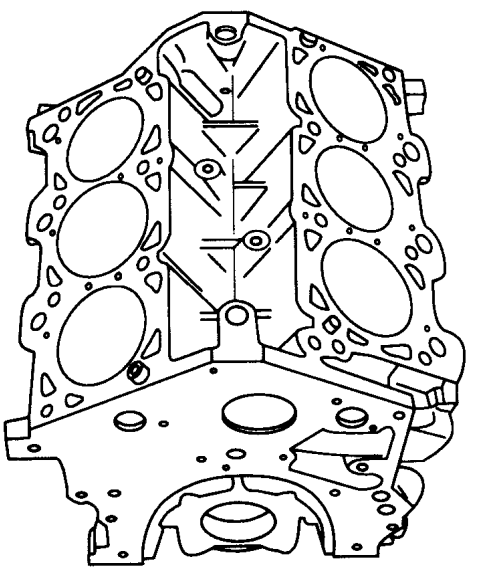

Figure 2-1 V6 engine block

Slant-Type Blocks. The slant-type engine is similar to the in-line engine, but the

complete slant-type engine is slanted to one side. This type of mounting reduces the distance from the top to the bottom of the engine, and thus allows the engineers to design a lower hood with improved aerodynamic qualities.

Opposed-Type Blocks. In an opposed-type block, the pistons are mounted horizontally across from each other at a 180 degree angle. This type of engine has one crankshaft and a cylinder head mounted on top of the cylinders on each side of the engine. Since this engine requires very little vertical underhood space, it is often used in the vehicles with a rear-mounted engine.

2.2 Block Assemblies 缸体总成

Many engine blocks contain a cast iron alloy, but aluminum blocks are becoming more common. Some aluminum blocks have steel cylinder liners. The aluminum in other blocks is mixed with silicon so the silicon accumulates on the cylinder walls to provide a hard surface that does not require a sleeve. Cast iron blocks are heavier and more rigid than aluminum blocks. However, aluminum blocks have superior heat-conducting qualities compared with cast iron blocks. Aluminum blocks are more subject to distortion than cast iron blocks.

Many engine components are supported by the cylinder block. These components include the crankshaft, pistons, cylinder heads, valve lifters, camshaft, water pump, oil pump, and timing gear cover.

Cylinder Sleeves: The cylinders are cast integrally with the block in most engines. However, some heavy-duty engines have removable dry-type or wet-type replaceable cylinder sleeves. A wet-type cylinder sleeve is in contact with the coolant. This type of sleeve must be sealed in the block at the top and bottom. Since the sides of the wet-type sleeve are not supported by the block casting, this type of sleeve must be thicker. A dry-type sleeve is pressed into the block, which contacts and supports the sleeve. Therefore, the dry-type sleeve is cast thinner than a wet-type sleeve. If a cylinder wall is damaged, the sleeve can be replaced without having to replace the complete block.

Main Bearing Bores: The circular main bearing bores are located on the lower side of the block. These bearing bores have removable caps. The main bearing bores support the crankshaft in the block. Extremely high combustion forces are applied to the pistons, connecting rods, crankshaft, and main bearing bores. The main bearing bores must be strong enough to withstand these forces without distorting or stretching.

Camshaft Bearing Bores: If the camshaft is mounted in the block, it is supported in circular openings in the block. Circular bearings are pressed into the openings that support the camshaft. These camshaft bearings and bearing bores must support the load of the camshaft and valve train.

Valve Lifter Bores: When the camshaft is mounted in the block, the valve lifter bores are machined in the block directly above the camshaft lobes. Oil is supplied from the main oil gallery in the block to each valve lifter bore.

Coolant Jackets: Coolant jackets surround the outside of each cylinder wall in the block. Coolant is circulated through each of these coolant jackets to cool the cylinder walls. A threaded coolant drain plug is positioned near the bottom of the coolant jackets in the block. In a V6 or V8 block, a coolant drain plug is located in each side of the block.

2.3 Engine Mounting Positions 发动机支撑位置

Front Engine Longitudinal. In many vehicles, the engine is mounted longitudinally at the front of the vehicle. Rear wheel drive (RWD) vehicles usually have this type of engine mounting with the transmission attached to the back of the engine. The differential is mounted under the rear of the chassis, and a driveshaft is connected between the transmission and the differential. This type of vehicle design has a somewhat higher weight on the front suspension compared with the rear suspension. However, this vehicle design provides satisfactory brake load distribution and steering force. A large underhood space is required by a longitudinally mounted engine, and the rear mounted differential reduces passenger compartment space. The engine, transmission, driveshaft, and differential may be removed individually on a RWD vehicle with a longitudinally mounted front engine too. Some front wheel drive (FWD) vehicles have a longitudinally mounted front engine too.

Front Engine Transverse. Many FWD vehicles have a transversely mounted engine at the front of the vehicle. The transaxle contains the transmission and the differential, and this transaxle is attached to the rear of the engine on the left side of the vehicle. Drive axles are connected from the transaxle to the front wheels.

With this engine and transaxle configuration, the rear-mounted differential and driveshaft are eliminated, assuming the vehicle is two-wheel drive (2WD). Transversely mounted engines and transaxles require less underhood space and reduce vehicle weight. The elimination of the rear-mounted differential and driveshaft allows increased interior space. The FWD transversely mounted engine and transaxle configuration has more weight on the front suspension than on the rear suspension. This weight distribution places a greater load on the front brakes and suspension.

Mid-Engine Transverse. The engine is always mounted transversely with a mid-engine mounting. With this type of engine mounting, the engine is positioned between the driver's seat and the rear wheels. Mid-engine vehicles often have a similar engine and transaxle configuration to a FWD vehicle. Drive axles are connected from the transaxle to the rear wheels.

The radiator is often mounted under the hood near the front of the vehicle, and the coolant is piped from the engine to the radiator. Since the engine is positioned between the driver's seat and the rear wheels, the front of the car can be designed with excellent aerodynamic qualities. The engine and transaxle intrude on the passenger compartment, and vehicles with this engine configuration are usually two-seater sports cars. A barrier is required to reduce engine heat, noise, and vibration transfer to the passenger compartment. Since the engine is positioned near the vehicle center of gravity, weight distribution between the front and rear wheels is much closer to being equal compared with other engine-mounting configurations. The mid-engine transverse design improves steering and handling characteristics.

2.4 Engine Measurements 发动机尺寸

Cylinder bore is the diameter of the cylinder measured in inches (in) or millimeters

(mm). The crank throw is the distance from the crankshaft center line to the center line of the connecting rod journal. The stroke is equal to twice the crank throw. An oversquare engine generally delivers high rpm as required in many cars. If an engine is undersquare, it delivers excellent torque at low rpm, which is desirable in truck and tractor applications.

TRADE JARGON: If the cylinder bore diameter is longer than the stroke, the engine is referred to as oversquare.

TRADE JARGON: An undersquare engine has a stroke that is longer than the cylinder bore diameter.

[词汇]

block	*n*.气缸体
cylinder	*n*.气缸，圆筒，圆柱体
cylinder head	气缸盖
hood	*n*.发动机罩
fender	*n*.翼子板
aerodynamic	*adj*.空气动力学的
bank	*n*.气缸侧体
crankshaft	*n*.曲轴
configuration	*n*.构造，结构，配置，外形
slant	*n*.倾斜，歪向
bearing	*n*.轴承
bore	*n*.气缸内径，口径，内径
mounting	*n*.安装，安置，固定
cast iron	*n*.铸铁，锻铁
alloy	*n*.合金
liner	*n*.里衬，衬垫，衬套
cylinder wall	气缸壁
silicon	*n*.硅
sleeve	*n*.套，套筒，套管
distortion	*n*.扭曲，变形，曲解，失真
valve lifter	气门挺杆，气门升程
timing gear	*n*.正时齿轮
cover	*n*.盖
replaceable	*adj*.可代替的
coolant	*n*.冷冻剂，冷却液，散热剂
lobe	*n*.凸角
gallery	*n*.油通
jacket	*n*.套
drain	*n*.排泄，排出，排水
longitudinal	*adj*.经度的，纵向的
longitudinally	*adv*.纵向地
transmission	*n*.变速器，变速箱
differential	*n*.差速器
chassis	*n*.底盘
transverse	*adj*.横向的，横断的
transversely	*adv*.横着，横切地，横断地
transaxle	*n*.变速驱动桥
drive axle	主动轴，驱动轴
brake	*n*.制动器，刹车，制动
suspension	*n*.悬架
mid-engine	中置式发动机
radiator	*n*.散热器，水箱
intrude	*v*.闯入，侵入
sports car	跑车
barrier	*n*.(阻碍通道的) 障碍物，栅栏，屏障
millimeter	*n*.毫米
journal	*n*.轴颈，期刊，杂志
oversquare	*n*.短行程
undersquare	*n*.长行程
rpm	*n*.每分钟转数
tractor	*n*.车头，牵引车
jargon	*n*.行话

[注释]

1. some heavy-duty engines have removable dry-type or wet-type replaceable cylinder sleeves. 有些重载发动机采用可拆卸更换的干式或湿式缸套。

2. Undersquare engine 缸径小于冲程的发动机：气缸直径小于冲程的发动机。

3. Crank throw 曲轴半径：从曲轴轴线到曲柄销轴线的距离，等于活塞行程的一半。

[问题]

1. What kinds of blocks have the engine?
2. Where are the engines placed in the automobile?
3. What's the meaning of front engine transverse?
4. What's the cylinder bore?

Lesson 3

Crankshafts, Bearing Inserts, Connecting Rods and Pistons
曲轴，轴瓦，连杆和活塞

3.1 Crankshaft 曲轴

The crankshaft changes the vertical piston movement to rotary motion, and transfers this rotary motion to the drivetrain. Crankshafts may contain cast iron alloy or forged steel. Cast iron crankshafts are satisfactory in car and light-duty truck engines. However, forged steel crankshafts provide increased strength compared with those made from cast iron alloy. All the main bearing and connecting rod bearing journals are machined to a highly polished finish. Bearing inserts are located between the main bearing bores and the main bearing journals on the crankshaft. Connecting rod bearing inserts are mounted between the connecting rod bores and the crankshaft journals. The main bearing journals must be perfectly aligned with each other. Connecting rod journals are offset from the center of the crankshaft. Therefore, the connecting rod journals orbit around the main bearing journals. The crankshaft journals must be properly spaced so the pistons reach TDC in the correct order.

Oil passages are drilled from each main bearing journal to the connecting rod journals to assure adequate oil supply at the connecting rod bearings.

A flexplate, or flywheel, is bolted to the transmission end of the crankshaft, and a vibration damper and pulley are pressed onto the front of the crankshaft.

3.2 Bearing Inserts 轴瓦

Bearing inserts must have these characteristics:

(1) Embedability to absorb foreign particles which may scratch the crankshaft journal.

(2) Surface action to prevent bearing seizure to the crankshaft if the bearing insert momentarily contacts the journal surface.

(3) Conformability to allow bearing material to creep slightly and compensate for some misalignment between the bearing insert and the crankshaft journal.

(4) Fatigue strength to withstand severe explosion impacts from the combustion chamber, piston, and connecting rod.

Commonly used bearing insert materials include steel-backed Babbit, overplated copper, nonoverplated copper, overplated aluminum-cadmium, and nonoverplated alu-