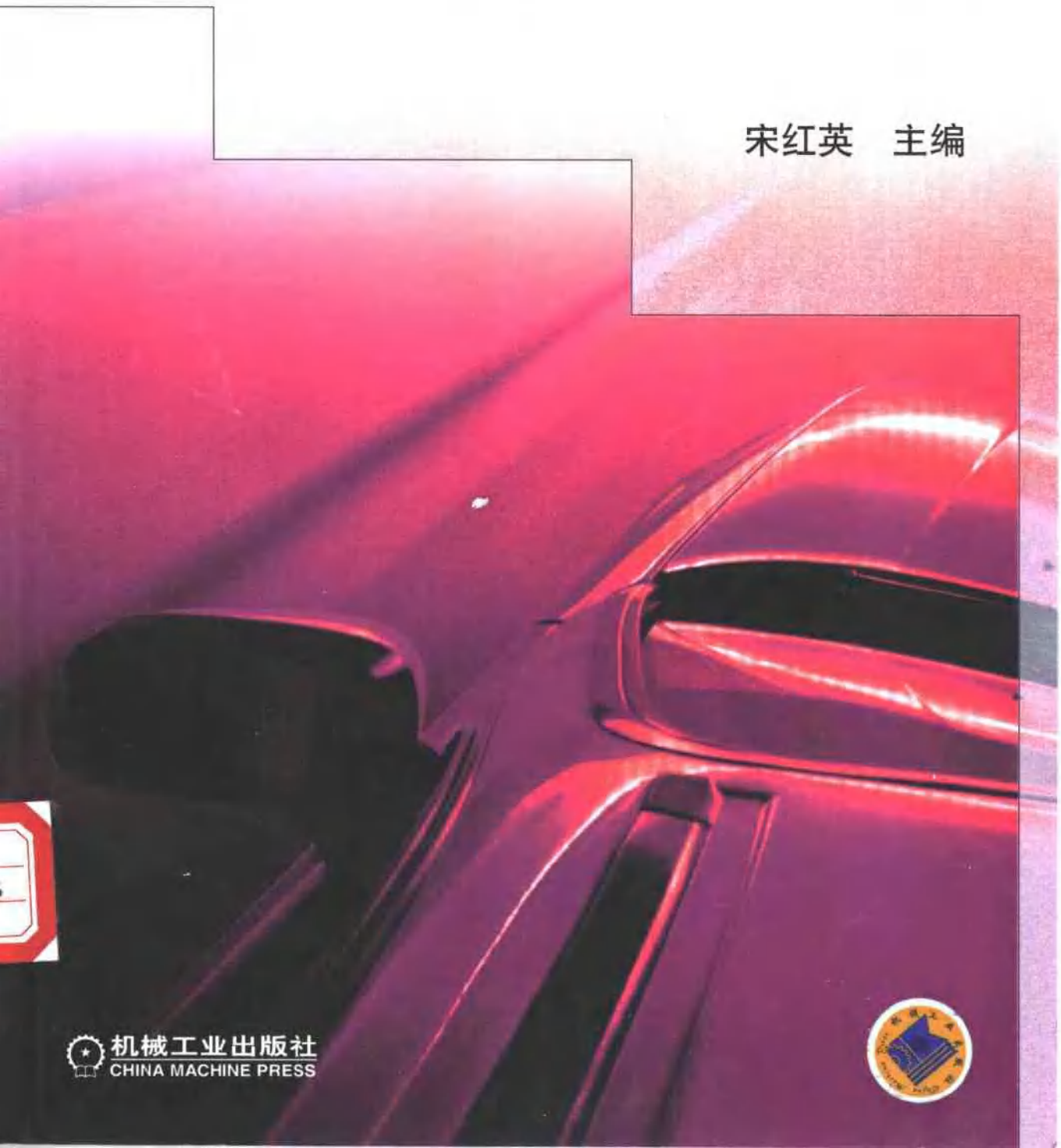
高等职业技术教育试用教材

汽车专业英语

宋红英　主编



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本书内容为汽车专业英语，以汽车的构造为主，全书共分为四章。第一章为发动机的构造及工作原理，共五个单元；第二章为汽车底盘的构造及工作原理，共五个单元；第三章为汽车的电控系统，共六个单元；第四章为汽车的维修与保养设备，共六个单元。每个单元包括课文、词汇和注释等。书后附有总词汇表、汽车英文标牌、常用汽车英文缩写、继电器。

该书可作为工科院校汽车及相关专业的英语教材以及汽车专业技术人员的参考书。

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前　言

近年来，我国的汽车工业迅猛发展，汽车的保有量逐年增加。随着中国加入 WTO，大量汽车涌入国内，汽车行业与国外的技术交流也日益频繁，大量的英文技术资料需要阅读。为了适应形势的发展，并且配合基础英语的教学，我们编写了这本《汽车专业英语》。它可以作为工科院校汽车专业的教材，通过学习，使学生掌握一定数量的专业词汇，提高英语的应用能力。本书也可以作为汽车专业技术人员的参考资料。

本书内容为汽车专业英语，以汽车的构造为主，全书共分为四章。第一章为发动机的构造及工作原理，共五个单元；第二章为汽车底盘的构造及工作原理，共六个单元；第三章为汽车的电控系统，共六个单元；第四章为汽车的维修与保养设备，共六个单元。每个单元包括课文、词汇和注释等。有的课文配有图表，课文中出现的一些长句和难句都在课文后面加了注释．另外书后还附有总词汇表、汽车英文标牌、常用汽车英文缩写、继电器。

该书的学习建议在基础英语的学习之后开始，通过对本书的学习，可以进一步巩固学生已掌握的词汇和语法知识，扩大专业词汇量，从而掌握阅读专业英语的方法，为将来获取相关的专业信息打下良好的基础。

本书由邢台职业技术学院宋红英、何宝文和侯江丽编写，由辽宁省交通高等专科学校张红伟审稿，并得到了机械工业出版社的大力支持，在此表示感谢。

由于作者水平有限，错误在所难免，敬请广大读者给予批评指正。

高等职业技术教育试用教材编委会

CONTENTS

Chapter One Engine System

Unit One Engine

Of all automobile components, an automobile engine is the most complicated assembly with dominant effects on the function of an automobile. So, the engine is generally called the "heart" of an automobile.

There are actually various types of engines such as electric motors, stream engines, and internal combustion engines. The internal combustion engines seem to have almost complete dominance of the automotive field. The internal combustion engine, as its name indicates, burns fuel within the cylinders and converts the expanding force of the combustion into rotary force used to propel the vehicle.

Engine is the power source of the automobile. Power is produced by the linear motion of a piston in a cylinder. However, this linear motion must be changed into rotary motion to turn the wheels of cars or trucks. The piston attached to the top of a connecting rod by a pin, called a piston pin or wrist pin. The bottom of the connecting rod is attached to the crankshaft. The connecting rod transmits the up-and-down motion of the piston to the crankshaft, which changes it into rotary motion. The connecting rod is mounted on the crankshaft with large bearings called rod bearings. Similar bearings, called main bearings, are used to mount the crankshaft in the block. Shown in Fig. 1-1.

The diameter of the cylinder is called the engine bore. Displacement and compression ratio are two

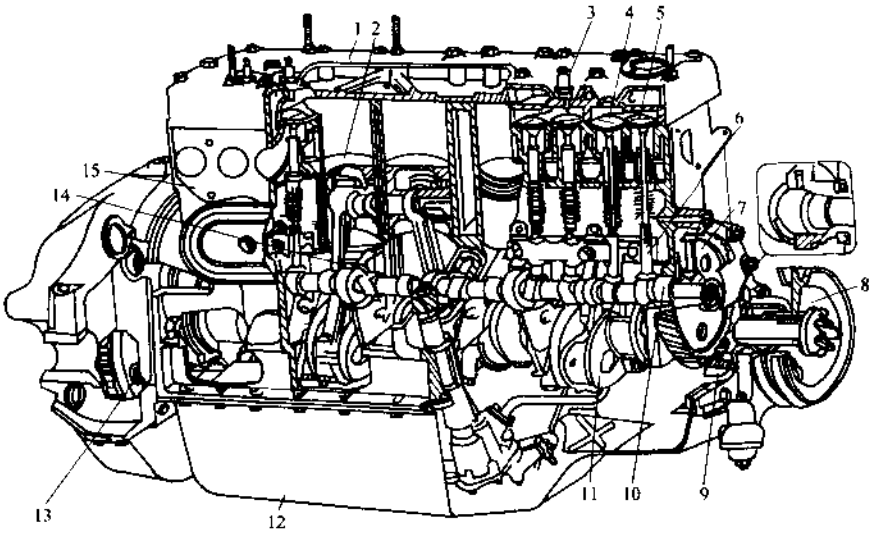

Fig. 1-1 The engine construction

1—cylinder head 2—piston 3—spark plug 4—intake valve 5—exhaust valve
6—lifter 7—camshaft gear-wheel 8—crankshaft pulley 9—crankshaft timing gear 10—camshaft
11—crankshaft 12—oil pan 13—flywheel 14—connecting rod 15—cylinder block

frequently used engine specification. Displacement indicates engine size, and compression ratio compares the total cylinder volume to compression chamber volume.

The term "stroke" is used to describe the movement of the piston within the cylinder. The operating cycle may require either two or four strokes to complete. Most automobile engines operate on the four stroke cycle.

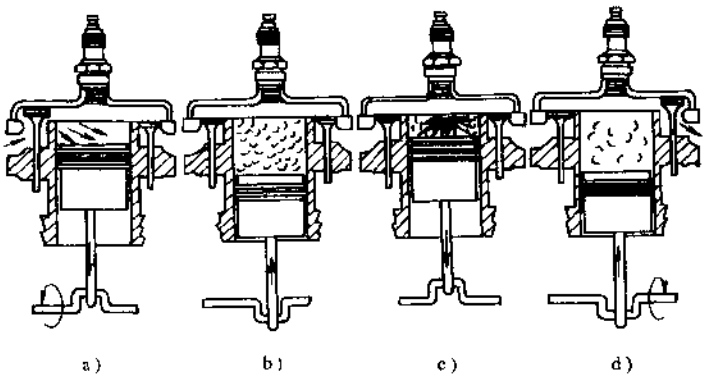

Fig. 1-2 The four strokes cycle
a) intake stroke b) compression stroke c) power stroke d) exhaust stroke

This type of engine is also known as Otto cycle, after the name of its inventor, Nikolaus Otto, who first applied the principle in 1876. In the 4-stroke engine, four strokes of the piston in the cylinder are required to complete one full operating cycle. Each stroke is named after the action. It performs intake, compression, power, and exhaust in that order, shown in Fig. 1-2.

1. Intake stroke

   The piston moves downward to the bottom dead center, a vacuum is created in the cylinder. The intake valve opens and air-fuel mixture comes into cylinder. To obtain the maximum filling of the cylinder the intake valve opens about 10° before t.d.c. giving 20° overlap. The inlet valve remain open until some 50° after b.d.c. to take advantage of mixture.

2. Compression stroke

   The air-fuel mixture is compressed within the combustion chamber. While the pressure rise to about 1MP, depending on various factors including the compression ratio, throttle opening and engine speed. The spark plug is fired to ignite the air-fuel mixture prior to the piston being at the t.d.c.. Note that both valves are closed.

3. Power stroke

   The air-fuel mixture expands, which creates the power to force the piston downward. The exhaust valve opens near the bottom of the stroke.

4. Exhaust stroke

   As the piston starts to move upward, the exhaust valve is opened.

   The piston moving up forces the exhaust gases out of the cylinder. The intake valve usually opens just before the exhaust stroke.

This 4-stroke cycle is continuously repeated in every cylinder as long as the engine remains running.

A "2-stroke" engine also goes through four actions to complete one operating cycle. However, the intake and the compression actions are combined in one stroke, and the power and exhaust actions are combined in the other stroke. The term 2-stroke cycle is preferred to the term 2-cycle, which is really not accurate.

In automobile engines, all pistons are attached to a single crankshaft. The more cylinders an engine has, the more power strokes produced for each revolution. This means that an 8-cylinder engine runs more smoothly because the power strokes are closer together in time and in degree of engine rotation.

The cylinders of multi-cylinder automotive engines are arranged in one of three ways.

1) Inline engines use a single block of cylinder. This is the simplest and most common arrangement, with all cylinders arranged vertically in line. Most 4-cylinder and 6-cylinder engines are of this design. If an engine has more than eight cylinders, it becomes difficult to make a sufficiently rigid frame and crankshaft with an in-line arrangement. Also the engine becomes quite long and takes up considerable space.
2) V-type engines use two equal banks of cylinders, usually inclined 60 degrees or 90 degrees from each other. Most V-type engines have 6 or 8 cylinders, although V-4 and V-12 engines have been built.
3) Horizontally opposed or "pancake" engines have two equal banks of cylinders 180 degrees apart. These space saving engine designs are often air-cooled. This arrangement is used where there is little headroom, as in trucks, buses, and rail cars.

Each engine has a few main working parts and auxiliary parts. Such as the cylinder block; cylinder head; crankcase; the piston; the connecting rod; the crankshaft; the fuel pump etc.

Many parts are also attached by fastening devices to the average block. These items include the water pump, oil pan, timing gear, the flywheel or clutch housing, the ignition distributor, oil and fuel pump, and the cylinder head. The water pump is a component of the cooling system. The crankshaft usually rotates this unit by means of a belt. When revolving, the water pump circulates coolant between the engine water jackets and the radiator.

The cylinder block is cast in one piece. Usually, this is the largest and the most complicated single piece of metal in the automobile. It is made of gray iron (cast iron) or aluminum and contains the cylinders and the water jackets that surround them. Several engines have aluminum cylinder blocks. Aluminum is a relatively light metal, weighing much less than cast iron. However, aluminum is too soft to use as cylinder-wall material. It wears too rapidly. Therefore, aluminum cylinder blocks must have cast-iron cylinder liners or be cast from an aluminum alloy that has silicon particles in it. The cylinder head closes one end of the cylinder and often contains the valves through which air and fuel are admitted and the exhaust gases discharged.

The oil pan and the lower portion of the block together are known as the crankcase; they enclose or encase the crankshaft. The oil pan itself is also a reservoir, which usually holds 4 to 9 quarts of lubricating oil, depending on the design of the engine.

When the engine is operating, the oil pump of the lubricating system draws oil from the pan and pumps it to all the moving parts of the engine. After the oil lubricates these parts, it drains off and run back down into the pan. Consequently, there is a constant circulation of oil between the pan and the moving parts of the engine.

The timing gear or chain cover, as its name implies, encloses and protects the timing gears or timing chain and sprockets from foreign materials. The cover has a machined area that accommodates the timing-

cover seal. The seal prevents leakage of lubricating oil from around the area where the crankshaft protrudes through the cover to the outside of the engine.

The ignition distributor usually has two basic factions. First, it closes and opens the electrical circuit between the battery and the ignition oil. The second task of the distributor is then to direct each high-voltage surge to the correct spark plug at the correct instant in the engine cycle hy the distributor rotor, cap, and secondary wiring.

The oil pump usually mounts to the upper crankcase area of the block. It is actually part of lubricating system. Its function is to draw lubricating oil from the pan and force it to all the moving parts of the engine.

The fuel pump is to transfer fuel from the fuel tank to the carburetor. This pump is actually parts of the fuel system.

New words

dominant *adj*. 支配的，统治的
pin *n*. 销
wristpin *n*. 轴颈
diameter *n*. 直径
bore *n*. 内径
displacement *n*. 排气量，气缸工作容积
specification *n*. 参数
stroke *n*. 行程，冲程
intake *v*. 进气
exhaust *v*. 排气
valve *n*. 气门，阀门
overlap *n*. 进气门和排气门同时打开的时间
throttle *n*. 节气门
horizontally *adv*. 水平地，平卧地
reservoir *n*. 贮油器，油箱，蓄电池
circuit *n*. 电路，回路，循环
carburetor *n*. 化油器，汽化器

Phrases and Expressions

cylinder block 气缸体
spark plug 火花塞
compression ratio 压缩比
ignition distributor 点火分电器，分电器
combustion chamber 燃烧室
cylinder block 气缸体
Bottom Dead Center 下止点

Top Dead Center 上止点
intake valve 进气阀
exhaust valve 排气阀
oil pan (oil sump) 油底壳，油盆

Notes

1. Of all automobile components, an automobile engine is the most complicated assembly with dominant effects on the function of an automobile.

汽车发动机是一切汽车部件中结构最复杂，对汽车功能起支配作用的一个总成。

2. In the 4-stroke engine, four strokes of the piston in the cylinder are required to complete one of full operating cycle.

在四冲程发动机中，需要四个行程来完成一个工作循环。

3. To obtain the maximum filling of the cylinder the intake valve opens about 10° before t.d.c. giving 20° overlap.

为了使进气充分，进气门在活塞到达上止点之前约 10°打开，使进、排气门有 20°的打开重合角。

4. The spark plug is fired to ignite the air-fuel mixture prior to the piston being at the t.d.c..

在活塞到达上止点前，火花塞发火点燃可燃混合气。

5. Aluminum is a relatively light metal, weighing much less than cast iron.

铝是比较轻的金属，其重量比铸铁轻多了。

Unit two Connecting Rods and Crankshaft

In a reciprocating engine, the power mechanism is called the crankshaft and connecting rod assembly. In this assembly, all of the major units such as the engine crankcase and cylinder block, the piston and connecting rod, and the crankshaft and flywheel work in close cooperation to convert thermal energy into mechanical energy used to drive the vehicle. The engine crankcase and block are usually cast into one piece and therefore can be seem as the largest and most intricate piece of metal in automobile. They are usually made of high-grade cast alloy iron to improve wear characteristics of the cylinder. This major unit must be strong and rigid enough to withstand any bending or distortion.

The piston converts the potential engines of the fuel into the kinetic energy that turns the crankshaft. The piston is a cylindrical shaped hollow part that moves up and down inside the engines cylinder. The piston is composed of piston head, piston rings, piston lands, piston skirt and piston pin hole. (see Fig. 1-3.) The piston head or "crown" is the top surface against which the explosive force is exerted. It may be flat, concave, and convex or any one of a great variety of shapes to promote turbulence or help control combustion. In some application, a narrow groove is cut into the piston above the top ring to serve as a "heat dam" to reduce the amount of heat reaching the top ring. The piston rings carried in the ring groove are of two basic types: compression rings and oil-control ring. Both types are made in a wide variety of designs. The upper ring or rings are to prevent compression leakage; the lower ring or rings control the

amount of oil being deposited on the cylinder wall. The lower groove or grooves often have holes or slots in the bottom of the grooves to permits oil drainage from behind the rings. The piston lands are parts of piston between the ring grooves. The lands provide a seating surface for the sides of piston rings.

The main section of a piston is known as the skirts. It forms a bearing area in contact with the cylinder wall. The piston pinhole in the piston also serves as a bearing for the piston pin, which is used to connect the connecting rod. In addition, because pistons operate under exceedingly difficult mechanical and thermal conditions, piston must be strong enough to stand the force of the expansion, yet light enough to avoid excessive inertia forces when their direction of travel is reversed twice each revolution. Piston must be able to withstand the heat from the burning air-fuel mixture, plus the heat generated by friction.

The connecting rod is attached to the crankshaft at one end (big end) and to the piston at the other end (small end). In operation, the connecting rod is subjected to both gas pressure and inertia loads, and therefore, it must be adequately strong and rigid and light in weight as well. The connecting rod shown in Fig. 1-3 is in form of a bar with ring-shaped heads at its end. So they are generally fabricated from high quality steel are composed of connecting rod small end, connecting rod shank, connecting rod big end, connecting rod cap, and connecting rod bearing half shells. Shank of the connecting rod is provided with an I-cross section to give the rod maximum rigidity with the minimum of weight. The big end of the rod is split so that it can be connected to the crankshaft. To avoid misplacing the rod caps during assembly, the connecting rods and their mating caps are marked on one side with serial numbers, starting with the first rod from the radiator, to identify their location in the engine.

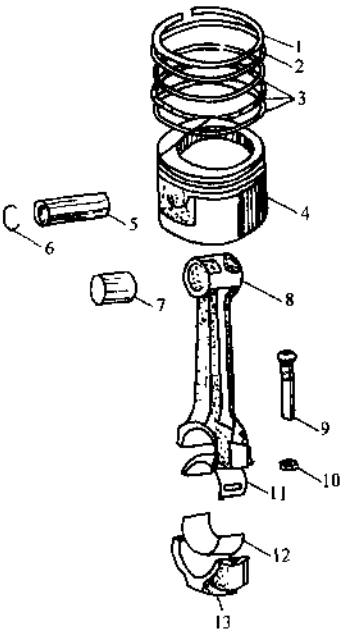

Fig. 1-3 A piston and a connecting-rod
1、2—compression rings 3—oil rings 4—piston
5—piston pin 6—piston-pin ring
7—connecting rod bushing 8—connecting rod
9—connecting rod bolt 10—connecting rod nut
11、12—crank bearing half shells
13—connecting rod cap

Some connecting rods have an oil spurt hole in the yoke or at the cap-mating surface to provide cylinder wall lubrication. The small end of the connecting rod is attached to the piston by a piston pin. In some cases the small end of the rod is clamped to the pin or has a bushing in it to allow the pin and rod oscillation. In other designs the pin is bolted to the rod. Connecting rod are usually drilled to provide lubrication to the piston pin and also to spray oil into the bottom of the piston for piston cooling on some designs.

The crankshaft, regarded as the "backbone" of the engine, serves to change the reciprocating motion of the piston into rotary motion and handles the entire power output. The periodic gas and inertia forces taken by the crankshaft may cause it to suffer wear and bending and tensional strains. The crankshaft therefore must be adequately strong and wear-resistant. So the crankshaft is either forged from a high quality steel or cast in a high-strong iron. The crankshafts shown in Fig. 1-4 is actually made up of vari-

ous parts such as main bearing journals, rod journal, crank arm, bearing, counter balanced weight and flywheel end. The crankshaft revolves in bearings located in the engine crankcase, but the number of bearings used usually depends on the number of cylinders in the engine, and the design of the engine. Mechanically, a crankshaft without special balanced weight would have severe vibration when revolving. In order to reduce or eliminate such vibration, it must be provided with counter balanced weights that extend radically from the crankshaft centerline in the opposite direction of the crank arms. In that way, the forces acting on the crankshaft are balanced and vibration is reduced. The rod journals are bored hollow in order to reduce the crankshaft inertia. Drilled diagonally through the crank arms are oil holes to supply oil to the rod journals.

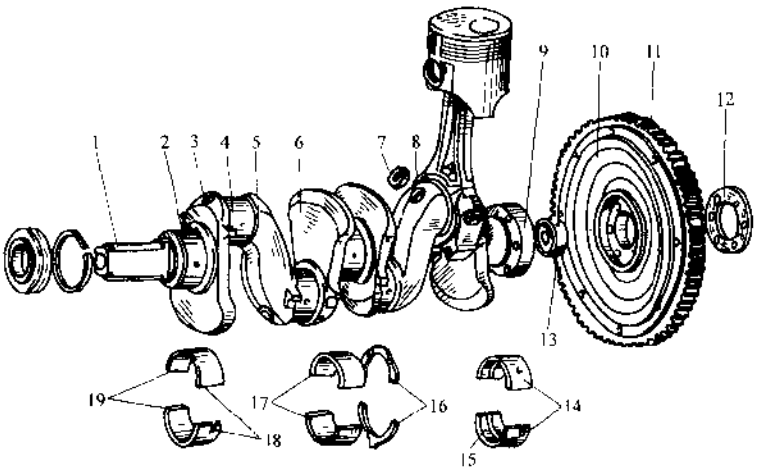

Fig.1-4 The crankshaft

1—crankshaft front end 2—front main journal 3—oil passage hole 4—crank pin 5—crank web 6—counter weight 7—oil passage plug 8—oil passage 9—crankshaft collar 10—flywheel 11—flywheel gear ring 12—flywheel lock plate 13—clutch shaft bearing 14—rear main bearing half shell 15—oil groove 16—crankshaft thrust 17—central main bearing half shell 18—bearing half shell 19—front main bearing half shell

The flywheel is a relatively heavy metal wheel, which is firmly attached to the crankshaft. Its function is to help the engine to run smoothly by absorbing some of the energy during the power stroke and releasing it during the other strokes.

Because of its rotation the flywheel acquires kinetic energy; when the flywheel speeds up, it stores additional kinetic energy, and when it slows down it gives back that energy. The amount of energy that a flywheel will store for a given change in speed depends on its inertia, which, in turn, depends on its mass and its effective diameter. The heavier the flywheel or the larger its diameter the smaller will be the speed changes. For an engine of a given horsepower, single cylinder engines require large flywheels to keep the momentary speed variations. While multi-cylinder require less flywheels can do it. In practice, the automobile engine is usually multi-cylinder engine. Flywheels however, because of its inertia, an excessively heavy flywheel will cause the engine to accelerate and decelerate slowly. For this reason, heavy-duty or truck engines have large and heavy flywheels, while racing engines or high performance engines have light flywheels.

In the front face of the flywheel, there is a shallow indentation used to determine the position of the piston in the first cylinder. When this indentation is aligned with a special hole provided in the bell housing, the piston is at top dead center (TDC) or indicates the start of fuel injection into the first cylinder. The flywheels of some engines also carry marks indicating the serial numbers of the cylinders where the compression occurs. The flywheel marks and indentation are used for setting the valve and ignition systems relative to prescribed positions of the crankshaft.

In conclusion, the connecting rod and crankshaft mechanism of the engine is composed of various units, and each of these units has its own functions in producing power for vehicles.

New words

mechanism *n*. 机械机构
crankcase *n*. 曲轴箱
intricate *adj*. 复杂的
rigid *adj*. 坚硬的，不易变形的
distortion *n*. 变形，扭曲
flat *adj*. 平的，平坦的
concave *adj*. 凹的，凹面的
turbulence *n*. 紊流，涡流
inertia *n*. 惯性，惯量
drainage *n*. 排水系统
serial *adj*. 连续的，一系列的
clamp *n*. 夹子 *v*. 夹紧
backbone *n*. 脊骨，支柱，骨干
vibration *n*. 振动，颤动
radially *adv*. 径向地

Phrases and Expressions

thermal energy 热能
kinetic energy 动能
piston head 活塞顶部
piston land 活塞环槽岸
piston pin hole 活塞销孔
compression ring 压缩环，气环
bearing journal 支承轴颈
oil-control ring 控油环，油环
counter-balanced weight 平衡重量，平衡块
crank arm 曲柄臂

Notes

1. This major unit must be strong and rigid enough to withstand any bending or distortion.

这一部件必须非常坚固刚硬，才足以抗得住任何的弯曲或扭曲。

2. The piston head or "crown" is the top surface against which the explosive force is exerted.

活塞头部、即冠部的上表面是承受爆燃所产生的力。

3. In order to reduce or eliminate such vibration, it must be provided with counter balanced weights that extend radically from the crankshaft centerline in the opposite direction of the crank arms.

为了减少或消除振动，它必须装有平衡块，而且平衡块应径向地从曲轴中心线向曲柄相对的方向延伸安装。

4. The heavier the flywheel or the larger its diameter the smaller will be the speed changes.

飞轮越重或飞轮直径越大，速度变化就越小。

Unit Three　Valve Gear

The valve gear of an internal combustion engine provides timely admission of the fresh charge into the cylinders and exhaust of spent gases from them. For this purpose the valves at definite moments open and close the intake and exhaust ports in the cylinder head, through which the cylinders communicate with the intake and exhaust manifold.

The valve gear is composed of timing gears, a camshaft, tappets, push rods, rocks with fasteners, valves, springs with fasteners and valve guides. (shown in Fig. 1-5)

The timing gears in most engines are housed in a special case fitted at the front end of the engine. These are necessary to transmit rotation from the crankshaft to the camshaft, fuel injection pump shaft, and to oil pump, and other mechanisms. The gears are made of steel and use helical teeth to reduce noise.

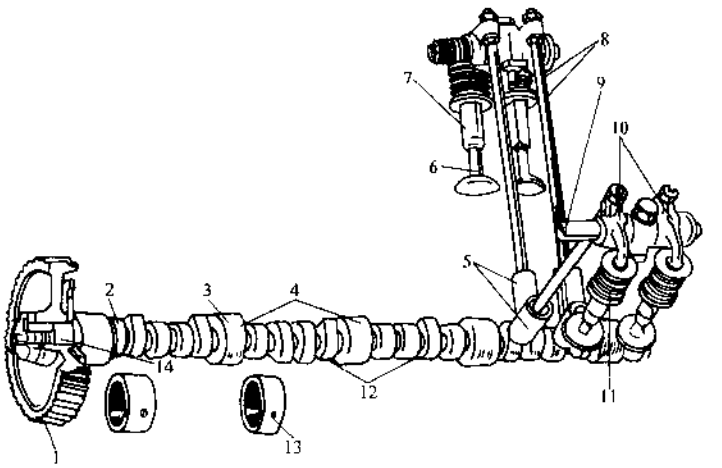

Fig. 1-5　Valve gear

1—timing gear　2—eccentric　3—camshaft　4—journals　5—tappets　6—valve　7—valve guide　8—push rods　9—rocker fulcrum　10—rockers　11—spring　12—cams　13—camshaft bushing　14—camshaft front end

Camshaft's function is to open the engine valves positively and timely, in a definite sequence, and to control their closing against the return action of the valve springs. The shaft is made integral with its cams and bearing journals. Each cam controls a single valve, either intake or exhaust. In some automobile engines, the camshaft is made integral with fuel pump eccentric wheel and oil pump drive gear. The camshaft bearings are lubricated with oil supplied under pressure from the main gallery in the cylinder block.

The tappets serve to transmit the force from the camshaft to the push rods. The tappets are small cylindrical bores receive the push rods. They are made of cast iron or steel and located in the guides, which

may be made integral with the cylinder block or removable as in the engine. When the engines operate, the tappets continuously rotate about their axes for uniform wear. The rotation is ensured by a convex surface of their bottoms and a slanted surface of the cams.

The push rods transmits the force from the tappets to the rocker and are made as steel stems with hardened tips or duralumin tubes with spherical steel tips press-fitted at both ends. The push rod tips bear against the tappet hollow at one end against the spherical surface of the rocker adjusting screw at the other.

The rockers transmit the force from the push rod to the valve. The rockers are made fro steel and are installed on a hollow fulcrum. A bronze bush is press fitted into the rocker hole to reduce friction. The hollow fulcrum is supported by standards on the cylinder head. Endplay of the rocker is prevented by a coil spring. The rocker arm is a bell crank made of steel. At the middle of the rocker arm, there is a boss with a bore into which is pressed the bushing. A hardened curved pad is provided on the end of the rocker where it contacts the valve stem tip, while a threaded hole is machined in its other end to receive the adjusting screw used to set the valve clearance, the clearance between the rocker contact pad and the valve stem tip, so that the valve will be tightly pressed against its seat when hot. The rocker arm freely oscillates about the rocker-arm shaft supported by a series of pedestals or brackets, which are bolted to the top deck of the cylinder head.

An engine valve is a device designed to open a passage when moving in one direction and to close it when moving in the opposite direction. Each cylinder of a four-stroke-cycle diesel or gasoline engine is commonly equipped with an intake valve and an exhaust valve. The purpose of the intake valve is to allow the air fuel mixture or air to enter the cylinder. After the combustion process has been completed, the burned gases are permitted to escape from the cylinder through the exhaust valve. To obtain sufficient valve area, some automobiles have two intake and two exhaust valves.

In the engines, the inlet and exhaust ports are made in the cylinder heads sand terminate in inserted valve seats of heat-resistant cast iron.

A valve consists of a head and stem. The valve head has a narrow chamfer of 45° or 30° referred to as valve face. The valve face fits tightly against the seat, which is achieved by grinding.

The kinds of the inlet and exhaust valves are of different diameter. For better engine breathing, the inlet valve has a larger diameter than the exhaust one. As the valves are not equally heated in the running engine, they are made from different materials. The inlet valves are made from chromium steel, the exhaust valves are of silchrome heat-resistant steel.

The cylindrical stem of the valve has a recess at the upper end for fastening the valve spring. The valve stems slide in the cast-iron or cerametallic valve guides.

The valve spring provides the force necessary to close the valve and hold it tightly against its seat.

Valve springs may have their coils spaced either evenly or variably. A variable coil pitch can lessen the tendency of the spring to vibrate or "flutter" at high speeds. Where such springs are used, the close-wound end (with less coil spacing) must be installed toward the valve head.

Some engines use two springs on each valve, which reduce the size of the springs, improves their reliability, and makes their operating conditions less arduous.

Valve guide supports the valve stem and guides its movement so that the valve face remains perfectly concentric with the valve seat and fits it without any skewing. Replaceable or insert, valve guides are fabricated from cast iron or a cermets material and pressed in the cylinder head.

To decrease oil penetration along the valve stem to the combustion chambers, the seating collars are fitted with rubber rings or the seats are provided with rubber caps. More uniform heating and wear of the valve are ensured with the valves rotating during the operation of the engine. In general, there are two ways of rotating: one is free rotate the other is positive rotate.

The valves of some automobile engines are made to rotate positively by a special mechanism during engine operation. This mechanism known as the valve rotator, consists of a stationary housing with five ramplike grooves along its circumference that contain five steel balls loaded by return spring. Freely placed on top of the balls is a flexible washer against which rests valve spring through the intermediary of a seating collar.

As the valve is opened, spring is compressed and its increasing load causes the flexible washer to flatten out and force balls down their ramps against the resistance offered by their return springs. As the balls roll down, they turn through some angle the flexible washer, seating collar and valve spring together with the valve; when the valve is closed, the valve spring load decrease, the flexible washer deflects to acquire its initial conical shape and abutting against a shoulder in housing, releases the balls which are then forced by their coil springs to return to their starting position.

New words

manifold *n*. 歧管，总管
tappet *n*. （凸轮）挺杆，气门推杆
helical *adj*. 螺旋的，螺旋形的
convex *adj*. 凸的，凸面的，凸圆的
duralumin *n*. 硬铝，杜拉铝
spherical *adj*. 球的，球形的
fulcrum *n*. 支点，支轴，支柱
oscillate *v*. 摆动，振动，摇摆
pedestal *n*. 轴承座，轴架，支座
terminate *v*. 终止，结束，终结
chamfer *n*. 锥角，切角面，圆角
chromium *n*. 铬
arduous *adj*. 陡峭的，艰巨的
concentric *adj*. 同心的，同轴的
penetration *n*. 渗透，穿透，侵入
conical *adj*. 圆锥形的，圆锥的

Phrases and Expressions

valve gear 气门机构，配气机构