十二五
汽车类

MIANXIANG SHIERWU GAODENG JIAOYU KECHENG GAIGE XIANGMU YANJIU CHENGGUO

面向“十二五”
高等教育课程改革项目研究成果

系统性强、定位明确。丛书中各教材之间联系密切，符合各个学校的课程体系设置，为学生构建了完整、牢固的知识体系。
层次性强。各教材的编写严格按照由浅及深、循序渐进的原则，采用以具体实操项目为单元的项目式编写方法，重点、难点突出，以提高学生的学习效率。
先进性强。本套教材吸收最新的研究成果和企业的实际案例，使学生对当前专业发展方向有明确的了解。
操作性强。教材重点培养学生的实际操作能力，并最大限度地将理论运用于实践中。本系列教材所选案例均贴合工作实际，
以满足广大企业对汽车类专业应用型人才实际操作能力的需求，增强学生在就业过程中的竞争力。

汽车专业英语（第2版）

主编　陈勇　边明远

北京理工大学出版社
BEIJING INSTITUTE OF TECHNOLOGY PRESS

汽车专业英语

（第2版）

English for Automobile Engineering

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副主编　何洪文　李真芳

北京理工大学出版社
BEIJING INSTITUTE OF TECHNOLOGY PRESS

编写委员会

前言

（第2版）

汽车专业英语（第2版）

本书是根据“面向‘十二五’高等教育课程改革项目研究成果编写研讨会”确定的教材编写规划进行编写的。

随着汽车技术的不断进步、汽车保有量的不断增加，汽车已经逐步进入家庭，成为人们工作和生活中的重要部分，提供汽车的相关知识非常必要。

本书内容主要涉及汽车工程专业领域，包括汽车的结构与原理、汽车发动机控制技术、汽车底盘控制技术、汽车代用燃料与代用燃料汽车以及汽车检测设备等内容。全书共分为5章，每章均包括课文以及重点或难点词汇的注释，注释采用了英汉两种方式，且书后附有课文的翻译。

本书可作为高等院校汽车工程专业的专业英语教材或双语教材，也可以作为相近专业学生的课外参考书以及从事汽车相关领域的工程技术人员了解汽车技术的参考资料。

本书由北京信息科技大学陈勇教授、清华大学边明远副教授任主编，北京理工大学何洪文副教授、中国农业大学李真芳副教授任副主编。编写者分工为：陈勇负责编写第1章第1节、第3章第1～3节、第4章；边明远负责编写第1章第2～6节；何洪文负责编写第2章、第3章第4～5节；李真芳负责编写第5章。

由于编写时间仓促，编者水平有限，书中难免有错漏之处，敬请读者批评、指正。

编　者

PREFACE
(The Second Edition)

This book is edited according to composing plans determined in conference of teaching materials during the twelfth five year plan.

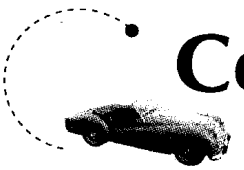
With the improvement of automotive technology and increases of the registered number of automobiles, automobiles have played an important role in people's work and life. So it is essential to provide related knowledge of automobiles.

This book involves the major contents in automobile engineering, which deals with automotive fundamentals, engine control technology, chassis control technology, alternative fuels and vehicles, automobile service equipment. The book is divided into five chapters, each of which consists of a text and its vocabulary explanation in English-Chinese. Translations of all texts are attached in the end.

It is intended to provide the students majoring in automobile engineering with an English textbook. At the same time, it is hoped that the book provides reference for the engineers working in the field of automobile-related engineering.

Prof. Chen Yong in Beijing Information Science & Technology University and Asso. Prof. Bian Mingyuan in Tsinghua University are responsible for the edition of this book. Asso. Prof. He Hongwen in Beijing Institute of Technology and Asso. Prof. Li Zhenfang in China Agricultural University take part in the edition.

We would like to thank readers for their comments. Readers' suggestions on the contents of this book are welcomed because their observations will be of great assistance when the book is revised.



Contents

Chapter One

Automotive Fundamentals

1.1 The Automobile

The modern automobile, as you know, evolved from the horse-drawn carriage, which was gradually replaced in the early part of last century. Early automobiles even looked like carriages. As the automobile made a place for itself in our daily lives, it also became more and more expensive to purchase, use, and maintain. Automobile expenses now account for a substantial portion of most family budgets. In fact, one out of every four retail sales dollars goes for an automotive-related purchase.

To make the best buy, a consumer must understand how cars work and what kinds of attention they need to stay in good shape. Knowledge of the automobile is equally important for anyone considering employment in the automotive industry. This chapter will begin the study of the automobile with an examination of its major components — frame, body, engine, drivetrain, and chassis(Fig. 1 – 1).

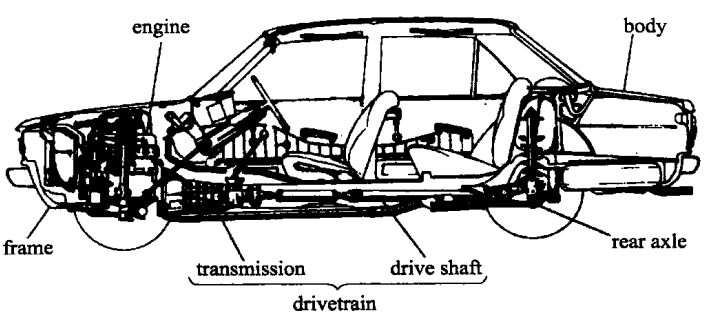


Fig. 1 – 1 Major parts of a car

1.1.1 The Frame

The frame is the basic foundation of the automobile, a platform to which the rest of the automobile components are attached. Each frame member, or separate part of the frame, is constructed of heavy steel bars welded into a square or box shape. These tough frame members, well-suited to supporting the car's tremendous weight, are fastened together in different framework designs.

One popular frame design uses two large side rails running beneath the sides of the car and a number of cross pieces which are called cross members. This design is often called a ladder frame (Fig. 1 – 2) because it resembles a stepladder. The ladder frame has one serious disadvantage. During a collision, the impact on one or another corner of the frame could push the frame out of square, resulting in the need for an expensive frame straightening.

In attempting to strengthen the ladder frame, car designers came up with the x-member frame, as shown in Fig. 1 – 3. The x-member frame uses two large members that cross under the center of the car. These members are welded to the frame's side rails and cross members.

Some automobiles are constructed without a regular frame. In these vehicles a very thick sheet of metal, called the floor pan, is used to support the car. The body of the car is welded directly to the floor pan. The other components are attached to the body-floor pan assembly. This design, a unitized body (Fig. 1 – 4) or monocoque design, has some advantages in terms of weight savings, and lower floor and production costs.

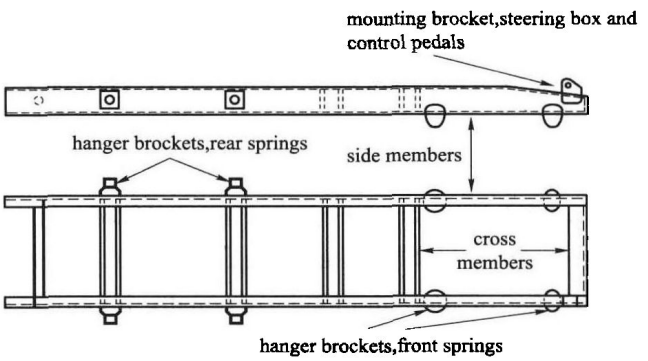


Fig. 1 – 2 A ladder frame

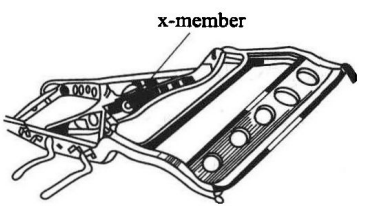


Fig. 1 – 3 An x-member frame

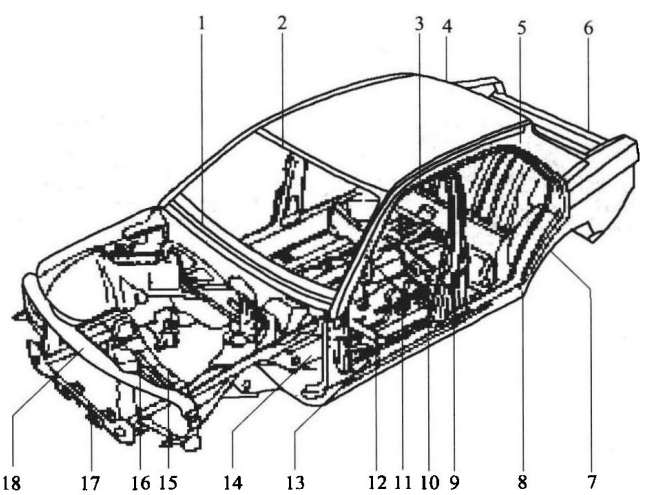


Fig. 1 – 4 A unitized body

1—Cross member under windshield;2—Roof frame, front;3—Roof frame, side;4—Roof frame, rear;5—C-pillar;6—Rear-facing panel;
7—Rear floor and spare-wheel pan;8—Side member, rear;9—B-pillar;10—Cross member under rear seat;11—A-pillar;
12—Cross member under driver's seat;13—Side member;14—Wheel well;15—Engine-support cross member;
16—Side member, front;17—Cross member, front;18—Radiator cross member

The relative merits of frame construction versus the unitized body, in terms of ability to withstand a crash, have not been fully determined. There is a growing conviction, however, that the sheet metal in the unitized construction may absorb the energy of impact more effectively than the rigid members of a frame.

Unitized construction suffers from one clear disadvantage: road noise. When a car has a frame, the passenger compartment can be insulated from road noise by the insertion of rubber biscuits between the frame and the body. With unitized construction, the noise telegraphs from the road directly into the passenger compartment.

1.1.2 The Body

The automobile body encloses the chassis, making the car comfortable to drive. It also makes the car more useful and nicer to look at. The body comprises fenders, hood, doors, roof, trunk lid, floor, seats, windows, dashboard, lights, windshield wipers, grille, and bumpers.

Today, body design is influenced not only by a desire to protect people from the elements and offer an esthetically pleasing vehicle, but also by the need to protect passengers in a crash. Crash testing now plays a major role in body design.

The modern automobile body is constructed from sheets of steel formed to the required shape in giant punch presses. Most of the body components are welded together to form a tight, rattle-free unit.

Automobiles of today have developed into many different body styles befitting their varied uses. Although bodies are manufactured in an almost infinite variety, it is possible to categorize all body styles by size and type. The five body sizes are:

Mini-compact — which is less than 85 cubic feet of passenger and luggage volume.

Subcompact — which is between 85 to 100 cubic feet of passenger and luggage volume and has the lowest original cost and delivers the best fuel economy.

Compact — which is between 100 to 110 cubic feet of passenger and luggage volume and a largely North American term denoting an automobile smaller than a mid-size car, but larger than a subcompact car, and gives additional room in the front and rear seats as well as added crash-protection for passengers.

Midsize — frequently referred to as an intermediate, which is between 110 to 120 cubic feet of passenger and luggage volume and the North American term for an automobile with a size between that of a compact and a full-size car and provides what many consider to be the best trade-off between economy and comfort.

Large — a full-size car, the equivalent class in Australian terms, which is more than 120 cubic feet of passenger and luggage volume. A full-size car is a term used in North America for an automobile larger than a mid-size car.

All of these sizes can apply to the eight body types, shown in Fig. 1 – 5.

Two-door sedan — which is similar to the 2-door coupe, but a sedan has at least 33 cubic

feet of rear interior volume, where as a coupe has less than 33 cubic feet.

Four-door sedan — which is a 4-door, with a B pillar that extends from the floor to the roof. This style generally holds 6 passengers, and is used in many years.

Convertible — whose body style is with a removable or retractable roof and rear window.

Hardtop — originally referred to a removable solid roof on a convertible; later, also a fixed-roof car whose doors have no fixed window frames, which is designed to resemble such a convertible.

Hatchback — identified by a rear door including the back window that opens vertically to access a storage area, which is not separated from the rest of the passenger compartment.

Station wagon — which is a car with a full-height body all the way to the rear; the load-carrying space created is accessed via a rear door or doors.

Pickup truck — which is a small or medium sized truck.

Van — in North America a van refers to a truck-based commercial vehicle of the wagon style, whether used for passenger or commercial use.

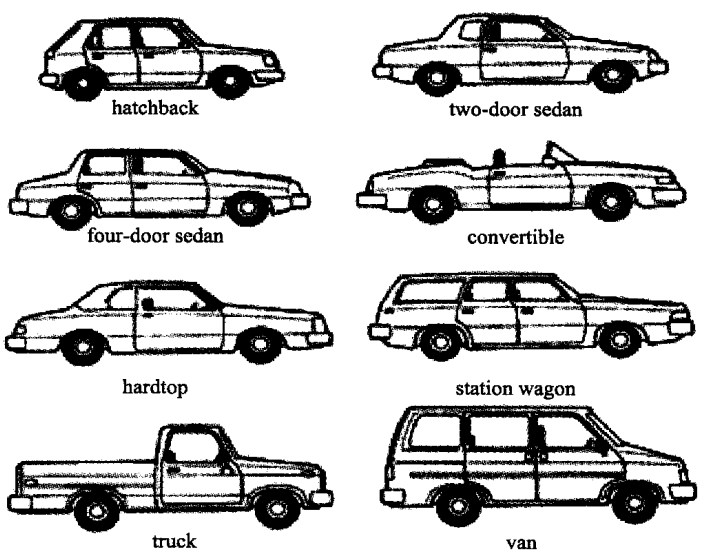


Fig. 1 – 5 Automobile body styles

1.1.3 The Engine

An engine (Fig. 1 – 6) is a machine that turns heat energy into mechanical motion. In so doing it consumes fuel. The engine, sometimes called the powerplant, makes the car go by using the explosive power of a mixture of gasoline and air or diesel fuel and air to push the pistons. The pistons are connected to a crankshaft and force it to turn. The rotating force of the crankshaft is used to make the car's wheels turn.

The most common American practice is to install the engine in the front of the car, because a front-mounted engine is readily accessible and can be cooled easily. European designers have often used rear-engine placement, which means the front of the car can be made more streamlined for

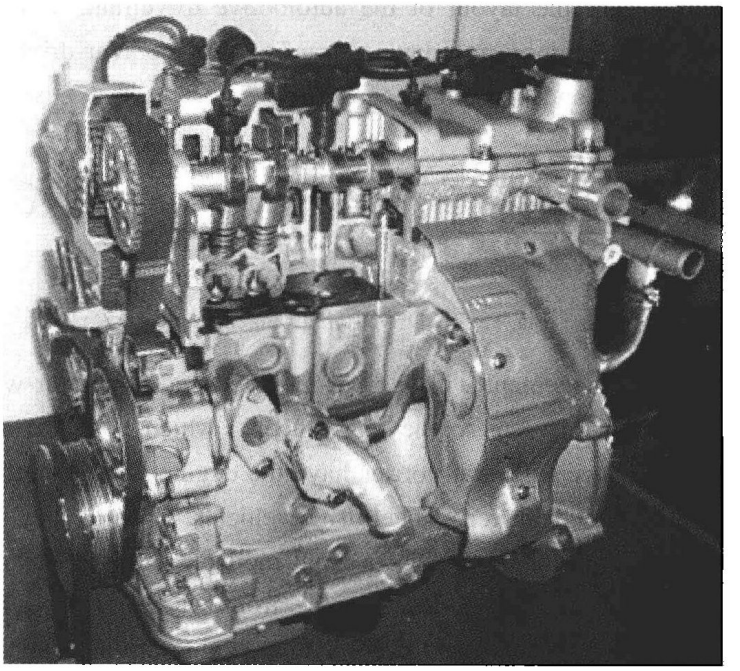


Fig. 1 – 6 An automobile engine

better fuel economy. Also, the hood can be lower, driver visibility can be increased, and the engine's weight over the rear wheels can serve to increase traction in a rear-drive car.

Although front- or rear-engine placement is most common, the engine can also be placed in the middle of the car. The earliest cars, in fact, used mid-engine placement. When something went wrong with the engine, the driver had to get out and lift up the seat to work on it.

Mid-engine installation is now enjoying a resurgence in some cars. A mid-engine car handles very well because the heavy engine in the middle of the car provides the best possible weight distribution. Like the early vehicles, however, today's mid-engine car still suffers from inaccessibility. And instead of having the engine under the seat, a modern mid-engine sports car has the engine behind the driver, which eliminates the rear seat.

1.1.4 The Drivetrain

The power developed by the engine must be transferred to the driving wheels. Delivering engine power to the driving wheels is the job of the drivetrain. It comprises the clutch (on manual-transmission car), transmission, (sometimes) drive shaft with universal joints, differential gearing, and drive axles and wheels. The main component of the drivetrain is the transmission, which contains a system of gears used to multiply the engine's turning effort to get the car going forward or, when necessary, backward. A drive shaft is used to transfer power from the transmission to the drive axle assembly. The drive axle assembly contains another system of gears that transfers the engine's power to each of the drive wheels.

The engine is mounted on the frame or underbody of the automobile. The position of the

engine and the drive axle vary the layout of the automotive drivetrain. Four kinds of drivetrain arrangements(Fig. 1 -7) are common in today's cars: front engine/rear-drive, front engine/front-drive, rear engine/rear-drive, and mid-engine/rear-drive.

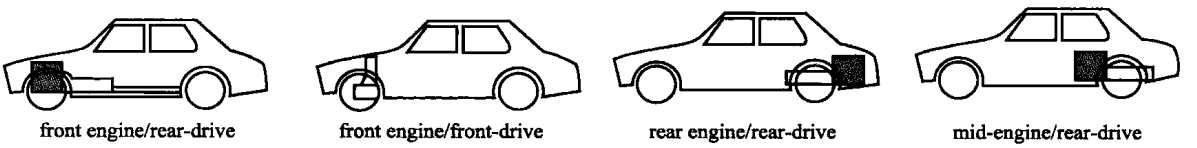


Fig. 1 -7 Drivetrain arrangements

The typical drivetrain arrangement with a front-mounted engine is rear-wheel drive(RWD). This means the engine's power is sent to the rear wheels, which push the car along. With the exception of light commercial vehicles, all lorries have the engine at the front or centrally between the front and rear axles together with rear-wheel drive vehicles.

An alternative drivetrain arrangement with a front-mounted engine, however, is front-wheel drive(FWD), which applies the driving force to the front wheels rather than the rear wheels. With this arrangement, the transmission and drive axle assembly are all combined in a single unit called the transaxle and mounted in the front of the vehicle.

Front-wheel drive has some advantages. The car may hold the road better on curves, since the drive is through the front wheels, which carry a heavier load. There is no hump in the passenger compartment caused by routing the drive shaft under the vehicle, which maximizes passenger space or enhances cargo area. The vehicle has less weight because there is no long drive shaft and separate rear differential housing. Lower weight results in higher fuel economy.

There are two basic arrangements of front-wheel drive. The lengthwise mounting has the engine mounted in the standard front-to-back position. The engine may be mounted ahead, behind, or on top of the driveline components.

In the transverse configuration, the engine is mounted sideways, perpendicular to the length of the car. The transverse layout is popular because it requires the least amount of engine compartment space and allows more space for the passengers.

When the engine is placed in the rear of the car, the transmission and drive axle assembly are usually also in the rear. This eliminates the long drive shaft.

Another type of drivetrain arrangement is four-wheel drive(4WD), with the engine's power directed to driving axles located at both the front and the rear of the vehicle. When four-wheel drive is engaged, all of the wheels are driven by the engine, and maximum traction can be achieved. The vehicle is able to climb steep hills and drive through deep sand or snow. The extra components required for four-wheel drive make it an expensive addition, mostly appropriate for off-the-road vehicles such as jeeps and trucks. But four-wheel drive is also used in some late model passenger cars. Often confused with four-wheel drive, all-wheel drive(AWD) automatically splits engine torque between the front and the rear wheels as needed, improving on-road traction in unfavorable road conditions. Unlike four-wheel drive, all-wheel drive is an on-road system and is

not designed for off-road use. AWD does not require the driver to actively engage the system.

1.1.5 The Chassis

The term chassis describes all the parts of the automobile under the body. The chassis forms the main structure of the modern automobile. A large number of designs in pressed-steel frame form a skeleton on which the engine, wheels, axle assemblies, transmission, steering mechanism, brakes, and suspension members are mounted. During the manufacturing process the body is flexibly bolted to the chassis. The major components of the basic chassis are the frame, engine, drivetrain, wheels, tires, steering, brakes, suspension and everything needed to drive the car (Fig. 1 - 8). In addition, several other systems are mounted to the chassis assembly. The wheels of the automobile are connected to the frame by a system of springs, shock absorbers, and linkages that make up the car's suspension system. The suspension system absorbs road shocks as the vehicle travels over rough roads and holds the tire and wheel in correct alignment with the car and the road. It also allows the tires and wheels to move up and down relative to the body over bumps and chuckholes.

Another important chassis component is the steering system, which allows the driver to control the direction the car travels. The steering wheel, which the driver controls, is connected to a gearbox that multiplies the driver's effort. The gearbox is linked to the front wheels of the vehicle.

The last major chassis component is the braking system, the function of which is to either reduce the vehicle's speed, bring the vehicle to a halt, or keep it stationary if already halted. When the driver pushes on the brake pedal, hydraulic fluid is forced out of a master cylinder to each of the four wheels. The resulting hydraulic pressure operates a drum or disk brake assembly to slow or stop the car's wheels.

Key Words and Expressions

Frame — the platform or foundation of the automobile to which the body, engine and running gear are attached. 车架

Cross member — the frame members that run between the side rails. 横梁

Body — the structure of the car that encloses the driver, passengers, engine compartment and trunk. 车身

Fender — any fixed side-panel of a vehicle that partially shrouds a road wheel. 翼子板

Hood — the hinged or removable body panel by which access is gained to the engine compartment of a vehicle. 发动机罩

Trunk lid — the entire back of the vehicle which can lift up(using a liftgate or hatch). 后箱盖

Dashboard — the interior panel beneath the windscreen or windshield, on which instruments are mounted. 仪表板

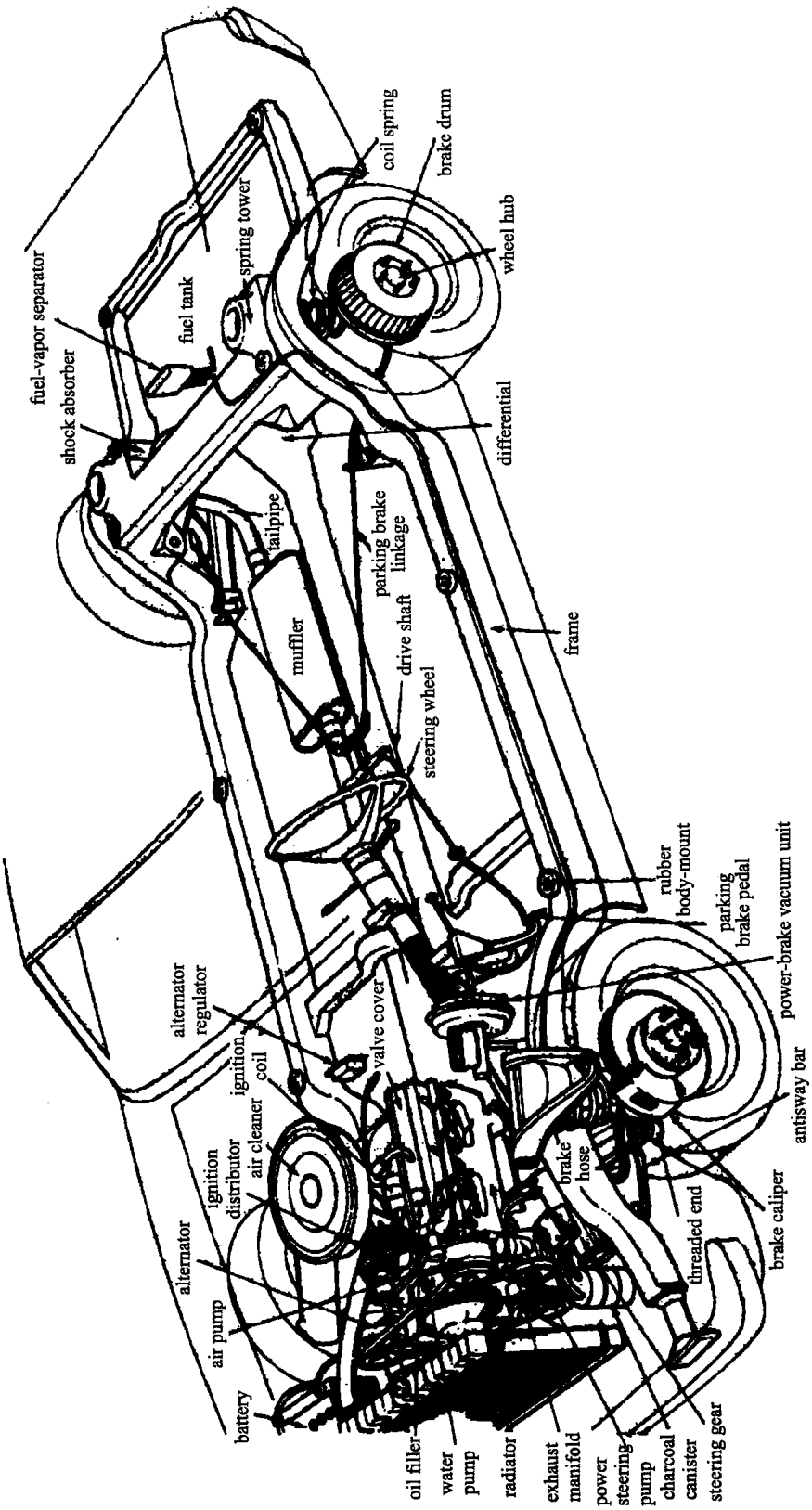


Fig. 1–8 An automobile chassis

Windshield wiper — the oscillating blade, with flexible rubber blade, for cleaning and removing water from a windshield or windscreen. 刮水器

Grille — the decorative and protective grid at the front of vehicle. 格栅

Bumper — the horizontal bar mounted at the front and the rear of vehicle to prevent or reduce damage in low-speed impacts, and to absorb impact energy. 保险杠

Engine — the main power unit of a vehicle, converting the energy of liquid or gas fuel into mechanical energy. 发动机

Drivetrain — the path through which power flows from the engine to the drive wheels. 传动系

Transmission — a gearbox used to multiply torque and allow various vehicle speeds while keeping the engine speed within its designed rpm range. 变速器

Chassis — the structural lower part of a vehicle to which the running gear and body is attached. The true chassis is now evident only in heavy goods vehicles, some public service vehicles, and some specialist cars. 底盘

Floor pan — the base panel of a passenger car. 地板

Unitized body — a body type construction where there is no frame and all assembly units are attached to the body. All the functions of the frame are carried out by the body and the frame that are a single unit welded together. The construction makes the body sheets relieve the metal frame work of part of the stress and results in some weight saving over the conventional separate frame and body construction. 整体式车身

Piston — a component, usually in the form of a cylinder closed at one end, that converts fluid pressure into mechanical movement and force, or vice versa, within a smooth walled cylinder, in which it is a sliding fit. 活塞

Crankshaft — the main power shaft of a reciprocating engine, comprising the cranks that impart reciprocating motion to the pistons by way of their crank throw or offset from the shaft axis, and the journals whereby it is located and supported by the crankcase main bearings. 曲轴

Front-wheel drive — a transmission system in which the engine power is delivered to the front wheels of a vehicle. 前轮驱动

Transaxle — a combined gearbox and differential unit attached to the engine in some front-wheel drive vehicles. It means contraction of transmission-axle. 驱动桥(与变速箱连成一体，用于前轮驱动的汽车)

Differential — a system of gears capable of driving the input torque of one shaft between two output shafts where rotation at different speeds is likely to occur. 差速器

Driving axle — an axle capable of transmitting power by way of a differential or other transmission arrangement. 驱动轴

Drive shaft — a hollow steel shaft that connects the transmission to the rear axle in a front-engine, rear-drive car. 传动轴

Four-wheel drive — a transmission system in which engine power is delivered to the front and the rear wheels of a vehicle. 四轮驱动

Shock absorber — the mechanism for damping vibration in a spring system. 减振器

Suspension system — the system of springs that supports the body and frame on the wheels. 悬架系统

Steering system — a mechanism by which a motor vehicle is steered. 转向系

Braking system — the hydraulic system of levers, cylinders, surfaces and fluid used to stop or slow down a vehicle. 制动系

Brake pedal — foot-operated control by which the service brake is applied. 制动踏板

Master cylinder — primary source of pressure in a brake system, containing the piston by which pressure is applied and connected to a source of hydraulic fluid. 制动主缸

Drum brake — the brake in which friction blocks called brake shoes lined with friction material are brought to bear on the periphery of a drum or cylinder. 鼓式制动器

Disk brake — the brake in which external friction pads are brought to bear on the faces of a dick, usually by the clamping action of a caliper. 盘式制动器

1.2 The Engine's System

The engine is an important part of the automobile, which provides the power that the car needs to run on the road. All the automotive engines today are the internal combustion engines (ICEs) because the fuel is burnt inside their cylinders and the energy is provided.

ICEs are those heat engines that burn their fuel inside the engine cylinder. In ICEs, the chemical energy stored in their fuels is converted into heat energy during the burning part of their operation. The heat energy is converted into mechanical energy by the expansion of gases against the piston attached to crankshaft that can rotate. The engines that burn petrol are known as petrol engines. Other types of internal combustion engines burn heavier oils. Of these types the diesel engine has come into the widest use.

Diesel and petrol engines have the same mechanical parts, except that diesel components are generally stronger and heavier. Both engines are internal combustion engines, but they have different fuel systems and use different fuels. With a diesel, only air enters the cylinder during the intake stroke. A petrol engine takes in an air-fuel mixture. Following are some general comparisons between diesel and petrol engines.

In a diesel, the fuel is injected into the cylinder as a fine spray near the top of the compression stroke. With a petrol engine, the fuel is injected into the intake ports at the start of the induction stroke.

Ignition in a diesel is activized by the high temperature from the highly compressed air. A petrol engine needs a spark for ignition.

Diesel engines generally operate at lower engine rpm than petrol engines.

Diesel engines use distillate for fuel, which is less volatile than petrol.

The design of diesel engines makes them noisier than petrol engines and they have a unique

diesel knock.

Small diesel engines, as well as petrol engines, are used in passenger cars and light commercial vehicles. Larger diesel engines are used in all heavy commercial vehicles, earthmoving equipment, and farm machinery.

1.2.1 Engine Configurations

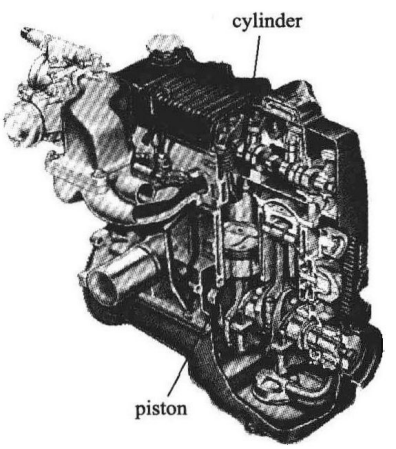
The term engine configuration refers to the way that the cylinders of an engine are arranged. The cylinders can be in-line, opposed, or at an angle (V-type). Within these three basic arrangements, there are a number of variations.

(1) In-Line Engines.

With in-line engines, the cylinders are arranged in a straight line, one behind the other. Most in-line engines have their cylinders vertical, but some are slanted. That is, the engine is tilted at an angle to reduce the overall height. These engines are sometimes called as slanted engines.

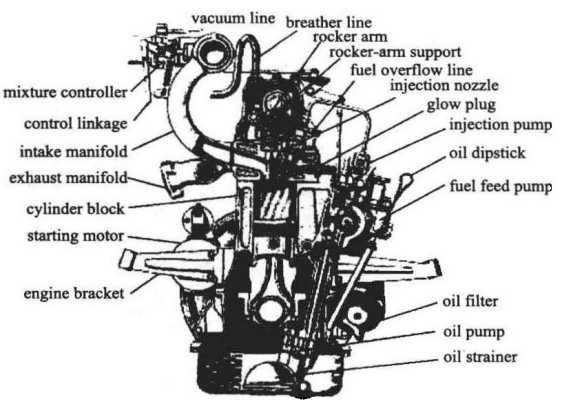
Some in-line engines have their cylinders horizontal, so that the engine is more or less on its side. This reduces the overall height of the engine. This arrangement is used mainly in larger commercial vehicles with the engine mounted under the part of the cab.

The mechanical arrangement of a four-cylinder in-line for a passenger car is shown in Fig. 1 – 9. The cut-away view in Fig. 1 – 10 enables the various parts to be identified.



Four-cylinder in-line overhead-camshaft engine, partly cut away to show internal construction. (*Ford Moter Company*)

Fig. 1 – 9 An in-line engine



A four-cylinder, four-cycle automotive diesel engine. (*Mercedes-Benz of North America, Inc.*)

Fig. 1 – 10 The cut-way view of an in-line engine

(2) Horizontally Opposed Engines.

This arrangement has its cylinders arranged in two flat banks with the crankshaft between them. The engine has a short rigid crankshaft with several bearings. A horizontally opposed engine has even firing impulses and good balance. Movement of a piston in one direction is opposed by movement of a piston in the opposite direction. The basic arrangement of a horizontally opposed engine is shown in Fig. 1 – 11.

Horizontally opposed engines, with their flat design, give the engine a low height and also help to keep the centre of gravity of the vehicle low. A low center of gravity gives the vehicle